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GOVERNMENT OF THE
ISLAMIC REPUBLIC OF PAKISTAN

PAKISTAN WATER AND POWER
DEVELOPMENT AUTHORITY

GHAZI - BAROTHA HYDROPOWER PROJECT

ENVIRONMENTAL ASSESSMENT

EXECUTIVE SUMMARY

October 1994

PAKISTAN
HYDRO
CONSULTANTS
A Joint Venture of
- National Engineering Services Pakistan (Pvt) Ltd.
- Associated Consulting Engineers ACE (Pvt) Ltd.
- Ewbank Preece Ltd.
- Harza Engineering Company International L.P.
- Binnie & Partners (Overseas) Ltd.

GHAZI-BAROTHA HYDROPOWER PROJECT

ENVIRONMENTAL ASSESSMENT EXECUTIVE SUMMARY

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1. INTRODUCTION

The Ghazi-Barotha Hydropower Project is a major run-of-the-river environmentally sustainable power project (1,450 MW installed capacity), designed to meet the acute shortage of power in Pakistan. This Executive Summary presents, the main results of studies of the potential effects of the Project on the natural and human resources of the northern Indus river plain.

These studies were part of the feasibility, design and preconstruction studies undertaken for the Pakistan Water and Power Development Authority (WAPDA) by Pakistan Hydro Consultants, a joint venture of National Engineering Services Pakistan (Pvt) Ltd., Associated Consulting Engineers ACE (Pvt) Ltd., Ewbank Preece Ltd., Harza Engineering Company International LP, and Binnie and Partners (Overseas) Ltd., since February 1990. The feasibility and design studies were funded by UNDP and the Government of Pakistan, with the World Bank as the executing agency.

The environmental assessment study has been prepared in accordance with the Environmental Impact Assessment Guidelines of the Government of Pakistan framed under Ordinance No. XXXVII (December 1983), the Antiquities Act (1975) and the World Bank Operational Directives (ODs), the most applicable of which are OD 4.01, Environmental Assessment, and OD 4.00, Annex B, Environmental Policy for Dam and Reservoir Projects. In addition, the requirements of OD 4.30, Involuntary Resettlement, and OD 4.50, Cultural Property, have been followed.

The following documents constitute the environmental and resettlement documentation for the Project:

- Volume 7 of the Feasibility Report (August 1991), which presents the detailed results of the environmental and social studies carried out during the feasibility studies.
- The Report on Archaeological Studies (1991), which presents the results of the survey of archaeological and historical sites.
- The Report on Supplementary Environmental Studies (July 1992), which presents the results of the supplementary studies undertaken during the tender design stage.
- The Environmental Assessment Summary (July 1992), which presents the main findings given in the above Reports and also includes the impact of the subsequent changes in channel capacity and headpond storage.
- The Report on Additional Supplementary Environmental Studies (August 1994), which presents the results of the additional studies undertaken during the preconstruction stage.
- The Resettlement Action Plan (September 1994), prepared in accordance with the provisions of OD 4.30, "Involuntary Resettlement".

An independent Environmental Review Panel participated in the environmental assessment and resettlement studies, reviewing reports on the studies undertaken and specifying aspects requiring additional studies.

These studies have identified alternative actions, mitigation activities, monitoring programs and institutional strengthening measures, which if effectively incorporated into the design and implementation of the Project would reduce environmental and social impacts to an acceptable level.

2. PROJECT DESCRIPTION

The Project (Drawings 1 and 2) will utilize the fall of about 76 m in the Indus river between the tailwaters of Tarbela dam and the confluence of the Indus and Haro rivers, a length of about 63 km. The Project has three basic elements: a barrage, a power channel and a power complex. The relatively flat slope of the power channel will permit most of the river drop to be utilized for power generation. The flow diverted into the power channel will be returned to the Indus river after passing through the power complex, with no consumptive use of the water. The salient features of the Project are summarized in Table 1.

The barrage, located about 7 km downstream of Tarbela dam and just upstream of Ghazi village (Drawing 3), will reregulate the daily discharges from Tarbela and divert flows into the power channel. Compensation water during the low-flow season and excess flows during the high-flow season will be released downstream of the barrage. The barrage will be able to pass the flood of record through its 20 standard bays and 8 undersluices at normal pond level. A fuse plug will help pass extreme floods. The barrage will include a public road crossing of the Indus river.

The concrete-lined power channel will convey up to 1,600 cumecs from the barrage to the power complex (Drawing 2). The channel will be 52 km long with a bed slope of 1 in 9,600, a water depth of 9 m, a base width of 58.4 m and a velocity of 2.33 m/s. Underdrainage facilities will keep the groundwater table below the channel invert. There will be 34 road bridges, a railway bridge, 12 pedestrian bridges and 45 cross-drainage structures.

The power complex (Drawing 4) will be located near the confluence of the Indus and Haro rivers, in the vicinity of Barotha Village. It will comprise a forebay, a siphon spillway, two headponds, a power intake structure, five penstocks, a powerhouse with five 290 MW turbo-generators, and a tailrace channel. An existing road would be upgraded to serve as an access road to the power complex. The headponds will allow daily peaking operations. The power will be transmitted by 500 kV circuits to WAPDA's national grid system.

The Project will have an installed generating capacity of 1,450 MW. Maximum power will be available during the critical months of May and June when the national system is short of power. The average annual energy output will be about 6,600 GWh.

The total capital cost of the Project, at September 1993 price levels, is estimated at US$ 2,166 m including the transmission links to the national grid, physical contingencies, price contingencies and engineering. The cost will have a local component of US$ 804 m and a foreign component of US$1,362 m.

Economic studies have demonstrated that the Project forms part of the least-cost expansion of the Pakistan power system for the full range of sensitivity analyses performed. The Project has an EIRR of 22.0% and an FIRR of 14.9%.

It is currently planned that civil works contracts would be awarded in May 1995, with the first unit to be commissioned in January 2000 and the last unit eight months later.

3. BASELINE DATA

The Project area forms the northwestern part of the Potawar Plateau. There are three main tracts which will be affected by Project activities (Drawing 2).

The Ghazi tract, in the neighborhood of the barrage and the upstream end of the power channel, extending to about Ghurghushti, is primarily rolling, rain-fed, agricultural land (near the river) and pasture (farther southeast).

The Chhachh tract, which extends from Ghurghushti to the Grand Trunk (GT) road (the main road from Lahore to Peshawar) and from the Indus river to the Ghandghar mountains is largely Indus flood plain and contains good agricultural land.

The Sarwala tract, which lies between the GT road and the Haro river and extends west to the Indus river, is the most hilly of the tracts and the land is generally of poor quality.

Most of the Project area consists of unconsolidated river deposits (gravels, sands and silts) to depths of at least 30 m. In the area around Kamra and Rumian, there are outcrops of argillites, limestones and quartzites.

The predominant land uses in the Project area are agriculture and pasture. Some hilly areas are allowed to remain in scrub forest, but the land is not dedicated to forest near the GT road, substantial areas are covered by infrastructure, especially the Kamra Aeronautical Complex.

Between Tarbela and the mouth of the Kabul river, the Indus flows in a wide braided channel with a number of islands (belas). Some belas are flooded only very rarely and these support a climax vegetation of trees, shrubs and grasses. Those located near the river banks are grazed by cattle, with some under cultivation.

Downstream of the barrage, the Indus water is used for watering livestock, washing, bathing, and some sewage disposal. Little water is taken for irrigation or drinking, reliance being placed instead on wells and tubewells.

Groundwater is the major source of irrigation and domestic water in the Project area, being extracted by a large number of open wells (many fitted with electric pumps), Persian wheels and tubewells. The depth of the water table varies greatly in the Project area and fluctuates seasonally.

The Project area supports no permanent natural wetlands or open water bodies, other than pools along the Indus. These are subject to scour during the flood periods and to partial drying during the low-flow season. There is little aquatic vegetation in these pools or in the river.

Wild animals in the Project area are limited and consist of jackals, fox and wild

boar. Densities of waterfowl and other water-related birds are not large. Game birds of the area include blue rock pigeon, kaunk (Chukor), seesee, grey partridge, large and small sandgrouse. Quail visit the area in spring and autumn. The most abundant fish in the Indus are the mullah, mahseer and chaina, which are caught by a few part-time fishermen.

The population of the region grew at an annual rate of only 1.6% during the nine years between the 1972 an 1981 censuses, a low rate attributable to emigration.

The employment structure of the region remains essentially agricultural, including the service sector. Most agriculture is barani (rain-fed). Land holdings in the Project area tend to be small and fragmented.

The Project area contains many graveyards and shrines, as well as archaeological and historical sites dating from the second century BC to the late colonial era.

Baseline data of the Project has been acquired from several sources: reports and open literature; interviews with individuals of various resource agencies; scoping sessions with potential affectees, public representatives, government officials and nongovernment organizations; project-related data collection programs (population, geology, soils, water); special programs of field surveys and sampling (water quality, disease vectors, village surveys, focussed census, income surveys, archaeological surveys).

4. ANALYSIS OF ALTERNATIVES

The major alternatives analyzed are described below, and a comparison is shown in Table 2.

No Action Alternative. The latest (1993) estimate of future power demand in Pakistan envisages an increase of nearly 6,000 MW in the peak demand by the turn of the century from the present level of around 9,000 MW. It has been projected that various measures being implemented to conserve energy may reduce the additional demand by up to 1,000 MW.

At present, load shedding takes place on a large scale whenever generation from Tarbela and Mangla dams is reduced significantly. This occurs during January when the releases (which are determined by irrigation requirements) are minimal, and also in May and June when both reservoirs are drawn down. Reduced load shedding occurs in the intervening period.

Failure to meet this increase in demand will result in more load shedding which will disrupt manufacturing processes and commerce, and have serious consequences for national economic development.

Alternative Generation Projects. In the economic assessment of the Project, alternative generation projects (thermal, nuclear and hydropower) were considered. Under all the scenarios studied, hydropower has been shown to be the most attractive option for meeting future demand. With Ghazi-Barotha included in the list of candidate plants, it was selected immediately.

Barrage Alternatives. Five barrage sites were identified in the reach of the Indus river between 7 and 12 km downstream of Tarbela (Drawing 5) . Of these, two sites, A and C, were selected for detailed study. Site C offered the advantage of greater storage capacity, whereas Site A was preferable on

environmental grounds. An independent study by the International Union for Conservation of Nature and Natural Resources (IUCN/Pakistan) confirmed the choice of Site A.

Power Channel Alternatives. Alternative designs studied for the power channel included an unlined channel and twin channels. Both options would have required a substantially wider right-of-way, with greater socioeconomic impacts and construction costs. Therefore these options were discarded.

The area studied for the alignment of the power channel is shown on Drawing 6. The most economical alignment for the channel would have passed through several long-established villages and this was considered unacceptable. Therefore, the power channel alignment was moved into higher ground in order to avoid all villages. The resulting alignment would then have passed through several graveyards, some very large. Accordingly, further modifications were made to the alignment to avoid these graveyards. As a result, the power channel alignment is largely in cut with nearly 70 m cu m of surplus excavated material.

Five alternative routes through the Kamra Aeronautical Complex were studied, and an acceptable alignment was selected that passes through a relatively less important part of the Complex.

A number of options have been studied for disposal of the surplus spoil from required excavations. The spoil will be used for terracing of wasteland where the surface relief is very rugged and for construction of spoil banks. About 1,640 ha of land will be acquired temporarily for spoil disposal. The spoil banks will be graded, provided with tubewell irrigation and sold back to the affected farmers.

Power Complex Alternatives. Five potential power complex sites were initially studied, between Dakhner and the Haro river (Drawing 7). Jaba, Dher and Barotha sites were selected for a detailed evaluation. All three sites being comparable from environmental impact considerations, Barotha was selected as it offered the most favorable topography.

Various alternatives were studied for the headpond capacity and the embankment alignments. The selected alternative requires more land, all of it barani and pasture land with no habitations, but significantly increases peaking capacity and also utilizes more of the surplus material from the required excavations.

Two tailrace alignments were considered, north and south of Barotha village. The latter has been selected because it uses the additional fall in the Indus and result in less spoil.

Following review of several alternative routes, the route adopted for the 7 km access road from Haji Shah to the power complex (Drawing 8) follows an existing dirt road which would be upgraded and widened.

Various alternative routes for the 500 kv transmission links were studied (Drawing 9). The routes selected have minimal environmental, social and archaeological impact. During detailed design, the alignment and tower locations will be fixed so as to provide specified clearances from villages and houses, to have a minimum impact on trees and agriculture, and to avoid archaeological sites.

5. IMPACTS OF THE PROJECT

Throughout the studies for the Ghazi-Barotha Project, emphasis has been placed on early identification of environmental and social impacts. Environmental and social considerations have been included in the process of selection of alternatives during the siting of structures, design of components and development of operational concepts.

The impact of this approach is exemplified by the alignment selected for the power channel. It is noteworthy that the alignment option that was selected directly addresses major resettlement concerns in two ways. One, minimal resettlement will take place because the adopted alignment avoids all villages by shifting the power channel to higher ground away from the river. This option significantly increases the requirement for excavation and therefore the overall cost of the Project, but decreases its negative social impact. Two, the Project will resettle the affectees in the Project area near their homes on new spoil banks land provided by the Project along the power channel. This is an innovative approach which provides the option of resettling people in host communities with all its attendant difficulties.

