4-2. Study on the Request for Grant Aid

(1) The Project Area

The request for grant aid was initially made for Abakaliki Zone located in the eastern part of Anambra State. This zone consists of the four Local Government Areas of Abakaliki, Ikwo, Ezza and Ishielu. However, in the beginning of the field survey, a discussion was made with the Government of Nigeria on the study area for this grant aid program in view of WATSAN program which had been started by UNICEF in Anabra State since 1988. As a result, Ikwo and Ezza in Abakaliki Zone and Awgu in Enugu Zone have been selected as the study area for Japanese grant aid program. The WATSAN Program of UNICEF covers the three Local Government Areas of Abakaliki and Ishielu in Abakaliki Zone and Isi-Uzo in NSSUKA Zone.

All these Local Government Areas are not different each other in relative difficulty in groundwater development, and has similar water supply conditions. Therefore, the proposal of the Government of Nigeria for the service area has been accepted by the Japanese side.

(2) Location and Quantity of Boreholes

The initial request of the Government of Nigeria described no name of villages for which boreholes should be constructed. Therefore, the borehole sites were decided during the survey period through discussions with the Government of Nigeria. In selecting the sites, the urgency and requirement in different villages were fully taken into consideration so as to concentrate the effect of the Project to the most polluted communities (a community is a group of several villages) by Guinea worm in principle. The communities thus selected as tabulated in Table 4-1.

Taking into consideration the frame work of Japanese grant aid and the construction schedule of the Project, the number of boreholes to be constructed in the Project has been decided at 150 as initially requested by the Government of Nigeria.

Table 4-1. Boreholes in This Project

No. of Community	Population ('000)	Nos. of Borehole	Planned Water Amount (lit/min)	Depth of Borehole (m)	Nos. of Village Infected by GW
Ikwo LGA					
Headquarters	-	2	50	50	5
Enyibichiri Alike	14	5	50	80	13
Adufu Alike	6	3	60	50	9
Echi Alike	6	3	60	50	7
Noyo	7	3	30	80	9
Ndufu Amagu	15	5	20	30	12
Ndegu Amagu	19	6	20	30	11
Igbudu	13	4	60	50	11
Inymagu	17	5	20	30	13
Eka Awcke	8	3	60	50	7
Ndagu Echara	14	5	20	30	10
Ekpanwudele	11	4	50	50	9
Ekpele	5	2	20	30	6
Amainyima	10	4	20	30	10
Ettam	9	3	50	50	8
Ezza LGA					
Ameka	16	5	60	80	11
Amusu	7	3	60	80	9
Amudo	7	3	20	30	8
Amagu	6	3	50	50	8
Amuda	5	2	20	50	7
Amawula	2	2	20	30	5
Achara Ukwu	3	2	50	30	6
Achara	2	2	50	50	7

No. of Community	Population ('000)	Nos. of Borehole	Planned Water Amount (lit/min)	Depth of Borehole (m)	Nos. of Village Infected by GW
Ekka	16	4	60	50	11
Ezzama	13	3	60	80	9
Idembia	13	3	60	50	10
Inyere	3	2	20	50	4
Amaezekwe	4	2	50	50	7
Nsokara	4	2	20	30	5
Ogboji	7	3	60	80	10
Okafia	10	3	20	30	8
Orizor	28	6	60	50	15
Umuezeoka	21	6	60	80	11
Umuoghara	30	6	60	80	13
Umuezeokeoha	30	6	60	80	15
Umu-Uwago Idembia	12	3	50	50	11
Nkomoro	8	3	20	30	5
Awgu LGA					
Oduma	36	6	60	30	16
Ndeabor	17	3	20	30	7
Okpanku	11	4	20	30	11
Mpu	7	2	50	30	6
Ogboii/Ululor	8	2	60	80	3
Amata Mgbowo	19	1	20	30	2
Nenwe	31	1	50	30	2
Total	530	150	44 (on average)	50 (on average)	382

(3) Designed Yield and Served Population

The request of the Government of Nigeria mentions that the served population per borehole is 500 persons. This population is computed from the potential yield of boreholes in Imo State which is located adjacent to Anambra State. It is considered that the potential yield of boreholes in the Project Area will be similar to that in Imo State. Therefore, the served population of 500 persons per borehole is judged to be adequate for the Project planning.

(4) Drilling Depth and Materials of Boreholes

The initial request of the Government of Nigeria did not specify the drilling depth of boreholes. However, the data of boreholes drilled by the task force of the Government in Anambra State were attached to the request. According to the data, the average depth of them is 41 m. The Study Team conducted electric conductivity surveys in a reconnaissance level, and detected high relative conductivities which suggest the existence of a fissure aquifer laying to a depth of 120 m in the northern part of the Project Area. On the contrary, extremely low conductivities were recorded at a depth above 30 m in the southern part of the Project Area, which suggest that mineralized water not suitable for drinking water in quality exists there.

Under the situations, the drilling depth of boreholes shall be about 80 m in the northern part and 30 m in the southern part of the Project Area with an averaged depth of about 50 m as shown in Table 4-1.

The borehole diameter is determined at 4 inches as requested by the Government of Nigeria. This diameter has been adopted to the existing boreholes as well as those constructed by UNICEF, and is economically and technically most adequate for installing hand pumps.

PVC will be selected as the materials for casings and screens as requested by the Government. Those of PVC have been used for the existing boreholes as well as those to be constructed by UNICEF. Groundwater in the Project Area is a little acid with pH value of six to seven. Therefore, PVC is preferable to steel.

(5) Study on Construction Machinery and Materials

1) Drilling Rigs

Initially a heavy rig was requested to drill to a depth of 200 m. However, the field survey revealed that the groundwater in the Project Area was mostly distributed within a depth of 50 m. Furthermore, judging from the road conditions in the Project Area, a light and small machine is preferable to be deployed. Accordingly, the rig shall be of middle scale one and have 100 m deep drilling capacity with function of both rotary and percussion drilling. The rig should be, as a matter of course, of the self propel type. In consideration of poor road conditions and off-road operation, the whole-wheal drive tractor type will be selected.

In view of an estimated period for drilling 150 boreholes, two units of rigs will be necessary for the Project.

2) Compressor

As mentioned above, the designed drilling depth in the Project Area is 80 m at maximum. Therefore, a small capacity of compressor will be sufficient to meet the requirement in percussion drilling. The necessary units of compressor is two in total, one for each rig.

3) Supporting Vehicle

Totally eight units of cargo truck and pickup were initially requested by the Government of Nigeria as supporting vehicles. However, in accordance with the study, the required types and numbers of vehicles are selected to cope with the activilies of the following five groups to be deployed on site to construct 150 boreholes in this Project.

Drilling Groups (Two groups)	Drilling boreholes Testing borehole walls Inserting casings Development
Testing Group (One group)	Lifting tests
Pump Installation Group	Installing hand pumps Constructing the foundation of pumps
Operation & Maintenance Group	Operation & maintenance of the constructed water supply facilities

4) Materials for Boreholes Development and Lifting Tests

Initially four units of submergible pump were requested for testing land cleaning of boreholes. However, the number has been decreased to two units, taking work programme into consideration.

Equipment and materials for air lift:		2 units
Submergible pumps with generator (Min. capacity for 4 inch hole)	:	2 "
Water level gauge	:	2 "

5) Quantities of Casings and Screens

The rates of casing and screen lengths to a total depth of designed boreholes are decided at 80 % and 20 %, respectively, as a result of discussions with the Ministry of Health and UNICEF, and 10 percent is added to the above quantity in consideration of damages in transportation and custody.

6) Side Wall Detector

No side wall detectors were initially requested. However, they will be included so as to utilize them to find the aquifer zone.

7) Handpump

The hand pumps for deep wells will be selected for the Project. Those accepted by the people of the Project Area, for instance, INDIA MARK II or those of Nigerian made will be used in consideration of the condition that the spare parts should be easily available. The necessary units is 150. In addition, 15 percent of it will be procured.

8) Electric Prospecting Equipment

The field survey by the Study Team as well as UNICEF's experience indicate that the electric prospecting should be conducted for selecting borehole sites. Taking into consideration the effective use of equipment and materials procured under the grant aid after the completion of the Project, the transfer of knowledge for electric prospecting and the procurement of electric prospecting equipment will be prerequisite. The necessary quantity is 1 unit.

9) Mudwater Agent, Foaming Agent

Percussion drilling will be the major way of drilling boreholes in the Project Area. Agent for rotary drilling will be used to a depth of 20 m. Polymer will be used as mudwater agent in place of bentonite. Foaming agent for air percussion will be used for drilling to a depth more than 20 m.

10) Communication System

The communication system is extremely poor in Nigeria. Therefore, wireless radio shall be used for communication among drilling groups, testing group and the Project Office, in order to get close contact to obtain high efficiency of the works.

11) Equipment and Materials for Repair

The workshop required for repair of the equipment procured in the Project will be constructed by the Ministry of Health and UNICEF before August 1988. Tools and devices required for the equipment procured and used in the Project shall be presented to this workshop.

12) Spareparts

Spareparts of the equipment sufficient for about 2-year normal operation shall be secured under the grant aid.

4-3. Project Plan

4-3-1. Organization for Implementation

The Water Corporation will be responsible for the Project implementation under the comprehensive control of the Ministry of Health, Anambra State Government. The Water Corporation has 1,700 personnels of which about 140 are sanitary or mechanical engineers to be involved in the Project. These sanitary and mechanical engineers include boreholes drilling engineers, hydrogeologists, and mechanical engineers for operation and maintenance of rigs and water supply facilities. The project office for the Project implementation will be superintended by the Ministry of Health. The workshop is to be newly constructed in WATSAN Project of UNICEF. This workshop is used for repair and maintenance of the equipment procured under the Japan's Grant Aid as well as the equipment of WATSAN Project.

The list of engineers and specialists proposed by the Water Corporation for the Project is as shown in 6-2, Chapter 6.

4-3-2. Implementation Programme

(1) Constitution of the Project

The Project consists of;

1) drilling of 150 boreholes, installation of handpumps and construction of appurtenant structures.

2) Supply of equipment and materials required for the above-mentioned works.

3) transfer of knowledge of O & M technology for supplied equipment and constructed water supply facilities to the Nigerian Staff.

(2) Implementation Programme

The main points of the project are as follows.

1) To secure good potable water by boreholes to eradicate Guinea worm disease.

2) To construct 150 handpump equipped boreholes in 3 LGA's situated in the eastern part of the Anambra State.

3) The depth of borehole changes between 30 m and 80 m by site, the average depth is 50 m. PVC casing pipe (100 mm in diameter) is to be inserted to the drilled borehole. The rate of screen to the whole borehole depth is 20% in length.

4) The service population by one borehole is 500 persons.

5) The substance provided by Japan's Grant Aid is as follows.

- Supply of related equipment and materials required for hand pump equipped boreholes such as rigs, supporting vehicles and hand pumps etc.
- Dispatch of Japanese engineers and experts to construct the boreholes.
- Consulting service for design, construction supervision and borehole siting.

6) The partial charge to the Nigerian Government is as below.

- Provision of Nigerian personnel and budget required for project office management and preparation of workshop during the construction period.
- Proper operation and maintenance of the granted equipment and constructed water supply facilities.

4-3-3. Summary of Equipment and Materials for Construction

The outline of the equipment and materials required for the implementation of the Project is as follows. The specifications and quantities of them are described in CHAPTER 5-BASIC DESIGN.

1) Equipment

- Drilling rigs with accessories
- Supporting equipment for drilling
- Supporting vehicles
- Equipment for borehole cleaning and water lifting test
- Electrical prospecting equipment for borehole siting
- Side wall detectors
- Communication system
- Spare parts etc.

2) Materials

- Casings and screens
- Hand pumps
- Mudwater Agent, Foaming Agent
- Fuels and lubricant
- Cement, aggregate and gravel
- Other miscellaneous materials

CHAPTER 5. BASIC DESIGN

5-1. Basic Concept

The basic design of the Project has be made taking into account the conditions prevailing in the Area such as inaccessibility of the Project Area during wet reason due to submerged road networks, poor provided infrastructures and drillings of alternative layers of hard and soft rocks, and at the same time implementing the Project works within the frame of the Japan's Grant Aid.

(1) To construct 150 wells together with providing the necessary equipment and materials such as handpumps, casings, screens, etc. for well construction,

(2) To provide drilling rigs, other equipment and materials well-suited in specifications to the previously-mentioned hydro-geological conditions of the Project Area as well as to the material conditions prevailing in the whole Nigeria,

(3) To provide such water supply facilities that can be consistent with the facilities planned by UNICEF in Anambra State and can play the role of an economic model facilities for other areas in the country in the future.

5-2. Basic Planning

5-2-1. Objective Area

The objective area of the Project consists of three LGAs of Ezza, Ikwo and Awgu of Anambra State. For Awgu, the southern part is the objective area. The area is flat farm land, grassland and savanna.

Hydro-geologically, most part of the objective area is composed of shale layers, and the potential groundwater for development can be found in the cracks in the hard rocks about 50 m to 80 m deep in the surface in the northern part, while in weathered layers as shallow as about 30 m in the southern part.

5-2-2. Designed Water Supply Amount and Beneficiary Population

The designed water demand adopted for the rural water supply in Anambra is 20 lit/head/day which is recommended by WHO, while an ordinary borehole in the Area is capable of yielding from 15 lit to 20 lit per minute only.

The Ministry of Health and UNICEF estimated the beneficiary population per borehole at 500 head, and with the figure, the well must be operated for about 11 hours a day to meet the aforesaid demand.

Water Demand = 20 lit/day x 500 head = 10,000 lit/day
Pump Operation Hours = 10,000 lit/day / 15 lit/min
= 11.1 hrs/day

Table 5-1. Beneficiary Population in Project Area

LGA	No. of Comm'ties	Total Population(1986) (person)	Boreholes (wells)	Beneficiary Population (person)
Ezza	22	247,000	74	37,000
Ikwo	15	154,000	57	28,500
Awgu	7	129,000	19	9,500
Total	44	530,000	150	75,000

5-2-3. Potential Groundwater for Development

The amount of groundwater exploitable for the Project can be taken by the result of the development made by UNICEF in Ohazola LGA, Imo State as mentioned in Table 3-5 in Chapter 3. In details, a borehole with depth a of 27.4 m and groundwater table 4.4 m, both on an average, could yield about 1.2 lit/sec.

The data suggest that more than 70 lit/minute can be lifted from one borehole. The result shows that the yield is more than the delivery capacity of handpump by 15 to 20 lit/minute and the designed water amount can be taken by 15 lit/minute.

5-2-4. Dimensions of Proposed Well Facilities

(1) Locations of Proposed Boreholes

The proposed number of the boreholes requested by the Ministry of Health is 150 located in 44 communities, as shown in Table 4-1.

(2) Designed Borehole Depth

The designed depths are in a range from 30 m to 80 m with an average of 50 m as shown in Table 4-1. The actual drilling depth, however, will be determined according to the results of electric prospecting to be conducted prior to drilling works.

(3) Success Rate of Boreholes Drilling

As discussed in paragraph 3-1-5 in Chapter 3, the success rate of borehole drilling by UNICEF in Imo State was 92.4 percent. The current Project will assume a rate of 90 percent based on the above rate and hydro-geological characteristic features of the Project Area.

5-2-5. Selection Criteria of Borehole Sites

The criteria of the borehole site selection is referred to as follows.

- Public places such as schools, clinics, markets, etc. in the requested areas
- Heavily polluted communities with Guinea-worm
- Communities where the inhabitants depend on water sources from artificial ponds or other stagnant water
- The communities densely populated
- The places satisfying the above conditions and where electric prospecting results show promising aquifers in cracks of rocks

5-3. Basic Design of Facilities

(1) Design of Boreholes

The well depth is designed by 80 m for the northern part of the Project Area while 30 m for the southern part, and 50 m on an average. The designed borehole diameter is four inches, which adopted in the UNICEF programme and existing rural wells.

The materials to be used for casings, screens, etc. are to be PVC products in considering anti-corrosivity, since water in the Project Area is acidic in quality.

Cement grout will be made to a minimum of six meters from the top to prevent surface water from flowing in.

And the proposed typical borehole is designed as shown in Figure 5-1.

(2) Design of Appurtenant Structures

For the upper part structures of the boreholes, 20 cm thick concrete slab will be placed to prevent direct infiltration of sewerage from the ground surface.

Drainage will be made with 40 m long concrete drain to carry sewerage to a flower bed, placed at the end of the drain. The flower bed should be arranged by the villagers to raise conscious of the local people for engagement in the Project and for ownership of the facilities; and therefore, the cost for flower bed arrangement shall be borne by themselves. Concrete blocks are to be placed surrounding the flower bed by the borehole constructor. And its layout is illustrated in Figure 5-3.

FIG. 5-1 DESIGN OF BOREHOLE

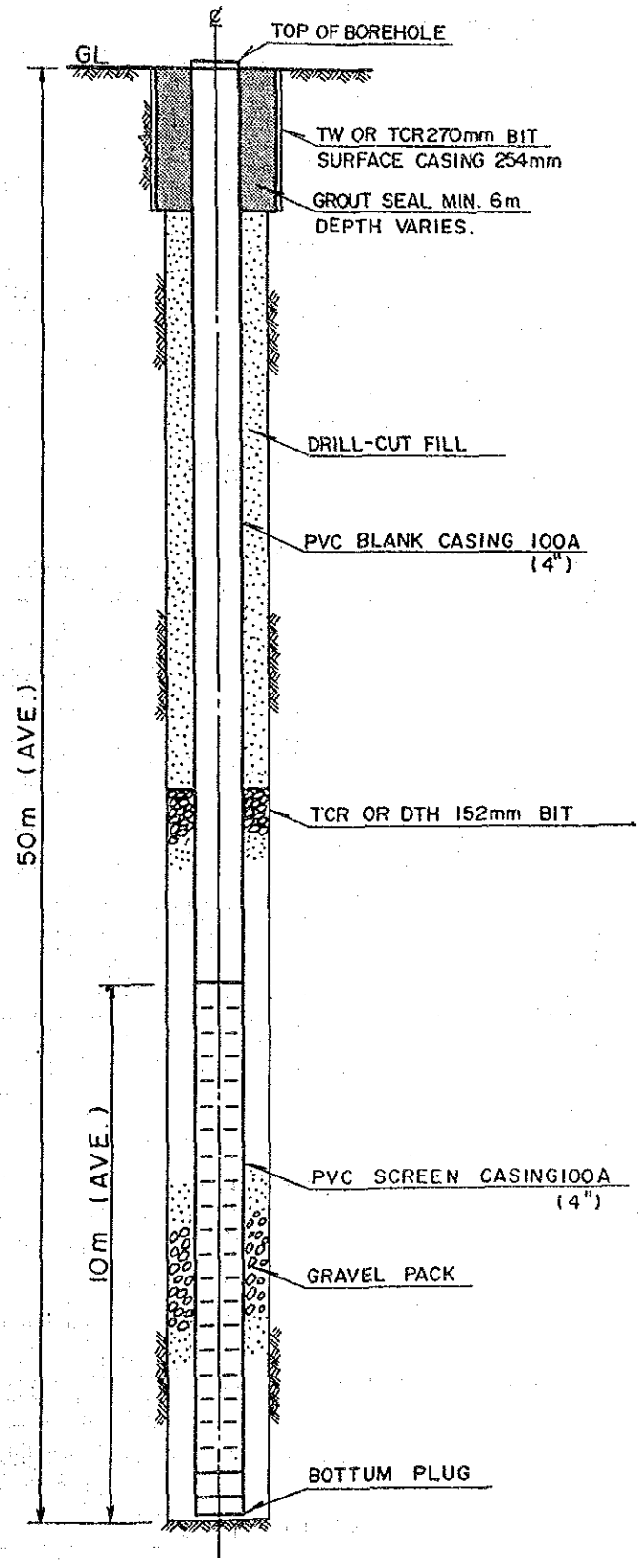
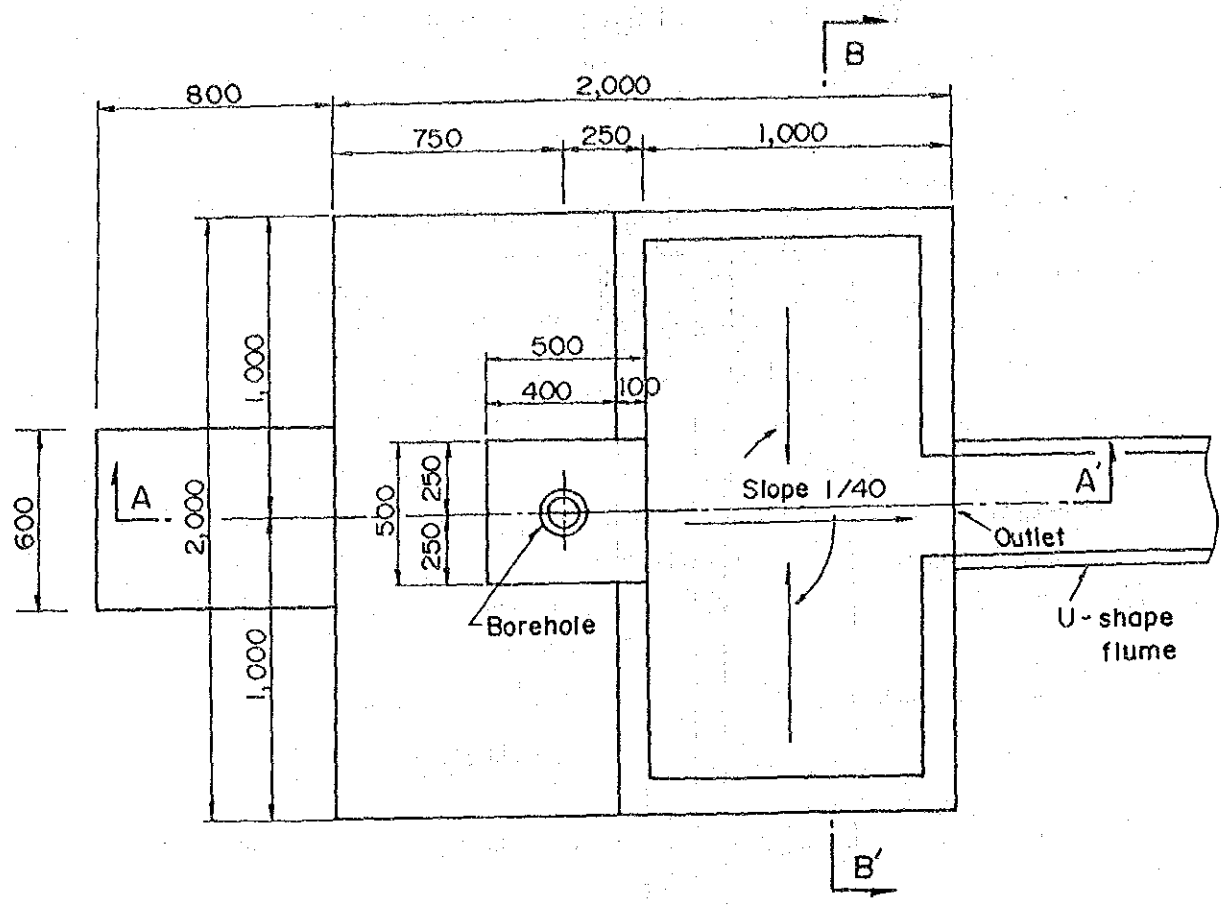
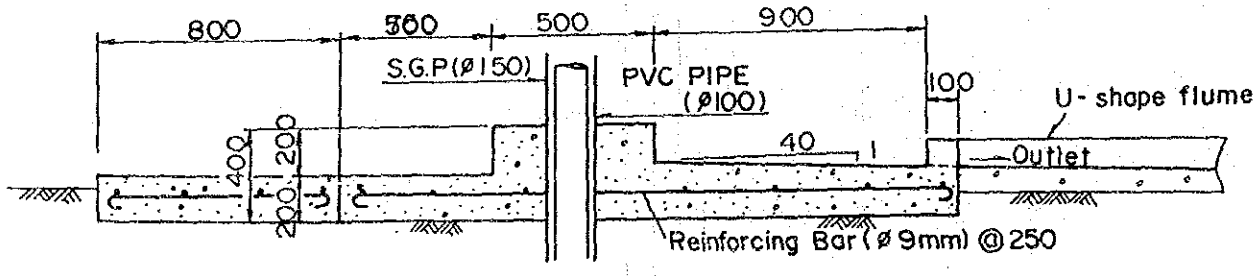


