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THE UNITED ARAB EMIRATES
THE MINISTRY OF AGRICULTURE AND FISHERIES
WATER AND SOIL DIRECTORATE

WADI AL BASSIERAH BASIN
WATER RESOURCES DEVELOPMENT PROJECT

REPORT
ON
FEASIBILITY STUDY

VOL. III

APPENDIX

JAPAN INTERNATIONAL COOPERATION AGENCY

NOVEMBER, 1981

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H1	Water resources survey, hydrological yearbook 1967/68, 1968/69
H2	Technical Report No.1, Vo.1 Hydrographical and Meteorological Observations at Khorfakkan, 1976
H3	Hydrometeorological field data collection, evaluation processing and in services training of staff, volume I, FAO
H4	Hydrometeorological data collection, evaluation and in services training report No.6, FAO
H5	Batina coast tide levels

1.1.2. Water Resources

W1 Report on the Water resources of the Trucial States vols. II, William Halcrow and Partners, 1969

W2 Wadi Hadf Water resources survey phase one report, Ministry of Electricity and Water, UAE, Hunting Technical services Limited and Sir Alexander Gibb & Partners, 1975

W3 Water resources and rural development in the UAE, Mission report. I.D. of Japan, 1978

W4 Water resources survey yearbook No.1, Ministry of agriculture & Fisheries, Water & Soil Directorate, 1979

W5 Water Supply augmentation for the UAE , USBR Dept. of the Interior, June 1979

W6 Technical notes in land and water resources of the UAE in relation to agricultural disease by David J. Burdon et al, FAO

W7 Groundwater pumping and Irrigation Costs in farms fields, central region, UAE by C.R.K. Prasher and Sudhir B, Thanki, UNDP/FAO

W8 Soil and Water Development Project UAE phase I, preliminary appraisal of water resources by D.P. carr and W. Barber, FAO

W9 Report on the Discovery of Submarine Springs Using infrared thermal imagery

1.1.3. Crops and Irrigation

CI1 Cropping pattern and Irrigation requirements, central region, UAE by C.R.K. Prasher and Badhir B. Thanki, UNDP/FAO

CI2 Crop water requirements in UAE, by C.R.K. Prashar and Robert Y. Karam, UNDP/FAO

CI3 Hamraniyah Irrigation Practices experiments 1976-1977 by Andreas P. Savva and Robert Y.K., UNDP/FAO

CI4 Arid Lands Research Center SADIYAT

CI5 UAE, Ministry of Agriculture and Fisheries Fruit Farm-Dibba, Preliminary Report

1.1.4. Statistical Data

S1 UAE, Ministry of Agriculture and Fisheries
Total year by Statistic for 1973
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S2 General frame of the first agricultural holding census in the UAE 1975

S3 Project for five-year plan for the Agriculture and fisheries development in the UAE 1978-1982
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S4 Statistics of Foreign Trade for UAE for the Year 1978

S5 Annual Statistical Bulletin for 1978

S6 Annual Statistical Bulletin for 1978, Nov. 1979

S7 UAE currency Board, Annual Report, December, 1979

S8 UAE, bulletin, Vol.5, No.2, June 1979

S9 UAE, bulletin, Vol.6. No.1. Dec. 1979

S10 Annual Statistical Abstract, 1979

S11 Statistical Supplement, Sept. 1979
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2.1. Area and Population in UAE

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TABLE A.2.1-1 AREA AND VILLAGES IN U A E

Emirates	Area		Villages					
	Km²	%	Total	More than 2,000	500-1,999	200-499	50-199	Less than 50 persons
Abu Dhabi	67,340	86.7	169	3	8	19	36	103
Dubai	3,885	5.0	14	-	2	2	5	5
Sharjah	2,590	3.3	29	1	8	4	10	6
Ajman	259	0.3	9	-	1	1	3	4
Umm Al-Qiwain	777	1.0	6	-	1	2	1	2
Ras Al-Khaima	1,684	2.2	55	1	13	18	13	10
Fujeira	1,165	1.5	46	1	9	7	18	11
Unknown	-	-	8	-	-	1	4	3
Total	77,700	100	336	6	42	54	90	144

Source : Annual Statistical Abstract, 1979, issued by Central Statistic Dept. Ministry of Planning UAE

TABLE A.2.1-2 MONTHLY TEMPERATURE AND RELATIVE HUMIDITY, 1978

Stations		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average	
Dibba Station	TX	26.1	26.0	28.5	33.6	37.8	40.6	39.7	36.9	35.1	34.5	30.2	27.5	33.0	28.9
	TN	-	-	17.6	-	24.8	29.8	31.0	30.4	28.1	23.7	21.8	15.0	24.7	
	HX	75	77	73	66	61	60	64	72	74	62	61	56	66.8	33.4
	HN	-	-	-	-	-	-	-	-	-	-	-	-	-	
Ras Al Khaima Airport	TX	25.9	26.4	30.0	-	39.8	42.5	-	-	39.1	36.7	30.6	27.3	33.1	25.2
	TN	11.8	12.1	14.9	-	21.3	25.9	-	-	20.9	16.5	19.4	12.5	17.3	
	HX	93	94	92	-	82	70	-	-	92	83	82	92	86.7	62.2
	HN	49	47	40	-	36	26	-	-	34	27	35	45	37.7	
Sharjah Airport	TX	25.5	25.2	29.8	34.8	38.2	41.9	43.3	42.1	38.8	36.8	31.4	28.4	34.7	27.1
	TN	12.4	12.6	14.8	17.3	19.9	24.8	28.9	28.1	23.9	19.8	17.4	13.5	19.5	
	HX	96	97	94	82	87	81	79	88	92	93	89	95	89.4	61.8
	HN	47	43	36	30	28	25	29	33	34	26	38	41	34.2	
Abu Dhabi Airport	TX	24.4	25.3	28.5	23.4	36.7	38.5	41.3	39.2	37.3	35.7	30.1	26.3	32.2	27.4
	TN	15.2	14.5	19.6	22.0	23.6	27.4	31.1	29.8	26.7	23.0	20.3	16.9	22.5	
	HX	83	88	82	71	79	80	79	85	85	86	78	85	81.8	60.1
	HN	51	43	36	28	28	33	33	42	41	29	45	50	38.3	

Note: TX: Maximum temperature centigrade
TN: Minimum temperature centigrade
HX: Maximum relative humidity
HN: Minimum relative humidity

Source : Annual Statistical Abstract, 1979 issued by Central Statictic Dept. Ministry of Planning, UAE

TABLE A.2.1-3 ESTIMATED POPULATION BY AGE GROUPS AND SEX. 31. 12. 1978

%	Total	Sex		Age Groups
		Female	Male	
11.64	102,100	49,950	52,150	0- 4
8.67	76,070	36,710	39,360	5- 9
6.72	58,940	26,450	32,490	10-14
20.40	178,960	47,340	131,640	15-24
27.57	241,960	44,730	197,230	25-34
14.48	127,030	23,760	103,270	35-44
6.36	55,780	13,410	42,370	45-54
2.55	22,350	8,080	14,270	55-64
1.18	10,360	4,370	5,990	65-74
0.38	3,330	1,460	1,870	75-84
0.05	440	210	230	85+
100.0	877,340	256,470	620,870	-
	100%	29%	71%	

Source : Statistical Diary 1979 issued by Central Statistical Dept. Ministry of Planning, UAE

TABLE A.2.1-4 DISTRIBUTION OF POPULATION AND CONSUMPTIVE USE OF WATER

Emirates	Populations				Annual Water 1978	
	1960	1975		1978		
	Unit:1000	Unit:1000	%	Unit:1000	L/D/C	Unit:MCM
Abu Dhabi	25.0	235.7	36.1	316.7	400	46.2
Dubai	57.4	206.9	31.7	278.1	400	40.6
Sharjah	20.6	88.2	13.5	118.4	400	17.3
Ajman	4.1	21.6	3.3	29.0	250	2.6
Umm Al-Qiwain	2.9	16.8	2.6	22.8	250	2.1
Ras Al-Khaima	8.7	57.3	8.8	77.2	300	8.5
Fujeira	2.0	26.5	4.0	35.1	250	3.2
Total	120.7	653.0	100	877.34	-	120.5

Notes:

(1) Data of 1960 and 1975 census are indicated in Report of Preliminary Appraisal of Water Resources by D.P. Carr and W. Barber, 1976.

(2) Total population of 877,340 is given by Annual Statistical Abstract, 1979, issued by Central Statistic Dept. ministry of Planning, UAE.

(3) Population of individual emirate for 1978 has been calculated on the basis of total population of 877,340 and percentage resulted from 1975 census.

(4) L/D/C: The values quoted by liter per day per capita are proposed due to difference of population.

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TABLE A.2.2-1 MONTHLY PRODUCTION OF CRUDE OIL IN U.A.E. BY MONTH, 1978

Emirate / Company

Unit: 1,000 Brls.

Company	Total	Dec.	Nov.	Oct.	Sep.	Aug.	July	June	May	Apr.	Mar.	Feb.	Jan.
Abu-Dhabi													
ADPC	312,268	26,661	25,811	26,650	25,824	26,644	26,673	25,820	27,777	24,030	26,569	24,564	25,245
ADMA	180,868	15,460	14,968	15,463	14,907	15,471	15,415	14,850	15,460	14,854	15,654	14,377	13,989
TBK	25,711	2,133	2,125	2,020	1,860	2,087	2,273	2,340	2,112	1,849	2,376	2,225	2,311
ADOC	7,906	759	705	743	701	702	648	571	650	649	643	550	585
Bondoq	1,098	155	148	156	150	120	-	37	9	-	73	131	119
Total Abu-Dhabi	527,851	45,168	43,757	45,032	43,442	45,024	45,009	43,618	46,008	41,382	45,315	41,847	42,249
Dubai													
Duma	131,841	11,468	10,990	11,371	10,692	11,467	11,242	11,211	11,549	10,746	11,133	9,397	10,575
Sharjah													
C.P.C.	8,078	437	454	540	622	727	695	627	643	741	880	889	823
Total	667,770	57,073	55,201	56,943	54,756	57,218	56,946	55,456	58,200	52,869	57,328	52,133	53,647

Source : Annual Statistical Abstract, 1979, issued by Central Statistic Dept. Ministry of Planning

TABLE A.2.2-2 AVERAGE DAILY OIL EXPORT BY U.A.E., 1978

Emirate

Unit: 1,000 Brls/daily

Company	Average	Dec.	Nov.	Oct.	Sep.	Aug.	July	June	May	Apr.	Mar.	Feb.	Jan.
Abu-Dhabi													
ADPC	837.0	861.1	797.8	868.4	843.0	842.1	808.8	866.1	905.6	775.0	838.8	820.4	812.0
ADMA*/	501.5	539.6	471.1	532.3	498.2	513.7	499.1	506.5	497.2	508.8	471.8	564.9	414.8
TBK	68.7	76.6	64.3	56.8	44.7	74.6	72.1	76.4	65.1	63.5	73.4	80.0	77.4
ADOC	21.4	20.4	37.7	35.4	-	38.9	16.0	18.0	18.1	17.9	17.4	37.9	-
Total Abu-Dhabi	1,428.8	1,503.7	1,370.9	1,492.9	1,385.9	1,469.3	1,386.0	1,467.0	1,486.0	1,365.2	1,401.4	1,503.2	1,304.2
Dubai													
DUMA	368.0	378.7	398.0	327.1	429.6	329.3	383.4	371.1	356.9	340.5	360.9	335.6	404.0
Sharjah													
CPC	22.0	13.3	13.5	13.7	26.8	25.5	26.4	13.2	25.5	15.3	38.5	30.4	21.5
Total	1,818.7	1,895.7	1,782.4	1,833.7	1,842.3	1,824.1	1,805.8	1,851.3	1,868.4	1,721.0	1,800.8	1,869.2	1,729.7

Notes: (1) */: ADMA's Total export includes Abu-Dhabi share only of EL Bondog Oil field exports.

Source : Annual Statistical Abstract, 1979, issued by Central Statistic Dept. Ministry of Planning, UAE

TABLE 2.2-3 CRUDE OIL EXPORT FROM UAE BY IMPORTING COUNTRIES AND PRODUCING COMPANIES, 1978

Unit: 1,000 Brls

Company / Country	Total	CPC	DUMA	Adoc	TBK	ADMA	ADPC
Japan	178,359	-	5,615	7,805	-	67,812	97,127
America	78,694	7,610	1,725	-	627	4,789	63,943
Netherlandintex	70,517	-	-	-	-	27,478	43,039
France	92,178	-	30,986	-	513	27,428	33,251
Holland	49,058	-	18,214	-	2,105	7,768	20,976
United Kingdom	35,191	405	18,104	-	622	13,156	2,904
Italy	19,094	-	5,708	-	8,799	559	4,028
F. Germany	24,221	-	12,556	-	-	-	11,665
Sweden	9,474	-	-	-	-	5,839	3,635
Egypt	5,781	-	-	-	3,579	-	2,202
Thailand	4,441	-	-	-	-	4,261	180
Pakistan	7,397	-	-	-	-	-	7,397
Switzerland	6,356	-	-	-	-	-	6,356
Bangladesh	4,460	-	-	-	-	-	4,460
Tanzania	2,181	-	-	-	-	-	2,181
Irland	1,464	-	-	-	-	-	1,464
West Indese	851	-	-	-	-	-	851
	589,717						

Source : Annual Statistical Abstract, 1979, issued by Central Statistic Dept. Ministry of Planning, UAE

TABLE A.2.2-4 OIL PRODUCTION IN UAE FOR 1972 - 1978

Unit: 1,000 Brls

	Abu-Dhabi	Dubai	Sharjah	Total	Growth Rate
1972	384,177	55,596	-	439,773	100
73	475,616	81,151	-	556,767	126.6
74	515,139	88,318	8,511	611,968	139.1
75	512,335	91,635	13,942	617,912	140.5
76	584,225	114,849	13,540	712,614	162.0
77	602,765	116,445	10,296	729,506	165.9
78	527,851	131,841	8,078	667,770	151.8
	79%	19.8%	1.2%		

Source: Ministry of Planning

2.3. Agriculture in UAE

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TABLE A.2.3-1 PROJECTION OF TOTAL AREA UNDER AGRICULTURAL HOLDINGS BY DISTRICT

1973, 1975, 1978

District	Estimation Sample 1978	Agriculture Cencus 1975	Estimation 1973
Southern	70,027*/	28,050	18,031
Central	37,165	28,142	21,450
Eastern	30,138	23,709	29,110
Northern	78,210	65,125	57,100
Total	215,540	145,026	125,691

Notes:

(1) */: The increase in agriculture area in 1979 is the result of the combination of the southern district.

(2) Unit area by Donum

(3) This data is issued by Ministry of Planning, Central Statistical Department, Annual Statistical Abstract, 1979.

Source : Annual Statistical Abstract, 1979, issued by Central Statistic Dept. Ministry of Planning, UAE

TABLE A.2.3-2 DEVELOPMENT OF AGRICULTURAL LANDS BY LAND UTILIZATION IN AGRICULTURE HOLDINGS FOR THE YEARS OF 1973, 1975, 1978

Land Utilization	1978	1975	1973
Vegetables	31,098	12,810	23,800
Field Crops	10,535	8,564	11,240
Fruit Trees	96,518	44,272	50,000
Wood and Ornamental	2,243	2,228	931
Other Land	71,794	73,345	39,720
Uncultivable	3,352	3,807	-
Total	215,540	145,026	125,691
Increasing Rate	171	115	100

Notes:

(1) Unit area by Donum

Source : Annual Statistical Abstract, 1979, Central Statistic Dept. Ministry of Planning, UAE

TABLE A.2.3-3 VEGETABLE PRODUCTS BY DISTRICT, 1978

Qty: in ton, Unit: DH 1,000

District / Type	Total		Northern		Eastern		Middle		Southern	
	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.
Tomato	35,658	21,637	7,434	4,511	13,626	8,268	9,641	5,850	4,957	3,008
Egg-Plant	8,769	7,241	1,858	1,534	3,793	3,132	2,209	1,824	909	751
Okra	2,533	443	440	77	961	168	520	91	612	107
Beans	1,065	145	-	-	595	56	190	36	280	53
Cow Peas	2,783	504	-	-	94	17	2,153	390	536	97
Marsh-Marrow	581	493	30	14	351	170	188	91	12	215
Chard	2,005	2,718	-	-	1,254	1,484	479	912	272	322
Squash	4,449	1,883	80	34	1,966	832	1,134	480	1,269	537
Cucumbers	14,968	4,583	2,005	614	3,893	1,192	4,507	1,380	4,563	1,397
Cabbages	11,873	5,689	1,315	630	7,747	3,712	1,690	810	1,121	537
Cauliflowers	11,083	4,496	168	68	8,573	3,478	1,282	520	1,060	430
Potatoes	5,884	2,003	-	-	2,541	865	1,448	490	1,895	645
Onion	4,185	2,737	1,321	864	1,147	750	1,223	800	494	323
Watermelon	12,276	8,968	6,966	4,644	2,756	2,244	2,026	1,650	528	430
Sweet Melon	5,961	2,303	2,835	1,101	1,185	460	1,082	420	859	323
Lettuce	836	530	6	4	597	393	152	80	81	53
Radish	1,169	1,143	230	115	71	78	475	520	393	430
Baraley	540	311	12	7	92	53	63	36	373	215
Carrots	1,632	933	722	361	535	336	291	183	84	53
Pepper	8,550	1,292	4,474	676	2,442	369	1,204	182	430	65
Others	3,890	1,809	527	245	1,114	518	632	294	1,617	752
Total	140,690	71,861	30,423	15,499	55,333	28,575	32,589	17,039	22,345	10,742

This data is issued by Ministry of Planning, Central Statistical Department, Annual Statistical Abstract, 1979.

TABLE A.2.3-4 FIELD CROP PRODUCTS BY AGRICULTURAL DISTRICT, 1978

Unit: DH 1,000 Qty. in ton

District / Type	Total		Northern		Eastern		Middle		Southern	
	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.
Clover	28,964	26,400	111	74	8,954	8,170	4,519	4,123	15,380	14,033
Tabacco	5,297	609	1,443	139	927	113	2,796	341	131	16
Other Crops	1,071	643	23	8	59	36	48	29	941	570
Total	35,332	27,652	1,577	221	9,940	8,319	7,363	4,493	16,452	14,619

This data is issued by Ministry of Planning, Central Statical Department, Annual Statistical Abstract, 1979.

TABLE A.2.3-5 DATES & FRUIT PRODUCTS BY DISTRICT, 1978

Unit: DH 1,000 Qty. in ton

District / Type	Total		Northern		Eastern		Middle		Southern	
	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.
Dates	64,295	38,990	14,450	8,763	19,523	11,839	6,797	4,122	23,525	14,266
Lemon	10,782	3,205	4,844	1,440	4,054	1,205	1,305	388	579	172
Orange	3,171	1,057	417	139	1,416	472	1,338	446	-	-
Guave	1,111	295	674	179	132	35	113	30	192	51
Manjo	2,490	972	1,816	709	26	10	566	221	82	32
Almond	75	288	15	56	50	193	7	27	3	12
Pome-Granates	306	85	22	6	14	4	144	40	126	35
Fig	114	51	11	5	29	13	16	7	58	26
Grapes	953	193	5	1	518	105	346	70	84	17
Banana	1,454	808	1,436	798	18	10	-	-	-	-
Others	1,244	783	84	121	200	286	262	375	698	1
Total	85,995	46,727	23,774	12,217	25,980	14,172	10,894	5,726	25,347	14,612

This data is issued by Ministry of Planning, Central Statistical Department, Annual Statistical Abstract, 1979.

