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SALVATION OF BALOCHISTAN KACHHI PLAIN THROUGH A WATER SUPPLY PROJECT

Engr. A. N. Cheema Sk.
B.Sc. Engg., F.I.E. (Pak); FIWEM. (Lond);
F. ASCE; F.R.S.H. (Lond); F.N.S.E. (NIG).
Vice President NESPAK

M. Saleem Chaudhry
B.E. (Civil); MIE (Pak)
Project Manager NESPAK

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ABSTRACT

The paper describes a project comprising the design of a water supply scheme for the towns and villages of Kachhi plain in Balochistan.

A population of about 156,000 alongwith lot of livestock will be catered for by the implementation of this project which is meant to provide potable water to the area.

The project involves the design of intake works to abstract water from Pat Feeder Canal at Dera Murad Jamali, treatment and pumping to Bellpat, Bhag and Lehri towns through 154 km transmission main. Villages enroute of the transmission main will also be provided with water supply. The total cost of the project is estimated to be Rs. 817 million with phase I to be completed by 1992 and phase II to be completed by 2002.

KACHHI PLAIN :

Balochistan the largest province of Pakistan in area is the driest with scorching heaf and scarcity of rain causing thereby the acute shortage of water. There are twenty Districts in Balochistan and Kachhi is the hottest plain situated between the latitudes of 27^0-53, to 29^0-35 North and longitude of 67^0-11 to 68^0-28 East (Exhibit-1). It is a flat triangular plain adjoining the upper Sind Frontier District of Jacobabad and comprises Jaffarabad District of Nasirabad Division and Kachhi District of Sibi Division. It is enclosed by Marri Bugti Hills on the East, Kalat District on the West and Sibi District in the North. The surface of the area is generally flat and no part of the area is exceeding 156 meters above mean sea level. The land slopes from North to South.

* B.Sc. Engg; F.I.E. (Pak) FIWEM. (LOND); F. ASCE; F.R.S.H. (Lond); F.N.S.E. (NIG) Vice President NESPAK.
** B.E. (Civil); MIE (Pak) Project Manager NESPAK.

Climatically, the area suffers from scanty rainfall with consecutive dry years. The rainfall in Kachhi is extremely small, averaging about eight centimeters per annum., most of which occurs in July and August. The winter rains are received in about January and February. During the summer scorching winds blow from the South which at times take the form of the deadly "Samoom" (poisonous wind) locally called Jhala or Luk. This is said to be caused by the generation in the atmosphere of a highly concentrated form of ozone by some intensely marked electrical condition. It is sudden in attack, destroying the vitality of human, animal and vegetable life. It occurs usually in June and July and is characterized by well marked sulfurous odour. Dust storms are quite frequent during hot weather and depict a particular phenomena in the form of circular eddies or whirl winds. These conditions alongwith high temperatures cause a very high surface evaporation. High summer temperatures around 46 degree centigrade (115 degree F) and very cold nights in winter are the extremes. The air is dry and high evaporation losses (over 356 cm. per year) occur.

EXISTING WATER SUPPLY SITUATION :

Numerous hill torrents which originate from the hills, cut deep channels, which are divided into countless channels which are eventually lost in the plain. A marked feature of these streams is that they are subjected to flashy floods during rains which is utilized generally for irrigation in alongside areas by constructing temporary Dams/Bunds locally called "Gandhas". The water diverted by these Gandhas is used for flood irrigation in the lands by turn along the streams following tribal and traditional practices. These Gandhas are washed away by floods or purposely breached to allow water for lower riparians along a streams. For some towns near to these streams, Gandhas are constructed to divert water to earthen ponds for storage and partial treatment, before supply to consumers at an extremely low per capita supply rate.

The ground water is generally non existing. There are some tubewells in Lehri, but the water is saline (dissolved solids 2228 ppm. and $CaCO_3$ upto 2000 ppm). After the construction of Pat Feeder Canal in 1966 it has become the only dependable water source.

SOCIO-ECONOMIC FEATURES :

The people are mostly nomads always in search of pastures and water, however, they are farmers in the irrigated areas. Their tribal background results into severe rivalries. Family feuds often become pitched battles fought with fire arms for generation. The level of literacy is low and health conditions are poor. The infant mortality rate is

very high as medical facilities are scarce coupled with lack of suitable quality of water in the whole region except in the big towns. High schools and colleges are available in big towns only and in some of the bigger villages, schools upto primary level only are available.

