Water and Power Development Authority

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Ghazi-Barotha Hydroelectric Power Project

Environmental Assessment of Transmission Lines

Environment Directorate
Office of the Chief Engineer (MP)/NPP Project

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1.0 INTRODUCTION

1.1 Project Description

The Ghazi-Barotha hydroelectric power project has a capacity of 1,450 MW. The project is going to utilise the fall of the Indus river between the tail water of the existing Tarbela Dam and the confluence of the Indus and Haro rivers. The basic elements of the project include: a barrage about 7 km downstream of Tarbela; a large power channel to convey water from the barrage to the generating facility; a power complex that will receive the water from the channel, pass it through turbine-generators to produce up to 1,450 MW of power and discharge it back into the Indus river, and a 500 KV switchyard along with transmission lines at Barotha.

1.2 Transmission Scheme

Pakistan Hydro Consultants prepared an environmental assessment for the proposed transmission scheme for the Ghazi-Barotha project in 1994. The scheme included

(i) 500 KV single circuit Barotha-Peshawar Transmission line
(ii) 500 KV single circuit Tarbela-Gatti in-out at Barotha

The transmission scheme was later on extended by adding additional circuits for full dispersal of power and stability of the system. These are

(i) 500 KV double circuit between Barotha-Rewat
(ii) 500 KV single circuit between Rewat-Gakkhar-Lahore
(iii) 500 KV double circuit (in-out) of Tarbela-Gatti lines

This report provides the environmental assessment of the extended transmission scheme of the Ghazi-Barotha hydroelectric power project. The route has been provided by the EHV department of Wapda. This report is primarily based on the field survey carried out by the combined EHV-Environment Directorate (NPP) team.
1.3 Approach to the Study

This environmental assessment has been carried out by the Environment Directorate of the Office of the Chief Engineer (Master Planning)/Project Director (National Power Plan Project). The assessment comprised of the following activities:

- A review of earlier Project reports, maps, and other documents relating to the transmission lines.

- Detailed examination of the topographical maps (at a scale of 1:50,000) to locate existing and proposed routes and identify points of special interest.

- A four week field reconnaissance by surveyors of WAPDA transmission line EHV department.

- A four day field survey by the members of the Environment Directorate (NPP).

- Collecting information from villagers living near the proposed transmission line, about the area and their living styles.

- Collecting information from various government departments such as Wildlife, Agriculture, Forestry and other social development offices.

- Meetings with electrical engineers of WAPDA and NESPAK to learn about prevailing transmission line planning, construction and maintenance policy and methods in Pakistan.

- Meetings with transmission people in WAPDA to acquire information about laws pertaining to transmission line construction in Pakistan.
2.0 LEGAL AND REGULATORY FRAMEWORK

The regulations, guidelines and standards governing the design, construction, and operation of the transmission lines for the Project and its environmental assessment are briefly discussed below.

2.1 Role Of Wapda

The authority of WAPDA to construct and operate electrical transmission lines was established in 1958 under the West Pakistan Water and Power Development Act, which assigns to WAPDA the powers and obligations of a licensee under the Electricity Act of 1910. These laws establish policy of land acquisition and compensation, as well as the degree of liability of WAPDA for damages sustained by landowners or others.

2.2 World Bank Requirements

This Environmental Assessment (EA) report has been prepared in accordance with the World Bank's Operational guidelines. The guidelines cover potential environmental impacts, effects on land use, health and safety issues, induced development, project alternatives and monitoring. The guidelines deal inconclusively with the question of electromagnetic fields (EMF), noting that the "Scientific community has not reached consensus on specific biological responses to EMF, but the evidence suggests that health hazards may exist." The guidelines do not provide standards for conductor clearances from residential, educational and/or business structures, or from vegetation or other environmental or socio-economic resources. As a matter of fact, the World Bank allows each country to establish its own standards for the design of transmission lines on Bank funded projects, provided those are consistent with international engineering and safety practices.

2.3 Public Health/Safety Standards

There is growing awareness that long-term exposure to the EMF effects of high voltage transmission lines could adversely affect the health of those living or working close to such line. There is particular concern over children studying in schools near high voltage transmission lines. Although the EMF decreases with the square of the distance from line, neither the specific health effects nor the distance at which such effects pertain over time is adequately understood.
2.4 Conductor to Ground Clearances

WAPDA has accepted current international standards for conductor to ground clearances for the construction of 500 KV transmission line projects. The specific standard accepted is that of the National Electrical Safety Code (ANSIC C2), currently applicable in the United States.

Actual conductor clearances (at a maximum temperature of 65°C) are as follows:

1. Cultivated land traversed by vehicles 9.0 m
2. Road and streets 9.0 m
3. Communication and Power Lines
   - Power lines upto 132 KV 4.5 m
   - Power lines upto 220 KV 5.0 m
   - Power lines upto 500 KV 6.7 m
4. Highways 11.75 m
5. Railroads 11.75 m
6. Electrified railroad trolley wire 4.5 m
7. River at high flood level 7.0 m
8. Places accessible to pedestrians only 8.0 m
9. Building roofs not accessible to people 6.0 m
10. Building roof accessible to people 8.0 m
11. Tops of trees (orchards) 6.0 m
12. Canals 9.0 m
13. Lightning protection wires 4.0 m

2.5 Corridor Clearances

WAPDA follows a policy of 50 m wide corridors for 500 KV transmission lines (25 m out from the centreline). In principle, no residential or other building structure should be within the 50 m wide corridor, although in densely populated areas, such as cities, the minimum distance from the centreline can be reduced to 21 m, which gives a minimum horizontal clearance of 12 m from the outer conductors.

