PLANNING & DEVELOPMENT DEPARTMENT
GOVERNMENT OF BALOCHISTAN
ISLAMIC REPUBLIC OF PAKISTAN

BASIC DESIGN STUDY REPORT
ON
THE PROJECT
FOR
EXPLOITATION OF GROUND WATER
IN BALOCHISTAN PROVINCE
IN
THE ISLAMIC REPUBLIC OF PAKISTAN

FEBRUARY 1996

JAPAN INTERNATIONAL COOPERATION AGENCY
NIPPON JOGESUIDO SEKKEI CO., LTD.

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PREFACE

In response to a request from the Government of the Islamic Republic of Pakistan the Government of Japan decided to conduct a basic design study on the Project for Exploitation of Ground Water in Balochistan Province in the Islamic Republic of Pakistan and entrusted the study to the Japan International Cooperation Agency (JICA).

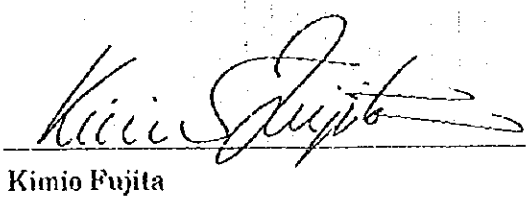
JICA sent to Pakistan a study team from 2 September to 10 October 1996.

The team held discussions with the officials concerned of the Government of Pakistan and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Pakistan in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Islamic Republic of Pakistan for their close cooperation extended to the teams.

February 1996



Kimio Fujita
President
Japan International Cooperation Agency

February 1996

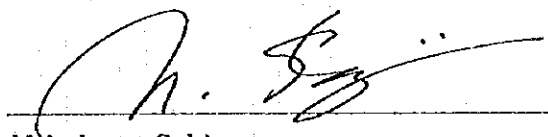
Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Exploitation of Ground Water in Balochistan Province in the Islamic Republic of Pakistan.

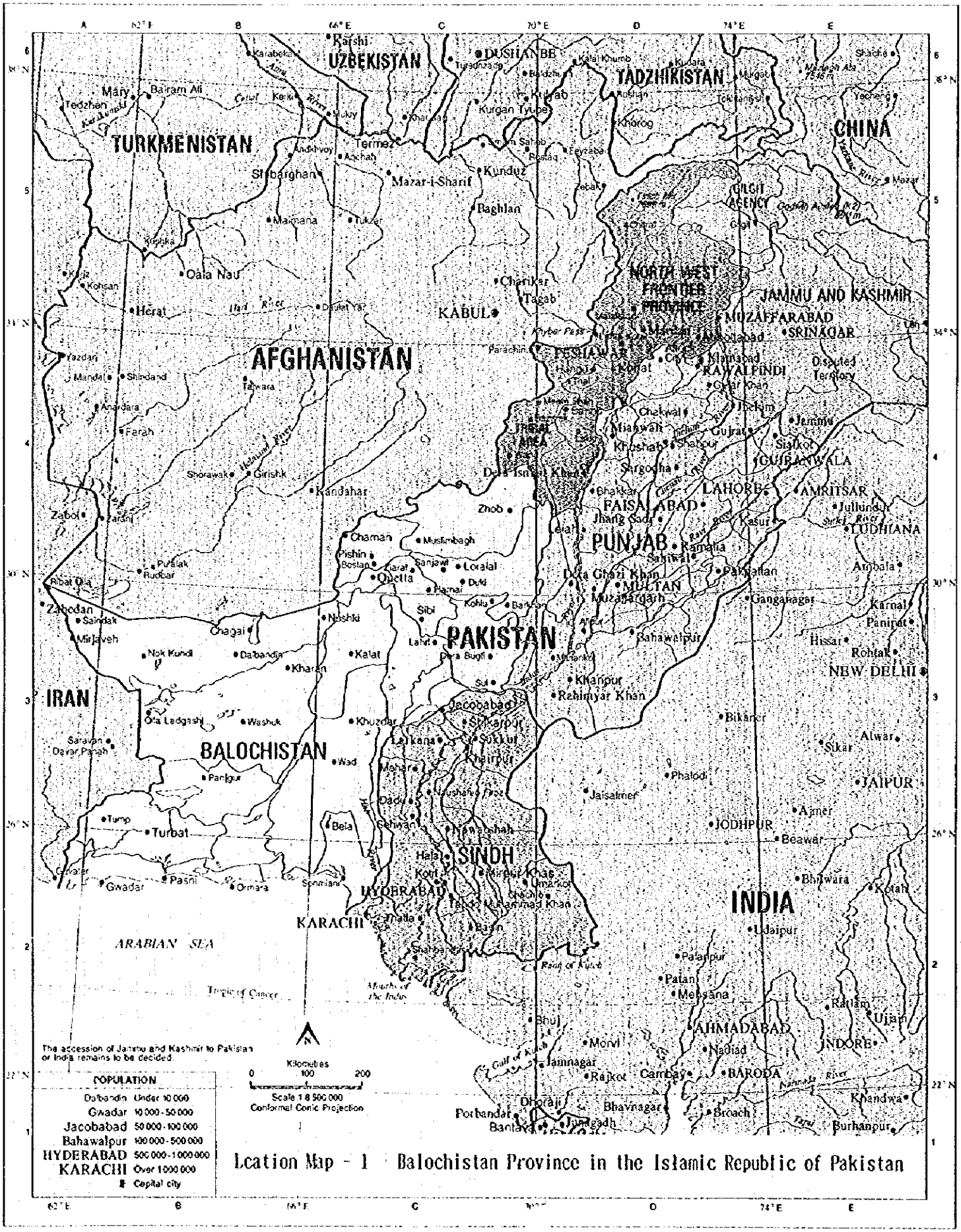
This study was conducted by Nippon Jogesuido Sekkei Co., Ltd., under a contract to JICA, during the period from August 30, 1995 to February 26, 1996. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Pakistan and formulated the most appropriate basic design for the project under Japan's Grant Aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

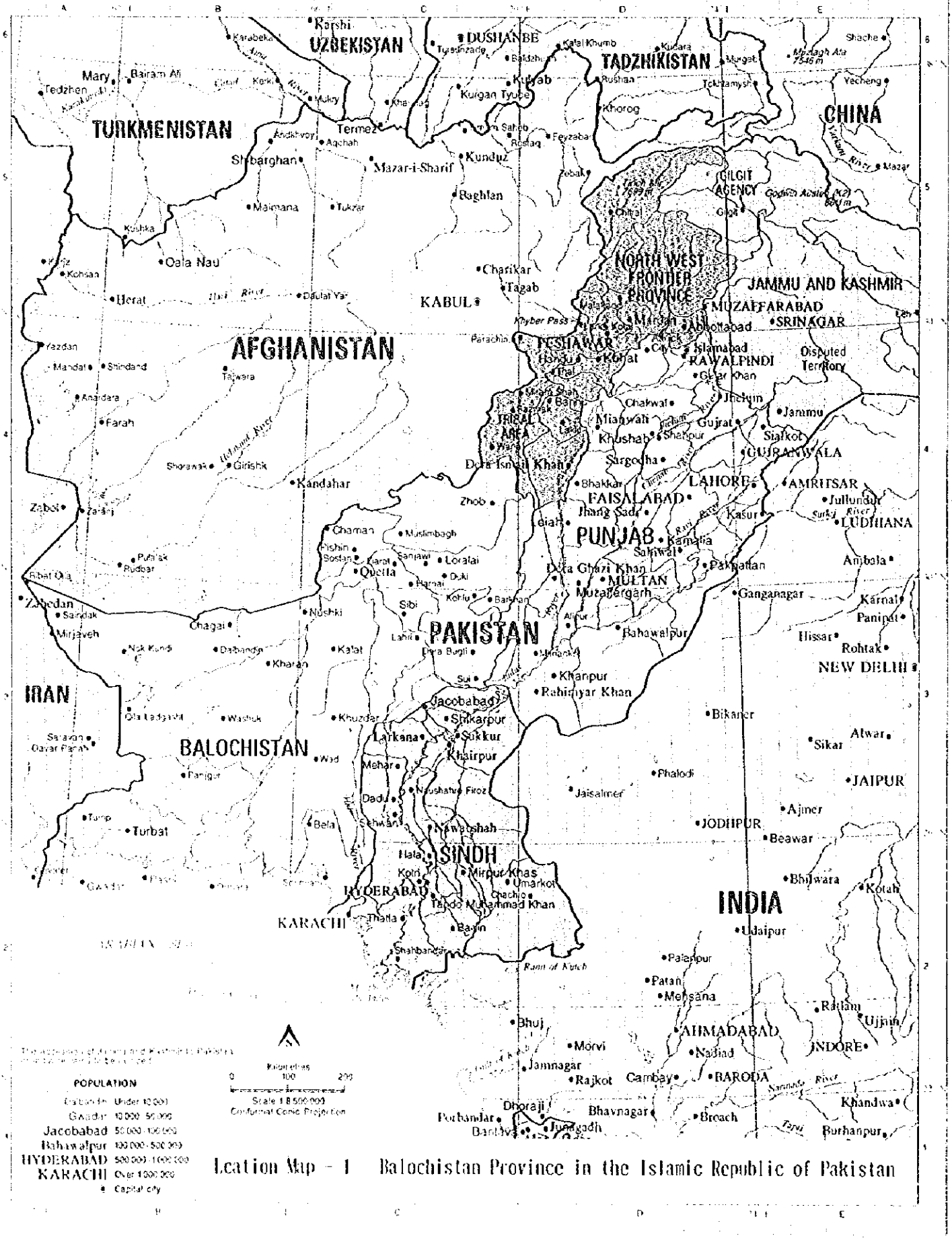
Very truly yours,



Nobukatsu Sakiyama
Project Manager
Basic Design Study Team on
The Project for Exploitation of Ground Water in
Balochistan Province in
the Islamic Republic of Pakistan
Nippon Jogesuido Sekkei Co., Ltd.



Lcation Map - 1 Balochistan Province in the Islamic Republic of Pakistan



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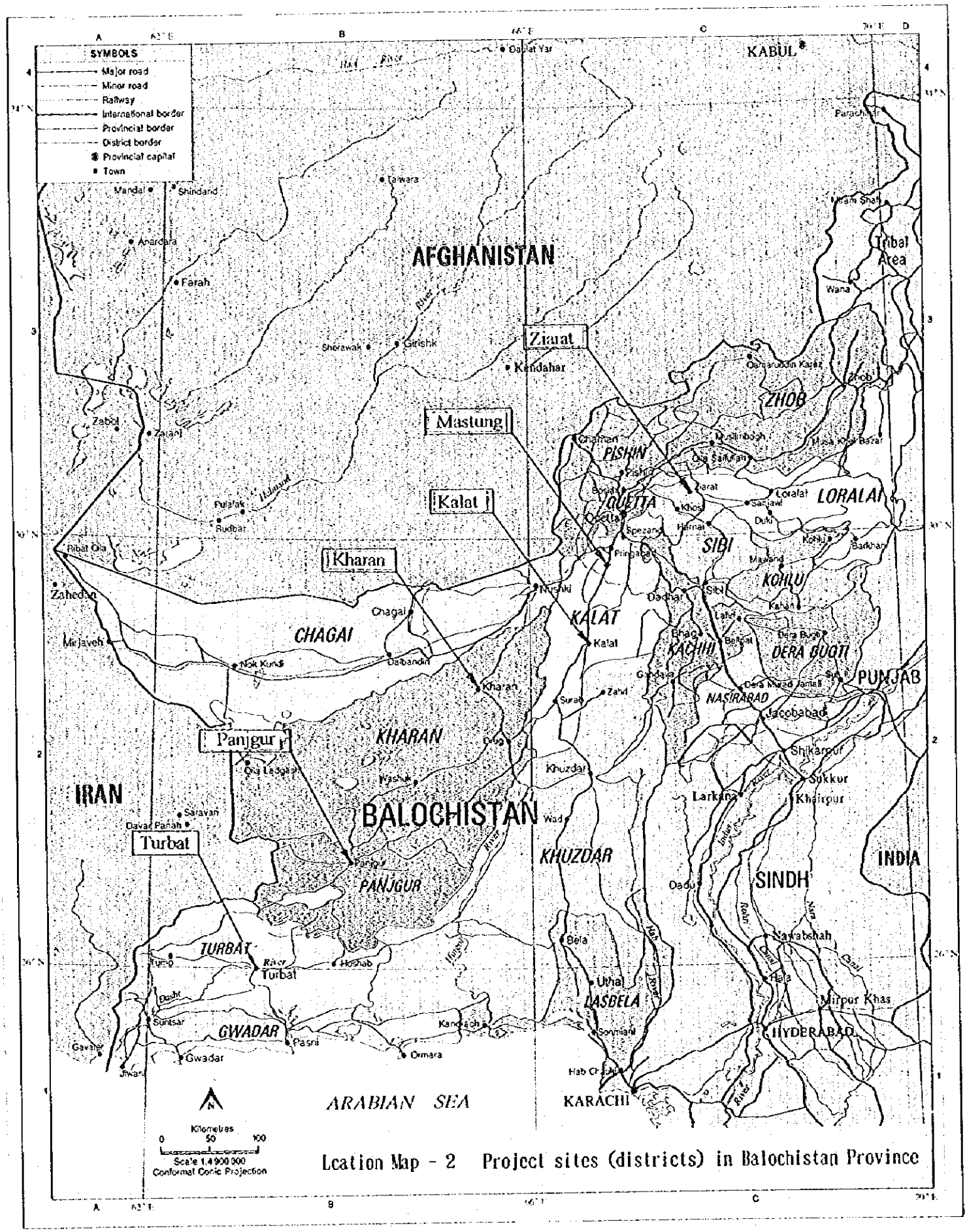
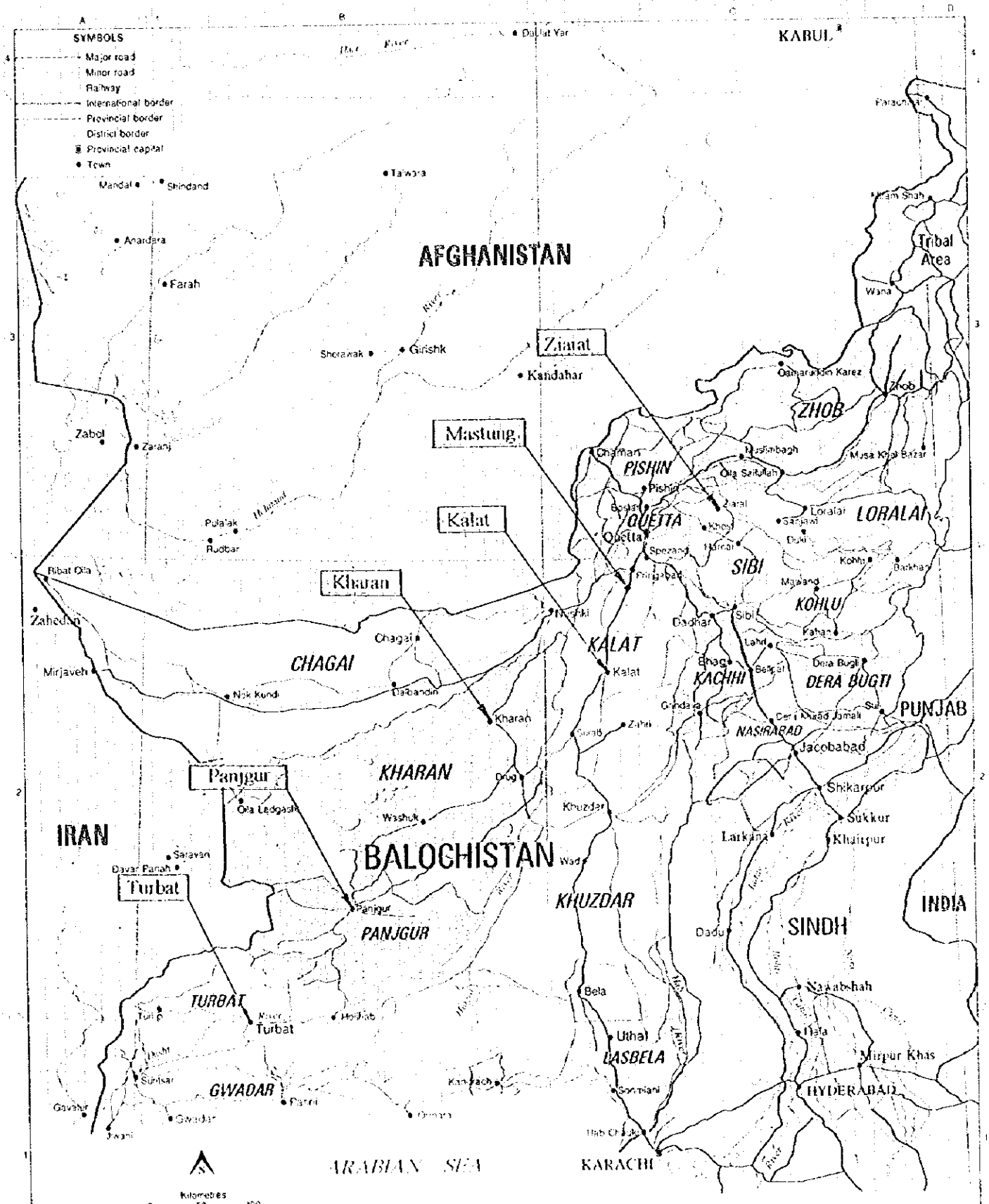