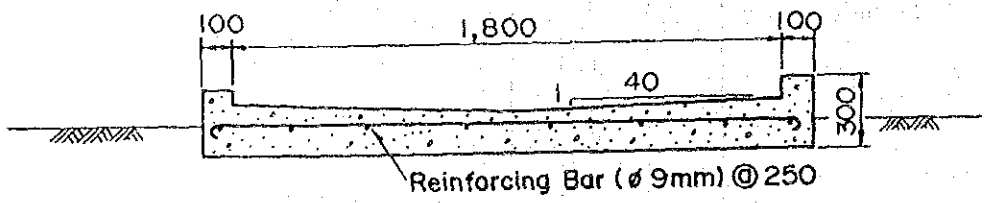
FIG. 5-2 CONCRETE SLAB OF WELL



Plan

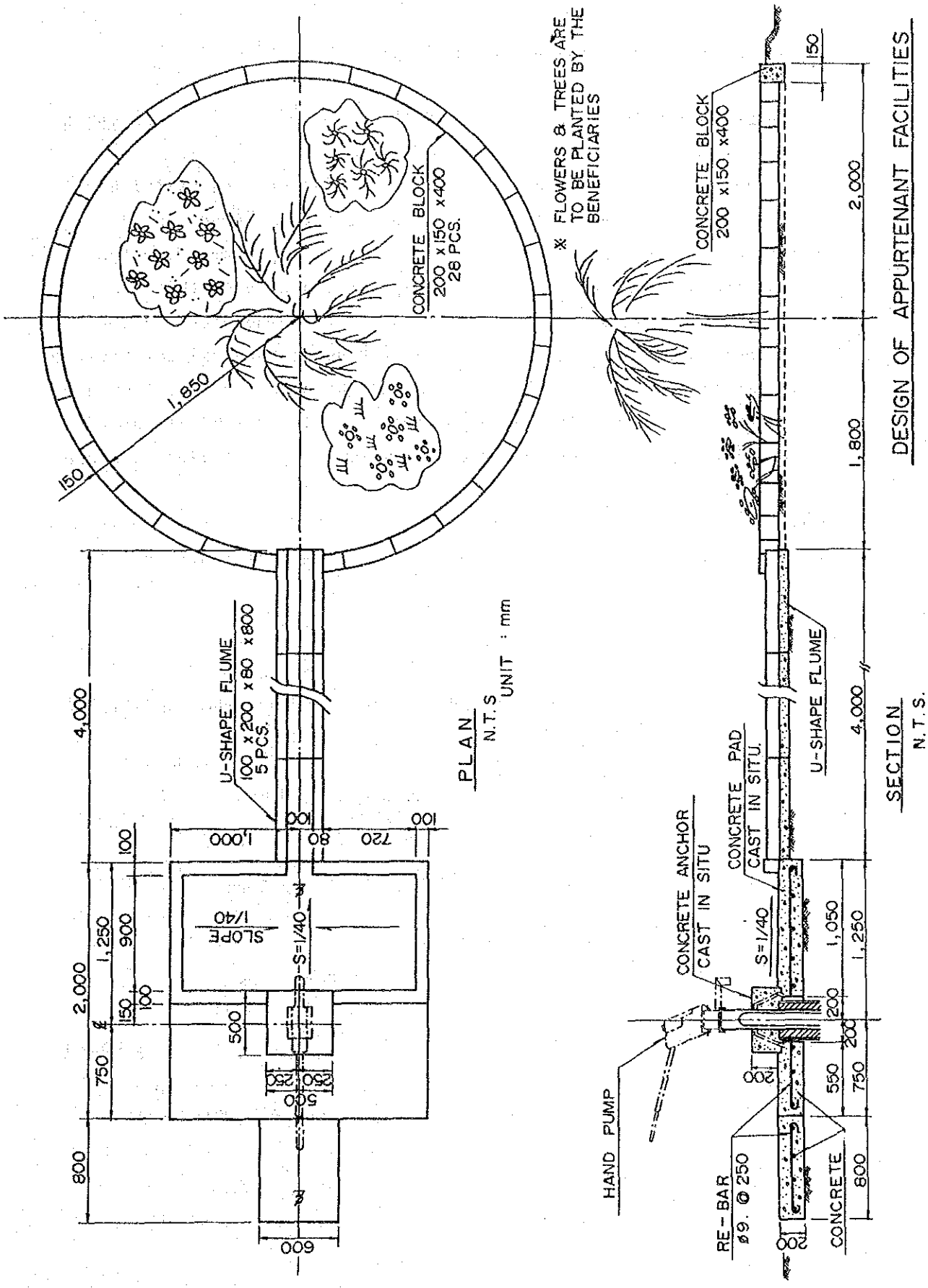


Section A-A'



Section B-B'

FIG. 5-3 DESIGN OF APPURTENANT FACILITIES



5-4. Basic Plan of Equipment and Materials

(1) Drilling Rig — 2 Units

Judging from the geology of the Project Area, the drilling rig employed for the Project should meet the requirements for drilling of both soft and hard rocks, and the top head drive type with percussion should be used for application of both the rotary type and percussion type. Due to unfavourable conditions of the road networks, particularly difficult access to the drilling site in the wet season, light drilling rig should be selected. Furthermore, tractor mounted type should be employed for higher mobility of the rig. Judging from working period and volume, two drilling rigs are required.

The specifications and quantities required are shown as follows:

a) Top Head Drive Type Drilling

Equipment available for both the Rotary Method and Air Percussion Method

Compression Capacity	:	5,500 kg
Drilling Capacity	:	more than 100 m with 120 mm Drilling pipe
Drainage Pump Capacity	:	more than 600 lit/min.

b) Standard Accessories and with Drilling Tools

c) Rig Carrier Tractors (4 x 4)

Water cooling Diesel Engine, Off-Road Type

(2) Air Compressor — 2 Units

One compressor shall be provided with each air percussion.

Compressor Capacity: more than 10.5 kg/cm^2 x 20 m^3/min.

(3) Supporting Vehicles 1 Set

The field works of the Project shall be executed by five groups consisting of Drilling Group (2 groups), Test Group (1 Group), Construction Group (1 group), and Water Supply Facilities O/M Group (1 group).

The details such as type, specifications, quantities, use, etc. of the vehicles, which are required by the above working groups for the Project are shown as follows:

Details of Supporting Vehicles

Kind	No. of Units	Spec. & Main Use
Cargo Truck	2 units	Capacity: More than 10 tons, 6x6 long body with 6-ton crane For carrying drilling tools such as drilling pipes, compressor pit, etc.
Tools Trucks	2 units	Capacity: 6 tons, 4x4, Ordinary body with 3-ton crane For carrying casing pipes, etc.
Small Trucks	2 units	4x4, with 400 kg crane, For water lifting test & earth works
Pick-up Trucks	3 units	6 passengers available, 4x4, 55 HP, For carrying personnel & tools and materials for operation and maintenance
Station Wagon	2 units	6 passengers available, 4x4, 65 HP, For carrying personnel concerned
Water Tank Lorry	1 unit	7.0 m^3, 4x4, For carrying water for drilling works

(4) Equipment and Materials for Borehole Cleaning and Water Lifting Test

The equipment and materials for borehole cleaning and water lifting test for measuring yield of borehole are shown as follows:

a) Equipment/Materials for Air Lift

Drill Rods	:	Size - BQ, 3.0 m long per piece,	54 pcs
Air Hose	:	1 inch x 10 m,	2 rolls
Nozzles and Other Accessories	:		1 set

(b) Equipment for Water Lifting Test

Pump with Submerged Motor	:	For 4 inch Use, 7.7 KW, 200V,	2 units
Diesel Generator	:	50 Hz, 200 V, 20 KVA,	2 units
Water level Meter for Borehole	:	by needle touch system cable more than 100 m	2 units

(5) Welder — 2 Units

One welder shall be provided for each drilling rig enable repair of the equipment and instrument on the working sites.

Specifications: Diesel Engine, 15 HP, 3,300 ppm

(6) Mud Water Agent, Foaming Agent — 1 Set

Since the groundwater is expected to be low and the drilling is made by air percussion in most cases, polymer shall be used as mud water agent for comparatively shallow soft portion of about 20 m deep, while foaming agent shall be applied for the portion deeper than 20 m. Consequently, bentonite will not be used, and the estimated quantity is shown as follows.

Polymer	6,600 kg
Foaming Agent	1,000 kg

(7) Communication System — 1 Set

A communication system shall be established for communication among the base camp (Enugu), mobile camps and job sites to ensure close liaison for smooth and safe progress of the works.

Radio Communication System

Base Station :	Output 150 W	1 unit
Mobile Station:	Output 50 W	3 units

(8) Electric Prospecting Equipment — 1 Set

An electric prospecting equipment shall be employed for hydro-geological survey to decide drilling points prior to borehole drilling.

(9) Geoelectric Borehole Logger — 2 Sets

The type and specifications of the geoelectric borehole loggers for determining the screen position are shown as follows.

Measuring Items:	Specific Resistivity, Caliper, Temperature,	
Recorder	:	Auto-recorder
Cable	:	more than 100 m long

(10) Water Analysis Kit — 2 Sets

The water analysis shall be made on the following 18 items regulated by WHO.

The measuring instruments shall be in kit to enable field measurement.

Measuring Items: Turbidity, Color, Taste, Odor, Potassium per Manganate Demand, pH value, Nitrite - Nitrogen, Nitrate - Nitrogen, Ammonium - Nitrogen, Chlorine, Hexavalent Chromium, Total Ion, Copper, Zinc, Total Hardness, Chlorine, Total contents of micro-organisms, coliform.

a)	Water Analysis Kit (for 100 samples)	2 sets
b)	pH meter	2 sets
c)	Pocket Type Electric Conductivity Meter	2 sets

(11) Casing Pipe — 1 Set

The casing pipe shall be 100 mm dia. PVC pipe taking anti-corrosivity and workability into consideration. The screen-pipe shall be prepared in the length to correspond to 20 percent of the expected borehole depth, and the slit works shall be made on the PVC pipes with the opening rate of 8 percent. Also, an excess of 10 percent of the pipes shall be prepared taking into account losses during transportion and site work. The designed borehole depth is determined at 50 m for quantity estimation.

a)	PVC casing pipes (100 mm dia. L = 4.0 m)	1,650 pcs
b)	PVC screen-pipes (100 mm dia. L = 4.0 m)	413 pcs
c)	Bottom plug	165 pcs
d)	Centralizer	1,050 pcs

(12) Handpumps — 173 Sets

There are several types of handpumps available. For the Project the type selected shall essentially be those easily repaired and supplied with spareparts because handpumps usually break down and require repair within one or two years after installation.

The UNICEF Programme has employed the INDIA MARK II in Nigeria, and the same type is to be adopted for the Project in Anambra State, and particularly, those types having inter-changeability of spare parts with the INDIA MARK II are to be selected. the riser pipes shall be stainless steel products, considering the water quality of the Project Area.

The quantity includes a reserve of 10 percent in excess of the total amount.

(13) Equipment and Tools for Workshop 1 Set

The UNICEF programme has planned to provide a workshop in Anambra State to play a role of the center of construction and maintenance works for community wells under WATSAN Project. The equipment and materials to be granted by Japan's Grant Aid will be handed over to WATSAN Project and will be controlled in this WATSAN's workshop after completion of the Project.

Under the circumstances, the workshop equipment and tools to be granted have been selected through consultative meeting with Anambra State Government and UNICEF Staff concerned, so that they will not be duplicated with those already prepared by WATSAN Project. The equipment and tools selected through these consultations are listed in the Appendix of this report.

(14) Spare Parts

The Project lasts for two years and the necessary spareparts shall be granted to meet the two-years requirements.

5-5. Project Cost

The project implementation costs for Nigerian side's works are roughly estimated as follows.

(1) Condition of Cost Estimation

1)	Estimated Date	:	April, 1988
2)	Exchange Rate	:	1 Naira = 31.446 Yen 1 US$ = 129.00 Yen
3)	Project Period	:	28.5 months after E/N
4)	Contractor	:	Equipment Supplyer (Japanese corporation)
5)	Other	:	To include the exemption from custom duty on import goods required for this Project and from enterprice tax for Japanese corporation.

(2) Estimated Costs for Nigerian Side's Works

1) Remuneration (Personnel cost)	₦183,000
2) Materials (fule,s office construction, etc.)	₦200,000
3) Contingency	₦ 49,800
Total	₦432,800

CHAPTER 6. PROJECT IMPLEMENTATION PROGRAMME

6-1. Organization of Project Implementation

6-1-1. Executing Body

The Project executing body is the Water Corporation under comprehensive superintendence of the Ministry of Health, Anambra State. The Water Corporation, having its staffs of about 1,700 in total, will assign about 140 engineers and mechanics to this Project. Among them, such staffs are included as borehole drilling engineers, hydrogeologists, and mechanics for O & M of the drilling equipment, and water supply facilities.

The project office is to be established under direct administration of the Ministry of Health. The equipment and materials to be provided under the Japan's Grant-Aid are to be maintained and repaired in the workshop newly built in the UNICEF-assisted WATSAN Project.

The proposed organization of the Project Office for execution is illustrated in Figure 6-1.

The water supply facilities, after their completion, will be handed over to the Water Corporation, however, their O & M service will be made by the office of WATSAN Project.

The relations between the Project and the WATSAN Project is shown in Figure 6-2.

The Ministry of Health of the Anambra State, under close cooperation with the authority concerned in the Federal Government will take necessary measures for implementation of the Project after the Exchange of Notes are mutually confirmed by two Governments, Japan and the Federal Republic of Nigeria.

FIG. 6-1 THE PROJECT ORGANOGRAM

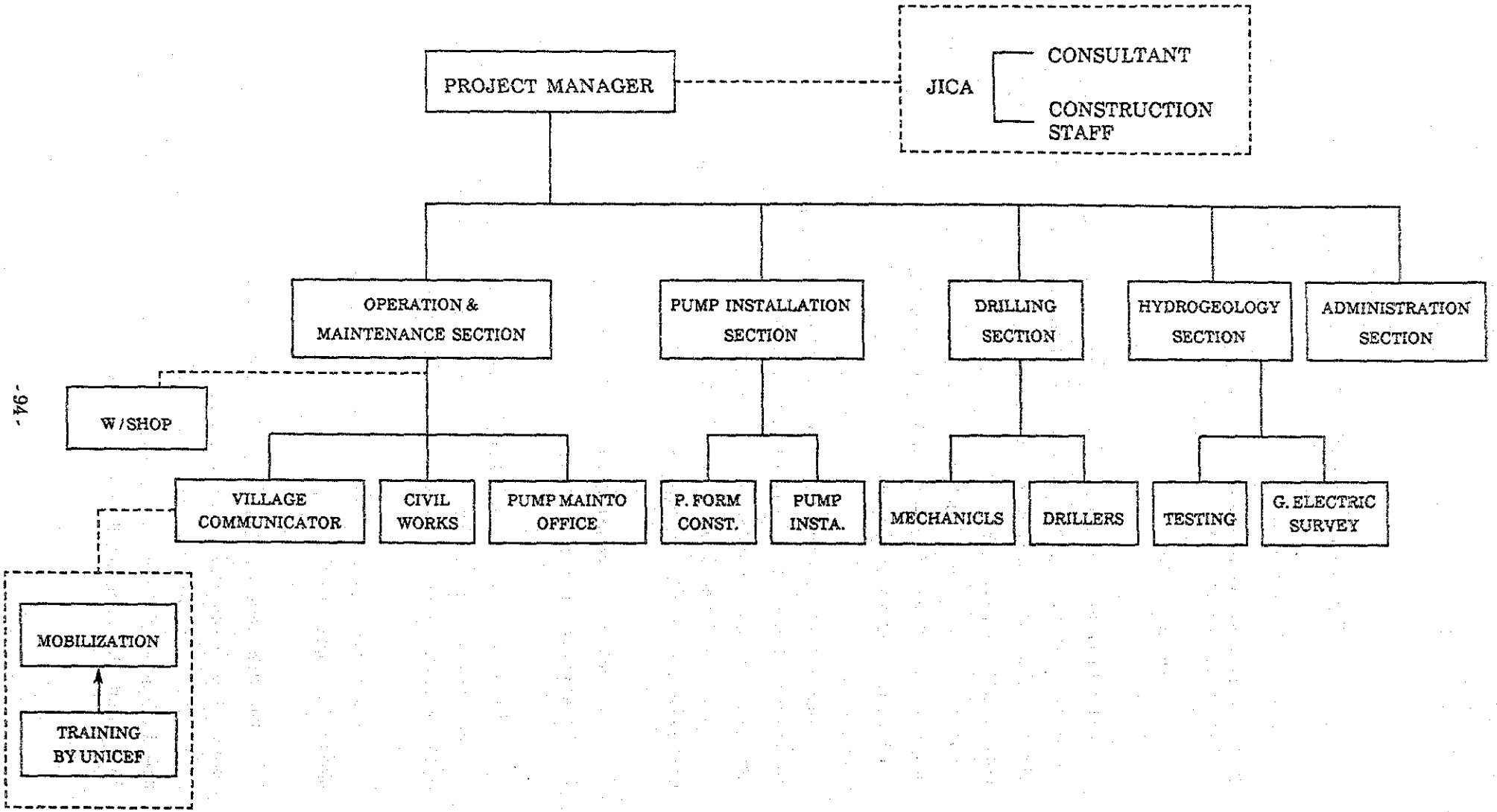
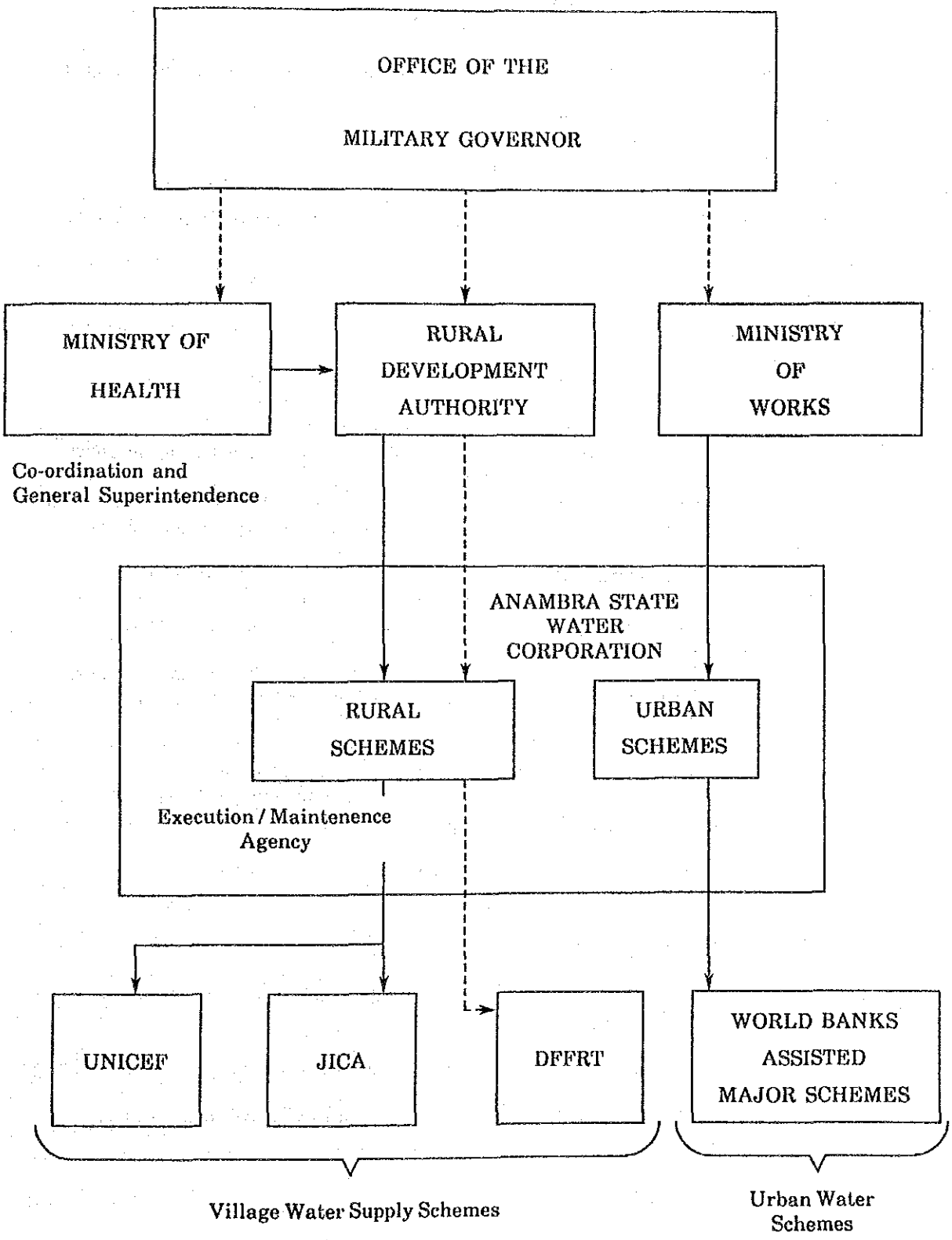


FIG. 6-2 ORGANOGRAM FOR THE IMPLEMENTATION OF POTABLE WATER SCHEMES IN ANAMBRA STATE



6-1-2. Plan of Detailed Design and Construction Supervision

(1) Consultants and Contractors

The Project will be studied for implementation under the Grant Aid of the Japanese Government.

