THE HASHEMITE
KINGDOM OF
JORDAN

JORDAN VALLEY AUTHORITY

JORDAN VALLEY IRRIGATION PROJECT

STAGE II

FEASIBILITY STUDY

VOLUME V

APPENDIX H
ECONOMIC ANALYSIS

APPENDIX I
FINANCIAL ANALYSIS

JANUARY 1978

PREPARED BY
HARZA OVERSEAS
ENGINEERING COMPANY

IN ASSOCIATION WITH
DAR AL-HANDASAH CONSULTANTS
(SHAIR & PARTNERS)

REPORT OUTLINE

VOLUME I	MAIN REPORT
VOLUME II	APPENDIX A, HYDROLOGY ATTACHMENT 1, THE HYDROMETEOROLOGICAL NETWORK AND DATA APPENDIX B, ENVIRONMENTAL ASSESSMENT APPENDIX C, OPERATION STUDIES
VOLUME III	APPENDIX D, CONSTRUCTION MATERIALS APPENDIX E, GEOLOGY
VOLUME IV	APPENDIX F, SOILS APPENDIX G, AGRICULTURAL DEVELOPMENT ATTACHMENT 1, CROP YIELD STUDY ATTACHMENT 2, IRRIGATION APPLICATION EFFICIENCIES
VOLUME V	APPENDIX H, ECONOMIC ANALYSES APPENDIX I, FINANCIAL ANALYSES
VOLUME VI	APPENDIX J, PRELIMINARY DESIGN OF STORAGE AND POWER FACILITIES APPENDIX K, PRELIMINARY DESIGN OF IRRIGATION FACILITIES APPENDIX L, COST ESTIMATES
ANNEX D–1	FIELD LOGS OF TEST PITS, ADITS AND SHAFTS, AND LABORATORY TEST RESULTS
ANNEX E–1	DRILL HOLE LOGS, DRILL HOLE PERMEABILITY TEST RESULTS, AND PETROGRAPHIC ANALYSES
ANNEX K–1	IRRIGATION SYSTEM LAYOUTS

Appendix H

ECONOMIC ANALYSES

Table of Contents

LIST OF TABLES

LIST OF TABLES (Cont'd)

LIST OF EXHIBITS

Appendix H

ECONOMIC ANALYSES

Summary

The economic justification of the Jordan Valley Irrigation Project Stage II development has been measured by a comparison of benefits and costs over a 50-year period beginning with the first year of project construction. A summary of the economic justification analysis is presented in Table H-1. The internal rate of return for the project using direct benefits and costs only amounts to 13.4 percent. If indirect benefits and costs are included, the internal rate of return increases to 15 percent. Assuming a discount or interest rate of 10 percent, the project has a benefit-cost ratio of 1.4 using direct benefits and costs only. With indirect benefit and costs added, the benefit-cost ratio increases to 1.6. The Project appears to offer an attractive economic and social development opportunity for the Government of Jordan.

Project benefits would be realized from irrigation, hydroelectric power, municipal and industrial water supply, and flood control. The average annual benefits from all project purposes except flood control are summarized in Table H-2. Data were not adequate to develop a numerical estimate of flood control benefits. Benefits have been adjusted for anticipated development lags using the assumed discount rate of 10 percent. The detailed derivations of the estimated benefits and a narrative discussion of flood control benefits are presented in subsequent sections of this Appendix.

Table H-1

SUMMARY OF ECONOMIC JUSTIFICATION

Item	Direct only	Indirect only	Direct Plus Indirect
Annual Benefits	17,495,000	11,857,000	29,352,000
Annual Costs	12,295,000	6,083,000	18,378,000
Benefit-Cost Ratio[a/]	1.4	1.9	1.6
Internal Rate of Return	13.4	17.0	15.0

a/ Based on assumed discount rate of 10 percent.

Table H-2

SUMMARY OF AVERAGE ANNUAL BENEFITS

Purpose	Direct Benefits	Indirect Benefits	Average Annual Benefits
Irrigation	16,308,000	11,857,000	28,165,000
Hydroelectric Power	332,000	-	332,000
M&I Water Supply	855,000	-	855,000
Total	17,495,000	11,857,000	29,352,000

The construction costs for project storage, power, and irrigation facilities are presented in Table H-3. These costs, amounting to a total of JD 135.6 million, include an allowance for contingencies and for engineering and administration. Other direct costs include project operation and maintenance costs which are summarized below in the Section on Project Costs. Indirect costs, including the costs for associated infrastructure and social development, also are discussed below in the Section on Associated Developments.

Table H-3

SUMMARY OF CONSTRUCTION COSTS[a/]

(JD x 1,000)

Item	Cost
Storage Facilities	70,891
Powerplant at Maqarin Dam	5,251
Powerplant at King Talal Dam	599
Diversion Facilities	348
Miscellaneous Costs	1,583
Main Canal Extension and Repair	2,389
Irrigation System - Converted Area (12,842 ha)	26,304
Irrigation System - New Lands (12,511 ha)	28,194
Total Construction Cost	135,559

a/ Based on 1977 price levels.

Project Description

The Jordan Valley Irrigation forms part of a comprehensive development plan for the Jordan Valley. The comprehensive plan, as presently envisioned, will be completed in three stages. Stage I development includes the existing and on-going projects. When completed, Stage I will provide facilities to irrigate 10,647 hectares by sprinkler methods and 11,927 hectares by surface irrigation. Stage II development provides facilities to irrigate 25,353 hectares by sprinkler irrigation. This area includes 11,927 hectares developed for surface irrigation in Stage I, 915 hectares that are located in the surface irrigation area but are not presently irrigated from the surface system because of topographic and elevation characteristics, and 12,511 hectares of new land. In addition, 20 million cubic meters (MCM) of water per year will be supplied for municipal and industrial (M&I) use, and 25 MCM per year will be released for use in the Yarmouk Triangle area. Stage III development will provide an irrigation supply for an additional 5,147 hectares and will increase the M&I water supply from 20 MCM per year to 47 MCM per year.

For the economic evaluation of Stage II, costs were estimated for a dam and powerplant at the Maqarin site on the Yarmouk River, a powerplant at King Talal dam on the Zarqa River, diversion facilities, an extension of the East Ghor Main Canal (EGMC) and a sprinkler irrigation system for 25,353 hectares.

The irrigation development proposals contained in the project can be grouped into two sub-projects; the irrigation of 12,842 hectares located in the East Ghor Canal Project (EGCP) most of which is to be converted from surface to

sprinkler irrigation, and the development of 12,511 hectares of land not previously currently included in any project.

Project Benefits

The Stage II development would provide direct, indirect, and intangible benefits. The direct benefits from irrigation, hydroelectric power, municipal and industrial water supply, and flood control are discussed in this section. The indirect and intangible benefits are presented in the following section.

Irrigation

Irrigation benefits have been measured on the basis of the with and without project principle. They represent the increase in net farm income that can be anticipated as a result of applying the project irrigation water. The benefits are computed as the difference in net income between future conditions with and without Stage II development. Details on the crop prices, yields, production costs and other information used in deriving irrigation benefits are presented in Appendix G -- Agricultural Development. Therefore, the discussions here are limited to a relatively brief summary.

The Jordan Valley has a climatic advantage over almost any other northern hemisphere production center. The year-long growing season permits the planting and harvesting of a wide variety of fresh fruits and vegetables which are available at times when most other areas are unable to produce.

The soils of the East Bank are fertile and capable, under irrigation and reasonable levels of husbandry, of producing high yields of the traditional crops of the area. Irrigation also affords the opportunity of producing vegetables and fruits not presently grown in the Valley.

The irrigation benefits of Stage II construction accrue from three project services. First, storage behind Maqarin dam makes possible the delivery of large quantities of water for specialized crop culture and the attainment of greater intensity of agricultural operations. Second, applying water by sprinkler rather than by surface methods results in water economies of significant proportion. Third, the project development will result in the use of modern technology, better seeds, pesticides, and fertilizers.

Despite the many immediate advantages of sprinkler irrigation, some crops may respond better to trickle or surface irrigation than to sprinkler application. The farm irrigation system may make use of a combination of surface, sprinkler and trickle application. These systems might also include gated pipe and other methods not now in use or projected. The project economics are based on sprinkler irrigation because it will be broadly used and is representative of the other methods.

Four types of land must be distinguished for the economic evaluation.

The Converted Area: (12,842 ha)

- Land presently irrigated in the EGCP (11,927 ha)
- Land not irrigated but located in the EGCP (915 ha)

The New Land Area: (12,511 ha)

- Land not presently irrigated (10,379 ha)
- Land presently irrigated from wells and side wadis (2,132 ha)

The suggested phasing for the development of these lands is shown in Table H-4.

Table H-4

PHASING OF THE LAND DEVELOPMENT PROGRAM

(ha)

Year	Conversion Area		New Lands		Total
	Presently Irrigated Lands	Land not presently irrigated	Land not presently irrigated	Irrigated from Wells & Wadis	
1978	-	-	-	-	-
1979	-	-	-	-	-
1980	4,152	305	1,543	-	6,000
1981	2,695	305	2,337	663	6,000
1982	2,695	305	2,337	663	6,000
1983	2,385	-	3,140	475	6,000
1984	-	-	1,022	331	1,353
TOTAL	11,927	915	10,379	2,132	25,353

The benefits that can be gained on each type of land depend upon its present condition and its location. The main distinction as far as present conditions are concerned is between irrigated and unirrigated land. Location must also be considered because it influences water use and crop choice. The East Ghor Canal Project (EGCP) land is located in the cooler northern part of the Valley while most of the presently unirrigated area is located in the drier and warmer south. The net farm income at full development under conditions with and without the project for the four types of land are shown in Table H-5. These estimates are taken from Appendix G -- Agricultural Development.

Land Presently Irrigated in the EGCP. The existing cropping intensity is estimated to be 106 percent. At present, wheat and tomatoes are the primary crops accounting for about one-half the cropped area. Other important crops are eggplant, barley, squash, and citrus fruit.

Currently, net farm income is estimated at JD 523 per hectare per year. It is assumed the maximum yield under without-project conditions will be obtained gradually over the next 15 years. Net farm income is estimated to increase to a maximum of JD 908 per hectare per year in 1993 without the Project and to remain constant thereafter.

Implementation of the project is expected to alter the potential for the agricultural development of this land. The conservation of water through the use of sprinklers will make it possible to increase the overall cropping intensity from 106 to 128 percent. It will also reduce uncertainity

Table H-5

NET FARM INCOME UNDER PRESENT CONDITIONS AND FUTURE CONDITIONS WITHOUT AND WITH THE PROJECT

Lands Presently Irrigated Located in EGCP

Crop	Present Conditions		Without Project Conditions		With Project Conditions	
	Cropping Intensity	Net Farm Income JD/ha	Cropping Intensity	Net Farm Income JD/ha	Cropping Intensity	Net Farm Income JD/ha
Wheat/Barley	.44	23.20	.44	53.00	.20	44.96
Maize	-	-	-	-	.03	9.36
Sorghum	-	-	-	-	.03	8.25
Berseem/Alfalfa	-	-	-	-	.13	59.19
Tomato	.17	166.09	.17	292.83	.17	339.92
Eggplant	.09	67.86	.09	112.99	.08	85.18
Squash/Cucumber	.09	57.40	.09	87.21	.05	102.91
Peppers	.01	5.17	.01	5.46	.04	14.54
Green Beans	.03	21.57	.03	24.71	.04	53.16
Cauliflower/Cabbage	.02	2.32	.03	6.28	.05	38.16
Onion/Garlic	-	-	-	-	.04	54.88
Potato	-	-	-	-	.06	100.86
Other Vegetables	.01	3.60	.02	10.30	.02	23.10
Watermelon	.04	10.78	.01	12.30	.12	70.74
Bananas	.02	43.51	.02	57.68	.01	33.78
Citrus Fruit	.13	110.54	.13	232.80	.11	237.82
Other Fruit	.01	10.50	.01	12.00	.10	248.35
Total	1.06	522.54	1.06	907.56	1.28	1,525.16
Less Cost of Portable Farm System		-		-		26.96
Average Total Net Farm Income		522.54		907.56		1,498.20
Presently Unirrigated, Located in EGCP						
Average Net Farm Income		50[a/]		50[a/]		1,498.20[b/]

a/ Dryland farming and pastoral use

b/ Same as for irrigated land in EGCP

Table H-5 (Cont'd)

Lands Presently Unirrigated Located in Southern Part of Valley

	Present Conditions		Without Project Conditions		With Project Conditions	
	Cropping Intensity	Net Farm Income JD/ha	Cropping Intensity	Net Farm Income JD/ha	Cropping Intensity	Net Farm Income JD/ha
Wheat/Barley	-	-	-	-	.20	44.96
Maize	-	-	-	-	.03	9.36
Sorghum	-	-	-	-	.03	8.25
Berseem/Alfalfa	-	-	-	-	.13	59.19
Tomato	-	-	-	-	.17	339.92
Eggplant	-	-	-	-	.08	85.18
Squash/Cucumber	-	-	-	-	.05	102.91
Peppers	-	-	-	-	.04	14.54
Green Beans	-	-	-	-	.04	53.16
Cauliflower/Cabbage	-	-	-	-	.05	38.16
Onion/Garlic	-	-	-	-	.04	54.88
Potato	-	-	-	-	.06	100.86
Other Vegetables	-	-	-	-	.02	23.10
Watermelon	-	-	-	-	.12	70.74
Bananas	-	-	-	-	.03	101.14
Citrus Fruit	-	-	-	-	.11	237.82
Other Fruits	-	-	-	-	.08	198.43
Dryland Farming	-	50	-	50	-	-
Total		50	-	50	1.28	1,542.90
Less Cost of Portable Farm System		-	-			18.90
Average Net Farm Income		50		50		1,524.00

Lands Presently Irrigaged, Located in Southern Part of Valley

Average Net Farm Income	200c/		200c/	1,524.00d/

c/ Partially Developed

d/ Same as for lands presently irrigated in southern part of Valley.

about the availability of water and will stimulate changes in farm technology. It is expected that yields and returns will improve rapidly when the project is completed.

Net farm income under with project conditions, is estimated at JD 1,498 that this development will be reached 4 years after installation of the sprinkler irrigation system.

The following values were used in the evaluation of the development of the land that is currently irrigated in the EGCP:

Annual Net Farm Income
(JD/ha per year)

1.	Existing	JD 523
2.	At Full Develcpment Without Project	JD 908
3.	At Full Development With Project	JD 1,498

Land Not Presently Irrigated in the EGCP. This land consists of small pockets within the existing irrigated land. It cannot be irrigated by surface methods because of elevation, but the installation of a sprinkler system will permit its development. For the purposes of the economic analysis it has been assumed that this land has the same overall potential as the land that surrounds it. It is estimated that net farm income on this land is about JD 50 per hectare per year at present. This net income results from dryland farming and pastoral use. Following the implementation of the Project, it is expected that annual net farm income will increase to JD 1,498 per hectare per year over a seven year period. The annual net farm income under their conditions of development are shown below:

Annual Net Farm Income
(JD/ha per year)

1.	Existing	JD 50
2.	At Full Development Without Project	JD 50
3.	At Full Development With Project	JD 1,498

Land Not Presently Irrigated in New Land Area. Net farm income on this land at present is estimated to average JD 50 per hectare per year. This income is generated by dryland agriculture and grazing. Following the implementation of the project, it is expected that a cropping intensity of 128 percent will be reached in seven years. It is assumed that average crop yields at full development will be equivalent to those forecast for the conversion area. It is also assumed that full advantage will be taken of the climatic conditions of this area for the production of high value fruits.

Annual net farm income will increase from JD 50 to JD 1,524 per hectare per year within seven years of the implementation of the Project. The values used in the economic evaluation are shown below:

Annual Net Farm Income
(JD/ha per year)

1.	Existing	JD 50
2.	At Full Development Without Project	JD 50
3.	At Full Development With Project	JD 1,524

Land Presently Irrigated from Wells and Side Wadis. About 2,132 hectares are presently irrigated from wells and side wadis. This area consists of land irrigated from wells south of the 18 kilometer extension to the EGMC, and land presently irrigated in the Yarmouk, Zarqa, Ziglab, and Kufrinja Gorges.

These lands can be considered partially developed. Their sources of water are uncertain, and increasing salinity problems are affecting the land that is irrigated from wells. Net farm income on these areas at present is estimated to be JD 200 per hectare per year. It is assumed that net farm income on this land will increase to JD 1,524 per hectare per year within seven years of the implementation of the project. Annual net farm income is shown below:

Annual Net Farm Income
(JD/ha per year)

1.	Existing	JD 200
2.	At Full Development Without Project	JD 200
3.	At Full Development With Project	JD 1,524

Summary of Irrigation Benefits. The difference between net farm income without the project and with the project in any year gives the net irrigation benefit that will be gained as a result of the land development proposals. Irrigation benefits for the four land types are shown below:

Irrigation Benefits (JD/hectare)

Present Status of Lands	Location	Net Income Without Project	Net Income With Project	Increased Net Income
Irrigated	EGCP	908	1,498	590
Irrigated	Southern Valley	200	1,524	1,324
Dryland	EGCP	50	1,498	1,448
Dryland	Southern Valley	50	1,524	1,474

The build-up of irrigation benefits for the various land land types is shown in Table H-6.