Another major planning activity has been early and frequent interactions with government authorities, local people and local non-governmental organizations (Table 3). This has kept the planning team attuned to public concerns and desires, and facilitated the participation of the local population in the planning process.

As a consequence of this approach, it has been possible to identify and avoid, or at least mitigate, the potentially serious adverse environmental and social effects. Table 4 shows the likely effects of the Project components on the physical, biological and social environment. The principal impacts are described below.

Impact on Land Resources. The land required for the barrage structures and pond (1,180 ha) is state-owned land. About 1,000 ha of land will be taken permanently by the power channel and 1,640 ha will be required temporarily for the spoil banks. About 133 ha of this land is state-owned. The major land acquisition near Barotha will be about 850 ha for the headponds, powerhouse structures and tailrace. About 100 ha will be required for the power complex colony and access roads. In addition, land would be required for construction of the towers for the 500 kV transmission lines to the national grid.

Thus the net loss of privately-owned land to the Project will be 1,817 ha, whereas about 1,640 ha of spoil bank land will be returned for cultivation after being provided with tubewell irrigation. Most of the privately-owned land to be taken by the Project (81.9%) is barani land (rain-fed). The next largest category is uncultivable (14.7%), followed by irrigated land (3.4%).

A recent study into the productivity potential of the spoil banks has shown that the productivity of the Irrigated spoil banks should be up to four times that of barani lands in the area. Thus the productivity of the 1,640 ha of spoil banks should be about double that of the 3,457 ha of land being acquired.

The Project will influence land use indirectly. Land along the roads near the living and working areas will acquire value for commercial development and the owners may Choose to sell or lease their lands for such purposes. Such shifts,

and the ensuing developments, will help to spread the money brought into the region by the Project.

Impact on Water Resources. The main effect of the barrage will be the partial redirection of the flow in the Indus river. During the high-flow season, the river downstream will receive the major portion of the releases from Tarbela. During periods of low flow, compensation flows will be released from the barrage to maintain aquatic ecosystems and provide local users access to water.

Groundwater inflow-outflow relationships along the river will be slightly altered, with additional inflow from the pond upstream of Ghazi and, during the dry season, increased outflow to the river downstream.

Reduction of flow in the river is not expected to affect the local livestock, as substantial pools will still remain. The total cattle herd of approximately 15,000 head consumes less than 0.01 cumecs for drinking.

The lining of the power channel and the underdrainage system will prevent any rise in groundwater levels. Where existing groundwater levels are near the surface, the underdrainage system will reduce these along the channel, and help to alleviate waterlogging.

The main effect of the power complex on water resources will be the disruption of a small irrigation system near Barotha. Seepage from the headponds will not have a significant impact due to the relatively steep groundwater gradient to the Indus river, and will reduce with time as sediment is deposited in the ponds.

Anticipated Project induced development would create a need for upgrading of existing and development of new sewerage networks and treatment facilities in the Ghazi-Khalo area.

Impact on Biological Resources. The effect of the Project on flora and fauna of the riverain area will be minimal.

The loss in riverain ecosystem in the barrage pond is expected to be balanced by the development of an aquatic ecosystem in this reach and an increase in the riverain ecosystem downstream of the barrage due to reductions in flood peaks.

Downstream of the barrage, the effect, if any, will be limited to the braided channel zone of the Indus River. The most probable effect may be a change in plant succession.

Riverain fisheries may be affected by the reduction in dry season flows, affecting mostly part-time fishermen. A recent study of the potential for the development of fisheries has shown that the existing fishery resources can be considerably enhanced by stocking fish species in the barrage pond and establishment of fisheries in the headponds at the power complex.

The intermittently flooded islands and floodplain vegetation support sparse wildlife population, including wild boar which is considered a pest. These populations are not expected to see significant reduction in habitat with reduced flows in the river.

The channel alignment does not pass through or near any forest reserves or natural areas.

The shores of the headponds will be a convenient source of water for wildlife.

Impact on Social and Cultural Resources. The potentially significant social effects of the project components, particularly of the power channel, have been largely avoided by the selection of environmentally and socially acceptable sites and alignments, sometimes at considerably increased costs. A total of only 110 scattered dwellings which house 179 families with a surveyed population of 899 inhabitants will have to be locally resettled for construction of the main civil works. The inhabitants of an estimated 15-20 dwellings are also anticipated to require local resettlement along the transmission line right of way for safety reasons. This, together with the measures adopted to safeguard the means of livelihood of the affectees, results in no out-of area resettlement being required.

Project construction, with its inflow of consumers, will introduce boom-town effects to the Ghazi-Khalo area. The river crossing provided by the barrage will also result in greater economic and commercial diversity, and should reduce the impact of the 'bust' cycle that could follow Project construction.

The power channel alignment has been selected to avoid archaeological and historical sites, graveyards and shrines. Two surveyed archaeological sites would be affected by the construction of the power channel. Near Banda Feroze, however, it will be necessary to move 14 graves in a family cemetery. In addition, one small mosque would also need to be moved.

The power channel will affect traffic across its alignment, both during construction and operation. It will also pose a threat to public safety, due to its smooth sides and high water velocities.

Upgrading of the Haji Shah-Barotha access road will increase road traffic and commercial development which could result in safety risks and unplanned roadside development.

The barrage pond and headponds will be poorly suited to mosquito breeding due to the rapid variations in water levels resulting from Project operation.

The secondary effects of the removal of income-producing land will be felt in the support sector, comprising artisans and shopkeepers, although this effect will not be significant as less than 8% of the total land of the affected villages is being acquired. Other possible adverse effects include loss of agricultural capability due to the diversion of labor to the Project, a risk of introducing diseases into the villages from outside workers or from poorly-treated sewage, and friction between outside workers and villagers.

6. MITIGATION

A mitigation plan has been prepared for the Project which is complemented by a detailed "Resettlement Action Plan." The key elements of the mitigation plan are summarized in Table 5 and Table 6 provides a summary of entitlement packages under the "Resettlement Action Plan." A summary of estimated environmental and resettlement costs for the Project is included in Table 7, and a schedule for their implementation is provided in Table 8.

The Project is committed to providing entitlements to persons who lose their land or other property as well as to those others whose livelihood is directly affected by the acquisition of land. These entitlements will be supplemented by entitlements for landless affected people and by Project activities such as training, work opportunities and credit in addition to provisions for infrastructure and an Integrated Regional Development Plan. WAPDA is committed to the provision of these entitlements and necessary funding allocations have been made for them. These combined Project efforts are intended to meet the resettlement objectives of rendering the affected people with a standard of living equal to if not better than that which they had before the Project.

Land Resources. The impact of land acquisition for the Project will be largely mitigated by the provision of irrigated land on the spoil banks and by measures for fair and prompt compensation. A number of measures are also being adopted to ensure that the affectees are provided adequate support during the transition period and that the compensation process is transparent.

Surplus excavated material from the channel excavation will be placed in spoil banks along both sides of the channel (Drawing 10), graded, covered with topsoil (stripped from the channel excavation and from adjacent spoil areas), provided with tubewells for irrigation and resold to the farmers.

Those losing irrigated land will be eligible to purchase an equal area of irrigated land on the spoil banks but at barani prices; similarly, those losing barani land will be eligible to purchase half the area as irrigated land but at barani prices. In both cases, farmers will have about half their compensation payment available to allow them to support their households in the transition period between the loss of their land and their gaining spoil banks land, as well as provide resources to invest in their new land.

In order to minimize the loss of agricultural production during the construction period, farmers will be allowed to continue cultivation on the land even after it is purchased but before it is actually required for construction activities.

Land valuation will be based on market rates and housing, infrastructure, etc., will be compensated for at replacement value.

Three resettlement villages will be established in the Project area. In each village, a road network, a water supply and sewerage system, and electricity will be provided under the Project. WAPDA will also construct a primary school, a mosque and a Basic Health Unit in each resettlement village.

The Project will undertake various efforts through employment, training and credit schemes to restore production systems, support family livelihoods otherwise lost, and provide general social and economic uplift to the Project region.

WAPDA will set up a system of work permits for affectees, thus identifying potential workers to whom preference would be given in employment for the construction and operation of the Project.

Village landless groups losing their household livelihoods due to land acquisition will receive special consideration both in work opportunities, as holders of high priority work permits, and in the programs of vocational training, credit and self-employment generation.

Water Resources. Future water requirements for diluting wastewater discharged into the Indus river have been evaluated, based on conservative criteria. The water required in the year 2057 for dilution is estimated at only 6 cumecs. However, a minimum compensation water flow of 28 cumes will be provided downstream of the barrage throughout the Project life. This will be monitored and supplemented as necessary.

Existing WAPDA sewage treatment works discharging into the river upstream of the barrage site will be renovated. A study has been carried out to define the remedial measures required. A new sewerage system will be provided for Ghazi-Khalo.

The irrigation system in Barotha nullah will be restored following construction of the power complex and associated headponds.

Biological Resources. With effective management, the barrage pool fisheries are expected to more than replace the loss of riverain fisheries downstream of the barrage. Fishery resources will also be enhanced by stocking fish species in the headponds.

Social/Cultural Resources. To ensure general uplift and planned development, WAPDA is having an Integrated Regional Development Plan prepared for the whole area affected by the Project and will contribute Rs. 176 million towards this development. This will included social uplift (education, health); agricultural development (credit, extension services); and business/industrial development (small and medium scale). The plan will cover electrification of villages, construction of village link roads and development of a town plan for Ghazi-Khalo. The plan will included specific programs for women and other vulnerable groups. The plan will also stress long-term job development in the region.

A minor shrine on the right bank of the barrage pond, 1 km upstream of Galla, will be protected by an embankment. Two mounds along the channel corridor are of archaeological interest and will be excavated beforehand. Another site lies in an area to be covered by spoil banks and will be protected. Only one significant cultural property has been identified in the proposed borrow area and this area will not be used as a source of material for the Project. In consultation with religious authorities, arrangements have been made to locally relocate 14 graves and a small mosque which could not be avoided by the power channel. Appropriate "chance find procedures" have been adopted for project use, in case any unknown archaeological properties are uncovered during the construction activities.

To discourage the public from attempting to use the channel as a source of water, the channel and the bridges will be fenced near settlements and warning notices installed. In addition, a program of educating people, particularly children, about the dangers of the channel will be implemented. Grab rails and floating safety ropes will be provided to help anyone falling in to get out.

There will be a total of 46 crossings provided for the power channel, somewhat closer together in the more populous upstream region. Most of these are located at traditional crossing points. Thus the impact on pedestrian, livestock and vehicular traffic will be minimal. A road bridge across the tailrace channel will restore the present access between Barotha village and its land to the south of the Barotha nullah.

Actions to minimize impacts from upgrading of the Haji Shah-Barotha access road would include compensation to land owners, actions to control strip development, measures to support road safety. An archaeological survey would be conducted as part of the final design process for the road.

To protect public safety the transmission lines to the national grid would be routed to avoid passage over or close to residential, educational, health or commercial facilities. Land owners and parties required to relocate for safety reasons would be compensated consistent with Project entitlement procedures. An archaeological review would be conducted as part of the final design process.

7. MONITORING PROGRAM

The monitoring program will be a continuing program of data gathering and analysis designed to ensure the effectiveness of the mitigation program and to bring to light any environmental problems that were not identified earlier. A summary of monitoring actions is included in Table 5.

Land Resources. The critical areas of land resources requiring monitoring are the spoil areas and the river banks, with emphasis on erosion, cropping problems and agricultural productivity. These areas will be monitored for at least five years, or until stability appears to be achieved. The riverain morphology and ecosystem will also be monitored.

Water Resources. A regular program of water quality analysis will be conducted to ensure that compensation water releases are sufficient to maintain dry season water quality in the river downstream of the barrage. Groundwater aspects to be monitored include recharge from the barrage pond, changes in groundwater levels caused by the power channel, and seepage from the headponds.

Biological Resources. The ecosystem of the braided channel zone will be monitored to assess the change in plant succession. The monitoring program will include monitoring of fish, other aquatic species, birds and other wildlife in the barrage pond, the Indus river below Ghazi, and the headponds and adjacent habitat near the power complex.

Social Effects. Major projects inevitably bring social change in their wake. Much of this is beneficial, particularly that which promotes economic and social development. But there is always another side to development: of wage earners, families, or skill groups left behind by new methods of production, or the disruption of village communities by population growth and a capitalizing economy. Much of this change would occur in the Project area, whether or not the Project was ever built.

The Project's mitigation and monitoring programs cannot be a panacea for all the social problems that may emerge in the Project area, but they can mitigate those direct effects of the Project that have been anticipated and seek timely intervention in those that have not. Monitoring will therefore be required to ensure that social mitigations and safeguards are implemented.

Responsibility for Program. The WAPDA Environmental Cell (WEC), with appropriate support, will be the agency with the overall responsibility for the environmental monitoring of the Project. It will oversee land acquisition and compensation processes, resettlement, hiring of local labor, restoration of the spoil banks,

etc. To achieve this, it will maintain a permanent presence in the Project area and coordinate the monitoring activities of the different technical units within WAPDA. Whenever necessary, the Cell will undertake or commission additional studies or surveys to gain a more accurate picture of the effects of the Project. The Cell will produce reports on the environmental and resettlement aspects of the Project every six months.

