REPUBLIC OF THE PHILIPPINES
NATIONAL IRRIGATION ADMINISTRATION

FEASIBILITY STUDY
ON
THE ASUE RIVER BASIN
AGRICULTURAL DEVELOPMENT PROJECT

VOLUME 2
APPENDICES I-VI

AUGUST 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

FEASIBILITY STUDY

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LIST OF REPORTS

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SOIL AND LAND CLASSIFICATION

1. GENERAL

1.1 The Project Area

The Project area is situated in the northeastern tip of the province of Iloilo, and is about 105km northeast of Iloilo City. It embraces practically all the basin-like alluvial plain of the municipality of Sara and portions of the municipalities of Ajuy, Concepcion and San Dionisio. It lies between 11°10' and 11°18' north latitude and between 122°58' and 123°06' east longitude. It is bounded on the south by Ajuy Bay; on the north and west by a vast rugged to mountainous terrain extending up to the Iloilo - Capiz provincial boundary; and on the east by the hilly areas of Concepcion and San Dionisio which are intermediary between the alluvial plain and the coastline of Concepcion and Bagacay Bay. The Project area covers a gross area of about 8,320ha.

Generally, the Project area is a basin-like plain formed mostly of alluvial sediments from the nearby uplands, terraces and rolling hills, the latter being utilized either for sugarcane, coconut or tropical fruit production as well as for scattered dwellings. Slopes vary from zero to 3% in the alluvial plain and 2 to 15% in the upland or residual terraces. Elevation decreases gradually from the foothill areas to the southern border and to the northeastern tip of the Project area. The Project area is traversed by several incised rivers and creeks which drain into Ajuy Bay in the south, and Bagacay in the northeast.

1.2 Objectives and Procedures of the Study

For the Project Area, the NIA carried out a semi-detailed soil and land classification survey under the direction of Messrs. Conrado Tingzon and Alejandro S. Cantor (Land Resources Utilization Div., P.D.D) in 1982. The results compiled in the report were valid and useful for the present feasibility study.

The main objectives of the soil and land classification study were to make a land use plan of the Project area after reviewing the said report and to make a supplementary field survey using newly prepared topographical maps and recent air-photos (JICA, 1983) as base maps. In consideration of these objectives, the following works were performed by the Team members concerned in cooperation with the NIA counterpart personnel:

a) Review and evaluation of existing data

b) Interpretation of new aerial photographs

c) Supplementary field survey

Auger boring	20 sites
Test pit digging	4 sites

d) Aerial photo interpretation of the watershed area

e) Preparation of maps (scales 1:20,000 and 1:50,000)
   - Location maps
   - Slope classification map (working map only)
   - Soil map
   - Land classification map
   - Present land use map

1.3 Previous Studies

1.3.1 Reconnaissance Soil Survey

For the entire province of Iloilo, a reconnaissance soil survey was carried out by the Bureau of Soils and a soil map of scale 1:250,000 was prepared in 1947. In this survey, the soils were grouped into three classification categories; namely, soil series, soil type, and soil phase. The report was a valuable tool in grasping the general condition of the soils prevailing in the province.

1.3.2 Semi-detailed Soil and Land Classification Survey

The semi-detailed soil and land classification survey was completed by the NIA in 1982. Although the results of this study required minor adjustment because the base map and aerial photos used were old and inaccurate, the results were still valid and useful for the present feasiblity study.

The NIA's semi-detailed survey was carried out using the following procedures. First, a series of photo interpretations were made on the approximately 1:15,000 scale aerial photos taken in 1966-67. Subsequently, 56 soil profiles (auger boring and master pits) taken from the field by NIA experts were analysed at the NIA Soil Laboratory at CLSU, Muñoz, Nueva Ecija to determine the physical and chemical properties. In addition, composite soil samples were collected from surface soils for natural fertility determination. Soil drainage condition was also investigated by infiltration test, deep percolation test, and hydraulic conductivity test.

2. SOIL CLASSIFICATION

2.1 Soil Classification

The soils of the Project area were classified into two main groups according to land formation; namely, alluvial plain which is mainly used for wetland paddy and intermediate upland which is used for sugarcane fields, coconut plantations mixed with fruit trees, as well as scattered dwellings. Said soils can be further divided into three series, namely, Sara, Bantog and Barotac as shown in TABLE I-1. The physical and chemical properties of these soil series are summarized in TABLE I-2.

2.1.1 Alluvial Plain Soil

Alluvial plain soils cover about 80% of the Project Area. These soils have good water holding capacity but poor internal drainage and are productive and intensively utilized for rice production.

Alluvial plain soils consist of loamy to clayey deep solum. Surface texture ranges from sandy loam, sandy clay loam, clay loam to clay. Internal drainage is generally poor due to either fine texture or relatively shallow water table. The relief is nearly level to level with slight depressions, low erosional remnants and cut-off sections.

Soil pH ranges from medium to strongly acid. Organic matter content varies from low to medium. Cation Exchange Capacity (CEC) and available phosphorous are generally low. Inherent fertility of the alluvial soils appears to range from low to medium. Considering the chemical characteristics which are within acceptable limits, these soils are best suited for crop production under full irrigation development. Two soil series were delineated in this soil group; namely, the Sara Series and the Bantog Series, which are explained in detail on the following page.

(1) Sara Series

Soils of this series are members of the fine loamy family, deep to very deep and somewhat poorly drained. They are developed from alluvial deposits formed on nearly level to level basin-like plain. Surface soils are dark brown to grayish brown with sandy clay loam as the dominant texture. Subsoils are brown, grayish brown to yellowish brown sandy loam, sandy clay loam to clay texture. External drainage is fair to good and internal drainage is poor to fair.

(2) Bantog Series

Soils of this series were formed from old waterlogged alluvium. They belong to the fine clayey, very deep and poorly drained soils. Surface soils are generally fine-textured with colors ranging from grayish brown to brown. Subsoils are brown, grayish brown to gray heavy clay. Consistency is very sticky and very plastic when wet, and hard when dry. External drainage is fair to poor while internal drainage is very poor. The relief is generally level to nearly level. This series is predominant in the eastern and northeastern sector of the Project area.

2.1.2 Intermediate Upland Soil

Intermediate upland soils are comprised of elevated undulating or rolling to hilly areas. This soil type covers about 20% of the Project area. These soils primarily originate from basaltic rocks overlaid by shales. They are lighter in color compared with alluvial plain soils. Texture ranges from sandy loam, sandy clay loam to clay. External drainage is somewhat excessive which tends to induce soil erosion.

Results of soil analysis showed that soil pH is strongly acid, organic matter content is generally low, and cation exchange capacity is low in both surface and subsoils. Inherent fertility ranges from low to medium.

Most of the intermediate upland soils are used as sugarcane or coconut plantations, with some scattered dwellings. Rice is also grown on localized man-made terraces. The Barotac series is the only soil series found in the intermediate upland area and its characteristics are described hereunder.

(1) Barotac Series

This soil series occupies the terraced to hilly areas, and belongs to the loamy, moderately deep soils. These soils are residual, originating from basaltic rock. Drainage condition is excessive externally and fair to poor internally. Surface soils are 10-15cm thick, dominantly brown to dark brown in color and sandy loam to loam in texture. Subsoils are mainly brown, yellowish brown to reddish brown and textures range from sandy clay loam to clay. Topography is undulating to rolling and sometimes steep.

2.2 Soil Mapping Unit

There are 7 soil mapping units delineated in the Project area. The basis of delineation was primarily land formation (slope) and morphological features (surface texture and color). The soil map of the Project area is given as FIG. I-1, and the total hectarage by soil mapping unit is summarized in TABLE I-3. The characteristics of each soil unit are as provided below.

SaA: Sara sandy clay loam: 0-2% slope (3,830ha)

This soil unit is characterized by its sandy clay loam surface texture with deep solum and fair to poor internal drainage. It is situated in the flat plain. Although some portions are subject to slight flooding caused by surface run-off during heavy rainfall, flooding does not materially affect crop production. This soil unit is the most extensive and covers about 46% of the Project area.

SaB: Sara sandy clay loam: 2-5% slope (440ha)

The soils of this unit are similar to SaA except for topography and surface drainability. They are situated on nearly level to gently sloping lands and external drainage is fair to good. This soil unit was mapped on the fringe of the Project area as well as in the local valleys between the intermediate uplands.

BtA: Bantog clay: 0-2% slope (1,700ha)

The soils of this unit are characterized by clayey texture throughout the solum. These soils are deep to very deep and poorly drained. Topography is level to nearly level. The land of this soil unit is subject to slight flooding during the first crop season. These lands extend over the left bank of the Asue River in the downstream area. The area covers about 20% of the total Project area.

BaB: Barotac sandy loam: 2-5% slope (750ha)

The soils of this unit are characterized by sandy loam surface texture and by a gravelly layer in the solum. These soils occupy the foot of the intermediate uplands and slightly elevated lands scattered within the alluvial plain. Topography is gently sloping or undulating. The solum is deep and has fair to good drainability.

BaC/SaB: Association of Barotac sandy loam: 5-8% slope and Sara sandy clay loam: 2-5% slope (1,200ha)

This soil unit occurs in the intermediate uplands. It is composed of elevated strips with gently rolling hills (BaC) and intricate narrow local valleys (SaB). The local valleys occur between the uplands and are mainly used for rainfed rice production. The upland portion is characterized by sandy loam surface texture with gently rolling topography. The majority of the land is used for sugarcane production at present. This soil unit occupies about 14% of the Project area.

BaD: Barotac sandy loam: 8-15% slope (155ha)

This soil unit is characterized by sandy loam surface texture and slightly excessive external drainage. It is situated in the rolling uplands and is limited to only about 2% of the total Project area.

BaE: Barotac sandy loam: more than 15% slope (145ha)

This soil unit occupies the isolated hilly lands in the Project area. It is easily differentiated from the other soil units by its topography and present land use.

2.3 Soil Drainage

2.3.1 Existing Drainage Conditions

The present drainage system in the Project area is provided by a series of well-incised rivers and creeks draining naturally into Ajuy and Bagacay Bay. The main drainage channels are Asue, Alibayog, Serruco, Pinantang, and Gubatan rivers draining southward to Ajuy Bay. The northeastern section is drained by the Hasohoy and Tabagay rivers which flow into Bagacay Bay. These natural drainage systems provide adequate drainage of the Project area under the prevailing conditions. There are minor drainage problems in small depressions, low erosional remnants, and localized valleys which form the main passageways of excessive run-off water during heavy rainfall. Therefore, additional drainage systems will be required for such areas when full irrigation is provided. Surface flooding is insignificant in the Project area as a whole.

Surface drainage is considered fair to good in the alluvial plain, and excessive in some portions of upland area especially on steep slopes. On the other hand, internal drainage is generally fair to poor. This is attributable to soil texture which is medium to heavy. The permeability is low to moderate, and the depth of ground water table is considered moderate to high. In most portions of the Project area, rice production in both first and second cropping seasons is recommended. Due to the unfavorable internal drainage and the shallow ground water table, some areas are not suited to most diversified crops.

2.3.2 Soil Drainage Investigation

To determine the water transmitting properties of Project area soils, infiltration tests, deep percolation tests and hydraulic conductivity tests were conducted by the NIA. The location of these tests is presented in FIG. I-2, while a brief description is given below.

(1) Infiltration Test

Infiltration tests were carried out to determine the rate of water intake by surface soil during water application. TABLE I-4 shows the results of 13 tests made in the Project area. The average infiltration rates (Iave) range from 0.006 to 0.12cm/min.

(2) Deep Percolation Test

Deep percolation refers to the vertical movement of water per unit of time through a horizontal area in a saturated soil. The results of 10 tests conducted in the Project area by NIA are presented in TABLE I-5. The percolation rates range from 0.5mm/day in sandy clay loam and clay soils to 1.1mm/day in sandy loam soils. The results of additional tests conducted by the Team and detailed discussions on deep percolation rate are presented in APPENDIX VII, IRRIGATION AND DRAINAGE.

(3) Hydraulic Conductivity

The hydraulic conductivity (k) represents the average water transmitting property of homogeneous and layered soils. Conductivity (k) was measured at 13 sites by the inverted auger-hole method above the ground water table, and the results are presented in TABLE I-6. Considering the arithmetic, geometric means and the median of the observed hydraulic conductivity (k) in the fine-textured soil layers, the average k is 0.03m/day or 3.4×10^{-5}cm/sec.

2.3.3 Depth of Ground Water Table

Excessive soil moisture at saturated condition adversely affects the production of a variety of diversified crops. The introduction of irrigation in the future might build-up the ground water table considering the present depth which is moderate to high.

As shown in FIG. I-2, 23 bore wells were used to observe the depth of the water table in the Project area. TABLE I-7 summarizes the ground water table observed during the dry season which ranged from 0.14m to 1.6m from the ground surface. Assuming a required aerated root zone depth of one meter for diversified crops, some areas are considered critical.

3. LAND CLASSIFICATION

3.1 Land Classification Method

Land classification involves the identification and delineation of arable and non-arable lands under irrigation. The method adopted for this

Project was primarily patterned after the U.S. Bureau of Reclamation Standards with minor modifications to suit local conditions.

According to crop suitability and present land use, and in consideration of soil, topography and drainage conditions, land was evaluated from two aspects; namely, suitability for diversified crop production and for rice production. Initially, land classification specifications were established as shown in TABLE I-8. In accordance with the specifications, land classes were determined reflecting the productive capacity of the land based on certain limitations such as soil, surface configuration, and drainage conditions. Delineation of land classes was made by air-photo interpretation and checked on site during the field survey.

3.2 Land Classification

There were 7 land classes delineated in the Project area as shown in FIG. I-3. TABLE I-9 indicates the hectarage summary of land class measured planimetrically on a 1:20,000 scale map.

(1) Class 1R/1D (3,805ha)

The lands in this class are suitable for both rice and diversified crop production under irrigation. The area is located in the alluvial plain with slopes ranging from zero to 3%, which have good external drainage and fair internal drainage. At present, all lands in this class are used for rice production and are best suited in all respects for irrigated paddy during the first and second cropping seasons and diversified crops during the dry season. It constitutes about 46% of the total Project area.

(2) Class 1R/3D (1,710ha)

This land class is suitable for rice production under irrigation, but has drainage limitations for diversified crop production due to poor external drainage and very poor internal drainage from heavy soil texture. The lands in this class are presently used only for rainfed rice production. About 20% of the Project area represents this class.

(3) Class 2R/1D (920ha)

This land class is suitable for rice production but has minor limitations resulting from coarse texture and surface irregularity. For diversified crop production, the lands in this class have no limitation. These lands were mapped on slightly undulating areas with slopes ranging from 2 to 5% and are presently used for either paddy or sugarcane fields with some scattered dwellings. About 11% of the total Project area was delineated under this class.

(4) Class 3R/2D (1,140ha)

This land class has physical limitations in terms of topography and soil which considerably affect suitability for rice production; however, the same is moderately suitable for diversified crop production. Most lands are presently used for sugarcane production. This area also includes some local valleys where rice productivity is moderate.

(5) Class 6R/3D (125ha)

This land class has severe physical limitations for rice production due to rolling topography; on the other hand, it is marginally suitable for diversified crops. These are hands presently used for coconut and fruit tree plantations or grasslands.

(6) Class 6 (200ha)

This land class includes all drainage channels, steep slopes and hilly areas, which are not suitable for irrigation development. The steep slopes and hilly areas could, however, be made productive for tree crops or for pasture.

(7) M Lands (245ha)

The lands in this land class are occupied by residential and commercial centers and others.

4. PRESENT LAND USE

In general, present land use in the Project area is predominantly agriculture, and the farming system and existing land utilization patterns are partially attributable to the local climate. In addition although the climate is identical throughout the area, present land use also varies according to different soil types and land classes. The variation is often due to the physiographic position of land.

Different land uses were first quantitatively delineated by photo intepretation using the most recent aerial photographs of the area (1983) with approximate scale of 1:23,000. This determination was later confirmed and verified during field investigation. The extent of these land uses are shown in FIG. I-4 and their coverage is presented in TABLE I-10.

Present agricultural land uses range from a great variety of annual food and cash crops to fruit and tree crops. The most dominant land use is the production of either transplanted or broadcasted paddy which covers most of the broad alluvial plain and, to some extent, the man-made terraces in local valleys and on the slopes of intermediate upland. In places where sufficient water for irrigation is available, rice is cropped two or three times per year. Of the total area devoted to rice cultivation, about 25% is presently irrigated by the existing Serruco Communal System, privately owned pumps and diversion channels from local streams or water impoundings by KABSAKA projects.

The intermediate upland is widely used for the production of sugarcane and scattered plantings of coconut trees. Also covering a portion of this land are clusters and belts of bamboo and strips of grassland which are often used as communal pasture. Associated to these land uses are patches or strips of vegetables, root crops, fruit trees and tree crops which generally occur as scattered or intermixed plantings. The common species are banana (Musa sapientum), jackfruit (Artocarpus heterophyllus), starapple (Chrycophyllum cainito), papaya (Carica papaya), corn (Zea mays), cassava (Manihot esculenta), sweet potato (Ipomoea batatas) and peanut (Arachis hypogaea).

Other sectors are also putting pressure on land use in the Project area. For the past several years commercial establishments have been expanding, including agro-industrial enterprises. Moreover, population growth has resulted in urban expansion. Consequently, as actual need for agricultural land increases on the one hand, the same is being expended for other purposes.

CHARACTERISTICS OF SOIL SERIES

Characteristics	Sara Series	Bantog Series	Barotac Series
Parent Material	Recent Alluvium	Old Alluvium	Volcanic rocks
Land Form	Alluvial Fan/ Terrace	Alluvial Fan	Residual terrace
Slope Range	0-5%	0-2%	2-30%
Relief	Level to nearly level	Level	Gently sloping to hilly
Soil Depth	Deep to very deep	Very deep	Moderately deep to deep
Textural Class	SCL, SC, SL	C	SL, SCL, SC
Color Range	DBr, Br, GBr,	DBr, B, Gr	DBr, Br, YeBr, ReBr
Drainage External	Fair to good	Fair	Good to excessive
Internal	Fair to poor	Poor	Fair to poor

SUMMARY OF RESULTS OF PHYSICAL AND CHEMICAL ANALYSIS OF SURFACE SOILS

PIT NO.	SOIL SERIES	DEPTH (cm)	PHYSICAL CHARACTERISTICS: Particle Size Distribution % Sand	% Silt	% Clay	Textural Class	Percent Moisture Retention: Field Capacity	Wilting Point
1	Sara Series	0 - 15	62	23	15	SL	15.62	5.35
2	-do-	0 - 15	80	14	6	SL	5.31	2.80
4	-do-	0 - 15	52	18	30	SCL	21.90	10.31
6	-do-	0 - 46	21	50	29	CL	35.34	13.68
7	-do-	0 - 15	47	33	20	L	22.20	9.82
9	-do-	0 - 15	59	23	18	SL	15.28	7.44
3	Bantog Series	0 - 25	13	21	66	C	44.88	23.37
5	-do-	0 - 12	11	17	72	C	44.13	22.79
8	Barotac Series	0 - 13	78	13	9	SL	10.00	4.13

PIT NO.	CHEMICAL CHARACTERISTICS: SOIL PH	EC x 10^3 (mmho/cm)	AVAIL P (ppm)	O.M. (%)	Exchangeable Cations (meq/100g): Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CEC (meq/100 g.)	B S P (%)	E S P (%)
1	5.0	0.38	15.7	1.7	2.97	1.84	0.31	0.09	6.94	73.4	4.47
2	4.8	0.13	12.5	1.5	1.21	0.99	0.17	0.11	1.88	127.6	9.04
4	5.1	0.30	14.8	3.4	5.32	2.81	0.32	0.19	9.55	90.4	3.35
6	5.1	0.61	12.5	2.7	7.82	4.63	0.26	0.30	14.00	91.0	1.86
7	4.8	0.22	14.8	2.7	4.94	1.91	0.23	0.17	8.86	81.8	2.60
9	4.6	0.18	14.8	2.0	1.89	0.84	0.16	0.13	4.80	62.9	3.33
3	5.1	1.43	10.2	3.4	15.98	8.05	1.85	0.13	25.33	102.6	7.33
5	4.7	0.61	10.2	3.7	11.35	7.67	0.54	0.42	21.23	94.2	2.54
8	4.8	0.08	10.2	1.1	1.08	0.86	0.10	0.16	2.01	109.4	4.98

SOIL CLASSIFICATION

Soil Type		Area (ha)			
		I	II[1/]	Total	%
SaA:	Sara sandy clay loam, 0-2% slope	3,830	-	3,830	46.0
SaB:	Sara sandy clay loam, 2-5% slope	350	90	440	5.3
BtA:	Bantog clay, 0-2% slope	1,700	-	1,700	20.4
BaB:	Barotac sandy loam, 2-5% slope	750	-	750	9.0
BaC/SaB:	Association of Barotac sandy loam, 5-8% slope and Sara sandy clay loam, 2-5% slope	1,130	70	1,200	14.4
BaD:	Barotac sandy loam, 8-15% slope	155	-	155	1.9
BaE:	Barotac sandy loam, steeper than 15% slope	145	-	145	1.8
	Rivers/Creeks	100	-	100	1.2
Total		8,160	160	8,320	100.0

1/ Ardemil/area in the upstream of the Asue River

TABLE I-4

RESULTS OF SOIL INFILTRATION TEST

LOCATION	LAND CLASS	LAND USE	SOIL: TYPE	SOIL: SURFACE/ SUB-SOIL	INFILTRATION RATE (cm/min): CUMULATIVE (Icum)	INSTANTANEOUS (I ins)	AVERAGE 2/ (Iave)	CLASS
1. Labigan, Sara	1R/1D	Pr	Sara A	SCL/C	$0.11t^{0.50}$	$0.06t^{-0.50}$	0.006	very slow
2. Apologista, Sara	1R/1D	Pr	Sara A	SC/SCL	$0.80t^{0.40}$	$0.32t^{-0.60}$	0.03	medium
3. Bato, Sara	1R/1D	PrI	Sara A	SCL/SC	$0.25t^{0.40}$	$0.10t^{-0.60}$	0.008	very slow
4. Pinay-Espinosa, Ajuy	1R/1D	PrI	Sara A	SCL/SiC	$1.10t^{0.30}$	$0.33t^{-0.70}$	0.02	very slow
5. Casa-Mata, Ajuy	1R/1D	Pr	Sara A	SCL/SiC	$1.0t^{0.50}$	$0.50t^{-0.50}$	0.06	medium
6. Aldeguer, Sara	2R/1D	Sc	Barotac B	SL/SCL	$0.80t^{0.50}$	$0.40t^{-0.50}$	0.05	medium
7. Tanduyan, Sara	1R/1D	Pr	Sara A	SCL/SiC	$0.70t^{0.50}$	$0.35t^{-0.50}$	0.04	medium
8. Agnaga, Concepcion	1R/3D	Pr	Bantog A	SiC/SiC	$1.30t^{0.60}$	$0.80t^{-0.40}$	0.12	very rapid 3/
9. Macalbang, Concepcion	1R/1D	Pr	Sara A	SCL/SiCL	$0.80t^{0.60}$	$0.48t^{-0.40}$	0.08	rapid
10. Siempre-Viva, Sn. Dionisio	2R/1D	Pr	Sara B	CL/C	$0.22t^{0.60}$	$0.13t^{-0.40}$	0.03	medium
11. Bondulan, Sn. Dionisio	1R/3D	Pr	Bantog A	C/C	$0.70t^{0.50}$	$0.35t^{-0.50}$	0.04	medium
12. Dugman, Sn. Dionisio	2R/1D	Pr	Sara B	SCL/C	$0.50t^{0.30}$	$0.15t^{-0.70}$	0.009	very slow
13. Alibayog, Sara	1R/1D	Pr	Sara A	SCL/SC	$0.10t^{0.80}$	$0.08t^{-0.20}$	0.03	medium