In this case, the Japanese consulting firm and Japanese contractor will carry out the following works in accordance with the regulation of the Japan's Grant Aid.

1) Consultants

(a) Detailed Design

° Preparation of detailed design and tender documents for the procurement of equipment and materials as well as the construction of 150 handpump equipped boreholes.

° Carrying out the tender works in proxy of the Nigerian authorities concerned together with tender analysis and evaluation of the offered tenders.

° Witnessing and advising on the negotiations between Nigeria Government and the successful tenderer.

° Supervision of procurement/transportation of the equipment and materials, and the Japanese engineers/experts assigned to the Project as well as the Project construction works,

° Other necessary services to be rendered.

(b) Construction Supervision

° Coordination with other organization and agencies concerned,

° Total management of the Project works,

° Keeping work records and accounting of the works,

- Comprehensive control of technology transfer,
- Determination of drilling sites (borehole siting).

2) Contractor

- Procurement/transportation of the equipment and materials,
- Dispatch of the construction experts to Nigeria,
- Implementation of the construction works,
- Technology transfer through construction works,

The necessary staffs and their works are as follows:

- Construction Supervisor One Engineer
  - Control of work progress and coordination of the works,
  - Supply and control of construction materials,
  - Operation and Management of the base camp,
  - Control of technology transfer.
- Chief Driller (Two engineers) and Assisant Driller (Two assistant engineers)
  - Operation of drilling rigs and their supporting equipment and instruments,
  - Test of the drilled boreholes,
  - Transfer of borehole drilling technology.
- Mechanical Engineer (One engineer)
  - Maintenance of the drilling equipment, supporting equipment, and vehicles,
  - Stock control of spareparts.

Civil Engineer (One engineer)

- Construction of water supply facilities and their appurtenant facilities,

Water Test Expert (One expert)

- Testing water quality and checking the yield,

Hydrogeologist (One engineer)

- Carrying out electric prospecting and analysis of the results,
- Preparation of the data for determining the borehole sites.

(2) Responsibilities of the Governments of Nigeria and Japan

When the Project is executed under the Japan's Grant Aid, the responsibilities to be shared by both Governments are considered reasonable as follows.

1) Undertakings of the Government of Japan

° Procurement, transportation, and delivery of the major equipment and materials referred to in paragraph 5-4, of Chapter 5.

° Dispatch of the necessary engineers and experts for borehole construction and technology transfer to the Nigerian staffs for the construction of handpump equipped boreholes.

2) Undertakings of the Government of Nigeria

° To bare such costs as salary of the Nigerian officials concerned, construction of the Project office and workshops.

° Securing necessary local staffs and payment their salary.

° Procurement with payment for the other necessary equipment and materials than those offered under the Japan's Grant Aid.

° Securing the necessary land and traffic right for successful implementation of the Project.

- Tax exemption of the equipment and materials to be brought into Nigeria for the Project implementation.
- Tax Exemption of the Japanese staffs assigned to the Project and their goods to be brought into Nigeria with themselves.
- Ensuring the security of the Japanese staff in Nigeria.
- Ensuring the Japanese staffs of their smooth entry/exit/re-entry of Nigeria for the Project.
- Payment of the Bank Commission.
- Operation and maintenance of the facilities completed.

(3) Basic Concept of Project Implementation

The construction of the borehole and the appurtenant structures shall be implemented by Water Corporation under the comprehensive superintendence of the Ministry of Health, Anambra State. And the construction works shall be executed in Ikwo, Ezza and Awgu LGAs in Anambra State with the quantity as shown below.

Table 6-1. Quantities of Well Drilling and Construction

LGA	Proposed No. of Borehole	No. of Drilling	Dryhole	Total Drilling Depth (m)	Depth of Casing (m)*
Ikwo	57	62	5	2,800	2,550
Ezza	74	82	8	4,710	4,280
Awgu	19	21	2	740	670
Total	150	165	15	8,250	7,500

* ... Including screen portions.

The works required for construction can be specified into the following seven kinds.

1) Project Management

- Coordination with the State Government, Ministry of Health, LGA Authorities, UNICEF, and other related organizations and agencies.

- Management of construction works
- Control and Coordination of the work progress
- Management of equipment and materials together with spareparts.
- Keeping the work records and accounting of the project works.
- The general management as above shall be carried out.

2) Construction Supervision

- Supervision of construction progress and workers together with close coordination.
- Supply and control of construction equipment and materials.
- Management of base camp.

3) Selection of Borehole Sites

- Selection of borehole drilling sites according to the field investigation and electric prospecting
- Selection of access roads to the proposed sites.

4) Drilling Works

- Mobilization and demobilization of the equipment and materials.
- Drilling and borehole check/cleaning .
- Supply of drilling water, fuel, etc.

5) Borehole Test

° Water lifting to confirm well-yield

° Water quality test

6) Construction Works of Appurtenant Structures

° Installation of hand pumps, etc.

° Construction of well base, drains and other appurtenant structures

7) Operation and Maintenance of the Project

° Daily operation and maintenance of drilling rigs and vehicles, etc.

° Maintenance of water supply well facilities after completion.

(4) Implementation Programme

The proposed 150 successful boreholes will be drilled according the following programme. The working rate is decided in taking into consideration the estimation data available in Japan (Japanese Standards of Construction Works - Large Borediameter for Geological Survey) and actual results obtained in various African countries as well as the current situation of Nigeria.

1) Numbers of the days required for borehole drilling

The typical boreholes with 50 m depth will require the following days;

(a) For successful boreholes

° Transporting and mounting of drilling equipment	1.0 day
° Drilling	1.5 days
° Borehole Check/Casing	0.5 days
° Gravel filling and Borehole Cleaning	0.5 day
° Cleaning of the job-site and transporting the equipment out of the site	0.5 day
Total	4.0 days

(b) For Unsuccessful boreholes (dry holes)

° Transporting and mounting the drilling equipment	1.0 day
° Drilling	1.5 days
° Cleaning of the job-site and transporting the equipment out of the site	0.5 day
Total	3.0 days

2) Borehole Test (Water Lift Test, Water Quality Test, Borehole Check Data Analysis)

° Transporting and setting of test pump	0.5 day
° Water lift test (observation)	1.0 day
° Cleaning of job-site and transporting equipment/tool out of the site	0.5 day
Total	2.0 days

3) Installation of Handpumps

° Transporting equipment materials, and installing the handpumps	0.5 day
° Earth works and concrete works	1.0 day
° Trial operation and removal tools and remaining materials out of the site	0.5 day
Total	2.0 days

4) Working Days and Construction Period

The proposed working days are estimated as follows.

Labour condition: 8 hours' working per day
(8:00 AM - 5:00 PM)

One holiday per week
National holidays: 12 holiday per year

Climatical conditions: Loss rate by rainy days in the wet season
March - September x 40%

Therefore, the number of the days unworkable per year is estimated as follows.

Sundays/holidays 12 month x 5 days/month = 60 days

Loss days by raining

4 month x 25 x 40% = 40 days

Total of the days unworkable: 100 days/year

As a result, the annual working days are as follows.

365 days/year - 100 days = 265 days

These working days can be considered as 205 days for the dry season and 60 days for the wet season.

According to the above (4), 1), the necessary number of the days for total borehole drilling is:

(150 S.holes x 4 days + 15 D.holes x 3 days) / 2 rigs
= 322.5 days

In the assumption that the drilling works would be started on June 1, 1989, the whole drilling works will be finished at the end of September, 1990, according to the annual working days estimated above.

And also the borehole test and handpump installation should be carried out within the borehole drilling period by the number of the days as follows.

Borehole Test: 165 holes x 2 days = 330 days

Pump Installation: 150 holes x 2 days = 300 days

The borehole test will last about 10 days longer than pump installation, and such difference of number of the working days can be covered by the works of the pump installation groups.

The pre-investigation and electric prospecting to be carried out prior to drilling works shall be conducted as follows.

Pre-investigation : 5 sites/day
Electric prospecting: 1.5 sites/day

(5) Staffing Plan of Nigerian Personnel

The staffing plan of Nigerian personnel for the project implementation shall be made along with the details referred to as 7 kinds of works described in the previous paragraph (3).

The numbers of the groups included in the respective works are two groups for drilling works and one each for other works.

The necessary Nigerian staffing for the project implementation is shown in Table 6-2.

Table 6-2. Sections and Personnels charged by Nigerian Staff

Work / Profession	Project Office	Siting	Drilling	Testing	App. Structure	O & M	Total
Project Manager	1						1
Construction Supervisor	1						1
Hydrogeologist		1		(1)			1
Mechanical Engineer			1				1
Civil Engineer					1		1
Driller			2				2
Assist. Driller			2				2
Heavy Vehicle Operator			5				5
Light Vehicle Driver	1	1	2	(1)	2	1	7
Stock Manager	1						1
Accountant	1						1
Typist	1						1
Guardman	2						2
Pipe Fitter						2	2
Labourer	2	5	10	(5)	5	2	24
Total	10	7	22	(7)	8	5	52

Note: Personnel in ( ) is concurrent as whom in siting work.

(6) Implementation Plan

It is deemed most reasonable that the Project implementation should be staged into Phase I and II in view of the work volume and construction cost, in case that the Project is implemented under Japan's Grant Aid.

The work volume and schedule in each phase are shown as follows.

Phase I

- Siting of borehole points
- 28 borehole drilling and construction of appurtenant structures in whole Awgu LGA and a part of Ezza LGA.

Phase II

- Siting of borehole points
- 122 Borehole drillings and construction of appurtenant structures in the remaining part of Ezza LGA and whole Ikwo LGA.

It is expected to take about four months from the Exchange of Notes for the Phase I to the conclusion of contract with the Contractors.

The contractor should start procurement of the necessary equipment and materials immediately after conclusion of contract. And it will take about six months for completing total procurement.

Furthermore, maritime and inland transportation of these equipment and materials will take another two months.

Therefore, about 12 months will elapse for these equipment and materials to reach Anambra State after E/N concluded.

The procured goods, immediately after arriving in Nigeria, shall be delivered to the Water Corporation, who shall follow the necessary procedure for registration and insurance of the equipment and vehicles with responsibility.

The construction works shall be carried out by the Contractors with their full responsibility. With a series of formalities and procedures cleared out, about 3.5 months will be left for construction under the regulation of the Japan's Grant Aid Project.

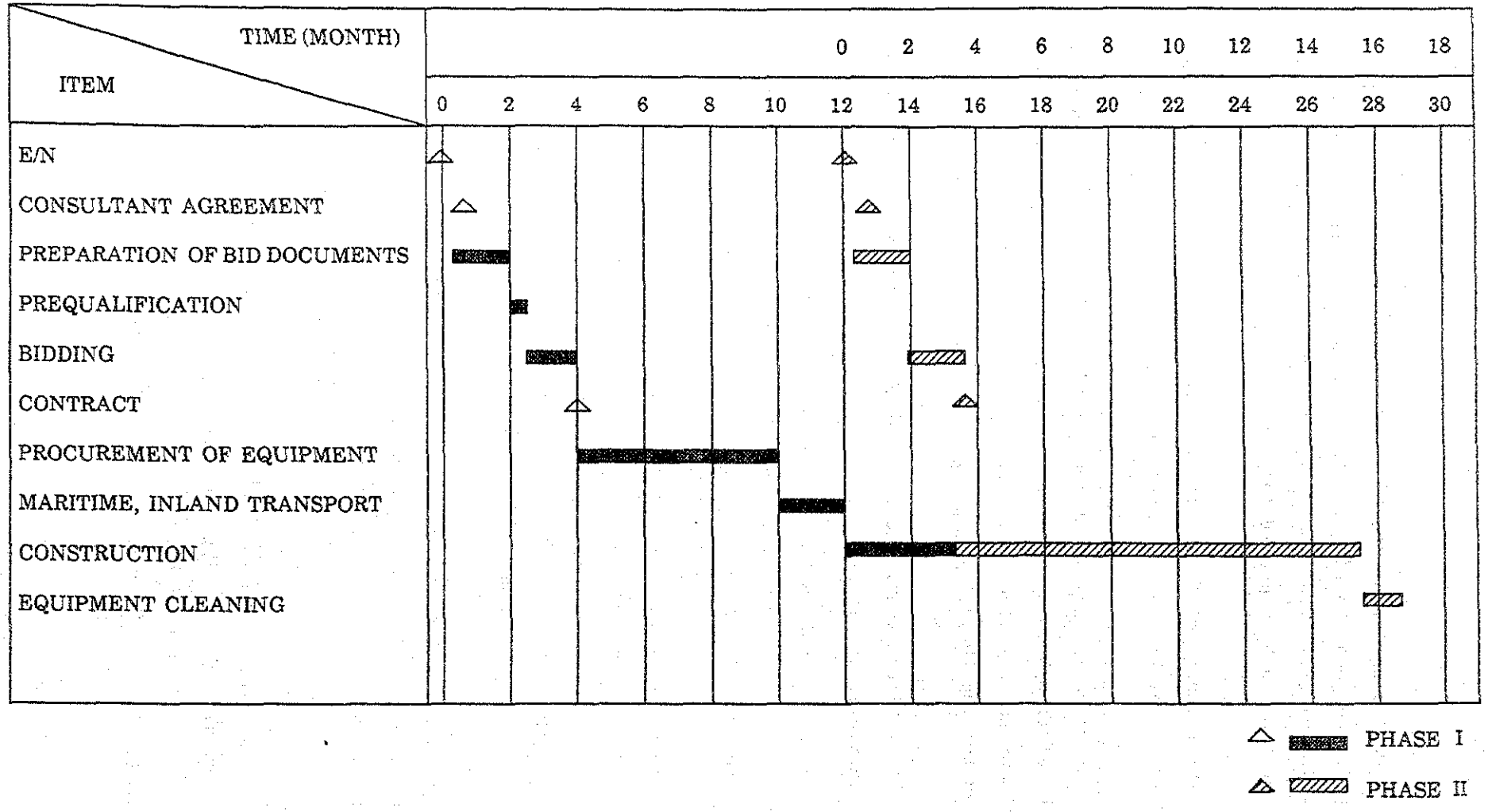
However, siting of boreholes can be executed before arrival of the procured goods in Nigeria, the Contractor should begin siting works immediately after the Contract concluded. In this case, about five months can be expected for siting works.

The Exchange of Notes for the Phase II will be concluded one year after the E/N for the Phase I.

For Phase II works, the construction can be started about three months after E/N concluded because procurement and transportation of equipment are not required. The Construction works will need 12 months for the Phase II.

As mentioned above the implementation programme of the Project is illustrated in Figure 6-3.

FIG. 6-3 PROJECT IMPLEMENTATION SCHEDULE



CHAPTER 7. OPERATION AND MAINTENANCE PROGRAMME

7-1. Operation and Maintenance Programme

(1) Water Supply Facilities

The Operation and Maintenance Group shall be established in the Project Office for well-keeping of the water supply facilities and equipment/materials for the Project. The group consists of six members: one liaison officer, two plumbers, two workers and one driver. These members of the group, after completion of the Project, will be deployed to the WATSAN Project Office to render O & M services.

The group shall render regular O & M services, rove the communities provided with water supply facilities once a week and also give training to the selected local members of daily maintenance works.

(2) Drilling Equipment and Materials

After completion of the Project, the drilling equipment and related materials which are offered by Japan's Grant Aid will belong to WATSAN Project under the control of the Ministry of Health and be utilized successively to drill boreholes for the similar projects in Anambra State for the prevention of potable water from Guinea-worm pollution.

To this end, the equipment and materials used in the Project will be placed under the control of the workshop of the WATSAN project, and the engineers assigned to this Project by Water Corporation will successively practise the O & M works of the equipment.

These Nigerian engineers who receive the on-the-job training during implementation of the Project, should educate and train the Nigerian staffs concerned through the works as well as the O & M services of the equipment and materials.

7-2. Operation and Maintenance Cost

The Operation and Maintenance Cost (O & M Cost) should cover those expenditures that two O & M groups can render regular O & M works for ten years in visiting borehole sites of the respective communities and the groups can repair the pumps which are assumed to occur once per 1.5 year per location for 150 boreholes.

The O & M cost of the drilling equipment and materials are not included in this O & M cost because the said cost shall be borne by the projects which use the equipment and materials already come under control of WATSAN Programme.

(1) Composition of each O & M Groups

Vehicle	:	Pick-up Truck 1 unit
Staff	:	1 Liaison Staff, 1 Driver, 2 Plumbers, 2 Workers
Average Moving Distance	:	150 km x One Round Trip (300 km)/Day

(2) Spare Parts: 346 Nira/year x 150 boreholes x 8 years

The costs for the first two years are included in the Grant Aid.

(3) Materials for Repair

This cost is included in the Grant Aid.

(4) Frequency of Repair

(150 holes x 10 years) / 1.5 Times/year = 1,000 Times

The cost estimation is made at the current prices of commodities without consideration for future price escalation.

O & M Cost (10 years, 150 boreholes)

(1)	Direct Salary	₦227,000
(2)	Fuel and Oil	₦112,500
(3)	Repair & Spare Parts	₦414,500
	Total	₦754,000

CHAPTER 8. PROJECT EVALUATION

The incidence of Guinea-worm disease in Nigeria is estimated at 60 percent in the heavily affected states, and Anambra State, the objective area, is one of them. In Anambra State, the most seriously affected area is Awgu LGA, where more than 10% of the total population came to the medicine dosing depots of the Ministry of Health. Since the number of potential patients is deemed to be 5 to 6 times the number of actual patients, the infection rate reported by the Ministry (i.e., 60% of total population) is considered reasonable.

The Guinea-worm disease is characterized by occurrence mostly among farmers and children. In Anambra, an agri-based state, if many farmers cannot engage in farming activities due to the terrible pain associated with Guinea-worm disease, the state economy, and even the national economy will be adversely and seriously affected by Guinea-worm.

In another respect, relieving the children of Guinea-worm pain will improve their schooling rate considerably to result in higher development of the national education level and will greatly contribute to development of both the State and the Country.

Eradication of Guinea-worm in the Country can be advantageously realized only through the diffusion of safe potable water.

The community of Kankan in Kwara State, having a population of about 500 persons, had been called the "Guinea-worm community" because about 63 percent of the population suffered from Guinea-worm in 1983; however, installation of two handpump equipped boreholes under the WATSAN programme allowed the patient rate to fall drastically to zero in 1987. In Asa LGA of Kwara State, similar favorable results were also obtained within three years.

UNICEF carried out the survey on Guinea-worm disease for 1.6 million rice growing farmers (195,000 families) in heavily affected areas of Anambra, Imo, and Cross-river States, and made an economic evaluation of the Guinea-worm Eradication Plan for the above three states for five years with the data on necessary costs and benefits expected from increasing paddy production. According to the evaluation, the total cost required for the eradication campaign is estimated at US$36 million, US$22.7 per capita, while the expected benefit per year from increased rice production is calculated at about US$20 million, or about US$100 million for five years.

The direct benefits expected from the implementation of this Project are obtained as follows for Ikwo, Ezza and Awgu LGAs in Anambra State.

(1) to supply clean and safe potable water to the inhabitants of communities where there exist no appropriate water supply facilities;

(2) to provide water supply facilities with groundwater as a source so that the patients now infected Guinea-worm at the rate of more than 60 percent can be aided and to curb other water-borne diseases;

(3) to alleviate the heavy burden of water fetching labor and to reduce the time devoted to it.