WAPDA will significantly strengthen its Environmental Cell and will add social science expertise to the WEC in order to deal with resettlement issues, appoint Monitoring Consultants to support the Environmental Cell in the monitoring requirements of the Project, establish a Project Resettlement Organization (PRO) and sponsor the formation of a Project Non-Governmental Organization (PNGO). The PRO would be responsible to provide specialized support for implementing the "Resettlement Action Plan" and would include a Social Sciences Branch.

The PNGO will assist WAPDA in contacts with the local population, particularly for matters related to land acquisition, compensation, the formation of Tubewell User's Associations and the allocation of developed spoil banks. The PNGO will also assist in the monitoring of the social aspects of the area during the construction and operation periods. The PNGO will also have a mandate to facilitate the implementation of the Integrated Regional Development Plan.

Relevant technical divisions of WAPDA and other Government Departments will collect periodic data pertaining to land resources, groundwater, riverain ecosystem, etc.

An external Environmental Panel will also be established, for the project implementation phase, to evaluate environmental aspects on a periodic basis and, where necessary, suggest ways of strengthening the implementation, monitoring and evaluation process. It would consist of at least two members, one an environmental expert and the other a resettlement expert.

8. INSTITUTIONAL NEEDS

The main feature of WAPDA's plan regarding institutional, development is the strengthening of WAPDA's Environmental Cell, which will be responsible for overseeing the environmental and resettlement aspects of the Project during and after construction.

WAPDA has embarked on a series of measures to create a technical capability in environmental and resettlement management focused on the existing Cell, so as to ensure that WAPDA's projects and programs are environmentally sound and result in sustainable socioeconomic development. The measures being adopted by WAPDA include:

- drafting environmental guidelines on water resource development;
- preparation of an Environmental Management Plan for an ongoing water resource project, both as an implementation of environmental management procedures and as a training exercise;
- implementation of both institutional and manpower development, including environmental management training in Pakistan and overseas; and

TABLES

TABLE 1

PRINCIPAL PROJECT DATA

BARRAGE

Area of pond at normal pond level		1,140	ha
Normal pond level		340.0	m
Maximum (survival flood) pond level		341.5	m
Live storage volume		62	M cu m
Low–flow season range in water level		3.3	m
Maximum depth		14	m
Design flood discharge capacity		18,700	cumecs
Survival flood discharge capacity		46,200	cumecs
Construction flood		14,500	cumecs
Bridge carriageway width		9.3	m
Gates (No. x width x height)			
Standard bays	20 x 18.3	m x 8.3	m
Undersluices	8 x 18.3	m x 3.5	m
Head regulator	8 x 18.3	m x 7.5	m

POWER CHANNEL

Design flow		1,600	cumecs
Longitudinal slope		1:9,600	
Length		52	km
Full supply depth		9	m
Side slope		1V:2H	
Width at water surface		94.4	m
Water velocity		2.33	m/s
Freeboard of concrete lining		1.5	m
Tail regulator gates (No. x width x height)	4 x 18.3	m x 9.5	m
Total excavation		76	M cu m
Service road width (on either side)		10	m
Embankment width retained by WAPDA (on either side)		25	m
Road bridges		34	
Railway bridges		1	
Pedestrian crossings		12	
Superpassages			
design flood (no overflow)		500	years
Number		26	
Culverts		1	
Nullah inlets		18	
Escapes		5	
Permanent land requirement		1,000	ha
Temporary land requirement		1,640	ha
Tubewells on spoil banks (No. x capacity)		150 x 7	l/s

TABLE 1

PRINCIPAL PROJECT DATA

POWER COMPLEX

Turbines/generators (Francis)	5 No x 290	MW
Total generation capacity	1,450	MW
Total design flow	2,300	cumecs
Average annual energy output	6,600	GWh
Penstock diameter	10.6	m
Forebay/headponds		
Area	540	ha
Normal water level	334	m
Minimum water level	329	m
Live storage volume	25.5	M cu m
Total embankment length	8.6	km
Spillway capacity	1,600	cumecs
Tailrace		
Bed width	100	m
Invert level	255	m
Slope	1:7,000	
Tailwater levels		
Minimum	260	m
Flood of record	275.5	m
Bridge across tailrace	1	
Land requirements		
Structures	236	ha
Headponds and embankments	614	ha
Permanent colony, roads	100	ha

TABLE 2. COMPARISON OF ALTERNATIVES CONSIDERED

TYPE	DESCRIPTION	ADVANTAGES	DISADVANTAGES
NO ACTION	Project not built; power from other sources	• National power demand met	• Air quality degradation • Higher cost (fossil fuel)
	Project not built; power demand not met	• No land loss • No social disruption • No diversion of Indus flows into power channel	• Hindered local/national economic development
ALTERNATIVE POWER SOURCE	Fossil fuels	• Less social disruption	• Air quality degradation • Competition with other fuel demands • Cooling water effects, heating of river water
	Other hydropower (Kalabagh & Basha Dams, which are in the planning process)	• Land taken is less productive • Less social obstruction	• Large scale resettlement (Kalabagh) • Local land and water rights dispute (Basha) • High transportation cost for Basha
	Energy conservation	• More efficient use of energy • Reduced environmental and social impacts	• Ongoing national program will reduce energy use • A need will still exist for additional generation capacity
BARRAGE	Location: Site A	• Slightly less inundation • Socio-economic growth for Ghazi-Khalo	
	Site C	• Greater storage capacity	• Little different from A., but less favorable to Ghazi-Khalo
	Low-head hydropower at peak flows	• Additional energy extraction at little extra cost	• Less flood water available for sluicing
POWER CHANNEL	Use of two channels	• Project could function with one channel out of service	• Groundwater pressure might endanger empty channel • Greater land taking
	Alignment: balanced cut and fill	• Less spoil to be disposed of	• Disruption of population centers • Lower structural integrity of the channel • Difficulties in nullah crossings
	Alignment: on high ground	• Avoids disruption of population centers • Better crossings for nullah flows through superpassages • Improved integrity against pressure of water	• More excavation; greater amount of spoil material
	Avoiding archaeological/historical sites, religious shrines and graveyards	• Reduced cultural impacts	• Slightly more excavation • Slight increase in length
	Route through Kamra Aeronautical Complex : north	• No impact on air base	• Substantially greater length
	center	• Least cost routing	• Channel in fill, replacement of structures
	south	• Little impact on air base	• Considerable excavation required

TABLE 2. COMPARISON OF ALTERNATIVES CONSIDERED

TYPE	DESCRIPTION		ADVANTAGES	DISADVANTAGES
POWER CHANNEL (cont'l)	Spoil disposal:	river bank reclamation	• Reclaim land previously eroded	• Uncertainty as to ultimate fate of material
		terracing	• Recover wastelands and eroded farmland	
		additional freeboard	• Overflow surge protection	
		spoil banks	• Convert some marginal lands into irrigated croplands • Large volumes possible	• Requires careful management to meet goals • Land acquisition/sale may be sensitive
		nullah reclamation	• Make nullah beds more useful	• May re-erode quickly unless protected with proper grade and vegetation
POWER COMPLEX	Location:	Dakhner	• Shorter power channel	• Prohibitive geotechnical problems
		Gariala		• Topography not suitable
		Jaba	• Shorter power channel	• Long (4 km) tailrace channel • Smaller head • Highest seismic risk
		Dher	• Ridge brings power channel to within 1 km of river	• Narrowness of ridge means less structural security for channel
		Barotha north	• Less agricultural disruption (than south alternative)	• Head loss of 0.8 m(1.1%)
		south	• Maximum head of all sites	• Disruption of irrigated agriculture
	Access Road:	Haji Shah-Barotha	• Upgrading of existing road • Minimize requirements for land	• Risk of unplanned development • Increased road traffic
	Transmission Lines:	various alignment alternatives	• Minimize relocation of structures for safety	• Land required for transmission towers • Relocation of structures required for safety

TABLE 3

SUMMARY OF SCOPING SESSIONS HELD

SCOPING SESSIONS HELD WITH	VENUE	DATE	TOTAL PARTICIPANTS	KEY PARTICIPANTS
1. Civil Administration	Committee Room, GM Office, Tarbela	July 16, 1990	15	.Deputy Commissioners of Abbottabad, Swabi and Attock
2. District Council, Abbottabad	District Council Hall, Abbottabad	Nov. 13, 1990	10	.Deputy Commissioner, Abbottabad .Chairman, District Council, Abbotabad .Councillor, Ghazi
3. District Council, Attock	District Council Hall, Attock	Nov. 14, 1990	30	.Deputy Commissioner, Attock .Chairman, District Council, Attock .Councillors of Ghurghushti, Khagwani, Musa, Kamra, Thikarian, Mala, Shah Dher and Rangpur
4. Local Population (Male)	Isa	Nov. 15, 1990	27	.Chairmen, Union Councils of Ghazi, Ghurghushti, Bhangi, Bahadur Khan and Kamra .Vice Chairmen, Union Councils of Khagwani, Ghazi and Rumian. .Members, Union Councils of Ghazi, Kotehra, Qazipur, Kamra, Salam Khan .Village Notables and Farmers
	Jallo	Nov. 17, 1990	23	
	Hasanpur	Nov. 18, 1990	43	
	Mian Dheri	Nov. 20, 1990	12	
	Ghurghushti	Nov. 20, 1990	54	
	Malak Mala	Nov. 21, 1990	26	
	Bhangi	Nov. 24, 1990	32	
	Khagwani	Nov. 25, 1990	18	
	Musa	Nov. 26, 1990	29	
	Bahadur Khan	Nov. 27, 1990	21	
	Kamra	Nov. 28, 1990	31	
	Ghazi	Nov. 29, 1990	52	
	Nurpur Karmalia	Dec. 02, 1990	43	
	Barotha	Dec. 02, 1990	107	
5. Local Population (Female)	Isa	Nov. 15, 1990	23	.Notable Ladies of the area .School Teachers .Lady Doctors .Social Workers .Housewives .School Girls
	Jallo	Nov. 17, 1990	30	
	Hasanpur	Nov. 18, 1990	91	
	Ghurghushti	Nov. 20, 1990	15	
	Mian Dheri	Nov. 20, 1990	44	
	Malak Mala	Nov. 21, 1990	9	
	Barazai	Nov. 21, 1990	39	
	Walidad	Nov. 24, 1990	15	
	Khagwani	Nov. 25, 1990	17	
	Musa	Nov. 26, 1990	17	
	Jatial	Nov. 27, 1990	17	
	Kamra	Nov. 28, 1990	23	
	Nurpur Karmalia	Dec. 02, 1990	18	
	Barotha	Dec. 02, 1990	12	
6. Members of National & Provincial Assemblies	Committee Room, GM Office, Tarbela	Jan. 14, 1991	15	.Member National Assembly from Attock .Member National Assembly from Swabi .Members Provincial Assembly from Attock (2) .Councillor, Ghurghushti
7. Speaker National Assembly	Committee Room, National Assembly	Mar. 13, 1991	5	.Speaker National Assembly/Member National Assembly from Abbotabad
8. Chief Minister, NWFP	Chief Minister's Secretariat, Peshawar	Feb. 16, 1992	10	.Chief Minister, NWFP .Minister for Finance, NWFP .Minister for Irrigation, NWFP .Chief Secretary, Govt. of NWFP
9. International Union for Conservation of Nature and Natural Resources (IUCN/Pakistan)	IUCN Office at Karachi	Feb. 27, 1992	6	.Programme Administrator
10. World Wide Fund for Nature (WWF/Pakistan)	PHC Office, Lahore	May 25, 1992	6	.Director, WWF, Pakistan .Director, Land and Wildlife, WWF, USA
11. Sungi Development Foundation	Committee Room, GM Office, Tarbela	July 13, 1992	14	.Chairman, Sungi Development Foundation .Programme Administrator (IUCN/Pakistan)
12. Affected House Owners	.Tarbela, Ghazi	Nov. 14, 15 1993 & Apr. 04, 1994	25	.Affectees losing houses
	.Banda Feroze		30	.Affectees losing houses
	.Barotha		36	.Affectees losing houses

