SECTION – II

SALIENT FEATURES

2.1 Name of the project — **Ken - Betwa Link Project (Phase -II)**

2.2 General

2.2.1 River basin

(a) Name — **Betwa basin**

(b) Located in

(i) State — M.P

(ii) Country — India

2.2.2 Name of

(a) River — Betwa

(b) Tributary — Orr, Keotan

(c) States — Madhya Pradesh

(d) Districts

	Headworks	Districts	Reservoir/ Pondage	Command area
1	Lower Orr	Ashok Nagar, Shivpuri	Ashok Nagar, Shivpuri	Shivpuri
2	Neemkheda	Raisen	Raisen	Raisen
3	Barari	Vidisha	Vidisha	Vidisha
4	Kotha	Vidisha	Vidisha	Vidisha, Sagar, Ashok Nagar
5	Kesari	Vidisha	Vidisha	Vidisha

(e) Tehsils & village near head works

	Headworks	Reservoir/ Pondage	Headworks	Command area	Village near the Head works
1	Lower Orr	Chanderi Khaniadhana	Chanderi, Khaniadhana	Khaniadhana, Pichhore, Karera	Didauni
2	Neemkheda	Goharganj	Goharganj	Goharganj	Neemkheda
3	Barari	Gyaraspur	Gyaraspur	Gyaraspur	Barrighat
4	Kotha	Basoda	Basoda	Basoda	Kotha
5	Kesari	Basoda	Basoda	Basoda	Didholi

2.2.3 Location of Head works and project area reference

Sl.No.	Headworks	Longitude	Latitude	Degree Sheets	Index Plan
1	Lower Orr	78^0 05’ 55”E	24^0 50’ 50”N	54L/1	Plate No.1.1
2	Neemkheda	77^0 40’ 49”E	23^0 16’ 40”N	55E/11	Plate No.1.1
3	Barari	77^0 50’ 30”E	23^0 40’ 23”N	55E/14	Plate No.1.1
4	Kotha	78^0 01’ 16”E	24^0 3’ 28”N	54L/4	Plate No.1.1
5	Kesari	78^0 01’ 34”E	24^0 52’ 32”N	55I/1	Plate No.1.1

2.2.4 Access to the project

Sl.No.	From / To	Airport	Rail head	Road head	River head	Sea port
1	Lower Orr	Gwalior, Bhopal	Lalitpur	Chanderi	Nil	Nil
2	Neemkheda	Bhopal	Bhopal	Bhopal	Nil	Nil
3	Barari	Bhopal	Vidisha	Vidisha	Nil	Nil
4	Kotha	Bhopal	Vidisha	Vidisha	Nil	Nil
5	Kesari	Bhopal	Basoda	Basoda	Nil	Nil

2.2.5 Estimated life of the projects (years) 100

2.3 Type of project Irrigation, Drinking water, Fishries, Tourism

2.3.1 Irrigation (ha)

Sl.No.	Head works	GCA	CCA	Intensity of Irrigation (%)	Annual Irrigation			
					Kharif	Rabi	Pere-nial	Gross irrigated area
1	Lower Orr	85672	45046	150	30451	36038	1081	67570
2	Neemkheda	5802	3066	100	-	3066	-	3066
3	Barari	5932	4444	100	-	4444	-	4444
4	Kotha	23168	17357	125	4340	17357	-	21697
5	Kesari	1973	1479	140	592	1478	-	2070

a Cost per ha of gross irrigated area Rs. 2.31 Lakh/ha of gross irrigated area

b Cost per MCM of gross storage Rs. 446.34 Lakh/MCM of gross storage

c Cost per MCM of live storage Rs. 487.96 Lakh/MCM of live storage

d Cost per 1000 cum of water delevered at the canal head/outlet

2.3.2 Power No power generation in projects

2.3.3 Flood control

Lower Orr

(a)	Area protected from floods (ha)	Due to the impoundment of water in Lower orr dam, there will be control of flood damages in d/s of the dam site in Orr river . However, the aspects like area proctected, saving of flood damages, etc. have not been assesed in this DPR which can be studied at the pre- construction stage.
(b)	Population protected from floods (No.)	
(c)	Average annual flood damage(Rs. Million)	
	(i) Without project	
	(ii) With project (anticipated)	
(d)	Safe carrying capacity of the river down stream (cumec)	
	(i) Without project	
	(ii) With project (anticipated)	