Lcation Map - 2 Project sites (districts) in Balochistan Province



Lcation Map - 2 Project sites (districts) in Balochistan Province

ABBREVIATIONS

1) Organizations

UNDP	United Nations Development Program
FAO	Food and Agriculture Organization of the United Nations
IBRD (WB)	International Bank of Reconstruction and Development
ADB	Asian Development Bank
GOP	Government of Pakistan
GOB	Government of Balochistan
P & DD	Planning and Development Department, GOB
WAPDA	Water and Power Development Authority, Quetta, GOP
BDA	Balochistan Development Authority, GOB
I & PD	Irrigation and Power Department, GOB
PHED	Public Health Engineering Department, GOB
WASA	Water and Sewerage Authority, GOB
JICA	Japan International Cooperation Agency
OECF	Overseas Economic Cooperation Fund

2) Others

mm	millimeter
cm	centimeter
m	meter
km	kilometer

m^2	square meter
km^2	square kilometer
m^3	cubic meter
kg	kilogram
ha	hectare
hr.	hour
℃	degree centigrade
O & M	operation and maintenance
Rs	Rupees (currency of Pakistan)
lpcd	liter per capita day

Chapter 1
Background of the Project

1. Background of the Project

1.1 Background of the Request

It took five years and several amendments to the proposed project request from the Pakistani side before it was accepted by the Japanese Government. The circumstances of the above-mentioned request were as follows:

1. Original Request (February 1990)

   The procurement plan of 30 rigs for groundwater development in Balochistan based on PC-1 was approved by the Government of Balochistan in 1989. This plan was to procure 21 rotary rigs and nine percussion rigs. The Government of Balochistan requested 21 rotary rigs from the Government of Japan.

2. Second Request (May 1994)

   The Government of Balochistan reduced the scope of the target areas, namely the Jhal Jao and Panjgur Districts, for a more realistic plan. Under this plan, about 76 wells in Jhal Jao and 45 wells in Panjgur were proposed to be drilled.

3. Final Request (July 1995)

   Jhal Jao as the target area was changed to Turbat in consideration of the its better access and public order.

1.2 Outline of the Request

The major economic activities of Pakistan are farming and other agricultural-related activities. Roughly 47% of the working population are farmers. This project is intended to increase agricultural production (currently 1.8 tons per ha).

The Conceptual Eighth Five Year Plan 1993-1998 for Agricultural Development has been established by the Government of Balochistan. Under the plan's concept, increasing food production and the efficiency of the working population in the province are stated goals.

However, due to the limited precipitation and adversely high evaporation, the surface water resources are insufficient for irrigation use in Balochistan. The only practical source for sustainable water supply is

groundwater. In this connection, groundwater investigations were carried out by WAPDA Quetta with UNDP cooperation from 1973-1984, and the study results were summarized in the Groundwater Resources of Balochistan Province published in June 1993.

The Government of Balochistan has promoted groundwater development using 17 drilling rigs which were procured through the Japanese Grant Aid project. Currently, about half of the available groundwater has been extracted, according to the previous study's estimates on potential groundwater. Thus, the Government of Pakistan has requested Japanese Grant Aid to procure the necessary drilling equipment to construct 121 tubewells in the Jhal Jao and Panjgur districts of Balochistan Province.

Requested Equipment:

1.	Rotary drilling rigs with accessories	4 units
2.	Percussion drilling rigs with accessories	2 units
3.	Supporting equipment (such as a service truck and a tanker truck)	not specified
4.	Geological survey instrument for logging & prospecting	not specified
5.	Workshop	not specified

In addition to the above equipment, other items were requested by WAPDA through the Team's field survey in Pakistan. These items are as follows:

1. Computers for management work
2. Vehicles for management work
3. Tractor for construction of the access way
4. Spare parts for Japanese rigs (inventory)

Chapter 2
Contents of the Project

2. Contents of the Project

2.1 Objectives of the Project

Water services for agriculture and domestic use in Balochistan are provided mainly by groundwater due to the non-sustainable surface water sources in this arid area. Groundwater development has been managed on a long-term program basis through mutual cooperation among the four concerned government agencies such as the Water and Power Development Authority (hereafter called WAPDA).

The objective of this project is to procure the necessary equipment for the Government of Balochistan to facilitate the development of groundwater for agriculture and domestic use in project sites in Balochistan through the installation of some 297 deep tubewells within five years using the procured equipment along with their own rigs.

2.2 Basic Concept of the Project

The responsible and implementing governmental agencies of the project are the following:

- The responsible agency of the project is the Planning and Development Department (hereafter called P&DD) of the Government of Balochistan.
- The implementing agency of the project is the Hydrogeology Project of WAPDA, headquartered in Quetta, of the Government of Pakistan.

The final items to be procured under Japanese Grant Aid were studied and decided upon in Japan in consideration of the items requested by the Pakistani side, by taking into account the following:

- the hydrogeological conditions of the project sites
- the number and specifications of investigation and production tubewells to be installed
- the economic and administrative viability of the project
- evaluation of the past performance of the groundwater development

The basic concept of this project was verified through a study of the viability and propriety of the groundwater development scheme to be implemented by the Pakistani side as follows:

2.2.1 Cooperation Concept

The necessity and reasonableness of the implementation of the project was verified during the study in Pakistan for the following reasons:

1. groundwater development is crucial to the development of Balochistan.
2. this project will enhance the groundwater development in Balochistan.
3. the execution of groundwater development would contribute greatly to the general welfare and improvement in the standard of living for the people of Balochistan.

Thus, it is assumed that Japanese Grant Aid can be applied to execution of this project. In keeping with this tenant, the Basic Design report shall be prepared with the intention of applying Japanese Grant Aid.

2.2.2 Realistic Groundwater Development

(1) Target Area of the Project

In the original project document, the project as of the date of commencement of the basic design study covered only two districts, namely the Panjgur and Turbat Districts as project sites. However, based on information obtained during the field visits, the team had the following observations:

- the groundwater level and the promising aquifers in most areas in the districts are relatively shallow (10 m to 30 m), and
- other methods than deep tubewells such as Karez and dug-wells are technically and economically more suitable for the hydrogeological conditions in the areas.

Therefore, the rig's capability of drilling up to 300 m, as requested by the Pakistani side, could not be technically justified as project components. In responding to the team's observations, the Pakistani side explained that:

- the rigs to be procured under the project are expected to serve for more than 10 years and thus they will continue to be utilized virtually in the whole of Balochistan in the same manner as the rigs previously procured under Japanese Grant Aid (fiscal year 1984 and 1990) have been used; and that

- the rigs to be included as project components are required to match various hydrogeological conditions in the province.

Based on the above discussions both sides had agreed that:

- the project has a "Groundwater Development Program" nature, and can be grouped under the projects to be implemented over a longer period in a geographically wider area with diversified objectives,
- the Projects are virtually a continuation of the above-mentioned programs, which would help enhance WAPDA's engineering fleet, and
- the project sites are in areas where deep tubewell investigation and development are required in future.

Finally, the project sites are in the following 6 districts in Balochistan:

1. Ziarat District
2. Mastung District
3. Kalat District
4. Kharan District
5. Panjgur District
6. Turbat District

(2) Verification of Groundwater Development Program

Currently, groundwater development in Balochistan has been carried out using a collection of some 33 well drilling rigs. Of this number, 17 are of Japanese manufacture and the remaining are from various other countries, with rigs of US manufacture being the majority. The Japanese-made rigs are all 16 years-old or newer. The remaining rigs are all 17 years-old or older. The antiquated rigs cannot be counted on to enhance the groundwater development program in Balochistan.

Balochistan on 1989, the project scheme was to be groundwater development for agricultural use in the each project sites. According to the explanation from the Pakistani side, the demand of groundwater

development was not limited in Balochistan and therefore groundwater development is the most important promotion work conducted by the Government of Balochistan.

However, the team could not reach an understanding as to whether the project is to procure the drilling rigs for a scheme of groundwater development under a Japanese Grant Aid Project. Unfortunately, the storage of groundwater is very limited in Balochistan. Even if the groundwater development program is hydrologically balanced under precise management, the development and use of groundwater without purpose cannot be recommended.

The team made several suggestions and discussed the groundwater development program with the Pakistani side, and reached an understanding regarding a lucid and realistic groundwater exploitation program for this project as follows:

1. Utilization of groundwater to be extracted

The main purpose of the program is to extract groundwater are for agriculture and domestic use. The requested groundwater demand, considering the expansion of irrigated arable land and the served area within five years, will be estimated below. There is also the possibility that surface water development will be developed with priority during the same period. The preliminary calculation results are as follows:

2. Estimation of water sources demand

A) Irrigation

The demand of irrigation will be estimated based on the assumption of the last 30 years growth ratio, which means that 5% of the non-irrigated arable area will be possible to irrigate within five years. The water source demand for new-irrigation will be estimated from the water consumption ratio of multiple crops with consideration for the agricultural system and meteorological data in each district being taken into account.

B) Water supply

The demand for water supply was estimated based on the population and on the percentage of water-served households in urban areas, which will be increased from 83% at present to 90% in 2002 (the target year), due to the centralization of surplus population such as refugees.

The unit consumption rate used for this study is defined as 117 lpcd as the standard unit of Pakistan.

3. The ratio of reliance to groundwater (See Appendices: Nature Environment)

Water sources are classified into surface water, dam, spring, Karez, dug well and tubewell. The groundwater potential could be estimated with regard to its storage and recharge cycle. To disturb the equilibrium of the hydraulic balance takes a long time, longer as several decades, and a century or more to recover the balance. Therefore, haphazard groundwater development should be avoided whenever possible. Based on the needs of water quality and quantity, the water sources other than groundwater extracted by tubewell have developmental priority due to the limited groundwater in Balochistan.

A) Irrigation

Water source development for irrigation water was requested to insure a great quantity of water rather than quality. Thus, groundwater exploitation by tubewell should be minimized versus the other possible sources. The reliance ratios for each water source are as follows.

Table 2-1 Distribution of Water Sources for Irrigation

District	Surface Water	Dam	Spring	Shallow Well	Deep Well
Ziarat	20 %	35 %	40 %	5 %	0 %
Mastung	0 %	15 %	5 %	50 %	30 %
Kalat	5 %	15 %	10 %	65 %	10 %
Khuzdar	5 %	15 %	10 %	65 %	10 %
Panjgur	5 %	25 %	5 %	60 %	5 %
Turbat	5 %	25 %	5 %	60 %	5 %

Note: the above percentages were estimated by the team's observations during their visit to each district (please refer to Appendix 5-5 Groundwater Development).

B) Water supply

The water source for water supply should be groundwater in terms of safety and stability.

4. Comparison of water demand and possibility of groundwater development

Previously the target of groundwater development was only porous aquifers in sedimentary formations. Currently however, groundwater development targets fissured aquifers in base rock formations.

However, the investigation of fissured aquifers has almost finished in some areas of Ziarat and Mastung. From the viewpoint of hydrogeology, the fissured aquifer would presents the greatest untapped potential for groundwater development in the whole of Balochistan without regard for the difficulties of technology and productivity.

At the present, the program's aim is to develop the groundwater as a basis of social infrastructure, therefore alluvium lowland as irrigation by topographical reason and a densely populated area as water supply, will be nominated as most effective areas for project sites. The potential will be evaluated equally between porous and fissured aquifers in Balochistan.

The ratio of demand versus potential of groundwater development is 14 percent on average. The most progressive areas of groundwater development are seen in the Mastung and Kalat Districts. Thus, effective use and management of groundwater is urgently required in two districts.

Based on the results of the Study, it was concluded that the necessary demand of groundwater development is 239,000m^3/day as shown in Table 2-4. This is much less than the area's potential.

Table 2-2 Required Groundwater Development for Irrigation

District	Non-Irrigated Area 1,000ha	Planned Irrigation Area 1,000ha	DeepWell Reliant Ratio %	Area Irrigated by GW 1,000ha	Planned Well Yield 1,000 m^3 /d
Ziarat	8.4	0.42	0	0	0
Mastung	28.0	1.40	30	0.42	63.6
Kalat	44.1	2.21	10	0.22	29.6
Khuzdar	57.8	2.89	10	0.29	56.1
Panjgur	15.9	0.80	5	0.04	11.2
Turbat	27.9	1.40	5	0.07	17.6
TOTAL	182.1	9.12		1.04	178.1

Note: the above percentages were estimated using data from the Agriculture Department (please refer to Appendix 5-3).