Table H-6

SUMMARY OF IRRIGATION BENEFITS BY YEAR

Year	EAST GHOR CANAL PROJECT AREA						NEW LAND AREA						PROJECT AREA	
	Presently Irrigated		Presently Unirrigated		Total		Presently Irrigated		Presently Unirrigated		Total			
	Area (ha)	Benefit (JDX1000)	Area (ha)	Benefit (JDX1000)	Area (ha)	Benefit (JDX1000)	Area (ha)	Benefit (JDX1000)	Area (ha)	Benefit (JDX1000)	Area (ha)	Benefit (JDX1000)	Area (ha)	Benefit (JDX1000)
1979	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1980	4,152	-	305	-	4,457	-	-	-	1,543	-	1,543	-	6,000	-
1981	2,695	906	305	63	3,000	969	663	-	2,337	-	3,000	-	6,000	969
1982	2,695	2,332	305	189	3,000	2,521	663	-	2,337	-	3,000	-	6,000	2,521
1983	2,385	4,226		379	2,835	4,605	475	251	3,140	1,309	3,615	1,560	6,000	6,165
1984		6,477		568		7,045	331	591	1,022	3,279	1,353	3,871	1,353	10,916
1985		7,777		757		8,534		995		5,465		6,460		14,994
1986		8,476		946		9,422		1,398		7,650		9,048		18,470
1987		8,623		1,136		7,959		1,801		9,836		11,637		21,396
1988		8,325		1,262		9,587		2,204		12,022		14,226		23,813
1989		8,027		1,325		9,352		2,608		14,207		16,815		26,167
1990		7,729		1,325		9,054		2,760		15,083		17,843		26,897
1991		7,431		1,325		8,756		2,823		15,299		18,121		26,877
1992 to 2028		7,037		1,325		8,362		2,823		15,299		18,121		26,483
		7,037		1,325		8,362		2,823		15,299		18,121		26,483

Power

The power features of Stage II development consist of a 20-MW powerplant at Maqarin Dam and a 2.0-MW powerplant at King Talal Dam. The firm power is defined for the purpose of this study as the power which can be obtained 95 percent of the time to meet system demand. The firm power is 12.8 MW for the Maqarin plant and 1.0 MW for the King Talal plant. The average annual energy generated at Maqarin and King Talal is estimated to be 58 GWh and 8.7 GWh respectively. Construction of the powerplant will be completed by the end of 1982 and the generating units will come on the line in 1983.

The power benefits are based on the least costly alternative for supplying the power and energy generated at the Project facilities. The least costly alternative is assumed to be the addition of an oil-fueled steam unit at the Hussein Thermal Power Station. The procedure for quantifying the power benefits was taken from "Hydroelectric Power Evaluation" prepared by the United States Federal Power Commission (FPC) in 1968. The FPC data was used with adjustments to current conditions because data are not available for large thermal stations in Jordan.

The following assumptions were made to develop the capacity and energy benefits:

1. The "life" of the thermal power facilities is 30 years,
2. The load factor of the plants will be 50 percent which approximately is the system load factor (52 percent),
3. The alternative power development would be manually operated,

4. The average annual heat rate for a 66-MW oil-fueled steam unit is 10,500 Btu per kWh,

5. The cost of Bunker "C" fuel oil is U.S. $11/bbl or JD 3.67/bbl and the heating value of Bunker "C" fuel is 147,500 Btu/gal. This corresponds to a cost for fuel of JD 0.6/Btu x 10^6.

Capacity Benefit. The capacity benefit is based on the cost presented in a recent report[1/] for a 66-MW steam unit with a useful life of 30 years. The capacity benefit consists of two components: 1) an initial benefit which represents the cost of alternative development plus a cost for fuel reserve, and 2) an annual benefit which represents the cost for replacement, insurance, the fixed component of operation and maintenance (O&M), the fixed component of the fuel cost, and administration and general expenses.

The cost of alternative development was taken as the construction cost of the 66-MW steam unit which is estimated to be JD 184/kW. The equivalent investment cost is JD 197/kW. The cost of a fuel reserve for 75 days of operation at a plant factor of 50 percent is JD 6/kW.

The interim replacement cost will be used to finance units of property with life spans less than the overall facility service life. The FPC experience data indicate that an annual allowance of 0.35 percent of the investment cost is required. The annual cost of insurance for fire, storm, vandalism, equipment, public liability and property damage averages about 0.25 percent of the investment cost. The cost of operation and maintenance was based on data

---

1/ Feasibility Study, Hussein Thermal Power Station Extension Unit No. 4 and 5, Zarqa, Jordan, Kuljian, May 1975.

presented in the FPC report for oil-fueled steam units in a powerplant with a capacity of 200 MW. The reported value was escalated to represent January 1977 prices and amounts to JD 2.30/kW per year. The fixed component of the O&M cost is assumed to be 65 percent of the total or JD 1.50/kW per year. The fixed component of the fuel cost is for the fuel required for starts and stops and while the units are spinning ready to serve but not carrying load. The fixed fuel component is assumed to equal 10 percent of the total annual fuel consumption which, for a plant factor of 50 percent, is valued at JD 2.76/kW per year. The administration and general expenses are for administrative and general salaries, regulatory expenses, outside services employed, injuries and damages, welfare, pensions, and miscellaneous expenses. These expenses amount to about 39 percent of the total annual operation and maintenance cost.

The alternative cost upon which the capacity benefit is based is shown below:

Alternative Cost

Initial Cost	
Construction cost of alternative	JD 184/kW
Fuel reserve	JD 6/kW
Total	JD 190/kW
Annual Cost	
Interim Replacement	JD 0.7/kW/yr
Insurance	JD 0.5/kW/yr
O&M (Fixed component)	JD 1.5/kW/yr
Fuel (fixed component)	JD 2.8/kW/yr
Adm. and General Expenses	JD 0.9/kW/yr
Total	JD 6.4/kW/yr

Energy Benefit . The energy benefit includes a fuel and lubrication cost and an allowance for O&M relating to these variable operating costs. The variable fuel cost is equal to 90 percent of the total fuel cost and is valued at 5.7 fils/kWh. Lubricating oil is listed by the Jordan Electric Authority (JEA) as costing about 1.0 fils/kWh. The variable cost of O&M is 35 percent of the total cost or JD 0.8/kW which is equivalent to 0.2 fils/kWh.

The unit energy benefit is summarized as follows:

Energy fuel	5.7 fils/kWh
Lubricating Oil	1.0 fils/kWh
O&M	0.2 fils/kWh
Total Energy Benefit	6.9 fils/kWh

A summary of the value of power and energy is shown below.

	Maqarin Powerplant	King Talal Powerplant
Installed Capacity	20 MW	2 MW
Firm Power	12.8 MW	1.0 MW
Average Energy	56 GWh/yr	8.7 GWh/yr
Capacity Value		
Initial Value	JD 2.43 x 10^6	JD 190,000
Annual Value	JD 82,000/yr	JD 6,000/yr
Energy Value	JD386,000/yr	JD 60,000/yr

The power benefits for the Maqarin and King Talal powerplants are shown in Table H-7.

The power and energy requirements for the irrigation system are estimated to be 6.6 MW and 31 GWh/yr based on information presented in Appendix E, K, Preliminary Design

Table H-7

SUMMARY OF POWER BENEFITS BY YEAR

(JD X 1000)

Year	Maqarin			King Talal			Saleable to JEA		
	Capacity	Energy	Total	Capacity	Energy	Total	Capacity	Energy	Total
1979	-	-	-	-	-	-	-	-	-
1980	-	-	-	-	-	-	-	-	-
1981	1,000	-	1,000	90	-	90	590	-	590
1982	1,430	-	1,430	100	-	100	778	-	778
1983 to 2006	82	386	468	6	60	66	46	246	296
2011	1,082	386	1,468	96	60	156	636	246	882
2012	1,512	386	1,898	106	60	166	824	246	1,070
2013 to 2027	82	386	468	6	60	66	46	246	292
2028	(890) a/	386	(504)	(70)	60	(10)	(502)	246	(258)

a/ Salvage value less annual capacity benefit.

of Irrigation Facilities. If the powerplants at Maqarin and King Talal are installed, the JVA has the option of generating its own power requirements and selling the remainder in bulk to the Jordan Electric Authority (JEA). An arrangment could be made with the JEA whereby an exchange of energy could be made. The amount of power and energy saleable to the JEA is shown below.

	Power (MW)	Energy (GWh)
Maqarin	12.8	58
King Talal	1.0	8.7
Total	13.8	66.7
System Requirements	6.6	31
Saleable to the JEA	7.2	35.7

The annual benefits developed from this situation also are shown in Table H-7.

Municipal and Industrial Water Supply

Provision has been made in the design of Maqarin Dam to supply 20 MCM per year, of water for municipal and industrial use. The Government's decision to withdraw water from the reservoir for these purposes is made with the knowledge that no cheaper alternative sources are available. It is recognized that water is becoming an increasingly scarce resource in Jordan and that the marginal cost of new sources of supply is constantly increasing. The cost of providing a M&I water supply is the incremental cost of raising Maqarin Dam to supply 20 MCM per year more than is required to meet the irrigation requirements of the Project. A dam at an elevation of 130 meters will impound a reservoir which will supply the irrigation requirements of Stage II development.

The cost of raising the dam from El. 130 to El. 158 is JD 11 million. The incremental cost is based on an extrapolation of a cost curve developed using costs for dams at elevations 158, 168, and 200 meters. These costs are given in Appendix L, Cost Estimates.

The M&I demand is discussed in Appendix C, Operation Studies and is based on a per-capita water use and estimates of population. Consumption of the water is expected to increase over the 17-year period from 1983 to 2000 until the 20 MCM per year is fully used. From year 2000 onward the full amount will be withdrawn, and it will be necessary to serve additional demand from new supplies.

In the absence of reliable information on the future value of municipal and industrial water, the benefits have been estimated on the basis of a present-day (1977) value of 80 fils/m^3. This is about equal to what is currently charged at Irbid and is viewed as a conservative estimate of the value of water at Maqarin damsite. Since there is no viable alternative sources the costs of the cheapest single purpose alternative could not be determined.

The annual M&I benefits are shown in Table H-8.

Table H-8

SUMMARY OF M&I WATER SUPPLY BENEFITS
BY YEAR

Year	M&I Benefit (JD x 1000)	Year	M&I Benefit (JD x 1000)
1978	-	1991	1,114
1979	-	1992	1,160
1980	-	1993	1,208
1981	-	1994	1,259
1982		1995	1,310
1983	803	1996	1,365
1984	835	1997	1,419
1985	872	1998	1,478
1986	909	1999	1,538
1987	947	2000	1,600
1988	986	to	
1989	1,027	2028	1,600
1990	1,069		

Flood Control

Historically the occurrence of heavy winter rains has caused much ponding and flooding in the low-lying reaches of the Valley. This flooding has occurred despite relatively good natural drainage and the fact that the main flow of the Jordan River is controlled at the outlet of Lake Tiberias. Flood damage along the East Bank is caused largely by the flows of the Yarmouk River and the side wadis.

Damage occurs to growing crops, private and public installations and is measured also in terms of bank erosion and the loss of top soil. An adverse effect of ponding and flooding is the proliferation of water-borne vectors.

The specific costs of repairing flood damage to irrigation structures in recent years has been recorded by the Jordan Natural Resources Administration. They report that such costs over the past 5 years have averaged around JD 1,000 per year. The greatest damage occurring in 1972 when JD 1,717 were expended in repairs, and the lowest damage occurring in 1976 when repairs cost only JD 519.

Since information on the value of flood damage is limited, no estimate of flood control benefits were made. It is apparent that flooding of the Yarmouk will be significantly reduced by Maqarin Reservoir. As an indication of the effect of the project facilities will have on flood flows, Maqarin Reservoir spilled only 12 months during the 22-year operating period used for these studies.

It is expected that with the coordinated operation of Maqarin, King Talal, and the other control structures on the side Wadis, the flooding along the East Bank will be essentially eliminated.

Indirect and Intangible Benefits

Monetary estimates and narrative descriptions of indirect benefits and costs are presented in this section as supplementary material to the analysis of direct benefits and costs. The analysis of indirect benefits offers a comprehensive view of the impact of the project on the rest of the Jordanian economy. Similarly, the analysis of indirect costs presented in the section on Associated Developments provides a broad perspective of the overall resource requirements for project development. Hopefully, this will assist officials of the Jordan Valley Authority not only in deter-

mining the economic feasibility of the project, but also in planning for the integrated development of the Valley.

For purposes of this discussion, the following definitions have been established to distinguish the terms "direct", "indirect', and "intangible" benefits. Direct benefits are the net value of the immediate products or services resulting from the development for which project costs were incurred. These have been quantified and their value is listed in Table H-2. Indirect benefits are all other benefits attributable to the project that can be expressed in monetary terms. Intangible benefits are all remaining benefits that cannot be expressed in monetary terms.

Indirect benefits have been measured on the basis of the "with and without" project principle. In the analysis, indirect benefits have been divided into three categories. The first category includes the profits earned on commodities produced on the project and sold directly to retail merchants. Indirect benefits of this type are computed by multiplying the amount of sales to retail businesses by a percentage factor, which approximates the average profits on sales by these merchants. The second type of indirect benefits in this category includes commodities requiring more elaborate handling, processing, and marketing between the farmer and the final consumer. Measuring these indirect benefits involves the use of factors representing the ratio of total profits in later processing to the value of the commodity at the farm. These factors vary from one crop to another. They are derived on the basis of research conducted in other countries which have been adjusted on the basis of professional judgement to reflect conditions in Jordan. This first category of indirect benefits is sometimes referred to as "stemming" benefits.

The second category of indirect benefits represents the profits of all enterprises supplying goods and services for the increased production on the project. In other words, they are the profits earned on purchases made by the project. They are sometimes referred to as "induced" benefits.

Public benefits are a third category of indirect benefits. They include the benefits from settlement opportunities, employment opportunities, new investment opportunities, increased tax revenues, and stabilization of the economy.

Intangible benefits are by definition not quantifiable in monetary terms. However, they are an important consideration in determining project feasiblity.

Direct project costs including construction, operation, maintenance, and replacements have been quantified and are reported in the "Project Cost" section of this Appendix. Indirect costs are all other costs associated with the project that can be expressed in monetary terms. They include costs for such items as housing, marketing facilities, research and extension services, social services, and public utilities. Many of these facilities and services are needed for basic development of the area regardless of whether the project is constructed. However, the costs are reported here because the development of this "infrastructure" must be done as an integral part of the project plan, if the project is to be successful.

Intangible costs, like intangible benefits, are by definition not quantifiable in monetary terms. They include any unmeasured social or environmental costs such as for changing traditional living patterns or damaging fish and wildlife habitat.

Indirect Benefits

The monetary value of annual indirect benefits at full development are derived in Table H-9. Total annual indirect benefits in the stemming, induced, and public categories amount to JD 22.6 million. This is in addition to the annual direct benefits at full development of JD 26.5 million for irrigation, JD 292,000 for energy and JD 1.6 million for M&I water. The "stemming" benefits are estimate at JD 7 million per year. Farm products that are sold directly to retail businesses are expected to result in average profits on sales amounting to 10 percent. Farm products that reach the consumer through more elaborate handling, processing, or marketing are conservatively estimated to result in total middlemen profits amounting to 25 percent of the value at the farm gate.

Induced benefits amount to JD 1.3 million, annually. This represents the net profits accruing to those who supply seed, planting stock, fertilizer, chemicals, farm tools, farm machinery, and other such farm production inputs. It is computed on the basis of a total profit by the enterprises supplying those goods and services amounting to 15 percent of the purchase price. Labor is excluded from the increased value of purchases since the benefits from creation of new jobs are included below as a "public" benefit.

Public benefits which can be measured in monetary terms are expected to be about JD 14.3 million, annually. This includes settlement opportunities on over 3,000 new farms, resulting in an annual benefit of JD 3,000,000. These settlement opportunities measurably enhance the earning potential and living standards of the farm families.

Table H-9

ESTIMATED ANNUAL INDIRECT BENEFITS AT FULL DEVELOPMENT

Item	Increased Value	Indirect Benefit Factor	Estimated Benefits to the Economy JD
Stemming Benefits			
Increased Sales of Farm Products to Retail Businesses	JD 30,000,000	10%	3,000,000
Increased Sales of Farm Products to Processors	JD 10,000,000	25%	4,000,000
Subtotal			7,000,000
Induced Benefits			
Increased Purchases For Production Purposes	JD 8,500,000	15%	1,300,000
Public Benefits			
Farm Settlement Opportunities	3,000	JD 1,000	3,000,000
Permanent Employment Opportunities	9,600	JD 500	4,800,000
New Investment Opportunities	JD 150,000,000	2%	3,000,000
Increased Tax Revenues	---	--	2,100,000
Stabilization of the Economy	JD 28,376,000	5%	1,400,000
Subtotal			14,300,000
Total Annual Indirect Benefits			22,600,000

Other public benefits result from creating new jobs in the Valley and throughout the Kingdom. It is estimated that project construction activities will result in about 21,700 man-years of employment. Construction employment will be the highest in the second, third, and fourth years of construction. As construction winds down and ultimately phases out, many construction workers will find continuing employment in the operation and maintenance of the project. About 600 people will be employed on a permanent basis as ditch-riders, gate tenders, pump and power plant operators, maintenance men, and other such jobs on this large, multi-purpose project. An estimated 3,000 additional workers will be employed on the project's new and improved irrigation farms, and about 6,000 new jobs will be created in agricultural related industries. All of these new jobs will be linked with the basic resource development. The new permanent employment opportunities created by the project will result in an estimated benefit to the economy of JD 4.8 million.