2.3.4 Navigation Not applicable

2.3.5 Water Supply

2.3.5.1 Domestic

Sl.No.	Name of projects	Name of towns/ Village served	Size of population served (projected upto 2050AD)	Quantum of water made available (MCM)	Quantum of water per Capita (Litre)
1	Lower Orr	Khaniyadhana, Pichhore, Karera	1.65 Lakh	6	Average demand considered 100 lpcd

2.3.5.2 Quantum of Water for industrial use NIL

2.3.6 Project performance

Sl. No.	Particular	Lower orr dam			
		Period of simulation		No. of failures	
		NIH	IP (South)	NIH	IP (South)
(a)	Irrigation	108	55	27	14
(b)	Power	-	-	-	-
(c)	Flood control	-	-	-	-
(d)	Water supply	108	55	27	4
(e)	Navigation	-	-	-	-

2.4 Hydrology

2.4.1 Catchment

2.4.1.1 Catchment area at head works site (Sqkm)

Sl. No.	Name of projects	Gross	Interc-epepted	Uninter-cepted	Snowfed	Rainfed
1	Lower Orr	1843	-	1843	Nil	1843
2	Neemkheda	1976	-	1976	Nil	1976
3	Barari	5474	1976	3498	Nil	5474
4	Kotha	8712	5980	2732	Nil	8712
5	Kesari	506	-	506	Nil	506

2.4.2 Precipitation (mm)

2.4.2.1 Catchment - Period of record (1980 to 2009)

Sl. No.	Rainfall (Weighted -mm)	Lower Orr		Neemkheda		Barari		Kotha		Kesari	
		Annual	Mon-soon	Annual	Mon-soon	Annual	Mon-soon	Annual	Mon-soon	Annual	Mon-soon
1	Average	926	890	1139	1076	1227	1151	1079	1021	1106	1045
2	Maximum	1420	1419	1666	1606	1954	1819	1607	1402	1662	1413
3	Minimum	646	570	789	782	827	808	675	620	753	690

2.4.2.2 Command

Sl. No.	Command	Cropping Season			
		Annual	Kharif	Rabi	Hot weather
			(Jun.-Oct.)	(Nov.-Feb.)	(Mar.-May)
(i)	**Lower orr command**				
(a)	**Average (mm)**	895.5	838.03	37.1	20.1
(b)	**ETo (mm)**	1516.0	704.0	286.0	526.0
(ii)	**Upper Betwa command**				
(a)	**Average (mm)**	1226.0	1165	48	13
(b)	**ETo (mm)**	1553	650	335.0	568.0

2.4.3 Net annual yield calculated at proposed dam/Barrages site (MCM)

Sl. No.	Name of projects	Dependable (percent)					
		50		75		90	
		Annual	Mansoon	Annual	Mansoon	Annual	Mansoon
1	Lower Orr	501.15	478.51	362.53	347.14	263.98	252.78
2	Neemkheda	440.19	417.06	328.61	311.20	257.03	244.21
3	Barari	1363.52	1316.50	1078.32	1040.26	785.07	757.63
4	Kotha	2061.06		1593.99		1184.90	
5	Kesari	156.16	148.99	120.66	115.33	91.55	87.45

2.4.4 Climatic data

2.4.4.1 Command - Names of stations - Period of record

(i) Lower orr Command

Station : Jhansi

	Period of record : 1961 - 90	**Average**	**Maximum**	**Minimum**
(a)	Air Temperature(^{0}c)	25.78	45.40	3.80
(b)	Humidity(Percent)	49.00	76.00	18.00
(c)	Wind (km/hr)	4.56	6.70	2.80