TABLE A.2.3-6 CALENDAR OF GROWING MAIN CROPS

Eastern Region, UAE

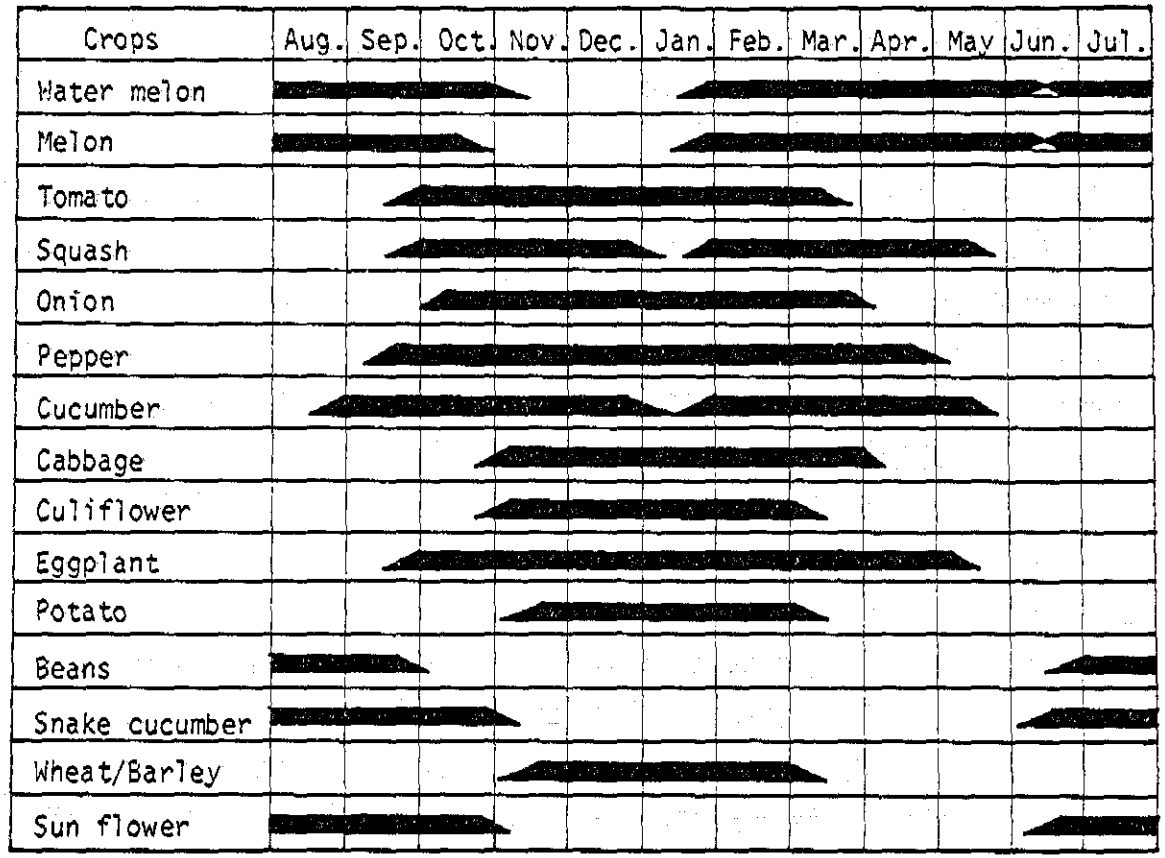


FIG. A.2.3-1 MINISTRY OF AGRICULTURE & FISHERIES ORGANIZATION CHART according to the cabinet decree No.8 of 1975 and modified according to the cabinet decree No.2 of 1979

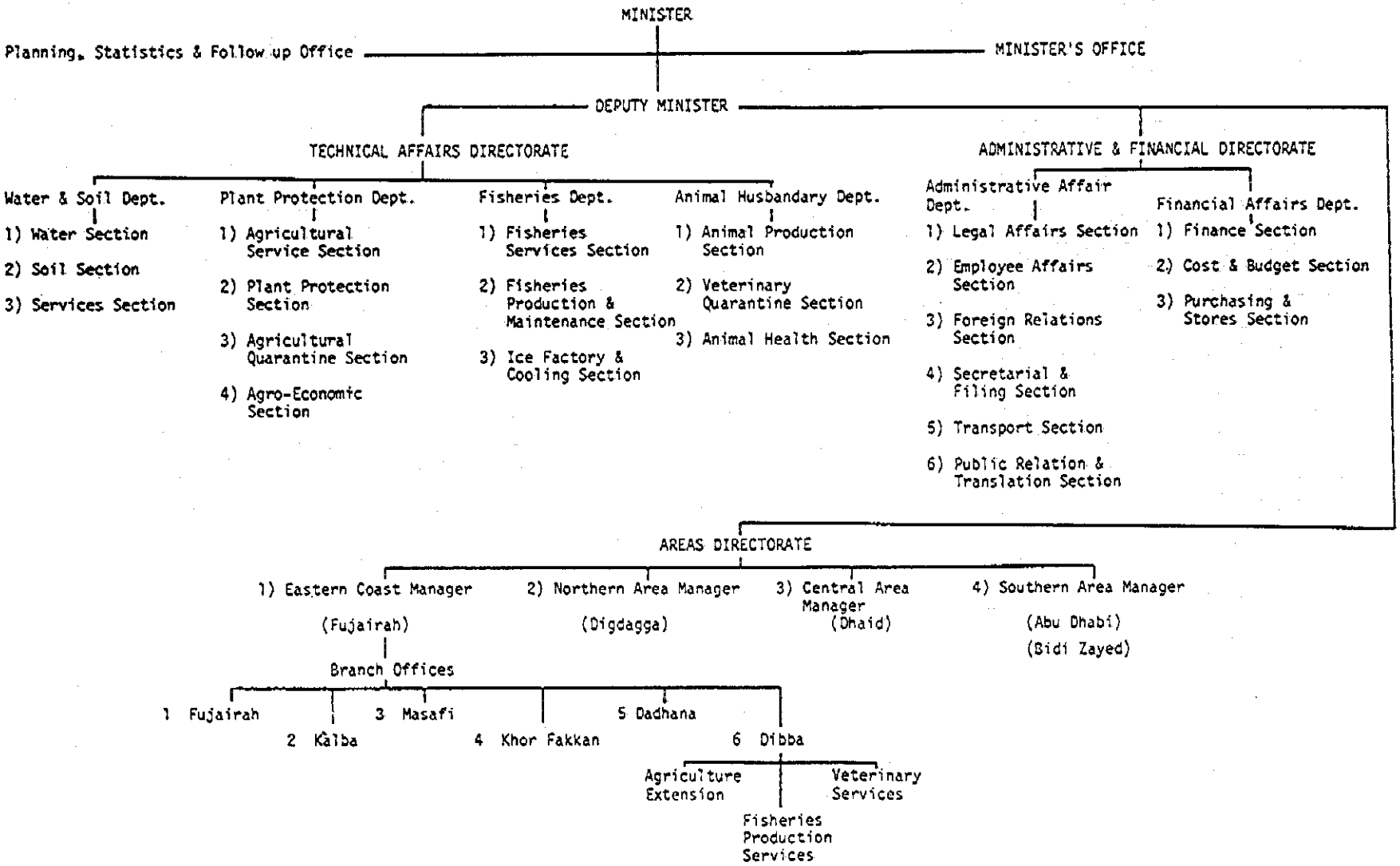
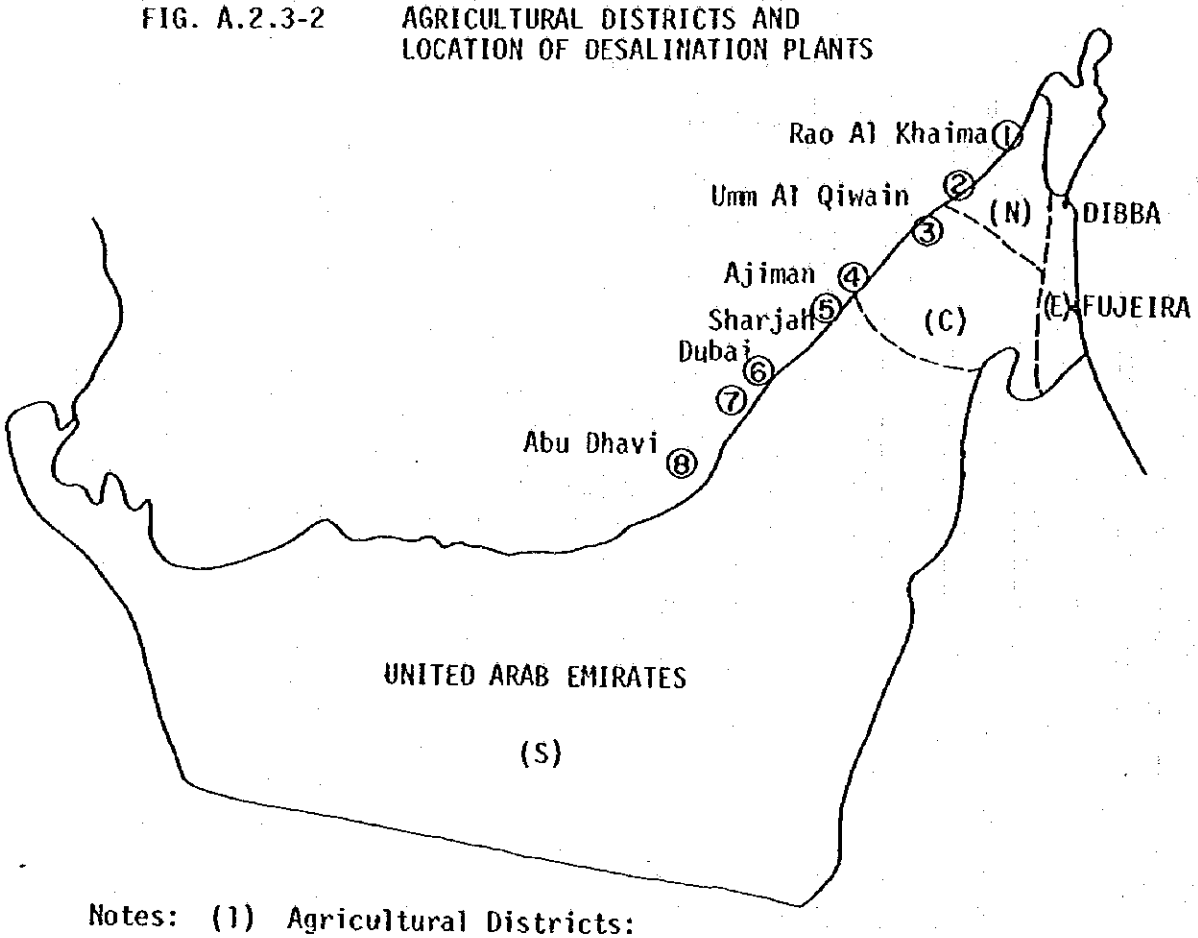


FIG. A.2.3-2 AGRICULTURAL DISTRICTS AND LOCATION OF DESALINATION PLANTS



Notes: (1) Agricultural Districts:

(E): East
(N): North
(C): Center
(S): South

(2) Desalination plants:

① Chalila
② Ras Al Khaima
③ Sharjah
④ Dec Jabal Ali Dubi
⑤ Dubai Jabal Ali
⑥ Um Al Nar West
⑦ Um Al Nar East
⑧ Abu Dhavi

TABLE A.2.3-7 WATER REQUIREMENT OF CROPS MM(M^3/DONUM)

CROPS	NORTHERN	CENTRAL	EASTERN	SOUTHERN	REMARKS	CENTRAL REGION	
WATER						NO. OF IRR.	PUMPED
MELON	629	529	823	815	SPRING	70	2,400
MELON	-	554	773	678	"	-	-
TOMATO	516	454	606	577	WINTER	90	2,950
SQUASH	375	356	506	511	SPRING	50	1,350
ONION	220	214	258	258	WINTER	45	1,350
PEPPER	789	751	896	718	-	95	3,350
CUCUMBER	427	385	479	390	WINTER	60	1,750
CABBAGE	381	335	467	463	"	30	950
CULIFLOWER	321	281	385	432	"	30	950
EGG PLANT	785	749	914	709	"	110	3,500
POTATO	294	255	330	365	-	-	-
BEANS	268	241	-	527	-	-	-
SNAKE CUCUMBER	568	537	823	-	SPRING	-	-
WHEAT/BARLY	266	228	318	298	-	-	-
SAN FLOWER	-	-	803	-	-	-	-

Source: Crop Water Requirements in United Arab Emirates by Dr. C.R.K. Prashar FAO Crop Water-Use Specialist and Sudhir B. Thanki Crop Water-Use Research Officer

TABLE A.2.3-8 NUMBER OF WELLS, FARMS AND CULTIVATED AREA IN DIBBA SEPT., 1980

Unit, Number, Donum

Villages	(1) Wells	(2) Farms	(3) Farmland (1980)	(4) Farmland (1975)	Remarks
1. Dibba Al Hisn	325	281	865.5	1,495	Dibba town
2. Al Akameah	107	90	137	100	
3. Al Rada	27	24	204	141	
4. Al Ghorfah	79	72	412	306	
5. Al Mohalah	20	18	121	123	
6. Sambrair	95	81	656.5	653	(3)Sub-total[(1)-(7)]
7. Al Doub	88	72	693	652	3,089 donum
8. Waset	-	-	-	-	
9. Waam	1	38	13	20	Villages
10. Wadi Al Fay	-	5	12.5	10	
11. Sanna	-	13	6.5	6	
12. Danha	1	25	13.5	11	
13. Dabha	-	8	2.7	3	
14. Al Halah	2	36	22.3	21	
15. Wadi Al Sider	-	6	6	6	
16. Ashasa	-	5	3.7	4	
17. Wadi Al Aiana	1	45	46.5	11	
18. Wadi Al Abadellah	-	30	32.5	20	
19. Al Guna	-	11	2.4	2	
20. Al Khipia	1	6	7.5	7	
Sub-total	747	866	3,258.1	3,729	
21. Dibba Oman	-	234	2.180	-	Oman
22. Al Kapous	12	16	62.5	70	Out of the project
23. Raul Dibba	16	19	44	45	area
24. Al Fugait	22	8	890	225	
		(Local Farms)			
25. Al Akameah	-	-(2)	205	138	
Sub-total	50	43	996.5	340	
Total	797+9 (806)	1,143	4,254.6 (4,459.6)	4,069	

No.22-25: Out of the project area

Nine deep wells: Marble factory 2,
Municipal Water Supply 3,
F.A.O. Farm 4.

Source: Dibba Office,
Ministry of Agriculture
and Fishery

2.4. Desalination Plants

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TABLE A.2.4-1 DESALINATION PLANTS UNDER CONSTRUCTION

Plant of:	Date of Commissioning	Number of Unit (m^3/day)	Installed Capacity (m^3/day)	Net Cost of Fresh Water (DH/m^3)
Chalila	1980	2x13,500	27,000	2.0
Ras Al Khalma	1977	3x 2,300	6,900	1.61 to 2.05
Sharjah	1981	2x19,500	39,000	6.4
Dec Jabal Ali Dubi	1980	5x13,000	65,000	3.3 to 5.5
Dubai Jabal Ali	1981	6x19,000	114,000	3.0
Um Al Nar West	1980	6X18,000	108,000	2.0
Um Al Nar East	1979	3x22,730	68,200	1.3
Abu Dhabi	1977	10 existing	109,000	3.3
Total		37	537,100	

Notes:

(1) This data is given by Report of Water and Soil Resources Survey Phase I Study, Part I, Collection of Technical data, 1978 Sogreah.

(2) The following net cost of fresh water is described in the above report.
Abu Dhabi municipal water has an estimated desalting cost of 5 dirhams per cubic metre. Saudi Arabia on its longer installation publishes a cost of US$ 0.8 per m^3. It is believed the average cost of water would be Dh 4.00 per m^3. This is the water cost that is used in the economic analysis.

2.5. Economic Aspect in UAE

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TABLE A.2.5-1 ECONOMIC INDICATORS IN U.A.E. FOR 1977 - 1979

Unit: MDH

Economic Indicators	1977 Actual Value	1978 Provisional Value	(Growth %)	1979 Estimated Value	(Growth %)
Population (Person)	862,000	877,360	1.8	905,000	3.2
Labour Force (Labour)	450,650	459,647	2.0	485,198	5.6
Gross Domestic Product	54,443.3	53,338.1	Δ2.0	55,603.9	4.2
Gross National Product (at market price)	50,578.3	49,991.1	Δ1.2	52,263.9	4.5
National Income	47,362.8	45,867.1	Δ3.2	47,503.2	3.6
Disposal National Income	43,961.8	43,102.1	Δ2.0	44,768.2	3.9
Expenditure on Final Consumption	16,786.5	18,808.8	12.0	19,997.9	6.3
Govenment Final Consumption	6,368.5	7,207.5	13.2	7,778.0	7.9
Private Final Consumption	10,418.0	11,601.3	11.4	12,219.9	5.3
Savings (National Savings)	27,175.3	24,293.3	Δ10.6	24,770.3	2.0
Gross Capital Formation	19,205.8	18,493.3	Δ3.7	19,501.0	5.4
Gross Fixed Capital Formation	18,362.8	18,364.3	-	19,501.0	6.2
Wages and Salaries	11,268.7	12,609.3	11.9	14,170.5	12.4
Total Imports	19,704.0	19,948.0	1.2	20,056.0	0.5
Imports (excluding Re-ex)	16,197.0	16,344.0	0.9	16,446.0	0.6
Total Exports	39,727.0	37,845.0	Δ4.7	38,102.0	0.7
Exports (excluding Re-ex)	36,220.0	34,241.0	Δ5.5	34,492.0	0.7
Surpuls of Balance of Trade	20,023.0	17,897.0	Δ10.6	18,046.0	0.8
Current Surplus Other Balance of Payment	11,185.0	9,924.0	Δ11.3	10,030.0	1.1
Capital of Payment	2,361.0	4,358.0	91.4	3,000.0	31.2

Source: Central Statistical Dept.
Ministry of Planning

TABLE A.2.5-2 UAE'S FOREIGN TRADE FOR 1978 CLASSIFIED BY ZONES (EXPORTS)

Unit: 1,000 DH

Zone	Crude oil	Re-exports	Other export	Total
Arab Countries	288,252	1,148,735	904	1,437,891
Asia	10,542,982	621,260	7,374	11,171,616
West Europe	13,929,357	16,266	-	13,945,623
Eastern Europe	166,611	13	-	166,624
North Europe	4,031,708	3,683	-	4,035,391
Latin America	4,163,480	21	-	4,163,501
Oceanic Countries	321,668	29	-	321,697
Unclassified Re-exports	-	1,797,555	-	1,797,555
Gas Exports	842,116	-	-	842,116
Total	34,286,174	3,587,562	8,278	37,882,014

Source: Foreign Trade Dept.
Ministry of Economy and Trade

TABLE A.2.5-3 UAE'S FOREIGN TRADE FOR 1978 CLASSIFIED BY ZONES (IMPORTS)

Unit: 1,000 DH, 1,000 ton

Zone	Value	Ratio	Weight
Arab Countries	956,386.2	4.67	1,249.9
Asia	6,172,980.5	30.17	2,268.6
Africa	128,706.7	0.63	148.4
Western Europe	10,011,241.2	48.94	1,973.6
Eastern Europe	242,176.1	1.18	343.0
North America	2,545,920.0	12.45	274.3
Latin America	134,798.4	6.66	80.9
Oceanic Countries	265,624.0	1.30	131.2
Total	20,457,833.6	100	6,470.4

Source: Foreign Trade Dept.
Ministry of Economy and Trade

TABLE A.2.5-4 FEDERAL GOVERNMENT BUDGET FOR 1978 - 1980

Unit: 1,000 DH

Ministry	1978 Actual	1979 Badget	Growth Ratio from 1978	1980 Badget	Growth Ratio from 1978	Ratio of Ministries
1. Protocal Department	34,072	45,903	134.7	38,987	114.4	0.316
2. Prime Minister, Vice Minister	6,504	8,324	127.98	3,668	56.396	0.0298
3. State for Supreme Council	1,616	2,127	131.62	5,569	344.6	0.0452
4. State of Cabinet	13,327	21,147	158.677	9,237	69.31	0.0751
5. State	1,154	906	78.509	2,206	191.16	0.0179
6. Federal National Council	12,126	13,800	113.80	41,756	344.35	0.339
7. Audit Department	17,353	21,258	122.50	27,480	158.358	0.223
8. Defence	2,659,864	3,000,000	112.787	4,500,000	169.18	36.58
9. Interior Affairs	517,022	468,990	90.709	739,081	141.20	5.93
10. Justice and Islamic Affairs and Awquaff	118,493	130,926	110.49	160,326	135.30	1.30
11. Finance and Industry	706,765	44,419	6.28	53,660	7.59	0.436
12. Planning	13,231	19,276	145.688	32,425	245.06	0.263
13. Petroleum, Mineral Resources	20,170	19,011	94.25	18,017	89.325	0.146
14. Economy and Trade	8,524	10,686	125.36	11,789	138.30	0.0958
15. Foreign Affairs	97,252	149,656	153.88	177,092	182.09	1.439
16. Information and Culture	170,593	202,023	118.42	209,945	123.06	1.706
17. Education, Youth, Sports	815,461	982,630	120.49	1,081,393	132.61	8.79
18. Health	552,166	815,534	147.69	1,071,628	194.07	8.71
19. Public Works and Housing	89,923	45,876	51.016	538,551	598.9	4.378
20. Communications	210,414	73,442	34.90	73,217	34.79	0.595
21. Electricity and Water	154,155	168,733	109.45	291,322	188.97	2.368
22. Agriculture and Fisheries	73,419	70,935	96.61	79,981	108.93	0.65
23. Labour and Social Affairs	260,131	294,465	113.19	307,659	118.27	2.50
Total	6,553,735	6,922,389	105.62	9,466,906	145.45	
24. Total Badget	336,605	895,620	266.07	2,833,450	841.77	23.035
Grand Total	6,890,340	7,818,089	113.46	12,300,356	178.51	100

Source: Ministry of Planning

APPENDIX III THE PROJECT AREA

3.1. Topography

3.2. Surveying and Topo-map Preparation

3.3. Population in the Basin

3.4. Meteorological Information

3.5. Geology and Soil

3.6. Hydrogeology

3.1. Topography

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3.1.2. Central Mountain Area	3.1-2
3.1.3. Gravel Plain and Sand Beach Strip	3.1-3

3.1. Topography

The Wadi Al Bassierah, mountain wadi, dissects the eastern slope of the Oman mountains, and pours into the Oman Gulf. Its watershed area occupies about 260 sq.km with about 38 km long from the south to north and about 12 km long from the west to east.

