REPUBLIC OF HONDURAS

DETAIL DESIGN REPORT

ON

TRAINING FARM

FOR

AGRICULTURAL DEVELOPMENT TRAINING CENTER

(MAIN REPORT)

APRIL 1983

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request from the Government of the Republic of Honduras, the Government of Japan has agreed to provide financial and technical cooperation for the construction of an Agricultural Development Training Center at Comayagua. The purpose of the Center is to offer training to selected personnel towards creation of a pool of experts knowledgeable in agricultural development. In accordance with the implementation schedule for the project, a basic design survey was conducted in February 1982 by a team dispatched from the Japan International Cooperation Agency (JICA).

Exchange of notes between concerned officials of the governments of Honduras and Japan regarding grant-in-aid cooperation for the Center project was completed in June 1982, and the commencement ceremony for first phase construction was held in February 1983. Construction is currently in progress.

In accordance with requirements of the Center project, concerned officials of both governments agreed to the need to conduct a detailed design survey for the upland field portion of the Attached Farm to be used for experimentation and training in irrigated agricultural techniques by the Center trainees. The scope of the subject survey was determined as encompassing detailed design for land preparation, irrigation and drainage canal facilities, upland field irrigation facilities, farm roads, etc., as well as selection of design crops.

This report presents the findings of the Detailed Design Survey Mission, headed by Hiroshi Nakamura of the Ministry of Agriculture, Forestry and Fisheries, Government of Japan, which executed a detailed design survey covering the above mentioned scope over a 17 day period from February 23 to March 11, 1983. It is my firm hope that this report shall hasten the successful implementation of the upland field portion of the Attached Farm of the Agricultural Development Training Center, and thereby contribute to strengthening of the bonds of friendship existing between the Republic of Honduras and Japan.

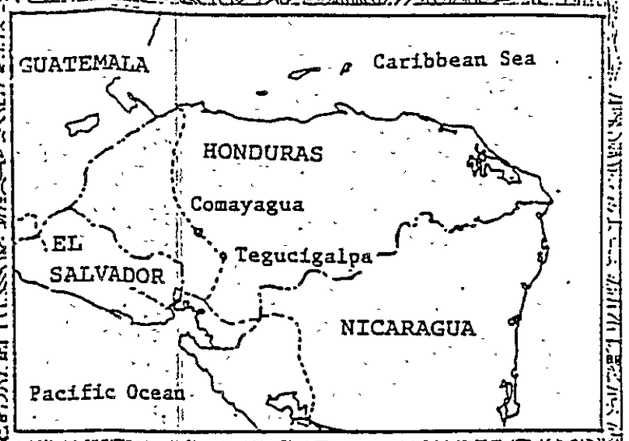
In closing, I would like to personally thank all concerned personnel in agencies of both governments whose most kindly rendered assistance and cooperation made this survey mission possible.

April 1983

Takashi TAUCHI
Director
Agricultural Development Cooperation Department
Japan International Cooperation Agency

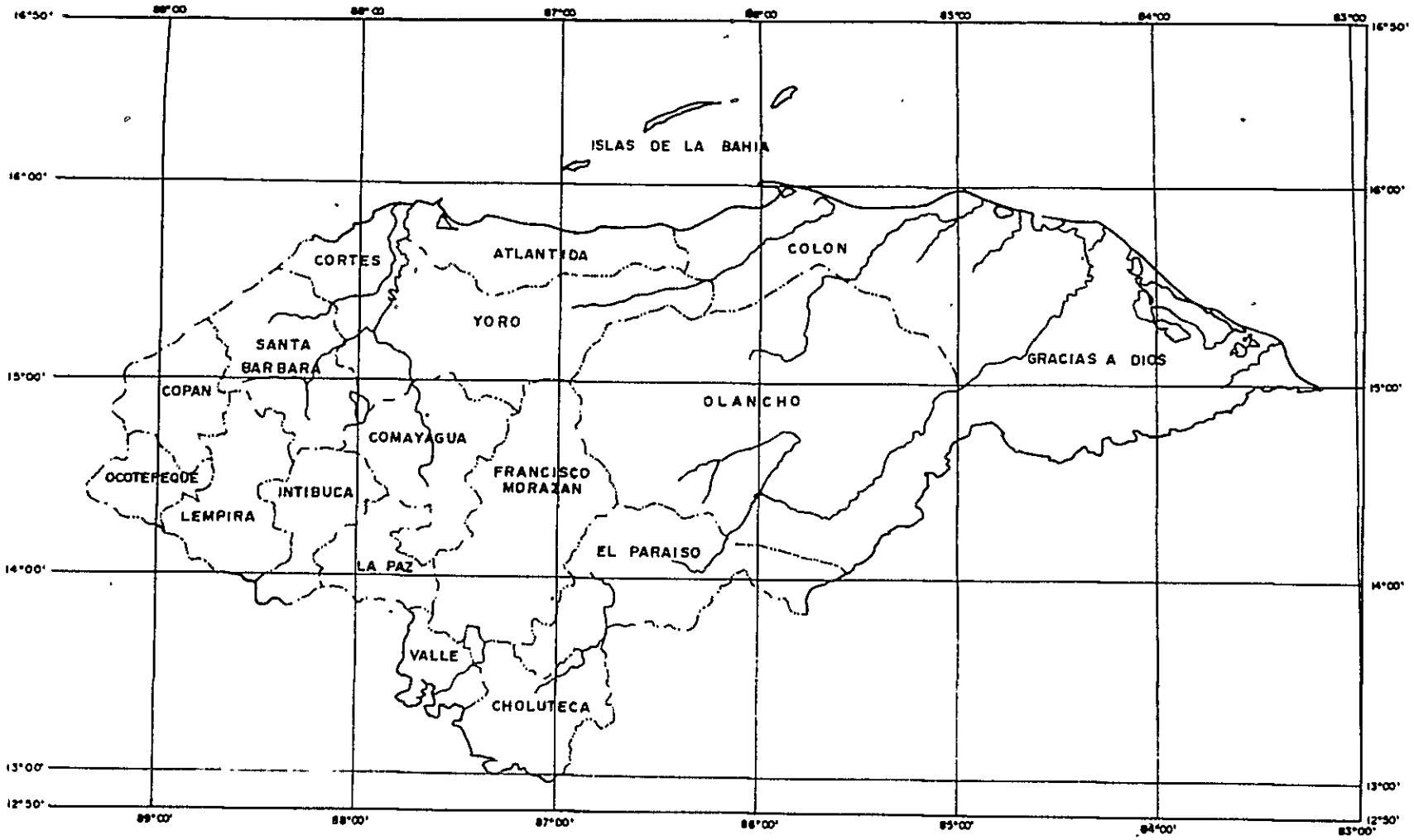
DEPARTAMENTOS DE COMAYAGUA Y LA PAZ 1:50,000

COMAYAGUA



PROJECT SITE (50Ha)

HONDURAS ADMINISTRATION MAP



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CHAPTER 1: Background and Purpose of Survey

1-1 Mission objectives and work schedule

With the request from the Government for cooperation on execution of the Agricultural Development Training Center Project in 1981, the necessity was realized for a detailed design survey mission to undertake survey for detailed design and cost estimation of the envisaged upland field area. By providing a site for practical experimentation and study, the upland field component of the Attached Farm will serve to materialize the objects of the technical cooperation.

In response to the above need, a Detailed Design Survey Mission was organized in February 1983, and consultations were held between the Mission and concerned individuals of the Government as well as agencies connected with technical cooperation projects within the Japanese Government.

In accordance with the work scope given below, the Mission studied the planning for upland field preparation, and carried out field survey of the Project site at Comayagua as well as investigation of local conditions relevant to construction. The Mission also conducted a land survey of the upland field site.

Furthermore, data and information on agricultural conditions deemed pertinent to understanding the background for implementation of the overall Center project were collected. (Annex III)

On the basis of survey findings, a construction plan (facilities plan) for the upland field component of the Center was determined, and a Detailed Design Survey Report (including detailed design, construction cost estimates, implementation schedule, etc.), specifications and bidding documents were prepared.

Mission work scope:

1) Elicitation of aspirations and intentions of the Government regarding the upland component;
2) Land survey of the upland field site;
3) Survey of conditions affecting the site area;

4) Survey of conditions relevant to construction cost;
5) Determination of upland field facilities;
6) Formulation of a detailed design proposal;
7) Presentation and explanation of the detailed design proposal to the
Government, and incorporation of consultation results within the detailed design;
8) Construction cost estimation; and
9) Preparation of specifications and bidding documents

1-2 Mission personnel

The Detailed Design Survey Mission (February 23, 1983 - March 11, 1983) consisted of the following individuals:

Mission leader:	Hiroshi Nakamura	Agricultural Civil Engineering Specialist, Design Section, Construction Department, Kyushu Agricultural Administration Agency, Ministry of Agriculture, Forestry and Fisheries
Facilities design: (Agriculture/ Facilities	Keisaku Kobayashi	Manager, Agricultural Facilities Department, International Projects Department, Chuo Kaihatsu Corporation
Facilities design: (Survey/design)	Shinichi Matsunaga	Section Chief, Agricultural Civil Engineering Section, International Projects Department, Chuo Kaihatsu Corporation
Administrative Coordination: (Cooperation planning)	Masashi Aoki	Technical Cooperation Division, Agricultural Development Cooperation Department, Japan International Cooperation Agency (JICA)

1-3 Mission schedule

February 23, 1983 (Wed):	Depart Tokyo and arrive Miami via. Chicago (NW 004/716)
" 24, " (Thu):	Depart Miami and arrive Tegucigalpa (TX801)
" 25, " (Fri):	Courtesy call and discussions at Ministry of Natural Resources and Japanese Embassy
" 26, " (Sat):	Discussions among Mission members; visit to Tamara, Zambrano farms
" 27, " (Sun):	Survey preparation; Matsunaga goes to Comayagua for land survey work
" 28, " (Mon):	Remaining Mission members move to Comayagua; survey Center site and area water resources
March 1, " (Tue):	Survey environs of Center site; gather agricultural data; Matsunaga remains at site to carry out land survey
" 2, " (Wed):	Discussions at Water Resources Bureau; data collection from FAO, USAID, etc.; land survey at site
" 3, " (Thu):	Discussions at Water Resources Bureau; data collection from USAID, IICA; survey at site
" 4, " (Fri):	Discussions at Water Resources Bureau; data collection from library at Ministry of Natural Resources, etc.; land survey at site
" 5, " (Sat):	Discussions among Mission members; data correlation, copying, etc.; completion of land survey
" 6, " (Sun):	Data correlation, copying, etc.; discussions with local personnel involved on land survey

March	7, 1983 (Mon):	Data collection from COSUDE, Ministry of Natural Resources; courtesy call and discussions at Ministry of Natural Resources
"	8, " (Tue):	Data correlation (Government holiday due to Papal visit)
"	9, " (Wed):	Depart Tegucigalpa and arrive Los Angeles via San Salvadoe (TA210)
"	10, " (Thu):	Depart Los Angeles (JL061)
"	11, " (Fri):	Arrive Tokyo

Note: IICA = Instituto Interamericano de Cooperacion Para La Agricultura

COSUDE = Cooperacion Suiza Al Desarrollo

1-4 Personnel concerned with Mission activities

Director General, Dirección de Recursos Hidricos, Ministerio de Recursos Naturales	Ing. Miguel Lardizabal
Sub-Director	Ing. Carlos Rivas Pagoaga
Jefe de Planificación	Lic. Jaime Lanza
Jefe Dpto. de Ingenieria de Riego y Drenaje	Ing. Orlando Auiles
Jefe de Departamento de Ingeniera Agrícola	Ing. Arnulfo Mazier

- -

Agricultural Development Dept., USAID	Mr. Jelipe D. Manteiga
Especialista en Credito y Planificacion, IICA	Dr. Marcelo Peinado
Cooperatión Suiza al Desarrollo, (COSUDE)	Ing. Peter Bischof
Programme Assistant, FAO Representative	Mr. Carlos A. Zelaya

- -

Embajador del Japón	Mr. Keiji Ishikawa
Primer Secretario del Embajada de Japón	Mr. Yoshinori Nuimura
Experto de JICA	Ing. Kuniwo Takagaki
"	Ing. Hidewo Agoh
Experto de JICA a corto plazo	Ing. Tooru Kitamura
Japonés Residente de Comayagua	Ing. Sakae Umakoshi
"	Ing. Yotsuwo Waki

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1-5 Background of request for cooperation

1-5-1 Nature of Honduran agriculture

The land area of the Republic of Honduras is approximately 112,000km^2, or roughly 1/3 that of Japan. Agriculture and forestry comprise the major sector of the Honduran economy, accounting for 30% of the Gross Domestic Product (GDP), 80% of total export value and 60% of employed labor.

Neverthless, the 1979 land use survey indicates that in relation to the total agriculturally productive land area, only 23% and 17% of the said area is cultivated with annual crops and perennial crops, respectively. In other words, 2.5 million ha, including land currently used for extensive agriculture, remains suitable for further agricultural development.

Honduran farmers can be broadly categorized into three types: (i) self-sufficient small farmers, (ii) intermediate scale farmers engaged in limited marketing of agricultural products and (iii) large scale commmercial estates. According to the 1981 survey, 279 large scale estates were identified, accounting for 500,000ha or 20% of agricultural land currently in use. Industrial crops such as banana, coffee, sugar cane and oil palm are cultivated on these estates. In contrast, small farms of less than 5ha total aproximately 125,000. Small farmers cultivate primarily for home consumption and rely on labor provided by family members and draft animals. Intermediate scale farmers number roughly 63,000, and engage in marketing of agricultural products which entails some limited investment and employment of labor.

Thus, although approximately 200,000 farms are currently engaged in agricultural activity, the total cultivated area amounts to only 5.3% of the overall Honduran land area, or 590,000ha. Of this amount, 38% comprises large scale estates where banana, coffee and other industrial crops are cultivated. Cultivated area serviced by irrigation infrastructure totals 50,000ha, of which 35,000ha constitutes export oriented banana orchards and 5,000ha is utilized primarily for sugar cane fields. In addition, small scale irrigation projects implemented by the government encompass 10,000ha., although only 20 - 30% of this area is

effectively irrigated due to problems of design, management, maintenance, etc.

Under the above conditions, national food crop production is heavily dependent on small scale farms of 5ha or less which make up 64% of the total number of farms in the country. These farms account for only 9% of all cultivated land and are characterized by extremely low productivity (refer to following table). Accordingly, self-sufficiency in national food production and enhancement of farmer standards of living are ugrent problems which must be addressed.

Farm size and rates of major cereals production

Unit: %

Farm scale	Number	Area	Corn	Kidney beans	Sorghum	Rice
Less than 5ha	63.9	9.1	41	41	47	27
5 - 10ha	14.5	7.6	15	16	17	14
10 - 20ha	9.8	10.2	13	15	13	14
20 - 50ha	9.8	10.2	13	15	13	14
20 - 50ha	7.8	17.5	14	14	10	18
Over 5ha	4.8	55.6	17	14	13	27

Source: Censo Nacional Agropecuario, 1974, D.G.E.C

To resolve these problems, the Govenment has made extensive efforts through specific measures such as expansion and effective utilization of agricultural land, and improved productivity. However, particulary regarding development of agricultural land and the promotion of irrigated agriculture, the following technical obstacles have been encountered:

1) Appropriate legislation pertinent to water resources development is lacking;
2) Basic data and information necessary for water resources development planning is not available and;
3) There is a shortage of technical experts knowledgeable in project planning, implementation and management of irrigation projects.

The lack of expert personnel is a particularly acute problem. As a response to this situation, the concept of the subject Agricultural Development Training Center was formulated with a view to providing an opportunity and facilities for the training of agricultural development experts.

1-5-2 Establishment of an Agricultural Development Training Center

The Government has designated self-sufficiency in major cereals (corn, kidney beans, sorghum, rice) through effective utilization of agricultural land and increased productivity as a major objective. This goal is premised on the necessity to improve the productivity of intermediate and small scale farmers by expansion of cultivated land area and the promotion of irrigated agriculture. Nevertheless, there exists an acute shorage in Honduras of technical personnel with sufficient expertise in planning, design and implementation of agricultural development projects necessary to realize the above objectives.

As a result of this need to create an adequate expert base for the execution of its agricultural development policy, the Government requested financial and technical cooperation from the Japanese Government under the latter's grant in aid program for the planning, design and construction of an Agricultural Development Training Center. The subject Center is designed to provide education to Government experts as well as

farm leaders in essential basic and applied knowledge relevent to agricultural development through a varied research and training curriculum in irrigated agriculture. Upon completion of their study, Center graduates will provide direct support to farmers and play a central role in Government programs to vitalize Honduran agriculture.

Planning and implementation of the Agricultural Development Training Center Project is being carried out with the assistance of experts dispatched by the Japanese government to the Ministry of Natural Resources at the reguest of the Government. In September 1980, a Latin America Agricultural Cooperation Project Finding Mission headed by Hiroshi Taira (Director, Vegetable Supply Stabilization Fund) was sent by the Japanese Government, at which time formal request was made by the Government for cooperation on the Project. A subsequent Preliminery Survey Mission led by Akiyoshi Tamaoka (Director of Development Division, Construction Development, Tookai Regional Administration Office, MAFF) arrived in Honduras in October 1981 and confirmed the Government's desire that the Project be realized as early as possible. During this mission, the site for the Center was determined at Comayagua. In February 1982, a Basic Design Survey Mission also headed by Akiyoshi Tamaoka was dispatched and a Basic Design Study Report was prepared for submission to concerned agencies in July 1982.

Exchange of notes on financial cooperation under the grant-in-aid program of the Japanese Government was completed in June 1982 and the consulting contract for the first phase detailed design was signed in August. Tendering for construction works was executed in November, with the commencement cermony for first phase construction works under grant-in-aid being held in February 1983. First phase construction is currently in progress, and completion is targeted for the end of March 1984. Second phase construction works are scheduled to be completed at the end of March 1985.

In conjuction with the above works, the subject Detailed Design Survey Mission was dispatched to undertake detailed design for the 6ha upland field portion of the Attached Farm which will serve as the site for the outdoor training activities of the technical cooperation program.