The public benefit from creation of new investment opportunities amounts to JD 3.0 million annually; and is estimated as two percent of the increased farm investment. This two percent factor represents the difference between the 10 percent rate of return anticipated on the farm investment and an estimated 8 percent return that could be obtained by investing in registered development bonds.

Increased tax revenues generated by project development will result in public benefits such as improved community facilities and government services. The increase was estimated by subtracting tax revenues under without project conditions from those anticipated with the project. Revenues from direct taxation are expected to increase by JD 523,000 per

year. This consists of an annual gain of JD 26,000 for land taxes, JD 317,000 for municipal taxes, and JD 180,000 for income taxes. Indirect taxes in Jordan for such items as customs, excise, licenses, and fees amount to about three times the value of direct taxes. Therefore, the gain in indirect taxes attributable to the project is estimated at about JD 1.6 million. The combined gain in tax revenues from the project is about JD 2.1 million per year.

The availability of a dependable supply of irrigation water in the Jordan Valley will result in a public benefit to the region by stabilizing the economy. Although the general benefits of stabilizing the economies of areas subject to severe drought are widely recognized, they are difficult to measure in precise monetary terms. For purposes of this analysis, they have been conservatively estimated as 5 percent of direct benefits. On this basis, they amount to JD 1.4 million, annually.

Intangible Benefits

Although intangible benefits by definition cannot be expressed in monetary terms for inclusion in the project benefit-cost ratio or internal rate of return, they can equal or exceed the importance of direct or indirect benefits in determining project feasibility. Several of the important intangible benefits are described in this section for consideration in determining the desirability of constructing the project.

Contribution in Easing Balance of Trade Problems. An adverse balance of trade situation has been a significant problem in Jordan's economy for several years. The influence of edible commodity exports and imports on trade deficits are presented in Table H-10 for the period from 1971 through

1975. The deficit for edible commodities has increased from about JD 17 million in 1971 to over JD 40 million in 1975. Implementation of Stage II will result in an estimated increase in annual gross crop value of JD 50.9 million. This production will both reduce the amount of agricultural imports and increase the amount of exports.

Table H-10

VALUES OF EXPORTS AND IMPORTS
AND TRADE DEFICITS FOR EDIBLE COMMODITIES
JORDAN 1971-1975 (JD 1,000)

	1971	1972	1973	1974	1975
Agricultural exports	4,003	5,070	4,774	10,039	10,612
Agricultural imports	20,920	28,392	32,327	42,893	50,675
Trade deficit (Agricultural)	16,917	23,322	27,553	33,854	40,063

Lasting benefits will accrue to the economy of Jordan by improving the balance of trade regardless of whether the products of the project are consumed in Jordan or exported.

Balance of trade benefits also will accrue to the economy from hydroelectric power generated by the project. Power generated by the hydro-electric plant will reduce the need to import oil for thermal electric plants. The projected generation will reduce imports by the equivalent of 116,500 barrels of Bunker "C" fuel oil per year. At JD 3.67 per barrel, this amounts to a reduction in imports of about JD 400,000 per year.

The balance of trade will be adversely affected because of the foreign exchange required to construct the project facilities. The anticipated foreign exchange requirements amount to JD 136 million, the annual repayment of these funds will depend on the loan requirements.

Balancing the Economy. In 1973 only 19 percent of the work force was employed in agriculture and that figure is declining. In contrast some 74 percent of the work force of the Kingdom is engaged in service activities. This accents the need to expand employment in the producing sectors such as agriculture, mining, and manufacturing. The imbalance in economic growth is most evident in the Kingdom's capital city. Amman has come to dominate the economic life of the Kingdom and about 70 percent of the national work force is employed there. This is creating congestion and contributing to inflationary pressures.

Because of inadequate rainfall, most of the surface area of Jordan cannot be utilized for any agricultural pursuit except extensive grazing. Lack of precipitation makes any significant expansion of rainfed agriculture unlikely, and grazing on the Kingdom's open range has probably reached the maximum capacity. The only major area for which a developable water supply is known to exist is on the East Bank of the Jordan River. Accordingly, a powerful and highly valuable contribution toward balancing the total economy of Jordan will come from Stage II development.

Meeting Food Requirements. The consideration of three major factors is involved in estimating Jordanian food requirements for any given point in time. These are (1) population, (2) purchasing power, and (3) dietary standard. Each is considered below.

Population. The 1975 population of Jordan (East Bank only) is estimated at 1,950,000. Growth rates are projected at about three percent per year until the year 2000. Total population is expected to be over 4.1 million people at the turn of the century. Thus, by that time there will be slightly more than twice as many Jordanians to feed.

Purchasing Power. Expendable income is expected to increase at a rate of about 2.5 percent per annum. Accordingly, the people of Jordan will have more income for the purchase of commodities and services.

Dietary Standard. The improvement of dietary standards in the Valley will require increased per capita consumption of animal protein, dairy products, and fresh fruits and vegetables. Considering the anticipated increases in population, purchasing power, and the reasonable aim for a better dietary standard, the amount of food consumed is expected to to more than double by the year 2000, and a subtantial change is anticipated toward more nutritional types of foods.

The production potential of the Jordan Valley is great. Moreover, irrigation makes agriculture flexible in meeting the Kingdom's need for food. Almost any crop can be grown, and the potential of using crop residues and aftermath pasture in animal production also make that enterprise profitable to the farmer and rewarding to the Kingdom.

Improved Living Standard. Increased earnings, improved commercial activity, and increased public investment in health, education, transportation and utilities, together with increased investment by both private and public groups and individuals in housing and commercial ventures will dramatically improve the living standards in the Valley.

The availability of fresh fruits and vegetables and the resulting improved nutrition will greatly improve the quality of life in the Valley and the Kingdom.

No suitable formula has been devised to measure the monetary benefits of literacy, acceptable housing, a balance and palatable diet, good community life, or adequate health facilities. However, the attainment of these values will be fostered in the Jordan Valley by the construction of Stage II.

Efficiencies in Providing Public Services. Closer settlement made possible with the concentrated production of irrigation farming contributes to a better ratio between public services and public expenditures than obtains in sparsely settled areas. It is not likely that less will be spent for schools and health facilities, but it will be possible to get better schools and health services per Dinar spent.

Under project conditions in the Jordan Valley, there are plans to establish 36 new communities in which there will be a health center, adequate school facilities, new dwellings (to be financed in part by private borrowing), an adequate potable water supply, household electricity, communication facilities, community centers, business complexes, and other appropriate facilities.

To provide these facilities and services at the same levels to an equivalent number of people living at widely disbursed sites would be excessively costly if not impossible. Accordingly an unmeasured benefit of significant proportions accrues to the Kingdom by being able to attain its social objectives at a lesser cost per unit of service.

Project Costs

Construction Costs

Cost estimates of project facilities are based on plans and schemes presented in detail in the Main Report, and in Appendix L, Cost Estimates. The construction and annual operation and maintenance costs for the storage, irrigation and power facilities are based on January 1977 prices. The construction costs are given in Table H-11. The annual expenditures were developed in conjunction with the construction schedule prepared for the feasibility studies. The irrigation system was developed at a rate of 6,000 hectares per year. The installation schedule for the irrigation system is shown below:

	Conversion Area (ha)	New Land Area: Irrigable (ha)	New Land Area: Potentially Irrigable (ha)	Total (ha)
1979	4,457	1,543	-	6,000
1980	3,000	3,000	-	6,000
1981	3,000	3,000	-	6,000
1982	2,385	3,021	594	6,000
1983	-	-	1,353	1,353
Total	12,842	10,564	1,947	25,353

The cost for relocating the Himma branch of the Hejaz Railroad has been excluded from the economic costs. With the filling of the reservoir, the railroad right-of-way will be flooded. To relocate the railroad around the reservoir will cost about JD 10.5 million using 1977 prices. Because of treaty agreements, provision for the cost of the relocation is necessary. It is assumed that complying with these

Table H-11

CONSTRUCTION COSTS FOR ECONOMIC ANALYSIS

(JD x 1,000)

Year	Storage Facilities	MAJOR WORKS					IRRIGATION SYSTEM COSTS			
		Powerplant at Maqarin	Diversion at Adasiye and and Side Wadis	Powerplant King Talal	Miscell-aneous Costs[a/]	Main Canal Extension & Repair	Converted Lands	New Lands	Potential Lands	Total
1979	8,637	-	-	-	950	1,520	-	-	-	11,107
1980	27,175	480	348	-	310	869	9,105	2,980	-	41,267
1981	21,573	2,871	-	360	160	-	5,983	5,560	-	36,507
1982	13,506	1,900	-	239	163	-	5,983	5,560	-	27,351
1983	-	-	-	-	-	-	5,233	5,933	2,473	13,639
1984	-	-	-	-	-	-			5,688	5,688
TOTAL	70,891	5,251	348	599	1,583	2,389	26,304	20,033	8,161	135,559

a/ Access, Land Acquisition, Operators Camp.

payment of land costs in Egypt ?

agreements has a benefit equal to the cost of the relocation and that the cost of the relocation is not a reimbursable project cost.

Operation and Maintenance Costs

The annual operation and maintenance costs are for the storage and power facilities, the irrigation system, and an allowance for installation of subsurface drainage. The development of these operation and maintenance costs is presented in the report on Preliminary Design and Cost Estimates. The O&M cost for the irrigation facilities is based on supplying the power and energy requirements for the irrigation system from project facilities. However, because the project facilities cannot supply all of the required energy when needed, a cost for exchanging energy with JEA was included in the O&M cost. This cost includes provision for transmitting power and energy over the interconnected transmission system. The installation period for subsurface drainage was phased over a 20-year period and is related to the need in the area for drainage under project conditions. The pumping plants for the irrigation system were assumed to have an economic life of about 25 years and an allowance for their replacement over a two year period is included in years 2006 and 2007. The estimates of annual disbursements for operation and maintenance are shown in Table H-12.

Associated Developments and Indirect Costs

Stage II is an integral part of a comprehensive rural development program for the Jordan Valley. This program is described in detail in the Jordan Valley Development Plan 1975-1982. A summary of this program and an analysis of those elements associated with Stage II development are presented in Appendix G, Agricultural Development. A

Table H-12

OPERATION AND MAINTENANCE COSTS

(JDx1000)

Year	Storage Facilities	Power Facilities		Sub-Surface Drains	Irrigation System	Total
		Maqarin	King Talal			
1979	-	-	-	-	-	-
1980	-	-	-	-	-	-
1981	-	-	-	-	229	229
1982	-	-	-	-	481	481
1983	205	45	13	-	527	790
1984	205	45	13	-	787	1,050
1985	205	45	13	130	854	1,247
To						
2004	205	45	13	130	854	1,247
2005	205	45	13	-	854	1,117
2006	205	45	13	-	854	1,117
2007	205	45	13	-	3,953	4,011
2008	205	45	13	-	3,953	4,011
2009	205	45	13	-	854	1,117
To						
2029	205	45	13	-	854	1,117

summary of the capital requirements derived in this analysis is presented in Table H-13.

Table H-13

SUMMARY OF CAPITAL REQUIREMENTS FOR DEVELOPMENTS ASSOCIATED WITH STAGE II

Item	Capital Cost (1000 JD)
Agriculture	
Livestock	10,600
Farm Machinery Pools	6,500
Marketing Facilities	2,000
Research and Extension	300
Portable Sprinkler Equipment	3,500
Farm Credit	4,900
Social Infrastructure	
Public Utilities	8,000
Housing	24,300
Social Services	7,500
Other	10,400
TOTAL	78,000

It is readily apparent from Table H-13 that the success of the Stage II development will require substantial capital investment in associated facilities, programs, and infrastructure. It is estimated that related agricultural and social infrastructure investments will require capital in the amount of JD 78,000,000.

These estimates of indirect investment for Stage II development are made primarily to emphasize the order of magnitude of the amounts involved. As previously mentioned, these costs will be incurred as an integral part of the comprehensive development plan for the Jordan Valley. A large number of international loans have already been made that will provide many of the facilities and programs required. The timely completion of these associated development is extremely important to the success of the Stage II development.

Economic Evaluation

To evaluate the various elements and assess the overall viability of the Project the following economic analyses were performed.

1. The economic justification of the Stage II development including irrigation of 25,353 hectares, power generation at Maqarin Dam and King Talal Dam, and M&I water supply.

2. The economic justification of the major components of the Stage II development:

a. Irrigation of 25,353 hectares.

   i. Irrigation of 12,842 hectares of land convered from surface to sprinkler irrigation

   ii. Irrigation of 12,511 hectares of land not presently included in any project and, for the most part, unirrigated.

b. Development of hydroelectric power at Maqarin Dam and at King Talal Dam.

c. Allocation of storage in Maqarin Reservoir for M&I water supply.

The economic analysis has been done for a period of 50 years from the beginning of construction of the project facilities.

Evaluation of Stage II Development

A summary of annual construction costs, operation and maintenance costs, total costs, irrigation, power, municipal and industrial water supply benefits, and total benefits is presented in Table H-14.

The present worth of the cost and benefit streams of Stage II development for discount rates of 10, 15, and 20 percent are shown in Table H-15. The development includes irrigation of 25,353 hectares, generation of 67 GWh/yr of energy, with 31 GWh/yr used by Project facilities, and the supply of 20 MCM/year for M&I use. The internal rate of return for the project is 13.4 percent. At a 10 percent interest rate, the ratio between benefits and costs is about 1.4. It is evident that the project is economically sound. The present worth of costs and benefits are shown on Exhibit H-1.

Evaluation of Irrigation Increment

An evaluation was made of the economic justification of the irrigation system and each of the irrigation components,

Table H-14

SUMMARY OF ECONOMIC COSTS AND BENEFITS BY YEAR (JD x 1000)

Year	Project Costs			Project Benefits			
	Construction Cost	O&M	Total Cost	Irrigation	Power	M&I	Total Benefit
1979	11,107		11,107				
1980	41,267		41,267				
1981	36,507	229	36,736	969	590		1,559
1982	27,351	481	27,831	2,521	778		3,299
1983	13,639	790	14,429	6,165	292	803	7,260
1984	5,688	1,050	6,738	10,916	292	835	12,043
1985		1,247	1,247	14,994	292	872	16,158
1986		1,247	1,247	18,470	292	910	19,672
1987		1,247	1,247	21,396	292	947	22,635
1988		1,247	1,247	23,813	292	986	25,091
1989		1,247	1,247	26,167	292	1,027	27,486
1990		1,247	1,247	26,897	292	1,070	28,259
1991		1,247	1,247	26,877	292	1,114	28,283
1992		1,247	1,247	26,484	292	1,161	27,936
1993		1,247	1,247	26,484	292	1,208	27,984
1994		1,247	1,247	26,484	292	1,259	28,035
1995		1,247	1,247	26,484	292	1,310	28,086
1996		1,247	1,247	26,484	292	1,365	28,141
1997		1,247	1,247	26,484	292	1,419	28,195
1998		1,247	1,247	26,484	292	1,478	28,254
1999		1,247	1,247	26,484	292	1,538	28,314
2000		1,247	1,247	26,484	292	1,600	28,376
2001		1,247	1,247	26,484	292	1,600	28,376
2002		1,247	1,247	26,484	292	1,600	28,376
2003		1,247	1,247	26,484	292	1,600	28,376
2004		1,247	1,247	26,484	292	1,600	28,376
2005		1,117	1,117	26,484	292	1,600	28,376
2006		1,117	1,117	26,484	292	1,600	28,376
2007		4,011	4,011	26,484	292	1,600	28,376
2008		4,011	4,011	26,484	292	1,600	28,376
2009		1,117	1,117	26,484	292	1,600	28,376
2010		1,117	1,117	26,484	292	1,600	28,376
2011		1,117	1,117	26,484	292	1,600	28,376
2012		1,117	1,117	26,484	882	1,600	28,966
2013		1,117	1,117	26,484	1,070	1,600	29,154
to				26,484	292	1,600	28,376
2028		1,117	1,117	26,484	292	1,600	28,376

Table H-15

PRESENT WORTH OF COSTS AND BENEFITS
(JDX1000)

Year	Total Costs including OM&R	Present Worth of Total Costs 10%	15%	20%	Total Benefits	Present Worth of Total Benefits 10%	15%	20%
1979	11,107	11,107	11,107	11,107	-	-		
1980	41,267	37,515	35,884	34,389	-	-		
1981	36,736	30,360	27,777	25,511	1,559	1,289	1,179	1,083
1982	27,831	20,910	19,299	16,106	3,299	2,479	2,169	1,909
1983	14,429	9,855	8,250	6,958	7,260	4,959	4,151	3,501
1984	6,738	4,184	3,350	2,708	12,043	7,478	5,988	4,840
1985	1,247	704	539	418	16,158	9,121	6,986	5,411
1986	1,247	640	469	348	19,672	10,095	7,395	5,490
1987	1,247	582	408	290	22,635	10,560	7,400	5,264
1988	1,247	529	354	242	25,091	10,641	7,132	4,863
1989	1,247	481	308	201	27,486	10,597	6,794	4,439
1990	1,247	437	268	168	28,259	9,904	6,074	3,803
1991	1,247	397	233	140	28,283	9,012	5,286	3,172
1992	1,247	361	203	117	27,936	8,092	4,540	2,611
1993	1,247	328	176	97	27,984	7,369	3,955	2,180
1994	1,247	298	153	81	28,035	6,711	3,445	1,820
1995	1,247	271	133	67	28,086	6,112	3,001	1,519
1996	1,247	247	116	56	28,141	5,567	2,615	1,268
1997	1,247	224	101	47	28,195	5,071	2,278	1,059
1998	1.247	204	88	39	28,254	4,620	1,985	884
1999	1,247	185	76	33	28,314	4,209	1,730	739
2000	1,247	168	66	27	28,376	3,834	1,508	617
2001	1,247	153	58	23	28,376	3,486	1,311	514
2002	1,247	139	50	19	28,376	3,169	1,140	428
2003	1,247	127	44	16	28,376	2,881	991	357
2004	1,247	115	38	13	28,376	2,619	862	297
2005	1,117	94	30	10	28,376	2,381	750	248

Table H-15 (cont.)