Open wells, including Persian wells, are allowed to remain under the high voltage conductors, as are existing orchards, provided the fruit trees are kept under 3 m in height. Farm buildings or single storey factory buildings not used as residences are also allowed to remain under the high voltage lines, provided an 8 m clearance is maintained. The height of the towers can be increased to
accommodate existing buildings. Tubewells are not permitted under the high voltage conductors, for fear that piping and cranes used to refurbish such wells could come in contact with the lines.

3.0 TRANSMISSION SCHEME DESCRIPTION

The switchyard for the Ghazi-Barotha project is located near the village of Barotha with an operating voltage of 500 KV. The lines under discussion will extend to the following destinations.

1. A switchyard near Rewat (Barotha-Rewat line)
2. A line from Rewat switchyard to a switchyard near Ghakkar (Rewat-Ghakkar line)
3. A line from Ghakkar switchyard to a switchyard near Lahore. (Ghakkar-Lahore line)
4. To the existing Tarbela-Gatti lines (Tarbela-Barotha in lines)
5. To the Tarbela-Gatti lines (Barotha-Gatti out lines)

4.0 ENVIRONMENTAL EVALUATION

4.1 BAROTHA-REWAT LINE.

The Barotha to Rewat 500 KV transmission line consists of 47.89 Km of double circuit on single towers and 114.5 Km of single circuit. It originates from a 500 KV switchyard near Barotha and reaches at 500 KV switchyard near Rewat. For convenience of planning, the line has been divided into ten segments.

4.1.1 Land Use

Segment-1
This segment is 12.53 Km long and stretches from Barotha Switchyard to Attock-Sher Shah railway line. The circuit starts at Barotha switchyard, passes over the outlet of the power channel and then crosses over 4-5 houses. The line then passes between Barotha and Gariala villages avoiding the village of Barotha by 100 meters, and 50 meters from the village school and then avoiding the village of Gariala by about 200 meters. The area is quite broken as the line comes out of Barotha. In this region the line remains parallel to the Indus river. As the line leaves the Indus, the land becomes more levelled. The line then crosses the Attock-Chhoi road north-east of Gariala. As the line approaches Haro river, the area around the river is more and more broken and it further deteriorates along the line. The line avoids the village of Mehdi Shah by 100 meters and village Salar by 360 meters and crosses the Haro river north of village Mehdi Shah. The line then passes over small nullah's avoiding the village of Sind Baghpur by 500 meters. The area is less broken as the line crosses the Haro river except near the village of Sind Baghpur. The line then crosses the...
major nullah of "Nandana Kas" three times in a length of 2.2 Km and reaches the Sher Shah railway line. The area of the segment is bushy with scattered trees of Kikar, Beri, and Phullai. The agriculture is barani and it is on the slopes of the hilly terrain. The rain water for agriculture and drinking is stored in ponds by constructing dykes. The main crops of the area are Peanut, Wheat, Corn and Barley.

Segment-2
This segment is 13.69 Km long from Attock-Sher Shah railway line to the village of Humak. The line crosses the Attock-Sher Shah railway line 350 meters south of Kanjur railway station. Its a broken plateau area. The line then crosses the Attock-Fateh Jang Road and slightly bending south, enters a broken area where it crosses two small nullah's and two minor track roads. There the line avoids the village of Suwalanwali Dhok by 500 meters. The region south of Suwalanwali Dhok is comparatively less broken. The line then crosses a katcha track entering into a broken area of small nullah's. The line then passes 315 meters north of village Dhok Mochian passing at the edge of nullah 'Nandana Kas'. The line crossing "Nandana Kas" reaches a point 510 meters north of Humak. The whole area around this section of line has very little agriculture. The area is mainly broken and bushy with scattered trees. There is little barani agriculture. This segment is located at the southern edge of Kawah Gar forest reserve.

Segment-3
The length of this segment is 19.15 Km. It begins from a point 510 meters North of village Humak to a point west of Sadkal oil field. The area north of Humak is less broken with much better agriculture potential. The line moves along nullah 'Nandana Kas' to a point where the line takes a bend towards south at an angle of 10°-39°. The line is still parallel to the nullah 'Nandana Kas'. It then enters a broken land. Here the line crosses small nullah's and then crosses the nullah of 'Nandana Kas' 650 meters north of Pind Niazi village. The line then passes through a point which is 500 meters North of Kot Salabat. The 'Nandana Kas' now moves away from the line. The line crosses the nullah of 'Ratala Kas' north of village Kot Salabat three times in a stretch of 3 Km. The line then enters a region which is less broken, more bushy and with more trees. The line then crosses the road to Langar village, 250 meters south of Langar. The line enters a hilly area with open scrub and scattered trees, passing through foot hills and reaches the edge of 'Nandana Kas' where it takes a turn of 46°-52° towards south, crossing the 'Nandana Kas' and Gakar-Bahtar road. The line then passes 400 meters east of Gakar and moves through an area of open scrub and scattered trees. It passes at a distance of 150 meters from Dera Wali Dhok crossing small nullah's and enters Kala-Chitta reserve forest. The Kala-Chitta reserve forest have bushes, Sanatee, Kao and Phulai. The line coming out of Kala-Chitta reserve forest crosses the nullah of 'Jabba Kas' and reaches a point 600 meters west of Sadkal oil field. This area is relatively flat with more agriculture and less bushes. The Kala-Chitta region has wildlife species of Deer, Rabbits, Jackal, Doves and
Pigeons and the endangered specie of Urial. The area near Sadkal oil field is 'Fateh Jang' industrial state where a ghee mill and a glass factory is under construction.

