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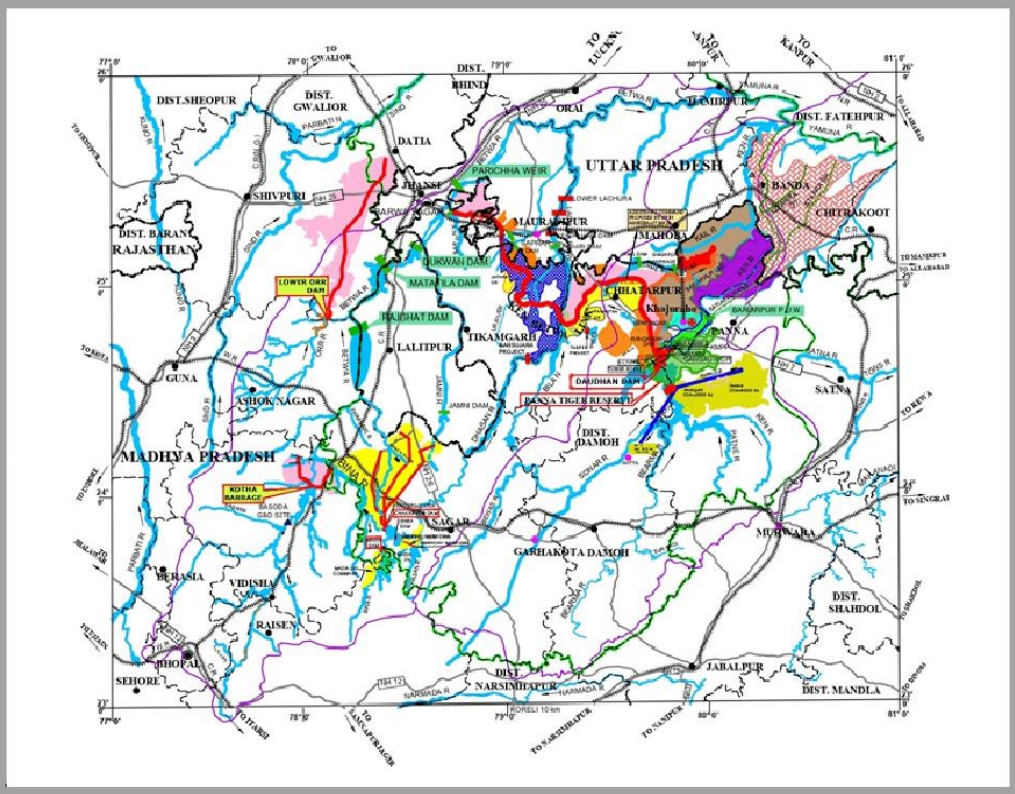
राष्ट्रीय जल विकास अभिकरण

(जल संसाधन, नदी विकास एवं गंगा संरक्षण मंत्रालय, भारत सरकार)

NATIONAL WATER DEVELOPMENT AGENCY

(Ministry of Water Resources, River Development and Ganga Rejuvenation, Govt. of India)



केन–बेतवा लिंक परियोजना का
व्यापक प्रतिवेदन

COMPREHENSIVE REPORT OF KEN-BETWA LINK PROJECT

खण्ड - I : प्रतिवेदन

VOLUME - I : REPORT

As Per MoA Signed on
22 March-2021

SALIENT FEATURES

SALIENT FEATURES OF DAUDHAN DAM

2.1 Name of the Project **Ken-Betwa Link Project**

2.2 Daudhan Dam

S. No.	Particulars			
I	**Location**			
1.	States	Madhya Pradesh		
2.	Districts	Chhatarpur/Panna (M.P.)		
3.	River	Ken		
4.	Accessibility	From/To	K-B Link Canal	Daudhan Dam
		Airport	Khajuraho& Gwalior	Khajuraho (40 Km)
		Rail Head	Khajuraho, Ranipur, Jhansi	Khajuraho (40 Km)
		Road Head	Bamitha on NH-76 (Chhatarpur-Panna); Mauranipur on NH-76 and Jhansi	Bamitha on NH-76 (Chhatarpur-Panna) (28 Km)
5.(a)	Latitude	$24^0$36'51"N		
(b)	Longitude	$79^0$50'30" E		
II	**Hydrology**			
1.	Catchment area at heads works in sqkm	Gross	19633	
		Intercepted (by Existing, ongoing & contemplated projects)	10194	
		Unintercepted	9439	
2.	Catchment area insqkm	Rainfed	19633	
		Snowfed	Nil	
3.	Rainfall in mm	Annual	Monsoon	
(a)	Maximum	1604	1555	
(b)	Minimum	560	503	
(c)	Average	1124	1054	

4.	Designed flood (PMF) in cumec		
(a)	Dam	57202	
(b)	Weir/Barrage	-	
(c)	Flood control work/construction diversion	1118	
5.	Gross annual yield in MCM		
(a)	Maximum	18304	
(b)	Minimum	3830	
(c)	Average	9289	
6.	Available yield in MCM at	Annual	Monsoon
(a)	75% dependability	6590	5955
(b)	50% dependability	8431	7799
III	**Reservoir Data**		
1.	Full reservoir levelin m	288	
2.	Submerged area at FRL in ha	9000	
3.	Culturable land in ha	2473	
4.	Irrigated land in ha	542	
5.	Free board in m	5.05	
6.	Wave height in m	4.13	
7.	Live storage in MCM	2683.74	
8.	Dead storage in MCM	169.27	
IV	**Capacity in MCM at**		
(a)	Maximum water level (288 m)	2853.01	
(b)	Full reservoir level (288 m)	2853.01	
(c)	Minimum draw down level (246 m)	344.75	
(d)	Dead storage level (240 m)	169.27	
V	**Sedimentation in MCM after**	**Year**	
		50	100
(a)	Above MDDL (246 m)	85.7	98.0
(b)	Below MDDL	120.4	263.7
(c)	Encroachment of live storage (percent)	4.4	9.58
VI	**Assumed Annual Evaporation Losses from the Reservoir**		
(a)	Quantum (MCM) Average	90.90	
(b)	Depth (m)	1.8352	

(c)	Submergence ratio (with reference to CCA)	0.0042
VII	MDDL in m	246
	Nos. of villages affected	10
	Population affected	8339
VIII	**Benefited Districts**	
	Madhya Pradesh	Chhatarpur, Tikamgarh & Panna
	Uttar Pradesh	Jhansi, Mahoba, Banda & Lalitpur
IX	**Head Works**	
	Dam	Earth and Rock fill dam
(a)	Type of dam	Earth dam (Homogenous zoned/ Rock-fill)
(b)	Length of dam at top in m	
	(i) Right flank	1233
	(ii) Left flank	-
(c)	Top width in m	8
(d)	Maximum height above G.L. in m	
	(i) Right flank	77
	(ii) Left flank	-
(e)	Type of cut off and maximum depthin m	18 Open trench type(Upstream blanket/open trench/diaphragm/grout curtain combination of alternatives)
X	**Masonry and Concrete Dam** (Non over flow section)	Daudhan dam left side
(a)	Type of dam (Masonry/Concrete/Composite/any	Concrete

	other	
(b)	El of top in m	293.00
(c)	El of deepest foundation in m	232.00
(d)	Length at top in m	262.00
(e)	Width at top in m	8.00
(f)	Width at deepest bed level in m	51.60
(g)	Maximum height above deepest foundation level in m	61.00
XI	**Spillway (Over Flow Section)**	
(a)	Type of spillway (Ogee/chute/side channel/tunnel/siphon/any other type)	Side Channel
(b)	Full reservoir level in m	288.00
(c)	Maximum water level in m	288.00
(d)	Length in m	536.00
(e)	Maximum height above the deepest foundation level in m	71.00
(f)	Crest level in m	270.00
(g)	Number of gates	27
(h)	Type of gates	Radial
(i)	Size of gate in m	16 x 18.5
(j)	Maximum discharging capacity (cumec) at FRL and MWL	57202
(k)	Flood lift in m	-
(l)	Tail water level in m	
	i) Maximum	241.00
	ii) Minimum	233.00
(m)	Type of energy dissipation	Ski-Jump bucket type

	arrangements	
XII	**River Sluice(s), Irrigation, Power Outlet(s)**	
a)	Purpose	Irrigation
b)	Number	2
c)	Size in m	1.6 x 2.4
d)	Sill level in m	237.2
e)	Discharging capacity (cumec) at Minimum draw down level	40.00
XIII	**Barrage**	No barrage proposed
XIV	**Guide Bunds/Afflux Bunds**	No guide bund is proposed in this project.
XV	**Weir**	No weir is proposed in this project.
XVI	**Head Regulator(s)**	No head regulator is proposed since the link canal has been proposed to draw water through Upper Level Tunnel.

2.2.1 Ken-Betwa Link

1.	Length of Main Canal	
	i) Open Canal	0 to 218 Km (218 km long)
2.	FSL at head in m	257.00
3.	Discharge	
	i) Discharge at head in cumec	159.9
	ii) Discharge at tail in cumec	41.43
4.	Bed width	13.2 m at head and 10 m at tail
5.	FSD in m	
	i) FSD at head	4.6
	ii) FSD at tail	3.0

6.	Bed slope RD 0 to 102 Km RD 102 to 171 Km RD 171 to 216 Km RD 216 to 218	 1:9000 1:10000 1:11300 1:12000
7.	Velocity at head	1.28 m/s
8.	Diameter of Upper Level Tunnel	8.5 m

2.2.2 Pressurised Micro Irrigation System

(a) For MP Portion

Sr. No.	Particulars	Unit	PH1	PH1	PH2	PH3	PH4	PH5	PH6	PH7
			Chhatarpur	Chhatarpur	Chhatarpur	Chhatarpur	Chhatarpur	Chhatarpur	Tikamgarh	Niwari
	RD (KM)		18	18	44.4	70.7	86.3	102.0	171.0	207.0
1	CCA	Ha	23678	20000	22730	29322	15823	20860	25112	25000
2	Duty	lit./sec/ha	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
3	Discharge	Cum ecs	9.47	8.00	9.09	11.73	6.33	8.34	10.04	10.00
4	CCA Level	M	300.00	345.00	270.00	270.00	255.00	280.00	290.00	240.00
5	Diameter	M	2.40	2.20	2.35	2.67	1.96	2.25	2.47	2.46
6	Velocity	M/S	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10
7	Length	km	5.00	25.00	2.00	2.00	2.00	2.00	2.00	2.00
8	Frictional Loss	M	4.84	26.75	1.98	1.70	2.46	2.09	1.87	1.87
9	Provision for exit gradient	M	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00
10	D.C LEVEL	M	349.84	416.75	316.98	316.70	302.46	327.09	336.87	286.87
11	BACK									
12	MDDL	M	252.00	252.00	245.80	244.70	243.04	241.03	232.75	223.50
13	Static Head	M	97.84	164.75	71.18	72.00	59.42	86.06	104.12	63.37
14	Designed Head	M	97.84	164.75	71.18	72.00	59.42	86.06	104.12	63.37
15	required power	KW	10873.71	15465.93	7594.49	9910.02	4413.10	8426.03	12272.51	7436.57
16	required power	MW	10.87	15.47	7.59	9.91	4.41	8.43	12.27	7.44
	Total CCA 182525 ha									
	Total Power Requirement in 76.39 MW									

(b) For UP Portion

S. No.	Particulars	Pumping station 2 (From RD 70.7 km of KBL)	Pumping station 3 (From RD 171 km of KBL)	Pumping station 4 (From RD 207 km of KBL)
		Mahoba& EnrouteCommand	KBL	KBL
1.	CCA (ha)	42214	5568	7270
2.	Duty (lit./sec/ha)	0.40	0.40	0.40
3.	Discharge (cumec)	16.89	2.23	2.91
4.	Max CCA level (m)	250	241	230
5.	MDDL (m)	245	233.6	225.8
6.	Velocity (m/sec)	1.8	1.8	1.8
7.	Diameter (m)	3.46	1.26	1.43
8.	Length (m)	7000	10000	9000
9.	Static head (m)	5.0	7.4	4.2
10.	Frictional loss (m)	3.34	13.15	10.36
11.	Command area loss (m)	9.60	18.00	9.60
12.	Provision for exit gradient and filter losses (m)	25.00	25.00	25.00
13.	Design head (m)	42.94	63.55	49.16
14.	Power requirement for highest command level (KW)	9315	1818	1836
	Total CCA 55,052 ha			
	Total Power Requirement 12970 KW			

2.2.3	**Ken LBC**	
1.	GCA in ha	200000
2.	CCA in ha	139848
3.	Duty in lit./sec/ha	0.41
4.	Discharge in cumec	57.34
5.	Max CCA level in m	210.00
6.	MDDL/level no power requirement in m	246.00/260.00
7.	Velocity in m/sec	1.8
8.	Diameter in m	3.19
9.	No. of rising main	2

10.	Length in m	90000
11.	Static head in m	-36.00
12.	Frictional loss in m	26.83
13.	Command area loss in m	18.00
14.	Provision for exit gradient and filter losses in m	5.00
15.	Design head in m	13.83
16.	Power requirement for highest command level in KW	9262
17.	**Total Power Requirement in MW**	**10.2**

2.2.4	**Design Features of Pumping Stations of Panna&Hatta Lift and Power Requirement**				
S. No.	**Particulars**	**KBL Saleha lift from Daudhan reservoir (Pannadistrict)**			
		Rising Main in Tunnel	Amanganj Hose Irrigation including 20101 ha on Hatta	Gunnore & Devendranagar MI	Water Supply for Panna
1.	CCA in ha	90101	45101	45000	0
2.	Duty in lit./sec/ha	0.41	0.43	0.39	
3.	Discharge in cumec	32.92	17.29	15.63	5.00
4.	Max CCA level in m	342.4135	325.00	350.00	400.00
5.	MDDL in m	246	337.58	337.77	325.00
6.	Velocity in m/sec	1.8	1.5	1.5	1.5
7.	Diameter in m	4.83	3.83	3.64	1.20
8.	Length in m	7000	18000	21000	40000
9.	Static head in m	96.4	-12.6	12.2	75.0
10.	Frictional loss in m	2.39	5.39	6.61	38.23
11.	Command area	0.00	21.60	25.20	0.00

	loss in m				
12.	Provision for exit gradient and filter losses in m	0.00	5.00	25.00	5.00
13.	Design head in m	98.81	19.41	69.04	118.23
14.	Power requirement for highest command level in KW	77835	3919	12605	6904
	Total Power Requirement 101.26 MW				

2.2.5	**Hydropower at Daudhan Dam**	
1.	**Head Race**	Tunnel for PH-II (Lower level tunnel)
(a)	Length in km	1.1
(b)	Shape	Modified horse shoe
(c)	Size in m	5.5
(d)	Thickness of lining in m	0.35
(e)	Designed discharge in cumec	65.19
(f)	Invert level in m at	
	(i) Inlet	244.60
	(ii) Outlet	243.20
(g)	Free flow/pressure in m	Free flow
2.	Balancing reservoir	No balancing reservoir is proposed.
3.	Forebay	No forebay is proposed.
4.	Surge tank/shaft	
(a)	Type	Restricted orifice type, Circular
(b)	Size (dia.) in m	18
(c)	Height above foundation level in m	60
(d)	Top level in m	305.00
(e)	Capacity in cumec	1000
(f)	Surge level in m	
	(i) Maximum	295.00
	(ii) Minimum	255.00

5.	Penstocks/pressure shafts	PH-I		PH-II	
(a)	Number	2		3	
(b)	Diameter in m	4.5		2.4	
(c)	Length in m	84.35		120	
(d)	Size of gate in m				
(e)	Bifurcations at lower end, if any				
(f)	Invert level in m	240.75		238.80	
6.	Power house				
(a)	Type (surface/underground)	Surface		Surface	
(b)	Head in m	Gross	Net	Gross	Net
	(i) Maximum	54.0	52.92	42.00	39.90
	(ii) Minimum	18.0	17.28	14.00	12.88
	(iii) Average	43.3	41.60	32.67	29.70
	(iv) Design	42.0	41.00	32.67	30.50
(c)	Dimensions in m	88.5 x 22		82.5 x 29	
(d)	Installed capacity in MW	60		18	
(e)	Turbine(s)				
	(i) Type	Vertical shaft, Kaplan		Vertical shaft, Kaplan	
	(ii) Number	2		3	
	(iii) Capacity in hp	30		6	
(f)	Type of generator	3 Phase, core or shell		3 Phase, core or shell	
(g)	Number of standby unit(s)	Nil		Nil	
7.	Tail Race	PH-I		PH-II	
(a)	Length in m	405		255	
(b)	Water level in m				
	(i) Maximum	234.000		246.000	
	(ii) Minimum	234.000		246.00	
(c)	Size of draft tube gates in m	5 x 4.4		5 x 4.0	

2.3.4 Command Area & Water Utilization from Ken-Betwa Link Project

		Area in ha						Utilization in MCM									
I. No.	**Canal system**	**CCA as per DPR (Original)**		**Annual irrigation as per DPR (Original)**		**CCA as per Comprehensive Project Report**		**Irrigation utilization**		**Domestic & Industrial requirement**		**Transmission losses**		**Total**		**Environ-mental flow**	**Grand Total (MP + UP)**
I	**Canal system under Daudhan dam**	**MP**	**UP**	**MP**	**UP**	**MP**	**UP**	**MP**	**UP**	**MP**	**UP**	**MP**	**UP**	**MP**	**UP**		
1	**K-B Link Main Canal**	46531	13763	46531	13763	138847	58585	701.782	327.68	60	66.77			**761.782**	**394.45**		**1156.232**
2	**High level Command by Pumping from Pumping House No. 1 at RD 18 Km.**					43678		220.765						**220.765**			**220.765**
3	**Ken LBC**	172853		233763		139848		706.842						**706.842**			**706.842**
4	**Bariarpur PUW Through Dam- (i) In Chhatarpur distt.**	46269	213610	58291	252017	38890	192479	224.015	1305.77					**224.015**	**1305.77**	493.6	**2023.385**
	(ii) Panna district	22184		31296													
5	**Lift From Daudhan Dam-Panna district**					70000		331.634						**331.634**			**331.634**
6	**Lift From Daudhan Dam- Damoh district**					20101		104.653						**104.653**			**104.653**
	Total under Daudhan dam	**287837**	**227373**	**369881**	**265780**	**451364**	**251064**	**2289.7**	**1633.45**	**60***	**66.77***		**-**	**2349.7**	**1700.22**	**493.6**	**4543.52**
	Total under Daudhan dam	**515210**		**635661**		**702428**		**3923.15**		**126.77**				**4049.92**		**493.6**	**4543.52**
II	**Bina Complex Project**					**96000**		324.95	Including Transmission losses	88.4**				413.35		6.51	419.86
III	**Kotha Barrage**					**20000**		80.69		7.5**				88.19		2.5	90.69
IV	**Lower Orr Project**					**90000**		285.77		6.0*				291.77		44.9	336.67
	Total					**206000**		**691.41**		**101.9**				**793.31**		**53.91**	**847.22**
	Grand Total	**515210**		**635661**		**908428**		**4614.56**						**4843.23**		**547.51**	**5390.74**

* Only Domestic Demand

** Domestic & Industrial Demand

2.3.5 Power Requirement of KBLP Micro Irrigation

S. No	Name of State	CCA (ha)	Power Requirement (MW)
1.	**Ken –Betwa Link Canal**		
(a)	MP (8 Lifts)	182525	76.39
(b)	UP (3 Lifts)	55052	12.97
	Sub Total	**2,37,577**	**89.36**
(c)	Ken left bank canal	139848	10.2
(d)	Panna&Hatta LIS	90101	101.26
	Total of Daudhan Dam Canal System	**467526**	**200.82**
2.	Lower Orr Project	90000	14
3.	Kotha Barrage	20000	5.39
4.	Bina Complex Multipurpose Project	96000	25.66
	Grand Total	**6,73,526**	**245.87**

Abstract Of Cost

Comprehensive Report of Ken- Betwa link Project

(Price level 2020-21)

(Rs. in Crore)

Sl. No.	***Component***	***Unit-I***	***Unit-II***	***Unit-III***	***Total***
		Head works	***Canals***	***Power***	
1	***Component as per DPR***				
I	***Daudhan dam and canals***				
i	*Daudhan dam*	*10899.65*	*-*	*-*	***10899.65***
ii	*Two new barrages of UP(Proposed Marauli and Pailani barrges near Banda)- subject to preparation of DPR of this part*	*2000.00*			***2000.00***
iii	*K-B link canal(Main)*	*-*	*10472.58*	*-*	***10472.58***
iv	*Ken LBC System*	*-*	*6734.79*	*-*	***6734.79***
v	*Panna and Hatta lift*	*-*	*5409.58*	*-*	***5409.58***
vi	*Repairing/Renovation of Ken Canal system of UP-subject to preparation of DPR of this*		*1000.00*		***1000.00***
vii	*Renovation of Mahoba tank with its connecting canal-subject to preparation of DPR of this part*		*500.00*		***500.00***
viii	*Power House-I*	*-*	*-*	*395.56*	***395.56***
ix	*Power House-II*	*-*	*-*	*146.59*	***146.59***
x	*Repairing /Strengthen of Barriyar PUW, Parichha weir,Barwa sagar etc (Lump sum provision)*	*220.00*	*-*	*-*	***220.00***
	Sub-total	***13119.65***	***24116.94***	***542.15***	***37778.75***

SALIENT FEATURES OF LOWER ORR PROJECT

SALIENT FEATURES					
1	Name of the project		Lower Orr Project		
	Type of project		Multipurpose		
	Location		Ashok Nagar, Shivpuri Madhya Pradesh		
2	River Basin		Betwa		
	Name		Orr		
	Located in State(s):		Madhya Pradesh		
	i)Countries (if international river)		NIL		
	River/Tributary		Orr		
			Tributaries - Makua, Reba		
3	State(s)/ District(s)/ Taluka(s) or Tehsils in which following are located		State	District	Tehsils
		(a)Reservoir	M.P	Ashok Nagar, Shivpuri	Chanderi/ khaniadhana
		(b)Headwork	M.P	Ashok Nagar, Shivpuri	Chanderi/ khaniadhana
		(c) Command Area	M.P	Shivpuri Datia	Khaniadhana, Pichhore Kakera, Narwar Datia
		(d)Power House	No Power House		
3.1	Name of Village near the Head-Works		Village: Didauni Tehsil: Khaniadhana		
3.2	Location of Head-Works				
		(a)Longitude	780 05’ 55”E		
		(b)Latitude	240 50’ 50”N		
		(c) Seismic	Zone II		
3.3	Access to the Project	Name	Distance		
	Airport	Gwalior, Bhopal	195 km 240 km		

	Rail Head	Lalitpur	60 km
	Road head (from Rajbagh)	Chanderi	22 km
4	International/Interstate aspects of the Project : NIL		
5	Catchment area of the basin		1843 sq. km
	Submergence due to projects	In M.P.	2723.70 ha (Whole in M.P.)
	Proposed annual utilization by the project	(i) Drinking water	6.00 MCM
		(ii)Environmental Flow	44.90 MCM
		(iii)Evaporation Loss	21.30 MCM

	Minimum agreed/proposed flow in the river for maintaining ecology			44.90 MCM.	
6	Estimated life of the project (years)			100 yrs.	
7	Irrigation	(Ha.)			
		Area under irrigation (break up)			
		(i) Kharif		Nil	
		(ii) Rabi		90000 hectare	
		(iii) Zaid		Nil	
		District(s) benefited		Shivpuri, Datiaof M.P.	
8	Water Supply	annual		6.00 MCM Drinking	
9	Data(averageof all stations in command area)				
				Maximum	Minimum
			(a) Air temp.(0C)	45	3.8
			(b) Seismic Zone	Zone– II	
			(c) Maximum probable flood	12704 Cumec(m /s)	
10	River flows (minimum observed)				
			(a)Water level (EI-m)	339.00 m	
			(b) Discharge(m3/s)	0.02 Cumecs (April, 1995	
			(c) Months of 'nil' flow. If any	May, June	

10.1	Reservoir				
10.2	Water levels (EI-m)				
			(a) Maximum Water Level (MWL)	380.40 m	
			(b) Full Reservoir Level (FRL)	380.00m	
			(c)Minimum Drawdown Level	360.50m	
			(d) Dead Storage Level	360.50m	
10.3	Outlet levels				
			(a) Irrigation	360m	
			(b) Power	No Hydro Power	
10.4	Other parameters				
			(a) Free board	2.94 m	
			(b) Live storage	328.17 MCM	
			(c) Gross storage	371.80 MCM	
10.5	Sedimentation rate and levels				
			(a) Rate	0.33 mm/Year	
			(b) New zero elevation after 50yrs.	351.80m	
			(c) New zero elevation after 100yrs.	353.53m	
11	Submergence				
11.1	Land and property submerged at MWL				
		(a) Revenue villages affected (no.)		Submergence	Canal System
			(i) Fully	7	
			(ii) Partially	5	
		(b) Land affected (ha)			
			(i) Gross	2723.70	
			(ii)Culturable	853.00	
			(iii Un-Culturable	576.18	
			(iv)Forest	968.24	

			(v) Others	State Land:326.00 ha	Pvt agri land=240.2 ha State revenue land=23.52 ha, Forest land=23.52 ha
		(c)Buildings/houses(No.)			
			(i) Houses	869	
			(ii) Govt.		
			(iii)Temples		
			(iv) Mosques		
			(v)Govt/Pvt schools		
			(vi) Cattle Shed		
			(vii) Structure of cultural		
			(viii) Lift Irrigation		
		(d)Tube Wells/Bore Wells (No.)		93/257	
		(e) Road(km) under submergence			
		(f)Transmission lines (km.) under submergence		NA	
11.2	Total Population under Submergence				
				Families	
		(a) Total		944	
		(b) Scheduled Castes		Not Available	
		(c) Scheduled Tribes		Not Available	
11.3	Population effected under Main Canals and under distributaries				
12	Head works				
12.1	Dam (Non-overflow section)				
		(a) Type of dam	Composite earthen and concrete dam		
		(b) EL of top(m)		384.00m	
		(c) Length of Over Flow section		247.00 m	
		(d) Length at the river bed(m)		180.00m	
		(e)Width at top(m)		8.00 m	

12.2	Spillway(overflow section)			
		(a) Location of spillway		Provided within the body of dam
		(b) Type of Spillway		Ogee
		(e) Max height above the deepest foundation(m)		45.00 m
		(f) Crest level (EL-m)		370m
		(g) Number of gates		12
		(h) Type of gate		Radial
			(i) Size of gate	15m(W)x10m(H)
			(ii) FRL	380.00 m
			(i) MWL	380.40 m
		(j) Tail water level (EL)		
			(i) Maximum	-
			(ii) Minimum	-
		(k)Type of energy dissipation arrangement		Stilling basin
12.3	U/S Coffer Dam			
		(a) Height of U/S coffer dam		-
		(b) EL of top		-
12.4	D/S Coffer Dam			
		(a) Height of D/S coffer dam		-
		(b) EL of top		-

12.5	Head Regulator(s)	Left side	Right side
	(a) Total length	104.95	Not provided
	(b) Height above deepest	40.50m	

	(c) Length of bay(m)	5.00m	
	(d) Sill level (EL-m)	360m	
	(e) Number of gates	2	
	(f)Type of gates	Vertical type	
	(g) Size of gate	2.5x 4.0 m	
	(h) Type of hoisting arrangement	Rope & Drum	
13	Canal System		
	14.1 Main canal	Left bank canal	
		14.1.1Purpose of canal	Irrigation & water supply
		14.1.2 Type of canal	Carrier contour
		(a) Flow/lift	Both
		(b) Lined/unlined	Lined
		(d) Type of lining	100mm thick M15 PCC (0 to 3.1 km)
			75mm thick M15 PCC (3.1 to 50.00 km)
	14.2Design data	Left Bank Canal	
	(a) Length (km)	66.67 km	
	(b) Full supply level at head	361.80 m	
	(c) Full supply depth at head	3.80 m	
	(d) Side slope(EL- m)	1.5:1	
	(e) Bottom width of canal upto spill channel	4.35 m	
	(f) Maximum discharging	NA	
	(i) At head	34.00 (0 to 3km) cumec	
	(ii) At tail	20.00 (3 to 66.67 km)cumec	

14.	Cropping Pattern	Name of crop (season- wise)	Area (ha)
	(i) Rabi Season	(a) Wheat (HYV)	39105
		(b) Wheat (ORD)	31995
		(c) Gram N2	7101
		(d) Gram N1 (Peas)	9999
		(e) Other Vegetables	1800
15.	Power	Type	Solar Power
		Installed capacity (MW)	19 MW about 36 ha over submergence Area in the reservoir
16	Total Project Cost (Rs in Crore)	2864.76	
17	BC Ratio	1.43	
	IRR	11.15%	

SALIENT FEATURES OF KOTHA BARRAGE PROJECT

S. No.	Particulars	
I	**Location**	
1.	State	Madhya Pradesh
2.	District	Sagar
3.	River	Betwa
4.	Accessibility	Kotha dam site is situated near village Kotha30 km from Kurwaidistt. Vidisha
5.	Toposheet	54L/4
6.	Latitude	$24^0$03'28" N
7.	Longitude	$78^0$01'16" E
8.	Nearest railway station	Mandi, Bamora/Kurwai
9.	Nearest airport	Bhopal
II	**Hydrology**	
1.	Catchment area in sqkm	8711
2.	Maximum annual rainfallin mm	1645.8
3.	Minimum annual rainfallin mm	779.4
4.	Average annual rainfall in mm	1170.60
5.	Designed flood (PMF) cumec	16457
6.	75% dependable yieldin MCM	1593.99
7.	50% dependable yieldin MCM	2016.10
III	**Reservoir Data**	
1.	Gross storage in MCM	63.51
2.	Live storage in MCM	63.22
3.	Dead storage in MCM	0.29
4.	Gross area of submergence at FRL in ha	1359
	Private land in ha	681
	Revenue land in ha	678
	Forest land in ha	0.0
IV	**Barrage Data**	
1.	Type of barrage	Concrete
2.	Total length of barrage in m	576
3.	Height of barrage in m	16.50
4.	Number of openings	32
5.	Size of gates in m	15.00 x 11.50
6.	Crest level in m	384.50

7.	Thickness of pier in m	3
8.	Top of bund level in m	398.00
9.	Full Reservoir Level in m	395.00
V	**Canals**	
1.	Length of rising main (Left) in km	11.50
2.	Length of rising main (Right) in km	8.50
3.	Dia. of rising main (Left) in m	1.60
4.	Dia. of rising main (Right) in m	1.60
5.	Lift (Left) in m	31
6.	Lift (Right) in m	26
VI	**Irrigation**	
1.	GCA (Left) in ha	15380
2.	GCA (Right) in ha	15380
	Total GCA in ha	30760
3.	CCA (Left) in ha	10000
4.	CCA (Right) in ha	10000
	Total CCA in ha	**20000**
5.	Annual Irrigation	
	(a)Kharif in ha	5500
	(b) Rabi in ha	20000
	(c) perennial	Nil
	Total Annual irrigation in ha	25500
10.	Benefited districts	Vidisha and very small area of Sagar
11.	Solar Power Generation	8 MW
12.	Power Requirement	

SALIENT FEATURES OF BINA COMPLEX

S. No.	Particulars	Madia	Semra Ghat Feeder	Dehra	Chakarpur
I	**Location**				
1.	State	MADHYA PRADESH			
2.	District	SAGAR			
3.	River	Bina	Dhasan	Dehra Nalla	Bina
4.	Accessibility	42 km from sagar on sagar Bhopal Road	36 km from sagar on sagarRahatgarh Road	36 km from sagar on sagarRahatgarh Road	50 km from sagar on sagar Vidisha Road
5.	Latitude	$23^0$45'11"	$23^0$46'17"	$23^0$48'11"	$23^0$50'27"
6.	Longitude	$78^0$23'24"	$78^0$32'43"	$78^0$26'37"	$78^0$23'16"
II	**Hydrology**				
1.	Catchment area sqkm.	1109.84	314.00	62.90	187.80
2.	Maximum annual rainfall (mm)	1640.7 mm	1245.7 mm	-	1840.30 mm
3.	Minimum annual rainfall (mm)	767.20 mm	814.4 mm	-	590.20 mm
4.	Average annual rainfall (mm)	1170.60 mm	1223.50 mm	1201.68	1201.68 mm
5.	Designed flood (PMF) cumec.	6647.00	2310	932	8241
6.	Gross yield (MCM)	294.04	89.30	17.10	51.00
7.	Available run off at site (MCM)				
8.	75% dependable annual	294.04	89.30	17.10	51.00
9.	Reserve for U/S (MCM)	24.00	Nil	Nil	Nil
10.	Reserve for D/S (MCM)	6.00	Nil	Nil	Nil
III	**Reservoir Data**				
1.	Maximum water level, m	500.65	499.8	492	453.00
2.	Full reservoir level, m	500.55	499.7	491.60	451.50
3.	Submerged area, ha.	6435.60	575.00	754.60	1349.50

I	Private land, ha.	5624.17	525.00	335.96	910
II	Other lands, ha.	680.45	50.00	40	68.01
III	Forest land, m	130.98	nil	378.64	462.52
IV	Other Land				
i	Power House ha	15.00		1.00	
ii	Canal ha				105
iii	Road Diversion ha			26.30	
iv	Pipe canal ha				
v	Feeder Channel Semra Ghat Feeder to Dehra ha		39		
4.	Dead storage level, m	487.62	495	465.35	435.75
5.	River bed level m	481	490.48	459.00	427
6.	Top of bund level m	504.55	501.80	494.00	456
7.	Height of dam m	23.55	11.32	35.00	25.00
8.	Gross storage (MCM)	270.10	6.46	72.36	74.31
9.	Live storage (MCM)	267.67	6.00	72.35	73.84
10.	Dead storage (MCM)	2.429	0.46	0.01	0.47
11.	Length of main dam m	2070	1440	3509	751.68
12.	Saddles, Nos.	1 (6.71m high)	Nil	2 (5m high)	2 (8m &3m high)
13.	Total length of saddles, m	1500m	Nil	(30m & 2148m)	(131.884m & 516.65m)
14.	MDD Level, m	492.50	-	484	439.5
15.	Feeder channel Semra Ghat Feeder to Dehra km.		8.0 Km with average depth of cutting 10 m		

V	**Irrigation**				
1.	Design irrigation	96,000 Ha. (Kharif Nil Ha , Rabi 90,000 Ha.& Basin Lift 6000 Ha)			
2.	CCA, Ha.	96,000 Ha			
VI	Drinking purposes (MCM)	19.20			
VII	Industrial Use (MCM)	25.00			
VIII	Total Village affected (84 no.)	59	8	6	11

IX	Total Benefited Village	296 no.
	Khurai Tehsil Malthone Tehsil Bina Tehsil	167 no. 107 no. 22 no.
X	**Hydropower**	
1.	Hydro Power component	Yes
2.	Hydro power generation	

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

1.0 General

Ken-Betwa Link is one of the 16 links under Peninsular Component of National Perspective Plan (NPP) for Water Resources Development under Interlinking of Rivers (ILR) Programme. Consensus was arrived among concerned States of MP & UP and Union Government and a tripartite Memorandum of Understanding (MoU) was signed by MP, UP and the Union Government on 25th August 2005 for preparation of Detailed Project Report (DPR) of Ken-Betwa Link Project (KBLP).

The DPR of KBLP was completed by NWDA in December, 2008 and the report was sent to Govts. of MP & UP for their comments/views. Further, for finalisation of DPR and future strategy for implementation of KBLP, a meeting was convened by Secretary, Ministry of Water Resources with Principal Secretaries of Govt. of MP & UP on 3rd February, 2010 and it was decided that in view to expedite the implementation of project; the same may be taken up in two phases. Subsequently, NWDA completed the DPR of KBLP, Phase-I in April, 2010 after incorporating the inputs as received from Govts. of MP & UP and circulated to the concerned State Governments. DPR of Phase-I comprises of Daudhan dam, two power houses, link canal and other components.

Further, during the meeting held under the Chairmanship of Secretary (WR) with the representatives of Govts. of MP & UP on 4th August, 2010 at New Delhi, it was decided that surveys and investigations (S&I) works of proposed projects in Betwa Basin including Lower Orr dam and preparation of DPR of KBLP Phase-II will be taken up by NWDA. The DPR of Phase II comprising Lower Orr Dam and other barrages as proposed by Govt. of MP was completed in January, 2014.

Thereafter, from time to time discussions were held between Govt. of MP, Govt. of UP and NWDA to finalize DPR of KBLP of Phase-I and Phase-II. Subsequently, as per the suggestions of Govt. of MP, the projects under KBLP, Phase-II have been finalised as Lower Orr, Kotha Barrage and Bina Complex.

A meeting regarding the implementation of KBLP was convened by Hon'ble Minister (WR,RD&GR) on 18th November, 2016 with the officials of MoWR,RD&GR, NWDA and Govt. of MP and it was decided that:

(i) DPR of Kotha Barrage is to be revised by WRD, Govt. of MP and handed over to NWDA.

(ii) DPR of Bina Complex prepared by Govt. of MP is to be included in Phase-II.

(iii) DPR of Lower Orr Dam prepared by NWDA will be submitted separately.

(iv) Moreover, it was also decided that entire DPR of KBLP, Phase-II comprising of above projects is to be completed and submitted by NWDA to CWC for techno-economic appraisal.

A review meeting was convened by Hon'ble Minister (WR, RD&GR) on 25th September, 2017 with Hon'ble Chief Ministers of MP and UP regarding the implementation of KBLP. In connection to this, Hon'ble Chief Minister, Govt. of MP vide D.O. letter dated 11th October, 2017 raised certain issues viz. implementation of both phases concurrently, enhancement of CCA from 3.57 lakh ha to 4.47 lakh ha and preparation of comprehensive DPR i.e. combined DPR of Phase-I & Phase-II. Chief Secretary, Govt. of UP vide D.O. letter dated 10th October also raised certain issues viz. cost of repair/strengthening of Bariyarpur Pickup Weir, Parichha Weir and Barwa Sagar Dam etc. should also be included in DPR. Consequently, NWDA has revised components of project and planning of KBLP and prepared Comprehensive Report of KBLP consisting of Daudhan Dam, Lower Orr Dam, Bina Complex Multipurpose Project, Kotha Barrage, the additional CCA, repair/strengthening of Bariyarpur Pickup Weir, Parichha Weir and Barwa Sagar Dam etc.

2.0 Comprehensive Report of KBLP as a Whole

The KBLP is a multi-purpose project with irrigation, hydropower and water supply benefits. The project envisages to provide enormous benefits to the water starved Bundelkhand region of MP and UP as well as to the Vidisha, Sagar, Shivpuri, Datia and Raisen districts of MP. Thus, the project will provide an annual irrigation of 9.08 lakh ha utilizing about 4843 MCM of water including drinking water supply and also generate 103 MW of hydropower and 27 MW solar power. A part of the power generation will be utilized to develop micro irrigation in the project.

3.0 Aim & Objective of the Project and Description of Works

KBLP envisaged transfer of surplus water from Ken basin to Betwa basin to provide water to water short areas of Betwa basin by substitution, keeping the needs of the in-basin requirements of Ken basin involving both the States of UP and MP in view and ensuring equity, optimization of water use and cost effectiveness. After detailed survey, investigation and optimization study, Lower Orr Dam, Kotha Barrage and Bina Complex projects were finally included to meet the water requirement of water short area of Betwa basin within allocated water to Madhya Pradesh at Rajghat dam i.e. 53 TMC (1510.5 MCM) + 50.93 MCM of water is proposed to be transferred from Ken basin to Betwa basin for utilization of water for irrigation/domestic purposes in Laltipur district of UP on substitution basis.

KBLP mainly envisages to provide irrigation and domestic water supply facilities to drought prone areas namely Chhatarpur, Tikamgarh, Panna, Damoh, Vidisha, Sagar, Shivpuri, Datia & Raisen districts of MP and Mahoba, Banda, Jhansi & Lalitpur districts of UP.

4.0 Planning and Layout

(A) Daudhan Dam

Daudhan Dam proposed across Ken river is 2031 m long, out of which 1233 m length of dam will be earthen and rest 798 m length of dam will be of concrete. The concrete portion of dam alongwith spillway has been proposed on the left flank of the dam. A penstock is proposed in left concrete portion of dam for taking water to Power House-I (PH-I) located at the toe of the dam. Tail race channel off-taking from PH-I will join Ken river again in d/s of the dam on left bank.

For providing irrigation water to enroute command of link canal, an Upper Level Tunnel (1.929 km long) with invert level and crown level of 256.0 m and 262.0 m respectively at the mouth of Daudhan Dam has been proposed. Diameter of the proposed tunnel is 8.5 m whereas slope of the tunnel is 1:800. However, cost of the tunnel taken for increased discharge is on proportionate basis. This tunnel takes off from the left bank of Ken river in upstream of Daudhan Dam. Invert level of Upper Level Tunnel at the exit

point is 253.601 m. After provision of energy dissipation device at the exit of tunnel, the link canal will take off with FSL of 257.0m and full supply depth of 4.6 m.

From the left bank of Ken river in upstream of Daudhan Dam but in the downstream of Upper Level Tunnel, another tunnel i.e. Lower Level Tunnel of 5.5 m dia. takes off. Invert level and crown level of Lower Level Tunnel at its inlet are 244.6 m and 250.1 m respectively. Power House-II (PH-II) having installed capacity of 18 MW is proposed at its outlet. After generation of power, water will be taken through canal to provide irrigation water for Ken command in MP as proposed in KMPP. The rest of Ken command area will be provided irrigation through canal taking off from Bariyarpur headworks. Provision of bye pass channel has also been made for supplying water to the canal directly from tunnel in case Powerhouse-II does not run. However, to take care of similar situation in Power house-I, sluices have been provided in the dam.

(B) Lower Orr Project

In the proposed composite dam, the concrete dam portion is 487.00 m long with 247 m long spillway in the left bank and 240 m long Non Overflow blocks. The earthen dam proposed is 1731 m long with a maximum height of 36.00 m.

(C) Kotha Barrage

The latitude and longitude of the barrage site are $24^0$3’28" N and $78^0$01'16" E respectively. The proposed barrage site is about 8 km from Kurwai which is the nearest town and the nearest railway station. Bhopal is the nearest airport, which is about 115 km from the site.

Left bank piped canal having a length of 11.50 km taken up to river Keotan and whole command served by laying Telescopic Pressurized Irrigation System at average CCA level of 415.00 m. The single stage lift of 31 m has been proposed to serve the irrigation in Vidisha district of Madhya Pradesh. The capacity of canal is designed for 3.50 cumec. The GCA and CCA of left bank canal is 15,380 ha and 10,000 ha respectively.

Right bank piped canal having a length of 8.50 km and capacity of 3.50 cumec taken up to river Bina. Single stage lift of 26 m has been proposed to

serve the irrigation in Vidisha and Sagar districts of Madhya Pradesh. The GCA and CCA of right bank canal is 15,380 ha and 10,000 ha respectively. The command area after confluence of Bina to Betwa is already included in Bina complex project.

(D) Bina Complex Multipurpose Project

The project is located in Sagar district, partly in Raisen District. The Bina and Dhasan rivers are tributaries of river Betwa. It is also proposed to construct 11.32 m high Semra Ghat Diversion Dam on Dhasan river, 35 m high Dehra Dam on Dehra Nalla and 23.55 m high Madia Dam on Bina river. Water stored in Semra Ghat Diversion Dam would be diverted to Dehra Dam. All water from Madia Dam and Dehra Dam would flow in Bina River and arrested by 25 m high Chakarpur Dam to irrigate 90,000 ha of CCA in villages located in Khurai, Malthone and Bina tehsils of Sagar district. Besides, 6000 ha area is proposed to be irrigated by local people through pumping from reservoir.

5.0 Surveys & Investigations

The DPR contains the details of surveys and investigations such as topographical surveys, geotechnical and construction material surveys, geological investigations, environmental impact assessment studies etc.

6.0 Hydrology and Water Assessment

(A) Daudhan Dam

The total 75% dependable yield of Ken River at proposed Daudhan Dam site has been assessed as 6590 MCM. The total upstream requirement of water for existing, ongoing and proposed projects is 2266 MCM. The total downstream water requirement below proposed dam site is 2236.63 MCM. Downstream environmental and ecological requirement to maintain river ecology is 493.60 MCM. The requirement of 436.287 MCM water of Panna & Hatta LIS in right bank is proposed to be fed directly through pumping from Daudhan reservoir for irrigating an area of 90,101 ha in Panna district of MP.

Thus, surplus water of 1377 MCM is proposed to be diverted into the main link canal. Out of which 220.77 MCM will be utilized at a pumping station at RD 18 Km to serve 43,678 ha of command located at high

elevation. This area entirely lies in Chhatarpur district of MP. Again, 1010.51 MCM of water will be utilized to irrigate an enroute command area of 1,93,899 ha (1,38,847 MP + 55,052 UP) in Chhatarpur, Tikamgarh districts of MP and Mahoba & Jhansi districts of UP including transmission losses. Further, 94.79 MCM of water will be proposed for drinking purpose in the enroute. And remaining 50.93 MCM of water is released to Betwa River through link canal in the upstream of Parichha Weir.

The 50.93 MCM of water which was released in river Betwa upstream of Parichha Weir will be utilized in Lalitpur district of UP. Out of which 31.98 MCM of water will be provided for drinking purpose and 18.95 MCM of water will be utilized to irrigate an area of 3533 ha.

Out of 2236.63 MCM of water proposed to be released downstream of Daudhan Dam, 930.86 MCM will be utilized to irrigate an area of 1,78,738 ha under Ken Command in Chhatarpur district of MP and remaining 1305.77 MCM of water will be utilized for stabilization of 1,92,479 ha area in Ken Command located in Banda district of UP..

Thus, total area of 7,02,428 ha (CCA) is proposed to be brought under irrigation through Daudhan Dam in MP and UP. Intensity of irrigation in MP is 134% and in UP is 100 %. Thus the annual irrigation from the Daudhan Dam is 8,55,892 ha.

(B) Lower Orr Project

NIH, Roorkee has carried out hydrological and water balance studies for assessment of diversion flood and design flood, sedimentation analysis, multi reservoir simulation studies and hydrodynamic modeling and related studies considering 10 structures. Accordingly, NIH divided the catchment of Betwa basin in ten sub catchments SB-1 to SB-10. Catchment of Lower Orr dam is designated as S-10 in the NIH study. The 75% and 50% dependable annual yield of the sub-basin upto the proposed dam site has been assessed as 362.53 MCM and 501.15 MCM respectively. Live storage capacity of Lower Orr dam is 328.17 MCM. Govt. of MP supplied their demand in two cases (1) as per modified Panmen method (2) as per practice in MP. Which are 238.73 and 285.77 respectively. Besides above, 6 MCM for drinking water supply and 44.9 MCM for environmental releases and 21.30 MCM evaporation losses from reservoir. Thus, total demand in above two cases is 310.92 MCM and 357.96 MCM respectively.

Accordingly, in above two cases the non-monsoon demand is 255.61 and 302.65 respectively, which are less than 328.17 MCM live storage capacity. Therefore, the demand of Lower Orr can be easily met.

(C) Kotha Barrage

The master plan of Betwa indicates an expected yield of about 1794.36 MCM up to the proposed Kotha Barrage site on the basis of studies carried out during framing of master plan of river Betwa in the year 1972 which also form basis of interstate agreement between MP and UP for upper Betwa basin. Whereas, the expected yield (virgin) at this site at 75% dependability on the basis of current data has been worked out as 1593.99 MCM.

(D) Bina Complex Multipurpose Project

Net dependable yield of about 418.50 MCM is available from all four sub catchments and is proposed to be utilized ex-chakarpur under the Bina Complex Irrigation Project of about 60 MCM will be contributed by the proposed diversion of Dhasan river through Dehra. Environmental water releases are assumed as 6 MCM of the gross dependable yields of respective catchments. It is anticipated that up to about 20% of net yield allocated for the project will be lost though evaporation and seepage at the four reservoir sites leaving only about 334.80 MCM for diversion for irrigation and domestic and industrial water demands of ex-chakarpur. Yield at different diversion sites under Bina Complex is given below:

Units MCM

S. No.	Sub-Catchment	Mean Annual Runoff	Contribution to 75% Dependable Yield	U/s Reserve	Minimum d/s Releases	Net Yield
1.	Bina upto Madia Dam	446.9	294.10	24.00	6.00	264.10
2.	Dehra up to Dehra Dam	38.50	17.10	Nil	Nil	17.1
3.	Chakarpur Free catchment	115.30	51	Nil	Nil	51
	Sub Total Bina River up to Chakarpur	**600.70**	**362.2**	Nil	Nil	**332.20**

4.	Semra Ghat Feeder upto storage cum diversion site at Dehra Dam	105.00	86.30	Nil	Nil	86.30
	Total from four catchments	**705.70**	**448.50**	**24.00**	**6.00**	**418.50**

7.0 Flood Control & Drainage

No flood cushion has been provided in any of the reservoirs in this project. However, storage of water in Daudhan Reservoir & Lower Orr Reservoir and its regulated releases in downstream will provide incidental benefit of flood moderation in downstream area of Ken & Betwa rivers. Since topography of area is having mild slopes, drainage problem is not expected. Since, Rajghat Dam is located in the downstream of Bina Complex Projects and Kotha Barrage. Therefore, no much impact on flood modernization may be seen.