NEED FOR THE PROJECT :

Kachhi plain in general is characterized by acute shortage of water. The towns of Lehri and Bhag being located respectively near non perennial Lehri and Nari streams, receive very little water during rains, which is stored in earthen ponds and subjected to partial water treatment by sedimentation and slow sand filtration. The supply apart from being far from the required standards of potable water, is highly inadequate. The ponds are shared by both human beings and animals and incidence of water borne diseases is therefore very common.

Bellpat Town is located at about 5 km from Sharkal Nullah. A small water supply scheme is being operated based on sedimentation and slow sand filtration, which is also inadequate. The water for Bellpat is also transported from Jacobabad by Railway Department. One rail tanker of about 5000 gallons is brought daily to supplement the meager supply from the town water supply scheme. All these water supply schemes are managed by the public Health Engineering Department.

Apart from this relief to these bestowed towns, the central Kachhi area in a length of 53 km from Dera Murad Jamali to Bellpat has no water source at all. As a result the villages have been abandoned. Even the railway stations of Wazirani and Chukhra have been closed. While travelling from Dera Murad Jamali to Sibi along road, the sights of the remains of animals perished due to thirst are very common.

Public Health Engineering Department is very actively providing the possible relief by running water supply schemes from whatever meager available sources, but is unable to cope with the problem of providing wholesome potable water to the vast tract of scorching Arid area. Due to inherent shortage of water source public Health Engineering Department has decided to develop a water supply scheme from Pat Feeder Canal and to pump water upcountry for distribution to the villages on both sides of the rail/road upto Bellpat, Lehri, Bhag and Jalal khan.

POPULATION FORECAST :

The four towns and thirteen villages along the route of transmission main have to be served by this project. These towns and villages are shown in Exhibit - 2. The

population projected to be served is shown in Table 1. Present population to be served by the project is 54,000 which is expected to increase to 94,000 in year 2002 and to 156,000 in year 2015. An average growth rate, of 4% for natural and migratory growths of these towns has been used which is based on the phenomenon of grouping of population after the supply of water as actually experienced in similar climate under similar conditions.

Table - I

KACHI WATER SUPPLY PROJECT POPULATION PROJECTION

Yearly Population

Sr. No.	Town/ Village	1981	1988	1993	1998	2002	2003	2008	2013	2015
1.	Dera Murad Jamali	9133	20800	25306	30789	36019	37460	45575	55449	59974
2.	Bellpat	2597	4500	5475	6661	9792	8104	9860	11996	12973
3.	Lehri	3472	5271	6413	7802	9127	9493	11549	14052	15198
4.	Bhag	8589	11303	13751	16731	19573	20355	24765	30131	32589
5.	Tangoti	977	1286	1564	1903	2226	2315	2817	3427	3707
6.	Babar	471	620	754	917	1125	1116	1358	1652	1787
7.	Deshti	422	555	676	822	962	1000	1217	1480	1601
8.	Jalal Khan	586	2686	3268	3976	4651	4837	5885	7160	7744
9.	Katpar	693	912	1110	1350	1645	1642	1998	2431	2629
10.	Chukra	210	276	336	409	478	498	606	737	797
11.	Deh Bagga	154	203	247	300	351	365	444	540	584
12.	Nuttal	--	1200	1460	1770	2078	2161	2629	3199	3460
13.	Hejwani	--	300	365	444	519	540	657	800	865
14.	Ramdani	301	396	482	586	685	713	868	1056	1142
15.	Wazirani	380	500	608	740	866	901	1096	1333	1442
16.	Shori	337	443	540	656	767	799	972	1182	1279
17.	Tunia	2041	2686	3268	3976	4676	4837	5885	7160	7744
	Total:-	30363	53937	65623	79838	93540	97136	118181	143785	155515

Note: Average growth rate: 4% (based on migratory trend of grouping of population on the supply of hitherto scorching areas without water).

WATER DEMANDS :

Towns of Dera Murad Jamali, Bhag, Lehri and Bellpat are the socio-cultural epicenters of the Kachhi Plain. Their growth was strangulated by the shortage of water. The villages in the area have no water at all and the people are forced to be nomadic, leaving the villages during drought and return during rains.