1-6 Basic description of Project

The subject Project constitutes the establishment of the upland field portion of the overall Agricultural Development Training Center. The Center has as its objective the training of agricultural development experts, which are currently in critical shortage in Honduras. The Project will accordingly provide for the creation of 6ha of upland field to serve as a site for practical and experimental studies in irrigated upland farming.

Farm blocks:

The upland field portion is to consist of a total of 6ha divided into 3 blocks. Each block is 2ha in area with dimensions of 200m x 100m.

Farm roads:

Farm roads are to be constructed at intervals of 100 - 200m. As the farm area is small, no distinction into main and secondary roads will be made. Road surface width is to be 5.0m, with an additional shoulder width of 1.0m on either side for a total of 7m. Road surface is to be gravel with a design vehicle speed of 40 km/hr.

Cropping plan:

The introduction of newly developed crops will be avoided. Crops will be selected from among traditional crops with emphasis on those which are most widely cultivated. Also, final crop designation will be made with due consideration to curriulum and irrigation requirements. In principal, cereals are to be cultivated in the rainy season and vegetables during the dry season in view of factors of pest damage and economic productivity. Candidate cereal crops are corn, sorghum, soy beans, kidney beans, etc., while appropriate vegetable crops would include tomato, onion, watermelon, melon, cabbage, etc.

In order to calculate the irrigation requirements, a cropping pattern model has been formulated (refer to Annex II, Table 1).

Irrigation plan:

The 6ha of upland field are to be irrigated by the furrow, sprinkler and drip methods. Although irrigation by the drip method

only is to be fixed for one portion of the field, the remaining area is to be capable of receiving irrigation by both the furrow and drip methods.

Diversion plan:

Water for irrigation is to be supplied from the existing headworks of the Selguapa river upstream from the Center site as well as from deep tubewells to be constructed within the Center project area with financial cooperation from the Japanese government under its grant-in-aid program. Diversion facilities under the subject Detailed Design include only the driving pipline from the deep tubewell to the farm pond.

Drainage plan:

Planning for the main drainage canal is currently being carried out under JICA's grant-in-aid program. The drainage plan for the Project will accordingly constitute establishment of terminal drainage facilities (drainage facilities from each field up to the main drainage canal).

1-7 Significance and effect of the Project

The total irrigated area at present in Honduras is 48,000ha, which amounts to 2.4% of all agricultural land. Of this amount, 12,000ha are contained within Government executed irrigation projects. The remaining irrigated area is comprised within privately owned plantations engaged in large scale cultivation of banana, sugar cane, etc. Of particular significance is the fact that small scale farms of less than 5ha, and which constitute 64% of the total number of farms, receive virtually no benefit from irrigation technology.

Although lack of available funding for irrigation projects remains a problem, one major reason for the above situation is the absence of adequate numbers of properly trained experts to participate in the planning, design, implementation and management of agricultural development projects.

As is the case in many countries, Honduras does not possess an established educational system in the field of agricultural civil

engineering, but rather relies on experts from the two separate fields of pure civil engineering and agriculture to cover requirements in this area. Consequently, the Center will aim to provide agricultural training to civil engineers and, conversely, civil engineering training to agricultural specialists in order to produce agricultural civil engineering experts knowledgeable in both related fields. In this context, the envisaged Attached Farm, of which the 6ha of upland field to be established under the Project constitutes a major component, assumes large significance.

Graduates of the Center, who through their study on the Attached Farm will have gained practical and first hand experience in the technology and benefits of terminal irrigation facilities, will be prepared to participate at all levels of planning and implementation of agricultural development projects, from new projects to the renovation and strengthening of existing irrigation facilities. As a result, the anticipated effectiveness of the Center in general and the Attached Farm in particular is great.

CHAPTER 2: Survey Description

2-1 Survey area

2-1-1 Location

The survey area is situated near the major city of Comayagua, which is located in southwestern Honduras at 14°21' north latitude and 87°41' west longitude. Comayagua is the old capital of Honduras, and lies 82km to the northwest of the present capital of Tegucigalpa along the national highway to San Pedro Sula and is accessible from Tegucigalpa in approximately 1.5 hours by automobile.

Comayagua has a population of roughly 12,000 (as of the 1976 census). The city and its environs constitute a major center of agricultural activity in Honduras. Meteorological conditions are relatively mild, with a maximum temperature of 32.9°C in April and a minimum of 16.3°C in February. The climate features a distinct rainy season and dry season.

Annual rainfall is small at approximately 880mm, 85% of which occurs during the rainy season from May to October. (Refer to Annex II, Table 2).

The Agricultural Development Training Center is located 5km west of Comayagua City, at a point 2.5km along the access road from the national highway to the nearby army camp. The Center site comprises 57.4ha situated along this access road.

2-1-2 Topography

The proposed upland field area is located within the catchment area of the Selguapa river situated on the western side of the Comayagua valley. The elevation at the site is 580m. Topography is generally flat with only slightly rising sloping of 1% from east to west. At present the site is being levelled by bulldozer. Trees are sporadically in evidence.

2-1-3 Soil

The soil at the site consists of sandy silt and sandy clay with a low permeability coefficient of $K=10^{-6} - 10^{-8}$. The topsoil layer is approximately 60cm thick. Lower strata consist of clayey gravel mixed

with cobbles. Soil features an acidity of PH 5-6, which although slightly acidic is considered suitable for crop cultivation.

2-1-4 Water sources

Existing headworks are present on the Selguapa river 3.3km above the point where the river flows to the northwest of the proposed Center. Constant diversion of fixed discharge to La Paz and Playitas occurs at the headworks. According to field survey conducted in March 1983, 2 m^3 of discharge was observed despite the fact that the survey was conducted during the dry season. Water management at the headworks and intake canal is executed by the Water Resources Bureau, and an understanding has been established with said agency that diversion of water to the upland field portion of the Center shall be permitted. Nevertheless, as some shortage of water occurs in the La Paz area during the dry season, diversion will be undertaken only during the rainy season. Irrigation water during the dry season will be principally obtained from the deep tubewells to be constructed within the Center project area. Water diverted from the intake canal from the Selguapa river headworks will be conveyed by a newly constructed canal either directly to the upland field blocks or first to the farm pond as required. Water from the deep tubewells, however, will all be carried by pipe line to the farm pond. Water temporarily stored in the farm pond will be pump-lifted to the upland field as circumstances necessitate.

2-2 Survey components

The agricultural land for the Center already provided by the Government consists of 9ha situated on the west side of the Center project area, as well as 25.1ha located to the south of the Center. Of this total area, the western 9ha is to be utilized for training in intensive agriculture through the cultivation of paddy rice and upland cops. The 25.1ha located to the south is to be reserved for extensive agriculture.

The above 9ha designated as a training site for intensive irrigated agriculture is further divided into 3ha of paddy field and 6ha of upland field. Detailed design has already been completed and construction commenced for the 3ha of paddy field under the Japanese Government's

program for grant-in-aid cooperation. The subject Survey is accordingly aimed at detailed design for preparation of the 6ha of upland field portion as well as the driving pipeline between the deep tubewell and farm pond.

Field survey was conducted by the team for 17 days from February 23, 1983. During this period, survey and data collection was undertaken regarding the following items;

1) . preparation of necessary topographical maps for the upland field area and the driving pipeline plan;
2) selection of design crops;
3) calculation of irrigation requirement; and
4) cost estimation for construction

Chapter 3: Detailed Design

3-1 Basic approach

The scope of the subject survey mission constitutes the detailed design for 6ha of upland field, as well as the driving pipe for conveying water from the deep tubewell to the farm pond. In its basic approach to this detailed design, the Mission has striven to incorporate facilities which, while fully satisfying the intended requirements for training, are optimally suited to conditions prevailing in and around the site area. Key guidelines in the formulation of the Mission's approach may be summarized as follows:

1) Land preparation is to follow site topography to the extent possible in order to minimize excavation works;

2) Irrigation methods are to include the furrow, sprinkler and drip methods in order to provide effective training in all 3 types of irrigation;

3) Crops to be selected are to consist of major cereals and vegetables, with primary consideration to be given to those crops which, inter alia, (i) are already cultivated extensively in Honduras, (ii) indicate good marketability, or (iii) are in the process of extension to Honduran farmers;

4) Crop rotation is to be adopted in consideration of meteorological conditions, irrigation methods, water conservation, pest damage, etc.;

5) Specifications for irrigation facilities are to made on the basis of calculations of water requirement based on an appropriate crop rotation model (with some extra allowance of discharge as a safety margin); and

6) Material and equipment for irrigation facilities is to be procured with primary emphasis given to price, durability and ease of installation.

3-2 Upland field plan

The proposed upland field comprises 6ha of the overall 9ha of intensive agriculture area located at the western edge of the Center project area. The upland field portion is situated immediately adjacent to the 3ha of paddy field, and consists of 3 blocks of 2ha each (200m x 100m).

3-2-1 Irrigation method

There are various types of irrigation methods for upland field. As the upland field of the Project is to be utilized for training purposes, the generally applied furrow, sprinkler and drip irrigation methods are to be adopted. Irrigation configuration is to be as follows:

1) drip irrigation for 1ha
2) furrow irrigation to be possible for the remaining 5ha
3) sprinkler irrigation facilities to be of the movable type with periphery piping design to allow for irrigation of the same 5ha as for furrow irrigation; however sprinkler equipment to service only 1ha at a time to be provided under the Project

Block no.	Irrigation method	Area
No. 1	furrow; sprinkler	2 ha
No. 2	furrow; sprinkler	2 ha
No. 3	furrow; sprinkler	1 ha
No. 3	drip	1 ha
Total		6 ha

Upland Field Layout

Paddy field	No. 1	No. 2	No. 3
3 ha	2 ha	2 ha	2 ha

Upland field irrigation

3-2-2 Field preparation plan

At present, the upland field area exhibits 1% rising sloping from east to west. In view of drainage considerations, etc., sloping of blocks to be irrigated by the furrow method (5ha) shall be made at 0.2%. However, for the area to be serviced by the drip irrigation method (1ha), the present sloping of 1% is to be preserved to allow for natural drainage.

3-3 Crop selection

The purpose of the upland field is to provide an area for training and experimentation in irrigated cultivation of upland crops, rather than to engage in the economic production of agricultural products. As a result, selection of crops is to be made on the basis of maximum direct benefit to small and intermediary scale farmers. Newly developed industrial and perennial crops will accordingly not be given consideration in favor of major cereals (corn, kidney beans, sorghum, rice) and vegetables (tomato, onion, garlic, cabbage, watermelon, melon, etc.) which are either already cultivated extensively in Honduras or are undergoing an increasing trend in cultivated area (refer to following table). Also, sesame and soybean which the Government is recently emphasizing as oil seed crops are also potential candidate crops.

The cropping pattern for the selected crops will in principal comprise cultivation of major cereals of low economic value in the rainy season with cultivation of vegetables of relatively high economic value in the dry season. Specifics of the cropping pattern will, however, be formulated annually in response to Center training requirements with the assistance of agronomy experts dispatched from Japan under the terms of technical cooperation.

A cropping pattern model has been formulated (Annex II, Table 1) to serve as a basis for calculation of the irrigation requirement.

Cropping Area of Major Crops

Crop	1965/66	1973/74	1974/65
	(1,000 ha)	(1,000 ha)	(%)
Corn	247.9	283.4	14.3
Paddy	7.8	14.8	89.7
Sorghum	33.9	32.5	4.2
Kidney bean	57.2	58.1	1.5
Tomato	0.3	1.6	443.3
Onion	0.2	0.6	200.0
Garlic	0.1	0.9	800.0
Cabbage	0.3	0.6	100.0
Water melon	0.5	1.2	140.0
Melon	0.1	0.4	300.0
Sesame	0.3	1.5	400.0

Source: Agricultural Census 1965/66, 1973/74, D.G.E.C.
(For details refer to Annex III, Agricultural Statistics)

3-4 Irrigation requirement

Meteorological data has been compiled for major areas throughout Honduras by the Water Resources Bureau of the Ministry of Natural Resources. Meteorological records are available at Playitus, the closest observation point to the site area, since 1971. Calculations of water requirement have been made on the basis of these records.

3-4-1 Design year

Discharge from the existing headworks on the Selguapa river upstream of the Center project site is not sufficient to service the upland field area during the dry season. As the upland field is intended for training purposes, minimum precipitation with a return period of five years has been adopted as a design criteria. Utilizing the Iwai method, minimum precipitation with a return period of five years is calculated at 848.6mm. The year closest to this figure in minimum rainfall is 1972, which has accordingly been selected as the design year.

3-4-2 Effective rainfall

Although effective rainfall is defined as that rainfall which is effectively utilized by the crop for plant growth, there are nevertheless inherent difficulties in calculating the precise limits of effective rainfall. Taking into account the fact that training is the purpose of the upland field area, and based on rainfall data from the design year 1972, daily rainfall less than 5mm or over 50mm is deemed as ineffective. On this basis, 70% of the monthly rainfall total is considered effective.

Effective rainfall amounts for each month are indicated in Table-3.

3-4-3 Consumptive water amount

The irrigation requirement for the upland field area has been determined according to the modified Penman method on the basis of the envisaged cropping pattern. Calculation of evapo-transpiration according to the modified Penman method and average monthly rainfall amounts are indicated in Annex II, Table 3.

The net and gross water requirements for each crop are calculated on the basis of considerations outlined below. The irrigation requirements for each crop and the water requirement for overall site area are given in Annex II, Table 4-16.

a) Conveyance loss for upland field (furrow irrigation) is considered negligible in view of the shortness of canals from the farm pond to each block

b) Irrigation efficiency for upland field is considered as follows:

sprinkler system	67%
furrow irrigation system	60%
drip irrigation system	90%

3-5 Irrigation and drainage plan

Water for upland field irrigation is to be provided by diversion from the existing headworks on the Selguapa river and by deep tubewells to be constructed within the Center project area. As discussed in Section 2-1-4, Water sources, this irrigation water is to be conveyed to the upland field blocks by means of open canal or pipe as per requirements of the irrigation method.

Taking into consideration the training purpose of the area as well as the study hours of the trainees at the Center, irrigation time is determined at 8 hrs. per day and intermittent irrigation is to be adopted.

3-5-1 Irrigation canals

1) Maximum water requirement

Although the Project calls for, at any given time during actual irrigation operations, furrow irrigation for 4ha, sprinkler irrigation for 1ha and drip irrigation for 1ha, canal cross-section was studied in terms of the water requirement if the total 6ha area were to be serviced by furrow irrigation.

On the basis of the proposed cropping pattern, the maximum water requirement for furrow irrigation (when provided for all 6ha) was calculated according to the modified Penman method. As indicated in Table 20, the said requirement is 176.4 m^3/day (2ha) in May.

2) Canal cross-section

As both conveyed discharge and canal length are small, main canal and terminal canals shall be earthen, Canal hydraulic calculations are as follows according to Manning's formula:

$$Q = VA$$

$$V = 1/n \times R^{2/3} \times I^{1/2}$$

Where:

Q: discharge (m^3/sec)

A: water cross-section (m^2)

V: average velocity (m/sec)

n: roughness coefficient

R: hydraulic radius (m)

I: hydraulic gradient

In carrying out hydraulic calculations, canal cross-section was determined on the basis of the factors indicated below given the fact that canal banking material can be assumed to be sandy loam.

Maximum tolerable average velocity	0.9m
Roughness coefficient	0.03

3) Standard cross-section

Side slope for all canals is to be 1:1. On this basis, the following specifications were calculated.

	Upland field canal		
Specification	Main canal	No. 1, No. 2	No. 3
Maximum discharge (ℓ/sec)	18.3	6.1	6.1
Velocity (m)	0.24	0.31	0.26
Base width (m)	0.30	0.30	0.30
Water depth (m)	0.15	0.06	0.67
Embankment height (m)	0.30	0.30	0.30
Gradient	1/500	1/125	1/250

3-5-2 Pipeline

The area to be serviced by pipeline under the Project consists of 1ha of sprinkler irrigation and 1ha of drip irrigation for a total of 2ha. However, as understood from the table in Section 3-2-1, Irrigation Method, pipeline will be designed for all 6ha (5ha of sprinkler irrigation and 1ha of drip irrigation) of the upland field area. Pipeline is to be embedded along road shoulders where the direct weight of vehicles does not come to bear. Embedding depth is to be 1.2m.

1) Hydraulic calculations

Hydraulic calculation for pipeline are according to Hazen Williams formula:

$$Q = VA$$

$$V = 0.35464\ C D^{0.63} I^{0.54}$$

$$I = h/\ell = 10.666\ C^{-1.85} D^{-4.87} Q^{1.58}$$

Where:

Q: discharge (m^3/sec)

A: water cross-section (m^2)

C: roughness coefficient

D: pipe diameter (m)

I: hydraulic gradient

h: friction head loss (m)

ℓ: pipe length (m)

2) Maximum irrigation requirement

The maximum irrigation requirements for areas serviced by sprinkler and drip irrigation systems are as given below. (also see Annex II, Table 20)

Block	Irrigation area	Maximum irrigation requirement
No. 1 (sprinkler irrigation)	1.0	57.3
No. 2 (sprinkler irrigation)	1.0	57.3
No. 3 (sprinkler and drip irrigation)	2.0	105.2

3) Standard cross-section

Pipe diameters were calculated by Hazen-Williams formula giving due consideration to frictional and other types of head loss. Although pipe flow speeds are somewhat larger than standard values, these have been adopted taking into consideration frictional head loss and economy of pipe materials.