(iii) Upper Betwa command

Station : Raisen

	Period of record : 1961 - 90	**Average**	**Maximum**	**Minimum**
(a)	Air Temperature(^{0}c)	24.80	41.90	7.00
(b)	Humidity(Percent)	67.50	88.00	23.00
(c)	Wind (km/hr)	5.70	10.40	2.30

2.4.5 Utilisation

2.4.5.1 Proposed utilisation by the project (MCM)

Sl. No.	Name of Project	Kharif	Rabi	Total
1	Lower Orr	**128.37**	**201.3**	**329.67**
2	Neemkheda	**-**	**16.61**	**16.61**
3	Barari	**-**	**24.53**	**24.53**
4	Kotha	**13.75**	**94.02**	**107.77**
5	Kesari	**1.88**	**8.15**	**10.03**

2.4.6 Floods near the head work site

2.4.6.1 Historical period of record

		Lower Orr
(a)	**Maximum water level (El-m)**	Not available
(b)	**Maximum discharge estimated(cumec)**	
(c)	**Year of occurence, date**	

2.4.6.2 Observed period of record (Observed at Basoda on Betwa)

(a) Maximum water level (El-m)

(b) Maximum discharge estimated (cumec)

(c) Year of occurence, date

2.4.6.3 Standard project flood (cumec)

	Name of Project	
1	Neemkheda barrage	6654.60
2	Barari barrage	16449.00
3	Kotha barrage	22486.00
4	Kesari barrage	2690.14

2.4.6.4 Maximum probable flood

Lower Orr Dam 12068 cumecs

2.4.6.5 Flood frequency

Sl. No.	**Name of Project**	**50 year**	**100 year**	**1000 year**
1	Lower Orr	3775.8	4430.9	6974.1
2	Neemkheda	3978.2	4668.4	7347.9
3	Barari	8542.6	10024.8	15778.7
4	Kotha	12104.1	14204.2	22356.9
5	Kesari	1432.1	1680.6	2645.2

2.4.6.6 Design and diversion flood (cumec)

(a)	**Dam**	**Design flood PMF/SPF**	**Diversion Flood**
1	Lower Orr dam	12068.0	4430.9
(b)	**Barrage**		
2	Neemkheda barrage	6654.6	304.0
3	Barari barrage	16449.0	653.0
4	Kotha barrage	22486.0	924.0
5	Kesari barrage	2690.1	110.0

2.4.6.7 River flows (Minimum observed)

(a)	**Water level (El-m)**	Not readily available
(b)	**Discharge (cumec)**	
(c)	**Months of 'nil' flow**	

2.5 Reservoir

2.5.1 Water levels (El-m)

		Lower orr dam
(a)	**Maximum water level**	380.408
(b)	**Full Reservoir level/Pond level**	380.00
(c)	**Minimum draw down level**	360.50
(d)	**Dead Storage level**	360.50

2.5.2 Free Board (m) 2.94

2.5.3 Wave height (m) 3.54

2.5.4 Live storage (MCM) 328.173

2.5.5 Capacity (MCM) at

(a)	**Maximum water level**	371.802
(b)	**Full Reservoir level**	371.802
(c)	**Minimum draw down level**	43.630
(d)	**Dead Storage level**	43.630

2.5.6 Flood absorption capacity (MCM)

(a) Below FRL

(b) Between FRL & MWL

2.5.7 Sedimentation (MCM) after

		Lower orr Years	
		50	**100**
(a)	**Above MDDL**	21.304	44.770
(b)	**Below MDDL**	12.692	23.242
(c)	**Encroachment of Live storage**		
	(percent)	0%	0%

2.5.8 Assumed Annual Evaporation losses from the reservoir

(a) Quantum (MCM) Average 31.40

(b) Depth (m)