**Segment-4**

It is 1.75 Km long, and starts from a point 600 meters west of Sadkal oil field to a point which is a crossing of Fateh Jang Railway line and Fateh Jang - Rawalpindi road. The line is located in an area which is a barani agriculture land. The line crosses two katcha tracks. After crossing the second track, the line takes a turn of 41°-01' towards east and reaches near an existing 132 KV Fateh Jang grid station. It then avoids the populated area of Fateh Jang by about 300 meters, crosses two 66 KV transmission lines, passes the Fateh Jang railway line and Fateh Jang-Rawalpindi road and finally reaches across the railway line. The ground water in the area is very deep and the water for drinking and agriculture is provided through small dams/ponds. The water in these dams/ponds is gathered through streams and rains. The crops in the region are Peanut, Wheat, Corn and Barley.

**Segment-5 (Rewat-I)**

This segment is 17.35 Km long and starts from a point south of railway line to a point at Jinder-Dhok Mallian road, 250 meters south of village Dhok Mallian. The line at this point branches out into two single circuits namely Rewat-I and Rewat-II. Rewat-I takes a left turn of 32°-03' passing north of Fateh Jang through a better agriculture land. The lines passes north of village Dhok Bidrah at a distance of 130 meters, and takes a right turn of about 8°-30' entering into a broken plateau area. In this area the agriculture is low with very few scattered trees and bushes. The line crosses small tracks and nullah's passing 100 meter north of the Bango village. After crossing Bango village, the line takes a right turn of 12°-15' entering hard sandy area. This is a dry area with pits 2-15 meters deep. The line after coming out of this sandy area reaches the Jinder-Dhok Mallian road 250 meters South of Dhok Mallian. The agriculture in the area is barani and quite low. The area is very broken and the sources of water for drinking are small streams, ponds and dams. The main crops are Wheat, Corn, Peanuts. The major species of trees in the region are Kikar, Phullai, and Sanatee.

**Segment-6 (Rewat-I)**

This segment is 18.5 Km long. The line starts from Jinder-Dhok Mallian road to a point across Soan River. The line crossing the Jinder-Dhok Mallian road passes through a less broken area with moderate agriculture and after crossing two nullah's it reaches Khari Murit reserve forest. The vegetation in the forest area is mainly of Senatee, Kao, and Phullai. The line then moves on top of hills through the Khari Murit reserve forest for about 2 Km. While moving through the forest the line takes a left turn of 30°-02'. Coming out of the forest, the line crosses 2 small nullah's and the motorway 150 meters north of Dhok Glanwala. The area around Dhok Glanwala is less broken and bushy with scattered trees. The line after crossing the motorway, takes a right turn of 27°-45' and
enters into a more broken and bushy area which is passing 300 meters north of Dhok Brei. Then the line passes through a plateau area of small nullah's and enters an area of hard sand mixed with stones where there are very few signs of vegetation. Coming out of the hard sandy area, the line enters into a region of mixed vegetation. The line then crosses nullah 'Gambir Kas' and a metalled road. After crossing the road, it enters into a region which is very broken and eroded. The line moves forward, the plateau starts becoming higher and less broken. The line then passes 1 Km south of Kasala Kalan and crosses the Soan river.

Segment-7 (Rewat-I)
This segment is 20.7 Km long. It starts from a point across Soan river south of Kasala Kalan to a grid station near Rewat. The line after crossing the Soan river, takes a left turn and passes through a plateau with bushes and scattered trees. It then crosses a nullah and passes 300 meters north of village Thatta. At this point, the line takes a right turn of about 6°-30', crosses two katcha tracks, two nullah's and enters a broken area with higher plateau. At this stage the line crosses several nullah's moving on top of the hills. The line then passes 300 meters south of Dhok Lari Maulana. The line moves over several small nullah's, dirt tracks and passes 350 meters south of Sangra village. After a few kilometres the line reaches a comparatively plain land. The line then crosses the Dhok Talian-Sarhandi and Rewat-Java roads. The line then crosses 2 nullah's and Rewat-Burhan 220 KV transmission line. This area has a moderate barani agriculture. The main crop in the region is Peanut. The line then passing over 4-5 katcha houses, crossing a small nullah and reaches the Rewat switchyard.