The proposed 150 handpump-equipped boreholes can cover the communities with drastically high patient rates of Guinea-worm disease although they cannot supply clean and safe potable water to all the local inhabitants in the Project Area. The Project will benefit directly the numbers of people shown in the following table.

LGA	Total Population	Benefitted Population
Ikwo	154,000	28,500
Ezza	247,000	37,000
Awgu	129,000	9,500
Sum Total	530,000	160,500

The transfer of technology through the Project's implementation will have a favorable effect not only on the objective area but on the whole of Anambra state in greatly contributing to promotion of the development of a clean and safe potable water supply by exploiting the groundwater.

From the above facts, it is judged that grant-aid assistance for this Project is justifiable from both the technical and financial points of view.

CHAPTER 9. CONCLUSION AND RECOMMENDATIONS

9-1. Conclusion

The following are the conclusions reached as a result of the field survey, frequent discussions and consultative meetings with the Nigerian Government officials concerned in Nigeria and the further detailed study made in Japan.

(1) The Project aiming at development of the rural water supply with 150 handpump equipped boreholes is seen as a link in the chain of the total rural water supply development programme in Nigeria.

(2) The arrangement of water supply facilities under this Project will not only eradicate the Guinea-worm disease from which more than 60 percent of the local people have been suffering, but also curb the occurrence of water-borne diseases carried in insanitary water.

(3) The Project shall be implemented for those areas urgently affected where the absence of proper water supply facilities has had serious adverse effects on the local people and their health.

(4) The Project's implementation essentially requires provision of two drilling rigs and other associated equipment and materials necessary for successful completion of the borehole construction.

(5) In due consideration of the foreign exchange situation of Nigeria, Japan's Grant-Aid Assistance is quite necessary for procurement of the necessary equipment and materials and implementation of the construction work. Thus, realization of the Project is quite justifiable.

9-2. Recommendations

The following would be recommended to the Government of the Federal Republic of Nigeria as a result of the Basic Design Study for the Project.

The beneficiaries to be served under this Project would not include the whole population in the Project Area since the Project will be implemented preferentially in the most urgently affected areas. It is therefore essential to continue the work to supply all the remaining inhabitants with safe potable water in order to eradicate Guinea-worm disease in the area.

For the above, the provision of staffing and a budget will be necessary for the effective utilization of the granted drilling rigs and associated equipment.

In order to carry out the operation and maintenance of the water supply facilities to be constructed in the Project, it will also be important to build up closer cooperation with the UNICEF assisted WATSAN Project to be established in Anambra State.

ATTACHED DOCUMENTS
(APPENDICES)

APPENDIX 1. Member List of the Survey Team

Name	Position
Masao TSUJIOKA	Leader Deputy Div. Chief, First Basic Design Study Div., Grant-Aid Cooperation, Planning & Survey Dept., JICA
Hiroshi OHARA	Public Health Doctor Experts Dispatch Service Div., Department of International Cooperation, National Medical Center Hospital
Yoshihisa SHIMIZU	Water Supply Planning Facility Department, Engineering Division, Osaka Municipal Water Works Bureau
Hisao ANDO	Groundwater Development Sanyu Consultants Inc.
Haruhiko NAKAMURA	Hydrogeologist Sanyu Consultants Inc.
Mitsuharu KURAKAZU	Machinery Planning Sanyu Consultants Inc.

APPENDIX 2. Itinerary of the Field Survey

Date	Day	Work Schedule
1988		
March 1	(Tue.)	Departure from Tokyo.
2	(Wed.)	Arrival in Paris.
3	(Thu.)	Discussion with JICA France Office, Trip to Lagos.
4	(Fri.)	Courtesy call on the Embassy and the Government in Lagos, Nigeria.
5	(Sat.)	Inter-team discussion.
6	(Sun.)	Trip to Enugu.
7	(Mon.)	Courtesy call on the Anambra State Government, discussion.
8	(Tue.)	Site investigation.
9	(Wed.)	Site investigation, Trip to Lagos.
10	(Thu.)	Courtesy call on UNICEF, discussion. Field survey (Mr. Nakamura and Mr. Kurakazu -- staying in Enugu until March 27th)
11	(Fri.)	Discussion and signing of the Minutes.
12	(Sat.)	Report to Embassy and the Government.
13	(Sun.)	Mr. Tsujioka, Dr. Ohara and Mr. Shimizu's departure for Japan.
14	(Mon.)	Trip to Enugu (Mr. Ando).
15	(Tue.)	Field survey and data collection in Enugu.
16	(Wed.)	-do- .
17	(Thu.)	-do- .
18	(Fri.)	-do- .
19	(Sat.)	-do- .
20	(Sun.)	-do- .
21	(Mon.)	-do- .
22	(Tue.)	-do- .
23	(Wed.)	-do- .
24	(Thu.)	-do- .
25	(Fri.)	Discussion with authorities of the Anambra State Government.
26	(Sat.)	-do- .
27	(Sun.)	Trip to Lagos.
28	(Mon.)	Discussion with foreign-aid authorities.
29	(Tue.)	-do- .
30	(Wed.)	Market survey and data collection.
31	(Thu.)	-do- .
April 1	(Fri.)	Discussion with authorities concerned.
2	(Sat.)	-do- .
3	(Sun.)	Data collection.
4	(Mon.)	-do-
5	(Tue.)	Courtesy call on Embassy and the Government.
6	(Wed.)	Departure from Lagos.
7	(Thu.)	Arrival at Paris.
8	(Fri.)	Departure from Paris to Tokyo.
9	(Sat.)	Arrival at Tokyo.

SCHEDULE OF THE FIELD SURVEY

Date	Mr. TSUJIOKA (Leader) Dr. OHARA, Mr. SHIMIZU and Mr. ANDO	Hydrogeology (Mr. NAKAMURA)	Equipment Planning (Mr. KURAKAZU)
1988 March			
4	Courtesy call on Embassy and the Government. Discussion with authorities concerned (L)		
5	Inter-team discussion (L)		
(6)	Trip to Enugu (WT262, 12:00) (E)		
7	Courtesy call on Anambra State, Ministry of Health and Water Corporation and discussions with authorities concerned (E)		
8	Site investigation at proposed borehole sites (E)		
9	Site investigation at typical water supply facilities. Trip to Lagos (WT-265, 16:45)	Discussion with State Ministry and Water Corporation on hydrogeology, existing borehole, and water supply facilities (E)	
10	Discussion with UNICEF (L)	Field survey for hydrogeology and water supply facilities	
11	Minutes discussion, signing (L)	Preparation of geo-electric survey (E)	Field survey for existing water supply facilities (E)
12	Report to Embassy and Government (L)	-do-	-do-
(13)	Leave for Japan (BR362 23:55) except Mr. ANDO	Geo-electric survey	Data collection on construction equipment
	Groundwater Development (Mr. ANDO) (L)		
14	Discussion with FDWR. Trip to Enugu (WT264 15:15) (E)	-do-	-do-
15	Field survey existing sources	-do-	Field survey for existing water supply facilities
16	-do-	-do-	-do-

(cont'd)

Date	Groundwater Development (Mr. ANDO)	Hydrogeology (Mr. NAKAMURA)	Equipment Planning (Mr. KURAKAZU)
1988 March			
17	Field survey for water resources (E)	Geo-electric survey. (E)	Data collection for construction equipment (E)
18	Data collection on socio-economy and public health	-do-	Data collection and field inspection on O & M
19	-do-	-do-	-do-
(20)	Field inspection for foreign aid project site	-do-	Field inspection for foreign aid project site
21	-do-	-do-	-do-
22	Data collection at private drilling company.	-do-	Data collection and inspection for work-shop
23	Data collection and discus-sion with authorities	Water quality analysis in exist-ing boreholes	Data collection on inspection for work-shop.
24	-do-	-do-	-do-
25	Data collection and discussions with State Government and Water Corporation (E)		
26	Data collection and discussion with foreign-aid organization		
(27)	Trip to Lagos (L)		
28	Data collection and discussions with foreign-aid authorities		
29	-do-		
30	Data collection at FDWR (L)	Data collection at private drilling company (L)	
31	-do-	Data collection on construction materials	

(cont'd.)

Date	Groundwater Development (Mr. ANDO)	Hydrogeology (Mr. NAKAMURA)	Equipment Planning (Mr. KURAKAZU)
1988			
April 1	Data collection and discussion with FDWR and other authorities (L)		
2	-do-		
(3)	Data collection on construction materials		
4	Discussion with FDWR on results of field survey		
5	Courtesy call on Embassy and the Government		
6	Leave for Japan (RK 082, 20:40)		

L = stay in Lagos.
E = stay in Enugu.

APPENDIX 3. Organizations and Related Officials Contacted by the Study Team

1. Nigerian Government and UNICEF staff

Name	Organization	Position
Mr. M. Shitu	Federal Ministry of Finance & Economic Development	Secretary
Mr. J. C. Chalowu	〃 〃	Principal Secretary
Mr. D. A Adesina	〃 〃	Senior Assistant Secretary
Mr. M. A. Alao	〃 〃	Principal Assistant Secretary
Mr. H. Eteama	Federal Office of Statistice	Information Services Unit
Mr. C. De Rooy	UNICEF, Lagos, Nigeria	Chief, Water and Sanitation Section
Mr. L. A. Donaldson	〃 〃 〃	Water Supply Officer
Mr. Harry A. Abe	WATSAN, Kwara State	Project Manager
Mr. M. KARIM	〃	Chief, Workshop
Mrs. May Anyabolu	UNICEF, Enugu	Liaison Officer
Colonel R. N. Akonobi	Anambra State of Nigeria	Military Governor
Prof. A. B. C. Nwosu	Ministry of Health, Anambra State	Commissioner for Health
Dr. I. E. Ituma	〃 〃	Permanent Secretary
Mr. C. Ezeoke	〃 〃	Senior Assis. Secretary
Dr. C. N. Obionu	〃 〃	Chief Health Officer
Dr. P. I. Okolo	〃 〃	State Chief Medical Officer
Mr. J. O. Nwojiji	〃 〃	Chief, Guinea-worm Coordinator.
Mr.David U.Chukwujekwu	Ministry of Works, Lands & Transport	Permanent Secretary

Name	Organization	Position
Eng. E. N. Agbala	〃	Chief Civil Engineer
Eng. A. D. Ezenwata	〃	Chief Engineer, Mech & Electric
Eng. Nath. C. Onwuagha	Anambra State Water Corporation	Chairman
Mr. E. N. Okongwu	〃 〃	General Manager
Eng. M. M. I. Chukwuka	〃 〃	Chief Engineer
Mr. P. Chudi Nwabuaun	〃 〃	Asst. Chief Hydrogeologist
Mr. A. N. Mojekwu	〃 〃	Chief Engineer
Dr. O. C. Nwaorgu	Dept. of Para Entomostrology Anambra State University of Technology	Chairman, Task Force on Guinea Worm Central
Mr. Adighije Chris	Cinab Eng. & Geological Service Ltd.	Consultant
Mr. A. O. Obianwu	Ministry of Works, Lands & Transport, Survey Dep.	Secretary of Survey Department
E. E. Okpa	Njikonu Social Club, Awgu	Chairman
B. U. Ikpenwa	Awgu Local Government	Chairman
Eng. A. A. Agbom	Ezza Local Government	Chairman
Mr. R. Barberopoulos	Nigerian Foundries Ltd.	Chairman

2. Embassy of Japan in Nigeria

Ambassador	H.E. Mr.Mitsuro Doonowaki
First Secretary	Mr.Toru Yamamoto
First Secretary	Mr.Takashi Kato
First Secretary	Mr.Takeaki Iwatsuki
First Secretary	Mr.Torazo Takimoto

APPENDIX 4. Minutes of Meetings between FMFED and the Study Team

MINUTES OF MEETINGS

OF THE PROJECT FOR

THE GUINEA-WORM ERADICATION AND RURAL POTABLE WATER SCHEME

IN

THE FEDERAL REPUBLIC OF NIGERIA

In response to the request made by the Government of the Federal Republic of Nigeria, the Government of Japan has decided to conduct a basic design study on the Project for the Guinea-worm eradication and rural potable water scheme (hereinafter referred to as "the Study"), and entrusted the study to the Japan International Cooperation Agency (JICA). JICA has sent the Study Team lead by Mr. Masao Tsujioka, Deputy Head, First Basic Design Study Division, Grant Aid Planning and Survey Department, JICA, to Nigeria to conduct the Study from 1st March to 9th April, 1988.

The Study Team held a series of discussions and conducted field inspection and exchanged views with the authorities concerned of the Government of the Federal Republic of Nigeria.

As a result of the Study, both parties have agreed to recommend to their respective Governments to examine the results of the discussions attached herewith towards the realization of the Project.

At Lagos, 11th March, 1988.

MR. MASAO TSUJIOKA
LEADER
THE BASIC DESIGN STUDY TEAM
JAPAN INTERNATIONAL COOPERATION AGENCY

MR. M. SHITU
SECRETARY FOR DEVELOPMENT AID
FEDERAL MINISTRY OF FINANCE &
ECONOMIC DEVELOPMENT

ATTACHMENT

1. The objectives of the Project are to construct boreholes of urgent programme in order to provide safe potable water supply for eradication of Guinea-worm disease and improvement of the living standard of the rural population.

2. The Project area is mainly the Abakalili zone in the Anambra State of Nigeria. The location of the Project area is shown in Appendix I attached hereafter.

3. Responsible bodies for implementation of the Project in the Federal Republic of Nigeria are the Anambra State Ministry of Health In-Charge of Coordination and Superintendent, and Anambra State Water Corporation In-Charge of Execution and Maintenance, as is shown in Appendix II.

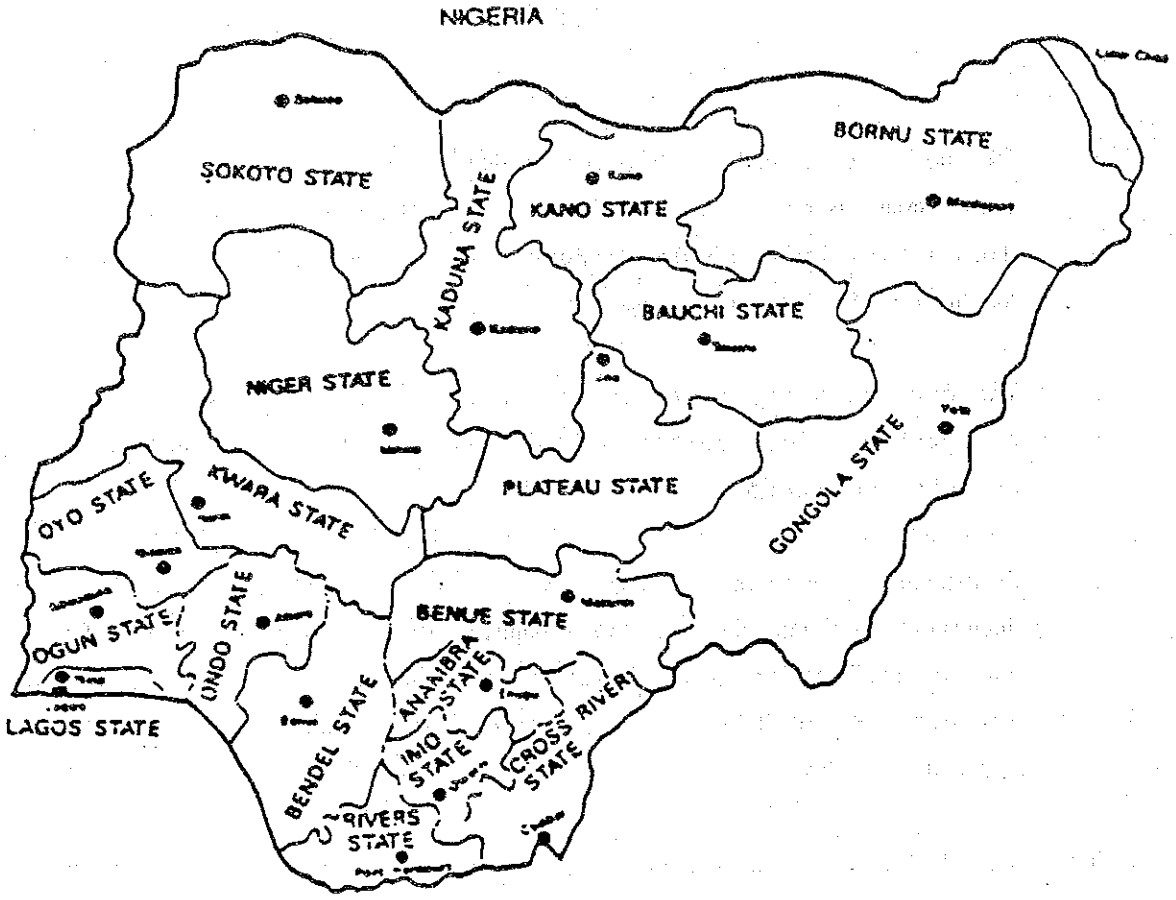
4. The Nigerian side has understood Japan's Grant Aid system explained by the Team which includes a principle of use of a Japanese Consultant firm recommended by JICA and Japanese Contractor(s) selected by open tendering.

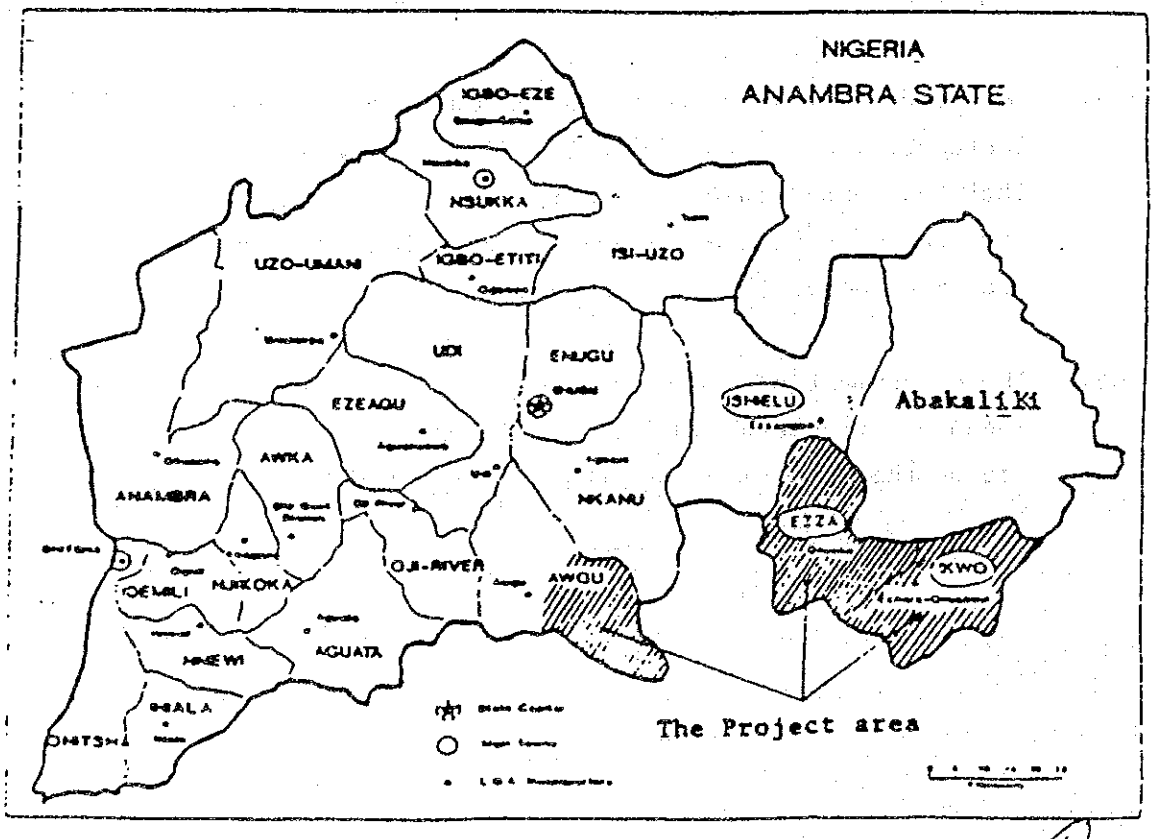
5. The Study Team will convey to the Government of Japan the request of the Government of the Federal Republic of Nigeria (Appendix III) that the former takes necessary measures to cooperate in implementing the Project requested by the latter within the scope of Japan's economic cooperation programme in grant form.

6. The Government of the Federal Republic of Nigeria will take necessary measures stipulated in Appendix IV under the condition that the grant-aid by the Government of Japan is extended to the Project.