2.6 Submergence

2.6.1 Land and property submerged

		Lower orr dam
(a)	**Villages affected (No.)**	
	(i) Full	7
	(ii) Partial	5
(b)	**Land affected (ha)**	
	(i) Gross	2723.70
	(ii) Culturable	853.00
	(iii) Un Culturable	576.22
(c)	**Building/houses (No.)**	
	(i) Private (Kachha/Pacca)	720
	(ii) Communities (Concrete Building)	2
(d)	**Wells (No.)**	355
(e)	**Road/Rail (km)**	
(f)	**Transmission**	
(g)	**Any other**	

2.6.2 Submergence ratio (with reference to CCA) 0.016

2.6.3 Number of families affected 944

Lower Orr dam

2.6.4 **Number of persons affected**

2.6.5 **Anticipated back water levels at important places along the periphery of the reservoir**

2.7 **Head works**

2.7.1 Dam

2.7.1.1 **Earth and Rock fill dam**

(a)	Type of dam (Homogenous/Zoned/Rock-fill)	Earth dam
(b)	Length of dam at top (m)	
	(i) Right flank	1731
	(ii) Left flank	-
(c)	Top width (m)	7.0
(d)	Maximum height above G.L.(m)	
	(i) Right flank	45.0
	(ii) Left flank	-
(e)	Dyke(s)	
	(i) Number	Nil
	(ii) Total length	
	(iii) Maximum height (m)	
(f)	Type of cut off and maximum depth(m) (Upstream blanket/ Open trench/diaphragm/grout curtain combination of alternatives)	Open trench type

2.7.1.2 **Masonry and Concrete dam**
(Non over flow section)

(a)	Type of dam (Masonry/Concrete/composite/any other	Concrete
(b)	El of top (m)	384.00
(c)	El of deepest bed level (m)	339.00
(d)	Length at top (m)	240.00
(e)	Length at the river bed (m)	180.00
(f)	Width at top (m)	8.00
(g)	Width at deepest bed level (m)	53.30
(h)	Maximum height above deepest foundation level (m)	45.00

2.7.1.3 Spillway (over flow section)

		Lower orr
(a)	Type of spillway (Ogee/chute/side channel/tunnel/siphon/any other type)	Ogee
(b)	Full reservoir level (El-m)	380.0

(c)	Maximum water level (El-m)	380.408
(d)	Length (m)	247.000
(e)	Maximum height above the deepest foundation level (m)	45.0
(f)	Crest level (El-m)	370.0
(g)	Number of gates	12.0
(h)	Type of gate	Radial
(i)	Size of gate (m)	15X10.0
(j)	Maximum discharging capacity	12068.0
	(cumec) at FRL and MWL	
(K)	Tail water level (El-m)	
	(i) Maximum	346.80
	(ii) Minimum	335.0
(L)	Type of energy dissipation arrangement	Stilling basin

2.7.1.4 River sluice (s), Irrigation, Power outlet (s)

(a)	Purpose	Irrigation
(b)	Number	3
(c)	Size (m)	5.0X3.0
(d)	Sill level (El-m)	340
(e)	Discharging capacity (cumec) at	
	(i) Full reservoir level	
	(ii) Minimum draw down level	