Segment-8 (Rewat-II)
This segment is 17.5 Km long, from Fateh Jang Railway line to a point at the boundary of Khari Murit reserve forest. The line starting north of Fateh Jang avoids the populated area of Fateh Jang by about 300 meters. It passes through a semi plateau area crossing 2 nullah's and Bidrah road south of Bidrah. The line then enters a broken area with bushes and scattered trees. There is little agriculture in this broken area. The line passes 400 meters north of Thatti Gujran and moves over two nullah's and Kasana road at 150 meters north of Kasana. It then takes a right turn of 6°-57' and crosses the major nullah of 'Chabbar Kas' and few katcha tracks. The line then enters a hard sand area where the pits are 2-10 meters deep. The line then crosses the Jinder road at 500 meters north of Jinder and reaches the boundary of Khari Murit reserve forest. The area of the segment is mainly broken with bushes and scattered trees except near Fateh Jang where there are more plains. The agriculture in the area is barani and is significant only near the town of Fateh Jang. The major crops in the area are Peanut, Wheat, Corn and Barley. The bushes and trees in the region are mainly of Senatee, Kao, and Phullai.
Segment-9 (Rewat-II)
This segment is 18.4 Km long, and lies between the edge of Khari Murit reserve forest to a point across Soan river. The line enters the Khari Murit reserve forest and moves over the forest area. The forest consist mainly of Kao, Phullai, and Kikar. As the line comes out of the Khari Murit reserve forest, it enters a broken plateau area crossing motor way, avoiding Dhok Chohan Wala by 130 meters and Chohan Wala by 100 meters. The line crosses many nullah and katcha tracks in this region. It then enters a dry area. After coming out of this area, it avoids village Dhala by about 400 meters and then crosses Soan river. Some of the area is under forest department but the vegetation in the area is not very significant.

Segment-10 (Rewat-II)
This segment is 21.93 km long starting from a point across Soan river to the switchyard near Rewat. This section of the line begins with a broken area passing 450 meters north of village Miamda. Then crossing two katcha tracks and many small nullah's, crosses a metalled road 150 meters south of Tarahia. Then the line enters an area of small hills. After coming out of this broken high area, the agriculture potential in the area starts getting better. The line now crosses a small metalled road and passes 200 meters north of Macra Gar, 100 meters north of Mohra langar and 200 meters north of Ghall. The line then crossing a small road and nullah’s moves 550 meters north of Java. It then crosses Rewat-Java road and turning north crosses 2 nullah’s and a 220 KV transmission line. It then passes at a distance of 220 meters from the village of Sukh Chainpur, crosses a nullah and reaches the Rewat switchyard.

4.1.2 Ecological
The barani agriculture land along the line provides habitat for a few species of birds and some small mammals, some of which are agricultural pests. Jackals, Foxes, Rabbits, Doves, Partridges, Urial and Deers etc. are found in the forest areas. In the uncultivated areas, the pressure of fuel wood cutting, lopping of limbs for fodder, and livestock foraging has greatly reduced bio-diversity. The removal of forests through centuries of fuel wood and timber cutting, coupled with live stock pressure, has left a dry scrub ecosystem of low vegetative diversity. This is well illustrated by the dominance of shrub “Senatee” Dodona Burmanniana (Myrtaceae).

The process of reforestation is a government function and does not find a public interest in this region. The presence of Indus river, Haro river, perennial streams and large number of nullah’s increases bio-diversity. This is indicated by the presence of white-breasted King Fisher, common Raven, Eagles, Buzzards, Hasrivers, Falcon and Sand Martin in the area. Such species are usually indicative of a rich population of small rodents. The main species of trees in the area are Kao, Phullai and Kikar. These trees are found in Kala-Chitta, Kawah Gar and Khari Murit reserve
forests. The wood of Kao is mainly used for making handles for axes, hammers and other tools. Kikar etc. is used as fuel wood.

Impacts and Recommendations
The construction of towers and stringing of wires will cause damage to the ecosystem within the narrow confines of the corridor. In all the non agricultural sections of the lines, the natural vegetation consists of grasses and shrubs, and is already subject to considerable human pressure. The line passes through the Kala-Chitta, Kawah Gar and Khari Murit reserve forest. A part of the Kala-Chitta reserve forest has already been acquired by the army, any further loss to the forest should be minimised to the extent possible. The Khari Murit reserve forest is very narrow and the transmission line crosses it in three to four spans. Care should be taken during construction and maintenance of the line to keep the impact to a minimum level.

4.1.3 Socio-Economic and Cultural Resources

This proposed new line from Barotha to Rewat, starts at a switchyard near Barotha passing south of Attock, turns north of Humak to enter Kala-Chitta reserve forest. The line crosses railway line north of Fateh Jang near Sadkal oil field. The double circuit line here changes to single circuit. Both the single circuits then cross the motorway after crossing the Khari Murit reserve forest. Then both the lines turn left after crossing Soan river to reach Rewat switchyard.