Pipe dimensions are given below:

Subject area	Pipe dia.	Flow speed	Discharge
	(mm)	(m)	(ℓ/sec)
Blocks no.1 and 2	ø75	0.45	2.0
Block no.3 (sprinkler system area)	ø75	0.84	3.7
Block no.3 (drip system area)	ø50	0.97	1.9

3-5-3 Drainage plan

Terminal drainage canals (earthen canals) are planned for portions of each upland field block to remove excess water. The maximum concentrated rainfall recorded for the Comayagua area over the past 10 years is 82.4mm in 6 hrs. at Playitas. If this amount is converted into the unit drainage amount, the result is 38.1 ℓ/sec/ha. The drainage amount for 2ha of area is accordingly:

$$Q = 0.0381 \times 2 = 76.3 \ \ell/sec$$

A drainage canal cross-section capable of passing the above discharge was determined according to Manning's formula, and is indicated below:

3-6 Facilities plan and design

3.6.1 Sprinkler facilities

In order to provide both furrow and sprinkler irrigation for the blocks so designated, sprinkler equipment is to be of the movable type.

1) Maximum irrigation requirement

The maximum irrigation requirement is 57.3 m^3/day/ha (July). Converted to water depth, this represents 5.73 mm/day.

2) Sprinkler pressure

Of the three types of sprinkler pressures available (low, intermediate and high pressure), the intermediate pressure type (1.5kg - 3.4kg/cm^2) is to be selected on the basis of suitability to design crop and site soil conditions, as well as generally superior water distribution pattern.

3) Sprinkler layout and sprinkler water requirement

The layout plan for the sprinkler system calls for utilization of uniform lengths of pipe section. To prevent the need for unusable pipe lengths, vertical and horizontal spacing between sprinkler units is to be 20m and 12.5m, respectively.

Sprinkler water requirement is calculated as follows:

$$Q = 20 \times 12.5 \times 0.,00573 = 1.433 \ m^3/H = 23.9 \ \ell/min$$

However, as the water requirement will change with any subsequent alteration of the design cropping pattern, sprinkler equipment capable of passing a 30% increase in the above discharge amount (23.9 x 1.3 = 31.07 ℓ/min) will be selected.

3-6-2 Drip irrigation facilities

As drip amount at each nozzle along the 100m drip-line decreases in proportion with drop in pressure (subsequently resulting in large differentials in drip amounts between initial and terminal nozzles), the drip system shall be designed such that nozzle pressure rises above 0.5 kg/cm^2 when drip amount falls below 50 cc/hr.

a) Dripper and drip line intervals

Dripper interval	1.0m
Drip-line interval	1.2m

b) Nozzle drip amount

Drip discharge rate Q (ℓ/hr) per nozzle may be expressed according to the following formula:

$$Q = AH/T$$

Where:

A: Command area per nozzle (m^2)

H: Maximum water requirement depth (mm/day)

T: Irrigation time

If irrigation time is considered to be 8 hrs/day, then:

$$Q = \frac{1.0 \times 1.2 \times 5.48}{8} = 0.82 \text{ ℓ/hr}$$

Drip system equipment will be selected which is capable of supplying the above discharge amount.

Chapter 4: Project Plan

4-1 Implementation schedule

As the upland field site is situated within the overall Center project area, it is desirable that the construction period be during the dry season from October to April and be such that it does not interfere with other aspects of Center construction.

The proposed implementation plan is as indicated in Table-21. Tender notice floating, sale of tender documents, opening of tenders, tender evaluation, etc. is to be conducted in Honduras. Following contractor selection and commencement of the preparatory stage for construction (land survey, procurement and deployment of equipment and materials, etc.), particular care shall be taken to ensure that delivery dates are strictly adhered to as procurement of equipment and material has a major controlling effect on the pace of construction implementation.

Construction works will begin with land preparation, which is independent of the effect of equipment and material procurement.

4-2 Cost estimation for construction works

Construction cost for upland field and appurtenant irrigation facilities of the Agricultural Development Training Center have been estimated on the basis of March 1983 prices. Taxes levied by the Government for equipment and material procured outside Honduras as well as for expatriate construction supervision services have not been included in the estimate.

The total construction cost for the Project is calculated at 23,852,000 yen.

Principal construction components and corresponding cost estimates are given below:

Construction Cost

(unit: 1,000 yen)

Item	Quantity	Cost*
Preparatory works	1 set	1,550
Land preparation	6 ha	4,528
Irrigation canal	719 m	671
Drainage canal	621 m	550
Sprinkler irrigation facilities	L.S.**	4,369
Drip irrigation facilities	1 ha	2,647
Driving pipeline	719 m	4,714
Sub-total (1)		19,029
Miscellaneous construction costs	(1) x 5.0 %	951
Contingency	(1) x 10.0%	1,903
Price escalation	(1) x 10.3%***	1,969
Total		23,852

---

* Conversion from lempira to yen has been made at the rate:
1 lempira = 120 yen

** To include piping for 5ha and sprinkler equipment for 1ha

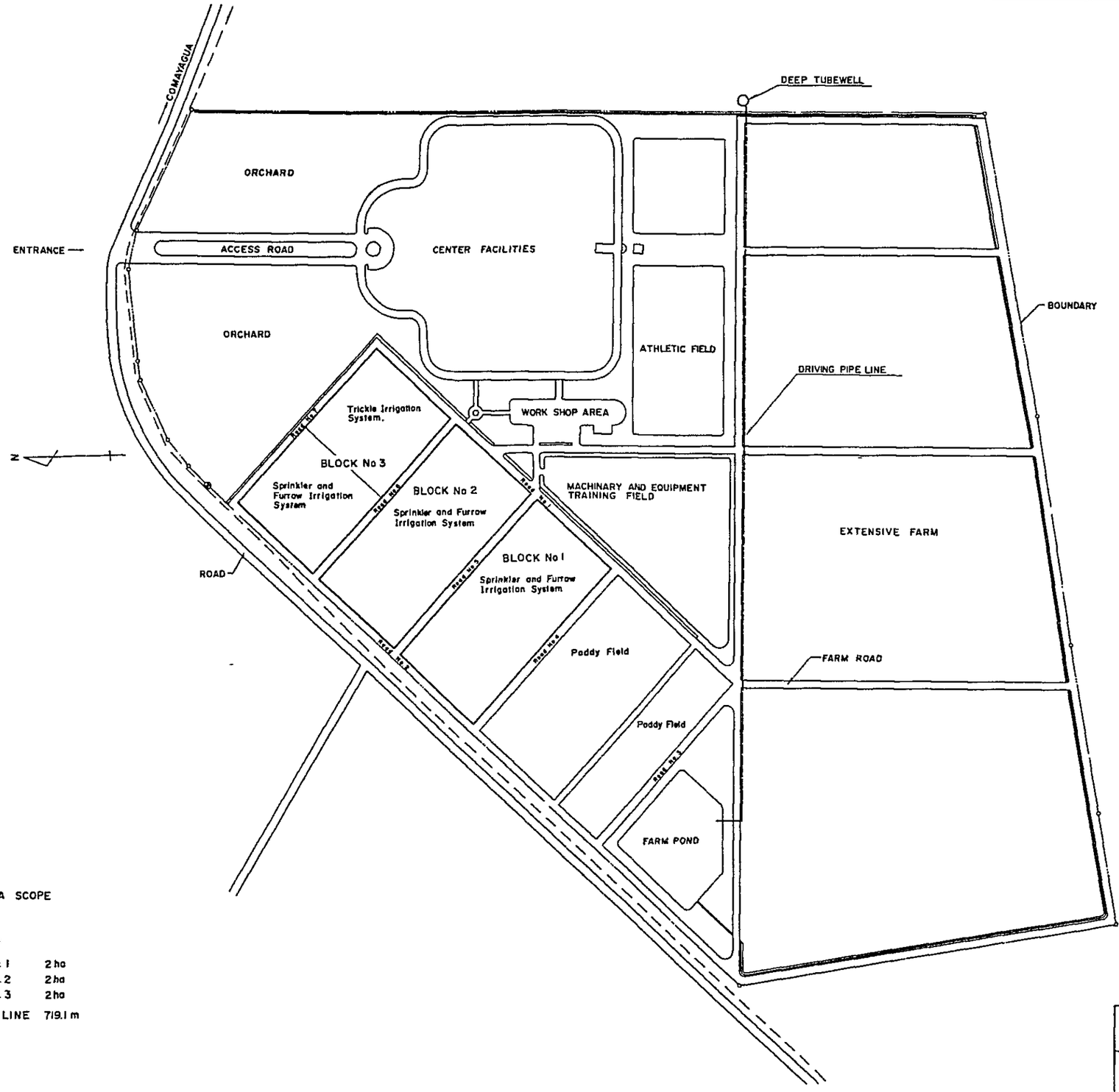
*** Based on price escalation rates over the past 5 years

ANNEX I

DRAWING

LIST OF DRAWING

DRAWING NUMBER	TITLE
NO. 1	PROJECT GENERAL PLAN
NO.2	CONTOUR MAP
NO.3	PROFILE OF DRIVING PIPELINE
NO.4	DETAIL OF OUTLET FOR DRIVING PIPELINE
NO.5	PLAN OF THE EXPERIMENTAL FARM
NO.6	CROSS SECTION OF THE UPLAND FIELD
NO.7	CROSS SECTION OF THE UPLAND FIELD
NO.8	CROSS SECTION OF THE ON FARM DITCH
NO.9	PROFILE OF THE ROAD
NO.10	PRDFILE OF THE ROAD
NO.11	PROFILE OF THE ROAD
NO.12	ON FARM DITCH AND DRAIN
NO.13	SPRINKLER SYSTEM PLAN
NO.14	TRICKLE SYSTEM PLAN
NO.15	DETAIL OF FACILITIES FOR THE SPRINKLER AND TRICKLE SYSTEM



PROJECT AREA SCOPE

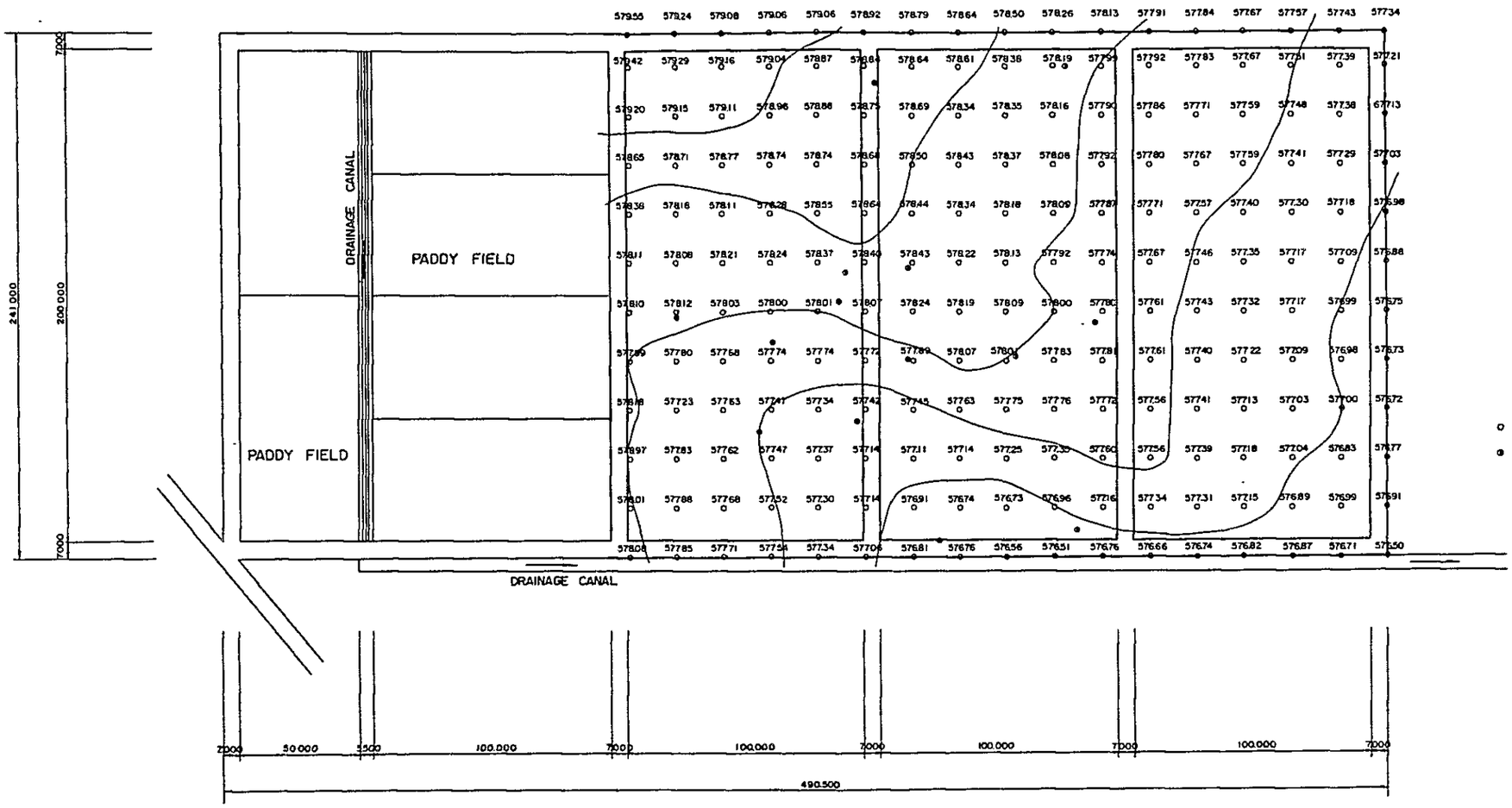
UPLAND FIELD

BLOCK NO. 1	2 ha
BLOCK NO. 2	2 ha
BLOCK NO. 3	2 ha

DRIVING PIPE LINE 719.1 m

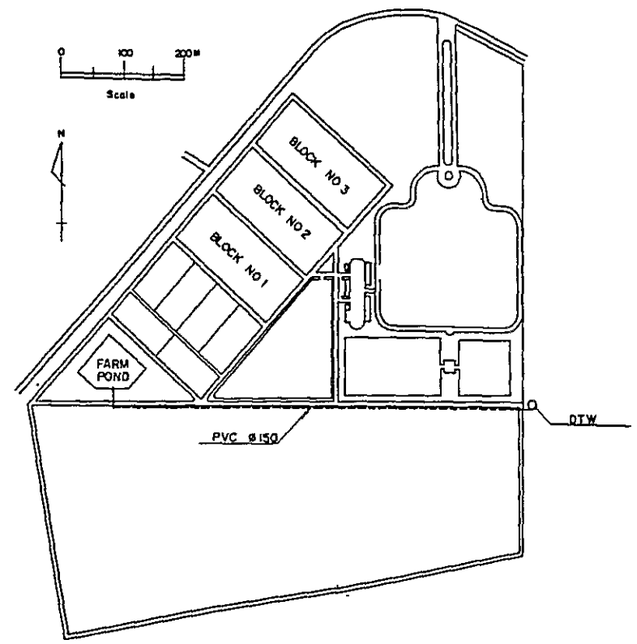
PROJECT TITLE	AGRICULTURAL DEVELOPMENT TRAINING CENTER
DRAWING TITLE	PROJECT GENERAL PLAN
DRAWING NO 1	SCALE 1: 2000
JAPAN INTERNATIONAL, COOPERATION AGENCY	

CONTOUR MAP

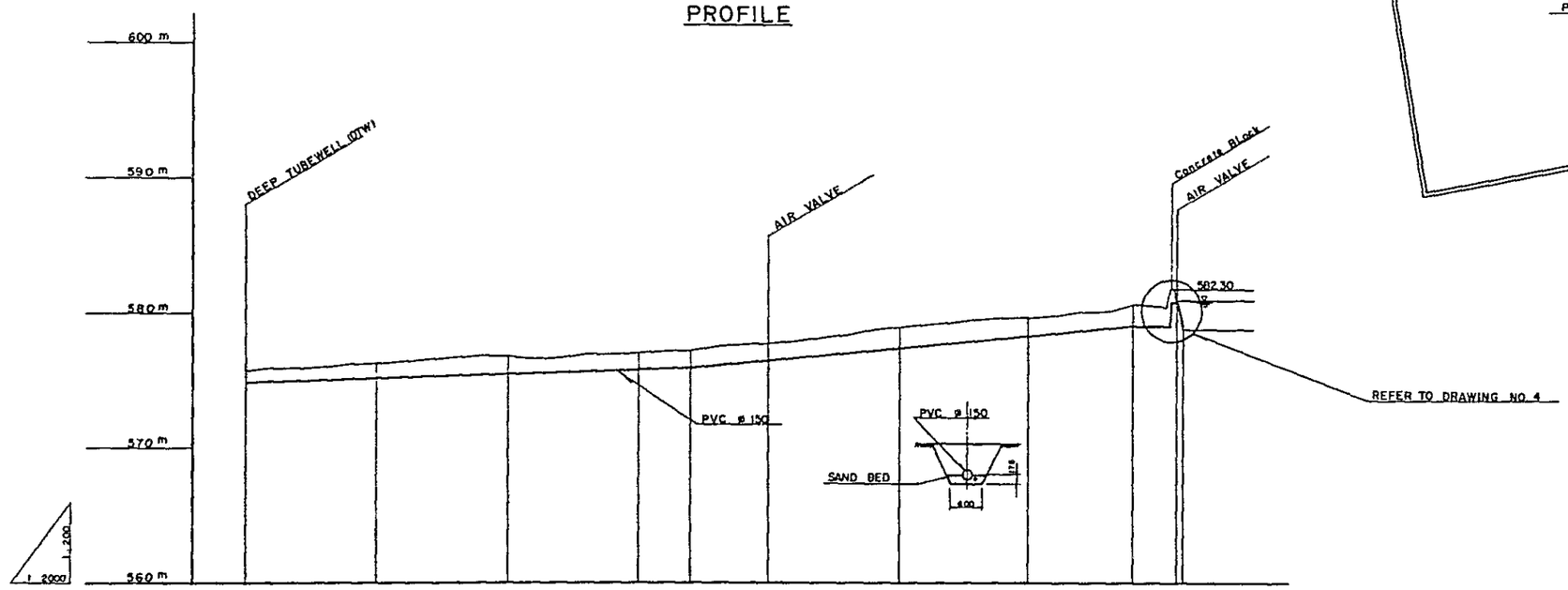


PROJECT TITLE AGRICULTURAL DEVELOPMENT TRAINING CENTER	
DRAWING TITLE CONTOUR MAP	
DRAWING NO 2	SCALE 1 : 1000
JAPAN INTERNATIONAL, COOPERATION AGENCY.	