PRESENT WORTH OF COSTS AND BENEFITS
(JDX1000)

Year	Total Costs including OM&R	Present Worth of Total Costs 10%	15%	20%	Total Benefits	Present Worth of Total Benefits 10%	15%	20%
2006	1,117	85	26	8	28,376	2,164	652	207
2007	4,011	278	80	24	28,376	1,968	567	172
2008	4,011	253	70	20	28,376	1,789	493	143
2009	1,117	64	17	5	28,376	1,626	429	120
2010	1,117	58	15	4	28,376	1,478	373	100
2011	1,117	53	13	3	28,966	1,372	331	85
2012	1,117	48	11	3	29,k54	1,255	290	71
2013	1,117	44	10	2	28,376	1,111	245	58
2014	1,117	40	8	2	28,376	1,010	213	48
2015	1,117	36	7	2	28,376	918	185	40
2016	1,117	33	6	1	28,376	834	161	33
2017	1,117	30	6	1	28,376	759	140	28
2018	1,117	27	5	1	28,376	690	122	23
2019	1,117	25	4	1	28,376	627	106	19
2020	1,117	22	4	1	28,376	570	92	16
2021	1,117	20	3	1	28,376	518	80	13
2022	1,117	19	3	0	28,376	471	70	11
2023	1,117	17	2	0	28,376	428	61	9
2024	1,117	15	2	0	28,376	389	53	8
2025	1,117	14	2	0	28,376	354	46	6
2026	1,117	13	2	0	28,376	322	40	5
2027	1,117	12	1	0	28,376	292	35	4
2028	1,117	10	1	0	28,016	263	30	4
Total		121,902	108,965	99,414		173,462	95,476	59,541

the conversion area and the new-land area. The total construction cost for this increment of the project is estimated to be JD 118.9 million. The cost of the storage facility used in this evaluation is for a raisable structure which impounds a reservoir capable of continuing the supply to the lands in the conversion area and irrigating the new lands. From an operation study, a reservoir at El. 130 (Crest El. 139) would be required. The cost of this structure was estimated on the basis of estimates made for dams at El. 133, 158, 168, and 200. The cost of the single-purpose dam is estimated to be JD 60.6 million. The irrigation benefits will begin in 1981 and will reach a maximum in 1990. The cost and benefit stream for this component is shown in Table H-16.

Irrigation development will provide an internal rate of return of 14 percent. The benefit-cost ratio for an interest rate of 10 percent is about 1.5. The present worth of costs and benefits for a range of discount rates is shown on Exhibit H-2.

Evaluation of the Converted Area Increment. An evaluation was made of the economic justification of the sprinkler irrigation system component on 12,842 hectares that are under the command of the EGMC. The cost of the diversion dam at Adasiye, repair of the EGMC, and the irrigation system were used in the analysis. The benefits will result from the controlled application of water and other farm inputs which will in-crease yields, and the saving of water which will permit an increase of the overall cropping intensity from 106 percent to 128 percent.

The total cost of the facilities is estimated to be about JD 27.1 million. The benefits will begin in 1981 reach a maximum in 1987. The benefits will decrease slightly

Table H-16

ECONOMIC COSTS AND BENEFITS FOR
IRRIGATION DEVELOPMENT

(JD X 1000)

Year	Construction Costs	O&M	Total Cost	Total Benefit
1979	11,107	-	11,107	-
1980	40,787	189	40,787	-
1981	33,757	229	34,481	969
1982	13,938	481	14,419	2,521
1983	13,639	732	13,876	6,165
1984	5,688	992	6,680	10,916
1985		1,189	1,189	14,994
1986		1,189	1,189	18,470
1987		1,189	1,189	21,396
1988		1,189	1,189	23,813
1989		1,189	1,189	26,167
1990		1,189	1,189	26,897
1991		1,189	1,189	26,877
1992		1,189	1,189	26,484
To				
2004		1,189	1,189	26,484
2005		1,059	1,059	26,484
2006		1,059[a/]	1,059	26,484
2007		3,953[a/]	3,953	26,484
2008		3,953[a/]	3,953	26,484
2009		1,059	1,059	26,484
To				
2028		1,059	1,059	26,484

a/ Includes cost for replacement of pumping plants.

until 1992 and remain stable. The decrease is due to the potential for development which would occur without the Project. The benefit and cost streams are shown in Table H-17.

Development of the conversion area will provide an internal rate of return of 25 percent. The benefit cost ratio at 10 percent is 2.5. The present worth of costs and benefits at various discount rates are shown on Exhibit H-3.

Evaluation of the New-Land Area Increment. An evaluation was made of supplying irrigation water to 12,511 hectares within the project service area which are not included in any project and, for the most part, are not currently irrigated. To irrigate these lands, a storage facility at Maqarin is required to regulate the flows of the Yarmouk River. The total construction cost for this increment of the project is estimated to be JD 92.9 million. The costs for the storage facility, the repair and extension of the EGMC, the diversion facilities, and the irrigation facilities were used in this analysis. The irrigation benefits will begin in 1983 and will reach a maximum in 1991, seven years after the installation of the irrigation facilities has been completed. The cost and benefit stream for this component is shown in Table H-18.

Development of the new lands will provide an internal rate of return of 11.3 percent. The benefit cost ratio for an interest rate of 10 percent is about 1.2. The present worth of costs and benefits for a range of discount rates is shown on Exhibit H-4.

Evaluation of the Power Increment

The evaluation of power development as an addition to Stage II development was considered in Chapter VIII. The powerplant at Maqarin Dam has a dependable capacity of 12.8

Table H-17

ECONOMIC COSTS AND BENEFITS - IRRIGATION OF THE CONVERSION AREA INCREMENT

(JD X 1000)

Year	COSTS					Benefit
	Diversion Dam	Repair EGMC	Irrigation System	O&M	Total Cost	
1978	-	-	-	-	-	-
1979	169	620	-	-	620	-
1980			9,105	-	9,274	-
1981			5,983	153	6,136	969
1982			5,983	257	6,240	2,521
1983			5,233	360	5,593	4,605
1984				442	442	7,045
1985				507	507	8,534
1986				507	507	9,759
1987				507	507	9,587
1988				507	507	9,352
1989				507	507	9,587
1990				507	507	9,352
1991				507	507	9,054
1992 To 2004				507	507	8,755
2005				442	442	8,362
2006				442	442	8,362
2007				1,217[a/]	1,217	8,362
2008				1,217[a/]	1,217	8,362
2009 To 2028				442	442	8,362

a/ Includes cost for replacement of pumping plants.

Table H-18

ECONOMIC COSTS AND BENEFITS - IRRIGATION OF THE NEW LAND AREA INCREMENT
(JD X 1000)

Year	Storage Facilities	EGMC Diversion Facilities	Repair & Extension	Irrigation System	Misc. Cost	O&M	Total Cost	Total Benefit
1978				-	-		-	-
1979	8,637		1,520	-	950		11,107	-
1980	27,175	348	869	2,980	310		31,682	-
1981	22,054			5,560	160	76	27,850	-
1982	3,506			5,560	163	224	8,495	-
1983				8,406		372	8,778	1,560
1984				5,688		550	6,238	3,871
1985						682	682	6,460
1986						682	682	9,048
1987						682	682	11,637
1988						682	682	14,226
1989						682	682	16,815
1990						682	682	17,844
1991 To 2004						682	682	18,121
2005						617	617	18,121
2006						617	617	18,121
2007						2,736[a/]	2,736	18,121
2008						2,736[a/]	2,736	18,121
2009 To 2028						617	617	18,121

a/ Includes cost of replacing pumping plants.

MW and generates an average of 58 GWh of energy each year. At King Talal Dam, the dependable capacity is 1.0 MW and the average energy generation is 8.7 GWh per year. The stream of costs and benefits are shown in Table H-19.

The internal rate of return for power development at Maqarin Dam is about 15 percent; at King Talal Dam, it is 12 percent. The benefit-cost ratios at 10 percent for power development at Maqarin Dam and King Talal Dam are 1.2 and 1.1 respectively. The present worth of costs and benefits for a combination of Maqarin and King Talal powerplants are shown on Exhibit H-5.

It is apparent that power development is a viable addition to the irrigation project and, therefore, has been included in the Project evaluation.

Evaluation of the M&I Water Supply Increment

The economic evaluation for M&I water supply is based on supplying 20 MCM per year to the Jordan Valley and Irbid. The cost associated with the M&I water supply is the incremental cost of raising the dam from the single-purpose irrigation height to the height required to supply both irrigation and M&I requirements. It will be necessary to raise the dam 20 m at a cost of about JD 11 million. The cost and benefit stream are shown in Table H-20.

Table H-19

ECONOMIC COSTS AND BENEFITS - POWER INCREMENT

(JD x 1000)

Year	Construction Cost	O&M	Total Cost	Total Benefit
Maqarin Powerplant				
1979	-	-	-	-
1980	480		480	-
1981	3,231		3,231	1,200
1982	2,139		2,139	1,242
1983		45	45	482
To				
2009		45	45	482
2010		45	45	1,682
2011		45	45	1,724
2012		45	45	482
To				
2027		45	45	482
2028		45	45	(504)
King Talal Powerplant				
1979	-	-		
1980	-	-		
1981	359		359	90
1982	240		240	100
1983		13	13	66
To				
2009		13	13	66
2010		13	13	156
2011		13	13	166
2012		13	13	66
2		13	13	66
2		13	13	(10)

Table H-20

INCREMENTAL COSTS AND BENEFITS - WATER SUPPLY INCREMENT
(JD X 1000)

Year	Storage Facility Cost	Benefits
1978	-	-
1979	-	-
1980	-	-
1981		-
1982	11,000	-
1983		803
1984		835
1985		872
1986		909
1987		947
1988		986
1989		1,027
1990		1,069
1991		1,114
1992		1,160
1993		1,208
1994		1,259
1995		1,310
1996		1,365
1997		1,419
1998		1,478
1999		1,538
2000		1,600
To		
2027		1,600

The internal rate of return for the M&I component is about 10.3 percent. The benefit-cost ratio for an interest rate of 10 percent is 1.0. The present work of costs and benefits is shown on Exhibit H-6.

Evaluation of Indirect Costs and Benefits

An estimate was made of the internal rate of return for the indirect costs and benefits discussed previously. It is realized that the indirect benefits do not necessarily result from the expenditure of the indicated indirect costs. The internal rate of return for the cost and benefit streams shown in Table H-21, is 17 percent. For a 10 percent interest rate, the benefit-cost is 2.0.

A second evaluation was made combining the indirect costs and benefits with the direct costs and benefits. The internal rate of return for this condition is 15 percent; the benefit-cost ratio for an interest rate of 10 percent is 1.6.

Table H-21

SUMMARY OF INDIRECT COSTS AND BENEFITS
(JD X 1000)

Year	Indirect Costs	Indirect Benefits
1979	10,000	
1980	15,000	
1981	15,000	
1982	15,000	
1983	15,000	2,000
1984	10,000	4,000
1985	8,000	7,000
1986		10,000
1987		13,000
1988		16,000
1989		19,000
1990		21,000
1991		22,600
to		
2028		22,600

Summary of Economic Analysis

A summary of the results of the economic analyses is shown in Table H-22.

Table H-22

SUMMARY OF ECONOMIC ANALYSES

	Internal Rate of Return	B/C at 10 percent
Stage II Development	13.4	1.4
Irrigation Increment	14.0	1.5
Power Increment	14.0	1.2
M&I Supply Increment	10.3	1.0
Including Indirect Costs and Benefits	14.0	1.5
Irrigation Components		
Conversion Area Increment	25.0	2.5
New Land Area Increment	11.3	1.2

Sensitivity Analyses

The basic estimates used in the economic evaluation may be adjusted to account for variations in the magnitude of costs and benefits, in the rate of construction of the facilities, and in the time required to reach full production. Sensitivity studies were conducted to determine the effect of these possible variations on the overall viability of the Project. The analyses included single-and multiple-variate tests using assumptions other than those anticipated in the Project evaluation.

Two alternative cropping patterns were considered. The first, the low summer water use pattern, concentrates vegetable production between November and April. This pattern provides about the same net income as the pattern used in the Project evaluation. The internal rate of return (IRR) of the Project under this condition is 13.3 percent. The second pattern gives major emphasis to the production of

vegetables at the expense of field crops. The area planted to fruit remained the same as for the pattern used in the Project evaluation. The IRR of the Project using the vegetable-intensive pattern is 16 percent.

For the Project evaluation, it was assumed that the irrigation system could be constructed at a rate of 6,000 hectares per year. To determine the effect of lengthening the construction period, an analysis was done for an irrigation system construction rate of 4,000 hectares per year. The IRR of the Project for this condition is 13 percent.

The estimated construction costs were adjusted for a price escalation of 10 percent. With the price escalation, the IRR of the Project would be reduced to 12.5 percent.

The buildup period required to reach full agricultural production was estimated to be 4 years for the currently irrigated portion of the conversion area and 7 years for all other land. An analysis was made of increasing these periods to 7 years and 10 years respectively. The Project IRR under this condition is 12 percent.

The assumptions used to determine the net income from agricultural production were varied to reflect lower yields or prices and higher production costs. If yields (or farmgate prices) are reduced by 10 percent, the Project IRR would be reduced to 11.4 percent. If yields (or prices) are reduced by 20 percent, the IRR would be reduced to 9.3 percent. If production costs are increased by 15 percent, the IRR would be 13 percent.

The farmgate prices were increased by 20 percent to reflect the possibility that prices are understated as indicated in Appendix G. For this condition, the IRR would be 17 percent.

The municipal and industrial water supply benefits were based on a value which represents the current cost of water delivered and treated in Irbid. As there is no alternative source of water for Irbid, the value of the benefit could be much higher. An analyses was made using a benefit value of 100 fils/m^3, 25 percent higher than in the Project evaluation. The IRR of the M&I component would increase from 10.4 to 12.4 percent. The Project return would increase to 14 percent.

The evaluation of the recommended project was done including the cost of relocating the Himma branch of the Hejaz Railroad. The IRR would be reduced to 12.9 percent.

Four multiple-variant analyses were done; three for conditions worse than anticipated and one for conditions more favorable than anticipated. If (1) the construction rate of the irrigation system was decreased to 4,000 hectares per year, (2) the benefit build-up period increased by three years to seven and 10 years for the currently irrigated land in the conversion area and the remaining lands respectively, and (3) the yields reduced by 10 percent, the Project rate of return would be 10 percent.

If the farmgate prices were reduced by 10 percent and the production costs increased by 15 percent, the rate of return for the Project would be 10.7 percent.

If the yields were reduced by 10 percent and the construction costs increased by 10 percent, the IRR becomes 10.7 percent.

A substantial market for vegetables could develop in Europe. These vegetables could command a very high price. If the vegetable-intensive pattern was used, and if the yields and farmgate prices for the produce were increased by 10 percent each, the Project rate of return would be as much

as 20 percent depending on the time required to develop the market.

A summary of the senitivity tests is shown in Table H-23.