2.7.2	**Barrage**	**Neemkheda**	**Barari**	**Kotha**	**Kesari**
2.7.2.1	**Length (m)**	203.2	440.0	579.0	181.0
2.7.2.2	**Spillway**				
(a)	Total length (m)	200.0	310.0	576.0	118.0
(b)	Full Pond Level (El-m)	426.0	407.72	396.0	403.9
(c)	Maximum water level (El-m)	426.0	407.72	396.0	403.9
(d)	Maximum height of spill way (crest) above deepest foundation level (m)	6.25	6.80	7.0	7.0
(e)	Length of bay (m)	18.0	10.0	15.0	10.0
(f)	Crest level (El-m)	421.25	404.0	384.5	404.0
(g)	Number of gates	10	25	32	10
(h)	Type of gate	Fixed wheel vertical lift	Fixed wheel vertical lift	Fixed wheel vertical lift	Fixed wheel vertical lift
(i)	Size of gate (m)	18X4.75	10X3.72	15X11.5	10X2.4
(j)	Type of energy dissipation arrangement	Stilling basin	Stilling basin	Stilling basin	Stilling basin
(k)	Maximum discharging capacity (cumec)	6654	12283	22486	2772
(l)	Tail water level (El-m)				
	(i) Maximum	424.64	612.90	392.60	405.60
	(ii) Minimum	416.64	400.00	380.30	401.50

2.7.2.4 Under sluice bays

		Neemkheda	Barari	Kotha	Kasari
(a)	Total length(m)	Not Provided	125.2	Not Provided	28.8
(b)	Maximum height of under sluice (crest above deepest foundation-m)		2.8		9.5
(c)	Length of bay (m)		10		10.0
(d)	Sill level (El-m)		400.0		399.0
(e)	Number of gates		10		5
(f)	Type of gate				
(g)	Size of gate (m)		10X7.72		10X4.9
(h)	Type of energy dissipation arrangement				
(i)	Maximum discharging capacity of under sluice (cumec)				

2.7.2.5 Guide bunds/Afflux bunds

Length		
Right (m)	560.0	413
Left (m)	560.0	413

			Lower orr	Barari	Kotha		Kesari
2.8	**Canal system**		LBC	RBC	LBC	RBC	RBC
2.8.1	**Main canal**						
2.8.1.1	**Purpose of canal (Irrigation/Power/Navigation/Diversion/Water supply/Multipurpose)**		Irrigation/ Water supply	Irrigation	Irrigation	Irrigation	Irrigation
2.8.1.2	**Type**						
	(a)	Flow/Lift	Flow	Lift/Flow	Flow	Flow	Lift/Flow
	(b)	Lined/Un lined	Lined	Lined	Lined	Lined	Lined
	(c)	Discharging capacity(cumec) of the channel above which lining is proposed	31.80	5.72	10.33	11.87	1.9
	(d)	Type of lining	C.C. Linning	C.C. Linning	C.C. Linning	C.C. Linning	C.C. Linning
2.8.1.3	**Main canal data**						
	(a)	Length (km)	91.26	4.5	39.00	44.00	12.5
	(b)	Full supply level at head (El-m)	360	424			409.5
	(c)	Full supply depth at head (m)	3.06	1.18			1.15
	(d)	Bed width at head(m)	5				
	(e)	Side slope at head	1.5:1	1.5:1			1.5:1
	(f)	Bed slope (range)	1 in 9000	1 in 10000			1 in 10000
	(g)	Maximum Discharging capacity at head (cumec)	31.99	1.12	10.33	11.87	1.07
	(h)	Total number of canal structures on main canal and branch canals					22
	(i)	Total assumed losses across the structure(m)					
	(j)	Gross command area (ha)	85672	5932			1973
	(k)	Culturable command area (ha)	45046	4444	8078	9278	1479
2.8.1.4	**Branch canal (s)**						
	(a)	Number	19				
	(b)	Total length (km)	116.55				
2.8.2	**Efficiencies (percent)**						
	(a)	Conveyance	75	75	75	75	75
	(b)	Field application	85	65			65