Settlement Pattern
The settlement pattern along the line is different in broken and plain plateau areas. Generally in the region of Haro river and nullah Nandana Kas, the central villages lie on the bench between the river valley and the hills (Kala-Chitta and Kawah Gar uplands), where relatively flat land is available for the barani cultivation. The land along the rivers for the most part is deeply eroded and gullied, while towards the hills it is also gullied and stony. These broken areas are used for pasturage, for fuel wood and fodder. In few places, where land slopes evenly down to the rivers, fertile pockets irrigated by persian wells are present, such as the Dhok Mouchian (Akori village) and around the confluence of the Shakardara kas with the Haro river (Dheri Kot and Sind Bagh).

Villages are slightly smaller than those west of the Indus, with populations of between 350 and 900 households. Numerous smaller settlements and family compounds are scattered around the central villages, a substantial portion of these being under the hills where permanent water is available. After crossing Fateh Jang the area is very broken and dry. the population density in this region is very low. The line then enters a less broken area where the population density keeps on increasing as we approach Rewat switchyard.
Ethnic Divisions
The first part of the region to be traversed by the proposed transmission line is a part of Attock District and is inhabited by Punjabi (Potohari dialect) speaking, post-tribal lineage groups (biradaries). The two major lineage groups are those of the Awans, who dominate most of the Potohar plateau south of Kala-Chitta range, and the small Khattar tribe. The later is confined to the southern belt of Attock tehsil and the northern margins of Fateh Jang tehsil. The second part of the region is the area nearby/adjacent to the Rewat. Here the majority is of the Rajgian lineage along with Awans and Maliks. This region has contributed substantial number of their men to the armed forces.

Economic Base
The economy south of Haro river is extensively rural, although the proximity of Attock city and the extensive Sanjwal Defence Industries north of Haro, industrial area of Fateh Jang and a few stone blasting and crushing factories provide some alternative daily work opportunities for the villages of the area. In addition, every village has members working outside the area in Islamabad, Karachi or abroad.

The rural economy is largely brarai agriculture, with Wheat, Maize, Barley and Bajra (fodder) as the main crops. The land holdings are smaller usually ranging from 0.1 ha to 3 ha. Livestock provides an important addition to the family incomes and diets. An average family with 0.3 ha holding can earn somewhere between Rs. 12,000 - 15,000 from crops; and from livestock Rs. 6,000 - 7,000. This is usually the average income for the village.

Basic education and medical care are available through a network of village primary and middle schools and basic health units. High schools are present at the Union Council level, while Attock city, Fateh Jang and Rewat has at least a degree college each and several private professional schools for commerce and computer studies. More advanced medical assistance is also available in Attock city, Rewat and Fateh Jang.

Transportation System
Some major and secondary transportation links pass through the area including both road and railway. The Attock-Sher Shah (via Kundian) railway line runs from Attock junction south across the Haro river and nullah Nandana Kas, before passing through the Kala-Chitta range. The road to Basal, Pindi Gheb, Talagang and Khushab is routed across the Haro near Gariala. Fateh Jang-Rawalpindi road, Jinder-Rawalpindi road, Rewat-Java road, Kasala Kalan-Rawalpindi road and Rawalpindi-Lahore road are also some of the main road links lying in the region traversed by the circuit. District roads across the area from Attock city to Fateh Jang and from Sanjwal to Fateh
The roads north and east of Attock city connect the whole region to the Grand Trunk road. Most villages are connected by metalled roads.

Archaeological and Historical Resources

The only known archaeological site near the transmission line is at Gariala, where a group of 17 Boulders is marked with petroglyphs. Gariala is also the site of a stone age culture from the early or Middle Pleistocene periods. The most prominent contemporary cultural property proximate to the transmission line is the shrine of Sakhi Zinda Pir at Akori.

Impacts and Recommendations

The transmission lines are not expected to cause any significant changes in the land use, since WAPDA policy is to avoid any damages by modifying the line route where necessary. Such modifications include avoidance of villages and when possible, of single dwellings. Where no alternative to moving a dwelling exists, the site of the dwelling and the new site of the resettled family will undergo minor landuse changes (residential to agricultural, and vice versa). Such areas will involve only fraction of hectare. The number of houses effected is given in Table-1. The line tends to avoid villages, schools, wells, shrines, graveyards, mosques and other dwellings to keep the impact on the area at a minimum level. Although the line passes over numerous village roads and tracks and railway line, no effect on transportation or village agricultural movement is anticipated.

4.2 BAROTHA-TARBELA (IN CIRCUITS)

The Barotha-Tarbela (in circuit) 500 KV transmission line consist of 26.3 Km of double circuit on a single tower and 8.9 Km of single circuit and has been divided into four segments for planning purposes. It originates from 500 KV switchyard near Barotha and reaches the existing 500 KV Tarbela-Gatti lines.

4.2.1 Land Use

Segment-1

This segment is 11.1 Km long and starts from Barotha switchyard to Attock-Sher Shah railway line at a point 500 meters South of Kanjur. The line originates from Barotha switchyard, moves along the village of Barotha at a distance of 70 meters. The line curving around, leaves the village at its southern end and moves towards east. This area is very much broken and bushy with very few trees. The line crosses the outlet of the power channel and then crosses over 4-5 houses. The line then crosses a Katcha track enters a less broken area with better agriculture. At this point it crosses Attock-Raindher road, a small nullah and Attock- Gheri road. The line then immediately enters a
broken bushy area. It then takes a right turn of 6°-00'. The population is scattered and thin around this turning. The line then passes 500 meters south of Mari Kanjur reaching Attock-Sher Shah railway line.