TABLE 4

PROJECT IMPACT MATRIX

ENVIRONMENTAL COMPONENTS / PROJECT COMPONENTS	PHYSICAL ENVIRONMENT										BIOLOGICAL ENVIRONMENT										SOCIAL ENVIRONMENT									
	Agricultural Lands	Soils (Erosion/Stability)	Housing/Infrastructures	Energy/Mineral Resources	Surface Water Quantity	Surface Water Quality	Groundwater Quantity	Groundwater Quality	Air Quality	Noise	Aquatic Ecosystem	Wetland Ecosystem	Terristrial Ecosystem	Endangered Species	Migratory Species	Beneficial Plants	Beneficial Animals	Pest Plants	Pest Animals	Disease Vectors	Public Health	Resource/Land Use	Communication System	Employment	At-Risk Population/Safety	Population Disruption	Community Stability	Cultural & Religious Values	Tourism And Recreation	Nutrition
CONSTRUCTION PHASE																														
BARRAGE																														
Structure	O	LA	O	LA	O	LA	O	O	LA	LA	O	NA	O	O	O	O	O	O	O	O	LA	O	O	HB	MA	O	O	O	O	O
Barrage Pond	O	O	O	O	O	O	O	O	O	O	O	NA	O	O	O	O	O	O	O	O	O	O	O	LB	O	O	O	O	O	O
Rim Embankment	O	O	O	O	O	O	O	O	O	LA	O	NA	O	O	O	O	O	O	O	O	O	O	O	LB	O	O	O	O	O	O
Borrow/Spoil Areas	LA	LA	O	LA	O	O	O	O	LA	LA	O	NA	LA	O	O	O	O	O	O	O	LA	O	O	LB	LA	O	O	O	O	O
Construction Camp	O	O	LA	LA	O	LA	O	O	LA	LA	O	NA	LA	O	O	O	O	O	O	O	O	LA	O	HB	LA	O	LA	LA	O	O
Barrage Colony	LA	O	O	O	O	O	O	O	O	O	O	NA	O	O	O	O	O	O	O	O	O	LA	O	HB	LA	O	O	O	O	O
Overall	LA	LA	LA	LA	O	LA	O	O	LA	LA	O	NA	LA	O	O	O	O	O	O	O	LA	LA	O	HB	LA	O	LA	LA	O	O
POWER CHANNEL																														
Channel	MA	MA	LA	LA	O	O	LA	O	LA	LA	NA	NA	LA	O	O	O	LA	O	O	O	LA	MA	MA	HB	MA	MA	LA	LA	O	O
Spoil Banks	MA	MA	LA	LA	O	LA	O	O	LA	LA	NA	NA	LA	O	O	O	O	O	O	O	LA	MA	LA	HB	MA	MA	LA	LA	O	O
Bridges	LA	LA	O	LA	O	O	O	O	O	LA	NA	NA	O	O	O	O	O	O	O	O	O	LA	LA	LB	LA	O	O	O	O	O
Drainage Structures	LA	MA	O	O	O	O	O	O	O	LA	NA	NA	O	O	O	O	O	O	O	O	O	LA	O	LB	LA	O	O	O	O	O
Borrow Area	O	MA	O	LA	O	LA	O	O	LA	LA	NA	NA	LA	O	O	O	O	O	O	O	LA	LA	O	LB	LA	O	O	O	O	O
Construction Camp	O	O	O	LA	O	O	LA	O	LA	LA	NA	NA	LA	O	O	O	O	O	O	O	O	LA	O	HB	O	O	MA	LA	O	O
Colony	LA	O	O	O	O	O	O	O	O	O	NA	NA	O	O	O	O	O	O	O	O	O	LA	O	HB	O	O	O	O	O	O
Overall	MA	MA	LA	LA	O	LA	LA	O	LA	LA	NA	NA	LA	O	O	O	LA	O	O	O	LA	MA	LA	HB	MA	MA	LA	LA	O	O

NA : Not Applicable
ND : Not Deteminable
HA : High Adverse

MA : Medium Adverse
LA : Low Adverse
O : None or Insignificant

LB : Low Beneficial
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TABLE 4

PROJECT IMPACT MATRIX

ENVIRONMENTAL COMPONENTS / PROJECT COMPONENTS	PHYSICAL ENVIRONMENT										BIOLOGICAL ENVIRONMENT										SOCIAL ENVIRONMENT									
	Agricultural Lands	Soils (Erosion/Stability)	Housing/Infrastructures	Energy/Mineral Resources	Surface Water Quantity	Surface Water Quality	Groundwater Quantity	Groundwater Quality	Air Quality	Noise	Aquatic Ecosystem	Wetland Ecosystem	Terrestrial Ecosystem	Endangered Species	Migratory Species	Beneficial Plants	Beneficial Animals	Pest Plants	Pest Animals	Disease Vectors	Public Health	Resource/Land Use	Communication System	Employment	At-Risk Population/Safety	Population Disruption	Community Stability	Cultural & Religious Values	Tourism And Recreation	Nutrition
POWER COMPLEX																														
Powerhouse	LA	LA	O	LA	O	O	O	O	LA	LA	NA	NA	LA	O	O	O	O	O	O	O	LA	LA	O	HB	LA	O	O	O	O
Embankment	LA	LA	O	LA	O	O	O	O	LA	LA	NA	NA	LA	O	O	O	O	O	O	O	LA	LA	LA	HB	LA	O	O	O	O
Headponds	MA	O	LA	O	LA	O	O	O	O	O	NA	NA	LA	O	O	O	O	O	O	O	LA	LA	O	O	O	O	LA	O	O
Tailrace	MA	LA	LA	LA	MA	O	LA	O	LA	LA	NA	NA	LA	O	O	LA	O	O	O	O	LA	MA	MA	HB	MA	LA	LA	LA	O
Borrow/Spoil Area	O	LA	O	MA	LA	LA	O	O	LA	LA	NA	NA	LA	O	O	O	O	O	O	O	O	LA	O	LB	LA	O	O	O	O
Construction Camp	O	O	O	LA	O	LA	O	O	LA	LA	NA	NA	LA	O	O	O	O	O	O	O	O	LA	O	HB	LA	O	MA	O	O
Colony	LA	O	O	O	O	O	O	O	O	O	NA	NA	O	O	O	O	O	O	O	O	O	LA	O	HB	O	O	O	O	O
Overall	MA	LA	LA	LA	LA	LA	LA	O	LA	LA	NA	NA	LA	O	O	LA	O	O	O	O	LA	LA	LA	HB	LA	LA	LA	LA	O	O
OPERATIONAL PHASE																														
BARRAGE																														
Structures	O	LB	O	O	MA	MA	LA	O	O	O	O	NA	O	O	O	O	O	O	O	O	O	LB	HB	MB	O	O	LA	O	O	O
Barrage Pond	O	LB	O	O	LB	LB	LB	O	O	O	MB	O	O	O	LB	O	MB	O	O	O	O	O	O	LB	LA	O	O	O	HB	MB
Overall	O	LB	O	O	LA	LA	O	O	O	O	MB	O	O	O	LB	O	MB	O	O	O	O	LB	HB	MB	LA	O	LA	O	HB	MB

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	Agricultural Lands	Soils (Erosion/Stability)	Housing/Infrastructures	Energy/Mineral Resources	Surface Water Quantity	Surface Water Quality	Groundwater Quantity	Groundwater Quality	Air Quality	Noise	Aquatic Ecosystem	Wetland Ecosystem	Terristrial Ecosystem	Endangered Species	Migratory Species	Beneficial Plants	Beneficial Animals	Pest Plants	Pest Animals	Disease Vectors	Public Health	Resource/Land Use	Communication System	Employment	At-Risk Population/Safety	Population Disruption	Community Stability	Cultural & Religious Values	Tourism And Recreation	Nutrition
POWER CHANNEL																														
Channel	O	O	O	O	O	O	LB	O	O	O	NA	NA	O	O	O	O	O	O	O	O	O	O	O	MB	MA	O	O	O	LB	O
Spoil Banks/Irrigation System	HB	LA	O	O	O	O	LA	O	O	O	NA	NA	MB	O	O	LB	O	O	O	O	O	HB	O	HB	O	MB	MB	O	O	HB
Drainage Structures	O	LB	O	O	LB	O	O	O	O	O	NA	NA	O	O	O	O	O	O	O	O	O	O	MB	LB	LB	O	O	O	O	O
Bridges	O	O	O	O	O	O	O	O	O	O	NA	NA	O	O	O	O	O	O	O	O	O	O	HB	O	O	O	O	O	O	O
Overall	HB	LB	O	O	LB	O	LB	O	O	O	NA	NA	MB	O	O	LB	O	O	O	O	O	HB	HB	HB	LA	MB	MB	O	LB	HB
POWER COMPLEX																														
Powerhouse	O	O	O	HB	O	O	O	O	O	O	O	NA	O	O	O	O	O	O	O	O	O	O	O	HB	LA	O	O	O	O	O
Headpond	O	O	O	O	LB	O	LB	O	O	O	LB	O	O	O	O	O	LB	O	O	O	O	O	O	O	LA	O	O	O	O	MB
Tailrace	O	O	O	O	O	O	O	O	O	O	O	NA	O	O	O	O	O	O	O	O	O	O	O	O	LA	O	O	O	O	O
Overall	O	O	O	HB	LB	O	LB	O	O	O	LB	NA	O	O	O	O	LB	O	O	O	O	O	O	HB	LA	O	O	O	O	MB
PROJECT																														
Overall	MB	LB	O	HB	LA	O	LB	O	O	O	LB	O	LB	O	LB	LB	LB	O	O	O	O	MB	MB	HB	LA	O	LB	O	HB	HB

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TABLE 5. SUMMARY OF POTENTIAL IMPACTS, MITIGATION AND MONITORING

Resource	Components	Impact	Mitigation/Enhancement	Action/Monitoring
Land Resources	Barrage	• Land taking and conversion to Project structure	• Land belongs to Government	• Assistance from WAPDA Environmental Cell (WEC) and Project Nongovernmental Organization (PNGO)
		• Changes in land use at Ghazi - agricultural to commercial	• Planning assistance required to avoid unplanned development	
	Power Channel	• Conversion of 867 ha of private land to Project use	• Fair and prompt compensation	• Payments cross-checked by PNGO, with monitoring by Project Resettlement Organization (PRO), WEC and Project Monitoring Consultants (MC)
		• Taking 1,640 ha for spoil disposal	• Equitable purchase/resale arrangements • Prompt payment • Effective rehabilitation of spoil banks for irrigated agriculture	• Monitoring by WEC, MC and PNGO
	Power Complex	• Land taking and conversion of 850 ha to Project structures and 100 ha for colony and access road	• Replacement with comparable irrigated land • Fair and prompt compensation • Measures adopted to protect irrigated agriculture in adjacent nullah	• Monitoring by WEC, MC and PNGO
		• Commercial development along Attock-Dakhner Road/ Haji Shah-Barotha Road	• Planning assistance required to avoid unplanned development	• Assistance from WEC and PNGO
Water Resources	Barrage and Pond	• Change of flow in Indus river	• Compensation water releases at barrage to supplement seepage	• Quarterly water sampling and analysis by WAPDA Staff to regulate compensation water releases, coordinated by WEC
			• Provision of sewage treatment facilities for Ghazi-Khalo	• Assistance from WEC with cooperation of Technical Divisions of WAPDA
		• Reduced flooding of recession (sailaba) agriculture lands downstream of barrage	• Tubewell irrigation possible, depending on severity of impact	• Monitoring by WEC, MC and PNGO
		• Reduced flooding of sailaba islands downstream of barrage	• No action necessary; benefits to wildlife/livestock	• Overseeing by WEC with the assistance of Technical Divisions of WAPDA
	Power Channel	• Potential reduction in groundwater levels	• Replacement wells • Beneficial in waterlogged areas	• Collection of periodic well observation data by Technical Divisions of WAPDA, and coordinated by WEC
		• Seepage from power channel	• Reduced by reinforced lining and waterstops • Collected by underdrainage system and pumped back	• Monitoring by WEC with the assistance of Technical Divisions of WAPDA
	Power Complex	• Reduced flows in Barotha Nullah	• No action unless serious social effects are found	• Monitoring by WEC and MC
		• Interruption of irrigation system	• Replacement of structures and provision of tubewells, if required	• Overseeing by WEC and PNGO
		• Reduced erosion by flood flows in smaller nullahs	• No action needed, beneficial	

TABLE 5. SUMMARY OF POTENTIAL IMPACTS, MITIGATION AND MONITORING

Resource	Components	Impact	Mitigation/Enhancement	Action/Monitoring
Biological Resources	Barrage and Pond	• Potential fishery development in pond • May induce change in plant succession in the braided channel zone of Indus river	• Management through stocking and controlled harvesting	• WAPDA on-site fisheries manager to monitor catch statistics by total weight and individual fish size • Monitoring of ecosystem by WEC
	Power Channel	• No significant biological impacts • Loss of crops, orchards and trees due to land taking	• Fair and prompt compensation	• Monitoring by PRO, WEC, MC and PNGO
	Power Complex	• No significant biological impacts • Loss of crops, orchards and trees due to land taking • Potential fishery development in headponds	• Fair and prompt compensation • Management through stocking and controlled harvesting	• Monitoring by PRO, WEC, MC and PNGO • WAPDA on-site fisheries manager to monitor catch statistics by total weight and individual fish size
Social/ Cultural Resources	Barrage	• Replacement of communal bathing/laundry areas with scattered water points, depriving village women of a gathering place • Change in social dependency relationships due to more restricted access to water • Health risk due to impoundment at barrage pond • Rapid population growth in Ghazi-Khalo, due to Project and river crossing; results in stressing community services and facilities, schools, health centers, etc.	• Seepage from barrage to maintain constant flow in river channel on right bank for Galla and Pontia villages • Additional tubewell water points, if needed • Water level fluctuation to control mosquito breeding • Development of a town plan for Ghazi-Khalo • Infrastructure development including sewerage and sewage treatment	• PNGO to maintain communication with leading women to evaluate need for a meeting place and apprise WEC for necessary action • PNGO should maintain contact with village poor to determine whether they have difficulty in obtaining water and apprise WEC for necessary action • Monitoring by Health Department • PNGO to meet periodically with local community leaders and administrators
	Power Channel	• Regional and local loss of income from 867 ha of agricultural land • Temporary loss of agricultural production and income from lands receiving spoil	• Resettlement on spoil banks • Job opportunities to landless displaced persons • Resettlement on spoil banks • Hiring of farmers on Project labour force • Investment of balance sale proceeds • Credit and self-employment schemes	• Organized by Project field teams • Monitoring by WEC, PRO, MC and PNGO • Project NGO to maintain contact with such families and apprise WAPDA • Monitoring by WEC and MC • Assistance by PNGO for reinvestment