8.0 Reservoir & Power

(A) Daudhan Dam

The gross storage capacity of Daudhan Dam at FRL/MWL 288.0 m is 2853 MCM, dead storage capacity at RL 240 m is 169.27 MCM. Thus, live storage capacity works out as 2683.74 MCM. After 50 years and 100 years of sedimentation, the revised live storage capacity will be calculated as 2644.48 MCM and 2491.65 MCM respectively.

Two power houses viz. PH-I & PH-II with installed capacities of 60 MW (2 x 30 MW) & 18 MW (3 x 6 MW) respectively have been proposed at Daudhan Dam. The average annual generation of power from PH-I & II has been estimated to be 219.03 Million Units. 76.39 MW and 12.97 MW installed capacity is required to develop pressurised micro irrigation system in the enroute command of MP and UP respectably including direct pumping from Daudhan reservoir for irrigating high level command of MP. Besides above, 10.2 MW installed capacity is required to develop micro irrigation system under Ken LBC command and 101.26 MW installed capacity for Panna and Hatta LIS (Lift Irrigation Scheme).

(B) Lower Orr Project

The gross storage capacity of the reservoir at FRL 380.0 m is worked out to be 371.802 MCM with corresponding submergence area of 2723.70 ha at FRL. There is no power house proposed on the Lower Orr dam. About 14 MW power is required for developing pressurized irrigation in the canal system from Lower Orr Dam. A provision of 19 MW solar power generation is kept under this project.

(C) Kotha Barrage

The pond level of the barrage is proposed to be kept as 395.00 m to restrict the submergence area to 1359 ha only and to allow passing of design flood without any considerable afflux. The total water storage capacity at pond level works out to 63.51 MCM excluding recharge of about 20.736 MCM (considered @ 5% of total u/s use). Being a medium height barrage, no power generation is possible from the project. However, considering the requirement of power for Telescopic Pressurized Irrigation System, it is proposed to install solar power panels in the project area for generating about 8.00 MW power. Out of which, about 5.39 MW is required for developing pressurised irrigation in Kotha Barrage and the surplus power i.e. 2.61 MW can be diverted to National Power Grid as a clean green energy. However, this is an opinion in project planning and is to be finalized during next stages of execution.

(D) Bina Complex Multipurpose Project

S. No.	Controlling Levels	Chakarpur Dam	Madia Dam	Semra Ghat DiversionDam	Dehra Dam
1	Top of dam in m	455.00	505.50	501.80	494.00
2	FRL in m	451.50	501.10	499.70	491.60
3	MWL in m	453.00	501.20	499.80	492.00
4	MDDL in m	439.50	492.50	-	484.00
5	Dead Storage Level in m	435.75	467.62	495.00	465.35
6	Lowest bed level in m	430.00	481.00	490.480	459.00
7	Gross Storage Capacity in MCM	74.31	270.10	6.46	72.36

8	Live Storage Capacity in MCM	73.84	267.67	6.00	72.35
9	Dead storage capacity in MCM	0.47	2.43	0.46	0.01
10	Free board in m	3.50	2.00	2.00	2.40
11	submergence area at FRL in ha	1349.50	6435.60	575.00	754.60

Two power houses with installed capacities of 2x10 MW and 1x5 MW respectively at Madia and Dehra Dams have been proposed in Bina Complex Multipurpose Project. About 25.66 MW power will be required for lift irrigation in Bina and Malthone area.

9.0 Irrigation & Command Area Development

(A) Daudhan Dam

Out of the total divertible quantity of 1377 MCM in link canal, 1231.28 MCM of water i.e. 701.78 MCM for MP and 308.73 MCM for UP including transmission loses will be utilized for enroute irrigation of 2,37,577 ha by micro irrigation system in Tikamgarh & Chhatarpur districts of MP and Mahoba & Jhansi of UP with 134% & 100% intensity of irrigation in MP & UP respectively. After taking into account the requirement of enroute water supply needs of 94.79 MCM the balance 50.93 MCM of water will be delivered in Betwa River, upstream of Parichha Weir. Out of this 50.93 MCM, 18.95 MCM of water by way of substitution will be utilized for irrigation (i.e.3533 ha CCA) and remaining 31.98 MCM for domestic uses in Lalitpur district of UP through Rajghat dam by feeding Govind Sagar Dam in Upper Betwa sub-basin. The Govt. of MP will plan new projects for utilisation of remaining water. The CCA of existing Ken river system under Bariyarpur Pick up Weir is 1,92,479 ha by micro irrigation system. This Ken command will get stabilized to an extent of 1305.77 MCM after implementation of the project. It is proposed to provide 224.02 MCM of water to MP for irrigation in Ken command through Bariarpur Pick up Weir across Ken river, located d/s of Daudhan Dam. This will irrigate an area of 38,890 ha. Similarly, 706.84 MCM of water will be provided for irrigation of 1,39,848 ha in MP through left bank canal by micro irrigation system (taking off from the tail end of lower level tunnel), u/s of Daudhan Dam. Besides, Govt. of MP also proposed, a Lift Irrigation Scheme (LIS) direct from Daudhan Reservoir to irrigate about 90,101 ha area of Panna and Hatta

utilizing 436.29 MCM water. About 43,678 ha high level command area is also proposed in Chhatarpur district by Pumping from Pumping House No. 1 at RD 18 Km utilizing 220.77 MCM of water. The details of CCA, irrigation intensity, annual irrigation and utilization under the project are furnished below:

S. No.	**Name of command**	**CCA**	**Irrigation Intensity**	**Annual Irrigation**	**Annual Utilization**
		ha	%	ha	MCM
1.	Ken Command (Ken LBC)	139848	134	187396	706.84
2.	Enroute Command (MP) including transmission loses	138847	134	186055	701.78
3.	Enroute command (UP) including transmission loses	55052	100	55052	308.73
4.	High level Command by Pumping from Pumping House No. 1 at RD 18 Km.	43678	134	58529	220.77
5.	Panna & Hatta LIS	90101	134	120735	436.29
6.	UP Command (Existing)	192479	100	192479	1305.77
7.	Ken Command MP	38890	134	52113	224.02
	Total CCA water requirement of MP				2289.70
	Total CCA water requirement of UP				1614.50
	Total CCA water requirement MP & UP				3904.20
	Domestic use MP & UP enroute & Ken-Betwa Link command				94.79
	Transfer of Water	3533			50.93
	Environmental Releases				493.6
	Total use from Reservoir				4543.52

(B) Lower Orr Project

A 50 km long carrier canal has been proposed on the left bank of river offtake from Lower Orr Dam after 50 Km through gravity pipeline. The project will provide annual irrigation to 90,000 ha area in Shivpuri and Datia districts of MP. Besides, 6 MCM water will be reserved for drinking water to

the enroute villages and towns in the vicinity of the canal. About 1.65 lakh people will get drinking water at a consumption rate of 100 lpcd. The FRL of the Lower Orr Dam is kept as 380 m. The submergence area at FRL is 2723.70 ha.

(C) Kotha Barrage

By providing micro irrigation between to 0.60 ha to 1.20 ha in 10,000 ha of left flank and 10,000 ha on right flank by lifting the water and providing water in a pressurised irrigation network through booster pumping. Annual irrigation in Kotha Barrage is planned for 25,500 ha.

(D) Bina Complex Multipurpose Project

Total CCA of this project comes to 96,000 ha in Khurai, Malthone and Bina tehsil of Sagar district. 57 MCM water is kept for drinking purpose and 31.40 MCM water is kept for industrial use. 25 MW of hydro power is also proposed to be generated through this project. Besides, 6000 ha irrigation by local farmers by direct lift from reservoir.

10.0 Navigation & Tourism

Full supply depth of Ken-Betwa link canal is 4.6 m whereas its bottom width is 13.2 m in head reaches. The section goes on reducing in lower reaches. Keeping in view, the availability of water in the link canal as well as numerous major CD structures, it may not be feasible to utilize it for navigation purpose. Hence, no provision for development of navigation aspect has been kept in this project.

As far as the development of tourism is concerned, this project has got full potential, particularly, because of close proximity of Daudhan dam with Khajuraho and that of tail end of link canal with Orchha Temple (near Jhansi). Provision for development of tourist huts, picnic spots has been made on the periphery of Daudhan reservoir, Barwasagar reservoir and Lower Orr reservoir. Existing Barwasagar reservoir (tail and of Ken-Betwa link canal) remains dry for most of the period. However, after implementation of this project, it would have water round the year. So, all the aforesaid reservoirs can also be developed for boating by tourists as well as for pisciculture. Necessary provisions for the aspects have been made in this project report.

11.0 Construction & Equipment Planning

A total period of eight years has been considered for completion of the project. The project includes construction of Daudhan Dam & its components, Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project, which would be completed in 8 years, 5 years, 4 years and 5 years respectively.

The infra-structural development, pre-construction surveys and investigations, preparation of design/specifications are proposed to be taken up during the first two years. It is planned to award contracts for all major works upto 1st/2nd year. However, some of the works like diversion channel, spillway channel and link canal may have to be undertaken from the 4th quarter of the 1st year itself and therefore award of work for these works is planned accordingly. The work on infrastructural facilities like project colonies, approach roads, workshop, haul roads, stores, office buildings etc. will also start in the second year. Few of residual activities will continue for some time during the third year also. The construction of all civil structures is proposed to be completed upto 2nd quarter of 8th year. The erection, commissioning and testing of units would be required to be planned so that full benefits could accrue at the end of the proposed construction period.

Construction equipment not proposed as the entire work for construction will be awarded by EPC (Turnkey) basis. Only inspection vehicles and trucks etc. are proposed for the construction of the project.

12.0 Environmental and Ecological Aspects of the Project

The objective of EIA study is to identify the possible benefit & adverse environmental effects due to proposed KBLP & to suggest measures to minimize to the extent possible the anticipated adverse impacts. The EIA study was done by M/s AFC Ltd., Hyderabad and included in DPR of April, 2010. The EIA study was further modified in 2015 considering latest data, in the accordance with provisions of the “Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013” and incorporating suggestions/comments of MoEF&CC. Modified environmental impact assessment studies submitted to MoEF&CC for environmental clearance of KBLP, Phase-I during May, 2015. Accordingly, the environment clearance was granted by MoEF&CC. The EIA studies of

Lower Orr Project have been done by WAPCOS Ltd., Gurgaon. In respect of Kotha Barrage, the EIA studies is being carried out by WRD, Govt. of MP. The EIA studies of Bina Complex Multipurpose Project have also been done by WRD, Govt. of MP.

Environmental Management Plan (EMP) Cost

(A) Daudhan Dam

The EMP proposed in the present study covers land environment including catchment area treatment, biological conservations, public health management plan, air & noise, pollution management plan the pre and post project periods. The total outlay of the EMP has been worked out to Rs. 189577.33 Lakh.

(B) Lower Orr Project

Provision of Rs. 226.65 crore has been kept EMP.

(C) Kotha Barrage

According to submergence survey, no villages are coming under submergence of proposed barrage. The submergence area of barrage is in the gorge portion. 1389 ha private land is coming under submergence only. The environment impact assessment studies are being carried out by Water Resources Department, Govt. of MP.

(D) Bina Complex Multipurpose Project

The total forest loss including submergence area and other project appurtenance is about 1024.44 ha. It is proposed to afforest, double the amount of forest land will be acquired for the project. Thus, a total of 1440 ha of land need to be afforested. The compensatory afforestation work is to be done by forest department. It is proposed to afforest an area of 50 ha @ 1100 trees/ha with the species available under the Bina Complex Multipurpose Project.

13.0 Socio-economic Aspects and R&R

(A) Daudhan Dam

(i) Submergence Area

It is estimated that a total submergence area of 9000 ha (worked out by M/s AFC Ltd, based on satellite data) spread over 10 villages would be adversely affected. Due to construction of the Daudhan Dam, 2171 ha of village land of 10 villages shall come under submergence. It is significant to note that no railway lines, telephone lines, main power lines, mineral deposits, historical and archaeological monuments are coming under submergence.

(ii) Project Affected Villages

It has been estimated that about 1913 families will be affected in these villages. A small population of peripheral villages would also be affected as lands of the people belonging of these villages will also be adversely affected. The total population of these 10 villages shall be 8339. The literacy rate of the study area is about 49.6 %. The percent of SC and ST population of the area at present is 14.62 and 33.90 respectively. About 24.12% of the area is sown with agricultural crops, dense forests cover about 6.56 % and open scrub, open and scrub forest cover 1.67%, 2.90% and 46.31% respectively.

(iii) Resettlement and Economic Rehabilitation Plan

It is an infrastructure project under the category of water harvesting and conservation structures and sanitation. Therefore, the R&R Plan of this project have been prepared as per the Act “The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013”.

(iv) Resettlement & Rehabilitation Plan

The cost of relief, resettlement and rehabilitation of the affected households under the KBLP were worked out in accordance with the R&R Policy Guidelines of the Government of India-2007 which is better than R&R Policy Guidelines of Madhya Pradesh-2002. Broadly, the issue has three major components : i) land compensation; ii) resettlement and economic rehabilitation of displaced persons; and iii) economic rehabilitation of PAFs who have lost only land but not house / house site.

a) Land Acquisition

According to the socio-economic survey conducted by M/s AFC Ltd, Hyderabad, 2171 ha of Patta land has to be acquired for Daudhan reservoir. In addition 4202.68 ha of Patta land would be acquired for the canal and distributary system. Besides about 37.95 ha of land for township and 4.0 ha of land for green belt development will be required. Thus, the total Patta land acquisition required for the project is estimated to be 6422.62 ha. The National Tiger Conservation Authority (NTCA) prepared action plan for relocation of PAF's of four villages located under Panna Tiger Reserve Forest. Also NTCA identified sites for relocation of these PAFs. The displaced persons will be settled in colonies near the area side identified by NTCA for relocation of PAFs of these four villages. Necessary provision has been made for housing plots, infrastructure like schools and other civic amenities.

The average cost (which is arrived from the village level rates) of involuntary acquisition of irrigated land and cultivable land at Rs.3,71,500 per ha and for un-irrigated Rs.1,85,000 per ha in Daudhan reservoir area and about Rs.3.71lakh per ha for cultarable land and 1.85 lakh per ha for un-culturable was considered for land for Ken -Betwa Link canal and LBC system. The Solatium of 100 percent for compulsory land acquisition, Standing Crop loss, interest, demarcation, legal and establishment charges were kept. Also lump sum provisions were made towards rent for use of land prior to acquisition, rehabilitation measures, compensation for temporary acquisition of borrow area, provision for branch canals. The above cost was proposed by M/s AFC Ltd. Hyderabad. The total compensation for land acquisition has been estimated to be Rs. 1007.07 crore.

Now, in the present scenario, Presurised pipe micro irrigation system has been proposed in the entire command of Ken- Betwa Link in the enroute, Ken LBC and Hatta & Panna lift. Therefore, area required for land acquisition under canals has been reduced except submergence area of Daudhan Dam. The cost has been revised at Price Level 2020-21. The area and cost of B- land for Ken LBC and Panna & Hatta lift have been works out by WRD, Govt. of MP and same is adopted in the report. The 2682.82 ha land (including 190.50 ha forest land) for Ken-Betwa Link main canal, 320 ha for Ken LBC and 195 ha for Panna & Hatta lift is proposed to be acquired including approach road and structures etc. In the revised cost estimate, the rate of land coming under submergence of Daudhan Dam has been

judiciously enhanced as Rs. 4.00 lakh/ha and Rs.2.00 lakh/ha for irrigated and unirrigated land respectively. The cost of B-Land of Daudhan Dam has been works out as Rs. 622.28 crore. The rate of B-Land of Ken-Betwa link has considered as Rs. 7.00 lakh/ha and Rs.8.00 lakh/ha for MP and UP area respectively. The total cost works out to Rs 613.88 crore. The cost for Ken LBC and Hatta & Panna lift are adopted as 10.75 crore and 11.13 crore respectively. Thus the total cost for land acquisition for all components under K-B link is works out to Rs. 1258.03 crore.

b) Total Cost of Resettlement and Rehabilitation

The total outlay proposed for the implementation of Project Affected Families Economic Rehabilitation Plan (PAFERP) for the Daudhan dam amounted to Rs. 2280.70 Crore.

In addition to this, a provision of Rs. **482.66 crore** have been made in the estimate for relocation of about 30 villages to acquire 4338 ha revenue land against forest land which is affected under Daudhan Dam.

(B) Lower Orr Project

Environmental impact assessment & socio-economic study of the project have been carried out for the command area with CCA of 45,047 ha. Now, as per suggestion of Govt. of MP, command area (CCA) have been increased from 45,047 ha to 90,000 ha. Therefore, environmental impact assessment & socio-economic study for additional command area about 45,000 ha is required to be carried out.

Detailed cost estimates have been prepared for land acquisition and rehabilitation including infra-structural facilities for the oustees. These are based on Environmental Management and Rehabilitation and Resettlement Plan prepared by the WAPCOS. The details of expenditure for land acquisition and rehabilitation are given below:

Expenditure for Land Acquisition and Rehabilitation

Sl. No	Description	Amount Rs. in lakhs
1	Land acquisition	21932.71
2	Rehabilitation and Resettlement	8410.94

3	NPV	7667.15
4	Compensatory afforestation plan	4450.00
	Total	**42460.80**

(C) Kotha Barrage

The submergence area of barrage is in the gorge portion only. 1389 ha private land is coming under submergence. The socio-economic aspects studies are being carried out by Water Resources Department, Govt. of MP. However, a provision of Rs. 1000 Lakh has been kept for EIA study and implementation of R&R plan and maintaining the environment & ecology of the project area.

(D) Bina Complex Multipurpose Project

Detailed cost estimates have been prepared for land acquisition and rehabilitation including infra-structural facilities for the oustees. These are based on Environmental Management and Rehabilitation and Resettlement Plan prepared by the WRD, Govt. of MP. The details of expenditure for land acquisition and rehabilitation are given below:

Sl. No	**Description**	**Amount Rs. in lakhs**
1	Land acquisition	97637.20
2	Forest land	18716.21
3	Rehabilitation and Resettlement	10796.76
4	CAT Plan	13332.00
5	Cost of diversion of Sagar- Bhopal Highway No. 4 length 12 km	13250.04
	Cost of diversion of Sagar- Vidisha Highway No. 4 length 20km	22083.40
	Total	**175815.61**

In addition to above, a provision of Rs. 17600 lakh has been kept for payment of NPV and CAMPA Fund.

14.0 Cost Estimate

Total cost of the project has been worked out as Rs. 44644.39 crore at price level 2020-21. The details are given below:

Abstract Of Cost					
Comprehensive Report of Ken- Betwa link Project					
				(Price level 2020-21)	
				(Rs. in Crore)	
Sl. No.	***Component***	***Unit-I***	***Unit-II***	***Unit-III***	***Total***
		Head works	***Canals***	***Power***	
1	***Component as per DPR***				
I	***Daudhan dam and canals***				
i	*Daudhan dam*	*10899.65*	*-*	*-*	***10899.65***
ii	*Two new barrages of UP(Proposed Marauli and Pailani barrges near Banda)-subject to preparation of DPR of this part*	*2000.00*			***2000.00***
iii	*K-B link canal(Main)*	*-*	*10472.58*	*-*	***10472.58***
iv	*Ken LBC System*	*-*	*6734.79*	*-*	***6734.79***
v	*Panna and Hatta lift*	*-*	*5409.58*	*-*	***5409.58***
vi	*Repairing/Renovation of Ken Canal system of UP-subject to preparation of DPR of this*		*1000.00*		***1000.00***
vii	*Renovation of Mahoba tank with its connecting canal-subject to preparation of DPR of this part*		*500.00*		***500.00***
viii	*Power House-I*	*-*	*-*	*395.56*	***395.56***
ix	*Power House-II*	*-*	*-*	*146.59*	***146.59***
x	*Repairing /Strengthen of Barriyar PUW, Parichha weir,Barwa sagar etc (Lump sum provision)*	*220.00*	*-*	*-*	***220.00***
	Sub-total	***13119.65***	***24116.94***	***542.15***	***37778.75***
II	***Lower Orr project & canals***	*1046.17*	*1707.55*	*111.05*	***2864.76***
III	***Kotha barrage & canals***	*367.34*	*347.25*	*46.76*	***761.35***
IV	***Bina Complex Multipurpose project and canals***	*1687.65*	*1389.67*	*162.21*	***3239.53***
	Total	**16220.81**	**27561.41**	**862.17**	**44644.39**

15.0 Economic & Financial Evaluation

The economic & financial evaluation is tabulated below:

Sl.no	Description	Rs. in crores
1.	Total net return from agricultural produce	7829.01
2.	Revenue from sale of power @ Rs.4.00/kwh for 219.03MU	282.21
3.	Revenue from Water supply	22.19
4.	Revenue from Fisheries	375.78
	Total Revenue	**8509.19**
6.	Annual cost like interest, depreciation, charges of operation & maintenance (O&M) for command area and head works, power plants, etc.	**5662.52**
7.	**Benefit cost ratio**	**1.50:1**
8.	**Internal Rate of Return**	**13.40**

16.0 Clearances Status

16.1 Clearances Received:

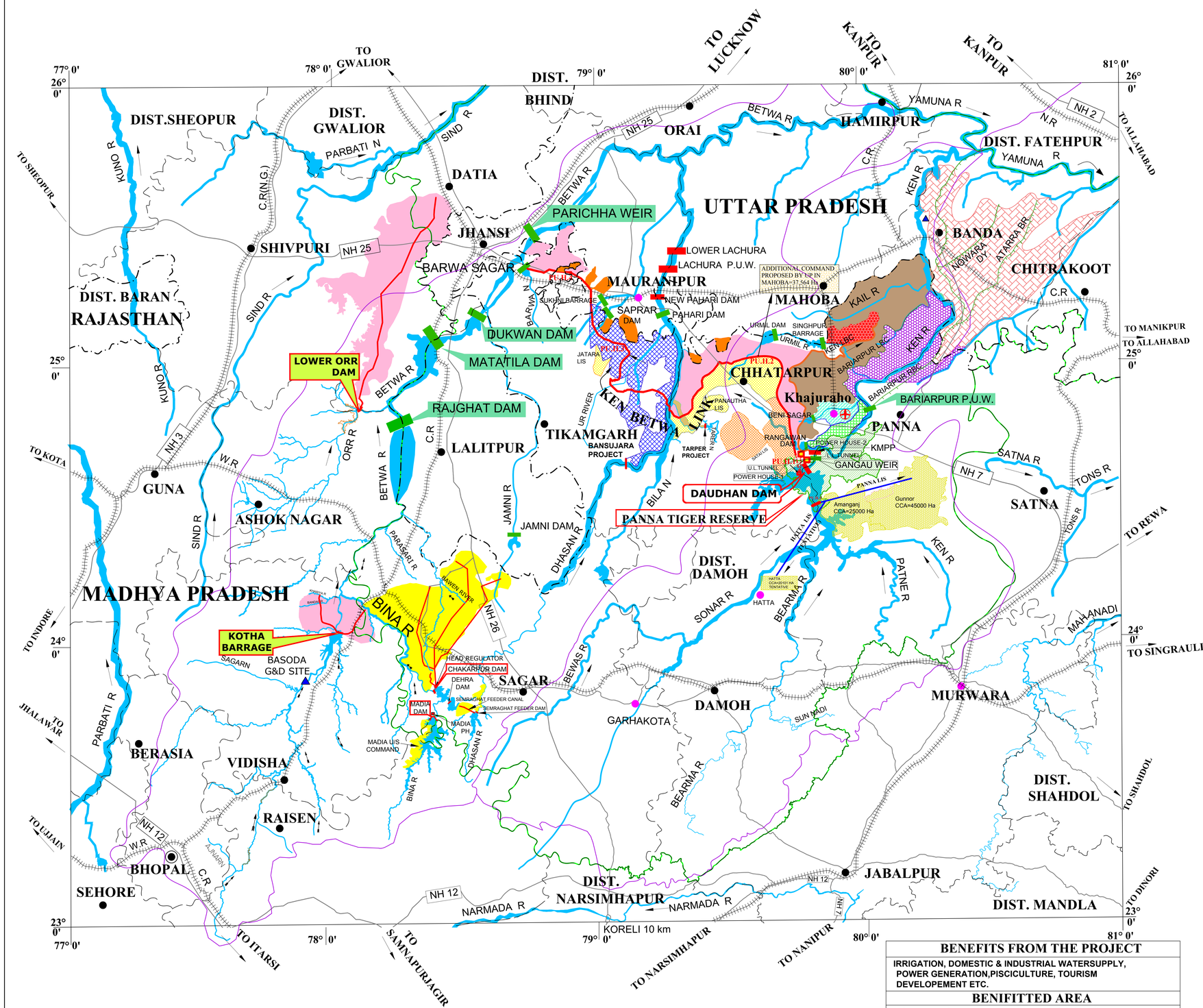
Status of various clearances for Daudhan & its Canal system are as follows:

S. No.	Activity	Present status
I	**Daudhan Dam**	
(i)	Techno-economic Clearance by Advisory Committee, MoWR, RD & GR	Techno-economic clearance to the project recommended by the Advisory Committee of MoWR,RD&GR in its 129th meeting held on 08.07.2016.
(ii)	Statutory Clearances	
(a)	Wildlife Clearance	Standing Committee of NBWL of MoEF&CC recommended the project to accord Wildlife Clearance in its 39th meeting held on 23.08.2016. The Wildlife Clearance has been accorded by MoEF&CC vide letter dated 21.09.2016 with the certain conditions. This clearance is presently under challenge in the Hon'ble Supreme Court of India. On the direction of the Hon'ble Supreme Court order dated 14.08.2018, the Central Empowered Committee (CEC) has examined the Wildlife Clearance of KBLP in

		consultation with NWDA, MoEF&CC and Govts. of MP & UP and submitted its report on 30.08.2019 recommending therein studies for examining (a) whether the mitigative measures now proposed effectively offset the adverse impact of the KBLP on the unique ecosystem of Panna National Park and Panna Tiger Reserve and (b) the alternatives to meet the objectives of the KBLP i.e. to meet the irrigational need of the command area proposed under the project to alleviate poverty. Regarding the recommendation of CEC for examining the alternative of KBLP, the Special Committee for ILR in its 17th meeting held on 26.02.2020 has observed that KBLP is the only best option to meet the Irrigation needs of Command area which will provide relief to the drought prone Bundelkhand region. The replies to the recommendations of CEC were also sent to the CEC by NWDA on 23/24.07.2020. Further, as directed by National Board of Wild Life of MoEF&CC, the work of preparation of Landscape Management Plan has been entrusted to Wild Life Institute of India and work is at advance stage.
(b)	Environmental Clearance	Environmental Clearance has been granted by MoEF&CC vide letter dated 25.08.2017 with certain conditions. The Environmental clearance is presently under challenge in the National Green Tribunal (NGT). The NGT during its hearing dated 12.10.2018 has ordered that first CEC should hear IA No. 27160/2018 in WPC(C) 202 of 1995 in the matter of Shri Manoj Kumar Misra forwarded by Hon'ble Supreme Court to them.
(c)	Forest Land Diversion Clearance	Stage-I Clearance/In-principle Approval has been granted by MoEF&CC vide letter dated

		25.05.2017 with certain conditions. One of the essential conditions is the identification of 6017 ha of revenue land and its transfer to PTR authorities. Out of this, 6017 ha of revenue land, 4206 ha/4396 ha has been identified by NWDA in consultation with Govt. of MP and the remaining revenue land is yet to be identified. Secretary, DoWR,RD&GR requested Secretary, MoEF&CC on 04.09.2020 to consider the proposal of 4206 ha of revenue land and double the remaining land of 1811 ha i.e. 3622 ha degraded forest land in MP in lieu of 6017 ha of submergence land and to accord Stage-II Forest Clearance for early implementation of KBLP. In response, Secretary, MoEF&CC on 17.09.2020 mentioned that Additional Principal Chief Conservator of Forest (APCCF, Land Management), Forest Department, Govt. of MP vide letter dated 03.07.2020 informed that they have no information about identification of 4206 ha of non-forest land in the State for the proposed diversion. Hon'ble Minister of Environment, Forest and Climate Change held a meeting with Hon'ble Minister of Jal Shakti on 09.07.2020 and it was decided that the details of 4206 ha of non-forest land identified by the user agency so far for raising compensatory afforestation shall be shared with State Forest Department. For the remaining requirement of compensatory afforestation, MoEF&CC will consider the request of the Ministry of Jal Shakti at appropriate forum following due process for considering double degraded land for compensatory afforestation in the above Central Government Project. The details of identified revenue land for compensatory afforestation was communicated to APCCF (Land Management), Govt. of MP

		vide NWDA letter dated 09.10.2020 and requested for the verification of the identification of the revenue land for transfer to the forest department and to submit the report to MoEF&CC for their consideration please.
(d)	Clearance from Ministry of Tribal Affairs (MoTA)	MoTA has accorded the clearance vide letter dated 04.01.2017.
(e)	Investment Clearance	The Investment Clearance has been accorded by MoWR, RD &GR vide letter dated 19.06.2017.



LEGEND

- STATE BOUNDARY
- DISTRICT BOUNDARY
- BASIN / SUB BASIN BOUNDARY
- RIVER
- PROPOSED PROJECTS (BY N.W.D.A.)
- EXISTING PROJECTS
- PROPOSED K-B LINK CANAL
- KEN LEFT BANK CANAL (M.P.)
- PROPOSED LIFT CANALS
- EXISTING CANAL
- ROAD, RAILWAY LINE
- AIRPORT
- STATE , DIST.H.Q., IMP. PLACE
- G&D SITE
- SUBMERGENCE AREA
- SINGHPUR COMMAND
- RANGWAN COMMAND
- BENISAGAR COMMAND
- COMMAND OF ONGOING BANSUJRA PROJECT
- BARIARPUR LBC AND RBC COMMAND (M.P.)
- PANNA TIGER RESERVE
- BUNDELKHAND BOUNDARY

N W E S

COMMANDS DETAILS OF K-B LINK MAIN PROJECT

S.No.	NAME OF COMMAND	Colour of Command	CCA in Ha.
1	**COMMAND IN MP**		
A	ENROUTE COMMAND		96,751
B	HIGH LEVEL COMMAND BY PUMPING FROM DAUDHAN RESERVOIR		43,678
C	HIGH LEVEL COMMAND BY PUMPING FROM K-B LINK		42,096
D	PANNA AND HATTA LIS		90,101
E	COMMAND OF KEN L.B.C.		1,74,742
		TOTAL IN MP	**4,47,368**
2	**COMMAND IN UP**		
A	ENROUTE COMMAND: (i) JHANSI & MAHOBA		17,488
	(i i) NEW COMMAND PROPOSED BY UP IN MAHOBA		37,564
B	COMMAND OF BARIYARPUR R.B.C KEN CANAL IN BANDA		1,92,479
C	COMMAND AREA IN LALITPUR BY SUBSTITUTION		3,533
		TOTAL IN UP	**2,51,064**
		TOTAL MP & UP	**6,98,432**

COMMANDS DETAILS OF BETWA PROJECTS

S.No.	NAME OF COMMAND	Colour of Command	CCA in Ha.
1	**COMMAND IN M.P.**		
A	ENROUTE COMMAND OF LOWER ORR DAM		90,000
B	KOTHA BARRAGE		20,000
C	BINA COMPLEX		96,000
		TOTAL	**2,06,000**

BENEFITS FROM THE PROJECT

IRRIGATION, DOMESTIC & INDUSTRIAL WATERSUPPLY, POWER GENERATION,PISCICULTURE, TOURISM DEVELOPEMENT ETC.

BENIFITTED AREA

(A) KEN-BETWA LINK MAIN PROJECT

STATES	DISTRICTS
M.P.	CHHATARPUR,TIKAMGARH AND PANNA AND DAMOH
U.P.	JHANSI, MAHOBA, LALITPUR AND BANDA

(B) BETWA PROJECTS

STATE	DISTRICTS
M.P.	RAISEN, VIDISHA, SAGAR, SHIVPURI AND DATIA

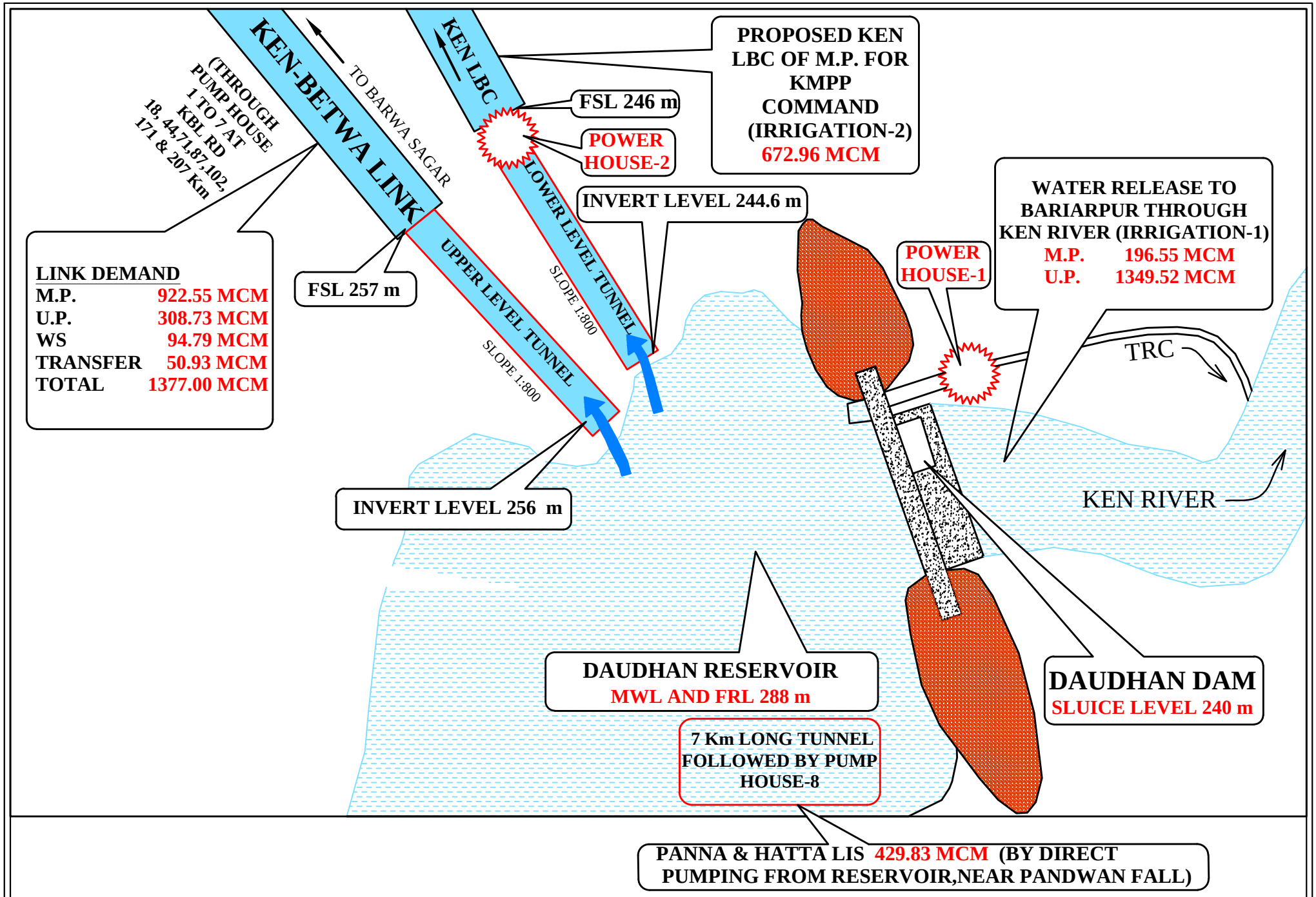
SCALE

Km 10 0 10 20 30 40 Km

राष्ट्रीय जल विकास अभिकरण
NATIONAL WATER DEVELOPMENT AGENCY

केन–बेतवा लिंक परियोजना का व्यापक प्रतिवेदन
COMPREHENSIVE REPORT OF KEN-BETWA LINK PROJECT

केन–बेतवा लिंक परियोजना का सूचक मानचित्र
INDEX MAP OF KEN-BETWA LINK PROJECT



LAY OUT PLAN SHOWING IMPORTANT STRUCTURES IN DOUDHAN DAM COMPLEX

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CHAPTER

DAUDHAN DAM & ITS APPURTENANT WORKS

CHAPTER-I
INTRODUCTION

1.0 General

The programme of Interlinking of river (ILR) is considered by Govt. of India on highest priority. National Water Development Agency (NWDA) was set up by Government of India as an Autonomous Society under Ministry of Water Resources (MoWR) in July, 1982 to study the feasibility of ILR under National Perspective Plan (NPP) prepared by erstwhile Union Ministry of Irrigation and Central Water Commission (CWC) and give a concrete shape to it. Accordingly, after carrying out detailed technical studies, NWDA identified 16 links under Peninsular Component and 14 links under Himalayan Component in the country for feasibility studies. Ken-Betwa link is one of the 16 links under Peninsular Component of NPP for Water Resources Development. The feasibility report of Ken-Betwa link was prepared by NWDA in the year 1995 and circulated among all concerned. Since then continuous efforts were made by NWDA, CWC and MoWR to arrive at consensus between two beneficiary States of Madhya Pradesh (MP) and Uttar Pradesh (UP). Finally consensus was arrived among Union Government and concerned States and a tripartite Memorandum of Understanding (MoU) was signed by MP, UP and the Union Government on 25th August 2005 for preparation of Detailed Project Report (DPR) of Ken-Betwa link. A copy of MoU is annexed at **Annexure-1.1**. Subsequently, the work of preparation of DPR was entrusted to NWDA by MoWR in January, 2006.

The DPR of Ken-Betwa Link Project (KBLP) was completed by NWDA in December, 2008 and the copy of DPR was sent to Governments of MP and UP for their examination and comments in February, 2009. Keeping in view of the comments of Governments of MP and UP, Secretary MoWR convened a meeting with concerned Principal Secretaries of MP and UP on February 3, 2010, to sort out the various issues raised by them. It was decided in the said meeting that the DPR of the project will be prepared in two Phases. In Phase-I, Daudhan Dam, two power houses and link canal were included and in Phase-II, projects proposed in Betwa basin by Government of MP were included.

The DPR of KBLP, Phase-I was completed by NWDA in April, 2010 after incorporating the inputs as received from Governments of MP and UP and circulated to concerned State Governments.

Further, during the meeting held under the Chairmanship of Secretary (WR), Govt. of India with the representatives of Governments of MP and UP on August 4, 2010 at New Delhi, it was decided that Survey and Investigations (S&I) works for proposed projects in Betwa basin including Lower Orr Dam and preparation of DPR of KBLP, Phase-II would be taken up by NWDA.

After firming up the feasibility of the projects in close association with the officials of Water Resources Department, Govt. of MP, NWDA carried out the S&I works of the Lower Orr Dam, Babnai, Tharr Dam and five barrages namely Neemkheda, Parariya (Madhopur), Narkheraghat, Kotha and Bijrotha (Rajkhera) under KBLP, Phase-II. In addition, the Barari and Kesari barrages proposed in Upper Betwa basin and surveyed during preparation of DPR of KBLP, Phase-I were also included in Phase-II of the project.

Further, during the November 20-22, 2013, the CWC design team headed by Chief Engineer, Design (NW&S) and officers of NWDA inspected the proposed Dam/Barrage sites under KBLP to review design features and feasibility of the locations of Dams/Barrage sites. After visiting the various proposed sites by CWC team, Lower Orr Dam, Kotha Barrage, Neemkheda Barrage, Barari Barrage and Kesari Barrage were included in DPR of Phase-II and same was circulated in November, 2014.

Thereafter, discussions were held between Government of MP and NWDA from time to time to finalize the DPR of KBLP, Phase-II. During the meeting convened by Hon'ble Minister (WR,RD&GR) held on 18th November, 2016 with NWDA and Government of MP officials to review the status of KBLP, it was decided that Lower Orr Dam and Kotha Barrage with increased height will be retained under Phase-II. Also, it was agreed that DPR of Bina Complex Multipurpose Project already prepared by Government of MP will be included in KBLP, Phase-II. The DPR of Lower Orr Project prepared by NWDA, DPR of Kotha Barrage modified by Government of MP and DPR of Bina Complex Multipurpose Project prepared by Government of MP are under techno-economic appraisal with CWC.

In the meantime, the proposal of KBLP, Phase-I was accepted by the Advisory Committee of MoWR, RD & GR in July, 2016. Further, the project proposal has been considered acceptable for investment clearance in June, 2017.After obtaining various statutory clearances, the Cabinet Note for KBLP, Phase-I was circulated to various Ministries and concerned State Governments in May, 2017.During the review meeting taken by the Principal Secretary to Hon'ble Prime Minister on 4th July, 2017, it was decided that both Phases of KBLP should be taken up concurrently for implementation. A copy of the minutes is annexed at **Annexure-1.2.**The matter was further taken up by Hon'ble Chief Minister, Government of MP vide letter No. 1006/CM(O)/2017 dated 11.10.2017 and requested to enhance Culturable Command Area (CCA) of Ken-Betwa link from 2.87 lakh ha to 4.47 lakh ha with pressurized pipe micro irrigation system in the command area of MP under KBLP.A copy of letter is annexed at **Annexure-1.3.** Governmentof UP vide letters No. 4026/17-27-Sep-9/65 SAV/15 dated4.09.2017 & No. 4026/17-27-Sep-9/65 SAV/15 dated 02.11.2017 have also requested for repair/strengthening of their existing structures viz. Bariyarpur PickUp Weir, Parichha Weir and related structures and also to include about 200 MCM water to Mahoba district within their overall share of 1700 MCM, thus reducing their water demand in Ken basin under existing Bariyarpur PickUp Weir. Copies of letters are annexed at **Annexure-1.4.** Hon'ble Minister (WR, RD&GR) during review meeting held on 25th September, 2017 decided that Comprehensive Report of KBLP should be prepared including KBLP Phase-I, enhanced CCA under KBLP, Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project for early implementation. A copy of minutes is annexed at **Annexure-1.5**.

Accordingly, NWDA has prepared Comprehensive Report of KBLP in which Daudhan Dam, Lower Orr Project, Kotha Barrage, Bina Complex Multipurpose Project, additional CCA under KBLP, repair/strengthening of Bariyapur PickUp Weir, Parichha Weir and Barwa Sagar Dam etc. are included. The separate DPRs of Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project are already submitted to CWC for techno-economic appraisal. The Comprehensive Report describes overall planning of KBLP with cost estimate at price level 2017-18and submitted for techno-economic, investment clearance. Further, Comprehensive Report was revised at price level 2020-21and a tripartite MoA was signed amongst State Government of UP, State Government of MP & Union Government of India.

A copy of MoA is attached as **Annexure-1.7**. Also, Public Investment Board (PIB) and Union Cabinet have approved the revised estimate at price level 2020-21. Index map of KBLP is enclosed at **Plate-1**.

1.1 Justification and Objective of the Project

KBLP envisaged transfer of surplus water from Ken basin to Betwa basin to provide water to water short areas of Betwa basin by substitution, keeping the needs of the in-basin requirements of Ken basin involving both the States of UP and MP in view and ensuring equity, optimization of water use and cost effectiveness. After detailed survey, investigation and optimization study, Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project were finally included to meet the water requirement of water short area of Betwa basin within allocated water to MP at Rajghat dam i.e. 53TMC (1510.5MCM) + 50.93 MCM of water is proposed to be transferred from Ken basin to Betwa basin for utilization of water for irrigation/domestic purposes in Lalitpur district of UP on substitution basis.

As per the decision taken by Hon'ble Minister (WR, RD& GR) and in consultation of officials of MPand UP Governments, new command area proposed by Government of MP in Chhatarpur, Tikamgarh, Panna, Damoh district in Ken-Betwa command, Shivpuri & Datia districts in Lower Orr Dam and Sagar/Raisen districts in Bina Complex Multipurpose Project and new enroute command in Mahoba district of UP have been included in the Comprehensive Report of KBLP. The report also includesthe cost of repair/strengthening of Bariyarpur PickUp Weir, Parricha Weir, BarwaSagar and Barwa Nalla etc.

1.2 Outline of the Comprehensive Report of KBLP

The preparation of DPR of link proposed under NPP was included in the function of NWDA in 2006. Due to concreted efforts of NWDA in association with CWC and MoWR, a tripartite MoU was signed by the state of MP, UP and Union Government on 25th August, 2005 in New Delhi for preparation of DPR of KBLP. NWDA completed the DPR of KBLP Phase-I in April, 2010. DPR of the KBLP phase-II was completed in January, 2014. During meeting convened by Hon'ble Minister (WR, RD&GR) on 18th November, 2016 with NWDA and Govt. of MP official it was decided that Lower Orr dam, Kotha Barrage with increased height and Bina Complex Multipurpose Project be included in KBLP, Phase-II. The minutes of the

meeting are annexed at **Annexure-1.6.** Further, Hon'ble Minister (WR, RD&GR) during review meeting held on 25th September, 2017 decided that Comprehensive Report of KBLP including KBLP, Phase-I, enhanced CCA under KBLP, Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project be prepared for early implementation.

1.3 Projects Taken up Under KBLP

The KBLP includes Daudhan Dam, Ken-Betwa link canal, Ken Left Bank Canal, Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project (comprising 4 projects).As project specific, DPRs of each project has already been prepared separately, only brief details extracted from respective DPRs are given in this Report. A brief list of works proposed under KBLP as per tripartite MoA signed amongst Uttar Pradesh Government, Madhya Pradesh Government & Government of India on 22 March, 2021 are given below:-

1.4 List of Works Included in KBLP

1.4.1 Head Works &Distribution System

1.4.1.1 Daudhan Dam Comprises

(i) An earthen embankment cum concrete dam across Ken River at Daudhan with FRL/MWL 288 m.

(ii) An Upper Level Tunnel about 170 m from the left bank of Daudhan dam having length of 1.9 km for conveying water to the link water carrier.

(iii) A Lower Level Tunnel about 100 m from the left bank of Daudhan dam having length of 1.1 km for conveying water to the Power House-II and from there to the Left Bank Canal of MP through a connecting channel of about 2.5 km.

(iv) Power House-I (2x30 MW) to the right of spillway at the toe of Daudhan dam.

(v) Power House-II (3X6 MW) at the outlet of Lower Level Tunnel.

1.4.1.2 Kotha Barrage Comprises

(i) A barrage across Betwa river at village Kotha, Tehsil Ganj Basoda, district Vidisha, Madhya Pradesh.

(ii) Pump Houses and Rising Mains

1.4.1.3 Bina Complex Multipurpose Project Comprises

(i) Four storage dams: Madia & Chakarpur on Bina River,, Semra Ghat Diversion on Dhasan River and Dehra Dam on Dehra Nalla.

(ii) Pump Houses, Rising Mains and Power Houses.

1.4.1.4 Lower Orr Project Comprises

(i) An earthen embankment cum concrete dam across Orr River near village Didauni, in district Shivpuri, Madhya Pradesh.

(ii) Pump Houses, Rising Mains and link water carrier.

1.4.1.5 Repair/strengthening/remodeling of Bariyarpur pick up weir, Parichha weir, Barwa Sagar Dam along with appurtenant structures and 7.1km long Barwa Nallah to carry water from Barwa Sagar to Betwa river upstream of existing Parichha weir.

1.4.1.6 Construction of two new barrages along with appurtenant structures d/s of existing Bariyarpur Pick up weir in the territory of UP.

1.4.1.7 Renovation of existing tanks and their connecting links in Mahoba district and carrier system for transfer of water from Ken Betwa link canal to tanks in order to enable UP to store the monsoon water to use during non-monsoon season.

