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FES 83-4

EVALUATION OF JORDAN RIFT VALLEY

WATER RESOURCES STUDY

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CLASSIFICATION
PROJECT EVALUATION SUMMARY (PES) - PART I

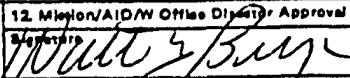
Report Symbol U-44

1. PROJECT TITLE JORDAN RIFT VALLEY WATER RESOURCES STUDY			2. PROJECT NUMBER 278-K-0229	3. MISSION/AID/W OFFICE USAID/JORDAN
4. EVALUATION NUMBER (Enter the number maintained by the reporting unit e.g., Country or AID/W Administrative Code, Fiscal Year, Serial No. beginning with No. 1 each FY) 83-4			<input checked="" type="checkbox"/> FINAL EVALUATION <input type="checkbox"/> SPECIAL EVALUATION	
5. KEY PROJECT IMPLEMENTATION DATES			6. ESTIMATED PROJECT FUNDING	
A. Firm PRO-AG or Equivalent FY 78	B. Final Obligation Expected FY 78	C. Final Input Delivery FY 83	A. Total \$ 6,871,502	F. U.S. \$ 5,000,000
7. PERIOD COVERED BY EVALUATION			Date of Evaluation Review	
From (month/yr.) August 1978			August 1983	
To (month/yr.) December 1982				

000105

8. ACTION DECISIONS APPROVED BY MISSION OR AID/W OFFICE DIRECTOR		
A. List decisions and/or unresolved issues; cite those items needing further study. (NOTE: Mission decisions which anticipate AID/W or regional office action should specify type of document, e.g., telegram, SPAR, PIO, which will present detailed request.)	B. NAME OF OFFICER RESPONSIBLE FOR ACTION	C. DATE ACTION TO BE COMPLETED
1. Reach agreement with Dames & Moore on L/Comm # 278-K-02201 regarding effecting final payment to contractor and notify USAID/Jordan of outcome.	AID/W FM/BFD	11/83
2. Upon notification of above agreement reached, take necessary action to release payment and close-out project.	USAID PROJECT OFFICER USAID CONTROLLER	11/83

9. INVENTORY OF DOCUMENTS TO BE REVISED PER ABOVE DECISIONS			10. ALTERNATIVE DECISIONS ON FUTURE OF PROJECT		
<input type="checkbox"/> Project Paper	<input type="checkbox"/> Implementation Plan e.g., CPI Network	<input type="checkbox"/> Other (Specify)	A. <input type="checkbox"/> Continue Project Without Change		
<input type="checkbox"/> Financial Plan	<input type="checkbox"/> PIO/T		B. <input type="checkbox"/> Change Project Design and/or		
<input type="checkbox"/> Logical Framework	<input type="checkbox"/> PIO/C	<input type="checkbox"/> Other (Specify)	<input type="checkbox"/> Change Implementation Plan		
<input type="checkbox"/> Project Agreement	<input type="checkbox"/> PIO/P		C. <input type="checkbox"/> Discontinue Project		

11. PROJECT OFFICER AND HOST COUNTRY OR OTHER RANKING PARTICIPANTS AS APPROPRIATE (Name and Title)		12. Mission/AID/W Office Director Approval	
AIED SWEIS, PROJECT OFFICER ALBERT KARIAN, ENGINEERING OFFICER WILLIAM LIBBY, ENGINEER		 Typed Name WALTER G. BOLLINGER DIRECTOR, USAID/JORDAN	
		Date November 2, 1983	

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EVALUATION OF JORDAN RIFT VALLEY
WATER RESOURCES STUDY

13. SUMMARY

The project provided a \$5.0 million loan to the Government of Jordan to assist in funding the studies and investigations, including drilling, required to define more clearly the quantity, quality and location of all ground and surface water available in the Jordan Rift Valley (JRV), which includes the Jordan Valley and Wadi Araba. This information is essential to meet the objective of formulating a comprehensive water resources development program to meet Jordan's water needs. The implementing agency is the Jordan Valley Authority (JVA). The loan agreement was executed on August 28, 1978; the PACD was December 31, 1982.