The Wadi Al Bassierah basin is divided into the following topographic and geologic sub-areas;

- Ruus Al Jabal area situated in the north-western mountain area and mainly composed of limestone;
- The central mountain area covering the upper Wadi Al Bassierah basin and a part of the south-eastern mountain area. The area is mainly formed by serpentinites and schists.
- The gravel plain on the wadi floodplain and the sand beach strip adjoining the gravel plain.

3.1.1. Ruus Al Jabal Area

Ruus Al Jabal area is situated on the south-eastern slope of the mountains that stand from the north-east to south west having the summit level of about 1,000 m. The Wadi Wamm and the Wadi Zanhah which cut the mountains have steep slopes with a great volume of wadi-fill debris. It seems that down-cutting is actually on going here. Moreover, the linear valleys and stair topography, which are presumably derived from the fault, have been developed.

3.1.2. Central Mountain Area

The central mountain area is situated on a part of the Al Ahadal mountains which run from the south to north and consists of complicated geological components, various serpentinites and schists. However, the area shows a gentle geomorphologic feature in comparison with Ruus Al Jabal area since all rocks have been weathered to a considerable extent.

The Wadi Abadilah, the upper most reach of the Wadi Al Bassierah, and the Wadi Al Bassierah itself flow down across the central mountain area dividing it into halves. The western half of this area is composed mainly of schists whereas the eastern half of serpentinites. The Wadi Al Fay running nearly from the north-east to south-west distinctly separates the schist block from Ruus Al Jabal area. The schist block is low and flat comparing with the other areas. The wadis dissecting this block are linear. And the topographic lineaments of the north to south are exclusively distributed in this area.

The terrace plain with an elevation of about 450 m, which is called "Nasafi plateau", has been formed on the upper most of the Wadi Al Fay situated in the southern edge of this block. The terrace is composed of diluvial gravel layers (upper Terrace).

The south-eastern half of the central mountain area is composed of serpentinite which is the major component forming the Al Ahadal mountain ridge and is widely distributed on the right bank of the Wadi Al Bassierah. The highest elevation of this area is about 1,000 m. Mountain wadis in the area show a dendritic pattern. In this geologic block, the lineaments from the north-east to south-east and from the north-north-east to south-south-west are exclusively distributed.

3.1.3. Gravel Plain and Sand Beach Strip

The Wadi Al Bassierah proper forms a wide floodplain thickly filled with gravel. This gravel plain are 16 km long and 1 to 5 km wide. The upper wadis shows bed slope of 1/85, whereas the lower wadi shows 1/105 on an average. The flow routes of wadi are not stable in the gravel plain. Relatively large mountain wadis such as the Wadi Abadilah, Wadi Uyaynah and Wadi Al Fay, etc., have cut the consolidated gravel layer, i.e., Diluvium wadi-fill, to a depth of 10 to 20 m such wadis form corridor valleys. The Diluvium terrace plain of the Wadi Abadilah has a slope of 1/50 on an average with an elevation of 200 to 400 m (Lower Terrace). This similar terrace plain is observed continuously along the mountain foot zones on the both downstream banks. Typical fan topography has formed in the middle and downstream gravel plain where mountain wadis flow out to the plain from mountain areas.

The downstream most of the gravel plain which is situated in the coastal area with an elevation of less than 20 m is composed of beach sand of 0.7 to 2.0 km wide. The prosperous farming and fishery village called Dibba Oasis has been located here.

The coastal terrace plane can be seen clearly at an elevation of around 10 m along the coast around the Wadi Dadnah, south of Dibba. The terrace plane is not clear at Dibba Oasis due to land development. However the deposits forming Dibba Oasis are deemed to be a similar terrace materials. The formation of abrasion platforms is not clearly observed in the coastal area.

3.2. Surveying and Topo-map Preparation

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3.2. Surveying and Topo-map Preparation

3.2.1. Topo-maps preparation

Two kinds of topo-maps (Scale at 1/25,000 & 1/5,000) have been prepared for the Wadi Al Bassierah Basin. The 1/25,000 map, which was prepared by Ministry of Agriculture and Fisheries (MAF), has been used in rectifying by supplemental surveying on the latest developed roads and the residential areas. Also, the 1/5,000 map, which was prepared by Ministry of Public Works for the Dibba Area Development Project in the east coast of the UAE, has been used in rectifying by supplemental surveying in the same way taken in the map of 1/25,000. However, for the map of 1/5,000, additional surveying has been carried out for the area of eight square kilometers in the downstream of the Wadi Fay, and the total area of about 35 km^2 is covered by 1/5,000 map including a part of Oman.

Under the progress of Works, topo-maps (Scale at 1/1,000) has been prepared for proposed Bassierah Dam site in order to make the design of dam.

3.2.2. Bench mark establishment

In the Wadi Al Bassierah Basin, five temporal bench marks have been established by levelling on the basis of the concrete jetty provided in the fish port, with EL. 2.6 m above sea level, which was set up by Ministry of Public Works for preparing 1/5,000 topo-maps, so as to determine the elevation of various facilities in the basin, such as water level gauging wells. Among five bench marks, three new bench marks have been established along the longitudinal line of the Wadi Al Bassierah and other two have been employed by the existing bench marks used by Ministry of Public Works for the highway construction. But some differences between the new bench marks and the existing ones are shown in next page.

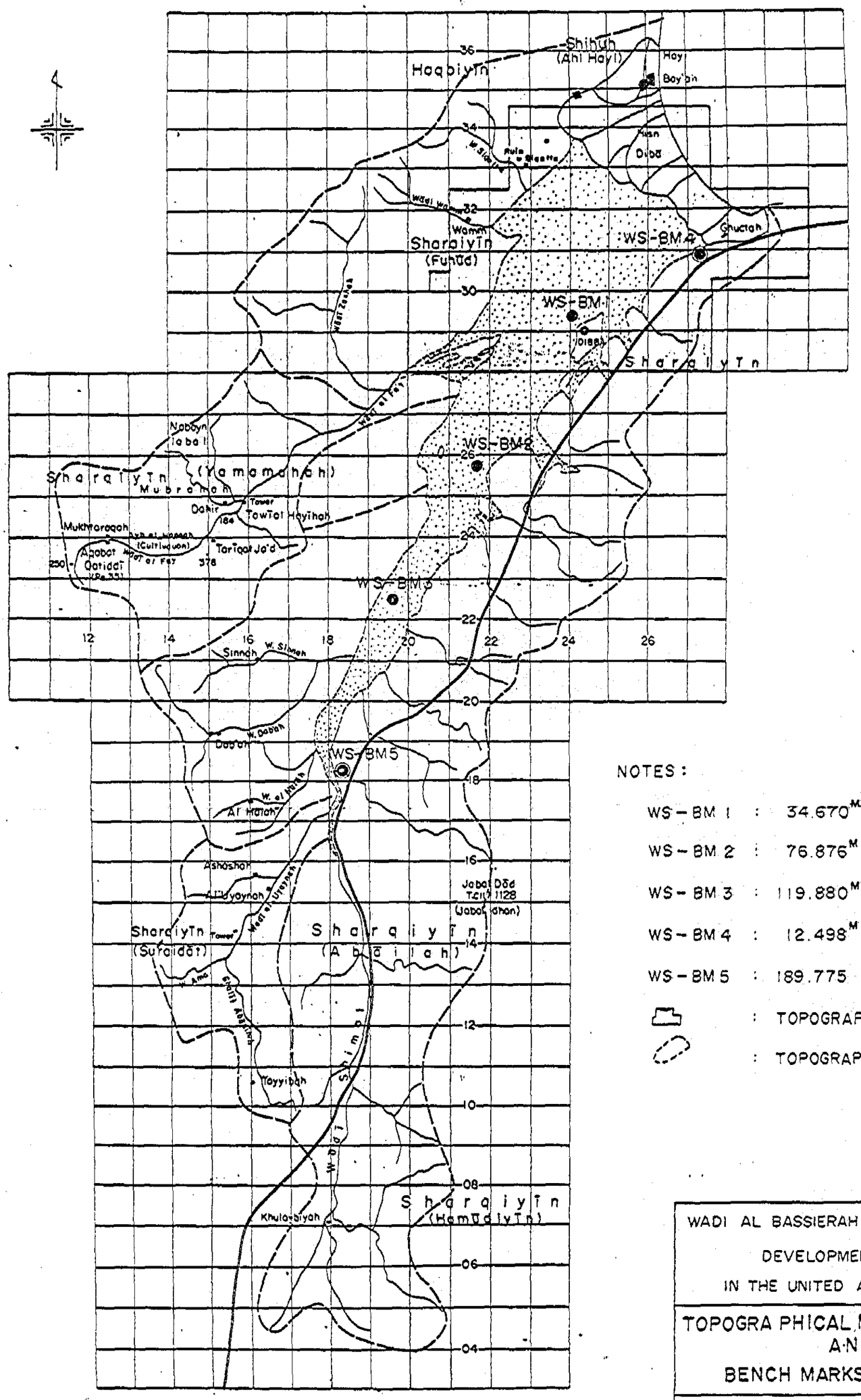
Bench Mark Point	Elevation (m)	Difference (m)
(BMDI)	22.498	-
WS-BM4	12.478	- 10.020
(BMD 62)	199.739	-
WS-BM5	189.775	- 9.964
BM1 (Shimal Dam site)	107.70	-
BM2 (")	113.91	-
RBP (Dam center)	179.13	-
LBP (Dam center)	165.18	-

NB: Elevation corresponding to (BMDI) and (BMD 62) are used by the Ministry of Public Works, and the above descriptions are confirmed by discussion among Ministry of Public Works, MAF and the survey team.

3.2.3. Surveying on the Wadi Al Bassierah

The center line surveying and levelling have been carried out for profile survey of the Wadi Al Bassierah to cover from the river mouth to 22 km upstream through the mid-stream part. For two major tributaries the river bed levelling have been carried out to cover from junction with the Wadi Al Bassierah to 3.0 km upstream.

On the other hand, the cross section surveyings for the center line have been made by levelling after measuring the center line by transit in considering that the cross section direction becomes fairly long. The surveying points have been selected in principle at the one kilometer interval along the center line, and additional surveyings have been made at other points, if necessity arises. For the site of water level gauging station, levelling surveying for profile and cross section have been carried out. The details of the results of the surveys are shown in Map-3.2.



NOTES :

WS – BM 1	:	34.670 M
WS – BM 2	:	76.876 M
WS – BM 3	:	119.880 M
WS – BM 4	:	12.498 M (22.498 M)
WS – BM 5	:	189.775 (199.739 M)
	:	TOPOGRAPY MAP (1 : 5,000)
	:	TOPOGRAPY MAP (1 : 25,000)

WADI AL BASSIERAH WATER RESOURCES DEVELOPMENT PROJECT IN THE UNITED ARAB EMIRATES

TOPOGRA PHICAL MAPS PREPARED AND BENCH MARKS ESTABLISHED

Map-3.2. | JICA

3.3. Population in the Basin

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TABLE A.3.3-1 ESTIMATED POPULATION, HOUSEHOLDS AND FARMERS IN DIBBA SEPT., 1980

(2)=included (3)

Villages	(1) Household (1975)	(1) Household 1980	(2) Farmer 1980	(3) Fish-eries 1980	(4) Popu-lation 1980	Remarks L=Local F=Foreigner
1. Dibba Al Hisn	228	281	280	275	3,500	L 2,770 F 730 (40 with family)
2. Al Akameah	75	180	90	)	2,000	L 850 F 1,150
3. Al Rada	11	45	24	)	250	L 220 F 30 Dibba town
4. Al Ghorfah	96	145	72	)	1,200	L 1,066 F 134
5. Al Mohalah	18	240	18 (From Waset 40)	)90	2,000	L 1,140 F 860 (From Village)
6. Sambrair	66	40	81 (From Waset 30)	)	480	L 420 (320) F 60
7. Al Doub	68	40	72	)	300	L 297 F 3
8. Waset	-	115	-	-	800	L 240 F 560
9. Waam	33	25	38	-	600	L 587 Villages F 13
10. Wadi Al Fay	-	20	5	-	50	L 43 F 7
11. Sanna	12	9	13	-	40	L 37 F 3
12. Danha	8	30	25	-	400	L 387 F 13
13. Dabha	3	5	8	-	12	L 12 F -
14. Al Halah	15	30	36	-	300	L 233 F 67
15. Wadi Al Sider	-	4	6	-	150	L 150 F -
16. Ashasa	2	9	5	-	8	L 8 F -
17. Wadi Al Aiana	-	45	45	-	300	L 270 F 30
18. Wadi Al Abadellah	-	60	30	-	500	L 474 F 26
19. Al Guna	3	4	11	-	105	L 105 F -
20. Al Khlipia	-	14	6	-	200	L 200 F -
Sub-total	638	1,341	865	365	13,195	L 9,509 78% F 3,686 28%

- continued -

Villages	(1) Household (1975)	(1) Household 1980	(2) Farmer 1980	(3) Fisheries 1980	(4) Population 1980	Remarks
21. Dibba Oman	-	150	*1 234	-	1,500	L 1,500 Oman
22. Al Kapous	15	4	16		10	Out of the project
23. Raul Dibba	19	45	*2 19		200	area
24. Al Fuqait	-	6	8		34	
Sub-total	34	55	43		244	
Total		1,546	1,142		14,939	

*1: 24 for Dobba Hism, 50 for Ras-Al Hjima, 150 for Dibba Oman
No.22-24 out of the project area

*2: Six for company 2 for Local Farmer

Source: Dibba Office
Ministry of Agriculture
and Fishery

3.4. Meteorological Information

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3.4.1. Meteorology

The meteorologic factors at Dibba Station are shown in Table A. 3.4-1, Fig. A.3.4-1. Those factors are of seven-year mean monthly values since 1973 till 1979.

Annual mean values for the seven-year period are;

wind velocity	173	Km/day
air temperature	27.6	degree centigrade
relative humidity	68	%
pan evaporation	3,600	mm/annum
rainfall	99	mm/annum.

The monthly mean values of the above factors at the major ten stations in UAE during 1968 to 1976 are shown in Fig. A.3.4-2. The meteorology of Dibba can be said, comparing with the other spots in UAE, to be stronger wind, high temperature, continuous humidity, lower evaporation and average rainfall. It is in general, slightly severe climatic condition.

The monthly mean annual tables of the said factors at Dibba are shown in Table A.3.4-2 to 3.4-6.

(1) Rainfall

An annual mean rainfall of 35 station in UAE during 1956 to 1979 is 100.9 mm.

The mean rainfall of 14 stations in the Mountain Region becomes 134.4 mm/annum. That in the Desert Foreland and West Coast is 68.9 mm/annum and in Gravel Plain is 102.6 mm/annum.

An isohyetal map by those mean values is illustrated in Map-3.4.

The rainfall record at Dibba station is available since 1965/66 hydrologic year. The monthly table is shown in Table A 3.4-7. The mean value of these 14 years is 99.4 mm/a. Most of rain fall on November to April and 79 % of annual rainfall concentrate at only three months from January to March.

The monthly tables of Masafi and Sharjah rainfalls are shown in Table A.3.4-8 and 3.4-9.

In 1980, eight automatic rain gauges were installed at strategic spots in the basin. The observation by the gauges is carried out since September, 1980. The description of record and others will be made in the following chapter.

(2) Tide

The tidal observation of the East Coast is made at Khor Fakkan. The Tidal factors based upon the Halcrow marine datum are as follows;

high water of ordinary spring tide	2.13 m
high water of ordinary neap tide	1.82 m
mean sea level	1.36 m
low water of ordinary neap tide	1.08 m
low water of ordinary spring tide	0.30 m
datum level	0.00 m.

TABLE A.3.4-1 SUMMARY OF METEOROLOGICAL OBSERVATIONS (MONTHLY MEANS FOR 1973 - 1980 AT DIBBA)

Month	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Total /Mean
Wind Movement (kms/day)	119.0	140.5	147.5	178.2	166.9	200.8	238.7	225.9	198.4	167.0	159.8	136.4	173.3
Air Temperature (°C)													
Min	23.7	20.3	14.1	11.5	13.1	16.6	19.9	21.5	25.7	28.0	25.5	24.2	
Mean	30.7	26.6	21.4	18.7	19.7	23.2	27.2	30.5	33.7	34.8	33.1	31.6	27.6
Max	37.7	32.9	28.6	25.8	26.3	29.8	34.5	39.4	41.6	41.5	40.6	39.0	
Relative Humidity (%)													
Mean	70	64	72	71	71	70	65	65	65	62	69	69	67.7
Pan Evaporation (mm/day)	8.9	8.2	5.8	5.3	6.4	10.3	11.2	12.4	13.5	12.8	12.0	11.3	3,598 mm
Rainfall (mm)	0.9	3.1	4.0	32.1	26.9	19.2	8.2	0.0	0.6	1.2	1.0	2.2	99.4 mm