1.4.2 Canal Pipe Line and Command Networks

1.4.2.1 Ken Basin

(i) A link canal (220.624 Km long including 1.9 m length of Upper Level Tunnel) with off take FSL 257 m to existing Barwa Sagar

with FRL 219.20 m across Barwa Nallah, a tributary of Betwa River.

(ii) A bye pass channel from exit of Lower Level Tunnel to connect proposed Ken Left Bank Canal of MP.

(iii) Pumping system arrangements for lifting of water to Upper Level Tunnel to ensure the water supply in the Ken-Betwa link canal whenever reservoir depletes below the crown level of Upper Level Tunnel.

(iv) Developing pumping system, pipe distribution network and micro irrigation system by lifting water from Daudhan reservoir/initial reach of Link water carrier to serve a part of high level command (43,678 ha.) of Chhatarpur District of MP.

(v) A 90 km long proposed ken Left Banal Canal of MP and developing pumping system, pipe distribution network and micro irrigation system for ken Left Bank Canal to serve 1,39,848 ha. CCA in Chhatarpur District.

(vi) From existing Bariyarpur LBC 38,890 ha. CCA will be covered by existing open canal network in Chhatarpur District of MP.

(vii) Developing pumping system, pipe distribution network and micro irrigation system for 90,101 ha. CCA by lifting water from Daudhan reservoir, out of which 70,000 ha. CCA will be in Panna District and 20,101 ha. CCA will be in Damoh District of MP.

(viii) Developing pumping system, pipe distribution network and micro irrigation system from Ken-Betwa link canal to serve left out area of 42,096 ha. of high level command & 96,751 ha. Enroute command of MP and 17,488 ha. of enroute command of UP.

(ix) Stabilization of irrigation in 1,92,479 ha. in Banda district in UP under existing Ken command by repair/strengthening of existing system. Enhancing command area of Bariyarpur Right Bank Canal (Ken Canal) system by utilizing pressurized pipe micro irrigation system.

1.4.2.2 Betwa Basin

(i) Kotha Barrage: - Pumping system, pipe distribution network and micro irrigation system for 20,000 ha. CCA of MP.

(ii) Bina Complex Multipurpose Project: - Pumping system, pipe distribution network and micro irrigation system for 96,000 ha. CCA of MP.

(iii) Lower Orr Project:-Pumping system, pipe distribution network and micro irrigation system for 90,000 ha. CCA of MP.

(iv) Development of existing command of 37,564 ha. in Mahoba district in UP with pressurized pipe micro irrigation system.

1.5 Details of Drinking Water Supply

Drinking water supplies shall be within the overall share of each State. 60 MCM of water is proposed to be provided for Panna, Chhatarpur and Tikamgarh districts of MP. 67 MCM of water is proposed to be provided for Jhansi, Mahoba and Lalitpur districts of UP.

1.6 Hydropower

Two power houses viz. PH-I & PH-II with installed capacities of 60 MW (2 x 30 MW) & 18 MW (3 x 6 MW) respectively have been proposed at Daudhan Dam. The average annual generation of power from PH-I & II has been estimated to be 219.03 Million Units. 76.39 MW and 12.97 MW installed capacity is required to develop pressurized pipe micro irrigation system in the enroute command of MP and UP respectively including direct pumping from Daudhan reservoir for irrigating high level command of MP. Besides above, 10.2 MW installed capacity is required to develop micro irrigation system under Ken LBC command and 101.26 MW installed capacity for Panna and Hatta LIS (Lift Irrigation Scheme).

1.7 Daudhan Dam and Ken-Betwa Link Canal

The KBLP envisages construction of 77.00 m high dam, namely Daudhan across river Ken (about 2.5 km upstream of existing Gangau Weir), 221km long link canal including cross drainage structures, two tunnels, two power houses (one at the toe of Daudhan dam (60 MW) and the other at the exit of lower level tunnel (18 MW)). The gross storage capacity of the Daudhan Dam is 2853 MCM from which it is proposed to provide irrigation and domestic water supply.

The total 75% dependable yield of Ken River at proposed Daudhan Dam site has been assessed as 6590 MCM. The total upstream requirement of water for existing, ongoing and proposed projects is 2266 MCM. The total downstream water requirement below proposed dam site is 2236.63 MCM. Downstream environmental and ecological requirement to maintain river ecology is 493.60 MCM. The requirement of 436.287 MCM water of Panna & Hatta LIS in right bank is proposed to be fed directly through pumping from Daudhan reservoir for irrigating an area of 90,101 ha in Panna district of MP.

Thus, surplus water of 1377 MCM is proposed to be diverted into the main link canal. Out of which 220.77 MCM will be utilized at a pumping station at RD 18 Km to serve 43,678 ha of command located at high elevation. This area entirely lies in Chhatarpur district of MP. Again, 1010.51 MCM of water will be utilized to irrigate an enroute command area of 1, 93,899 ha (1,38,847 MP + 55,052 UP) in Chhatarpur, Tikamgarh districts of MP and Mahoba & Jhansi districts of UP including transmission losses. Further, 94.79 MCM of water will be proposed for drinking purpose in the enroute. And remaining 50.93 MCM of water is released to Betwa River through link canal in the upstream of Parichha Weir.

The 50.93 MCM of water which was released in river Betwa upstream of Parichha Weir will be utilized in Lalitpur district of UP. Out of which 31.98 MCM of water will be provided for drinking purpose and 18.95 MCM of water will be utilized to irrigate an area of 3533 ha.

Out of 2236.63 MCM of water proposed to be released downstream of Daudhan Dam, 930.86 MCM will be utilized to irrigate an area of 1,78,738 ha under Ken Command in Chhatarpur district of MP and remaining 1305.77 MCM of water will be utilized for stabilization of 1,92,479 ha area in Ken Command located in Banda district of UP.

Thus, total area of 7,02,428 ha (CCA) is proposed to be brought under irrigation through Daudhan Dam in MP and UP. Intensity of irrigation in MP is 134% and in UP is 100 %. Thus the annual irrigation from the Daudhan Dam is 8,55,892 ha.

The other details viz. survey and investigation, hydrology, design, irrigation planning, socio-economic aspects, environment study, construction manpower planning, cost-estimate etc. are given in respective Chapters of DPR of KBLP-2010.

The total cost of the Daudhan Dam works out to Rs. 37778.75 crore at price level 2020-21which includes the cost of link canal, two power houses, two tunnels, repair/strengthening of Bariyarpur Pick Up Weir, Parichha Weir, Barwa Sagar Dam and Barwa Nalla.

1.11 Irrigation Planning

As per decision taken during the meeting held on 18.11.2016 Chaired by Hon'ble Minister (WR,RD&GR) with the officials of WRD, Govt. of MP and NWDA, three projects viz. Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project considered in KBLP (Phase-II).A copy of the minutes of meeting are annexed at **Annexure-1.6**. Accordingly, separate DPR of each project has been prepared and submitted to the CWC for appraisal. Out of these three DPRs, NWDA has prepared DPR of Lower Orr Project while other two have been prepared by WRD, Government of MP.

Further, as per the decision taken by MoWR,RD & GR in consultation with official of Govt. of MP, Phase-I and Phase-II will be combined as KBLP and taken up concurrently. Left out command areas proposed in Chhatarpur, Panna & Damoh districts of MP and new enroute command in Mahoba district of UP have been included is the Comprehensive Report of KBLP. Besides, Lower Orr and Bina Complex Multipurpose Project proposed by Government of MP are also included in the Comprehensive Report as a part of KBLP.The total command area works out to7,02,428 ha. Out of which, 4,51,364 ha area lies in MP and remaining 2,51,064 ha area is in UP. Most of command area lying in Bundelkhand region of MP & UP will be benefitted. State wise details of command area are given below in **Table-1.1.**

Table – 1.1
Area covered under Canal System under Daudhan Dam of KBLP

Area in ha

S. No.	Canal system	CCA as per DPR (2010)		Annual irrigation as per DPR (2010)		CCA as per Comprehensive Project Report (2022)	
I	**Canal system under Daudhan Dam**	**MP**	**UP**	**MP**	**UP**	**MP**	**UP**
1	K-B Link Main canal	46531	13763	46531	13763	138847	58585 *
	High level command through Link	_	_	_	_	43678	_
2	Ken LBC	172853		233763		139848	
3	Bariyarpur Pick up weir through Dam- (i) Chhatarpur	46269	213610	58291	252017	38890	192479
	(ii) Panna	22184		31296			
4	Panna & Hatta Lift from Daudhan Dam					90101	
	Sub-total under Daudhan Dam	**287837**	**227373**	**369881**	**265780**	**451364**	**251064**
	Total	**515210**		**635661**		**702428**	

*17488 ha Enroute through K-B Link Main Canal
37564 ha in Mahoba district
3533 ha in Lalitpur district by substitution

The details of total command area, cropping pattern and operation table etc. are given in Chapter-VI.

1.12 Cost Estimate & Financial Analysis

The cost of Daudhan Dam including Ken-Betwa Link Canal, Ken LBC, two tunnels, two power houses, micro irrigation cost of new and existing command, Panna & Hatta LIS, repair/strengthening cost of Bariyarpur PUW, Parichha Weir, Barwa Sagar Dam, training of 7.1 km long Barwa Nalla is calculated at price level 2020-21.The details are given below in **Table-1.2**.

Table -1.2
Estimated Cost of Daudhan Dam of the KBLP

Sl. No.	Name of Projects	Estimated Cost (Rupees in Crore)
1.	Daudhan Dam including its canal system	37778.75

The benefit cost ratio works out to 1.51 and IRR will be 13.35% for the Ken-Betwa Link Project Phase-I.

1.13 Clearances

1.13.1 Clearances Received:

Status of various clearances for Daudhan & its Canal system are as follows:

S. No.	Activity	Present status
I	**Daudhan Dam**	
(i)	Techno-economic Clearance by Advisory Committee, MoWR, RD & GR	Techno-economic clearance to the project recommended by the Advisory Committee of MoWR,RD&GR in its 129th meeting held on 08.07.2016.
(ii)	Statutory Clearances	
(a)	Wildlife Clearance	Standing Committee of NBWL of MoEF&CC recommended the project to accord Wildlife Clearance in its 39th meeting held on 23.08.2016. The Wildlife Clearance has been accorded by MoEF&CC vide letter dated 21.09.2016 with the certain conditions. This clearance is presently under challenge in the Hon'ble Supreme Court of India. On the direction of the Hon'ble Supreme Court order dated 14.08.2018, the Central Empowered Committee (CEC) has examined the Wildlife Clearance of KBLP in consultation with NWDA, MoEF&CC and Govts. of MP & UP and submitted its report on 30.08.2019 recommending therein studies for examining (a) whether the mitigative measures now proposed effectively offset the

		adverse impact of the KBLP on the unique ecosystem of Panna National Park and Panna Tiger Reserve and (b) the alternatives to meet the objectives of the KBLP i.e. to meet the irrigational need of the command area proposed under the project to alleviate poverty. Regarding the recommendation of CEC for examining the alternative of KBLP, the Special Committee for ILR in its 17th meeting held on 26.02.2020 has observed that KBLP is the only best option to meet the Irrigation needs of Command area which will provide relief to the drought prone Bundelkhand region. The replies to the recommendations of CEC were also sent to the CEC by NWDA on 23/24.07.2020. Further, as directed by National Board of Wild Life of MoEF&CC, the work of preparation of Landscape Management Plan has been entrusted to Wild Life Institute of India and work is at advance stage.
(b)	Environmental Clearance	Environmental Clearance has been granted by MoEF&CC vide letter dated 25.08.2017 with certain conditions. The Environmental clearance is presently under challenge in the National Green Tribunal (NGT). The NGT during its hearing dated 12.10.2018 has ordered that first CEC should hear IA No. 27160/2018 in WPC(C) 202 of 1995 in the matter of Shri Manoj Kumar Misra forwarded by Hon'ble Supreme Court to them.
(c)	Forest Land Diversion Clearance	Stage-I Clearance/In-principle Approval has been granted by MoEF&CC vide letter dated 25.05.2017 with certain conditions. One of the essential conditions is the identification of 6017 ha of revenue land and its transfer to PTR authorities. Out of this, 6017 ha of revenue land, 4206 ha/4396 ha has been

		identified by NWDA in consultation with Govt. of MP and the remaining revenue land is yet to be identified. Secretary, DoWR,RD&GR requested Secretary, MoEF&CC on 04.09.2020 to consider the proposal of 4206 ha of revenue land and double the remaining land of 1811 ha i.e. 3622 ha degraded forest land in MP in lieu of 6017 ha of submergence land and to accord Stage-II Forest Clearance for early implementation of KBLP. In response, Secretary, MoEF&CC on 17.09.2020 mentioned that Additional Principal Chief Conservator of Forest (APCCF, Land Management), Forest Department, Govt. of MP vide letter dated 03.07.2020 informed that they have no information about identification of 4206 ha of non-forest land in the State for the proposed diversion. Hon'ble Minister of Environment, Forest and Climate Change held a meeting with Hon'ble Minister of Jal Shakti on 09.07.2020 and it was decided that the details of 4206 ha of non-forest land identified by the user agency so far for raising compensatory afforestation shall be shared with State Forest Department. For the remaining requirement of compensatory afforestation, MoEF&CC will consider the request of the Ministry of Jal Shakti at appropriate forum following due process for considering double degraded land for compensatory afforestation in the above Central Government Project. The details of identified revenue land for compensatory afforestation was communicated to APCCF (Land Management), Govt. of MP vide NWDA letter dated 09.10.2020 and requested for the verification of the identification of the revenue land for transfer to the forest department and to submit the report to MoEF&CC for their consideration

		please.
(d)	Clearance from Ministry of Tribal Affairs (MoTA)	MoTA has accorded the clearance vide letter dated 04.01.2017.
(e)	Investment Clearance	The Investment Clearance has been accorded by MoWR, RD &GR vide letter dated 19.06.2017.

CHAPTER-II
SURVEYS AND INVESTIGATIONS

2.0 Background

The DPRs of KBLP, Phase-I and Phase-II were completed by NWDA in 2010 and 2014 respectively after carrying out detailed Surveys and Investigations (S&I). Lower Orr Dam and Kotha Barrage were also included in Phase-II. In respect of canal system under Daudhan Dam, enhanced CCA proposed by Government of MP from 2.87 lakh ha to 4.51 lakh ha**,** NWDA has carried out additional command area survey of 26500 ha (12500 ha in enroute command of the link canal and 14000 ha in command of Ken Left Bank Canal). In respect of additional command of 37564 ha in Mahoba district of UP, NWDA collected irrigation map of Mahoba district from irrigation department of UP showing dams tanks and canal system and adopted in study. Irrigation planning has been provided by Government of MP and same is adopted in the Comprehensive Report. In respect of Bina Complex Multipurpose Project, surveys and investigations has been done by Government of MP and the same is adopted in Comprehensive Report. The component wise details of various surveys and investigations extracted from specific DPRs of above projects are furnished below:

2.1 Daudhan Dam and Ken-Betwa Link Canal

2.1.1 Topographical and Other Allied Surveys of Daudhan Dam and Canals

Various field S&I viz. topographical, geological, construction material, geo-technical investigations & borrow area surveys (soils) in respect of Daudhan Dam and Ken- Betwa link canal have been carried out as per the Terms of Reference (ToR) for preparation of DPR of KBLP, 2006 and the Guidelines for preparation of Detailed Project Report of Irrigation and Multipurpose Projects of Ministry of Water Resources, Govt. of India, (2010).

Topographical surveys like river survey, reservoir survey, head works including dykes, barrages and weirs etc., plant and colony layout, canal & water conductor system and canal structures, powerhouses, switchyards, surge-shaft, tailrace, and tunnels, adits and penstocks etc. have been carried out by NWDA and details covered in Chapter-II of DPR of KBLP, Phase-I.

Under the other allied surveys, archaeological surveys in the reservoir area, mineral (useful and harmful) surveys in the catchment/ reservoir areas, right of way surveys for the reservoir, communication surveys and drainage surveys have been done by concerned organisations.

Details of other allied surveys have been described in the DPR of KBLP, Phase-I, April, 2010. However brief details of these investigations are covered in the following paragraphs.

2.1.2 Geology, Geophysical & Seismic Investigations

As a part of DPR, the pre-construction stage geotechnical and geological investigation of Daudhan Dam was carried out through Geological Survey of India (GSI), Bhopal. The note on pre-construction stage geotechnical investigation of Daudhan Dam site and the regional geology and local geology of the project area was prepared by GSI.

At Feasibility Report (FR) stage, geophysical investigations along the dam axis were carried out by the teams of Central Soil and Material Research Station (CSMRS),New Delhi during 1993.

The studies for site-specific design earthquake parameters for the proposed Daudhan Dam area have been carried out by the Department of Earthquake Engineering, IIT, Roorkee in 2008.

The work of foundation investigations (geotechnical) was carried out through GSI, Bhopal in association with CSMRS, New Delhi. The laboratory testing of rock core samples has been carried out by Rock Mechanics Wing of CSMRS, New Delhi. The findings and test results of the GSI and CSMRS are used in the design of suitable foundations for various components of the project by the Design Directorates of CWC.

2.1.3 Construction Material Investigations

2.1.3.1 Soils, Sand, Rock and Aggregates

The work of borrow area soil investigations, Laboratory investigations of rock & sand samples for use as coarse & fine aggregates and laboratory investigations of rock samples for their use as coarse aggregate in concrete during construction of the project for the proposed Daudhan Dam & link canal was carried out by CSMRS in May, 2007.

CHAPTER-III
HYDROLOGY AND WATER ASSESSMENT

3.0 Background

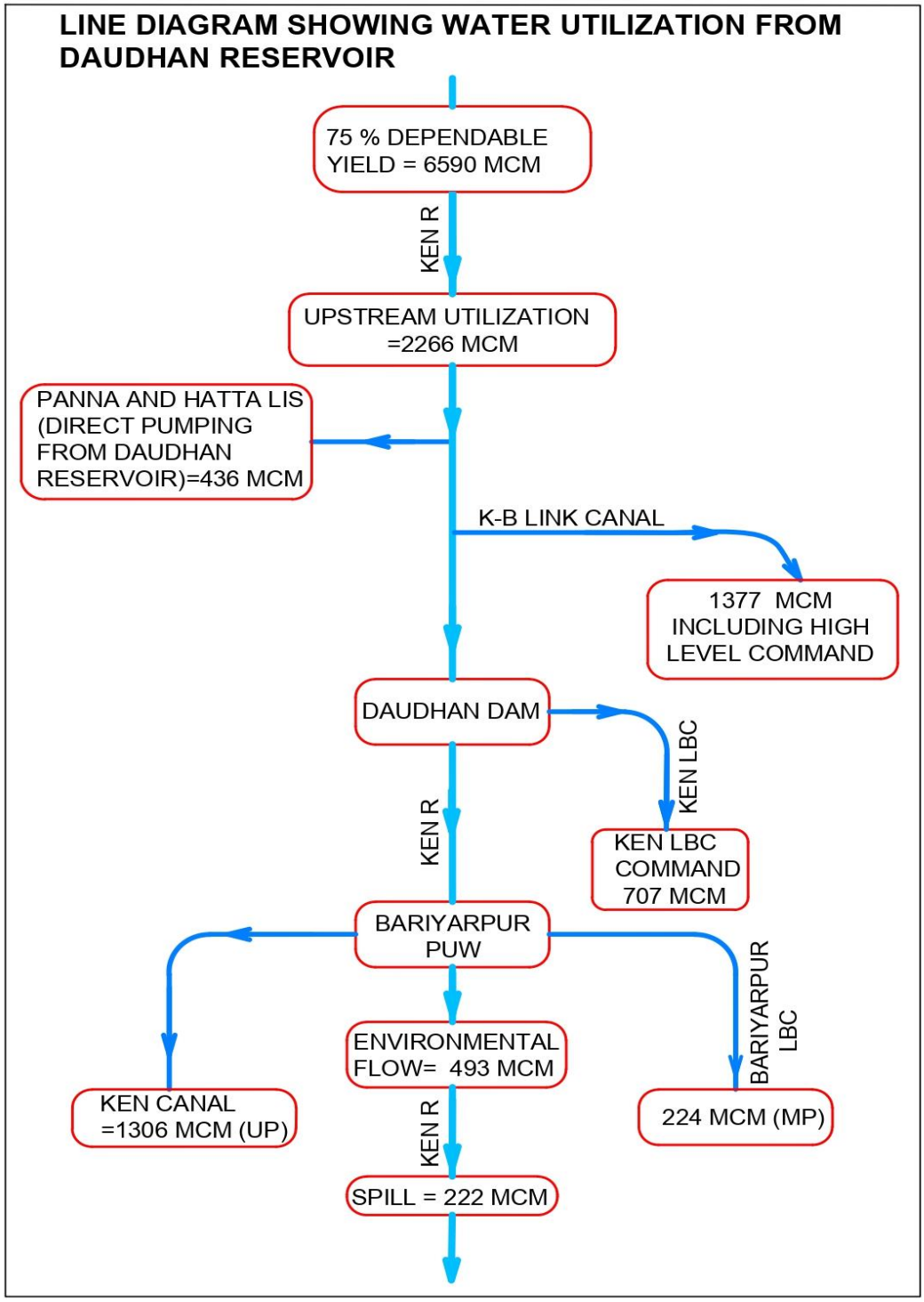
This chapter deals with hydrology and water assessment of various projects components under KBLP. The hydrology and water assessment of Ken Basin upto Daudhan Dam was completed by NWDA and included in DPR of KBLP, Phase-I (2010) and techno-economically approved by CWC in 2017. The hydrology and water assessment of Lower Orr Dam and Kotha Barrage was completed by NWDA and included in DPR of KBLP, Phase-II (2014). Whereas, the hydrology of Bina Complex Multipurpose Project was completed by Water Resources Department, Government of MP. Separate DPRs of Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project have been approved by CWC in the 148th meeting held on 17.02.2022. The component wise details of hydrology, water assessment and latest water planning are covered in this Chapter.

3.1 Daudhan Dam and Ken-Betwa Link Canal

3.1.1 Hydrology

The KBLP envisages diversion of surplus waters of Ken basin to water deficit Betwa basin by constructing a dam over the Ken River at Daudhan and a link canal from the dam to Barwa Sagar Dam, upstream of Parichha Weir in Betwa basin. The quantity of water proposed to be diverted has been modified according to addition/alteration of command area of MP from Daudhan reservoir after considering in-basin demands and downstream commitments as 1813 MCM (1377 MCM from K-B Link work Command including 221 MCM for High Level Command + 436 MCM Direct Pumping from reservoir for Panna & Hatta LIS) instead of 1074 MCM as proposed in DPR of KBLP, Phase-1 (April-2010). The hydrology of Daudhan Dam described under Chapter-III i.e. Hydrology and Water Assessment Chapter of DPR of KBLP, Phase-I is adopted in Comprehensive Report. Hydrological studies of KBLP were got carried out by National Institute of Hydrology (NIH), Roorkee in four parts and are furnished in Volume-III Hydrology, DPR of KBLP, Phase-I (April-2010).

Line diagram showing water utilization from Daudhan reservoir is given below:



The main objectives of the previous study are: (i) to estimate the water yield and conduct water balance studies for the Ken river up to the Daudhan Dam site, (ii) to estimate the design flood for the Daudhan Dam, (iii) to estimate the diversion flood for river diversion works at Daudhan Dam site during construction of the dam, (iv) to estimate evaporation losses for the reservoir at Daudhan (v) to estimate the sedimentation rate and revised elevation-area-capacity curve after 50 and 100 years sedimentation analysis for Daudhan reservoir, and (vi) to determine live storage capacity and conduct simulation study of the Daudhan reservoir.

3.1.2 Water Assessment

The catchment area of Ken river up to the proposed Daudhan Dam site is 19,633 sq km. The hydrological studies upto Daudhan Dam site have been carried out by using the data of Madla G&D site 150 km d/s of Daudhan Dam. The water available at Daudhan Dam at 75% and 50% dependability is 6590 MCM and 8431 MCM respectively.

Month wise water availability at Daudhan Dam at various dependabilities based on data of Madla G&D site is given below in **Table-3.1.**

Table-3.1

Water availability at Daudhan Dam at various dependabilities

Unit: MCM

Depend-ability	**Monthly Water Availability**												**Annual Water Availability**
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Average	116.2	108.3	45.1	6.3	32.5	204.1	1514.2	3815.9	2560.0	408.3	149.8	92.7	9289.1
50%	106.3	110.6	35.1	4.5	28.2	14.2	1043.7	3685.8	1400.5	281.7	147.5	63.4	8431.3
75%	75.8	73.3	29.3	3.3	16.7	4.1	622.9	2403.6	794.4	174.8	117.9	51.1	6589.8
90%	62.2	55.0	26.0	2.9	7.9	2.1	347.2	1849.0	502.8	133.4	80.8	44.7	4978.7
100%	57.0	49.5	24.5	2.6	5.8	1.6	65.8	1435.9	283.1	36.6	24.5	43.8	3830.1

As per tripartite MoU signed amongst the States of MP, UP and the Union Government on 25th August, 2005, MP shall have all rights to use the surplus yield. Further, as proposed by Government of MP that in years of scarcity, after reserving 2266 MCM (80 TMC) for upstream uses in MP and deducting quantity for mandatory flows and reservoir losses, the remaining water shall be shared by the two States in the ratio of 83 MP : 60 UP. An upstream use of 80 TMC should be kept for the proposed Ken Multi Purpose Project (KMPP) as decided during the meeting between Governments of MP & UP and Secretary, Irrigation & Power, Govt. of India held at New Delhi on 10.12.1981. The surface water demand for upstream use in MP is 2266 MCM and regeneration was considered in Agreement of 2005 as 442 MCM. The downstream water requirement from Daudhan Dam works out to be 2236.63 MCM in addition to 493 MCM of water is released d/s as committed flow for maintaining environmental and ecological flow of the river. The total surface water available at Daudhan Dam site is assessed as 6590 MCM at 75% dependability. The surface water balance at Daudhan Dam site was assessed as 2035 MCM at 75% dependability (i.e. 6590 MCM total availability of water at Daudhan Dam site at 75% dependability + 442 MCM regeneration – 2237 MCM d/s requirement – 2266 MCM u/s requirement – 493.60 MCM for environmental and ecological flow = 2035 MCM balance water at 75% dependability). Out of 2035 MCM of balance water available, 436 MCM of water is proposed to be utilized directly from reservoir for Panna and Damoh districts of MP through proposed Saleha Lift Irrigation Scheme and 1377 MCM of water will be used through Ken-Betwa link canal including 220.77 MCM High Level Command (Direct Pumping from Daudhan Reservoir). Evaporation losses from the reservoir are included in Water use. Thus, the remaining 222 MCM of water in extreme monsoon season will be available as spill water in the river.

Target monthly utilization of water from the Daudhan reservoir as per latest irrigation planning proposed by Water Resources Department, Government of MP and Government of UP is given in **Table-3.2.**

Table-3.2
Monthly Water Demands from Daudhan Dam

Unit: MCM

Month	Release of Water from Reservoir for Saleha	Drinking water demand for enroute command in MP	Drinking water demand for enroute command in UP	Irrigation demand for Ken command in UP	Irrigation demand for Ken command in MP through Bariyrpur barrage	Irrigation demand for Ken command in MP through Ken LBC	Surface water demand for Irrigation in enroute command (MP) Including Transmission Losses	Surface water demand for Irrigation in enroute command (UP) Including Transmission Loses	Water transfer at Parichha for utilisation in Lalitpur(UP) on substitution basis	Total Ken-Betwa link enroute demand (3+4+8+9+10)	Environmental flow (MCM) in the Ken river	Surface water from Daudhan + Diversion in Ken LBC + Diversion in Link canal (2+5+6+7+11+12)
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Jun	21.40	0.00	0	13.49	2.54	7.67	10.01	0.69	0.00	10.69	17.63	73.42
Jul	69.48	6.00	0	127.58	18.60	56.02	73.12	5.81	0.00	84.93	123.6	480.21
Aug	3.35	6.00	0	207.14	6.31	19.00	24.80	6.71	0.00	37.51	257.49	530.81
Sep	30.63	6.00	0	240.81	21.76	65.51	85.50	6.69	0.00	98.19	36.17	493.06
Oct	9.92	6.00	0	152.35	5.38	16.30	21.27	4.77	0.00	32.04	4.81	220.81
Nov	90.19	9.00	0	54.68	17.40	153.12	199.84	29.15	1.86	239.85	7.7	562.94
Dec	81.90	9.00	0	127.56	51.95	153.05	199.76	65.89	4.60	279.26	7.7	701.43
Jan	93.44	9.00	0	149.63	54.01	172.69	225.38	67.97	11.63	313.98	7.7	791.45
Feb	35.96	9.00	0	150.12	46.05	63.49	82.86	69.42	11.44	172.72	7.7	476.05
Mar	0.00	0.00	12	82.40	0.00	0.00	0.00	51.64	10.42	74.06	7.7	164.16
Apr	0.00	0.00	13	0.00	0.00	0.00	0.00	0.00	7.00	20.00	7.7	27.70
May	0.00	0.00	9.79	0.00	0.00	0.00	0.00	0.00	3.98	13.77	7.7	21.47
Total	**436.29**	**60.00**	**34.79**	**1305.77**	**224.02**	**706.84**	**922.55**	**308.73**	**50.93**	**1377.0**	**493.60**	**4543.51**

3.1.3 Design Flood

The design flood for Daudhan Dam has been estimated using two approaches: (i) unit hydrograph and (ii) frequency analysis. The design flood estimated by unit hydrograph method is found to be 57202 cumec with time to peak at 49 hours and the time base of the hydrograph as 123 hours. The diversion flood for the project is estimated at 1118 cumec. The design flood by unit hydrograph method i.e. 57202 cumec duly appraised and agreed by CWC is adopted in DPR for design purposes.

3.1.4 Reservoir Sedimentation

The total sediment deposition in the reservoir during 50 and 100 years are estimated to be 206.1 MCM and 361.73 MCM respectively. The new zero elevations after 50 years and 100 years have been worked out as 230.9 m and 236.4 m respectively. The total sediment deposited in the reservoir during 50 and 100 years at different elevations have been worked out and given in **Table-3.3**.

Table 3.3
Reservoir Sedimentation

Reservoir Level	**Sediment Deposition in MCM**	
	After 50 years	After 100 years
Up to 231 m	49.3	50.3
Above 231 m	156.8	311.4
Up to 236.4 m	85.7	98.0
Above 236.4 m	120.4	263.7
Up to 244 m	127.5	185.7
Above 244 m	78.6	176.0

Original and revised (after 50 and 100 years) Elevation-Area-Capacity table for Daudhan reservoir is given in **Table-3.4**.

Table-3.4

Original and Revised Elevation-Area-Capacity table for Daudhan Reservoir (after 50 and 100 years)

Elevation (m)	Original		Revised			
			After 50 years		After 100 years	
	Area (ha)	Capacity (MCM)	Area (ha)	Capacity (MCM)	Area (ha)	Capacity (MCM)
216.00	0	0.00	0	0.00	0	0.00
220.00	150	2.00	147	0.00	147	0.00
225.00	400	15.25	398	0.00	398	0.00
230.00	700	42.40	698	0.00	698	0.00
230.90	735	49.48	733	0.00	733	0.00
234.50	875	77.77	874	4.34	874	0.00
235.00	981	82.40	980	5.62	980	0.00
235.50	1050	87.48	1049	7.39	1049	0.00
236.40	1374	100.77	1373	15.08	1373	0.00
238.00	1950	124.40	1949	28.74	1949	7.76
241.00	2550	191.70	2549	79.20	2549	38.55
244.00	3200	277.77	3199	150.27	3199	92.10
247.00	3500	378.24	3499	237.41	3499	163.67

250.00	3950	489.92	3949	337.30	3949	249.80
253.00	4450	615.84	4449	452.86	4449	353.23
256.00	4750	753.82	4749	581.77	4749	471.56
259.00	5150	902.28	5150	722.39	5150	603.02
262.00	5400	1060.51	5400	873.92	5400	746.72
265.00	5800	1228.48	5800	1036.23	5800	902.43
268.00	6025	1405.84	6025	1208.93	6025	1069.66
271.00	6625	1595.52	6625	1394.84	6625	1251.18
274.00	6775	1796.52	6775	1592.91	6775	1445.82
277.00	7025	2003.51	7025	1797.73	7025	1648.11
280.50	7300	2254.18	7300	2046.74	7300	1895.17
283.50	7800	2480.64	7800	2272.41	7800	2119.93
287.60	8650	2817.71	8650	2609.18	8650	2456.35
288.00	9000	2853.01	9000	2644.48	9000	2491.65

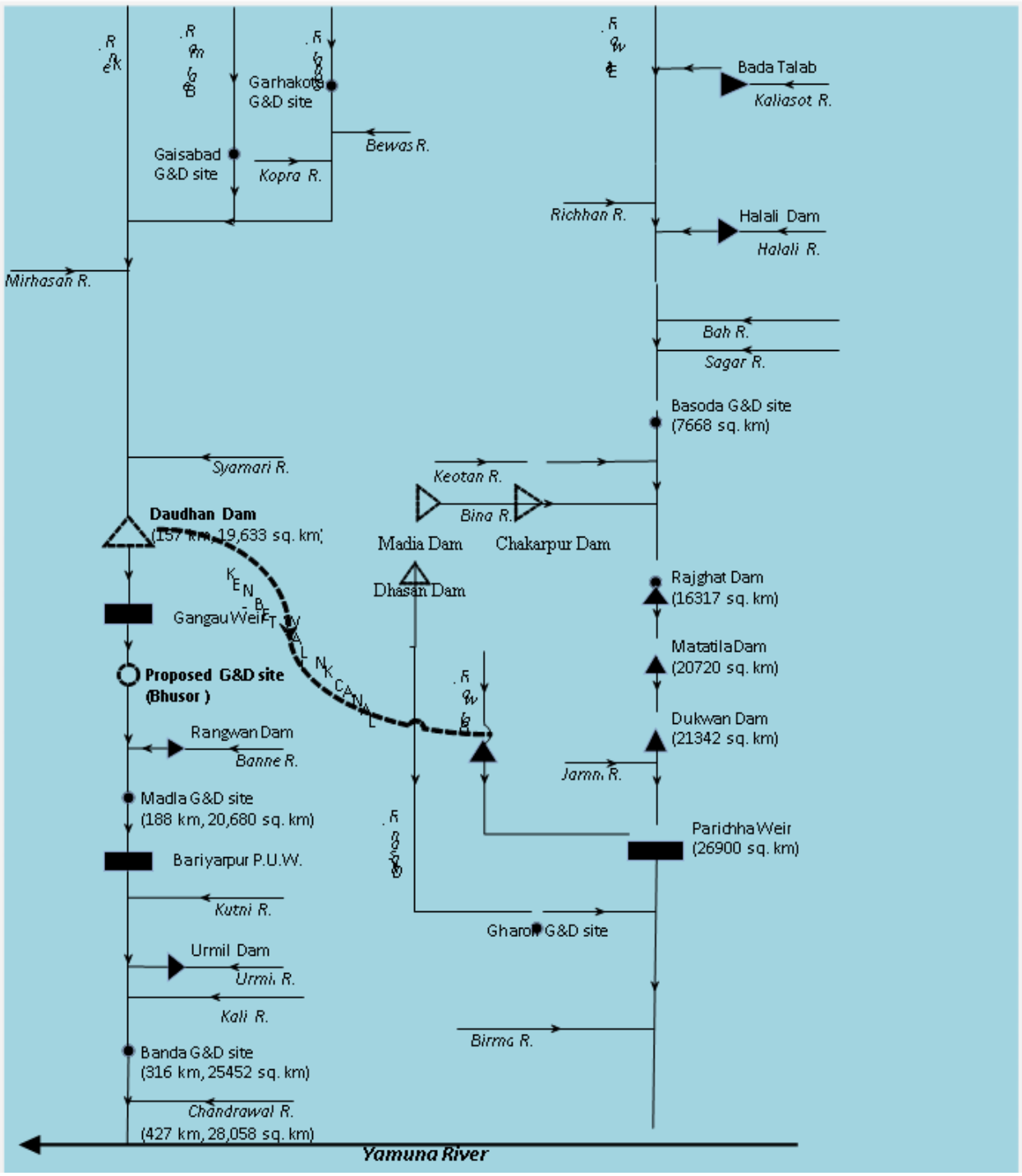
3.1.5 Evaporation Losses from Daudhan Reservoir

The gross storage capacity of Daudhan Dam is 2853 MCM and live storage capacity is 2684 MCM out of which 81 MCM is reported as evaporation losses from the Daudhan reservoir. Highest evaporation losses of 100.85 MCM took place during year 1990-91 and the lowest evaporation losses 42.13 MCM was in year 1981-82.

3.1.6 Schematic Diagram of the Ken-Betwa River System

Schematic diagram of Ken and Betwa basin including major structures (existing and proposed) and the link canal is shown below:

Schematic Diagram of the Ken-Betwa River System with Major Structures (existing and proposed) and the Link Canal



CHAPTER – IV

DESIGN ASPECTS

4.0 Background

The designs of Daudhan Dam, Ken-Betwa link canal, Ken Left Bank Canal, Lower Orr dam and Kotha Barrage were carried out by CWC as detailed in respective DPRs. The design of Bina Complex Multipurpose project has been done by Government of MP and adopted in this report. The component wise details of design are briefly described below:

4.1 Daudhan Dam and its Canal System

The works related with the design aspects of various components of the project have been carried out by different concerned Directorates of CWC, based on the inputs from GSI, CEA, NIH, IIT, Delhi, IIT, Roorkee, CSMRS, etc.

Details of Design aspects of Headworks, Tunnels and Power Houses I & II are described in the Chapter-IV "Design Aspects" of DPR of KBLP, Phase- I (April-2010). In this DPR, the design of Ken - Betwa link main canal has been done by NWDA while the design of Ken LBC and Panna-Hatta lift pressurized pipe micro irrigation including pipe line supplied by WRD, Govt. of MP and same are adopted in the DPR.

The salient details of the designs carried out by respective Directorates of CWC and supplied by Water Resources Department, Govt. of MP in respect of various main components are briefly discussed in this chapter.

4.1.1 Design Flood

The design flood for Daudhan Dam has been estimated using two approaches viz., (i) unit hydrograph, and (ii) frequency analysis. The design flood estimated by unit hydrograph method is found to be 57202 cumec with time to peak at 49 hours, and the time base of the hydrograph as 123 hours, which is duly approved by CWC and considered for design.

4.1.2 Reservoir Sedimentation

The type of Daudhan Reservoir is considered as gorge type. For computation of rate of silt load expected at Daudhan Reservoir, the silt observations carried out at Banda G & D site located on Ken river on D/S of the proposed dam site are considered. This sediment rate of 329.8 m^3/sq km/year has been considered appropriate for design purpose.

4.1.3 Free Board

The basic requirement of free board for the earth dam is that the dam should not be overtopped under design wind conditions. The procedure adopted is based on recommendations of IS 10635-1993 (Reaffirmed 1998) "Guidelines for free board requirements in Embankment dams". For normal freeboard the wind velocity at the dam site over land has been taken as 39 m/s. The computed free board comes out to be 5.0 m for and accordingly the top of dam has been provided as 293.0 m against FRL of 288.0 m. The total height of dam will be 77 m above deepest river bed level of 216.0m.

4.1.4 River Diversion Arrangement

NIH, Roorkee has analysed the flood characteristics and suggested 1 in 25 year non monsoon flood and 1 in 100 year monsoon flood at the dam site for diversion. Since the earth dam is located in the deepest bed level of the river and concrete gravity dam on the left flank, diversion flood of 1 in 100 years return period which works out to 30,794 cumechas been considered in the design of river diversion arrangement.

4.1.5 Daudhan Earth Dam – Design criteria & Stability Analysis

A homogenous earth dam 1233 m long with a height of 77 m above deepest river bed level is proposed. The U/S part of the main dam will be used as a cofferdam thereby fully utilizing the available construction material. Daudhan dam of KBLP is a 77 m high dam with top at EL 293.00 m and having river bed EL of 216.0 m. The left side of the dam is wrapped around non-overflow blocks of 120m length. The right flank is resting on hill slope.

The stability analysis has been carried out by a software based on Swedish slip circle or Fellenius method.

4.1.6 Daudhan Concrete Dam/ Non over Flow Section / Stability analysis/Spillway section

Daudhan Dam consists 30.0 m long Non Over Flow blocks on the left side, 232.0 m long on the right side (112 m long for Power and 120 m long Non Over Flow blocks for Earthen Dam) with a 536.0 m long spillway on the left flank (27 bays of 16.0 m width with 26 piers of 4.0 m width) to pass a peak flood of 57,202 cumec.

4.1.6.1 Non Over Flow Section

The stability analysis for Non Over Flow Section has been done at the deepest foundation level i.e., 232.0 m as per IS-6512-1984.

4.1.6.2 Spillway

The overflow section has been designed to pass peak flood of 57,202 cumec keeping crest level at 270.00 m and MWL 288.00 m through the length of the spillway section (over flow section). The stability analysis for Overflow section has also been done at the deepest foundation level i.e. 232.0 m as per IS-6512-1984.

4.1.6.3 Gates

Radial gates shall be provided on Spillway of Daudhan Dam. There will be Irrigation Sluice Gates and various Intake Gates. The description of various gates is as follows.

A) Spillway Radial Gates

27 Nos. Spillway Radial Gates of size 16 m X 18.5 m will be provided to control the flow of spillway. These gates shall be operated by D/S twin cylinder Hydraulic Hoists The sill level of gate shall be 269.50 m and trunion shall be installed at 277.0 m. The radius of gate leaf shall be kept as 21.5 m. The gate shall be designed as per IS: 4623.

B) Spillway Stoplogs

Three sets of stoplogs shall be provided to carry out the maintenance of spillway Radial Gate. Each set of stoplogs shall consist of ten units of 16000 mm X 1900 mm. Bottom Unit shall be non-interchangeable type. All other units shall be interchangeable. The stoplogs shall be connected to Gantry Crane through Lifting Beam and Rams horn Hook.

C) Gantry Crane

The Spillway Stoplogs shall be operated by moving Gantry Crane. The tentative capacity of gantry crane shall be 60 Tonne. The Gantry Crane shall have hoist machinery mounted on trolley. The trolley shall be of moving type. The crane shall be designed as per IS: 3177 and IS: 807. 10 Tonne Auxiliary hoist shall be provided to operate the irrigation sluice Stoplogs.

4.1.6.4 Energy Dissipation Arrangement

Energy dissipation arrangement envisaged is that of ski-jump bucket type. IS-7365-1985 stipulates that ski-jump bucket is used when the tail water depth is insufficient for the formation of hydraulic jump and when the bed of the river channel on D/S consists of sound rock. However, based on site condition and model studies sufficient precaution would be taken in design at preconstruction stage.

4.1.6.5 Openings through Daudhan Dam

In all four openings are provided in the concrete section of the Daudhan Dam of which 2 openings act as intake for the dam toe PH-I and II openings act as river sluices to release water to meet D/S requirement when the PH-I is not in operation. It has been planned to release a water of 40 cumec through sluice when the water level in reservoir reduces to below EL 252.00 m. However the sluices can be operated when the water is at crest. Accordingly two numbers of sluices size 1.6 m x 2.4 m have been proposed at EL 237.2m in block no 27. Gates for river sluice will be operated through operation Chamber provided at EL 242.60 m. there will be direct approach to this gallery from the Elevator shaft and staircase provided in Block No. 30.

4.1.6.6 Dam Sluice Gate

Two numbers sluice shall be provided in Dam to reduce the flow in the main river course. Provision of service, emergency and bulkhead gates shall be provided. Service and Emergency gates shall be slide type. These gates shall be operated under unbalance water head condition by Hydraulic Hoists.

4.1.6.7 Instrumentation

This involves providing different types of instruments in the structure for measurement of parameter such as surface displacements, deformations, load variations, measurement of stress, seepage, uplift pressure levels, temperature etc.The main objectives of the instrumentation are:

1. To check safety of the structure during construction, first filing of reservoir and during long term service operation.
2. To keep a constant watch on the performance and to identify distress spots requiring remedial measures.
3. To have cumulative record of structural behaviour which can be analysed and used to verify the design assumptions & formulation of more realistic design criteria for future project designs.
4. To improve understanding of influence of various parameters on Dam behaviour.
5. To assess the effectiveness of future remedial actions.

Design and detailing of instrumentations has not been done at this stage. Therefore, this aspect must be taken care at the time of implementation of the project. However, the overall cost has been taken as 1 % of the cost of relevant structure for automation of instrumentation.

4.1.7 Ken-Betwa Link Canal

4.1.7.1 Upper Level Tunnel

The diversion of 1377 MCM water (earlier 1074 MCM) proposed through Ken-Betwa link canal (including transmission losses) to serve command of MP and UP States in the enroute. To facilitate flow of water into Ken-Betwa Link canal, an Upper level tunnel of 1929 m length is proposed from the Daudhan

Reservoir. The lined concrete tunnel having diameter of 8.5 m, S shaped and slope of 1:800 is proposed to pass 159.9 cumec of discharge efficiently from above tunnel and velocity of water passing through tunnel will be in permissible limit. Design of tunnel is given at **Anneuxure-4.1**.

The hydraulic design of tunnel is as per IS code 4880-Part III (Latest revision).The invert level at the start of the tunnel is EL 256.0 m and at the end of the exit portal is EL 253.601 m. One number Service Gate and one number Emergency gate of size 7.4 m x 7.4 m shall be provided in Upper Level Tunnel Intake. The gates shall be Fixed Wheel Vertical Lift type.

4.1.7.2 RCC Syphon Duct

Under modified proposal given in Comprehensive Report prepared in 2019, length of the Ken-Betwa link canal was proposed to reduce to 176 km from 218 km. This reduction in the length is due to taken over the proposed command of Ken-Betwa link canal on the both side of Dhasan river by Bansujara and Tarped project of Government of MP. But CWC vide their letter no. T-11308/4/2020-BCD(NWS) DTE mentioned that due to economic un-viability, silt related management issues and O&M challenges, the proposal for the 32 km long alternate alignment of Ken-Betwa Link Project may not be feasible. Hence, the original proposal for 74 km long (open channel) is better and safe. (Letter of CWC is attached as **Annexure-4.2**) Therefore, length of the Ken-Betwa link canal again proposed to be 218 Km.

4.1.7.3 Reach wise description of Modified Ken-Betwa Link Canal

The Ken-Betwa Link canal which takes off from the de-silting basin located after the exit portal of the Upper Level tunnel, traverses a total length of 218.695 km and will out falls into Barwa Sagar reservoir. The canal will start with FSL of 256.931 m (at RD 500 m) from Daudhan Dam and will outfall in Barwa Sagar at FSL of 221.000 m.

The design discharge of the canal at head worked out to 159.9 cumec against 76 cumec in original DPR 2010. The bed width and FSD at start of canal are 13.2 m and 5.1 m respectively. The alignment of canal is almost same as adopted in the DPR-2010. Since the entire water planning of Ken-Betwa link

canal has been modified, therefore the reach wise canal size has been redesigned and given at **Anneuxre-4.3**. A provision of 10% irrigation demand has been made towards rush irrigation demand in canal capacity. The reach wise design details of Ken-Betwa Link Canal are given in the Table-4.1.

Table 4.1
Reach wise details of Link Canal Sections

Sl. No.	Canal reach	Bed Width m	FSD m	Design Discharge cumec	Bed Slope	Velocity m/sec
1	From RD 0 to 18 km	13.2	5.1	165.05	1:9000	1.36
2	From RD 18 to 44 km	13.2	4.6	134.46	1:9000	1.28
3	From RD 44 to 71 km	13.2	4.3	117.77	1:9000	1.23
4	From RD 71 to 87 km	13.2	3.3	70.71	1:9000	1.07
5	From RD 87 to 102 km	13.2	3	59.07	1:9000	1.01
6	From RD 102 to 171 km	10	3	45.39	1:10000	0.98
7	From RD 171 to 207 km	10	3	42.70	1:11300	0.98
8	From RD 207 to 216 km	10	3	42.70	1:11300	0.89
9	From RD 216 to 218 km	10	3	41.43	1:12000	0.89
	Transfer to Parichha	10	3	41.43		

4.1.7.4 Design of Pumping System of Ken-Betwa Link Main Canal

Details design of pumping station for serving the enroute and high elevated command of MP&UP through main canal has been done by Govt. of MP and adopted with slight modifications wherever is necessary to keep consistency in data. Details of design parameters of pumping system of Ken-

Betwa Link Main Canal for MP and UP are given in **Table -4.2** and **Table- 4.3** respectively.