The AID loan has been used to finance technical assistance, commodities and most of the drilling costs for 14 deep exploratory wells along the Jordan Valley escarpment. The full amount of the loan has been disbursed, except for final payments totalling less than \$24,000 (see Table I), which are in the process of being paid*. JVA, using its own funds, financed 18 percent of the cost of drilling the 14 wells along the Jordan Valley escarpment and all of the costs of drilling 26 shallow exploratory wells in the Southern Ghors and 23 shallow exploratory wells in Wadi Araba. The purpose of this evaluation is to assess the results achieved through the project implementation period, September 1978 - December 1982.

The installation of seven surface water monitoring stations in Wadi Araba and the extensive drilling in the Southern Ghors and Wadi Araba have enabled the JVA to define most of the available surface and groundwater resources in those areas. The JVA has also drilled additional production wells in those areas to provide water for domestic use in population centers and for irrigation.

The 14 exploratory wells along the Jordan Valley escarpment, when tested after drilling, yielded a total of 3,200 cubic meters per hour or about 28 million cubic meters per year (MCM/a) (See Table II). Even before all the results of the exploratory drilling program were in, JVA had made plans to drill production wells in the more promising areas, particularly in the northern part of the Jordan Valley. Wells

* FM/BFD is to reach agreement with Dames & Moore on effecting the final payment and to notify USAID/Jordan of the outcome in order to release the final payment and close-out the project.

drilled near Mukheiba along the Yarmouk River are currently yielding at a rate of about 50 MCM/a. A supplemental canal has been constructed to carry this water to the East Ghor Main Canal (EGMC), thus helping to relieve the chronic irrigation water shortage in the lower Jordan Valley during the summer months. The JVA plans to install a mini hydropower station at the point where water from the new canal drops into the EGMC. Similarly, three production wells have been drilled in the Wadi Araba watershed. Contracts have been awarded to construct facilities to treat and pump about 20 MCM/a of this water to Irbid and towns and villages in the Northern District of the Water Supply Corporation, where drinking water is now severely rationed.

Plans are also being formulated to use water from three wells at Kafrein in the south to meet the irrigation needs of the area beyond the reach of the EGMC. Water from the wells at Mukheiba and Wadi Kafrein, as well as in some of the other areas, is of good quality and quantity. On the other hand, the yield of water from four other project wells was low and the total dissolved solids were high. This is extremely useful information that will allow JVA to avoid development in these areas.

The project has been eminently effective in its primary objective of providing information for the formulation of plans for the development of the water resources of the JRV. It also was effective in institution building in terms of improving JVA's capacity to locate possible drilling sites, monitor well production, and oversee contractors' drilling programs. The Jordanian contractors also benefitted from experience gained from drilling deep water wells.

Because of the initial inexperience of the Jordanian contractors in drilling wells at depths of more than 500 meters and tender document delays, project implementation was delayed some two years. Despite this, the project achieved its objectives and in fact, is one of the most successful AID projects in Jordan.

14. Evaluation Methodology

This evaluation was undertaken to assess the results achieved at the end of project implementation. Although the Project Paper (PP) stated that "there is no project evaluation other than AID monitoring and report reviews," the Loan Agreement contains the standard covenant on evaluation. This evaluation is based on comprehensive monitoring during project implementation and on contacts and discussions with the JVA. Principal contributors were Dr. Omar Judeh, Chief Hydrogeologist and Project Manager for the JVA, and Aied Sweis, USAID Project Officer. Other contributors were Dr. Munther J. Haddadin, President of JVA, and Messrs. Albert A. Karian and William A. Libby, USAID/Jordan Chief Engineer and Deputy Chief Engineer, respectively.

15. External Factors

There were no significant external factors.