PLAN



PROFILE

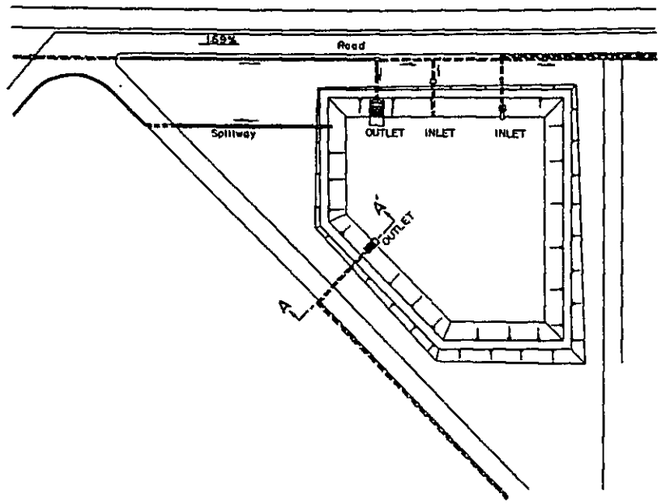


SLOPE				I=0.471 % L=340.000 H=1.600			I=0.941 % L=340.000 H=3.200			4000
DESIGN ELEVATION	574.40	574.870	575.340	575.810	576.000	576.560	577.50	578.450	578.920	581.000
GROUND ELEVATION	575.73	576.23	576.91	577.21	577.46	577.93	578.18	578.68	580.82	
ACCUM DISTANCE	0	100.0	200.0	300.0	340.0	400.0	500.0	600.0	680.0	718.9
DISTANCE	0	100.0	100.0	100.0	40.0	60.0	100.0	100.0	80.0	31.9
STA.	0	5	10	15	17	20	25	30	34	35+18.9

PROJECT TITLE AGRICULTURAL DEVELOPMENT TRAINING CENTER	
DRAWING TITLE PROFILE OF DRIVING PIPE LINE	
DRAWING NO 3	SCALE
JAPAN INTERNATIONAL, COOPERATION AGENCY	

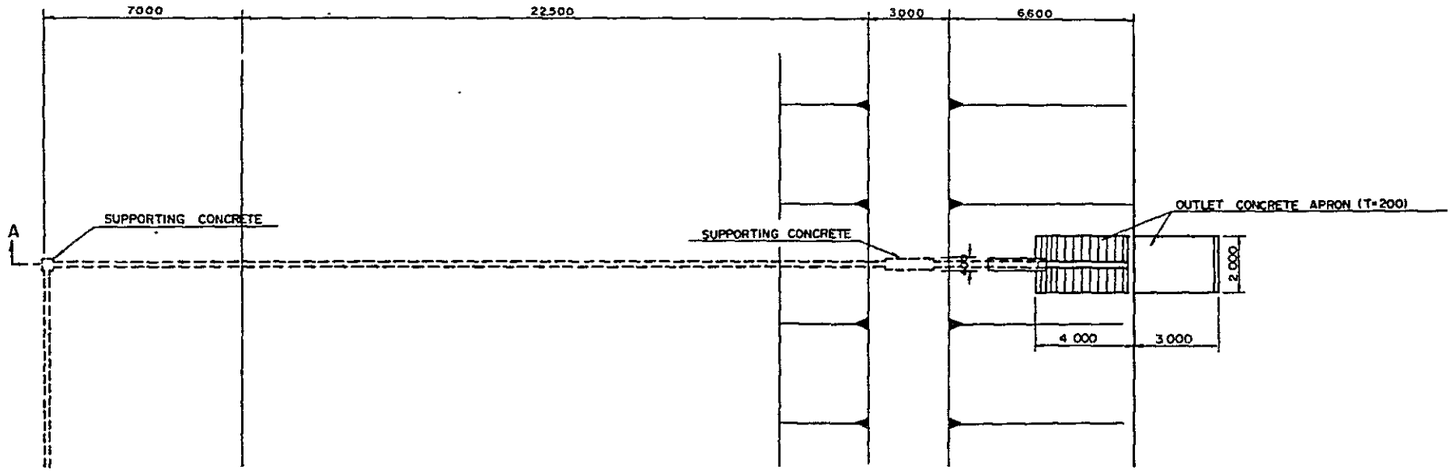
PLAN

SCALE 1:1000

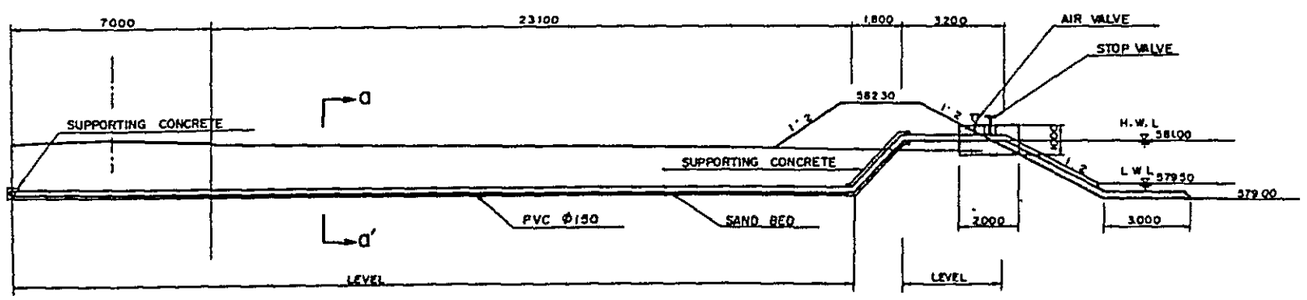


DETAIL PLAN

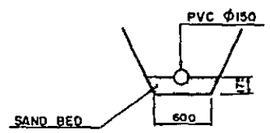
SCALE 1:100



Section A — A'



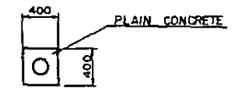
Section a — a'



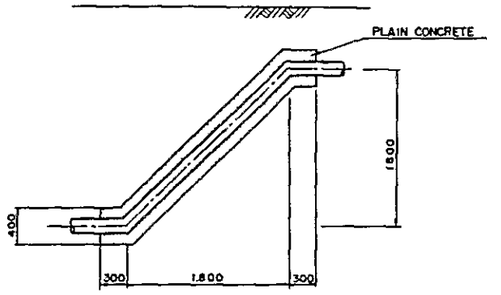
SUPPORTING CONCRETE

SCALE 1:30

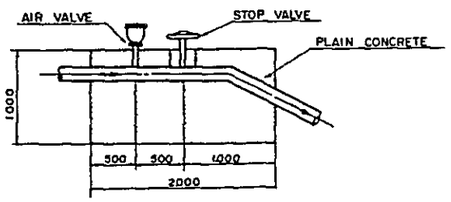
Cross Section



Profile Section

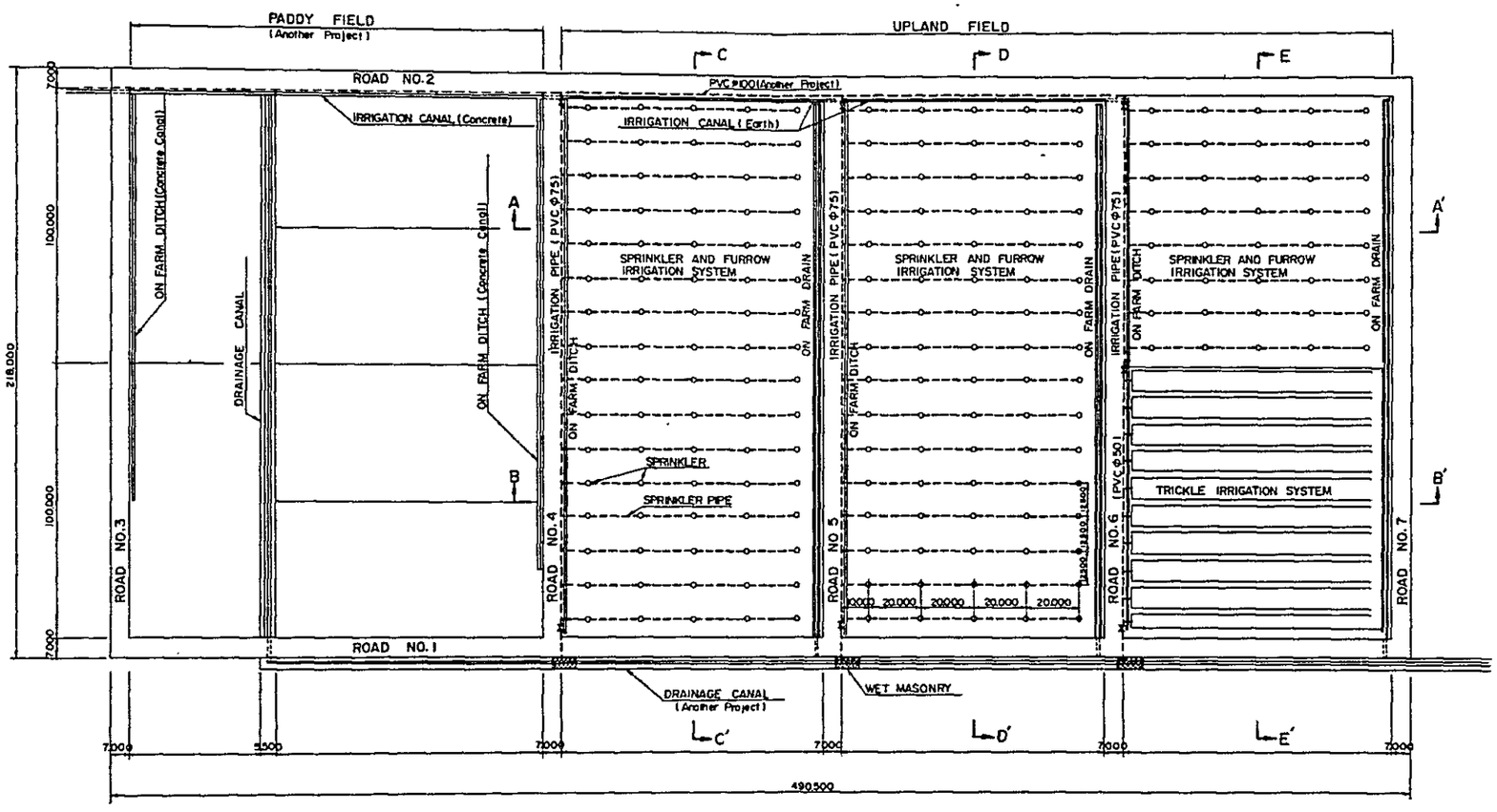


DETAIL OF VALVE PORTION



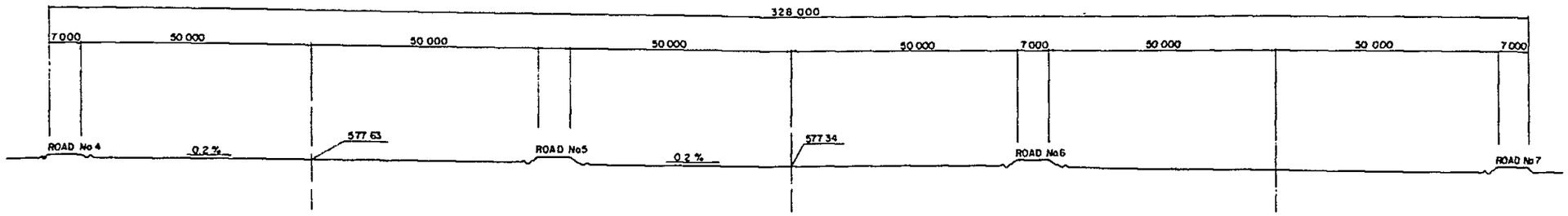
PROJECT TITLE AGRICULTURAL DEVELOPMENT TRAINING CENTER	
DRAWING TITLE DETAIL OF OUTLET FOR DRIVING PIPELINE	
DRAWING NO 4	SCALE
JAPAN INTERNATIONAL COOPERATION AGENCY	

PRAN



PROJECT TITLE AGRICULTURAL DEVELOPMENT TRAINING CENTER	
DRAWING TITLE PLAN OF THE EXPERIMENTAL FARM	
DRAWING NO 5	SCALE
JAPAN INTERNATIONAL, COOPERATION AGENCY	

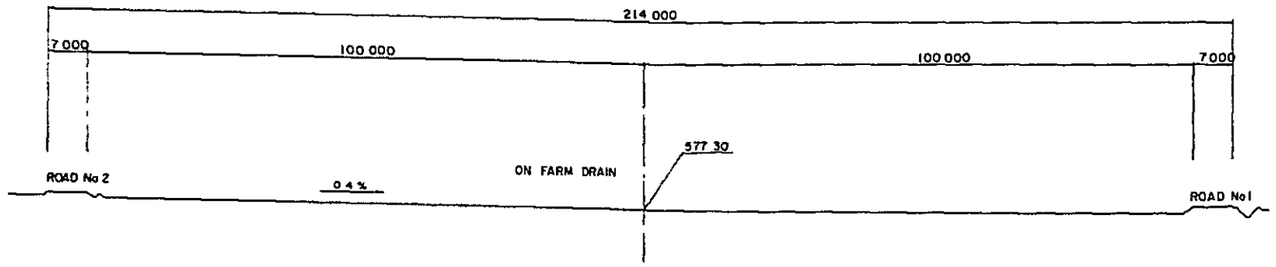
SECTION B – B'



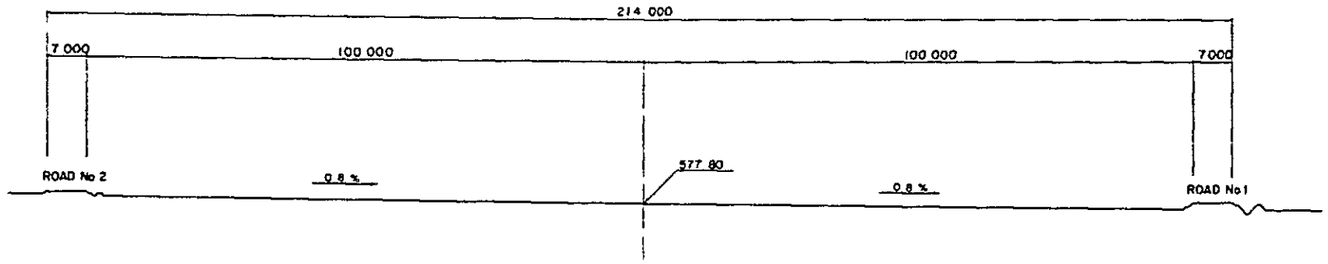
SECTION A – A'

PROJECT TITLE AGRICULTURAL DEVELOPMENT TRAINING CENTER	
DRAWING TITLE CROSS SECTION OF THE UPLAND FIELD	
DRAWING NO. 6	SCALE : 500
JAPAN INTERNATIONAL, COOPERATION AGENCY	

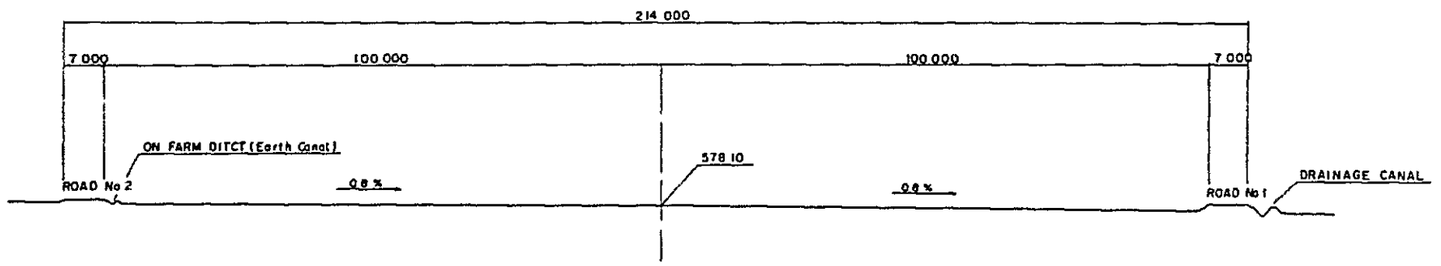
SECTION E - E'



SECTION D - D'

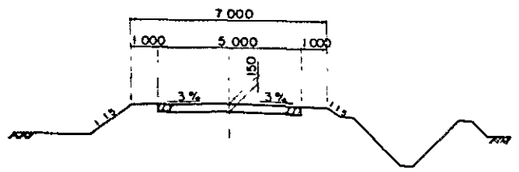


SECTION C-C'

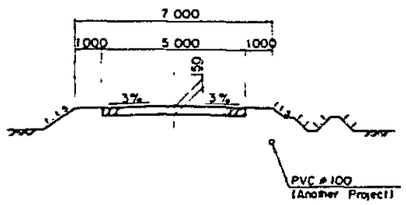


PROJECT TITLE AGRICULTURAL DEVELOPMENT TRAINING CENTER	
DRAWING TITLE CROSS SECTION OF THE UPLANO FIELD	
DRAWING NO 7	SCALE 1 500
JAPAN INTERNATIONAL, COOPERATION AGENCY.	