TABLE 5. SUMMARY OF POTENTIAL IMPACTS, MITIGATION AND MONITORING

Resource	Components	Impact	Mitigation/Enhancement	Action/Monitoring
Social/ Cultural Resources cont'd		• Threat to public safety due to risk of drowning	• Education programmes on dangers of channel, in schools and village meetings • Warning posters in schools, clinics, public buildings, and at the channel • Fencing at villages, bridges, and other places where people are near the channel • Escape assistance; handrails extending into water and floating booms	• WEC to maintain contact with community leaders to learn of concerns through PNGO
		• Resettlement of 179 families with 899 surveyed inhabitants living in 110 scattered houses	• Resettlement villages with social amenities and infrastructure	• Monitoring by WEC and assistance by PNGO
		• Disruption of archaeological sites	• Salvage provided for two surveyed sites	• Monitoring for unanticipated discoveries by WAPDA, salvage by Archaeology Department
		• Relocation of 14 graves and one small mosque	• Proper procedures would be used for relocation of graves and mosque	• Assistance from WAPDA, monitored by WEC, PNGO and religious authorities
	Power Complex	• Loss of agricultural production due to farmers hiring on with Project; may be offset by additional income	• Planning assistance to families in managing new cash flow and altered resource base	• Project field teams to monitor overall living conditions of affected families and apprise WEC
		• Introduction of diseases by contact with workers from elsewhere or from poorly treated sewage in Barotha nullah	• Health checks for incoming workers • Careful attention to Project wastewater management	• Overseeing of contractor's wastewater management practices by WEC
		• Degradation of village lands by poor construction practices	• Careful attention to construction methods, chemical disposal	• WEC to monitor local conditions
		• Friction between outside workers (or villagers working for the Project) and villagers following the traditional life style	• Formal and informal meetings between Project management staff, Project NGO and village leaders • Establishing a formal grievance channel to take care of more serious problems	• Project NGO to be alert to problems as they develop and apprise WEC. No formal monitoring other than keeping lines of communication open.
		• Health risk due to impoundment at barrage pond	• Water level fluctuation to control mosquito breeding	• Monitoring by Health Department
		• 7.2 km road would improve access to Barotha village and Power Complex, requires acquisition of 19.8 ha of private land	• Compensation to be provided to land owners as in other elements of project • Actions to control strip development measures to support safety • Archaeological survey included in finalization of design.	• WEC, PRO, PNGO, and Archaeological Department
		• Transmission lines would require relocation of a number (to be determined) of houses, schools and commercial structures and other improvements to meet safety requirements	• Compensation to be provided to land owners and parties to be relocated • Archaeological review activities to be included in final design process	• WAPDA Transmission Line Cell, WEC, PRO, PNGO, Archaeological Department

TABLE 5. SUMMARY OF POTENTIAL IMPACTS, MITIGATION AND MONITORING

Resource	Components	Impact	Mitigation/Enhancement	Action/Monitoring
Project Area Social and Economic Resources	All Components	• Need for access to information concerning the environmental and social aspects of the Project	• Project would support a Project Information Center (PIC)	• WAPDA, WEC, PRO and PNGO
		• General Project effect on economic resources • Loss of traditional categories of work • "Boom-bust" cycle of Project construction • Urbanization	• Formation of Integrated Regional Development Plan (IRDP) to organize credit and self-employment generation scheme; small industrial and business growth; and long-term job growth	• Monitoring by WEC and PRO with the assistance of PNGO and local communities

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TABLE 6

ENTITLEMENT PACKAGES

SR. NO	TYPE OF LOSS OR DISTURBANCE	DEFINITION OF ENTITLED PERSON (EP)	DEFINITION OF ENTITLEMENT	ADDITIONAL FACILITIES/ SERVICES	ACTIONS	ACTORS
I.	Loss of privately-owned agricultural land					
	A Irrigated	Owner of land as recorded in the Revenue Record updated through the census survey and to be verified in accordance with legal requirements.	1. Cash cum land compensation - Cash compensation at full market value plus additional 15% of the value for compulsory acquisition. - Entitled to purchase same size of plot on irrigated spoil banks, but at barani rate. The difference will enable EPs to maintain their standard of living during the transition period. 2. Blue work permits (one for each EP). 3. Land owners who are losing their entire land, and who have no other sources of income will be given green work permits.	1. Access to a credit facility provided under IRDP in line with priorities fixed in accordance with the impact of the Project 2 Vocational training and self-employment schemes under IRDP in line with priorities fixed as above. 3. Licence to cultivate the acquired land till such time that the land is required for construction. EPs will be notified about the date of this requirement before the start of the next sowing period EPs will not be allowed to do any development on the land during the licence period. 4. Assistance in Tubewell Users Association (TUA) formation and operation 5. Agricultural extension services for spoil banks.	1 Determination of market value for the land through a Land Valuation Committe (LVC) consisting of: - Assistant Commissioner (AC) of respective subdivision (Chairman) - WAPDA Representative (Grade 19) - PNGO Representative - Two representatives of EPs of the respective village. The representatives shall be EPs losing private land and nominated by other EPs losing private land. 2. Issuance of orders for the formation of LVC 3 Updating of Land records in respect of land classification and ownership as per census survey after legal verification. 4. Prompt payments within stipulated period. 5. Payment of compensation amount through crossed cheques into accounts of the EPs opened by mobile commercial banks. 6. Opening joint accounts in the name of each EP and WAPDA for the amount required for purchase of spoil bank land. The amount will remain deposited in the joint account till it is payable to WAPDA. 7. Issuance of Compensation Certificates to EPs. 8. Public Notice of awards to EPs to make process transparent. 9. Grievance resolution relating to entitlements 10. Payment of stamp duty on purchase of land on spoil banks by WAPDA, if not exempted by Provincial Governments. 11. Provision of the guardianship certificates for minors prior to payment being released. 12. Assure payment cheques to women owners are made out in their own name and deposited in their own accounts.	1. Overall management by : - LAC - AC, WAPDA , PNGO & Representatives of EPs 2. District Collector 3. District Administration & Project Resettlement Organisation (PRO), WAPDA 4. Land Acquisition Collector (LAC) 5. LAC, Commercial Banks & EPs. 6. LAC, PRO & EPs. 7. PRO. 8. PRO 9. PRO, PNGO & LVC 10. Provincial Governments & WAPDA 11. Guardians of minors, LAC & PRO. 12. LAC, PRO & Commercial Banks.

TABLE 6

ENTITLEMENT PACKAGES

SR NO.	TYPE OF LOSS OR DISTURBANCE	DEFINITION OF ENTITLED PERSON (EP)	DEFINITION OF ENTITLEMENT	ADDITIONAL FACILITIES/ SERVICES	ACTIONS	ACTORS
					13 Ensure proper construction of spoil banks, top soil placement, grading, etc.	13. Contractor, Project Consultants, PRO & Environmental Cell.
					14 Layout, demarkation and allotment of plot on spoil banks.	14. PRO, PNGO, Environmental Cell & EPs.
					15 Siting and installation of tubewells, and formation of Tubewell Users Association (TUA).	15. PRO, PNGO, Environmental Cell, EPs & Provincial Governments.
					16 Research into rapid achievement of agricultural production from spoil banks.	16. WAPDA Technical Divisions, Provincial Departments of Agriculture and PNGO.
					17 Issuance of work permit.	17. PRO, PNGO & Contractor.
					18 Access to training and credit.	18 PRO, PNGO & Commercial Banks.
	B Barani land	Owner of land as recorded in the Revenue Record updated through the census survey and to be verified in accordance with legal requirements	1 Cash cum land compensation – Cash compensation at full market value plus additional 15% of the value for compulsary acquisition – Entitled to purchase half size of plot on irrigated spoil banks, but at barani rate. The difference will enable EPs to maintain their standard of living during the transition period 2. Blue work permits (One for each EP) 3 Land owners who are losing their entire land, and who have no other sources of income will be given green work permit.	1 Access to a credit facility provided under IRDP in line with priorities fixed in accordance with the impact of the Project 2 Vocational training and self – employment schemes under IRDP in line with priorities fixed as above. 3 Licence to cultivate the acquired land till such time that the land is required for construction. EPs will be notified about the date of this requirement before the start of the next sowing period EPs will not be allowed to do any development on the land during the license period 4. Assistance in TUA formation and operation 5. Agricultural extension services for spoil banks.	Actions 1 through 18 as for Category IA above.	Actors for various actions as for Category IA above.
II.	Loss of privately owned uncultivable land.	Owner of land as recorded in the Revenue Record updated through the census survey and to be verified in accordance with legal requirements.	1 Cash compensation at full market value plus additional 15% of the value for compulsary acquisition. 2. Blue work permits (one for each EP).	1. Access to a credit facility provided under IRDP in line with priorities fixed in accordance with the impact of the project. 2. Vocational training and self – employment schemes under IRDP in line with priorities fixed as above.	Actions 1 to 5, 7 to 18 as for Category IA above.	Actors for relevant actions as for Category IA above

TABLE 6

ENTITLEMENT PACKAGES

SR. NO.	TYPE OF LOSS OR DISTURBANCE	DEFINITION OF ENTITLED PERSON (EP)	DEFINITION OF ENTITLEMENT	ADDITIONAL FACILITIES/ SERVICES	ACTIONS	ACTORS
				3. Provided that surplus land is available on the spoil banks, owners of uncultivable land will have the right to purchase land on spoil banks equal to one – quarter of their holding of uncultivable land.		
III.	Loss of Shamilat (common) land	As recorded in the Revenue Record	1. Cash compensation according to the share of owners in Shamilat.	None.	Actions 1 to 5, 7 to 9, 11, 12, 17 & 18 as for Category IA above.	Actors for relevant actions as for Category IA above.
IV.	Loss of crops, orchards and other trees.	Land owners/tenants/ renters as per Revenue Record updated through census survey and to be verified in accordance with legal requirements.	1. Cash compensation, as provided under the Law. 2. If shamilat land is cultivated, compensation will be paid to the cultivators.	None.	1. Value will be determined through the Land Valuation Committee (LVC). 2. If the construction schedule permits, the cultivator will be allowed to harvest the crops.	1. LAC, LVC. 2. PRO & Project Consultants
V.	Loss of Agricultural infrastructures (eg tubewells, open wells, deras, cattle sheds and farms, fish & poultry farms, privately owned irrigation diversion structures, etc.)	Land owners/tenants/ renters as appropriate	1. Replacement cost in cash.	None.	1. Value of the facility will be determined through the Land Valuation Committee (LVC) as structured above.	1. LAC, LVC & WAPDA Engineering Division.
VI.	Loss of residential house.	A. Owner/ occupant.	1. Allotment of a plot equal to the plot on which the house is built (min. 500 sq m), provided to plot owner. 2. Allotment of a plot of 500 sq m to the occupant of the house, if different from owner. 3. Full replacement value to be paid in 4 advance installments for the constuction of a house on the alloted plot paid to the owner of the house structure. 4 If occupant of house is different from the owner of the house structure, the occupant will be alloted a plot of 500 sq m and given credit facility for constuction of a house.	1. Additional plot(s) of 500 sq m in the resettlement village for member(s) of the family of over 25 year of age sharing the present residence, up to a maximum of 1000 sq m for each house to be relocated. 2. Occupant will have the right to salvage housing material free of cost. 3. WAPDA will provide transport to move the family and its belongings.	1. Valuation by WAPDA Engineering Division. 2. Payments of installments at appropriate times, ie advance, after foundation completed, after walls completed and when roofing completed. 3. Evacuation to be completed prior to requirement of land for construction. If the structure is not completed in time by the EP, then WAPDA will shift the EP to rented accomodation at EP's cost.	1. LAC, LVC & WAPDA Engineering Division. 2. LAC, PRO & PNGO. 3. PRO, PNGO & WAPDA Engineering Division.