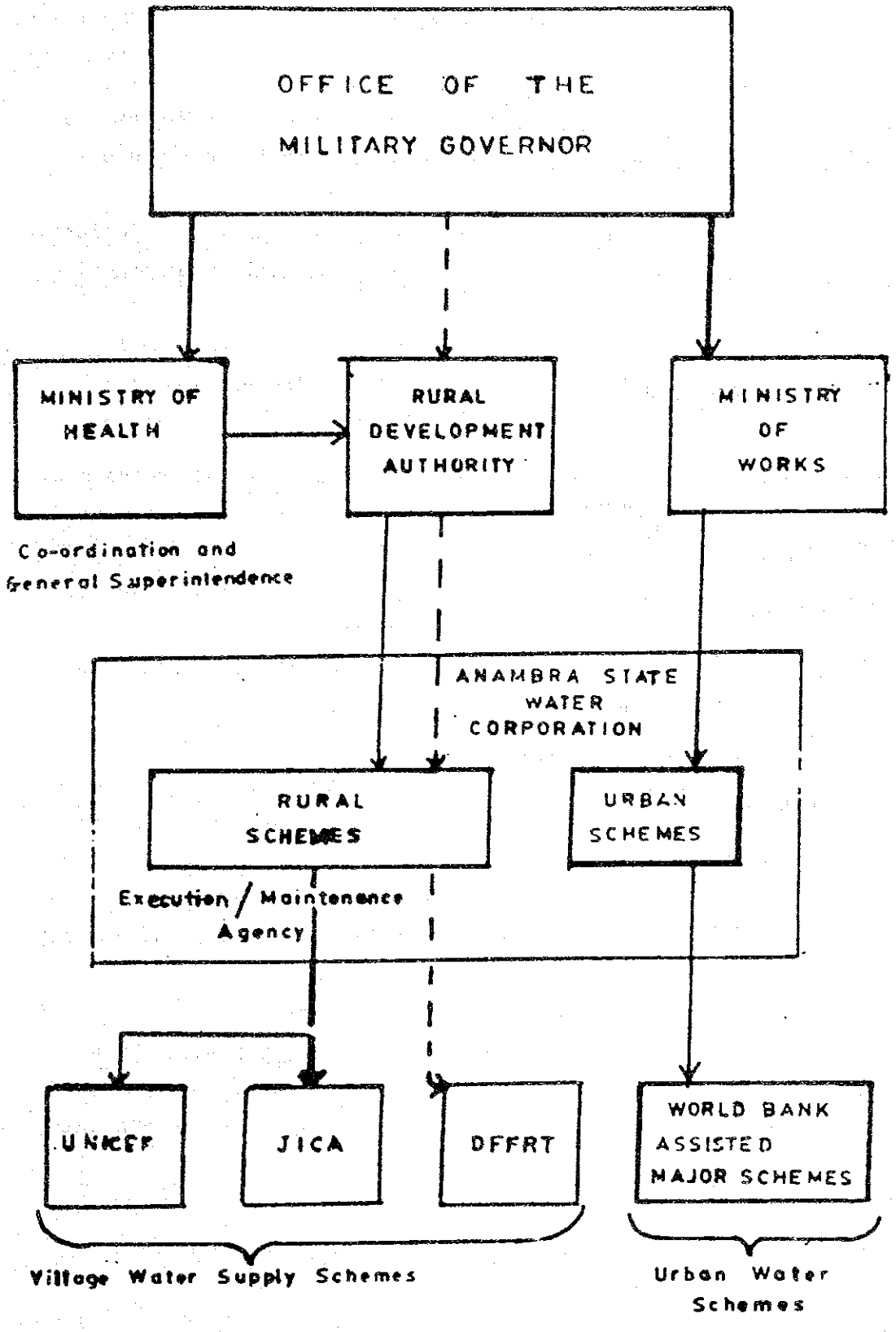
APPENDIX I

LOCATION MAP





ORGANOGRAM FOR THE IMPLEMENTATION OF POTABLE WATER SCHEMES IN ANAMBRA STATE



APPENDIX III

The request by the Government of the Federal Republic of Nigeria to be executed with the Japanese Government grant-aid is as follows:-

1. Construction of 150 boreholes and appurtenant facilities inclusive of supply of construction materials and installation of manual pump sets.

2. Provision of equipment necessary for the implementation of the Project:-

   1) Drilling Equipment
   2) Supporting Equipment
   3) Supporting Vehicles
   4) Equipment for Well Development
   5) PVC well casings and screens for boreholes
   6) Drilling mud and chemicals
   7) Hand pump set
   8) Spareparts

APPENDIX IV

Following arrangements are to be taken by the Government of the Federal Republic of Nigeria:-

1. To provide necessary data and information for basic design, detail design and construction

2. To secure land for the wells and other water supply facilities as needed before the start of the construction

3. To undertake incidental civil works such as planting and fencing, if needed

4. To provide the space necessary for temporary offices, working areas, stock yards and others

5. To secure necessary budget and personnel for the maintenance and operation and to organize proper maintenance program for the purpose of maintaining properly and effectively the water supply facilities and related equipment provided under the grant aid

6. To use properly the facilities constructed and equipment purchased under the grant aid

7. To bear the commissions to the Japanese foreign exchange bank for the banking services based upon the Banking Arrangement

8. To ensure prompt unloading, tax exemption and custom clearance at ports of disembarkation in Nigeria and prompt internal transportation therein of the products and related equipment purchased under the grant aid

...next page please

9. To exempt Japanese nationals engaged in the Project from custom duties, internal taxes and other fiscal levies which may be imposed in Nigeria and with respect to the supply of the related goods and services under the verified contracts

10. To accord without delay to Japanese national whose services may be required in connection with the supply of the related goods and services under the verified contracts such facilities as may be necessary for the entry into Nigeria and their stay therein for the performance of their work

11. To bear all the expenses, other than those to be borne by the Grant for the Project

JICA STUDY TEAM

Name	Position
Masao TSUJIOKA	Leader Deputy Division Chief, First Basic Design Study Division, Grant-Aid Cooperation, Planning & Survey Dept., JICA
Miroshi OHARA	Public Health Doctor Experts Dispatch Service Division Department of International Cooperation National Medical Center Hospital
Yoshihisa SHIMIZU	Water Supply Planning Facility Department, Engineering Division Osaka Municipal Water Works Bureau
Hisao ANDO	Groundwater Development Sanyu Consultants Inc.
Haruhiko NAKAMURA	Hydrogeologist Sanyu Consultants Inc.
Mitsuharu KURAKAZU	Machinery Planning Sanyu Consultants Inc.

EMBASSY OF JAPAN

Takeaki IWATSUKI	First Secretary, Embassy of Japan
Toru YAMAMOTO	First Secretary, Embassy of Japan
Takashi KATO	First Secretary, Embassy of Japan

LIST OF ATTENDANCE

THE GOVERNMENT OF NIGERIA

Name	Position
Mr. M. SHITU	Secretary for Development Aid
Mr. J. C. CHALOKWU	Principal Secretary, Development Aid
Mr. D. A. ADESINA	Senior Assistant Secretary Development Aid
Prof. A. B. C. NWOSU	Commissioner for Health Anambra State
Dr. C. N. OBIONU	Ministry of Health, Anambra State

APPENDIX 5. Collected Data and Information

Name of Data, Information	Collected from	Feature
Guinea Worm Control as a major contribution to Self-Sufficiency in rice production in Nigeria UNICEF 1987	UNICEF, Lagos/ Embassy	Publication
Directorate of Public Health Services 1988 Program of Activities, UNICEF	〃 〃	Copy Sheets
From a Pilot Project to a National Strategy, UNICEF Nigeria Water and Sanitation Programme 1981-1986, June.1987	〃 〃	Publication
Present Status and Future Requirements of the FM.H/ UNICEF Rural Clinic Water and Sanitation Project Nov. 1987.	〃 〃	〃
2nd Annual Symposium/Conference Rural Water Supply, NIGERIA Nigeria Water and Sanitation Asso.	UNICEF, Lagos	Copy
First Annual Symposium and Exhibition Ground Water Resources in Nigeria 1986.	UNICEF, Lagos	〃
Imo State Project Evaluation	〃 〃	〃
Disability from Dracunculiasis	〃 〃	〃
Geological Map of Nigeria,1974 1:2,000,000	Geological Survey, ENUGU	Map Sheet
Nigeria 1:250,000 Geological Series OGOJA,UMUAHIA, OBAN HILL	〃 〃	Map Sheets

Name of Data, Information	Collected from	Feature
Map of Local Government Area 1:100,000 Anambra Awgu Ezza & Ikwo	Ministry of Works, Lands & Transports Survey Division Enugu	Map Sheets
Quarterly Abstracts of Statistics, Anambra	Statistic Division, Anambra	Publication
Economic Indicators	〃	〃
Anambra State Population Estimates by Local Government Area	〃	〃
Report on Rural Economic Survey, Anambra	〃	〃
Directory of Distributive Trades and Service in Anambra State	〃	〃
Report on Survey of Distributive Trade and Services in Anambra State	〃	〃
Digest of Social Statistics	〃	〃
Digest of Finance Statistics	〃	〃
Motor Vehicle Statistics	〃	〃
Estimated Population of Anambra State by Local Government, Age Group, and Sex	〃	〃
Facts and Figures about Anambra State 1986	〃	〃
Directory of Educational Institutions in Anambra State 1984/85	〃	〃
Statistics of Higher Educcational Institutions in Anambra State, 1986	〃	〃
Rural Economic Survey, Anambra Time Series of 1980-84	〃	〃

Name of Data, Information	Collected from	Feature
Anambra State Prices Bulletine October 1987	Statistic Division, Anambra	Publication
Economic and Social Statistics Bulletine 1986	Federal Office of Statistics	〃
The Health of Nigeria 1983/84	〃	〃
Digest of Statistics 1985	〃	〃
National Integrated Survey of Households 1984	〃	〃
Distribution Survey of Nigeria 1978	〃	〃
Review of External Trade 84-85	〃	〃
Nigeria Trade Summary '86	〃	〃
Nigerian Gross Domestic Product and Allied Macro-Aggregates 1973-1981	〃	〃
Forth National Development	〃	Extract Copy
Primary Atlas for Nigeria	Book Shop	Publication

APPENDIX 6. Area and Population by Local Government Areas, Anambra State

L. G. A.	AREA (Square km)	POPULATION			
		Census 1963	Projected 1986	1987	Density 1987
ABAKALIKI	2,257.96	208,724	409,034	421653	186.8
AGUTA	806.30	250,010	441,174	452,206	560.8
ANAMBRA	1,321.99	198,609	350,822	359,595	272.0
AWGU	775.84	170,647	301,119	308,646	397.8
AWKA	602.29	176,138	374,414	387,597	643.5
ENUGU	74.03	174,361	488,629	511,477	6909.0
EZEAGU	626.59	110,184	194,432	199,165	317.8
EZZA	763.28	139,535	246,255	252379	330.6
IDEMILI	301.45	109,094	192,512	197,326	654.6
IGBO-ETITI	415.09	119,232	210,402	215,664	519.6
IGBO-EZE	475.9	158,117	279,015	285,991	600.9
IHIALA	327.89	136,975	241,707	247,751	755.6
IKWO	381.59	87,585	154,758	158,528	415.4
ISHIELU	347.08	251,458	443,723	454,819	248.9
ISI-UZO	1,287.58	140,136	247,285	253,466	196.9
NJIKOKA	347.08	251,458	443,723	454,819	1310.4
NKANU	1,528.19	154,908	273,,52	281,308	184.1
NNEWI	298.80	181,864	320,921	328,942	1100.9
NSUKKA	415.99	154,032	305,079	315,538	758.5
ONITSHA	502.35	196,203	559,010	585,506	1165.5
OJI-RIVER	387.51	61,143	107,837	111,077	286.6
UDI	994.09	107,895	190,330	195,090	196.3
UZO-UWANI	1388.95	117,836	207,916	213,125	153.4
TOTAL	17,675.00	3,596,631	6,879,073	7,084,668	400.8

SOURCE: Statistic Division, Ministry of Finance and Economic Planning, ENUGU.

APPENDIX 7. Population of Ikwo, Ezza and Awgu LGAs

(1) EZZA LOCAL GOVERNMENT AREA

EZZA LOCAL GOVERNMENT AREA
TOTAL AREA IN SQ. K. = 763.28

AUTONOMOUS TOWNS/ COMMUNITIES	1963 POPULATION	PROJECTED POPULATION 1985	1986	1987
AMAKA	8,797	15,145	15,524	15,912
AMUSU	4,175	7,189	7,368	7,552
AMUDO	3,861	6,647	6,813	6,983
AMAGU	3,556	6,122	6,275	6,432
AMUDA	2,999	5,163	5,292	5,424
AMANA	4,327	7,450	7,636	7,827
AMAWULA	1,209	2,081	2,133	2,186
ACHARA UKWU	1,647	2,835	2,906	2,979
ECHARA	1,253	2,157	2,215	2,270
EKKA	8,663	14,917	15,290	15,672
EZZAMA	6,093	11,522	11,810	12,105
IDEMBIA	6,920	11,913	12,211	12,516
INYERE	1,686	2,903	2,976	3,050
AMAEZEKWE	2,342	4,032	4,133	4,236
NSOKRA	2,258	3,887	3,984	4,084
OGBOJI	4,132	7,111	7,289	7,471
OKAFIA	5,426	9,341	9,575	9,814
ORIZOR	15,119	26,028	26,679	27,346
UMUEZEOKA	11,107	19,122	19,600	20,090
UMUOGHARA	16,309	28,077	28,779	29,499
UMUEZEKOHA	16,382	28,203	28,908	29,631
UMU-UWAGU/IDEMBIA	6,179	10,633	10,904	11,177
NKOMORO	4,491	7,782	7,925	8,123
TOTAL	139,535	240218	246 255	272,379
NO. OF PERSONS PER SQ. KM.	183	315	313	320

(2) IKWO LOCAL GOVERNMENT AREA

IKWO LOCAL GOVT. AREA.

TOTAL AREA IN SQ. KM = 381.59

AUTONOMOUS TOWNS/ COMMUNITIES	1963 POPULATION	PROJECTED POPULATION		
		1985	1986	1987
Enyibichiri /Alike	8,160	14,048	14,399	14,759
Ndufu Alike	3,633	6,254	6,410	6,570
Echara Ike	3,322	5,719	6,067	6,219
Noyo	3,844	6,618	6,783	6,953
Ndufu-Amagu	8,899	15,320	15,703	16,096
Ndiagu-Amagu	10,600	18,249	18,705	19,173
Inyimagu	9,534	16,413	16,823	17,244
Igbudu	7,555	12,999	13,293	13,625
Ndiagu Echara	8,034	13,831	14,177	14,531
Akpa Nwudele	6,125	10,545	10,809	11,079
Eka Awoke	4,521	7,783	7,978	8,178
Ekpelli	2,698	4,645	4,761	4,880
Amainyima	5,380	9,262	9,494	9,631
Ettam	5,302	9,128	9,356	9,590
Total	87,585	150,784	154,758	158,528
No of Person Per Sq. Km.	230	395	406	415

(3) AWGU LOCAL GOVERNMENT AREA

AWGU LOCAL GOVERNMENT AREA H. Q. AWGU
TOTAL AREA IN SQ. Km. = 775.34

AUTONOMOUS TOWNS/ COMMUNITIES	1953 POPULATION	PROJECTED POPULATION 1985	1986	1987
NF'ABO *)	9,351	16,098	16,500	16,913
AGBOGUGU	14,506	24,973	25,597	26,237
AMOLI	3,441	5,921	6,069	6,221
ANIKENANO	4,255	7,325	7,508	7,696
AWGU	18,504	31,856	32,652	33,468
NWE MGBIDI	5,597	9,636	9,877	10,124
IHE	11,922	20,525	21,038	21,564
ISU/AGBUDU	3,065	5,277	5,409	5,544
ITUKU	2,287	3,937	4,035	4,136
NENWE *)	17,703	30,477	31,239	32,020
MAKU	8,710	14,995	15,370	15,754
MGBOWO *)	11,160	19,213	19,693	20,185
NPU *)	3,816	6,570	6,734	6,902
OBEAGU	2,226	3,832	3,928	4,026
OGBAKU	7,348	12,650	12,966	13,290
OGUGU	2,979	5,129	5,257	5,388
OKPANKU *)	5,910	10,174	10,428	10,689
OWELLI	9,049	15,578	15,967	16,366
ODUMA *)	20,426	35,165	36,044	36,945
UGBO	3,678	6,332	6,490	6,652
UGWUEME	4,714	8,115	8,318	8,526
TOTAL	170,647	293,788	301,119	308,646
NO. OF PERSONS PER SQ. KM	220	379	388	397

*) Project area

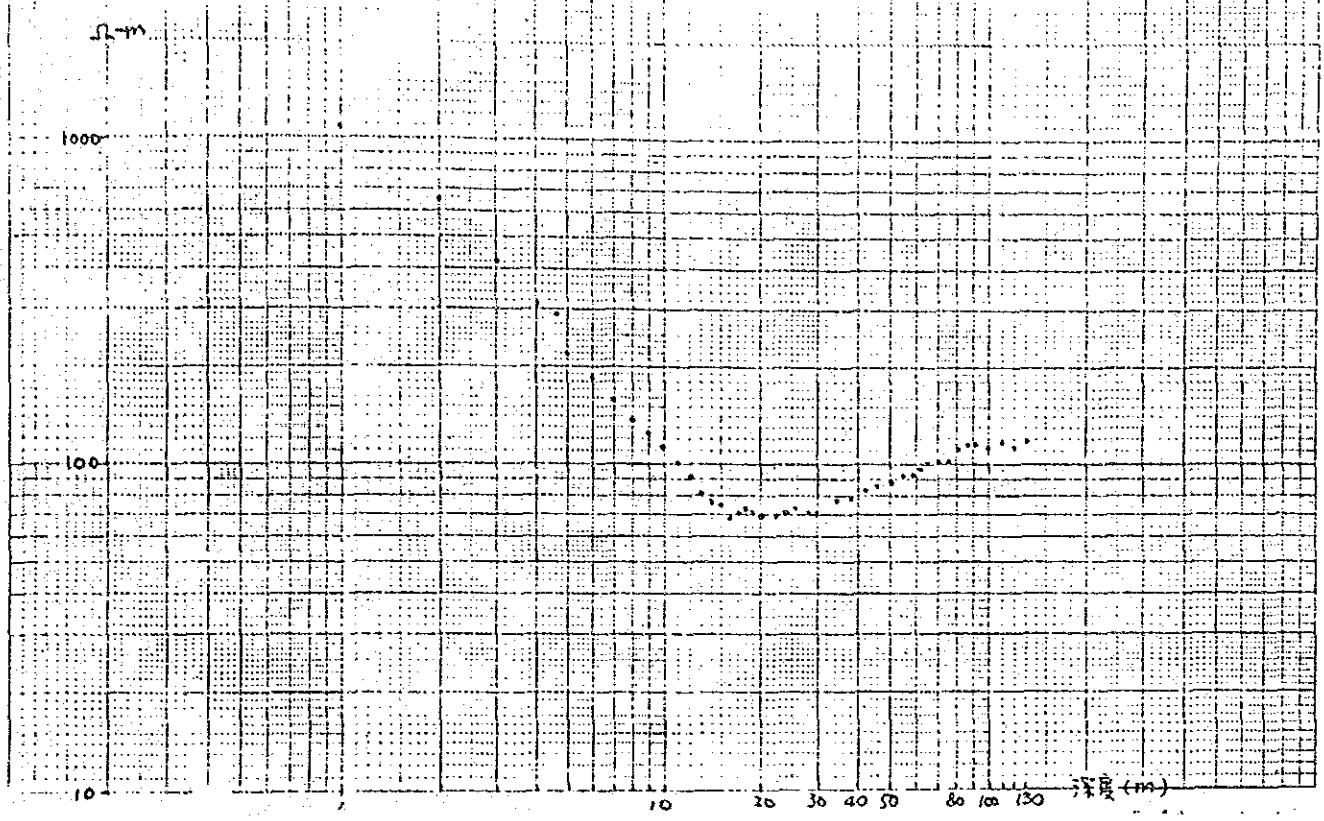
APPENDIX 8. Rainfall Data at the Lower Anambra Irrigaton Project Office