2.9 Cropping pattern (%)

2.9.1 Name of crop season-wise

Sl. No.	Name of Crop	Lower Orr command			Neemkheda command		Barari command		Kotha command		Kesari command	
		Existing	Proposed		Exis-ting	Propo-sed	Exis-ting	Propo-sed	Exis-ting	Propo-sed	Exis-ting	Propo-sed
			For tradition irrigation	For pressurize irrigation								
	Kharif											
(i)	Paddy	1.40	1.00	-	4.60	-	0.10	-	0.10	-	0.10	-
(ii)	Jowar	0.20	5.00	-	-	-	-	-	-	-	-	-
(iii)	Soyabean	24.50	19.00	7.00	27.60	-	30.70	-	30.70	-	30.70	40.03
(iv)	Maize	3.50	5.00	-	0.60	-	0.40	-	0.40	25.00	0.40	-
(v)	Pulses	3.20	20.00	25.00	0.60	-	6.20	-	6.20	-	6.20	-
(vi)	Oil seeds	2.00	10.00	13.00	-	-		-	-	-		-
(vii)	Vegetables	0.90	4.00	5.00	0.40	-	0.20	-	0.20	-	0.20	-
(viii)	Groundnut	15.30	-	-	-	-	0.20	-	0.20	-	0.20	-
(ix)	Bajra	1.50	5.00	6.00	-	-	-	-	-	-		-
(x)	Others	-	1.00	2.00	-	-	-	-	-	-		-
	Sub-total	**52.50**	**70.00**	**58.00**	**33.80**	**-**	**37.80**	**-**	**37.80**	**25.00**	**37.80**	**40.03**

	Rabi											
(i)	Wheat (Local)	28.80	60.00	75.00	35.00	20.00	30.80	20.00	30.80	20.03	30.80	19.96
(ii)	Wheat (HYV)	-	-	-	-	49.80	-	70.00	-	50.06	-	69.99
(iii)	Gram	7.70	15.00	15.00	17.60	30.20	21.10	10.00	21.10	29.91	21.10	10.02
(iv)	Linseed	-	-	-	0.10	-	-	-		-	-	-
(v)	Tur	0.20	-	-	6.60	-	0.80	-	0.80	-	0.80	-
(vi)	Mustard	5.90	-	-		-	0.10	-	0.10	-	0.10	-
(vii)	Barley	0.20	-	-	-	-	-	-		-		-
(viii)	Vegetables	0.10	2.00	2.00	0.10	-	0.20	-	0.20	-	0.20	-
(ix)	Pulses	1.00	-	-	5.60	-	8.40	-	8.40	-	8.40	-
(x)	Fodder	3.40	-	-	1.00	-	0.80	-	0.80	-	0.80	-
	Sub-total	**47.30**	**77.00**	**92.00**	**66.00**		**62.20**		**62.20**	**100.00**	**62.20**	**99.97**
	Perennial											
	Sugarcane	0.20	**3.00**	**0.20**	-	-	-	-	-	-	-	-
	Total	**100.00**	**150.00**	**150.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**125.00**	**100.00**	**140.00**

2.1 Cost

2.10.1 Cost of the project (Rs. Lakhs) (Unit wise)

2.10.2 Allocated cost (Rs. Lakhs)

		Unit-I	Unit-II	Unit-III	Unit-VI	Total
(a)	Irrigation	145634.30	75239.88	3116.10	1653.00	228293.79
(b)	Power	Nil	-	-	-	-
(c)	Flood control	Nil	-	-	-	-
(d)	Navigation	Nil	-	-	-	-
(e)	Water Supply	2650.51	-	-	-	-
(f)	Any other	-	-	-	-	-

2.11 Benefits/Revenue

			Quantity (Rs.lakhs)		Value (Rs.lakhs)	Revenue
(a)	Food Production (Tonne)	Nil	-	-	37144.93	-
(b)	Power (Mkwh)	Nil	-	-	-	-
(c)	Flood Protection (ha)	Nil	-	-	-	-
(d)	Navigation (Tonnage)	Nil	-	-	-	-
(e)	Water Supply (Population served)	Nil	1.65	-	15.60	-
(f)	Any other (fisheries)	Nil	3592 tones	-	5388.00	-
(g)	Tourism	Nil	-	-	-	-

2.12 Benefit cost ratio 1.56

1.13 Internal Rate of Return 14.87