Segment-2
This segment is 15.1 Km long. The segment starts at a point 500 meters south of Mari Kanjur to a point west of existing Tarbela-Gatti (I) line. The line crosses the Attock-Sher Shah railway line and crosses two small nullah’s. All this area is broken and plateau. It then crosses a katcha track moving over 2-3 houses. The line then crossing Attock-Fateh Jang and Attock-Bariar road, crosses Haro river. After crossing Haro river, the line enters ‘Kawah Gar’ reserve forest. The line moves left at an angle of 8° -25’ and 180 meters north of Dhok Bariar. As the line comes out of the forest, the area is suitable for agriculture. Here it crosses three small nullah’s and two katcha tracks avoiding Dhok Tare by 90 meters and Kahutra by 750 meters. Then the line crossing a katcha track moves south of pind Tara and Boliwanwal at a distance of 300 meters. There are 5-6 houses which are situated close to the end of the segment.

Segment-3 (Tarbel-I)
This segment is 3.25 Km long. The line starts at a point west of the exiting Tarbela-Gatti (I) line and moving north-east reaches Tarbela-Gatti (I) line at 1 km north of Daualatwal. There are few houses at a distance of 50 meter in the southern direction, from where this segment begins. The line moving north-east, crosses the Bolianwal-Batar road and passes through a broken bushy area. The agriculture decreases as the line enters the broken area. The agriculture in the whole area is barren. The major crops in the region are Peanut, Wheat, Corn and Barley. The line then moving over two nullah’s and passing 800 meters west of Dhok Nadir Ali (Dolatwal), reaches the Tarbela-Gatti (I) line.

Segment-4 (Tarbelu-II)
This segment is 5.7 Km long and begins at a point west of existing Tarbela-Gatti (I) line to an existing tower of Tarbela-Gatti (II) line 1.5 Km south of ‘Mian Sultan Ki Dhok’. This segment starts in an area which is plateau but not broken and there are two houses in the southern direction at a distance of 75 meters. The line then crosses Dauradad road, Bolianwal-Batar road and a katcha track avoiding Dhok Akbari by about 600 meters. The line then moves over three minor nullah’s and two katcha tracks just before reaching Tarbela-Gatti (II) line. There is moderate agriculture in the area.
4.2.2 Ecological

The ecological value of the region falling under the route of this transmission line is similar to that of the Barotha-Rewat line. The only difference is in the area south of Attock, where the biodiversity is very low. The line passes through Kawah Gar reserve forests along Haro river where the bio-diversity is relatively significant. A considerable number of reptors are present at various points in the area. The habitat is not very conducive to the growth of wildlife/bird species since it lacks most of its original and natural vegetation and also because there is an increasing human activity and settlements.

4.2.3 Socio-Economic and Cultural Resources

This proposed new line from Barotha to Tarbela, starts at a switchyard near Barotha. It passes south of Attock, crosses Attock-Sher Shah railway line and Haro river, passes through Kawah Gar reserve forest and reaches the Tarbela-Gatti lines.

Settlement Pattern
In the region of Haro river and Nandana Kas, the villages lie on the bench between the river valley and the hills, where relatively flat land is available for barani cultivation. The region is not densely populated. In few places, where land slopes evenly down to the rivers, fertile pockets irrigated by persian wells are present. The broken areas are used for pasturage, and for fuel wood and fodder. Villages are slightly smaller than those west of the Indus. Numerous smaller settlements and family compounds are scattered around the villages, a substantial portion of these being under the hills were permanent water is available, although, there has been some tubewell development over the years.

Ethnic Divisions
The region to be traversed by the propose transmission line is a part of Attock District and is inhabited by Punjabi (Potohari dialect) speaking people. The two major lineage groups are those of the Awans, who dominate most of the Potohar plateau south of Kala-Chitta range, and the small Khattar tribe. The later is confined to the southern belt of Attock tehsil and the northern margins of Fateh Jang tehsil.

Economic Base
The economy of the area is extensively rural, although the proximity of Attock city and the extensive Sanjwal Defence Industries north of Haro provide some alternative daily work opportunities for the villages of the area. The rural economy does not cater for all the needs of the people for family livelihood and the area is one of the persistent out migration with adult males
temporarily moving out to take jobs in big cities or further away in abroad. Basic education and medical care are available in villages. Electricity is supplied through out most of the region. Many villages have govt. supplied tubewells.

Transportation System
Secondary transportation links pass through the area. The Attock-Sher Shah (via Kundian) railway line runs from Attock junction and across the Haro and Nandana rivers, before passing through the Kala-Chitta range. The road to Basal, Pindi Gheb, Talagang and Khushab is routed across the Haro near Gariala. District roads cross the area from Attock city to Fateh Jang and from Sanjwal to Fateh Jang. The roads north and east of Attock city connect the whole region to the Grand Trunk road. Most of the large villages are connected by metalled roads.

Archaeological and Historical Resources
The only known archaeological site near the transmission line is at Gariala. The most common form of local cultural property in rural areas are “Shrines (Ziarats)” and old village mosques.