Table H-23

SENSITIVITY ANALYSES
INTERNAL RATE OF RETURN

	Single-Variate	IRR (percent)
1.	Project Evaluation	13.4
2.	Low Summer Water Use Pattern	13.3
3.	Vegetable-Intensive Pattern	16.0
4.	Irrigation System Construction Rate at 4,000 ha/yr	13.0
5.	Construction Costs Increased by 10 percent	12.5
6.	Benefit Build-up Period of 7 to 10 years	12.0
7.	Yields reduced 10 percent	11.4
8.	Yields reduced 20 percent	9.3
9.	Production Costs increased 15 percent	13.0
10.	Farmgate Prices increased by 20 percent	17.0
11.	M&I benefit increased 25 percent	14.0
12.	Project evaluation including cost of railroad relocation	12.9
	Multiple-Variate	
1.	Irrigation System Construction Rate - 4,000 ha/yr Benefit Build-up Period of 7 to 10 years Yields reduced by 10 percent	10.0
2.	Farmgate Prices increased by 10 percent Production Costs increased by 15 percent	10.7
3.	Yields reduced by 10 percent Construction costs increased by 10 percent	10.7
4.	Vegetable - Intensive Pattern Yields increased by 10 percent Farmgate prices increased by 10 percent	20.0

Raising Maqarin Dam for Power

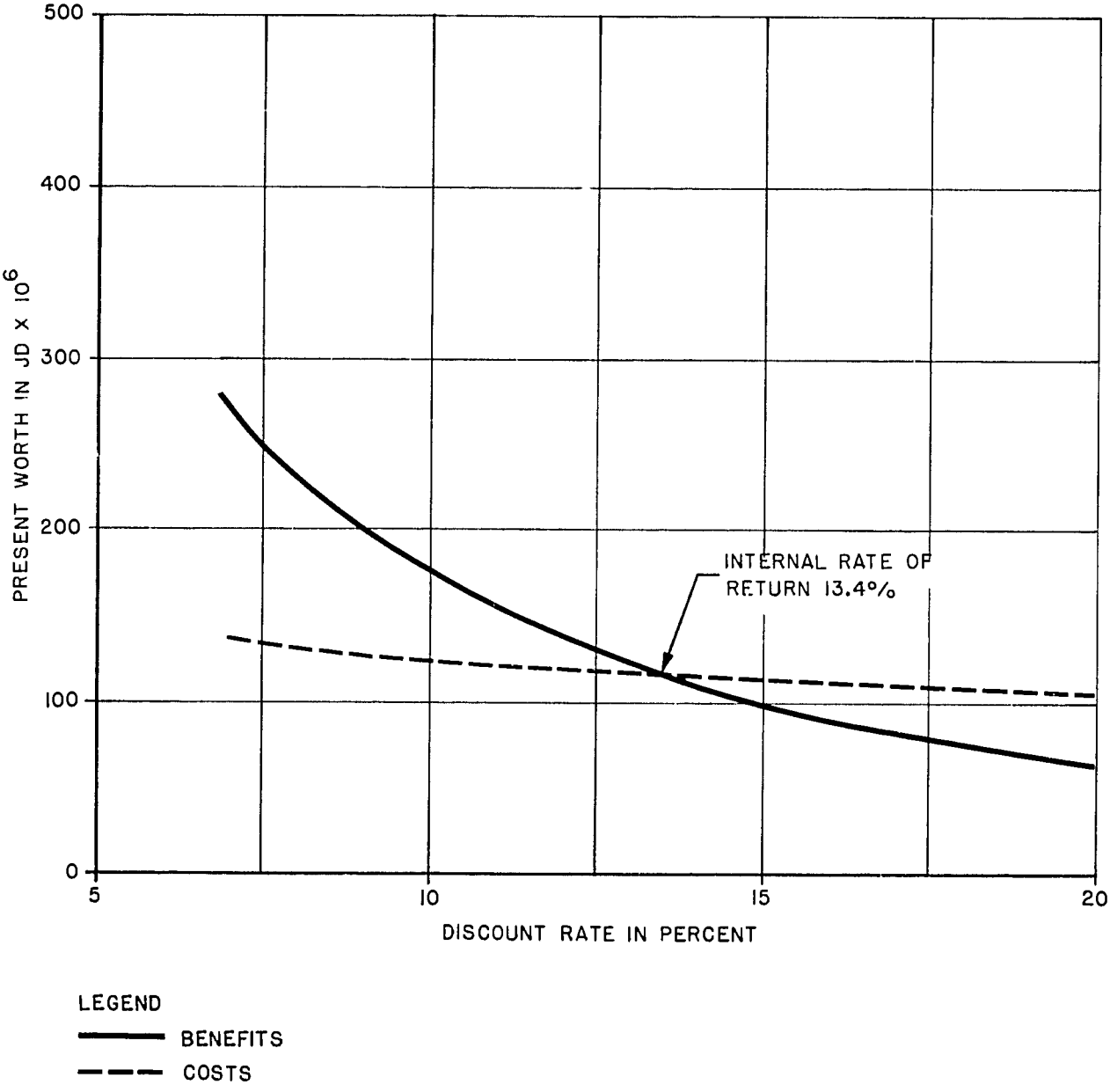
Based on the operation studies, a reservoir at El. 150 has been selected to meet the requirements of Stage II development. As a result of this storage facilities, the installation of a powerplant with an installed capacity of 20 MW appears to be viable. Additional studies were done to determine if increasing the dam height to generate additional energy is viable and, if so, to determine the optimum addition to the Stage II storage capacity for energy generation.

A comparison was made of the incremental costs and benefits of raising the reservoir elevation to El. 160 for which feasibility-level costs are available. The reservoir was operated to supply the Stage II irrigation area. The dependable capacity of the powerplant remained at 12.8 MW. The energy was generated from irrigation releases and, up to the capacity of the turbines, from uncontrolled releases when the reservoir is full. The incremental energy generated during this operation amounted to an average of 4 GWh per year over the 22-year period of record.

The costs which were used in the incremental analysis were for the dam and spillway. The following tabulation shows these costs and the incremental cost of providing the additional energy.

Reservoir Elevation (m)	Dam Cost (JDX1000)	Spillway Cost (JDX1000)	Total (JDX1000)
150	42,933	22,582	65,515
160	48,062	22,714	70,776
Incremental Cost			5,261

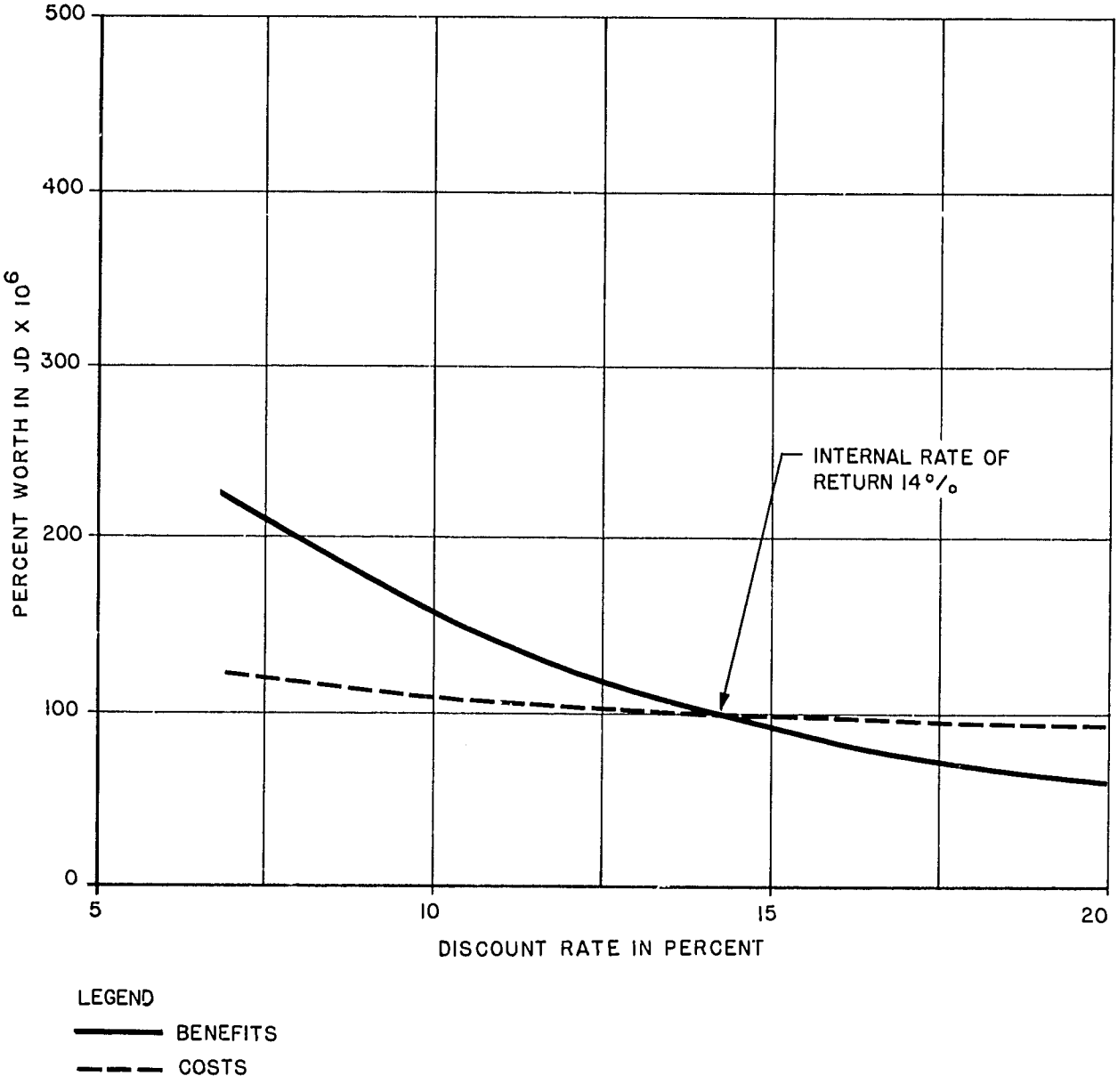
The benefit from the increased energy production would amount to about JD 28,000 per year. It is obvious that raising Maqarin Dam to generate additional energy is not a viable option for Stage II development.