Table 2-3 Projected Groundwater Development for Water Supply

District	1997		2002		Increase	
	Projected Population	Water Volume m^3 /d	Projected Population	Water Volume m^3 /d	Projected Population	Water Volume m^3 /d
Ziarat	49,500	5,760	67,500	7,900	18,000	2,140
Mastung	192,400	22,385	257,400	30,120	65,000	7,735
Kalat	301,500	35,070	401,400	46,960	99,900	11,890
Khuzdar	163,350	19,010	221,000	25,860	57,650	6,850
Panjgur	231,250	26,900	307,800	36,010	76,550	9,110
Turbat	559,450	65,090	754,200	88,240	194,750	23,150
TOTAL	1,497,450	174,215	2,009,300	235,090	511,850	60,875

Note: the above estimation is based on data from PHED (please refer to Appendix 5-2 & 5-3).

Table 2-4 Confirmation of Groundwater Balance

($1,000m^3$ /d)

Distrct	Groundwater Requirment			Groundwater Potential
	Irrigation	Water Supply	TOTAL	
Ziarat	0	2.1	2.1	< 200.6
Mastung	63.6	7.7	71.3	< 322.5
Kalat	29.6	11.9	41.5	< 118.7
Khuzdar	56.1	6.9	63.0	< 623.3
Panjgur	11.2	9.1	20.3	< 113.7
Turbat	17.6	23.2	40.8	< 275.1
TOTAL	178.1	60.9	239.0	< 1,673.9

Note: the groundwater potential can be found in Appendix 5-2.

5. Planned tubewell installation

The execution program will be scheduled in view of the required demand for groundwater development. The program shall be implemented with the necessary rigs in each year in consideration of well yield and the installation schedule. Hydrogeological factors, production factors, geological condition and matters determined by rig performance, installation schedule and annual working time, are to be used for trial estimation as shown below.

A) Necessary tubewells

The 297 tubewell installation were counted by well yield and demand in each district. The well yields were accounted due to the target aquifer condition. The sites are so varied because of the wide project area, which are approximately 117,000 km^2. Therefore, well yield will be assumed by adoption of mean condition includes abandoned tubewells based on WAPDA's data of the last five years as the most practical method.

Table 2-5 Required Numbers of Wells to be Constructed

District	Groundwater Requirement 1,000m^3/d			Well Yield 1,000 m3/d	Well Number		
	Irrigation	Water Supply	Total		Irrigation	Water Supply	Total
Ziarat	0	2.1	2.1	1.26	0	2	2
Mastung	63.6	7.7	71.3	0.68	94	11	105
Kalat	29.6	11.9	41.5	0.79	38	15	53
Khuzdar	56.1	6.9	63.0	0.83	68	8	76
Panjgur	11.2	9.1	20.3	0.72	16	13	29
Turbat	17.6	23.2	40.8	0.72	24	32	56
TOTAL	178.1	60.9	239.0		240	81	321

Note: well yield can be found in Appendix 5-5.

B) Standard tubewell installation term

The well construction period shall be scheduled depending on the well structure, geological conditions, rig performance and transport conditions. Therefore, a standard construction term for tubewell installation will be estimated by the average rate, which is derived from WAPDA's data of the last five years as below.

Table 2-6 Standard Well Construction Term for Tubewell Installation

District	Depth (m/well)		Construction Term (day/well)				Term
	Max.	Ave.	Setup	Drilling	Install	Total	(Month)
Ziarat	305	230	5	50	10	65	2.2
Mastung	340	245	5	55	10	70	2.3
Kalat	270	150	5	40	10	55	1.8
Kharan	245	120	5	35	10	50	1.7
Panjgur	150	80	5	30	10	45	1.5
Turbat	150	80	5	30	10	45	1.5

Note: the above-mentioned data can be found in Appendix Article 5.

6. Required rigs

The annual required amount of rigs will be examined by the necessary tubewell installation number, the standard construction term and the annual working days.

Rig working days = (365 days x 6/7) - 25 days for holidays - 18 days for maintenance

= 270 days or 9 months

Then the required total rigs are estimated to total 67 annually as shown below.

Table 2-7 Required Number of Rigs

District	Well Number			Construction Term (Month/Well)	Required Rig Number		
	Irigation	Water Supply	Total		Irigation	Water Supply	Total
Ziarat	0	2	2	2.2	0	0.5	0.5
Mastung	94	11	105	2.3	24.0	2.8	26.8
Kalat	38	15	53	1.8	7.6	3.0	10.6
Khuzn	68	8	76	1.7	12.8	1.5	14.3
Panjgur	16	13	29	1.5	2.7	2.2	4.9
Turbat	24	32	56	1.5	4.0	5.3	9.3
TOTAL	240	81	321		51.1	15.3	66.4

Note: The above-mentioned data can be found in Appendix Article 5.

The number of rigs to be procured under this project is calculated from a) total number of rigs as given in Table 1-7, b) number of rigs workable at concerned government agencies, and c) out of the total number of rigs to be used for the project area.

A) Workable rig number

Generally, the service life of drilling rigs is 10 to 15 years and 20 years in some cases depending on operating conditions and normal O&M. However, some rigs are still in service beyond 20 years in Balochistan despite the hostile environment and operating conditions. The rigs are used properly by WAPDA. Therefore, the useful service life of rig has been assumed as 23 years taking into account the above situations.

Based on this assumption of the service life of rigs, the number of workable rigs is estimated as in Table 1-8. In this estimation, six rigs to be procured from France in 1996 are not considered as they will be used outside the project area.

Table 2-8 Number of Workable Rigs in the Future

Year / Agency	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
WAPDA	13	15	13	13	13	13	10	10	6	6	4	4
B D A	8	4	5	5	5	5	5	5	5	5	5	5
I & P D	7	7	7	7	7	7	7	7	7	7	7	7
P H E D	7	7	8	8	8	8	8	8	8	8	8	8
TOTAL	35	33	33	33	33	33	30	30	26	26	24	24

B) Number of rigs to be used for project area

The groundwater development in the project area had not made a good progress since 1970's due to the long distances of the potential sites from Quetta, and also in the absence of groundwater investigation aquifers. However, development has begun as a matter of high priority in recent years. This is mainly because of the use of high-performance rigs provided by The Japanese Government and the wide and deep groundwater investigation in the environs of Quetta assisted by JICA.

Therefore, the number of rigs to be used for project area will be calculated based on the data of the recent five years.

Table 2-9 Number of Rigs to be used in the Project Area

Year / Agency	1997	1998	1999	2000	2001	Total	Useable Ratio in Project Area
WAPDA	2.7	1.6	1.6	1.1	1.1	8.1	27 %
B D A	1.5	1.5	1.5	1.5	1.5	7.5	30 %
I & P D	2.1	2.1	2.1	2.1	2.1	10.5	30 %
P H E D	2.4	2.4	2.4	2.4	2.4	12.0	30 %
TOTAL	8.7	7.6	7.6	7.1	7.1	38.1	

Note: Refer to Appendix 5-4 & 5-5.

C) Rigs to be procured

As a result of the above mentioned process, number of rigs to be procured for the project is determined as below:

Number of rigs to be procured = (required total rig number - workable rig number) / program years

= (66.4 - 38.1)/5 = 5.66 = 6 (the requested number)

7. Decision of rig numbers to be procured

It is confirmed that 6 rigs would be necessary to promote the groundwater development program in Balochistan. The items (rigs and accessories with supporting equipment) to be covered by the Project have been discussed extensively by both parties, and the result has been summarized in Table 1-10.

Items under the column "Original" are those originally requested by the government of Balochistan in July of 1995. Items under the columns "Alternative 1" and "Alternative 2" are those to be considered by the Government of Japan in the case the items in the original request cannot be fully met due to budget constraints within the Government of Japan.

Among the two alternatives, the Pakistani side prefers Alternative 2 due to the inability to proceed with the groundwater development work without the supporting equipment.

Table 2-10 Requested Items

ITEM	QUANTITY		
	Original	Alternative 1	Alternative 2
1. Well Construction Equipment			
1.1. Rotary Type Rig Unit	4	4	4
<Contents of Unit>			
Rotary Type Rig (300 m)	(1)	(1)	(1)
Service Truck	(1)	(1)	(1)
Water Tanker Truck	(1)	(1)	(1)
Service Pickup	(1)	(1)	(1)

Table 1-10 (Continued) ITEM	QUANTITY		
	Original	Alternative 1	Alternative 2
1.2. Percussion Type Rig Unit	2	2	1
<Contents of Unit>			
Percussion Type Rig (200 m)	(1)	(1)	(1)
Service Truck	(1)	(1)	(1)
Water Tanker Truck	(1)	(1)	(1)
Service Pickup	(1)	(1)	(1)
1.3 Air Drilling Equipment	1	0	0
2. Supporting Equipment			
2.1 For Mobilization and Demobilization			
(1) Cargo Truck with Crane	2	1	2
(2) Tractor	1	0	0
2.2 Pumping Test Equipment			
(1) Submersible Motor Pump	1	0	0
(2) Turbine Pump	1	0	1
3. Mobile Type Well-logger	1	1	1
4. Mobile Type Workshop	1	1	1
5. Spare Parts			
5.1 For the equipment to be supplied	1	1	1
5.2 For the existing drilling rigs	1	0	0

In the case of "Alternative 2", the following well number will be constructed by the equipment to be procured under Japanese Grant Aid.

Agency \ Purpose		Rig Number	Construction Wells		
			Irrigation	Water Supply	TOTAL
WAPDA	New Rigs	25.0	94	24	118
	Existing Rigs	8.1	38	--	38
	Total	33.1	132	24	156
B D A		7.5	35	--	35
I & P D		10.5	49	--	49
P H E D		12.0	--	57	57
T O T A L		63.1	216	81	297
In Case of 6 Rigs		68.1	240	81	321

Table 2-11 WAPDA's Construction Wells and Rig Number of New Rigs

District	Construction Well Number		New Rig Number Breakdown					
			Number/5year			Number/year		
	Irrigation	Water Supply	Irrigation	Water Supply	Total	Irrigation	Water Supply	Total
Ziarat	0.0	0.6	0.00	0.13	0.13	0.00	0.03	0.03
Mastung	36.8	3.3	7.78	0.70	8.48	1.55	0.14	1.69
Kalat	14.9	4.4	3.16	0.93	4.09	0.63	0.19	0.82
Khuzdar	26.6	2.4	5.64	0.51	6.15	1.12	0.10	1.22
Panjgur	6.3	3.9	1.33	0.83	2.16	0.27	0.17	0.44
Turbat	9.4	9.4	1.99	2.00	3.99	0.40	0.40	0.80
TOTAL	94.0	21.0	19.90	5.10	25.00	3.97	1.03	5.00
	118.0							

Table 2-12 Area, Number and Use of WAPDA's Rigs

(3) Identity of the rigs

Presently, WAPDA has four Japanese rotary rigs with a capability of 300 m drilling, which were procured under the previous Japanese Grant Aid project. WAPDA has requested additional four rotary rigs (300 m depth capacity) and two percussion rigs (200 m depth capacity).

The percussion rigs will be used for tubewell installation in unconsolidated formations with a maximum depth of 200 m and also in areas with well-known hydrogeology conditions. In this case, the percussion rigs have advantages, such as saving of costs for well construction and equipment maintenance.

This is highly appreciated as a practical request. The validity of the demarcation to provide suitable rig types for each district will be identified in terms of factors such as the well construction numbers and the tubewell structures, including geological conditions as below.

Table 2-13 Rig Identification

District	Planned Tubewell Depth		Applicability of Rig Type		Applicability of Rig Number	
	Ave. (m)	Max. (m)	Rotaly	Percussion	Rotaly	Percussion
Ziarat	230	305	○	×	0.03	—
Mastung	245	340	○	×	1.69	—
Kalat	150	270	○	△	0.62	0.20
Kharan	120	245	○	△	0.92	0.30
Panjgur	80	150	△	○	0.11	0.33
Turbat	80	150	△	○	0.20	0.60
TOTAL					3.57 → 4	1.43 → 1

NOTE : ◎=Most Suitable, ○=Suitable, △=Near Suitable, ×=Unfit

2.3 Basic Design

The basic design will with follow a concept for the promotion of a groundwater development program in Balochistan.

2.3.1 Design Concept

The goal of the groundwater development program for Balochistan is to construct 297 tubewells in six districts of the project sites for irrigation and water supply. Thus, the equipment to be procured under Japanese Grant Aid should be fitted to the specifications of this program and that the rigs will conform to the necessary design specifications in consideration of the hydrogeology, weather and other factors as shown below.

(1) Environmental Considerations for Project Equipment

1. Geological conditions and standard tubewell design

The project sites are areas where deep tubewell investigation and development will be required in the future and the sites are mainly located in the Central Convergence Zone of Balochistan Province. The target groundwater will be developed from the porous and fissured aquifers found therein. The standard tubewell structures are to have a depth of 200 m (maximum) for drilling in sedimentary formations and 300 m (maximum) for drilling in rock formations. The average depth of the tubewells were recorded at 100 m to 250 m using the district-wide statistics from WAPDA, and well depths in northern areas were found to require more depth than the southern districts.

2. Highland sites

The project sites will cover the highland district of Ziarat. The power-unit specifications of should be phrased in output-power down of machinery power unit in maximum 2,500 m altitude above the sea level.

3. Temperature variation

The equipment should be specified for both cold and hot climate use, because Balochistan has one of the biggest temperature daily and seasonal differences in Pakistan.

(2) Tubewell construction method

The equipment should be designed with consideration of the construction schedule as is denoted below.

1. Drilling method

WAPDA uses the direct mud and air circulation method for rotary drilling and the cased hole method for percussion drilling. However, using air drilling as a down-the-hole (DTH) method is one capable of drilling in hard rock formations only in a small diameter. This method is for groundwater investigation and is not suitable for tubewell construction for production use. It is recommended that equipment for the direct-mud method for rotary drilling and for the cased-hole method for percussion drilling will be designated.

2. Water sampling

WAPDA has used a water sampling procedure during the pilot hole drilling, except in those areas precisely investigated previously. This procedure is necessary to evaluate the quantity and quality of the groundwater in the test area. The equipment used for water sampling will be fixed to the drilling units.

(3) Local Products

Local products are most suitable to maintain the equipment procured under this project. If the parts and other materials necessary for the supplied equipment is available on the local market through local agents, WAPDA will be able to purchase them easily and quickly. This will ensure better maintenance of the equipment.

(4) WAPDA Maintenance Abilities

WAPDA has a high technical proficiency level and has a great deal of experience in maintaining equipment. This is especially true in regard to the harsh hydrogeology, weather and road conditions in Balochistan. WAPDA has maintained its equipment for a duration exceeding the expected equipment life cycles. In keeping with this, the maintenance equipment should be designed for making the most of their maintenance work.

(5) Implementation Schedule

The implementation schedule will be an estimated 12 months for the detailed design and for the procurement of the equipment. Thus it is not necessary to execute within multiple fiscal years.