Notes: 1/ Conducted from April to May 1982 - (dry season)
2/ Average infiltration at t=300 minutes
3/ test sites with developed soil series

TABLE I-5

RESULTS OF DEEP PERCOLATION TEST

LOCATION	LAND CLASS	LAND USE	SOIL TYPE	SOIL SURFACE/SUB-SOIL	PERCOLATION RATE (mm/day)
1. Pasig, Sara	1R/1D	PrI	Sara A	SCL/C	0.50
2. Aguire, Sara	1R/1D	PrI	Sara A	SCL/SC	0.60
3. San Luis, Sara	1R/1D	PrI	Sara A	SCL/SCL	0.90
4. Pinay-Espinosa, Ajuy	1R/1D	PrI	Sara A	SCL/SiC	0.80
5. Nangka, Sara	2R/1D	PrI	Barotac B	SL/SCL	1.10
6. Lanjagan, Ajuy	1R/3D	PrI	Bantog A	C/C	0.50
7. Crespo, Sara	1R/3D	PrI	Bantog A	SC/C	0.60
8. Dugman, San Dionisio	2R/1D	PrI	Sara B	SCL/SCL	0.70
9. Tubli, San Dionisio	1R/1D	PrI	Sara A	SCL/SiCL	0.80
10. De Vera, Sara	1R/1D	PrI	Sara A	SCL/C	1.00
				Mean	0.80

1/ Conducted from April to May, 1982 - (dry season)

TABLE I-6

RESULTS OF HYDRAULIC CONDUCTIVITY TEST

	LOCATION	LAND CLASS	LAND USE	SOIL TYPE	TEST ZONE (Soil Layer, cm)	K (meter per day)
1.	Padios, Sara	1R/1D	Pr	Sara A	70-85 SC/85-100 SCL	0.04
2.	Bato, Sara	1R/1D	Pr	Sara A	70-80 SCL	0.05
3.	Pinay-Espinosa, Ajuy	1R/1D	Pr	Sara A	70-90 SCL/90-100 SC	0.02
4.	Casa-Mata, Ajuy	1R/1D	Pr	Sara A	70-90 FSCL/90-100 SC	0.24
5.	Aldeguer, Sara	2R/1D	Sc	Barotac B	70-100 SCL	0.04
6.	Tanduyan, Sara	1R/1D	Pr	Sara A	70-100 SCL	0.04
7.	Agnaga, Concepcion	1R/3D	Pr	Bantog A	70-100 SC	0.01
8.	Macalbang, Concepcion	1R/1D	Pr	Sara A	70-100 SCL	0.02
9.	Siempre-Viva, San Dionisio	1R/1D	Pr	Sara A	70-100 SC	0.01
10.	Bondulan, San Dionisio	1R/3D	Pr	Bantog A	70-80 SC/80-100 C	0.01
11.	Dugman, San Dionisio	2R/1D	Pr	Sara B	70-100 C	0.01
12.	Alibuyog, Sara	1R/1D	Pr	Sara A	70-100 C	0.01
13.	Amante, Sara	1R/1D	Pr	Sara A	70-100 C	0.01

1/ Conducted from April to May, 1982 (dry season)

GROUND WATER TABLE DEPTH

LOCATION		BORED WELL NUMBER	DEPTH (meters) from ground surface
1.	Apologista, Sara	11	0.14
2.	San Luis, Sara	9	0.50
3.	Padios, Sara	12	0.60
4.	Tanduyan, Sara	10	0.75
5.	Bato, Sara	1	0.95
6.	Alibuyog, Sara	8	1.00
7.	Bunglas-Fuente, Ajuy	20	1.00
8.	Lanjagan, Ajuy	22	1.00
9.	Salcedo, Sara	13	1.15
10.	Casa-Mata,Ajuy	21	1.20
11.	Bato, Sara	2	1.25
12.	Dugman, San Dionisio	3	1.40
13.	Capinang, San Dionisio	4	1.40
14.	Bondulan, San Dionisio	6	1.40
15.	Salcedo, Sara	14	1.45
16.	Dugman, San Dionisio	5	1.50
17.	Crespo, Sara	15	1.50
18.	Siempre-Viva, San Dionisio	16	1.50
19.	Agnaga, Concepcion	18	1.50
20.	Macalbang, Concepcion	19	1.50
21.	Poblacion, Ajuy	23	1.50
22.	Bondulan, San Dionisio	7	1.60
23.	Pinay-Espinosa, Ajuy	17	1.20
	MEAN		1.20

Measured April-May, 1982 (dry season)

LAND CLASSIFICATION SPECIFICATIONS FOR IRRIGATION

Land Characteristics	For Diversified Crop Production			For Paddy Rice Production		
	Class 1D - Arable	Class 2D - Arable	Class 3D - Arable	Class 1R - Arable	Class 2R - Arable	Class 3R - Arable
Soils						
. Texture						
Surface, 0-30cm	Fine sandy loam to friable clay loam	Fine loamy sand to permeable clay	Loamy sand to permeable clay	Sandy clay loam to clay with fair tilth	Sandy clay loam to clay	Sand loam to clay
Sub-surface	Fine sandy loam to clay loam	Loamy sand to permeable clay	Loamy sand to permeable clay	Silty clay loam to clay	Silty clay loam to clay	Silty clay loam to clay
. Depth to clean sand, gravel or cobble	>90cm	>60cm	>30cm if surface soil is FSL or finer	>90cm	>60cm	>30cm
. Cation exchange-capacity in surface soil	> 8meq/100g	> 4meq/100g	> 4meq/100g	> 8meq/100g	> 4meq/100g	> 4meq/100g
. Exhangeable cations Ca+Mg	> 7meq/100g	>3meq/100g	> 3meq/100g			
. Soil reaction	5.5 - 8.0	4.5 - 8.5	4.5 - 8.5	> 5.5	> 5.0 May be less provided aluminum & active iron are satisfactory	> 5.0 May be less provided aluminum & active iron are satisfactory
. Soil salinity (EC)	< 1.0mS/cm	< 4.0mS/cm	< 4.0mS/cm	< 3.0mS/cm	< 8.0mS/cm	< 8.0mS/cm
Topography						
. Slope in general gradient	< 5%	5 - 8%	8 - 15%	< 2%	2 - 5%	5 - 8%
. Requirement of land leveling/terracing and clearing	Nil	Nil	Nil	Nil	Nil	Nil
. Field size or shape	No restriction to cultivation or irrigation	Moderate restriction resulting from the irregular surface features	Moderate restriction resulting from the irregular surface features	No restriction to cultivation or irrigation	Moderate restriction resulting from the irregular surface features	Moderate restriction resulting from the irregular surface features
Drainage						
. Flooding	May be subject to occasional minor flooding which does not materially affect productivity	May be subject to periodic flooding of short duration which may materially affect productivity	Flooding may seriously affect wet season production or may result in costly repairs	May be subject to occasional flooding of short duration which does not materially affect productivity	May be subject to annual flooding which materially affects productivity	May be subject to severe flooding which may affect wet season production
. Internal	Well aerated, no limit to moisture movement or root development; tillable over a wide range of moisture	Well to moderately well aerated moisture movement and root development somewhat impeded; tillable over a moderate wide moisture range	Moisture movement and root development moderately restricted; tillable over a narrow moisture range	Slow	Slow	Slow

CLASS 6 - Non-arable includes lands which do not meet the minimum requirements for arable land classes and therefore are not suitable for irrigation. They include lands with shallow soil layer over bedrock or other formations impervious to roots or water, lands with extremely coarse textured surface soil, soil having low available water capacity, rough and severely dissected land, areas such as river levees, overflow and run-off channels, permanent waste and dump areas, lands having excessively steep or complex topography, and all other obviously non-arable areas.

H-LANDS - Lands in municipalities of residential areas. Barrio site or lands in an active subdivision.

LAND CLASSIFICATION

Land Class	Area (ha)			
	I	II[1/]	Total	%
1R/1D	3,805	-	3,805	45.7
1R/3D	1,710	-	1,710	20.6
2R/1D	835	85	920	11.1
3R/2D	1,065	75	1,140	13.7
6R/3D	125	-	125	1.5
6	200	-	200	2.4
Residential Area	245	-	245	2.9
Road	75	-	75	0.9
Rivers/creeks	100	-	100	1.2
Total	8,160	160	8,320	100.0

1/ Ardemil Area

PRESENT LAND USE BY MUNICIPALTY[1/]

Land Use	Sara		Ajuy		San Dionisio		Concepcion		Total	
	ha	%	ha	%	ha	%	ha	%	ha	%
Paddy: Total Area	3,275 (105)[2/]	69.2	1,699	88.2	1,093	84.4	348	95.3	6,415	77.1
Irrigated	1,015		575		-		-		1,590	
Rainfed	2,260		1,124		1,093		348		4,825	
Sugarcane	618 (55)	13.0	59	3.1	78	6.0	-	-	755	9.1
Coconut	227	4.8	6	0.3	2	0.2	5	1.4	240	2.9
Grassland	178	3.7	28	1.5	54	4.1	-	-	260	3.1
Bush & Bamboo	35	0.7	3	0.2	7	0.5	-	-	45	0.6
Hill	103	2.2	48	2.5	32	2.5	2	0.5	185	2.2
Rivers & Creeks	65	1.4	20	1.0	10	0.8	5	1.4	100	1.2
Residential area	189	4.0	47	2.4	9	0.7	-	-	245	2.9
Roads	45	1.0	15	0.8	10	0.8	5	1.4	75	0.9
Total	4,735 (160)	100.0	1,925	100.0	1,295	100.0	365	100.0	8,320	100.0

1/ Surveyed during the first crop season of 1984

2/ Ardemil Area

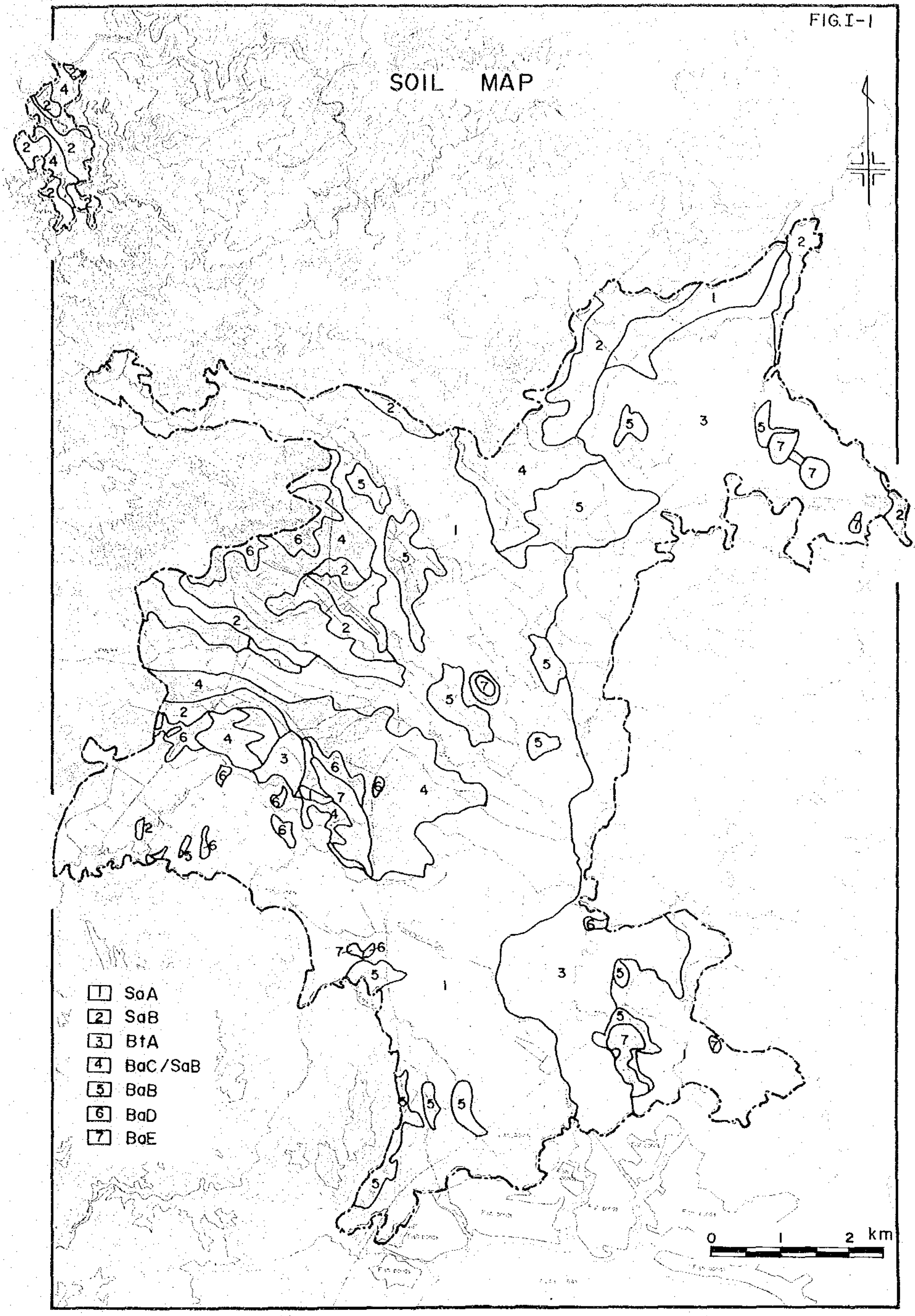


FIG.I-1
SOIL MAP
1 SaA
2 SaB
3 BtA
4 BaC/SaB
5 BaB
6 BaD
7 BaE
0 1 2 km

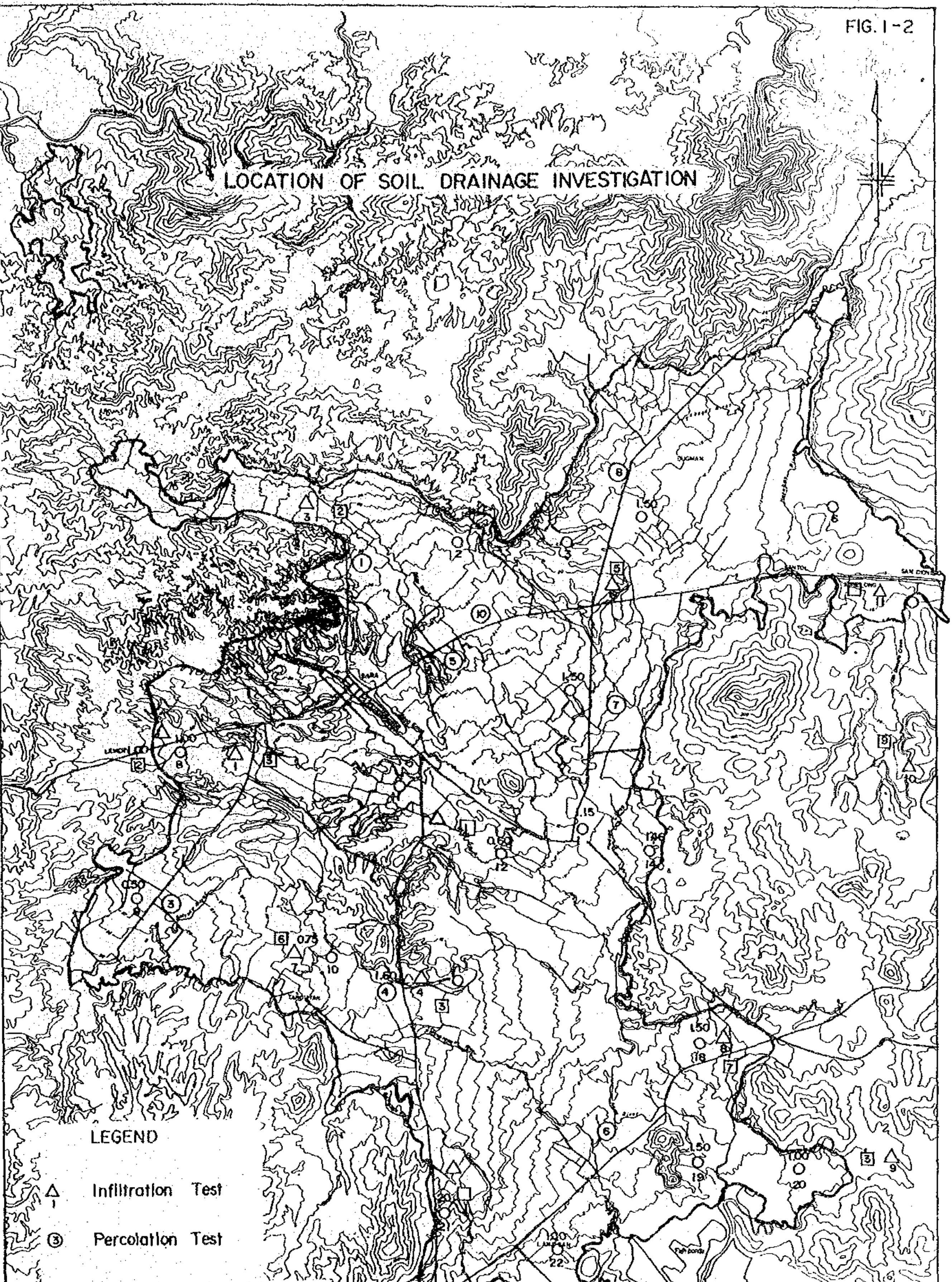


FIG. I-2
LOCATION OF SOIL DRAINAGE INVESTIGATION
LEGEND
Infiltration Test
Percolation Test
Hydraulic Conductivity Test
Auger Boring
1.50 Depth of Water Table (meter)
Fish ponds
0 1 2 km

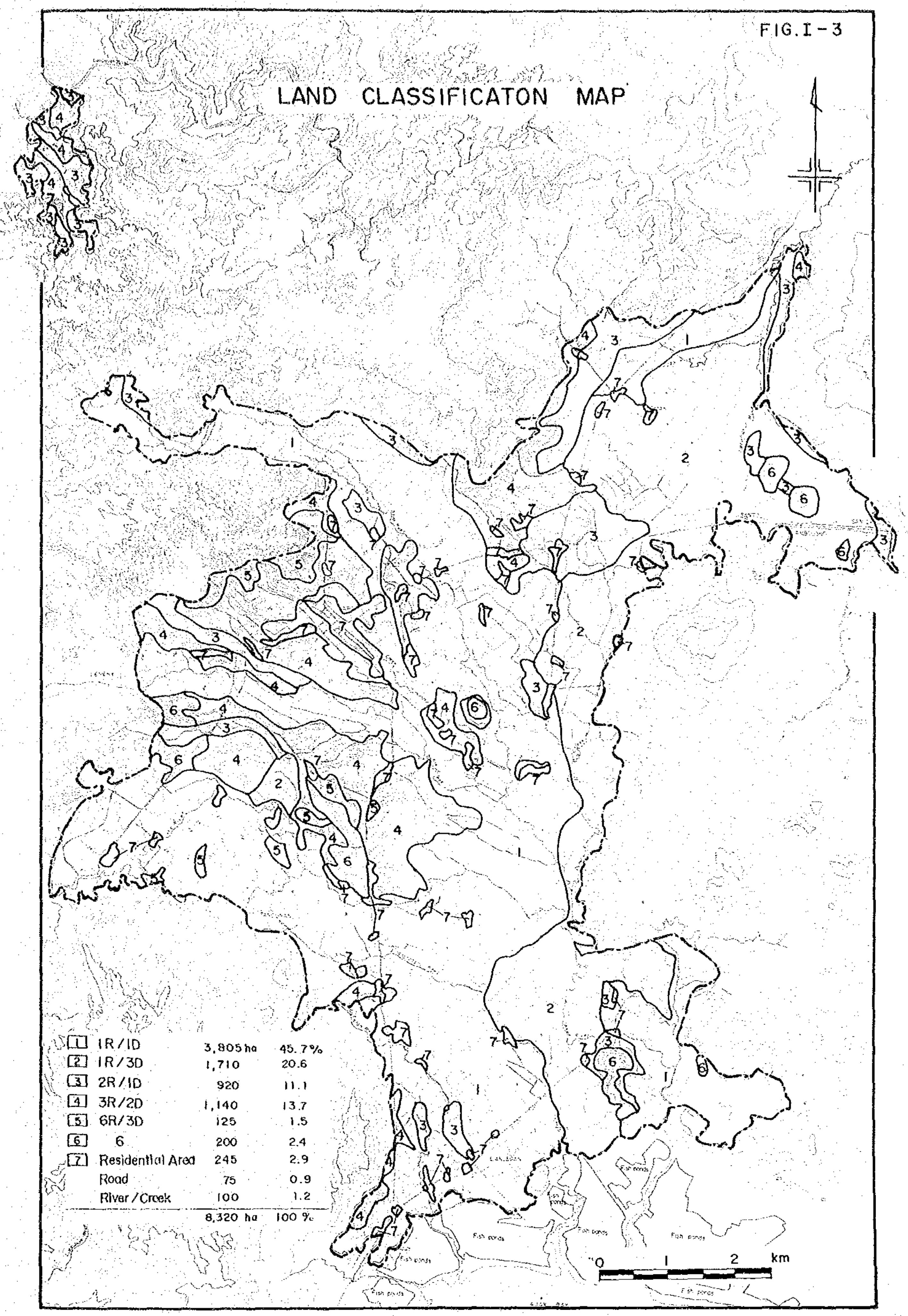
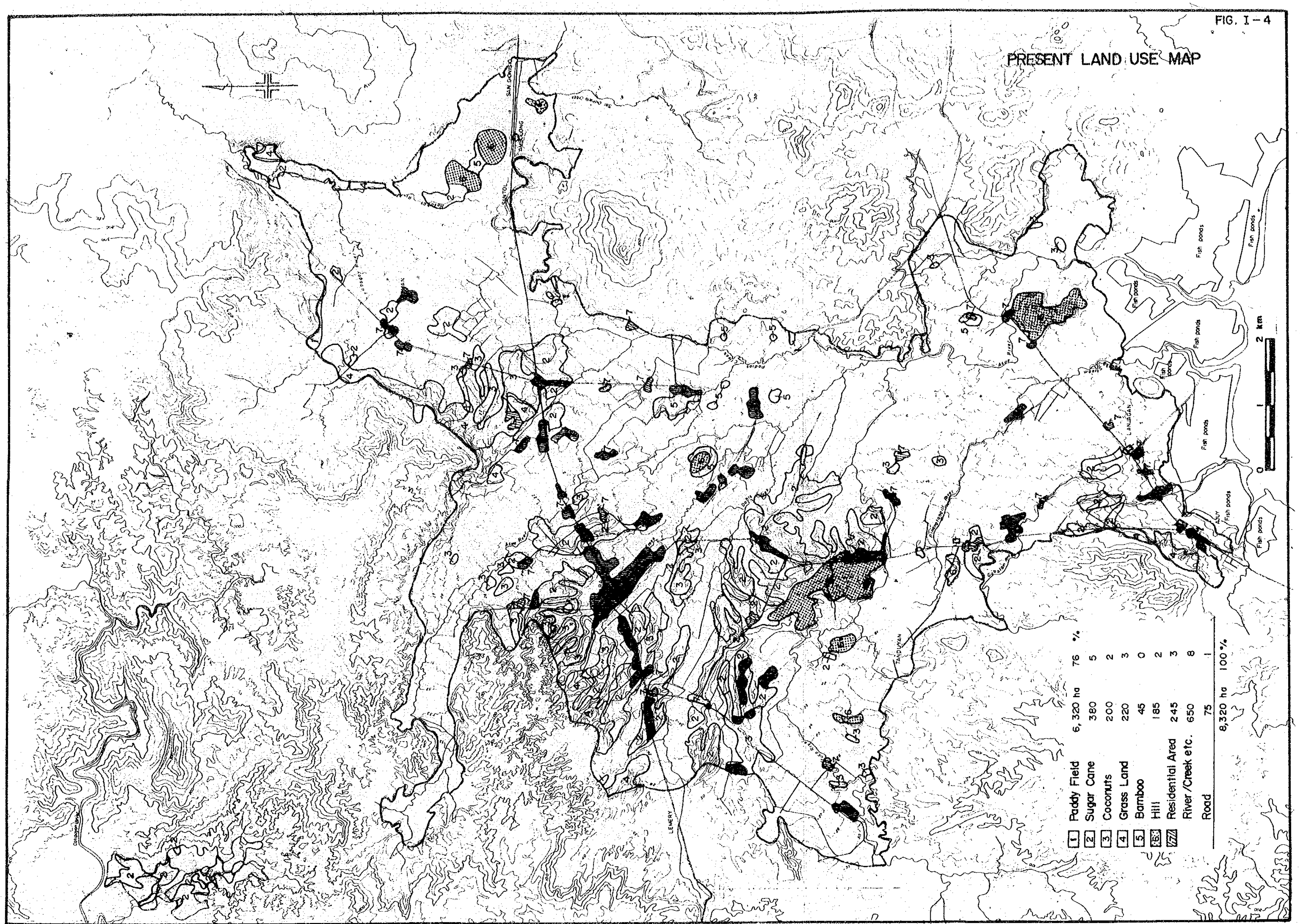


FIG.I-3
LAND CLASSIFICATON MAP
1 1R/1D 3,805 ha 45.7%
2 1R/3D 1,710 20.6
3 2R/1D 920 11.1
4 3R/2D 1,140 13.7
5 6R/3D 125 1.5
6 6 200 2.4
7 Residential Area 245 2.9
Road 75 0.9
River/Creek 100 1.2
8,320 ha 100 %
0 1 2 km
Fish ponds

FIG. I-4

PRESENT LAND USE MAP



APPENDIX II

METEOROLOGY AND HYDROLOGY

APPENDIX II

METEOROLOGY AND HYDROLOGY

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APPENDIX II

METEOROLOGY AND HYDROLOGY

1. AVAILABLE DATA

1.1 Available Data

In the Project area, a rainfall and evaporation station was installed at Barangay Aguirre, Municipality of Sara in December 1978 and from that time to the present, a period of more than five years, NIA has conducted observations at the same. The water level of the rivers has been observed twice a day on the staff gauges which were installed on the Catipayan, Asue and Serruco rivers on December 6, 1978. Discharge measurement at the three gauging stations was conducted once a month; at the same time water samples were collected for chemical and wash/suspended sediment load analysis. Other climatological data including temperature, relative humidity and wind run however, are not available in the area.