ECONOMIC ANALYSIS
STAGE II DEVELOPMENT

JORDAN VALLEY IRRIGATION PROJECT

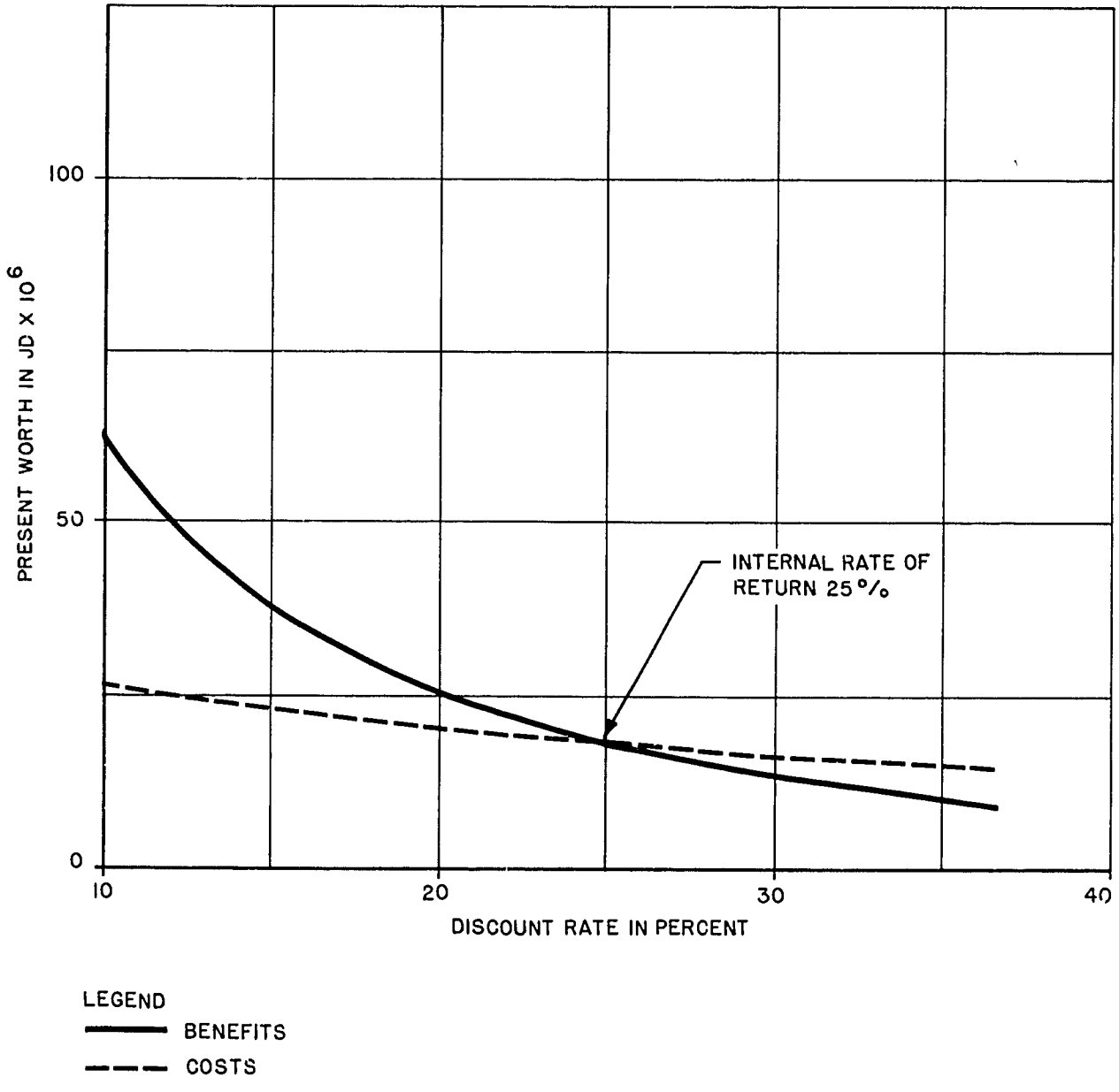
STAGE II



ECONOMIC ANALYSIS
IRRIGATION DEVELOPMENT

JORDAN VALLEY IRRIGATION PROJECT

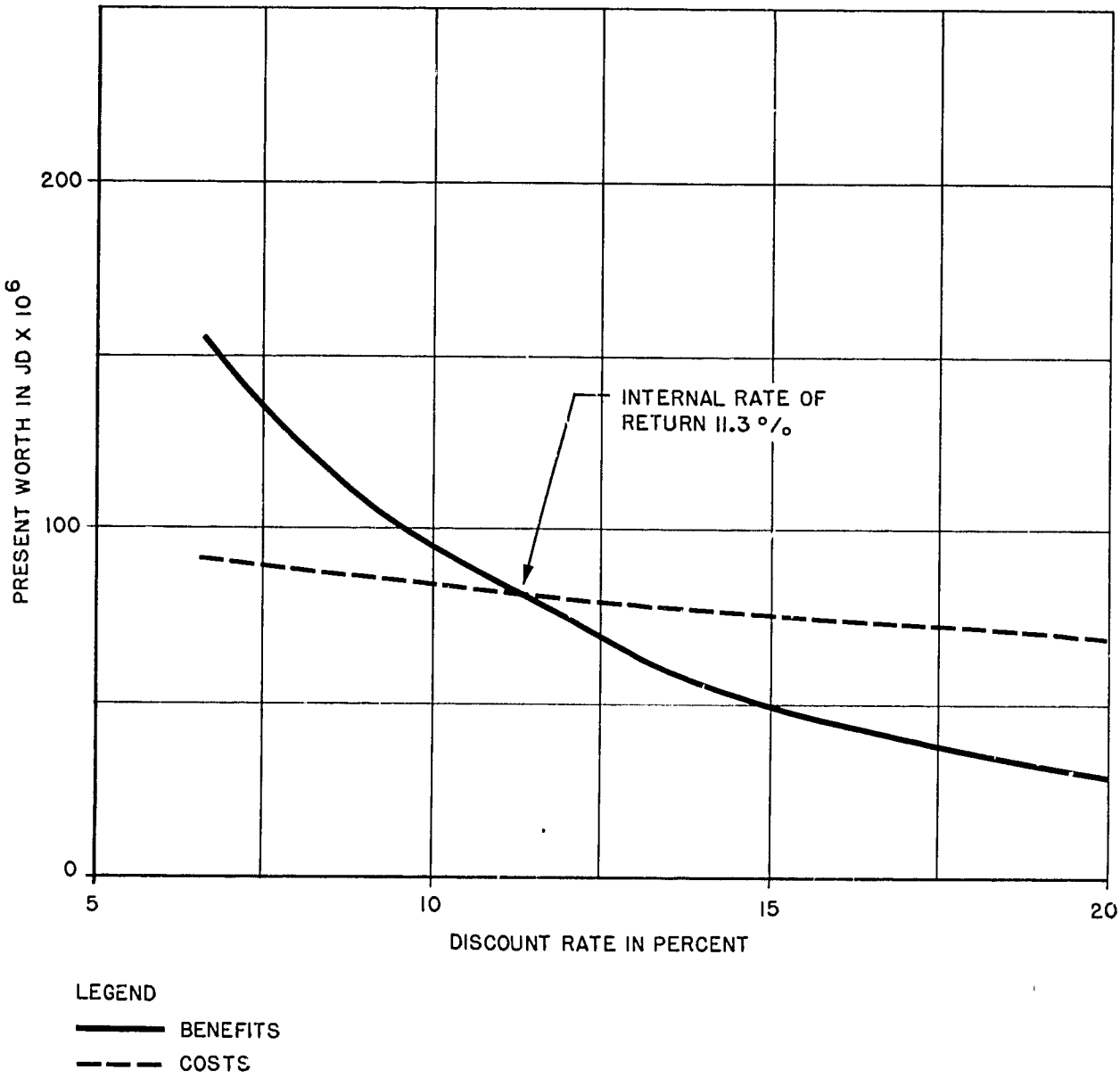
STAGE II



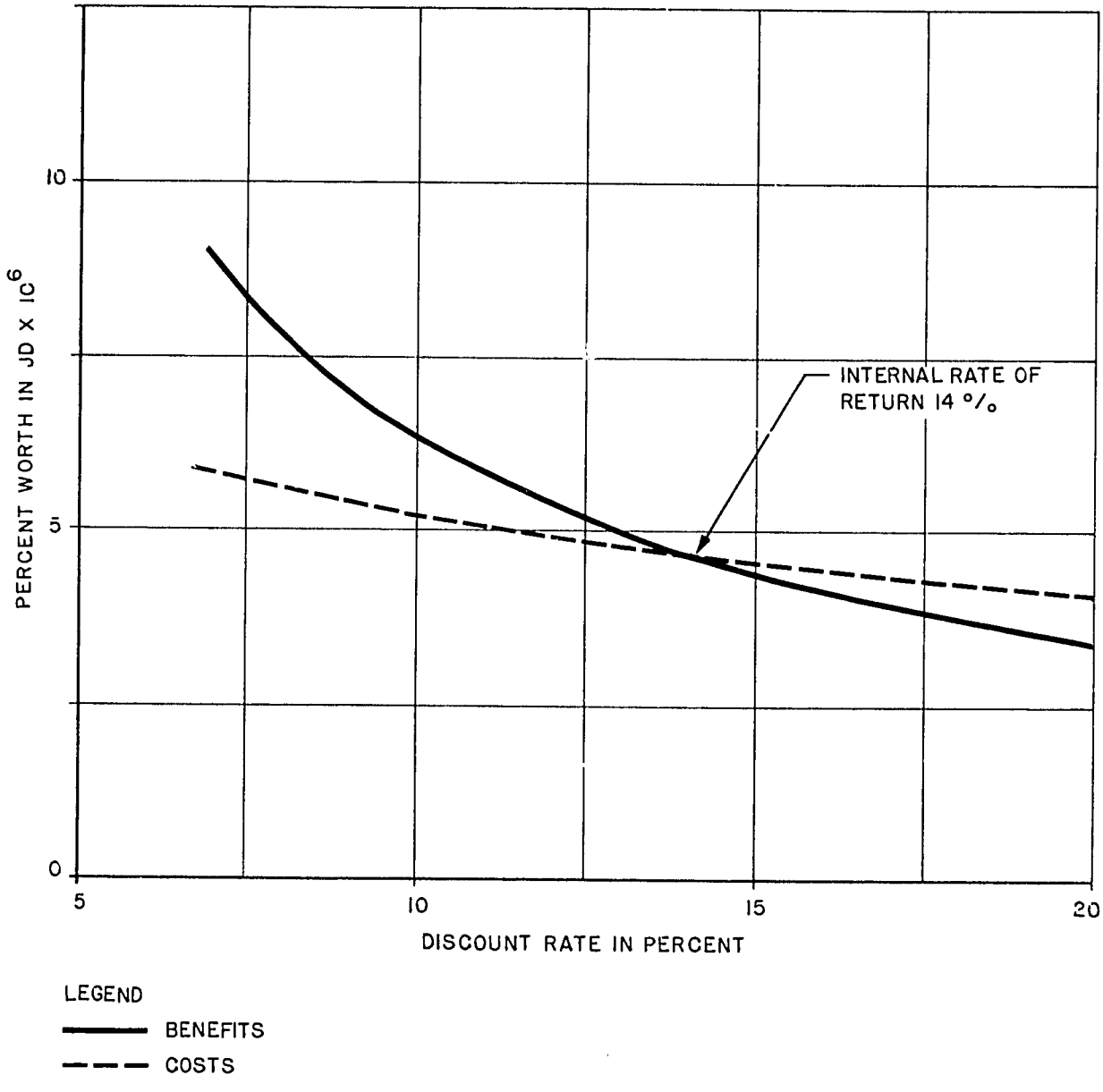
ECONOMIC ANALYSIS
DEVELOPMENT OF CONVERTED AREA

JORDAN VALLEY IRRIGATION PROJECT

STAGE II



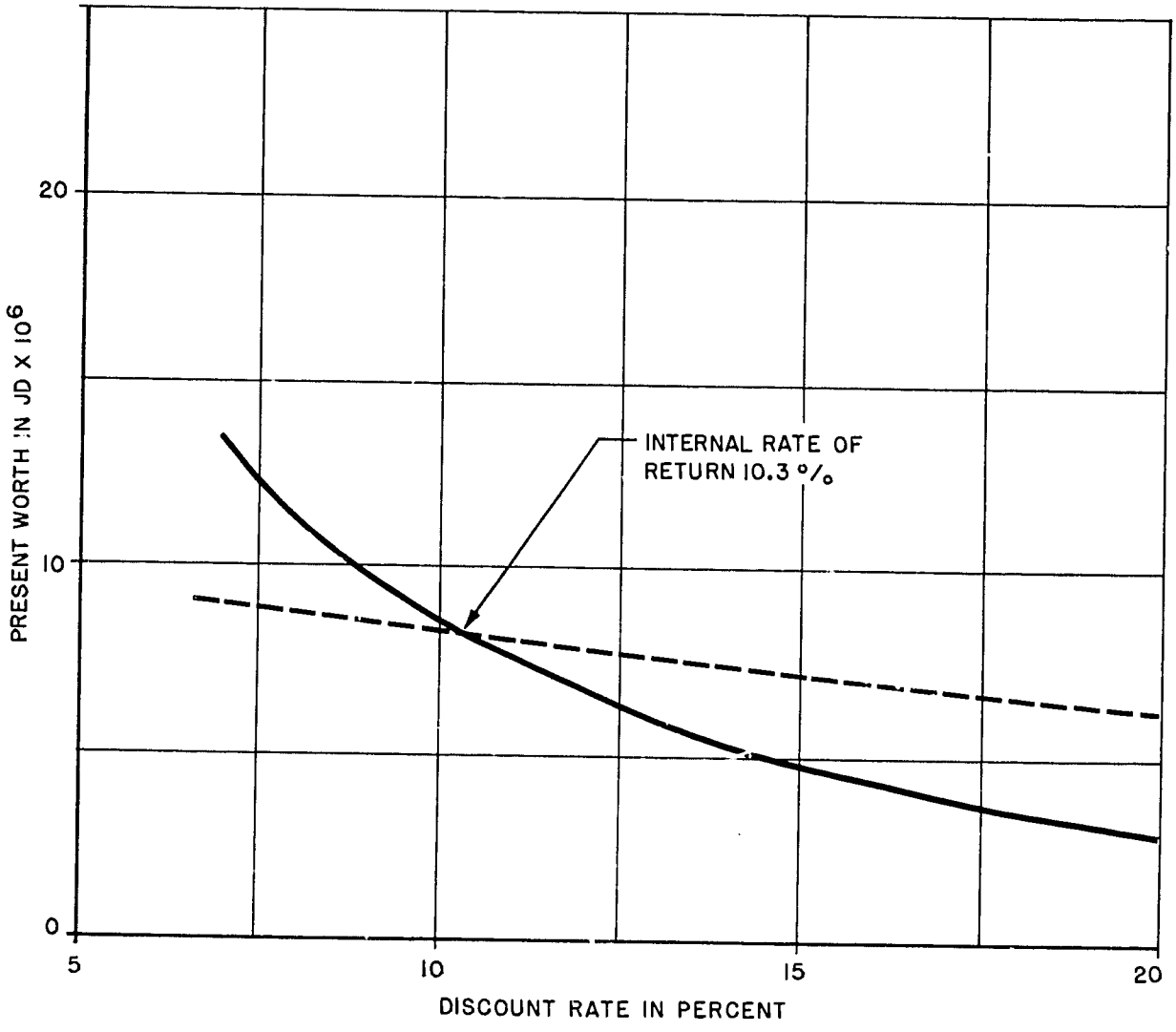
ECONOMIC ANALYSIS
DEVELOPMENT OF NEW-LAND AREA
JORDAN VALLEY IRRIGATION PROJECT
STAGE II



ECONOMIC ANALYSIS
POWER DEVELOPMENT

JORDAN VALLEY IRRIGATION PROJECT

STAGE II



ECONOMIC ANALYSIS
MUNICIPAL & INDUSTRAL WATER SUPPLY

JORDAN VALLEY IRRIGATION PROJECT

STAGE II

Appendix I

FINANCIAL ANALYSIS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF EXHIBITS

Appendix I

FINANCIAL ANALYSES

Summary

The financial analyses included (1) the preparation and analysis of budgets for representative farm units to determine the amounts of income that can be available for payment of Project costs; (2) a preliminary Project repayment analysis using various assumed interest rates and percentages of investment recovery over a 35-year loan period; (3) a cash flow analysis based on an assumed interest rate of 3.5 percent and initial irrigation, power, and M&I water charges of 10 fils/m^3, 12 fils/Kwh, and 30 fils/m^3, respectively; and (4) an allocation of costs among Project purposes using the separable costs - remaining benefits method. The purpose of the analysis is to provide JVA officials with the necessary information to formulate repayment policies, determine financial feasibility, and make arrangements for financing.

The analysis of payment capacity on representaive farm units indicates that substantial amounts of residual income will be available for payment of Project costs by year 7 of Project development. For example, by year 7 the residual annual income after meeting other obligations on a four hectare general farm on new lands is JD 4,011. This amounts to about JD 1003 per hectare or 128 fils/m^3 of irrigation water. However, prior to reaching full development farmers on new lands may experience serious financial problems unless such assistance as intermediate-term credit and a grace period on payment of project costs are provided. The farmers in the conversion area will have less difficulty in becoming established during the development period and

will attain payment capacities similar to those on new lands by year 7.

The preliminary Project repayment analyses indicates that Project costs, including escalation, can be paid by anticipated revenues from the sale of irrigation water, hydroelectric power, and M&I water. For example, a 35-year loan at 3.5 percent interest with a 10-year grace period could be repaid along with the annual operation and maintenance costs with initial charges of 11.0 fils/m^3 for irrigation, 12.0 fils/Kwh for power, and 30 fil/m^3 for M&I water. It was assumed that variable price contracts will be negotiated with the Project beneficiaries (farmers) and the initial charges would escalate at a rate of 4 percent per year through the period of anlaysis. If the interest rate on the loan is 7 percent, an initial water charges for irrigation of 17.5 fils/m^3 would be required to fully recover investment and O&M costs. Since these rates are considerably less than the estimated residual farm income available for payment of water charges, it is evident that the Project is financially feasible. However, as previously mentioned, special assistance will be required during the initial 4 or 5-years to avert financial problem for farmers on new land.

The cash flow analysis illustrates the flow of Project disbursements and revenues by year under a specific set of financial assumptions. The analysis serves as an example and a guide for financing negotiations until more definite information becomes available on interest rates and repayment policies.

The cost allocation shows an equitable distribution of Project costs among Project purposes. It is anticipated that this may be of use to JVA officials in establishing pricing policies for the irrigation water, hydro-electric power, and M&I water service available from the Project.

Farm Budgets and Payment Capacity

Farm budgets have been prepared to estimate the farmers' income and payment capacity. The budgets have been prepared for four conditions as follows:

Farm Type	Location	Area
General	Conversion Area	4 ha
General	Southern Valley	4 ha
Fruit	Conversion Area	3 ha
Fruit	Southern Valley	3 ha

The farm budgets for these farm types are shown in Tables I-1, I-2, I-3, and I-4. The farm budgets show residual returns to water after charges for basic production costs, value of family labor, a management allowance, portable sprinkler equipment cost, and equity accumulation. These residual returns to water are available for payment of Project costs.

It was assumed that the farms in the conversion area will reach full development in four years; the farms in the new land area will reach full development in seven years. The basic production costs are for seeds and plants, fertilizer, plant protection, hired labor, machinery and overhead costs.

The value of family labor was assumed to be JD 1,000 which is equivalent to the average per-capita income (JD 200) for a family of five persons. The management allowance is equal to 10 percent of the sales revenue less basic production costs and value of family labor. The sprinkler equipment cost represents repayment of a loan to purchase the equipment over eight years at 7.0 percent interest on the outstanding balance.

Table I-1

FARM BUDGET AND PAYMENT CAPACITY: 4 HECTARE GENERAL FARM, CONVERSION AREA
(JD)

Item	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Sales Revenue	2,766	4,162	5,558	6,955	6,955	6,955	6,955
Less:							
Basic Production Costs	657	866	1,075	1,284	1,284	1,284	1,284
Value of Family Labor	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Management Allowance	110	230	348	467	467	467	467
Basic Payment Capacity	999	2,066	3,135	4,204	4,204	4,204	4,204
Less:							
Sprinkler Equipment Cost	108	108	108	108	108	108	108
Equity Accumulation	117	117	117	117	117	117	117
Residual Return to Water/Farm	774	1,841	2,910	3,979	3,979	3,979	3,979
Residual Return Water/Hectare	194	460	728	995	995	995	995

Table I-2

FARM BUDGET AND PAYMENT CAPACITY: 4 HECTARE GENERAL FARM, NEW-LAND AREA
(JD)

Item	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Sales Revenue	994	1,988	2,982	3,975	4,969	5,963	6,955
Less:							
Basic Production Costs	900	964	1,028	1,092	1,156	1,220	1,284
Value of Family Labor	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Management Allowance	-	2	95	188	281	374	467
Basic Payment Capacity	(906)	22	859	1,695	2,532	3,369	4,204
Less:							
Sprinkler Equipment Cost	76	76	76	76	76	76	76
Equity Accumulation	117	117	117	117	117	117	117
Residual Return to Water/Farm	(1,099)	(171)	666	1,502	2,339	3,176	4,011
Residual Return to Water/Hecatare	-	-	166	376	585	794	1,003

Table I-3

FARM BUDGET AND PAYMENT CAPACITY: 3 HECTARE GENERAL FRUIT FARM CONVERSION AREA
(JD)

Item	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Sales Revenue	4,381	5,933	7,485	9,037	9,037	9,037	9,037
Less:							
Basic Production Costs	1,236	1,498	1,760	2,023	2,023	2,023	2,023
Value of Family Labor	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Management Allowance	315	343	473	601	601	601	601
Basic Payment Capacity	1,830	3,092	4,252	5,413	5,413	5,413	5,413
Less:							
Sprinkler Equipment Cost	81	81	81	81	81	81	81
Equity Accumulation	88	88	88	88	88	88	88
Residual Return to Water/Farm	1,661	2,923	4,083	5,244	5,244	5,244	5,244
Residual Return to Water/Hectare	554	974	1,361	1,748	1,748	1,748	1,748

Table I-4

FARM BUDGET AND PAYMENT CAPACITY: 3 HECTARE GENERAL FRUIT FARM NEW-LAND AREA
(JD)

Item	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Sales Revenue	-	1,118	2,236	2,236	2,236	5,636	9,036
Less:							
Basic Production Costs	5,148	1,369	1,394	1,457	1,572	1,667	1,174
Value of Family Labor	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Management Allowance	-	-	-	-	-	297	686
Basic Payment Capacity	(6,148)	(1,251)	(158)	(221)	(336)	2,672	6,176
Less:							
Sprinkler Equipment Cost	57	57	57	57	57	57	57
Equity Accumulation	117	117	117	117	117	117	117
Residual Return to Water/Farm	(6,322)	(1,425)	(332)	(395)	(510)	2,498	6,002
Residual Return to Water/Hectare	-	-	-	-	-	833	2,001

The equity accumulation is the annual cost of repaying money borrowed to purchase land. It was assumed the farmers will pay JD 250 per hectare for land. The loan will be repaid over 20 years at an interest rate of 10 percent. A summary of the residual return to water by year during the development period is shown in Table I-5.

It is apparent that the farmers in the conversion area on both the general farm and fruit farm would receive a substantial residual income to pay water charges after meeting their other obligations. For example, the residual income available on the four-hectare general farm in the conversion area is sufficient to pay a water charge equivalent to 25 fils/m^3 in year 1 and this increases to 127 fils/m^3 by year 7. Actual water charges will be determined on the basis of policies established by JVA as a means of recovering Project costs. The amounts required to recover Project costs under various repayment assumptions are presented in the "Project Repayment" section.

Farmers in the Southern Valley (new lands) may have serious financial problems during the initial four or five years of the development period unless substantial intermediate-term credit and a grace period for water charges are provided. However, by year 7, farmers on new lands will be capable of paying substantial water charges at levels similar to those on the conversion-area lands.