APPENDIX-10. RAINFALL DATA AT THE LOWER ANNAMBRA IRRIGATION PROJECT OFFICE

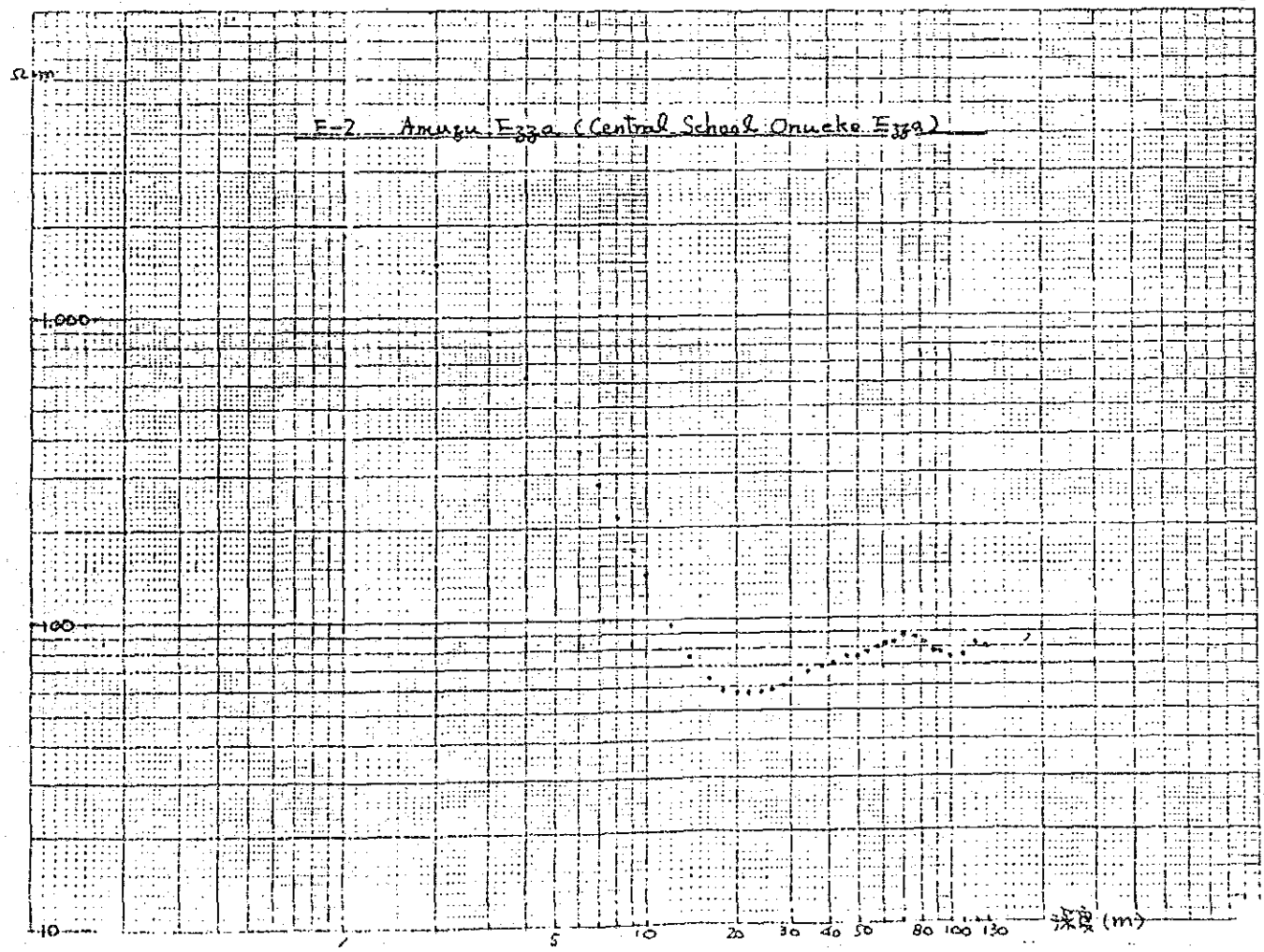
YEAR	DESCRIPTION	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL
1982	Rainfall (mm)	0.0	88.8	36.6	95.5	219.9	290.8	223.1	167.0	141.3	225.7	15.0	0.0	1,503.7
	Days	0	3	3	9	13	20	24	18	18	19	1	0	128
1983	Rainfall (mm)	0.0	0.0	10.0	19.5	136.6	182.3	297.4	204.8	351.0	36.3	0.0	0.0	1,237.9
	Days	0	0	1	5	13	17	15	18	18	3	0	0	90
1984	Rainfall (mm)	0.0	0.0	50.8	142.8	197.8	323.6	335.1	286.6	410.6	99.4	10.3	0.0	1,857.3
	Days	0	0	3	10	8	13	16	14	14	10	2	0	90
1985	Rainfall (mm)	14.2	0.0	181.2	124.1	161.5	187.6	252.8	309.6	158.4	133.8	6.0	0.0	1,529.2
	Days	2	0	7	6	13	11	17	20	19	11	2	0	108
1986	Rainfall (mm)	3.4	0.0	73.9	85.1	140.5	205.3	253.7	143.6	328.0	254.8	80.2	0.0	1,576.7
	Days	1	0	7	6	8	10	12	11	16	10	2	0	83
1987	Rainfall (mm)	1.2	4.3	7.2	1.6	18.7	22.3	262.0	335.5	154.2	249.0	0.0	0.0	1,056.0
	Days	1	2	2	1	5	8	8	8	7	8	0	0	50
Average	Rainfall (mm)	3.1	15.5	60.0	78.1	145.8	171.2	270.7	241.2	257.3	166.5	18.6	0.0	1,428.0
	Days	0.7	0.8	3.2	6.2	10.0	13.2	15.3	14.8	15.3	10.2	1.2	0.0	90.9

APPENDIX 9. p-a Curves (E-1 - E-17)

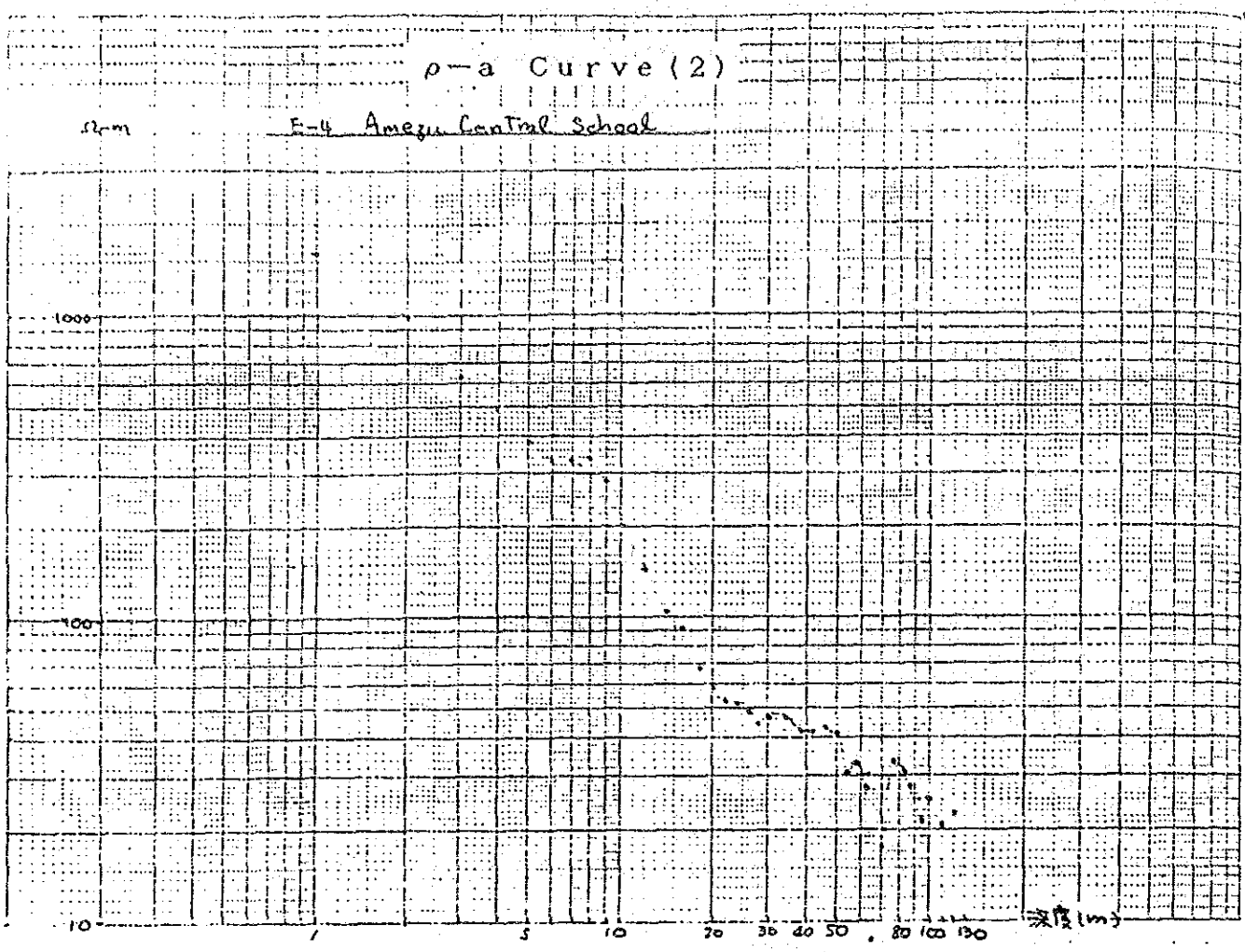
E-1 Odoji (close to an existing borehole)

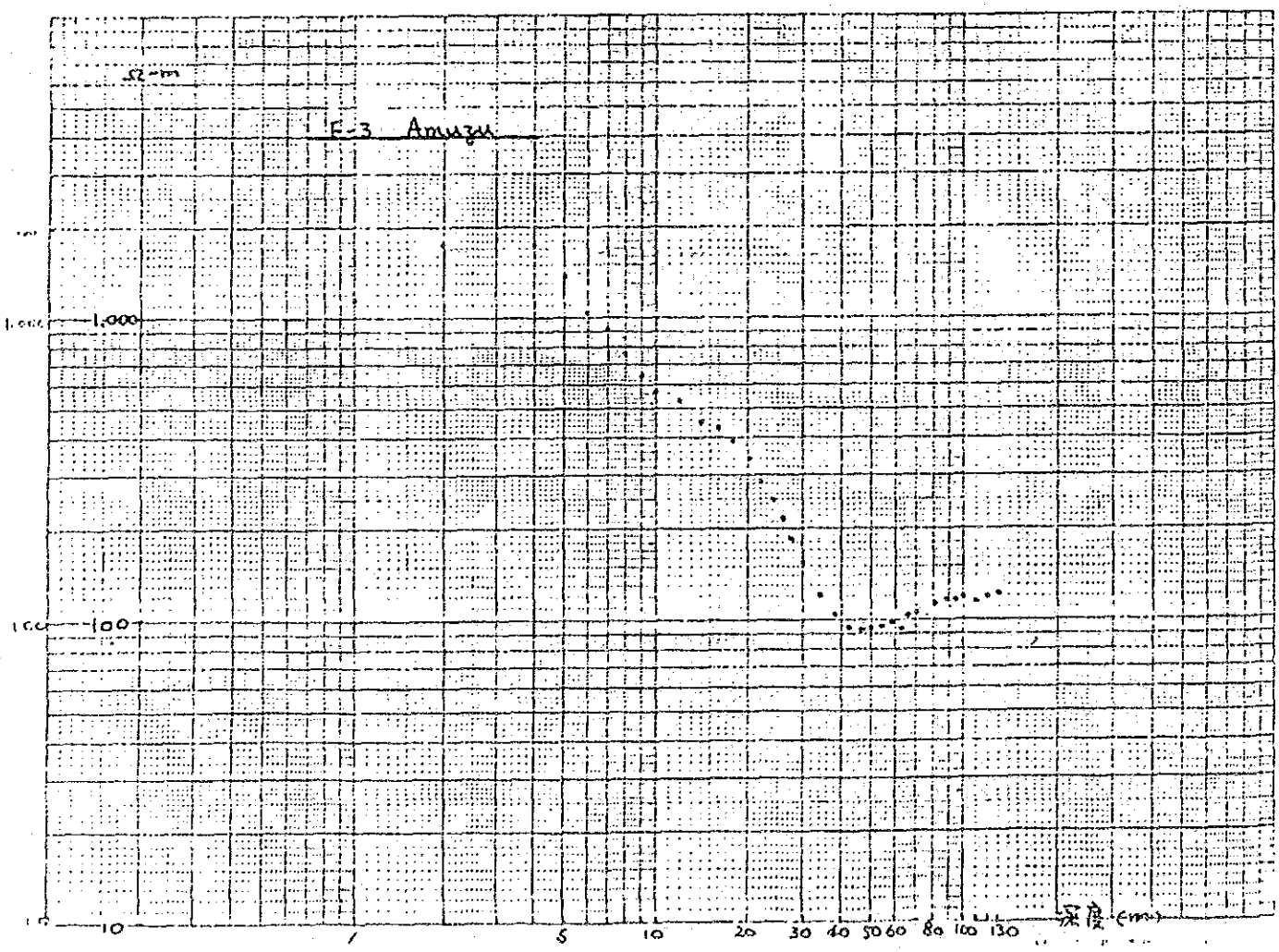


E-2



ρ－a Curve (2)

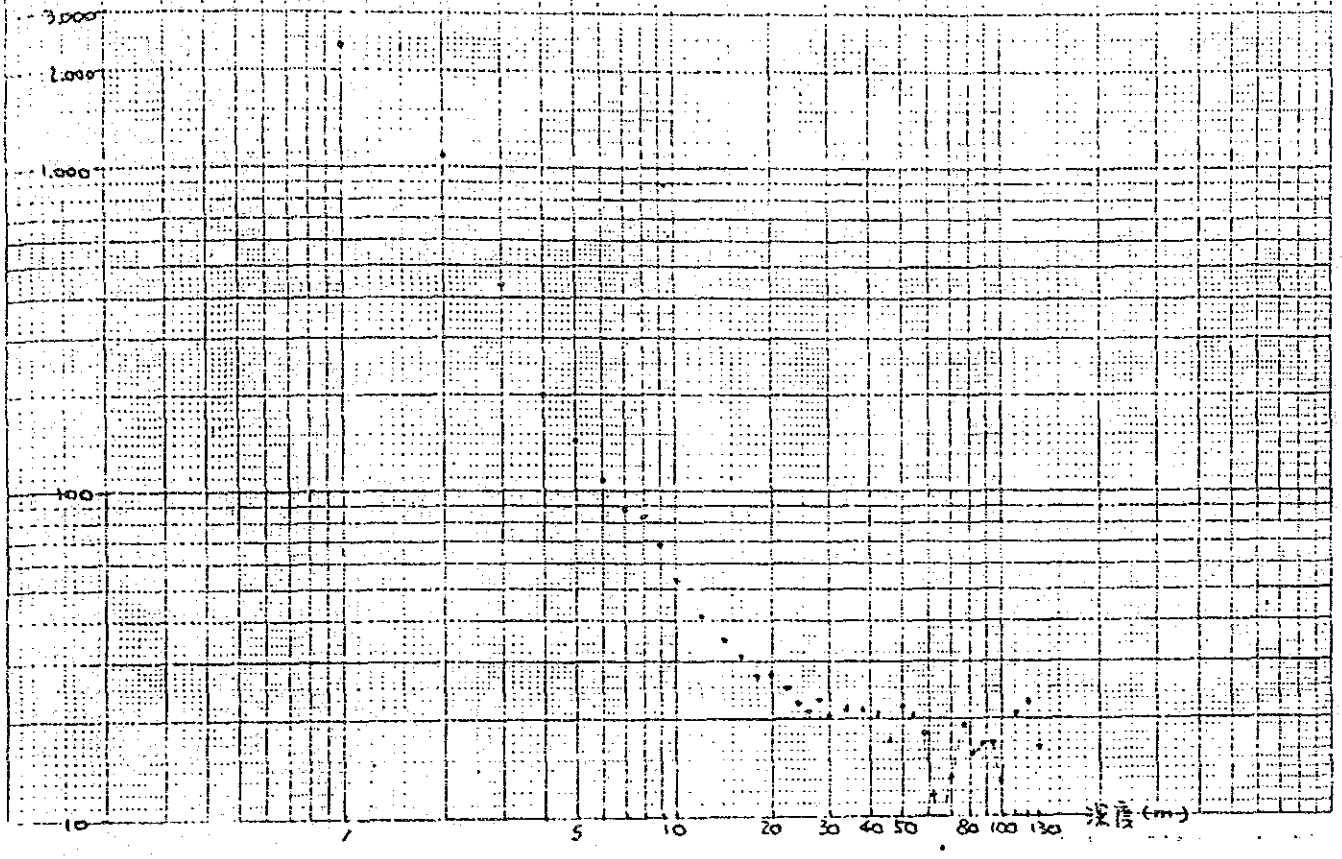

Ω-m
E-4 Amezu Central School
1000
100
10
1
5
10
20
30
40
50
80
100
130
深度 (m)


Ω-m
E-3 Amazu
1,000
100
10
1
5
10
20
30
40
50
60
80
100
130
深度 (cm)

E-5

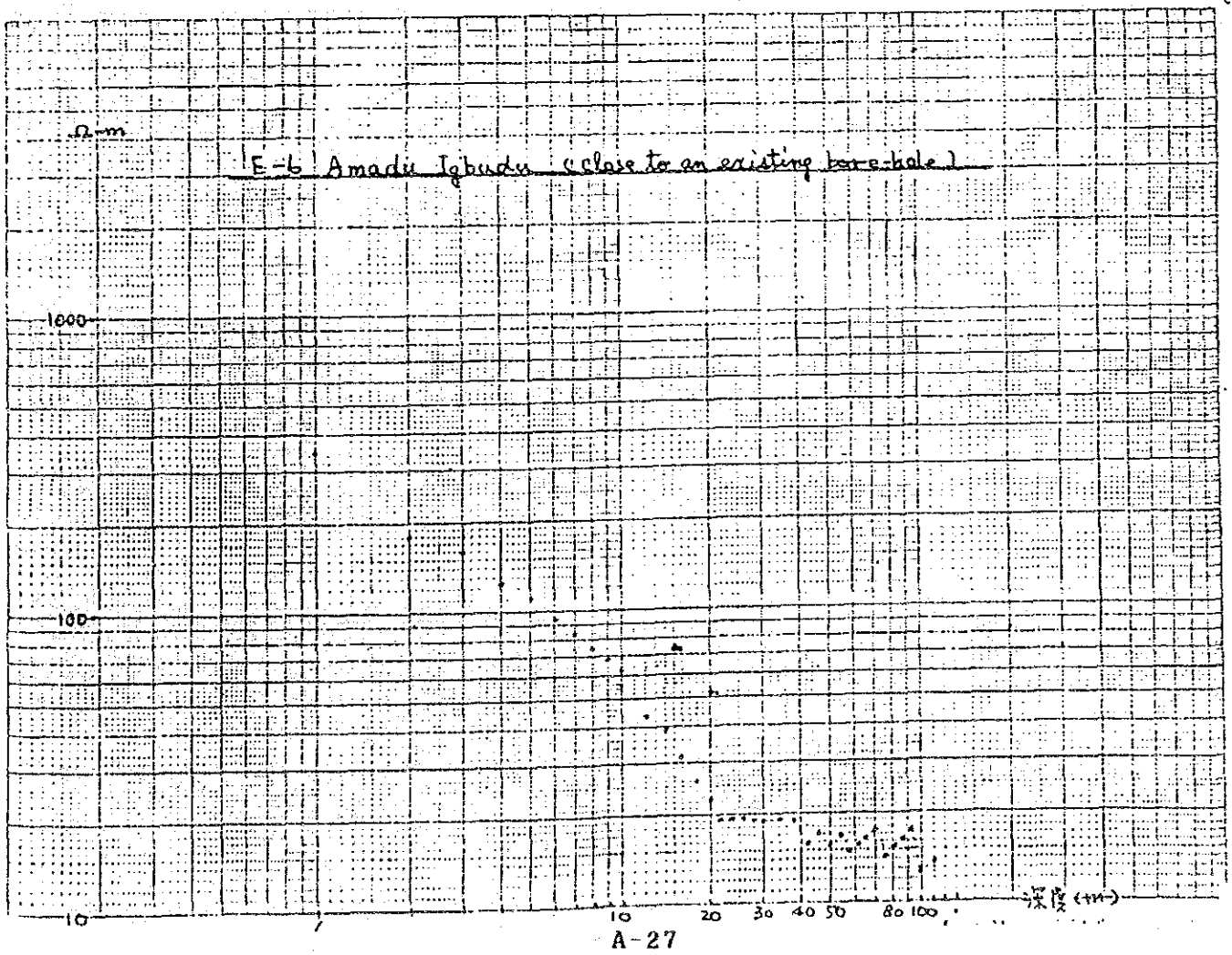
ρ—a Curve (3)

E-5 Amezu Community Primary School



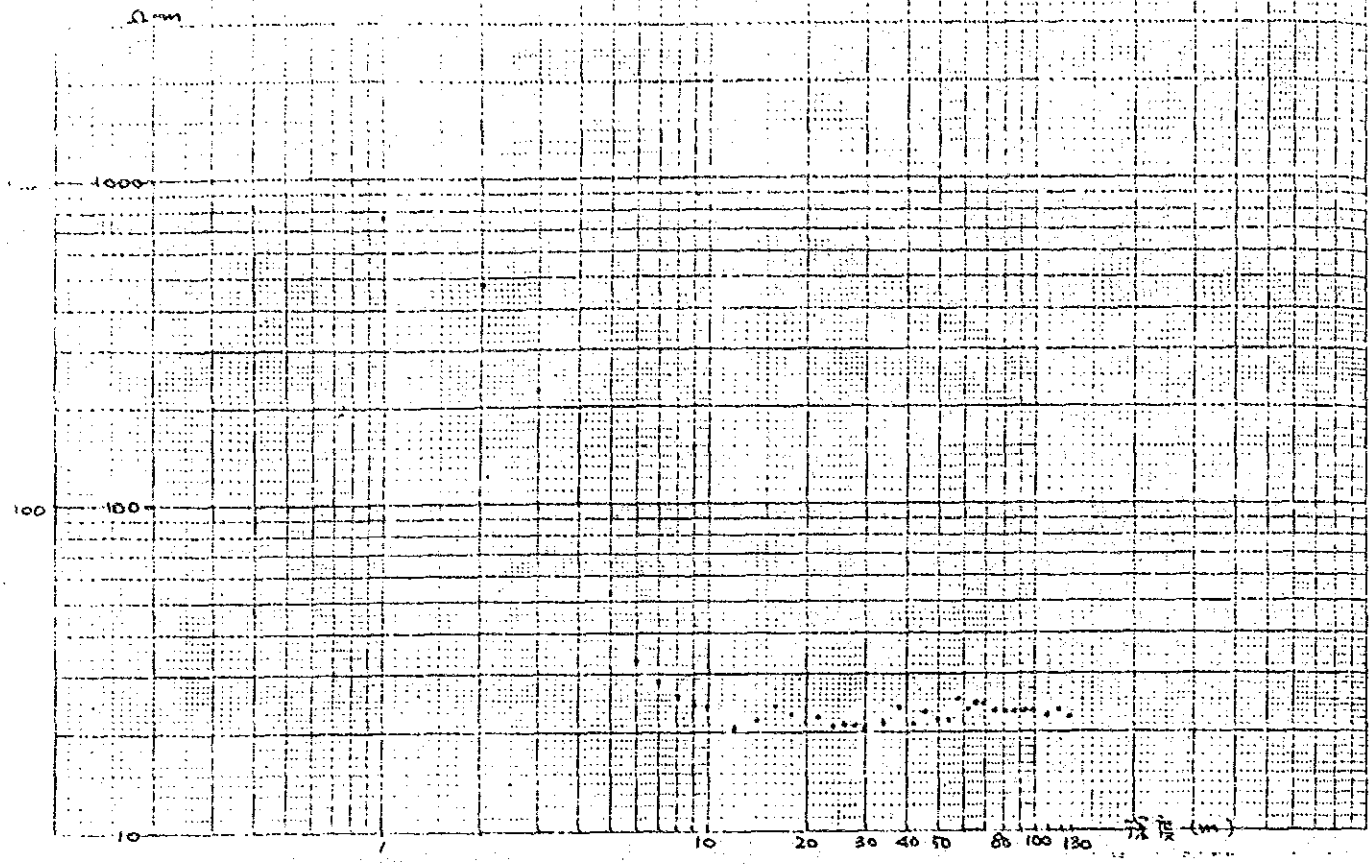
E-6

E-6 Amadu Igbudu (Close to an existing bore-hole)