2.3.2 Basic Design

(1) Optimum Type and Number of Main Equipment

The type and number of rigs is justified as below from examination of the groundwater development program in 2.2.2 Realistic Groundwater Development .

Table 2-14 Outline of Planned Rigs

Description	Capacity	Number	Notes
Rotary type	Max 300m of Depth or more	4	Top Head Drive
Percussion type	Max 200m of Depth or more	1	Spudding Drive

While the team stayed for the field survey in Pakistan, the team held discussions with WAPDA to finalize the other main items requested by the Pakistani side as shown below.

Final Items Requested by the Pakistani Side:

Item	Quantity
1. Service truck:	same number of rigs
2. Water tanker truck:	ditto
3. Service pickup:	ditto
4. Air compressor for well development:	ditto
5. Welding plant:	ditto
6. DTH drilling equipment:	1 unit
7. Cargo truck with crane:	2 units
8. Tractor with road-scraper:	1 unit
9. Pumping test equipment:	2 units
10. Geophysical survey instrument:	1 unit
11. Workshop equipment:	1 unit
12. Spare parts for above equipment:	1 lot
13. Spare parts for Japanese rig (inventory):	1 lot

Based on the final requirements of the Pakistani side, the study team had re-examined the rig inventory of government agencies, the capabilities and technology of well construction, the performance of rig O&M, and the organizational operating formation in Japan.

For smooth and effective implementation of groundwater development program, the next main items are determined as the proper useful types and numbers for the project. The grounds of this decision are as follows:

A) Well drilling equipment (Items 1 to 5)

The well construction work cannot function without the main and supporting equipment such as drilling rigs, tools, tanker truck, etc. In addition, the project sites are widely disbursed throughout Balochistan, and thus the equipment as mentioned below should be present and in ready position at each site with each rig to be procured as part of the progressive implementation of the groundwater development program.

a. Service truck

Fourteen (14) service trucks are in working condition. This number is almost the same number of the present working rigs. Normally, mobilization and demobilization to each job site will be undertaken 10 to 15 times via truck transportation. Under the usual road conditions, driving and maintenance, the useful life driving distance of a truck is approximately 500,000 km. On the other hand, the average distance traveled by WAPDA's truck inventory is about 384,000 km. Thus, this service truck is an indispensable item for the well drilling units in order to keep an effective rig operation ratio.

b. Water tanker truck

Fifteen (15) water tanker trucks are in operational condition. This number is the same as the number of rigs. Usually, a rig's operation is mostly for drilling work at every site, including water sampling for water quality analysis. The construction water should be ready for drilling work at any time and for any drilling method. If the construction water is not delivered, the drilling work and borehole condition became difficult almost immediately. Thus, this water tanker truck is an indispensible item for the well drilling units.

c. Service pickup

There is no service pickup in WAPDA's inventory. They use a service truck even for the urgent delivery of small parts from Quetta or other local markets. This might be one of the factors making the rig

operation ratio lower. WAPDA would be able to get valuable service from a service pickup for job site management works and transportation of sundry parts and supplies. Thus, this service pickup is an indispensible item for the well drilling units.

d. Air compressor for well development

Five (5) air compressors are being used for well development at 13 rig sites in the whole of Balochistan. These air compressors are divided amongst several territories and are shifted to various sites depending on the progress of construction schedule. This means that about half of the sites are forced to wait for air an compressor to start well development for a few days or sometimes a month. On the other hand, WAPDA has used these air compressors both for well development and DTH drilling jobs. It is therefore recommended that the specification for air compressors should be fixed to the development tubewell only. Based on the situation of the site work in Balochistan, the air compressor is an indispensable item.

e. Welding plant

At present, 11 welding plants are operated at the sites of 13 rigs. A welding plant should be established at each site not only for the installation of well casing strings, but also for the emergency and temporary repair of equipment. Thus, the welding plants are indispensable items for the well drilling units.

The number and other conditions of the above items in WAPDA's inventory are indicated in the table below.

Table 2-15 Supporting Equipment Inventory

Equipment	Number	Workable Number	Service Year	Distance Travelled (1,000km)	Operation Hours
Service Truck	19	14 (9)	12.8	384	–
Water Tanker Truck	17	15 (2)	17.9	434	–
Service Pickup	0	0	–	–	–
Air Compressor	7	5 (2)	9.0	–	2,890
Welding Plant	15	11 (8)	16.1	–	7,200

NOTE : Numbers in ( ) procured by Japanese Grant Aid in 1985 and 1991

B) DTH (down-the-hole) drilling equipment (Item 6)

The DTH drilling method is most suitable for drilling in hard rock formations with a small diameter (maximum 200 mm, or 7 7/8") up to about 200 m (650'). This bore hole structure is utilized only for groundwater investigation purposes.

For the installation of production tubewells, a final bore hole diameter should be reamed with a 445 mm (17 1/2") diameter hole opener and have 250A (10") diameter casing strings installed into the bore hole. WAPDA has had experience in drilling using DTH equipment a few times before, but their own air compressors also have the capability to be used for DTH drilling with one unit of DTH hammer unit that was procured under the past Japanese Grant Aid project.

While the study team stayed in Pakistan for the field survey, the DTH drilling equipment was included among the final items requested as independent items. However, the team finally decided to exclude this item from the project components in consideration of the geological conditions of the project sites and their equipment inventory.

C) Supporting equipment (Items 7 to 9)

This equipment consists of items to be used for a given period of time or at necessary sites only. The results of the examination of the equipment needs are shown as below.

a. Cargo truck with crane

WAPDA possess three crane trucks. These were procured under the previous Japanese Grant Aid project and are still in working condition. Before these crane trucks were procured, WAPDA had used tripods with manual-powered chain hoists or man power for loading and unloading at the warehouse and job sites.

The well construction equipment is of heavy duty make and of heavy weight. Equipment for safe loading/unloading, such as cranes, is necessary.

The drilling equipment to be procured should be utilized for a long-term period of groundwater development in Balochistan. Thus two units of cargo truck with crane is appropriate as part of the project components.

b. Tractor with road-scraper

The tractor will be used for the construction of access ways to drilling points. Usually, when WAPDA needs land readjustment at the way to sites, they rented tractor from someone such as the Agricultural Department or a local farmer. The team could understand the reason to include this item among the project components, but it would be quite difficult to use the item over the whole of project area. Also due to the difficulty of transporting or driving the tractor to the various sites, the existing method is more practical and cost-effective. Thus the tractor with road-scraper is not considered a necessary item under the project.

c. Pumping test equipment

WAPDA owns six (6) units of pumping equipment. Pumping tests should be carried out as an evaluation of the reasonable pumping ratio for production tubewells and of an aquifer's hydraulic coefficient, such as permeability coefficient, storativity and influence circle with the observation wells. Also the pumping test results will be use for designing the pumping facilities.

Presently, about 90 percent of the tubewells to be installed are tested (excluding some investigative tubewells). Thus, this is necessary equipment for the project. However, WAPDA usually installs local manufacturer's products, and there is no problem of quality, performance, and delivery in the local market.

The number and conditions of the above items in WAPDA's inventory are indicated in the table below.

Table 2-16 Supporting Equipment Inventory

Equipment	Number	Workable Number	Service Year	Distance Travelled (1,000km)	Operation Hours
Cargo Truck with Crane	3	3 (3)	8.0	192	—
Tractor	0	0 (0)	—	—	—
Pumping Test Equipment	8	6 (0)	12.3	—	12,800

Note: the numbers in ( ) are those items procured by Japanese Grant Aid in 1985 and 1991.

D) Geophysical survey instrument (Item 10)

WAPDA had requested two kinds of geophysical survey instruments such as resistivity meter and well-logging units. A resistivity meter is used for a rough geological survey of a wide area within a short time period. The Geology Section of WAPDA is responsible for conducting geological surveys and has two parties with two instruments. Deeper surveys were requested by WAPDA, but in Balochistan's arid conditions electrical prospecting is limited to 250 m (800') to 350 m (1,200') in depth analytically. Only a seismic meter is available to sound over 500 m (1,600'). But under the laws of Pakistan, the use of dynamite as a large focus is not approved except in the conduct of the Geological Survey of Pakistan and by some authorized oil companies. Therefore, the team removed the resistivity meter from the final requested list. The examination results of the other item is as follows:

a. Well-logging instrument

A well-loggers is used for physical logs to determine of a formation's condition and boundary depth with consideration of soil samples and drilling operation logs. These logs are the most important data for deciding upon a final well design program. WAPDA's Hydrogeology Section is responsible for conducting the well design process and has two units of well-loggers. The calibration of these two well-loggers are fixed to existing drilling units. An additional unit of well-logger is deemed useful for the project.

The number and conditions of above items inventory by WAPDA are indicated as below table.

Table 2-17 Geophysical Survey Instrument Inventory

Geophysical Survey Instruments	Number	Workable Number	Service Year
Resistivity Meter	3	2 (2)	9.0
Well-logger	4	2 (1)	8.3

Note: the numbers in ( ) are those items procured by Japanese Grant Aid in 1985 and 1991.

E) Workshop equipment (Item 11)

The workshop is the only one located at Quetta beside the head quarters building. If equipment is not so seriously damaged, the drilling staff tries to repair the equipment themselves at each drilling site.

Otherwise, they have to send the damaged parts to a local repair shop or return the equipment to the Quetta workshop. This has disadvantages in that the local workshops have quiet primitive repair techniques, and it takes much time to return the equipment to the Quetta workshop. WAPDA's data from the last few years indicate that every piece of equipment stayed 18 days in their workshop for maintenance on average.

In connection with the above conditions, the request of mobile type workshop is so reasonable. Thus, this item will be included in the project components.

When this mobile workshop is provided, the number of WAPDA's rigs will be reduced to four from the present 13 rigs. The total number of rigs would be nine (9) with five (5) rigs to be procured under the project. The one mobile workshop is enough for the project by the reason detailed below.

1. preparation days before and after the traveled maintenance per unit
   3 days + 1 day = 4 days
2. days of back and forth travel to the site for each unit
   3 days + 3 days = 6 days
3. days of traveled maintenance and repair at the site for each unit
   5 days
4. traveled maintenance times per year and each unit
   1.5 times/year and unit
5. reasonable number of mobile workshop
   [(1) + (2) + (3)] x (4) x number of rig unit (workdays/year)
   = [4 + 6 + 5] x 1.5 x 9 ÷ 270 = 0.75 →1 unit

F) Spare parts (Items 12 to 13)

In the past Japanese Grant Aid Projects, the provided spare parts were recommended by the manufacturer of the the equipment provided. Some parts were never used, and some parts were consumed within short periods due to the peculiar conditions of Balochistan, such as inclimate weather, inferior roads, poorly supplied markets and poor work progress.

Descriptions of the main consumable items were first for rigs such as uncommon, special steel and hydraulic parts, and second for trucks, such as long-period delivery and costly parts. Other parts were purchased by WAPDA. The cost to be allocated by WAPDA is approximately Rs45,000 (¥142,000) per well to cover the maintenance costs, which is about six percent of the direct well construction costs. Thus, only useful parts should be selected for the project through the examination of the spare parts inventory shown below.

a. Spare parts to be procured

Drilling rigs are very unique machines. Most of a rig's parts are uncommon and are supplied only by the manufacturer. This means that all kinds of spare parts for the rigs should be procured in accordance with the parts consumption ratio of the last few years.

The spare parts for other equipment should be selected only for necessary items such as engines, alternators, transmissions and differentials.

b. Spare parts to be procured for the existing rigs

The implementing agency is responsible for the purchase of spare parts after consuming the spare parts procured with the equipment. Even though it takes the time and cost to order a rig's spare parts, it was recorded that WAPDA bought some spare parts for the existing Japanese rigs last year. Thus, these requested items will be excluded from the project.

(2) Specification of main equipment

Based on the above-mentioned design concept, the specifications of main equipment were determined as follows:

1. Drilling equipment

Contents for one (1) unit of rotary drilling equipment : total 4 units

A) Rotary drilling unit : Total: 4 units

a. Rotary Rig: 1 unit

Model

Top head drive type, enabling both conventional mud and air drilling.

The rig components are assembled and mounted on truck.

Capacity

The rig has the capacity to drill boreholes with a 17 1/2" diameter to a depth of 300 m or more.

Truck

Truck is a standard product for Pakistan import. It is water-cooled diesel engine truck, 6x6 drive with standard accessories and a spare tire.

- Standard accessories: 1 lot

  Handling tools for all tool strings and hand tools for maintenance and job site works.

- Drilling tools: 1 lot

  drill pipes; OD flash joint type, 6 m/pc x 55 pcs (330 m)

  drill collar; OD flash joint type, 6 m/pc x 2 pcs

  stabilizer; for 7 7/8" and 12 1/4", 2 pcs each

  tricone bit; for 7 7/8" and 12 1/4", 1 lot each

  hole opener ; for 12 1/4" and 17 1/2", 1 pc each with spare cutters

  subs; bit subs, ware subs, cross over subs and so on, 1 lot

- Casing tools: 1 lot

  casing clamps; for 8" and 10", 1 set each, with sling wire ropes

- Fishing tools: 1 lot

  inside tap; for all drilling strings, 1 pc

  outside tap; for all drilling strings, 1 pc

  magnet; for tip insert, 1 pc

b. **Air Lifting Equipment: 1 unit**

Model

Screw type, water cooled diesel engine driven with standard accessories.

The air compressor is mounted on trailer.

Capacity

Normal effective working pressure is 17 bares or more.

Actual free air delivery is 8 m^3/min. or more.

Trailer

Trailer is four wheels type.

- Air line

  The pipes for air line are 1 1/4" diameter and total length 250 m

  The air hose will be fixed to air compressor and pipes, length 30 m

- Screen for riser pipe

  This screen should be jointed to drilling tools, and 6 m long x 1 pc.

- Measurement instrument

  Water level indicator, battery operated, 200 m, 1 set.

  Portable conductivity and pH meter, 1 set each.

c. **Welding Plant: 1 unit**

Model

Water cooled diesel engine driven with standard and welding accessories.

The welding plant is mounted on trailer.

Capacity

current; 30 to 280 A

welding rod; 2.0 to 6.0 mm

auxiliary; single phase, 1 kVA x AC220 V

Trailer

Trailer is four wheels type.

d. **Service Truck: 1 unit**

Model

Truck is standard product for Pakistan import. It is water-cooled diesel engine truck, 4x2 drive with standard accessories and a spare tire.

Type

loading; 8 tons or more

platform; 7m or more

e. water tanker truck: 1 unit

Model

Truck is standard product for Pakistan import. It is water-cooled diesel engine truck, 4x2 drive with standard accessories and a spare tire.

Type

tank; 9,000 liters or more

pump; self-priming pump, power-take-off driven

f. Service Pick-up: 1 unit

Model

Truck is standard product for Pakistan import. It is water-cooled diesel engine truck, 4x4 drive with standard accessories and a spare tire.