TABLE 6

ENTITLEMENT PACKAGES

SR. NO.	TYPE OF LOSS OR DISTURBANCE	DEFINITION OF ENTITLED PERSON (EP)	DEFINITION OF ENTITLEMENT	ADDITIONAL FACILITIES/ SERVICES	ACTIONS	ACTORS
VII.	Loss of public/ community infrastucture	Affected institution/ community	1. The Project will be responsible for relocation of infrastuctures such as graves, mosques, water supply system and overhead tanks near Ghazi–Khalo, and village roads leading to Barotha and Dhir.	None	1. Insure that the structures are timely relocated so that constuction does not interrupt the relevant services to the community.	1. PRO, PNGO & WAPDA Engineering Dvision.
VIII	Fragmented land	Persons who are losing part of a contiguous landholding, and the residual fragment is smaller than 2 kanal	1. If desked by the EP, the residual fragment of the land will be acquired.	None	Same actions as for appropriate category of land being acquired.	Actors for relevant actions as for appropriate category of land being acquired.
IX.	Severed land	Persons whose land is severed by the Project	1 As permissible under the Law.	None	LAC, PRO and PNGO to assess claims of EPs.	LAC, PRO & PNGO
X	Loss of Land Tenancy Rights					
	A Legal Tenants	Legal tenants in accord–ance with updated Revenue Record	1 Right to part of the cash compensation for the land owner in accordance with the provisions of the Law. 2 Cash compensation for physical invest–ments in land, including crops and trees 3. Blue work permits (one for each EP)	1. Access to a credit facility provided under IRDP in line with their priorities fixed in accordance with the impact of the Project. 2. Vocational training and self–employment schemes under IRDP in line with priorities fixed as above. 3 Provided that surplus land is available on the spoil banks, tenants with a residual tenancy of less than 0 5 ha will have the right to purchase land on spoil banks equal to one–half of the tenancy land acquired.	Actions 1 to 5, 7 to 18 as for Category IA above.	Actors for relevant actions as for Category IA above
	B Informal tenants	Informal tenants as documented by the census survey.	1. Green work permits 2. Cash compensation for physical investm–ents in land, including crops and trees.	1. Priority access to credit facility provided under IRDP. 2. Vocational training and self–employment schemes under IRDP on priority basis. 3 Provided that surplus land is available on the spoil banks, tenants with a residual tenancy of less than 0.5 ha will have the right to purchase land on spoil banks equal to one–half of the tenancy land acquired.	Actions 9,10,13 to 18 as for Category IA above.	Actors for relevant actions as for Category IA above.

TABLE 6

ENTITLEMENT PACKAGES

SR. NO.	TYPE OF LOSS OR DISTURBANCE	DEFINITION OF ENTITLED PERSON (EP)	DEFINITION OF ENTITLEMENT	ADDITIONAL FACILITIES/ SERVICES	ACTIONS	ACTORS
X.	Loss of Rental Rights (Tjaradar)	Tjaradar as per contract	1. Right to part of the payment made to the landowner in accordance with the provisions of the Law. 2. Blue work permit.	1. Access to a credit facility provided under IRDP in line with their priorities fixed in accordance with the impact of the Project. 2. Vocational training and self – employment schemes under IRDP in line with priorities. 3. Provided that surplus land is available on the spoil banks, tenants with a residual tenancy of less than 0.5 ha will have the right to purchase land on spoil banks equal to one–half of the tenancy land acquired.	Actions 1 to 5, 7 to 18 as for Category IA above.	Actors for relevant actions as for Category IA above.
XI.	Loss of Employment	A. Permanent agricultural labourer or family labourer documented by census survey.	1. Green work permit.	1. Priority access to a credit facility provided under IRDP. 2. Vocational training and self – employment schemes under IRDP on priority basis.	1. Issuance of green work permit. 2. Access to training and credit.	1. PRO, PNGO & Contractors. 2. PRO, PNGO & Commercial Banks.
		B. Seasonal Labourer	1. Blue work permit.	1. Access to vocational training and self – employment scheme under IRDP	1. Issuance of blue work permits. 2. Access to training and self – employment schemes.	1. PRO, PNGO & Contractors. 2. PRO, PNGO & Commercial Banks.

NOTES : Holders of green work permits will be given priority over those holding blue work permits, who in turn will have priority over non–permit holders. Holders of green work permits will be paid Rs. 600 per month until they find work for a period of up to one year.

TABLE 7

ENVIRONMENTAL AND RESETTLEMENT COSTS

SR. NO.	COMPONENT	TOTAL COST	
		LOCAL (RS M)	FOREIGN (US$M)
1.	LAND ACQUISITION (Privately-owned land)		
	Irrigated (107 ha)	126.86	
	Barani (2,616 ha)	1550.76	
	Uncultivable (470 ha)	92.88	
	Contingency Land (264 ha)	146.39	
	Less resale of land on spoil banks (1,640 ha)	-845.38	
	Sub-Total	1071.51	
2.	COMPENSATION FOR PAF & PAC KAMRA INCLUDING LAND	876.89	
3.	REPLACEMENT COST OF RESIDENTIAL HOUSES		
	Type A houses(covered area 1,213 sq m)	4.85	
	Type B houses(covered area 1,012 sq m)	3.24	
	Type C houses(covered area 5,190 sq m)	12.46	
	Type D houses(covered area 4,388 sq m)	7.02	
	Sub-Total	27.57	
4.	REPLACEMENT COST OF PRIVATELY OWNED INFRASTRUCTURE		
	Irrigation tubewells(20)	1.40	
	Open wells(19)	0.38	
	Irrigation watercourses(3)	6.00	
	Water diversion structures(2)	0.10	
	Deras(23)	0.23	
	Cattle shed(2)	0.01	
	Cattle farm(1)	0.50	
	Fish farm(1)	0.50	
	Poultry farm(2)	1.00	
	Sub-Total	10.12	
5.	COMPENSATION FOR FARM PRODUCE		
	Crops	1.20	
	Orchards	9.10	
	Other trees	20.00	
	Sub-Total	30.30	
6.	RELOCATION OF COMMUNITY INFRASTRUCTURES		
	Relocation of graves & mosque	1.49	
	Relocation of water supply system & over head tanks	6.00	
	Relocation of village roads	6.00	
	Sub-Total	13.49	
7.	RELOCATION OF PUBLIC INFRASTRUCTURES	271.26	0.23

TABLE 7

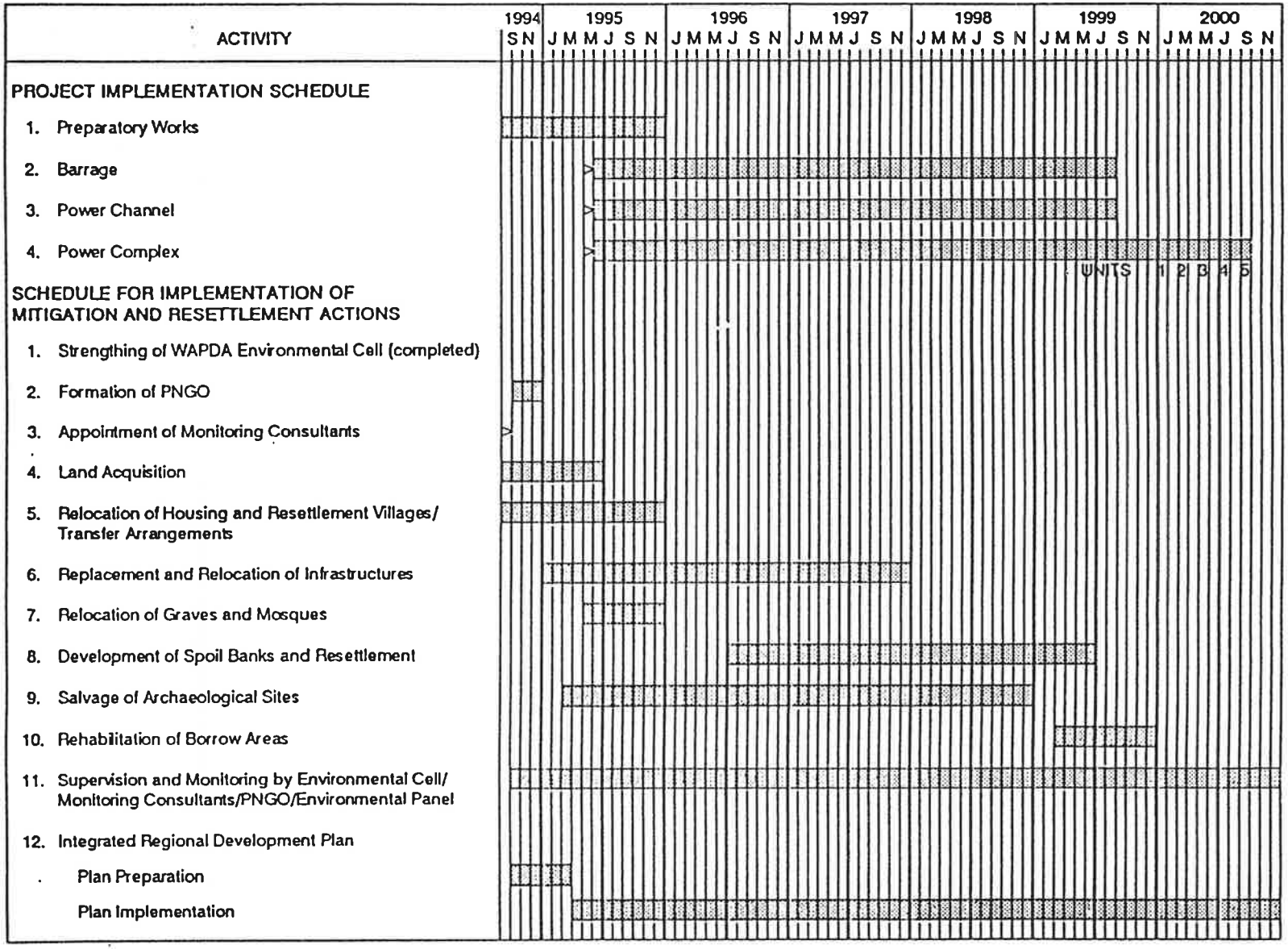
ENVIRONMENTAL AND RESETTLEMENT COSTS

SR. NO.	COMPONENT	TOTAL COST	
		LOCAL (RS M)	FOREIGN (US$M)
8.	RIVER CROSSING	40.80	1.38
9.	PROTECTION AGAINST RIVER EROSION	209.39	
10.	COST OF BRIDGES (VRB & MB)	224.31	
11.	SALVAGE OF CULTURAL PROPERTIES	2.01	
12.	WORKS FOR SAFETY MEASURES	128.72	
13.	COST OF CHANNEL AVOIDING VILLAGES	1864.47	
14.	COST OF RESETTLEMENT VILLAGES		
	Development of Resetlement Villages	5.79	
	Social infrastructure for resettlement villages	2.76	
	Sub-Total	8.55	
15.	COST OF DEVELOPMENT OF SPOIL BANKS	60.36	
16.	TRUST FUND FOR PNGO	100.00	
17.	CONTRIBUTION TO INTEGRATED REGIONAL DEVELOPMENT PROGRAMME	176.00	
18.	COST ASSOCIATED WITH WORK PERMITS	9.00	
19.	COST OF STUDIES		
	Integrated Regional Development Plan	2.00	
	Sewage and treatment facilities for Ghazi-Khalo	1.00	
	Town planning for Ghazi-Khalo	2.00	
	Pilot project for spoil banks	5.00	
	Sub-Total	10.00	
20.	MONITORING COSTS		
	Cost of Environmental Monitoring Cell (WAPDA)	9.00	
	Cost of Allied Organisations of WAPDA	3.00	
	Monitoring Consultants	18.00	
	Visits of Environmental Review Panel	5.00	0.60
	Environmental Laboratory	5.00	
	Sub-Total	40.00	0.60
21.	WAPDA – ADMINISTRATION COSTS (3%)	155.24	
22.	CONTINGENCIES (5%)	266.50	
	TOTAL	5596.49	2.21

Note : Equivalent amount in US$ is 182.74 M with conversion rate of 1 US$ = Rs. 31.00.