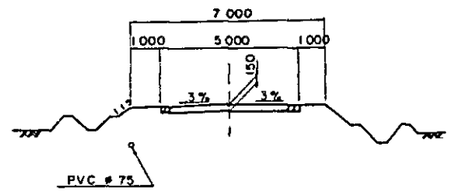
Road No. 1



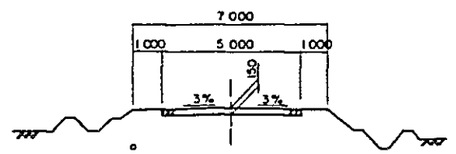
Road No. 2



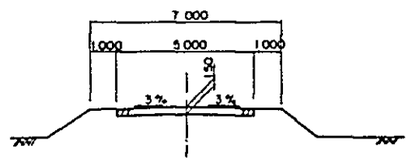
Road No. 4 & No. 5



Road No. 6

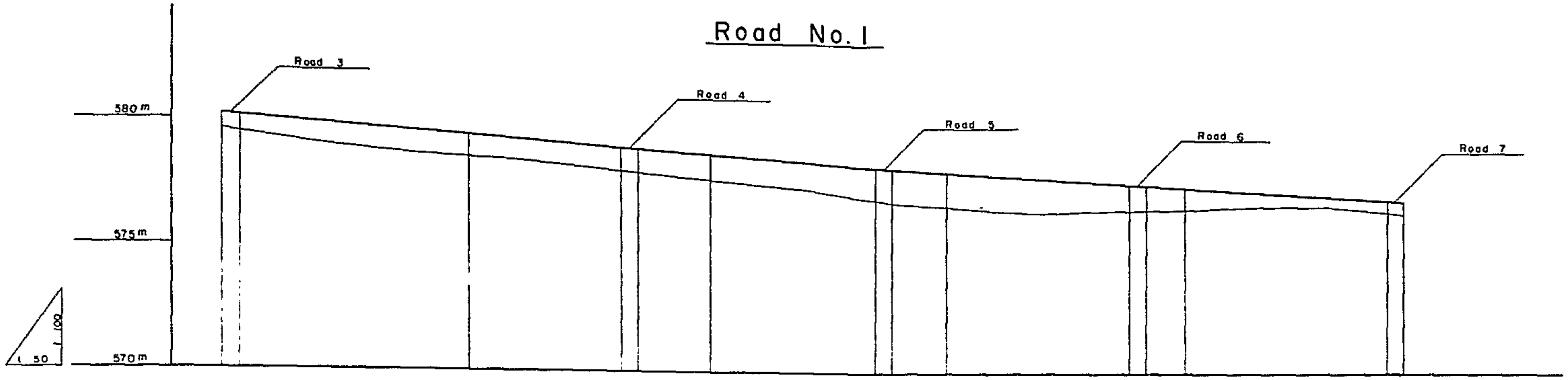


Road No. 7



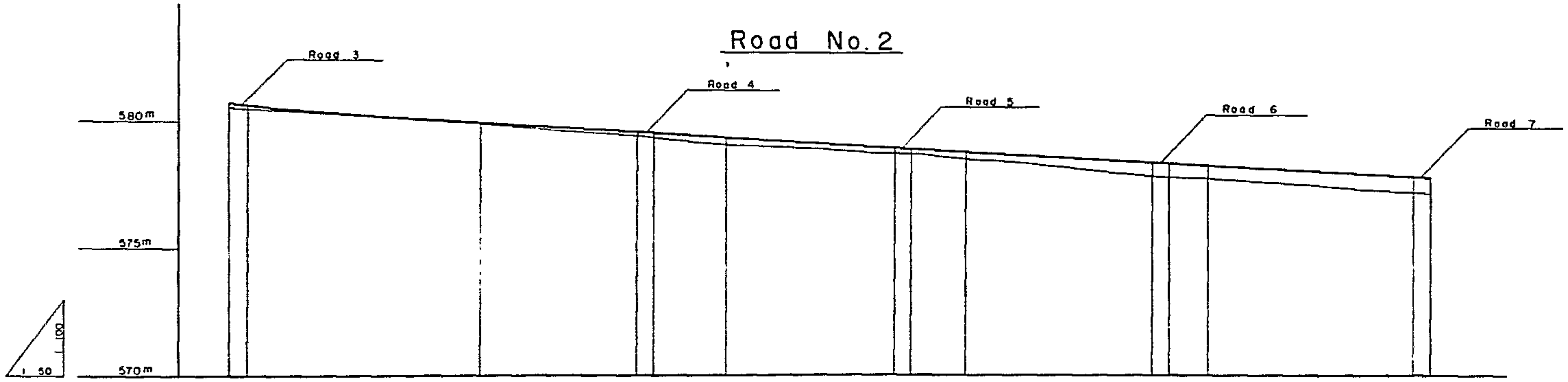
PROJECT TITLE AGRICULTURAL DEVELOPMENT TRAINING CENTER	
DRAWING TITLE CROSS SECTION OF THE ON FARM DITCH	
DRAWING NO 8	SCALE 1:1000
JAPAN INTERNATIONAL, COOPERATION AGENCY.	

Road No.1



SLOPE	580200		i=0.708 % L=169.500 H=1.200		579000			i=0.623 % L=321.000 H=2.000						577000
DESIGN ELEVATION	580200	580150	579492	579050	579000	578810	578377	578333	578187	577710	577667	577564	577044	577000
GROUND ELEVATION	579.57	579.50	578.65	578.13	578.06	577.78	577.08	576.99	576.79	576.70	576.71	576.70	576.57	576.50
ACCUM DISTANCE	0	7.0	100.0	162.5	169.5	200.0	269.5	276.5	300.0	376.5	383.5	400.0	483.5	490.5
DISTANCE	0	7.0	93.0	62.5	7.0	30.5	69.5	7.0	23.5	76.5	7.0	16.5	83.5	7.0
STA	0	+7.0	5	8+2.5	8+9.5	10	13+9.5	13+16.5	15	18+16.5	19+3.5	20	24+3.5	24+10.5

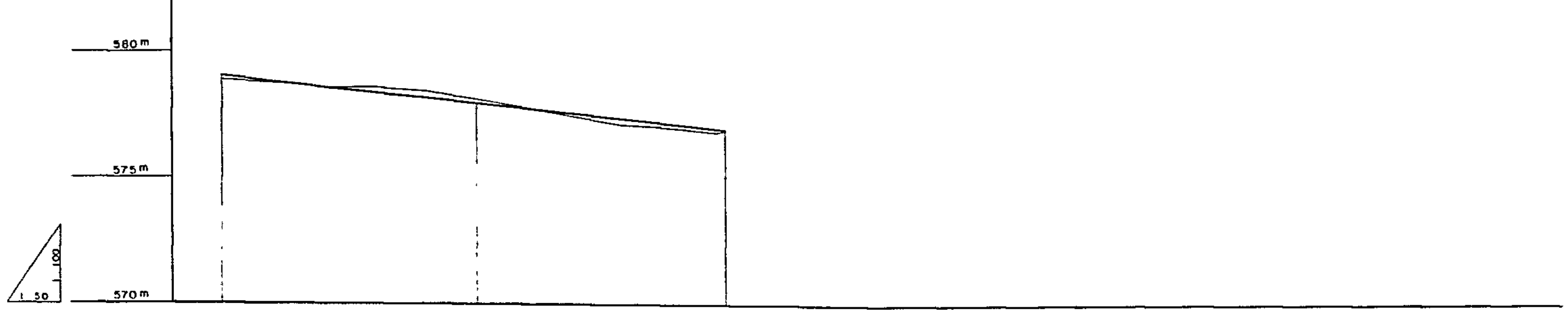
Road No.2



SLOPE	580.50						i=0.527 % L=490.500 H=2.600							577.90
DESIGN ELEVATION	580500	580463	579973	579644	579607	579446	579080	579043	578919	578516	578479	578392	577952	577915
GROUND ELEVATION	580.70	580.63	579.98	579.50	579.35	579.19	578.88	578.85	578.64	577.98	577.93	577.88	577.35	577.30
ACCUM DISTANCE	0	7.0	100.0	162.5	169.5	200.0	269.5	276.5	300.0	376.5	383.5	400.0	483.5	490.5
DISTANCE	0	7.0	93.0	62.5	7.0	30.5	69.5	7.0	23.5	76.5	7.0	16.5	83.5	7.0
STA	0	+7.0	5	8+2.5	8+9.5	10	13+9.5	13+16.5	15	18+16.5	19+3.5	20	24+3.5	24+10.5

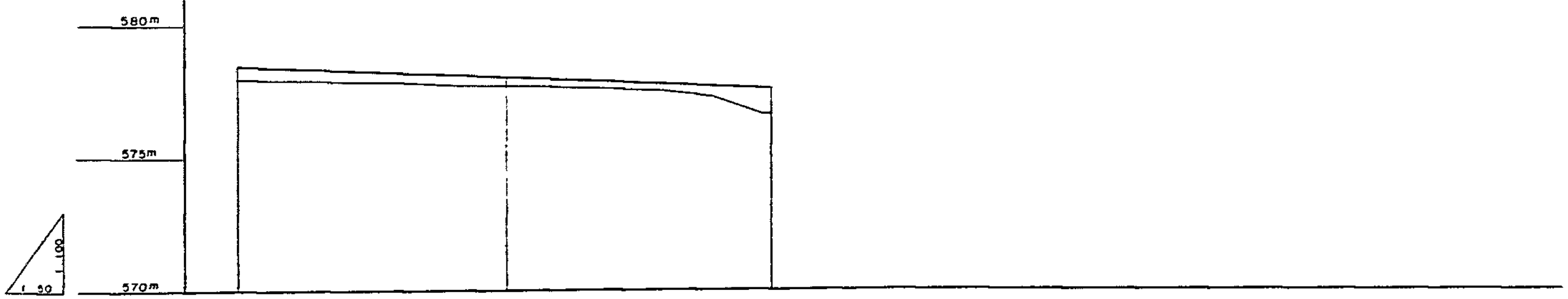
PROJECT TITLE AGRICULTURAL DEVELOPMENT TRAINING CENTER	
DRAWING TITLE PROFILE OF THE ROAD	
DRAWING NO 9	SCALE
JAPAN INTERNATIONAL COOPERATION AGENCY	

Road No. 5



SLOPE	579062	i=0342% L=207000 H=0707	578353
DESIGN ELEVATION	579062	578708	578366 / 578353
GROUND ELEVATION	57887 / 57888	57824	57694 / 57704
ACCUM DISTANCE	-35 / 0	1000	2000 / 2035
DISTANCE	-35 / 0	1000	1000 / 35
STA	0-35 / 0	5	10 / 10+35

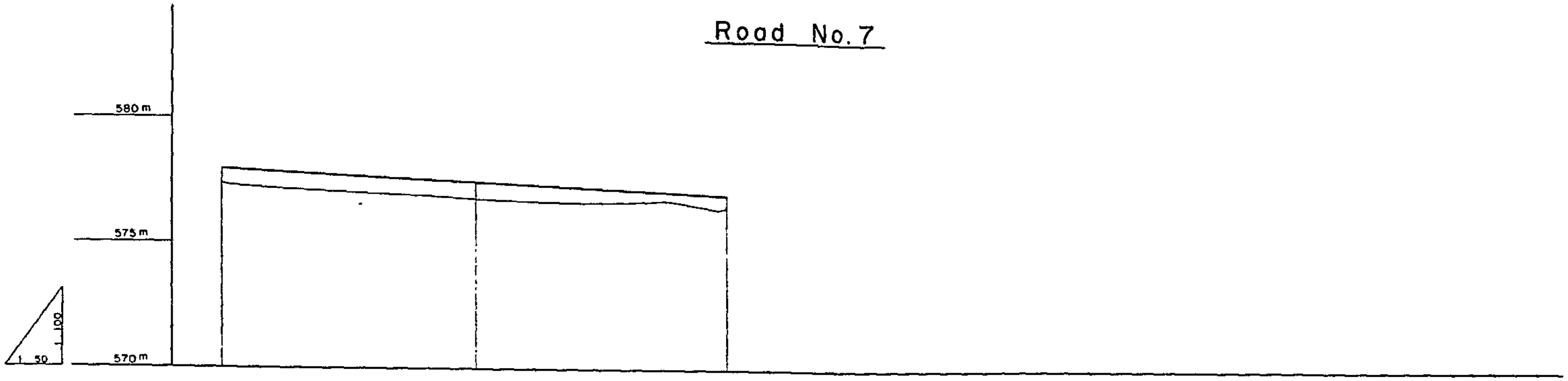
Road No. 6



SLOPE	578498	i=0391% L=207000 H=0809	577689
DESIGN ELEVATION	578438 / 578484	578093	577702 / 577689
GROUND ELEVATION	57796 / 57795	57774	57671 / 57671
ACCUM DISTANCE	-35 / 0	1000	2000 / 2035
DISTANCE	-35 / 0	1000	1000 / 35
STA.	0-35 / 0	5	10 / 10+35

PROJECT TITLE AGRICULTURAL DEVELOPMENT TRAINING CENTER	
DRAWING TITLE PROFILE OF THE ROAD	
DRAWING NO 10	SCALE
JAPAN INTERNATIONAL, COOPERATION AGENCY	

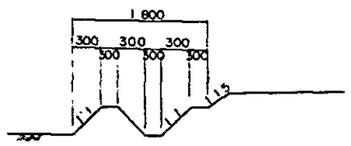
Road No.7



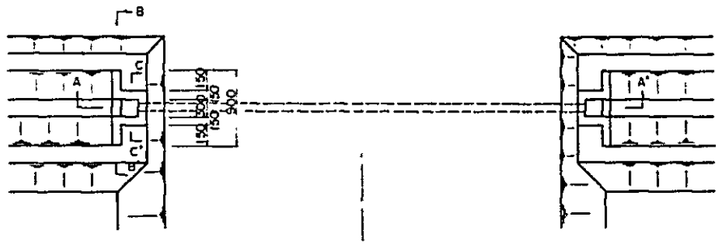
SLOPE	577933	i = 0 440% L = 207000 H = 0 911	577022
DESIGN ELEVATION	577933 577918	577478	577038 577022
GROUND ELEVATION	577 33 577 28	57682	576 50 576 54
ACCUM DISTANCE	-3 5 0	100 0	200 0 203 5
DISTANCE	-3 5 0	100 0	100 0 3 5
STA	0-35 0	5	10 10+35

PROJECT TITLE AGRICULTURAL DEVELOPMENT TRAINING CENTER	
DRAWING TITLE PROFILE OF THE ROAD	
DRAWING NO 11	SCALE
JAPAN INTERNATIONAL, COOPERATION AGENCY	

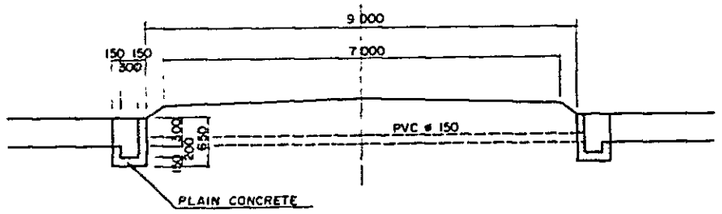
ON FARM DITCH (Earth Canal)



PLAN



SECTION A-A'



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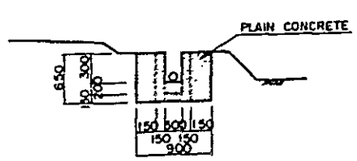

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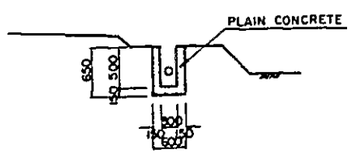
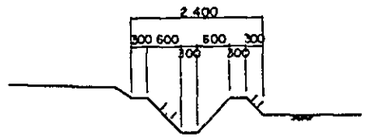
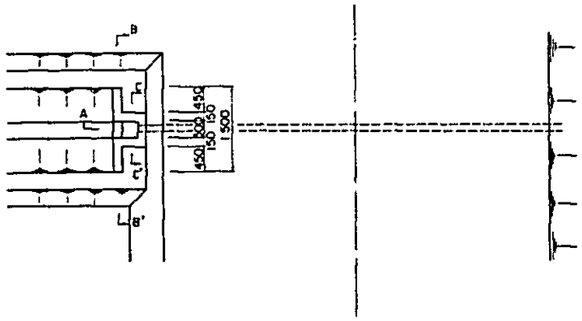


ON FARM DRAIN



PLAN



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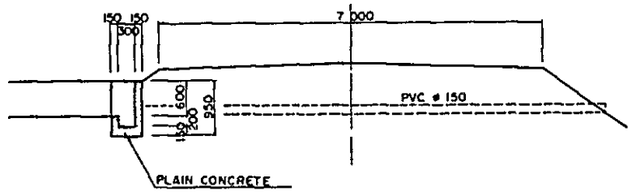
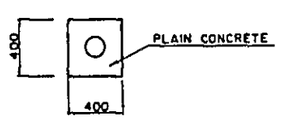


SUPPORTING CONCRETE

SCALE 1 20



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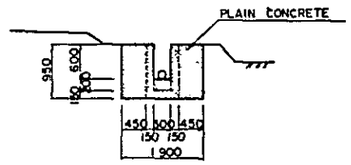