Type

loading; 900 kg or more

cab; double cab with 5 passenger seating

B) Percussion drilling unit: Total: 1 unit1

a. Percussion Rig: 1 unit

Model

Cable tool spudding and deck engine drive type. The rig components are assembled and mounted on truck.

Capacity

The rig has capacity to drill borcholes with 17" diameter to a depth of 200 m or more. Tool weight shall be 1,800 kg or more.

Truck

Truck is standard product for Pakistan import. It is water cooled diesel engine truck, 4x4 drive with standard accessories and a spare tire.

- standard accessories: 1 lot

  Handling tools for all tool strings and hand tools for maintenance and job site works.

- drilling tools: 1 lot

  conventional; for 17" and 15" of inside diameters, 2 pcs each size tubular; for 17" and 15" of inside diameters, 2 pcs each size

- drive pipes: 1 lot

  pipes; ASTM A53, grade B or equivalent

  thread; BS 879, 4 threads/inch or equivalent

  size; 18" OD x 17" ID x 3 m long/pc; 16" OD x 15" ID x 3 m long/pc

  length; 18" OD x 40 pcs, total 120 m; 16"OD x 70 pcs, total 210 m

  drive shoe; for 18" and 16", 1 set each

  drive head; for 18" and 16", 1 set each

  casing clamps; for 18"OD and 16"OD, 1 set each

- casing tools: 1 lot

  casing clamps; for 8" and 10", 1 set each, with sling wire ropes

- fishing tools: 1 lot

  conventional; suitable for above mentioned specification

  tubular; suitable for above mentioned specification

  jack; twin hydraulic type, 50 tonnes jack capacity

  fishing rod; tensile strength shall be 100 tonnes or more, 200 m

  magnet; for steel materials

b. **Air Lifting Equipment: 1 unit**

Model

Screw type, water cooled diesel engine driven with standard accessories.

The air compressor is mounted on trailer.

Capacity

Normal effective working pressure is 12 bars or more.

Actual free air delivery is 8 m^3/min. or more.

Trailer

Trailer is four wheels type.

- Air line

  The pipes for air line are 1 1/4" diameter and total length 165 m.

  The air hose will be fixed to air compressor and pipes, length 30 m

  The riser pipes are 4" diameter and total length 220 m

- Measurement instrument

  Water level indicator, battery operated, 200 m, 1 set.

  Portable conductivity and pH meter, 1 set each.

  Cable tool type water sampler, 2 sets

c. **Welding Plant: 1 unit**

Same as rotary drilling unit

d. **Service Truck: 1 unit**

Same as rotary drilling unit

e. **Water Tanker Truck: 1 unit**

Same as rotary drilling unit

f. **Service Pick-up: 1 unit**

Same as rotary drilling unit

2. Supporting equipment

A) cargo truck with crane: 2 units

Model

Truck is standard product for Pakistan import. It is water-cooled diesel engine truck, 4x2 drive with standard accessories and a spare tire.

Type

loading; 5 tones or more

crane; 5 tones or more, power-take-off hydraulic operation

accessories ; pipe hooker and other sling wire ropes

B) Turbine Pump: 1 unit

Performance

Pump capacity of 1.7 m^3/min discharge and a total head of 107 m or more.

Power Unit

Diesel engine power unit and gear head with suitable gear ratio.

Accessories

Installation tools, measuring accessories for water discharge and level should be included.

3. Geophysical survey instrument

mobile type well-logger : 1 unit

Model

Geophysical logging instrument mounted on vehicle with standard

accessories and maintenance tools.

Performance

probe; resistivity, SP and natural gamma-ray

cable; 400 m of armored cable, power winch and cable counter

Vehicle

Water-cooled diesel engine hard top vehicle, 4x2 drive with standard accessories and a spare tire.

4. Workshop

mobile type workshop equipment : 1 unit

Model

Workshop equipment mounted on truck with standard accessories and maintenance tools. Workshop house is structural aluminum constructed, ventilators and a door at ear end, furnished with room lamps, receptacles, work tables, tool chest and tool box.

Equipment

welding plant; 30 to 280 A

generator; 15 kVA or more, AC440/220V x 50 Hz

gas equipment; oxygen-acetylene welding and cutting

compressor; 7 bares x 80 liters per minute or more

bench drill; capable to drill up to 13 mm diameter

bench grinder; 150 mm grinding wheel

bench vise; 150 mm jaw opening

bench press; 5 tones or more with 120 mm ram strokes

hand drill; capable to drill up to 10 mm diameter

hand grinder; 100 mm grinding wheel

machinist; machinist hand tool kit

electric; electrical hand tool kit

measure; measuring tool kit

meter; megger, V-A, hydrometer and so on

others; chain hoist, tri-pod, sling wire ropes

Truck

Water-cooled diesel engine truck, 4x4 drive with standard accessories and a spare tire.

5. Spare parts

A) drilling equipment: 1 lot

B) cargo truck with crane: 1 lot

C) mobile type well-logger: 1 lot

D) mobile type workshop: 1 lot

Chapter 3
Implementation Plan

3. Implementation Plan

3.1 Implementation Plan

The following are basic items related to the project after the basic design study.

3.1.1 Implementation Concept

WAPDA, as the implementing agency, is under direct control of the Government of Pakistan. At the same time, WAPDA is also under the management of the P&DD (Planing and Development Department) of the Government of Balochistan, for the purposes of groundwater development program in Balochistan. The following table shows the formation of project operation.

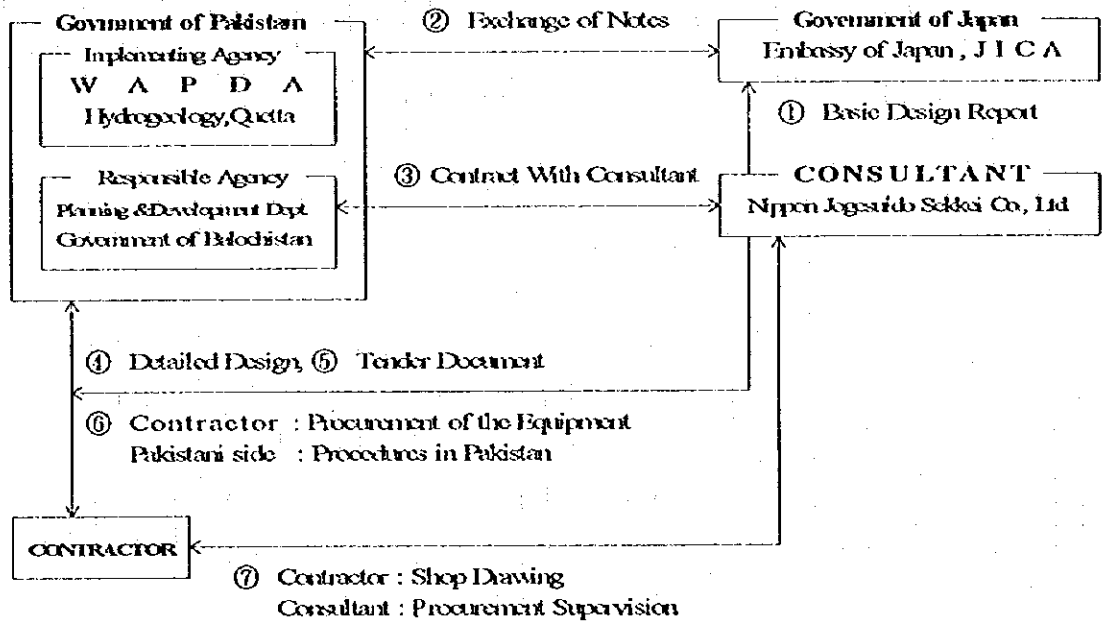


Figure 3-1 Project Formation

(1) Implementing Agency

After the Exchange of Notes is signed between the Government of Pakistan and the Government of Japan for the project, WAPDA secure personnel necessary for the promotion of groundwater development program, and the Government of Balochistan is responsible for implementation of the program.

Since beginning of the project, the Pakistani side is responsible to take the various procedure smoothly such as banking arrangement, tax exemption and customs clearance for import products and arrangement of Japanese Engineers for the technical transfer. Thus the Pakistani side will be desired to have a project team in the implementing agency for consistently execution of the Pakistani side tasks. The project team consists of the Project Director with some members of the Hydrogeology Section, the Workshop Section and the Drilling Section.

This project team should have the following duties:

1. to conduct the project for the responsible team in charge.
2. to connect and arrange the interrelationships of the concerned agencies.
3. to connect and arrange to the other concerned agencies.
4. to provide counterparts to the detailed design team.
5. to provide necessity staff for re-survey and re-examination.

(2) Consultant

After the Exchange of Notes is signed between the Governments of Pakistan and Japan, the consultant will make a contract with the Pakistani side for the consulting services to proceed the project.

The consultant should send the engineers who know rig performances and groundwater development work under the harsh hydrogeology and weather conditions in Balochistan for the Project. The consultant will send persons with administrative skill regarding Japanese Grant Aid projects to proceed smoothly and to complete the project within the required time frame.

The main services of the consultant are as follows.

1. to decide upon and estimate the cost of the equipment to be procured.
2. to arrange and conduct the bidding on behalf of the Pakistani side.
3. to assist and advise regarding the contract negotiations.
4. to supervise the procurement and technical transfer of equipment.
5. to execute the related consulting services.

(3) Contractor

After the procurement contract has been signed by recipient side and verified by the Government of Japan, the contractor is responsible to supply the compatible equipment with tender specifications within the period of the agreement. The contractor should apply the engineers to inspect the pre-delivery condition and transfer the standard operation and maintenance of the equipment after equipment delivery to implementing agency.

However, WAPDA is used to the equipment such as rigs, supporting equipment and other instruments made by Japanese manufacturers. For smoother operation the following numbers and assignment periods for engineers shall be requested to be dispatched for above-mentioned skills.

rotary drilling engineer:	1 engineer x 2 months
percussion drilling engineer:	1 engineer x 2 weeks
mechanical engineer:	1 engineer x 2 weeks
geophysicist or hydrogeologist:	1 engineer x 2 weeks

*note: above mentioned period based on the 2 weeks per unit

3.1.2 Implementation Conditions

There are no extra conditional problems regarding the implementation of the project, but due to the geology and weather matter in Balochistan, notice should be taken of the machine specifications and O&M instructions as below.

(1) Countermeasures for equipment power reduction in the highland sites.

In the Ziarat district of the project area, there are some highland sites which are around 2,500 m above sea level. The 2,500m height means that the atmospheric air pressure is be less than 27% of normal altitudes. Low atmospheric air pressure makes the power unit decrease its output power by about 5% to 20% depending on the temperature. Accordingly, the power units of the specified equipment should be have specifications which take into account their highland use.

(2) Countermeasures for the equipment used in cold and tropical districts.

Balochistan has one of largest differentials of daily, yearly and seasonal temperatures. Therefore, the equipment should be specified for cold and tropical use. This is especially true regarding the proper selection and use of lubricants and coolants. Thus the technical instructions shall be not only the standard operations, but also maintenance technologies.

3.1.3 Scope of Work

The burdens of the Japanese and recipient sides shall be demarcated within the following items.

(1) The Japanese side is responsible for:

1. Procurement cost of:
   A) equipment, the products to be manufactured,
   B) transportation and insurance of the equipment and
   C) training fees of the technical transfer.
2. Consulting services fee for;
   A) designing and cost estimation of the project implementation,
   B) assistance and execution of tender by proxy on behalf of client and
   C) supervision of manufacture and hand over the equipment to recipient.

(2) The Pakistani side is responsible for:

1. Preparation of:
   A) the warehouse or open space for parking vehicles and trucks,
   B) formation staffs for the equipment operation and management,
   C) proper program operation as a scheme of Japanese Grant Aid,
   D) proper maintenance of the equipment and
   E) additional implementation budget for program promotion.
2. Arrangement for:
   A) banking services to bear commissions to the Japanese foreign exchange bank,
   B) exemption of Japanese products from customs duties, internal taxes and other fiscal levies,
   C) land and passing permission to hand over the equipment,
   D) Japanese nationals engaged in the schedule of the project and
   E) expenses other than those to be borne by Grant and necessary of the execution of the project.

3.1.4 Procurement Plan

The specifications of the equipment to be procured should be designed for a durable program of groundwater development, and also based on the availability to obtain the spare parts in a local market. So that the design of equipment should be decided in consideration of performance, quantity, compatibility, marketability and cost.

The procurement plan was decided reflected the results of field survey in Pakistan and examination in Japan as determined below:

(1) Units of drilling equipment

There are no rigs manufactured in Pakistan. The rigs of the government agencies totaled 39 rigs and were manufactured by rig makers of Japan (17 rigs), the United States (19 rigs with only 13 rigs in working condition), and Australia (3 rigs). The spare parts for the rigs were not supplied in the local market through a local agency.

The vehicles and trucks of WAPDA are mostly products of Japan and England. The supporting equipment, such as welding plants and generators, were Japanese products. The manufacturers of the above-mentioned equipment provided stabilized provision of spare parts into the local markets of Pakistan. Thus, the drilling equipment will be procured in Japan.

(2) Cargo truck with crane

There are no trucks manufactured in Pakistan. The trucks in Pakistan are mostly products of Japan at present; spare parts for these trucks are supplied into the local markets of Pakistan. Thus, the cargo truck with crane will be procured in Japan.

(3) Turbine pump unit

The turbine pump unit inventory of WAPDA were all produced in Pakistan. Their services, such as the provision of spare parts and technical support are sustained throughout Pakistan. The turbine pump will be procured in Pakistan.

(4) Mobile type well-logger

There is no manufacturer for geophysical survey instruments in Pakistan.

The well-logger of the government agencies were manufactured in Japan and the United States. The spare parts for these instruments were not supplied to the local markets in Pakistan through a local agency. However, the sounding capability of a depth of 300 m to 400 m level were usually provided from Japan. Thus the mobile type well-logger will be procured in Japan, with consideration of the vehicle type to be equipped with well-logger.

(5) Mobile-type workshop

WAPDA has only one workshop in Quetta for the maintenance and repair of equipment. All equipment had to be shifted to Quetta for periodical checkups even when they were in service

condition. The mobile type workshop as the traveled maintenance and repairing makes the life extend, if the equipment will be checked without any detection of trouble or damage at the sites.

However, maintenance machines are available in Pakistan, but in consideration of the vehicle selection, the mobile type workshop will be procured in Japan.