For general Project study, 15-20 years of meteorological and hydrological data are required to establish a water resource development plan. Accordingly correlated data was derived from other neighboring stations. Rainfall and meteorological stations in Iloilo and Capiz provinces on Panay Island are depicted in FIG. II-1, while the corresponding periods of available records are presented in FIG. II-2.

Stations located in Antique, Aklan and Negros Occidental provinces seem inapplicable to the Project area because most stations in the three Provinces present quite different rainfall patterns and thereby belong to another climate type. These stations, records for which cover only short periods and contain incomplete data, are not included in FIG. II-2.

1.2 Installation of Automatic Rain Gauges

The Team brought two (2) automatic recording rain gauges in accordance with the "Implementing Arrangement" agreed upon by NIA and JICA on 31st January, 1983, and installed the same on June 25, 1984 during the field survey.

One rain gauge was installed at the top of the hill in the right bank of alternative dam site B on the Catipayan River to obtain higher altitude rainfall. The site is easily accessible for proper maintenance. Another rain gauge was installed at the corner of the paddy in Barangay Padios, approximately at the center of the proposed service area. Location of these sites are shown in FIG. II-3. The specification of the rain gauge is as follows:

Detector	:	Tipping-bucket type
Inlet diameter	:	200mm
Sensitivity	:	0.5mm
Recording System	:	one way 50 tips two ways
Chart Paper	:	Roll-type (effective recording width: 200mm)
Chart Drive	:	1.50 battery quartz clock
Chart Speed	:	6mm/hr
Recording Period	:	3 months
Dimensions	:	ϕ 320mm x (H) 700mm
Weight	:	Approx. 18kg

2. METEOROLOGY

2.1 General Climate

The climate of the Philippines is principally dominated by prevailing winds. As a result, the year is broadly divided into four seasons; namely, the Northeast Monsoon Season from December to January, the Trade Wind Season in April, the Southwest Monsoon Season from July to September, and the transition period for the remainder of the year.

The climate of a certain area generally depends on many factors, however, the main factors especially in Southeast Asia, are temperature, rainfall and wind. Several classifications have been made for weather patterns in the Philippines. Since the temperature of the Philippines is nearly constant throughout the year, these classifications are mainly based on the annual rainfall distribution pattern. Climate classifications by Mr. F. Jose Coronas and by Mr. Hernandez are illustrated in FIG. II-4 and II-5, respectively.

The Project area is located at latitude 11°15' N, longitude 123° E and belongs to climatic Type-III, defined as "not very pronounced, relatively dry from November to April, wet during the rest of the year" according to Coronas's classification. According to Hernandez's classification, the area belongs to B-type which is "humid; rain well or evenly distributed throughout the year with at most 3 dry months, ratio of dry months to wet months equals 0.14 or more but less than 0.33".

In the Project area, daily rainfall and pan-evaporation have been observed since 1979, although observation of other climatological data such as temperature, humidity, wind, etc., has not been conducted. On Panay Island, climatological stations with long-term data periods exist in Iloilo City and in Roxas City, 80km southwest and 50km northwest of the Project area, respectively, and data regarding relative humidity, wind direction, daily wind run and cloudiness is available at both these stations from 1950.

Iloilo City is located on the border of Type-I and Type-III according to Coronas's classification, and belongs to C-type of Hernandez's classification, while Roxas City belongs to Type-III and A-type, respectively. Comparison was made for temperature, humidity, wind direction, wind speed and cloudiness data for Iloilo and Roxas cities which will be discussed hereinafter, and no distinct climatological difference was observed, the annual tendency being generally similar in both cities.

Based on the rainfall distribution, climate in Roxas is similar to that of the Project area. In the recent 20-year period from 1964 to 1983 however, data for Roxas are lacking for over a 5-year period. Topographical conditions in the Project area and altitude are similar in comparison to the above cities. Data from Iloilo City which are more complete than that of Roxas City are preferable for use in the present study.

2.2 Meteorology

2.2.1 Temperature, Humidity, Wind and Cloudiness

(1) Temperature

Monthly mean temperatures for the period from 1949-83 observed at Iloilo and Roxas cities are tabulated below.

MONTHLY MEAN TEMPERATURE FOR ILOILO AND ROXAS

(Unit: °C)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave.
Iloilo	26.1	26.4	27.2	28.6	28.9	28.0	27.4	27.4	27.5	27.5	27.3	26.7	27.4
Roxas	26.4	26.6	27.3	28.5	29.0	28.4	28.1	28.0	28.0	27.7	27.6	26.9	27.7

The above table shows no distinct difference in monthly mean temperature between Iloilo and Roxas cities. The difference between the maximum and minimum mean temperature throughout the year is small at about 3°C in both cities. The maximum value is 28.9°C in May and the minimum value is 26.1°C in January in Iloilo City.

Mean daily maximum and minimum temperatures for each month in Iloilo City are presented below.

DAILY MAX. AND MIN. TEMPERATURE FOR ILOILO

(Unit: °C)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave.
Daily Max.	28.2	29.7	30.9	32.3	32.3	31.2	30.4	30.1	30.3	30.7	30.3	29.5	30.5
Daily Min.	22.6	22.7	23.3	24.7	24.9	24.5	24.3	24.3	24.3	24.1	23.9	23.4	23.9
Difference	5.6	7.0	7.6	7.6	7.4	6.7	6.1	5.8	6.0	6.6	6.4	6.1	6.6

(2) Humidity

Monthly mean humidity for Iloilo and Roxas cities is tabulated below.

MONTHLY MEAN HUMIDITY FOR ILOILO AND ROXAS

(Unit: %)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave.
Iloilo	82	80	76	74	78	82	85	85	85	85	85	85	82
Roxas	80	79	77	74	76	80	81	81	81	82	80	81	79

(3) Wind

Prevailing wind direction can be broadly and rather clearly divided into two periods throughout the year, both influenced by the monsoons as previously mentioned. At Iloilo and Roxas cities, the south to southwesterly wind is dominant from June to September, and the north to northeasterly wind is prevailing for the rest of the year. Monthly mean wind velocities for both cities are shown below.

MONTHLY MEAN WIND VELOCITIES FOR ILOILO AND ROXAS

(Unit: km/hr)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave.
Iloilo	16.4	16.4	16.5	14.5	10.5	9.1	11.4	12.1	9.5	9.8	11.5	14.3	12.7
Roxas	15.3	14.3	14.9	14.0	11.1	10.1	9.6	10.6	9.6	11.7	14.4	16.5	12.7

(4) Cloudiness

Monthly mean cloudiness for the two cities is tabulated below.

MONTHLY MEAN CLOUDINESS FOR ILOILO AND ROXAS

(Unit: degree in tenths)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave.
Iloilo	6	6	5	5	6	8	8	8	8	7	7	7	7
Roxas	7	6	5	4	5	7	7	7	7	7	7	7	6

2.2.2 Evaporation

Daily evaporation observation has been carried out by NIA from 1979 in the Project area at Barangay Aguirre in Sara Municipality. Monthly data from the same are tabulated in TABLE II-1. In Iloilo City, evaporation observation was carried out by PAGASA for 9 years from 1957-65. Monthly values for the same are shown in TABLE II-2. Although the observation periods are different, the following table compares the monthly mean values at these stations.

COMPARISON OF MONTHLY MEAN EVAPORATION

(Unit: mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Sara	109.7	129.6	161.3	182.3	160.1	107.8	108.5	100.9	96.9	98.3	94.2	100.0	1564.4
Iloilo	148.3	153.7	207.3	211.7	207.3	166.1	152.9	152.0	141.5	144.4	135.2	139.8	1960.2
Sara/ Iloilo	0.74	0.84	0.78	0.86	0.77	0.65	0.71	0.66	0.68	0.68	0.70	0.72	0.80

Note: Mean Value from 1979-83 in Sara, 1957-65 in Iloilo

The data from Sara includes some unreliable data and accordingly the reliability of observation seems low, although it can be concluded that, on the average, actual evaporation at Sara is lower than that at Iloilo. As the above table shows, the ratios of evaporation at Sara to those at Iloilo are 0.65 to 0.86. Evapotranspiration value, which is the basis of irrigation water requirement calculation, will be discussed in APPENDIX VI under WATER RESOURCES DEVELOPMENT on the basis of the above results.

2.2.3 Rainfall in General

As stated earlier, the climate in the Project area is broadly divided into two seasons; the wet season from May/June to October/November and the dry season in the rest of the year. Based on analysis made in 3. RAINFALL ANALYSIS, the average monthly rainfall for the 20 year period from 1964-83 is tabulated below. The table also presents the monthly coefficient of variation (standard deviation/arithmetic mean) for 20-year period data to clarify rainfall variation for each month.

PROJECT AREA MONTHLY MEAN RAINFALL, COEFFICIENT OF VARIATION

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall (mm)	79.5	37.1	42.6	42.9	112.3	257.9	237.7	227.2	215.6	229.7	215.7	137.6	1835.7
Standard Deviation	75.5	32.6	43.2	61.2	95.6	139.6	108.1	87.5	107.4	87.7	119.9	99.8	408.7
Coefficient of Variation	0.95	0.88	1.01	1.43	0.85	0.54	0.45	0.39	0.50	0.38	0.56	0.73	0.22

The average annual rainfall in the Project area is 1,836mm. The first month of the wet season varies from year to year while rainfall from June to November is relatively stable compared to the rest of the year. May and December can be defined as transition periods, while the monthly rainfall in the dry season presents relatively greater variation especially in April which is almost at the end of the dry season. Based on studies and field interviews by the Team, the dry season is particularly intense between February and April, although yearly fluctuation of annual rainfall distribution occurs.

Detailed analysis will be made in APPENDIX VI under WATER RESOURCES DEVELOPMENT, based on the above rainfall pattern, although a cropping calendar which effectively utilizes the rainfall of June to November seems preferable. Rainfall analysis such as daily rainfall, probable rainfall, etc., will be discussed in the following section.

3. RAINFALL ANALYSIS

3.1 Daily Rainfall

3.1.1 Monthly Rainfall

Long term rainfall data which are required to establish a water resources development plan are not existant in the Project area. Accordingly, these data must be derived from other neighboring stations.

Out of the stations shown in FIG. II-1, the station at Barotac Viejo is the nearest to the Project area with a comparatively long data period from 1971. On the other hand, the stations at Iloilo and Roxas are comparatively far from the site, although the records at these stations continue for more than 30 years. The Team accordingly examined the rainfall correlation between Sara and Roxas, Iloilo, Barotac Veijo from 1979-83. The observed monthly rainfall for 1979-83 is tabulated in TABLE II-3.

Within the above 5-year period, all four stations had complete records for 1982, the observed rainfall pattern for which is presented in FIG. II-6. The rainfall pattern at each station in 1982 shows that the pattern at Roxas is similar to that of Sara as compared to rainfall of other stations. Barotac Viejo presents quite a different rainfall pattern, and also the data seem partly unreliable. As a result, Barotac Viejo is excluded from the studies thereafter. Observed monthly rainfall at Sara (Project area), Roxas City and Iloilo City are tabulated in TABLE II-4, II-5 and II-6. On the basis of these values, monthly and 3-month running mean rainfall correlation between Sara and Roxas, and between Sara and Iloilo for a 5-year period (1979-83) are presented in FIG. II-7 and II-8.

Precipitation in the Philippines, including the Project area, includes substantial local showers, and correlations of monthly rainfall between Sara and Roxas and between Sara and Iloilo are not clearly evident. Sara-Roxas monthly rainfall correlation, however, is comparatively better than that of Sara-Iloilo. It seems preferable therefore, to supplement rainfall from Roxas when the Project area lacks data, and, in cases where Roxas lacks data, to supplement the same with data from Iloilo. The Team developed a correlation equation of monthly rainfall for Sara-Roxas and Sara-Iloilo as follows:

- Sara Monthly Rainfall - Roxas Monthly Rainfall
  - (Sara monthly rainfall)=0.93x(Roxas monthly rainfall)-3.3

- Sara Monthly Rainfall - Iloilo Monthly Rainfall
  when Iloilo monthly rainfall is less than or equal to 150mm
  - (Sara monthly rainfall)=(Iloilo monthly rainfall)
  when Iloilo Monthly Rainfall is more than 150mm
  - (Sara monthly rainfall)=0.67x(Iloilo monthly rainfall)+50

Estimated monthly rainfall in the Project area (Sara) based on the above correlations for a 20-year period (1964-83) is tabulated in TABLE II-7.

3.1.2 Annual Rainfall

Annual rainfall on the basis of the above estimated monthly rainfall in the Project area is tabulated in TABLE II-8. The table also shows hydrological annual rainfall for June to May. According to the results, average annual rainfall for a 20-year calendar period (1964-83) is 1,835.7mm, while for the hydrological 19-year period (1964/65-82/83) the same is 1820.9mm.

3.1.3 Daily Rainfall

(1) Daily Rainfall

The Team examined the relation between the monthly average number of rainy days at Sara, Roxas and Iloilo. However, the yearly variation was found to be substantial and no distinct relation was obtained. On average, the number of rainy days is almost the same, and hence the number of rainy days was assumed to be the same in Sara, Roxas and Iloilo. Daily rainfall in cases of missing data in the Project area has thus been estimated from Roxas daily rainfall multiplying the monthly Sara-Roxas rainfall ratio to the daily rainfall at Roxas. The same method was adopted for estimation from Iloilo data. The results are tabulated in TABLE II-9.

(2) Seasonal Heavy Rainfall Distribution

In order to assess the effect of heavy rainfall on paddy cultivation, comparatively heavy daily rainfall in each 10-day period throughout the year has been compiled and depicted in FIG. II-9 based on the daily rainfall in the Project area. As shown in the figure, almost no heavy rainfall was observed for a 20-year period in September, October, January and February in which harvesting is mainly planned under the proposed cropping pattern.

(3) Number of Rainy Days

On the basis of the daily rainfall in the Project area as discussed above, number of rainy days for every magnitude of daily rainfall was obtained and the results are tabulated in TABLE II-10. On the basis of the said table, an average of 172 work days annually for impervious zone embankment construction is planned for the proposed Catipayan dam.

3.1.4 River Basin Rainfall

Rainfall has been estimated on the basis of rainfall in the lowland cities of Barangay Aguirre, Sara Municipality and Roxas and Iloilo. Accordingly the rainfall data represent a lowland rainfall value. These rainfall data were used for calculation of irrigation water requirement. On the other hand, basin rainfall must be used in runoff analysis.

In general, the amount of rainfall increases in relation to increase in altitude. In the Project's mountain area, elevation of the Asue and Gubaton river basins ranges mainly from 0 to 100m and there are no high mountain peaks. For the rainfall of these basins therefore, the estimated rainfall of the Project's lower area was adopted in the Study. On the other hand, the Catipayan River basin has one 700m class mountain in the divide. Areas of each elevation class and ratio of the same in relation to the Catipayan River catchment at the staff gauge are presented below.

RELATIONSHIP BETWEEN ELEVATION AND AREA OF CATIPAYAN BASIN

Elevation (m)	Area (km^2)	Ratio (%)
100 - 200	34.02	66.3
200 - 300	12.03	23.4
300 - 400	3.01	5.9
400 - 500	1.31	2.6
500 -	0.93	1.8
Total	51.30	100.0

In this Study, reference has been made to rainfall amount in relation to altitude elevation with other project examples in the Philippines. Accordingly, Catipayan River basin rainfall is estimated on the basis of the assumption that rainfall amount increases by 5% for every 100m elevation increase, resulting in a 10% increase in the rainfall of the Project's lower area.

3.2 Hourly Rainfall

3.2.1 Observed Hourly Rainfall

TABLE II-11 shows observed hourly rainfall at newly installed rain gauges in the Project area for the period from June 27 to Nov. 5, 1984. At both sites, no heavy rainfall was recorded during the same period; 41.5mm is the maximum 24-hour rainfall at Barangay Tady, while 61.5mm is the maximum at Barangay Padios.

Hourly rainfall distributions observed at both stations, except those with small amounts, are illustrated in FIG. II-10. As observed from the same figure, spot showers are predominant in the Project area resulting in quite different rainfall patterns between the two stations. Rainfall observed at both stations during typhoon Undang on Nov. 5, 1984 however, have similar patterns as shown in the figure.

Hourly rainfall records outside the Project area in Panay Island were collected and tabulated in TABLE II-12, since no sufficient heavy rainfall record was obtained in the Project area. FIG. II-11 shows observed hourly rainfall except insignificant amounts at Roxas City, Agbadiang in Tapaz, and Iloilo City. Within the records shown in the same figure, rainfall at Agbadiang, Tapaz, Capiz from 6:00 a.m. on Sep. 22 to 6:00 a.m. on Sep. 23, 1977 presents appropriate 24-hour rainfall distribution caused by a monsoon, while the remaining seem to be spot showers.

3.2.2. Typhoon Undang Rainfall

The Team was in the Project area, Sara, when typhoon Undang struck the Visayas on November 5, 1984. The typhoon caused serious damage with maximum center winds of 185km/hour and heavy rainfall. According to the Team's observation, the total rainfall of the typhoon was 300mm or more, although the recorded rainfall of the two automatic rain gauges was only 53.5mm at Barangay Padois and 41.0mm at Barangay Tady. The Team concluded that the reason for the relatively small observed rainfall is that rainfall was not perfectly caught by the gauges due to the strong wind.

In order to estimate actual total rainfall for the typhoon, the Team collected more data at various points as presented in the following table.

TOTAL RAINFALL DURING TYPHOON UNDANG

Equipment	Site	Total Rainfall (mm)
Evaporation Pan	Barangay Aguirre, Sara	210
-do-	Barangay Padios, Sara	115
Pool	Municipal Hall, Sara	195
Rain Gauge	PAGASA, Iloilo City	255.6
-do-	NIA, Bgy. Dongsol, Pototan, Iloilo	137.4
-do-	PAGASA, Tacloban City, Leyte	153
-do-	PAGASA, Bago city, Negros Occ.	86.6
-do-	BRIS, Bago City, Negros Occ.	98

The Team also collected records of typhoon Undang prepared by PAGASA, which are presented as TABLE II-13.

3.3 Probable Rainfall

3.3.1 Probable Annual Rainfall

On the basis of the annual rainfall as estimated in section 3.1.2, probable excessive and non-excessive annual rainfall in the Project area was calculated and is presented in TABLE II-14. According to the estimated probable rainfall, annual rainfall in the Project area which is below the 5-year return period as a non-exessive value is tabulated below. The years 1981, '82 and '83 are found to have relatively less rainfall in the scale of a 20-year return period.

PROBABLE ANNUAL RAINFALL

Calendar Year			Hydrological Year		
Year	Rainfall (mm)	Return Period (year)	Year	Rainfall (mm)	Return Period (year)
1968	1492.5	5	1977/78	1409.3	6
1982	1240.6	20	1972/73	1223.8	14
1981	1221.2	23	1981/82	1202.3	16
			1982/83	1133.4	25

3.3.2 Probable Daily and Continuous Rainfall

On the basis of the estimated daily rainfall for a 20-year period (1964-83), annual maximum 1-day, 2-day and 3-day rainfall is tabulated in TABLE II-15. Probable daily maximum and continuous rainfall is presented in TABLE II-16.

3.3.3 Probable Hourly Rainfall

The numbers of observed hourly rainfall in the Project area discussed previously are not sufficient to obtain probable rainfall. For the analysis of flood, therefore, probable rainfall at Iloilo City tabulated in TABLE II-17, compiled by PAGASA has been adopted in this study.

10-year and 20-year return period and duration of 24-hour design rainfall for drainage analysis were thus developed on the basis of rainfall patterns at Agbadiang, Tapaz, Capiz on September 22-23, 1977 as described previously and of probable rainfall obtained for Iloilo City as tabulated below. For the estimation of hourly rainfall distribution, 1-hour, 6-hour and 24-hour rainfall were assumed to be the same as those for probable rainfall.

24-HOUR DESIGN RAINFALL FOR DRAINAGE ANALYSIS

Unit: mm/hr

Hour	0	1	2	3	4	5	6	7	8
Observed		1.0	3.0	1.0	2.0	4.0	2.0	3.0	35.0
10-year		2.7	8.4	2.7	5.6	11.2	5.6	8.4	68.2
25-year		3.1	11.2	3.7	7.6	15.0	7.6	11.2	79.5
Hour	8	9	10	11	12	13	14	15	16
Observed		13.0	2.0	9.0	8.0	4.0	1.0	1.0	0.0
10-year		21.3	3.3	14.7	13.1	6.6	2.8	2.8	0.0
25-year		26.1	4.0	18.0	16.0	8.0	3.7	3.7	0.0
Hour	16	17	18	19	20	21	22	23	24
Observed		2.0	0.0	5.0	2.0	0.0	3.0	1.0	1.0
10-year		5.6	0.0	14.0	5.6	0.0	8.4	2.8	2.8
25-year		7.5	1.0	18.7	7.5	0.0	11.2	3.7	3.7

Note: Total amount of rainfall for observed, 10-year and 20-year periods are 103.0,216.6 and 271.3mm, respectively.

3.3.4 Design Hyetograph for Flood Analysis

For the analysis of flood discharge, 24-hour hyetographs for various return periods were developed on the basis of probable rainfall at Iloilo City. The hyetographs were estimated to satisfy the rainfall amount during 1-hour, 12-hour and 24-hour periods as the same value as those of the probable value.

The peak was set at the 13th hour for a 10-year return period hyetograph, while for hyetographs of more than 10-year return periods, the same was set at the 17th hour. The estimated hyetographs are presented in TABLE II-18.