TABLE 8

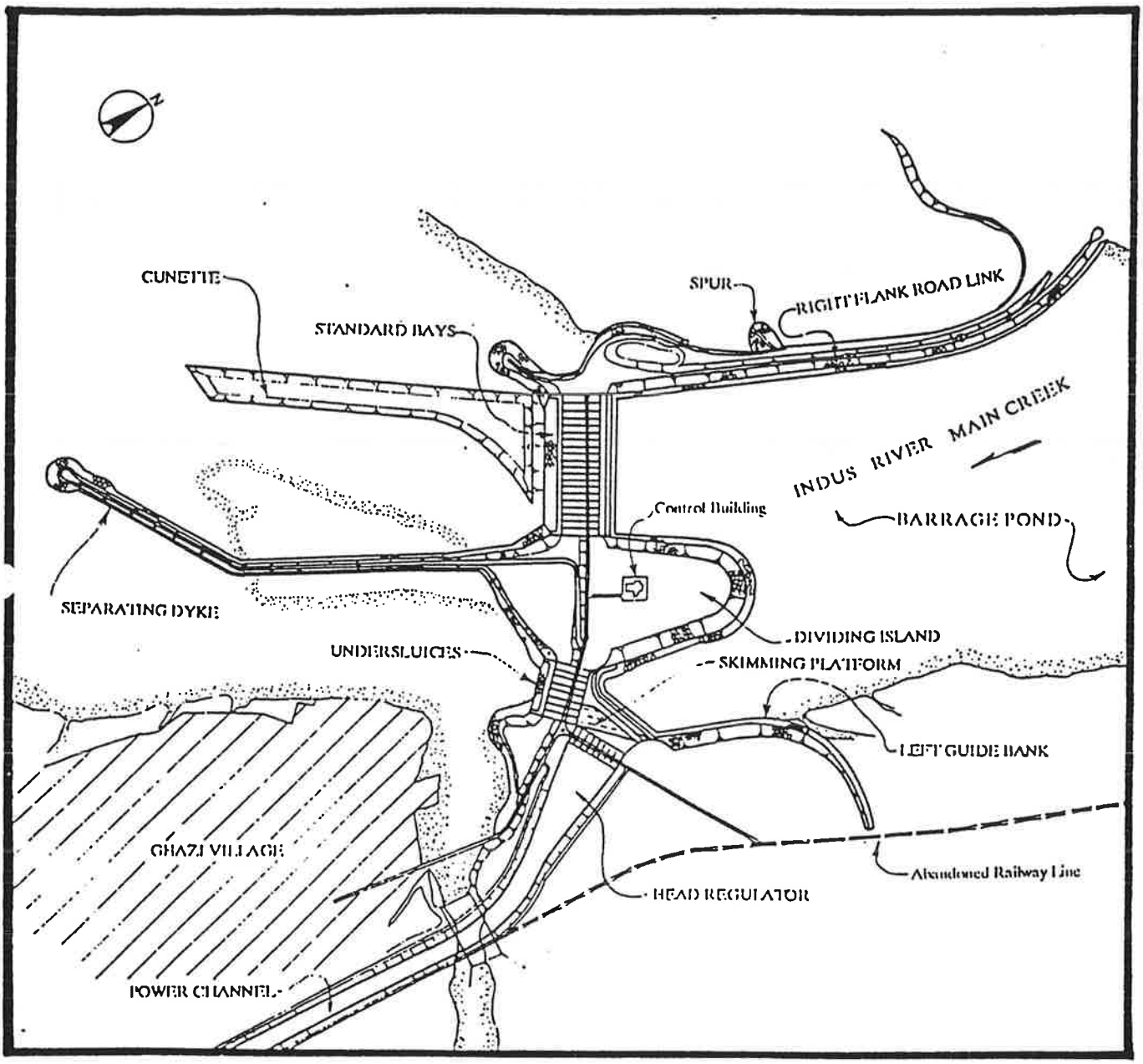
SCHEDULE FOR PROJECT IMPLEMENTATION AND RELATED MITIGATION AND RESETTLEMENT ACTIONS