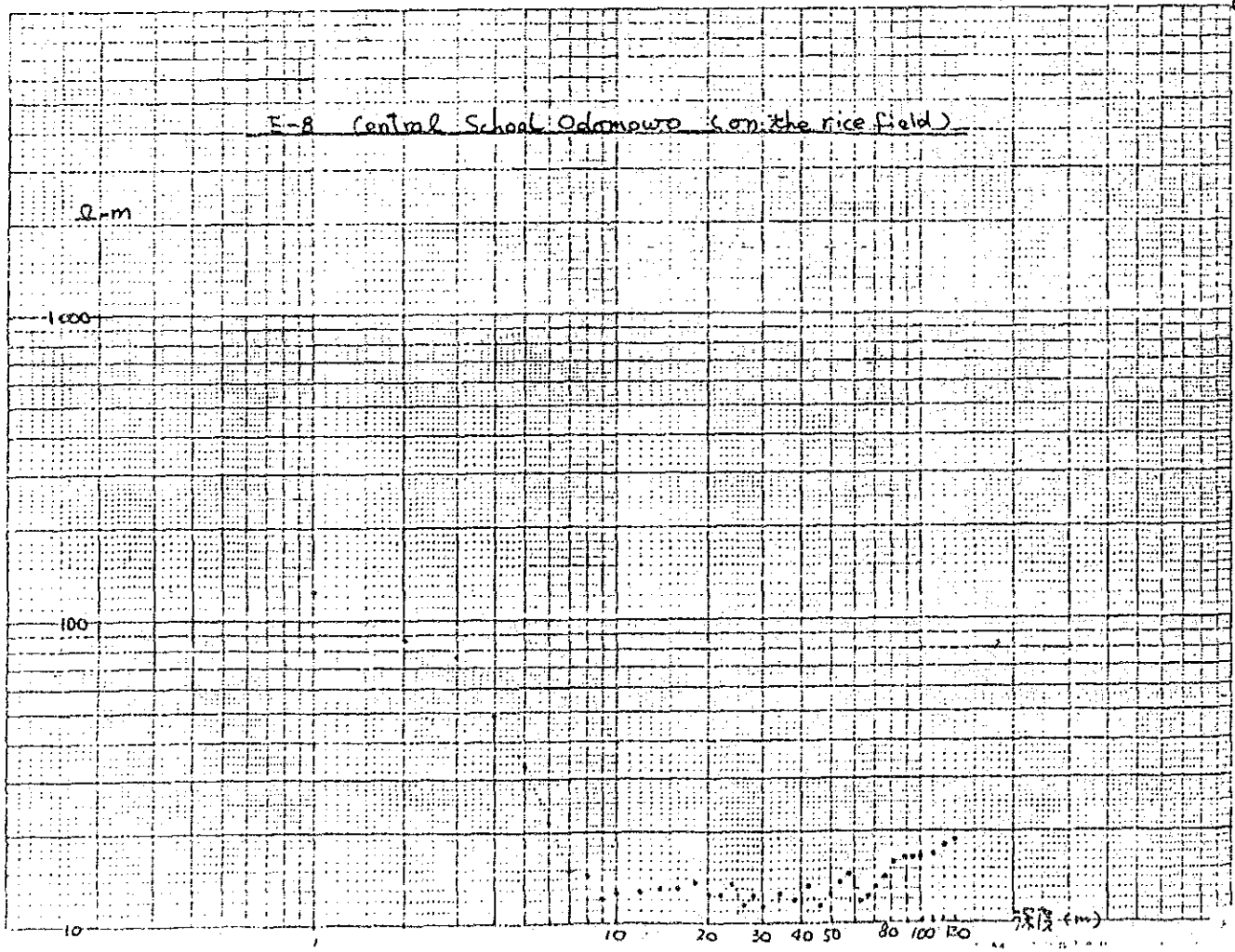
ρ－a Curve (4)

E-7 Amadu Community School Campus II Ibudu



E-8

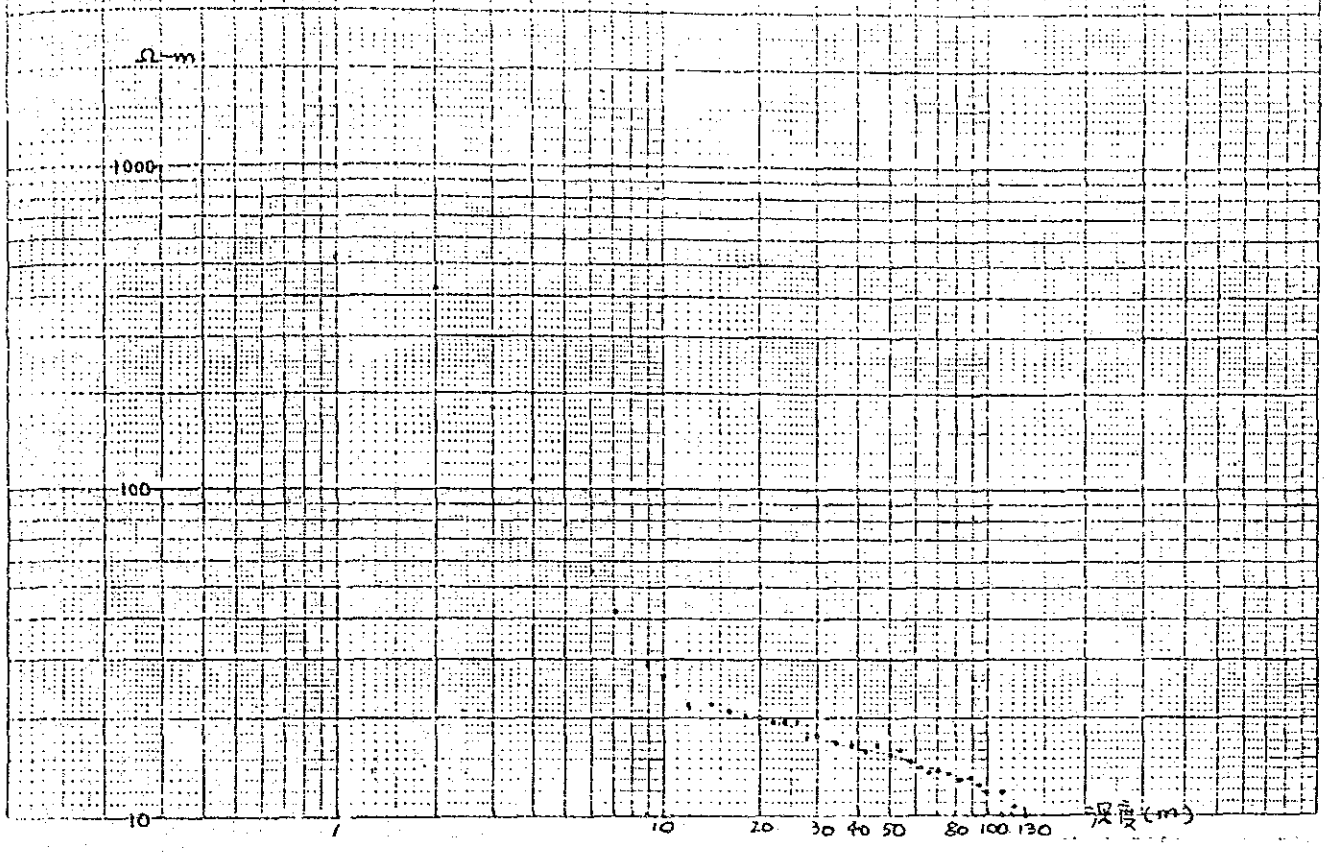
E-8 Central School Odomowo (on the rice field)



E-9

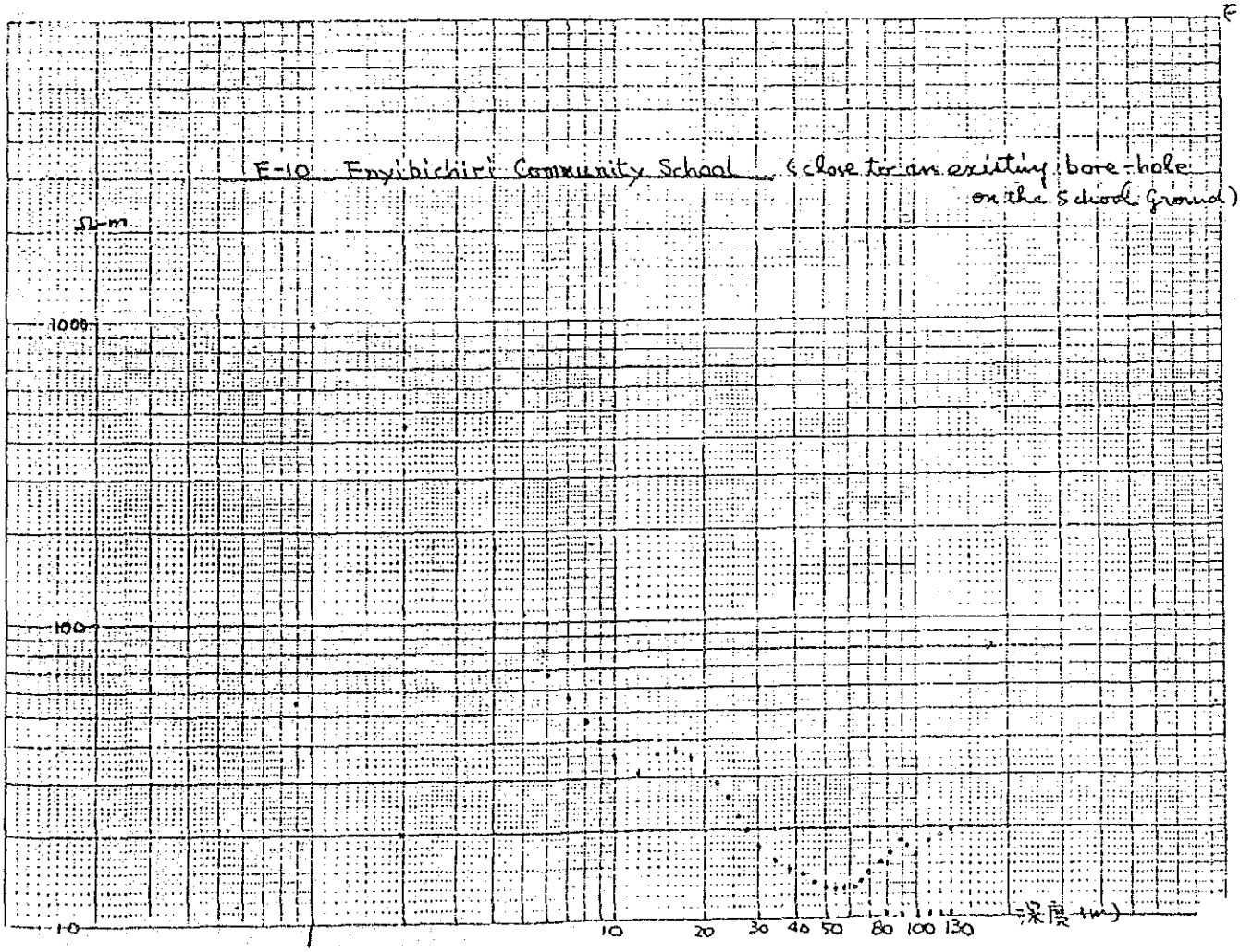
ρ－a Curve (5)

E-9 Echilike Community (near an existing bore-hole)



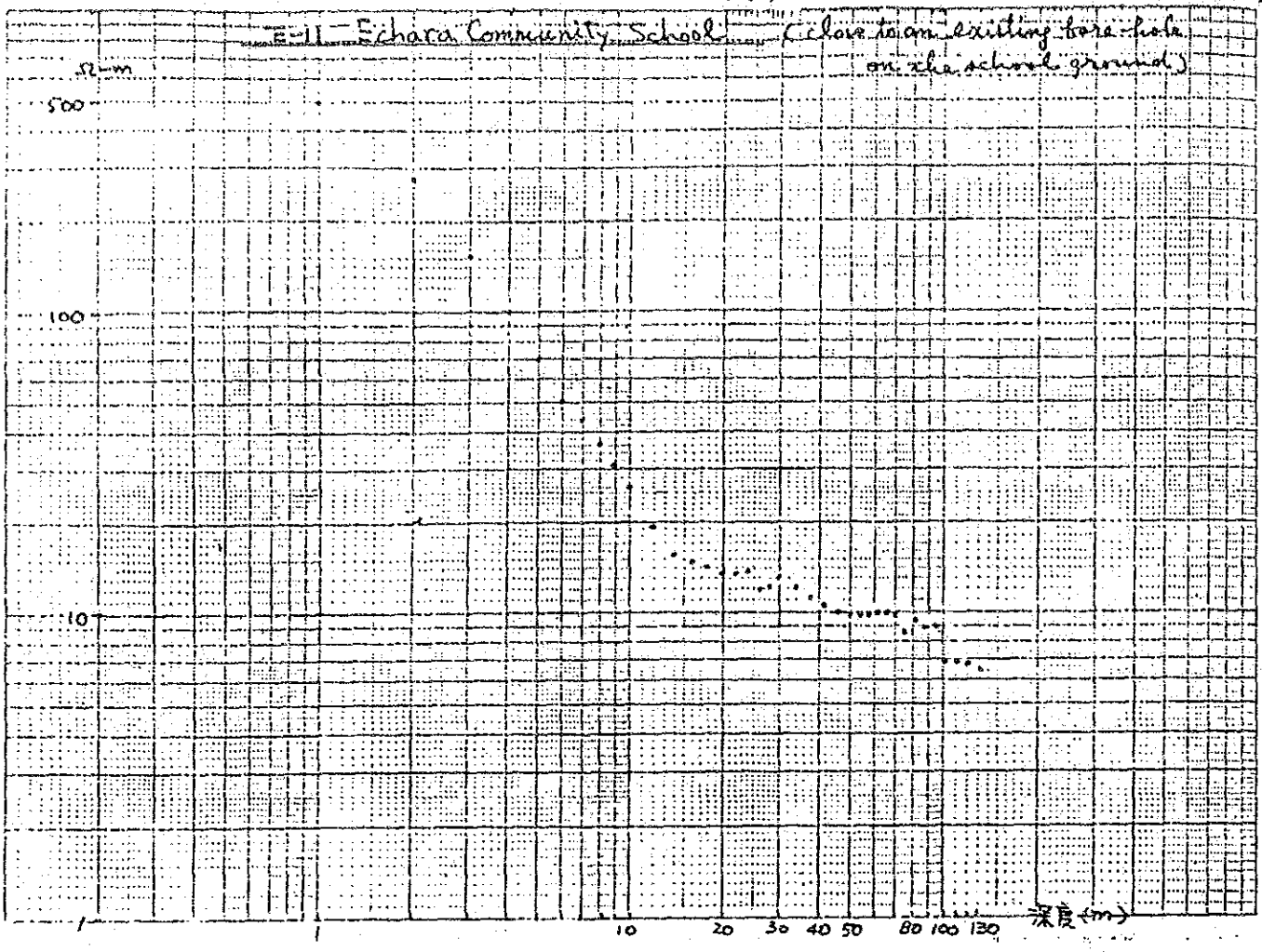
E-10

E-10 Enyibichiri Community School (close to an existing bore-hole on the School Ground)



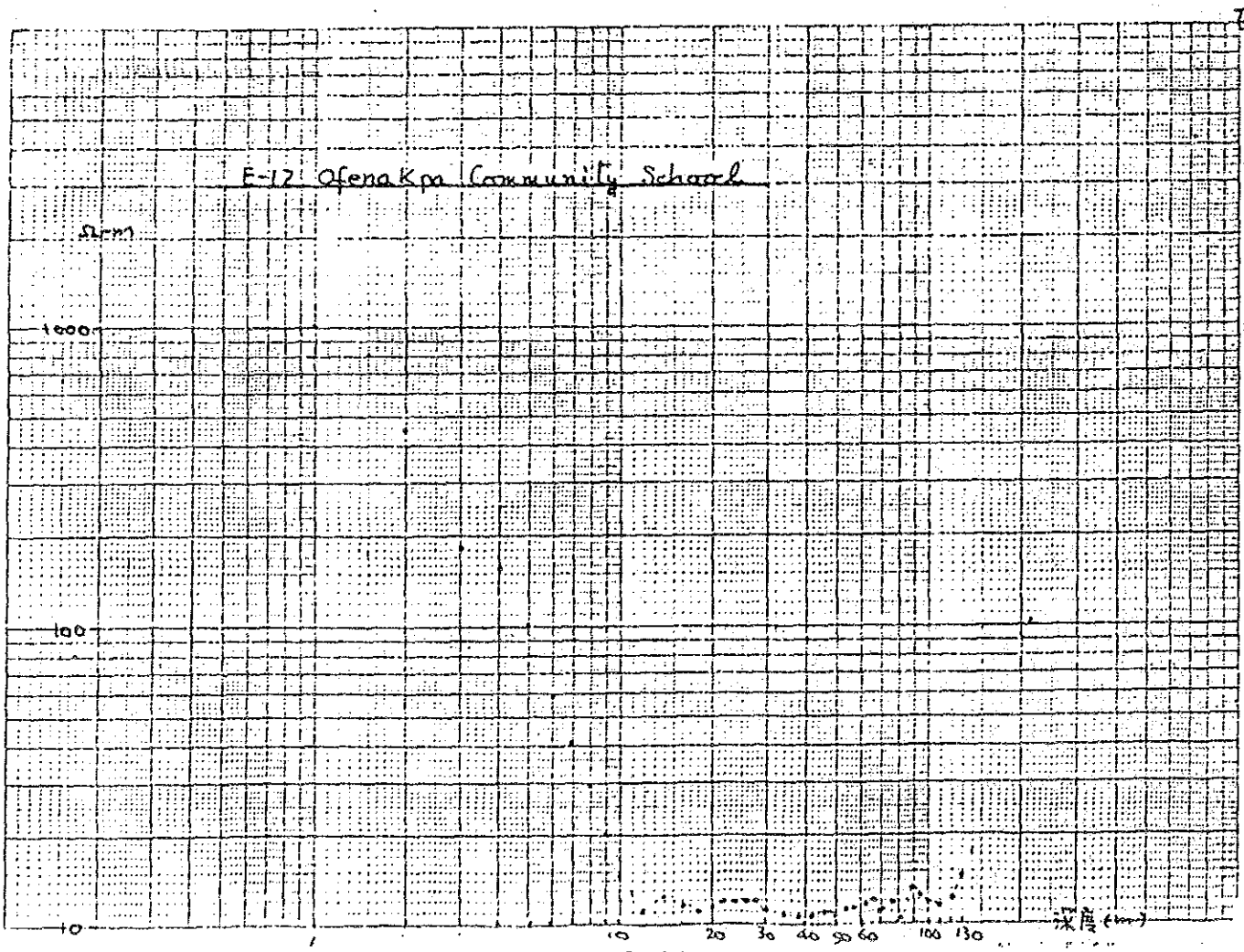
E-11

E-11 Echara Community School (close to an existing bore-hole on the school ground)



E-12

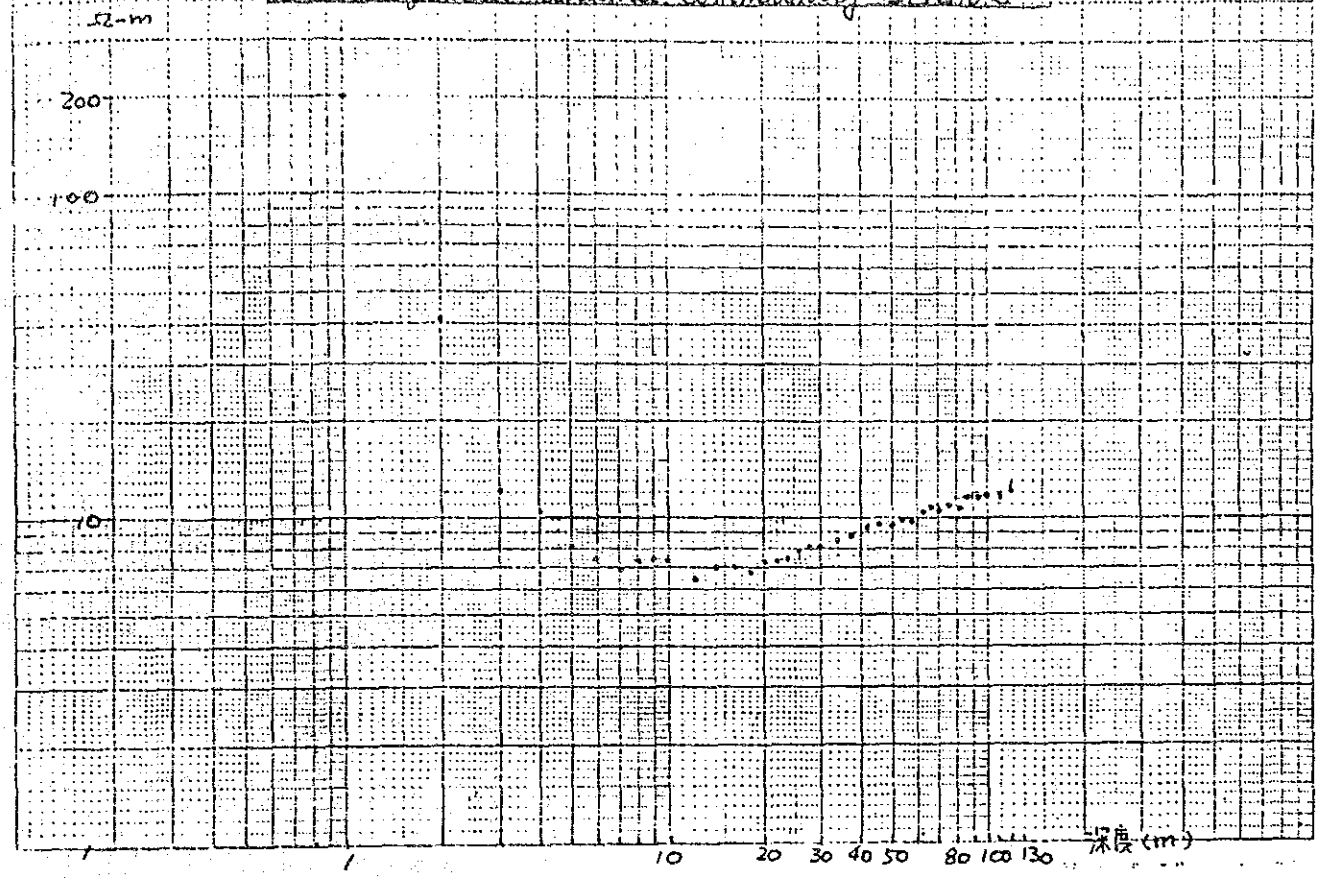
E-12 Ofenakpa Community School



ρ－a Curve (7)