The water demands of the population has been worked out considering the following consumption rates :

PER CAPITA DAILY WATER DEMAND

	Phase I (Upto year 2002)			(Phase II (Upto year 201		
Town Category	Domestic LPCD (GPCD)	Non-Domestic LPCD (GPCD)	Total Average Day Demand LPCD (GPCD)	Domestic LPCD (GPCD)	Non-Domestic LPCD (GPCD)	Total Average Day Demand LPCD (GPCD)
Medium Towns	140 (29)	28 (6)	168 (35)	159 (35)	32 (7)	191 (42)
Small Towns	104 (21)	21 (4)	125 (25)	113 (25)	21 (5)	134 (30)
Villages	54 (12)	11 (2)	65 (14)	68 (15)	14 (3)	82 (18)

These expected consumption figures have been selected keeping in view the local environmental conditions, socio-economic requirement and the project economy to serve the maximum population.

Non domestic demand includes the provision for live stock, commercial and institutional uses and has been taken at 20% of the Average Day Domestic Demand. Water demand for the populace in such areas suffering under the crunch of thirst has its own pattern as compared with the other urban or rural centers of the country. When the water is supplied grouping of population takes place in accordance with the parabolic parameters. The population migrates into the area during the first few years of supplying water and depending upon other life sustaining requirements, this trend diminishes. Average population is shown in Table I incorporating all the foregoing factors.

According to the experience in Muslim Countries, the Max. Day Demand varies

from 1.3 to 1.5 depending upon the climatic extremes. For Kachhi, the upper limit of 1.5 has been adopted for maximum day demand. For Peak Hour Demand, a moderate multiplier of 2 has been used which is the case for the developing countries experienced elsewhere under similar conditions.

The total water demands thus worked out are given in Table. 2.

Table - 2

KACHHI WATER SUPPLY PROJECT WATER DEMAND PROJECTION

Sr. No.	Towns/ Village	PHASE I YEAR 1998				PHASE II YEAR 2015			
		Popu-lation	Consump-tions Rate LPCD (GPCD)	Average Day Demand cu.m (gals.)	Max. Day Demand (1.5* ADD) cu.m (gals.)	Popu-lation	Consump-tions Rate LPCD (GPCD)	Average Day Demand cu.m. (gals.)	Max. Day Demand (1.5* ADD) cu.m (gals.)
1.	Dera Murad Jamali	36019	158 (35)	5881 (1260665)	8823 (1890998)	59080	191 (42)	11427 (2519160)	17140 (3778740)
2.	Bhag	19573	158 (35)	3196 (685055)	4794 (1027583)	32590	191 (42)	6209 (1368780)	9313 (2053170)
3.	Lehri	9127	108 (35)	1490 (319445)	2235 (479168)	1519	191 (42)	2896 (638350)	4343 (957577)
4.	Bellpat	7792	114 (25)	919 (194800)	1379 (292200)	12975	134 (30)	1766 (389250)	2648 (583875)
5.	Tunia	4676	63 (14)	297 (65464)	446 (98196)	7744	82 (18)	632 (139392)	948 (209088)
6.	Katpar	1645	63 (14)	105 (23030)	158 (34545)	2629	82 (18(	215 (47322)	322 (70983)
7.	Jalal Khan	4651	63 (14)	295 (65114)	443 (97671)	7744	82 (18)	632 (139392)	948 (209288)
8.	Babbar	1125	63 (14)	71 (15750)	107 (23625)	1788	82 (18)	144 (32184)	219 (48276)
9.	Tangoti	2226	63 (14)	141 (31164)	212 (46746)	3708	82 (18)	303 (66744)	454 (100116)
10.	Deshti	962	63 (14)	61 (13468)	92 (20202)	1601	82 (18)	131 (28818)	196 (43227)
11.	Deh Bagga	351	63 (14)	22 (4314)	33 (7371)	584	82 (18)	48 (10512)	71 (15768)
12.	Chukra	478	63 (14)	30 (6692)	45 (10038)	797	82 (18)	65 (14346)	98 (211519)
13.	Hejwani	519	63 (14)	33 (7266)	50 (10899)	865	82 (18)	71 (15570)	106 (23355)
14.	Ramdani	685	63 (14)	43 (9590)	65 (14385)	1142	82 (18)	93 (20556)	139 (30834)
15.	Nuttal	2078	63 (14)	132 (29092)	198 (43638)	3460	82 (18)	283 (62280)	424 (93420)
16.	Shori	767	63 (14)	48 (10738)	72 (16107)	1279	82 (18)	104 (23022)	157 (34533)
17.	Wazirani	866	63 (14)	55 (12124)	83 (18186)	1441	82 (18)	118 (25938)	176 (38908)
Sub total				12494 (2754372)	18741 (4131558)			25137 (5441642)	37750 (812436)
Unaccounted Water 20%				2499 (550875)	3758 (826312)			5027 (1108328)	7541 (1662187)
Grand Total				14933 (3305246)	2248 (4954870)			30167 (6649970)	45246 (9974223)
Adopted Demand				15120 (333333)	22680 (500000)			30240 (666666)	45360 (1000000)