LEGEND

UNIT 1 First Unit Commissioned
> Contract Award

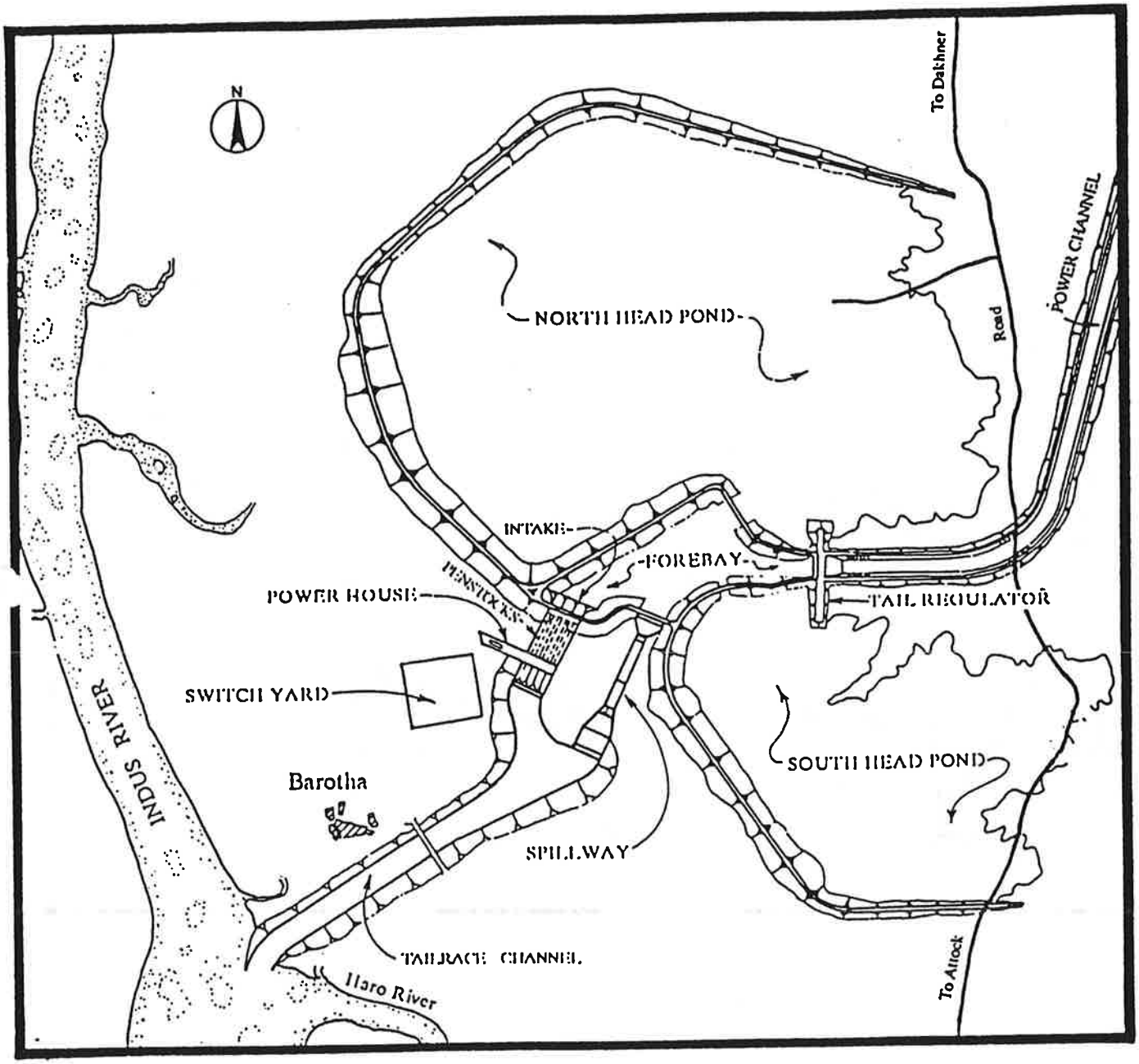
DRAWINGS



BARRAGE

LAYOUT PLAN

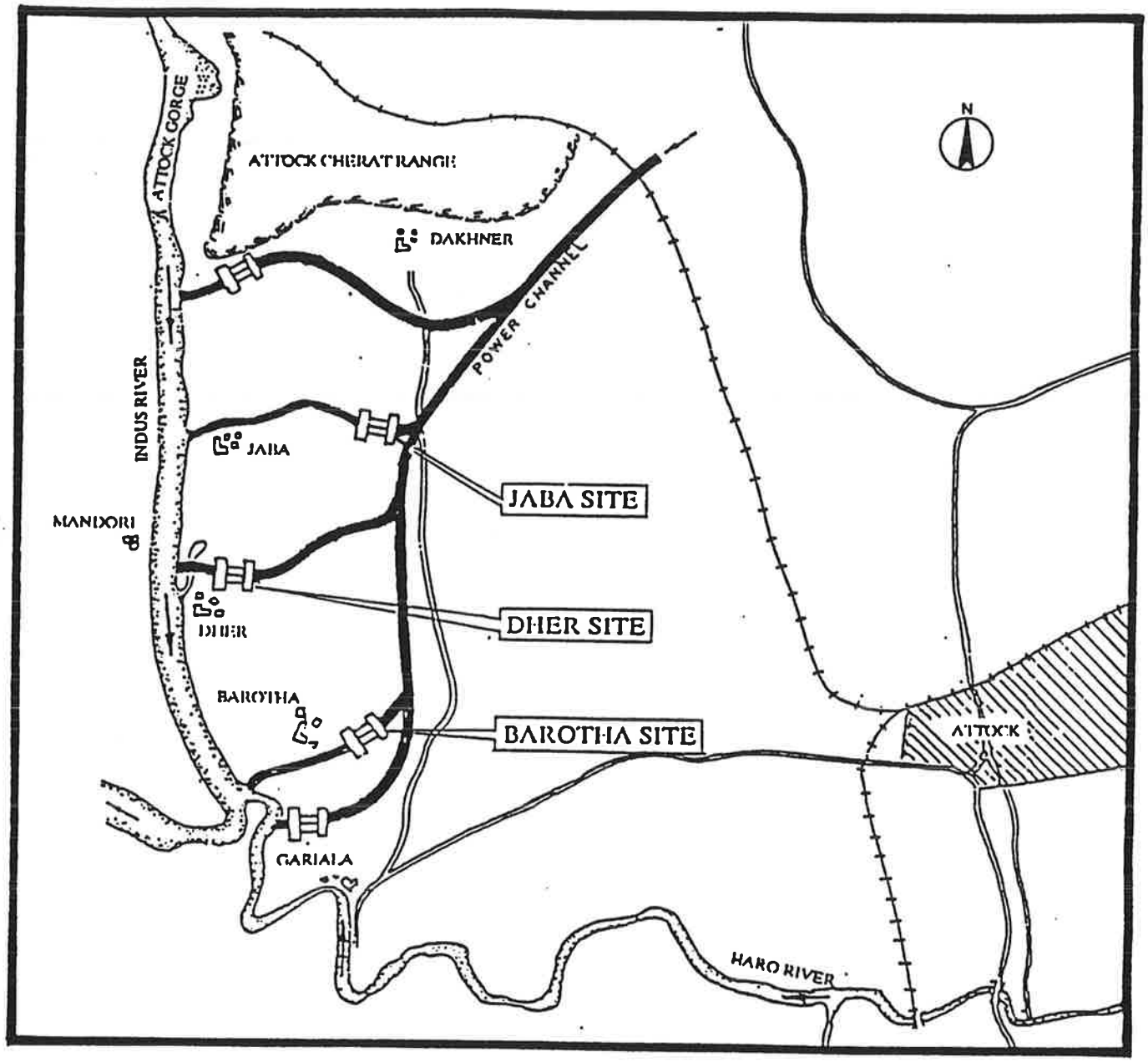
DRAWING 3



POWER COMPLEX
LAYOUT PLAN

200 0 200 400m
Scale

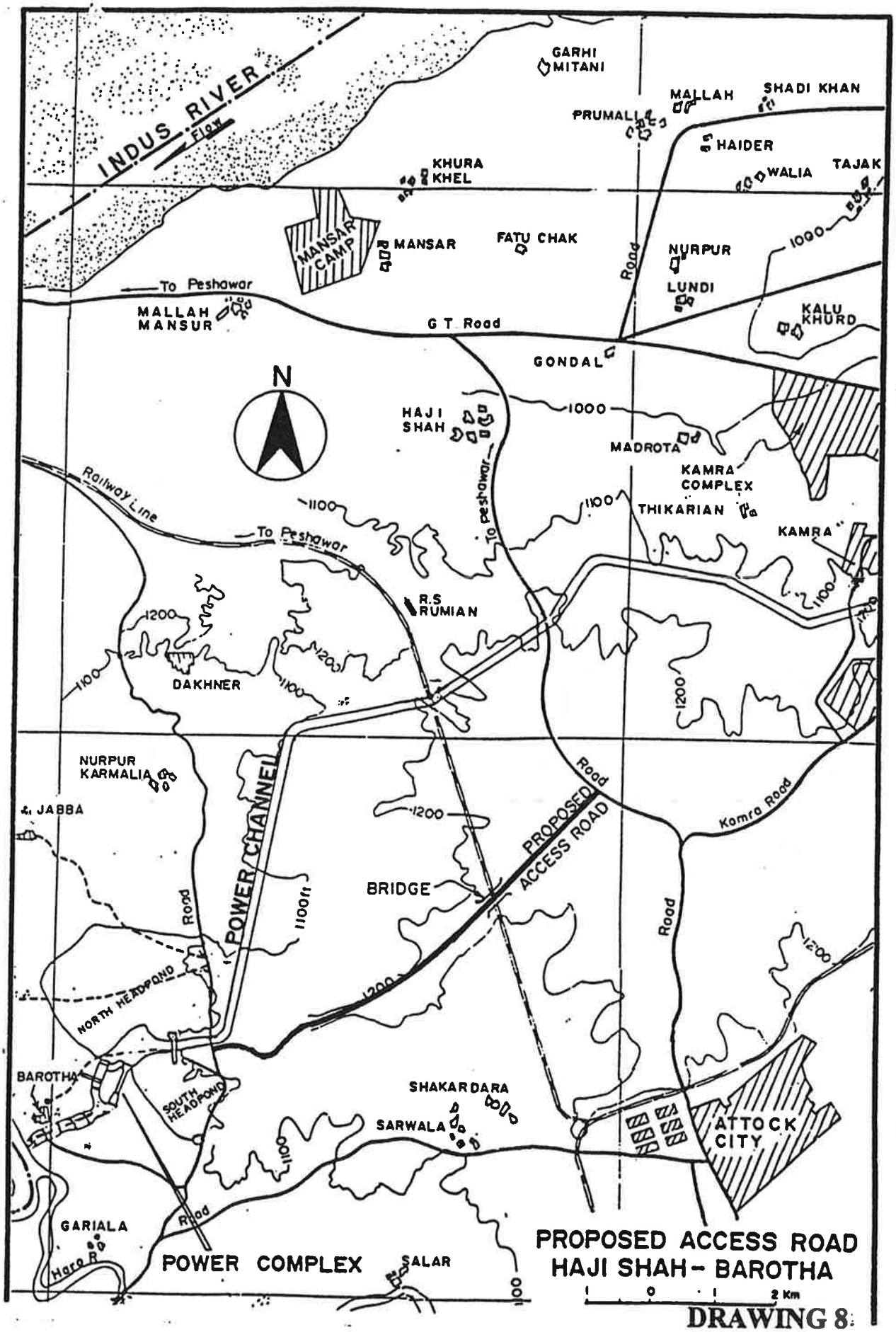
DRAWING 4



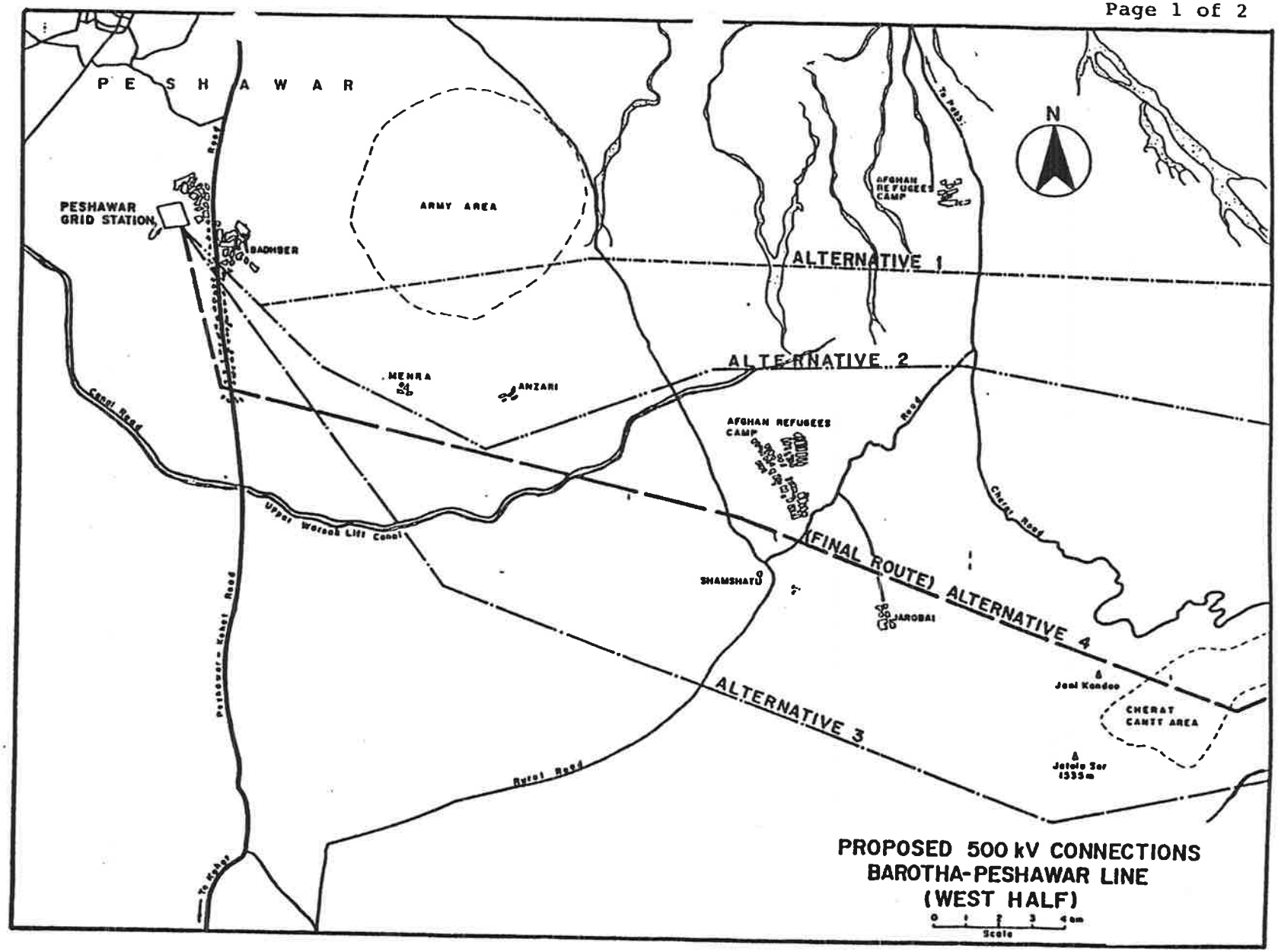
POWER COMPLEX
ALTERNATIVE SITES

1000 0 1000m

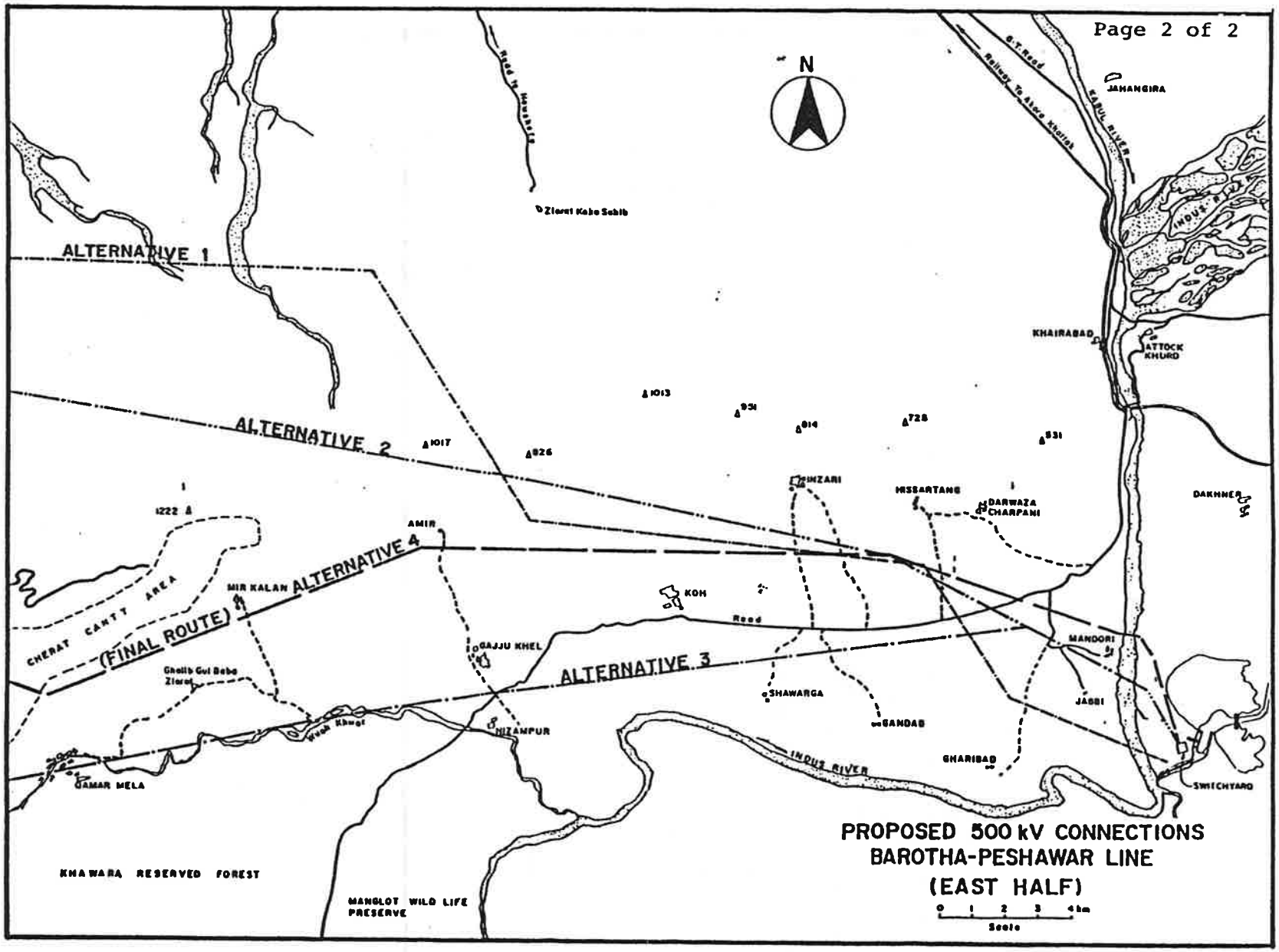
DRAWING 7


INDUS RIVER
Flow
GARHI MITANI
MALLAH
SHADI KHAN
PRUMALL
HAIDER
KHURA KHEL
WALIA
TAJAK
MANSAR CAMP
MANSAR
FATU CHAK
NURPUR
LUNDI
1000
To Peshawar
MALLAH MANSUR
G T Road
KALU KHURD
GONDAL
N
HAJI SHAH
MADROTA
KAMRA COMPLEX
Railway Line
1100
THIKARIAN
KAMRA
R.S RUMIAN
1200
DAKHNER
NURPUR KARMALIA
JABBA
POWER CHANNEL
PROPOSED ACCESS ROAD
Kamra Road
BRIDGE
North Headpond
BAROTHA
South Headpond
SHAKARDARA
SARWALA
ATTOCK CITY
GARIALA
Hara R
POWER COMPLEX
SALAR
PROPOSED ACCESS ROAD
HAJI SHAH - BAROTHA
2 Km

DRAWING 8:



DRAWING 9
(Sheet 1)



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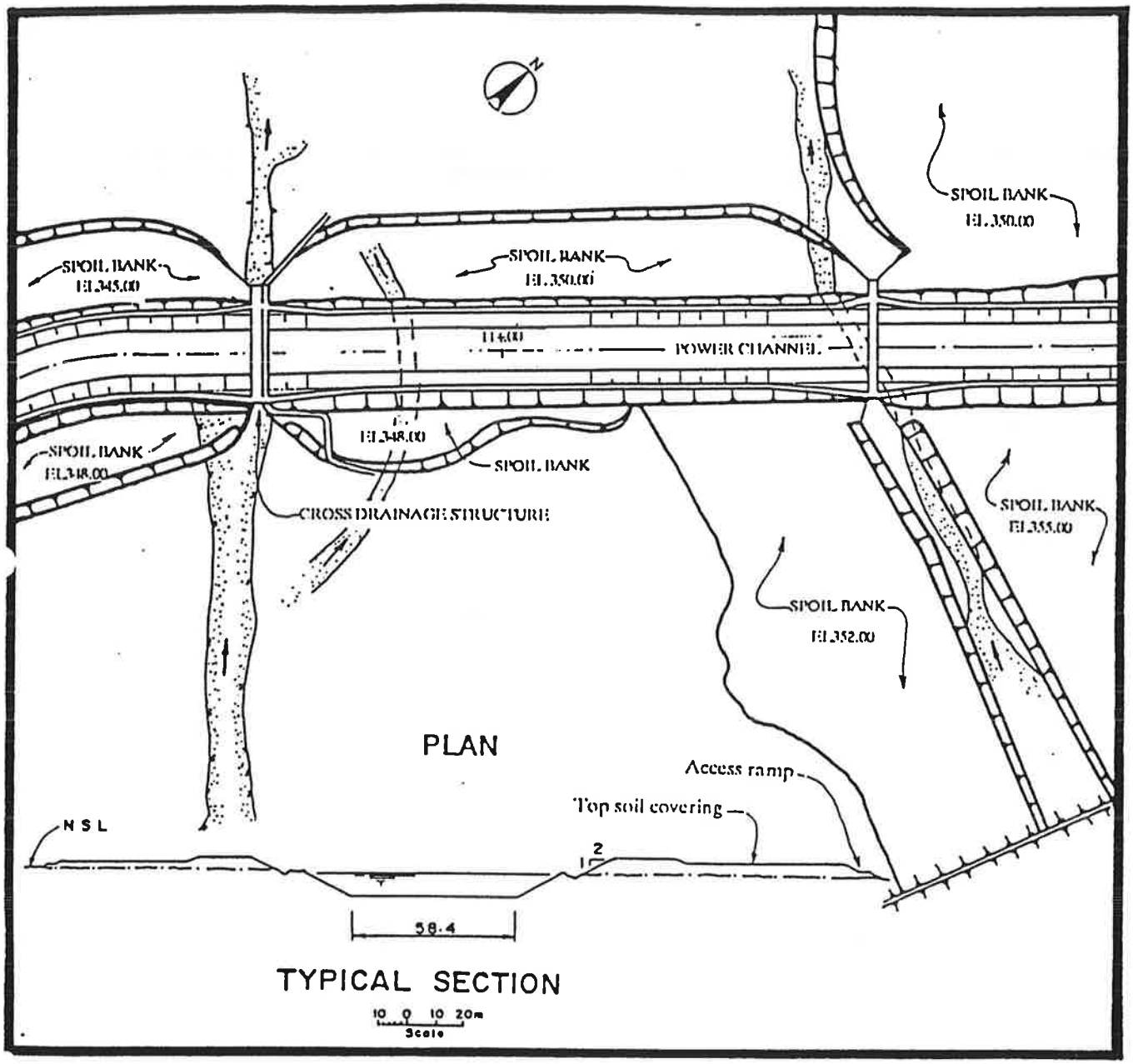
(Sheet 2)



TYPICAL SPOIL BANK

100 0 100m
Scale

DRAWING 10