16. Inputs

AID financed a contract between JVA and Dames and Moore, in association with Boyle Engineering Corporation (signed in February 1979), to provide technical and managerial services to JVA for a period of two years. The contract included most of the hydrological and geological program proposed in the Project Paper, except for the artificial recharge study and the geophysical survey of the Southern Ghors. (The latter studies were conducted by a firm financed by the Federal Republic of Germany).

Dames & Moore adequately completed most* of the studies called for in their contract. However, the JVA concluded that the firm's performance was unsatisfactory and the firm's services were no longer required. The firm's contract was terminated for convenience on June 30, 1980. Justification provided by JVA TO USAID follows:

A. The preparation of tender documents by the consultant took longer than planned and resulted in a delay of award of the drilling contract.

B. The original drilling program was amended by the JVA and some of the originally planned work was performed under the auspices of the West German Cooperation program, thereby obviating any need for the consultant's involvement in this aspect of the program.

C. By late spring 1980, the JVA had recruited ten qualified geologists and hydrogeologists to participate in the project and work with the consultants. Previously lacking these types of skilled personnel, JVA relied on Dames and Moore to provide geological and hydrogeological expertise. At this point in the project, however, these skills were no longer needed from the consultant.

* i.e., two geological reports on Wadi Araba and the Jordan Valley, surface water study, remote sensing study, and draft final report.

In view of the above, the JVA proposed to provide construction supervision with its own staff, reinforced with specific, technical assistance from one advisor to be provided under a personal service contract. The supervision of drilling of exploratory wells and of well development and testing was undertaken, through a two-year personal services contract (execution date: November 18, 1980) with Stanley M. Remington, a retired AID hydrogeologist with extensive well-drilling experience, and was satisfactorily completed before the end of his contract period. Both parties mutually agreed to terminate Mr. Remington's contract in August 1982 "for convenience," not for any deficiencies, but because his work was finished.

In the hiatus between the termination of the Dames and Moore contract and Mr. Remington's arrival, the lack of specialized technical assistance hindered project implementation. A period of five months elapsed until the Remington contract was signed. The drilling contractor was drilling at depths greater than anticipated and encountered problems such as bit and pipe losses. Although the JVA hydrogeologists and geologists benefitted from work with the Dames and Moore consultant, neither the contractor nor the JVA project personnel were fully experienced in deep well drilling and monitoring.

In addition, AID financed the equipment for seven surface water monitoring stations, which were installed in the Wadi Araba by Boyle Engineering under the Dames and Moore contract, and also hydrometeorological and other small-value technical equipment.

Drilling was done by Jordanian contractors, most of whom were initially inexperienced. This coupled with tender document delays, caused the project to be delayed some two years beyond the date estimated in the Project Paper.

The major AID input in terms of the drilling program, was the financing of about 82 percent of the cost of a contract between JVA and Equipment Sales and Services Company, a Jordanian company, for drilling exploratory wells in the JRV.

In summary, AID's contribution of \$5 million to the project was used to finance technical services, commodities and 82 percent of the cost of drilling 14 deep exploratory wells in the Jordan Valley escarpment. A breakdown of AID's contribution is given in Table I. The JVA financed the local costs of establishing surface water monitoring stations, 18 percent of the cost of drilling the 14 deep wells, and some well development and testing. JVA's total contribution, which includes all of the costs of drilling 40 shallow exploratory wells in the Southern Ghor and Wadi Araba, and considerable staff time and other in-kind costs, has not been completely quantified. Not included as inputs to the project are JVA's follow-on expenditures and commitments approaching \$60 million to develop the water resources identified by the project.

17. Outputs

The project consultant, Dames and Moore, in association with Boyle Engineering Corporation, completed most of the technical reports required by the contract before it was terminated by the JVA for convenience. They prepared technical specifications and contract documents for the drilling programs. They helped install stream gauging stations in the side wadis of the Wadi Araba and a meteorological station network. They supervised some of the drilling in the Southern Ghors and Wadi Araba. The supervision of drilling of exploratory wells and of well development and testing financed by AID was undertaken and completed by Mr. Remington.