4. DAILY DISCHARGE

4.1 River Conditions

The Asue River and its tributaries, the Gubaton River and the Catipayan River basins are illustrated in FIG. II-12 and the profiles of these rivers are shown in FIG. II-13.

The Asue River originates in a gentle mountain about 10km northwest of Sara Town and flows along the east side of the Project irrigation area from northwest to south, eventually flowing into Ajuy Bay. The total length of the river is about 30km. The river gathers discharge from small rivers and creeks which flow from the western and eastern mountains, the hills and the low flat area.

Although the Asue River has a total catchment area of 110km^2 at the river mouth, the confluence of these rivers and creeks is mostly at the downstream portion, and hence the catchment area in the upstream portion is limited. Accordingly, the river does not provide sufficient irrigation water to the area at present. Especially in the dry season, river discharge is very small and during severe droughts the river occasionally dries up in the upstream portion. A staff gauge was installed in December, 1978 at the upstream portion in Barangay Aguirre with a catchment area of 9.48km^2, and since then water level gauging has been carried out twice daily.

The Serruco River is one of the tributaries of the Asue River and flows into the Asue River about 8km upstream from the river mouth. The catchment area at the confluence point with the Asue River is 45.36km^2 and total length is about 18km. The river presently supplies water to a Communal Irrigation System through a diversion dam which was constructed at a point with a catchment area of 22.9km^2. The river basin at the diversion dam is composed of hills and gentle mountains. A gauging station was installed in December 1978. The station was transferred 3 times in accordance with the construction of the said diversion dam, and is presently installed 1.2km upstream from the diversion dam with a catchment area of 18.9km^2.

Besides the Asue River basin, the Gubaton River basin lies in the eastern part of the Serruco River basin with a catchment of about 25.3km^2. The river flows directly into Ajuy Bay. About 33% of the basin is composed of low-flat cultivated land and the remaining area is gentle mountains and hills. Depending upon the proposed irrigation scheme, the rivers in this area may be utilized to provide irrigation water. Furthermore, creeks in the Asue River basin present the possibility of effectively utilizing the return flow of the upstream portion.

The Catipayan River located in the southeastern end of the Panay River is a tributary of the same which has the largest basin in Panay, and flows into the Panay River through the Maayon River. Under the present Project, construction of a dam is proposed on the said river to supplement irrigation water. The southern portion of the basin borders on the Asue River Basin with 200m class mountains while the Catipayan basin is composed of 100m to 700m mountains. The watershed is poorly vegetated, and a low water holding capacity is therefore assumed. A gauging staff was installed in 1979 at Barangay Ardemil with a catchment area of 51.3km^2.

4.2 <u>Daily Discharge</u>

4.2.1 <u>Observed Discharge</u>

The Team examined the records of daily water level of the Catipayan, Asue and Serruco rivers for the 5-year period from 1979-83. Based on discharge measurement which was conducted almost every month, a rating curve was drawn for each river. Catipayan and Asue rivers have a relatively good relation between the gauge height and discharge in the exponent function, although the Serruco River presents no clear relation because the gauge site has been transferred 3 times and hence each site does not have a sufficient number of discharge measurements recorded.

TABLE II-19 shows monthly average discharge of each river which was calculated on the basis of estimated daily discharge. The table also shows annual runoff coefficients based on the Project area's annual rainfall. The results show a comparatively high runoff coefficient (0.76) for the Catipayan River, which seems appropriate considering topographical, geological and vegetation conditions in the watershed area.

On the other hand, the runoff coefficient obtained for the Asue River is rather small at 0.44. The reason may be that in the upstream portion of the Asue River, creeks and hill slope water are utilized for minor irrigation. Therefore, the discharge of the Asue River available for use after development is assumed to be greater than the above value.

The correlation of the discharge for the 3 rivers is not clearly evident, although discharge measurements by the Team revealed that the Catipayan River discharge at the gauging station and proposed dam site have almost the same unit discharge per km^2. This is true also for the discharge of the Serruco and Gubaton rivers.

4.2.2 <u>Estimated Discharge</u>

The Team estimated discharge of the Asue and Catipayan rivers for a 20-year period by the Tank-Model simulation method. Simulation was based on observed discharge for the 5-year period from 1979-83. Simulation was performed giving due attention to i) annual runoff coefficient, ii) tendency of discharge recession curve and iii) specific drought discharge. The comparative plot of observed and simulated discharges for the Catipayan River at Barangay Ardemil and the Asue River at Barangay Aquirre is shown in FIG. II-14. FIG. II-14 also shows simulated tank structure for the two rivers. On the basis of the simulated tank model, daily discharge for the 20-year period from 1964-83 was estimated for the Catipayan River and the Asue River, and the 10-day value is tabulated in TABLE II-20 and II-21, respectively.

As the Serruco River's observed daily water level and monthly discharge is unreliable, daily level simulation will likewise be inaccurate. Therefore, the tank structure of the Asue River was adopted for the Serruco River and the discharge was adjusted by coefficient to the Asue Basin after considering annual runoff coefficient, drought discharge and discharge recession curve tendency. FIG. II-15 shows correlation of monthly discharges of the Serruco and Asue rivers. No monthly or seasonal correlation is evident from the same, and a constant coefficient at 1.25 to the Asue Basin was adopted for estimation of the Serruco River discharge. The same method was also adopted for the estimation of the Gubaton River discharge. The following table summarizes the discharge of each river showing a 20-year monthly average discharge.

DISCHARGE OF THE 4 MAIN RIVERS

	Catipayan	Asue	Serruco	Gubaton
Catchment (km^2)	44.2	9.48	22.9	18.8
January	1.41 3.763	0.26 0.703	0.79 2.121	0.65 1.742
February	0.82 1.996	0.15 0.374	0.46 1.130	0.38 0.927
March	0.78 2.095	0.12 0.324	0.37 0.978	0.30 0.803
April	0.72 1.860	0.11 0.275	0.32 0.830	0.26 0.681
May	1.23 3.304	0.15 0.392	0.44 1.184	0.36 0.972
June	3.16 8.197	0.33 0.868	1.01 2.620	0.83 2.151
July	3.52 9.421	0.44 1.175	1.32 3.549	1.09 2.914
August	3.19 8.557	0.43 1.144	1.29 3.454	1.06 2.836
September	3.26 8.455	0.45 1.172	1.37 3.540	1.12 2.906
October	3.57 9.564	0.50 1.348	1.52 4.071	1.25 3.342
November	3.34 8.650	0.51 1.309	1.53 3.954	1.25 3.246
December	2.40 6.424	0.40 1.058	1.19 3.196	0.98 2.624
Ave./Total	2.29 72.288	0.32 10.143	0.97 30.626	0.80 25.143

Note: Values are 20-year average from 1964-83
Upper column (m^3/s), Lower column (MCM)

4.2.3 Low Water Flow

Based on the estimated discharge, the annual lowest discharge of the Catipayan and Asue rivers during the 20-year period from 1964-83 are tabulated in TABLE II-22 and II-23. The table also shows the probable minimum water discharge of each river.

5. FLOOD DISCHARGE

In this section, flood analysis for the Catipayan River is discussed while flood and runoff analysis for the irrigation service area is discussed in APPENDIX VII under IRRIGATION AND DRAINAGE.

5.1 Observed Flood in Catipayan River

5.1.1 Observed Water Stage

Hourly water stage record at the Catipayan River gauging station during the period when the water level exceeds a gauge of 0.80m was obtained by the Team for four months from July to October, 1984. Major records are collated in TABLE II-24 coupled with estimated corresponding discharge which will be discussed hereinafter. During typhoon Undang, water stage was not observed since the gauge was washed away by the flood.

5.1.2 Water Stage - Discharge Relation

In order to develop water stage - discharge relation at the gauge site and dam site B on the Catipayan River, the Team carried out a water surface profile survey. At the same time, a flood mark survey for typhoon Undang was conducted. These survey results were compiled as shown in FIG. II-16, while river cross sections for each site are presented in FIG. II-17.

At the gauge site, water stage - discharge relation is expressed by Manning's formula as follows:

$$Q = \frac{1}{n} \cdot A \cdot R^{2/3} \cdot I^{1/2}$$

where; Q : discharge (m^3/sec)

n : Manning's roughness coefficient

A : cross-sectional area of flow (m^2)
When water stage: H is equal to or less than 2.0m
A=(1.535 H + 17.447)(H-0.1)
When H exceeds 2.0m and is equal to or less than 4.0m
A=(2.355 H + 18.723)(H-2.0) + 38.98
When H exceeds 4.0m
A=(5.250 H + 11.850)(H-4.0) + 95.27

R : hydraulic mean depth (A/P)

P : Wetted perimeter (m)
When H is equal to or less than 2.0m
P=3.278 H + 17.227
When H exceeds 2.0m and is equal to or less than 4.0m
P=5.276 H + 14.129
When H exceeds 4.0m
P=10.70 H - 7.57

I : riverbed gradient

For the gauge site, a roughness coefficient 'n' of 0.05 and a riverbed gradient of 1:1,013 are assumed on the basis of field survey results.

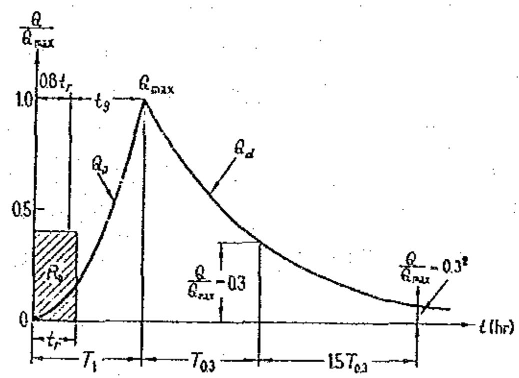
5.1.3 Observed Flood Discharge

Using the above Manning's formula, the observed water stages at the gauge site have been converted to discharges as shown in TABLE II-24. On the basis of the results of flood mark survey for typhoon Undang, peak discharges at the gauge site and dam site B were estimated by Manning's formula at 343m^3/sec and 383m^3/sec, respectively.

5.2 Flood Analysis

5.2.1 Development of Unit Hydrograph

Considering the fact that no sufficient data on flood and corresponding rainfall are available for the Catipayan River, the unit hydrograph method was employed in flood analysis. The unit hydrograph is expressed as follows:



$$Qmax = \frac{1}{3.6} \cdot A \cdot R_o \quad / \ (0.3T1 + To.3)$$

Upgrading curve

when $0 \leqq t \leqq T1$ then $Qa/Qmax = (t/T1)^{2.4}$

recession curve

when $1 > Qd/Qmax \geqq 0.3$ then $Qd/Qmax = 0.3^{(t - T1) / To.3}$

when $0.3 > Qd/Qmax \geqq 0.3^2$ then $Qd/Qmax = 0.3^{(t - T1 + 0.5To.3)/1.5To.3}$

when $0.3^2 > Qd/Qmax$ then $Qd/Qmax = 0.3^{(t - T1 + 1.5To.3)/2.0To.3}$

where:
- Qmax : peak flow of unit hydrograph (m^3/sec)
- Qa : flow in upgrading curve (m^3/sec)
- Qd : flow in recession curve (m^3/sec)
- A : catchment area (km^2)
- Ro : unit rainfall (mm)
- T1 : time of concentration (hr)
- To.3 : time from the peak to reduce 0.3 Qmax (hr)

Tl at 2 hours and To.3 also at 2 hours have been assumed for all sites. Catchment area at dam site C, dam site B and the gauge site are $44.2km^2$, $48.0km^2$ and $51.3km^2$, respectively.

5.2.2 Verification by Observed Discharge

The developed unit hydrograph was verified through comparison of the observed discharge and simulated discharge by unit hydrograph and is presented hereinafter. For verification, simple pulse of flood was selected for convenient comparison.

Out of the observed floods of the Catipayan River at the gauging station listed in TABLE II-24, the floods on Sep. 17, Sep. 22 and Oct. 20-21 were selected for verification. FIG. II-18 shows the comparative plot of observed and simulated hydrographs derived from dam site rainfall. As shown in the figure, observed and simulated discharge are very similar. Although the observed and simulated magnitudes of peak discharges are somewhat different, the difference is within the allowable scale considering the preciseness of basin rainfall.

Total rainfall for typhoon Undang was estimated and is presented hereinafter, based on the determined unit hydrograph and observed peak discharge at both the gauging station and alternative dam site B.

Assuming that the 12-hour rainfall pattern is the same as the pattern which was observed at Barangay Tady, observed peak discharge of $343m^3$/sec at the gauging station and $383m^3$ /sec at dam site B as discussed previously were adversely converted to total rainfall. As a result, a total rainfall of 155mm and 185mm for the respective sites was derived. This value corresponds to about a 10-year return period 12-hour value on the basis of probable rainfall at Iloilo. The total rainfall of about 170mm obtained above seems appropriate compared to the observed value in and around the Project area as discussed previously.

5.2.3 Design Flood Hydrograph for Dam and Appurtenant Structures

(1) Standard Rainfall

For the estimation of the design flood hydrograph of dam and appurtenant structures, probable rainfall prepared for Iloilo by PAGASA was adopted.

Twenty-four hour hyetographs peaking at the 17th hour for the dam and spillway and at the 12th hour for the bypass tunnel were used as standard rainfalls for the design hydrograph of the dam and appurtenant structures. Adjustment factors for elevation increase were not applied to the design storm, since rainfall considered is point rainfall and will provide offset adjustment.

(2) Design Flood Hydrograph

Design flood hydrographs for various return periods were prepared and are presented in TABLE II-25. As a result, peak discharges for a 200-year return period and a 10-year return period of $703.7m^3$/sec and $358.7m^3$/sec, respectively were obtained.

6. SEDIMENTATION, WATER QUALITY AND WATER RIGHTS

6.1 Sedimentation

Monthly water sampling and sediment concentration analyis for the Asue River at Barangay Aguirre and for the Catipayan River at Barangay Ardemil have been conducted by NIA. Water sampling was conducted at the same time as discharge measurement. Accordingly, only data for relatively low discharge were collected.

Furthermore, water sampling was conducted with a depth-integrating sediment sampler (milk bottle type) and sediment concentration analysis is for wash and suspended load and does not include bed load. The results of the analysis, accordingly were not used in the estimation of design sediment volume for the proposed Catipayan dam.

6.2 Water Quality

Chemical analyses for the above samples of the Asue, Serruco and Catipayan rivers were made by NIA Laboratory. On the basis of these analyses and US Department of Agriculture and Environmental Protection Agency Standards, water quality for irrigation was evaluated. The quality analysis of 16 samples are shown in the classification chart, FIG. II-19. All samples are classified into C1-S1 and C2-S1 grades, i.e., low to medium salinity hazard and low sodium hazard which is assessed by the sodium absorption ratio. On the whole, the results indicate that all water sources of the Asue, Serruco and Catipayan rivers are suitable for irrigation purposes with no cause for water quality management problems.

Results of bacteriological analysis of water in wells and springs in the Project area are complied in the DATA BOOK. As shown in the results, almost all samples in the Project area have a bacterial count within the allowable limit and have a negative coliform organism count. Accordingly, no specific measures will be required for water in the area for domestic water supply.

6.3 Water Rights

Registered water rights in the municipalities related to the Project are listed in TABLE II-26. All the water rights are for irrigation purposes and, as the area will be included under the Project, no problems are envisioned.

TABLE II-1

OBSERVED MONTHLY EVAPORATION IN SARA

Unit: mm

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1979	144.0	159.8	217.1	224.5	167.7	86.9	96.2	98.1	108.2	74.2	86.1	109.7	1,572.5
80	76.9	111.3	163.0	196.8	-	-	-	60.5	58.8	80.1	65.2	65.1	-
81	86.4	143.4	136.9	149.0	154.2	100.2	117.7	131.1	124.8	130.5	116.1	137.9	1,528.2
82	136.0	132.2	128.3	159.0	158.5	136.4	142.9	113.9	114.4	120.2	122.0	128.7	1,592.5
83	105.3	101.2	(24.3)	(26.4)	(36.2)	(42.6)	77.0	-	78.1	64.2	81.6	58.5	-
84	(38.2)	(40.0)	(15.3)	-	-	-	-	-	-	-	-	-	-
Mean	109.7	129.6	161.3	182.3	160.1	107.8	108.5	100.9	96.9	93.8	94.2	100.0	1,564.4

Note : ( ) value seems inapplicable

TABLE II-2

OBSERVED MONTHLY EVAPORATION IN ILOILO

Unit: mm

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1957	-	-	229.7	197.6	236.1	171.9	139.9	151.1	139.0	157.4	158.3	174.0	-
58	157.6	177.8	248.6	242.7	228.2	181.0	166.3	150.4	171.8	141.1	135.6	132.2	2,133.3
59	147.4	187.1	204.2	225.8	189.9	217.4	152.1	142.8	142.4	138.9	130.4	128.3	2,006.7
60	156.6	150.6	184.5	210.8	186.2	159.9	149.5	146.6	-	144.5	110.1	132.4	-
61	141.3	147.6	215.1	218.6	188.4	139.7	160.6	138.6	149.9	151.6	147.6	140.4	1,939.4
62	123.7	113.5	185.9	213.0	226.9	146.1	148.8	130.4	119.1	156.1	144.9	147.3	1,855.7
63	133.2	133.2	172.8	232.3	226.0	149.0	171.1	-	145.1	119.7	132.9	141.2	-
64	183.7	155.3	242.0	208.2	174.5	168.7	137.6	178.4	125.2	146.0	122.2	122.2	1,964.0
65	142.8	164.4	182.7	156.6	209.7	161.2	150.2	177.9	139.2	-	-	-	-
Mean	148.3	153.7	207.3	211.7	207.3	166.1	152.9	152.0	141.5	144.4	135.2	139.8	1,960.2

1979-83 OBSERVED MONTHLY RAINFALL IN SARA, ROXAS, ILOILO, BAROTAC VIEJO

Unit: mm

Year	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1979	Sara	19.9	34.1	62.5	101.1	193.0	387.0	467.5	245.7	130.3	113.5	125.6	122.4	2,002.6
	Roxas	***	***	***	***	104.5	381.7	136.1	241.3	174.6	227.4	80.5	177.4	(1,523.5)
	Iloilo	12.5	17.7	0.0	125.3	97.0	129.5	501.5	667.4	207.6	706.4	84.5	***	(2,549.4)
	Barotac Viejo	42.8	13.4	39.3	159.5	50.8	154.4	174.8	114.0	129.2	157.4	70.1	57.2	1,162.9
1980	Sara	80.7	24.4	115.8	4.3	***	***	***	232.6	295.3	331.4	148.9	166.2	(1,399.6)
	Roxas	82.3	60.3	99.9	39.0	***	706.6	255.8	181.7	122.0	254.5	214.0	119.9	(2,136.0)
	Iloilo	21.5	74.3	74.8	7.3	***	648.0	220.8	206.6	348.4	363.2	193.2	84.3	(2,252.4)
	Barotac Viejo	49.3	11.3	119.5	18.5	23.7	205.7	201.4	136.8	108.5	196.3	68.3	143.3	1,282.6
1981	Sara	53.1	19.0	18.0	55.8	79.4	131.1	171.1	62.1	302.6	122.6	93.1	113.3	1,221.2
	Roxas	96.0	***	12.7	30.7	57.3	211.7	122.8	145.8	222.8	235.9	192.6	118.5	(1,446.8)
	Iloilo	23.1	5.8	7.6	80.4	30.6	422.4	203.0	345.9	283.8	117.3	134.3	84.8	1,739.0
	Barotac Viejo	118.2	24.2	15.3	***	64.5	100.9	130.6	55.1	277.0	103.6	101.3	***	(990.7)
1982	Sara	58.3	0.0	59.7	0.0	88.4	283.3	133.3	344.3	63.0	161.0	21.8	27.5	1,240.6
	Roxas	60.3	36.0	93.2	10.5	101.5	199.2	87.7	369.5	143.7	142.1	94.8	55.2	1,393.7
	Iloilo	15.3	2.0	151.8	60.8	158.0	396.6	285.7	668.1	405.9	215.6	53.4	9.9	2,423.1
	Barotac Viejo	21.5	18.5	175.9	30.3	45.5	83.3	194.9	198.3	51.3	46.2	17.7	20.5	903.9
1983	Sara	84.2	0.0	0.0	0.0	15.0	289.7	353.2	***	296.1	233.1	310.7	92.3	(1,674.3)
	Roxas	22.8	4.0	5.7	1.5	6.4	392.4	366.8	214.3	245.8	***	***	***	(1,159.7)
	Iloilo	73.4	5.0	31.2	2.4	9.4	181.5	247.0	278.5	350.1	264.6	284.9	102.1	1,830.1
	Barotac Viejo	7.7	5.5	5.5	0.0	11.5	27.5	192.1	24.5	29.5	84.5	***	98.7	(487.0)

Note: *** no data

TABLE II-4

OBSERVED MONTHLY RAINFALL AT SARA

Unit: mm

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1964													
65													
66													
67													
68													
69													
70							NO DATA						
71													
72													
73													
74													
75													
76													
77													
78													
79	19.9	34.1	62.5	101.1	193.0	387.0	467.5	245.7	130.3	113.5	125.6	122.4	2,002.6
80	80.7	24.4	115.8	4.3	-	-	-	232.6	295.3	331.4	148.9	166.2	-
81	53.1	19.0	18.0	55.8	79.4	131.1	171.1	62.1	302.6	122.6	93.1	113.3	1,221.2
82	58.3	0.0	59.7	0.0	88.4	283.3	133.3	344.3	63.0	161.0	21.8	27.5	1,240.6
83	84.2	0.0	0.0	0.0	15.0	289.7	353.2	-	296.1	233.1	310.7	92.3	-
MEAN	59.2	15.5	51.2	32.2	83.8	272.8	281.3	221.2	217.5	192.3	140.0	104.3	1,488.1

TABLE II-5

OBSERVED MONTHLY RAINFALL AT ROXAS CITY

Unit: mm

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1964													
65						NO DATA							
66													
67													
68	-	30.8	15.5	3.3	30.8	171.4	268.1	-	148.1	366.2	231.9	-	-
69	43.1	32.3	21.1	10.5	163.0	193.8	394.9	275.9	137.4	156.3	80.6	171.4	1,680.3
70	47.2	122.6	96.7	-	-	-	284.8	148.5	293.7	-	419.4	141.5	-
71	147.8	72.0	191.3	131.3	307.0	625.5	447.4	171.9	248.9	379.3	372.9	78.9	3,174.2
72	379.6	19.7	60.8	21.7	28.7	277.8	46.3	136.7	230.0	168.0	248.9	166.3	1,784.5
73	3.5	25.5	39.0	12.9	0.0	121.5	290.9	372.8	580.7	287.3	534.2	429.6	2,697.9
74	102.8	74.2	21.2	22.6	74.1	154.4	284.2	149.2	114.5	464.0	224.3	231.8	1,917.3
75	126.2	72.9	8.9	270.8	95.4	212.8	159.6	215.6	387.2	395.9	209.2	389.8	2,544.3
76	33.3	25.6	30.0	12.9	164.7	141.4	137.5	299.1	138.3	237.2	362.3	267.3	1,849.6
77	123.2	134.7	29.5	46.6	79.4	315.8	227.9	209.2	197.0	183.0	74.7	77.5	1,698.5
78	-	-	-	-	-	-	-	-	-	-	-	-	-
79	-	-	-	-	104.5	381.7	136.1	241.3	174.6	227.4	80.5	177.4	-
80	82.3	60.3	99.9	39.0	-	706.6	255.8	181.7	122.0	254.5	214.0	119.9	-
81	96.0	-	12.7	30.7	57.3	211.7	122.8	145.8	222.8	235.9	192.6	118.5	-
82	60.3	36.0	93.2	10.5	101.5	199.2	87.7	369.5	143.7	142.1	94.8	55.2	1,393.7
83	22.8	4.0	5.7	1.5	6.4	292.4	366.8	214.3	245.8	-	-	-	-
MEAN	97.5	54.7	51.8	47.3	101.1	286.1	234.1	223.7	225.6	269.0	238.6	186.5	2,082.3