The LPCD varies with the size of Village or Town

PROJECT PHASING :

Based on the population and to avoid uneconomical project Investment the project has been divided in two phases as follows :

Phase I : Upto year 2002 to serve 94,000 population.

Phase II : Upto year 2015 to serve 156,000 population.

The water demands for the project thus worked out as follows :

Phase I : 5.00 million gallons per day (mgd) (10 cusecs).

Phase II : 10.00 million gallons per day (mgd) (20 cusecs).

WATER QUALITY :

The water of Pat Feeder Canal is sweet, with normal turbidity and other typical characteristics of river water. The chemical analysis shows the presence of traces of iron. The maximum suspended solids are of the order of 1100 mg/litre. The treatment processes have been accordingly designed for the removal of suspensions and disinfection is provided to attain the quality of treated water to be in accordnce with the WHO guide-lines.

PROJECT COMPONENTS :

Based on the above mentioned projections of population, water demands and the quality of water source, Water Supply Project has been designed.

As mentioned earlier, the project is planned in two phases. The requirements of Phase I to suffice the requirements upto 2002 shall be constructed now. Additions of facilities to meet the requirements upto 2015 shall be made in 2002.

The project has the following components :

1. Intake and Pump House at Pat Feeder Canal.
2. Raw Water Transmission Main - 5 km long.
3. Raw Water Storage : 270 million gallons to last for 45 days of closure period of the canal.
4. Treatment Works : Aerators, Clarifiers, Chemical House, Rapid Gravity Filters and Treated Water Balancing Tanks.
5. High Lift Pump House : To pump water to the towns and villages.

6. Water Transmission Mains :
   (a) To Dera Murad Jamali.
   (b) To Nuttal, Bellpat.
   (c) Bellpat to Lehri.
   (d) Bellpat to Bhag.
   (e) Branch Lines to villages.
7. Booster Stations : At Nuttal, Bellpat and Bhag.
8. Distribution Networks including Elevated Service Reservoirs.

Exhibit - 3 : Shows the layout of the Treatment Works

Exhibit - 4 : Provides a schematic layout of project components.

The major design considerations employed for the economy and dependability of the service to the consumers are summarized below :

1. INTAKE WORKS :

It is a piped outlet from the canal drawing water from 0.8m above the bed of the canal to exclude the inflow of silt load into a sump as shown in Exhibit 4, from where the raw water shall be pumped into a raw water storage tank. Pipes provided shall maintain non-silting velocity. Trash screen has been provided to prevent floating matter entering the intake.

2. RAW WATER STORAGE :

The earthen ponds shall have 45 days storage capacity. The depth has been designed to avoid occurrence of anarobic conditions, as well as to avoid aquatic growth in the body which is caused by the nutrients provided by ultraviolet rays penetrating into shallow waters. The algal control on the surface shall be affected by surface dragging of copper sulphate or other algicides with the help of a boat.

3. TREATMENT UNITS :

(a) Aerators have been provided for the oxidation of iron as and when required.

(b) To the aerated water alum is added to coagulate the colloidal suspension and to remove the electrolytic charge on the suspension. Two centrifloc clarifiers each of 2.5 mgd capacity have been provided for Phase I. Two more units shall be added in 2002 for Phase II. The sludge removal shall be under hydrostatic water

head to a common sump from where it shall be pumped to the nearest stream for disposal.

The adoption of said clarifiers is based on the experience elsewhere under similar conditions and hence the suitability of this type of clarifier is established.