(6) Spare parts

These are to procured from the producers' country under the conditions as follows:

1.	Rig:	standard spare parts recommended by the manufacturer
2.	Drilling Tools:	no spare parts due to long service life
3.	Vehicles:	for engine, transmission and differential only
4.	Air Compressor:	for engine and compressor only
5.	Welding Plant:	for engine and alternator only
6.	Well Logger:	standard spare parts recommended by the manufacturer
7.	Workshop:	standard spare parts recommended by the manufacturer

ITEM	No.	Procurement Country	
		Japan	Pakistan
1. Well Construction Equipment			
1-1. Rotary Type Rig Unit	4	O	
< Contents >			
Rotary Type Rig (300m)	(1)		
Service Truck	(1)		
Water Tanker Truck	(1)		
Service Pickup	(1)		
1-2. Percussion Type Rig Unit	1	O	
< Contents >			
Percussion Type Rig (200m)	(1)		
Service Truck	(1)		
Water Tanker Truck	(1)		
Service Pickup	(1)		
2. Cargo Truck with Crane	2	O	
3. Turbine Pump Unit	1		O
4. Mobile Type Well-logger	1	O	
5. Mobile Type Workshop	1	O	
6. Spare Parts	1	O	

Table 3-1 Procurement Country

3.1.5 Implementation Schedule

The project will be started by the signing of "Exchange of Notes" connected to the Japanese Grant Aid project between the Government of Pakistan and the Government of Japan through the approval of the Japanese Cabinet after this "Basic Design Study". The schedule and descriptions are indicated in Table 3-2 and as below.

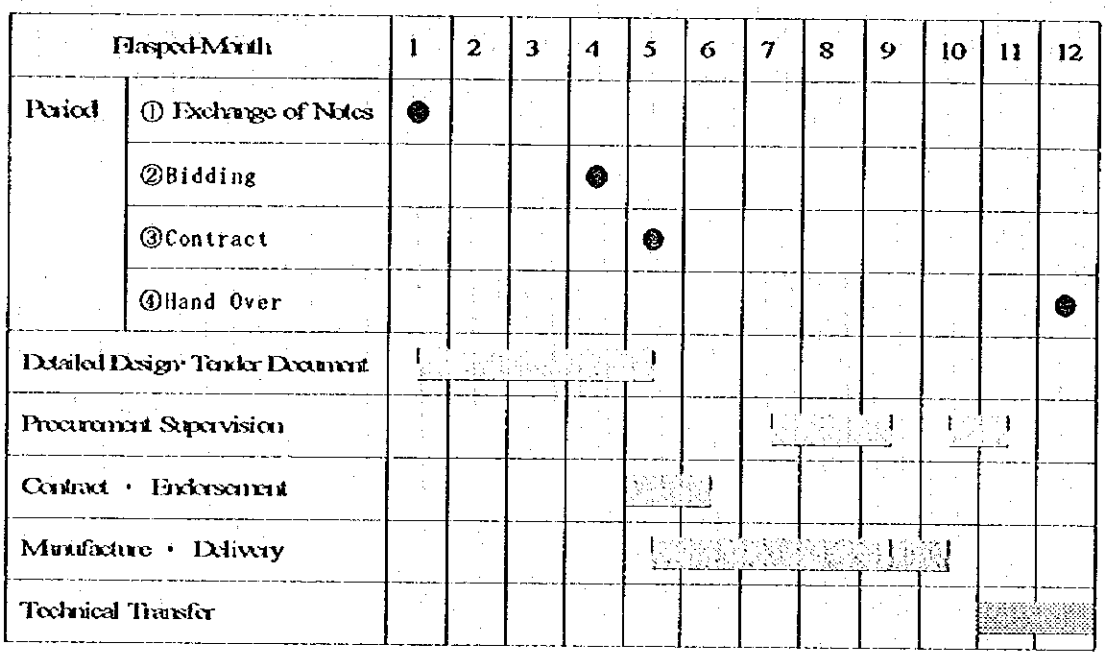


Table 3-2 Implementation Schedule

(1) Detailed Design

After the signing of "Exchange of Notes", P & DD as the responsible agency conclude the agreement for the consulting services to execute this project with consultant. After the consultancy agreement is verified by the Government of Japan, the consultant proceed to execute the project as follows.

1. to make the tender document through a detailed design and project cost estimation.

2. to arrange and conduct the bid on behalf of the Pakistani side, items such as:

- tender document verification by both countries,
- public tender notice,
- distribution of tender document,
- post-qualification of bidder,
- bidding,
- bid evaluation,
- contract negotiation,
- contract with successful bidder and
- verification of contract by the Japanese Government.

(2) Procurement of the equipment

After the verification of the contract, the contractor is responsible to supply the compatible equipment with tender specifications within the period of agreement. If it is requested and necessary, the shop test of

equipment will be executed before shipment by the Consultant. Finally, the contractor will hand over the equipment to recipient after carrying out of technical transfer of main equipment.

3.1.6 Obligations of Recipient Country

In the implementation of the Japanese Grant Aid project, the Pakistani side is required to undertake such necessary measures as the following:

(1) to ensure prompt unloading and customs clearance at port of disembarkation in Pakistan and facilities internal transportation therein of the products purchased under Japanese Grant Aid.

(2) to exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the verified contracts.

(3) to accord Japanese nationals whose services may be required in connection with the supply of the products and services under the verified contracts, such as facilities as may be necessary for their entry into the Pakistan and stay therein for the performance of their work.

(4) "Proper Use" The recipient country is required to maintain and use the equipment purchase under Japanese Grant Aid properly and effectively and to assign staffs necessary for this operation and maintenance as well as to bear all the expenses other than those covered by Japanese Grant Aid.

(5) "Re-export" The products purchased under Japanese Grant Aid should not be re-export from the Pakistani side.

(6) Banking Arrangement (B/A) The Government of Pakistan or its designated authority should open an account in the name of the Government of Pakistan in an authorized foreign exchange bank in Japan. The Government of Japan will execute Japanese Grant Aid by making payment in Japanese yen to cover the obligations incurred by the Government of Pakistan or its designated authority under the verified contracts.

The payments will be made when payment requests are presented by the Bank to the Government of Japan under an authorization to pay issued by the Government of Pakistan or its designated authority.

3.2 Operation and Maintenance Plan

The Government of Balochistan should promote and execute the groundwater development program in Balochistan to use the equipment to be procured under Japanese Grant Aid. For the smooth and effective implementation of the program, the following items will be suggested to sustain the scheme of the Japanese Grant Aid Project.

3.2.1 Promotion of Groundwater Development Program

The Hydrogeology Project, WAPDA, Quetta was established in 1973 initially for groundwater investigations in Balochistan with the collaboration of the UNDP. The investigation work was completed in 1984 and in the second phase groundwater development was started. In the project organization there are many highly experienced engineers and scientists available. Thus, the recruitment of new manpower is not required. The existing manpower is sufficient for achieving the drilling targets of about 100 tubewells per annum. The Government of Balochistan, who is presently bearing all the administrative expenses of the project, shall be requested for permission to use the technical staff in the interest of the development of Balochistan Province.

WAPDA is required to use the equipment and to assign staffs necessary for this operation and maintenance to enhance the progress of groundwater development program as below.

(1) Proper use

WAPDA is required to use the equipment purchase under Japanese Grant Aid properly and effectively as below.

1. Drilling equipment

Drilling equipment such as unit of rotary and percussion rigs will be used for groundwater development program as irrigation and domestic use in project sites.

2. Cargo truck with crane, turbine pump unit and mobile type well-logger

These items will be used to support the tubewell construction, design and evaluation work of WAPDA along the scheme of above mentioned program.

3. Mobile type workshop

Mobile workshop will be used to maintain and repair the equipment properly of WAPDA along the scheme of above mentioned program.

(2) Formation staffs to be required

The necessary staff, if required, would be transferred to this project from the other WAPDA formations to this project.

1. Drilling section: 156 persons present

This section is responsible for the construction of tubewells. Only three welders should be arranged, because of the presence of sufficient staff of this section are present except welders as below.

I. management staff: 14 persons
II. drilling staff: 66 persons for 22 parties as one party of
    A. one Driller Grade-A,
    B. one Driller Grade-B and
    C. one Assistant Driller.
III. Driver: 52 persons including some Assistant Drivers.
IV. Operator: 13 persons such as Welders, Electrician, Plumber, Air Compressor Operators and Turbine Pump Operator.
V. Others: 11 persons as Fitters.

2. Workshop section: 58 persons present

This section is responsible to maintain and repair the equipment, but the party for the mobile workshop is not present. So only one party for the mobile workshop would be arranged separately.

Also when the mobile workshop is on service, priority their duties will be urgent repairing works at each sites. Thus this workshop party shall be a independent group.

I. Drivers: 2 persons as main Driver and Assistant.
II. Mechanic: 1 person as Mechanic Grade-I.
III. Fitters: 2 persons.
IV. Welder: 1 person

Total: 6 persons.

3. Hydrogeology section: 36 persons present

This section is responsible to design the tubewell structure and evaluate the performance of aquifer permeability and tubewell yield.

They have some vehicles only for management work. Therefore only two persons will function as driver and assistant should be arranged for the mobile well-logger.

3.2.2 Program Costs

From the analyzed result of WAPDA's annual report from 1991 to 1994, the amount of each articles such as revenue and expenditure were balanced and stabilized except ADB groundwater subproject in 1992. The ratio of direct and indirect costs were approximately 48:52. The Pakistani side is responsible to ensure all the expenses and prompt execution for groundwater development program to use the equipment purchased under Japanese Grant Aid.

Table 3-3 Annual budget of WAPDA, fiscal year 1991/92 to 1994/95

(M Rs)

ITEM \ Year		1991-1992	1992-1993	1993-1994	1994-1995
REVENUE	Well Construcion	5.00	7.50	5.63	8.00
	Investigation	3.19	21.70	2.34	2.71
	Indirect Cost	32.26	31.01	31.44	32.00
	Deposit Work	21.60	20.00	21.60	22.00
	TOTAL	62.05	80.21	61.01	64.71
SPENDING	Well Construcion	5.81	6.00	2.70	6.04
	Investigation	2.60	20.76	2.34	3.05
	Indirect Cost	27.90	31.70	30.40	32.09
	Deposit Work	21.60	20.00	21.60	22.00
	TOTAL	57.91	78.46	57.04	62.73

Table 3-4 Yearly Tubewell Construction Costs and Numbers

(M Rs)

ITEM \ Year		1991-1992	1992-1993	1993-1994	1994-1995	Average
COST	Direct Odor Intake	5.81	6.00	2.70	6.04	5.14
	Deposit Work	21.60	20.00	21.60	22.00	21.30
	TOTAL	27.41	26.00	24.30	28.04	26.44
Well Number		82	93	80	60	79
Unit-Price		0.33	0.28	0.30	0.47	0.33

(1) Operation costs for implementing agency

The operation costs are devised into the indirectly and directly costs. The total additional operation costs as an annual budget for WAPDA will be estimated roughly as below.

Operation Costs = indirect costs + direct costs

= Rs.0 + Rs.9,804,000= Rs.9,804,400/year

1. Indirect costs

It will not be necessary to recruit new employees.

2. Direct costs

direct costs = an allotment by the Government of Pakistan

= irrigation scheme + water supply scheme

= Rs.6,204,000 + Rs.3,600,000= Rs.9,804,000

Basically, the direct costs of WAPDA's budget from the Government of Balochistan were provided in accordance with the number of tubewells installation to be requested. The groundwater development program for the project has a scheme to construct 297 tubewells within five years in six districts. The 118 tubewells out of this program will be constructed by the equipment purchased under Japanese Grant Aid by WAPDA. Therefore, the additional directly costs to be provided from the Government of Pakistan will be calculated with trial from the standard directly costs of average tubewell structure as 600' depth in 10" of diameter as below.

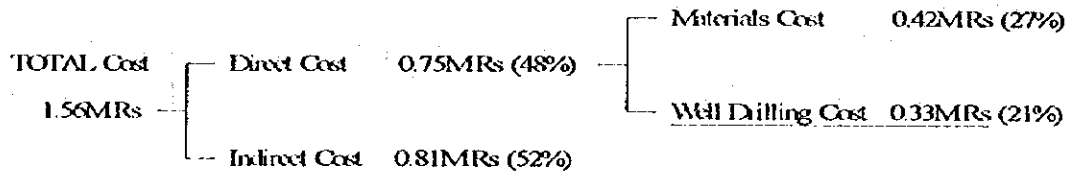


Figure 3-2 Costs of Standard Tubewell Construction

A) irrigation use

The number of tubewells construction will be 94 wells for irrigation use. The Government of Balochistan provides the charges of drilling fee in the directly costs.

irrigation use = drilling fee/well x 94 wells/5 years
= Rs.330,000/well x 94 wells/5 years
= Rs.6,204,000/year

B) water supply use

The number of tubewells construction will be 24 wells for water supply use. The Government of Balochistan bears the charges of all expenses in the direct costs.

water supply use = direct cost/well x 24 wells/5 years
= Rs.750,000/well x 24 wells/5 years
= Rs.3,600,000/year

(2) Maintenance costs

The statistics data to evaluate the maintenance charges and costs of the equipment were not cleared in details. However, it is the opinion of the team that the maintenance costs will be possible to reduce more smaller than present costs. On the other hand, WAPDA has estimated Rs.45,000 for the spare parts costs which is approximately 6% of the direct well construction charge. Thus WAPDA should deposit this charge with an account in different name and use the costs validly, cause the implementing agency is responsible to purchase spare parts after consume spare parts procured with the equipment.

Chapter 4
Project Evaluation and Recommendation

4. Project Evaluation and Recommendation

4.1 Project Effect

Out of the 297 tubewells under the proposed program, a total of 118 tubewells will be constructed using the five (5) new rigs to be procured under the Project. This undertaking will be divided into 94 tubewells for irrigation usage and 24 tubewells for domestic usage. It is possible under this program that the Government of Balochistan will receive substantial benefits as an additional 5% of arable land will be be irrigated and safe water will be supplied to 7% of the population of Balochistan.

Table 4-1 Project Effect

Problems	Countermeasure	Effect
1. Decrease in the capability to construct wells by the antiquated rigs.	5 rigs to be procured	to help enhance WAPDA's engineering fleet
2. Ineffective work progress	sufficient supporting equipment to be procured	to support rig's work
3. Low irrigation ratio	construction of 94 tubewells (total of 216 tubewells)	additional 1,000 ha of irrigated land available
4. Low agricultural income (refer to Table 4-2)		
5. Increase in non-sustainable workers		
6. Sanitary environment	construction of 24 tubewells (total of 81 tubewells)	additional 500,000 people will receive safe and sustainable water

Table 4-2 Trial Esitmation of Typical Income by Irrigated Farmers

			Karez	Tubewell
Revenue (1,000 Rs/year)	Average area of farm land (ha)		1	5
	Average crop (t/year)		40	200
	Resulting income		400	2,000
Expenditures (1,000 Rs./year)	Irrigation water (m3/day)		250	1,250
	Cost of facilities	Tubewell (material fee)	-	39 (390/10 year lifespan)
		Pump house	-	40 (400/10 year lifespan)
		Pump and Generator	-	85 (850/10 year lifespan)
	Fuel consumption		-	58 (20 l/day x Rs. 8/l)
	Maintenance Fee		-	4 (5% of pump & generator)
	Personnel Expenses		120 (2 persons x 60/year)	600 (10 persons x 60/year)
	Total Expenditure		120	826
Net Income (1,000 Rs./year)	280		424	
	Increase of Income:		144	

4.2 Recommendation

The promotion the Groundwater Development Program fits in with the policies of the Conceptual Eigth Five Year Plan, Balochistan. Also, the implementation ofthe Project under Japanese Grant Aid will be providing benefits to many people in Balochistan and meets fufills basic human needs.