TABLE II-6

OBSERVED MONTHLY RAINFALL AT ILOILO CITY

Unit: mm

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1964	38.2	38.7	14.2	37.6	250.2	308.8	81.6	324.0	206.3	195.7	460.8	52.5	2,008.6
65	57.8	12.7	81.8	33.3	70.6	249.3	360.7	267.5	219.0	166.4	251.8	121.2	1,892.1
66	81.1	21.1	10.5	11.0	514.4	255.5	364.7	115.4	234.5	200.5	255.6	70.7	2,135.0
67	184.8	48.8	39.9	12.4	78.1	246.4	326.6	425.0	102.0	322.5	185.4	29.7	2,001.6
68	11.5	7.1	10.7	15.1	75.7	158.4	184.4	409.7	141.2	50.8	190.4	9.9	1,264.9
69	6.4	0.0	8.9	10.0	45.3	152.6	426.1	124.7	183.6	109.6	53.2	71.2	1,191.6
70	25.9	7.2	35.1	5.3	151.0	414.4	195.8	255.1	234.9	225.0	101.8	60.7	1,712.2
71	9.2	4.1	5.6	84.0	94.2	168.8	353.3	182.4	42.6	301.3	77.4	110.5	1,433.4
72	143.4	23.4	26.0	31.0	118.7	236.6	767.4	221.9	377.6	187.9	188.1	150.0	2,472.0
73	3.5	20.5	2.0	12.5	0.0	120.2	392.6	533.9	480.9	272.3	483.5	161.7	2,483.6
74	48.8	22.0	33.1	27.5	36.8	265.2	302.4	326.9	92.9	669.0	147.0	139.0	2,110.6
75	130.5	85.7	11.1	144.9	147.1	378.5	99.5	253.6	297.7	328.2	55.0	119.5	2,051.3
76	45.5	37.9	26.0	20.6	305.3	217.3	509.1	386.7	331.2	174.3	131.8	99.5	2,285.2
77	38.7	60.4	21.0	0.0	8.1	247.5	224.3	281.0	545.4	73.6	77.0	21.7	1,598.7
78	26.2	9.1	3.8	131.4	66.8	150.1	131.6	503.6	320.8	252.7	111.6	162.6	1,870.3
79	12.5	17.7	0.0	125.3	97.0	129.5	501.5	667.4	207.6	706.4	84.5	-	-
80	21.5	74.3	74.8	7.3	-	648.0	220.8	206.6	348.4	363.2	193.2	94.3	-
81	23.1	5.8	7.6	80.4	30.6	422.4	203.0	345.9	283.8	117.3	134.3	84.8	1,739.0
82	15.3	2.0	151.8	60.8	158.0	396.6	285.7	668.1	405.9	215.6	53.4	9.9	2,423.1
83	73.4	5.0	31.2	2.4	9.4	181.5	247.0	278.5	350.1	264.6	284.9	102.1	1,830.1
MEAN	49.9	25.2	29.8	42.6	118.8	267.4	308.9	338.9	270.3	259.8	176.0	88.0	1,916.9

TABLE II-7

ESTIMATED MONTHLY RAINFALL IN PROJECT AREA

Unit: mm

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1964	38.2	38.7	14.2	37.6	216.8	255.9	81.6	266.0	187.5	180.5	357.2	52.5	1,726.7
65	57.8	12.7	81.8	33.3	70.6	216.2	290.5	228.3	196.0	160.9	217.9	121.2	1,687.2
66	81.1	21.1	10.5	11.0	392.9	220.3	293.1	115.4	206.3	183.7	220.4	70.7	1,826.6
67	173.2	48.8	39.9	12.4	78.1	214.3	267.7	333.3	102.0	265.0	173.6	29.7	1,738.0
68	11.5	25.3	11.1	0.0	25.3	156.1	246.0	323.1	134.4	337.3	212.4	9.9	1,492.5
69	36.8	26.7	16.3	6.5	148.3	176.9	364.0	253.3	124.5	142.1	71.7	156.1	1,523.1
70	40.6	110.7	86.6	5.3	150.7	326.3	261.6	134.8	269.8	200.0	386.7	128.3	2,101.4
71	134.2	63.7	174.6	118.8	282.2	578.4	412.8	156.6	228.2	349.4	343.5	70.1	2,912.4
72	349.7	15.0	53.2	16.9	23.4	255.1	39.8	123.8	210.6	152.9	228.2	151.4	1,620.0
73	0.0	20.4	33.0	8.7	0.0	109.7	267.2	343.4	536.8	263.9	493.5	396.2	2,472.8
74	92.3	65.7	16.4	17.7	65.6	140.3	261.0	135.5	103.2	428.2	205.3	212.3	1,743.5
75	114.1	64.5	5.0	248.5	85.4	194.6	145.1	197.2	356.8	364.9	191.3	359.2	2,326.6
76	27.7	20.5	24.6	8.7	149.9	128.2	124.6	274.9	125.3	217.3	333.6	245.3	1,680.5
77	111.3	122.0	24.1	40.0	70.5	290.4	208.6	191.3	179.9	166.9	66.2	68.8	1,540.0
78	26.2	9.1	3.8	131.4	66.8	150.1	131.6	385.7	263.9	218.5	111.6	158.4	1,657.0
79	19.9	34.1	62.5	101.1	193.0	387.0	467.5	245.7	130.3	113.5	125.6	122.4	2,002.6
80	80.7	24.4	115.8	4.3	43.1	653.8	234.6	232.6	295.3	331.4	148.9	166.2	2,331.1
81	53.1	19.0	18.0	55.8	79.4	131.1	171.1	62.1	302.6	122.6	93.1	113.3	1,221.2
82	58.3	0.0	59.7	0.0	88.4	283.3	133.3	344.3	63.0	161.0	21.8	27.5	1,240.6
83	84.2	0.0	0.0	0.0	15.0	289.7	353.2	196.0	296.1	233.1	310.7	92.3	1,870.3
MEAN	79.5	37.1	42.6	42.9	112.3	257.9	237.7	227.2	215.6	229.7	215.7	137.6	1,835.7

ESTIMATED ANNUAL RAINFALL IN PROJECT AREA

Unit: mm

Calendar Year				Hydrological Year			
Year	Rainfall	Year	Rainfall	Year	Rainfall	Year	Rainfall
1964	1,726.7	1974	1,743.5	64/65	1,637.4	74/75	2,003.2
1965	1,687.2	1975	2,326.6	65/66	1,947.6	75/76	2,040.4
1966	1,826.6	1976	1,680.5	66/67	1,662.4	76/77	1,817.1
1967	1,738.0	1977	1,540.0	67/68	1,458.9	77/78	1,409.3
1968	1,492.5	1978	1,657.0	68/69	1,653.8	78/79	1,330.3
1969	1,523.1	1979	2,002.6	69/70	1,682.4	79/80	1,860.3
1970	2,101.4	1980	2,331.1	70/71	2,481.0	80/81	2,288.1
1971	2,912.4	1981	1,221.2	71/72	2,597.2	81/82	1,202.3
1972	1,620.0	1982	1,240.6	72/73	1,223.8	82/83	1,133.4
1973	2,472.8	1983	1,870.3	73/74	2,668.5		
		Ave.	1,835.7			Ave.	1,820.9

ESTIMATED DAILY RAINFALL IN PROJECT AREA

1964 Daily Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1	0.5	0.0	0.5	0.0	0.0	3.4	0.0	11.3	0.0	19.9	1.9	0.0	
2	0.0	1.5	0.0	0.0	0.0	0.0	0.0	1.1	0.0	2.1	0.0	0.0	
3	0.0	0.3	0.0	0.8	0.0	0.0	0.5	8.9	1.2	12.2	0.2	0.0	
4	0.0	0.3	0.0	0.0	0.0	0.0	33.3	29.4	6.0	0.0	7.1	0.0	
5	0.0	0.0	0.0	0.5	0.0	0.0	7.1	11.1	0.0	2.6	17.6	12.7	
6	0.0	0.3	0.0	0.0	2.7	0.0	3.3	16.3	13.9	2.8	24.4	1.7	
7	0.0	0.0	0.0	0.0	0.3	17.2	0.0	30.2	5.4	0.0	6.9	1.4	
8	1.3	0.0	0.0	3.1	0.0	0.0	8.7	0.0	2.8	0.0	11.6	0.0	
9	0.0	0.0	0.0	0.3	1.1	9.4	1.3	0.0	0.7	6.8	0.0	0.0	
10	0.5	0.0	0.0	5.6	27.1	6.0	0.0	22.9	18.3	4.9	0.0	0.0	
ST	2.3	2.4	0.5	10.3	31.2	36.0	54.2	131.2	48.3	51.3	69.9	15.9	
11	0.0	0.0	0.0	0.0	21.1	1.9	0.0	0.0	9.3	0.0	0.0	6.1	
12	6.4	4.8	0.0	0.0	6.8	0.0	1.5	0.0	1.2	4.0	12.2	0.0	
13	0.0	0.0	0.0	0.0	0.0	0.0	10.9	0.0	9.7	8.4	0.5	0.0	
14	0.0	24.6	0.0	0.0	0.0	0.4	0.0	0.0	0.0	34.2	2.9	15.0	
15	0.0	0.0	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.5	0.0	0.0	
16	0.0	0.0	0.0	0.0	0.0	0.8	0.6	0.0	0.0	0.6	2.0	0.0	
17	0.0	0.0	0.0	0.0	2.0	27.3	0.0	12.5	0.0	0.0	26.6	1.5	
18	0.0	0.0	0.0	0.3	72.2	3.4	0.0	6.2	0.0	10.4	12.6	2.0	
19	0.0	3.0	0.0	0.0	0.0	2.1	3.3	11.1	4.4	0.0	121.3	0.0	
20	0.3	0.0	0.0	0.0	4.0	28.0	9.2	3.8	4.0	0.5	11.0	0.0	
ST	6.7	32.4	0.0	0.3	106.1	68.6	25.5	33.6	27.5	58.5	189.2	24.6	
21	5.6	0.0	0.0	0.3	1.1	1.1	0.0	47.9	2.5	8.4	0.0	1.3	
22	3.0	0.8	0.0	0.0	38.6	1.1	1.6	12.7	0.3	9.6	1.4	0.3	
23	0.0	0.0	0.0	0.0	20.3	3.6	0.0	0.0	20.5	0.0	0.6	0.0	
24	0.0	0.0	0.0	0.0	6.2	6.4	0.3	0.4	12.3	1.2	18.9	0.0	
25	0.0	1.3	0.0	0.0	3.6	8.9	0.0	15.9	0.3	0.0	9.8	0.0	
26	0.0	0.0	13.7	0.0	0.0	7.5	0.0	0.0	0.0	0.7	27.6	10.2	
27	0.0	0.8	0.0	0.0	0.0	16.0	0.0	0.0	2.8	13.1	6.1	0.0	
28	0.0	1.0	0.0	0.0	8.6	7.4	0.0	0.0	59.5	7.5	33.9	0.0	
29	0.0	0.0	0.0	26.4	0.0	56.3	0.0	0.0	11.4	22.0	0.0	0.0	
30	1.5	###	0.0	0.3	0.0	43.0	0.0	6.2	2.1	8.2	0.0	0.0	
31	19.1	###	0.0	###	1.1	###	0.0	18.0	###	0.0	###	0.3	
ST	29.2	3.9	13.7	27.0	79.5	151.2	1.9	101.2	111.7	70.7	98.2	12.1	
T	38.2	38.7	14.2	37.6	216.8	255.9	81.6	266.0	187.5	180.5	357.2	52.5	1726.7

1965 Daily Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1	0.0	4.6	0.0	9.4	0.0	0.7	3.3	6.3	4.3	0.0	2.9	3.6	
2	0.0	0.0	0.0	0.0	4.3	1.6	0.4	0.7	0.9	1.7	0.0	0.0	
3	0.0	0.3	0.0	0.0	4.1	0.7	4.7	0.9	15.9	13.2	0.0	17.9	
4	0.0	0.0	0.0	0.0	0.0	12.1	0.0	0.0	0.0	9.9	0.0	0.0	
5	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	19.3	0.0	7.9	15.8	
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	15.4	2.3	
7	0.0	0.0	9.4	0.0	0.0	1.7	0.0	0.4	0.0	0.0	1.6	0.5	
8	2.5	0.0	1.5	0.0	0.0	11.3	15.9	7.3	7.1	0.0	0.9	0.3	
9	0.0	0.0	0.0	1.8	4.1	0.0	20.1	5.2	9.3	0.0	0.0	0.3	
10	1.1	0.0	0.0	5.1	0.0	0.9	0.2	1.7	1.8	4.9	0.0	0.0	
ST	3.6	4.9	10.9	16.3	12.5	29.0	44.9	22.5	59.3	29.9	28.6	41.6	
11	0.0	0.0	0.0	2.6	0.0	4.0	15.9	3.5	36.3	35.2	0.0	0.0	
12	0.0	0.0	0.0	8.6	0.0	3.3	15.9	0.0	22.4	2.2	3.7	0.0	
13	0.3	0.0	0.0	0.0	0.0	10.3	7.6	0.0	9.3	11.3	0.0	0.0	
14	0.3	0.0	0.0	0.0	0.0	12.0	0.0	0.0	6.8	0.0	0.0	5.0	
15	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.5	1.9	0.0	10.5	
16	4.9	0.3	0.0	5.3	1.0	0.4	4.5	9.7	1.6	0.5	0.0	24.9	
17	0.3	0.0	0.3	0.0	0.0	15.0	6.2	0.0	0.0	22.3	0.0	0.0	
18	20.3	0.0	0.0	0.0	0.0	23.0	0.6	34.5	0.0	10.3	2.4	20.8	
19	0.0	0.0	0.0	0.0	0.0	9.0	9.6	0.0	0.0	1.5	0.0	0.3	
20	0.0	0.0	0.0	0.0	0.3	0.4	12.1	0.0	0.0	6.6	0.4	10.5	
ST	28.5	0.3	0.3	16.5	1.3	82.5	71.5	47.7	89.9	91.4	6.6	72.0	
21	0.0	3.3	0.0	0.0	0.0	6.6	15.1	0.0	0.3	19.1	1.3	0.0	
22	0.0	0.0	0.0	0.0	1.3	32.4	9.0	11.3	0.0	12.3	2.4	2.6	
23	0.0	0.0	0.0	0.5	0.3	29.5	5.8	16.5	12.7	2.4	0.7	0.0	
24	10.2	0.0	4.1	0.0	22.1	7.5	19.4	1.3	0.0	0.0	0.0	0.0	
25	5.1	0.3	0.0	0.0	7.9	0.0	75.3	10.8	0.0	0.0	98.2	0.3	
26	0.0	3.3	66.5	0.0	24.9	0.0	39.1	4.6	0.0	0.0	78.5	4.4	
27	0.0	0.6	0.0	0.0	0.0	0.0	0.0	16.0	12.4	0.0	0.3	0.3	
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.2	10.5	0.0	0.0	0.0	
29	0.0	###	0.0	0.0	0.3	0.3	0.0	58.2	0.0	0.0	1.3	0.0	
30	0.0	###	0.0	0.0	0.0	28.4	0.2	16.1	10.9	5.9	0.0	0.0	
31	10.4	###	0.0	###	0.0	###	10.1	3.0	###	0.9	###	0.0	
ST	25.7	7.5	70.6	0.5	56.9	104.9	174.1	158.1	46.7	39.7	182.7	7.6	
T	57.9	12.7	91.8	33.3	70.6	216.2	290.5	228.3	196.0	160.9	217.9	121.2	1587.2

1966 Daily Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1	0.0	0.0	1.5	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	2.0	
2	0.3	0.0	0.0	0.0	0.6	0.0	0.0	0.0	19.9	2.4	0.0	0.0	
3	0.0	0.0	0.0	0.0	0.0	0.0	20.7	0.5	6.7	4.2	3.3	1.3	
4	3.6	0.0	0.0	0.0	0.0	2.2	0.0	0.0	18.1	1.6	0.0	0.0	
5	0.0	0.0	1.3	0.0	0.0	15.8	6.2	1.0	1.3	10.3	0.0	0.9	
6	31.0	0.0	0.0	0.0	0.0	22.2	3.1	17.3	7.8	5.3	0.0	0.0	
7	0.0	0.0	0.0	0.0	0.0	1.6	7.3	3.1	0.9	3.2	0.0	0.0	
8	0.0	0.0	0.0	0.0	0.8	0.0	6.3	1.3	9.0	0.0	47.5	0.0	
9	0.0	0.0	0.8	0.0	0.0	16.6	1.8	0.3	0.0	46.4	1.6	12.9	
10	0.0	0.0	0.0	0.0	1.5	0.0	48.6	0.0	0.7	1.0	5.7	9.9	
ST	34.9	0.0	3.6	0.0	2.9	58.3	96.8	23.5	64.4	74.4	58.0	26.9	
11	0.5	0.0	0.0	0.0	0.0	0.7	20.3	12.2	17.0	0.0	0.7	0.0	
12	0.0	4.3	0.0	10.2	0.0	0.0	1.2	2.6	8.7	0.0	9.9	0.0	
13	2.5	4.1	0.5	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	
14	0.8	0.0	0.0	0.3	1.9	0.9	0.0	7.9	2.2	0.0	3.3	0.0	
15	0.0	0.0	0.0	0.5	65.2	28.5	0.0	1.0	0.0	0.0	22.2	1.5	
16	0.0	0.0	0.0	0.0	79.0	3.5	10.9	0.0	2.2	0.0	0.0	5.8	
17	18.5	0.0	6.4	0.0	65.5	0.0	53.3	0.0	35.5	15.4	2.4	10.9	
18	11.2	0.0	0.0	0.0	0.6	4.8	2.7	0.0	0.3	19.3	2.4	3.3	
19	0.0	0.5	0.0	0.0	43.2	0.0	0.0	0.0	31.1	19.1	1.1	0.0	
20	0.5	0.0	0.0	0.0	3.9	7.9	6.3	0.8	33.9	22.8	2.2	0.0	
ST	34.0	8.9	6.9	11.0	259.3	46.4	104.7	24.5	130.8	76.7	44.1	21.5	
21	1.8	1.0	0.0	0.0	19.8	4.1	1.3	0.0	4.8	0.0	11.0	0.0	
22	0.0	0.0	0.0	0.0	46.6	0.0	1.6	0.0	2.3	17.5	5.8	0.0	
23	8.6	1.0	0.0	0.0	14.4	16.5	10.4	0.0	0.0	0.0	4.1	0.0	
24	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.7	0.0	0.3	
25	1.8	0.0	0.0	0.0	0.0	15.8	0.0	0.8	0.0	0.0	19.5	0.0	
26	0.0	0.0	0.0	0.0	0.0	55.3	2.3	1.8	3.2	13.9	5.3	3.0	
27	0.0	0.0	0.0	0.0	1.0	22.2	10.8	0.0	0.0	0.5	5.5	5.1	
28	0.0	10.2	0.0	0.0	0.6	1.6	10.9	42.9	0.0	0.0	0.0	0.0	
29	0.0	###	0.0	0.0	3.7	0.0	33.0	16.0	0.0	0.0	0.0	8.1	
30	0.0	###	0.0	0.0	41.2	0.0	21.1	4.6	0.9	0.0	67.1	5.8	
31	0.0	###	0.0	###	3.5	###	0.3	1.3	###	0.0	###	0.0	
ST	12.2	12.2	0.0	0.0	130.8	115.6	91.7	67.4	11.1	32.6	118.2	22.3	
T	81.1	21.1	10.5	11.0	392.9	220.3	293.1	115.4	206.3	183.7	220.4	70.7	1926.6

1967 Daily Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1	0.0	0.0	0.0	0.0	0.0	1.7	1.2	0.8	2.5	1.5	3.1	1.5	
2	0.0	0.0	8.9	0.0	0.0	0.0	6.2	10.0	1.3	16.7	9.9	4.3	
3	11.7	0.0	4.8	0.0	0.0	4.9	0.0	9.5	0.0	31.8	25.9	0.0	
4	27.6	0.0	0.0	0.0	0.0	1.7	0.0	0.0	24.6	5.3	17.6	0.0	
5	15.7	0.0	0.0	0.0	1.0	2.7	23.4	0.0	27.5	0.0	8.3	0.0	
6	11.2	0.0	12.2	0.0	0.0	0.0	68.4	0.6	0.0	6.4	0.0	0.0	
7	0.0	0.0	0.0	0.0	0.0	0.0	34.1	22.0	0.0	10.2	4.1	0.0	
8	0.0	0.0	0.0	0.0	0.0	49.7	3.8	75.1	0.0	0.0	28.3	0.0	
9	0.0	0.0	0.0	0.0	0.0	87.1	37.9	0.0	0.0	0.0	8.3	0.0	
10	0.0	0.0	0.0	0.0	0.0	0.0	9.2	0.0	0.0	0.0	4.8	13.0	
ST	66.4	0.0	25.9	0.0	1.0	147.9	184.2	118.0	55.9	71.8	111.5	18.8	
11	0.0	13.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	30.7	3.1	
12	0.0	10.4	0.0	0.0	0.0	0.0	0.0	0.0	5.8	6.2	0.9	3.1	
13	4.6	7.9	14.0	0.0	0.0	0.0	0.0	16.5	15.3	0.0	13.9	0.0	
14	18.9	1.6	0.0	0.0	0.0	2.9	5.2	2.0	0.0	18.7	6.6	0.0	
15	0.0	0.0	0.0	0.0	0.0	1.6	0.8	0.0	13.5	1.9	0.0	0.0	
16	2.2	0.0	0.0	0.0	0.0	0.0	3.9	0.0	0.0	9.2	0.0	0.8	
17	6.9	2.8	0.0	0.0	0.0	2.2	0.0	23.1	0.0	50.4	0.0	0.8	
18	19.6	2.5	0.0	0.0	0.0	0.0	1.6	49.3	0.0	3.9	0.0	0.0	
19	51.9	7.7	0.0	0.0	10.2	1.6	0.0	37.0	0.0	0.0	0.0	0.0	
20	2.4	1.0	0.0	0.0	0.0	0.0	24.2	14.0	0.0	0.0	0.0	0.0	
ST	106.6	47.8	14.0	0.0	10.2	8.2	35.8	141.9	34.6	91.3	52.1	7.8	
21	0.0	0.0	0.0	4.8	9.7	1.6	0.0	6.0	0.9	2.1	0.0	0.0	
22	0.0	0.0	0.0	0.0	0.0	10.0	0.0	12.0	0.0	10.8	3.1	0.0	
23	0.0	0.0	0.0	0.0	0.0	14.9	11.2	5.2	0.0	2.1	4.3	0.0	
24	0.0	0.0	0.0	0.0	0.0	3.0	13.9	5.2	0.0	31.0	0.9	0.0	
25	0.0	0.0	0.0	0.0	0.0	1.7	4.2	0.0	0.0	25.5	1.7	0.0	
26	0.0	0.0	0.0	5.8	17.0	7.7	0.0	0.0	0.0	0.0	0.0	0.0	
27	0.0	0.0	0.0	1.8	21.1	15.2	5.0	23.5	0.0	0.0	0.0	0.0	
28	0.0	1.0	0.0	0.0	15.8	0.0	3.1	17.1	0.0	30.5	0.0	0.0	
29	0.0	###	0.0	0.0	0.0	0.0	8.1	2.0	0.0	0.0	0.0	1.3	
30	0.3	###	0.0	0.0	0.8	4.0	0.2	2.0	10.7	0.0	0.0	1.8	
31	0.0	###	0.0	###	2.5	###	1.9	0.6	###	0.0	###	0.0	
ST	0.3	1.0	0.0	12.4	66.9	58.2	47.7	73.4	11.5	101.9	10.0	3.1	
T	173.2	48.8	39.9	12.4	78.1	214.3	267.7	333.3	102.0	265.0	173.6	29.7	1738.0