(c) Twelve filtration units (6 in phase I and 6 in phase II) of rapid gravity sand filters have been provided. Filter rate of 120 gallons/Sq.ft./hr. (5.45 cu.m./Sq.m./hr.) has been adopted to economize on land costs and construction cost of large filter beds prone to aquatic growth.

(d) Chemical Additives :

(i) *Coagulation :* The canal water is particularly difficult from the treatment point of view as compared to the river waters. The silt excluders remove the coarser particles and only fine, suspended and colloidal matter is mostly left in suspension. Such waters have therefore to be specially taken care of by chemical coagulation to form thicker and tougher floc. This shall be achieved by mixing alum to the raw water as coagulation agent. Sodium Alginate will also be used which shall act as a coagulant aid. The doses of these chemicals have been worked out by laboratory jar test.

(ii) *pH Correction :* Lime slurry shall be added for pH correction of the filtered water before entering into the treated water balancing tank.

(iii) *Disinfection :* The filtered water shall be disinfected by chloramine instead of chlorine alone for longer effect since the length of pipe line and travel time is quite high i.e. about 12 hours to farthest end of the transmission main.

The usual disinfectant chlorine is a strong oxidizing agent for disinfection but the hypochlorous acid produced after its mixing with water is always in reversible form with the result that the free chlorine can always escape through the tank vents. The most stable disinfectant though weak in characteristics but having lasting effect is chloramine or what is commonly known as combined chlorine which results from the combination of ammonia with chlorine. The Ammonium Sulphate solution when reacts with the calcium

hydro-oxide used for pH correction of the filtered water would produce free ammonia gas which mixes with chlorine gas to form chloramine.

4. TREATED WATER BALANCING TANK :

Two treated water balancing tanks of 0.5 million gallon capacity have been proposed, which is equal to two hours of max. day demand for Phase I of the project.

5. PUMP HOUSES :

From Pat Feeder Canal to the farthest end of pipeline there is an elevation difference of 58 meters. Water has therefore to be pumped and boosted at various locations. Fifty six pumps of horse powers varying from 10 to 180 shall be employed, in the form of staged boosting with break pressure tanks instead of in-line boosters for the remoteness of the pipe line where communication or complex instrumentation is not feasible.

(i) *Intake Pumps* : Ten turbine pumps of 1273 gpm are proposed. Six shall be installed in Phase-I and four in Phase-II.

(ii) *Raw Water Pump at Raw Water Tank* : Eight turbine pumps of 1273 gpm are proposed out of which four shall be installed in Phase-I.

(iii) *High Lift Pumps :*

(a) *For Dera Murad Jamali* : Six pumps of 781 gpm are proposed. These shall be installed in phase-I.

(b) *For Nuttal* : Eight pumps of 628 gpm are proposed. Four shall be installed in phase-I.

(c) *Wash Water Pumps* : Two pumps of 500 gpm are proposed to be installed.

(iv) *Booster Pumps :*

(a) *At Nuttal* : Eight pumps of 625 gpm are proposed. Four shall be installed in phase-I.

(b) *At Bellpat* : Nine pumps (3-315 gpm, 4-680 gpm and 2-486 gpm) are proposed. Five shall be installed in phase-I. These shall supply water to Bhag, Lehri and Bellpat towns.

(c) *At Bhag :* Three pumps of 178 gpm shall be installed to serve Jalal Khan Town.

(v) *Sludge Water Pumps for Clarifiers :* Two centrifugal pumps of 750 gpm are proposed.

6. TRANSMISSION MAINS :

(i) *Raw Water Transmission Main :* A Ductile Iron Transmission Main of 700 mm. dia and 5 km in length has been provided to carry discharge 10% more than the max. day demand.

(ii) *Treated Water Main :* Ductile Iron Mains of 500 mm dia have been provided to convey water to the towns of Dera Murad Jamali and Bellpat, 350 mm and 400 mm dia pipe lines respectively carry water to the towns of Bhag and Lehri. For supplying water to villages enroute the offtake lines of D.I. Pipes upto 80mm dia as shown in exhibit-2 have been used. The pipes smaller in diameter than 80mm to carry smaller discharges to the villages are of Galvanized Iron with Bituminous protection on the outer side.

All these pipes are designed to carry max. day demands.