It is recommended that the following measures be undertaken by the Pakistani side to ensure the maximization of the Project and its smooth implementation.

(1) Cooperation with the agencies concerned

In Balochistan Province, the following authorites besides WAPDA are also involved in groundwater development:

- Irrigation and Power Department
- Public Health Engineering Department
- Balochistan Development Authority

Therefore, in order to establish a groundwater development scheme which is cost-effective, economically viable and self-sustained, coordination among the above-mentioned authorities is considered essential. The team has recommended to the Pakistani side that the Planning and Development and WAPDA play a pivotal role in this regard in implementing the Project.

(2) 2KR Program

The team explained that the resources necessary for part of the recurring costs of the Project could be sought from the counterpart fund deposited under the 2KR Program (Increase of Food Production Aid by the Japanese Government) and suggested that the Pakistani side consult the relevant authorities of the Government of Pakistan in this regard.

Appendices

Appendices

Tables

Figures

1. Member List of the Survey Team

1. Field Survey in Baluchistan (2nd Sep 1995 ～ 10th Oct 1995)

Mr. Hidetomi OI / Team Leader
Development Specialist, Japan International Cooperation Agency

Mr. Hisatoshi OKUBO / Project Coordinator
1st. Basic Design Study Div., Grant Aid Study & Design Department,
Japan International Cooperation Agency

Mr. Nobukatsu Sakiyama / Hydrogeologist
Assistant Manager, Nippon Jogesuido Sekkei Co., Ltd

Mr. Isao MITSUNAGA / Irrigation Planner
Senior Engineer, Nippon Jogesuido Sekkei Co., Ltd

Mr. Atsushi UJIIE / Equipment Planner, Operation & Maintenance Planner
Senior Engineer, Nippon Jogesuido Sekkei Co., Ltd

2. Explanation of Draft Report (5th Dec 1995 ～ 15th Dec 1995)

Mr. Hidetomi OI / Team Leader
Development Specialist, Japan International Cooperation Agency

Mr. Nobukatu Sakiyama / Hydrogeologist
Assistant Manager, Nippon Jogesuido Sekkei Co., Ltd

Mr. Atsushi UJIIE / Equipment Planner, Operation & Maintenance Planner
Senior Engineer, Nippon Jogesuido Sekkei Co., Ltd

2. Survey Schedule

Date	Day	Accommodation	Work Contents		Mark
2Sep	Sat	Tokyo - ISB			
3	Sun	Islamabad	Courtesy call at the JICA, Embassy of Japan, EAD		
4	Mon		Meeting with P&DD		
5	Tue	Quetta	Meeting with WAPDA, Workshop, Site Survey		
6	Wed		Site Survey / Panjgur		
7	Thu	Panjgur	Site Survey / Panjgur		
8	Fri		Site Survey / Turbat		
9	Sat	Turbat	Site Survey / Turbat		
10	Sun		Meeting with WAPDA		
11	Mon	Quetta	Draft Miking : Minutes of Discussions		
12	Tue		Signing with WAPDA, P&DD for Minutes of Discussions		
13	Wed	Islamabad	JICA, Embassy of Japan, EAD : Explantion		
14	Thu		JICA : Explantion		
15	Fri		Move to Quetta		
16	Sat		Discussion with WAPDA		
17	Sun		Discussion with AD, I&ID, PHED, BDA		
18	Mon		Discussion with WAPDA, P&DD		
19	Tue		Site Survey / Quetta	Discussion with WAPDA, I&ID	
20	Wed		Site Survey / Mastung	Discussion with I&ID, PHED, BDA	
21	Thu		Site Survey / Ziarat	Discussion with WAPDA, AD	
22	Fri				
23	Sat	Quetta	Site Survey / Kalat	Discussion with WAPDA	
24	Sun		Discussion with WAPDA, PHED, BDA, AD		
25	Mon		Discussion with WAPDA, PHED, AD		
26	Tue		Discussion with P&DD, PHED, AD		
27	Wed		Discussion with WAPDA		
28	Thu		Discussion with WAPDA, P&DD		
29	Fri				
30	Sat		Discussion with WAPDA		
1Oct	Sun		Discussion with WAPDA		
2	Mon		Discussion with WAPDA		
3	Tue		Discussion with WAPDA		
4	Wed		Courtesy call at the JICA		
5	Thu		Meeting with French Embassy, UNDP		
6	Fri	Islamabad			
7	Sat		Report Miking		
8	Sun		Courtesy call at the EOJ, JICA		
9	Mon	ISB - Tokyo			
10	Tue				

Date	Day	Accommodation	Work Contents	Mrk
5Dec	Tue	Tokyo - Karachi		
6	Wed	Islamabad	Courtesy call at the JICA, EOJ, FAD	
7	Thu		Discussion with P&DD	
8	Fri			
9	Sat	Quetta	Discussion with WAPDA	
10	Sun		Discussion with WAPDA	
11	Mon		Discussion with WAPDA, P&DD	
12	Tue		Signing with P&DD for Minutes of Discussions	
13	Wed	Islamabad	Courtesy call at the JICA, EOJ, FAD	
14	Thu	ISB - Tokyo		
15	Fri			

3. List of Party Concerned in the Recipient Country

Organization	Position	Name
E A D	Deputy Secretary	Mr.Shahid Humayun
P & D D	Additional Chief Secretary Chief of Section(Water) Chief Foreign Aid Section Officer(Admin)	Mr.Ata Mohammad Jaffar Mr.Mian Anwar-ul-haq Badar Mr.Shahid Parvez Mr.Raheel Zia
W A P D A	Project Director Director Field Senior Engineer(Mech) Senior Hydrogeologist Senior Geologist Senior Geologist Economist	Mr.Fida Mohammad Khan Mr.Syed Asim Ali Mr.Talat Mahmood Mr.Mohammad Baloch Mr.Peer Bakhsh Mr.Khan Shakeel Mr.Shahid Gillani
P H E D	Director General Executive Engineer Chief Engineer Chief Hydrogeologist	Mr.Mohammad Khan Mr.Ali Khoso Mr.Sardar Ahmed Mr.Syed Aftab
I & P D	Assistant Project Director Executive Engineer Executive Engineer	Mr.Mumtaz Khan Mr.Usman Baloch Mr.Syed Bukhari
B D A	General Manager Additional General Manager	Mr.Naqvi Mr.Mansoor Huda
A D	Director Planning Agricultural Economist	Mr.Arif Ansari Mr.Mushtaq Ahmad
U N D P	Asst. Resident Representative Programme Officer	Mr.Mohammad Zafar Iqbal Mr.Yasumitsu Doken
French Embassy	Deputy Economic & Commercial Counsellor Commercial Attache	Mr.Hugues Reydet Mr.Philippe Mineut

MINUTES OF DISCUSSIONS

BASIC DESIGN STUDY ON THE PROJECT FOR GROUNDWATER DEVELOPMENT IN BALOCHISTAN IN PAKISTAN

In response to a request from the Government of the Islamic Republic of Pakistan, the Government of Japan decided to conduct a basic design study on the Project for Groundwater Development in Balochistan in Pakistan (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA has sent to Pakistan a study team, headed by Mr. Hidetomi OI, Development Specialist, JICA, from 3 September to 9 October 1995.

The team held discussions with the officials concerned of the Government of Pakistan and the Government of Balochistan, and conducted field surveys in the study areas.

In the course of the discussions and field surveys, both sides have confirmed the main items described on the attached sheets. The team will proceed to further works and prepare the basic design study report.

Quetta, 12 September 1995

Mr. Hidetomi OI
Leader
Basic Design Study Team
Japan International Cooperation Agency

Mr. Fida Muhammad Khan
Project Director
Water and Power Development Authority
Government of Pakistan

Mr. Ata Mohammad Jaffer
Additional Chief Secretary
Planning & Development Department
Government of Balochistan

Mr. Shahid Humayun
Deputy Secretary
Economic Affairs Division
Ministry of Finance and Economic Affairs
Government of Pakistan

ATTACHMENT

1. Objective

The objective of the Project is to procure necessary equipment, machinery and accessories for groundwater development in Balochistan Province.

2. Project Sites

The Project sites are in the following 6 districts in Balochistan Province. (See map in Annex I)

(1) Panjgur District
(2) Turbat District
(3) Mastung District
(4) Kharan District
(5) Ziarat District
(6) Kalat District

3. Responsible and Implementing Agencies

(1) The responsible agency of the Project is the Planning and Development Department of the Government of Balochistan.

(2) The implementing agency of the Project is the Hydrogeology Project, Water and Power Development Authority (WAPDA), Quetta.

4. Items requested by the Pakistani side

The items requested by the Pakistani side are shown with a priority order in Annex II. However final items to be procured under Japanese Grant Aid will be decided after further studies in Japan , taking into account ;

- hydrogeological conditions of the Project sites
- number and specifications of investigation and production tubewells to be constructed
- economic and administrative viability of the Project
- evaluation of the past performance of the groundwater development

5. Japan's Grant Aid System

(1) Pakistani side has understood the system of Japanese Grant Aid explained by the team. (Annex III)

(2) Pakistani side will take necessary measures, as described in Annex IV, for smooth implementation of the Project, on condition that the Grant Aid by the Government of Japan is extended to the Project.

6. Major Points of Discussions

(1) Project areas
In the original project document, the Project as at the date of commencement of the basic design study would cover only 2 districts namely Panjgur and Turbat Districts as the Project sites. However, based on information obtained during the field visits, the team has the following observations:

a) the groundwater level in most areas in the districts are relatively shallow (10m to 30m);

b) other methods than deep tubewells such as Karez and dug-wells are technically and economically more suitable for the hydrolgeological conditions in the areas,

c) therefore, rigs capable of drilling up to 1000ft depth as requested by Pakistani side could not be technically justified as the Project components.

In responding to the team's observations, Pakistani side has explained that:

a) rigs to be procured under the Project are expected to serve for more than 10 years and thus they will continue to be utilized virtually in the whole Province, in the same manner as the rigs previously procured under Japan's Grant Aid (FY 1984 to1990) have been used; and that

b) rigs to be included as the Project components are required to match various conditions in the Province hydorogeologically.

Based on the above discussions both sides have agreed that:

a) the Project has a "programme" nature, i.e. a group of projects to be implemented over a longer period in a geographically wider area with diversified objectives (i.e. not only irrigation purposes but also domestic use and others),

b) the Project is virtually a continuation of the above mentioned grant aid projects, which were de facto programmes to help enhance WAPDA's engineering fleet,

c) the Projects sites recorded in the Attachment are areas where deep tubewell investigation and development is required in future, and

d) Pakistani side will prepare brief project documents for the new Project sites by 16 September 1995 and submit them to the team.

(2) As in Annex II, Pakistani side has made a request for a lot of spare parts for existing rigs. A detailed list of required spares including parts no. is to be prepared by Pakistani side by 17 September 1995.
The list is subject to further studies by the team, which will also include physical examination of the conditions of the existing rigs and maintenance records.

(3) In Balochistan Province, the following authorities besides WAPDA are also involved in groundwater development;

- Irrigation and Power Development,
- Public Health Engineering Department and
- Balochistan Development Authority.

Therefore, in order to establish a groundwater development scheme, which is cost-effective, economically viable and self-sustained, coordination and cooperation among the above-mentioned authorities is considered essential. The team has recommended to Pakistani side that Planning and Development Department and WAPDA play a pivotal role in this regard in implementing the Project.

(4) Pakistani side expressed the willingness to have Japanese technical cooperation for the Project, namely, trainings of hydrogeologists and other engineers in Japan.
The team explained to Pakistani side the procedure of Japanese technical cooperation, which requires as a first step submission of official request forms to Japanese Government through Economic Affairs Division to the Embassy of Japan in Islamabad.

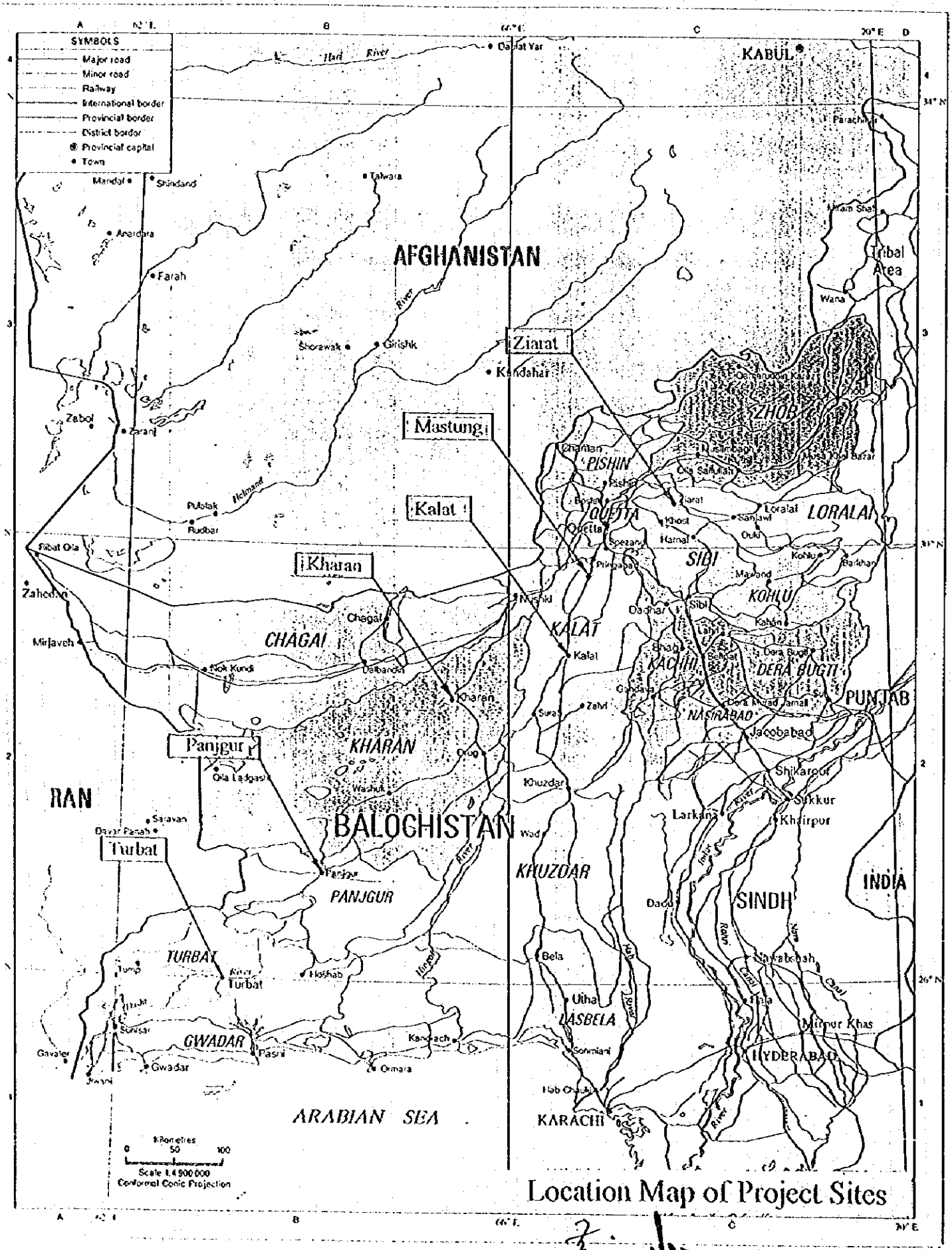
(5) The team explained that resources necessary for part of recurrent costs of the Project could be sought from counterpart fund deposited under 2KR program (Increase of Food Production Aid by Japanese Government) and suggested Pakistani side to consult relevant authorities of the Government of Pakistan in this regard.