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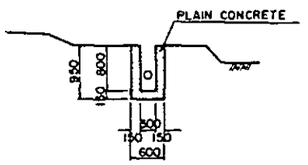
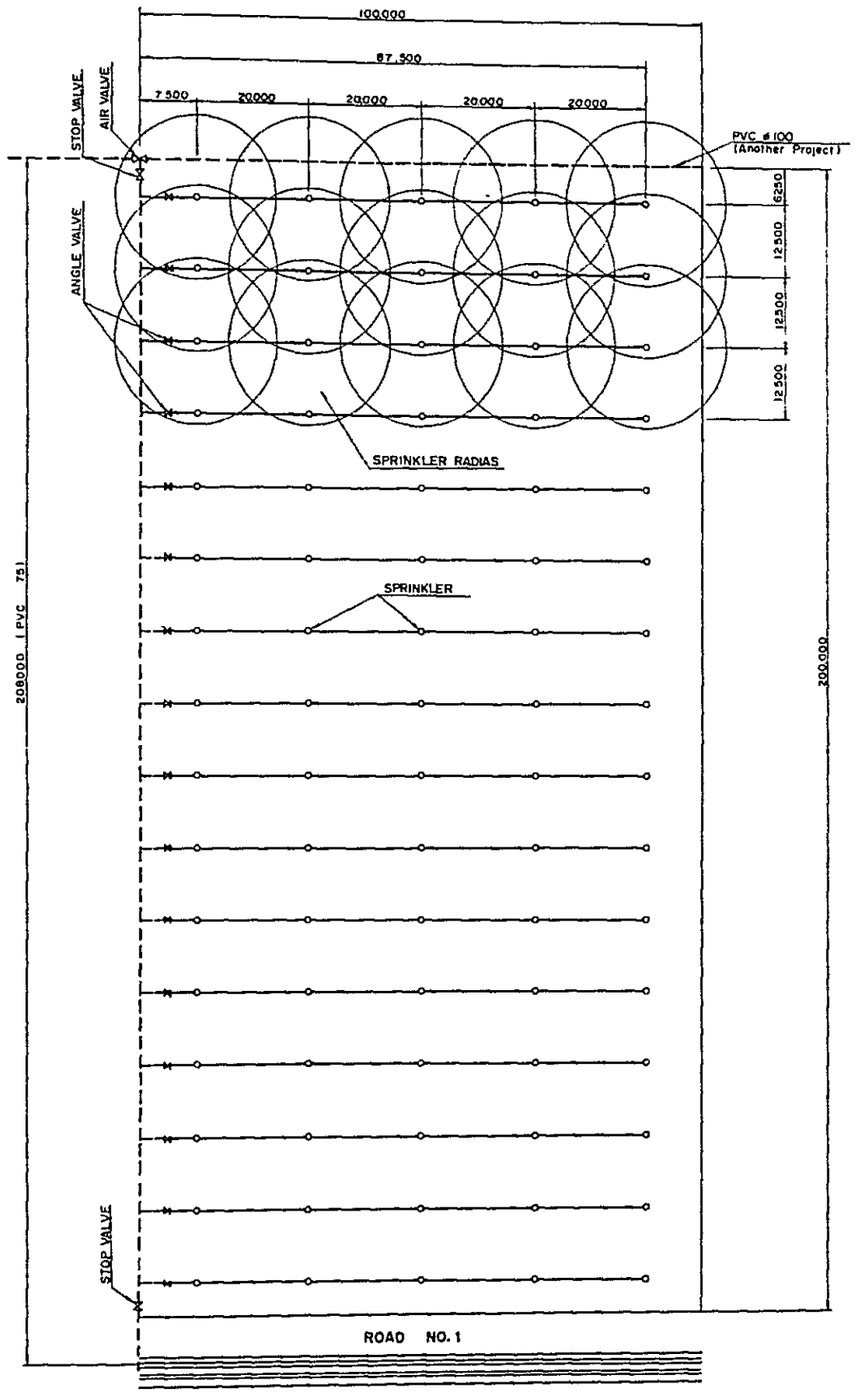
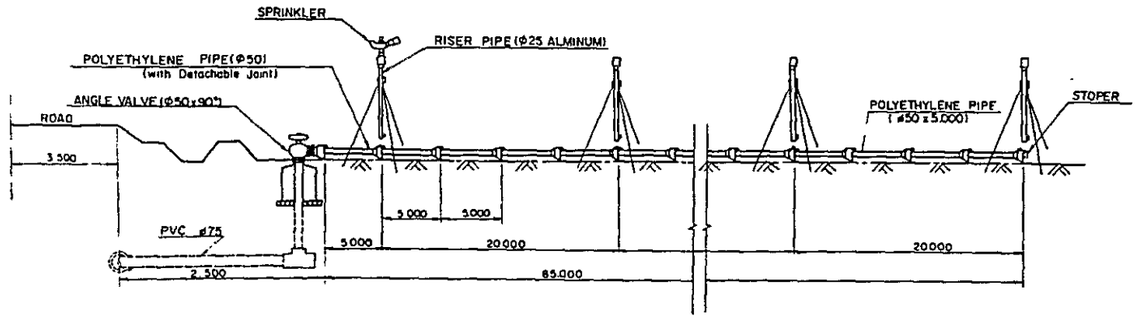


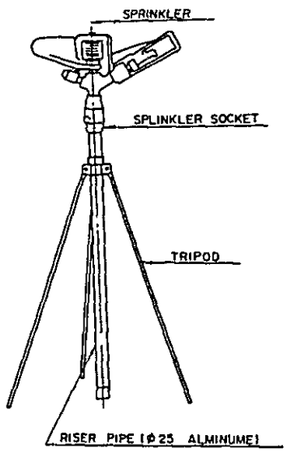
PROJECT TITLE AGRICULTURAL DEVELOPMENT TRAINING CENTER	
DRAWING TITLE ON FARM DITCH AND DRAIN	
DRAWING NO. 12	SCALE : 500
JAPAN INTERNATIONAL, COOPERATION AGENCY	

PLAN



SPLINKLER SIDE VIEW





COMPONENT FOR ONE SET SPRINKLER

1	Angle valve (ø50 x 90°)	1
2	Polyethylene Pipe with Detachable Joint (ø50 x 5000)	17
3	STOPER	1
4	TRIPOD	5
5	RISER PIPE (ø20 x 1000) with SOCKET	5
6	SPRINKLER	5

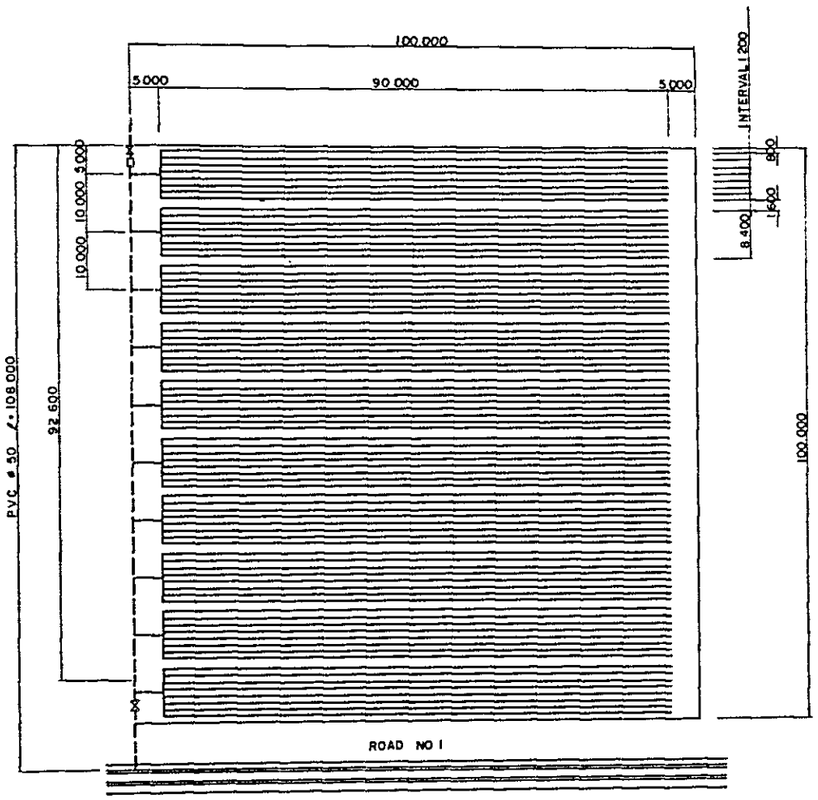
PROJECT TITLE
AGRICULTURAL DEVELOPMENT TRAINING CENTER

DRAWING TITLE
SPRINKLER SYSTEM PLAN

DRAWING NO 13 | SCALE

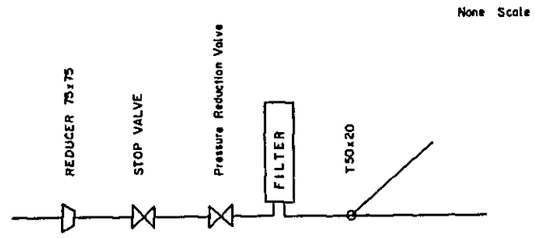
JAPAN INTERNATIONAL, COOPERATION AGENCY

PLAN



DETAIE OF PRIMARY RGULATING FACILITIES

None Scale



DETAIL OF SECONDARY REGULATING & TRICKLE SYSTEM

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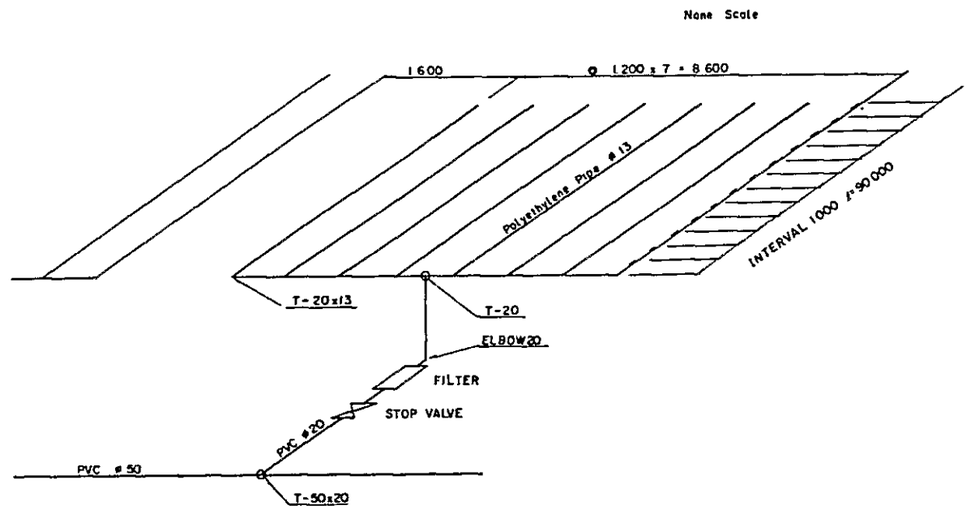

TRICKIE NOZZLE INTERVAL

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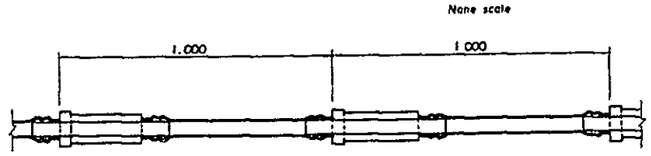


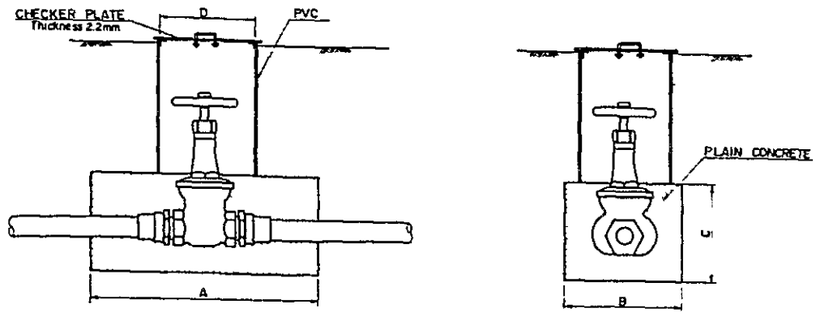
PROJECT TITLE
AGRICULTURAL DEVELOPMENT TRAINING CENTER

DRAWING TITLE
TRICKLE SYSTEM PLAN

DRAWING NO 14 | SCALE 1:500

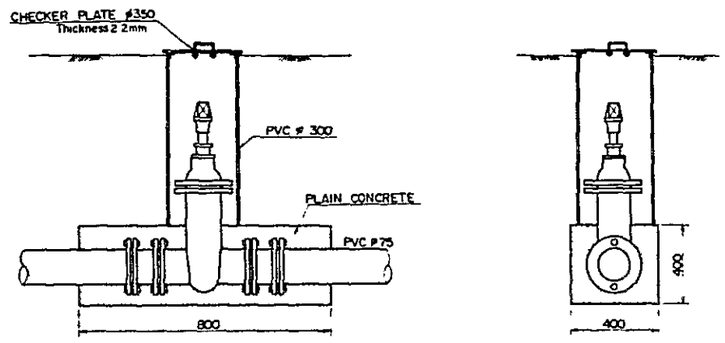
JAPAN INTERNATIONAL, COOPERATION AGENCY

STOP VALVE (ø 50 & ø 20)



	A	B	C	D
PVC ø 50	600	400	400	ø 300
PVC ø 20	300	200	200	ø 150

STOP VALVE (ø 75)



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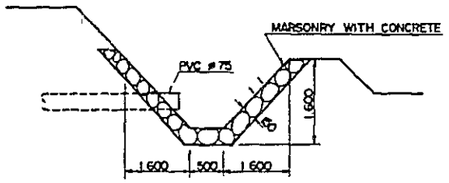
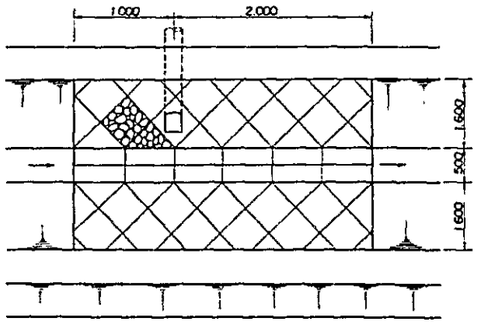
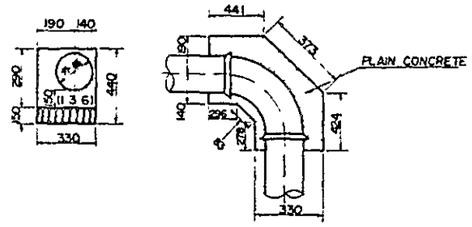
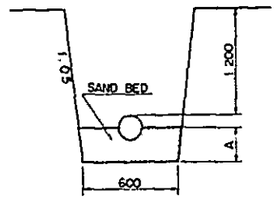




SUPPORTING CONCRETE



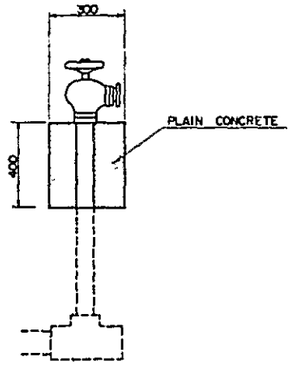
CROSS SECTION



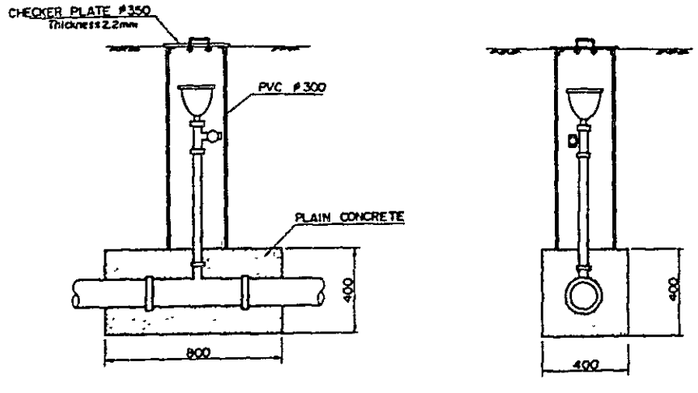
	SAND BED (A)
ø 75	137.5
ø 50	125
ø 20	none

ANGLE VALVE

ø 50 x 90°



AIR VALVE



PROJECT TITLE
AGRICUL TURAL DEVELOPMENT TRAINING CENTER

DRAWING TITLE
DETAIL OF FACIRITIES FOR THE SPRINKLER AND TRICKLE SYSTEM

DRAWING No. 15 | SCALE none-scale

JAPAN INTERNATIONAL, COOPERATION AGENCY

ANNEX II

TABLE

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Table-1 Proposed Cropping Pattern (Net Area 9.0 Hectares)

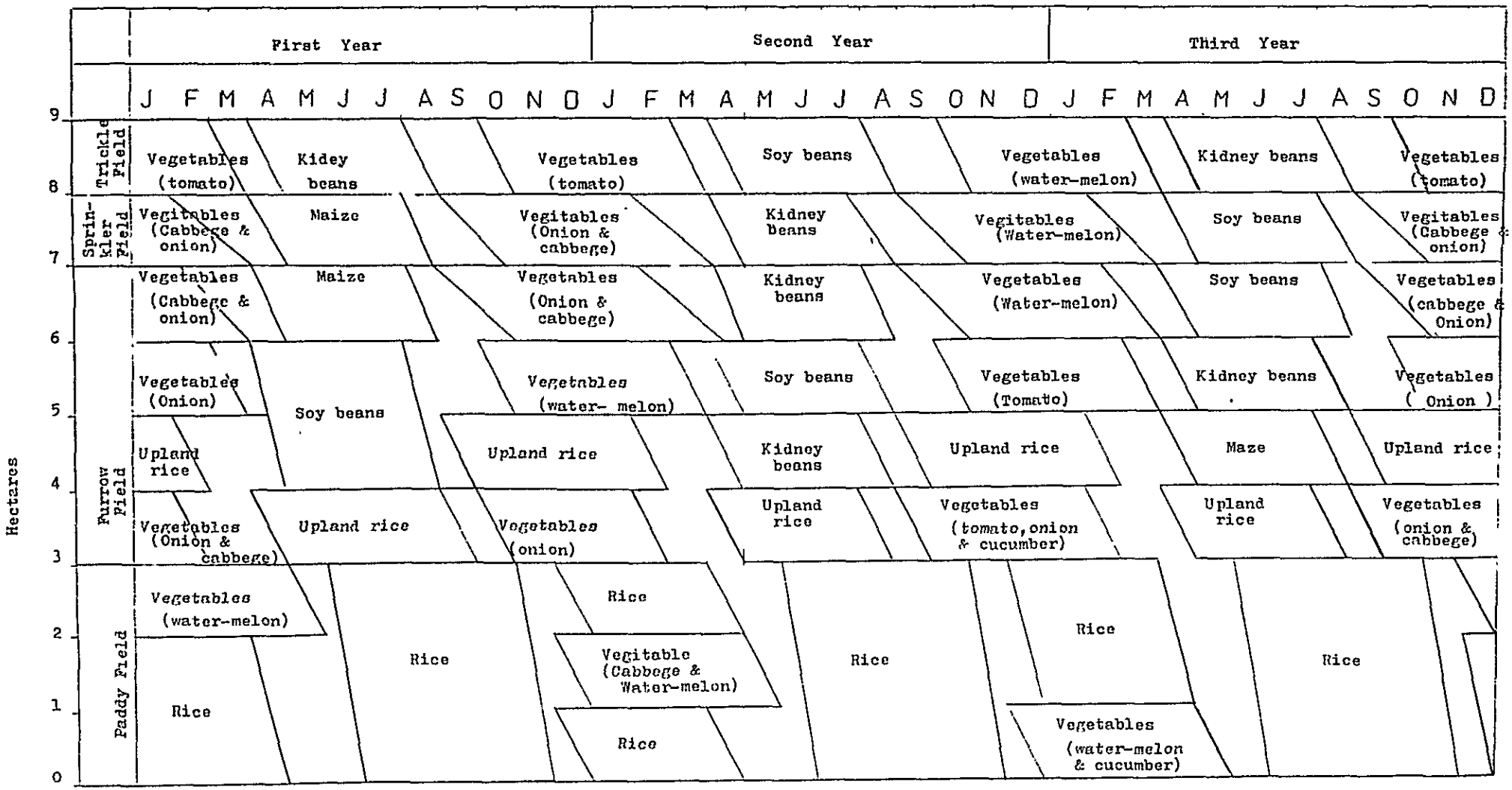

Table-2 Summary of Climatic Data for COMAYAGUA

	Mean Temperature (°C)		Mean Humidity (%)	Mean Evaporation (mm)	Mean Rainfall (mm)
	Min.	Max.			
JAN	16.3	28.7	65	146	7.7
FEB	16.2	29.9	61	169	5.1
MAR	17.5	32.8	55	232	7.3
APR	19.2	32.9	57	219	63.8
MAY	20.2	32.8	64	194	112.2
JUN	19.8	30.7	72	128	178.4
JUL	19.1	30.7	70	165	99.9
AUG	19.5	31.0	72	170	116.1
SEP	19.6	30.3	77	143	137.1
OCT	19.5	29.0	77	132	107.7
NOV	18.3	28.0	76	117	35.8
DEC	16.7	28.0	71	123	12.5