7. DISTRIBUTION SYSTEM :

For each town of Dera Murad Jamali, Bellpat, Bhag and Lehri and 13 villages the distribution systems using Hazen William formula and computer program have been designed. Asbestos cement pipes have been used being locally manufactured and more durable in the hot climate as compared to PVC Pipes. The pipes are designed to carry Peak hour discharges. Elevated R.C.C. Tanks shall be constructed at Dera Murad Jamali, Bhag, Lehri and Bellpat since the water is available for construction. At the villages prefabricated welded steel tanks are proposed for ease of erection.

8. INFRASTRUCTURE :

(i) Stand-by Generators at the Intake, Treatment Works, and the Booster Stations have been provided to ensure water supply during the eventualities of load shedding or electric break down.

(ii) Workshop and ware house facilities have been provided at the treatment works.

(iii) Staff Quarters for essential staff and office accommodation have been provided at Intake, Treatment Works, and Booster Stations.

PROJECT COSTS :

The project is estimated to cost Rs. 817 million with phase-I to be completed by 1992 and phase-II to be completed in 2002. The details are as tabulated below :

CAPITAL COST ESTIMATE (PHASE-I + PHASE-II)

1.	Land Acquisition	= Rs.	6.765 million
2.	Civil Works and Infrastructures	= Rs.	72.033 million
3.	Transmission Mains	= Rs.	359.953 million
4.	Service Reservoirs and Distribution Network	= Rs.	72.215 million
5.	Electrical and Mechanical Works	= Rs.	78.885 million
6.	Contingencies, Consultancy and Escalatation	= Rs.	227.200 million
	Total :	= Rs.	817.05 million

Cost of production of water works out to be Rs. 41 per 1000 gallons after it reaches the consumer. Though it looks on the higher side but for provision of the basic living necessity it would be justified and would be paid back by ensuing socio-cultural and health benefits.

OPERATIONS & MAINTENANCE AND INSTITUTIONAL REQUIREMENTS :

(a) O&M Setup :

Operation and Maintenance of the Project having a transmission main of more than 150 km. in length and a Distribution Network of about 60 km length in four towns and thirteen villages needs an elaborate organizational setup fully equipped and geared for the task. The following provisions have been made for the satisfactory running and upkeep of the project for optimum consumer service.

(i) *Organization for O&M* : An independent division headed by an Executive Engineer based at Bellpat is proposed to be created in PHED. He shall be assisted with two assistant engineers, sub-

engineers, foremen, operators, plumbers, mechanics, billing clerks etc. The total proposed staff is of 100 officials.

(ii) Communication shall be the major problem for O&M. A V.H.F. radio link between the towns, major villages, base stations, pump houses, intake has been proposed. Radios shall also be available in the mobile vehicles used by O&M staff.

(iii) The essential equipment such as crane, trucks, vehicles, workshops have been provided for the ease in maintenance. A site laboratory to test water quality shall be provided.

(b) **COST RECOVERY :**

Full recovery of the capital cost and the O&M costs shall not be possible and the cost of production of water shall be high due to long lengths of transmission, & distribution systems. However it is desirable that the consumers must participate and bear reasonable part of the O&M cost. It is proposed that a flat water rate per house connection be charged. At the moderate rate of Rs. 5 per thousand gallon the revenue is expected to be Rs. 10 million per year.

The O&M costs will be of the following order:

O&M staff	Rs. 3.45 million
Electric power	Rs. 15.43 million
Chemicals	Rs. 5.43 million
Repairs of Equipments civil works	Rs. 2.36 million
Total:	Rs. 26.52 million

The O&M costs are very high as compared to the revenue, but the difference shall be offset by indirect savings in national health costs, boost up of the production due to socio-economic development, increase in per capita income and therefore, the income tax revenue.

The nomadic population is mostly cattle growing. Some pasture/fodder is available locally after rains.Fodder can also be transported from the sibi areas near Nari River and the adjoining Sind areas. With water available for drinking by animals the nomads are likely to become sedentary and dairy farming or poultry farming may develop.

CONCLUSIONS :

The water supply project, first of its kind in the area shall be considered as a divine bounty in the area suffering for ages and would Insha-Allah give rise to general development in the area to transform it into Dasht-e-Zeest (desert of life) after implemention of the project. This would alleviate the sufferings of the people including improvement in health and the area shall no longer be called Dashte-Amwat a term used for centuries.