FIG. A.3.4-1

SUMMARY OF METEOROLOGIC OBSERVATION
MONTHLY MEANS FOR YEAR 1975~1980 AT DIBBA

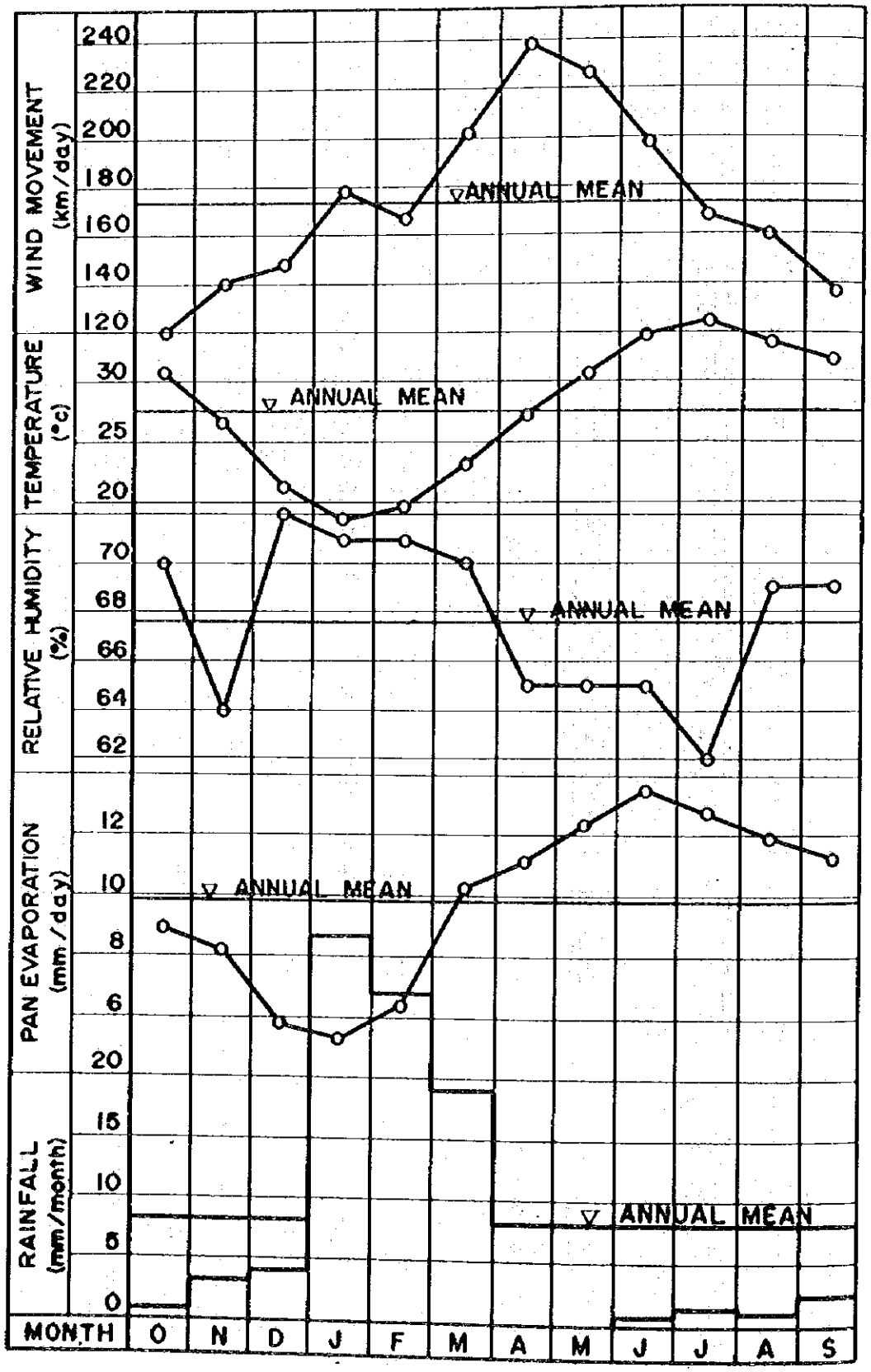


FIG. A.3.4-2

MEAN METEOROLOGIC FACTORS IN UAE
THROUGH PERIOD 1968/69~1975/76

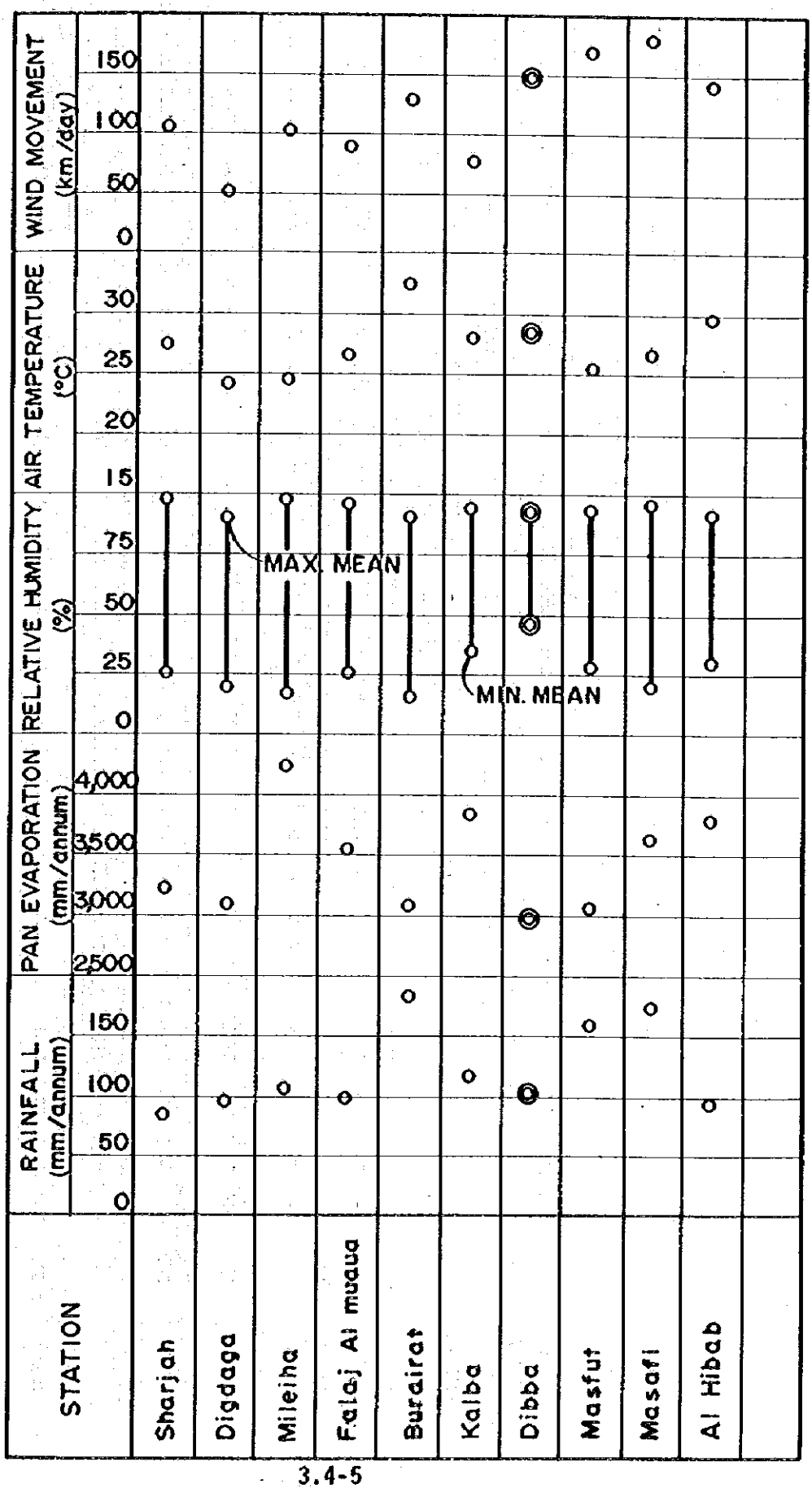


TABLE A.3.4-2 ATOMOSPHERIC TEMPERATURE AT DIBBA

Year	Oct.		Nov.		Dec.		Jan.		Feb.		Mar.		Apr.		May		Jun.		Jul.		Aug.		Sep.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1973-74	-	(20.0)	-	(12.8)	-	(8.9)	-	(11.1)	-	(10.0)	(36.7)	(12.2)	(39.4)	(15.6)	(42.8)	(15.5)	(45.6)	(16.7)	-	-	(43.3)	(20.0)	(43.3)	(20.0)
	-	24.9	-	18.1	-	13.6	-	14.6	-	15.1	29.6	17.7	34.0	18.6	39.7	19.1	41.6	21.3	-	-	41.7	23.3	41.3	23.2
1974-75	(41.7)	(17.8)	-	-	-	(11.7)	(35.6)	(9.4)	(30.0)	(11.7)	(34.4)	(15.6)	-	-	(43.3)	(15.6)	(46.7)	-	(44.4)	-	(46.1)	-	(47.2)	-
	40.3	21.7	-	-	-	13.4	27.7	10.2	25.6	14.3	32.1	17.1	-	-	41.1	17.6	44.0	-	42.7	-	42.9	-	38.0	-
1975-76	(40.0)	-	(35.0)	-	(33.3)	-	(29.4)	-	(28.9)	-	(31.1)	-	(36.7)	-	(43.3)	-	(45.6)	-	(46.7)	-	(46.7)	-	(43.3)	-
	35.0	-	31.7	-	30.0	-	26.1	-	26.1	-	28.9	-	35.5	-	40.0	-	43.3	-	44.8	-	44.2	-	42.6	-
1976-77	(42.8)	-	(40.6)	-	(32.2)	-	(27.2)	(3.3)	(31.1)	(3.3)	(36.7)	(5.0)	(41.1)	(10.0)	(44.4)	(15.6)	(45.0)	(16.7)	(43.3)	(20.0)	(43.3)	(15.6)	(44.4)	(15.6)
	41.0	-	36.6	-	28.6	-	23.0	6.7	26.7	5.9	32.0	11.5	35.2	15.6	41.0	19.6	39.7	21.1	41.3	22.0	39.3	18.4	40.3	17.3
1977-78	(40.0)	(20.0)	(37.8)	(18.3)	(32.2)	-	(30.0)	-	(29.4)	-	(35.0)	(10.0)	(39.0)	(17.0)	(43.0)	(18.0)	(47.8)	(27.4)	(46.8)	(26.4)	(40.0)	(27.4)	(39.0)	(26.2)
	37.8	24.4	32.5	21.3	28.2	-	26.1	-	26.4	-	28.9	17.7	33.7	23.1	37.8	24.9	40.7	29.9	39.7	31.0	36.9	30.4	35.1	28.1
1978-79	(38.4)	(21.2)	(34.8)	(17.2)	(31.2)	(13.0)	(28.0)	(9.8)	(32.0)	(12.0)	(31.0)	(14.2)	(40.6)	(19.0)	(42.8)	(18.8)	(46.0)	(27.0)	(46.0)	(28.4)	(42.0)	(27.6)	(42.0)	(25.0)
	34.6	23.7	30.7	21.6	27.5	15.4	26.1	14.4	26.8	17.1	27.1	19.1	34.0	22.3	36.8	26.4	40.1	30.4	39.1	31.1	38.4	29.8	36.7	28.2
1979-80	(38.6)	(23.0)	(34.0)	(14.0)	(28.8)	(13.0)	(26.4)	(12.0)	(32.0)	(11.0)	(34.0)	(15.8)	(42.2)	(21.0)	(43.2)	(24.0)								
	35.1	25.2	29.5	19.0	25.2	17.2	24.2	14.7	24.8	16.9	27.7	19.3	36.2	23.9	40.2	27.6								
Mean	37.3	24.0	32.2	20.0	27.9	14.9	25.5	12.1	26.1	13.9	29.5	17.1	34.8	20.7	39.5	22.5	41.6	25.7	41.5	28.0	40.6	25.5	39.0	24.2
	30.7		26.1		21.4		18.8		20.0		23.3		27.8		31.0		33.7		34.8		33.1		31.6	

Note: The values in blacket show absolute maximum and minimum.

TABLE A.3.4-3 RELATIVE HUMIDITY AT DIBBA

Year	Oct.		Nov.		Dec.		Jan.		Feb.		Mar.		Apr.		May		Jun.		Jul.		Aug.		Sep.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1973-74	(92)	(53)	(82)	(42)	(95)	(51)	(95)	(51)	(95)	(45)	(89)	(45)	(90)	(55)	(96)	(52)	(89)	(59)	-	-	(92)	(70)	(94)	(76)
	76		64		72		75		74		74		75		76		73		-		82		80	
1974-75	(94)	(66)	-	-	(90)	(54)	(100)	(58)	(100)	(71)	(95)	(58)	-	-	(84)	(51)	(82)	(40)	(81)	(45)	(84)	(44)	(84)	(26)
	80		-		78		80		88		78		-		72		63		61		66		65	
1975-76	(80)	(32)	(87)	(64)	(94)	(60)	(94)	(56)	(94)	(60)	(95)	(60)	(91)	(59)	(88)	(65)	(88)	(62)	(88)	(58)	(85)	(56)	(84)	(56)
	65		72		76		77		80		81		74		77		77		73		70		70	
1976-77	(83)	(58)	(89)	(40)	(90)	(45)	(100)	(38)	(84)	(41)	(81)	(38)	(83)	(33)	(79)	(33)	(84)	(53)	(81)	(43)	(81)	(54)	(84)	(53)
	73		61		69		71		59		59		63		58		65		63		69		69	
1977-78	(83)	(54)	(85)	(41)	(85)	(44)	(85)	(52)	(88)	(49)	(86)	(50)	(91)	(44)	(79)	(18)	(78)	(37)	(79)	(36)	(86)	(50)	(86)	(45)
	69		68		68		70		71		69		64		54		56		60		66		67	
1978-79	(78)	(41)	(75)	(36)	(100)	(42)	(73)	(18)	(74)	(27)	(81)	(38)	(83)	(16)	(79)	(11)	(80)	(26)	(80)	(20)	(79)	(41)	(86)	(39)
	57		55		70		53		53		57		50		50		55		53		60		63	
1979-80	(77)	(40)	(81)	(21)	(94)	(36)	(80)	(27)	(81)	(23)	(84)	(13)	(85)	(11)	(72)	(11)								
	59		52		61		50		55		59		49		42									
	(94)	(32)	(89)	(21)	(100)	(36)	(100)	(18)	(100)	(23)	(95)	(13)	(91)	(11)	(96)	(11)	(89)	(26)	(88)	(20)	(92)	(41)	(94)	(26)
Mean	84	49	83	41	(93)	47	90	43	88	45	87	45	87	36	82	34	84	46	82	40	85	53	86	49
	68		62		71		68		69		68		63		61		65		62		69		69	

TABLE A.3.4-4 WIND MOVEMENT AT DIBBA

Year	Oct.		Nov.		Dec.		Jan.		Feb.		Mar.		Apr.		May		Jun.		Jul.		Aug.		Sep.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1973-74	(206.7)	(51.2)	(344.2)	(57.1)	(417.6)	(63.7)	(411.4)	(42.2)	(388.3)	(17.5)	(464.4)	(21.4)	(545.2)	(78.1)	(498.8)	(62.1)	(525.8)	(55.4)	-	-	(266.1)	(82.8)	(163.2)	(17.6)
	108.3		125.8		157.8		176.9		154.6		173.2		223.8		266.9		211.7		-		113.1		97.2	
1974-75	(277.0)	(43.7)	-	-	(323.0)	(27.5)	(410.9)	(49.9)	(445.0)	(9.6)	(444.6)	(63.1)	-	-	(590.4)	(22.9)	(589.2)	(67.8)	(283.4)	(18.3)	(303.0)	(15.7)	(198.1)	(33.7)
	91.3		-		140.0		152.3		118.2		194.2		-		157.6		140.7		111.9		98.9		62.7	
1975-76	(220.8)	(10.2)	(105.0)	(38.3)	(255.2)	(36.0)	(273.5)	(44.8)	(410.0)	(31.6)	(386.4)	(36.4)	(427.3)	(37.0)	(453.6)	(70.7)	(382.8)	(12.3)	(287.6)	(8.8)	(222.3)	(41.0)	(230.4)	(66.6)
	83.8		77.0		96.7		127.3		117.2		140.7		169.3		190.2		152.9		125.9		98.0		101.0	
1976-77	(200.4)	(30.4)	(272.6)	(39.8)	(280.9)	(35.8)	(364.3)	(13.8)	(368.4)	(28.6)	(363.5)	(48.0)	(465.4)	(54.0)	(356.5)	(36.2)	(450.1)	(77.4)	(206.7)	(69.8)	(283.4)	(130.6)	(310.3)	(43.2)
	86.0		83.4		84.2		127.3		123.7		133.1		196.1		178.4		154.4		102.8		212.7		177.3	
1977-78	(430.1)	(98.6)	(435.5)	(85.9)	(454.1)	(86.0)	(526.6)	(81.1)	(472.4)	(102.0)	(611.7)	(111.4)	(649.2)	(140.8)	(643.7)	(139.1)	(625.8)	(99.4)	(549.8)	(181.8)	(352.1)	(147.8)	(312.4)	(93.8)
	172.8		193.6		222.2		236.4		241.9		252.2		341.6		310.1		292.6		255.8		210.6		184.0	
1978-79	(400.1)	(122.6)	(393.1)	(53.8)	(583.4)	(103.3)	(742.9)	(81.8)	(517.7)	(97.8)	(750.0)	(118.7)	(719.6)	(111.6)	(451.2)	(100.8)	(435.4)	(107.3)	(403.0)	(143.0)	(503.0)	(129.1)	(430.6)	(136.0)
	171.9		222.5		183.9		249.2		245.6		311.3		262.5		251.9		237.8		238.4		225.6		196.3	
1979-80	(380.0)	(104.8)	(257.2)	(110.3)	(501.6)	(58.2)	(488.0)	(51.1)	(465.2)	(50.1)	(463.2)	(31.3)	(631.2)	(68.5)	(669.2)	(91.6)								
	176.9		142.8		198.1		241.7		156.9		157.8		206.6		281.0									
Mean	127.3		140.9		154.7		187.3		165.4		194.6		233.3		233.7		198.4		167.0		159.8		136.4	

TABLE A.3.4-5 MEAN MONTHLY PAN-EVAPORATION AT DIBBA (mm/day)

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Total
1973-74	8.4	7.8	5.7	6.8	5.4	16.8	ND	10.0	10.6	ND	9.8	10.0	91.3
1974-75	7.3	ND	3.1	2.1	3.5	7.4	ND	10.9	13.3	11.8	11.1	9.4	79.9
1975-76	7.3	6.1	4.9	5.0	4.6	7.4	8.3	11.4	11.6	10.9	10.8	9.7	98.0
1976-77	7.4	6.0	5.4	3.9	6.4	9.5	8.9	12.1	13.1	10.9	11.9	13.1	108.6
1977-78	11.7	10.4	8.6	8.2	9.7	11.2	13.5	14.6	16.8	15.3	13.2	11.8	145.0
1978-79	11.5	10.6	6.9	6.0	8.5	9.4	14.2	15.4	15.5	15.3	15.1	13.9	142.3
1979-80	11.2	10.2	11.0	5.2	8.5	10.5	13.8	20.0	—	—	—	—	90.4
Average	8.9	8.2	5.8	5.3	6.4	10.3	11.2	12.4	13.5	12.8	12.0	11.3	
Total	275.9	246.0	179.8	164.3	179.2	319.3	336.0	384.4	405.0	396.8	372.0	339.0	3,597.7

TABLE A.3.4-6 PAN WATER TEMPERATURE AT DIBBA

Year	Oct.		Nov.		Dec.		Jan.		Feb.		Mar.		Apr.		May		Jun.		Jul.		Aug.		Sep.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1973-74	-	(17.0)	-	(12.0)	-	(8.0)	-	(8.0)	(26.7)	(8.0)	(32.2)	(9.0)	(39.4)	(10.0)	(37.8)	(13.0)	(39.4)	(13.0)	-	-	(39.4)	(14.0)	(39.4)	(15.0)
	-	21.6	-	16.9	-	12.7	-	12.0	23.3	12.1	29.4	13.3	32.2	14.0	35.6	14.6	37.8	15.4	-	-	37.8	17.9	37.8	16.7
1974-75	(37.2)	(14.0)	-	-	(33.9)	(11.0)	(25.6)	(9.0)	(28.9)	(9.0)	(31.1)	(10.0)	-	-	(37.2)	(10.0)	(38.3)	-	(38.3)	-	(42.2)	-	(41.1)	-
	34.7	16.0	-	-	30.6	12.7	24.4	10.4	25.6	10.7	29.2	11.7	-	-	36.2	12.8	37.0	-	37.0	-	38.3	-	38.3	-
1975-76	(37.8)	(13.0)	(32.2)	(12.0)	(31.1)	(10.0)	(26.7)	(10.0)	(26.7)	(10.0)	(29.4)	-	(35.0)	-	(40.0)	-	(40.6)	-	(40.0)	-	(40.6)	-	(40.0)	-
	35.0	19.5	30.3	16.8	27.8	13.6	22.8	15.2	24.7	15.1	26.7	-	32.0	-	37.4	-	39.5	-	39.5	-	39.5	-	39.2	-
1976-77	(39.4)	(10.0)	(36.7)	(10.0)	(32.8)	(4.0)	(31.7)	(7.0)	(31.7)	(8.0)	(35.6)	(8.0)	(32.2)	(8.0)	(38.9)	(12.0)	(40.1)	(16.0)	(40.6)	(16.0)	(40.0)	(15.0)	(39.4)	(14.0)
	38.0	14.0	34.5	13.4	29.4	10.5	29.0	10.0	26.6	10.5	30.8	10.7	32.5	11.3	37.2	14.3	39.2	18.9	39.3	18.8	38.2	18.6	37.2	17.8
1977-78	(37.8)	(14.0)	(37.8)	(10.0)	(32.8)	(13.0)	(31.6)	(10.0)	(30.6)	(12.0)	(33.3)	(16.0)	(37.0)	(10.0)	(37.2)	(11.0)	(40.2)	(18.4)	(40.0)	(18.4)	(39.8)	(19.4)	(39.4)	(20.4)
	35.6	18.5	31.1	16.1	27.7	17.2	26.0	14.2	26.9	17.3	28.5	19.0	33.3	13.5	35.5	18.5	37.3	21.8	37.5	22.2	38.1	21.5	37.0	23.5
1978-79	(37.2)	(18.6)	(34.0)	(15.2)	(29.8)	(9.9)	(30.0)	(9.4)	(31.4)	(7.8)	(31.6)	(10.2)	(36.0)	(11.0)	(38.0)	(12.0)	(42.0)	(11.0)	(42.0)	(12.0)	(39.2)	(16.4)	(39.6)	(18.4)
	34.5	20.7	31.0	18.6	27.2	15.2	26.8	12.5	27.3	13.1	28.8	14.8	33.3	16.0	35.4	15.2	38.7	15.6	38.6	17.1	38.0	20.4	37.0	21.1
1979-80	(36.8)	(17.0)	(32.6)	(10.0)	(29.0)	(13.2)	(27.0)	(10.0)	(29.0)	(12.0)	(34.0)	(10.0)	(38.0)	(15.6)	(39.0)	(16.0)								
	35.1	19.8	28.9	15.9	25.3	15.2	24.3	13.3	25.9	14.9	29.4	16.9	24.1	19.8	35.3	20.5								
Mean	35.5	18.6	31.2	16.3	28.0	13.9	25.6	12.5	25.8	13.4	29.0	14.4	32.9	14.9	36.1	16.0	38.2	17.9	38.4	19.4	38.3	19.6	37.8	19.8
	27.1		23.8		21.0		19.1		19.6		21.7		23.9		26.1		28.1		28.9		29.0		29.8	