Table- Potential Evatotranspiration, Rainfall and Effective Rainfall

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Potential Evapotranspiration (mm/month)	124.5	142.8	180.0	177.0	149.4	145.2	139.8	142.5	137.7	127.5	109.2	111.6
Monthly Rainfall in Basic Planning Year (mm/month)	4.5	8.1	0.0	67.8	60.0	230.5	74.5	86.1	97.0	180.7	39.1	16.8
Effective Rainfall for Upland Field (mm/month)	0.00	0.00	0.00	31.36	16.10	86.66	27.86	32.13	38.57	79.59	11.48	3.29
Effective Rainfall for Paddy Field (mm/month)	0.00	0.00	0.00	40.32	20.70	111.69	35.82	41.31	49.59	102.33	14.76	4.23

Table -4 Crop Water Requirement for Rice

	JUN	FEB	MAR	APR	MAY	JUN	JUN	AUG	SEP	OCT	NOV	DEC
ETo (mm/month)	124.5	142.8	180.0	177.0	49.4	145.2	139.8	142.5	137.7	127.5	109.2	111.6
Crop Factor (kc)						1.10	1.10	1.05	1.05	1.05	0.95	
ETc (mm/month)						159.72	153.78	149.63	144.59	133.88	103.74	
Land Preparation (mm/month)						150.00	-	-	-	-	-	
Percoration * (mm/month)						120.00	120.00	120.00	120.00	120.00	120.00	
Re (mm/month)	0	0	0	40.32	20.70	111.69	35.82	41.31	49.59	102.33	14.76	4.23
Intensity						1/2	1	1	1	1	1/2	
Net Requirement (mm/month)						159.015	237.960	228.320	215.000	515.550	104.490	
Gross Requirement ** (mm/month)						227.162	339.943	326.171	307.143	216.500	149.271	

Note; Re: Effective Rainfall
ETo: Potential Evapotranspiration
ETc: Crop Evapotranspiration
* Deep percoration losses of 4mm per day
** Field application efficiency is estimated at 70 per cent

Table-4 Crop Water Requirement for Rice

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
ETo (mm/month)	124.5	142.8	180.0	177.0	149.4	145.2	139.8	142.5	137.7	127.5	109.2	111.6
Crop Factor (kc)	1.10	1.25	1.25	1.00								1.10
ETc (mm/month)	136.95	178.50	225.00	177.00								122.76
Land Preparation (mm/month)	-	-	-	-								150
Percoration * (mm/month)	120	120	120	120								120
Re (mm/month)	0	0	0	40.32	20.70	111.69	35.82	41.31	49.59	102.33	14.76	4.23
Intensity	1	1	1	1/2								1/2
Net Requirement (mm/month)	256.950	298.500	345.000	128.340								194.000
Gross Requirement ** (mm/month)	367.071	426.429	492.857	183.343								277.143

Note; Re: Effective Rainfall
ETo: Potential Evapotranspiration
ETc: Crop Evapotranspiration

* Deep percoration losses of 4mm per day
** Field application efficiency is estimated at 70 per cent

Table-5 Crop Water Requiremnet for Upland Rice

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
ETo (mm/month)	124.5	142.8	180.0	177.0	149.4	145.2	139.8	142.5	137.7	127.5	109.2	111.6	
Crop Factor (kc)				1.10	1.10	1.25	1.25	1.00					
ETc (mm/month)				194.70	164.34	181.50	174.75	142.50					
Land Preparation (mm/month)			52.70										
Re (mm/month)	0	0	0	31.36	16.10	86.66	27.86	32.13	38.57	79.59	11.48	3.29	
Intensity				1/2	1	1	1	1/2					
Net Requirement (mm/month)			52.700	81.670	148.240	94.840	146.89	55.185					
Gross Requirement Drip (mm/month)			58.556	90.744	164.711	105.378	163.211	61.317					
Gross Requirement Splinclar (mm/month)			78.657	121.896	221.254	141.552	219.239	82.366					
Gross Requirement Fullow (mm/month)			87.833	136.117	247.067	158.067	244.817	91.975					
	Note; Re: Effective Rainfall ETo: Potential Evapotranspiration ETc: Crop Evapotranspiration												

Table-6 Crop Water Requirement for Upland Rice

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
ETo (mm/month)	124.5	142.8	180.0	177.0	149.4	145.2	139.8	142.5	137.7	127.5	109.2	111.6	
Crop Factor (mm/month)	1.25	1.00							1.10	1.10	1.25	1.25	
ETc (mm/month)	155.63	142.80							151.47	140.25	136.50	139.50	
Land Praparation (mm/month)	-	-						53.00	-	-	-	-	
Re (mm/month)	0	0	0	31.36	16.10	86.66	27.86	32.13	38.57	79.59	11.48	3.29	
Intensity	1	1/2						-	1/2	1	1	1	
Net Requirement (mm/month)	155.630	71.400						20.870	56.450	60.660	125.020	136.210	
Gross Requirement Drip (90%) (mm/month)	172.922	79.333						23.189	62.722	67.400	138.911	151.344	
Gross Requirement Splinklar (67%) (mm/month)	232.284	106.567						31.149	84.254	90.537	186.597	203.297	
Gross Requirement Fullow (60%) (mm/month)	259.383	119.000						34.783	94.083	101.100	208.367	227.017	

Note; Re: Effective Rainfall
ETo: Potential Evapotranspiration
ETc: Crop Evapotranspiration

Table-7 Crop Water Requirement for Upland Rice

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
ETo (mm/month)	124.5	142.8	180.0	177.0	149.4	145.2	139.8	142.5	137.7	127.5	109.2	111.6	
Crop Factor (kc)	1.10	1.25	1.25	1.00								1.00	
ETc (mm/month)	136.95	178.50	225.00	177.00								122.76	
Land Preparation (mm/month)	–	–	–	–								150	
Percoration (mm/month)	90	90	90	90								90	
Re (mm/month)	0.00	0.00	0.00	40.32	20.70	111.69	35.82	41.31	49.59	102.33	14.76	4.23	
Intensity	1	1	1	1/2								1/2	
Net Requirement (mm/month)	226.95	268.50	315.00	113.34								179.265	
Gross Requirement (mm/month)	226.95	268.50	315.00	113.34								179.265	

Table-8 Crop Water Requirement for Maize

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
ETo (mm/month)	124.5	142.8	180.0	177.0	147.4	145.2	137.8	142.5	137.7	127.5	109.2	111.6	
Crop Factor (mm/month)				0.42	0.74	1.05	1.05	1.00					
ETc (mm/month)				74.34	110.56	152.46	146.79	142.50					
Land Praparation (mm/month)			52.70	-	-	-	-	-					
Re (mm/month)	0	0	0	31.36	16.10	86.66	27.86	32.13	38.57	79.57	11.48	3.29	
Intensity			-	1/2	1	1	1	1/2					
Net Requirement (mm/month)			52.700	21.490	94.460	65.800	118.930	55.185					
Gross Requirement Drip (90%) (mm/month)			58.556	23.878	104.956	73.170	132.149	61.317					
Gross Requirement Splinklar (67%) (mm/month)			78.657	32.075	140.785	98.209	177.507	82.366					
Gross Requirement Fullow (60%) (mm/month)			84.833	35.817	157.433	109.667	198.217	91.975					

Note; Re: Effective Rainfall
ETo: Potential Evapotranspiration
ETc: Crop Evapotranspiration

Table-9 Crop Water Requirement for Soy Beans

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
ETo (mm/month)	124.5	142.8	180.0	177.0	149.4	145.2	137.8	142.5	137.7	127.5	107.2	111.6	
Crop Factor (mm/month)				0.41	0.71	1.00	1.00	0.73					
ETc (mm/month)				72.57	106.07	145.20	139.80	104.03					
Land Praparation (mm/month)			52.70	-	-	-	-	-					
Re (mm/month)	0	0	0	31.36	16.10	86.66	27.86	32.13	38.57	79.59	11.48	3.29	
Intensity			-	1/2	1	1	1	1/2					
Net Requirement (mm/month)			52.700	20.605	89.970	58.540	111.940	35.950					
Gross Requirement Drip (90%) (mm/month)			58.556	22.894	99.967	65.044	124.378	39.944					
Gross Requirement Splinklar (67%) (mm/month)			78.657	30.754	134.284	87.373	167.075	53.657					
Gross Requirement Fullow (60%) (mm/month)			87.833	34.342	149.950	97.567	186.567	59.917					
	Note; Re: Effective Rainfall ETo: Potential Evapotranspiration ETc: Crop Evapotranspiration												

Table-10 Crop Water Requirement for Onion

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
ETo (mm/month)	124.5	142.8	180.0	177.0	149.4	145.2	137.8	142.5	137.7	127.5	109.2	111.6	
Crop Factor (mm/month)	0.95	0.90	0.85						0.44	0.57	0.70	0.95	
ETc (mm/month)	118.28	128.52	153.00						60.58	72.68	76.44	106.02	
Land Praparation (mm/month)	-	-	-					53.00	-	-	-	-	
Re (mm/month)	0	0	0	31.36	16.10	86.66	27.86	32.13	38.57	79.59	11.48	3.20	
Intensity	1	3/4	1/4						1/4	3/4	1	1	
Net Requirement (mm/month)	118.28	96.390	38.250					20.870	5.503	0	64.960	102.730	
Gross Requirement Drip (90%) (mm/month)	131.432	107.100	42.500					23.289	6.114	0	72.178	114.144	
Gross Requirement Splinklar (67%) (mm/month)	176.537	143.866	57.090					31.149	8.213	0	96.955	153.328	
Gross Requirement Fullow (60%) (mm/month)	197.133	160.650	63.750					34.783	9.172	0	108.267	171.217	
	Note; Re: Effective Rainfall ETo: Potential Evapotranspiration ETc: Crop Evapotranspiration												

Table-11 Crop Water Requirement for Onion

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
ETo (mm/month)	124.5	142.8	180.0	177.0	149.4	145.2	139.8	142.5	137.7	127.5	109.2	111.6	
Crop Factor (mm/month)	0.90	0.85							0.44	0.57	0.70	0.95	
ETc (mm/month)	112.05	121.38							60.59	72.68	76.44	106.02	
Land Praparation (mm/month)	-	-						53.00	-	-	-	-	
Re (mm/month)	0	0	0	31.36	16.10	86.66	27.86	32.13	38.57	79.59	11.48	3.29	
Intensity	1	1/2						-	1/2	1	1	1	
Net Requirement (mm/month)	112.050	60.690						20.870	11.010	0	64.960	102.730	
Gross Requirement Drip (90%) (mm/month)	124.500	67.433						23.189	12.233	0	72.178	114.144	
Gross Requirement Splinklar (67%) (mm/month)	167.239	90.582						31.149	16.433	0	96.178	153.328	
Gross Requirement Fullow (60%) (mm/month)	186.750	101.150						34.783	18.350	0	108.267	171.217	
	Note; Re: Effective Rainfall ETo: Potential Evapotranspiration ETc: Crop Evapotranspiration												

Table -12 Crop Water Requirement for Onion

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
ETo (mm/month)	124.5	142.8	180.0	177.0	149.4	145.2	139.8	142.5	137.7	127.5	109.2	111.6	
Crop Factor (mm/month)	0.95	0.95	0.85							0.45	0.70	0.95	
ETc (mm/month)	118.28	135.66	153.00							57.38	76.44	106.02	
Land Praparation (mm/month)	-	-	-						57.00	-	-	-	
Re (mm/month)	0	0	0	31.36	16.10	86.66	27.86	32.13	38.57	79.59	11.48	3.29	
Intensity	1	1	1/2						-	1/2	0	0	
Net Requirement (mm/month)	118.280	135.660	76.500						18.430	0	64.960	102.730	
Gross Requirement Drip (90%) (mm/month)	131.422	150.733	85.000						20.478	0	72.178	114.144	
Gross Requirement Splinklar (67%) (mm/month)	176.537	202.478	114.000						27.507	0	96.955	153.328	
Gross Requirement Fullow (60%) (mm/month)	197.133	226.100	127.000						30.717	0	108.267	171.217	

Note; Re: Effective Rainfall
ETo: Potential Evapotranspiration
ETc: Crop Evapotranspiration

Table-13 Crop Water Requirement for Water Melon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
ETo (mm/month)	124.4	142.8	180.0	177.0	149.4	145.2	139.8	142.5	137.7	127.5	109.2	111.6	
Crop Factor (mm/month)	0.95	0.90	0.85						0.44	0.57	0.70	0.95	
ETc (mm/month)	118.28	128.52	153.00						60.59	72.68	76.44	106.02	
Land Praparation (mm/month)	-	-	-					53.00	-	-	-	-	
Re (mm/month)	0	0	0	31.36	16.10	86.66	27.86	32.13	38.57	79.59	11.48	3.29	
Intensity	1	3/4	1/4					-	1/4	3/4	1	1	
Net Requirement (mm/month)	118.280	96.390	38.250					20.870	5.505	0	64.960	102.730	
Gross Requirement Drip (90%) (mm/month)	131.422	107.100	42.500					23.189	6.117	0	72.178	114.144	
Gross Requirement Splinklar (67%) (mm/month)	176.537	143.866	54.090					31.149	8.216	0	96.955	153.328	
Gross Requirement Fullow (60%) (mm/month)	197.133	160.650	63.750					34.783	9.175	0	108.267	171.217	
	Note; Re: Effective Rainfall ETo: Poteitial Evapotranspiratoin ETc: Crop Evapotranspiration												

Table-14 Crop Water Requirement for Water Melon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
ETo (mm/month)	124.5	142.8	180.0	177.0	149.4	145.2	139.8	142.5	137.7	127.5	109.2	111.6	
Crop Factor (mm/month)	0.95	0.95	0.85							0.45	0.70	0.95	
ETc (mm/month)	118.28	135.66	153.00							57.38	76.44	106.02	
Land Praparation (mm/month)	-	-	-						57.00	-	-	-	
Re (mm/month)	0	0	0	31.36	16.10	86.66	27.86	32.13	38.57	79.59	11.44	3.29	
Intensity	1	1	1/2						-	1/2	1	1	
Net Requirement (mm/month)	118.280	135.660	76.500						18.430	0	64.960	102.730	
Gross Requirement Drip (90%) (mm/month)	131.422	150.730	85.000						20.478	0	72.178	114.144	
Gross Requirement Splinklar (67%) (mm/month)	176.537	202.478	114.179						27.507	0	96.955	153.328	
Gross Requirement Fullow (60%) (mm/month)	197.133	226.100	127.500						30.717	0	108.267	171.217	

Note; Re: Effective Rainfall
ETo: Potential Evapotranspiration
ETc: Crop Evapotranspiration

Table-15 Drop Water Requirement for Water Melon

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
ETo (mm/month)	124.5	142.8	180.0	177.0	149.4	145.2	139.8	142.5	137.7	127.5	109.2	111.6	
Crop Factor (mm/month)	0.75	0.95	0.95	0.95	0.80							0.54	
ETc (mm/month)	93.38	135.66	171.00	168.15	119.52							60.26	
Land Praparation (mm/month)	-	-	-	-	-						54.00	-	
Re (mm/month)	0	0	0	31.36	16.10	86.66	27.86	32.13	38.57	79.59	11.48	3.29	
Intensity	1	1	1	1	1/2						-	1/2	
Net Requirement (mm/month)	93.380	135.660	171.000	136.790	51.710						42.520	28.485	
Gross Requirement Drip (90%) (mm/month)	103.756	150.733	190.000	151.989	57.456						47.244	31.650	
Gross Requirement Splinklar (67%) (mm/month)	139.373	202.478	255.224	204.164	77.179						63.463	42.515	
Gross Requirement Fullow (60%) (mm/month)	155.633	226.100	285.000	227.983	86.183						70.867	47.475	

Note; Re: Effective Rainfall
ETo: Potential Evapotranspiration
ETc: Crop Evapotranspiration