ESTIMATED DAILY RAINFALL IN PROJECT AREA

1968 Daily Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1	0.8	0.0	0.0	0.0	0.0	26.2	1.9	0.0	0.0	0.0	1.8	0.0	
2	0.0	0.0	0.0	0.0	0.0	0.0	19.4	0.0	0.0	1.2	0.0	0.0	
3	0.0	0.0	0.0	0.0	0.0	7.4	30.3	6.0	0.0	0.0	0.0	0.0	
4	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	6.1	0.0	0.0	
5	2.5	0.4	0.0	0.0	0.0	7.7	38.3	3.0	21.9	0.0	0.0	2.5	
6	0.0	0.0	0.9	0.0	0.0	0.0	0.0	1.8	0.0	14.0	3.5	7.4	
7	0.0	0.0	0.0	0.0	0.0	9.3	19.4	5.4	0.0	0.0	0.0	0.0	
8	0.0	0.0	0.0	0.0	0.0	22.7	3.8	9.0	0.0	23.9	0.0	0.0	
9	0.8	0.0	0.7	0.0	0.0	7.9	7.4	16.4	0.0	11.0	0.0	0.0	
10	0.0	0.2	0.0	0.0	0.0	3.7	20.3	10.3	21.9	0.0	26.6	0.0	
ST	4.1	0.7	1.6	0.0	0.0	84.9	141.6	51.9	43.8	56.1	31.9	9.9	
11	0.0	0.0	2.9	0.0	1.1	0.0	0.0	13.6	22.3	22.5	27.4	0.0	
12	0.0	0.0	1.6	0.0	0.0	0.0	4.7	52.3	0.0	3.3	0.0	0.0	
13	0.0	0.2	0.0	0.0	0.0	4.8	1.8	9.2	0.0	82.8	0.7	0.0	
14	0.0	0.0	1.4	0.0	0.0	4.4	0.9	0.8	23.1	42.3	0.0	0.0	
15	2.3	0.0	0.0	0.0	0.0	0.0	4.9	13.3	11.5	45.3	0.0	0.0	
16	0.0	0.0	0.0	0.0	10.7	0.0	3.0	63.7	0.0	3.8	0.0	0.0	
17	0.0	0.0	0.0	0.0	0.0	0.0	21.2	28.6	0.0	14.6	0.9	0.0	
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.8	0.0	7.5	35.3	0.0	
19	0.0	0.0	0.9	0.0	0.0	0.0	0.0	49.7	0.0	14.7	9.0	0.0	
20	0.0	4.4	0.0	0.0	0.0	0.7	0.9	4.0	2.3	2.9	10.3	0.0	
ST	2.3	4.6	6.9	0.0	11.9	9.9	37.4	265.0	59.2	239.5	83.6	0.0	
21	0.0	4.4	0.0	0.0	0.0	11.6	0.9	0.0	2.9	32.5	0.0	0.0	
22	0.0	3.9	1.3	0.0	2.6	0.0	0.0	0.0	0.9	0.0	0.0	0.0	
23	1.3	0.0	0.7	0.0	0.2	1.8	1.8	0.0	15.0	0.0	54.3	0.0	
24	0.0	0.0	0.6	0.0	0.0	0.0	2.8	0.0	0.0	0.0	40.0	0.0	
25	0.0	9.8	0.0	0.0	0.0	0.9	0.0	0.0	1.4	0.0	0.0	0.0	
26	2.5	1.1	0.0	0.0	0.0	23.6	0.0	0.0	4.4	0.0	2.6	0.0	
27	0.0	0.8	0.0	0.0	0.0	0.5	0.0	6.2	1.6	0.0	0.0	0.0	
28	0.0	0.0	0.0	0.0	0.0	23.0	0.0	0.0	5.4	2.9	0.0	0.0	
29	1.3	0.0	0.0	0.0	1.7	0.0	52.0	0.0	0.0	3.9	0.0	0.0	
30	0.0	###	0.0	0.0	0.7	0.0	0.0	0.0	0.0	2.6	0.0	0.0	
31	0.0	###	0.0	###	8.4	###	9.4	0.0	###	0.0	###	0.0	
ST	5.1	20.1	2.6	0.0	13.6	61.3	67.0	6.2	31.5	41.7	96.9	0.0	
T	11.5	25.3	11.1	0.0	25.3	156.1	246.0	323.1	134.4	337.3	212.4	9.9	1492.5

1969 Daily Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1	0.0	0.0	0.0	0.0	0.3	44.1	14.0	4.7	16.1	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.7	19.8	1.8	1.2	3.3	
3	0.0	0.0	0.0	0.0	0.0	8.6	18.7	0.0	16.6	0.0	0.9	0.0	
4	0.0	16.9	0.0	0.0	0.0	40.6	0.0	0.0	0.0	3.7	3.4	10.2	
5	8.2	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	11.0	1.4	
6	0.0	1.1	0.0	0.0	0.0	3.5	16.9	0.0	0.0	0.0	0.0	2.4	
7	3.8	0.7	0.0	0.0	0.0	4.7	64.1	0.0	7.0	5.8	0.0	0.0	
8	0.7	3.6	0.0	0.0	0.0	0.9	21.3	0.0	0.0	21.7	0.0	6.5	
9	2.6	0.0	16.3	0.0	0.0	0.9	0.0	0.0	0.0	14.3	1.3	9.5	
10	11.0	0.0	0.0	0.0	0.0	11.1	0.7	0.9	0.0	0.0	6.8	11.1	
ST	26.3	25.9	16.3	0.0	0.3	115.3	135.8	6.3	59.4	50.4	24.6	44.3	
11	0.0	0.0	0.0	0.0	18.5	2.1	1.1	19.6	0.0	7.4	0.0	15.6	
12	0.0	0.0	0.0	0.0	9.3	0.0	26.7	0.0	5.1	27.6	0.0	0.0	
13	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.9	11.1	0.0	0.3	0.0	
14	0.0	0.8	0.0	0.0	0.0	0.0	42.9	23.8	16.6	0.5	0.0	2.1	
15	0.0	0.0	0.0	0.0	0.0	0.0	57.3	21.9	0.0	0.0	0.0	10.7	
16	0.0	0.0	0.0	0.0	0.0	0.0	18.2	10.1	2.9	18.5	3.4	10.0	
17	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	2.3	0.0	1.8	
18	0.0	0.0	0.0	0.0	0.0	0.0	0.3	23.0	0.0	0.0	7.7	18.9	
19	0.0	0.0	0.0	0.0	0.0	0.0	10.3	1.2	0.0	5.5	3.4	0.0	
20	2.6	0.0	0.0	0.0	0.0	2.8	0.3	29.1	0.0	0.0	1.2	0.3	
ST	6.3	0.8	0.0	0.0	27.7	4.9	157.1	129.6	38.5	61.7	15.9	59.4	
21	4.2	0.0	0.0	0.0	0.0	1.6	30.2	3.8	15.5	1.4	0.0	6.6	
22	0.0	0.0	0.0	0.8	0.3	0.0	0.0	25.7	10.1	0.9	0.0	16.9	
23	0.0	0.0	0.0	5.7	0.0	16.3	0.0	0.0	0.0	0.0	19.4	0.0	
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.6	0.0	0.0	0.0	0.0	
25	0.0	0.0	0.0	0.0	0.0	16.3	15.5	11.7	0.0	0.0	11.7	0.0	
26	0.0	0.0	0.0	0.0	12.7	2.8	0.7	0.9	0.0	0.0	0.0	0.3	
27	0.0	0.0	0.0	0.0	0.0	16.4	7.3	1.2	0.0	2.8	0.0	1.2	
28	0.0	0.0	0.0	0.0	0.9	0.0	0.0	3.8	0.0	8.3	0.0	2.1	
29	0.0	###	0.0	0.0	67.0	0.0	0.0	36.7	0.0	16.6	0.0	15.1	
30	0.0	###	0.0	0.0	39.3	3.3	0.0	0.0	0.9	0.0	0.0	9.3	
31	0.0	###	0.0	###	0.0	###	17.3	21.0	###	0.0	###	0.9	
ST	4.2	0.0	0.0	6.5	120.3	56.7	71.1	117.3	26.5	30.0	31.1	52.5	
T	36.8	26.7	16.3	6.5	148.3	176.9	364.0	253.3	124.5	142.1	71.7	156.1	1523.[illegible]

1970 Daily Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1	0.0	1.6	4.3	0.0	0.0	0.0	15.6	1.6	0.5	0.0	15.5	9.2	
2	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	2.3	0.9	11.7	0.0	
3	0.9	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	1.2	12.2	
4	5.5	12.6	3.7	0.3	0.0	6.6	2.1	2.1	50.6	0.0	1.7	0.0	
5	2.7	0.0	0.0	0.0	0.0	0.0	0.0	2.4	6.1	1.3	0.0	9.9	
6	0.4	0.7	2.1	0.0	0.0	2.8	0.0	1.4	0.0	2.0	16.1	3.9	
7	0.0	0.0	0.0	0.0	0.0	0.0	3.5	8.3	0.5	2.2	6.1	1.6	
8	0.0	0.0	0.0	0.0	3.3	3.2	36.2	5.5	0.0	0.0	34.6	1.2	
9	0.7	6.7	0.0	0.0	25.9	0.0	42.0	0.0	10.0	0.0	3.0	2.8	
10	0.0	22.5	0.0	0.0	0.0	7.4	0.0	0.3	0.9	3.4	1.4	3.7	
ST	10.1	44.2	10.0	0.3	29.5	20.1	99.9	21.5	70.8	9.9	91.3	44.6	
11	0.0	0.9	0.0	0.0	0.0	0.0	39.3	0.0	3.0	0.7	85.8	0.0	
12	0.0	0.0	0.0	0.4	40.5	0.2	10.6	1.4	0.0	12.9	69.8	31.2	
13	0.0	0.0	0.0	0.0	1.5	0.0	10.6	2.4	0.9	11.8	4.9	5.2	
14	0.0	0.0	0.0	0.0	26.6	0.0	1.5	0.0	11.9	88.0	0.0	0.0	
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.2	28.7	4.5	12.2	2.5	
16	1.7	0.0	38.1	0.0	0.0	4.8	0.0	51.4	24.7	0.4	0.7	17.2	
17	4.8	0.0	17.1	0.0	0.8	34.6	0.0	4.6	13.3	0.0	13.1	0.7	
18	6.4	0.0	0.0	0.0	0.0	10.6	8.2	6.7	10.9	7.3	1.2	0.0	
19	0.0	0.0	0.0	0.0	0.0	11.0	0.0	0.0	6.3	8.1	0.0	1.2	
20	0.0	1.2	0.0	0.0	0.0	1.4	21.0	0.9	23.2	2.5	7.3	1.2	
ST	12.9	2.1	55.2	0.4	69.4	62.7	91.1	86.5	123.0	136.3	194.9	59.2	
21	0.0	0.0	0.0	0.0	0.0	0.0	22.6	0.0	6.8	0.0	0.0	0.0	
22	2.8	1.6	1.8	0.0	0.0	46.8	4.4	0.0	0.7	21.9	9.9	0.0	
23	0.0	0.0	1.6	0.0	0.0	72.0	1.2	0.0	0.0	0.9	43.6	0.0	
24	0.0	14.4	14.2	0.0	0.0	21.0	0.0	0.0	1.2	1.8	5.3	1.6	
25	0.0	0.3	3.9	0.0	8.9	11.0	3.9	0.0	0.0	23.7	5.9	2.1	
26	0.0	48.1	0.0	0.0	38.0	0.0	0.0	0.5	41.2	1.6	7.5	0.0	
27	0.3	0.0	0.0	0.0	0.0	39.6	0.0	0.5	4.7	0.0	13.1	5.1	
28	0.0	0.0	0.0	4.6	0.0	2.4	0.0	3.7	11.4	1.1	3.3	14.5	
29	0.0	###	0.0	0.0	0.0	21.7	34.8	1.8	3.0	0.0	4.7	1.2	
30	0.0	###	0.0	0.0	4.8	29.0	3.3	20.1	7.0	1.6	7.3	0.0	
31	14.4	###	0.0	###	0.0	###	0.3	0.3	###	1.3	###	0.0	
ST	17.5	64.5	21.4	4.6	51.7	243.5	70.5	26.8	76.0	53.9	100.5	24.5	
T	40.6	110.7	86.6	5.3	150.7	326.3	261.6	134.8	269.8	200.0	386.7	128.3	2101.4

1971 Daily Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1	0.9	1.3	3.7	0.0	15.6	23.0	0.0	11.4	0.0	3.3	1.7	0.0	
2	1.6	0.0	0.0	0.0	5.9	4.7	5.5	1.6	0.0	41.9	6.4	0.0	
3	8.1	0.9	0.0	0.0	16.5	0.0	128.2	2.8	1.2	66.2	22.9	0.0	
4	67.6	4.5	0.0	0.0	19.4	0.0	4.9	0.0	6.5	13.8	29.5	2.0	
5	4.4	0.0	0.0	0.0	2.6	3.5	0.0	4.4	28.9	1.7	3.0	0.0	
6	1.5	0.3	0.0	0.0	0.0	26.5	0.0	1.8	0.0	0.0	0.7	14.5	
7	3.1	0.0	0.0	0.0	16.1	15.1	30.3	0.0	0.0	0.0	0.0	6.1	
8	5.1	2.1	0.0	0.0	0.0	15.3	12.9	10.2	0.0	1.2	60.2	0.0	
9	0.0	7.4	0.3	0.0	0.0	0.0	20.5	1.2	0.0	39.1	70.0	8.1	
10	0.0	8.0	72.7	0.0	0.0	59.2	17.6	24.0	0.9	11.2	14.0	8.1	
ST	92.2	24.5	76.8	0.0	76.1	147.3	220.0	57.5	37.5	178.5	208.4	38.8	
11	0.9	7.9	2.8	2.1	9.8	29.6	0.0	0.0	0.9	14.6	7.7	0.0	
12	0.0	5.0	74.1	0.0	1.8	21.5	4.9	0.9	0.0	0.0	1.8	0.0	
13	0.9	2.0	0.0	0.0	0.0	35.2	8.0	0.0	0.0	0.5	0.0	3.8	
14	0.0	4.1	0.0	0.0	0.0	3.3	80.6	0.0	0.0	0.5	0.0	0.0	
15	0.0	11.8	0.9	0.0	0.0	13.7	4.7	26.4	0.0	60.4	33.7	2.0	
16	4.4	2.7	14.4	0.0	0.0	4.4	0.0	0.0	0.9	15.8	0.7	0.3	
17	0.0	0.7	0.0	0.0	15.6	0.3	0.0	2.8	5.1	0.0	0.7	0.0	
18	0.9	0.0	0.0	0.0	0.0	0.0	1.8	6.7	0.9	0.0	0.0	0.0	
19	0.0	0.0	0.0	0.0	0.0	0.0	7.4	1.8	2.3	0.0	12.7	0.0	
20	0.0	0.0	0.0	0.0	4.7	0.0	23.9	4.5	0.0	30.2	18.1	6.0	
ST	7.1	34.2	92.3	2.1	32.0	108.0	131.4	43.2	10.2	122.0	75.5	12.2	
21	0.0	0.0	0.0	0.0	0.9	0.0	12.2	0.3	0.0	0.3	27.6	3.4	
22	0.5	4.5	0.0	0.0	0.0	3.1	0.0	10.8	34.2	0.0	11.2	0.0	
23	1.6	0.4	0.0	0.0	29.5	7.1	1.5	8.6	0.0	32.8	6.4	0.0	
24	2.1	0.0	0.0	51.6	35.0	114.4	0.0	2.1	0.0	12.2	0.0	1.2	
25	0.0	0.0	0.0	3.7	1.7	89.5	0.0	13.7	0.0	3.0	0.0	2.9	
26	0.0	0.0	0.0	0.0	7.5	0.0	0.9	5.6	0.0	0.0	2.6	0.0	
27	1.4	0.0	4.8	0.0	38.3	0.0	0.0	3.3	30.3	0.0	0.0	1.6	
28	16.6	0.0	0.7	29.2	0.0	64.6	0.0	4.6	63.3	0.7	6.8	0.3	
29	2.3	###	0.0	0.0	16.8	24.4	42.2	2.6	10.0	0.0	5.0	9.1	
30	0.7	###	0.0	32.2	14.0	20.0	0.0	3.3	42.6	0.0	0.0	0.0	
31	9.7	###	0.0	###	30.3	###	4.7	1.2	###	0.0	###	0.7	
ST	34.9	5.0	5.6	116.7	174.1	323.1	61.4	55.9	180.5	49.0	59.6	19.1	
T	134.2	63.7	174.6	118.8	282.2	578.4	412.8	156.6	228.2	349.4	343.5	70.1	2912.4

ESTIMATED DAILY RAINFALL IN PROJECT AREA

1972 Daily Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1	0.0	0.0	0.0	14.9	12.0	0.9	0.0	0.0	7.0	0.0	53.5	2.4	
2	0.0	0.0	0.0	1.0	0.0	32.6	0.0	0.0	13.5	39.9	1.2	34.9	
3	0.0	0.0	0.0	0.0	0.0	35.4	0.0	1.2	27.2	6.7	2.8	29.7	
4	11.1	0.0	0.0	0.0	0.0	0.3	0.0	1.6	18.9	8.1	5.3	22.0	
5	12.1	0.2	0.0	0.0	0.0	0.0	4.0	0.0	0.7	0.0	126.2	1.6	
6	0.0	0.0	0.0	0.0	0.0	0.0	14.5	0.0	7.2	1.6	0.0	1.5	
7	24.5	0.0	0.0	0.4	0.0	12.1	16.7	0.0	17.9	0.5	0.0	0.0	
8	174.3	13.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
9	4.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	10.0	0.0	0.0	14.9	
10	9.7	0.0	0.0	0.0	0.0	3.0	0.0	0.0	24.9	0.0	0.0	0.0	
ST	235.6	13.4	0.0	16.3	12.0	84.4	36.2	5.5	127.3	56.7	189.1	106.9	
11	38.2	0.0	0.0	0.6	0.0	43.2	0.0	0.0	4.4	0.0	0.5	0.0	
12	1.8	0.0	0.0	0.0	0.0	15.2	0.0	0.0	0.0	5.7	0.7	0.0	
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	3.7	0.0	1.2	0.0	
14	8.0	0.0	3.2	0.0	0.0	0.0	0.0	5.5	0.0	0.0	1.2	0.0	
15	0.7	0.0	0.0	0.0	0.0	5.6	0.0	5.9	0.0	0.0	4.9	1.6	
16	2.9	0.0	6.2	0.0	0.0	0.0	0.0	5.7	0.0	0.0	0.0	13.5	
17	17.4	0.0	39.8	0.0	0.0	3.8	0.0	7.7	0.0	12.7	14.9	11.1	
18	5.7	1.6	0.0	0.0	0.0	22.4	0.0	0.0	15.7	0.0	0.0	3.2	
19	0.9	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.5	9.3	0.7	2.5	
20	2.1	0.0	0.0	0.0	0.0	1.7	0.0	7.8	29.4	0.0	0.0	1.6	
ST	77.9	1.6	49.2	0.6	0.0	91.8	0.0	43.7	52.6	27.8	24.1	33.6	
21	0.0	0.0	0.0	0.0	0.0	15.6	0.0	0.3	2.1	2.8	0.0	0.0	
22	0.0	0.0	0.0	0.0	0.0	26.8	2.1	7.2	0.0	0.0	0.0	0.0	
23	0.0	0.0	0.0	0.0	0.0	10.7	0.7	2.1	0.0	5.3	0.0	8.3	
24	0.0	0.0	0.0	0.0	0.0	19.4	0.0	0.0	0.0	0.9	0.0	0.0	
25	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	23.1	5.7	1.7	0.0	
26	19.9	0.0	0.0	0.0	2.3	3.9	0.4	0.0	0.0	0.0	0.0	0.0	
27	0.0	0.0	4.0	0.0	1.5	0.9	0.0	0.0	1.8	0.0	1.2	0.0	
28	14.3	0.0	0.0	0.0	6.2	0.5	0.0	0.0	0.0	3.3	8.8	1.6	
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.2	0.0	4.6	3.3	0.9	
30	2.1	###	0.0	0.0	0.0	0.5	0.0	23.3	3.8	0.0	0.0	0.0	
31	0.0	###	0.0	###	1.5	###	0.2	4.6	###	45.8	###	0.0	
ST	36.3	0.0	4.0	0.0	11.4	78.9	3.3	74.5	30.9	68.5	14.9	10.8	
T	349.7	15.0	53.2	16.9	23.4	255.1	39.3	123.8	210.6	152.9	228.2	151.4	1620.0

1973 Daily Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1	0.0	0.0	0.0	0.0	0.0	0.0	16.4	3.5	8.9	32.2	76.0	82.5	
2	0.0	0.0	0.0	0.0	0.0	0.0	23.9	0.0	0.0	102.6	4.9	151.3	
3	0.0	2.6	0.0	0.0	0.0	0.0	6.8	0.0	20.0	0.0	0.0	0.9	
4	0.0	0.0	0.0	0.0	0.0	4.2	0.5	8.5	24.2	0.0	5.0	0.0	
5	0.0	0.0	0.0	0.9	0.0	3.9	4.9	0.0	3.3	0.0	3.8	0.0	
6	0.0	0.0	0.0	0.0	0.0	0.0	9.8	1.8	0.0	10.9	3.5	2.6	
7	0.0	1.6	0.0	0.0	0.0	0.0	29.2	0.0	12.5	7.1	53.3	14.8	
8	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	15.3	2.8	0.0	0.0	
9	0.0	0.0	0.0	0.0	0.0	0.0	66.8	38.9	1.7	0.0	0.0	0.0	
10	0.0	0.0	0.0	0.0	0.0	0.0	2.1	3.8	36.2	0.0	14.3	0.0	
ST	0.0	4.2	0.0	0.9	0.0	8.0	167.3	56.5	122.0	155.7	160.8	252.1	
11	0.0	0.0	0.0	1.3	0.0	0.0	0.7	13.4	1.4	0.0	35.8	1.7	
12	0.0	7.8	0.0	0.0	0.0	0.7	3.5	0.9	87.8	9.1	15.3	11.7	
13	0.0	1.0	0.0	0.0	0.0	5.5	1.7	2.1	33.4	0.0	6.1	0.0	
14	0.0	0.0	0.0	0.0	0.0	33.7	0.0	0.0	29.4	3.9	0.5	0.0	
15	0.0	0.0	0.0	0.0	0.0	8.9	0.0	14.7	9.9	4.7	0.0	0.7	
16	0.0	4.9	0.0	0.0	0.0	0.0	21.7	0.0	0.5	0.5	0.0	0.0	
17	0.0	0.0	0.0	0.0	0.0	0.0	8.6	9.5	10.3	0.0	6.1	16.0	
18	0.0	0.0	0.0	6.5	0.0	4.8	0.0	0.5	1.8	0.0	33.8	1.8	
19	0.0	0.0	0.0	0.0	0.0	0.7	0.0	10.0	12.9	2.1	70.9	8.4	
20	0.0	1.0	0.0	0.0	0.0	0.0	0.0	20.8	12.7	15.4	144.4	1.7	
ST	0.0	14.7	0.0	7.8	0.0	54.4	36.2	70.9	200.0	35.7	312.8	42.1	
21	0.0	1.4	2.4	0.0	0.0	4.3	0.0	11.4	19.8	3.8	1.8	56.0	
22	0.0	0.0	12.3	0.0	0.0	0.0	0.0	8.2	21.1	0.0	2.9	1.7	
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.8	7.9	9.6	1.7	0.0	
24	0.0	0.0	0.0	0.0	0.0	5.5	1.9	9.8	3.5	7.7	0.0	16.0	
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.3	0.0	0.0	0.0	9.9	
26	0.0	0.0	0.0	0.0	0.0	0.5	35.0	36.5	0.0	0.0	2.6	0.5	
27	0.0	0.0	0.0	0.0	0.0	23.9	2.6	0.5	44.4	0.0	0.0	2.1	
28	0.0	0.0	0.7	0.0	0.0	4.8	4.0	15.2	60.4	0.0	5.5	7.0	
29	0.0	###	16.7	0.0	0.0	3.3	0.7	0.0	6.4	17.3	0.7	6.1	
30	0.0	###	0.8	0.0	0.0	5.1	15.0	21.1	51.5	32.9	4.7	0.0	
31	0.0	###	0.0	###	0.0	###	4.7	45.3	###	1.2	###	2.9	
ST	0.0	1.4	33.0	0.0	0.0	47.3	63.8	216.0	214.7	72.5	19.9	102.1	
T	0.0	20.4	33.0	8.7	0.0	109.7	267.2	343.4	536.8	263.9	493.5	396.2	2472.3