Table -4.2
Design Features of Pumping stations (MP)

Sr. No.	Particulars	Unit	PH1	PH1	PH2	PH3	PH4	PH5	PH6	PH7
			Chhatarpur	Chhatarpur	Chhatarpur	Chhatarpur	Chhatarpur	Chhatarpur	Tikamgarh	Niwari
	RD (KM)		18	18	44.4	70.7	86.3	102.0	171.0	207.0
1	CCA	Ha	23678	20000	22730	29322	15823	20860	25112	25000
2	Duty	lit./sec/ha	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
3	Discharge	Cumecs	9.47	8.00	9.09	11.73	6.33	8.34	10.04	10.00
4	CCA Level	M	300.00	345.00	270.00	270.00	255.00	280.00	290.00	240.00
5	Diameter	M	2.40	2.20	2.35	2.67	1.96	2.25	2.47	2.46
6	Velocity	M/S	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10
7	Length	km	5.00	25.00	2.00	2.00	2.00	2.00	2.00	2.00
8	Frictional Loss	M	4.84	26.75	1.98	1.70	2.46	2.09	1.87	1.87
9	Provision for exit gradient	M	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00
10	D.C LEVEL	M	349.84	416.75	316.98	316.70	302.46	327.09	336.87	286.87
11	BACK									
12	MDDL	M	252.00	252.00	245.80	244.70	243.04	241.03	232.75	223.50
13	Static Head	M	97.84	164.75	71.18	72.00	59.42	86.06	104.12	63.37
14	Designed Head	M	97.84	164.75	71.18	72.00	59.42	86.06	104.12	63.37
15	required power	KW	10873.71	15465.93	7594.49	9910.02	4413.10	8426.03	12272.51	7436.57
16	required power	MW	10.87	15.47	7.59	9.91	4.41	8.43	12.27	7.44
	Total CCA 182525 ha									
	Total Power Requirement in 76.39 MW									

Table -4.3
Design features of Pumping stations (UP)

Sl. No.	Particulars	Pumping station 2	Pumping station 3	Pumping station 4
		(From RD 70.7 km of KBL)	**(From RD 171 km of KBL)**	**(From RD 207 km of KBL)**
		Mahoba& Enroute command	**KBL**	**KBL**
1	CCA in ha	42214	5568	7270
2	Duty in lit /Sec/ha	0.40	0.40	0.40
3	Discharge in cumec	16.89	2.23	2.91
4	Max CCA Level in m	250	241	230
5	MDDL in m	245	233.6	225.8
6	Velocity in m/sec	1.8	1.8	1.8
7	Diameter of pipe in m	3.46	1.26	1.43
8	Length in m	7000	10000	9000
9	Static Head in m	5.0	7.4	4.2
10	Frictional Loss in m	3.34	13.15	10.36
11	Command area loss in m	9.60	18.00	9.60
12	Provision for exit gradient and filter losses in m	25.00	25.00	25.00
13	Design Head in m	42.94	63.55	49.16
14	Total Power Requirement (MW)	9.315	1.818	1.836
15	Total Power Requirement (MW)	**12.97**		

4.1.8 Ken Left Bank Canal (LBC) (including connecting canal)

The command area under the Ken left bank canal proposed from Lower Level Tunnel works out to 139848 ha utilizing 706.842 MCM of water against 172853 ha utilising 1007.41 MCM of water in DPR of KBLP prepared earlier Phase-I. After joint visit of officer of NWDA and WRD,Govt of MP on dated 1stNovember, 2014 it was found that some of area proposed under Ken LBC as reported in DPR of 2010 was developed by the WRD, Govt. of MP through existing projects and some area proposed will be covered by the Ken-Betwa link main canal through lift as explained in Para 4.1.7 itself. Pressurized pipe micro irrigation system has been introduced in the entire command of Ken LBC. Therefore, direct pipe line of 90 km length and 3.19 m diameter is proposed instead of open Canal system of Ken LBC. Design features of Ken LBC (Pipeline) are given below in **Table-4.4.**

Table 4.4
Design Features of Pumping Stations of Ken LBC

Sl. No.	Particulars	Lower Level Tunnel
1	CCA in ha	139848
2	Duty in lit /Sec/ha	0.41
3	Discharge in cumec	57.34
4	Max CCA Level in m	210
5	MDDL in m	246
6	Velocity in m/sec	1.8
7	Diameter of telescopic pipe in m	3.19
8	No of Rising Main	2.00
9	Length in m	90000
10	Static Head in m	-36.0
11	Frictional Loss in m	26.83
12	Command area loss in m	18.00
13	Provision for exit gradient and filter losses in m	5.00
14	Design Head in m	13.83
15	Total Power Requirement (MW)	10.2

Connecting canal of 2.1 km length will join tail race channel of PH-II to Ken LBC to convey the water from the Daudhan Dam to Ken LBC Command.

4.1.9 Panna and Hatta lift system

The total (CCA) under Panna & Hatta lift system covered 90101 ha utilizing 436.287 MCM of water. Pressurised pipe micro irrigation system proposed in the entire command area. Design features of Panna and Hatta LIS are given below in **Table-4.5.**

Table-4.5
Design Features of Pumping Stations of Panna and Hatta area

Sr. No.	Particulars	KBL Saleha lift from Daudhan reservoir in Panna and Hatta-Pump house No-5			
		Rising Main in Tunnel	Amanganj hose irrigation including 20101 ha in Hatta Dam	Gunnore & Devendranagar MI	Water Supply for Panna
1	CCA in ha	90101	45101	45000	0
2	Duty in lit /Sec/ha	0.41	0.43	0.39	
3	Discharge in cumec	32.92	17.29	15.63	5.00
4	Max CCA Level in m	342.4135	325.00	350.00	400.00
5	MDDL in m	246	337.58	337.77	325.00
6	Velocity in m/sec	1.8	1.5	1.5	1.5
7	Diameter of pipe in m	4.83	3.83	3.64	1.20
8	Length in m	7000	18000	21000	40000
9	Static Head in m	96.4	-12.6	12.2	75.0
10	Frictional Loss in m	2.39	5.39	6.61	38.23

11	Command area loss in m	0.00	21.60	25.20	0.00
12	Provision for exit gradient and filter losses in m	0.00	5.00	25.00	5.00
13	Design Head in m	98.81	19.41	69.04	118.23
14	Total Power Requirement (KW)	77835	3919	12605	6904
15	Total Power Requirement (MW)	**101.26**			

CHAPTER-V

RESERVOIR & POWER

5.0 Background

The present chapter deals with reservoir and power assessment of various projects components under KBLP. The reservoir simulation and power studies of Daudhan Dam was carried out by NIH, Roorkee and CEA and included in DPR of April,2010.The reservoir simulation study of Lower Orr Project and Kotha Barrage were carried out by NIH, Roorkee and included in DPR of January,2014.The reservoir simulation and power studies of Bina Complex Multipurpose Project were carried out by Water Resources Department, Government of MP. The DPRs of Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project are under techno-economic appraisal in CWC. The component wise details of reservoir capacity, simulation and power assessment are described in the subsequent paras.

5.1 Daudhan Reservoir

The gross availability of water at 75% dependable annual yield has been worked out as 6590 MCM as per hydrological studies done by NIH, Roorkee. Hydrological controlling levels of dam were fixed after detailed design of various components related to project. Brief details are given in**Table-5.1**.

Table-5.1
Levels fixed as per Simulation Study

Controlling Levels	**Elevation(m)**
• FRL of Daudhan reservoir	288.0
• MWL of Daudhan reservoir	288.0
• FSL of link canal	257.0
Minimum Levels for Irrigation	
• Ken-Betwa link through upper level tunnel	256.0
• Ken Left Bank Canal through lower level tunnel	246.0
• D/s requirement through PH-I	246.0

Controlling Levels	Elevation(m)
Upper Level Tunnel	
• Invert level at inlet	256.0
• Crown level at inlet	262.0
• Invert level at outlet	253.601
Lower Level Tunnel and Power House-II	
• Invert level at inlet	244.6
• Crown level at inlet	250.1
• Invert level at outlet	243.2
• MDDL for PH-II considering vortices criteria & 5.5m dia. of tunnel	253.1
• MDDL for PH-II proposed by CEA after carrying out preliminary power potential study	260.0
Power House-I (at toe of dam)	
• Invert level of pen stock at inlet	240.0
• MDDL for PH-I considering vortices criteria & 6m dia. of tunnel	252.0

5.1.1 Elevation-Area-Capacity Table of Daudhan Dam

Details of reservoir &power houses are described in the Chapter-V "Reservoir and Power" of DPR of KBLP, Phase-I (April, 2010). No parameters of Daudhan Dam are required to be changed.

The original and revised Elevation-Area-Capacity Table of Daudhan reservoir, as considered for the reservoir simulation studies are given in **Table-5.2**.

Table-5.2

Original and Revised Elevation-Area-Capacity Table of Daudhan Reservoir

Elevation (m)	Original		Revised			
			After 50 Years		After 100 Years	
	Area (ha)	Capacity (MCM)	Area (ha)	Capacity (MCM)	Area (ha)	Capacity (MCM)
288.00(FRL)	9000	2853.008	9000	2644.479	9000	2491.645
287.6	8650	2817.711	8650	2609.182	8650	2456.35
283.5	7800	2480.636	7800	2272.408	7800	2119.926
280.5	7300	2254.177	7300	2046.736	7300	1895.175
277	7025	2003.505	7025	1797.729	7025	1648.112
274	6775	1796.516	6775	1592.907	6775	1445.822
271	6625	1595.521	6625	1394.841	6625	1251.178
268	6025	1405.842	6025	1208.926	6025	1069.661
265	5800	1228.478	5800	1036.234	5800	902.426
262	5400	1060.513	5400	873.921	5400	746.716
259	5150	902.278	5150	722.392	5150	603.023
256	4750	753.819	4749	581.773	4749	471.564
253	4450	615.843	4449	452.858	4449	353.232
250	3950	489.917	3949	337.304	3949	249.796
247	3500	378.235	3499	237.41	3499	163.675

Elevation (m)	Original		Revised			
			After 50 Years		After 100 Years	
	Area (ha)	Capacity (MCM)	Area (ha)	Capacity (MCM)	Area (ha)	Capacity (MCM)
244	3200	277.769	3199	150.267	3199	92.097
241	2550	191.703	2549	79.198	2549	38.548
238	1950	124.404	1949	28.736	1949	7.757
235.5	1050	87.48	1049	7.394	1373	0
235	981	82.403	980	5.616	1049	0
234.5	875	77.766	874	4.34	980	0
230.9	735	49.475	733	0	874	0
230	700	42.402	698	0	698	0
225	400	15.249	398	0	398	0
220	150	2	147	0	147	0
216	0	0	0	0	0	0

From the above, it can be seen that the gross storage available at FRL is 2853 MCM.

5.1.2 Power

Two power houses viz. PH-I & PH-II have been proposed at Daudhan Dam under the project. The PH-I will have an installed capacity of 60 MW (2 x 30 MW) whereas the PH-II will have an installed capacity of 18 MW (3 x 6 MW). The average annual generation of power from PH-I & II has been estimated to be 219.03 Million Units. The power potential study of the PH-I and PH-II was carried out by CEA, New Delhi on the basis of releases from the

Daudhan Dam computed in KBLP, Phase-I (April,2010) and brief are given in following paras. However, it is to mention that the power potential study need to be reviewed at the time of EPC contract for implementation. 76.39 MW and 12.97 MW power is required to develop micro irrigation system under Ken Betwa link canal command in the enroute including direct pumping from reservoir in MP and UP respectively. Besides above, 10.2 MW is required to develop pressurized pipe micro irrigation system under Ken LBC command and 101.26 MW for Panna and Hatta LIS (Lift Irrigation Scheme).

5.1.2.1 Tailrace Water Level (TWL)

(a) Daudhan Power House (PH-I)

The top of pond level at the existing Gangau Weir is 234.9 m while the minimum operating level is 232.4 m. A constant average TWL of 234 m has been adopted for PH-I for the power potential study.

(b) Lower Level Tunnel Power House (PH-II)

FSL of the proposed Ken LBC would be 246.34 m. In absence of any information on tail water data for the proposed power house, a constant average TWL of 246 m has been adopted for PH-II for the power potential study.

5.1.2.2 Minimum Draw Down Level (MDDL)

The project envisages the three irrigation outlets at different levels from Daudhan reservoir to cater to the d/s irrigation and drinking water requirements. The details are given in **Table-5.3**.

Table-5.3

Levels & Storages for Irrigation Outlets

Description of Irrigation Outlet	Draw Down Level from Irrigation Considerations (m)	Gross Storage Available (MCM)
For releasing water to Bariyarpur through Ken river with generation at PH-I	246	344.70
For Ken command through lower level tunnel with generation at PH-II	246	344.70
For Barwa Sagar through Ken-Betwa link canal	256	753.20

5.1.2.3 Draw down Level for Power Generation

The draw down levels for power generation at PH-I and PH-II would be 252 m and 260 m from the consideration of permissible head variations on Kaplan turbine which has been proposed for the two power houses. No power generation has been proposed across the Ken-Betwa link canal.

As per the sedimentation studies carried out by NIH, Roorkee, the new zero elevation after 50 years and 100 years of sedimentation would be 230 m and 235.5 m respectively, which are considerably lower than the proposed outlets for irrigation and the draw down level for power generation and therefore, it may not pose any problems.

The live storage available between the FRL 288 m and the proposed draw down levels of 252 m and 260 m for power generation at PH-I and PH-II respectively would be 2279.14 MCM and 2541.75 MCM respectively.

5.1.2.4 Head Availability & Head Loss in Water Conductor System

For carrying out the power potential study, available head and the head loss in water conductor system for PH-I and for PH-II have been considered as given below in **Table-5.4**.

Table-5.4

Maximum and Minimum Head for Power Houses

	PH-I				PH-II			
	Gross Head	Head Loss		Net Head	Gross Head	Head Loss		Net Head
	m	%	m	m	m	%	m	m
Max. Head	54	2%	1.08	52.9	42	5%	2.10	39.9
Min. Head	18	4%	0.72	17.3	14	8%	1.12	12.9
Avg. Head	43.33	4%	1.73	41.6	32.67	9%	2.94	29.7

From the above table, it is observed that the maximum gross head in case of PH-I and PH-II would be around 54 m and 42 m with minimum head as 18 m and 14 m respectively. Accordingly, for the above head range, maximum head would be three times the minimum head, which is permissible for operation of Kaplan turbine proposed for the above project.

5.1.2.5 Operation of the Power Houses

The KBLP is primarily to be operated in the interest of irrigation and drinking water supply. There is no re-regulating barrage/structure in the d/s of PH-II. Therefore, the power house is proposed to be operated as a Base Load Station.

The PH-I would be operated as a Peaking Station with re-regulation at the existing Gangau Weir where adequate diurnal pondage is available for re-regulation of the daily peaking flows.

Due to availability of diurnal pondage at Gangau Weir, the PH-I has been proposed for operation as a peaking station. For selection of installed capacity, simulation studies have been carried out for Daudhan reservoir and annual energy benefits from the project in 90% definable year have been estimated from

the project. The detailed study is given in Chapter-V of DPR of KBLP, Phase-I (2010). For selection of installed capacity for PH-II, annual energy benefits have been estimated from the project in 90% dependable year. The detailed study is given in Chapter-V of DPR of KBLP, Phase-I (2010).

The annual energy benefits and the power house discharges are given in **Table-5.5.**

Table-5.5

Annual Energy Benefits and Power House Discharges

	PH-I	**PH-II**
Installed Capacity	60 MW	18 MW
Unit Size	30 MW	6 MW
Power House Discharge		
At Max. Head	131 cumec	48 cumec
At Min. Head	93 cumec	35 cumec
At Average Head	164 cumec	61 cumec
Annual Energy Benefits	188.5 MU	44.54 MU

The detailed month-wise power study for the initial scenarios of u/s utilizations, corresponding to the installed capacity of 60 MW at PH-I and 18 MW at PH-II is given in Chapter-V of DPR of KBLP, Phase-I (April, 2010).

5.1.2.6 Summary of the Study

Based on the studies carried out, the results of the power potential study for KBLP are summarized in **Table-5.6**.

Table-5.6

Location & River	Across the Ken River near Daudhan village in MP, about 19 km from Chattarpur-Panna State Highway
Height of dam	about 77 m
FRL	288 m
Gross storage at FRL (Daudhan)	2853 MCM
Draw Down Level for power generation	
PH-I	252 m
PH-II	260 m
Draw Down Level for Irrigation	
For releasing water to Bariyarpur i) through PH-I	246 m
ii) through PH-II for KMPP Command	246 m
iii) through Ken-Betwa link for Barwa Sagar	262 m
Annual average inflow data	1981-82 to 2002-03
(Initial scenario) Maximum	18113 MCM (year 1999-2000)
Minimum	3443 MCM (year 1981-82)
Average	8536 MCM
Average flows during July-October	94.5 %
Annual average inflow data	1981-82 to 2002-03
(Final Scenario) Maximum	17525 MCM (year 1999-2000)
Minimum	2950 MCM (year 1981-82)
Average	8142 MCM
Average flows during July-October	98.3 %
TWL	
PH-I	234 m
PH-II	246 m
Operation of power station	

PH-I	Peaking Operation	
PH-II	Base Load Operation	
Gross head	Max.	Min.
PH-I	54 m	18 m
PH-II	42 m	14 m
Power house discharge	PH-I	PH-II
At Max. Head	131 cumec	48 cumec
At Min. Head	93 cumec	35 cumec
At Average Head	164 cumec	61 cumec
Pondage availability at Gangau Weir	About 5 MCM	
Unit size & installed capacity		
PH-I	2 x 30= 60 MW	
PH-II	3 x 6 = 18 MW	
Annual energy of generation in 90% dependable year	Initial Scenario	Final Scenario
PH-I	188.51 MU	158.32 MU
PH-II	50.14 MU	41.10 MU

CHAPTER - VI
IRRIGATION PLANNING AND COMMAND AREA DEVELOPMENT

6.0 Background

The present chapter deals with irrigation planning and command area development of various project components under KBLP. The irrigation planning and command area development of KBLP, Phase-1 was completed by NWDA and included in DPR of 2010. The irrigation planning of KBLP including K-B link main canal, Ken command in MP & UP and additional area suggested by WRD, Governments of MP & UP have been revised as per their latest water requirement. The component wise details of irrigation planning and command area development of KBLP are given in the following paras.

6.1 General

The command of Ken-Betwa Link Project is given below.

i) Ken-Betwa Link Canal Command

a) High level Command by Pumping from Pumping House No. 1 at RD 18 Km and Part of this Command from Ken-Betwa Link.
b) Enroute Command by Ken-Betwa Link including New Command of Mahoba District of UP (from upper level tunnel)
c) Ken Command of MP
d) Ken Command of UP
e) Panna and Hatta command of MP by 8 Km long tunnel near Gehrighat of Daudhan Reservoir followed by Rising Mains for their Command Area and also followed by 40 Km long Rising Mains for drinking water supply in Panna city
f) Govind Sagar (Lalitpur district in UP) command in Betwa Basin and drinking water supply for Lalitpur District.

ii) Betwa Basin Command

a) Lower Orr Project
b) Kotha Barrage
c) Bina Complex Multipurpose Project

6.2 Main Ken-Betwa Link Command

6.2.1 Needs of Modification of Command Area Proposed in DPR of Ken-Betwa Link Project (2010)

During planning of Ken-Betwa link, Government of MP constructed Bansujara project benefiting Tikamgarh district, Tarped and Kutani Dam project benefiting Chhatarpur district, Runj and Majhgaon project benefiting Panna district. These commands were not included in KBLP earlier. On the request made by Government of MP, these commands are included under KBLP. Therefore, irrigation planning of Ken-Betwa link has been modified. Due to taking up of area for irrigation by constructing Bansujara and Tarped projects by Government of MP, the alignment of Ken-Betwa link canal has been modified after RD 85 km. The link canal will now cross Dhasan river straight instead of forming a loop in DPR of 2010. Thus, total length of the link canal will be reduced by 42 km.

As per earlier proposal of KBLP, Phase-I, the command area of MP was 2,87,837 ha. After scrutiny of comments received from Government of MP, it has been pointed out that the command area of projects mention above is overlapping with the proposed command under KBLP. Moreover, it is also pointed out that the lift schemes proposed in KMPP command can be avoided by aligning K-B link at higher elevation.

In view of the above and after series of discussions between the officials of Water Resources Department of MP, NWDA and MoWR,RD & GR and adopting pressurized pipe micro irrigation system for optimum utilization of available water, command area of MP has increased to 4,51,364 ha from 2,87,837 ha. Command area map of Ken-Betwa link canal is placed at **Plate-2**. Details of command area of MP are given below in **Table-6.1.**

Table-6.1
Abstract of Outlet Wise Command Area of MP under Ken-Betwa Link Project proposed by Government of MP

S. No.	Canal System	CCA as per DPR (2010) in ha	CCA as per Comprehensive Project Report in ha
1.	K-B Link Main Canal	46531	138847
2.	High level Command by Pumping from Pumping House No. 1 at RD 18 Km.	-	43678
3.	Bariyarpur PUW through Dam (i) Chhatarpur (ii) Panna	 46269 22184	38890
4.	Ken Left Bank Canal	172853	139848
5.	Lift from Daudhan Dam Submergence to Panna & Hatta (Damoh district)	-	90101
	Grand Total	**287837**	**451364**

After detailed deliberation and to avoid delay in implementation of the project, it is decided that the Ken-Betwa link canal be kept as open canal up to 85 km, thereafter about 32 km long canal as RCC syphon duct to cross low lying areas and Dhasan river, and remaining 59 km long as open canal up to RD 176 km (end). In view of the economic un-viability, silt related management issues and O&M challenges, the proposal for the 32 km long alternate alignment of Ken-Betwa Link Project may not be feasible. Hence, CWC considered that the original proposal for 74 km long (open channel) is better and safe proposition to proceed with and dropped the new alternate for the aforesaid reasons. Reach wise design of Ken-Betwa link canal has also be carried out keeping in view the demands of Government of MP. The details of Ken-Betwa link enroute command and additional command proposed by Government of MP are given below:-

1. The pumping station No-1 proposed at RD 18 km will serve about 18,678 ha CCA for Satai lift irrigation scheme and about 5,000 ha area of proposed High Level command will also be served by pumping station No-1. The second unit of pumping station No-1 is also proposed at RD 18 km and will serve about 20,000 ha area of proposed High Level command.
2. The pumping station No-2 proposed at RD 44.4 km will serve about 22,730 ha area of Ken-Betwa link enroute command.
3. The pumping station No-3 proposed at RD 70.7 km will serve about 29322 ha area of Ken-Betwa link enroute command in MP and about 4,650 ha enroute area in UP. Besides these area, about 37,564 ha. command area in Mahoba district of UP (newly proposed) has also been covered from this pumping station .
4. The pumping station No-4 proposed at RD 86.3 km will serve about 15823 ha area of Ken-Betwa link enroute command.
5. The pumping station No-5 proposed at RD 102.0 km will serve about 13464 ha area of Ken-Betwa link enroute command. Also, 7,396 ha CCA of Panotha LIS is proposed from RD 102.0 km of Ken-Betwa link canal.
6. The pumping station No-6 at RD of 171.0 km is proposed to serve about 25112 ha CCA in Tikamgarh district including Jatara LIS of MP and about 5,568 ha enroute area of UP.
7. One pump house No-7 at RD of 207 km is proposed to serve about 16,419 ha and 8,581 ha area of MP in different patches and 7,270 ha enroute area under Ken-Betwa link canal including additional command proposed by Government of MP.
8. About 50.93 MCM water will be released in to Parichha PUW through Barua Nalla. Out of which, 22 MCM water will be utilized for irrigating the area of about 3533 ha through Govind Sagar Dam whereas remaining (32 MCM) water will be utilized for drinking purpose in Lalitpur district on the substitution basis.
9. Under modified proposal given in Comprehensive Report prepared in 2019, length of the Ken-Betwa link canal was proposed to reduce to 176 km from 218 km. This reduction in the length is due to taken over the proposed command of Ken-Betwa link canal on the both side of Dhasan river by Bansujara and Tarped project of Government of MP. But CWC vide their letter no. **T-11308/4/2020-BCD(NWS) DTE** mentioned that due to

economic un-viability, silt related management issues and O&M challenges, the proposal for the 32 km long alternate alignment of Ken-Betwa Link Project may not be feasible. Hence, the original proposal for 74 km long (open channel) is better and safe. Therefore, length of the Ken-Betwa link canal again proposed to be 218 Km.

6.2.2 Details of various Pumping Stations and Design

6.2.2.1 Ken-Betwa Link Canal

Design features of pumping stations for serving the enroute and high elevated command of MP through K-B link canal made available to NWDA by Governmentt of MP have been used with some modification whenever required. CCA and GCA in the MP portion is 1,82,525 ha and 2,50,000 ha respectively. The design features of pumping stations in respect of UP portion have been planned by NWDA. The CCA and GCA in the UP portion is 55,052 ha and 78,724 ha respectively. Details of design parameters of pumping system of Ken-Betwa link canal for MP and UP are given in **Table-4.2 & 4.3 of Chapter- IV of this report.**

6.2.2.2 Ken LBC Command

CCA and GCA Ken LBC in MP portion is 1,39,848 ha and 2,00,000 ha respectively. Details of various pumping points and design of pumping stations for serving the command under Ken LBC in MP portion are given in **Table-4.4 of Chapter-IV of this report.**

6.2.2.3 Panna & Hatta LIS

CCA and GCA under Panna and Hatta LIS in MP portion is 90,101 ha and 1,25,000 ha respectively. Details of various pumping points and design of pumping station for serving the command under Panna and Hatta LIS in MP portion are given in **Table-4.5 of Chapter-IV of this report.**

6.2.3 Irrigation Planning

To maximize benefits the pressurised pipe micro irrigation system has been introduced in the entire command under Ken-Betwa link canal and additional command proposed by Governmentt of MP. The entire water for the command of Ken-Betwa link canal will be withdrawn from a outlet of dam (upper level tunnel). An additional power house has also be constructed at the exit of upper level tunnel which is not provided in DPR (April 2010). This power house may be helpful for providing power for developing pressurize irrigation in the area. The Governments of MP and UP have provided the cropping pattern and monthwise crop water requirement for entire command area proposed in MP and UP including enroute command of Ken-Betwa link canal. The same are given at **Annexures-6.1 to 6.3**.

6.2.4 Details of Command Area

Initial planning of KBLP has been modified in view of construction of Bansujara, Tarped, Majganwa and Runj projects under the proposed command of KBLP, Phase-I. Some additional command in MP and UP has been added which was not covered in the proposed command of KBLP Phase-I. It is also noticed that Government of MP is not in position to construct projects which was proposed in earlier KBLP due to non-availability of storage sites. Therefore, NWDA has modified command area plan of KBLP. District wise details of command area are given in **Table-6.2**.

Table-6.2
Districts Wise breakup of Command Area of KBLP

S. N.	Components of KBLP	Command in MP as per DPR 2010 (ha)				Command as Proposed by MP (ha)					Uttar Pradesh including Mahoba and Jhansi and Banda distt.	Remark
		CCA 287837 ha				CCA 451364 ha						
		Chhatarpur	Tikamgarh	Panna	Total	Chhatarpur	Tikamgarh	Panna	Niwari	Total		
1.	**High level Command by Pumping from Pumping House No. 1 at RD 18 Km.**	0	0	0	0	43678	0	0	0	43678	0	MP
2.	**Ken-Betwa link canal**	23225	23306	0	46531	88735	25112	0	25000	138847	58585 (55052+3533)	MP &UP
3.	**Ken LBC**	172853	0	0	172853	139848	0	0	0	139848	0	MP
4.	**Bariyapur Pick Up Weir (Through Dam Sluice)**	46269	0	22184	68453	38890	0	0	0	38890	192479	
5.	**Lift from Daudhan Reservoir at Pandwan Fall**	0	0	0	0	0	0	90101	0	90101	0	MP
6.	**Sub-Total CCA**	**242347**	**23306**	**22184**	***287837 (MP)***	**311151**	**25112**	**90101**	**25000**	**451364 (MP)**	**251064**	
					227373 (UP)							
7.	**Sub-Total CCA (MP+UP)**				**515210**					**702428 (MP+UP)**		
8.	**Annual Irrigation**									**604828 Intensity of Irrigation in the Command of MP portion=134%**	**251064 Intensity of Irrigation in the Command of UP portion=100%**	**855892 (total MP & UP)**

6.2.4.1 Additional Command in Betwa Basin System

Three projects viz. Lower Orr, Kotha Barrage and Bina Complex Multipurpose Project and their command areas are also included in the KBLP. The details of project wise command area are given in **Table-6.3.**

Table-6.3
Details of Project Wise CCA included under KBLP

S. No.	Name of Project	CCA Area (ha)	Annual Irrigation (ha)
1.	Bina Complex Multipurpose Project	96000	96000
2.	Lower Orr Project	90000	90000
3.	Kotha Barrage	20000	25500
	Total	**206000**	**211500**

Thus, the total CCA and annual irrigation from KBLP including Daudhan Dam are 9,08,428 ha and 10,67,392 ha respectively.

6.2.5 Cropping Pattern

Water Resources Department, Government of MP is of the view that the proposed cropping pattern in the earlier DPR of KBLP (2010) are not suitable because of variation in the existing practice adopting in enroute districts of MP. Governments of MP and UP proposed modified cropping pattern for adopting in the KBLP for preparation of Comprehensive Report. According to the cropping pattern and crop water requirement proposed by the Government of MP, the crop wise area from high level command from link, Ken-Betwa Link Canal, Ken Command of MP & UP including Ken LBC and requirement of Bariyarpur PUW, newly proposed command in Panna and Hatta tehsil of Panna & Damoh districts through Saleha LIS by MP, newly proposed command by UP in Mahoba and command of Govind Sagar Dam in Lalitpur district are given in **Table-6.4 & 6.5.**

Table-6.4
Cropping pattern proposed for the Ken Betwa Link Project for Madhya Pradesh

CCA 451364 Ha

			% of CCA											
	S. No.	Name of the crop	HLC Command		Ken LBC MP Command		SALEHA Damoh		KBL Enroute Command		Bariyarpur		SALEHA Panna	
			%	Area	%	Area	%	Area	%	Area	%	Area	%	Area
Kharif	1	Paddy	7	3057.46	7	9789.36	7	1407.07	7	9719.29	7	2722.3	7	4900
	2	Jowar / Maize/Bajra	6	2620.68	6	8390.88	6	1206.06	6	8330.82	6	2333.4	6	4200
	3	Pulses	10	4367.8	10	13984.8	10	2010.1	10	13884.7	10	3889	10	7000
	4	Oil seeds	15	6551.7	15	20977.2	15	3015.15	15	20827.05	15	5833.5	15	10500
	5	Vegetables	6	2620.68	6	8390.88	6	1206.06	6	8330.82	6	2333.4	6	4200
		Total	**44**	**19218.32**	**44**	**61533.12**	**44**	**8844.44**	**44**	**61092.68**	**44**	**17112**	**44**	**30800**
Rabi	1	Wheat(HYV)-1MV	60	26206.8	60	83908.8	60	12060.6	60	83308.2	0	0	60	42000
	2	Wheat(HYV)-3MV	0	0	0	0	0	0	0	0	60	23334	0	0
	3	Gram	23	10045.94	23	32165.04	23	4623.23	23	31934.81	23	8944.7	23	16100
	4	Peas/Fodder 1RA	5	2183.9	5	6992.4	5	1005.05	5	6942.35	5	1944.5	5	3500
	5	Oil seeds	7	3057.46	7	9789.36	7	1407.07	7	9719.29	7	2722.3	7	4900
	6	Vegetables	5	2183.9	5	6992.4	5	1005.05	5	6942.35	5	1944.5	5	3500
		Total	**100**	**43678**	**100**	**139848**	**100**	**20101**	**100**	**138847**	**100**	**38890**	**100**	**70000**

Annual Irrigation of Rabi with 90% Irrigation Intensity for computing crop water requirement			**90**	**39310**	**90**	**125863**	**90**	**18091**	**90**	**124962**	**90**	**35001**	**90**	**63000**
		CCA		**43678**		**139848**		**20101**		**138847**		**38890**		**70000**

Note -

1. Crop water requirement for rabi reduced to 90% in crop water computation in light of 90% rabi irrigation intensity. Hence irrigation intensity accounts to 134%
2. Rainfall data is as per MPWRD database
3. Effective rainfall computation for kharif crops is as per TC-25
4. Percolation losses are adopted as 3mm/day for paddy (ponded crops)
5. Efficiency adopted for crop water requirement computation is as TC 59 of MPWRD which depends on type of crop and method of irrigation.

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Table-6.5

Cropping pattern proposed for the Ken Betwa Link Project for Uttar Pradesh

CCA : 251064 ha

Season	S. No.	Name of the Crop	Ken Canal		Enroute Command		Mahoba Command		Govind Sagar (Lalitpur) Command	
			% of area	Area	% of area	Area	% of area	Area	% of area	Area
Kharif	1	Paddy	44	84990	15	2606				
	2	Jowar / Maize/Bajra								
	3	Pulses								
	4	Oil seeds								
	5	Vegetables								
Rabi	6	Wheat (Local)								
	7	Wheat (HYV)	46	88012	85	14882	100	37564	100	3533
	8	Gram								
	9	Peas								
	10	Oil seeds								
	11	Vegetables	10	19477						
	12	Masoor								
		Annual Irrigation	**100**	**192479**	**100**	**17488**	**100**	**37564**	**100**	**3533**
		CCA		**192479**		**17488**		**37564**		**3533**

6.2.6 Introduction of Pressurized Pipe Micro Irrigation System in the Command Area

A pressurized pipe micro irrigation system is a system that relies on water pressure for the system to work. In pressurized irrigation system water is pressurized and precisely applied to the plants under pressure through a system of pipes. Pressurized systems as opposed to surface irrigation system are more effective in application of water to the crops there are many

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variations of pressurized irrigation systems but the two major ones are drip irrigation system and sprinkler system. They consist of the control station where the pressure is applied; the mains and the sub mains, which are pipes of different dimensions, irrigation system or other fixtures delivering water to plants or spray booms for forage and entire pivot system (in sprinkler system). Pressurized pipe micro irrigation systems have the potential to avail the water loss related to surface irrigation system increasing the open irrigation application efficient from 45%-60% to pressurized pipe micro irrigation system with efficiency of 75% to 90%. Therefore, Government of India promoting pressurized irrigation system in the command of major and medium irrigation projects.

Out of total 4,51,364 ha, 4,12,474 ha command area of MP is proposed under pressurized pipe micro irrigation system i.e. direct from canal (59700 ha), Satai LIS (18678 ha), Panotha LIS (7396 ha) and enroute command of Ken Betwa Link canal in MP (96751 ha including Jatara LIS) and 139848 ha of Ken LBC and 90101 ha of Saleha LIS. Thus, the total pressurized irrigation system is proposed around 91.4% in MP. The delta for pressurized irrigation system is 0.460 m which is being adopted by Government of MP in their projects. Suitable modification in the major & minor canals and their sub minors for connecting up to field are being studied and shall be constructed by MP & UP in their respective area based on pipe system.

6.2.6.1 Crop Water Requirement

The annual seasonal crop water requirement for each crop has been supplied by Governments of MP (vide their letter no. 1566/838/Canal/BODHI on Dated 25.06.2021) & UP (vide their letter no. 8985/मु.अ.प.बे./केन-बेतवा/ on Dated 15.11.2021). The crop water requirement for each crop worked out by MP on the basis of climatological approach by modified Penman Method and furnished at **Annexures-6.4 to 6.8.** The total CCA in the MP is 4,51,364 ha. Considering 134% intensity of irrigation, irrigation potential under Kharif season and Rabi season works out to 1,98,600 ha and 4,06,227 ha respectively in MP. Corresponding crop water requirement works out to 515.70 MCM and 1773.99 MCM respectively. Government of UP desired 766.05 MCM in Kharif season (June to October) and 934.17 MCM in Rabi season (November to May). Month wise water requirement for MP and UP are given in **Table-6.6 & 6.7** respectively.

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Table-6.6

Month wise Water Requirement of MP

All figures are in mcm												
Particulars	**Months**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MAR**	**TOTAL**
CCA-KBL	Kharif (61093 ha)	7.612	55.621	18.865	65.037	0.000	0.000	0.000	0.000	0.000	0.000	147.135
138847 Ha	Rabi (124962 ha)	0.000	0.000	0.000	0.000	16.182	152.021	151.959	171.450	63.035	0.000	554.647
Micro	**Sub Total**	**7.612**	**55.621**	**18.865**	**65.037**	**16.182**	**152.021**	**151.959**	**171.450**	**63.035**	**0.000**	**701.782**
CCA-HLC	Kharif (19218 ha)	2.395	17.498	5.934	20.459	0.000	0.000	0.000	0.000	0.000	0.000	46.286
43678 Ha	Rabi (39310 ha)	0.000	0.000	0.000	0.000	5.091	47.822	47.803	53.934	19.829	0.000	174.48
Micro	**Sub Total**	**2.395**	**17.498**	**5.934**	**20.459**	**5.091**	**47.822**	**47.803**	**53.934**	**19.829**	**0.000**	**220.765**
CCA-KEN_Command	Kharif (61533 ha)	7.667	56.022	19.001	65.506	0.000	0.000	0.000	0.000	0.000	0.000	148.196
139848 Ha	Rabi (125863 ha)	0.000	0.000	0.000	0.000	16.299	153.117	153.055	172.686	63.489	0.000	558.646
Micro	**Sub Total**	**7.667**	**56.022**	**19.001**	**65.506**	**16.299**	**153.117**	**153.055**	**172.686**	**63.489**	**0.000**	**706.842**
CCA-Bariyarpur_LMC_Command	Kharif (17112 ha)	2.540	18.601	6.312	21.761	0.000	0.000	0.000	0.000	0.000	0.000	49.214
38890 Ha	Rabi (35001 ha)	0.000	0.000	0.000	0.000	5.382	17.402	51.951	54.014	46.052	0.000	174.801
Flow	**Sub Total**	**2.540**	**18.601**	**6.312**	**21.761**	**5.382**	**17.402**	**51.951**	**54.014**	**46.052**	**0.000**	**224.015**
CCA-SALEHA Panna	Kharif (30800 ha)	16.598	62.945	1.492	23.695	0.000	0.000	0.000	0.000	0.000	0.000	104.730
70000 Ha	Rabi (63000 ha)	0.000	0.000	0.000	0.000	7.666	67.664	57.561	67.664	26.348	0.000	226.903
Micro	**Sub Total**	**16.598**	**62.945**	**1.492**	**23.695**	**7.666**	**67.664**	**57.561**	**67.664**	**26.348**	**0.000**	**331.634**
CCA-SALEHA Damoh	Kharif (8844 ha)	4.806	6.535	1.862	6.936	0.000	0.000	0.000	0.000	0.000	0.000	20.138
20101 Ha	Rabi (18091 ha)	0.000	0.000	0.000	0.000	2.250	22.529	24.343	25.777	9.615	0.000	84.515
	Sub Total	**4.806**	**6.535**	**1.862**	**6.936**	**2.250**	**22.529**	**24.343**	**25.777**	**9.615**	**0.000**	**104.653**
Total CCA - Ken Betwa	Kharif (198600 ha)	41.617	217.222	53.466	203.395	0.000	0.000	0.000	0.000	0.000	0.000	**515.70**
451364 Ha	Rabi (406227 ha)	0.000	0.000	0.000	0.000	52.870	460.555	486.673	545.524	228.369	0.000	**1773.99**
Hybrid	**Total**	**41.617**	**217.222**	**53.466**	**203.395**	**52.870**	**460.555**	**486.673**	**545.524**	**228.369**	**0.000**	**2289.7**
Flow	8.6	%										
Micro	91.4	%										

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Table-6.7
Month wise Water Requirement of UP

Month	**Ken Canal (Banda District)** Irrigation			**Enroute Command** (Jhansi District) Irrigation		Mahoba Command Irrigation	**Govind Sagar** Dam (Lalitpur) Command Irrigation	Drinking Water Requirement (MCM)			**Total Water Requirement (MCM)**
	Paddy **84990** Ha. Lined Canal	Wheat **88012** Ha. Lined Canal	Jayad **19477** Ha. Lined Canal	**Paddy 2606** Ha. Pressurised-Piped/ Micro Irrigation	Wheat **14882** Ha. Pressurised-Piped/ Micro Irrigation	Wheat **37564** Ha. Pressurised-Piped/ Micro Irrigation	Wheat **3533** Ha. Lined Canal	**Jhansi City** (Population-6.54 Lakh)	**Lalitpur City** (Population-1.33 Lakh)	**Mahoba City** (Population-0.95 Lakh)	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**(=2+3+4+5+6+7+8+9+10+11)
Jan		116.24	33.39		19.17	48.80	4.63		7.00		229.22
Feb		113.36	36.77		18.93	50.49	4.44		7.00		230.98
March		82.40			14.52	37.12	3.42	5.00	7.00	7.00	156.46
April								5.00	7.00	8.00	20.00
May								4.66	3.98	5.13	13.77
June	13.49			0.69							14.18
July	127.58			5.81							133.39
Aug	207.14			6.71							213.85
Sep	240.81			6.69							247.50
Oct	152.35			4.77							157.13

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Nov		50.02	4.66		8.49	20.66	1.86				85.69
Dec		111.79	15.78		18.98	46.91	4.60				198.05
Total-	**741.37**	**473.81**	**90.59**	**24.67**	**80.09**	**203.97**	**18.95**	**14.66**	**31.98**	**20.13**	**1700.22**

6.2.7 Command Area & Water Utilization from KBLP

The revised command area and water utilisation from KBLP have been received from both states for inclusion in the Comprehensive Report and is given in **Table-6.8**

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Table-6.8 :Command Area and Water Utilization as per Concerned States (MP & UP)

	Area covered under canal system of KBLP (ha)							Water Utilization as per Comprehensive Report (MCM)									
	Area in ha							Utilization in MCM									
SI. No.	**Canal system**	**CCA as per DPR (Original)**		**Annual irrigation as per DPR (Original)**		**CCA as per Comprehensive Project Report**		**Irrigation utilization**		**Domestic & Industrial requirement**		**Transmission losses**		**Total**		**Environ-mental flow**	**Grand Total (MP + UP)**
I	**Canal system under Daudhan dam**	**MP**	**UP**	**MP**	**UP**	**MP**	**UP**	**MP**	**UP**	**MP**	**UP**	**MP**	**UP**	**MP**	**UP**		
1	**K-B Link Main Canal**	46531	13763	46531	13763	138847	58585	701.782	327.68	60	66.77			**761.782**	**394.45**		**1156.232**
2	**High level Command by Pumping from Pumping House No. 1 at RD 18 Km.**					43678		220.765						**220.765**			**220.765**
3	**Ken LBC**	172853		233763		139848		706.842						**706.842**			**706.842**
4	**Bariarpur PUW Through Dam- (i) In Chhatarpur distt.**	46269	213610	58291	252017	38890	192479	224.015	1305.77					**224.015**	**1305.77**	493.6	**2023.385**
	(ii) Panna district	22184		31296													
5	**Lift From Daudhan Dam-Panna district**					70000		331.634						**331.634**			**331.634**
6	**Lift From Daudhan Dam- Damoh district**					20101		104.653						**104.653**			**104.653**
	Total under Daudhan dam	**287837**	**227373**	**369881**	**265780**	**451364**	**251064**	**2289.7**	**1633.45**	**60***	**66.77***		**-**	**2349.7**	**1700.22**	**493.6**	**4543.52**
	Total under Daudhan dam	**515210**		**635661**		**702428**		**3923.15**		**126.77**				**4049.92**		**493.6**	**4543.52**
II	**Bina Complex Project**					**96000**		324.95	Including Transmission	88.4**				413.35		6.51	419.86
III	**Kotha Barrage**					**20000**		80.69		7.5**				88.19		2.5	90.69
IV	**Lower Orr Project**					**90000**		285.77		6.0*				291.77		44.9	336.67
	Total					**206000**		**691.41**		**101.9**				**793.31**		**53.91**	**847.22**
	Grand Total	**515210**		**635661**		**908428**		**4614.56**						**4843.23**		**547.51**	**5390.74**

* Only Domestic Demand

** Domestic & Industrial Demand

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6.2.7.1 Water Planning

The total 75% dependable yield of Ken River at proposed Daudhan Dam site has been assessed as 6590 MCM. The total upstream requirement of water for existing, ongoing and proposed projects is 2266 MCM. The total downstream water requirement below proposed dam site is 2236.63 MCM. Downstream environmental and ecological requirement to maintain river ecology is 493.60 MCM. The requirement of 436.287 MCM water of Panna & Hatta LIS in right bank is proposed to be fed directly through pumping from Daudhan reservoir for irrigating an area of 90,101 ha in Panna district of MP.

Thus, surplus water of 1377 MCM is proposed to be diverted into the main link canal. Out of which 220.77 MCM will be utilized at a pumping station at RD 18 Km to serve 43,678 ha of command located at high elevation. This area entirely lies in Chhatarpur district of MP. Again, 1010.51 MCM of water will be utilized to irrigate an enroute command area of 1, 93,899 ha (1,38,847 MP + 55,052 UP) in Chhatarpur, Tikamgarh districts of MP and Mahoba & Jhansi districts of UP including transmission losses. Further, 94.79 MCM of water will be proposed for drinking purpose in the enroute. And remaining 50.93 MCM of water is released to Betwa River through link canal in the upstream of Parichha Weir.

The 50.93 MCM of water which was released in river Betwa upstream of Parichha Weir will be utilized in Lalitpur district of UP. Out of which 31.98 MCM of water will be provided for drinking purpose and 18.95 MCM of water will be utilized to irrigate an area of 3533 ha.

Out of 2236.63 MCM of water proposed to be released downstream of Daudhan Dam, 930.86 MCM will be utilized to irrigate an area of 1,78,738 ha under Ken Command in Chhatarpur district of MP and remaining 1305.77 MCM of water will be utilized for stabilization of 1,92,479 ha area in Ken Command located in Banda district of UP. The details are given in **Table-6.9** and month wise requirement is given at **Anneuxure-6.9.**

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Table-6.9
Water Planning for Daudhan Dam

S. No.	Name of Component		CCA (ha)	Intensity of Irrigation	Method of Irrigation	Water Requirement (MCM)
(A)	**Madhya Pradesh**					
1.	Panna and Hatta LIS direct pumping from reservoir				Pressurised pipe micro Irrigation system	
	I	Lift From Daudhan Dam-Panna district	70000	134%		331.634
	II	Lift From Daudhan Dam-Damoh district	20101	134%		104.653
		Sub Total	**90101**			**436.287**
2.	High level Command by Pumping from Pumping House No. 1 at RD 18 Km.		43678	134%		220.765
4.	Enroute command from Ken-Betwa link		138847	134%		701.782
5.	Ken Left Bank Canal (KMPP) from lower level tunnel (PH-II)		139848	134%		706.842
6.	From PH-I/River Sluice Through Bariyapur PUW		38890	134%	Flow Irrigation	224.015
7.	Domestic Water supply in enroute					60.00
8.	Transmission loss					Included in Water Requirement
	Total of MP		**4,51,364**			**2349.7**
(B)	**Uttar Pradesh**					
1.	Enroute command in Jhansi		17488	100%		104.76
2.	Enroute command in Mahoba (new)		37564	100%		203.97
3.	Substitution command in Lalitpur		3533	100%	Flow Irrigation	18.95
4.	From PH-I/River Sluice Through Bariyarpur PUW		192479	100%	25504 ha by Pressurised pipe micro Irrigation system and remaining by flow irrigation	1305.77
5.	Domestic Water supply in enroute					66.77
	Total of UP		**2,51,064**			**1700.22**

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6.2.8 Working Tables

The water demands for the project have been operated for the period from 1981-82 to 2003-04 with the monthly virgin flow worked out by NIH at the proposed Daudhan Dam site to ascertain the success of project in meeting the various water demands. The monthly virgin flow at Madla G&D site on Ken River downstream of proposed Daudhan Dam has been computed by NIH, Roorkee. As no G&D site is available at Daudhan Dam, therefore, using the rainfall-runoff relationship developed at Madla G&D site, the monthly virgin flow at Daudhan Dam has also been worked out by NIH, Roorkee for the period 1981-82 to 2003-04. The details are given in **Annexure-6.10**. Considering upstream utilisation of 2266 MCM of water, earmarked for MP, monthly requirement for the same period have been computed and furnished at **Annexure-6.11**. Accordingly, net inflow available at Daudhan Dam has been worked out and furnished at **Annexure-6.12**. Evaporation losses for each month have been computed on the basis of water spread area of the reservoir and PAN evaporation value of Jabalpur IMD station. In the operation study live storage capacity v/s water spread area relationship has been developed for Daudhan reservoir. Considering above relationship NWDA has computed month wise water spread area corresponding to live storage at the end of each month in the Daudhan reservoir.