The 26 shallow wells drilled in the Southern Ghors ranged in depth from 55 to 160 meters and had a yield of 30 to 100 cubic meters per hour with total dissolved solids (TDS) of 550 to 3,000 parts per million (PPM). The 23 shallow wells in the Wadi Araba were drilled to depths ranging from 60 to 220 meters and had yields from 25 to 200 cubic meters with TDS of 800 to 2700 PPM. Although yields are small and water from some wells is too saline for use, a sufficient amount of usable water has been found to allow JVA to start a number of pilot irrigation projects in the areas south of the Dead Sea.

The Project Paper envisaged drilling only 12 deep exploratory wells on the Jordan Valley escarpment between the Yarmouk River and the Dead Sea. About seven boreholes were started and not completed because of problems encountered in the drilling. Ultimately 14 wells were completed. Details of the completed wells are given in Table II. It should be noted that eight were flowing artesian wells. The TDS of the water from all but four of the wells is less than 1,000 PPM which means that these waters are suitable for both irrigation and potable uses.

The drilling of production wells has yielded much additional information and some surprises. A production well drilled a short distance from JRV-1 at Mukheiba, which had a modest yield of 175 cubic meters per hour, proved to be a "gusher", with a yield of over 5,500 cubic meters per hour, that overturned the drilling rig and flowed uncontrolled into the Yarmouk River. JVA has constructed a canal, at a cost of about \$10 million, to carry the water from four production wells at Mukheiba to the EGMC.

18. Purpose

The project purpose is best expressed as follows: "Through studies and investigations, including drilling, to define more clearly the quantity, quality and location of ground and surface water that is available in the Jordan Rift Valley, including the Southern Ghors and Wadi Araba." The end of project status (EOPS) can be expressed as follows: "Hydrological and hydrogeological information will be obtained and available for the formulation of future plans for the development of water resources of the JRV." Both the purpose and the EOPS have been achieved, as described in Section 13. Summary.

19. Goal

The goal to which this project will contribute is best expressed as "effective development, management, conservation, protection and utilization of Jordan's scarce water resources as required for future economic growth and development." The project has already contributed significantly to this goal. Based on the information gathered by the studies and investigations of this project, the JVA has already drilled four production wells near the Mukheiba exploratory well and has constructed a canal, at a cost of \$10 million, to convey about 50 MCM/a of water to the East Ghor Main Canal to help meet the agricultural demands of the Jordan Valley. This additional water will be particularly valuable in the summer season when the flow in the Yarmouk River is low. In addition the JVA has awarded contracts worth about \$40 million, which will soon be undertaken, to treat and pump about 20 MCM/a of water to the Irbid plateau for domestic use. Such an immediate and effective contribution to a goal is probably unprecedented.

20 Beneficiaries

The direct beneficiaries are the engineers and hydrologists of the JVA who have gained additional knowledge through association with the data gathering and analysis aspects of the project and the Jordanian drilling contractors who have learned through experience how to drill to depths of 1,000 meters or more under adverse conditions.

The indirect beneficiaries are the farmers and their families in the Jordan Valley, the Southern Ghors and Wadi Araba who will receive increased amounts of irrigation water, the residents of the Balqa Area who will be getting the water supply from the East Ghor Canal and the residents of the Irbid Plateau whose supply of drinking water will more than double. The people of Jordan will benefit from increased agricultural production in the JRV area.

21. Unplanned Effects

The JVA had expected to find some water in the JRV as a result of this project and had made some modest preliminary plans for its use. The discovery of substantial quantities of water, particularly in the north, however, spurred the JVA into a crash program of design and construction to bring additional agricultural water to the Jordan Valley and drinking water to the population of the Irbid Plateau. It had been expected that the water for these uses could come, about a decade from now, only from the Maqarin Dam on the Yarmouk, the construction of which has been deferred until resolution of riparian issues. The unplanned major construction now being implemented because of the project and its findings will partially relieve water shortages that had been expected to continue well into the 1990s.