The nomadic culture in the area shall convert into the sedentary one with extensive mental transformation. People shall resort to more productive professions and the abandoned railway stations and villages, shall reappear on the scene. The feudal system of the life would change to better cooperative living. The settled life shall improve the literacy level in the region.

Various categories of local labour will be recruited. This will provide on the job training and a better understanding of the works. This would create a better chance of the local people being able to operate and maintain the works in the years after the project is completed.

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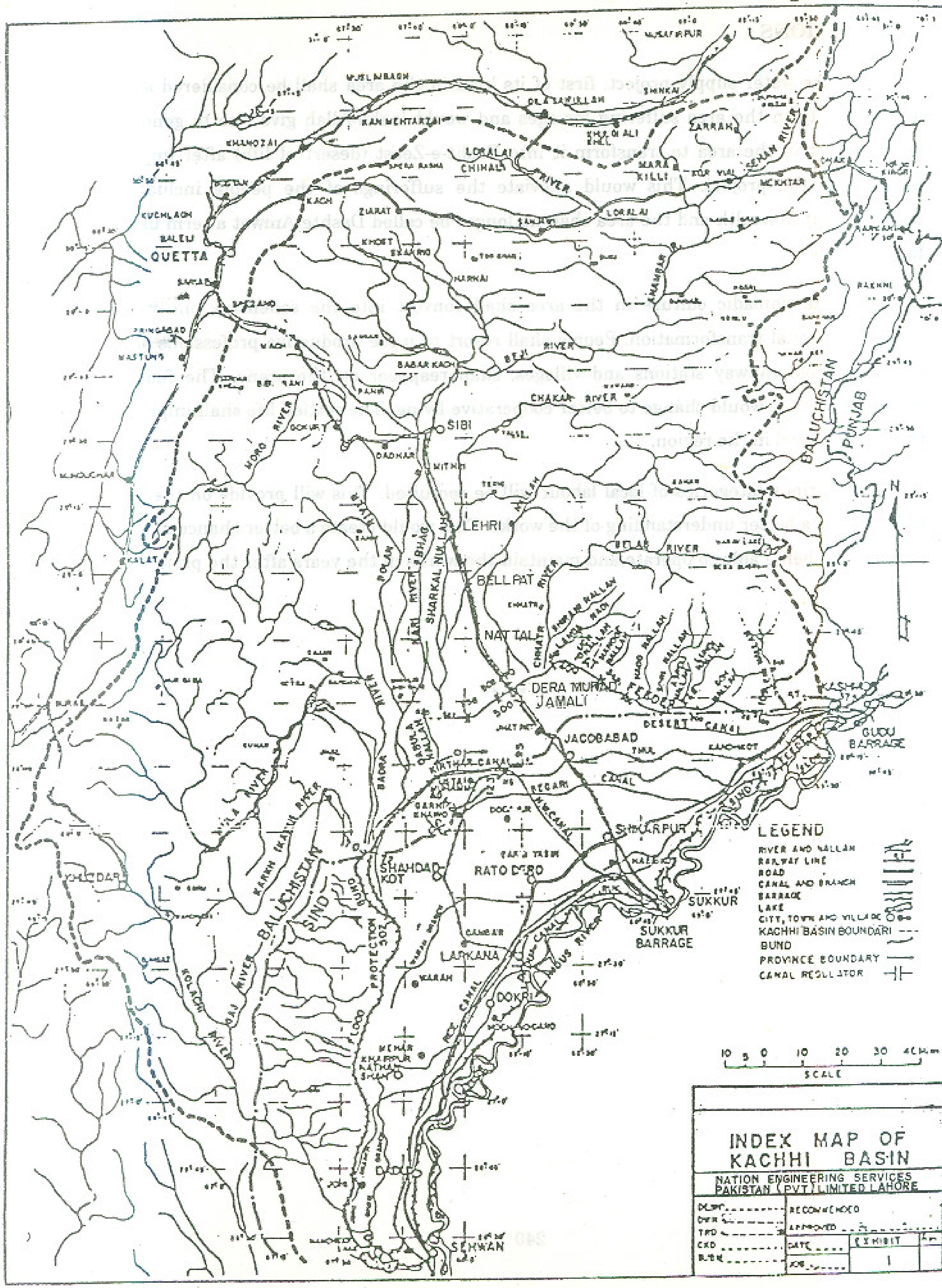
EXHIBIT - 1