Impacts and Recommendations
This transmission line is not expected to cause any significant changes in the area. All the important potential impacts from the transmission line will be noted and their mitigation measures, if required, will be suggested at the design and construction stage. The number of houses effected is given in Table-I.

4.3 BAROTA-GATTI (OUT CIRCUITS)

The Barotha-Gatti (out circuit) 500 KV transmission line consists of 30.6 Km of double circuit on a single tower and 29.8 Km of single circuit and comprises of five segments. It originates from a 500 KV switchyard near Barotha and extends to the existing Tarbela-Gatti 500 KV lines.

4.3.1 Land Use

Segment-1
This segment is 12.85 Km long. It starts from the Barotha switchyard to a point north of Dheri Langhai. The line originates at Barotha switchyard and moves through the broken area at a distance of 130 meters from the village. It makes a semi circle around the village, and passes north of Gariala keeping a distance of 250 meters. The line crosses over the power channel outlet and above 3-4 houses. The line then enters a less broken area where it crosses Attock-Chhori road. There is more agriculture in this region. The line then crosses the Haro river. The area after crossing the Haro river is comparatively more broken and the line passes 550 meters north of Dher Kot and after
crossing two small nullah's it crosses Dheri-Chohar road. From this point onwards the area begins to deteriorates. The line then crosses Dheri Langhal road passing at a distance of 500 meters north of Dhari Langhal.

Segment-2
This segment is 17.75 Km long. This segment starts 500 meters north of Dhari Langhal to a point north of Jabbi Kasran. The line takes a 30⁰ left turn and enters a broken area where it crosses Attock-Sher Shah railway line and nullah 'Nandana Kas'. The line then passes 400 meters north of Dhok Nawab Khan. The area gets better near the Dhok Nawab Khan road. It then passes 300 meters south of Jawan Dewali Dhok. The line again crosses the nullah 'Nandana Kas'. The line then passes over small nullahs and katcha tracks. Moving at a distance of 280 meters north of village Nawa, the line passes through the Buta village. The population of Buta village is on both sides of the line. The population is at a distance of 100 meters on one side and 150 meters on the other side of the line. The line then passes through the foot hills of the Kala-Chitta forest crossing small nullahs and Attock-Fateh Jang road, at a distance of 500 meters from a rock blasting and crushing site. The line then crossing the nullah of 'Jabbi Kas' reaches a point north of Jabbi Kasran. There is moderate barani agriculture in this region.

Segment-3
This segment is 1.45 Km long. It starts from a point north of Jabbi Karan to a point east of Jabbi Karan on the existing Tarbela Gatti (I) line. The line moves through a broken area and passes over small nullahs. The agriculture is not significant in the region. The area is bushy with very few scattered trees. The vegetation in the region is mainly Kao, Phullai and Kikar.

Segment-4
This segment is 18.6 Km long. It starts from a point north of Jabbi Kasran to a point at Jand-Fateh Jang road. The area along this segment is a less broken plateau. The area has scattered trees and bushes. The line crosses small nullahs, katcha tracks and Langar road and moving parallel to nullah 'Nandana Kas' reaches the edge of an army area. The line then turns right along the edge of the army area and moves south. The line now crosses the Gakar road and enters the Kala-Chitta hills and forest. The line after coming out of the Kala-Chitta forest crosses Attock-Fateh Jang road and enters a broken area where it avoids Ajjuwala by about 200 meters. The line then crosses two nullahs, two katcha tracks, a 66 KV line, a railway line and reaches the Jand-Fateh Jang Road. There are two houses and brick kilns in the southern direction 50 meters from the end of this segment.
Segment-5
This segment is 9.75 Km long. It starts from a point at Jand- Fateh Jang road to a point at Tarbela-Gatti (II) line south-east of Fateh-Jang. This segment begins in a semi broken plateau area which has moderate agriculture. The line crosses two small nullah and a katcha track to reach Fateh Jang-Talagang road. There are few houses at 100 meters south of line between Fateh Jang-Jand road and Fateh Jang-Talagang Road. The agriculture in the area is barani and the major crops are Peanut and Corn. The line after crossing Fateh Jang-Talagang road enters a broken and plateau area. Then it crosses two katcha tracks and a major nullah and reaches a tower on Tarbela Gatti (II) line. There are 4-5 houses at 50-100 meters south at this end of line.

4.3.2 Ecological

The ecological value of this line is essentially the same as that of comparable areas of Barotha-Rewat line.

4.3.3 Socio-Economic Cultural Resources

This proposed new line from Barotha to Gatti, starts at a switchyard near Barotha crossing Attock-Sher Shah railway line. It passing south of Attock, through the foothills of the Kala-Chitta hills and reaches the Tarbela-Gatti (I) line north of Jabbi Kasran. From here it changes to a single circuit line. The line then avoids the arid area of Kala-Chitta moving along its edge and then avoiding the populated area of Fateh Jang city passing south of Fateh Jang reaches the Tarbela-Gatti (II) line south-east of Fateh Jang.

Settlement Pattern
Since this line is aligned in the same sub-region as that of Barotha-Rewat and Tarbela-Barotha lines, therefore, the settlement pattern of the area is more or less same as of the other two lines.