Project Repayment

A preliminary analysis was conducted using a mathematical model which compared the total disbursements and revenues for the project and computed a surplus or deficiency. The model was used to evaluate the financial feasibility of the Project which includes irrigation of the new and converted

Table I-5

RESIDUAL RETURN TO WATER BY YEAR

DURING DEVELOPMENT PERIOD

	General Farm				Fruit Farm			
	Conversion Area		Southern Valley		Conversion Area		Southern Valley	
Year	JD/Farm	Fils/m^3	JD/Farm	Fils/m^3	JD/Farm	Fils/m^3	JD/Farm	Fils/m^3
1	774	25	(1,099)[a/]	-	1,661	41	(6,322)	-
2	1,841	59	(171)	-	2,923	72	(1,425)	-
3	2,910	93	666	21	4,083	101	(332)	-
4	3,979	127	1,502	48	5,244	130	(395)	
5	3,979	127	2,339	75	5,244	130	(510)	
6	3,979	127	3,176	102	5,244	130	2,498	55
7	3,979	127	4,011	128	5,244	130	6,002	133

a/ ( ) indicates deficit

land areas, and construction of storage and power facilities.

It was assumed that the loan period would cover 35 years including a grace period of 10 years. The grace period begins in the first year of construction. No interest is paid until the end of construction, and interest only is paid from the end of construction to the end of the grace period. The studies were done assuming interest rates of zero, 3.5 percent, and 7.0 percent.

The 1977 foreign component of the construction costs was escalated over the construction period at a rate of 8.0 percent per year; the national currency costs at a rate of 12 percent per year. Interest during construction was assumed to equal the loan rate. Operation and maintenance costs were escalated at a rate of 3.0 percent per year. The revenues from irrigation, power, and M&I water charges were escalated at a rate of 4.0 percent per year from 1981. The initial charge for irrigation water was varied from 6.0 fils/m^3 to 20 fils/m^3. The initial power and M&I water charges were 12 fils/kWh and 30 fils/m^3 respectively.

The initial irrigation water charges necessary to recover the full amount of operation and maintenance costs and portions of the investment costs ranging from 25 to 100 percent are summarized in Table I-6 and in Exhibit I-1. The variation in initial water charges corresponding to the three rates of interest assumed in the analysis also can be determined from the table. For example, at an interest rate of 3.5 percent, an initial irrigation water charge of 11.0 fils/m^3, subsequently escalated at a rate of 4 percent per year, would be necessary to recover the full investment and O&M costs over the 35-year loan period. At 7 percent interest, an irrigation water charge escalated from an initial rate of

6 fils/m^3 would pay the full O&M costs plus 25 percent of the capital costs over the 35-year period.

Table I-6

INITIAL IRRIGATION WATER CHARGES CORRESPONDING TO VARIOUS REPAYMENT ASSUMPTIONS

Investment Cost Recovery	O&M Cost Recovery	Initial Water Charge at No Interest	Initial Water Charge at 3.5% Interest	Initial Water Charge at 7% Interest
Percent	Percent	fils/m^3	fils/m^3	fils/m^3
100	100	6.1	11.0	17.5
75	100	5.0	8.5	13.5
50	100	3.6	6.5	10.0
25	100	2.5	4.0	6.0

Cash Flow Analysis

Table I-7 shows the estimated cash flow for the Project for an interest rate of 3.5 percent and an initial irrigation water charge of 10 fils/m^3, an initial power charge of 12 fils/Kwh, and an initial M&I water charge of 30 fils/m^3. The assumtpions about escalation are the same as those discussed above in the "Project Repayment" section. The analysis illustrates the flow of Project disbursements and revenues for the years 1979 through 2031 under the stated assumptions. The analysis serves only as an example since information is not yet available on the appropriate interest rate and repaymennt policies that will be used in financing the Project.

Table I-7

CASH FLOW ANALYSIS
(JDX1000)

Year	Total Payments		O&M	Total Revenues					Annual Net
	Principal	Interest	Costs	Total	Irrigation	M&I	Power	Total	Revenues
1979	-	-	-	-	-	-	-	-	
1980	-	-	-	-	-	-	-	-	
1981	-	-	173	173	420	-	-	420	247
1982	-	-	297	297	731	-	-	731	434
1983	-	4,113	1,188	5,301	1,959	300	404	2,663	(2,638)
1984	-	5,564	1,543	7,107	2,734	326	420	3,480	(3,627)
1985	-	7,340	1,839	9,179	3,016	353	438	3,807	(5,372)
1986	-	7,340	1,894	9,234	3,137	383	455	3,975	(5,259)
1987	-	7,340	1,951	9,291	3,263	415	472	4,150	(5,141)
1988	-	7,340	2,009	9,349	3,393	450	491	4,334	(5,015)
1989	389	7,340	2,069	9,798	3,529	487	511	4,527	(5,271)
1990	1,933	7,326	2,132	11,391	3,670	528	532	4,730	(6,661)
1991	3,455	7,259	2,195	12,909	3,817	571	553	4,941	(7,968)
1992	4,717	7,138	2,262	14,117	3,969	620	575	5,164	(8,953)
1993	5,474	6,972	2,330	14,776	4,128	671	598	5,937	(9,379)
1994	5,943	6,781	2,399	15,123	4,293	727	622	5,642	(9,481)
1995	6,151	6,573	2,471	15,195	4,465	787	647	5,899	(9,296)
1996	6,636	6,358	2,546	15,270	4,644	852	672	6,168	(9,102)
1997	6,589	6,135	2,622	15,346	4,829	922	700	6,451	(8,895)
1998	6,820	5,904	2,701	15,425	5,023	998	727	6,748	(8,677)
1999	7,058	5,666	2,782	15,506	5,223	1,081	757	7,061	(8,445)
2000	7,305	5,418	2,866	15,589	5,432	1,170	787	7,389	(8,200)
2001	7,561	5,163	2,951	15,675	5,650	1,216	818	7,684	(7,991)
2002	7,826	4,898	3,040	15,764	5,876	1,264	851	7,991	(7,773)
2003	8,100	4,624	3,131	15,855	6,111	1,315	886	8,312	(7,543)
2004	8,383	4,341	3,225	15,949	6,335	1,367	921	8,643	(7,306)
2005	8,676	4,047	3,025	15,748	6,609	1,422	958	8,989	(6,759)

Table I-7 (cont.)

CASH FLOW ANALYSIS
(JDX1000)

Year	Total Payments		O&M	Total Revenues					Annual Net
	Principal	Interest	Costs	Total	Irrigation	M&I	Power	Total	Revenues
2006	8,980	3,744	3,115	15,839	6,874	1,479	996	9,349	(6,490)
2007	9,294	3,429	3,209	15,932	7,149	1,538	1,036	9,723	(6,209)
2008	9,620	3,104	3,305	16,029	7,435	1,600	1,077	10,112	(5,917)
2009	9,956	2,767	8,875	21,598	7,732	1,664	1,120	10,516	(11,082)
2010	10,305	2,419	8,977	21,701	8,041	1,731	1,165	10,937	(10,764)
2011	10,666	2,058	9,082	21,806	8,363	1,800	1,210	11,373	(10,433)
2012	11,039	1,685	9,190	21,914	8,897	1,872	1,260	11,829	(10,085)
2013	11,425	1,299	9,301	22,025	9,045	1,946	1,311	12,302	(9,723)
2014	10,906	899	9,417	21,222	9,407	2,024	1,363	12,794	(8,428)
2015	7,671	517	9,535	17,723	9,783	2,105	1,418	13,306	(4,417)
2016	4,503	248	9,657	14,408	10,175	2,189	1,474	13,838	(570)
2017	1,963	91	4,311	6,363	10,582	2,277	1,533	14,392	8,027
2018	634	22	4,441	5,097	11,005	2,367	1,595	14,967	9,870
2019	0	0	4,574	4,574	11,445	2,463	1,658	15,566	10,992
2020	0	0	4,712	4,712	11,903	2,561	1,725	16,189	11,477
2021	0	0	4,853	4,853	12,379	2,664	1,794	16,837	11,984
2022	0	0	4,999	4,999	12,874	2,771	1,865	17,510	12,511
2023	0	0	5,149	5,149	13,389	2,881	1,941	18,211	13,062
2024	0	0	5,303	5,303	13,925	2,996	2,018	18,939	13,636
2025	0	0	5,462	5,462	14,482	3,116	2,098	19,696	14,234
2026	0	0	5,626	5,626	15,061	3,241	2,182	20,484	14,858
2027	0	0	5,795	5,795	15,664	3,370	2,270	21,304	15,509
2028	0	0	5,969	5,969	16,290	3,506	2,360	22,156	16,187
2029	0	0	6,148	6,148	16,943	3,645	2,455	23,043	16,895
2030	0	0	6,332	6,332	17,619	3,791	2,553	23,963	17,631
2031	0	0	6,522	6,522	18,324	3,943	2,655	24,922	18,400

Cost Allocations

The objective of a cost allocation is to distribute the costs of a multiple-purpose project, such as the Stage II development, equitably among the several purposes served. The costs of a multiple-purpose project include the specific or separable costs of individual features that serve only a single purpose and the joint costs of features that serve more than one purpose. The costs to be allocated include the investment costs, the interest during construction, and the annual operation, maintenance, and replacement costs. The cost of relocating the Himma branch of the Hejaz Railroad is not included in the costs to be allocated since it was assumed that this is not a reimbursable Project cost.

For purposes of this discussion, the following definitions of terms are adopted:

1. Specific costs are the costs of individual physical features and other costs that serve only a single purpose.

2. Joint costs are the costs of individual physical features and other costs that serve more than one purpose.

3. Separable Costs are the costs which could be omitted from the project if one purpose of the project were excluded. They may also be costs incurred for structures serving several but not all purposes. In some cases specific costs and separable costs are identical.

4. Justifiable expenditure is the lesser of benefits or alternative costs and is the maximum allocation assignable to any purpose.

5. Remaining joint costs comprise that portion of joint costs which remain to be distributed after the total of separable costs for all project purposes has been deducted from the cost of the multiple-purpose project.

6. Investment costs for allocation purposes are the costs necessary to construct the project and place it in operation. They include investigation costs, construction costs, related items such as transitional development costs, and interest during construction.

7. Operation, maintenance, and replacement costs are the costs necessary to ensure the continued operation of the project throughout the period of analysis.

The separable costs - remaining benefits method of cost allocation was used. In this method, each project purpose is assigned its separable cost plus a share of joint costs proportionate to the remainders found by deducting the separable cost of each purpose from the justifiable expenditure for that purpose. The cost allocation is presented in Table I-8. A concurrent allocation was made of investment costs and capitalized annual costs with present worths taken at the beginning of project operation using 10 percent interest. As is apparent from Table I-6, all Project costs are separable costs. Therefore, there are no joint costs to allocate among project purposes. Allocated construction costs are allocated among the Project purposes as follows: irrigation, JD 119,190,000; hydro-electric power, JD 5,369,000, and M&I water, JD 11,000,000.

Table I-8

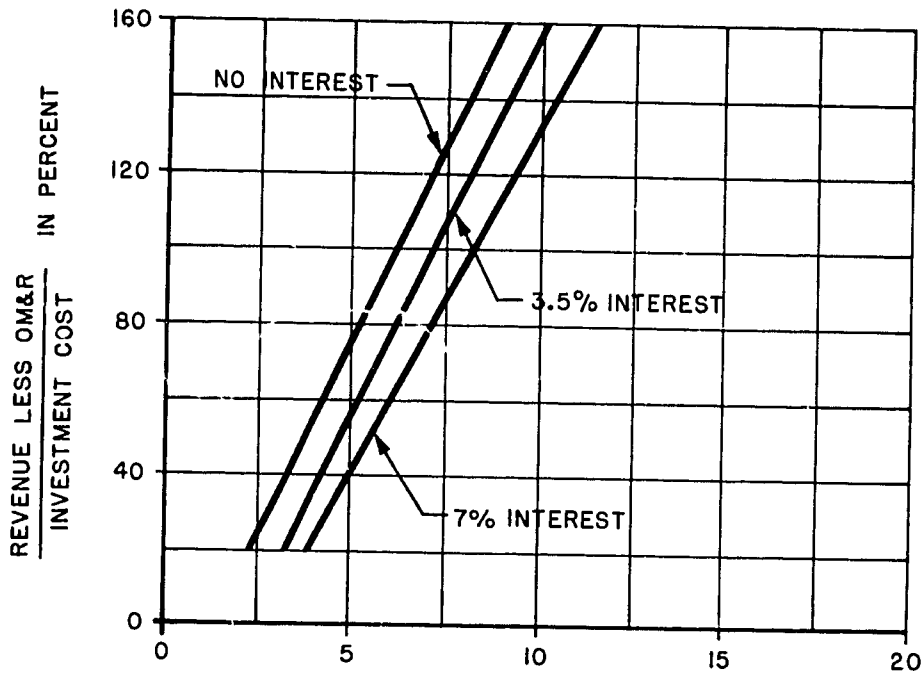
COST ALLOCATION[a/]
(JD 1000)

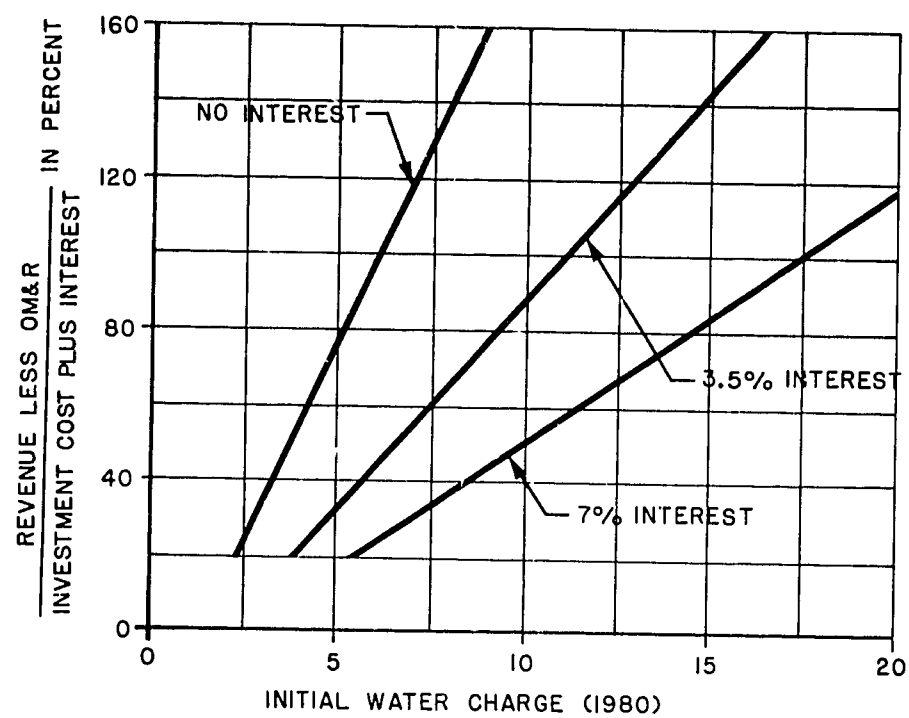
P IV Vol I

Item	Irrigation	Hydro-electric Power	M&I Water	Total
Costs to be Allocated:				
Construction Costs				135,559
Interest During Construction				28,842
O&M Costs				12,812
Total (Present Worth)				177,213
Benefits	235,300	8,218	11,650	255,168
Alternative Costs	Exceeds benefits	4,781	Exceed benefits	
Justifiable Expenditure	235,300	8,218	11,650	255,168
Separable Costs				
Construction Costs	119,190	5,369	11,000	135,559
Interest During Construction	27,571	662	609	28,842
O&M Costs	12,239	573	-	12,812
Total	159,000	6,604	11,609	177,213
Remaining Justifiable Expenditure	76,300	1,614	41	77,955
Percent Distribution	98	2	0	100
Remaining Joint Costs				
Construction Costs	0	0	0	0
Interest During Construction	0	0	0	0
O&M Costs	0	0	0	0
Total Allocated Costs				
Construction Cost	119,190	5,369	11,000	135,559
Interest During Construction	27,571	662	609	28,842
O&M Costs	12,239	573	-	12,812
Annual O&M Costs (Average)	1,240	58	-	1,298
Ratio of Benefits to Allocated Costs	1.48	1.24	1.00	1.44

208,750

a/ Concurrent allocation of investment costs and capitalized annual costs with present worths taken at the beginning of project operation using 10 percent interest.