MUZAFFARPUR
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QILA SAIFULLAH
SHINKAI
KAN MEHTARZAI
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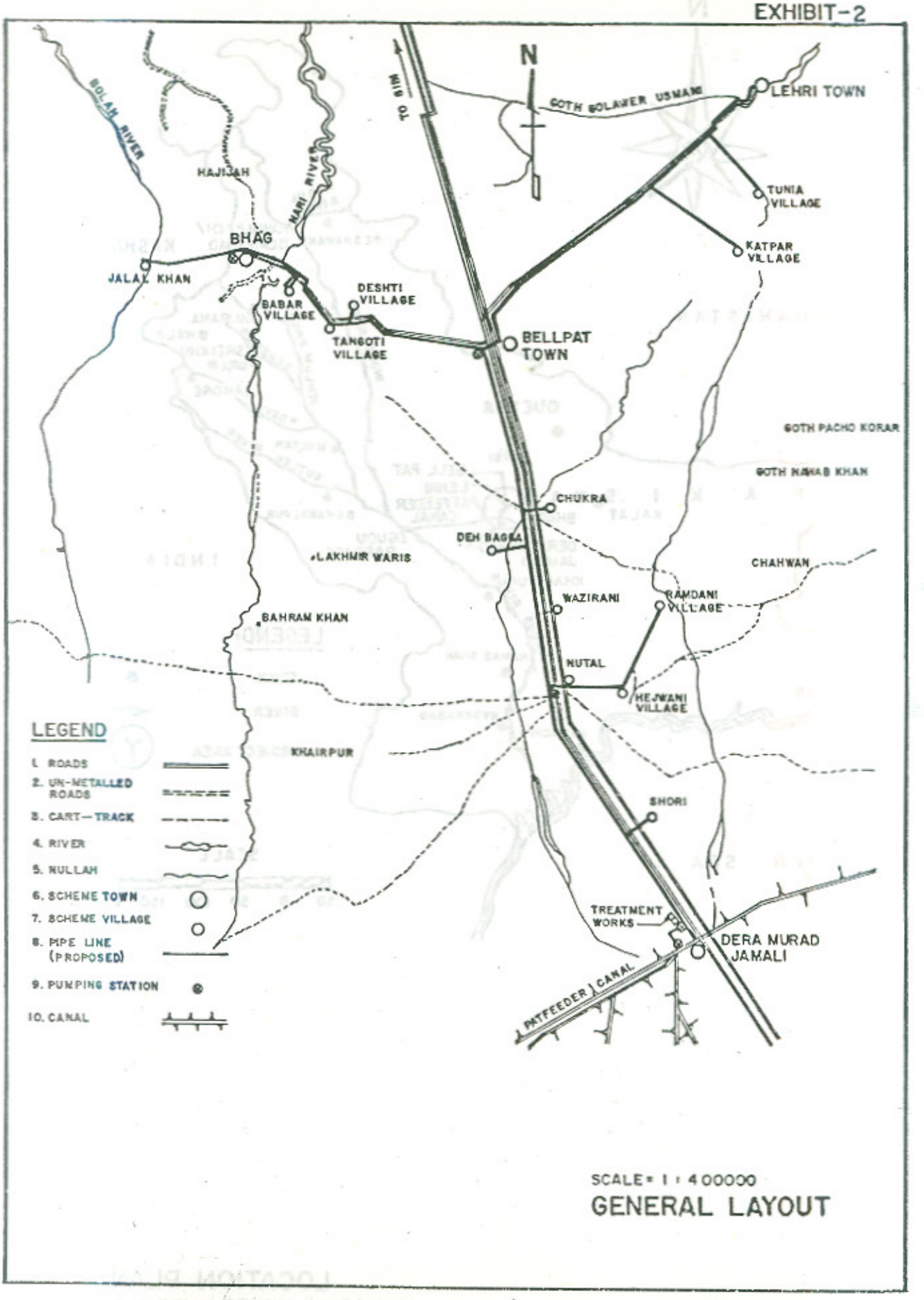
APPROVED
DATE
EXHIBIT
1

LOCATION PLAN
KACHHI WATER SUPPLY SCHEME

EXHIBIT-2



SCALE = 1 : 400000

GENERAL LAYOUT

EXHIBIT-3

LAYOUT OF TREATMENT WORKS