22. Lessons Learned

(a) Highly specialized, technical advisory assistance is needed at all stages of a project such as this one. From the termination of the consultants' contract until the hiring of an experienced hydrogeologist, the JVA had no expert advisory assistance on the project. Both the JVA supervisory staff and the drilling contractor for the deep wells along the escarpment were inexperienced. Many serious drilling mistakes, that delayed the project for several months, were made during this period. Admittedly the contractor did learn from these mistakes, but they cost him time and money. Most of the mistakes probably could have been avoided if experienced advisors had been available.

(b) In projects in which the purpose is the gathering and interpretation of information, the project agreement needs to be written in such a way to allow the Borrower and AID to modify elements of the project as new information becomes available. In this case, the number and location of wells were fixed and only minor modifications were made possible. Fortunately, the production wells that the JVA is actively drilling will supply additional hydrogeological information.

(c) The terms and conditions of contracts for exploratory drilling or for any other activity in which there is a high degree of uncertainty should include provisions dealing with possible unanticipated results. It had been expected that none of the wells would be deeper than 750 meters and no prices were included in the contract for drilling beyond that depth. In the first well, JRV-1 at Mukreiba, it became obvious that it would be necessary to drill much

deeper than 750 meters to get necessary information on the complex formation at that location (the total depth at JRV-1 was 1,238 meters). Drilling stopped for several weeks while JVA and the contractor negotiated prices for drilling deeper than 750 meters and USAID then debated the reasonableness of these prices. Time and effort would have been saved if the original IFB had required the bidders to submit provisional unit prices for drilling to depths greater than anticipated.

23. Special Comments or Remarks

Geological mapping of the Jordan Valley was completed in the mid 1960s and showed a possibility of significant groundwater occurrence along the eastern escarpment. In the late 1960s and early 1970s a number of exploratory wells were drilled in several parts of the escarpment. These exploratory wells confirmed the existence of groundwater in the upper limestone formations. However, depths were limited to 300 meters because only small drilling rigs were available in Jordan at that time. In 1977 the West German Agency for Technical Cooperation prepared a National Water Master Plan for Jordan. The master plan included estimates of groundwater in storage and exploitable groundwater for each of Jordan's groundwater systems, including the Jordan Valley. These estimates were considered by the JVA to be too low. Additionally, the estimates of groundwater in storage did not differentiate between saline and fresh groundwater areas.

PROJECT EXPENDITURE

TABLE I

AID EXPENDITURE

(Loan Agreement Signed for US Dols 5,000,000.00)

I T E M	EXPENDITURE		
	Local Currency	Foreign Currency	T O T A L
Dames and Moore	---	780,729.95	\$ 780,729.95*
Boyle Eng. Corp.	---	172,854.80	172,854.80
JVA (ESSCC - Drilling)	3,797,021.17	---	3,797,021.17
Geophysical Instrument Supply (GISCO)	---	22,331.66	22,331.66
JVA (Stanley Remington)	42,138.59	122,613.83	164,752.42
JVA (Commodities)	62,310.00	---	62,310.00
T O T A L	3,901,469.76	1,098,530.24	\$5,000,000.00

* Includes accrued expenditure of Dols 23,539.22;
payment of this amount is underway.