Ethnic Divisions
The region mainly constituted upon Attock District, is inhabited by Punjabi (Potohari dialect) speaking people with biradary system. The rest is same as the Tarbela-Barotha line.

Economic Base
The economy is again extensively rural with very few industries such as Kamra/Sanjwal Defence Industries in the area. The rural economy is largely barani, with Wheat, Maize, Barley and Bajra (fodder) the main crops. The land holdings are smaller and livestock provides an important addition to the family incomes and diets. Basic education and medical care are available through a network
of village primary and middle schools and basic health units. High schools are present at the Union Council level and degree colleges are present in big cities.

**Transportation System**
The transmission line corridor passes through a country side that is served by secondary and tertiary road and railway systems. The Attok-Sher Shah (via Canadian) railway line runs from Attok junction south across the Haro and Bandanna rivers, before passing through the Kala-Chitta range. The road to Basal, Pindi Gheb, Talagang and Khushab is routed across the Haro near Gariala. District roads across the area from Attok city to Fateh Jang and from Sanjwal to Fateh Jang. The roads north and east of Attok city connect the whole region to the Grand Trunk road. Most of these village roads are metalled.

**Archaeological and Historical Resources**
The only known archaeological site near the transmission line is at Gariala. Any other site will be noted in the final alignment. During the detailed design and construction stage, tower locations will be adjusted to avoid any relevant sites.

**Impacts and Recommendations**
This transmission line is not expected to cause any significant changes in the land use. The changes/modifications may include avoidance of villages and when possible, of single dwellings. The number of houses effected is given in Table-1. The detailed survey will note all the major impacts related to resettlement, damage to buildings, crops, human health and water resources and will recommend appropriate mitigation measures.

4.4 

**REWAT-GHAKKAR-LAHORE LINE**

The environment assessment for this part of the transmission lines from Rewat to Gakkhar and Gakkhar to Lahore is based on the tentative route provided by the EHV department WAPDA, and desk study carried out by the Environment Directorate.

(A) Rewat - Ghakkar Section
The line is about 200 Km long starting from the Rewat switchyard to a switchyard at Ghakkar. The line after coming out of Rewat switchyard, avoids the populated areas of Sukho and Darwaza. It then crosses river Jhelum near Rasul headwork's and avoids the populated areas of Chilianwala and Mandi Bahauddin. The line crosses the Chenab river near Khanki headwork's. The corridor then avoiding villages and towns reaches the switchyard near Gujranwala/Ghakkar.
4.4.1 Land use
The corridor starts at a switchyard near Rewat passing through an area with plateau topography. The area has low to moderate agriculture. The agriculture increases as we move south. The area south of Jhelum is fertile and has a high agriculture potential.

4.4.2 Ecological Value
The corridor passes near two areas of wildlife and a forest reserve near Domeli. The corridor also passes close to an area of forest cover near Rasul.

4.4.3 Archaeological and Historical Resources
The archaeological value of the region is not significant. A few sites of historical significance exist in the region, the most prominent is the Rohtas Fort near Dina.

(B) Ghakkar - Lahore Section
The corridor of this line is about 80 Km long. The corridor is to by-pass the populated areas of Ajnianwala and Sheikhupura to reach the switchyard at Lahore (near Sheikhupura).

4.4.4 Land use
The corridor is located in the area of prime agriculture. The area has a high population density and industry.

4.4.5 Ecological Value
The ecological value of this corridor is not very significant, since the area is of high population density and agriculture.

4.4.6 Archaeological And Historical Resources
The corridor area is not of very high archaeological or historical significance. The only historical site is “Hiran Minar” near Sheikhupura which will be avoided.

4.4.7 Socio-Cultural Resources
The region ranges from rural upland country, to the populated Indus plains. As we move south the population density and agriculture increases. The change is significant as the line crosses the river of Jhelum into Indus plains, the land has a high agriculture potential and population density. The people living in the area are Punjabi’s with almost a common dialect of Punjabi language.
5.0 CONCLUSION

The transmission lines of WAPDA are not going to cause any major change in the land use of the region since the corridors tend to avoid areas of population, forest, agriculture, wildlife or of any other environmental significance. Care should be taken while crossing through or nearby areas of population, forest and wildlife. The major damage to the environment specially ecosystem will be during the construction and patrolling of the line. The routing in the corridor (tower location) will be important for soil erosion. The transmission and switchyard system along with the project will bring social uplift in certain regions. The relocation / resettlement with the corridors is not very much (Table-1). The school near the Barotha switchyard is to be relocated, further if any other school or dwelling will lie within the safe distance from the line corridor during the final routing, it will also be relocated. This cost of relocation will be included in the project cost. Thus in the light of the above mentioned the transmission line scheme, Ghazi-Barotha project will have no major environmental impacts.
<table>
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<tr>
<th>Sr. No.</th>
<th>Description of Lines</th>
<th>Length of Line.</th>
<th>Approximate crops &amp; trees compensation cost (Pak. Rs.)</th>
<th>Approximate No. of Houses</th>
<th>Approximate cost of Affected Houses</th>
<th>Grand Total (4+6)</th>
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