The operation studies of Daudhan reservoir for the period from 1981-82 to 2003-04 have been carried out considering monthly demands of MP & UP. The details are given at **Anneuxre-6.13**. The demand of UP is supplied vide their letter no. 8985/मु.अ.प.बे./केन-बेतवा/ on Dated 15.11.2021 for non-monsoon season (November to May) is 934.4 MCM. Further, Govt. of UP agreed to store 147 MCM of monsoon water by filling unfilled capacity of existing tanks and creating two new barrages in the downstream of existing Bariyarpur pickup weir to restrict demand of UP in non-monsoon period as 750 MCM as suggested by Secretary, MoWR,RD&GR in the meeting held 23.04.2018. Accordingly, NWDA planned to release the water from Daudhan reservoir for meeting demand of UP. Month wise details of possible water releases from Daudhan reservoir for MP as well as UP are given below in **Table-6.10**.

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Table-6.10
Details of month wise demand of MP & UP and possible releases from Daudhan Reservoir

Unit: MCM

Months	Demand of MP vide their letter no. 1566/838/Canal/BODHI on Dated 25.06.2021				Demand of UP vide their letter no. 8985/मु.अ.प.बे./केन-बेतवा/ on Dated 15.11.2021					
	Irrigation Demand	Irrigation Release	Domestic Demand	Domestic Release	Irrigation Demand for Enroute, Ken & Mahoba Command	Irrigation Release for Enroute, Ken & Mahoba Command	Irrigation Demand/ Release for Lalitpur by Transfer in Betwa	Total Irrigation Release of UP	Domestic Demand	Domestic Release
June	41.62	41.62	0	0	14.18	14.18	0	14.18	0	0
July	217.22	217.22	6	6	133.39	133.39	0	133.39	0	0
Aug	53.47	53.47	6	6	213.85	299.33	0	299.33	0	0
Sept.	203.39	203.39	6	6	247.5	346.43	0	346.43	0	0
Oct.	52.87	52.87	6	6	157.13	157.13	0	157.13	0	0
Total of monsoon months	**568.57**	**568.57**	**24**	**24**	**766.05**	**950.46**	**0**	**950.46**	**0**	**0**
Nov.	460.56	460.56	9	9	83.83	65.61	1.86	67.47	0	0
Dec.	486.67	486.67	9	9	193.45	151.40	4.6	156.00	0	0
Jan	545.52	545.52	9	9	217.6	170.31	4.63	174.94	7	7
Feb.	228.37	228.37	9	9	219.54	171.82	4.44	176.26	7	7
Mar	0.00	0.00	0	0	134.04	104.91	3.42	108.33	19	19
April	0.00	0.00	0	0	0	0.00	0	0.00	20	20
May	0.00	0.00	0	0	0	0.00	0	0.00	13.77	13.77
Total of non-monsoon months	**1721.12**	**1721.12**	**36**	**36**	**848.46**	**664.05**	**18.95**	**683.00**	**66.77**	**66.77**
Annual total	**2289.69**	**2289.69**	**60**	**60**	**1614.51**	**1614.51**	**18.95**	**1633.46**	**66.77**	**66.77**

Above demands have been simulated and it is revealed that out of 276 (23 years x 12) months, 224 months are success months i.e. monthly success rate of 81% is achieved.

Yield at 75% dependability at Daudhan dam site	6590 MCM
Upstream uses of MP	2266 MCM
Balance water available	4324 MCM
Regeneration (+)	442 MCM
Total water availability at 75% dependability	4766 MCM
Net storage in Daudhan reservoir on 1st October	2582 MCM

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6.2.9 Proposed Water Sharing

As most of the water of Ken basin up to Daudhan Dam is proposed to be utilized in the water short/drought prone areas of enroute of canal in MP. Also, only 63 MCM water is utilized in Betwa basin u/s of Rajghat Dam by Kotha Barrage instead of 591 MCM as envisaged in MoU signed between Governments of MP & UP and Union Government of India stated that the demand of Kotha Barrage and Bina Complex Multipurpose Project are within the allocated share of 53 TMC as per interstate agreement on Betwa river, Upper Betwa region. Now, Government of UP desired 51 MCM of water for Govind Sagar Dam to meet out the irrigation and domestic demand of Lalitpur district through Rajghat Dam. Therefore, to meet out the demand of UP, it is also proposed to be transfer 51 MCM water to river Betwa at Parichha Weir. This water will be utilised by UP in Lalitpur district from Rajghat Dam by substitution basis within allocated share of UP of 1700 MCM. Accordingly, water planning of Ken basin Ex. Daudhan Dam has been revised and given below in **Table-6.11**.

Table 6.11
Water Sharing of Ken Basin Ex. Daudhan Dam

S. No.	Particulars	Proposed Water Sharing as per Agreement 25.08.2005	Planned Sharing as per DPR of April-2010	Planned Sharing after considering Additional Command of MP (Total 4.51 lakh ha)
		MCM	MCM	MCM
A	75% dependable yield of Ken river at Daudhan Dam site is 6590 MCM	6188	6590	6590
B	After accounting for upstream uses 2266 MCM	-2266	-2266	-2266
C	Regeneration from upstream utilization	+442	+442	+442
	Net Availability	**4364**	**4766**	**4766**
1.	**Total Requirement of MP**			
	a) D/s of Ex. Daudhan	1375	1405	930.86
	b) Enroute use including High level command including 51 MCM transmission loses	263	277	922.55
	c) for Panna and Hatta district			436.29
	d) Domestic enroute utilization	49	38	60

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	e) Transmission Losses		68	
	Total	**1687**	**1788**	**2349.7**
2.	**Total Requirement of UP**			
	a) D/s of Daudhan	1600	1600	1305.77
	b) Enroute irrigation use	100	89	104.76
	c) For Lalitpur and through Rajghat dam	-	-	18.95
	d) Domestic enroute utilization (31.98 MCM in Lalitpur, 20.13 MCM in Mahoba and 14.66 MCM in Jhansi)		11	66.77
	e) Development of new command in Mahoba including Transmission loses			203.97
	Total	**1700**	**1700**	**1700.22**
3.	Proposed water transfer to Betwa basin in lieu of water provided to left out area of Lalitpur and through Rajghat dam	591	591	51
4.	Environmental releases			493

6.2.10 Design of Canal Systems

In view to increase irrigation facilities in the Bundelkhand region and increase in the command area of KBLP, it is necessary to introduce the pressurised pipe micro irrigation system in the entire Ken-Betwa link canal system, Ken LBC system and Panna & Hatta LIS. The details are given in **Chapter-4 of this report.**

6.2.10.1 Ken-Betwa Link Canal

As mentioned at para 6.2.1, the alignment of the canal has been modified, the reach wise link canal has been redesigned and details are given in **Table-4.1 of Chapter-IV of this report.**

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6.2.10.2 Ken Left Bank Canal (including connecting canal)

The command area under the Ken LBC from Lower Level Tunnel works out to 1,39,848 ha utilizing 706.842 MCM of water. The canal capacity at the canal head has been worked out as 57.34 cumec and duty is 0.41 lit /sec/ha. The length of the Ken LBC piped canal will now be 90.0 km whereas diameter of Telescopic Pipe is 3.19 m. The designed velocity is 1.8 m/s. The number of row of rising main is two. Whole command will be served by laying pressurized pipe micro irrigation system at maximum CCA Level of 210 m. The MDDL is kept as 246 m. 2.0 km long connecting canal off taking from exit of PH-II. Connecting canal of 2.1 km length will join tail race channel of PH-II will join the ken LBC to the Ken LBC. The static head is 36 m. The total power requirement worked out to 10.2 MW.

6.2.10.3 Panna and Hatta Lift Irrigation System

The total (CCA) under Panna & Hatta LIS is 90,101 ha utilizing 436.29 MCM of water. Pressurized irrigation system has been proposed in the entire command area. Saleha LIS scheme is set to benefit 90101 Ha area in Panna and Hatta. It is planned to lift water directly from daudhan dam and utilise in upstream command area. As the dam is located in PTR hence building pumphouse and operating will be problematic. Hence a tunnel from MDDL of dam is proposed of length around 7 km by which water will be diverted towards upstream panna command area. As command area is on higher side hence shaft with sufficient access provison shall be provided to operate pump house inside the shaft. All the activities will be outside forest area. After lifting water from shaft it will be stored in DC/ BPT located at nearby hill and from DC/BPT micro irrigation shall be planned in complete 90101 Ha area. Intake point of tunnel is from MDDL 248m from submergence of Daudhan dam. Maximum overburden for tunnel will be approx. 180m. The ground level available at 315m hence around 70m deep shaft is provisioned. The pump house will be inside the shaft and access approach channel will be provided from panna side. The tunnel will be followed by rising main having diameter of 4830 m. The static and design head are 96.414 m and 98.808 m respectively. The discharge and velocity would be 32.923 cumec and 1.80 m/sec respectively. The MDDL is kept as 246 m. Thereafter, two pipelines are proposed for irrigation in the tehsils of Panna, Amanganj, Gunnor and Hatta of MP. One pipe line of 18 km long having diameter 3.832 m is proposed for irrigation in the command of Amanganj and Hatta tehsils. The discharge and velocity would be 17.292 cumec and 1.50 m/sec respectively. The duty is 0.426 lit/sec/ha. The maximum CCA level is 325 m. The total CCA covered under this system would be 45,101 ha. This pipe line is further extended to provide drinking water for Panna city. The pipe line of 40 km long having diameter 1.2 m is

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proposed. The discharge and velocity would be 5.0 cumec and 1.50 m/sec respectively. The maximum CCA level is 400 m.

The other pipe line of 21 km long having diameter of 3.644 m is proposed for irrigation in the command of Gunnor and Devendra Nagar tehsils. The discharge and velocity would be 15.633 cumec and 1.50 m/sec respectively. The duty is 0.386 lit/sec/ha. The maximum CCA level is 350 m. The total CCA covered under this system would be 45,000 ha. In this report, the design of Ken-Betwa link canal has been done by NWDA while the design of Ken LBC and Panna & Hatta lift pressurized pipe micro irrigation system have been done by Water Resources Department, Government of MP and some are adopted in the Comprehensive Report.

6.2.11 Command Area Development

Development of all commands is being described in following paragraphs:

6.2.11.1 Enroute Command

6.2.11.1.1 Location

The enroute command area comprising 85,774 ha from High Level Command and 1,51,803 ha from Ken-Betwa link canal 2,37,577 ha is falling in Chhatarpur and Tikamgarh districts of MP and Mahoba and Jhansi districts of UP. The district/tehsil wise breakup of the enroute command area is given at **Table-6.12**.

Table-6.12

District/tehsil Wise Details of Enroute Command Area (Ken-Betwa Link Canal)

S. No.	District/tehsil	CCA As per DPR (ha)	Net CCA as per Additional Component of MP (ha)	Annual Irrigation (ha)	Annual Utilization (MCM)
	A. Irrigation Benefits				
MP					
Chhatarpur District					
(I) High level command (Reservoir)		-	43678	58529	220.77
(II) Ken-Betwa Link canal command (KBL)		23225	88735	118905	448.50
Tikamgarh District					
(II) Ken-Betwa Link canal command (KBL)		23306	25112	33650	126.92
Niwari District					
(II) Ken-Betwa Link canal command			25000	33500	126.36

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(KBL)					
Total (II) KBLP command (MP)		***46531***	***138847***	***186055***	***701.78***
UP					
Mahoba district					
(II) Ken-Betwa Link canal command (KBL)		4650	37564	37564	203.97
Jhansi district					
(II) Ken-Betwa Link canal command (KBL)		9113	17488	17488	104.76
Total Ken-Betwa Link canal (UP)		***13763***	***55052***	***55052***	***308.73***
Total of Ken-Betwa Link canal command (KBL) for MP&UP		60294	193899	241107	1010.51
Grand -Total of Ken-Betwa Link canal command (KBL)+High level Command for MP&UP		60294	237577	299636	1231.28
B. Drinking Water Supply					
1.	MP				60
2.	UP				34.79
	Sub-total of (B)				94.79
	C. Transfer of Water for Target Command				
1.	For Lalitpur (UP) through Rajghat dam (19 MCM irrigation+32 MCM domestic)		3533	3533	50.93
	Sub-total of (C)		3533	3533	50.93
	D. Transmission Losses				
1.	MP (already in the demand)				-
2.	UP (already in the demand)				
	Sub-total of (D)				-
Total water releases from Ken-Betwa Link including Transmission Losses			*241110*	*303169*	*1377*
	(E)Ken LBC (MP)		139848		706.84
	(F)Bariyarpur Command (MP)		38890		224.02
	(G) New Command in Panna & Hatta by Saleha LIS		90101		436.29
	(H) Ken Command UP		192479		1305.77
	Grand Total of Ken-Betwa Link				4049.92
	Environmental Flow				
1.	MP				246.8
2.	UP				246.8
	Sub-total				493.6
	Grand Total		**7,02,428**		**4543.52**

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6.2.11.1.2 Land Development Work Proposal

Command area proposed under high level command are proposed to be developed in proportion to the command area development proposed for Ken-Betwa link canal and Ken LBC command in EIA report of AFC Ltd., Hyderabad. A provision of Rs. 31180.74 lakh has been kept in the estimate for command area development works. A provision of Rs. 2953.16 lakh has been kept in the estimate for land development works. At the time of implementation of the project, detailed survey of each command will be carried out and based on the requirement, land development works will be taken up. This work will be done by State Irrigation Department or State Agriculture Department or command area or Command Area Development Authority (to be decided by concerned State Governments).

At present fairly good extension services exist in the command area and number of commercial banks and co-operative banks also have their branches there. Branches of land development banks are also located in some rural areas of the command. Moreover, the agricultural materials like seeds, fertilizers, insecticide, pesticides, etc. are provided to the farmers by the concerned government department at subsidized rates through different sale booths or fair price shops. However, due to numerous reasons, especially inadequacy of financial resources, extension services have not yet become very popular.

(i) Estimated Cost of Increased Production

Based on the increased production, cost of increased production in the KBLP command has been assessed in **Annexure-10.6**

(ii) Likely Socio-Economic Aspects

Due to increase in food grain production, the socio-economic condition of farmers will improve in general. Agricultural labourers will get employment in the nearby area. Situation of livestock will improve. Farmers will try to establish agro-based industries in the area.

6.2.12 Ken Command

6.2.12.1 Location

The Ken command area comprising 1,78,738 ha (1,39,848 ha and 38,890 ha through Ken LBC and Bariyarpur Pick up Weir respectively) is spread over

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Chhatarpur and Panna districts of MP. The district/ tehsil wise break-up of the Ken command area is given below in **Table-6.13**.

Table- 6.13
District/Tehsil wise break-up of the Ken Command Area

S. No.	District/ tehsil	CCA as per DPR (ha)	CCA added/ deleted (ha)	Net CCA (ha)
MP Chhatarpur district				
1.	Gaurihar	67948	+3996	
2.	Laundi	51148	-	
3.	Rajnagar	63855	-	
	a. Additional command		+7500	
	b. Deduct Lift Irrigation scheme		-31939	
	c. Command taken over by Kutni dam		-18452	
4.	Chhatarpur Lift	6473		
	Irrigation scheme		-8566	
5.	Nowgong	29698		
	Sub-total	***219122***	***-47461***	***171661***
Panna district				
1	Ajaygarh	22184		
	Command taken over by Runjh and Manjhgwan dam		-15107	
	Sub-total	***22184***	***-15107***	***7077***
	Grand total	**241306**	**-62568**	**178738**

(i) Estimated Cost of Increased Production

Based on the increased production, cost of increased production has been assessed in **Annexure-10.6**.

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(ii) Likely Socio-Economic Aspects

Due to increase in food grain production, the socio-economic condition of farmers will improve in general. Agricultural labourers will get employment in the nearby area. Situation of livestock will improve. Farmers will try to establish agro-based industries in the area.

6.2.13 Provision for Lalitpur and Mahoba Districts

Government of UP desired 50.93 MCM of water to fill up Govind Sagar Dam from Rajghat Dam through 2 km long tunnel within the share of Government of UP (1700 MCM) on substitution basis.

Government of UP has also desired 203.97 MCM of water from Ken-Betwa link canal for Mahoba district. This amount of water is proposed to be provided to Mahoba district at RD 70.7 km of Ken-Betwa link canal through pumping station-4. Government of UP will make their planning to utilize above water.

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6.3 Summing Up of Command Area and Water Requirement from KBLP

The abstract of component wise break up of command area and water requirement from KBLP as finalized in Comprehensive Report is given in **Table-6.14.**

Table-6.14
Component Wise break up of Command Area and Water Requirement from KBLP

Component	CCA (Lakh ha)	Water Requirement (MCM)				Environ-mental Releases
		Irrigation Demand	Transmission losses	Domestic & Industrial Demand	Total	
Ken-Betwa Link Canal (MP)	4.51	2289.7 Including transmission losses	-	60*	2349.7	
Ken-Betwa Link Canal (UP)	2.51	1633.45 Including transmission losses	-	66.77*	1700.22	
Sub-Total of Ken Betwa Link Canal (MP & UP)	***7.02***	***3923.15***	***-***	***126.77***	***4049.92***	***493.6***
Total (MP)	***4.51***	***2289.7***	***-***	***60****	***2349.7***	
Total (UP)	***2.51***	***1633.45***	***-***	***66.77****	***1700.22***	

* Only Domestic Demand

CHAPTER-VII
CONSTRUCTION PROGRAM, MANPOWER DEPLOYMENT & PLANT PLANNING

7.1 General

This chapter describes the construction methodology and equipment planning for construction of the main components under Ken-Betwa Link Project Phase-I. The construction methodology for each type of structure has been described under the relevant sub sections of this chapter. The type and sizes of the equipment to be used have also been indicated while describing the construction methodology. The number of machines required for construction of each component of the project has been worked out and total requirement for each type and size of the major equipment has been arrived at after preparing the construction/ deployment schedule for main components of the project. In case, the work is executed through award of contract, the contractors in all probability may suggest their own construction techniques and equipment for execution of the job based on equipment actually available with them. The tentative requirement of machines as worked out herein will help in analysis of rates of works, cost estimation and in evaluating the reasonableness of the participating bidders' construction techniques and equipment, within overall construction schedule and cost estimate.

7.2 Main Project Components

Ken-Betwa Link Project Phase-I envisages diversion of the surplus water available in Ken basin to water short Betwa basin. Main project components of the Project involve construction of a 77.00 m high and 1233 m long earth dam across river Ken near Daudhan village. A 798 m long concrete dam with 536 m long channel spillway on left flank has been proposed. Two power houses viz. PH-I with an installed capacity of 2 x 30 MW and PH-II with 3 x 6 MW installed capacity have also been planned. PH-I will be located at foot of the dam and PH-II will also be a surface power house at the end of 1.10 km long tunnel. The tunnel with a finished diameter of 5.5 m serves as water conductor for PH-II. A 675 m long TRC will thereafter discharge the water into the Ken LBC.

The surplus water available in Ken basin up to Daudhan dam will be diverted through a 218.70 km long link canal to water short Betwa basin and for enroute utilization. In this entire length of the canal, seven

aqueducts, six super passages, four syphon aqueducts, thirteen canal syphons, ten pipe culverts and eighteen road bridges and one railway crossing are required to be constructed.

7.2.1 Salient Features of main Components

Salient Features of main Components of the Project are given in **Table 7.1**.

Table - 7.1

Salient Features of main Components of Phase-I of the Project

(i)	**Earth Dam**	**(Daudhan)**
	Type	Earthfill dam with central core
	Height	77.00 m
	Length at the top	1233 m
(ii)	**Concrete Dam**	
	Length	798.0 m
	Height	77.0 m from deepest foundation level
(iii)	**Spillway**	
	Type	Channel spillway with ski-bucket
	Gates	27 nos. of radial gates (16.0 m x 18.5 m)
(iv)	**PH-I (Dam Power House)**	
	Intake structure	
	Length	215 m long penstock
	Diameter	
	Shape	Circular
	Power House	
	Type	Surface
	Installed Capacity	2 x 30 MW
	Turbine	vertical shaft type Kaplan
(v)	**PH-II**	

	(Canal Power House)	
	Intake structure	
	Length (low level tunnel)	1100 m
	Diameter	5.5 m
	Shape	Modified horse-shoe
	Surge Shaft	
	Length	62.0 m
	Diameter	18.0 m
	Shape	Circular
	Power House	
	Type	Surface
	Installed Capacity	3 x 6 MW
	Turbine	vertical shaft Kaplan
	Tail Race Channel	
	Length	675 m
	Lining	Concrete lined
(vi)	**Link Canal**	
	Length	220.624 km including 1.929 km long, 6 m diameter tunnel
	Lining	Concrete lined
	Bed width	13.20 m at head
	Bed slope	1:9000 to 1:12000

7.3 Basis for Study

7.3.1 General

Methodology adopted for construction of Ken-Betwa Link Project takes into consideration the construction schedule, the compatibility of the construction equipment to site conditions and the quantities as well as the utilization factor of the equipment within the scheduled construction period. Number of machines required for construction of each component of the project has been worked out and the total requirement for each type and size of machine for the project as a whole has been arrived at after

drawing up the construction/deployment schedule for the main components of the project.

Mechanized construction has been planned for almost all types of construction jobs so as to achieve consistent quality at a faster rate and also to minimize the requirement of skilled manpower. Moreover, very high degree of quality standards are required to be maintained as underground works are normally not available for regular maintenance after the completion.

Sequencing of construction activities, wherever possible, has been attempted in such a way that equipment from one activity, on its completion can be shifted to the other. This way, the total requirement of equipment at a time would be reduced and also, sufficient utilization of equipment on the project would be ensured.

7.3.2 Construction Material Sources

Locations of different borrow areas and quarries for construction material with respect to the dam location has been described in the Chapter on Surveys & Investigations.

Suitable fill material for the earth fill dam has been found in the borrow area upstream of the proposed Daudhan dam. About 46.0 MCM of soil is available in Daudhan, Palkohan and Kharyani borrow areas located in the upstream of proposed Daudhan dam. Borrow areas with minimum lead should be utilized during dam construction. For the purpose of equipment planning, average distance of these three borrow areas from dam axis has been considered. The material to be used for filter is available at Daudhan, Gangau, Palkohan and Kharyani borrow areas. However, during construction, appropriate decision may be taken to select the borrow areas which meet the requisite specifications. For the purpose of equipment planning, average distance of these borrow areas to the dam site has been considered.

Construction material for concrete, viz., sand/fine aggregate, rock/coarse aggregate, for both non-wearing and wearing surfaces are also located in the vicinity of dam site. For fine aggregate Banne river sand quarry and Barne river sand quarry have been identified. Banne river sand quarry is located at about 25 km from dam axis on the left side of approach road. The other sand quarry is situated at about 30 km from dam axis. The Daudhan village quarry and Palkohan village quarry at a

distance of 1.2 km and 1.3 km, respectively and extending up to 2 km have been identified for meeting the requirement of coarse aggregate.

Total concrete requirement of different grades for the main components of the project has been estimated to be approximately 51 lakh cum.

The area for disposal of excavated material has been considered at an average distance of 2.0 km from the dam site for equipment planning purpose.

7.3.3 Basic Considerations

Based on past experience, about 8 working months in a year are available in the area where the project is situated. Other projects in the region have also been planned with this consideration. However, all underground works like tunnels can be constructed throughout the year.

All the surface works are proposed to be executed in two shifts. All the underground works are proposed to be executed in three-shift operation throughout the year.

7.3.3.1 Scheduled Working Hours

Equipment planning for calculating requirement of equipment is carried out based on the number of working days available, which further depends upon climatic conditions of the project area. In the present scenario, the monsoon sets in during June and continues till October in the project area. For equipment planning purpose the monsoon season has been considered from 15th June to 15th October. Thus, for over ground works i.e. dam and appurtenant works a working season of eight months would be available. The underground works are generally not affected by the vagaries of weather and work has, thus, been planned to continue throughout the year. However, since the production capability would be affected during monsoon months especially for the supplies/ services and muck disposal, etc., suitable reduction in the progress has been taken into account for the year as a whole. The scheduled working hours considering 25 working days per month is given in **Table 7.2**.

Table-7.2

Scheduled working hours

Type of Work / Type of Shift	Over ground works (hr)	Under ground works(hr)
Single shift work/day	8 x 25 x 6 = 1200	12 x 25 x 6= 1800
Two shift work/day	8 x 25 x 11=2200	12 x 25 x 11= 3300
Three shift work/day	8 x 25 x 15 = 3000	12 x 25 x 15= 4500

Two shifts working of equipment is normally considered most economical in view of the high cost of three shift working on account of low availability of equipment and higher stand-by equipment requirement. Thus planning for all over ground works has been carried out based on two shifts per day working. Underground works in any case, are planned for three shifts working as these involve cyclic operations, which do not follow normal shift operation. Provision of standby equipment has been considered as follows:

1. Single shift working	10%
2. Two shift working	20%
3. Three shift working	30%

7.3.3.2 Construction Period

A total period of eight years has been considered for completion of the project. The infra-structural development, pre-construction surveys and investigations, preparation of design/ specifications and tender documents are proposed to be taken up during the first two years. In case the works are to be executed through award of contract, it is planned to award contracts for all major works by the 4^{th} quarter of 2^{nd} year . However, some of the works like diversion channel, spillway channel and link canal may have to be undertaken from the 4^{th} quarter of the 1^{st} year itself and therefore award of work for these works may be planned accordingly. The work on infrastructure facilities like project colonies,

approach roads, workshop, haul roads, stores, office buildings etc. will also start in the second year itself. Some of these activities will continue for some time during the third year also. The construction of all civil structures is proposed to be completed within 1st quarter of year 8. The erection, commissioning and testing of units would be required to be planned so that full benefits could be accrued at the end of the proposed construction period.

A total construction period of 51 months have been earmarked for completion of main canal including branch canals, distributaries and other canal structures like aqueducts, super passages, siphons', pipe culverts, road bridges and railway crossings.

The detailed construction schedule for the project in the form of a bar chart is attached as **Annexure 7.1**.

7.4 Construction Methodology and Equipment

The construction methodology and equipment planning along with construction programme for different components of the project have been described in the succeeding sub-sections.

7.4.1 River Diversion Works

To facilitate construction of earth fill dam, the river will be diverted through left flank by constructing diversion channels. The portion corresponding to 2 blocks of overflow section of the concrete dam will be utilized for diverting the river. Initially, the excavations in these 2 blocks will be carried out and the same will be connected to the river by excavating u/s diversion channel and d/s spillway channel. The excavations will be limited to the extent required for diverting the river.

For diversion works, 12,25,000 cum of excavations will have to be carried out. A period of 1 working season has been planned to undertake the above quantity. The required concreting for this portion is proposed to be carried out in a period of 3 months. The following construction methods have been considered for river diversion works:

- Excavation and loading of the material by 2.5 cum hydraulic excavator.

- Transport to the disposal area by means of 18/20 t rear dumpers.
- The rock excavation to be undertaken by drilling & blasting. Jack hammers and wagon/crawler drill with hole patterns of 1m and 2.75 m c/c respectively to be deployed for drilling of charge holes.

Separate provision of the equipment for this activity has not been kept as some of the equipment to be deployed for earth dam can be utilized on this activity.

7.4.2 Earthfill Dam (Daudhan)

The construction of the dam involves surface excavation, placement of fill material, spreading & wetting and compaction of the fill material. The quantities involved in construction of the dam are given in **Table 7.3**.

Table-7.3

Quantities involved in construction of the dam

Description of Work	Type / Material	Quantity, in-situ	Unit
Stripping	-	2,69,680	cum
Excavation	Common	2,25,573	cum
	Rock	19,169	cum
Fill placement	Hearting material	23,44,958	cum
	Casing material	102,13,782	cum
	Filter, Fine	5,19,691	cum
	Filter, Coarse	5,64,639	cum
	Rock toe	1,72,247	cum

7.4.2.1 Surface Excavation

The surface excavation for main dam as well as for cofferdams involves both common and rock excavations. The volume of required excavation is given in **Table 7.4**.

Table-7.4: Volume of Surface Excavation

Type / Description	Common excavation (cum)	Rock excavation (cum)
Stripping	2,69,680	Nil
Excavation for trenching and preparation of base	2,25,573	19,169
Total	4,95,253	19,169

One working season has been earmarked for undertaking surface excavation pertaining to main dam. Although work in the river bed can be undertaken only after completion of river diversion work, the work of stripping can be taken up earlier. The requirement for which provision of equipment for the surface excavation is to be made is given in **Table 7.5**.

Table-7.5
Estimation of hourly quantity of excavation

Type / Description	Common Excavation	Rock Excavation
Total volume (cum)	495253	19169
Time period (months)	8	8
Shift proposed	2	2
Total operational hours (hr)	2200	2200
Volume to be handled in-situ (cum/hr)	225	9
Volume to be handled loose (cum/hr)	281	15

Total quantity **= 281+15 = 296** cum/hr

Peak quantity **= 370** cum/hr

Following construction methods are proposed for surface excavations:

- Stripping and excavation for trenching & preparation of base of dam and loading of the soft material (earth and alluvium) by 2.5 cum hydraulic excavators assisted by 180 HP crawler dozer.

- Transportation to the disposal area by 18/20 t capacity rear dumper.

- A 180 HP bulldozer is also considered to stay in the disposal area for spreading of the unloaded materials.

- The rock excavation to be undertaken by drilling & blasting. Jack hammers and wagon/crawler drill with hole patterns of 1 m and 2.75 m c/c respectively to be deployed for drilling of charge holes.

7.4.2.2 Fill Placement

The construction of earth fill dam involves placement of 1,36,43,030 cum of fill materials. As per construction schedule the fill placement is to be undertaken in a period of 32 months excluding the monsoon period. The break-up of total quantity into different types of fill material to be placed in different zones and their expected source of supply is given in **Table 7.6**.

Table-7.6
Quantities and source of fill material

S. No.	Fill Material	Quantity (compacted) (cum)	Average distance of borrow area/quarry (km)
1.	Hearting Material	23,44,958	6.0
2.	Casing material	102,13,782	6.0
3.	Filter, Fine	5,19,691	5.25
4.	Filter, Coarse	5,64,639	2.25
5.	Rock toe	72,247	.25
	Total	**1,36,43,030**	

The fill placement will require excavation and loading of material at the borrow areas/quarries, transportation of the material to the placement site and unloading. It is necessary that various alternative methods and equipment are evaluated and appropriate construction methods and suitable construction equipment are selected.

Hydraulic excavator-rear dumper combination is the most commonly used method of material transportation in a river valley project. The selection of hydraulic excavators depends on the quantities to be handled, limitations of space at the site and the availability of standard equipment. Matching rear dumpers are estimated taking into account the distance to be travelled, the load ratings of haul roads and traffic intensity. This method is considered quite flexible as this allows introduction of additional equipment to supplement the capacity, if required. These equipments are available as standard items and most of the sizes which may be required on river valley projects are manufactured indigenously.

Belt conveyor system is considered a good alternative for transportation of material over long distances. In this method the capital cost of equipment is high, but the disadvantage is offset by the low running and maintenance costs. However, some limitations are posed by the maximum lump size, which can be transported through these belt conveyors.

In the present case, since fill material is available within a distance of 6 km and borrow areas are scattered over different locations, the conventional method of material transportation, i.e., hydraulic excavator-dumper combination has been considered for material transportation.

(i) Hearting Material

As mentioned above, the fill quantities are to be placed in four working seasons. The hourly placement quantities for hearting material have been worked out and given in **Table 7.7**.

Table-7.7
Estimation of hourly quantity of hearting material placement

S.No	Description	Quantity	Unit
1.	Total volume	23,44,958	cum
2.	Time period	32	month
3.	Shift proposed	2	-
4.	Operational hours/month	275	hr
5.	Total operational hours	8,800	hr
6.	Volume to be handled (in-situ)	267	cum/hr
7.	Volume to be handled (loose)	333	cum/hr
8.	Peak quantity	417	cum/hr

The following construction methods have been considered for hearting fill:

- Excavation and loading by means of 2.5 cum hydraulic excavator.
- Transport to the embankment by means of 18/20 t capacity rear end dumpers.
- Spreading by 180 HP bulldozers.
- Moisture adjustment by 8000 L water sprinklers.
- Compaction by 8 passes of 10 t pad foot vibrating roller.

An average distance of 6.0 km from dam site has been considered for the borrow areas for impervious material.

(ii) Casing Material

The total quantity of semi-impervious material to be placed in the earth dam is 1,02,13,782 cum. It is proposed that all the material will be transported from the borrow areas which are within a distance of 6.0 km (average distance) from the dam axis.

The hourly placement quantity for semi pervious material has been worked out and given in **Table 7.8**.

Table 7.8

Estimation of hourly quantity of semi-impervious material placement

Description	Quantity	Unit
Total volume	102,13,782	cum
Time period	32	month
Shift proposed	2	-
Operational hours/ month	275	hr
Total Operational hours	8,800	hr
Volume to be handled (in situ)	1,160	cum/hr
Volume to be handled (loose)	1,450	cum/hr
Peak quantity	1,814	cum/hr

The following construction methods have been considered for semi-impervious earth fill:

- Excavation and loading of the material at borrow area by 2.5 cum hydraulic excavator.
- Transport to the embankment by means of 18/20 t rear dumpers.
- Spreading by 180 HP bulldozers.
- Moisture adjustment by 8000 L water sprinklers
- Compaction by 8 passes of 10 t pad foot vibrating roller.

(iii) Fine, Filter

The fine filter will have a total volume of 5,19,691 cum and this quantity will be brought from quarries located at an average distance of 5.25 km from dam site. The material will be processed in a processing plant located suitably near the quarry itself. The fine filter material will be processed and brought to the dam site for placement.

As the quantity of filter material is comparatively less, single shift work/day is proposed for filter placement. The hourly rate at which placement of filter is to be carried out is given in **Table 7.9**.

Table-7.9

Estimation of hourly quantity of filter material placement

Description	Quantity	Unit
Total volume	5,19,691	cum
Time period	32	month
Shift proposed	1	-
Operational hours/month	150	hr
Total operational hours	4,800	hr
Volume to be handled (in-situ)	108	cum/hr
Volume to be handled (loose)	135	cum/hr
Peak quantity	169	cum/hr

The filter materials will be placed in accordance with the following construction methods.

- Loading at the quarry by 2.5 cum hydraulic excavator and transportation up to filter processing plant by 18/20t capacity rear dumper.
- Processing at the filter processing plant of capacity, 350 tph installed near the quarry.
- Loading by 1.5 cum loader and transport to the dam site by 18/20 t capacity rear dumper.
- Spreading on the embankment in layers up to 50 cm thick by bulldozer with flywheel power of 180 HP.
- Compaction with 6 passes of 10t smooth drum vibratory roller.

(iv) Coarse Filter and Rock-toe

The requirements of coarse filter and rock-toe is approximately 7,36,886 cum, which will be met from rock quarries. The rock will be transported to the placement site. As in the case of fine filter material, the coarse filter and rock-toe material quantity being less, a single shift working is proposed for placement. The estimation of hourly quantities involved is given in **Table 7.10**.

Table-7.10
Estimation of hourly quantity of coarse filter and rock-toe material placement

Description	Quantity	Unit
Total volume	7,36,886	Cum
Time period	32	Month
Shift proposed	1	-
Operational hours/month	150	hr
Total operational hours	4800	hr
Volume to be handled/hr (in situ)	154	cum/hr
Volume to be handled/hr (loose)	246	cum/hr
Peak quantity	307	cum/hr

The following construction methods and equipment are considered suitable for rockfill placement:

- Drilling of charge holes at the quarry by means of jack hammers and crawler drills with hole patterns of 1-2.75 m c/c.
- Blasting by means of electric detonators connected to proper wire circuits.
- Loading at the quarry by 2.5 cum hydraulic excavator and transportation up to filter processing plant by 18/20t capacity rear dumper.
- Processing at the filter processing plant of capacity, 500 tph installed near the quarry.
- Loading at the filter processing plant by 2.5 cum loader and transport to the dam site by 18/20 t capacity rear dumper.

- Spreading of the unloaded material on the embankment to about 70 cm layer thickness, by means of 180 HP flywheel power bulldozer.
- Compaction by 10 t smooth drum vibrating rollers.

7.4.2.3 List of Major Construction Plant and Equipment for Earth Dam

Based on above methodology and equipment planning the list of equipment required for construction of earth dam (Daudhan) is given in **Table 7.11**.

Table-7.11
List of equipment required for construction of earth dam (Daudhan)

S. No.	Description	Size/capacity	Quantity
1.	Hydraulic excavator	2.5 cum	15
2.	Crawler/wagon drill	600 cfm	4
3.	Jack hammer	120 cfm	24
4.	Front end loader	2.5 cum	3
5.	Front end loader	1.5 cum	3
6.	Rear end dumper	18/20t	144
7.	Crawler dozer	180 HP	10
8.	Vibratory compactor (pad foot)	10t	6
9.	Vibratory compactor (smooth drum)	10t	2
10.	Water sprinklers	8000 L	8
11.	Air requirement	cfm	5000
12.	Filter processing plant	500 tph	1
13.	Filter processing plant	350 tph	1
14.	Truck	8/10 ton	8

7.4.2.4 Construction Programme

The excavations for the dam will start from the abutments above river bed level in the 4th quarter of year 2 and will be completed within 1 working season. Excavations in the river bed including cut-off trench will start as soon as the work area in the river bed becomes dry. The dam foundation treatment, which includes consolidation grouting and curtain grouting, will start locally as the excavation is completed in that area. The timely completion of the surface treatments for the core foundation in the river bed is essential in order to allow the beginning of the clay placement. Thereafter, this work will proceed slightly in advance of the raising of the core where it is required.

Embankment construction will start by 1st quarter of year 4, once the excavation and foundation preparation works in the river bed are sufficiently advanced. The period before the beginning of the embankment construction shall be devoted to the preparation of the haul roads and development of the borrow area.

A total period of 32 months, excluding the monsoon period has been allowed for the completion of the dam embankment with the aim to reach crest elevation by the end of 4th quarter of year 7.

7.4.3 Concrete Dam (Daudhan)

Main activities to be undertaken for construction of concrete dam (over flow & non-over flow sections) are surface excavations and concreting. Surface excavations will comprise of common excavation in overburden and rock excavation. The quantities involved in construction of dam are given in **Table-7.12**.

Table-7.12
Quantities involved in construction of concrete dam (over flow & non-over flow)

S. No.	Description	Common Excavation (cum)	Rock Excavation (cum)	Concreting (cum)
1.	Over Flow Section	-	11,27,716	9,47,426
2.	Non-over Flow Section	25,227	1,35,910	4,61,676
3.	d/s Spillway Channel (Balance Qty.)	-	96,80,650	-
4.	u/s Diversion Channel (Balance Qty.)	-	50,98,000	-
	Total	25,227	1,60,42,276	14,09,102

7.4.3.1 Surface Excavations

In addition to the quantity of excavation for concrete dam, the balance quantities of u/s diversion channel and d/s spillway channel will also be undertaken simultaneously. Spillway being a gated structure enough time is required for concreting and erection of gates. The surface excavations have been planned to be completed within 5 working seasons (32 months). The excavated material will be transported to the disposal area using conventional excavator and rear dumper combination. The estimation of hourly quantity of excavation is given in **Table 7.13**.

Table-7.13
Estimation of hourly quantity of excavation

Type / Description	Common Excavation	Rock Excavation
Total volume (cum)	25,227	1,60,42,276
Time period (months)	40	40
Shift proposed	2	2
Total operational hours (hr)	11000	11000
Volume to be handled in-situ (cum/hr)	2	1458
Volume to be handled loose	3	2333

(cum/hr)		
Peak Volume to be handled (cum/hr)	4	2916

Total quantity = 4 + 2916 = 2920 cum/hr

The construction equipment for surface excavations is as under:

- Excavation and loading of the soft material (common excavation) by 2.5 cum hydraulic excavators assisted by 180 HP bulldozers.
- For rock excavations requiring drilling & blasting, drilling the very steep areas by hand-held rigs (jack hammer) of 38 mm diameter with hole patterns of about 2.75 sq m and drilling the accessible areas by crawler drill.
- Loading of blasted rock by 2.5 cum hydraulic excavator, shovel attachment and assisted by 180 HP dozers.
- Transportation to the disposal areas/main dam by 18/20t rear dumpers.
- Crawler dozer, 180 HP to be deployed at the disposal area to spread the material.

7.4.3.2 Concreting

For concreting of main dam and appurtenant structures, total quantity of the order of 15 lakh cum, will have to be placed. A period of 3 working seasons has been planned for the placement. The rate of placement works out to 150 cum/hr approximately. The concrete required for main dam is proposed to be produced in a centralized automated Batching and Mixing Plant of capacity 180 cum/hr. The plant shall be located in the vicinity of the dam. In addition, two numbers mobile batching & mixing plant each of capacity, 18 cum/hr will be provided. The concrete from the plant will be transported with the help of transit mixers, 4.5 cum capacity.

Following construction equipments have been considered for concreting of main dam and appurtenant structures:

- Placing of concrete with the help of travelling type tower cranes. 4 Nos. tower cranes, 10 ton @ 30 m radius are proposed to be deployed at suitable locations. In addition, 3 Nos. 70

cum/hr concrete pumps with 36m boom will be used for concrete placement.

- Concrete transportation by transit mixers of 4/9 cum capacity.
- Batching and mixing plant of capacity 180 cum/hr to be located preferably within a radius of 2 km from the concrete dam.
- The aggregate crushing and screening plant of 350 tph for preparation of coarse and fine aggregates.

7.4.3.3 List of Major Construction Plant and Equipment for Concrete Dam

Based on above construction methodology, major construction plant and equipment required for construction of concrete dam are given in **Table 7.14**.

Table-7.14
Major construction plant and equipment required for construction of concrete dam

S. N0.	Equipments	Size/capacity	Quantity
1	Hydraulic excavator	2.5 cum	16
2	Crawler dozer	180 hp	10
3	Front End Loader	2.5 cum	4
4	Crawler/wagon drill	600 cfm	14
5	Jack hammer	120 cfm	54
6	Rear dumper	18/20t	96
7	Tippers	4.5 cum	20
8	Hydraulic Rock breaker		2
9	Tower Crane, travelling type	10t@30m	4
10	Aggregate processing plant	350 tph	1
11	Batching & mixing plant	180 cum/hr-Twin Shaft computerized with in house scada software-Dual Conveyor with waiting hopper/suitable	1

S. N0.	Equipments	Size/capacity	Quantity
		for Microsilica-30*5 Bins	
12	Mobile Batching & mixing plant	18 cum/hr Pan mixer-with skip bucket operation/completely automated control system/Compatible with 2 Screw conveyor	2
13	Transit mixers	4cum with total geometric volume above 7850 & water line volume 4550 Litre &9 Cubic-geometric volume-15800 & water line volume-10000	9 numbers -4 cubic & 9 numbers -9 cubic
14	Concrete pump with 36 m boom (Rock Valve-Hydraulic Outrigger)	70 Cubic/Hr	3
15	Concrete Vibrator (electrical/pneumatic)		30
16	Compressed air	Cfm	8000
17	Grout pump	20 kg/m^2	4
18	Trucks	8/10 ton	10

7.4.3.4 Construction Programme

The sequence of construction of concrete dam takes into account the following aspects:

- Surface excavation of concrete dam to start during the 4th quarter of Year 2.
- The excavation of balance quantities of u/s diversion channel and d/s spillway channel to be taken up simultaneously with the dam excavation.

- The total quantity of excavation to be completed in a period of 5 working seasons. The activity to be completed by the end of 2nd quarter of year 7.
- Concreting to start in the 4th quarter of Year 4 and will continue for 3 working seasons and to be completed by the end of the 2nd quarter of year 7.
- Since a part of over-flow section (two blocks) is to be used for diversion of river during construction of earth dam, the phasing of concreting is to be planned in such a way that the work of these two blocks is completed during lean season.
- Gate installation work to start in the beginning of 1st quarter of year 7 and will be completed by the end of 2nd quarter of Year 8.

7.4.4 PH-I (Dam Power House) Complex

PH-I complex (Dam power house) will house two nos. of Vertical Shaft Kaplan turbines.

7.4.4.1 Excavation and Concreting

Main activities to be undertaken for construction of power house complexes are surface excavations and concreting along with erection of electro-mechanical equipment. The quantities involved in the dam power house complex are given in **Table 7.15**.

Table-7.15
Quantities involved in the dam power house complex

S. No.	Description	Quantity (cum)
1.	Surface excavations	
	a) Common Excavation	10,000
	b) Rock excavation	1,02,000
2.	Concreting	62,630

The sequence of operations for power house complex is based on the following construction methods and equipment:

- Excavation and loading of the soft material by 2.5 cum hydraulic excavators assisted by 180 HP dozer.
- For rock excavations requiring drilling and blasting, drilling the very steep areas by hand-held rigs with 38 mm diameter with

hole patterns of about 1-2.5 sq m and drilling the accessible areas by crawler rigs with 76 mm bits and hole patterns ranging from 7.5 to 9.0 sq m.

- Loading of the blasted rock by 2.5 cum hydraulic excavator bucket shovel attachment and assisted by 180 HP dozers.
- Transportation to the disposal areas by 18/20 t rear end dumpers.

- Placing of concrete with 70cum/hr concrete pumps with 36 m boom.
- Concrete transportation by 4/9cum transit mixers.
- Concrete production in a Batching and mixing plant of capacity 180 cum/hr.
- The aggregate crushing and screening plant of 350 tph for preparation of coarse and fine aggregates.
- Tower crane of 10 t at 30 m radius is to be utilized for handling of construction material, shutter forms etc.

7.4.4.2 List of Major Construction Plant and Equipment

No separate equipment for construction of PH-I has been provided as equipment deployed for concrete dam shall be utilized for construction of PH-I.

7.4.4.3 Construction Programme

As the excavation quantities are not much, a period of 5 months has been planned beginning in the 4th quarter of year 5. The construction of the concrete structures will begin by the 1st quarter of Year 6 starting from the structures of the erection area. Almost 14 months have been considered necessary to complete the first stage structures to the extent required to allow the erection of main powerhouse cranes.

The encasement of the draft tubes and spiral cases and the subsequent construction of the second stage structures of the powerhouse will continue according to the equipment erection schedule. All works including electro-mechanical works will be essentially completed by 2nd quarter of year 8.

7.4.5 PH-II (Canal Power House) Complex

The structures for PH-II include a lower level tunnel, surge shaft, and surface type power house. The water from the power house shall be discharged through a TRC in to Ken LBC. An arrangement to bye-pass power house and discharge water directly into Ken LBC has also been made to feed water into Ken LBC when the power house is not running.

7.4.5.1 Intake Structure

The intake structure for PH-II, i.e. lower level tunnel shall be modified horseshoe shaped having 5.5 m diameter and 1100 m length. In view of its size, the intake tunnel is proposed to be excavated by full face drill and blast method.

Heavy duty rock drills mounted on work platform will be utilized for drilling of charge holes. Pull of 2.0 m per cycle of operation has been planned in good rock strata.

The method of excavation for a pull of 2.0 m in good rocks using heavy duty rock drills is as under:

- Drilling with heavy duty rock drills for which cycle time would be around 8 hrs.
- Charging operations of explosive executed by means of platform jumbo.
- Wheel loader of 1.5 cum bucket capacity in combination with 10 ton tippers will be deployed for mucking operation.
- Shotcrete with the help of 25-30 cum/hr capacity with 14 mtr boom wet shotcrete machine.
- Rock bolting by using rock drills for drilling holes and inserting and tightening of rock bolts manually using work platform.

The cycle time for excavation of lower level tunnel (2.0 m pull) is given in **Table 7.16**.

Table-7.16 : Cycle time for excavation of lower level tunnel

S. No.	Item of work	Time (hr)
1.	Preparation	0.5
2.	Drilling	8.0
3.	Loading/blasting/ defuming	1.5
4.	Removal of jumbo	0.5
5.	Shotcreting (primary)	1.0
6.	Scaling	1.0
7.	Shotcreting (secondary)	2.0
8.	Mucking	4.0
9.	Rock bolting	3.0
Total cycle time		**21.5**

With this progress rate, excavation of 1100 m length can be completed in 16 months by working simultaneously on both the faces.