Table-16 Crop Water Requirement for Tomato

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
ETo (mm/month)	124.5	142.8	180.0	177.0	149.4	145.2	137.8	142.5	137.7	127.5	109.2	111.6	
Crop Factor (mm/month)	0.95	0.95	0.85							0.45	0.70	0.95	
ETc (mm/month)	118.28	135.66	153.00							57.38	76.44	106.02	
Land Praparation (mm/month)	-	-	-						57.00	-	-	-	
Re (mm/month)	0	0	-	31.36	16.10	86.66	27.86	32.13	38.57	79.59	11.48	3.29	
Intensity	1	1	1/2						-	1/2	0	0	
Net Requirement (mm/month)	118.280	135.660	76.500						18.430	0	64.960	102.730	
Gross Requirement Drip (90%) (mm/month)	171.422	150.733	85.000						20.478	0	72.178	114.144	
Gross Requirement Splinklar (67%) (mm/month)	176.537	202.478	114.179						27.507	0	96.955	153.328	
Gross Requirement Fullow (60%) (mm/month)	197.133	226.100	127.500						30.717	0	108.267	171.217	
	Note; Re: Effective Rainfall ETo: Potential Evapotranspiration ETc: Crop Evapotranspiration												

Table-17 Irrigation Demand for Tentative Farm

(First Year)

IRRIGATION METHOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Sprinklar (2 ha)	1765.4	1438.7	570.9	320.8	1407.9	982.1	1775.1	823.7	182.1	0	969.6	1533.3
	Onion				Maize					Vegitable(Onion)		
Drip (1 ha)	1314.2	1507.3	850.0	228.9	999.7	650.4	1243.8	399.4	204.8	0	721.8	1141.4
	Tomato					Kidney Beans				Vegotable(Tomato)		
Furrow (1 ha)	1971.3	1606.5	637.5	358.2	1574.3	1096.7	1982.2	919.8	91.2	0	1082.7	1712.2
	Onion				Maize					Vegitable(Onion)		
(1 ha)	1971.3	2261.0	1275.0	343.4	1499.5	975.7	1865.7	599.2	307.2	0	1082.7	1712.2
	Onion					Soy Beans				Vegitable(Water Melon)		
(1 ha)	2593.8	1190.0	878.3	343.4	1499.5	975.7	1865.7	599.2	940.8	1011.0	2083.7	2270.2
	Upland rice					Soy Beans				Upland Rice		
(1 ha)	1867.5	1011.5	878.3	1361.2	2470.7	1580.7	2448.2	919.8	183.5	0	1082.7	1712.2
	Onion					Upland Rice				Vegitable(Onion)		
Paddy Field (3 ha)						6814.9	10198.3	9895.1	9214.3	6495.0	4478.1	
								Rice				5542.9
(2 ha)	7341.4	8528.6	9857.1	3666.9								Upland rice
		Rice										474.8
(1 ha)	1556.3	2261.0	2850.0	2279.8	861.8							Water-melon
		Vegitable (Water Melon)										
Total (m^3/month)	20301.4	19804.6	17797.1	8902.6	10313.4	13076.2	21379.0	14046.2	10942.7	24848.5	9701.3	16099.2

Table-18 Irrigation Demand for Intensive Farm
(Second Year)

IRRIGATION METHOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Sprinklar (1 ha)	1765.4	1438.7	570.9	307.5	1342.8	873.7	1670.8	536.6	82.2	0	969.6	1533.3
	Onion				Kidney Beans					Vegitable(Water-Melon)		
Drip (1 ha)	1314.2	1507.3	850.0	220.9	999.7	650.4	1243.8	399.4	204.8	0	721.8	1141.1
	Tomato				Soy Beans					Vegitable(Water Melon)		
Furrow (1 ha)	1791.3	1606.5	637.5	343.4	1499.5	975.7	1865.7	599.2	91.8	0	1082.7	1712.2
	Onion											
(1 ha)	1971.3	2261.0	1275.0	343.3	1499.5	975.7	1865.7	599.2	307.2	0	1082.7	1712.2
	Water-melon				Soy Beans					Vegitable(Tomato)		
(1 ha)	2593.8	1190.0	878.3	343.4	1499.5	975.7	1865.7	599.2	940.8	1011.0	2083.7	2270.2
	Upland rice				Kidney Beans					Upland Rice		
(1 ha)	1867.5	1011.5	878.3	1361.2	2470.7	1580.7	2448.2	919.8	183.5	0	1082.7	1712.2
	Onion				Upland Rice					Vegitable(Onion)		
Paddy Field (3 ha)						9814.9	10198.3	9785.1	9214.3	6495.0	4478.1	
								Rice				5542.9
(2 ha)	7341.4	8528.6	9857.1	3666.9								Rice
		Rice										474.8
(1 ha)	1556.3	2261.0	2850.0	2279.8	661.8							Water-melon
		Vegitable(Water Melon)										
Total (m^3/month)	20201.1	9804.5	17797.1	8880.4	9971.5	12846.8	21158.2	13478.5	11024.3	7506.0	11501.3	16099.2

Table-19 Irrigation Demand for Tentative Farm

(Third Year)

IRRIGATION METHOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Sprinklar (2 ha)	1765.4	1438.7	540.9	307.5	1342.8	873.7	1670.8	536.1	82.1	0	969.6	1533.3
	Water-melon				Soy bean					Vegitable(Onion)		
Drip (1 ha)	1314.2	1507.3	850.0	228.9	999.7	650.4	1243.8	399.4	204.8	0	721.8	1141.4
	Water-melon				Kidney Beans					Vegetable(Tomato)		
Furrow (1 ha)	1971.3	1606.5	637.5	343.4	1499.5	975.7	1865.7	599.2	91.7	0	1082.7	1712.2
	Water-melon				Soy bean					Vegitable(Onion)		
(1 ha)	1971.3	2261.0	1275.0	343.4	1499.5	975.7	1865.7	599.2	307.2	0	1082.7	1712.2
	Tomato				Kidney Beans					Vegitable		
(1 ha)	2593.8	1190.0	878.3	358.2	1574.3	1096.7	1982.2	991.8	940.8	1011.0	2083.7	2270.2
	Upland rice				Maze					Upland Rice		
(1 ha)	1867.5	1011.5	878.3	1361.2	2470.7	1580.7	2448.2	919.8	183.5	0	1082.7	1712.2
	Onion					Upland Rice				Vegitable(Onion)		
Paddy Field (3 ha)						6814.9	10198.3	9985.1	9214.3	6495.0	4478.1	
								Rice				5549.2
(2 ha)	7341.4	8528.6	9857.1	3666.9								Upland rice
		Rice										474.8
(1 ha)	1556.3	2261.0	2850.0	2279.8	861.8							Onion
		Vegitable (Water Melon)										
Total (m^3/month)	20381.2	19799.6	17767.1	8889.9	10248.8	12987.8	21274.7	13759.1	11024.4	2868.5	9701.3	16099.2

Table-20 Maximum Water Requirement for Each Month

Unit m^3/day

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Paddy Field	(3 ha)	287.0	385.3	409.9	320.5	55.6	454.3	329.0	257.6	307.1	209.5	298.5	378.6
Furrow Field	(2 ha)	147.3	165.8	139.0	114.6	176.4	89.3	142.9	118.6	83.2	32.6	105.6	128.4
"	(2 ha)	123.8	129.7	97.8	45.8	99.2	65.0	120.0	77.4	18.3	0	72.2	110.4
Splinkler	(1 ha)	56.9	51.4	36.8	21.4	45.4	32.7	57.3	53.1	5.5	-	32.3	49.5
Drip	(1 ha)	42.6	53.8	54.8	15.3	32.2	21.7	40.1	25.8	6.8	-	24.1	36.8
Total	(9 ha)	657.4	786.0	738.3	517.6	408.8	663.0	689.7	532.5	420.9	251.3	532.7	703.7

Table-21 Construction Schedule

Discription \ Month	1		2		3		4		5		Remarks
	10	20	10	20	10	20	10	20	10	20	
Bidding and Contruct .	■										
Preparation		■									
Construction			═	═	═	═	═	═	═	═	
Land leveling			■	■	■						
Irrigation and Drainage canal									■	■	
Sprinkler System							■	■			
Drip Irrigation System							■	■			
Driving Pile Line					■	■					

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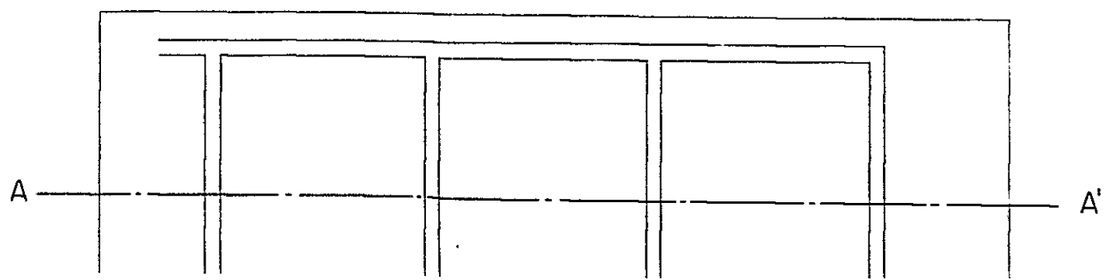

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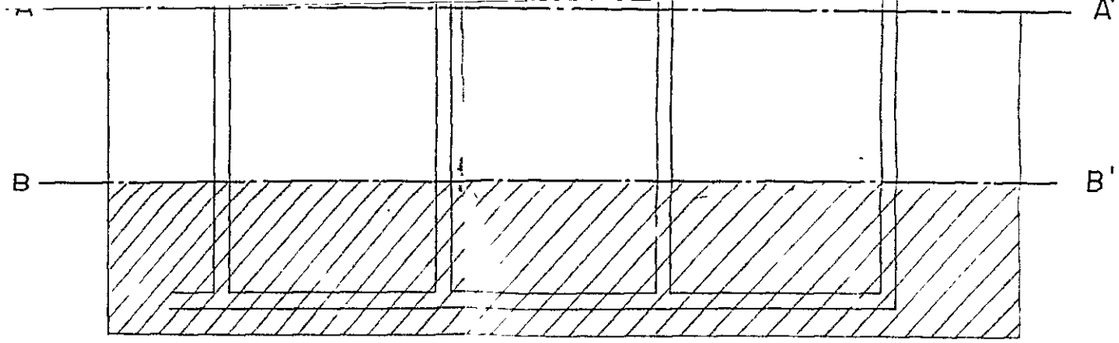

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○ ------ Indicates measured elevation point

◐ ------ Indicates the location of trees

PROJECT TITLE
AGRICULTURAL DEVELOPMENT TRAINING CENTER

DRAWING TITLE

Contour Map

DRAWING NO

SCALE 1 200

JAPAN INTERNATIONAL, COOPERATION AGENCY.

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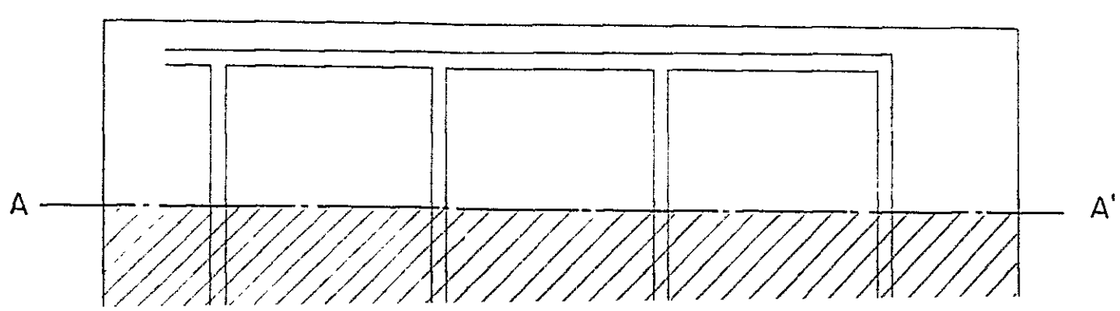

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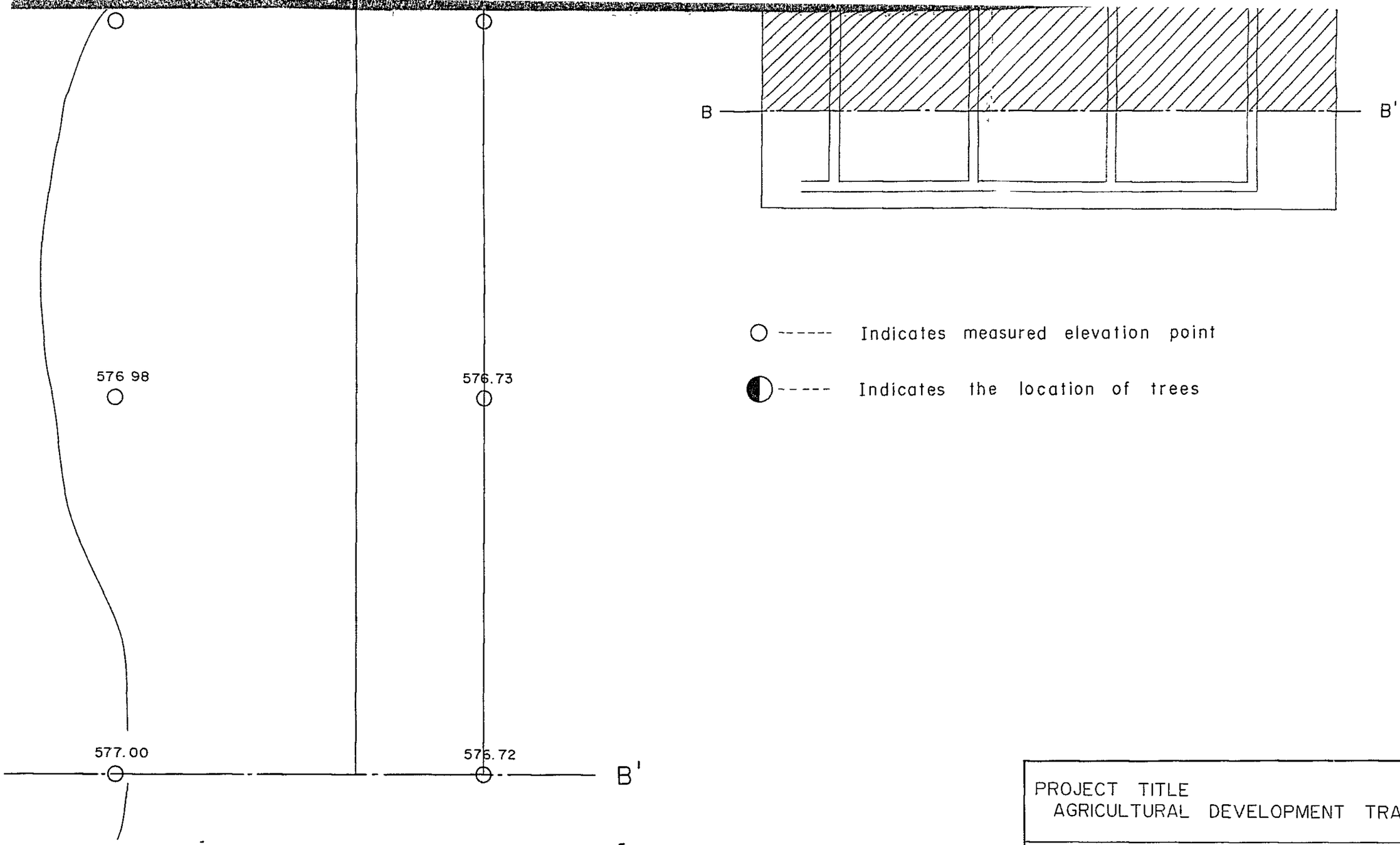

○ ------ Indicates measured elevation point

◐ ----- Indicates the location of trees

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DRAWING TITLE Contour Map	
DRAWING NO	SCALE 1 : 200
JAPAN INTERNATIONAL, COOPERATION AGENCY	

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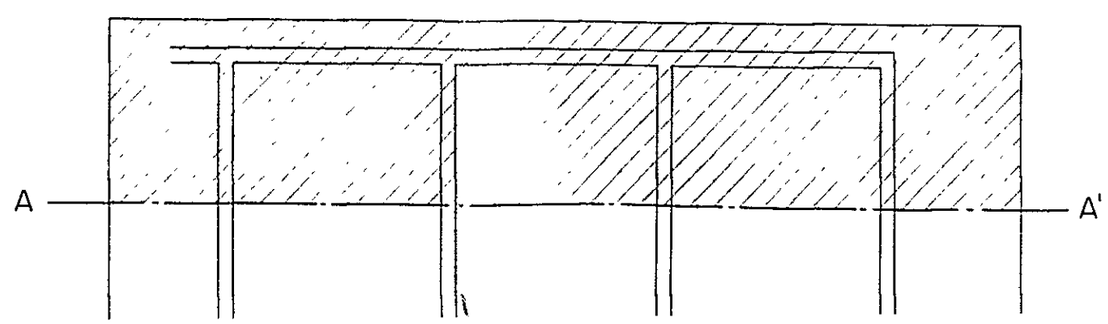

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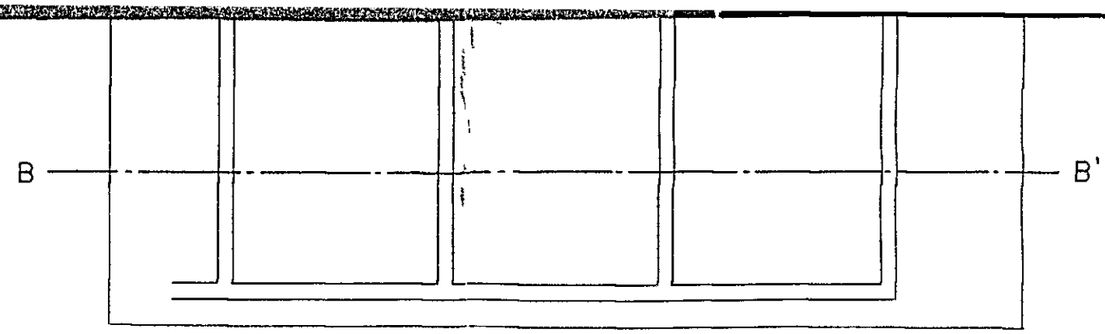

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A'

○ ------ Indicates measured elevation point

◐ ----- Indicates the location of trees

PROJECT TITLE AGRICULTURAL DEVELOPMENT TRAINING CENTER	
DRAWING TITLE Contur Map	
DRAWING NO	SCALE 1 : 200
JAPAN INTERNATIONAL, COOPERATION AGENCY