TABLE A.3.4-7 MONTHLY RAINFALL AT DIBBA

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Annual
1965-66	0	1.0	1.0	0	48.6	0	0	0	0	0	0	0	50.6
1966-67	0	0	1.0	1.0	2.0	1.0	0	0	0	15.8	0	0	20.8
1967-68	0	0	1.8	0	87.1	0	0	0	0	0	0	0	88.9
1968-69	0	0	37.8	118.6	19.6	0	0	0	0	0	0	0	176.0
1969-70	(0)	(0)	(0)	(12.3)	22.3	15.5	0	(0)	0	0	10.2	(0)	60.3
1970-71	(0)	(0)	(0)	(0)	(16.3)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	16.3
1971-72	0.3	4.6	2.3	24.5	0	121.8	13.6	0	0	0	0	0	167.1
1972-73	2.0	0	0	91.4	0.3	0	0	0	0	0	0	0	93.7
1973-74	0	0	0	11.9	0	0	0	0	0	0	0	0	11.9
1974-75	0	0	0	9.4	33.0	0	0	0	0	0	0	30.0	72.4
1975-76	0	0	0	1.0	92.6	27.9	74.1	0	0	0	4.0	0	199.6
1976-77	0	0	5.2	175.6	17.2	15.5	24.1	0	8.9	0	0	0	246.5
1977-78	10.9	36.1	0.5	0	22.4	22.9	3.0	0	0	0.6	0.2	0	96.6
1978-79	0	1.0	6.8	3.4	15.0	64.2	0	0	0	0	0	0	90.4
1979-80	<0.4>	<0>	<54.2>	<3.8>	<20.3>	<10.7>	<0>	<0>					
Mean	0.9	3.1	4.0	32.1	26.9	19.2	8.2	0	0.6	1.2	1.0	2.2	99.4

TABLE A.3.4-8 MONTHLY RAINFALL AT MASAFI

STATION MASAFI

MONTHLY RAINFALL (MM)

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1965- 1966	0.0	0.0	0.0	0.0	63.3	0.0	0.0	2.0	1.5	0.0	5.5	0.0	******
1966- 1967	20.5	0.0	0.0	0.0	0.0	******	******	0.0	0.0	46.2	0.0	0.0	******
1967- 1968	0.0	2.8	18.9	0.9	58.6	0.0	0.0	0.0	0.0	0.0	25.4	0.0	106.6
1968- 1969	0.0	0.0	36.3	127.9	11.2	0.0	0.2	0.0	0.0	0.0	5.6	0.0	181.2
1969- 1970	******	******	******	******	******	******	******	******	******	******	******	******	******
1970- 1971	******	******	******	******	******	******	******	******	******	******	******	******	******
1971- 1972	10.2	20.2	15.2	3.9	0.9	128.2	2.2	0.0	1.9	0.0	0.0	9.2	******
1972- 1973	0.8	2.2	0.0	80.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	******
1973- 1974	0.0	0.0	0.0	29.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0	******
1974- 1975	21.0	0.0	0.0	95.0	129.5	0.0	0.0	0.0	0.0	0.0	80.0	0.0	******
1975- 1976	0.0	0.0	0.0	23.8	130.8	43.5	61.4	0.0	0.0	0.0	78.5	0.0	******
1976- 1977	84.0	2.5	4.4	57.4	37.6	5.2	40.8	22.6	9.2	0.0	0.3	0.0	264.0
1977- 1978	28.6	21.1	9.2	0.0	63.8	2.2	0.6	0.0	0.0	5.0	56.4	0.0	187.7
1978- 1979	0.2	0.6	0.8	10.4	1.0	51.0	0.0	0.0	22.0	14.0	0.0	4.2	104.2
1979- 1980	12.6	0.0	73.2	******	******	******	******	******	******	******	******	******	******

TABLE A.3.4-9 MONTHLY RAINFALL AT SHARJAH

STATION SHARJAH

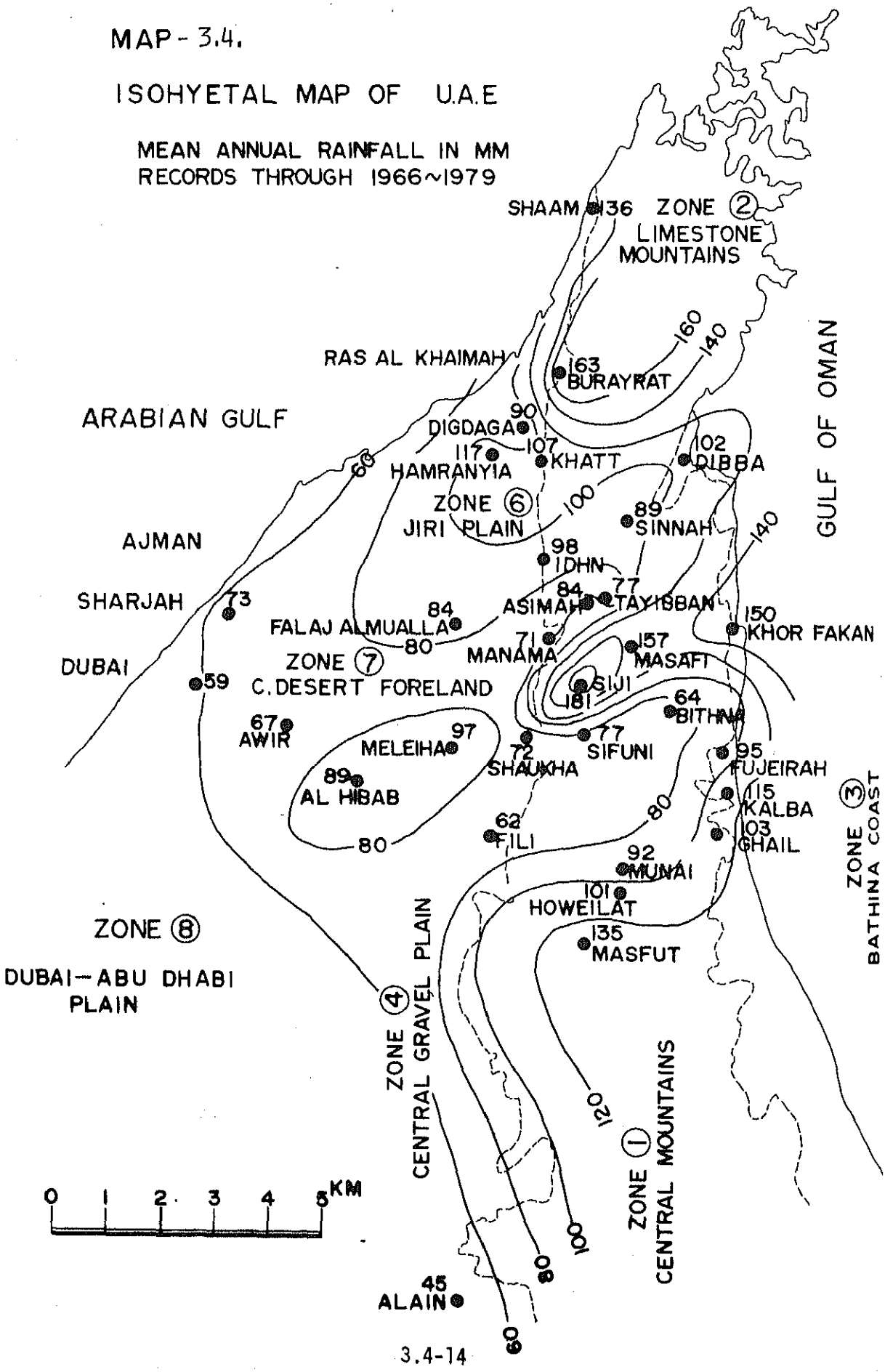
MONTHLY RAINFALL (MM)

YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
1949- 1950	0.0	45.0	9.0	18.6	2.0	10.2	0.0	2.1	0.0	0.2	0.0	0.0	87.2
1950- 1951	0.0	3.3	8.8	0.7	0.0	14.4	0.0	5.9	0.0	0.0	0.0	0.0	33.1
1951- 1952	0.0	0.0	36.4	65.2	0.0	0.5	2.4	0.0	0.0	0.0	0.0	0.0	104.5
1952- 1953	0.0	0.0	27.8	0.0	53.2	0.5	1.7	0.0	0.0	0.0	0.0	0.0	83.2
1953- 1954	0.0	0.0	4.5	0.0	66.6	17.4	0.0	0.0	0.0	0.0	0.0	0.0	88.5
1954- 1955	0.0	69.4	0.2	88.2	0.4	50.1	0.0	0.0	0.0	0.0	0.0	0.0	208.3
1955- 1956	0.0	0.0	56.1	7.1	0.0	1.0	0.5	0.0	0.0	15.6	0.0	5.4	85.7
1956- 1957	0.7	0.0	2.9	95.1	4.9	2.0	152.0	0.6	0.0	0.0	0.0	0.0	258.2
1957- 1958	0.0	76.7	12.2	16.0	0.0	0.1	0.0	0.0	0.0	3.0	0.0	0.0	108.0
1958- 1959	0.0	19.2	61.7	56.8	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	141.7
1959- 1960	0.0	12.2	3.2	7.8	0.0	4.8	19.6	0.0	0.0	0.0	0.0	0.0	47.6
1960- 1961	0.0	0.0	3.3	8.6	34.0	14.6	28.8	0.0	0.0	0.0	0.0	0.0	89.3
1961- 1962	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.3
1962- 1963	0.0	0.0	7.5	0.0	2.4	13.2	8.4	120.6	0.0	8.3	0.0	0.0	160.4
1963- 1964	0.0	30.4	3.4	61.4	29.6	2.8	0.0	0.0	0.0	0.0	0.0	0.0	127.6
1964- 1965	0.0	0.0	80.7	59.7	0.0	0.7	11.8	0.0	0.0	0.0	0.0	0.0	152.9
1965- 1966	0.0	0.0	1.4	0.3	59.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.8
1966- 1967	0.0	0.0	0.0	0.0	3.4	6.9	1.2	0.0	0.0	0.0	0.0	0.0	11.5
1967- 1968	0.0	0.0	3.6	1.6	76.3	0.0	0.3	0.0	0.0	0.0	0.0	0.0	81.8
1968- 1969	0.0	0.0	17.2	112.5	0.3	0.0	5.2	0.0	0.0	0.0	0.0	0.0	135.2
1969- 1970	19.5	0.0	0.3	30.3	0.5	0.0	0.0	0.0	0.0	0.0	2.4	0.0	53.0
1970- 1971	0.0	0.0	0.0	4.9	0.6	0.2	5.1	0.0	0.0	0.0	0.0	0.0	10.8
1971- 1972	0.0	27.8	14.2	12.0	0.0	114.8	5.6	0.0	0.0	0.0	0.0	0.0	174.4
1972- 1973	0.0	0.0	0.0	45.0	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.7
1973- 1974	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1
1974- 1975	******	******	******	164.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	******	167.4
1975- 1976	******	******	******	******	128.2	20.0	******	******	******	0.0	0.0	0.0	******
1976- 1977	0.0	0.0	******	******	******	******	******	******	******	******	******	******	******
1977- 1978	******	******	******	******	******	******	******	******	0.0	0.0	0.0	0.0	******
1978- 1979	0.0	0.0	0.0	4.0	0.0	68.2	0.0	0.0	0.0	0.0	0.0	0.0	72.2
1979- 1980	0.0	0.0	52.6	******	******	******	******	******	******	******	******	******	******

MAP - 3.4.

ISOHYETAL MAP OF U.A.E

MEAN ANNUAL RAINFALL IN MM
RECORDS THROUGH 1966~1979



3.5 Geology and Soil

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3.5.1 Geology

The geology of the Wadi Al Bassierah Basin and its vicinity consists of, as illustrated in Map-3.5-1, the followings;

- The Permian to lower Cretaceous submarine explosive and related igneous rocks which are called the "Semail suite";
- A series of the Triassic to Cretaceous marine sedimentary rocks which are called the "Hawasina series";
- The Neogene to Diluvial terrace gravel covering the above-mentioned old rocks; and,
- Recent wadi-bed deposits and beach deposits of the Alluvium.

The above-mentioned stratigraphy is shown in Table A.3.5-1 and explained hereinafter.

(1) Semail Suite

The wadi basin is underlain by the complex suite composed of serpentinite, gabbro and micro gabbro, etc. The base rocks have, as a whole, a plenty of fissures and show one of the following facies;

1) Clastic facies with fissures;
2) Facies with siliceous veins;
3) Facies characterized by magnesite and chrysotile veins.

(2) Hawasina Series

The Hawasina series is composed of the metamorphic rocks derived from siliceous rocks, limestone and submarine explosives. The alternative layers mainly of marble, crystalline limestone and chert crop out in the north-western side (on the left bank) of the Wadi Al Fay whereas the various crystalline schists such as calcureous, green and quartz schists, etc., expose in the wedge mass bordered by the Wadi Al Fay and the Wadi Abadilah.

(3) Terrace Gravel

The electric prospecting and test-well drillings conducted in this study have revealed that the bedrocks in the downstream portion are overlain by younger clastic deposits of more than 150 m deep and that even at the dam site on the middle reaches the bedrocks are covered by such deposits of about 60 m. The younger clastic deposits are mostly composed of sand and gravel. Except the coastal area it is clearly recognized that deposits have sedimented in order of talus, upper terrace, lower terrace and recent wadi-bed. In general, Upper terrace deposits have been consolidated with secondary carbonates, and show the facies of conglomerate. The low terrace deposits also show a somehow consolidated facies.

(4) Present Wadi-Bed Deposits and Beach Deposits

The present wadi-deposits are unconsolidated. In general, the deposits are well sorted than the terrace deposits. The depth is 80 m at the maximum. In the coastal area, marine deposit layers and the above-mentioned wadi-bed deposit layers bear an interfinger relation.

The surface of these deposits has a slope of about 10 degree toward the sea on which the hard coastal sabkha consisting of relatively fine sand and gravel has been formed.

(5) Geological Structure

The base rocks of the study area are roughly classified into the Hawasina suite and the Semail ophiolite suite as mentioned above. These two suites come into contact at the fault running through the upper Wadi Al Bassierah basin.

Faults in the Hawasina suite distributed on the left bank continueously run in echelon to the Dibba line lying toward the southwest in the western part of the basin. Faults in the Semail ophiolite suite forming the right bank area are observed concentrically surrounding the mountain ridge. The direction and shape of these faults have a close correlation with the existing topographic conditions.

The Wadi Al Bassierah, Wadi Uyaynah and Wadi Douhah are apparent tectonic valleys. Furthermore, mountain masses divided by the above-mentioned valleys have been strictly controlled by the disturbance of lineations of the bedrocks and foldings. In this connection, faults in the Semail ophiolite suite have been presumably derived from the uplift movements of this suite after its formation. Judging from the discontinuity of rock facies, etc., faults in the upper Wadi Al Bassierah and echelen faults on the left bank are most probably the wrench faults. Taking into consideration the original rock restored with discriminated schists, the rock facies observed in the study area are presumably the contemporaneous heterotopic ones.

Th Dibba line and numerous faults derived from the line are ascribed to this tectonic movement. As already explained above, these faults run in echelong along the mountain wadis such as the Wadi Al Fay and Wadi Douhah, go through the middle and lower Wadi Al Bassierah reaches filled with deposits and then proceeds to the sea.

Deposits covering a wadi, i.e., tectonic valley, consist of the two terrace layers and talus. These layers are divided by unconformity planes.

It is known that there are sandy marine deposits in the coastal area. The horizon of these deposits is located in a higher portion of the upper terrace deposit layer. This fact suggests that this tectonic valley has experienced geologic processes such as trans-

gression, regression, orogenic movement and submergence. It is recognized that deposits forming a surface in the watershed have also experienced the said geologic processes. This peculiar plain has been presumably formed through subsidy and up-lifting of surrounding mountain masses.

(6) Geohistory

Before the Pre-Permium period, the base rock formed fore-bay on which clastics have been accumulated. In these fore-bay the two contemporaneous heterotopic facies were formed, that is, the one mainly composed of carbonate sediment and the other predominantly composed of sandy and lutaceous rocks. In addition, igneous activities such as the intrusion of basic plutonic rocks into the above-mentioned rocks took place. As a result of continuous sedimentation and igneous activities until the upper Cretaceous period, the original rock of various bacies presently forming the mountainous portion of the study area appeared.

Rocks having various facies such as muddy, sandy and calcareous materials are correlative with the Hawasina series forming the mountainous zone on the left bank whereas the basic plutomic rocks are correlative with the Semail rocks.

A part of the sedimentary basin has already been buried with the original rock whereas sedimentation of carbonate materials has been continued in the remaining portion. These tectonic movements have formed the upper Cretaceous limestone which unconformably contacts with the Hajal series and shows interfinger relationship with the Hawasina series. The limestone and marl layers visible on the lower left bank might be correlative with the above-mentioned.

From the lower Cretaceous to Tertiary periods great crustal movements took place resulting in the foundamental geophysical

formation of the mountain zone. The crustal movement picture is characterized by the emergence accompanied by thrust faults. In the study area, the wrench faults pictorially reproduce the tectonic movement in old days.

Erosion of the rocks started along their crushed and fracture zones, and formed valleys. Thus, the original shape of tectonic valleys such as the Wadi Al Bassierah, Wadi Al Fay and Wadi Hyaynah, etc., has been formed. It is supposed that, as soon as the erosion starts, the accumulation of clastics became visible on the mountain foot zone. On the other hand, the surrounding mountain areas continued the emergence. Since the emergence was suspended from time to time, valleys were filled with various materials. The original shape of sediment has become indistinct due to repeated accumulation and erosion. During this period, such high sea water level as its trace is found in Ruus Al Khaimah presumably took place. The remaining sediment presently filling up the Wadi is distinguished to have the surface of unconformity (erosion surface), which suggests that the erosion and sedimentation regularly repeated in past. Furthermore, this period is possibly correlative with the low sea water and mountain making periods when abundant clastics were produced.

The marine sediment layer is distinguishable between the low terrace layer, i.e., inland river terrace layer, and high terrace layer. On the assumption that the marine sediment layer was formed during the marine transgression in the Pleistocene period, some of the unconformable surfaces seem to be correlative with the eroded surface in the Wurm maximum period.