The concrete lining of tunnel shall start after the completion of excavation. The concrete will be placed in the overt section with the help of 12 m long shutter form and in invert with the help of open screen. A peak progress rate of 10 m per day is expected at each face.

7.4.5.2 Surge Shaft

A surge shaft of 18.0 m diameter and having height of 62.0 m is a part of water conductor system.

Considering the dimensions of shaft and ease of construction, the surge shaft will be excavated in two stages, first a pilot shaft will be excavated throughout the length and thereafter, the shaft will be widened to final dimensions. The pilot shaft of 2.5 m diameter would be consequently utilized for the mucking of the second stage widening.

Excavation of pilot shaft will be undertaken manually using conventional drilling and blasting method from top to bottom with jack hammers. Men and material will be lowered from the top using winch-operated hoist.

The construction methods for excavation of pilot shaft of 2.5 m diameter from the top are as follows:

- Drilling of charge holes by jack hammer and charging them with explosives.
- Blasting after taking the man and material up using hoist.
- Defuming by spraying a mixture of air and water from top.
- Mucking using 1.0 cum skip bucket lifted by 10t winch installed on the top of the shaft. Loading of muck on the skip bucket will be done manually.

Once the pilot shaft has reached the excavated level of the surge shaft the pilot shaft shall be enlarged to the final size. An elevator (rack & pinion type) will be installed for the movement of men. The area to be enlarged shall be subjected to drilling and blasting with an average pull of 1.0 m. While drilling at the top and mucking through the bottom, top of the pilot shaft will be covered with a steel baffle plate as a safety precaution. During enlargement, drilling will be done on a slightly inclined plane so that the blasted muck can be pushed down through the shaft manually. Muck can be removed from the bottom of the shaft by deploying wheel loader of 1.5 cum bucket capacity in combination with 10 ton tippers. This mode ensures excavation at a fast pace and with little effort. Material will be lowered from the top using winch-operated hoist.

The construction method for widening of shaft with 1.0 m lift is as under:

- Drilling of charge holes by jack hammers after covering the pilot hole with a steel baffle plate to ensure safety for the crew.
- Drilling length to be controlled to produce tunnel profile to facilitate flow of blasted material towards pilot shaft.
- Pushing of remaining blasted material through pilot shaft manually by hand shovel.
- Loading of muck at bottom of pilot shaft by deploying wheel loader of 1.5 cum bucket capacity in combination with 10 ton tippers.
- Rock bolting and Shotcreting as per design parameters.

A typical cycle of widening one fourth of surge shaft for a lift of 1.0 m is given in **Table 7.17**.

Table-7.17
Cycle time for surge shaft enlargement

S.No.	Item of work	Time (hr)
1.	Preparation Time	1.00
2.	Lowering drilling Machinery and Men	1.00
3.	Drilling	2.70
4.	Charging	0.50
5.	Retrieving drilling Machinery and Men	1.00
6.	Loading/Blasting/Defuming	1.00
7.	Lowering shotcrete m/c and men	1.00
8.	Pushing of muck	1.00
9.	Stabilization measures	2.00
10.	Retrieving shotcrete m/c and men	1.00
11.	Mucking	0.50
12.	Miscellaneous activities	1.00
Total cycle time (approx.)		**13.70**

Concreting of surge shaft will be undertaken in the last. Concreting of surge shaft will be carried out from bottom to top. The formwork for concreting would be 2.0 m height. Concrete shall be poured either by chute from the top or by concrete pump from the bottom. A typical concrete cycle is given in **Table 7.18**.

Table-7.18
Cycle time for concreting

SN	Schedule of Work	Time (hr)
1.	Move, set form	5.00
2.	Place concrete	4.00
3.	Setting Time	12.00
4.	Removal of set form and misc. time	3.00
Total cycle time		**24.00**

A pour can be achieved every alternate day. The average monthly progress that can be achieved is 25 m.

7.4.5.3 PH-II

PH-II will be surface type to house three vertical shaft Kaplan turbines.

Main activities to be undertaken for construction of PH-II are surface excavations and concreting along with erection of electro-mechanical equipment. Surface excavations will comprise of common excavation in overburden and rock excavation. The quantities involved in the main structures of powerhouse are given in **Table 7.19**.

Table 7.19
Quantities involved in the main structures of powerhouse

S. No.	Description	Quantity (cum)
1.	Surface excavations	
	a)Common Excavation	10,000
	b) Rock excavation	45,900
2.	Concreting	21,450

The sequence of operations for power house complex is based on the following construction methods and equipment:

- Excavation and loading of the soft material by 2.5 cum hydraulic excavators assisted by 180 HP dozer.
- For rock excavations requiring drilling and blasting, drilling the very steep areas by hand-held rigs with 38 mm diameter with hole patterns of about 1-2.5 sq m drilling the accessible areas by crawler rigs with 76 mm bits and hole patterns ranging from 7.5 to 9.0 sq.m.
- Loading of the blasted rock by 2.5 cum hydraulic excavator bucket shovel attachment and assisted by 180 HP dozers.
- Transportation to the disposal areas by 18/20t rear end dumpers.
- Placing of concrete with 70cum/hr concrete pumps with 36m boom.
- Concrete transportation by 4cum transit mixers.
- Concrete production in a Batching and mixing plant of capacity 30 cum/hr.

- The aggregate crushing and screening plant of 70 tph for preparation of coarse and fine aggregates.
- Tower crane of 5t at 30 m radius is to be utilized for handling of construction material, shutter forms etc.

7.4.5.4 List of Major Construction Plant and Equipment

Based on the above methodology, major construction plant and equipment required for construction of PH-II complex have been worked out and given in **Table 7.20**.

Table-7.20
Major construction plant and equipment required for construction of PH-II complex

S. No.	Equipments	Size/capacity	Quantity
1.	Hydraulic excavator	2.5 cum	2
2.	Front End Loader	1.5 cum	2
3.	Crawler/ wagon drill	600 cfm	1
4.	Jack hammer	120 cfm	5
5.	Heavy duty rock drill mounted on platform jumbo	4 x 120 cfm	2
6.	Rear dumper	18/20 t	10
7.	Tippers	4.5 cum	8
8.	Crawler dozer	180 HP	1
9.	Aggregate processing plant	70 tph	1
10.	Batching & mixing plant	30 cum/hr-Pan mixer Mobile Series with 4 bins/fully automated control system with in house Scada	1
11.	Concrete pump with 36 m boom-Rock Valve with Hydrualic Outriggers	70 cum/hr	3
12.	Shotcrete m/c -Self propelled Rock Valve,	25-30 Cubic/Hr, 14 mtr Boom,	2
13.	Transit mixers	4cum with total geometric	4

		volume above 7850& water line volume 4550 Litre	
14.	Grout pump	20 kg/m^2	2
15.	Tower crane	5 t/30 m	1
16.	Mobile crane	20 t	1
17.	Crawler crane	30 t	1
18.	Concrete Vibrator (electrical/pneumatic)		20
19.	Compressed air	Cfm	5000
20.	Electric winch	20 t	2
21.	Concrete Shutter Form	2m x 6 m	4
22.	Concrete Shutter Form	10 m x 5.5 m	1

7.4.5.5 Construction Programme

The excavation of tunnel from both the faces will start simultaneously in the beginning of 2nd quarter of year 4 after the completion of portals. The excavation from the two faces will be completed by the end of 2nd quarter of year 5, after which concreting will be carried out and will be completed by the end of year 5.

The construction sequence and programme of surge shaft is as follows:

- Excavation of pilot shaft will start after the completion of open excavation and to complete within a span of 4 month.
- Enlargement of surge shaft will start subsequently and to continue for 6 months till the end of May of year 5.
- Concreting will start after the work of enlargement is over and will be completed within a period of 6 months.

For power house excavation, a period of 8 months has been planned starting from 4th quarter of year 4. The construction of the concrete structures will begin in the 4th quarter of Year 5 starting from the structures of the erection area. Almost 14 months excluding the monsoon period have been considered necessary to complete the first stage structures to the extent required to allow the erection of main powerhouse cranes. After that, 3 additional months will be required to complete all first stage structures.

The encasement of the draft tubes and spiral cases and the subsequent construction of the second stage structures of the powerhouse will continue according to the equipment erection schedule.

7.4.6 Ken LBC

The construction of Ken LBC and associated branch canals involve surface excavation in some reaches and placement of fill material in others. The excavations include common excavation and rock excavation which may require drilling and blasting. For fill reaches, spreading & wetting and compaction of the fill material will have to be undertaken. In addition, the canal will be lined with concrete lining. The quantities involved in construction of the Ken LBC and associated branch canals are shown in the **Table 7.21**.

Table-7.21

Quantities involved in construction of the Ken LBC and associated branch canals

Description of Work	Type / Material	Quantity, in-situ	Unit
Excavation	Common	91,90,490	cum
	Rock	3,78,910	cum
Fill placement		64,31,500	cum
Lining	Concrete	30,21,000	cum

The estimation of hourly quantity of excavation is given in **Table 7.22**.

Table-7.22
Estimation of hourly quantity of excavation

Type / Description	Common Excavation	Rock Excavation
Total volume (cum)	91,90,490	3,78,910
Time period (months)	48	48
Shift proposed	2	2
Total operational hours (hr)	13200	13200
Volume to be handled in-situ (cum/hr)	696	29
Volume to be handled loose (cum/hr)	870	46
Peak volume to be handled (cum/hr)	1088	58

Total quantity **= 1088+58 = 1146** cum/hr

The construction methodology and equipment for the activities involved in the construction of Ken LBC and associated branch canals will be similar to those required for Ken-Betwa Link Canal and have been described in the relevant section.

7.4.6.1 List of Major Construction Plant and Equipment

Based on above construction methodology, major construction plant and equipment required for construction of Ken LBC are given in Table **7.23**.

Table-7.23
Major construction plant and equipment required for construction of Ken LBC

S. N0.	Equipments	Size/capacity	Quantity
1.	Hydraulic excavator	2.5 cum	8
2.	Front End Loader	1.5 cum	2
3.	Crawler dozer	180 HP	4
4.	Crawler/wagon drill	600 cfm	2
5.	Jack hammer	120 cfm	20
6.	Rear dumper	18/20 t	40
7.	Tippers	4.5 cum	10
8.	Aggregate processing plant	100 tph	3
9.	Batching & mixing plant	45 cum/hr- Pan mixer Mobile Series with 4	3

S. N0.	Equipments	Size/capacity	Quantity
		bins/fully automated control system with in house Scada compatible with 3 Screw conveyors	
10.	Mobile Batching & mixing plant	18 cum/hr Pan mixer-with skip bucket operation/completely automated control system/Compatible with 2 Screw conveyor	2
11.	Transit mixers	4cum with total geometric volume above 7850 & water line volume 4550 Litre &9 Cubic-geometric volume-15800 & water line volume-10000	4 Cubic-9 numbers & 9 cubic -9 numbers
12.	Concrete Roller finisher with (Automatic Grade/ Steering Sensor	14 Meter	10
13.	Concrete slipform Paver with Trimmer	12 Meter	2
14.	Trimmer / Placer	5.5 Meter	2
15.	Concrete pump with 36m boom-Rock valve with Hydraulic Outriggers	70 cum/hr	3
16.	Concrete Vibrator (electrical/pneumatic)		20

S. N0.	Equipments	Size/capacity	Quantity
17.	Compressed air	cfm	4000
18.	Grout pump	20 kg/m^2	4
19.	Trucks	8/10 ton	10
20.	Vibratory compactor (pad foot)	10 t	4
21.	Vibratory compactor (smooth drum)	10 t	2
22.	Water sprinklers	8000 L	8

7.4.6.2 Construction Programme

The sequence of construction of Ken LBC takes into account the following aspects:

- A period of 6 working season beginning 4th quarter of year 2 has been planned for undertaking surface excavation as well as fill placement.
- Concreting to start in the 4th quarter of Year 5 and will continue for 27 months and to be completed by the end of the year 8.
- Cross-drainage works and other canal structures to be completed within the above period.

7.4.7 Ken-Betwa Link Canal

The proposed link canal for transferring the surplus water from Ken basin up to Daudhan dam to Betwa basin is 218.695 km long. The water from the reservoir will be led through a tunnel (Upper Level Tunnel) into link canal.

7.4.7.1 Upper Level Tunnel

The tunnel to be excavated is 6 m dia. and 1929 m long. The tunnel will be excavated by drill & blast method by working from two faces simultaneously.

The methodology and equipment for construction of upper level tunnel will be similar to that of the lower level tunnel that have been described under relevant section.

7.4.7.2 Link Canal

Main activities to be undertaken for construction of canal are main canal, branch canals, distributaries and other canal structures like siphons, bridges, railway crossings, super passages along with concrete lining of the main canal. Earth work comprises of both the common excavation in overburden and rock excavation. For fill reaches, spreading & wetting and compaction of the fill material will have to be undertaken. The quantities involved in construction of the Link Canal and associated branch canals are shown in the **Table 7.24**.

Table-7.24

Quantities involved in construction of the Link Canal and associated branch canals

Description of Work	Quantity, in-situ	Unit
Excavation	4,36,75,204	cum
Fill placement	1,17,41,438	cum
Lining	7,08,599	cum

It is proposed to divide the entire length of canal into four segments and take up the work in all the segments simultaneously so the work can be completed within the stipulated time period. The **e**stimation of hourly quantity is given in **Table 7.25**.

Table-7.25

Estimation of hourly quantity excavation

Type / Description	Excavation	Fill Placement
Total volume (cum)	4,36,75,204	1,17,41,438
Av. Volume in each of 4 segments	1,09,18,801	29,35,360
Time period (months)	48	48
Shift proposed	2	2
Total operational hours (hr)	13,200	13,200
Volume to be handled in-situ (cum/hr)	827	222
Volume to be handled loose (cum/hr)	1,034	278
Peak Volume to be handled (cum/hr)	1,292	348

Total quantity =1,292+348=1,640 cum/hr

The sequence of operations for Ken-Betwa Link Canal is based on the following construction methods and equipment:

- Excavation and loading of the soft material by 2.5 cum hydraulic excavators assisted by 180 HP dozer.
- For rock excavations requiring drilling and blasting, drilling the very steep areas by hand-held rigs with 38 mm diameter with hole patterns of about 1-2.5 sq.m and drilling the accessible areas by crawler rigs with 76 mm bits and hole patterns ranging from 7.5 to 9.0 sq m.
- Loading of the blasted rock by 2.5 cum hydraulic excavator bucket shovel attachment and assisted by 180 HP dozers.
- Transportation to the disposal areas by 18/20 t rear end dumpers.
- For fill reaches spreading by 180 HP bulldozer. Moisture adjustment by 8000 L water sprinklers and compaction by 8 passes of 10t pad foot vibrating roller.
- For concrete lining and concreting works, placing of concrete by 70cum/hr concrete pumps with 36 m boom.
- Concrete transportation by 4/9cum transit mixers.
- Concrete production in a Batching and mixing plant of capacity 90 cum/hr.
- The aggregate crushing and screening plant of 250 tph for preparation of coarse and fine aggregates.

7.4.7.3 List of Major Construction Plant and Equipment

Based on the above methodology, major construction plant and equipment required for construction of link canal including upper level tunnel have been worked out and given in **Table 7.26**.

Table-7.26
Major construction plant and equipment required for construction of link canal including upper level tunnel

S. No.	Equipments	Size/capacity	Quantity
1.	Hydraulic excavator	2.5 cum	32
2.	Front End Loader	2.5 cum	4
3.	Front End Loader	1.5 cum	2
4.	Crawler/ wagon drill	600 cfm	15
5.	Jack hammer	120 cfm	60
6.	Rear dumper	18/20 t	160
7.	Tipper	4.5 cum	8
8.	Crawler dozer	180 HP	16
9.	Crawler dozer	90 HP	8
10.	Aggregate processing plant	250 tph	4
11.	Batching & mixing plant	90 cum/hr fully automated with in house Scada/Inline bins 15*4/Provision for 5 no screw conveyors	4
12.	Concrete Roller finisher with (Automatic Grade/ Steering Sensor	14 Meter	4
13.	Concrete Slipform Paver with Trimmer	12 Meter	1
14.	Trimmer / Placer	5.5 Meter	2
15.	Concrete pump-Rock Valve	40 cum/hr	8
16.	Mobile Drum Slewing hydraulic driven concrete mixer with 4 cubic batch size with batch report	12-18 cum/hr	8
17.	Transit mixers 4/9 Cub	4cum with total geometric volume above 7850& water line volume	50-4 Cubic 50-9 Cubic

S. No.	Equipments	Size/capacity	Quantity
		4550 Litre &9cum with total geometric volume above 15800 & water line volume 10000 Litre	
18.	Concrete Vibrator (electrical/pneumatic)		60
19.	Grout pump	20 kg/m^2	8
20.	Mobile crane	20 t	4
21.	Compressed air	Cfm	16000
22.	Trucks	8/10 ton	20
23.	Vibratory compactor (pad foot)	10 t	8
24.	Vibratory compactor (smooth drum)	10 t	4
25.	Water sprinklers	8000 L	12

7.4.7.4 Construction Programme

As the main canal stretches over a significant distance, sufficient time is required to carry out detail surveys for main canal, branch canals, distributaries, minors and to finalize portions of canals for irrigation along with specific emphasis on time required for land acquisition. The contracts for all major works are to be awarded by the first year itself so that all the basic infrastructure required for the canal construction can be completed within second year itself.

A construction period of 6 working seasons has been planned starting from beginning of 4th quarter of year 23. A period of 27 months excluding the monsoon period have been considered necessary to complete the lining of link canal along with the all canal structures.

For construction of upper level tunnel, the excavation from both the faces will start simultaneously from the 2nd quarter of year 2 after the completion of portal construction. Excavation is expected to be completed by 1st quarter of year 4, after which concreting will be carried out and will be completed by the 1st quarter of year 5. An additional 3 months have been provided for grouting and cleaning activity.

7.5 Deployment Schedule

Based on equipment planning and construction programme described in preceding Sections, a construction schedule for whole of the project has been prepared in the form of a Bar Chart. Keeping this construction schedule as one of the major criteria, a deployment schedule of major construction equipment that would be required for the project is prepared. The number of equipment shown in the list has been arrived at after scheduling the equipment in such a way that minimum number of equipment, in general, would be needed. The basis for planning, indicating the type of equipment to be used, has already been dealt with in the respective sections and sub-sections corresponding to different items of the structures. As the deployment schedule may differ depending upon the number of executing agencies, the total number of equipment required will have to be reviewed at the time of project execution.

7.6 Total Requirement of Major Construction Equipment

The latest budgetary prices of the equipment have been indicated in the list which could be utilized for working out the analysis of rates as required. The total cost of construction equipment is Nil.

The provision on this account will not be included in the sub-head Q - Spl T&P of Cost Estimate since works are to be executed by the contracting agencies.

7.7 Year wise allocation of cost

The total cost of the project including Bariyarpur Barrage and Parichha dam proposed by UP State, Irrigation Department is worked out to be Rs. 37778.75 Crores. The yearly phasing of the same is given in **Table 7.27.**

Table – 7.27
Yearly Phasing of cost of project

Year	Requirements of funds (Rs. Crores)
1	7314.07
2	4702.65
3	3832.23
4	5490.41
5	5680.40
6	4993.19
7	3787.76
8	1978.04
Total	**37778.75**

The yearly phasing of cost of Project is more or less same as that approved in Cabinet Note. Hence, the cost given in Cabinet Note can be adopted.

CHAPTER-VIII

ENVIRONMENTAL IMPACT ASSESSMENT & ENVIRONMENTAL MANAGEMENT PLAN

8.0 General

The present chapter deals with Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) of various projects components under KBLP. The EIA studies of KBLP as proposed earlier were done by Agriculture Finance Corporation (AFC) Ltd., Hyderabad and included in DPR of April, 2010. The EIA studies were further modified in 2015 considering latest data and in the accordance with provisions of the "Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013" and incorporating suggestions/comments of MOEF&CC. Modified EIA studies were submitted to MoEF&CC for environmental clearance of KBLP, Phase-I during May, 2015. Accordingly, MoEF&CC granted environmental clearance (EC).

8.1 Need for Impact Assessment

KBLP involves impoundment of water by construction of a dam across river Ken at Daudhan for irrigation, drinking and hydro-electric purpose besides transfer of water from Ken river to Betwa river in u/s of Parichha Weir. Water, so transported to Betwa river is further proposed to be utilized in Upper Betwa basin on substitution basis in KBLP. As it is well known, any water resources development project may result in both positive and negative impacts on the environment. Such projects require a detailed study of various aspects for identifying positive and negative impacts that may occur in the area and also to formulate a meaningful and applicable management plan to mitigate these adverse environmental impacts, or if possible completely eliminate.

8.1.1 Project Background

Ken and Betwa rivers have their origin in MP and the rivers flow through MP and UP. No major irrigation projects were taken up in the Ken River basin in MP up to Gangau Weir to harness the waters to irrigate the backward and drought prone areas in the districts of Chhatarpur, Panna, Damoh and Tikamgarh of MP and Jhansi & Mahoba districts of UP.

A large population in Chhatarpur, Tikamgarh, Panna & Damoh districts of MP and Jhansi, Mahoba & Lalitpur districts of UP experienced acute shortage of drinking water. In this context, the proposed Ken-Betwa Link Project finds significance. As the proposed project has been found to be techno-economically viable, it is expected that the proposed project is likely to meet the requirements to the tune of 6,98,432 ha besides providing drinking water of 60 MCM in MP, 67 MCM in UP and generating 78 MW of power which is an added advantage of the project from Daudhan Dam. Besides, 2,06,000 ha from Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project in Shivpuri, Datia, Sagar and Vidisha districts of MP will be irrigated.

8.1.2 Project Justification

The National Water Policy (2002) emphasizes the need for interlinking of rivers in the country from water surplus areas to water short areas based on NPP after taking into account the requirement of the surplus areas/basins. This shall be a significant step forward to achieve the objective of equitable distribution and utilization of our limited water resources.

8.1.3 Project Description

The Comprehensive Report of KBLP comprises the following:

8.1.3.1 Head Works &Distribution System

8.1.3.1.1 Daudhan Dam Comprises

(i) An earthen embankment cum concrete dam across Ken River at Daudhan with FRL/MWL 288 m.

(ii) An Upper Level Tunnel about 170 m from the left bank of Daudhan dam having length of 1.9 km for conveying water to the link water carrier.

(iii) A Lower Level Tunnel about 100 m from the left bank of Daudhan dam having length of 1.1 km for conveying water to the Power House-II and from there to the Left Bank Canal of MP through a connecting channel of about 2.5 km.

(iv) Power House-I (2x30 MW) to the right of spillway at the toe of Daudhan dam.
(v) Power House-II (3X6 MW) at the outlet of Lower Level Tunnel.

8.1.3.1.2 Kotha Barrage Comprises

(i) A barrage across Betwa river at village Kotha, Tehsil Ganj Basoda, district Vidisha, Madhya Pradesh.
(ii) Pump Houses and Rising Mains

8.1.3.1.3 Bina Complex Multipurpose Project Comprises

(i) Four storage dams: Madia & Chakarpur on Bina River,, Semra Ghat Diversion on Dhasan River and Dehra Dam on Dehra Nalla.
(ii) Pump Houses, Rising Mains and Power Houses.

8.1.3.1.4 Lower Orr Project Comprises

(i) An earthen embankment cum concrete dam across Orr River near village Didauni, in district Shivpuri, Madhya Pradesh.
(ii) Pump Houses, Rising Mains and link water carrier.

8.1.3.1.5 Repair/strengthening/remodeling of Bariyarpur pick up weir, Parichha weir, Barwa Sagar Dam along with appurtenant structures and 7.1km long Barwa Nallah to carry water from Barwa Sagar to Betwa river upstream of existing Parichha weir.

8.1.3.1.6 Construction of two new barrages along with appurtenant structures d/s of existing Bariyarpur Pick up weir in the territory of UP.

8.1.3.1.7 Renovation of existing tanks and their connecting links in Mahoba district and carrier system for transfer of water from Ken Betwa link canal to tanks in order to enable UP to store the monsoon water to use during non-monsoon season.

8.1.3.2 Canal Pipe Line and Command Networks

8.1.3.2.1 Ken Basin

(i) A link canal (220.624 Km long including 1.9 m length of Upper Level Tunnel) with off take FSL 257 m to existing Barwa Sagar with FRL 219.20 m across Barwa Nallah, a tributary of Betwa River.

(ii) A bye pass channel from exit of Lower Level Tunnel to connect proposed Ken Left Bank Canal of MP.

(iii) Pumping system arrangements for lifting of water to Upper Level Tunnel to ensure the water supply in the Ken-Betwa link canal whenever reservoir depletes below the crown level of Upper Level Tunnel.

(iv) Developing pumping system, pipe distribution network and micro irrigation system by lifting water from Daudhan reservoir/initial reach of Link water carrier to serve a part of high level command (43,678 ha.) of Chhatarpur District of MP.

(v) A 90 km long proposed ken Left Banal Canal of MP and developing pumping system, pipe distribution network and micro irrigation system for ken Left Bank Canal to serve 1,39,848 ha. CCA in Chhatarpur District.

(vi) From existing Bariyarpur LBC 38,890 ha. CCA will be covered by existing open canal network in Chhatarpur District of MP.

(vii) Developing pumping system, pipe distribution network and micro irrigation system for 90,101 ha. CCA by lifting water from Daudhan reservoir, out of which 70,000 ha. CCA will be in Panna District and 20,101 ha. CCA will be in Damoh District of MP.

(viii) Developing pumping system, pipe distribution network and micro irrigation system from Ken-Betwa link canal to serve left out area of 42,096 ha. of high level command & 96,751 ha. Enroute command of MP and 17,488 ha. of enroute command of UP.

(ix) Stabilization of irrigation in 1,92,479 ha. in Banda district in UP under existing Ken command by repair/strengthening of existing system. Enhancing command area of Bariyarpur Right Bank Canal (Ken Canal) system by utilizing pressurized pipe micro irrigation system.

8.1.3.2.2 Betwa Basin

(i) Kotha Barrage: - Pumping system, pipe distribution network and micro irrigation system for 20,000 ha. CCA of MP.

(ii) Bina Complex Multipurpose Project: - Pumping system, pipe distribution network and micro irrigation system for 96,000 ha. CCA of MP.

(iii) Lower Orr Project:-Pumping system, pipe distribution network and micro irrigation system for 90,000 ha. CCA of MP.

(iv) Development of existing command of 37,564 ha. in Mahoba district in UP with pressurized pipe micro irrigation system.

8.1.4 Study Area of the Project

The study area considered for the Comprehensive EIA studies and preparation of EMP comprise the following:

- 1 km on either side of the canal
- 10 km radius around the project area from periphery of the project site
- submergence area under the proposed reservoir
- catchment area of dam/reservoir.
- command area on the d/s side of reservoir and en-route link canal
- areas of backwater influence on u/s side of dam

The EIA studies for newly proposed High level command and additional enroute command have not been carried out at this stage.

8.2 Daudhan Dam

8.2.1 Site Selection

With a view to provide irrigation facilities in the backward regions of Chhatarpur and Panna districts of MP and to improve the socio-economic conditions of the people, the State Government proposed to construct Greater Gangau Dam on Ken river 210 m d/s of Gangau Weir for irrigating 2.41 lakh ha of CCA in the districts of Chhatarpur and Panna. FRL of the proposed Dam was worked out to be 278.89 m with live storage of 2062 MCM. In the context of linking of rivers, NWDA carried out exhaustive studies and FRL was revised as 284.2 m with live storage of 2544 MCM.

During review of the PFR with the above proposal, it was opted to increase the FSL of link canal to 260 m to serve the command area at higher elevations. Also, due to construction of Greater Gangau Dam, the existing Gangau Weir functioning well since 1915 would be submerged. Therefore, it was considered to locate the dam site u/s of Gangau Weir with the possibility of utilizing the pondage in between the dam and the weir for generation of hydro power as a pumped storage scheme.

8.2.2 Alternate Site

While investigating the potential reservoir sites on Ken river to realign the Ken-Betwa link canal with higher off take levels, three reservoir sites were considered on the d/s side of Sonar and Bearma tributaries of Ken river are:

(a) Jhalar Reservoir Site,
(b) Ghari Ghat Reservoir Site and
(c) Daudhan Reservoir Site.

After considering several parameters like submergence area, capacity of reservoir, number of villages likely to be affected, forest and cultivable land area, Daudhan Dam site located about 2.50 km u/s of Gangau Weir had been found most suitable and preferred on account of the following reasons:

(i) It would not submerge the existing Gangau Weir.
(ii) It would provide enroute irrigation to higher level command of link canal.
(iii) Additional power generation can be achieved.

The FRL & MWL of Daudhan reservoir had finally been proposed at 288 m with gross storage capacity of 2853 MCM. This site also conforms to the geological aspects of the region.

8.2.3 No Project Option

If no project is constructed at the proposed dam site at Daudhan, available 75% dependable yield of Ken basin cannot be fully utilized to meet the irrigation requirements of the projected Ken command, within Ken basin particularly in MP. Even existing Ken command of UP would get irrigation water at 40-50% of intensity of irrigation due to insignificant storage of Gangau Weir. Further, enroute command would also not get requisite quantum of water and the present trend of migration of people from command area to other places would continue. Large part of Bundelkhand area which had been suffering due to frequent occurrence of drought would continue to suffer. The area does not have any mineral deposit based on which some related industry can be set up for socio-economic upliftment of the area. Water is the only available natural resource which can be developed through proposed Daudhan Dam for the betterment of area at reasonable cost.

8.2.4 Legal Status of the Project

Though there are large benefits that may accrue after implementation of the project, due weightage has to be given to social, environmental and economic concerns. One of the important social considerations is the process of public consultation. It has two components viz. public hearing at site or its close proximity for ascertaining concerns of local affected persons and obtain responses in writing from concerned persons having a stake in the environmental aspects of the project. While formulating the various components of the KBLP Phase-I, the provisions of National Water Policy (2002) have been kept in view. Similarly, the Forest (Conservation) Act-1980 has been completely complied with while dealing with the forest area in the project. As the Daudhan Dam project, submerges a forest land of 5258 ha, a provision for double the area has been proposed towards compensatory afforestation as per the Forest (Conservation) Act-1980.

The Wildlife (Protection) Act-1972 provides for protection of listed species of flora and fauna and establishes a network of ecologically important

areas. The provisions of this Act have also been kept in view while dealing with the wildlife issues in the project area. Permission of Central Empowered Committee would be obtained for conservation of Wildlife before taking up implementation of the project. Similarly, clearance of MoEF&CC would be required to be obtained and techno-economic clearance of the project is required from the CWC. NOC is required from Ministry of Coals and Mines stating that no potential minerals are likely to be submerged due to the project. Also, a NOC would be required from the Ministry of Archaeology about the submergence of monuments of archaeological importance. Due attention has been paid to the various provisions of National Policy on Resettlement & Rehabilitation and the policy enunciated by the GoMP regarding the R&R of displaced people due to the construction of Daudhan project.

Wild life clearance, forest clearance Stage-1 and environment clearance of KBLP, Phase-I have been accorded by MoEF&CC, New Delhi vide letter dated 19.09.2016, 25.05.2017 and 25.08.2017 respectively.

Clearance from Ministry of Tribal Affairs (MoTA) for R&R Plan for Scheduled Tribal Project Affected Families STPAFs have also been accorded vide letter dated 04.01.2017. Techno-economic and investment clearance of the project have also been accorded by the CWC & MoWR,RD &GR vide letter dated 04.08.2016 and 19.06.2017 respectively. Clearances from Central Empowered Committee, New Delhi are under consideration.

8.2.5 Baseline Environmental Data

Before initiating any step for studying EIA of the project, it is essential to identify the baseline levels of relevant environmental parameters which are likely to be affected as a result of the construction and operation of the proposed project. A similar approach has been adopted for conducting comprehensive EIA study for the proposed KBLP. A scoping matrix has been formulated to identify various parameters that are likely to be affected. Baseline status has been ascertained for air, water, land, public health and biological (terrestrial and aquatic) environment.

The status of base line environmental data has been elaborated in detail in Chapter-VII of DPR of KBLP, Phase-I (2010).

8.2.6 Environmental Impact Assessment

EIA consists of a systematic investigation of both positive and negative impacts on the physical, biological and socio-economic environment that would be caused or induced due to a proposed developmental project. Its primary objective is to encourage the inclusion of environmental considerations in planning and decision-making and to ultimately arrive at actions that are environmentally more compatible. Most of the environmental attributes are spatial in nature and to understand these attributes, suitable spatial database management system is required. GIS is a tool for collection, storing, retrieving, transforming and displaying spatial data for a particular set of purposes can provide all desirable requirements.

For generation of maps through Remote Sensing and GIS applications, SOI, topography maps on 1:250,000 and 1:50,000 scale, satellite data and secondary information have been collected from various sources. The maps that have been generated are preliminary base maps, land use and land cover maps, slope maps, hydro-geomorphologic maps, soil maps, land irrigability maps, sediment yield index etc. Based on the information generated, a detailed treatment plan for the catchment area has been developed. Similarly, treatment plan for command area has also been devised.

Para wise details have been elaborated in Chapter-VII of DPR of KBLP, Phase-I (2010).

8.2.7 Environmental Management Plan (EMP)

EMP is an integral component for the sustainability of any water resources project. The development of water resources projects is always accompanied by a complex interplay of people, natural resources and the biota of the region. This induces changes in the environment. Therefore, monitoring of various critical parameters is essential in the project operation phase. From the monitoring point of view, the important parameters are air quality, water quality, land use, ecology etc.

The para wise details have been presented in Chapter-VIII of DPR of KBLP, Phase-I (2010).

8.2.8 Environmental Management Plan (EMP) Cost

The EMP proposed in the present study covers air and noise pollution management, land and water manager plan including catchment area treatment, public health management plan and biological conservation plan for each component attempts have been made to work out the estimate costs, the total financial provision required for implementation of EMP under the project has been estimated to be Rs. 189577.33 lakh. The component wise cost is presented in the **Table-8.1**.

Table-8.1
Component Wise Cost for the Environmental Management Plan

S. No.	Particulars	Amount in Rs. Lakh
1.	Catchment area treatment plan	27258.52
2.	Land management plan	2953.16
3.	Command area management plan	31180.74
4.	Bio Diversity management plan	2747.44
5.	Fisheries conservation and development plan	1409.72
6.	Surface & ground water management plan	6340.00
7.	Public health management plan	2160.25
8.	Tourism development plan	577.50
9.	Lump sum cost for preparation of Landscape Management & Protection (LMP) Plan by WII Dehradun and conservation of Vulture plan to be prepared by Mumbai History Society	96288.00
10.	5% Cost of project to be constructed in the protected area	18662.00
	Total Cost for EMP	**189577.33**

The details have been presented in final EIA and EMP Report Volume-I, II & III of KBLP, Phase-I (May-2015) and demand of Net Present Value (NPV) by Forest Department. According to condition imposed by MoEF&CC during environmental clearance and forest clearance, a lump sum provision of Rs. 96288.00 lakh for for preparation of LMP Plan by Wildlife Institute of India (WII), Dehradun and conservation of vulture plan to be prepared by Mumbai History Society and Rs. 18662.00 lakh as a 5% cost of project to be constructed in the protected area has been kept for the environmental plan.

CHAPTER –IX
SOCIO-ECONOMIC ASPECTS AND R & R

9.0 Background

The present chapter deals with Socio-Economic Aspects and R & R studies of various projects components under KBLP. The studies of KBLP were done by M/s Agriculture Finance Corporation (AFC) Ltd., Hyderabad and included in DPR of 2010 and also techno-economically cleared by CWC in 2017. Environment clearance and 1st Stage forest clearances for the diversion of 6017 ha of forest land have been accorded by MoEF& CC vide its letters No.J-12011/20/2013-IA-I dated 25.08.2017 and letter No. F.No.8-49/2016-FC dated 25/05/2017 and same are appended as **Annexures-9.1 and 9.2** respectively.

Environment and 1st Stage clearances for the diversion of 1024.44 ha of forest land in respect of Ken-Betwa link have been accorded by MoEF&CC vide its letters No.J-12011/31/2014-IA-I dated 22.02.2017 and letter No. F.No.8-13/2015-FC dated 27/07/2016 and same are appended as **Annexures-9.3 and 9.4** respectively.

9.1 Daudhan Dam and Canals

9.1.1 Socio-Economic Aspects

The total catchment area of Ken River up to Daudhan Dam site is 19633 sq. km. The submergence area of the proposed project is spread over two districts of MP viz. Chhatarpur & Panna. However, villages coming under submergence fall in Chhatarpur district only. EIA & Socio-economic studies of the project have been carried out for the Ken command area with CCA of 515210 ha. Now, as per suggestion of Governments of MP & UP, CCA have been increased from 515210 ha to 702428 ha. Therefore, EIA & Socio-economic studies for additional command area for 183222 ha are required to be carried out. Entire command area of the project falls in Panna, Damoh, Chhatarpur and Tikamgarh districts of MP and Banda, Mahoba, Jhansi & districts of UP.

9.1.2 Submergence Area

It has been estimated by M/s AFC Ltd, Hyderabad that a 9000 ha of land spread over 10 villages shall come under submergence. Out of which 2171 ha is patta land spread over 10 villages. It is significant to note that no railway lines, telephone lines, main power lines, mineral deposits, historical and archaeological monuments are coming under submergence.

9.1.3 Project Affected Villages

It has been estimated that about 1913 families will be affected in these villages. A small population of peripheral villages would also be affected as lands of the people belonging of these villages will also be adversely affected. The total population of these 10 villages shall be 8339. The literacy rate of the study area is about 49.6 %. The percent of Scheduled Caste (SC) and Scheduled Tribe (ST) population of the area at present is 14.2 and 33.90 respectively. About 24.12% of the area is sown with agricultural crops, dense forests cover about 6.56 % and open scrub, open and scrub forest cover 1.67%, 2.90% and 46.31% respectively.

9.1.4 Resettlement and Economic Rehabilitation Plan

Daudhan Dam is an infrastructure project under the category of water harvesting and conservation structures and sanitation. Therefore, the R & R Plan of this project have been prepared as per the Act “The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013”.

The details of demography, Agriculture, Literacy, Public Health facilities, livestock, agricultural implements, Income and Expenditure and Housing in the project area have been given in relevant para of Chapter-IX of DPR of KBLP, Phase-I, 2010 and final EIA and EMP Report Volume-I, II &III of KBLP, Phase-I, prepared by M/s AFC Ltd., Hyderabad during May-2015.

9.1.5 Identified Project Affected Families (PAF's)

The caste-wise distribution of the Project Affected Families (PAFs) in the reservoir area is given in **Table 9.1.**

Table9.1

Caste Wise Distribution of Affected Families in the Daudhan reservoir area

Sl No	Caste	PAFs	
		No	% to total
1	SC	271	14.2
2	ST	648	33.9
3	BC	735	38.4
4	OC	259	13.5
	Total	**1913**	**100.0**

The PAF's would be classified under two categories. The affected households loose their land or houses or both under submergence when the dam is created. None of the households are losing only land in the project affected area of Daudhan Dam.

9.1.6 The Cost of R & R

Broadly, two major components have been considered viz land compensation and resettlement and economic rehabilitation of PAFs.

9.1.7 Land Acquisition

9.1.7.1 Daudhan Dam, Canals and Power Houses

According to the socio-economic survey conducted by M/s AFC Ltd, Hyderabad, 2171 ha of Patta land has to be acquired for Daudhan reservoir. In addition 4202.68 ha of Patta land would be acquired for the canal and distributary system. Besides about 37.95 ha of land for township and 4.0 ha of land for green belt development will be required. Thus, the total Patta land acquisition required for the project is estimated to be 6422.62 ha. The National Tiger Conservation Authority (NTCA) prepared action plan for relocation of PAF's of four villages located under Panna Tiger Reserve Forest. Also NTCA

identified sites for relocation of these PAFs. The displaced persons will be settled in colonies near the area side identified by NTCA for relocation of PAFs of these four villages. Necessary provision has been made for housing plots, infrastructure like schools and other civic amenities.

The average cost (which is arrived from the village level rates) of involuntary acquisition of irrigated land and cultivable land at Rs.3,71,500 per ha and for un-irrigated Rs.1,85,000 per ha in Daudhan reservoir area and about Rs.3.71lakh per ha for cultarable land and 1.85 lakh per ha for un-culturable was considered for land for Ken -Betwa Link canal and LBC system. The Solatium of 100 percent for compulsory land acquisition, Standing Crop loss, interest, demarcation, legal and establishment charges were kept. Also lump sum provisions were made towards rent for use of land prior to acquisition, rehabilitation measures, compensation for temporary acquisition of borrow area, provision for branch canals. The above cost was proposed by M/s AFC Ltd. Hyderabad. The total compensation for land acquisition has been estimated to be Rs. 1007.07 crore.

Now, in the present scenario, Presurised pipe micro irrigation system has been proposed in the entire command of Ken- Betwa Link in the enroute, Ken LBC and Hatta & Panna lift. Therefore, area required for land acquisition under canals has been reduced except submergence area of Daudhan Dam. The cost has been revised at Price Level 2020-21. The area and cost of B- land for Ken LBC and Panna & Hatta lift have been works out by WRD, Govt. of MP and same is adopted in the report. The 2682.82 ha land (including 190.50 ha forest land) for Ken-Betwa Link main canal, 320 ha for Ken LBC and 195 ha for Panna & Hatta lift is proposed to be acquired including approach road and structures etc. In the revised cost estimate, the rate of land coming under submergence of Daudhan Dam has been judiciously enhanced as Rs. 4.00 lakh/ha and Rs.2.00 lakh/ha for irrigated and unirrigated land respectively. The cost of B-Land of Daudhan Dam has been works out as Rs. 622.28 crore. The rate of B-Land of Ken-Betwa link has considered as Rs. 7.00 lakh/ha and Rs.8.00 lakh/ha for MP and UP area respectively. The total cost works out to Rs 613.88 crore. The cost for Ken LBC and Hatta & Panna lift are adopted as 10.75 crore and 11.13 crore respectively. Thus the total cost for land acquisition for all components under K-B link is works out to Rs. **1258.03** crore. Details are given in **Table-9.2**.

Table-9.2

Cost of Land acquisition

Sl. No.	Particulars	Area of land in ha	Total Amount in Rs Lakh
1	Daudhan Reservoir	7573*	62227.93
2	Ken- Betwa link canal	2492.32	61387.65
3	Ken LBC	320	1075.00
4	Panna & Hatta lift	195	1112.50
	Total	**10580.32**	**125803.08**

***Revenue land 4338 ha considered in the cost estimate as the cost of forest land included in the Net Present Value (NPV). Forest & Other land of 5765 ha is included in X-Environment & Ecology. Details are given in Annexure-9.5.**

The cost of forest land under submergence considering Net Present NPV works out to Rs. 3512.80 crore. The details are given in **Table -9.3.**

Table -9.3

A	**Net Present Value**					
Sl. No.	**Particulars**	**District**	**Forest area inha**	**NPV Rate Rs. Lakh/ha**	**Multiple Factor as per core area and Eco-density**	**Amount in Rs. Crore**
1	Submergence Area under Daudhan Dam (Panna Tiger Reserve Core Area)	Panna	1334.80	8.03	10	1071.84
		Chhatarpur	2806.20	8.03	10	2253.38
		Sub-total	**4141.00**	**8.03**	**10**	**3325.22**
2	Other Component (Panna Tiger Reserve Core Area)	Chhatarpur	65.5	8.03	10	52.60
3	Submergence Area (Panna Tiger Reserve Buffer Area density	Chhatarpur	503	6.26	1	31.49

	less than 0.4)					
4	Submergence Area (Panna Tiger Reserve Buffer Area density less than 0.5 to 0.7)	Chhatarpur	811.4	8.03	1	65.16
5	Submergence Area (Chhatarpur-Terrestrial)	Chhatarpur	305.69	8.03	1	24.55
	Sub-Total					**3499.02**
6	Canal Area (Panna Tiger Reserve Buffer Area)	Chhatarpur	58.02	8.03	1	4.66
	Canal Area (Chhatarpur-Terrestrial)	Chhatarpur	31.96	8.03	1	2.57
7	Canal Area (Tikamgarh-Terrestrial)	Tikamgarh	14.86	8.03	1	1.19
8	Canal Area (Tikamgarh-Terrestrial)	Tikamgarh	85.66	6.26	1	5.36
	Sub-total					**13.78**
				Total for NPV		**3512.80**
B	**Provision of Catchment Area Treatment (CAT) Plan**					**272.59**
C	**Provision for Compensatory Afforestation**					**313.12**
	Total cost for Daudhan Dam					**4098.51**

As per clause 2 of second schedule of “the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013”

land for land is proposed for two categories of farmers. These two categories of farmers and their entitlements are as follows:

Categorization	Entitlements
a) In case of irrigation projects as far as possible, and lieu of compensation to be paid for land acquired, each affected family owning agricultural land in the affected area and whose land has been acquired or lost or who has as a consequence of acquisition for loss of land been reduced to the status of marginal farmer or landless.	Farmers shall be allotted, in the name of each person included in the record of rights with regard to the affected family, a minimum of one acre land (0.40 ha) in the command area of the project for which the land is acquired.
b) In every project those persons loosing land and belonging to SC or ST.	Such farmers will be provided land equivalent to land acquired or two and half acres (1.0 ha) whichever is lower.

Since most of the PAFs prefer to be rehabilitated in the same location and the nearest command area of the project is more than 40 km away from the proposed resettlement colonies, the provision of land to land may not be feasible. Therefore, only cash compensation is proposed for the entire land loss. It is proposed to provide land to land compensation to ST and SC PAFs by purchasing the land in the nearby area to rehabilitation colonies of the project from private land owners on mutual negotiation basis". This is proposed since no suitable government land is available in the nearby areas of rehabilitation colonies. The estimated land requirement for this purpose would be about 919 ha. However, this land is already included in the 2171 ha of Patta land to be acquired for Daudhan reservoir and a provision for compensation is also made. Such provision may be used for purchase of land from private landowners.

9.1.8 Resettlement and Economic Rehabilitation of displaced person

9.1.8.1 Elements of Rehabilitation and Resettlement as per Second Schedule of Act

The Economic Rehabilitation and Resettlement package as per the second schedule of "the Right to Fair Compensation and Transparency in Land Acquisition, "Rehabilitation and Resettlement Act 2013" for 2667 households identified (which is inclusive of 1913 PAF head households and 754 major children)has been estimated to cost about **209.66 crore**. The details of the economic rehabilitation programme are presented in **Table 9.4**.