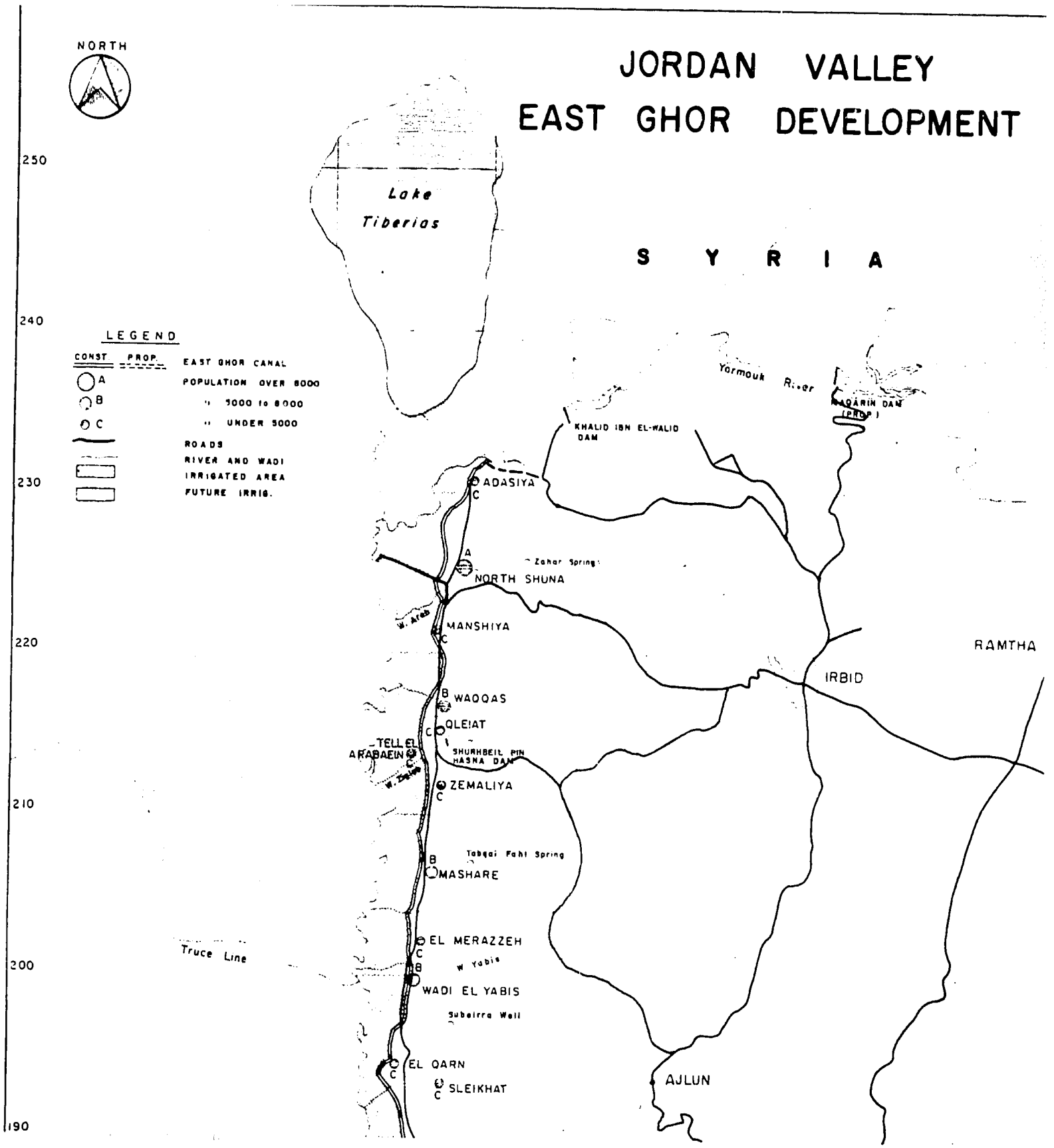


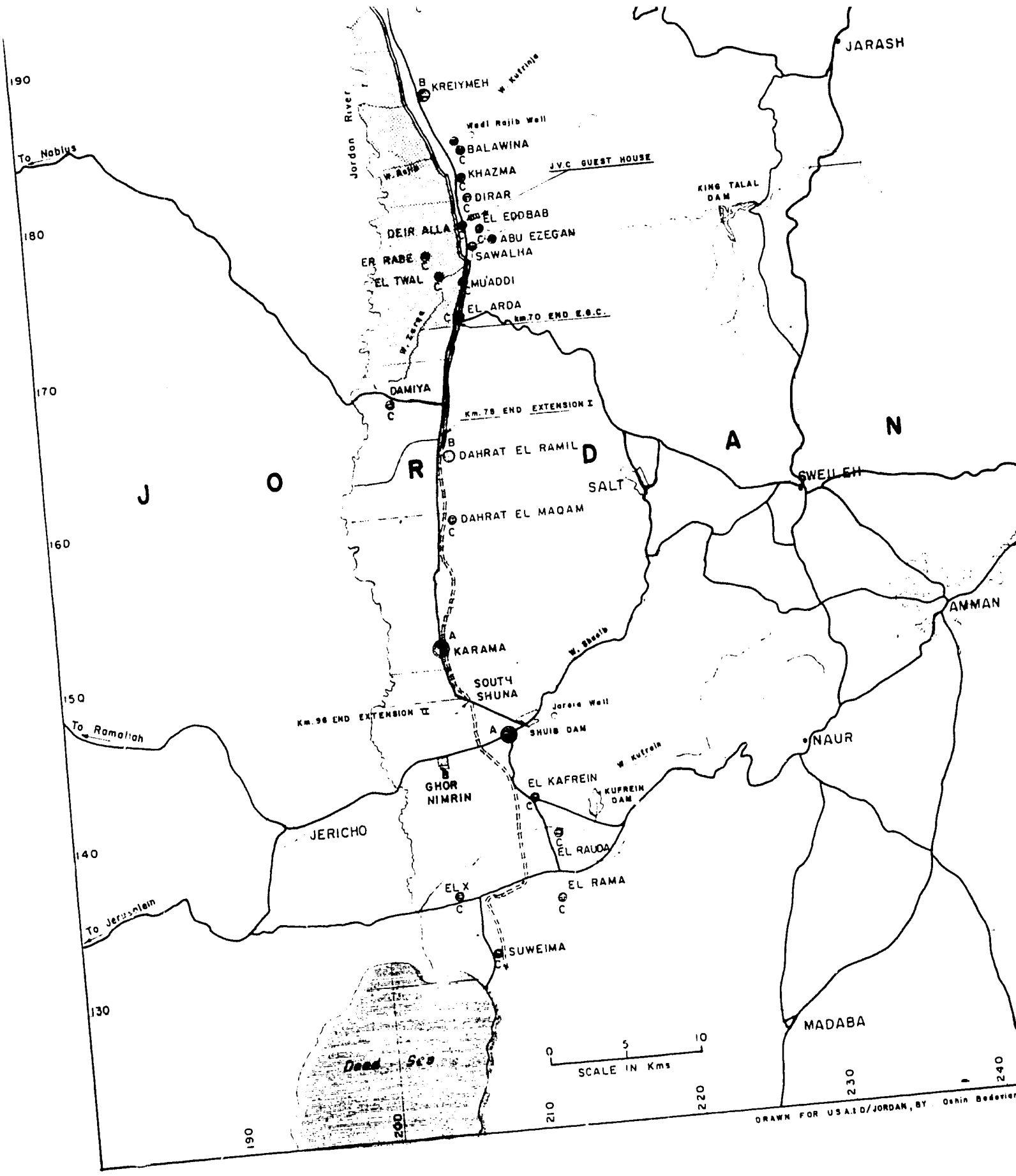


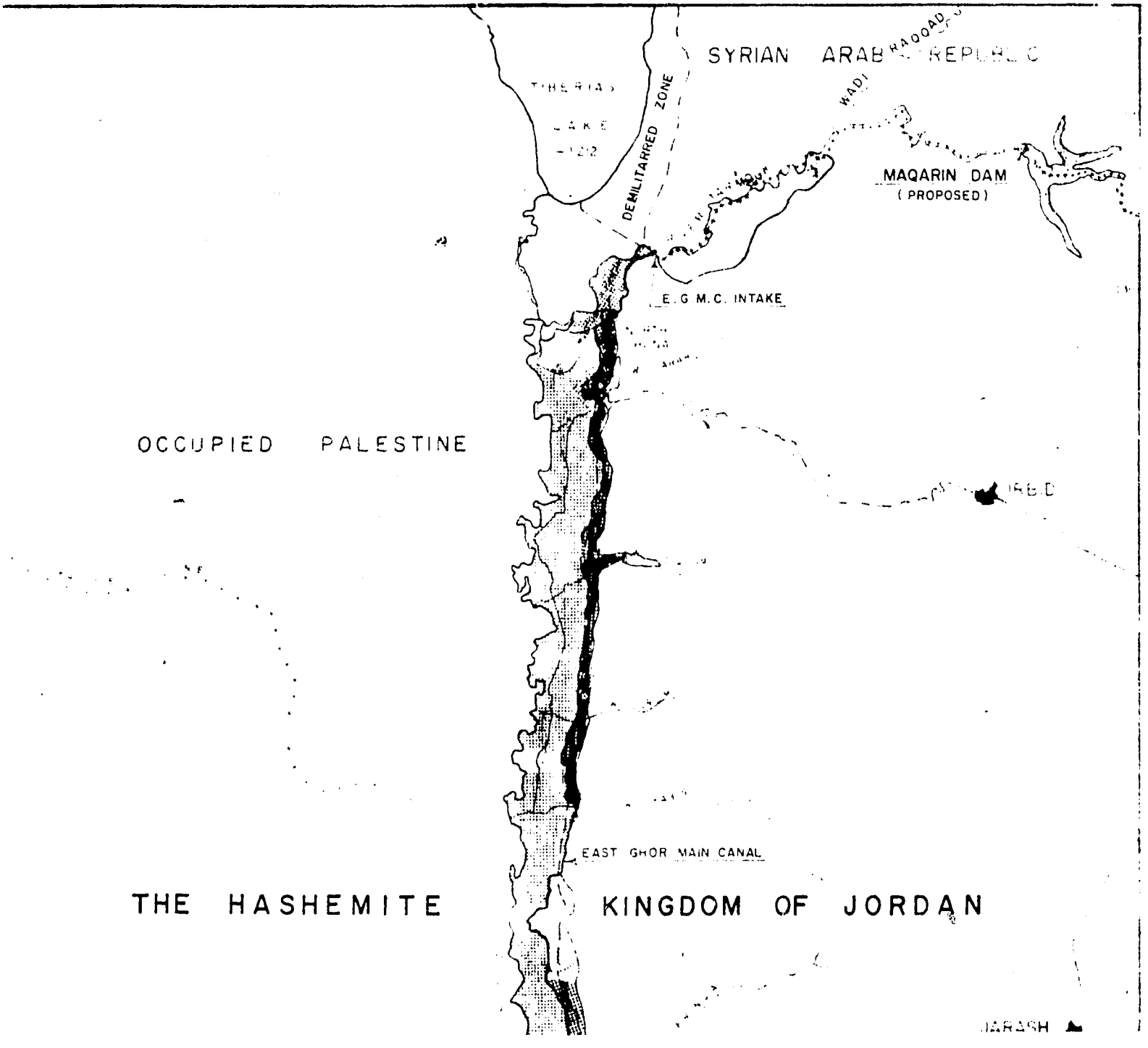
PERCENT REPAYMENT VS INITIAL WATER CHARGE

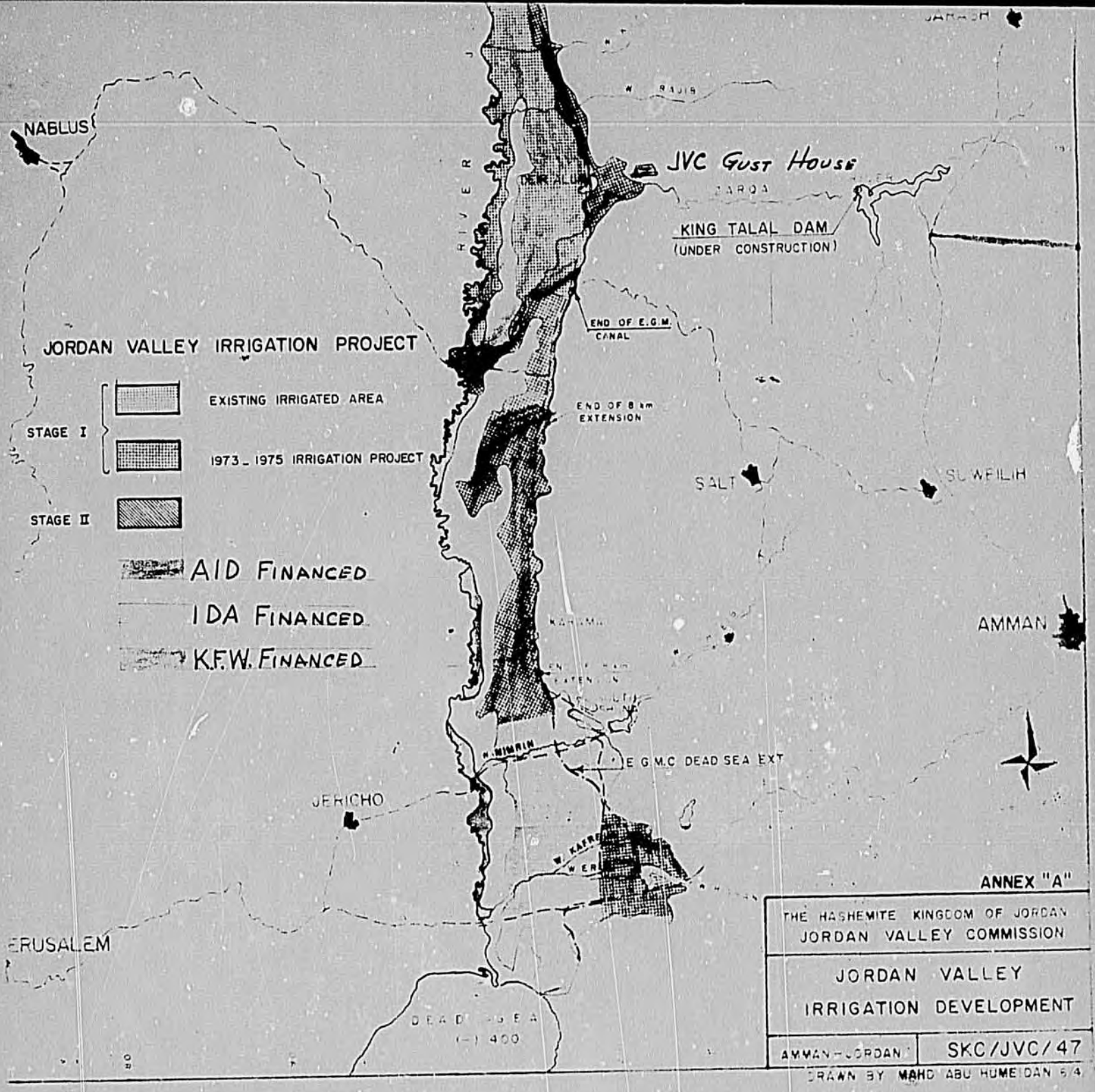
JORDAN VALLEY IRRIGATION PROJECT

STAGE II


NORTH
JORDAN VALLEY
EAST GHOR DEVELOPMENT
250
240
230
220
210
200
190
Lake
Tiberios
S Y R I A
LEGEND
CONST PROP.
EAST GHOR CANAL
A
POPULATION OVER 8000
B
" 5000 to 8000
C
" UNDER 5000
ROADS
RIVER AND WADI
IRRIGATED AREA
FUTURE IRRIG.
Yarmouk River
KHALID IBN EL-WALID DAM
ADASIYA
Zahar Spring
NORTH SHUNA
W. Arab
MANSHIYA
RAMTHA
IRBID
WAQQAS
QLEIAT
TELL EL ARABAEIN
SHURHBEIL BIN HASNA DAM
W. Zeimar
ZEMALIYA
Tabqat Fahl Spring
MASHARE
EL MERAZZEH
W Yabis
WADI EL YABIS
Subeirra Well
EL QARN
SLEIKHAT
Truce Line
AJLUN


JARASH
KREIYMEH
W. Kufrinja
Wadi Rajib Well
BALAWINA
KHAZMA
DIRAR
JVC GUEST HOUSE
KING TALAL DAM
EL EDDBAB
DEIR ALLA
ABU EZEGAN
SAWALHA
ER RABE
EL TWAL
MU'ADDI
EL ARDA
km.70 END E.S.C.
Jordan River
W. Zarqa
DAMIYA
Km.78 END EXTENSION I
DAHRAT EL RAMIL
SALT
SWEILEH
DAHRAT EL MAQAM
ANMAN
KARAMA
W. Shoeib
SOUTH SHUNA
Km.96 END EXTENSION II
Jorein Well
SHUIB DAM
NAUR
W. Kufrein
GHOR NIMRIN
EL KAFREIN
KUFREIN DAM
To Ramallah
JERICHO
EL RAUDA
EL RAMA
EL X
To Jerusalem
SUWEIMA
MADABA
Dead Sea
SCALE IN Kms
DRAWN FOR U.S.A.I.D/JORDAN, BY Oshin Bedevian
190
180
170
160
150
140
130
200
210
220
230
240


SYRIAN ARAB REPUBLIC
TIBERIAS
LAKE
DEMILITARRED ZONE
WADI
MAQARIN DAM
(PROPOSED)
E.G.M.C. INTAKE
OCCUPIED PALESTINE
EAST GHOR MAIN CANAL
THE HASHEMITE KINGDOM OF JORDAN



ANNEX "A"

THE HASHEMITE KINGDOM OF JORDAN
JORDAN VALLEY COMMISSION

JORDAN VALLEY
IRRIGATION DEVELOPMENT

AMMAN-JORDAN | SKC/JVC/47

DRAWN BY MAHD ABU HUMEIDAN 5/4