1974 Daily Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1	0.0	0.0	11.1	0.0	0.0	0.0	0.0	3.5	0.0	76.7	9.1	0.0	
2	0.0	0.9	0.0	0.0	0.0	1.6	5.0	23.4	10.1	19.2	0.0	3.3	
3	25.3	3.6	0.0	0.0	0.0	0.0	0.0	2.3	0.5	21.8	5.9	0.5	
4	18.7	9.2	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.5	3.5	1.2	
5	0.4	0.0	0.0	0.0	0.0	0.0	9.2	0.0	0.0	62.4	0.0	0.0	
6	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.5	0.0	7.7	0.0	0.0	
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	26.1	51.8	0.0	47.7	
8	3.4	0.0	0.0	0.0	0.0	5.5	0.0	0.7	0.0	0.0	14.2	6.0	
9	0.0	0.4	0.0	0.0	0.0	38.5	53.7	0.0	4.6	1.8	15.1	24.5	
10	6.8	0.0	0.0	0.0	0.0	16.9	0.7	1.2	0.7	3.0	0.0	0.5	
ST	54.7	14.2	11.1	0.4	0.0	62.7	69.5	40.8	42.0	244.8	47.7	83.6	
11	4.5	0.9	0.0	0.0	0.4	0.9	24.5	3.3	0.0	17.4	24.4	0.0	
12	0.4	1.6	2.4	0.0	0.0	0.0	0.0	21.2	0.0	7.0	59.5	3.5	
13	0.0	13.0	0.0	0.0	0.7	1.5	7.0	0.0	0.0	0.0	17.2	2.3	
14	0.0	7.5	0.0	0.0	0.0	0.0	0.0	7.5	7.9	12.5	0.0	72.3	
15	5.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	3.7	15.5	0.0	4.9	
16	1.6	0.0	0.8	0.0	2.5	7.2	0.0	0.0	5.2	6.1	0.0	0.0	
17	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	13.2	0.5	5.3	0.0	
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	19.2	5.1	0.9	
19	0.0	0.0	0.0	0.0	4.7	0.0	4.5	2.7	0.0	0.0	0.0	0.0	
20	0.0	8.6	0.6	0.0	0.0	0.0	0.0	23.4	5.9	0.0	0.5	24.9	
ST	11.6	34.1	3.8	0.0	8.3	9.7	36.0	[illegible]	38.4	78.1	112.0	108.7	
21	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	6.0	
22	11.9	0.0	1.5	0.0	0.0	0.0	5.0	0.0	12.3	9.9	3.9	2.3	
23	0.0	0.7	0.0	0.0	0.0	0.0	41.5	0.0	0.0	0.0	0.0	0.0	
24	0.0	0.0	0.0	0.0	12.6	13.9	5.5	0.0	1.4	0.0	0.7	0.0	
25	0.0	0.0	0.0	0.0	2.5	15.1	0.0	0.0	0.0	37.3	0.0	0.7	
26	0.0	0.0	0.0	0.0	3.8	2.7	70.[illegible]	0.0	0.0	0.0	0.0	0.0	
27	0.0	0.0	0.0	0.0	0.0	5.5	0.0	0.0	1.4	0.0	0.0	3.0	
28	0.0	16.7	0.0	0.0	10.8	1.6	0.7	0.0	0.0	0.5	0.0	2.6	
29	13.2	###	0.0	0.0	27.6	3.5	19.5	21.0	0.0	0.0	40.9	4.9	
30	0.0	###	0.0	17.3	0.0	25.5	1.7	4.6	4.8	2.6	0.0	0.5	
31	0.0	###	0.0	###	0.0	###	9.2	0.0	###	55.1	###	0.0	
ST	26.0	17.4	1.5	17.3	57.3	67.9	155.[illegible]	25.6	22.8	105.3	45.6	20.0	
T	92.3	65.7	16.4	17.7	65.6	140.3	261.[illegible]	[illegible]	103.2	428.2	205.3	212.3	1743.5

1975 Daily Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	1.8	5.5	36.8	0.0	
2	29.2	0.0	0.0	0.0	2.1	0.7	0.0	0.0	17.6	1.8	0.0	2.4	
3	7.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	15.0	9.4	37.7	2.9	
4	6.5	0.0	0.0	3.9	0.0	2.3	0.0	0.0	10.8	0.0	2.8	19.9	
5	3.7	1.8	0.0	0.0	1.3	0.0	6.3	0.0	0.9	7.0	0.0	20.8	
6	13.7	0.0	0.0	0.0	0.0	11.4	0.0	45.3	1.7	6.4	59.9	0.0	
7	1.8	0.0	0.0	0.0	0.0	6.1	0.0	0.5	0.0	4.9	2.6	0.0	
8	4.8	0.0	0.0	0.0	2.1	0.0	0.0	8.9	14.7	47.3	0.0	0.0	
9	0.0	0.0	0.0	7.1	5.5	0.9	1.4	0.0	0.0	52.7	1.9	10.5	
10	0.0	0.0	0.0	0.0	0.0	0.7	13.2	0.0	26.2	11.7	0.0	5.6	
ST	66.9	2.7	0.0	11.0	10.9	22.2	20.8	61.6	88.7	145.7	141.6	62.1	
11	7.1	0.0	0.0	0.0	0.0	7.4	23.3	0.0	29.0	0.0	0.0	1.8	
12	0.7	15.9	0.0	0.0	2.1	13.3	3.1	0.0	62.8	0.0	0.0	5.2	
13	0.0	1.8	0.0	0.0	23.9	0.0	9.5	0.0	20.8	4.9	3.5	5.4	
14	0.0	0.0	0.0	0.0	1.2	0.0	0.0	27.7	0.5	28.6	0.0	15.6	
15	0.0	0.0	0.0	0.0	0.0	0.0	24.3	17.5	26.7	24.8	0.0	37.0	
16	0.0	0.0	0.0	2.8	13.4	23.7	0.0	0.0	0.0	15.9	18.4	0.0	
17	0.0	0.9	0.0	0.0	0.0	49.9	33.2	0.0	0.0	26.6	0.0	13.8	
18	0.0	4.1	1.6	0.0	0.0	11.9	13.2	0.0	0.9	0.0	0.0	1.8	
19	0.0	9.0	3.4	2.6	0.0	9.5	0.0	0.0	0.0	6.5	1.2	2.9	
20	0.0	3.2	0.0	0.0	0.0	37.5	2.8	0.0	0.0	0.0	0.0	3.3	
ST	7.9	34.9	5.0	5.4	40.6	153.2	109.3	45.2	140.7	107.4	23.0	86.9	
21	0.0	13.1	0.0	28.3	0.0	7.0	0.5	0.0	0.0	55.9	0.0	17.6	
22	0.0	0.9	0.0	38.8	0.0	6.5	14.1	0.0	24.8	0.0	0.0	0.9	
23	0.0	0.0	0.0	64.3	0.0	2.6	0.0	0.0	0.0	0.0	10.7	113.3	
24	17.5	0.0	0.0	39.6	0.0	1.4	0.0	47.4	0.5	24.6	5.6	4.9	
25	0.5	0.0	0.0	38.9	0.0	0.0	0.0	17.7	8.0	0.0	2.8	2.8	
26	21.3	0.0	0.0	2.6	15.5	0.0	0.0	7.3	2.1	0.0	4.2	3.7	
27	0.0	13.0	0.0	19.5	0.0	0.5	0.0	0.5	2.9	6.1	0.0	1.7	
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	44.0	0.0	3.3	2.6	
29	0.0	###	0.0	0.0	0.0	1.4	0.5	0.0	7.7	6.6	0.0	59.4	
30	0.0	###	0.0	0.0	0.0	0.0	0.0	4.2	37.4	0.0	0.0	2.9	
31	0.0	###	0.0	###	18.4	###	0.0	8.6	###	18.5	###	0.5	
ST	39.3	27.0	0.0	232.1	33.9	19.2	15.0	90.5	127.3	111.8	26.6	210.2	
T	114.1	64.5	5.0	248.5	85.4	194.6	145.1	197.2	356.8	364.9	191.3	359.2	2325.6

ESTIMATED DAILY RAINFALL IN PROJECT AREA

1976 Daily Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1	0.0	0.0	0.0	2.7	0.0	5.1	0.0	0.0	13.1	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.1	0.0	0.0	0.0	
3	0.0	0.0	0.0	1.6	0.0	15.1	0.0	1.4	10.3	26.1	0.0	0.0	
4	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.8	
5	0.0	0.0	5.2	0.0	0.0	0.0	0.0	0.0	0.0	12.8	4.7	28.9	
6	0.0	0.0	4.2	0.0	0.0	0.0	1.2	0.0	7.8	40.7	0.0	0.0	
7	0.0	0.0	0.0	0.0	0.0	0.5	1.8	0.0	0.0	23.5	0.0	7.7	
8	0.0	0.0	0.0	0.0	0.0	13.6	1.8	11.7	0.0	3.5	0.0	25.8	
9	0.0	0.0	0.0	0.0	0.0	12.2	0.0	20.0	8.2	0.0	0.0	11.8	
10	0.0	0.0	0.8	0.0	1.9	0.0	6.9	0.9	9.2	1.4	12.2	5.9	
ST	0.0	0.0	12.8	4.2	1.9	46.5	11.7	34.0	93.9	107.9	16.9	141.0	
11	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.0	0.0	0.0	
12	5.9	0.0	0.0	0.0	0.0	0.0	0.5	54.9	3.2	0.0	0.0	0.0	
13	12.5	0.0	0.0	0.0	0.0	0.0	48.6	70.0	0.9	0.0	0.0	8.4	
14	0.0	0.0	0.0	0.0	37.0	16.4	0.4	0.0	0.9	7.2	0.5	7.9	
15	0.0	0.4	0.0	0.0	24.8	1.2	0.5	0.0	0.0	6.3	0.9	3.8	
16	0.0	0.0	0.0	0.0	3.9	0.0	5.5	18.3	0.0	35.8	0.0	0.0	
17	0.0	0.0	0.0	0.0	1.4	0.0	6.4	0.5	0.0	0.0	2.3	0.0	
18	0.0	5.4	0.0	0.0	0.5	0.0	31.1	0.0	0.5	0.0	6.5	0.0	
19	0.0	0.6	0.0	0.0	4.6	7.3	1.6	0.0	0.0	0.0	0.0	5.1	
20	0.0	0.0	0.0	0.0	6.6	0.0	0.5	0.0	0.0	0.0	7.7	4.2	
ST	18.4	9.3	0.0	0.0	78.7	24.9	94.9	143.6	5.4	82.4	18.0	29.4	
21	1.2	0.0	0.0	1.7	14.7	0.0	0.5	31.5	0.0	7.2	0.5	2.8	
22	1.2	0.0	0.0	0.0	3.6	0.0	0.0	1.8	25.3	0.0	0.0	9.4	
23	4.5	0.0	7.1	2.8	19.3	24.8	0.0	6.5	0.5	0.0	0.0	0.0	
24	0.8	0.0	0.0	0.0	29.8	12.5	6.0	15.3	0.0	0.0	5.6	0.0	
25	0.0	11.2	0.0	0.0	3.0	18.9	2.8	0.0	0.0	0.0	0.0	0.0	
26	0.0	0.0	4.8	0.0	0.0	0.0	0.9	4.7	0.0	17.2	18.1	21.2	
27	0.0	0.0	0.0	0.0	0.0	0.5	7.8	0.0	0.0	0.0	23.6	11.9	
28	0.8	0.0	0.0	0.0	0.0	0.0	0.0	13.3	0.0	0.0	0.0	8.4	
29	0.7	0.0	0.0	0.0	0.0	0.0	0.0	10.5	0.3	1.8	249.4	0.0	
30	0.0	###	0.0	0.0	0.0	0.0	0.0	11.7	0.0	0.7	1.7	11.5	
31	0.0	###	0.0	###	0.0	###	0.0	1.8	###	0.0	###	9.8	
ST	9.3	11.2	11.9	4.4	69.3	56.8	17.9	97.2	26.0	27.0	298.8	75.0	
T	27.7	20.5	24.6	8.7	149.9	128.2	124.6	274.9	125.3	217.3	333.6	245.3	1680.5

1977 Daily Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1	0.0	0.0	0.0	16.8	0.4	0.0	2.3	48.1	36.7	0.0	0.0	0.0	
2	0.0	0.0	0.7	0.0	0.0	0.0	9.1	43.0	4.7	0.0	1.2	16.5	
3	0.0	0.5	0.0	0.0	3.2	4.7	2.6	51.7	0.0	0.0	0.0	0.0	
4	0.0	0.0	0.0	0.0	0.4	3.7	0.0	5.8	5.8	48.4	0.0	0.0	
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	0.0	0.0	0.0	0.0	
6	0.0	23.3	0.0	0.7	0.0	7.4	29.8	0.3	12.8	0.9	0.0	0.0	
7	0.0	0.5	0.0	0.0	0.0	0.0	3.0	0.0	12.8	0.0	0.0	0.0	
8	0.5	0.5	0.0	0.0	0.0	40.2	3.0	0.5	7.7	0.0	7.2	0.0	
9	11.9	0.0	0.0	0.0	0.0	15.6	13.3	0.5	47.6	0.0	3.6	0.0	
10	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.3	0.9	0.0	
ST	12.4	25.5	0.7	17.5	4.1	71.6	63.0	163.7	128.0	67.7	12.8	16.5	
11	0.5	6.1	0.0	5.5	0.0	37.8	0.0	0.0	0.0	16.0	0.0	0.0	
12	0.0	1.0	1.6	0.4	0.0	18.9	25.1	0.0	0.0	5.6	0.0	10.8	
13	19.5	0.0	7.0	16.2	0.0	55.4	5.9	0.0	0.9	2.3	0.0	2.9	
14	0.5	0.0	0.0	0.4	0.0	5.1	16.8	0.0	9.0	0.0	0.0	0.0	
15	0.0	27.8	0.0	0.0	0.0	1.4	12.4	0.0	3.2	0.0	0.4	0.0	
16	0.0	13.4	0.0	0.0	0.0	0.0	27.2	6.6	0.5	36.6	0.0	0.0	
17	0.0	0.3	0.0	0.0	0.0	14.3	9.5	9.5	0.0	6.5	0.0	0.0	
18	2.3	0.5	12.1	0.0	0.0	1.2	2.6	3.5	0.0	0.0	0.0	0.0	
19	0.0	1.8	0.0	0.0	46.3	0.0	0.0	0.0	0.0	0.0	18.2	0.0	
20	0.0	1.4	0.0	0.0	0.0	0.0	19.6	0.9	0.0	0.0	0.0	8.2	
ST	22.7	52.2	20.8	22.5	46.3	134.1	118.9	20.5	13.6	66.8	18.7	21.9	
21	13.1	5.1	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	
22	0.0	11.8	0.0	0.0	0.0	0.0	0.0	0.9	15.5	0.0	28.3	0.0	
23	11.5	1.4	0.0	0.0	0.0	0.0	0.0	0.0	9.8	4.2	0.0	0.0	
24	43.6	1.4	2.7	0.0	0.0	36.0	0.0	0.0	0.5	16.1	0.0	9.9	
25	0.0	23.4	0.0	0.0	5.2	7.0	1.4	0.0	0.0	3.7	0.0	2.8	
26	0.0	0.0	0.0	0.0	11.4	0.5	0.0	0.0	0.0	4.2	4.5	17.2	
27	0.0	0.9	0.0	0.0	0.0	1.4	0.0	0.0	2.3	2.6	0.0	0.4	
28	0.0	0.5	0.0	0.0	3.6	34.3	0.0	0.0	0.0	0.0	1.3	0.0	
29	8.0	###	0.0	0.0	0.0	0.0	0.0	2.8	8.6	0.0	0.0	0.0	
30	0.0	###	0.0	0.0	0.0	5.6	0.0	3.3	0.0	0.0	0.4	0.0	
31	0.0	###	0.0	###	0.0	###	25.4	0.0	###	1.6	###	0.0	
ST	76.2	44.3	2.7	0.0	20.2	84.7	26.7	7.0	38.3	32.4	34.6	30.3	
T	111.3	122.0	24.1	40.0	70.5	290.4	208.6	191.3	179.9	166.9	66.2	68.8	1540.0

1978 Daily Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1	0.0	0.0	1.2	0.0	0.0	9.3	0.1	2.5	0.0	0.3	2.2	0.0	
2	1.3	0.0	0.0	0.0	0.0	0.0	0.6	11.0	0.2	0.0	0.0	6.3	
3	10.8	0.0	0.0	0.0	0.0	0.0	0.0	3.4	0.0	0.0	7.6	3.5	
4	0.0	0.0	0.0	0.0	0.0	11.1	1.0	0.0	0.0	23.0	59.6	2.2	
5	0.0	0.0	0.0	0.0	0.0	0.1	0.0	14.1	0.0	30.3	0.0	37.4	
6	0.4	0.0	0.0	0.0	0.0	0.1	0.0	26.7	0.0	0.2	0.0	0.2	
7	0.1	0.0	0.0	0.0	0.0	0.0	4.9	8.6	0.1	4.1	1.0	1.0	
8	0.0	0.0	0.0	0.0	0.0	5.0	0.0	3.5	1.1	12.4	0.6	0.0	
9	0.0	1.8	0.0	0.0	0.0	1.0	0.0	0.8	5.4	41.8	0.0	0.0	
10	0.0	0.0	0.0	0.0	0.0	14.4	0.0	41.8	0.2	13.8	1.2	0.0	
ST	12.6	1.9	1.2	0.0	0.0	41.0	6.6	112.4	7.0	126.0	72.2	50.7	
11	0.0	1.3	0.0	0.0	0.1	0.0	11.2	30.5	0.0	12.8	9.2	10.1	
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.2	0.0	19.5	2.8	0.0	
13	0.0	0.0	0.0	0.0	0.0	22.0	0.0	20.2	4.6	22.8	6.2	51.4	
14	6.8	0.0	0.0	0.0	0.0	6.2	0.3	38.0	9.9	9.0	0.0	30.2	
15	0.0	0.0	2.6	0.0	0.0	4.4	0.0	8.0	39.4	0.0	0.0	12.9	
16	0.0	0.0	0.0	0.0	9.4	0.0	0.0	0.2	5.8	0.9	0.0	0.0	
17	0.0	0.0	0.0	0.0	6.0	0.0	22.4	0.0	0.0	5.3	0.0	0.0	
18	0.0	0.0	0.0	0.0	16.2	2.0	35.3	0.0	0.3	0.5	0.0	0.0	
19	0.0	0.0	0.0	3.7	27.2	5.4	4.6	0.0	0.0	0.0	0.0	0.0	
20	0.0	1.2	0.0	75.0	9.7	2.0	0.0	11.0	1.3	0.0	0.0	0.0	
ST	6.8	2.5	2.6	78.7	59.6	42.0	73.8	119.0	61.3	70.8	18.2	104.6	
21	0.2	4.2	0.0	0.0	0.0	0.0	0.0	16.5	0.1	0.2	1.2	0.0	
22	0.0	0.0	0.0	52.6	0.0	3.7	0.0	13.3	2.3	0.0	20.0	0.0	
23	0.0	0.0	0.0	0.1	0.0	5.4	5.0	44.6	11.4	0.0	0.0	0.0	
24	2.6	0.6	0.0	0.0	0.0	0.0	0.9	4.3	0.0	15.7	0.0	0.0	
25	0.0	0.0	0.0	0.0	4.3	0.0	0.4	71.5	55.1	0.3	0.0	0.0	
26	4.0	0.0	0.0	0.0	0.5	28.8	0.0	2.3	25.8	0.0	0.0	0.0	
27	0.0	0.0	0.0	0.0	0.0	24.6	4.2	0.1	66.0	1.0	0.0	0.0	
28	0.0	0.0	0.0	0.0	0.0	1.6	15.5	0.0	33.5	0.3	0.0	0.0	
29	0.0	###	0.0	0.0	1.2	0.0	2.0	1.5	1.5	0.0	0.0	0.0	
30	0.0	###	0.0	0.0	1.2	3.0	6.4	0.2	0.0	1.4	0.0	1.9	
31	0.0	###	0.0	###	0.0	###	16.8	0.0	###	2.6	###	1.2	
ST	6.8	4.8	0.0	52.7	7.2	67.1	51.2	154.3	195.6	21.6	21.2	3.1	
T	26.2	9.1	3.8	131.4	66.8	150.1	131.6	385.7	263.9	218.5	111.6	158.4	1657.0

1979 Daily Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1	9.0	1.0	0.0	0.0	0.0	48.0	1.0	0.0	3.8	11.0	14.0	0.0	
2	0.0	1.5	0.0	0.0	0.0	12.3	0.0	0.0	0.0	0.0	22.0	0.0	
3	0.5	2.3	0.0	0.0	0.0	0.1	1.0	20.3	0.0	0.0	2.6	0.0	
4	0.0	0.0	0.0	0.0	1.0	18.5	1.5	1.3	1.0	4.0	0.0	0.0	
5	0.0	0.0	0.0	0.0	2.5	14.0	2.9	0.0	0.0	8.0	0.0	0.0	
6	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.7	18.0	16.0	0.0	0.0	
7	0.0	0.0	0.0	0.0	0.0	0.0	2.5	2.0	13.0	13.0	1.5	0.0	
8	0.0	0.0	10.5	0.0	0.0	0.0	1.0	0.0	0.0	3.9	1.0	0.0	
9	0.0	10.0	0.0	0.0	0.0	2.0	0.0	0.0	18.0	0.0	2.5	5.2	
10	0.6	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	12.3	0.0	0.0	
ST	10.1	14.8	10.5	0.0	4.5	94.9	9.9	28.8	53.8	68.2	43.6	5.2	
11	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	6.5	18.8	12.8	0.0	
12	0.0	11.2	0.0	0.0	2.0	22.0	0.0	9.5	0.0	0.0	0.0	0.0	
13	0.0	0.0	0.0	0.0	6.9	7.3	1.3	36.0	38.0	0.0	1.9	0.0	
14	0.5	0.0	0.0	1.1	0.0	0.0	0.0	46.1	1.3	0.0	0.0	0.0	
15	0.0	0.0	0.0	10.1	24.3	17.0	1.4	1.2	1.5	0.0	4.3	0.0	
16	0.0	0.0	50.7	53.3	1.0	85.0	0.0	11.0	1.5	0.0	4.5	3.2	
17	0.0	1.7	0.0	26.8	26.3	112.0	0.0	20.0	2.4	0.0	0.0	1.0	
18	0.8	0.0	0.0	0.0	0.0	0.2	0.0	5.0	7.8	1.5	0.0	0.0	
19	0.0	0.0	0.0	0.0	0.0	0.1	6.7	0.0	0.0	0.0	0.0	0.0	
20	0.0	0.0	0.0	0.0	7.6	0.4	42.0	39.8	0.0	3.2	0.0	15.0	
ST	1.3	12.9	50.7	91.3	71.1	244.0	51.4	168.6	59.0	23.5	23.5	19.2	
21	0.4	0.0	0.0	8.3	4.5	0.0	150.0	0.0	0.0	4.2	0.0	35.0	
22	0.8	0.0	0.0	0.0	7.3	0.3	182.1	0.0	0.0	0.0	0.0	0.0	
23	2.4	0.0	0.0	0.0	0.0	0.0	34.0	0.0	0.0	0.0	0.0	0.0	
24	0.0	0.0	0.0	0.0	18.1	0.0	16.7	0.0	0.0	0.0	5.4	0.0	
25	3.2	0.0	0.0	0.0	0.0	2.0	3.8	0.0	0.0	1.3	0.0	63.0	
26	0.0	0.0	0.0	0.0	0.0	9.0	14.8	18.0	6.8	0.0	1.0	0.0	
27	0.0	0.0	0.0	1.5	0.0	35.8	1.5	10.0	4.2	0.0	0.0	0.0	
28	1.7	6.4	1.3	0.0	0.0	1.0	0.0	0.0	0.0	8.8	6.6	0.0	
29	0.0	###	0.0	0.0	0.0	0.0	0.0	20.3	5.0	7.5	43.0	0.0	
30	0.0	###	0.0	0.0	3.4	0.0	0.0	0.0	1.5	0.0	2.5	0.0	
31	0.0	###	0.0	###	84.1	###	3.3	0.0	###	0.0	###	0.0	
ST	8.5	6.4	1.3	9.8	117.4	48.1	406.2	48.3	17.5	21.8	58.5	98.0	
T	19.9	34.1	62.5	101.1	193.0	387.0	467.5	245.7	130.3	113.5	125.6	122.4	2002.6