Table 9.4

Elements of Rehabilitation &Resettlement as per the Second Schedule of Act

S No	Elements of Rehabilitation and Resettlement Entitlements	Nos.	Unit Cost (Rs. Lakh)	Amount (Rs. Lakh)	Remarks
1	**Provision of housing unit in case of displacement**				
	If a house is lost in rural areas	2667	**1.50**	**4,000.50**	Provision of Rs 1.50 lakh per house is made as per latest guidelines of Indira Awas Yojna. Further Provisions were made for both head of House Hold(1913) and major children (754)
	If a house is lost in urban areas	N. A.	-		No homesteads lost in urban areas
	Or				
	If PAF of rural area opts not to take house offered	-	-		Option for cash will be given as per above

S No	Elements of Rehabilitation and Resettlement Entitlements	Nos.	Unit Cost (Rs. Lakh)	Amount (Rs. Lakh)	Remarks
	If PAF of urban area opts not to take house offered	N. A.	-		Not applicable
2	**Land for Land (in lieu of compensation)**	-	-		
	Each affected family owning agricultural land in the affected area and whose land has been acquired or lost, or who has, as a consequence of acquisition or loss of land, has been reduced to the status of a marginal farmer or landless, shall be allotted, a minimum of (0.4 ha)land in command area of the project for which the land is acquired. Persons loosing land and belonging to the S/C &S/T will be provided land equivalent to land acquired or 1.01 ha, whichever is lower.	-	-		Provisions of Act of 2013 are adopted and accordingly provisions were made in Land acquisition
3	**Offer for Developed Land**	N.A	N.A	N.A	Not Applicable
4	**Choice of Annuity or Employment**				Provision has been made for Onetime payment of Rs 5.0 Lakh
	*Job (training, skill development, etc.)or	-	-	-	

S No	Elements of Rehabilitation and Resettlement Entitlements	Nos.	Unit Cost (Rs. Lakh)	Amount (Rs. Lakh)	Remarks
	* Onetime payment of Rs. 5.30 lakhs to each affected family or	2667	5.0	13335.00	per affected family
	*Rs. 2000 per month per affected family for 20 years with appropriate indexation	-	-	-	
5	**Subsistence grant for displaced families for a period of one year**	2667	0.36	**960.12**	Provisions were made for both head and major children
	In addition SC & ST displaced from Schedule Areas to receive Rs. 53,000	919	0.50	**459.50**	Provisions were made for 271 SC and 648 ST Household Families
6	**Transportation cost for displaced families**	1913	0.50	**956.50**	Provision has been made @Rs 50,000 per family.
7	Each affected family having cattle or having a petty shop shall get one time financial assistance of such amount as the appropriate Government may, by notification ,specify subject to a minimum of twenty five thousand rupees for construction of cattle shed or petty shops as the case maybe				
	a)Cattle Sheds	995	0.250	**248.75**	Compensation for Cattle sheds @ Rs.25,000 per shed.
	b)Petty Shops	86	0.250	**21.5**	Compensation for Cattle sheds @Rs. 25,000 per shed

S No	Elements of Rehabilitation and Resettlement Entitlements	Nos.	Unit Cost (Rs. Lakh)	Amount (Rs. Lakh)	Remarks
8	**One time grant to artisans, small traders and others**	111	0.250	**27.75**	Provision for Grant @ Rs. 25,000 per member of 25 Artisians and 86 small traders
9	**Fishing Rights**				Would be given to PAFs
10	**One-time Resettlement Allowance**	1913	0.50	**956.50**	Provision has been made @Rs 50,000 per affected family.
11	**Stamp duty and Registration Fee**				Exempt U/S96 of Act of 2013
	TOTAL			**20966.12**	

9.1.8.2 Provision of Infrastructural Amenities as per the Third Schedule of the Act

The Act specified the minimum facilities and resources for habitable and planned resettlement colonies. The basic infrastructure amenities to be provided by the requisition authority consist of 25 different items. The listing along with the financial provisions of these facilities is presented in **Table 9.5.** The cost of these infrastructure amenities is assessed to be **Rs 26.9 crore.**

Table 9.5

Provision of Infrastructural Amenities as per the Third Schedule of the Act

S No	Components of infrastructure amenities provided/proposed to be provided by the acquirer of land	Units	Unit cost(Rs Lakh)	Amount of Provision (Rs. Lakh) or Details of infrastructure amenities provided by the acquirer of land
1	Roads within the resettled villages and an all-weather road link to the nearest pucca road, passages and easement rights for all the resettled families be adequately arranged	2667	0.400	1066.80
2	Proper drainage as well as sanitation plans executed before physical resettlement	2667	0.050	133.35
3	One or more assured sources of safe drinking water for each family as per the norms prescribed by the government of India	2667	0.120	533.40
4	Provision of drinking water for cattle.			
5	Grazing land as per proportion acceptable in the State.	-	-	Reserved

6	Integrated Complex having Fair price shops, Panchayat Ghars, Post Offices Seed cum fertilizer storage facility, Veterinary services etc at one place.	5	20.00	100.00
7	Panchayat Ghars, as appropriate.			Included in S No 6
8	Village level Post Offices, as appropriate with facilities for opening saving accounts.			Included in S No 6
9	Appropriate seed-cum-fertilizer storage facility if needed.			Included in S No 6
10	Efforts must be made to provide basic irrigation facilities to the agricultural land allocated to their settled families if not from the irrigation project, then by developing a cooperative or under some Government scheme or special assistance.	Lump sum	-	500.00
11	All new villages established for resettlement of the displaced persons shall be provided with suitable transport facility which must include public transport facilities through local bus services with the nearby growth	-	-	Yes, facilities shall be Ensured. Efforts will be made with concerned like State Road Transport Corporation

12	Burial or cremation ground, depending on the caste-communities at the site and their practices. (about 5 Grounds having 2 acres of land @ Rs1.85lakhs per acre)	10	1.85	18.50
13	Facilities for sanitation, including individual toilet points.	2667	0.02	53.34
14	Individual single electric connections (or connection through non-conventional sources of energy like solar energy),for each household and for public lighting.	-	-	Yes, as per State Rural Electrification Policy
15	Anganwadi's providing child and mother supplemental nutritionals services., Nos	5	5.00	25.00
16	School as per the provisions of the Right of Children to Free, Compulsory Education Act, 2009 (35 of2009)Nos.	5	10.00	50.00
17	Sub-health centre with in two kilometers range., Nos	5	5.00	25.00
18	Primary Health Centre as prescribed by the Government of India, Nos.	1	20.00	20.00
19	Playground for children., Nos	5	5.00	25.00
20	One community centre for every hundred families, Nos	26	3.00	78.00
21	Places of worship and chowpal/tree platform for every 50 families, Nos	52	1.00	52.00

22	Separate land must be earmarked for traditional tribal institutions	-	-	Will be ensured
23	The forest dweller families must be provided, where possible with their forest rights on non-timber forest produce and common property resources, if available close to the new place of settlement and, in case any such family can continue their access or entry to such forest or common property in the area close to the place of eviction, they must continue to enjoy	-	-	Yes, shall be provided
24	Appropriate security arrangements must be provided for the settlement, if needed.	-	-	Yes
25	Veterinary service centre as per norms., Nos	2	5.00	10.00
	Total			**2690.39**

9.1.8.3 Compensation in lieu of Properties

Under the R&R, compensation for loss of properties of PAFs like houses and cattle sheds has also been computed. In addition to the loss of 1913houses and additional 5% budget has been included in the Indicative Budget. Budgetary provision for 2296 productive trees and 96 farmhouses has also been made. The total cost for compensation of properties worked out to be **Rs.17.64 crore** as per details given in **Table- 9.6.**

Table 9.6
Compensation to Properties in lieu of properties

Sl.No	Particulars	Daudhan Dam Area			
		Socio Economic survey		Indicative Budget@5%	Total Budget
		Number	Rs. Lakh	Rs. Lakh	Rs. Lakh
1	**Loss of Houses**				
	a)Pucca @Rs. 1.50 lakh/house	24	36.00	1.80	37.80
	b) Semi pucca@Rs.1.0 lakh/house	1,252	1,252.00	62.60	1,314.60
	c)Kutcha @0.50 lakh/house	637	318.50	15.93	334.43
	Sub Total	**1,913**	**1,606.50**	**80.33**	**1,686.83**
2	Compensation to productive trees	2,296	68.88	3.44	72.32
3	Compensation for farm houses	96	4.80	0.24	5.04
Total			**1,680.18**	**84.01**	**1,764.19**

The implementation of the Project results in the involuntary displacement of 2667families including major children in10 villages as their land or houses get submerged under Daudhan Reservoir. Accordingly, the re settlement is proposed for all the10 villages and of which four villages are being taken care by NTCA during implementation.

9.1.9 Training

Training is a very crucial component for successful implementation of the EMP having varied components related to different disciplines. The training is also important for the project-affected persons for up-gradation of their skills and also for imparting new skills to undertake different avocations of their interest. The training for implementation of components of Economic

Rehabilitation Programme (ERP) is at two levels viz. Departmental Level and PAP's.

9.1.9.1 Training at Departmental Level

Training of personnel belonging to Departments of Water Resources, Forests, Agriculture, Fisheries Rehabilitation and Resettlement would be an important component of any training programme under EMP. The essential components of a given training programme would be aware about environment and its impacts EMP, R&R Policies, soul and Water conservation measures. Afforestation, on farm Development Reservoir, Fisheries, Animal, Husbandry, knowledge of Law etc.

9.1.9.2 Training the Project Affected Persons (PAP's)

The identified PAP's shall be the ultimate beneficiaries of the Project Affected Families Economic Rehabilitation Plan (PAFERP). The action plan will not be successful without the deep involvement and active participation of the beneficiaries. This requires proper understanding of the Act, imparting knowledge on new skills and upgrading the existing skills including proper maintenance of assets provided. The strategy of training to PAFs especially the women should comprise the following:

i. Awareness of aims and objectives of the Act 2013, R&R Policy of the Government and their entitlements under the Action Plan.
ii. Co-operating and coordinating with NGOs for identifying the PAFs for vocational training for which provision of Rs.5000 per PAF is made in the budget. It also includes choosing of training centres for different trades, attending such trainings and suggesting placement in the respective trades.
iii. Imparting training to PAPs for proper utilization of productive assessment grants for purchase of assets. They should also be encouraged to avail the loan facilities available through banks.
iv. Women beneficiaries are to be trained informing State Rural Livelihood Mission (SRLM) groups and Synthetic Hydrograph Generation (SHG), selection of suitable activities for women beneficiary for income generation and inculcate thrift culture.

v. The training to women beneficiaries should be preceded by deputation of the presidents and leaders of their groups, for a week's training in organizing SHG groups and ensuring their successful implementation.

vi. Tribals should be encouraged to take up bee keeping collection of gum and its processing collection of forest produce etc.

vii. Training to PAFs will also include lectures, visual aids and visits to nearby places where such activities are already taking place

viii. Knowledge about the entitlements accruing to PAFs through village action plan, etc., would be disseminated to all beneficiaries during the course of training for ensuring transparency.

9.1.10 Financial Requirements

The cost involved for imparting training to the departmental staff dealing with EMP may be drawn from the normal budgetary provisions of the respective departments. However, the personnel involved in R&R implementation are trained at the project cost. Therefore, the cost involved for imparting training to the staff and the PAFs in particular only has been assessed. The training schedule for farmers may also be designed and cost involved may be drawn from the agricultural extension budgetary provisions of agricultural department.

The training details have been elaborated in respective para in Chapter IX of DPR of KBLP, Phase-I, 2010.

9.1.11 Total Cost of Resettlement and Rehabilitation

The cost of relief, resettlement and rehabilitation of the affected households has been worked out in the accordance with provisions of the "Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013". Brief description under this head has been given in Chapter-IX of DPR of KBLP, Phase-I, 2010 and final EIA and EMP Report Volume-I of KBLP Phase-I, May-2015. The total outlay proposed for the implementation of Project Affected Families Economic Rehabilitation Plan (PAFERP) for the Daudhan dam amounted to Rs. **2280.70** Crore. The

component–wise distribution of Project Affected Families Economic Rehabilitation Plan outlay has been presented in **Table-9.8**.

In addition to this, a provision of Rs **482.66 crore** have been made in the estimate for relocation of about 30 villages to acquire 4338 ha revenue land against forest land affecting under Daudhan dam Under Ken-Betwa Link Project and EIA Studies for additional command area.

Table-9.8
Component –wise distribution of PAFERP (Project Affected Families Economic Rehabilitation Plan) outlay

(Rs. In Lakh)

S.N.	Particulars	Daudhan Reservoir	Canal and Power Houses	Total
1	Land Compensation	109931.57	50786.88	160718.45
2	Elements of Rehabilitation &Resettlement as per the Second Schedule	59874.26	0.00	59874.26
3	Provision of Infrastructural Amenities as per the Third Schedule	7477.68	0.00	7477.68
Total		**177283.51**	**50786.88**	**228070.39**

CHAPTER-X

COST ESTIMATE, BENEFIT COST RATIO AND FINANCIAL ASPECTS

10.0 Background

The present chapter deals with cost estimate, benefit cost ratio and financial aspects of various project components under KBLP. The cost estimate and benefit cost ratio of Daudhan Dam and its canal system was completed by NWDA and included in DPR of 2010 and already techno-economically approved by Central Water Commission in 2016. The cost estimate of headwork of Lower Orr Dam was prepared by NWDA, while, the cost estimate of carrier canal, gravity pipeline and rising mains have been prepared by the WRD, Govt. of MP and the same are adopted in the estimate. The cost estimate of Kotha Barrage and Bina Complex Multipurpose Project was completed by WRD, Govt. of MP and the same are adopted in the estimate by escalating at price level 2017-18. All these three projects are under techno-economic appraisal with CWC. The component wise details of cost estimate are covered in this chapter.

10.1 KBLP

The KBLP envisages construction of a dam at Daudhan on Ken river, Ken-Betwa link canal, two tunnels, two power houses, Ken LBC, Panna & Hatta Lift Irrigation Schemes and their canal networks, Lower Orr Dam at Didauni on Orr river at the border of Shivpuri and Ashok Nagar districts, Kotha Barrage at Kotha village on Betwa river in Vidisha district, Bina Complex Multipurpose Project consisting of four projects (Semraghat diversion dam on Dhasan river, Dehra Dam on Dehra nala, Madia and Chakarpur dam on Bina river) in Sagar district and their canal networks, repair /strengthening of Bariyarpur Pick up Weir on Ken river, Parichha Weir on Betwa river, Barwa Sagar Dam and training works of 7.1 km long Barwa Nalla alongwith developments in command areas of the project.

The Working Group Report of erstwhile Ministry of Irrigation, Govt. of India had issued broad guidelines for preparation of Detailed Project Report for major irrigation and multipurpose projects in 1980. These are based on the IS : 4877-1968 which have subsequently been updated with explanatory notes for each unit / minor head / sub-head. For preparing the cost estimates of KBLP, these guidelines have been followed.

The cost estimates have been worked out by calculating the quantities of different items of the works involved for the execution of the project components. Quantity of Daudhan Dam, Ken-Betwa link canal & Ken LBC under main project was computed by NWDA on the basis of design carried out by CWC, for which, DPR of KBLP, Phase-I was already techno-economically appraised by CWC during 2016. Parameters of Daudhan Dam have been kept intact in the Comprehensive Report. However, the parameters of Ken-Betwa link canal & Ken LBC has been changed according to the new planning for Pressurised pipe micro irrigation system and inclusion of new/additional command area of MP & UP. The quantity and cost of these two canal system and additional Panna & Hatta LIS have been provided by Govt. of MP & the same are incorporated in the report. However, quantity and costing of main canal were carried out by NWDA. The cost estimate of Lower Orr, Kotha Barrage and Bina Complex Multipurpose Project were made available by Government of MP. The cost estimate of these projects after escalation by considering the Unified Schedule of Rates (USOR – 2017) of Govt. of MP is adopted in the Comprehensive Report.

The rates for some principal items of various works have been adopted from USOR - 2017 of Govt. of MP and its amendments. As per Government of MP letter dated 23.07.2015, the escalation on the rates of various items can be escalated by overall 18% over the USOR - 2009 of MP to arrive rate at price level 2015-16 for working out the cost estimate of KBLP, phase-I which is approved by CWC. Accordingly, rate of various items which are not available in USOR – 2017 are considered by escalating overall 18% over the 2008-09 SOR rate and escalated by 6% per year to arrive at price level 2017-18 and further escalated 10% to arrive at price level 2020-21. The escalation on the rates of various items which is not amended has been escalated by overall 10% over the USOR - 2017 of MP to arrive rate at price level 2020-21 for working out the cost estimate of KBLP which is approved by CWC.

10.2 Classification of units

The cost estimate of the project has been grouped into the following units and shown in **Table 10.1.**

Table-10.1

General Abstract of Cost Estimate of the Daudhan Dam, Canals and Power house

(Price level 2020-21)

(Rs. in Crore)

Sl. No.	Component	Unit-I	Unit-II	Unit-III	Total
		Head works	Canals	Power	
I	**Daudhan Dam and Canals**				
i	Daudhan dam	10899.65	-	-	10899.65
ii	Two New Barrages of UP (Proposed Marauli and Pailani barrages near Banda)- subject to preparation of DPR of this part	2000.00			2000.00
iii	K-B link canal(Main)	-	10472.58	-	10472.58
iv	Ken LBC System	-	6734.79	-	6734.79
v	Panna and Hatta lift	-	5409.58	-	5409.58
vi	Repairing/Renovation of ken canal system of UP- subject to preparation of DPR of this part		1000.00		1000.00
vii	Renovation of Mahoba tank with its connecting canal-subject to preparation of DPR of this part		500.00		500.00
viii	Power House-I	-	-	395.56	395.56
ix	Power House-II	-	-	146.59	146.59
x	Repairing/Strengthen of Bariyarpur PUW, Parichha weir, Barwa sagar etc (Lump sum provision)	220.00	-	-	220.00
	Total	13119.65	24116.94	542.15	37778.75

Thus, the total cost of the Daudhan Dam, canals and Power house works out to **Rs. 37778.75 crore at price level 2021-22**, which includes Environmental Management Plan (EMP) and Socio-economic Survey and Resettlement & Economic Rehabilitation Plan. The provision of amount of Rs. 1200 crore has been made in the estimate towards acquisition of 6017 ha non-forest land including R&R of proposed villages to be relocated and EIA studies of additional command area included in the project. The amount of Rs. 80 crore has also been included in the estimate for the development of Land Scape Management Plan and vulture mitigation measures. The general abstract of cost of the project is given at **Annexure: 10.1**. Relevant annexures pertaining to this chapter are placed in

Volume-II: Cost Estimate. The details under various heads are described in the following paragraphs.

Sub head-wise Expenditure for various Components of Daudhan Dam Head Works

S.No.		Particulars	Amount (Rs. in Lakhs) 2020-21
		Sub-head	**Unit-I**
A		**DIRECT CHARGES:**	
I		WORKS:	
	A	Preliminary	20557.89
	B	Land	105035.67
		(i) Land acquisition	33112.86
		(ii) Rehabilitation & Resettlement	23656.51
		(iii) Amount proposed for Land aquisitution and R&R for proposed villages to be relocated to acquire 6017 ha revenue land.	48266.30
	C	Works	193529.40
	K	Buildings	15422.36
		Temporary Buildings	10039.38
		Permanent Buildings	4474.45
		Hostel Accommodation (Temp.)	908.53
	L	Earth work	113710.13
	M	Plantation	12.31
	O	Miscellaneous	1090.84
	P	Maintenance	2106.25
	Q	Special T&P	1768.00
	R	Communication	1673.33
	X	Environment & Ecology	572169.33
	Y	Losses on Stock & Unforeseen @ 0.25% on all heads excluding A, B,X & Q	818.86
		Total I-Works	**1027894.37**
II		Establishment & Pensionary Charges @ 8%-10% of I-Works less B – Land, NPV & CA Plan	**43221.34**
III		Ordinary T&P @ 1% of I - Works	**10278.94**
IV		**Receipts & Recoveries**	
	(a)	Recoveries on account of resale value of Q - Special T&P 25%	-442
	(b)	Recoveries by resale/transfer of Generator sets, electric lines, telephone lines and other accessories under Capital Cost of O-Miscellaneous @20%	-218.17
	(c)	Recoveries on account of resale value of Temporary Buildings @ 15%	-1505.91
		Total Direct Charges	**1079228.57**

B		**INDIRECT CHARGES**	
	(a)	Cost of abatement of Land Revenue on the area occupied by the Project @ 5% of (Rs 32399.20/68212.70	457.89
	(b)	Audit & Account Charges @ 1% of I - Works	10278.94
		Total Indirect Charges	**10736.83**
		NET COST	**1089965.40**

10.2.1 Unit – I: Head Works

Unit-I Head works mainly includes cost of the following structures of the project:

- Daudhan Dam including earth dam, non-over flow section with irrigation sluices, over flow section with spillway & energy dissipation arrangements and intake structure of dam toe power house (PH-I) etc.
- Two new barrages of UP i.e. proposed Pailani & Banda Barrage in Banda District.
- Repairs/strengthening of Bariyapur Pickup weir, Parichha Weir, Barwa Sagar Dam etc.

Cost of I-Works for each head works are given in **Table 10.2**

Table 10.2

(Rs. in Lakhs)

Head works	**Daudhan Dam**
Total I-Works	1027894.37
Net Cost	1089965.40

The Net cost of Unit-I: Head Works is estimated to be Rs. **10899.65** crore. Details are given in **Annexure-10.1**. The sub-head wise details are given below.

10.2.1.1 A - Direct Charges

In general, direct charges cover minor heads like I-Works, II-Establishment, III- Tools & Plants and IV- Receipts & Recoveries.

I-Works

A. Preliminary

Provision under this sub-head has been made to cover the actual expenditure incurred on detailed survey & investigation works mentioned below for preparation of Comprehensive Report of the project.

- Topographical surveys & investigations
- Hydrological & meteorological surveys
- Geological & Geotechnical surveys
- Construction material survey
- Seismic studies
- Construction of access roads to facilitate site investigations
- Charges for consultancy works for various studies and
- Preparation of Comprehensive Report

However, for detailed survey & investigations for establishing the final locations of project components at pre-construction stage, a lump sum provision of 2 % of I-Works has been considered under this sub-head for Daudhan Dam which DPR was prepared by NWDA. The details are given in **Annexures- 10.1.1.1.** The cost component of Unit-I of Preliminaries are given in **Table 10.2.1**

Table 10.2.1
A. Preliminary

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	20557.89

B. Land

Under this sub-head, provision for acquisition of land for construction of the project, colonies, offices, stores, stock yards, working area and approach roads etc. , compensation for houses, solatium charges, standing crops and other immovable properties, cost of resettlement colonies for displaced persons, economic rehabilitation of PAFs, training of R&R staff

and PAFs etc. have been considered. The details are given in **Annexures-10.1.1.2 & 10.1.1.2(a).** The cost component of Unit-I of B. Land is given in **Table 10.2.2**.

Table 10.2.2

B. Land

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	105035.67

C. Works

This sub head includes cost of construction of following components:

- Earth dam, cofferdam, concrete dam (Over Flow & Non Over Flow), intake structure for dam toe Power House (PH-I), Irrigation sluices etc of Daudhan Dam, Lower Orr Dam.
- Repairs/strengthening of Bariyarpur Pickup Weir, Parichha Weir, Barwa Sagar Dam etc.
- The quantities and the cost of the components have been evaluated as per the design drawings supplied by the Specialized Directorates of CWC, New Delhi for Duadhan dam. Necessary provisions have been made for Spillway radial gates with embedded parts, stop logs and hoisting arrangements etc.. The details of works under this sub-head are given in **Annexure- 10.1.1.3.** The cost component of Unit-I of C. Works is given in **Table 10.2.3**

Table 10.2.3

C. Works

Sl. No.	Component	Cost (Rs. in lakh)
I	Daudhan Dam	193529.40

K. Buildings

Provision has been made under this sub-head for construction of temporary & permanent buildings for both residential & non-residential buildings and hostel accommodation for various categories of staff, offices, inspection bungalow, circuit house, workshops, stores, sheds as well as other service buildings like hospital, schools, police station, post office & welfare center etc. The details under this sub-head are given in **Annexure- 10.1.1.4.** The cost component of Unit-I of K. Buildings is given in **Table 10.2.4**.

Table 10.2.4

K. Buildings

Sl. No.	**Component**	**Cost (Rs in lakh)**
I	Daudhan Dam	15422.36

L. Earth work

Under this sub-head, the cost of earth work and lining involved in the upstream diversion channel and downstream spillway channel of all the dams has been considered. The details under this sub-head are given in **Annexure - 10.1.1.5.** The cost component of Unit-I of L. Earth work is given in **Table 10.2.5**.

Table 10.2.5

L. Earth work

Sl. No.	**Component**	Cost (**Rs in lakh)**
I	Daudhan dam	113710.13

M. Plantation

Under this sub-head, cost of proposed plantation in the colony, parks in the d/s of dams and along the approach roads to the dam sites have been considered. The details under this sub-head are given in **Annexure- 10.1.1.6.** The cost component of Unit-I of M. Plantation is given in **Table 10.2.6**.

Table 10.2.6

M. Plantation

Sl. No.	**Component**	**Cost (Rs in lakh)**
I	Daudhan Dam	12.31

O. Miscellaneous

Under this sub head provision has been made to cover the cost of the following works

- Capital cost of electrification, water supply purification and distribution system, sewage disposal, medical equipment, firefighting equipment, furniture and crockeries for inspection bungalow and circuit houses, initial camp equipment for hospital, primary & secondary schools, community centre etc.
- R & M of above equipments/infrastructural facilities etc.
- R & M of inspection vehicles, market complex, police station, post office, pump house, telephone lines etc.

Provision has also been made for other miscellaneous items such as inaugural foundation laying ceremony, compensation to work men, visit of VIP dignitaries, anti malaria measures, security arrangements for dam sites, flood lighting, model studies, data processing machines etc. The details are given in **Annexure- 10.1.1.7.** The cost component of Unit-I of O. Miscellaneous is given in **Table 10.2.7.**

Table 10.2.7
O. Miscellaneous

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	1090.84

P. Maintenance

Under this sub-head provision has been made to cover the cost of maintenance of all works during the construction. A provision of 1% on cost of C-Works (Concrete Dam & Earthen Dam), Buildings and maintenance of roads has been considered for Daudhan Dam. The details are given in **Annexure- 10.1.1.8.** The cost component of Unit-I of P. Maintenance is given in **Table 10.2.8**.

Table 10.2.8
P. Maintenance

Sl. No.	Component	Rs in **lakh**
I	Daudhan Dam	2106.25

Q. Special Tools & Plants

Under this sub-head provision has been made for the cost of inspection/ transportation equipment has been added to the above cost to arrive the total cost chargeable under this sub-head. The recoveries on account of resale value of Q-Spl. T&P are considered as 75% to 20% cost of inspection/transport equipment which works out to Rs 1768.00 lakh. Details of the equipment as suggested by CMO, CWC, New Delhi and the cost that to be chargeable to the project works is given in **Annexure- 10.1.1.9.** The cost component of Unit-I of Q. Maintenance is given in **Table 10.2.9**

Table 10.2.9
Q. Special Tools & plants

Sl. No.	Component	Cost (Rs. in lakh)
I	Daudhan Dam	1768.00

R. Communication

Necessary provision has been made under this sub-head to cover the cost of widening of existing roads in the near vicinity of the project area, formation of approach roads to project area from the existing roads, W.B.M road from quarry sites to dam/barrage sites etc. The details of length of roads and costs are given in **Annexure- 10.1.1.10.** The cost component of Unit-I of R. Communication is given in **Table 10.2.10**.

Table 10.2.10
R. Communication

Sl. No.	Component	Cost (Rs. in lakh)
I	Daudhan Dam	1673.33

X. Environment and Ecology

This sub-head includes provision for extensive management measures to sustain environment and ecology such as catchment areas treatment, forestry & salve postural management/ afforestation/ deforestation, soil erosion control and water conservation measures, reservoirs rim treatment/green belt development, treatment of agricultural lands, compensatory afforestation, land management plan (stabilization of muck disposal management), restoration of quarry site, tourism development plan, provision for free fuel to department engaged labourers, bio-diversity management plan, restoration and land scrapping of project sites, fisheries development plan, ground water management plan, public health management, Environmental Monitoring Programme (EMP), dam break analysis and Disaster Management Plan. The details are given in **Annexure-10.1.1.11.** The cost component of Unit-I of X. Environment and Ecology is given in **Table 10.2.11.**

Table 10.2.11
X. Environment and Ecology

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	572169.33

Y. Losses on Stock and Unforeseen Items

Provision has been made for losses on stock and unforeseen @ 0.25% on all sub-heads under I- works excluding sub – heads A- Preliminary, B-Land & Q-Spl. T&P & X-Environmental & Ecology for Daudhan Dam. The details are furnished in **Annexure 10.1.1**. The cost component of Unit-I of X. Losses on stock and unforeseen items is given in **Table 10.2.12.**

Table 10.2.12
Y. Losses on Stock and Unforeseen Items

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	818.86

Additional works:

A Lump sum provision for Repair/ strengthening of Bariyarpur pickup weir, Parichha Weir, Barwa Sagar etc has been taken as Rs. 22000.00 lakh

However, for detailed survey & investigations for establishing the final locations of different project components at pre construction stage, a lump sum provision of Rs. 22000 lakh has been considered under Daudhan works head.

II-Establishment

The project is planned to be completed in a period of 8 years. Provision has been made @ 8% of I-Works excluding B- Land, NPV & CA Plan towards establishment & pensioner charges. The details are furnished in **Annexure 10.1.1.** The cost component of Unit-I of II-Establishment is given in **Table 10.2.13.**

Table 10.2.13
II-Establishment

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	43221.34

III-Ordinary Tools & Plant

Provision has been made under this head for ordinary Tools & Plant @ 1% of I-Works. This provision is distinct from the Q-Spl. T&P and is meant to cover the cost of survey instruments, camp equipment and other small tools & plant. The details are furnished in **Annexure 10.1.1.** The cost component of Unit-I of III-Ordinary Tools & Plant **is** given in **Table 10.2.14.**

Table 10.2.14
III-Ordinary Tools & Plant

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	10278.94

IV- Receipt & Recoveries

Under these head, estimated recoveries by way of resale or transfer of temporary buildings, special T&P and by resale or transfer of generator sets, electrical lines, telephone lines and other accessories are accounted for and provision has been made accordingly. The details are furnished in **Annexure 10.1.1.** The cost component of Unit-I of IV- Receipt & Recoveries is given in **Table 10.2.15.**

Table 10.2.15
IV- Receipt & Recoveries

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	-2166.08

10.2.1.2 B - Indirect Charges

Provisions for abatement of land revenue and audit & account charges are covered under 'Indirect Charges' at the following rates

- Abatement of land revenue - 5% of cost of land
- Audit and account charges - 1% of I-Works

The details are furnished in **Annexure 10.1.1.** The cost component of Unit-I of B - Indirect Charges is given in **Table 10.2.16.**

Table 10.2.16
B - Indirect Charges

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	10736.83

10.2.2 Unit – II: Canals

Unit-II Canal system covers the cost of the following structures along with their appurtenant works.

- Ken-Betwa link canal
- Intake structure to the Upper level tunnel
- Upper level tunnel
- Ken LBC system (Pipe line)
- Intake structure to the Lower level tunnel
- Lower level tunnel
- Panna & Hatta lift (Pipe line)

Table 10.3
Cost of I-Works for each canal system

(Rs. in Lakh)

Unit –II Canals system	**Daudhan Dam**			
	K-B Links Canal	**Ken LBC**	**Panna & Hatta Lift**	**Total**
Total I-Works	956886.28	612316.92	491844.34	2061047.54
Net Cost	1047257.62	673478.86	540957.89	2261694.37

The Net cost of Unit-II: Canal system is estimated to be Rs**. 22616.94** crore at 2021-22 price level. Details are given in **Annexures- 10.2.1, 10.2.2, 10.2.3**. The sub-head wise details are discussed in the following paragraphs.

10.2.2.1 A - Direct Charges

I-Works

A. Preliminary

Provision under this sub-head has been made to cover the actual expenditure incurred on detailed survey & investigation works mentioned below for preparation of Comprehensive Report of the project.

- Topographical surveys & investigations
- Geological & Geotechnical surveys
- Construction material survey

- Vehicle charges for inspecting officers for site investigations
- Survey & Camp equipment
- Charges for consultation for various studies
- Actual expenditure on establishment and
- Preparation of Comprehensive Report

However, for detailed survey & investigations for establishing the final locations of different project components at pre-construction stage, a lump sum provision of 2% of I-Works has been considered under this sub-head for Daudhan Dam. The details are given in **Annexures 10.2.1.1, 10.2.2.1, 10.2.3.1.** The cost component of Unit-II of A. Preliminary is given in **Table 10.3.1.**

Table – 10.3.1
A. Preliminary

Sl. No.	Component	Cost (Rs in lakh)
I	Ken-Betwa Link Canal	19137.73
II	Ken LBC	1610.11
III	Panna & Hatta Lift	1214.32
	Total	21962.16

B. Land

Under this sub-head, provision for acquisition of land for construction of canals viz. Ken -Betwa link canal and Ken LBC system and approach roads, colonies, canal structures etc. , solatium charges, standing crops and other immovable properties, rent for use of land prior to acquisition, economic rehabilitation measures etc. have been considered. The details are given in **Annexures 10.2.1.2, 10.2.2.2, 10.2.3.2.** The cost component of Unit-II of B. Land is given in **Table 10.3.2.**

Table – 10.3.2

B. Land

Sl. No.	Component	Cost (Rs in lakh)
I	Ken-Betwa Link Canal	61333.92
II	Ken LBC	1075.00
III	Panna & Hatta Lift	1112.50
	Total	63521.42

C. Works

Under this sub-head the cost of upper and lower level tunnels and their intake structures, surge Tank at the end of lower level tunnel and bypass arrangements from surge tank to connecting canal etc. have been considered. The quantities and the cost of the components have been worked out as per the designed drawings made available by the Central Water Commission, New Delhi. Necessary provisions have been made in the estimate for service gates and emergency gates with embedded parts, stop logs and rope drum hoisting arrangements etc. in the intake structures of tunnels. The details of works under this sub-head are given in **Annexures 10.2.1.3, 10.2.2.3, 10.2.3.** The cost component of Unit-II of C. Works is given in **Table 10.3.3.**

Table – 10.3.3

C. Works

Sl. No.	Component	Cost (Rs in lakh)
I	Ken-Betwa Link Canal	34016.17
II	Ken LBC	5937.46
III	Panna & Hatta Lift	84165.33
	Total	124118.96

D. Regulators

Under this sub-head, provision for head and cross regulators at intake / outfall of the canals and at appropriate locations where branch canals take off from main canal, desilting chamber at beginning of K-B canal, exit regulator at Barwa Sagar, service gates with embedded parts, stoplogs and rope drum hoists, monorail arrangements, etc. at regulators have been

made. Provision for cross regulators for branch canals has also been made. Estimate of a typical cross regulator is prepared based on the detailed drawings made available by CWC, New Delhi and the cost of other regulators are arrived based on the estimated cost of the typical regulator proportionate to discharges. The details are given in **Annexures -10.2.1.4.** The cost component of Unit-II of D. Regulators is given in **Table 10.3.4.**

Table – 10.3.4
D. Regulators

Sl. No.	Component	Cost (Rs in lakh)
I	Ken-Betwa Link Canal	10734.57
II	Ken LBC	0.00
III	Panna & Hatta Lift	0.00
	Total	10734.57

E. Falls

Four falls varying from 2 m to 3.6 m have been proposed along the K-B link canal at suitable locations. Provision is kept under this sub-head for Ken LBC system and accordingly, the cost has been worked out for construction of these falls in all the canal systems based on the cost curves prepared for Bargi Diversion Project of Govt. of MP. The details are given in **Annexure- 10.2.1.5.** The cost component of Unit-II of E. Falls is given in **Table 10.3.5.**

Table – 10.3.5
E. Falls

Sl. No.	Component	Cost (Rs in lakh)
I	Ken-Betwa Link Canal	673.32
II	Ken LBC	0.00
III	Panna & Hatta Lift	0.00
	Total	673.32

F. Cross Drainage Structures

The cross drainage works proposed across the main canals and branch canals are aqueducts, syphon aqueducts, canal syphons, super passages and culverts to facilitate the crossing of rivers/streams. Certain typical structures are estimated based on the designed drawings. The cost of the structures which are not actually priced are deduced from the cost curves. The details are given in **Annexure- 10.2.1.6.** The cost component of Unit-II of F. Cross drainage structures is given in **Table 10.3.6.**

Table – 10.3.6

F. Cross Drainage Structures

Sl. No.	Component	Cost (Rs in lakh)
I	Ken-Betwa Link Canal	40332.39
II	Ken LBC	0.00
III	Panna & Hatta Lift	0.00
	Total	40332.39

G. Bridges

The bridges (major & minor) are required to be constructed on the K-B Link canal & Ken LBC of the project to facilitate crossing of various roads. Necessary Provision has been made for these bridges. The estimate is prepared based on the cost curves. The details are given in **Annexures- 10.2.1.7, 10.2.2, 10.2.3.** The cost component of Unit-II of G. Bridges is given in **Table 10.3.7.**

Table – 10.3.7

G. Bridges

Sl. No.	Component	Cost (Rs in lakh)
I	Ken-Betwa Link Canal	17551.95
II	Ken LBC	3000.00
III	Panna & Hatta Lift	500.00
	Total	21051.95

H. Escapes

Under this sub-head provision has been made for canal escapes at suitable locations where drainage facilities exist to take care of the discharge in the eventuality of canal breaches. The details are given in **Annexure-10.2.1.8.** The cost component of Unit-II of H. Escapes is given in **Table 10.3.8.**

Table – 10.3.8

H. Escapes

Sl. No.	Component	Cost (Rs in lakh)
I	Ken-Betwa Link Canal	4755.56
II	Ken LBC	0.00
III	Panna & Hatta Lift	0.00
	Total	4755.56

K. Buildings

Provision has been made under this sub-head for construction of temporary & permanent buildings for both residential & non-residential buildings for various categories of staff, offices, inspection bungalow, stores, club-cum-welfare hall, laboratory & research station etc. Rates have been adopted for these buildings based on the plinth area and prevailing market rates. The details under this sub-head are given in **Annexures- 10.2.1.9, 10.2.2.4, 10.2.3.3.** The cost component of Unit-II of K. Buildings is given in **Table 10.3.9.**

Table – 10.3.9

K. Buildings

Sl. No.	Component	Cost (Rs in lakh)
I	Ken-Betwa Link Canal	11601.51
II	Ken LBC	250.00
III	Panna & Hatta Lift	250.00
	Total	12101.51

L. Earthwork & Lining

The quantity of excavated earth motional from the project to locations based on the type of soils and the quantity of earthwork required for embankment from borrow areas are worked out separately. The detailed estimates are prepared considering the cross sections taken at 50 m interval along the canals and detailed drawings made available by CWC, New Delhi at various sections. Provision is also made for branch canals proportionate to the discharges of the main canal. Lining is provided for both main and branch canals at bed and side slopes in the entire length of canals as per the drawings. Provision is also made in the estimates for pressure relief and drainage arrangements under lining, expansion joints etc. The details under this sub-head are given in **Annexures- 10.2.1.10, 10.2.2.5, 10.2.3.4.** The cost component of Unit-II of L. Earthwork & Lining is given in **Table 10.3.10.**

Table – 10.3.10

L. Earthwork & Lining

Sl. No.	Component	Cost (Rs in lakh)
I	Ken-Betwa Link Canal	503573.85
II	Ken LBC	418687.41
III	Panna & Hatta Lift	302237.59
	Total	1224498.85

M. Plantation

Under this sub-head, cost of plantation in the colony areas and along the main canals & branch canals on both sides has been provided. The details are given in **Annexures - 10.2.1.11, 10.2.2.6, 10.2.3** (Lump sum provision in Panna & Hatta LIS). The cost component of Unit-II of M. Plantation is given in **Table 10.3.11.**

Table – 10.3.11
M. Plantation

Sl. No.	Component	Cost (Rs in lakh)
I	Ken-Betwa Link Canal	0.00
II	Ken LBC	100.00
III	Panna & Hatta Lift	100.00
	Total	200.00

N. Reservoir & DC Tanks

Reservoir and DC tanks are not proposed under this project. Hence no provision is required under this sub head.

Table – 10.3.12
N. Reservoir & DC Tanks

Sl. No.	Component	Cost (Rs in lakh)
I	Ken-Betwa Link Canal	0.00
II	Ken LBC	0.00
III	Panna & Hatta Lift	0.00
	Total	0.00

O. Miscellaneous

Under this sub head, provision has been made to cover the cost of the following works:

- Capital cost of electrification, water supply purification and distribution arrangements, sewage disposal, firefighting equipment, telephones, wireless sets, equipment for quality control and field labs, initial equipment and other accessories for hospitals etc.
- R & M of above equipments/infrastructural facilities etc.
- R & M of inspection vehicles, inspection bungalow etc.

Provision has also been made for other miscellaneous items such as inaugural foundation laying ceremony, compensation to work men, flood lighting, model exhibits etc. The details are given in **Annexures-10.2.1.12.** The cost component of Unit-II of O. Miscellaneous is given in **Table 10.3.13.**

Table – 10.3.13
O. Miscellaneous

Sl. No.	Component	Cost (Rs in lakh)
I	Ken-Betwa Link Canal	1311.82
II	Ken LBC	0.00
III	Panna & Hatta Lift	0.00
	Total	1311.82

P. Maintenance

Under this sub-head, provision has been made to cover the cost of maintenance of all works during the construction. A provision of 1% on cost of C-Works, K-Buildings and R-maintenance of roads has been considered for Ken-Betwa Link Canal, However, for Ken LBC, Panna & Hatta lift are considered in the estimate. The details are given in **Annexures-10.2.1.13, 10.2.2.7, 10.2.3.5.** The cost component of Unit-II of P. Maintenance is given in **Table 10.3.14.**

Table – 10.3.14
P. Maintenance

Sl. No.	Component	Cost (Rs in lakh)
I	Ken-Betwa Link Canal	14561.10
II	Ken LBC	18277.32
III	Panna & Hatta Lift	13819.20
	Total	46657.62

Q. Special Tools & Plants

Under this sub-head, provision has been made at 25% of capital cost of major construction equipment and general purpose equipment. Cost of inspection/ transportation equipment has been added to the above cost in full to arrive the total cost chargeable under this sub-head. The recoveries on account of resale value of Q-Spl. T&P is considered as 75% of the capital cost of the major construction/general purpose equipment chargeable to Q-Spl. T&P and 75% on 20% cost of inspection/transport equipment chargeable to Q-Spl. T&P which works out to Rs 858.00 lakhs. Details of the equipment as suggested by CWC, New Delhi and the cost that to be chargeable to the canal works are given in **Annexures -10.2.1.14.** The cost component of Unit-II of Q. Special Tools & Plants is given in **Table 10.3.15.**

Table – 10.3.15
Q. Special Tools & Plants

Sl. No.	Component	Rs in lakh
I	Ken-Betwa Link Canal	858.00
II	Ken LBC	0.00
III	Panna & Hatta Lift	0.00
	Total	858.00

R. Communication

Under this sub-head, provision for construction of temporary roads and remodeling of existing roads for approach to canal and regulatory system, quarry sites and other working areas has been kept. The details are given in **Annexures 10.2.1.15, 10.2.2.9, 10.2.3.6.** The cost component of Unit-II of R. Communication is given in **Table 10.3.16.**

Table – 10.3.16
R. Communication

Sl. No.	Component	Cost (**Rs in lakh)**
I	Ken-Betwa Link Canal	6443.62
II	Ken LBC	3300.00
III	Panna & Hatta Lift	825.00
	Total	10568.62

S. Power Plants

Solar Power Plant is not proposed under this project. Hence no provision is required under this sub head.

Table – 10.3.17

S. Power Plants

Sl. No.	Component	Cost (Rs. in lakh)
I	Ken-Betwa Link Canal	0.00
II	Ken LBC	0.00
III	Panna & Hatta Lift	0.00
	Total	**0.00**

U. Distributaries

Under this sub-head, provision has been made for providing distributaries pressurize irrigation network system for the total culturable command area of the project. The details are given in **Annexures- 10.2.1.16, 10.2.2.10, 10.2.3.7.** The cost component of Unit-II of U. Distributaries & Minors is given in **Table 10.3.18.**

Table – 10.3.18

U. Distributaries & Minors

Sl. No.	Component	Cost (**Rs in lakh)**
I	Ken-Betwa Link Canal	227817.34
II	Ken LBC	158559.34
III	Panna & Hatta Lift	86399.65
	Total	472776.33

Y. Losses on Stock and Unforeseen

Provision has been made for losses on stock and unforeseen @ 0.25% on all sub-heads under I- Works excluding sub – heads A- Preliminary, B- Land & Q-Spl. T&P & X-Environmental & Ecology for Ken-Betwa Link canal, Ken LBC and Panna & Hatta lift. The details are given in **Annexures**

10.2.1, 10.2.2, 10.2.3. The cost component of Unit-II of Y. Losses on stock and unforeseen is given in **Table 10.3.19.**

Table – 10.3.19
Y. Losses on Stock and Unforeseen Items

Sl. No.	Component	Cost (Rs in lakh)
I	Ken-Betwa Link Canal	2183.43
II	Ken LBC	1520.28
III	Panna & Hatta Lift	1220.74
	Total	4924.45

II-Establishment

Provision has been made as per norms i.e. @ 8% of I-Works excluding B- Land towards establishment & pensioner charges except for Ken-Betwa Link canal. However, Establishment charges @ 10% considered by CWC for Ken – Betwa Link Canal has been adopted. The details are given in **Annexures 10.2.1, 10.2.2 & 10.2.3.** The cost component of Unit-II of II-Establishment is given in **Table 10.3.20.**

Table – 10.3.20
II-Establishment

Sl. No.	Component	Cost (Rs in lakh)
I	Ken-Betwa Link Canal	71644.19
II	Ken LBC	48899.35
III	Panna & Hatta Lift	39258.55
	Total	159802.09

III- Tools & Plant

Provision has been made under this head for ordinary tools & plant @ 1% of I-Works. This provision is distinct from the Q-Spl. T&P and is meant to cover the cost of survey instruments, camp equipment and other small tools & plant. The details are given in **Annexures 10.2.1, 10.2.2, 10.2.3.**

The cost component of Unit-II or III- Tools & Plant is given in **Table 10.3.21.**

Table – 10.3.21
III- Tools & Plant

Sl. No.	Component	Cost (Rs in lakh)
I	Ken-Betwa Link Canal	9568.86
II	Ken LBC	6123.47
III	Panna & Hatta Lift	4918.44
	Total	20610.77

IV- Receipt & Recoveries

Under this head, estimated recovery by way of resale or transfer of temporary buildings, special T&P and by resale or transfer of generator sets, electrical lines, telephone lines and other accessories are accounted for and provision has been made accordingly. The details are given in **Annexures 10.2.1, 10.2.2, 10.2.3.** The cost component of Unit-II of IV- Receipt & recoveries is given in **Table 10.3.22.**

Table – 10.3.22
IV- Receipt & Recoveries

Sl. No.	Component	Cost (Rs in lakh)
I	Ken-Betwa Link Canal	-1577.80
II	Ken LBC	-37.50
III	Panna & Hatta Lift	-37.50
	Total	-1652.80

10.2.2.2 B - Indirect Charges

Provisions for abatement of land revenue and audit & account charges are kept under 'Indirect Charges' at the following rates

- Abatement of land revenue - 5% of cost of land
- Audit and account charges - 1% of I-Works

The details are given in **Annexures 10.2.1, 10.2.2, 10.2.3.** The cost component of Unit-II of B- Indirect Charges is given in **Table 10.3.23.**

Table – 10.3.23

II of B- Indirect Charges

Sl. No.	Component	Cost (Rs in lakh)
I	Ken-Betwa Link Canal	10736.09
II	Ken LBC	6176.92
III	Panna & Hatta Lift	4974.07
	Total	21887.08

10.2.3 Unit – III: Hydroelectric Installation

KBLP envisages construction of four hydel power houses. Power house-I (2x30 MW) is proposed at the toe of Daudhan Dam while power house-II (3x6 MW) is proposed at the exit of lower level tunnel of Ken LBC.

Unit-III "Hydro electric installation" contains the provisions for expenditure on installation of these power houses, penstocks, switch yards, tail race channel, various electromechanical equipments, transmission lines etc. The total cost of unit – III for PH-I & PH-II. are estimated to be Rs 395.56 crore & 146.59 crore respectively at 2021-22 price level.

Cost of I-Works for each Power plant is given Table **10.4** as under:

Table 10.4

Cost of I-Works for each Power plant

(Rs. in Lakh)

Power Plant	Daudhan Dam		Total Cost
	PH I	PH II	
Total I-Works	35975.93	13384.25	**49360.18**
Net Cost	39555.98	14659.40	**54215.38**

The details are given at **Annexure 10.3.1 to 10.3.2** and also refer **Annexure No.- 10.1** with its Sub-Annexure. The sub-head wise details are given below:

10.2.3.1 Direct charges

A. Preliminary

Under this sub-head provision for preliminary surveys & investigations to be conducted to arrive at optimum designs for the project components including consultancy charges for design works at pre construction stage at 2% of I-Works has been made. The details are given in **Annexures 10.3.1.1 & 10.3.2.1.** The cost component of Unit-III of A. Preliminaries is given in **Table 10.4.1.**

Table – 10.4.1
A. Preliminary

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	
(i)	Power House-I	719.52
(ii)	Power House-II	267.69
	Total	987.21

J. Power plant civil works

Under this sub head, provision has been made towards civil engineering structures comprising of pen stocks, power house complexes and tail race channel. The details are given in **Annexures 10.3.1.3 & 10.3.2.3.** The cost component of Unit-III of J. Power plant civil works is given in **Table 10.4.2.**

Table – 10.4.2
J. Power Plant Civil Works

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	
(i)	Power House-I	20938.77
(ii)	Power House-II	6161.40
	Total	**27100.17**

M. Plantation

Provision has been kept under this sub head for cost of plantation along project roads, land scalping and improvement of area around power plant and maintenance and protection of plants. The details are given in **Annexures 10.3.1.4 & 10.3.2.4.** The cost components of Unit-III of M. Plantation are given in **Table 10.4.3.**

Table – 10.4.3
M. Plantation

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	
(i)	Power House-I	12.24
(ii)	Power House-II	11.63
	Total	23.87

O. Miscellaneous

Under this sub head, provision has been made to cover the cost of the following works

- Capital cost of electrification, firefighting equipment, telephones & wireless sets, boundary pillars & fencing etc.
- R & M of above equipments/infrastructural facilities etc.