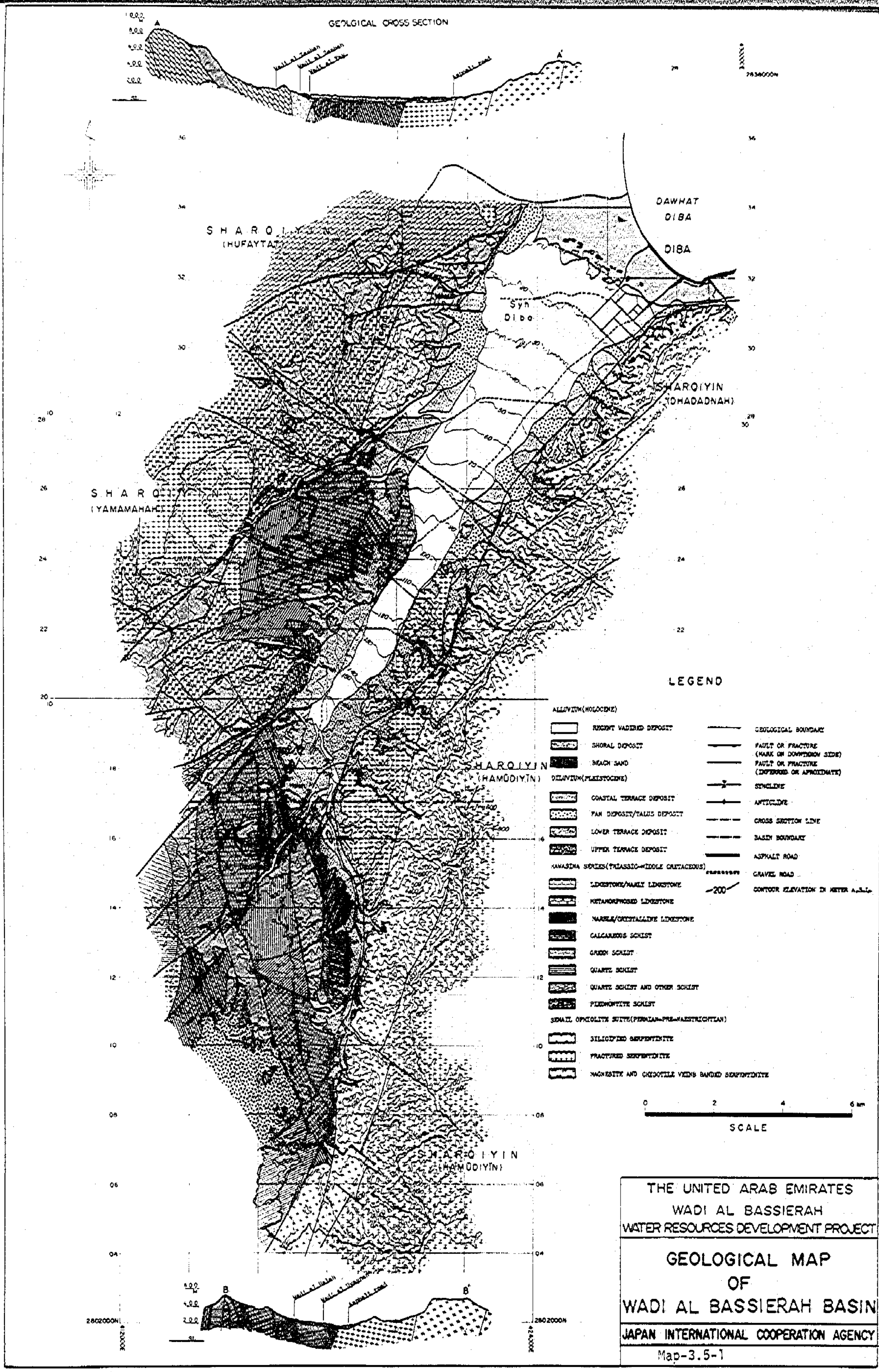
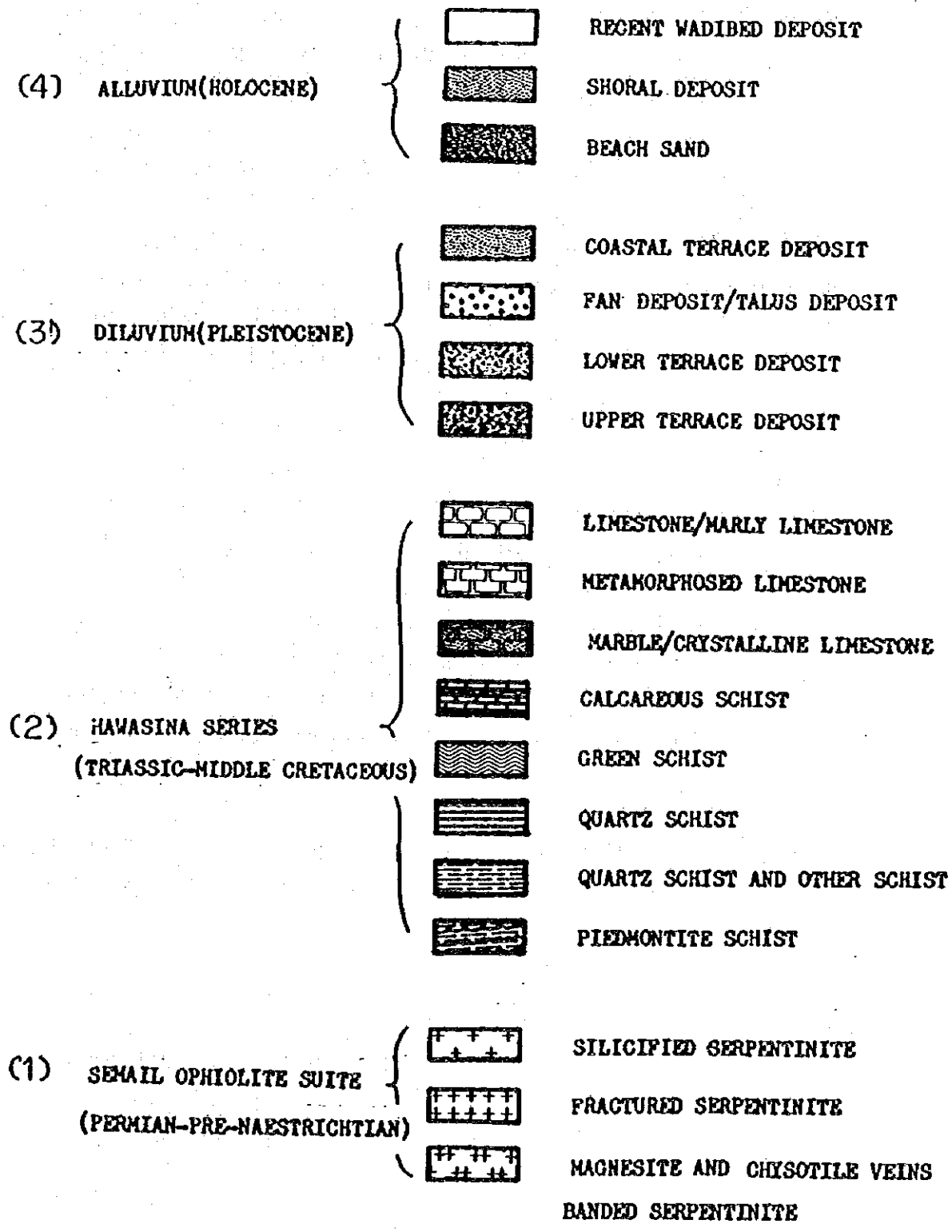

GEOLOGICAL CROSS SECTION
A
A'
B
B'
DAWHAT DIBA
DIBA
Syh Dibo
SHARQIYIN (HUFAYTAT)
SHARQIYIN (DHADADNAH)
SHARQIYIN (YAMAMAHAH)
SHARQIYIN (HAMUDIYIN)
LEGEND
ALLUVIUM(HOLOCENE)
RECENT VADIED DEPOSIT
SHORAL DEPOSIT
BEACH SAND
DILUVIUM(PLEISTOCENE)
COASTAL TERRACE DEPOSIT
FAN DEPOSIT/TALUS DEPOSIT
LOWER TERRACE DEPOSIT
UPPER TERRACE DEPOSIT
HAWASINA SERIES(TRIASSIC-MIDDLE CRETACEOUS)
LIMESTONE/MARLY LIMESTONE
METAMORPHOSED LIMESTONE
MARBLE/CRYSTALLINE LIMESTONE
CALCAREOUS SCHIST
GREEN SCHIST
QUARTZ SCHIST
QUARTZ SCHIST AND OTHER SCHIST
PIEDMONTITE SCHIST
SEMAIL OPHIOLITE SUITE(PERMIAN-PRE-MAESTRICHTIAN)
SILICIFIED SERPENTINITE
FRACTURED SERPENTINITE
MAGNESITE AND CHRYSOTILE VEINS BANDED SERPENTINITE
GEOLOGICAL BOUNDARY
FAULT OR FRACTURE (MARK ON DOWNTHROW SIDE)
FAULT OR FRACTURE (INFERRED OR APPROXIMATE)
SYNCLINE
ANTICLINE
CROSS SECTION LINE
BASIN BOUNDARY
ASPHALT ROAD
GRAVEL ROAD
200 CONTOUR ELEVATION IN METER A.S.L.
0 2 4 6 km
SCALE
THE UNITED ARAB EMIRATES
WADI AL BASSIERAH
WATER RESOURCES DEVELOPMENT PROJECT
GEOLOGICAL MAP OF WADI AL BASSIERAH BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY
Map-3.5-1

TABLE A.3.5-1 STRATIGRAPHY OF WADI AL BASSIERAH BASIN



3.5.2 Soil and Land Classification

(1) Soils in the sample areas

The sample areas No.2 and No.3 are located in the farm land of the coastal plain on the right area which are mainly cultivated with mango and citrus fruits. The sample areas No.4 and No.5 are located in the date palm farm, and the sample area No.1 is located in a large vegetalbe and date palm farm of 3.1 ha. All these farms are situated on the coastal plain on the left area. Farms are equipped with wells for irrigation. In general, soils in the sample areas fall in the category of sandy loam, sandy clay or sand brown or yellowish brown in color when wet. The soil structure has not been well developed, and the soils are loose and fragile. It is observed that surface clastic has been developed, however, the soils are favorable in their permeability.

A remarkable difference of soils in the sample areas No.2 and No.3 on the right area and in the sample areas No.1, No.4 and No.5 is noticed in their gravel content. The former contains breccia (32 to 57%) whose host rocks are serpentinite derived from the surrounding mountains on the right area whereas the latter contains schist and Breccia derived from serpentinites but of only a few percent. One of the characteristics of soils in this area is a high content of carbonic of lime in them (29 to 30%). Before reclamation, stones and gravels of farms on the right area were removed.

The basin irrigation is employed for each fruit tree. Partially vegetables are grown in the spaces not occupied by such fruit trees.

In farm lands on the left area, the basin irrigation is made for dates palm. Farm lands not occunied by date palm are mostly bare ground. Only in the sample area No.1 vegetables and date palm are separately grown. The furrow irrigation is applied for vegetables whereas the basin irrigation for date palm. The difference of irrigation method seems to relate with the salinization of soils althrough irrigation itself has caused soil salinization.

Non-irrigated soils in the uncultivated areas in which the soil survey was conducted in the first stage are considered original soils of this area. In comparison with the irrigated soils in the sample areas, the non-irrigated soils have small EC, SAR, ESP and Na/Total cation values, which suggests that repeated irrigation since old days has caused to salinity of the soils.

Soils in the sample areas No.2 and No.3 show a higher clay content than these in the other three areas, however, their sand and silt content is low. Soils in farm lands on the left area show a bulk density of 1.22 to 1.47. The irrigated soils have a higher moisture content than the non-irrigated soils. These phenomena might take place due to repeated farming. The solidus of soils is generally high. The surface layer has a solidus of 59 to 70% whereas the sub-layers 31 to 44%.

It is a tendency that a lower layer has a small solidus. The porocity is low from 31 to 44%. It is also a tendency that a lower layer has a large porosity. Such low porosity is not geophysically favorable for rooting of crops.

It is well known that the compactness of soils has a close relation with crop rooting. In general, the soils show a high compactness. Furthermore, a lower layer has a higher compactness. Specially, soils at the test pit No.4 in the sample area No.3 shows the graduation of 25 to 30 mm in the scale of hardness. In general, the graduation ranging from 17 to 22 mm (15.4 to 16.3 kg/sq.m) is

accepted as the upper limit for easy growth of rootlets of crops. Judging from the above-mentioned standard of compactness, the soils are categorized in hard soil in which it is quite difficult for crops to extend their rootlets though it is considered that the soils were hardened in the dry season as a result of the basin irrigation for agriculture of rainy season sweet potato.

A study was conducted on the relationship between the quality of irrigation water presently used in each farm and the soil conditions of the farm. The salinity of groundwater sunplied to the sample areas No.2, No.3 and No.5 is relatively high from 1.44 to 1.49 mmho/cm. It is considered that such groundwater has caused soil salinization, however, it does not affect much on the permeability of soils. In the aspects of sodium and chlorine content of irrigation water which affects the growth of crops, their density in the above-mentioned three areas is all high. Specially the values of the Sample areas No.2 and No.3 fall in "the severe problem grade" on the FAO standard.

(2) Land classification

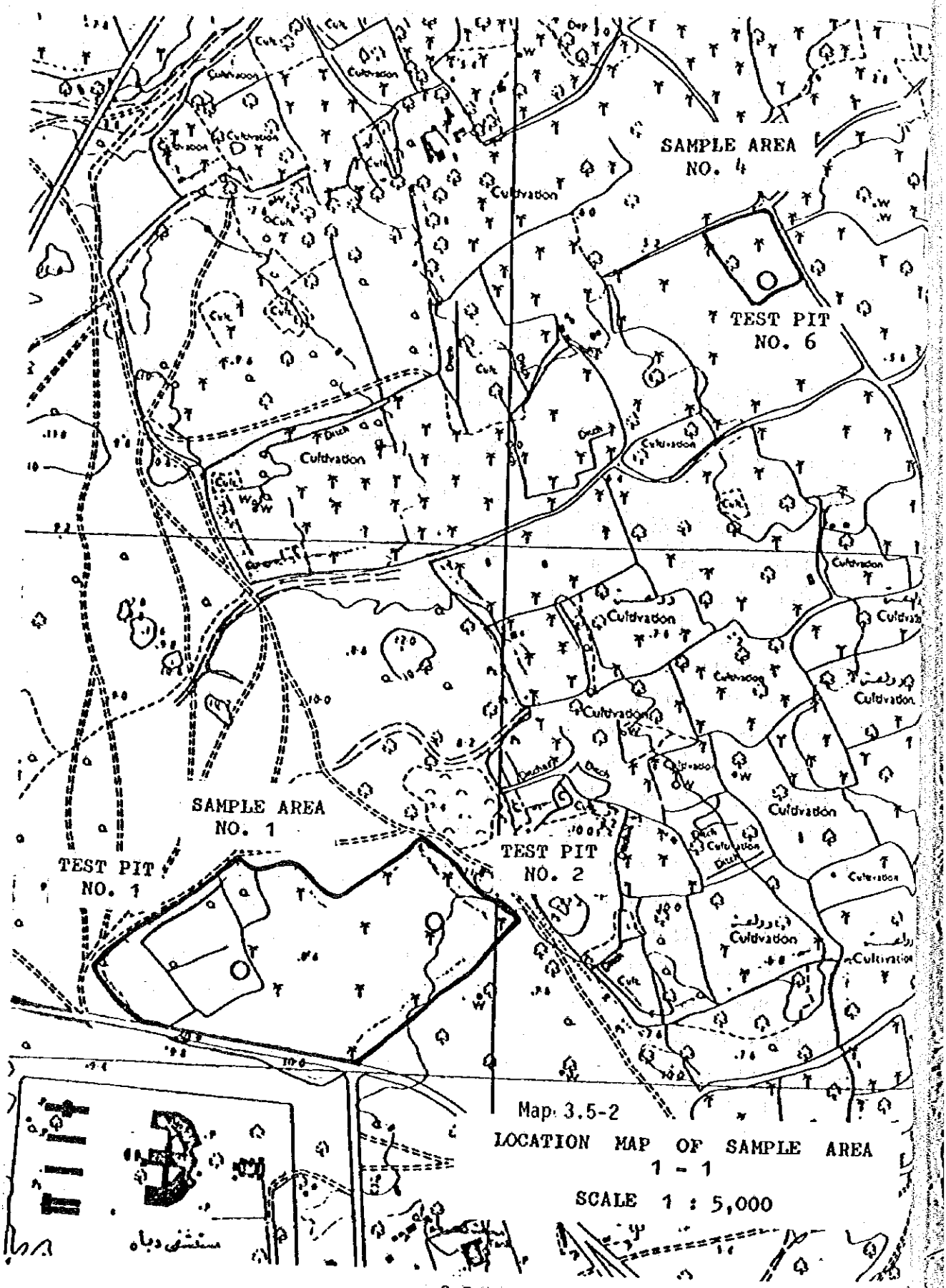
It can be said that soils in the study area have many geophysical and chemical defects for agricultural development. The wadi fan has an area for further land reclamation, however, all soils fall in the category of the sixth class on the USBR land classification standard, i.e., soils not suitable to cultivation since the moisture content of soils is extremely poor, containing much gravel.

The land classification is shown in Map 3.5-6. The acreage of each class of land is tabulated below;

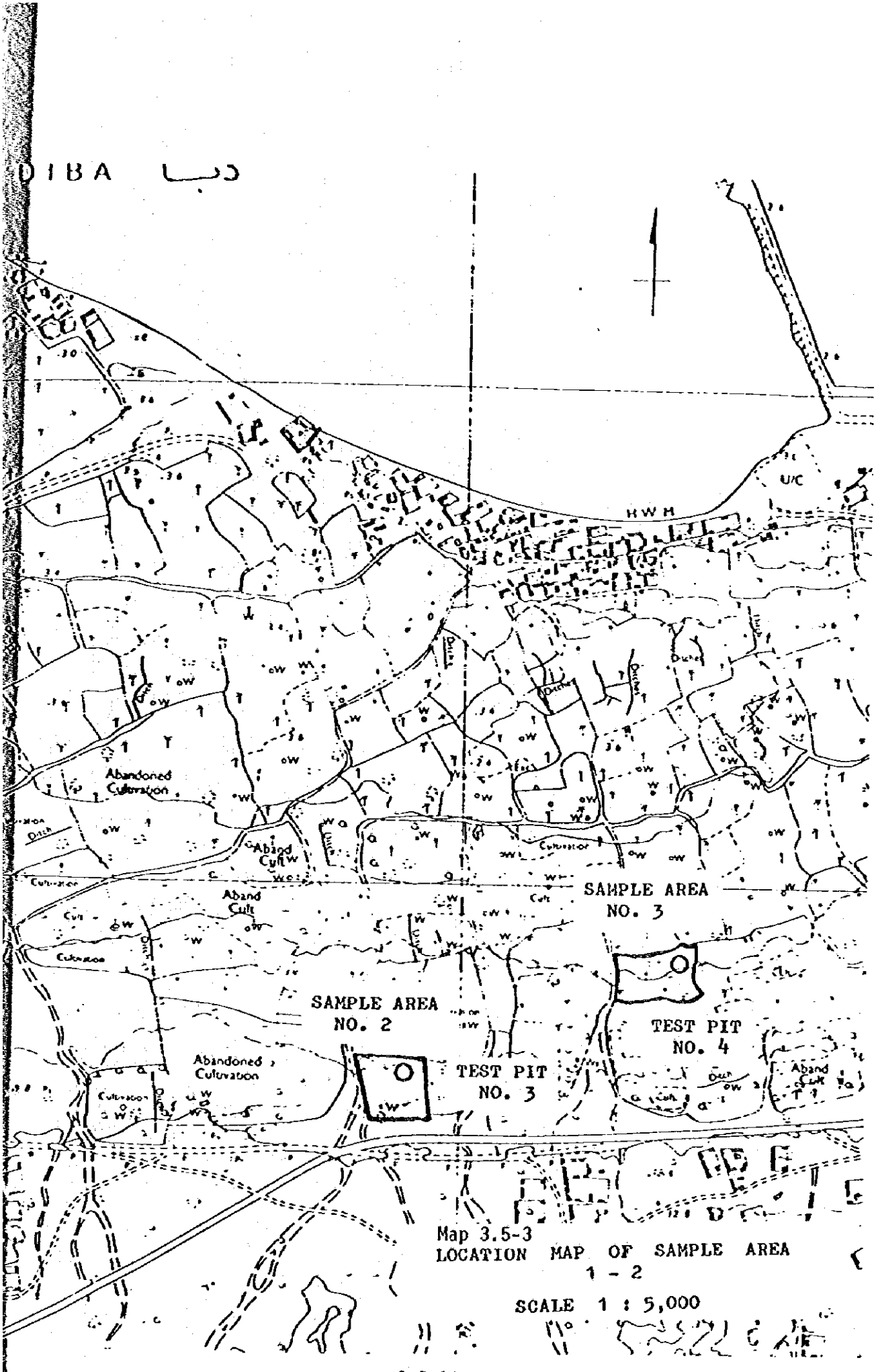
(Unit: hectare)

Class	Wadi fan	Coastal Plain	Total
1st	-	-	-
2nd	-	87	87
3rd	-	244	244
4th	16	36	52
5th	-	-	-
6th	717 (164)	- (56)	717 (220)
Total	897	423	1,320

No land in the study area falls in the category of the Class 1st on the above-mentioned land classifications standard. A part of the coastal plain belongs to the Class 2nd. All the other cultivated areas in the coastal plain take the 3rd rank. The major constraints are the poor soil texture and thin effective soil layers on the left area whereas soil salinity caused by sea water intrusion in the left area. Cultivated land on the upper left area has been abandoned by farmers. Soils of this cultivated land is extremely tightened, and classified into the 4th class. With careful plowing, the soils will be upgraded to the 2nd class. Due to the poor soil texture, a thin effective soil layer and the existence of gravel, all soils in the wadi fan are ranked the 6th. FAO has established an experimental farm of 10 ha for tropical fruit plants by removing gravel and by constructing irrigation facilities. It is possible to materialize orchards or intensive horticulture with facilities in the land presently classified into the soil not suitable to cultivation if plants having a high market price are grown to cover the cost for environmental improvement though it is impossible at all to grow such plants under the present natural conditions without some countermeasures.