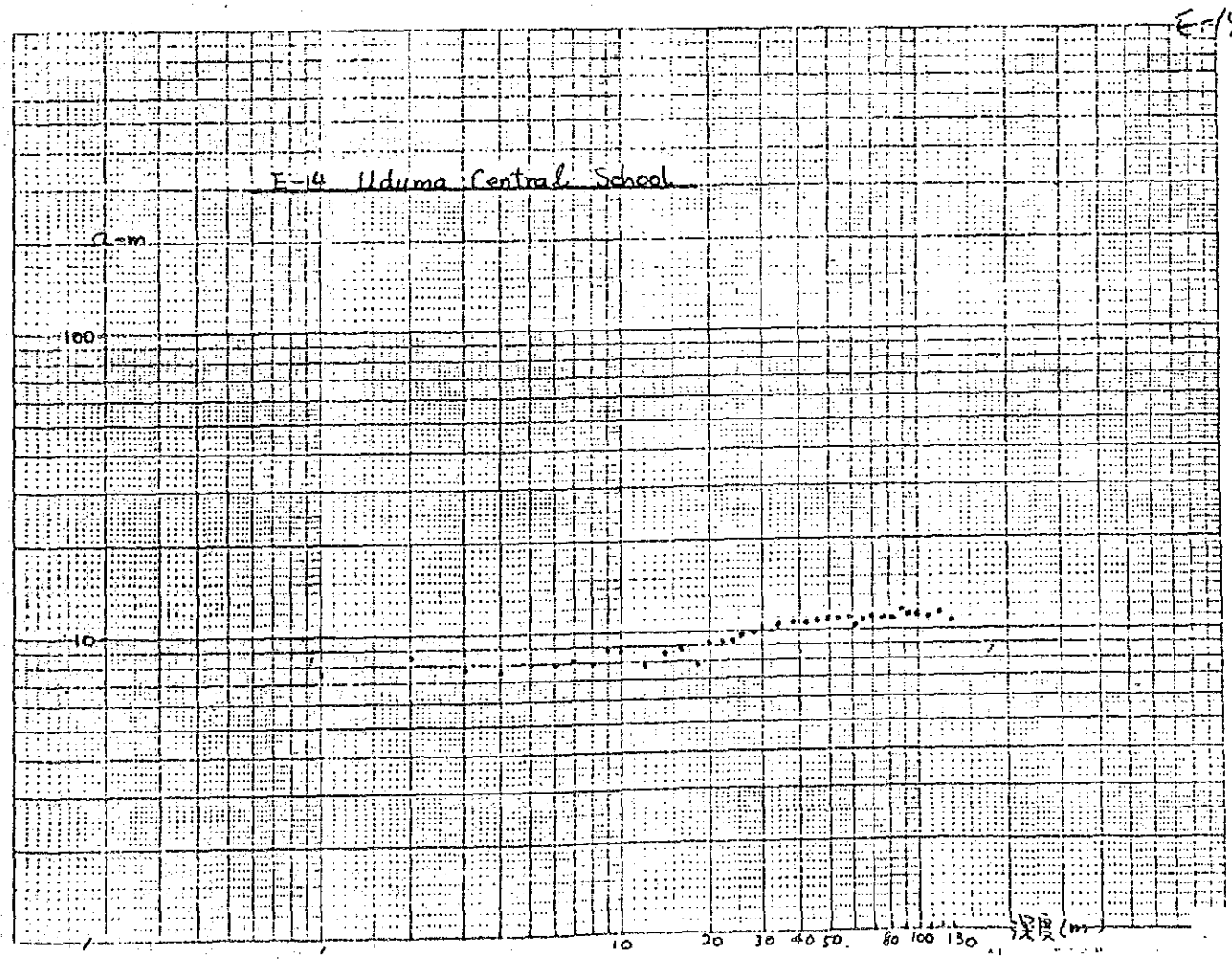
E-13

E-13 Ezinesi Uduma Community School



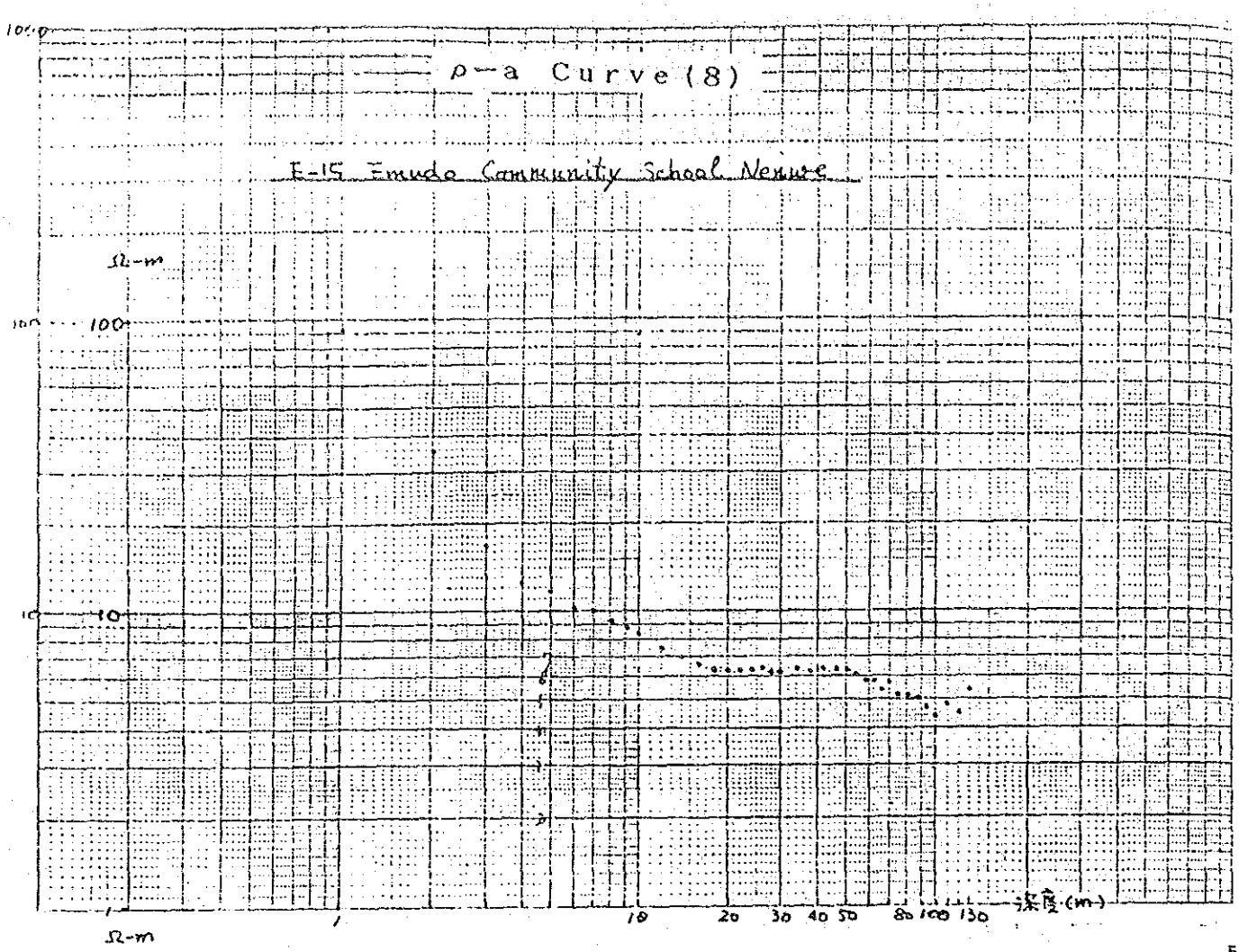
E-14

E-14 Uduma Central School

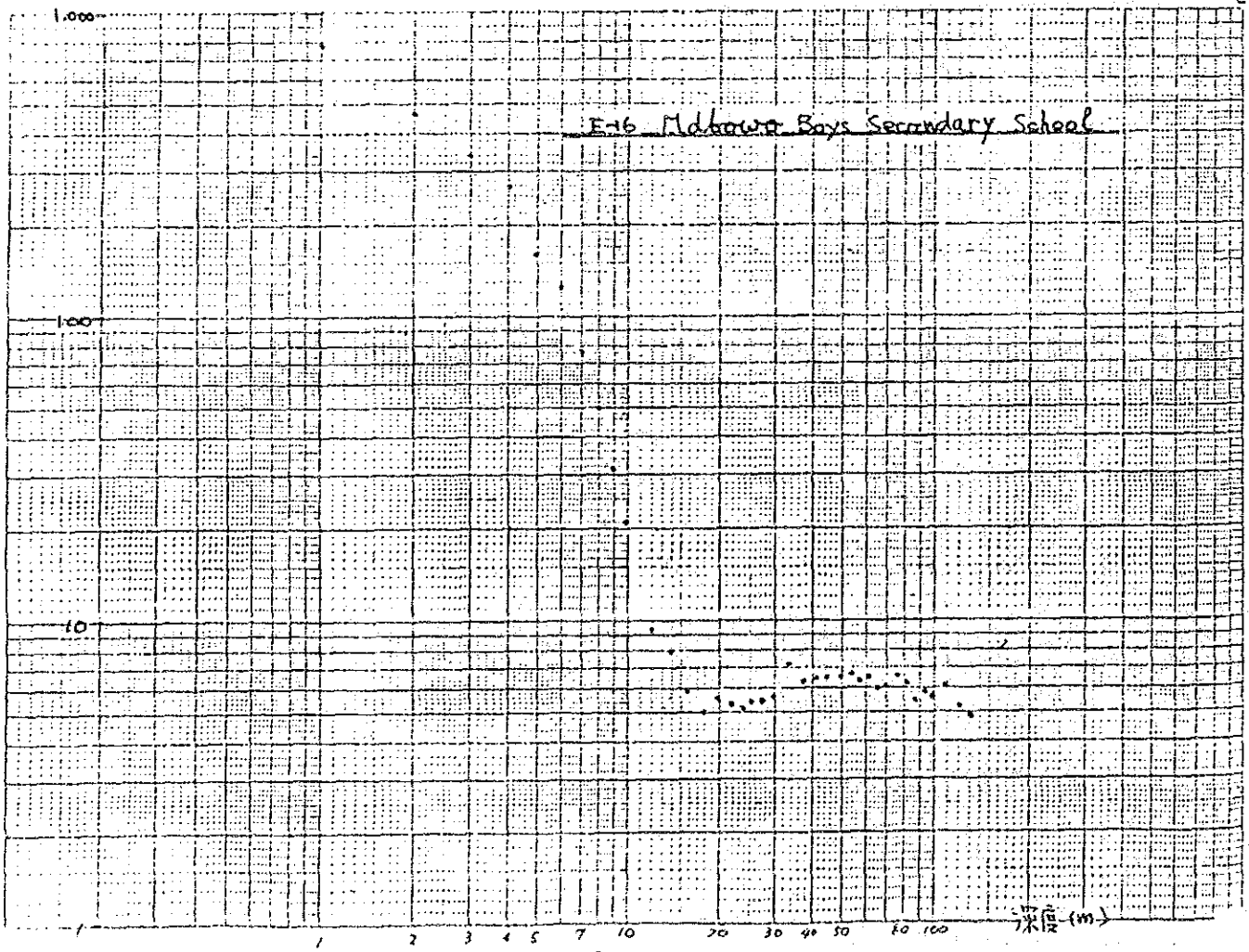


ρ－a Curve (8)

E-15 Emuda Community School Nexure

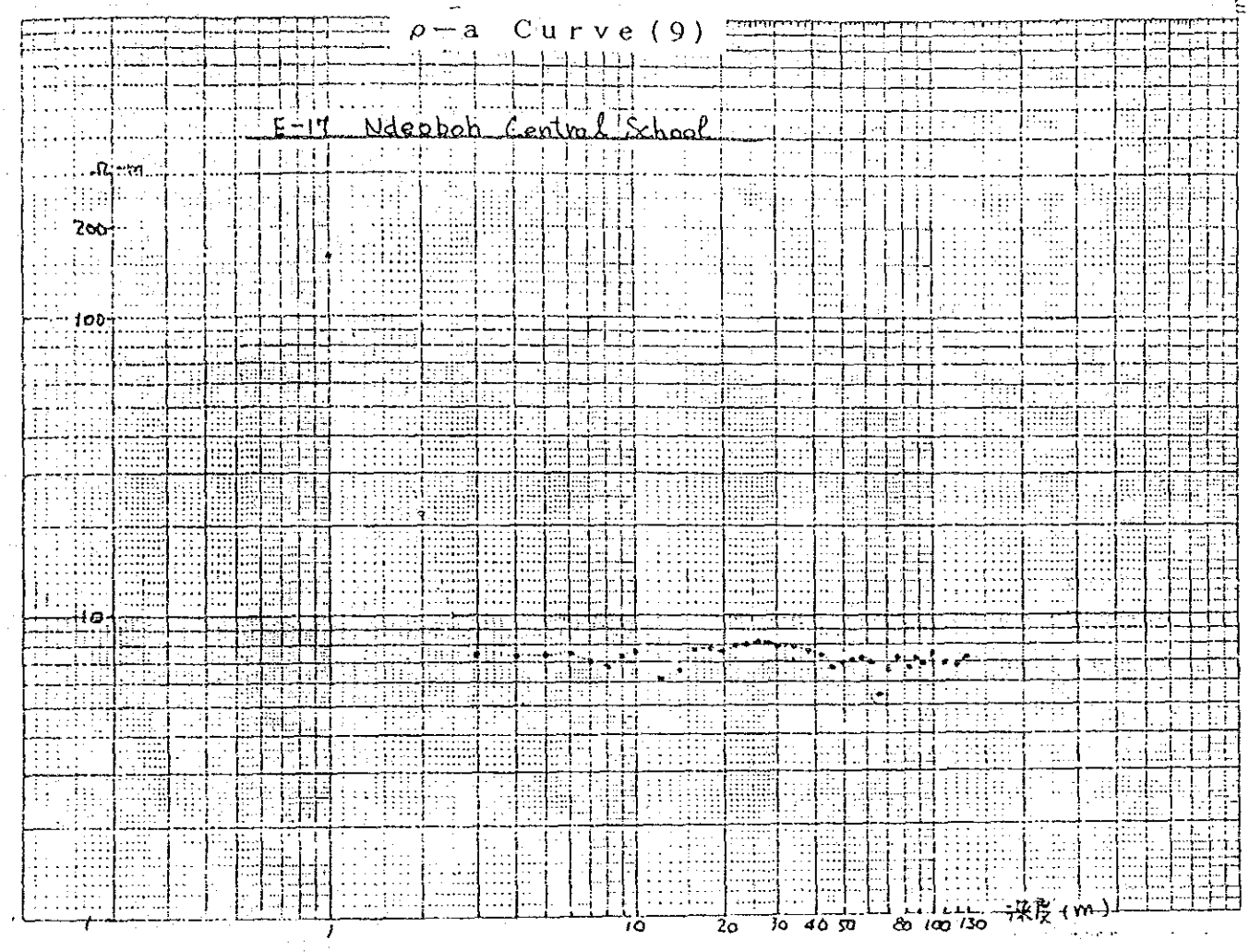


E-16



E-17

ρ—a Curve (9)



APPENDIX 10. Workshop Equipment

WORKSHOP EQUIPMENT

1. Equipment and Tools for Drilling Unit and Vehicles	1 Set
Tool box with complete tool set	1 box
Socket spanners set with wrench (9 - 26 mm)	1 box
Tap and dice set	1 set
Vernier caliper	1 no.
Bench level	1 no.
Measuring tape (3 m, 5 m)	2 each
L-type metric rule	1 no.
Metric straight rule (1 m)	1 no.
Standard thickness gauge	1 no.
Hacksaw (spare blade 100)	1 no.
Wire brush (big and small)	5 each
Megger tester (rated V.500)	1 no.
Electric soldering iron with solder 5 kg and paste	1 no.
Adjustable pipe wrench((4 sizes)	1 set
Chain wrench (450 mm; 600 mm)	2 each
Double-face sledge hammer (900 g)	1 no.
Plastic hammer (3 sizes)	1 set
Electric cord reel (20 m)	2 nos.
Bench drilling machine	1 no.
Electric bench grinder (500 w)	1 no.
Cutter for wire	1 no.
Bench vice (jaw width 150 mm)	1 no.
Electric air compressor (8 kg/cm2, 150 L/min)	1 no.
Electric welder (welding rod, 20 kg)	1 no.
Gas cutting tool and regulator set	1 set
Pipe slotting machine	1 set

Hydraulic garage jack (5 ton)	1 no.
Portable hydraulic jack (2 ton)	1 no.
Chain block (3 ton)	1 no.
Rigid rack (5 ton)	1 set
Aluminium folding service ladder (4 m)	2 nos.
Tool cabinet (1 ton)	1 no.
Work table, 1,500 mm x 700 mm	2 nos.
Pulley (6 inch)	2 nos.
Turn buckle (12 mm)	5 nos.
Shackle (12 mm, 6 mm)	5 each
Sling wire	2 sets
Cast iron anvil (30 kg)	1 no.
Bearing pullet set	1 set
Battery charger (12/24V, 15A)	1 set
Spark-plug cleaner	1 no.
Battery hydrometer set	1 set
Tire pressure gauge (3 kg/cm2)	3 nos.
Grease gun (200 cc)	3 nos.
Oil measure (polyethylene make, 1 L and 2 L)	5 each

2. Equipment and Tools for Hand Pump — 1 Set

Bench vice (jaw width 100 mm)	1 no.
Socket wrench set	1 set
Screw driver set	2 sets
Adjustable pipe wrench (4 sizes)	1 set
Ratcheting spanner set (8 sizes)	1 set
Hammer	1 set
Chisel set	1 set
Wood hammer (300 mm)	3 nos.
Dies handle	1 set
Pipe cutter	1 set
Monkey wrench	1 set
Caliper gauge	1 no.
Metric straight rule (1 m)	1 no.
Measuring tape (50 m)	1 no.
Portable electric drill set (300W)	1 set
Hacksaw (spare blade 100)	2 nos.

Combination plier (200 mm)	1 no.
Wire brush	10 nos.
Brush	10 nos.
Sling wire	1 set
Sand paper	1 set
Portable electric grinder with accessories (200W)	1 set
Iron bar	2 nos.
Bolt clipper	1 no.
Water pump plier (L = 250 mm)	2 nos.
Tool box with complete tool set	2 boxes

3. Diesel Generator, 50KVA — 1 Set

The generator shall be skid mounted type, having capacity not less than 50KVA, 200V, 50Hz, 3 phase, 4 wire. The generator shall be powered by diesel engine not less than 65 PS.

4. Tools for Earth Work — 1 Set

Wheel barrow	5 nos.
Mixing iron plate for concrete (t = 2 mm)	1 no.
Scaffolding wooden plate (4.0 m x 0.2 m x 3 cm)	10 nos.
Water/flame proof sheet (2.7 m x 3.6 m)	20 nos.
Scoop (round, flat)	10 each
Pick	4 nos.
Saw for wood	2 nos.
Trowels for concrete	2 sets
Bench level (L = 30 cm)	2 nos.
Manila rope (dia. 9 mm, 100 m)	2 rolls
Wooden maul	2 nos.
Iron maul	2 nos.
Cutter for reinforcing bar (9 mm)	1 no.
Transit with tripod mast, stadia rod and steel tape	1 no.
Fuel tank, 6 m3 capacity	2 nos.

5. 5 Ton Folk Lift, Diesel Engine Driven — 1 Set

The folk lift shall be 5 ton capacity having 1.2 m folk length and max. 3 m lifting height. The engine shall be 6 cylinders diesel type, having not less than 70 PS output.

6. Concrete Mixer — 1 Set

Type:	Portable, manual tilting system.
Wet capacity:	Approx. 0.25 m3.
Power:	Diesel engine driven.
Diesel engine:	4-cycle, water-cooled, single cylinder, 5 HP at 2,000 rpm.
Accessories:	As necessary.

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