GOJ EXPENDITURE

(GOJ Contribution per PP is US Dols 1,750,000.00)

	EXPENDITURE LOCAL CURRENCY	
	Jordan Dinars	Equivalent to Dols ¹⁾
Drilling (14 wells)	283,870.000	811.057.00
Well Developing and Testing	7,650.000	21,857.00
Station Buildings	37,750.000	107,857.00
Pipes	133,291.000	380,831.00
Administration	187,615.000	536,043.00
Commodities	4,850.000	13,857.00
	655,026.000	1,871,502.00

1) Average exchange rate: \$ 1.00 = JD 0.350

JORDAN RIFT VALLEY PROJECT
DEEP WELLS IN JORDAN VALLEY ESCARPMENT

TABLE II

Well No.	Well Name	Coordinates		Elevation Meters	Total Depth Meters	Yield M ³ /Hr.	TDS	Remarks
		East	North					
1.	Hamma Muḳheiba	215.200	239.500	-60	1238	175	797	
2.	Wadi El Arab	211.150	224.900	-95	600	158	569	Flowing
3.B*	Wadi El Arab (N. Shuneh)	208.217	224.350	-177	967	900	516	Flowing
5.	Tabqat Fahil	209.200	207.150	25	450	173	538	
6.	Wadi El Yabis	208.820	198.100	100	596	28	1245	
7.	Kuraima	208.950	184.000	-120	567	122	435	Flowing
8.	Sleikhat	207.840	193.050	- 10	220	61	538	
9.E	Karama	206.900	151.180	-155	365	92	1056	
10.	Bassat El Faras	207.400	157.200	-131	297	122	3404	Flowing
11.B	Kafrein	215.500	141.900	-90	465	400	384	Flowing
11.C	Kafrein	216.070	142.340	-85	396	400	448	Flowing
11.D**	Kafrein	214.900	140.500	-100	550	400	524	Flowing
12.	Sakna	209.000	147.450	-125	377	135	768	
13.	Wadi Shueib	211.150	147.060	-140	400	<u>100</u>	1728	Flowing
						3,266		

* Temperature of the groundwater at this well is 56° C

** Well No. 11.D. is considered No. 14 funded under amendment to the drilling contract.

Implementation Schedule

<u>1. Loan</u>	<u>Planned</u>	<u>Actual</u>
Project Appraisal and Project Paper Completed	Aug. 1, 1978	June 18, 1978
Authorization of Loan	Aug. 28, 1978	Aug. 8, 1978
Negotiation and Execution of Loan Agreement	Sept. 30, 1978	Aug. 28, 1978
Conditions Precedent Met	Nov. 1, 1978	Jan. 9, 1979
Initial Disbursement	Mar. 1, 1979	June 17, 1979
Final Disbursement	Sept. 30, 1981	Pending
<u>2. A & E Firm</u>		
Advertisement for Prequalification of A & E firms	Jan. 1978	Jan. 1978
Receive Prequalification Data	Feb. 28, 1978	Feb. 28, 1978
Evaluate and Complete Short List by JVA	Apr. 1, 1978	Apr. 1, 1978
AID approval of Short List	May 17, 1978	July 15, 1978
Issue REP to Short Listed Firms	Sept. 1978	Sept. 1978
Receive Responses to RFP	Nov. 1978	Nov. 1978
Evaluate Proposals and Select Firm for Negotiation	Jan. 1979	Dec. 1978
AID Approval of JVA Selection	Feb. 1979	Jan. 31, 1979
Negotiate and Execute Contract	Mar. 1979	Feb. 7, 1979
Contract Termination	Mar. 1981	June 30, 1980
Stanley Remington - Contract signed and terminated		Nov. 18, 1980 Aug. 31, 1982
<u>3. Drilling Contract</u>		
Begin Preparation of IFB	Oct. 1978	Jan. 24, 1980
A.I.D. Approval of IFB	Jan. 1979	Apr. 8, 1980
Issueance of IFB	Feb. 1979	March 1980
Receipt of Bids	Mar. 1979	April 1980
Evaluation of Bids and Selection of Contractor	Apr. 1979	May 20, 1980
Mobilization and Begin Drilling Program	May 1979	Aug. 30, 1980
Completion Drilling Program	Dec. 31, 1980	Dec. 31, 1982
Purchase of Meteorologic Equipment for Wadi Araba		June 13, 1981