7. Schedule of the Study

(1) The team will proceed to further studies in Pakistan until 9 October 1995.

(2) JICA will prepare a draft basic design study report and dispatch a mission to explain it to Pakistani side in December 1995.
If both sides agree on the contents of the report, JICA will complete the final report and send it to the Government of Pakistan around March 1996.

Annex I



Location Map of Project Sites

Annex II

Items Requested by Pakistani Side

Item and Description	Priority			Quantity
	A	B	C	
1. Drilling Equipment				
R300, Unit of Rotary Drilling Equipment	2	2	0	4
P200, Unit of Percussion Drilling Equipment	1	1	0	2
1-1. Details of R300 are specified as below: Following items are included for one (1) unit of rotary drilling equipment.				
(1) Rotary Drilling Rig Top Head Drive Type, enabling both conventional mud and air drilling. The rig components are assembled and mounted on 6x6 diesel engine truck, and has capacity to drill boreholes with diameter 17-1/2" to a depth of 300m. The accessories are also necessary, such as tools for rig set up, daily maintenance, casing installation and well development.				1
(2) Rotary Drilling Tools Drilling and fishing tools have enough quantities to drill up to 300m depth. The drill pipes have a FI connection. The bits are tricone bits for mud drilling, blast bits and DTH hammers for air drilling.				1
(3) Air Compressor For DTH drilling and well development, mounted on full trailer with standard accessories.				1
(4) Electrical Welder Full trailer mounted diesel engine driven with standard accessories and auxillary power.				1
(5) Service Truck Diesel engine 4x2 driven cargo truck, equipped with air compressor lubricator and standard accessories.				1
(6) Water Tanker Truck Diesel engine driven truck, equipped with water tank of not less than 9m^3 in effective volume, complete with a self-priming pump unit and pipe connection and standard accessories.				1
(7) Service Pick-up Diesel engine 4x4 driven double cab pick-up, equipped with air compressor lubricator and standard accessories.				1

Item and Description	Priority			Quantity
	A	B	C	
1-2. Details of P200 are specified as below: Following items are included for one (1) unit of percussion drilling equipment.				
(1) Percussion Drilling Rig Spudding Drive Type, cased hole drilling. The rig components are assembled and mounted on 4x4 diesel engine truck, and has capacity to drill boreholes with diameter 18" to a depth of 200m. The accessories are also necessary, such as tools for rig set up, daily maintenance, casing installation and well development.				1
(2) Percussion Drilling Tools Drilling and fishing tools have enough quantities to drill up to 200m depth. The sizes and quantities of drive pipes are suitable to install the casing strings with minimum diameter of 8". The jack-up equipment is fixed to drive pipes and fishing rods.				1
(3) Electrical Welder Same as "R300"				1
(4) Gas Cutter Oxygen-Acetylene cylinders equipped with regurator, twin hose and cutting torches.				1
(5) Air Compressor For well development, mounted on full trailer with standard accessories.				1
(6) Service Truck Same as "R300"				1
(7) Water Tanker Truck Same as "R300"				1
(8) Service Pick-up Same as "R300"				1
2. Supporting Equipment				
2-1. For Mobilization and Demobilization				
(1) Cargo Truck with Crane Diesel engine driven truck, equipped with engine PTO drive, 5 ton capacity, hydraulical operating crane and standard accessories.	1	1	0	2
(2) Tractor Diesel engine driven tractor, equipped with attachement for road scraper.	0	0	1	1

Item and Description	Priority			Quantity
	A	B	C	
2-2. Pumping Test Equipment				
(1) Submersible Moter Pump Pump capacity is 0.85m³/min discharge x 183m total head approximately. Submersible Moter 2-pole and 3-phase for star-delta starting system with control pannel. Diesel engine driven generator for above, mounted on full trailer. Installation tools, measuring accessories for water discharge and level are also necessary.	0	1	0	1
(2) Turbine Pump Pump capacity is 1.7m³/min discharge x 107m total head approximately. Diesel engine power unit and gear head with suitable gear ratio. Installation tools, measuring accessories for water discharge and level are also necessary.	1	0	0	1
3. Geophysical Survey Instrument				
3-1. Well Logger Logging system consists of normal resistivity, SP and natural gamma, which have single core armoured cable with power winch and controller, mounted on 4x4 diesel engine driven vehicle. The accessories are also necessory, such as cable-counter sheave, maintenance tools and so on.	1	0	0	1
3-2. Electrical Prospector Resistivity unit have signal averaging processor for resistivity and SP measurement with improvement of S/N ratio.	1	0	0	1
4. Workshop Mobile Workshop, mounted on 4x4 diesel engine driven truck with equipment and tools for maintenance.	1	0	0	1
5. Spare Parts				
5-1. For the equipment to be supplied	1	0	0	1
5-2. For the existing drilling rigs	1	0	0	1

N.D.

Annex III

Japan's Grant Aid Scheme

1. Grand Aid Procedures

(1) Japan's Grant Aid Program is executed through the following procedures.

Application	(Request made by a recipient country)
Study	(Basic Design Study conducted by JICA)
Appraisal & Approval	(Appraisal by the Government of Japan and approval by Cabinet)
Determination of Implementation	(The Notes exchanged between the Governments of Japan and the recipient country)

(2) Firstly, the application or request for a Grant Aid Project submitted by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA (Japan International Cooperation Agency) to conduct a study on the request.

Secondly, JICA conducts the study (Basic Design Study), using (a) Japanese consulting firm(s).

Thirdly, the Government of Japan appraises the Project to see whether or not it is suitable for Japan's Grant Aid Program, based on the Basic Design Study report prepared by JICA, and the results are then submitted to the Cabinet for approval.

Fourthly, the Project, once approved by the Cabinet, becomes official with the Exchange of Notes signed by the Governments of Japan and the recipient country.

Finally, for the implementation of the Project, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

NO.

2. Basic Design Study

(1) Contents of the Study

The aim of the Basic Design Study (hereinafter referred to as "the Study") conducted by JICA on a requested Project (hereinafter referred to as "the Project") is to provide a basic document necessary for the appraisal of the Project by the Japanese Government. The contents of the Study are as follows;

a) Confirmation of the background, objectives, and benefits of the requested Project and also institutional capacity of agencies concerned of the recipient country necessary for the Project's implementation.
b) Evaluation of the appropriateness of the Project to be implanted under the Grant Aid Scheme form a technical, social and economic point of view.
c) Confirmation of items agreed on by both parties concerning the basic concept of the Project.
d) Peparation of a basic design of the Project
e) Etimation of costs of the Project

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid Project. The Basic Design of the Project is confirmed considering the guidelines of Japan's Grant Aid Scheme.

The Government of Japan requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Study, JICA uses (a) registered consultant firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms. The firm(s) selected carry(ies) out a Basic Design Study and write(s) a report, based upon terms of reference set by JICA.

The consulting firm(s) used for the Study is (are) recommended by JICA to the recipient country to also work on the Project's implementation after the Exchange of Notes, in order to maintain technical consistency and also to avoid any undue delay in implementation should the selection process be repeated.

3. Japan's Grant Aid Scheme

(1) What is Grant Aid?

The Grant Aid Program provides a recipient country with non-reimbursable funds to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. Grant Aid is not supplied through the donation of materials as such.

(2) Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes exchanged by the two Governments concerned, in which the objectives of the Project, period of execution, conditions and amount of the Grant Aid, etc., are confirmed.

(3) "The period of the Grant Aid" means the one fiscal year which the Cabinet approves the Project for. Within the fiscal year, all procedures such as exchanging of the Notes, concluding contracts with (a) consultant firm(s) and (a) contractor(s) and final payment to them must be completed.

However in case of delays in delivery, installation or construction due to unforeseen factors such as weather, the period of the Grant Aid can be further extended for a

NO,

maximum of one fiscal year at most by mutual agreement between the two Governments.

(4) Under the Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased.

When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country.

However the prime contractors, namely, consulting, contracting and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals". means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

(5) Necessity of "Verification"

The Government of recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by the government of Japan. This "Verification" is deemed necessary to secure accountability to Japanese taxpayers.

(6) Undertakings required of the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as the following:

1) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the construction.
2) To provide facilities for the distribution of electricity, water supply and drainage and other incidental facilities in and around the sites.
3) To secure buildings prior to the procurement in case the installation of the equipment.
4) To ensure all the expenses and prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid.

5) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts.

6) To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the Verified Contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.

(7) "Proper Use"

The recipient country is required to maintain and use the facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign staff necessary of this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

(8) "Re-export"

The products purchased under the Grant Aid should not be re-exported from the recipient country.

(9) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in an authorized foreign exchange bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an authorization to pay issued by the Government of the recipient country or its designated authority.

Annex IV

Necessary measures to be taken by the Government of Pakistan on condition that Japan's Grant Aid is extended;

1. To bear commissions to the Japanese foreign exchange bank to execute the banking services based upon the banking arrangement

2. To ensure prompt unloading and customs clearance at port of disembarkation in Pakistan and facilitate internal transpiration therein of the products purchased under the Grant.

3. To exempt Japanese nationals from custom duties, internal taxes and other fiscal levies which may be imposed in Pakistan with respect to the supply of the products and services under the verified contracts.

4. To accord Japanese nationals, whose services may be required in connection with the supply of products and the services under the verified contracts, such facilities as may be necessary of their entry into Pakistan and stay therein for the performance of their work.

5. To use and maintain properly and effectively all the equipment purchased under the Grant.

6. To bear all the expenses other than those to be borne by the Grant, necessary of the execution of the Project.

MINUTES OF DISCUSSIONS

BASIC DESIGN STUDY ON THE PROJECT

FOR

GROUNDWATER DEVELOPMENT

IN

BALOCHISTAN IN PAKISTAN

(CONSULTATION ON DRAFT REPORT)

In September 1995, the Japan International Cooperation Agency (JICA) dispatched a team for basic design study on the Project for Groundwater Development in Balochistan in Pakistan (hereinafter referred to as "the Project") to the Islamic Republic of Pakistan, and through discussions, field surveys and technical examination of the results in Japan, has prepared the draft report on the study.

In order to discuss and finalize the report, JICA sent to the Pakistan another team, headed by Mr. Hidetomi OI, Development Specialist, JICA, from 5 to 16 December 1995.

The result of discussions has been summarized and annexed in the ATTACHMENT.

Quetta, 12 December 1995

Mr. Hidetomi OI
Leader
Basic Design Study Team
Japan International Cooperation Agency

Mr. Fida Muhammad Khan
Project Director
Water and Power Development Authority
Government of Pakistan

Mr. Ata Mohammad Jaffer
Additional Chief Secretary
Planning & Development Department
Government of Balochistan

Mr. Shahid Humayun
Deputy Secretary
Economic Affairs Division
Ministry of Finance and Economic Affairs
Government of Pakistan

ATTACHMENT

1. Contents of the Draft Report

Pakistani side has agreed and accepted the contents of the Draft Report with minor corrections.

2. Items of the Project

Items (rigs and accessories with supporting equipment) to be covered by the Project has been discussed extensively by both parties, and the result has been summarized in Annex I .
Items under column "Original" are those originally requested by the Government of Balochistan in July 1995.
Items under columns "Alternatives" are those to be considered by the Government of Japan in case the items in the original request can not be fully met due to budget constraint of the Government of Japan.
Among the two alternatives, Pakistani side prefers Alternative 2.

3. Construction, Operation and Maintenance

Pakistani side has assured that would be no problem in taking measures required for construction, operation and maintenance including assignment of personnel and allocation of budget as mentioned in section 2.3 of the Report.

4. Japan's Grant Aid System

(1) Pakistani side has understood the system of Japanese Grant Aid explained by the team.

(2) Pakistani side will take necessary measures, as described in Annex II, for smooth implementation of the Project, on condition that the Grant Aid by the Government of Japan will be executed.

5. Further Schedule

The team will prepare the Final Report and send it to the Pakistani side by the end of March 1996.

Annex I Request Items

ITEM	Quantity		
	Original	Alternative 1	Alternative 2
1. Well Construction Equipment			
1-1. Rotary Type Rig Unit	4	4	4
< Contents of Unit >			
Rotary Type Rig (300m)	(1)	(1)	(1)
Service Truck	(1)	(1)	(1)
Water Tanker Truck	(1)	(1)	(1)
Service Pickup	(1)	(1)	(1)
1-2. Percussion Type Rig Unit	2	2	1
< Contents of Unit >			
Percussion Type Rig (200m)	(1)	(1)	(1)
Service Truck	(1)	(1)	(1)
Water Tanker Truck	(1)	(1)	(1)
Service Pickup	(1)	(1)	(1)
1-3. Air Drilling Equipment	1	0	0
2. Supporting Equipment			
2-1 For Mobilization and Demobilization			
(1)Cargo Truck with Crane	2	1	2
(2)Tractor	1	0	0
2-2 Pumping Test Equipment			
(1)Submersible Motor Pump	1	0	0
(2)Turbine Pump	1	0	1
3. Mobile Type Well-logger	1	1	1
4. Mobile Type Workshop	1	1	1
5. Spare Parts			
5-1 For the equipment to be supplied	1	1	1
5-2 For the existing drilling rigs	1	0	0

Annex II

Necessary measures to be taken by the Government of Pakistan on condition that Japan's Grant Aid is extended;

1. To bear commissions to the Japanese foreign exchange bank to execute the banking services based upon the banking arrangement

2. To ensure prompt unloading and customs clearance at port of disembarkation in Pakistan and facilitate internal transpiration therein of the products purchased under the Grant.

3. To exempt Japanese nationals from custom duties, internal taxes and other fiscal levies which may be imposed in Pakistan with respect to the supply of the products and services under the verified contracts.

4. To accord Japanese nationals, whose services may be required in connection with the supply of products and the services under the verified contracts, such facilities as may be necessary of their entry into Pakistan and stay therein for the performance of their work.

5. To use and maintain properly and effectively all the equipment purchased under the Grant.

6. To bear all the expenses other than those to be borne by the Grant, necessary of the execution of the Project.