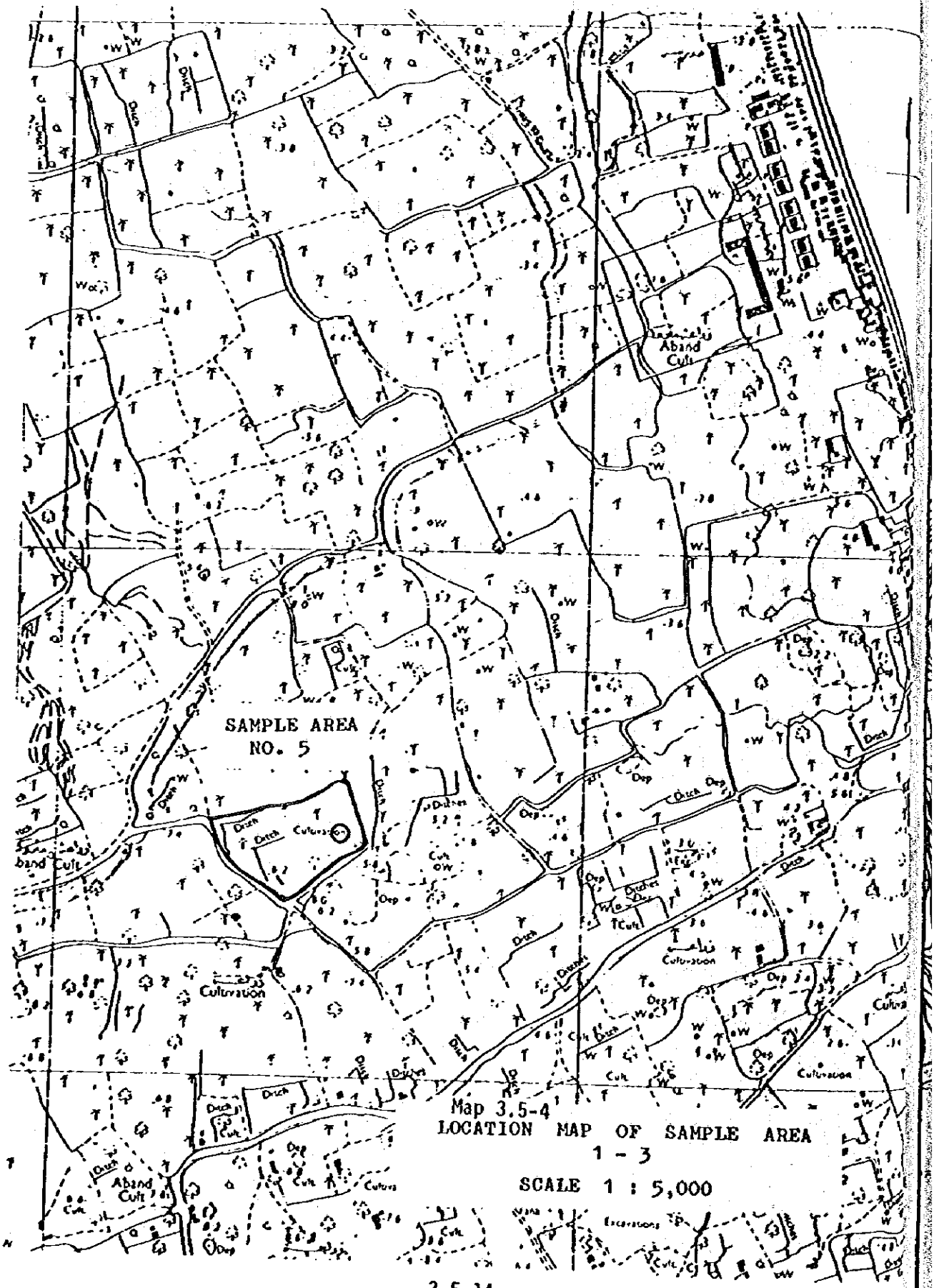


Map 3.5-2
LOCATION MAP OF SAMPLE AREA
1 - 1
SCALE 1 : 5,000

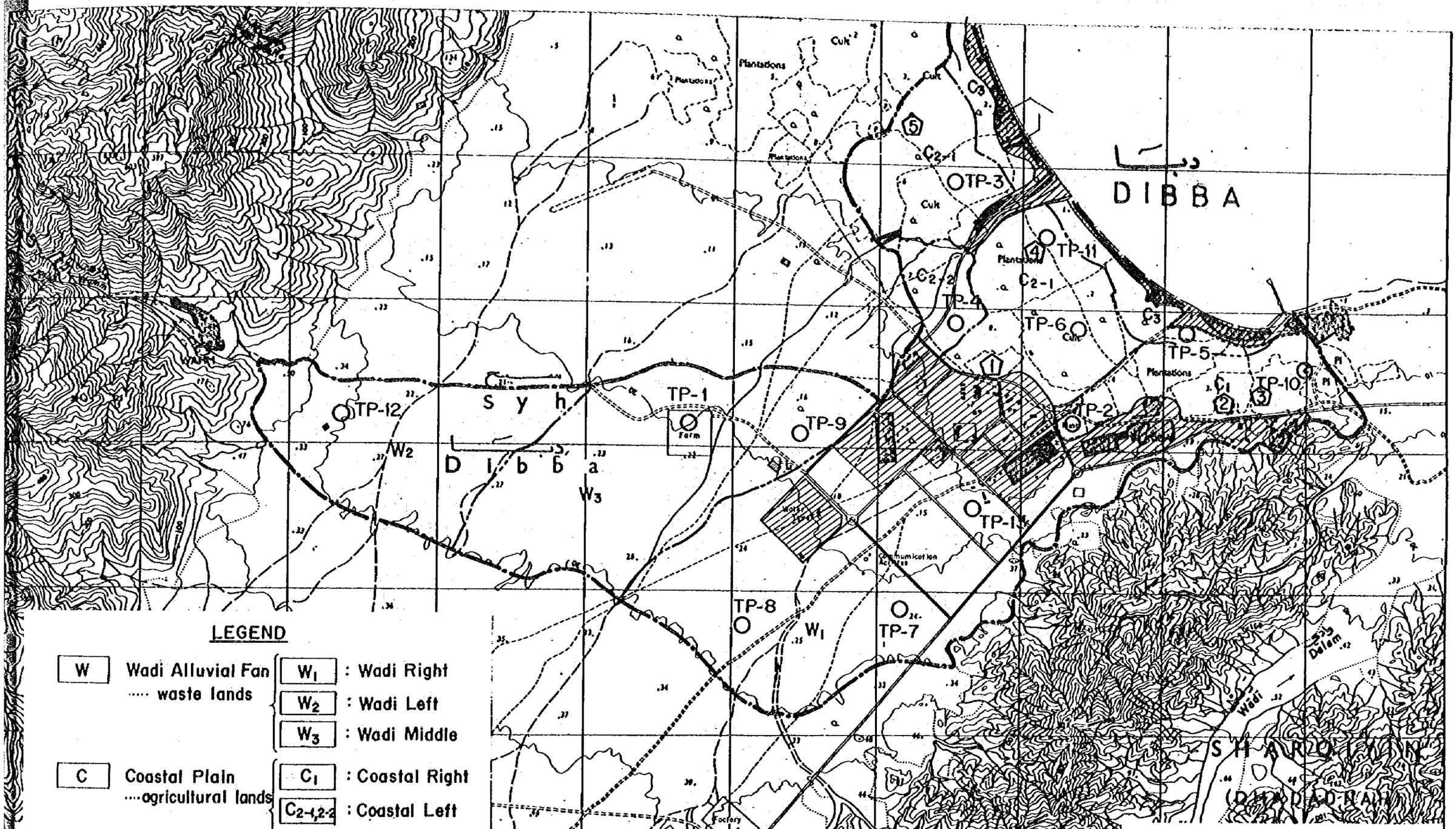


Map 3.5-3
LOCATION MAP OF SAMPLE AREA
1 - 2

SCALE 1 : 5,000



Map 3.5-4
LOCATION MAP OF SAMPLE AREA
1 - 3
SCALE 1 : 5,000



LEGEND

- W — Wadi Alluvial Fan ····· waste lands
  - W_1 : Wadi Right
  - W_2 : Wadi Left
  - W_3 : Wadi Middle
- C — Coastal Plain ····agricultural lands
  - C_1 : Coastal Right
  - $C_{2-1,2-2}$: Coastal Left
  - C_3 : Beach Flat
- Land Under City Planning
- TP-9 — Test pit
- (1) — Sample Areas

Map 3.5-5

LOCATION MAP OF TEST PITS AND SAMPLE AREAS

Scale 1 : 25,000

FIG. A.3.5-1

COLUMNAR SECTION OF TEST PITS

FIG. A.3.5-2 DIAGRAMATIC REPRESENTATIVE OF SOIL PROFILES

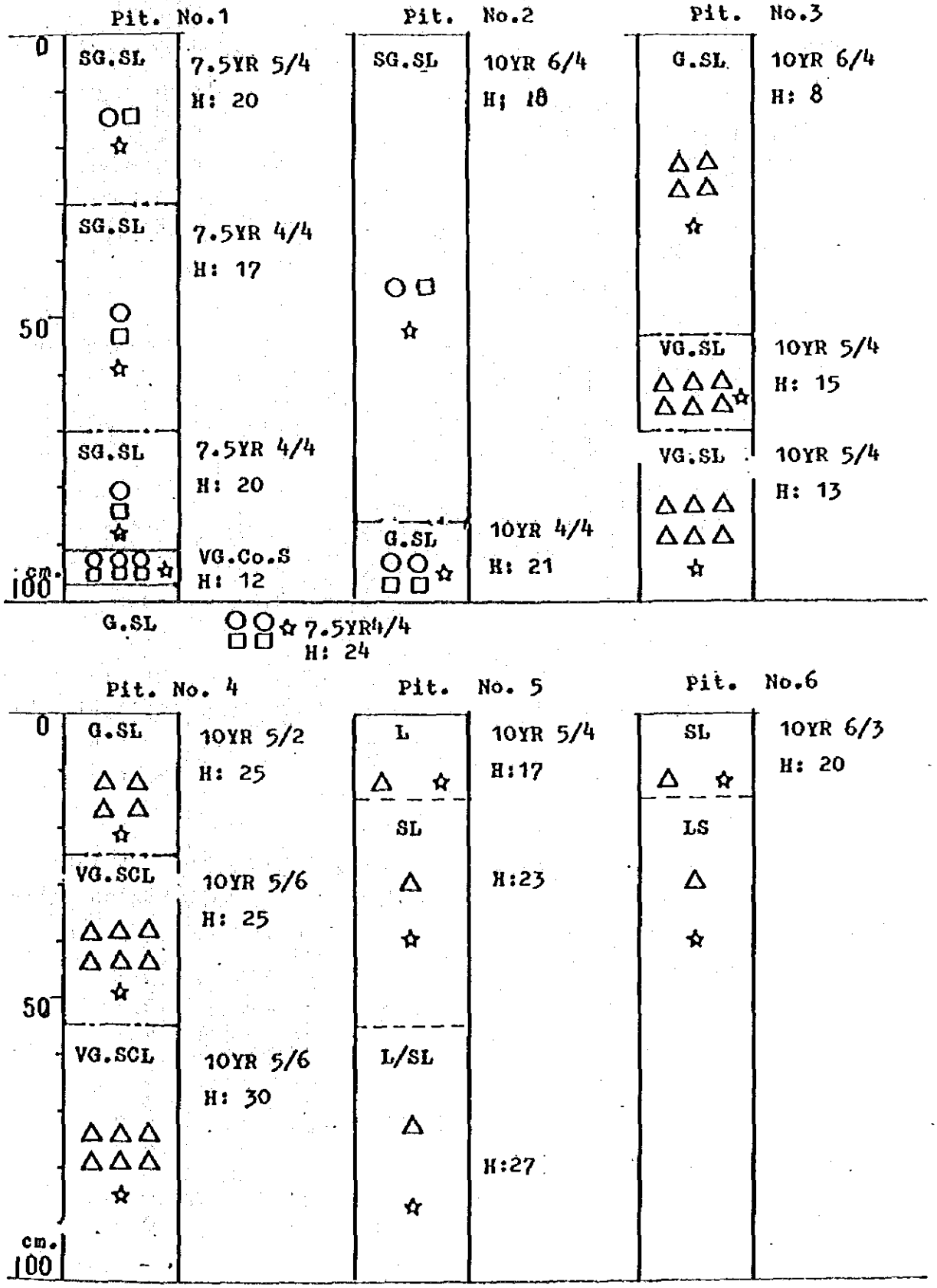
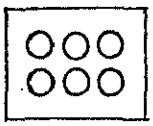
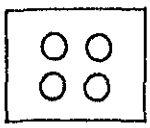


FIG. A.3.5-3 LEGENDS OF DIAGRAMATIC REPRESENTATIVE OF SOIL PROFILES

GRAVEL

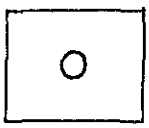


Very frequent (40-80 %)



Frequent (15-40 %)

Few (5-15 %)



Very few (<5 %)

○ rounded gravel

□ subangular gravel

△ angular gravel

☆ violent effervescence (10% Hcl)

BOUNDARY

—— abrupt(1-3cm)

— - — clear (3-5cm)

- - - - gradual(5cm<)

SHAPE OF BOUNDARY

—— smooth

~ wavy

⌇ irregular

SOIL TEXTURE

SG:	Slightly gravelly
G:	Gravelly
VG:	Very gravelly
Co.S:	Coarse sand
LS:	Loamy sand
SL:	Sandy loam
L:	Loam
SCL:	Sandy clay loam

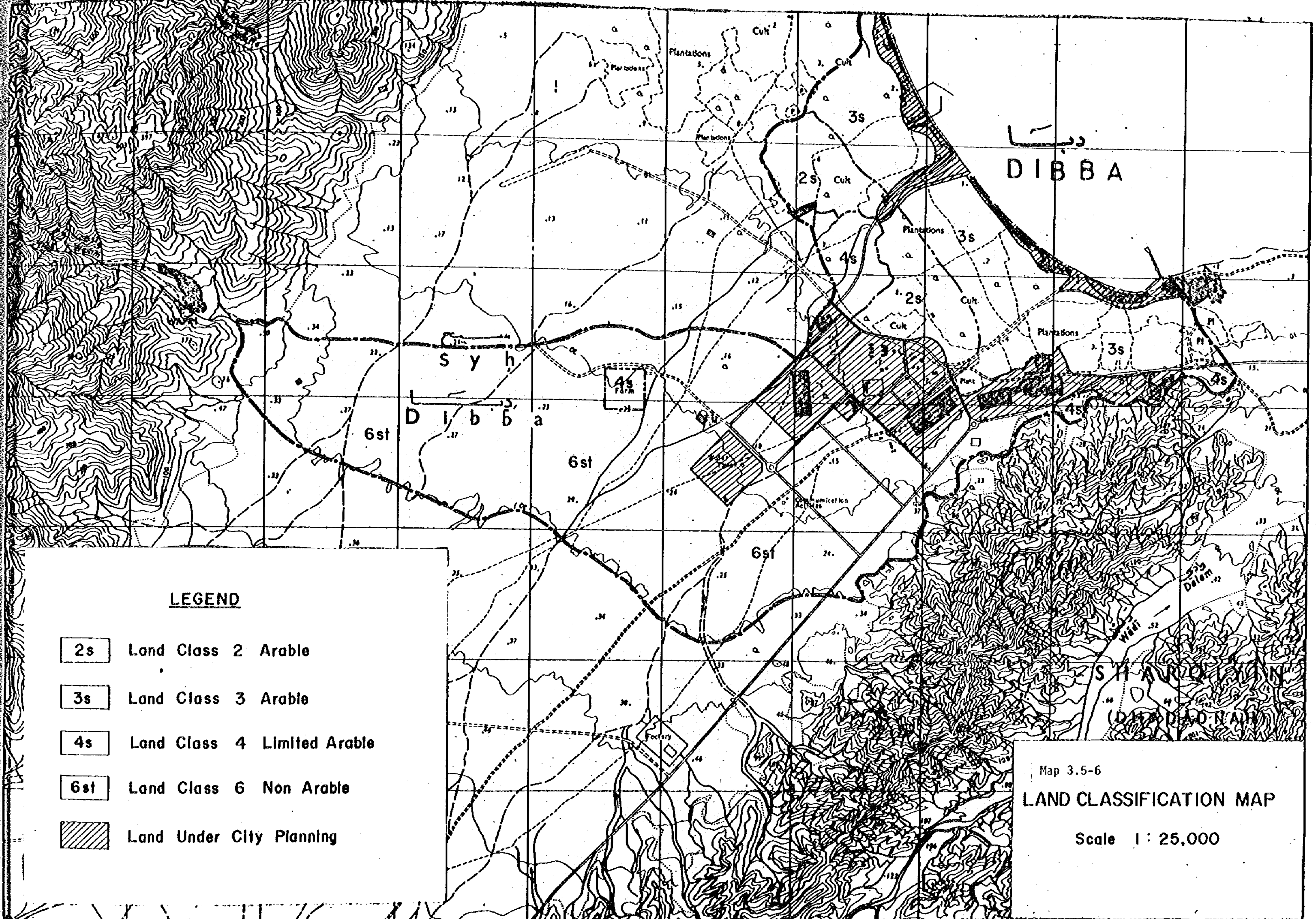
SOIL COLOR NAMES

7.5YR5/4	Brown
" 4/4	Dark brown
10YR6/3	Pale brown
" 6/4	Light yellowish brown
" 5/2	Grayish brown
" 5/4	Yellowish brown
" 5/6	"
" 4/4	Dark yellowish brown

SOIL COMPACTNESS

(by hardness meter)

8 mm	--	1.0 Kg/cm^2
12	--	1.9
13	--	2.2
15	--	3.9
17	--	4.0
18	--	4.7
20	--	6.3
21	--	7.3
23	--	10.0
24	--	12.0
25	--	14.0
27	--	20.0
30	--	38.0



Map 3.5-6

LAND CLASSIFICATION MAP

Scale 1 : 25,000

TABLE A.3.5-2 PHYSICAL PROPERTIES OF SOILS

Test Pit	Depth cm	Soil Texture	Bulk Density gr/cu.cm	Moisture Content at 1/10 atm %	Moisture Content at 15 atm %
TP-2	0 - 15	LS	1.47	17.9	3.9
TP-3	0 - 10	SL	1.0	46.1	10.2
	20 - 30	SL	1.2	33.7	7.0
	60 - 70	SL	1.1	34.8	8.4
TP-4	0 - 10	LS	1.37	21.7	4.0
TP-9	10 - 20	S	1.47	19.9	3.2
TP-10	0 - 15	LS	1.32	23.8	6.0
TP-11	0 - 10	S	1.22	23.3	4.6
	50 - 60	S	1.43	22.4	4.6

TABLE A.3.5-3 PHYSICAL PROPERTIES OF SELECTED SOIL SAMPLES

Pit No.	Depth (cm)	Bulk density	True density	Three Phases of Soil % Liquid	Vapor	Soild	Porosity %	Moisture Retention % 1/10 bar. (1)	15 bar. (2)	(1) - (2)	SP
1	0-30	1.41	2.03	16.3	14.2	69.5	30.5	26.36	5.63	20.73	28
2	0-10	1.40	2.10	12.0	21.2	66.8	33.2	16.94	4.63	12.31	28
	15-25	1.31	2.27	18.5	23.6	57.9	42.1	21.68	5.01	16.67	28
	50-60	-	-	-	-	-	-	20.38	4.86	15.52	22
	90-100	1.32	2.40	12.0	32.9	55.1	44.9	19.47	4.43	15.04	22
5	10-20	1.30	2.40	13.7	31.9	54.4	45.6	27.35	5.68	21.67	42
	100-110	-	-	-	-	-	-	26.41	3.00	23.41	42
6	5-15	1.35	2.30	24.9	16.1	59.0	41.0	23.70	3.96	19.74	32
	50-60	1.22	2.30	14.3	32.4	53.3	46.7	24.47	2.35	22.12	32
	100-110	-	-	-	-	-	-	30.15	4.76	25.39	31

Note: Data source: Soil and Laboratory Section. Soil and water Dept. Ministry of Agriculture and Fisheries. UAE

TABLE A.3.5-4 CONTENT OF GRAVEL IN THE SOIL PROFILE

Pit No.	Sample No.	Depth (cm)	Distribution % <2mm	2-4	4-6	>6mm	Gravel Total
1	1	0 - 30	95.5	1.6	1.3	1.6	4.5
	2	30 - 70	88.8	5.8	2.0	2.4	11.2
	3	70 - 91	91.0	5.1	2.6	1.3	9.0
	4	91 - 97	40.9	20.4	11.4	27.3	59.1
	5	97 -105	80.1	8.6	3.3	8.0	19.9
2	6	0 - 86	92.2	4.1	0.9	2.8	7.8
	7	86 -100	79.7	9.5	3.6	7.2	20.3
3	8	0 - 48	67.6	17.7	8.8	5.9	32.4
	9	48 - 70	43.1	8.1	4.4	44.4	56.9
	10	70 -100	44.6	13.3	6.9	35.2	55.4
4	11	0 - 25	68.4	13.7	4.7	13.2	31.6
	12	25 - 55	45.7	16.7	9.7	27.9	54.3
	13	55 -100	48.7	24.1	10.8	16.4	51.3
5	14	0 - 15	99.5	-	-	-	0.5
	15	15 - 55	97.5	-	-	-	2.5
	16	55 -100	99.5	-	-	-	0.5
6	17	0 - 15	99.5	-	-	-	0.5
	18	15 - 55	99.5	-	-	-	0.5
	19	55 -100	99.5	-	-	-	0.5

Note: Gravel means 2 - 75 mm particles.