ESTIMATED DAILY RAINFALL IN PROJECT AREA

1980 Daily Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1	0.0	0.0	0.0	0.3	0.0	15.0	7.9	0.0	0.0	18.1	3.3	0.0	
2	0.0	0.0	0.0	0.0	0.0	0.5	3.0	2.0	3.0	0.0	5.0	5.8	
3	3.0	1.0	0.0	2.0	0.0	159.8	27.5	0.0	0.0	0.0	0.0	0.0	
4	0.0	0.0	2.8	1.0	0.0	6.6	6.8	10.2	28.3	0.0	8.1	0.0	
5	0.0	0.0	0.0	0.0	16.2	24.2	0.0	0.0	25.2	58.5	2.0	6.8	
6	4.3	0.0	0.0	0.0	2.4	6.8	0.0	0.0	2.0	1.5	2.5	0.0	
7	1.0	0.0	0.0	0.0	0.0	29.3	0.0	0.0	12.0	30.0	5.2	7.0	
8	0.0	0.0	0.0	0.0	0.0	32.5	0.0	1.0	0.0	3.8	1.5	0.0	
9	0.0	2.4	0.0	0.0	5.5	0.0	0.0	7.2	0.0	0.0	0.0	0.0	
10	0.0	0.2	0.0	0.0	0.0	7.5	0.0	6.5	0.0	16.5	3.5	7.6	
ST	8.3	3.6	2.8	3.3	24.1	282.2	45.2	26.9	70.5	128.4	31.1	27.2	
11	1.0	1.2	0.0	0.0	0.0	0.0	0.0	2.0	0.0	33.8	62.0	0.0	
12	0.0	3.5	0.0	0.0	9.1	0.0	0.0	1.0	0.0	8.5	29.9	0.0	
13	4.2	14.2	0.0	0.0	0.0	21.4	1.4	3.3	0.0	35.2	0.0	0.0	
14	1.1	0.0	0.0	0.0	0.0	21.7	3.8	6.5	0.0	3.8	0.0	6.0	
15	6.8	0.0	0.0	0.0	0.0	0.0	27.5	7.0	16.8	2.0	0.0	0.0	
16	0.0	0.4	0.0	0.0	0.0	0.0	38.7	3.5	0.0	0.0	0.0	0.0	
17	1.8	1.0	0.0	0.0	3.6	77.1	0.0	0.0	1.3	32.2	0.0	7.4	
18	0.0	0.5	5.6	1.0	4.5	87.7	7.9	38.6	0.0	3.0	0.0	1.3	
19	0.0	0.0	0.0	0.0	0.0	30.8	0.0	40.2	61.0	0.0	5.2	12.3	
20	11.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	15.0	1.5	27.6	
ST	25.9	20.8	5.6	1.0	17.2	240.5	79.2	102.1	79.1	133.5	98.6	54.6	
21	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	12.5	27.4	2.0	3.6	
22	19.5	0.0	0.0	0.0	0.0	0.5	0.0	7.0	0.0	28.3	0.0	18.9	
23	5.0	0.0	58.2	0.0	1.8	21.4	0.0	19.5	1.0	0.0	0.0	40.8	
24	5.0	0.0	48.0	0.0	0.0	0.0	5.1	1.5	21.6	0.0	0.0	3.2	
25	5.9	0.0	0.0	0.0	0.0	6.1	1.8	42.7	16.2	1.0	0.0	2.5	
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	57.2	0.0	0.0	2.0	
27	0.0	0.0	0.0	0.0	0.0	16.7	0.0	1.8	0.0	0.0	8.0	1.0	
28	0.0	0.0	0.0	0.0	0.0	39.7	43.3	8.1	0.0	6.0	0.0	3.8	
29	2.0	0.0	0.0	0.0	0.0	38.4	19.8	0.0	22.2	3.8	0.0	1.6	
30	7.9	###	0.0	0.0	0.0	8.4	26.1	0.0	15.0	1.1	9.2	4.5	
31	1.2	###	0.0	###	0.0	###	13.9	22.0	###	1.9	###	2.5	
ST	46.5	0.0	107.4	0.0	1.8	131.1	110.1	103.6	145.7	69.5	19.2	84.4	
T	80.7	24.4	115.8	4.3	43.1	653.8	234.6	232.6	295.3	331.4	148.9	166.2	2331.1

1981 Daily Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1	0.0	0.0	17.0	1.6	22.2	30.0	0.0	0.0	0.0	0.0	4.2	1.8	
2	4.8	0.0	0.0	2.8	0.0	10.8	1.5	4.5	0.0	0.0	0.0	31.5	
3	0.0	0.0	0.0	1.8	0.0	0.0	0.0	37.0	0.0	0.0	0.0	17.2	
4	0.0	0.0	1.0	5.9	0.0	0.0	2.0	0.0	0.0	1.5	0.0	4.2	
5	1.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	3.5	0.0	3.0	
6	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	12.8	
7	0.0	6.0	0.0	0.0	0.0	0.0	24.0	0.0	0.0	0.0	16.8	1.0	
8	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	10.5	0.0	
9	0.0	0.0	0.0	0.0	0.0	0.0	22.8	0.0	9.8	28.8	9.4	0.0	
10	10.4	0.0	0.0	0.0	0.0	0.0	0.0	1.8	3.5	1.0	10.0	2.5	
ST	16.2	9.0	18.0	12.1	24.4	40.8	54.3	43.3	15.3	34.8	50.9	74.0	
11	1.0	0.0	0.0	0.0	0.0	0.0	44.5	0.0	0.0	12.5	0.0	0.0	
12	0.0	2.0	0.0	0.0	12.5	0.0	38.1	0.0	0.0	0.0	20.5	0.0	
13	0.0	0.0	0.0	0.0	0.0	0.0	5.3	18.8	50.9	0.0	0.0	0.0	
14	1.0	3.0	0.0	0.0	0.0	2.0	4.4	0.0	31.8	0.0	0.0	0.0	
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	22.0	0.0	0.0	
16	0.0	0.0	0.0	0.0	12.6	1.2	2.0	0.0	57.8	0.0	1.2	0.0	
17	1.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	
18	0.0	0.0	0.0	0.0	0.0	12.2	0.0	0.0	0.0	0.0	2.0	0.0	
19	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	2.5	0.0	0.0	0.0	
20	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	3.2	0.0	0.0	0.0	
ST	3.0	5.0	0.0	0.0	27.9	19.4	94.3	18.8	148.2	34.5	23.7	0.0	
21	2.0	0.0	0.0	1.5	3.0	1.2	0.0	0.0	0.0	0.0	0.0	2.5	
22	0.0	0.0	0.0	40.2	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	
23	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	22.0	0.0	0.0	
24	1.5	0.0	0.0	0.0	0.0	3.0	0.0	0.0	130.0	0.0	0.0	0.0	
25	4.4	0.0	0.0	0.0	7.5	4.2	0.0	0.0	0.0	0.0	0.0	36.8	
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	28.8	0.0	0.0	
27	0.0	0.0	0.0	0.0	0.0	2.5	22.5	0.0	0.0	0.0	0.0	0.0	
28	0.0	5.0	0.0	0.0	0.0	34.2	0.0	0.0	3.9	1.5	15.0	0.0	
29	26.0	###	0.0	0.0	8.6	3.0	0.0	0.0	4.2	0.0	1.0	0.0	
30	0.0	###	0.0	0.0	8.0	20.0	0.0	0.0	0.0	0.0	2.5	0.0	
31	0.0	###	0.0	###	0.0	###	0.0	0.0	###	1.0	###	0.0	
ST	33.9	5.0	0.0	43.7	27.1	70.9	22.5	0.0	139.1	53.3	18.5	39.3	
T	53.1	19.0	18.0	55.8	79.4	131.1	171.1	62.1	302.6	122.6	93.1	113.3	1221.2

1982 Daily Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
3	0.0	0.0	0.0	0.0	0.0	12.0	0.0	12.5	0.0	2.0	0.0	0.0	
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.5	0.0	20.5	0.0	0.0	
5	0.0	0.0	0.0	0.0	0.0	0.0	2.9	5.5	0.3	39.6	0.0	0.0	
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0	0.3	0.0	0.0	0.0	
7	3.0	0.0	0.0	0.0	0.0	0.0	8.9	0.0	13.2	0.0	0.0	7.0	
8	2.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	19.6	0.0	0.0	0.0	
9	0.0	0.0	0.0	0.0	0.0	0.0	14.0	0.0	0.5	0.0	0.0	0.0	
10	0.0	0.0	0.0	0.0	0.0	44.0	0.0	0.0	0.2	0.2	0.0	0.0	
ST	5.0	0.0	0.0	0.0	0.0	56.0	32.5	59.5	34.1	62.4	0.0	7.0	
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.2	0.0	0.0	0.0	0.0	
12	0.0	0.0	0.0	0.0	0.0	10.3	2.5	10.8	0.0	3.2	0.0	0.0	
13	0.0	0.0	0.0	0.0	0.0	0.0	4.9	0.0	8.5	0.0	0.0	0.0	
14	0.0	0.0	0.0	0.0	0.0	2.8	10.5	0.0	5.2	71.5	20.0	0.0	
15	4.8	0.0	0.0	0.0	30.5	0.0	0.0	0.0	2.0	0.0	0.0	0.0	
16	0.0	0.0	0.0	0.0	0.0	2.3	0.0	31.0	2.2	1.8	0.0	0.0	
17	3.5	0.0	2.5	0.0	5.0	39.5	0.0	9.9	4.0	6.3	0.0	0.0	
18	1.0	0.0	0.0	0.0	12.0	20.8	0.0	85.9	7.0	0.0	0.0	0.0	
19	0.0	0.0	0.0	0.0	22.0	6.7	8.9	8.2	0.0	0.0	0.0	0.0	
20	0.0	0.0	0.0	0.0	0.0	47.7	6.1	10.3	0.0	2.0	0.0	20.5	
ST	9.3	0.0	2.5	0.0	69.5	130.1	32.9	189.1	28.9	84.8	20.0	20.5	
21	0.0	0.0	0.0	0.0	0.0	74.5	34.7	24.6	0.0	0.0	0.0	0.0	
22	0.0	0.0	0.0	0.0	0.0	0.0	3.0	29.0	0.0	0.0	0.0	0.0	
23	2.5	0.0	0.0	0.0	12.4	0.0	10.2	10.6	0.0	0.0	0.0	0.0	
24	18.5	0.0	37.0	0.0	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
25	3.0	0.0	0.0	0.0	0.0	12.5	20.0	0.0	0.0	0.0	0.0	0.0	
26	20.0	0.0	0.0	0.0	0.0	10.2	0.0	0.0	0.0	0.0	1.8	0.0	
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0	
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
29	0.0	###	15.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	
30	0.0	###	5.2	0.0	0.0	0.0	0.0	29.5	0.0	4.8	0.0	0.0	
31	0.0	###	0.0	###	0.0	###	0.0	2.0	###	0.0	###	0.0	
ST	44.0	0.0	57.2	0.0	18.9	97.2	67.9	95.7	0.0	13.8	1.8	0.0	
T	58.3	0.0	59.7	0.0	88.4	283.3	133.3	344.3	63.0	161.0	21.8	27.5	1240.6

1983 Daily Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1	0.0	0.0	0.0	0.0	0.0	0.0	25.6	8.6	48.2	3.9	8.7	0.0	
2	0.0	0.0	0.0	0.0	0.0	0.0	7.0	7.8	0.0	6.2	0.0	0.0	
3	19.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.0	6.5	0.0	21.5	
4	12.2	0.0	0.0	0.0	0.0	0.0	0.0	2.8	3.0	28.6	0.0	0.0	
5	0.0	0.0	0.0	0.0	0.0	0.0	31.0	14.5	4.0	0.3	81.9	0.0	
6	0.0	0.0	0.0	0.0	0.0	0.0	27.0	0.5	0.0	0.5	0.0	0.0	
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.4	0.0	8.2	27.0	0.0	
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	7.0	10.0	0.0	
9	2.8	0.0	0.0	0.0	0.0	26.8	9.0	0.0	0.0	55.3	7.3	6.3	
10	0.0	0.0	0.0	0.0	0.0	16.0	27.0	0.0	0.0	5.2	6.2	6.5	
ST	34.2	0.0	0.0	0.0	0.0	42.8	126.6	78.7	81.1	121.7	141.1	34.3	
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2	3.0	0.0	0.0	2.7	
12	9.0	0.0	0.0	0.0	0.0	0.0	47.0	0.0	13.5	6.6	5.6	0.1	
13	0.0	0.0	0.0	0.0	0.0	4.5	18.3	22.4	0.0	0.0	6.2	15.3	
14	0.0	0.0	0.0	0.0	0.0	3.9	42.3	2.4	0.0	0.0	4.2	0.0	
15	0.0	0.0	0.0	0.0	0.0	0.0	7.7	15.5	6.4	0.0	10.2	15.3	
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.5	0.0	10.8	0.0	
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	0.0	0.0	52.0	0.0	
19	0.0	0.0	0.0	0.0	0.0	8.7	8.5	32.5	22.0	1.4	2.0	0.0	
20	8.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	5.7	16.8	2.0	0.2	
ST	17.0	0.0	0.0	0.0	0.0	17.1	125.8	80.1	106.1	29.8	93.0	33.6	
21	23.8	0.0	0.0	0.0	0.0	9.9	26.6	0.0	12.2	0.0	0.0	0.3	
22	0.8	0.0	0.0	0.0	0.0	85.0	52.0	3.2	12.8	0.0	0.0	1.4	
23	8.4	0.0	0.0	0.0	0.0	2.5	0.2	0.0	0.2	0.0	0.0	1.0	
24	0.0	0.0	0.0	0.0	15.0	0.0	5.0	0.0	0.5	0.0	9.8	0.6	
25	0.0	0.0	0.0	0.0	0.0	30.4	0.0	0.0	5.3	0.0	46.5	0.4	
26	0.0	0.0	0.0	0.0	0.0	50.0	3.0	0.0	1.4	0.0	7.0	4.7	
27	0.0	0.0	0.0	0.0	0.0	52.0	0.0	0.0	7.2	10.0	0.0	4.6	
28	0.0	0.0	0.0	0.0	0.0	0.0	4.0	2.7	55.5	69.6	13.3	0.2	
29	0.0	###	0.0	0.0	0.0	0.0	2.0	3.5	12.8	0.0	0.0	0.2	
30	0.0	###	0.0	0.0	0.0	0.0	8.0	3.8	1.0	2.0	0.0	0.0	
31	0.0	###	0.0	###	0.0	###	0.0	24.0	###	0.0	###	11.0	
ST	33.0	0.0	0.0	0.0	15.0	229.8	100.8	37.2	108.9	81.6	76.6	24.4	
T	84.2	0.0	0.0	0.0	15.0	289.7	353.2	196.0	296.1	233.1	310.7	92.3	1870.3

NUMBER OF RAINY DAYS

		Daily Rainfall Range								
Year		0 R 1	1 R 2	2 R 3	3 R 4	4 R 5	5 R 10	10 R	20 R	30 R
1	1964	224	25	13	11	4	33	30	14	12
2	1965	233	15	11	8	13	27	35	13	10
3	1966	230	22	14	12	8	23	30	8	18
4	1967	210	22	12	9	26	30	30	12	14
5	1968	257	17	15	8	7	18	15	15	14
6	1969	244	13	14	14	3	18	40	10	9
7	1970	202	32	18	12	11	27	28	14	21
8	1971	192	24	16	11	18	28	31	15	30
9	1972	247	19	14	11	4	25	24	10	12
10	1973	225	16	12	12	11	30	24	10	25
11	1974	240	14	14	10	9	28	24	13	13
12	1975	215	17	20	9	8	30	27	18	21
13	1976	251	17	8	5	7	30	26	10	12
14	1977	250	13	13	8	5	26	28	8	14
15	1978	262	13	9	6	11	16	21	10	17
16	1979	242	26	10	10	7	20	25	7	18
17	1980	217	28	10	13	7	33	20	16	22
18	1981	268	22	16	5	9	9	13	11	12
19	1982	284	8	9	3	4	16	21	7	13
20	1983	250	8	9	9	7	32	19	13	18
Average		237.2	18.6	12.9	9.3	9.0	25.0	25.6	11.7	16.3

OBSERVED HOURLY RAINFALL IN THE PROJECT AREA

		a.m.													p.m.											
Date, 1984	Station	0	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
June, 30	D.S.																4.5	5.5	2.0	1.0	0.5	0.5				
	I.A.																0.5	1.0	2.0	0.5	0	0.5				
Aug. 4	D.S.																2.5	3.0	0	0	0	0	0.5			
	I.A.																12.5	5.0	0	0	0	0	0			
Aug. 10	D.S.																		7.5	7.5	2.0	0.5				
	I.A.																		7.5	1.5	0	0				
Aug. 23	D.S.																9.0	0.5	7.0	0.5						
	I.A.																2.0	13.0	0.5	0.5						
Sep. 2	D.S.						0	0.5	1.5	1.0	1.0	1.0	0.5	0	6.0	2.0	0.5	0	0	0.5	0	0	0.5	1.5	0.5	0.5
	I.A.						0.5	0	2.5	0.5	2.5	0	0.5	0.5	3.5	0	1.0	0	0	0.5	0	0	1.0	1.5	0	0
Sep. 9	D.S.							0	0	0	0															
	I.A.							4.0	5.0	3.0	0.5															
Sep. 10-11	D.S.		17.0	3.5	0																					0
			0	0.5	2.0																					7.5
Sep. 17	D.S.														1.5	20.0	4.0	0	0.5	7.5	0	0	0.5	0	0	0
	I.A.														1.0	0.5	0.5	0	0	0	0	0	0	0	0	0
Sep. 18	D.S.		0	1.5	2.0	1.0	0.5	0	0	0	0	0	0	0.5	0	0	0	0	1.0	0.5	1.0	0	0	0.5	1.0	0.5
	I.A.		0	2.5	2.0	1.5	0.5	0.5	0	0	0	0	0	0	10.5	0.5	0	0	0	0.5	0	0	0	0	0.5	0.5
Sep. 19	D.S.														2.0	1.0	1.0	0	0	18.5	4.5	11.0	1.0	0.5		
	I.A.														0	3.0	1.0	0	0	0	0	0	0			
Sep. 20	D.S.																						6.5	13.5	8.5	0.5
	I.A.																						5.5	5.5	1.0	1.5
Sep. 21	D.S.																				0.5	9.5	0.5	2.5	2.0	
	I.A.																			8.5	8.0	9.5	0.5	1.5	2.0	
Sep. 22	D.S.															8.0	0	0	0	0	0	0	0			
	I.A.															0	15.0	16.5	0	0.5	0	0	0.5			
Nov. 5	D.S.			0.5	1.0	1.0	1.0	1.0	1.0	3.5	0.5	2.0	2.0	6.5	7.5	2.5	2.0	3.0	2.5	1.0	0	0	0.5			
	I.A.			0	0	0.5	0	0.5	2.5	2.5	7.0	2.0	3.0	10.0	12.0	3.0	2.5	4.0	2.0	1.5	0.5	0	0			

Note: D.S.: Dam Site, I.A.: Irrigation Area

OBSERVED HOURLY RAINFALL IN PANAY ISLAND

Date, 1984	Station	a.m. 0	1	2	3	4	5	6	7	8	9	10	11	12	p.m. 1	2	3	4	5	6	7	8	9	10	11	12
Oct. 2 '73	Roxas											51.5	28.8	20.1	3.4	4.1	2.6	0.2								
Sep. 27 '73	-do-					21.7	7.6	9.8	7.6																	
28			45.9	2.9	4.9																					
Nov. 19 '73	-do-		5.0	0.9	2.1	1.5	4.8	5.3	6.4	13.9	27.9	0.5						0.8					0.4	4.0	2.3	1.4
20												6.3	13.0	5.7	5.9	7.2	10.4	9.6	3.4	6.1	4.4	8.2	10.0	1.0		
Sep. 21, '77	Agbadi-ang, Tapaz, Capiz		3.0	4.0	2.0	1.0	1.0	1.0	1.5	0.5							3.0	7.0	5.0	11.0	2.0			4.0	1.0	1.0
22					1.0				1.0	3.0	1.0	2.0	4.0	2.0	3.0	35.0	13.0	2.0	9.0	8.0	4.0	1.0	1.0		1.0	
23			5.0	2.0		3.0	1.0	1.0							3.0		5.0									
Jul. 14, '77	- do -			7.0	6.0	26.0	20.0	2.0	2.0	3.0	8.0	3.0	1.0			1.0							1.0			
Feb. 15, '77	- do -																4.0	1.0	4.0	1.0		1.0		3.0	9.0	10.0
16, '77			7.0	26.0	6.0	5.0	4.0		3.0	1.0			1.0		1.0	1.0										
Nov. 4, '77	- do -													1.0						2.0	18.0	6.0	1.0			
5, '77			1.0	5.0		4.0	3.0	25.0																		
Apr. 20, '78	- do -		30.0	15.0						3.0	1.0	7.0		1.0	8.0	6.0	1.0	3.0	5.0	1.0	1.0					1.0

RECORDS ON TYPHOON UNDANG

	Min. Atmospheric Pressure (mb) Time/Date	Max. Winds (m/s) Time/Date	Max. 24-hr Rainfall (mm) Date
Tacloban	970.2 3:30 am, Nov. 5	62 3:30 am, Nov. 5	153.0 Nov. 4
Guinan	980.0 1:45 am, Nov. 5	60 12:04 am, Nov. 5	53.5 Nov. 4
Borongan	981.1 3:50 am, Nov. 5	50 2:54 am, Nov. 5	133.9 Nov. 4
San Jose	996.2 7:00 pm, Nov. 5	31 9:27 pm, Nov. 5	84.4 Nov. 5
Cuyo	1001.1 10:00 pm, Nov. 5	26 8:40 pm, Nov. 5	68.1 Nov. 5
Mactan	1004.2 8:00 am, Nov. 5	25 9:40 am, Nov. 5	70.6 Nov. 5
Romblon	1002.9 8:00 am, Nov. 5	23 2:30 pm, Nov. 5	20.2 Nov. 5
Calapan	1007.0 5:00 pm, Nov. 5	22 11:14 pm, Nov. 5	55.6 Nov. 5
Masbate	1003.7 3:00 pm, Nov. 5	20 10:30 am, Nov. 5	10.4 Nov. 5
Tagbilaran	1004.7 6:00 am, Nov. 5	10 12:12 pm, Nov. 5	27.0 Nov. 5
Dagupan	1008.0 5:00 pm, Nov. 5	6 5:00 pm, Nov. 5	- -