TABLE A.3.5-5 CHEMICAL AND PHYSICAL PROPERTIES OF THE SOILS, WADI AL BASSIERAH, U.A.E. (1)

Pit No.	Depth cm	Gravel >2 mm %	Carbonate %	Mechanical Analysis Sand %	Silt %	Clay %	Texture	Gypaum %	Organic Carbon %	Organic Matter %	Satur Percent %	PH	EC. m.mhos/cm	Cations and Aniens meq/l Ca	Mg	Na	K	Cl	SO_4	HCO_3	CO_3
1	0- 20	55	17	74	3	6	S	0.8	0.08	0.15	18	8.6	0.58	2.8	1.3	1.4	0.1	1.9	2.0	1.9	Nil
	20- 52	62	15	80	1	4	S	0.7	0.06	0.11	21	9.0	0.40	1.8	1.4	0.9	0.1	0.1	2.6	2.6	0.2
	52-100	70	18	76	1	5	S	0.75	0.06	0.11	17	9.0	0.30	1.3	1.4	0.7	0.1	0.4	2.2	2.2	Nil
2	0- 25	44	21	67	4	8	LS	0.75	0.46	0.80	27	8.5	1.10	3.1	2.8	6.1	1.1	5.0	5.4	2.4	0.3
	25- 55	73	22	68	3	7	S	0.8	0.19	0.31	25	8.6	2.10	4.7	2.2	14.3	0.7	14.4	5.8	1.5	0.2
	55-100	64	20	71	2	7	S	0.8	0.10	0.17	31	8.7	1.80	3.1	2.3	13.9	0.4	12.8	4.9	2.0	Nil
3	0- 20	Nil	20	38	25	17	SL	5.2	1.70	2.90	45	8.6	22.20	26.9	58.7	186.9	3.9	179.7	93.1	3.6	Nil
	20- 50	4	23	41	24	12	SL	4.7	0.58	1.00	36	8.8	10.30	5.7	16.9	88.0	0.9	77.1	31.9	2.6	Nil
	20-100	4	26	47	16	11	SL	4.4	0.31	0.54	34	8.7	7.20	4.7	15.5	62.0	1.0	54.4	26.2	2.6	Nil
	100-160	4	22	56	12	10	SL	4.1	0.28	0.50	33	8.8	4.50	2.6	7.3	33.5	1.1	30.3	11.8	2.3	Nil
	160-180	4	26	56	10	8	LS	3.5	0.20	0.34	35	8.9	4.90	2.6	9.2	37.4	0.9	29.8	18.3	1.8	0.3
4	0- 30		19	62	10	9	LS	0.8	0.24	0.42	24	8.8	0.45	1.8	1.4	1.1	0.2	0.9	1.7	1.7	0.2
	30- 65	3	22	51	16	11	SL	0.9	0.19	0.34	26	8.8	0.56	1.8	1.9	1.7	0.1	2.1	1.4	1.9	Nil
	65-100	3	18	60	13	9	LS	1.0	0.10	0.18	25	8.7	2.20	3.1	7.7	11.3	0.3	17.7	2.8	1.9	Nil
5	0- 20	18	22	57	13	8	LS	4.0	0.22	0.39	21	8.4	13.90	26.4	24.8	91.3	8.8	119.4	29.5	2.0	Nil
	20- 45	36	22	65	4	9	LS	1.8	0.10	0.18	22	8.5	8.20	10.3	18.7	45.7	8.8	68.6	12.9	2.0	Nil
	45- 65	40	22	70	3	5	S	2.3	0.09	0.16	24	8.9	3.30	2.6	4.3	23.5	2.6	25.5	5.4	2.0	Nil
	65-100	49	47	47	1	5	S	3.3	0.07	0.13	26	8.9	4.10	3.1	7.7	28.7	1.4	32.2	6.2	2.6	Nil
6	0- 20	Nil	42	27	21	10	SL	4.5	1.13	1.90	38	7.8	78.50	170.6	306.6	652.2	43.0	1,095.0	76.0	1.5	Nil
	20- 75	3	42	43	7	8	S/LS	5.2	0.32	0.55	27	8.4	27.20	18.1	50.8	256.5	9.2	321.3	11.5	1.8	Nil
	75-100	4	40	40	11	9	LS	5.3	0.21	0.36	35	8.7	18.80	5.2	24.4	171.7	4.4	185.6	17.4	2.6	Nil
	100-120	9	44	36	14	6	LS	5.2	0.20	0.34	42	8.5	16.96	5.2	31.7	150.0	3.6	161.8	26.6	2.0	Nil
7	0- 6	41	40	41	9	10	LS	1.08	0.31	0.53	21	8.6	0.70	3.9	1.5	1.6	0.3	2.3	2.0	2.8	0.3
	6-100	84	32	61	2	5	S	0.8	0.03	0.02	24	9.0	0.45	1.3	1.7	1.3	0.2	1.4	1.2	1.5	0.3
8	0- 6	57	31	52	8	9	LS	1.1	0.15	0.09	17	8.5	0.75	3.9	1.5	1.8	0.2	2.6	2.8	2.0	Nil
	6- 35	80	30	63	2	5	S	0.9	0.10	0.06	21	9.0	0.70	2.1	2.9	2.5	0.1	3.5	2.5	1.3	0.3
	35-100	83	30	65	1	4	S	0.75	0.03	0.02	21	8.3	0.45	1.0	1.7	2.0	0.1	1.4	1.6	1.8	0.3

Notes: S: Sand
LS: Loamy Sand
SL: Sandy Loam
S/LS: Slightly Loamy Sand

- Continued -

CHEMICAL AND PHYSICAL PROPERTIES OF THE SOILS, WADI AL BASSIERAH, U.A.E. (2)

Pit No.	Depth cm	Gravel > 2 mm %	Carbonate %	Mechanical Analysis Sand %	Silt %	Clay %	Texture	Gypaum %	Organic Carbon %	Organic Matter %	Satur Parcent %	PH	EC. m.mhos/cm	Cations and Aniens meq/l Ca	Mg	Na	K	Cl	SO_4	HCO_3	CO_3
9	0- 28	42	30	61	3	6	S	0.9	0.05	0.09	21	8.8	0.50	2.1	1.4	1.5	0.1	1.6	1.1	2.3	Nil
	28-100	63	19	76	1	4	S	0.8	0.01	0.02	22	9.2	0.40	1.3	1.2	1.4	0.1	1.3	0.3	2.3	Nil
10	0- 16	40	40	45	6	9	LS	0.75	0.50	0.90	29	8.9	0.96	2.1	2.9	3.7	0.7	3.7	1.1	4.6	Nil
	16- 32	65	45	42	5	8	LS	2.9	0.20	0.34	26	8.8	2.20	2.1	4.3	16.1	0.2	13.8	6.3	2.3	0.3
	32- 48	75	30	63	2	5	S	2.5	0.07	0.12	28	8.8	3.40	3.6	9.2	20.9	0.2	26.1	5.8	1.8	Nil
	48- 72	72	51	43	1	5	S	2.9	0.07	0.12	40	8.6	3.81	4.1	9.6	24.3	0.2	30.7	6.1	1.5	Nil
	72-100	69	47	43	4	6	S	3.3	0.10	0.17	43	8.4	5.13	5.2	14.5	31.3	0.2	42.8	6.3	2.0	Nil
11	0- 12	4	58	31	4	7	S	0.9	0.49	0.84	26	8.8	0.66	2.1	2.9	2.7	0.3	1.0	3.1	3.6	0.3
	12- 65	8	53	37	3	7	S	0.9	0.24	0.41	24	8.8	0.70	2.1	1.4	3.3	0.1	2.0	2.2	2.3	0.3
	65-100	5	68	24	2	6	S	0.9	0.08	0.14	22	8.7	1.70	2.1	5.8	9.6	0.1	11.1	4.7	1.5	0.3
12	0- 18	67	32	57	4	7	LS	0.8	0.10	0.17	20	8.6	0.40	2.1	0.9	0.9	0.2	0.8	1.2	1.8	0.3
	18- 38	56	27	54	5	14	SL	0.75	0.05	0.09	20	8.4	0.45	1.8	0.9	1.8	0.1	0.7	1.9	2.0	Nil
	38- 60	63	25	60	5	10	LS	0.75	0.04	0.07	25	8.7	0.40	1.8	0.8	1.4	0.1	1.4	1.0	1.7	Nil
	60-100	55	22	65	4	9	S/LS	0.75	0.02	0.03	23	8.8	0.45	1.8	0.7	2.0	0.1	1.8	0.7	2 0	Nil
13	0- 15	24	31	60	3	6	S	0.8	0.21	0.36	26	8.8	0.45	2.6	1.1	0.9	0.1	1.2	1.2	2.3	Nil
	15- 40	63	29	65	1	5	S	1.0	0.07	0.12	23	8.9	0.45	2.1	1.6	0.7	0.1	1.2	1.2	2.0	Nil
	40-100	68	31	61	2	6	S	0.75	0.08	0.14	23	8.8	0.40	1.9	1.5	0.7	0.1	1.1	1.2	2.0	Nil

Notes: S: Sand
LS: Loamy Sand
SL: Sandy Loam
S/LS: Slightly Loamy Sand

TABLE A.3.5-6 DISTRIBUTION OF FRAGMENTS BY PARENT MATERIALS

Unit: percent

Pit.No. & horizone	Serpentinite	Chert	Schist	Mable	Subkha	Organic deposit	Marly siltstone	Others
No.1 1)								
91-97	30	40	15			3		2
No.3 2)								
0-48	97	2			1			
48-70	96	1			3			
70-100	95	2			3			
No.4 2)								
0-25	90	6			4			
25-55	94	3			3			
55-100	60	1			39			
No.5 3)								
0-15	35		40	5		5	15	
15-55	48		35	2		5	5	5
55-100	30		39	1		5	25	
NO.6 3)								
0-15	60		15	1		10	13	
15-55	40		25	2		13	20	1
55-100	20		10	1		25	44	

Note: 1) gravelly layer
2) sorting above 6 mm, gravel
3) sorting above 2 mm, gravel

TABLE A.3.5-7 BRIEF DESCRIPTION OF SOIL PROFILE IN TEST PIT (1)

Sample Area No.	Pit. No.	Land Use	Depth cm	PH	Compact-ness	Color	Texture	Gravel %	Remarks
1	1	Melon field	0- 30	8.1	20	Dark brown (7.5YR4/4)	SG.SL	4.5	structureless; very friable; subangular, rounded gravel
			30- 70	8.6	17	"	"	11.2	structureless; friable; subangular, rounded gravel
			70- 91	8.7	20	"	"	9.0	" "
			91- 97	8.6	12	"	VG.CoS	59.1	subangular, rounded gravel
			97-105	8.4	24	"	G.SL	19.9	weak fine platy structure; slightly plastic; subangular, rounded gravel
	2	Date garden	0- 86	8.5	18	Dark yellowish brown (10YR4/4)	SG.SL	7.8	weak medium angular blocky structure; friable; subangular, rounded gravel
			86-100	8.3	21	"	G.SL	20.3	structureless; friable; subangular, rounded gravel; few shell fragments
2	3	Mango garden	0- 48	8.4	8	Yellowish brown (10YR5/4)	G.SL	32.4	structureless; loose; angular gravel
			48- 70	8.5	15	"	VG.SL	56.9	structureless; loose; angular gravel; few small store (ø 10 - 15 cm)
			70-100	8.5	13	"	VG.SL	55.4	structureless; loose; angular gravel
3	4	Citrous garden	0- 25	8.4	25	Yellowish brown (10YR5/6)	G.SL	31.6	structureless; friable; angular gravel
			25- 55	8.5	25	"	VG.SCL	54.3	structureless; friable; angular gravel
			55-100	8.5	30	"	VG.SCL	51.3	structureless; friable; slightly sticky plastic; friable; angular gravel
4	6	Date garden	0- 15	8.6	20	Dark yellowish brown (10YR4/4)	SL	0.5	weak fine blocky structure(0-15 cm); loose; common date roots (ø5-10 mm) below 30 cm depth
			15- 55	8.5	20	"	SL	0.5	few shell & coral fragments below 55 cm depth
			55-100	8.6	20	"	SL	0.5	
5	5	Date garden	0- 15	8.2	17	Dark yellowish brown (10YR4/4)	L	0.5	structureless; loose; common date roots (ø5-8 mm) below 50 cm depth
			15- 50	8.5	23	"	SL	2.5	few shell fragments below 50 cm depth
			50-100	8.5	27	"	L/SL	0.5	

Notes:
L: Loam
SG.SL: Slightly Gravel Sandy Loam
G.SL: Gravel Sandy Loam
VG.SL: Very Gravel Sandy Loam
SL: Sandy Loam
L/SL: Loam/Sandy Loam
VG.SCL: Very Gravel Sandy Clay Loam
VG.CoS: Very Gravel Coarse Sand

TABLE A.3.5-8 BRIEF DESCRIPTION OF SOIL PROFILE IN TEST PIT (2)

Pit. No.	Land Use	Depth cm	PH	Color	Texture	Gravel %	Remarks structure, gravels, roots, shells
1	FAO Extension Farm	0- 20	8.6	Pale brown (10YR6/3)	S	55	structureless; loose; very few fine roots
		20- 52	9.0		S	62	gravel layer
		52-100	9.0		S	70	gravel layer
2	Date garden	0- 25	8.5	Pale brown (10YR6/3)	LS	44	structureless; friable; many fine roots, few small angular gravels
		25- 55	8.6		S	73	gravel layer
		55-100	8.7		S	64	gravel layer
3	Date garden	0- 20	8.6	Brown (10YR4/3)	SL	Nil	very weak medium granular; friable; slightly plastic; common fine roots
		20-100	8.7	Brown (10YR4/3)	SL	4	weak medium subangular blocky; friable; slightly plastic; many date palm roots
		100-160	8.8	Dark yellowish brown (10YR4/4)	SL	4	plastic; many date palm roots
		160-180	8.9	Yellowish brown (10YR5/4)	LS	4	common date palm roots
4	Waste land	0- 30	8.8	Pale brown (10YR6/3)	LS	Nil	structureless; common fine roots; very few small round gravels
		30- 65	8.8	Yellowish brown (10YR5/4)	SL	3	moderate coarse subangular blocky; hard; slightly plastic
		65-100	8.7	Yellowish brown (10YR5/4)	LS	3	strong coarse subangular blocky; very hard; cemented
5	Date garden	0- 20	8.4	Dark yellowish brown (10YR4/6)	LS	18	structureless; crumbs-like; friable; common fine roots
		20- 45	8.5	" (10YR4/4)	LS	36	structureless; loose; few shell fragments; common small round gravels
		45- 65	8.9	" (10YR3/4)	S	40	structureless; many date palm roots; many small round gravels
		65-100	8.9	" ( )	S	49	structureless; loose; many shell and coral fragments; coarse sand
6	Date garden	0- 20	7.8	Dark yellowish brown (10YR4/4)	SL	Nil	structureless; crumbs-like; friable; slightly plastic; few humic spots
		20- 75	8.4	" (10YR4/4)	S/LS	3	structureless; friable; common date palm roots; humic spots
		75-100	8.7	" (10YR4/4)	LS	4	weak medium subangular blocky/platy; friable; common fire pores
		100-120	8.5	Light yellowish brown (10YR6/4)	LS	9	moderate to strong coarse platy; hard; cemented

Notes:
S: Sand
LS: Loamy Sand
SL: Sandy Loam
S/LS: Slightly Loamy Sand

(Continued)

Pit. No.	Land Use	Depth cm	PH	Color	Texture	Gravel %	Remarks
7	Waste land	0- 6	8.6	Very pale brown (10YR7/3)	LS	41	firm to moderate fine subangular blocky; slightly firm; common fine roots
		6-100	9.0	Dark yellowish brown (10YR4/4)	S	84	gravel layer; yellowish white $CaCO_3$ coating on gravel surface
8	Waste land	0- 6	8.5	Very pale brown (10YR7/3)	LS	57	structureless; loose; slightly plastic; slightly sticky; few fine roots
		6- 35	9.0	Yellowish brown (10YR5/4)	S	80	gravel layer
		35-100	8.3		S	83	gravel layer; white $CaCO_3$ thin coating on gravel surface
9	Waste land	0- 28	8.8	Light brownish gray (2.5Y6/3)	S	42	structureless; many small round gravels
		28-100	9.2		S	63	gravel layer
10	Date garden	0- 16	8.9	Brown (10YR5/3)	LS	40	structureless; loose; many fine roots; common small gravels
		16- 32	8.8	Brown (10YR5/3)	LS	65	structureless; loose; many roots; many small angular gravels
		32- 48	8.8		S	75	gravel layer
		48- 72	8.6		S	72	gravel layer; very many yellowish white $CaCO_3$ coating on gravel surface
		72-100	8.4	Dark yellowish brown (10YR4/6)	S	69	structureless; compacted; many small subangular gravels
11	Date garden	0- 12	8.8	Brown (10YR5/3)	S	4	structureless; loose; common fine roots
		12- 65	8.8	Dark yellowish brown (10YR4/4)	S	8	structureless; friable; many Prosopis free roots; few shells and gravels
		65-100	8.7	Brown (10YR5/3)	S	5	moderate medium subangular blocky; very hard; few small gravels
12	Waste land	0- 18	8.6	Pale brown (10YR6/3)	LS	67	structureless; loose; many small angular and cherty gravels
		18- 38	8.4	Dark yellowish brown (10YR4/6)	SL	56	structureless; friable; common small angular gravels
		38- 60	8.7		LS	63	gravel layer
		60-100	8.8		S/LS	55	gravel layer
13	Waste land	0- 15	8.8	Pale brown (10YR6/3)	S	24	very weak fine to medium subangular blocky; loose; few fine roots
		15- 40	8.9		S	63	gravel layer
		40-100	8.8		S	68	gravel layer; yellowish white $CaCO_3$ coating on gravel surface

Notes:
S: Sand
LS: Loamy Sand
SL: Sandy Loam
S/LS: Slightly Loamy Sand

TABLE A.3.5-9 ANALYSES OF SOILS COLLECTED FROM SAMPLE AREAS

Sample Area		No.1					No.2		No.2			No.3			No.4			No.4			No.5		
Test Pit		No.1					No.2		No.3			No.4			No.6			No.5					
Depth cm		0- 30	30- 70	70- 91	91- 97	97-105	0- 86	86-100	0- 48	48- 70	70-100	0- 25	25- 55	55-100	0- 15	15- 55	55-100	0- 15	15- 55	55-100
Gravel > 2mm	%	4.5	11.2	9.0	59.1	19.9	7.8	20.3	32.4	56.9	55.4	31.6	54.3	51.3	0.5	2.5	0.5	0.5	0.5	0.5
Carbonate	%	33.3	31.6	32.4	N.D	33.8	33.1	29.2	35.4	35.5	36.6	37.9	35.5	38.6	34.0	35.3	34.3	29.9	34.3	33.9
Mechanical analysis Sand	%	42.5	57.7	57.2	"	46.3	46.6	60.0	54.4	54.7	49.1	43.7	46.1	38.1	40.0	47.0	55.3	34.3	39.4	35.2
Silt	%	11.8	3.3	3.6	"	9.1	13.2	3.6	2.8	2.8	2.7	9.9	2.5	6.9	16.1	11.7	5.8	25.1	17.0	19.3
Clay	%	12.4	7.4	6.8	"	10.8	7.1	7.2	7.4	7.0	11.6	8.5	15.9	16.4	9.9	6.0	4.6	10.7	9.3	11.6
Texture		SL	SL	SL	"	SL	SL	SL	SL	SL	SL	SL	SCL	SCL	SL	LS	LS	L	SL	L/SL
PH		8.1	8.6	8.7	8.6	8.4	8.5	8.3	8.4	8.5	8.5	8.4	8.5	8.5	8.6	8.5	8.6	8.2	8.5	8.5
ECe (m.mhos/cm)		9.40	2.00	1.50	1.68	3.20	0.60	1.50	10.20	1.79	1.61	6.40	3.40	3.73	2.04	2.35	1.84	0.65	1.83	5.61
Org.matter	%	0.77	0.30	0.28	-	0.30	0.58	0.36	0.55	0.31	0.27	1.84	0.14	0.50	1.17	0.84	0.48	1.87	0.84	0.86
Cations & Anions meq/l	Ca	19.05	2.50	1.54	1.72	5.15	1.24	3.26	6.95	2.23	2.06	5.66	3.09	3.35	1.89	2.40	1.54	2.47	2.75	3.06
	Mg	13.04	5.76	3.52	4.65	10.37	1.80	6.87	14.45	3.49	3.63	13.94	3.52	8.17	6.28	6.91	4.83	2.14	4.93	17.03
	Na	67.40	10.43	9.35	9.35	15.65	2.54	5.04	86.96	9.60	8.70	39.60	22.20	21.70	11.30	12.80	10.20	1.6	8.04	36.10
	K	0.97	0.08	0.08	0.06	0.24	0.14	0.08	2.30	0.20	0.18	0.51	0.28	0.66	0.17	0.08	0.03	0.08	0.36	0.15
	Cl	73.85	13.88	7.90	9.71	24.35	2.99	12.09	90.20	11.90	10.95	52.84	23.80	27.61	14.40	18.53	12.14	1.57	11.90	41.25
	SO_4	24.50	3.61	4.59	4.29	5.74	0.66	1.69	16.72	2.60	1.85	3.45	3.18	4.68	2.43	1.88	2.59	0.78	2.03	13.34
	HCO_3	1.84	1.38	1.79	1.58	0.70	1.77	1.47	2.63	1.26	1.26	2.89	1.58	1.58	2.11	1.40	1.68	3.22	1.37	1.40
	CO_3	Nil	0.35	0.21	0.21	0.35	0.21	Nil	1.05	0.21	0.21	0.53	0.53	Nil	0.70	0.35	0.21	0.63	0.42	0.35

Notes: Deta Source: Soil and Laboratory Section, Soil and Water Dept. Ministry of Agriculture and Fisheries, U.A.E.

S: Sand
L: Loam
SL: Sandy Loam
LS: Loamy Sand
SCL: Sandy Clay Loam
L/SL: Loam/Sandy Loam