The details are given in **Annexure 10.3.1.5 & 10.3.2.5.** The cost component of Unit-III of O. Miscellaneous is given in **Table 10.4.4.**

Table – 10.4.4
O. Miscellaneous

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	
(i)	Power House-I	87.71
(ii)	Power House-II	50.46
	Total	138.17

P. Maintenance

Under this sub head provision has been made to cover the cost of maintenance of all works during the construction of power houses. A provision of 1% cost of I-works less A-Preliminary, B-Land, M-Plantation, O-Miscellaneous, and Q-Spl. T&P has been considered. The details are given in **Annexures- 10.3.1.6 & 10.3.2.6.** The cost component of Unit-III of M. Plantation is given in **Table 10.4.5.**

Table – 10.4.5
P. Maintenance

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	
(i)	Power House-I	351.56
(ii)	Power House-II	128.42
	Total	**479.98**

Q. Special T&P

Under this sub-head provision has been made at 25% of capital cost of major construction equipment and general purpose equipment. Cost of inspection/ transportation equipment has been added to the above cost in full to arrive the total cost chargeable under this sub-head for power house-II. The special T&P acquired for Daudhan Dam will be utilized for Power house-I. The recoveries on account of resale value of Q-Spl. T&P is considered as 75% of the capital cost of the major construction/ general purpose equipment chargeable to Q-Spl. T&P and 75% on 20% cost of inspection/transport equipment chargeable to Q-Spl. T&P which works out to Rs 212.74 lakh. Details of the equipment as suggested by CWC, New Delhi and the cost that to be chargeable to the works are given in **Annexure 10.3.1.7 & 10.3.2.7.** The cost component of Unit-III of Q. Special T&P is given in **Table 10.4.6.**

Table – 10.4.6
Q. Special T&P

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	
(i)	Power House-I	0.00
(ii)	Power House-II	212.74
	Total	212.74

R. Communication

Under this sub-head, provision for Construction of new roads for approach to Power plant, switch yard and other working areas has been kept. The details are given in **Annexures 10.3.1.8 & 10.3.2.8.** The cost component of Unit-III of R. Communication is given in **Table 10.4.7.**

Table – 10.4.7
R. Communication

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	
(i)	Power House-I	924.00
(ii)	Power House-II	924.00
	Total	1848.00

S. Power plant & electromechanical works

This sub-head covers the cost of power plant equipment and electrical system to be installed at both the power houses at Daudhan Dam. Provision made under this sub-head for various components are based on the drawings and costs supplied by CEA, New Delhi. The details under this sub-head are given in **Annexure 10.3.1.9, 10.3.2.9.**The cost component of Unit-III of Power plant & electromechanical works is given in **Table 10.4.8.**

Table – 10.4.8
Power Plant & Electromechanical Works

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	
(i)	Power House-I	12854.20
(ii)	Power House-II	5595.74
	Total	18449.94

Y. Losses on stock and unforeseen

Provision has been made for losses on stock and unforeseen @ 0.25% on all sub-heads under I- works excluding sub – heads A- preliminary, B-land & Q-Spl. T&P. The details are given in **Annexure 10.3.1, 10.3.2.** The cost component of Unit-III of Power plant & electromechanical works is given in **Table 10.4.9.**

Table – 10.4.9
Y. Losses on Stock and Unforeseen

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	
(i)	Power House-I	87.92
(ii)	Power House-II	32.18
	Total	120.10

II-Establishment

Provision has been made as per norms @ 8% of I-Works excluding B-land towards establishment & pensionary charges. The details are given in **Annexures 10.3.1 & 10.3.2.** The cost component of Unit-III of II-Establishment is given in **Table 10.4.10.**

Table – 10.4.10
II-Establishment

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	
(i)	Power House-I	2878.07
(ii)	Power House-II	1070.74
	Total	3948.81

III- Tools & Plant

Provision has been made under this head for ordinary Tools & Plant @ 1% of I-Works. This provision is distinct from the Q-Spl. T&P and is meant to cover the cost of survey instruments, camp equipment and other small tools & plant. The details are given in **Annexure 10.3.1 & 10.3.2** and also refer **Annexure No. 10.1**. The cost component of Unit-III of III- Tools & Plant is given in **Table 10.4.11.**

Table – 10.4.11
III- Tools & Plant

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	
(i)	Power House-I	359.76
(ii)	Power House-II	133.84
	Total	493.60

IV- Receipt & recoveries

Under this head, estimated recovery by way of resale or transfer of special T&P and by resale or transfer of generator sets, electrical lines, telephone lines and other accessories are accounted for and provision has been made accordingly. The details are given in **Annexure 10.3.1 & 10.3.2** and also refer **Annexure No. 10.1**. The cost component of Unit-III of IV-Receipt & recoveries is given in **Table 10.4.12.**

Table – 10.4.12
IV- Receipt & Recoveries

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	
(i)	Power House-I	-17.54
(ii)	Power House-II	-63.28
	Total	-80.82

10.2.3.2 Indirect charges

Provisions for abatement of land revenue and Audit & account charges are kept under 'Indirect charges'.

- Abatement of land revenue - 5% of cost of land
- Audit and account charges - 1% of I-Works.

The details are given in **Annexure 10.3.1, 10.3.2** and also refer **Annexure 10.1**. The cost component of Unit-III of Indirect charges is given in **Table 10.4.13.**

Table – 10.4.13
Indirect charges

Sl. No.	Component	Cost (Rs in lakh)
I	Daudhan Dam	
(i)	Power House-I	359.76
(ii)	Power House-II	133.84
	Total	493.60

10.2.4 Unit – IV: Navigation works

Navigation is not proposed under this project. Hence, no provision is required under this sub head.

10.2.5 Unit – V: Water supply works

The project envisages providing drinking water in command areas as well as to the urban centers adjacent to canal alignment. Water will be supplied through main canals and various branch canals, whose cost is

considered under Unit -II: Canal system. However, water supply network to the local areas will be the responsibility of the local development body / local administration. Hence, no provision towards water supply works at local level has been kept under this head.

10.2.6 Unit – VI: Command Area Development

The total culturable command area covered under the project is 702428 ha. The cost of command area development has already been covered under the subhead of X-Environmental under each head.

10.3 Revenues

10.3.1 Yearly programme of development

The link Project is scheduled to be completed in 8 years. Yearly programme of construction schedule of the project has been discussed in detail in Chapter-VII "Construction Programme, Manpower Deployment & Plant Planning".

10.3.2 Sources of Revenue

Ken-Betwa link project has been planned to provide irrigation in water short areas directly as well as in exchange. Also, the project envisages power generation and domestic water supply in the command area and adjacent towns along the canal. Accordingly, following would be the sources of revenue from the KBLP as a whole.

- Irrigation water rates
- Irrigation cess
- Sale of water for domestic water supply
- Sale of power

Other than the above, tourism & fisheries development in the project areas as described in brief in the Volume- VI "Reservoir" can also be one of the major sources of revenue on account of this project.

10.3.3 Water Rates –Irrigation Cess

(a) Water rates

A large infrastructural network such as this project being created for making water available in the proposed command areas for irrigation and drinking purposes besides power generation, needs to be self sustainable.

Therefore, appropriate water pricing is quite necessary, so that cost of operation & management of project could be recovered from the beneficiaries of the project up to some extent. Water rates may be different for irrigation & non irrigation use. Water rates for irrigation use can be applied on the basis of per unit area irrigated. On the other hand, for drinking water supply, rates may be applied on the basis of per unit volume of water supplied, while power can be charged per unit basis.

The present range of water rates in MP is from Rs 50 to 960 per ha for both flow and lift irrigation. In Uttar Pradesh, it ranges from Rs. 30 to 474 for flow irrigation & Rs 15 to 237 per ha for lift irrigation.

These charges are in addition to the irrigation cess & betterment levy to be paid and land revenue being paid by the land holder.

(b) Irrigation cess

As approved by the concerned State Govt., Irrigation cess would be recovered from all the land holders in the commands of the Ken-Betwa link project irrespective of whether the land holder takes irrigation water or not.

(c) Betterment levy

When a major project is constructed, it leads to appreciation of land prices in the areas lying in the vicinity of the project. In case of an irrigation project, better yields of crops are produced. On account of this appreciation in land prices and increased yields of produce, the land owners are required to pay some share to the Govt. as betterment levy.

10.3.4 Auction of Service, Land Lease, Auction and Navigational Permits.

Vacant lands on either side of canals may be leased for plantation of fruit bearing trees. Similarly, in project colony areas, land for shops may also be leased.

10.3.5 Power Rate

Installed capacity of Hydropower at Daudhan Dam Project is 78 MW. The average annual energy at Daudhan Dam worked out as 219.03 MKWh would be generated, at 90% dependability. This energy can be sold at prevailing rate of Rs. 8.00 per Kwh or utilize for pressurize irrigation in the

area. 503.17 MU energy will be required for pressurized irrigation in the area. 503.17 MU energy will be required for pressurized irrigation micro system in Ken-Betwa link (MP& UP), Ken LBC and Panna and Hatta LIS command area. Therefore, these energy is proposed to be purchased @ Rs. 8 per Kwh. Details are given in **Anneuxre-10.6 (b)**.

10.3.6 Navigation

Full supply depth of Ken-Betwa link canal is 4.3 m whereas its bottom width is 13.2 m in head reaches. The section goes on reducing in different reaches. Keeping in view, the availability of water in the link canal as well as numerous major CD structures, it may not be feasible to utilize it for navigation purpose. Hence, no provision for development of navigation aspect has been kept in this project.

10.3.7 Other Sources (Pisciculture, Tourism, etc)

Revenue would occur from the project through allied benefits like pisciculture, tourism, etc. and these benefits have been considered in the benefit-cost analysis of the Project.

10.3.8 Concession in Water Rates (irrigation), Cargo and Passenger Rates, etc.

As the water rates (irrigation) prescribed by the States are highly subsidized, there appears to be no rationale for further concession of these rates in the project commands.

10.3.9 Administrative Charges for Supply of Water and Collection of Revenues etc.

Suitable provision has been made for running and maintenance of the canals, which include administrative charges for supply of water.

10.3.10 If the Area to be Irrigated is Prone to Scarcity, The Expenditure Normally Incurred to Redress the Scarcity

The area proposed to be irrigated enroute though link canal under Ken LBC is water short and devoid of assured supply.

10.3.11 Year in Which the Revenue Would Start Accruing From Various Sources Counting From the First Year of Construction

The construction of project is scheduled to be completed in 8 years. The irrigation development in all the commands is also expected to be completed by then. Revenue from irrigation is expected to start accruing from beginning of 9th year i.e after completion of the project. Power benefits from Power House – I can be realized after completion of head works. Benefits from PH-II are linked with irrigation development in Ken LBC System and hence, can be realized after completion of the project.

10.3.12 Total Income from Various Sources

The total revenue from various sources is furnished in **Table-10.5**.

Table – 10.5
Source of Revenue

Sl. No.	Source of Revenue	Rs in crore
1	Agricultural produce	6789.71
2	Sale of power	175.22
3	Domestic water supply	7.11
4	Fisheries	168.37
	Total	**7140.41**

10.3.13 Details of Staff Proposed for Collection of Revenue and its Basis

Revenue Department of Governments of MP & UP would strengthen their existing system for collection of revenues.

10.3.14 Net Revenue Expected From Different Components of Project

It is estimated that the net value of produce after irrigation will be Rs. 730884.36 Lakh whereas it is Rs. 51913.60 lakh before irrigation. Thus, the net annual irrigation benefits from the total command area works out to Rs. 678970.76 lakh. The average annual energy at Daudhan Dam worked out as

219.03 MKWh would be generated, at 90% dependability. The revenue from the sale of this power considering Rs. 8.00 per unit works out to Rs. 17522.40 lakh. It is estimated that the revenue generated from 127 MCM of domestic water supply @ Rs. 0.56 per cum will be Rs. 711.20 lakh. It is also proposed to develop fisheries in the reservoirs, by which Rs. 16837.33 lakh of revenue could be generated. Thus, the net income/benefit from various sources is estimated to be Rs. 714041.69 lakh. Details are given in **Annexure-10.8.**

10.3.15 Productivity of Project in Terms of Percentage Financial Returns

Project wise pre-project production and post project production of the crop has been worked out on the basis of data collected from agriculture department of MP for Ken-Betwa link main project pre project and post project production of the each crop has been extracted from their respective DPR. The DPRs of projects are already under techno-economic-appraisal in CWC. The details of productivity in the command area at pre and post project scenarios are given in **Annexure No. 10.4.1.1, 10.4.1.2, 10.4.1.5**. Details of productivity in the command area are given in Table-**10.6.**

Table-10.6
Details of Productivity in the Command Area

Unit: Quintals

Name of Project	**Pre-project Production**			**Post Project Production**		
	Kharif	**Rabi**	**Perennial**	**Kharif**	**Rabi**	**Pere-nnial**
Ken-Betwa Link Canal	1098650	927881	10460200	3116527.5	11095343	0
Ken LBC	1840979	1919211	49400	7663396	15361720	0
Saleha	250810	866708	0	1720929.1	3989672.28	0
Total	**3190439**	**3713800**	**10509600**	**12500852.6**	**30446735.28**	**0**
Grand Total	**17413839**			**42947587.88**		
Net increase in produce	**25533748.88 (146.63%)**					

10.4 Benefit– Cost (BC) Ratio and Internal Rate of Return (IRR)

The BC ratio and IRR has been worked out as detailed below:

10.4.1 Estimate of Annual Cost

Annual cost of the project as a whole has been worked out according to the guideline for preparation of Detailed Project Report of irrigating and Multipurpose project of Ministry of Water Resources (2010) except the depreciation for pump system and rising main. In this guideline, the life of the pumping system and rising main is to be considered as 12 year and 30 years respectively. However, in present scenario, development of new techniques such as lamination and improvement in the quality of rising main and pump items, the life of the pumps and rising main may be considered as 33 years and 50 years respectively. Accordingly, while working out annual cost of the project, depreciation for the pumps and rising main are considered as 3% and 2% of their cost respectively. Details of annual cost of the project are given in **Table-10.7.**

Table-10.7
Details of Annual Cost of the Project

Rs. in Lakh

Sl. No.	Description	Annual Cost
1	Interest on capital @ 10% (Estimated total cost of the project including cost of land development)	377787.52
2	Depreciation of the project @ 1% of the cost of project for 100 years life of the project and @ 2% for 50 years life of the project	37778.75
3	Annual operation and maintenance charges for 702428 ha@ 1175 Rs Per Ha	8253.53
4	Maintenance of the head works @ 1% of H/W cost less B Land	10813.37
5	Depreciation of the pumping system @ 3.33% of the estimated cost of the pumping system assuming life of the system as 33 years (Applicable to lift irrigation)	2376.61
6	Depreciation of the rising mains @ 2% of the estimated cost of the rising mains assuming life of the system as years (Applicable to lift irrigation)	14236.24
7	Annual cost of tube well after assuming 12 year service life of pump	0.00
8	Power Charges for lift water Rs 3281.0 @ per Ha.	23046.66
9	**Total Annual Costs (G) = Sum (1 to 8)**	**474292.68**

10.4.2 Benefit Cost (BC) Ratio

As described in the above paras, the net annual benefits from various components of the project works out to Rs.**714041.69** lakh and the annual costs works out to Rs. **474292.68 lakh.** Thus the BC Ratio of the project works out to **1.51:1.** Detailed calculation is placed at **Annexure-10.5.**

10.4.3 Internal Rate of Return (IRR)

The project has been planned to be completed in a period of 8 years including pre-construction year. The phasing of the expenditure has been planned accordingly. The details of yearly expenditure chargeable to link project have been given in **Table 7.7.** Considering life of the project as 100 years, the IRR of the KBLP has been computed as **13.35 %.** The detailed calculations of IRR are given at **Annexure-10.6**.

10.4.4 BC Ratio for Flood Control Component of the Projects

No cushion in the reservoir storage is provided exclusively for flood control. Flood control is only an incidental benefit from Daudhan Dam. Hence, no B.C. ratio for flood control component of the project is worked out.

10.4.5 Benefits Other Than those Considered in the BC Ratio and IRR

While calculating BC ratio, benefits from irrigation, power, water supply and fisheries have been considered. However, project will also provide other benefits such as tourism, employment generation, industrial development, infrastructure development, socio-economic condition of people in project area. These benefits have not been accounted for.

CHAPTER- XI

OTHER ASPECTS

11.1 Foreign Exchange Element

The Govt. of India has declared the KBLP as one of the National Projects. As such, 90% of the cost of the KBLP is expected to be borne by Central Government whereas the balance 10% will have to be borne by the beneficiary states viz. MP and UP. Further most of the required materials like plant and machinery, spares, instruments, etc. are proposed to be purchased /hired locally from internal resources thereby requiring no import under foreign grants/credits from other countries. Thus, prima facie, no foreign exchange element is required for the project. However, if implementing agency of the project decides at a later date to import 'Turbine' or any other item of the project from other country, foreign exchange element will come into picture.

11.2 Revenue

The source of revenue from the project is mainly from the benefits accrued from the following items.

11.2.1 Irrigation Water Rates

Annual O&M cost of the project works out to Rs. 105.57 Crore (excluding O & M of power component) whereas benefited area from irrigation is Rs. 8.98 Lakh ha. The irrigation water rates will be collected from land holders to recover O & M cost of the project. The present range of water rates in MP state is from Rs.50 to Rs. 960 per ha for both flow and lift irrigation. In UP, it ranges from Rs.30 to Rs. 474 per ha for flow irrigation and Rs.15 to Rs. 237 per ha for lift irrigation. The land owners are free either to enter into an agreement with the Project authorities or to get irrigation on demand from time to time. However, these charges are in addition to the land revenue paid by them.

11.2.2 Betterment Levy

With the introduction of irrigation and improved method of cultivation, the yield of the crops and value of the land will appreciably increase. Therefore, land owners are to pay some share to the government for this

increase in the value of their lands. Subsequently, betterment levy can be charged from beneficiaries of existing command in Banda district of UP who are not getting adequate water for their command from existing system.

11.2.3 Sale of Power

The average annual generation of power from PH-I and PH-II proposed at the toe of Duadhan Dam and exit of lower level tunnel has been worked out as 219.03 MU. The annual revenue from this power component has been worked out to be Rs.87.61 crores at the rate of Rs.4.03 per kwh as per the prevailing rates for domestic consumption in MP state. Considering a depreciation of 5% (for a life period of 30 years) for E&M of power houses and a depreciation of 1.2% for power component, the annual cost of maintenance has been worked out to Rs.40.66 crore. As such, the cost of installation i.e. Rs.898 crore, can be recovered fully within 15 years in the form of the revenue even after meeting maintenance charge.

11.3 Financial Resources

After getting techno-economic clearance from CWC and obtaining necessary statutory clearance from MOEF, Ministry of Tribal Affairs, etc., the DPR of the project will be put up to Planning Commission for investment clearance. The concurrence of Ministry of Finance will also be obtained. This project will be covered under central sector since it has already been announced as a National project and 90% of funding will be borne by central govt. Further, no foreign assistance/ aid will be required for this project since the entire cost will be met from internal resources of Government of India and State Governments.

11.4 Future Utilisation of Facilities (Buildings)

Two categories of buildings i.e. permanent and semi-permanent/ temporary are proposed at Daudhan Dam site, Chhatarpur & Jhansi. Further, the Permanent buildings already available at Jhansi under the control of Betwa River Board are also proposed to be utilized for the KBLP to the extent possible. Most of the permanent buildings proposed at Daudhan dam site, Chhatarpur and Jhansi will be utilized for operation and maintenance of the project, whereas the remaining buildings can be utilized for the future projects likely to come up in the vicinity or for offices of other State/Central Govt. organizations.

11.5 Legal Aspects of Inter basin Transfers Such as Impact on Existing Awards/Agreements/ Treaties

11.5.1 Existing Interstate Agreement on Sharing of Ken water

Since the Ken is an inter-state river between MP and UP, agreements were arrived at on Rangwan dam in the year 1972 on Ken canal and headworks of UP, Bariarpur left bank canal of MP and Urmil Project in the year 1977. In the meeting with Secretary, Irrigation & Power, Govt. of India held at New Delhi on 10.12.1981, it was decided that an upstream use of 80 TMC should be kept for the proposed KMPP. The **Table-11.1** furnishes the abstract of water use allocations as per the agreements and decision indicated above.

Table-11.1
Abstract of Water Allocation as per Earlier Agreements

Ken System	**Quantity**	
	MCM	**TMC**
Total 75% dependable yield at Ken dam	**4489.94**	**158356**
Water use by M.P. U/S of Ken	2265.60	80.00
Water use by M.P. ex-Ken	1375.22	48.56
Water use by U.P. ex-Ken	849.60	30.00
Total 75% dependable yield at Rangawan dam	**192.57**	**6.80**
Use by M.P. for Kharif crops (Existing use by M.P.)	56.64	2.00
Use by M.P. U/S of Rangawan dam	30.87	1.09
Use by M.P. from the balance water	8.78	0.31
Use by U.P. from the balance water	96.29	3.41
Water available to U.P. from the catchment between Ken, Rangawan Dam and Bariarpur barrage	**101.95**	**3.60**
Total water to be spared to U.P. from Ken system	**1047.84**	**37.00**

11.5.2 Proposed Water Sharing of Ken Basin upto Daudhan Dam as per MoU dated 25th August, 2005

At the time of signing of MoU at 25th August,2005 for DPR of KBLP, States of UP and MP have agreed for water sharing of Ken basin upto Daudhan Dam as per details is furnished in **Table-11.2**.

Table-11.2
Proposed Water Sharing of Ken Basin upto Daudhan Dam as per MoU dated 25th August, 2005

Sl. no.	Particulars	Proposed water sharing	
		MCM	TMC
1.	**Gross water available at proposed dam**	**6188**	**218.54**
2.	Madhya Pradesh requirement in u/s of dam	2266	80.03
3.	**Balance water available**	**3922**	**138.51**
4.	Regeneration(+)	442	15.61
5.	**Net water balance available**	**4364**	**154.12**
6.	Total requirement of MP		
	a) D/s of Ex. Daudhan	1375	48.56
	b) Enroute use	263	9.29
	c) Domestic enroute utilization & transmission losses	49	1.73
	Total	**1687**	**59.58**
7.	Total Requirement of Uttar Pradesh		
	D/s of Daudhan including enroute command	**1700**	**60.04**
8.	**Proposed water transfer to Betwa basin**	**659**	**23.27**
9.	Requirement for D/s of Dam for ecological need	318	11.23

While preparing DPR due to change in water availability and finalization of type of crops, irrigation intensity, there was variation in water use from the quantities signed/agreed by states in MoU. Hence, as per the provision of MoU, this issue can be discussed further, if considered necessary.

The annual generation of power to the tune of 188.50 MU and 50.14 MU from two Power Houses in Daudhan Dam Project will definitely improve the power shortage situation and also meet the power requirement in pressurised pipe micro irrigation system in the command of MP. The power generation from Bina Complex Multipurpose Project and solar power generation from Kotha barrage will also meet the requirement of pressurised pipe micro irrigation system.

As per the final report of hydrological studies of KBLP carried out by NIH, Roorkee, the 75% dependable yield available at Daudhan Dam site is 6590 MCM showing an increase of 402 MCM when compared to earlier

availability of 6188 MCM. The increase in availability of water can also be taken into consideration while further planning at construction stage. While doing planning at DPR stage, attempt has been made to keep utilization of both the states nearer to their share as shown in **Table-11.3**.

Table-11.3
Allocation of Water

Sl. No.	Particulars	Water sharing as per MoU dated 25th August, 2005	Planned sharing as per DPR	Planned sharing as per Comprehensive Report
		MCM	**MCM**	**MCM**
1.	**Total requirement of MP**			
	a) D/s of Ex. Daudhan	1375	1405	930.86
	b) Enroute use	263	277	922.55
	c) Domestic enroute utilization	49	38	436.29
	d) Panna & Hatta district	-	-	60
	e) Transmission losses		68	Already included in Requirement
	Total	**1687**	**1788**	**2349.7**
2.	**Total Requirement of UP**			
	a) D/s of Daudhan	1600	1600	1305.77
	b) Enroute irrigation use	100	89	104.76
	c) For Lalitpur and through Rajghat dam	-	-	18.95
	d) Domestic enroute utilization (31.98 MCM in Lalitpur, 20.13 MCM in Mahoba and 14.66 MCM in Jhansi)		11	66.77
	e) Development of new command in Mahoba including Transmission loses			203.97
	Total	**1700**	**1700**	**1700.22**
3.	Proposed water transfer to Betwa basin in lieu of water provided to left out area of Lalitpur and through Rajghat dam	659	591	51
4.	Environmental releases			493

Utilization of MP has increased due to change in cropping pattern. Additional quantity can be adjusted in MP's share of upstream utilization of Daudhan Dam or against utilization of upper Betwa Projects.

11.5.3 Proposed Memorandum of Agreement (MoA) amongst the states of MP, UP and Union Government on KBLP

The Clause-2 of the MoU dated 25.08.2005 indicates that specific MoUs as required will be entered into amongst the states of MP, UP and Union Govt. based on the DPR of KBLP and agreements reached on scope of the link, sharing of costs and benefits and arrangements for management and control of water etc. and that as DPR of KBLP has been prepared and to proceed further towards execution of the Link Project. The tripartite proposed MoA have been discussed several times amongst states of UP, MP and Union Govt. and have come to a mutual understanding on scope of the Link Project, sharing of water & Power, sharing of cost, benefits and mechanism for implementation of project as follows.

11.5.4 Existing interstate agreement on sharing of Betwa water between MP and UP

The river Betwa is an inter-state river between MP and UP. During British period two projects were constructed by Government of UP as early as in 1920. These are Dhukwan reservoir on the Betwa river upstream of Jhansi and Parichha weir downstream of Jhansi for Irrigation in UP. In order to supplement Dhukwan Reservoir, Matatila major project has been constructed by UP in the year 1953. The Matatila project was augmented for 0.45 lakh ha (1.12 lakh acres) irrigation in MP through Bhander canal system and 1.07 lakh ha (2.64 lakh acres) irrigation in UP. Thereafter, Rajghat Dam has been constructed on river Betwa, upstream of Matatila Dam. Agreements between the two states of MP and UP have been drawn up for distribution of water at Matatila Dam and Rajghat Dam. The abstract of water use allocation without taking into consideration the regeneration is given in **Table 11.4** below:

Table – 11.4
Abstract of Water Use Allocation

S. No.	Description	MCM	TMC
1	Total 75% dependable surface water yield at Rajghat Dam	3370.08	119.00
2	Availability by inter valley water transfer upto Rajghat and being used directly for Bhopal Town water supply	-	-
3	Existing water use by MP 65.0 MCM, Future water use 65.00 MCM, Total (65+65)=130 MCM	130	4.59
	(a) For Irrigation purposes from Betwa Basin	900	31.78
	(b) For Domestic and Industrial proposes from Betwa Basin @ 214-130=84 MCM	84.00	2.966
	(c) For Domestic & Industrial proposes from Inter valley water transfer directly to Bhopal	130.00	4.590
4	Reservation for future use by MP in Betwa Basin upto Rajghat (A) For Irrigation purposes (B) For domestic and Industrial Purposes Committed	0	0
	(a) For irrigation purposes U/S of Rajghat Dam without considering any Regeneration	484.765	17.117
	(b) For domestic and Industrial purposes from basin water 595-(130+0.2x828)	299.4	10.57
5	Committed Irrigation use by MP from Rajghat	750.48	26.50
6	Committed Irrigation use by UP from Rajghat	750.48	26.50
7	Committed Irrigation use by MP on D/S of Rajghat from water of Rajghat Reservoir	84.96	3.00
8	Committed Irrigation use by UP on D/S of Rajghat from water of Rajghat Reservoir	169.92	6.00
9	Utilization by UP from Rajghat Dam project (6+8)	920.40	32.50
10	Contribution to be spared to UP from M.P.C.A. from Rajghat 578 sqkm @ 0.2077 MCM/sqkm or 19 MCFT/sq. miles	141.60	5.00
11	Water to be spared to UP from MP catchment area from Rajghat reservoir (920.40-141.60)	778.80	27.50
12	Water use by UP from Matatila Project for 264000 Acre Irrigation	526.75	18.60
13	Contribution by UP catchment area of 1854.49 Sq.km @ 0.2077 MCM/Sq. km	382.32	13.50
14	Water to be spared to UP from MP catchment area from Matatila (12-13)	144.43	5.00
15	Total quantity of water to be spared for other State @ UP from Rajghat and Matatila Reservoir (14+11)	923.23	32.60

11.6 Public Awareness Programme

KBLP is the first project in which public Awareness programme was organized at Uldhan village in Jhansi district lying in enroute commend in 08.05.2008 to explain benefits of the project to the beneficiaries and to remove their doubts about the project. However, it was found that people in general were very much supportive of this project and they wanted its early implementation. During survey & investigation of the project, summary of the project in Hindi along with salient features were distributed among the villagers for their awareness about the project.

LOWER ORR PROJECT & CANALS

Chapter I

Introduction

1.0 General:

National Water Development Agency (NWDA) identified Ken-Betwa Link as one of the 16 links under Peninsular Component of National Perspective Plan for Water Resources Development for which feasibility report was prepared by NWDA in the year 1995. Tripartite Memorandum of Understanding was signed by Madhya Pradesh (MP), Uttar Pradesh (UP) and the Union Government on 25th August 2005 for preparation of Detailed Project Report (DPR) of Ken- Betwa Link Project (KBLP). The work of preparation of DPR was entrusted to NWDA by Erstwhile Ministry of Water Resources (MoWR) in January 2006. The DPR was completed in December 2008 and was circulated to the Governments of Madhya Pradesh and Uttar Pradesh in February, 2009. To discuss various issues raised by the Govts. of MP and UP, a Secretary level meeting was convened by Erstwhile MoWR on 03.02.2010 at New Delhi. During the meeting, it was opined that the Survey & Investigation of the alternative projects/schemes proposed by Madhya Pradesh in Upper Betwa region will take about 2 years' time. In order to avoid undue delay in implementation of KBLP, it was decided to reframe the DPR in two separate parts viz., DPR of KBLP (Phase-I) comprising components of Daudhan dam and DPR of KBLP (Phase-II) comprising Lower Orr Dam Project, Bina Complex Project and Kotha Barrage Project. Subsequently, during the meeting held under the Chairmanship of Secretary (WR), Govt. of India with the representatives of Govts of M.P. and U.P. on August 4,

2010 at New Delhi, it was decided that Survey and Investigations (S&I) works of proposed projects in Betwa Basin including Lower Orr Dam Project and preparation of Detailed Project Report (DPR) of KBLP (Phase-II) will be taken up by NWDA. The survey and investigations and preparation of DPR of KBLP (Phase-II) was taken up by NWDA in January, 2011.

The DPR of KBLP (Phase II) including Lower Orr Dam Projects and other

barrages as proposed by Govt. of MP was completed in January, 2014.
Thereafter, from time to time discussions were held between Govt. of MP, Govt. of UP and NWDA to finalize DPR of KBLP (Phase-II). Subsequently, as per the suggestions of Govt. of MP, the projects under KBLP (Phase-II) have been finalised as Lower Orr Dam, Kotha Barrage and Bina Complex

1.1 National Projects:

On 7th February 2008, Government of India had approved a scheme of National Projects during XI Plan with a view to expedite completion of identified National Projects for the benefit of the people. Such Projects were provided Central Assistance (CA) of 90% of the cost of irrigation & drinking water component (as per original Guideline) of the project as CA by Government of India in the form of Central Grant for their completion in a time bound manner.

The Government of India initially declared 14 projects as National Projects in February 2008. Later, Cabinet Committee on Infrastructure approved inclusion of Saryu Nahar Pariyojna (Uttar Pradesh) in the scheme of National Project on 3rd August, 2012. Polavaram Irrigation Project (Andhra Pradesh) was included under the scheme of National Projects vide Gazette notification dated 01.03.2014.

The List of 16 National Projects in tabular form is attached as **Annexure 1.1.**

1.2 Hon'ble Supreme court direction in respect of Ken Betwa Link Project

The Hon'ble Supreme Court in the matter of Writ Petition (Civil) No.512 of 2002 "In Re: Networking of Rivers" along with Writ Petition (Civil) No.688 of 2002 delivered a judgement dated 27.2.2012. The Hon'ble Supreme Court has directed that an appropriate body should be created to plan, construct and implement the interlinking of rivers programme for the benefit of the nation as a whole. The main direction of the Hon'ble Supreme Court are covered under Para 64 of judgement. Hon'ble Supreme Court has directed the Union of India

and particularly the Erstwhile MoWR, Govt of India, to constitute forthwith a committee to be called "Special Committee for Interlinking of rivers" under the Chairmanship of Hon'ble Minister (Water Resources). The Hon'ble Supreme Court in its judgement (under Para 64(viii) dated 27.2.2012) directed the committee to take up the KBLP for implementation at the first instance itself.

The Union Cabinet in its meeting dated 24th July, 2014 has decided to implement the above direction of Hon'ble Supreme Court. In compliance of the above directions of the Hon'ble Supreme Court, the Erstwhile MoWR, RD & GR has constituted the Special Committee for Interlinking of rivers vide Notification dated 23rd September, 2015. The Hon'ble Minister (Water Resources, RD&GR) is Chairman of the committee and Water Resources Ministers of various States are members of the committee. The committee is regularly monitoring the progress of the interlinking rivers.

1.3 Proposal:

KBLP mainly envisages transfer of surplus water from Ken Basin to Betwa Basin to provide water to water short areas of Upper Betwa Basin. Lower Orr Dam Project as part of KBLP (Phase-II) has been planned as a multipurpose project with irrigation as a major benefit whereas power, drinking water supply and flood moderation are other incidental benefits.

The main objective of the KBLP (Phase-II) is to make available water to water deficit areas of Upper Betwa Basin through substitution from the surplus waters of Ken Basin.

Lower Orr Dam Project as part of KBLP (Phase-II) envisages construction of 45 m high Composite Dam, in which Concrete portion is 487 m long and earthen dam is 1731 m long with a maximum height of 36.00 m, across river Orr (a tributary of Betwa river, which is a tributary of Yamuna river in Betwa Basin). The main objective of the Lower Orr Dam Project is to provide irrigation and domestic water supply to water deficit areas of Shivpuri and Datia districts of MP. The total catchment area of Orr river upto Lower Orr Dam is 1843 sq km.

The 75% dependable annual yield of the sub-basin upto the proposed dam site has been assessed as 362.53 MCM. A main canal has been proposed on the left bank of river. The FRL of the Lower Orr Dam has been kept as 380 m. The submergence area at FRL is 2723.70 ha.

The project will provide annual irrigation to 90,000 ha in Shivpuri and Datia districts of MP. Crop Water Requirement has been finalized as 389.53 MCM. Ground water use of 77.91 MCM (20% of 389.53 MCM) had also been considered in the Project. There is provision of 6 MCM of water for drinking water supply and 44.90 MCM for environmental releases.

The salient features of the Projects are at **Annexure-1.2.2**. An index map showing the proposals is at **Plate-I.**

2. TECHNO ECONOMIC APPRAISAL:

Lower Orr Dam Project as Part of KBLP (Phase-II) with estimated cost of Rs 3065.14 Cr had also been submitted. After detailed examination of estimates based on available data/records, the cost of Lower Orr Dam Project has been finalized for Rs 2864.76 Cr at Price Level (PL) 2020-21.

Corresponding to final cost estimate of the Lower Orr Dam Project amounting Rs 2864.76 Cr, the Benefit Cost (B. C.) ratio for the project has been finalized for 1.43:1 having Internal Rate of Return (IRR) as 11.15%.

3. HYDROLOGY:

3.1 WATER AVAILABILITY:

KBLP (Phase-I) envisages diversion of surplus water from proposed Daudhan dam on Ken River. Out of diverted water, after enroute utilizations, balance water will be diverted to

Betwa River upstream of existing Parichha weir. As part of KBLP (Phase-II) work, it is proposed to utilize equal quantity of balance water in Upper Betwa sub basin upstream of Rajghat Dam through construction of lower Orr Dam and other projects. The hydrological studies of the above projects have been

incorporated in DPR of the KBLP (Phase-II).

One Gauge & Discharge site is existing at Basoda (CA: 7726 sq km) in the Upper Betwa Basin where long term flow data is available for the period 1976-2009. The rainfall data of 15 rain gauge stations is available in the Basin for variable time periods. The consistency of the rainfall data is carried out using the double mass curve technique and necessary corrections are made in the data. The missing rainfall data is filled up using nearby rainfall station data. Based on the refined rainfall data, the weighted areal monthly rainfall for all the projects (including Lower Orr Dam) and Basoda G&D site is computed for the period 1901-2009 using Thiessen polygon method.

Bhopal Lake with a catchment area of 354 Sq Km utilises water of Betwa River and contributes quite marginal quantity of spills downstream side. In view of this, the catchment area of Bhopal Lake is excluded in further water availability studies duly deducting the spills from Basoda discharge data and catchment area from relevant project's catchment areas. As per the DPR, 34 Projects (1 Major, 2 Medium and 31 Minor Projects) utilize / withdraw water upstream of Basoda G&D site. Utilizing the relevant inflow series, project operation/ working tables of major and medium projects as well as utilisations of 31 minor projects the virgin flows at Basoda are computed for the period 1976-2009.

Using the Virgin flows and the weighted areal rainfall at Basoda G & D site, rainfall-runoff relationship is established for the monsoon months (viz. June, July, August, September and October). The non-monsoon flows are estimated as 4.264% of the monsoon flows and further the flows are disaggregated into individual non-monsoon month flows in the ratio of relevant month average virgin flows and average non-monsoon virgin flows at Basoda site. Based on the estimated rainfall-runoff relationship and weighted areal monthly rainfall, the virgin flows are computed for Basoda site and all the proposed projects for the period 1901- 2009.

The net water yield series at the *proposed projects* including Lower Orr Dam

Project is estimated after accounting the diversion from the existing / proposed projects, net domestic and industrial demands in the sub-basins. Dependable flow, hence, derived for Lower Orr Dam Project came out to be 501.15MCM (for 50% dependability), 362.53MCM (for 75% dependability) and 263.98MCM (for 90% dependability). Details are annexed as **Annexure-1.2.3.**

3.2 DESIGN FLOOD:

The KBLP envisages diversion of surplus water of Ken basin to water deficit Betwa basin. The KBLP (Phase-II) consists of Lower Orr Dam and other projects. Lower Orr Dam qualifies for PMF studies whereas others are barrages qualify for 100 year return period as design flood and SPF as check flood. The catchment area of Lower Orr dam up to the dam site is 1843 Sq Km.

The peak for Lower Orr Dam (PMF) has been worked out as **12704 Cumec (Annexure-1.2.4).**

As there is no change in the parameters of Lower Orr dam, the hydrological aspects in revised DPR remain the same. However, it was advised to carry out an analysis at an appropriate stage subsequently to assess the impact of all structures under KBLP (Phase-II) on the major regulating sections downstream on Betwa River **(Annexure-1.2.4).** Further, NWDA submitted study that there is no adverse effect on Matatila committed withdrawals due to this project. The same has also been vetted by CWC.

3.3 SEDIMENTATION STUDIES:

The KBLP (Phase-II) consists of Lower Orr Dam and other projects. Out of these projects, Lower Orr Dam is the only Dam for which sedimentation studies are carried out and the details are as follows.

No Sediment data is available either at the proposed project or nearby sediment site on Betwa River. Rajghat dam located upstream of the confluence of Orr river with Betwa river, Matatila dam and Dhukwan dams located at the downstream of the confluence of Orr river with the Betwa River are the nearest dams to the proposed Lower Orr Dam. As per CWC publication "Compendium

on Silting of Reservoirs in India" in 2015, the silt rate at Matatila dam, Dhukwan dam and median value of the silt rate of Indo Gangetic plains are 0.483, 0.030 and 0.752 Th.cu.m/sqkm/year, respectively. Looking at the variability of sediment rate at above two projects, the median value of silt rate pertaining to Indo Gangetic plains (i.e.0.752 Th.cu.m/sqkm/year) is adopted as the design sediment rate for the project.

The Bed Level and FRL of the reservoir are 340.0 m and 380.0 m respectively.

The Trap efficiency has been calculated based on Brune's curve for every 5 years period and the sediment load is estimated for 50 and 100 years and the details are enclosed as Annexure-l. The type of the reservoir has been found to be Type-l. Sediment distribution has been studied based on Empirical Area Reduction method for 50 years and 100 years. For the proposed project the New Zero elevation after 100 years is estimated as 352.830 m and the revised area-elevation-capacity curve after 50 years is enclosed as **Annexure-1.2.5**. Further, the project authorities are suggested to establish hydro-metrological network in the catchment and start observing the data so that studies may be firmed up at later stage.

3.4 DIVERSION FLOOD STUDIES:

Lower Orr being a large dam, it is desirable that 100-year return period flood should be adopted for diversion works. Accordingly, the annual peaks of daily flow provided by Project Authority for Basoda G&D Site have been used for computing the 100- year return period flood for Lower Orr Dam. Peak flows were adjusted in proportion to the ratio of (Catchment area)$^{0.75}$. 'Log Pearson Type-III' frequency distribution has been used to compute the 100- year flood for the Dam site. The Diversion Flood for Lower Orr Dam computed and recommended is **4576 cumec**. Details are annexed as **Annexure-1.2.6.**

4. IRRIGATION ASPECTS AND WATER REQUIREMENT:

As per the DPR of Lower Orr Dam Project under KBLP (Phase II), 45,047 ha of CCA were proposed to be irrigated. However, with same quantity of water,

as per the revised DPR (submitted with comprehensive report in 2018), the total area to be irrigated was stated as 90,000 ha (50000 ha will be irrigated under gravity and 40000 ha under lift system). The reason for increase in the command area mentioned by the project authorities has been adoption of Micro Irrigation system for the entire command of 90000 ha of Lower Orr Dam Project. The working table submitted by the Project Authorities was examined in CWC and it has been found that the same has been prepared from period 1978-79 to 2008-09 (31 years). Further, the working table prepared by the project authorities considering the inflow series approved by CWC**,** Crop Water Requirement has been finalized as 389.53 MCM. Ground water use of 77.91 MCM (20% of 389.53 MCM) had also been considered in the Project. Subject to above, the working table has been examined and success rate thus worked out as 80.65 %.

Project also has fishery component. The rate per kg of fish has been revised by the project authorities at 2017-18 price level with 3 % depreciation each year as Rs. 504.68 / kg and the same has been used for calculating the benefits of fisheries, as the rate provided by state Govt. is for year 2021-22. Details are annexed as **Annexure-1.2.7.**

Lower Orr Dam Project also has solar power generation of 19 MW. The total cost of Power plant and electric system (Unit-III) is taken as Rs. 10070.70 lakhs and the benefits have been considered as Rs. 3665.1 lakhs and the solar power purchase rate has been considered @ Rs. 6.43/ Kwhr as per the Retail Supply Tariff Order FY 2017-18 of Madhya Pradesh Electricity Regulatory Commission.

5. PROVISION OF DRINKING WATER:

Provision of 5.49 MCM (say 6MCM) for Drinking Water requirement has been proposed, Out of which around 1.13 MCM is for Datia and 4.36 MCM for Shivpuri Districts of Madhya Pradesh.

6. INTER STATE ASPECTS:

In respect of Comprehensive Project Report of KBLP (including Lower Orr Dam Project), CWC vide letter dated 30.01.2018 (**Annexure- 1.2.8**) conveyed that it may be acceptable from inter-state angle subject to signing of Memorandum of Agreement (MoA) among the States of Madhya Pradesh, Uttar Pradesh and Union Govt. for implementation of KBLP. MoA on Comprehensive Project Report of KBLP (including Lower Orr Dam Project) has been signed on 22.03.2021 among Madhya Pradesh, Uttar Pradesh and Union Govt. for implementation of KBLP (**Annexure-1.2.18).** Thereafter, CWC vide letter dated 02.07.2021 has communicated that Comprehensive Project Report of KBLP (including Lower Orr Dam Project under KBLP (Phase-II)) may be considered acceptable from inter-state aspects. Details are annexed at **Annexure-1.2.9.**

7. DESIGN ASPECTS:

The design aspects of the project have been examined in CWC and found to be generally in order. As the Design Chapter and drawings of earthen dam of KBLP (Phase-II) was prepared in CWC in January 2014. The lower Orr Dam Project is a part of KBLP (Phase-II). The proposal present in revised DPR submitted to Specialized Directorate vide letter dated 05.09.2017 was at the same location for which design was done, so **Embankment Dams (NW&S) Directorate, Barrage and Canal Design Directorate (NW&S)** had no comments to offer.

Instrumentation Directorate vide letter dated 04.12.2017 suggested that for concrete, instrumentation has to be provided only in Dam not in training wall along with the installation of stress strain meter. It also suggested for the installation of numbers of temperature meters on upstream and downstream sections. In case of Earthen Dam Embankment piezometer may also be installed in impervious soil (**Annexure-1.2.10).**

8. ENVIRONMENTAL & FOREST CLEARANCE:

The Environmental clearance for Lower Orr Dam project was accorded in 93rd meeting of EAC held on 2nd May, 2016 (**Annexure-1.2.11)**. Stage-I Forest clearance was accorded by MoEF&CC vide their letter dated 12.02.2019 and stage –II Forest clearance was accorded vide MoEF&CC vide their letter dated 06.05.2021. Letters for Forest Clearances in respect to Lower Orr Dam project are attached as **Annexure –1.2.12.**

9. TRIBAL AFFAIRS & R&R:

The Clearance of the Rehabilitation and Resettlement Plan for Lower Orr Dam Project under KBLP, near Didauni village in Khaniyadhana /Chanderi Tehsil of Shivpuri / Ashok Nagar, Madhya Pradesh was accorded by MoTA letter dated 03.10.2018. MoTA letter dated 03.10.2018 is annexed at **Annexure-1.2.13.**

10. PLAN PROVISIONS:

Union Cabinet has approved proposal of Ken-Betwa Link Project (Lower Orr Dam Project as part of KBLP) on 08.12.2021 and its funding will be as per decision taken therein.

11. COST ESTIMATE:

The Cost Estimate of Comprehensive Project Report of KBLP for an amount of Rs 35111.24 Cr at PL 2017-18 had been received in CWC during October, 2018 for examination of Cost aspects. In this Report, the Cost Estimate of "Lower Orr Dam Project" as Part of KBLP (Phase-II) amounting Rs 3065.14 Cr has also been submitted by Project Authority. The discussion on the Cost Estimate of Lower Orr Major Irrigation Project was held with the Project Officials from 25th to 29th October, 2021. NWDA has submitted revised cost estimate of Rs 3013.51 Cr at 2017-18 Price Level on 20.10.2021. After detailed examination of estimates based on available data, the cost of Lower Orr Dam Project have been finalised for Rs 265703.68 lakhs (Rs 2657.04 Cr) at SoR 2017-18. The Unit wise finalized cost of the project is as under

S.No.	Items	Cost (Rs in lakhs)
1	Unit I(Head Works like Dam, Barrage etc)	104521.08
2	Unit II(Canal Works)	151011.91
3	Unit III (Power Plant and Electrical systems)	10170.70
4	**Total**	**265703.68**

The Project Cost is subjected to the correctness of the quantities as per the detailed survey carried out and rates indicated in the cost estimates at Madhya Pradesh Unified Schedule of Rates 2017-18. NWDA has also submitted a certificate regarding the correctness of quantities as per Design and Drawings proposed for preparation of Cost Estimate**.** In this regard, it is to mention that project is under execution. Expenditure up to 30 Nov, 2021 on the project is Rs. 1664.52 Cr, which includes Rs 414.92 Cr on Land acquisition and Rs 1249.60 Cr on works. The Abstract of Cost of the Project and expenditure is enclosed as **Annexure-1.2.15.**

Further, The Cost Estimate is revised at 2020-21 price level which works out to be Rs. 286476.17 Lakhs.

12. ECONOMIC EVALUATION:

12.1 BENEFIT COST RATIO:

The cost of the project has been finalized at 2020-21 price level for Rs 2864.76 Cr. Accordingly, corresponding to final cost estimate of Rs 2864.76 Cr at 2020-21 price level, the benefit cost ratio for the project has been finalized to 1.43:1 and the Internal Rate of Return (IRR) as 11.15%.

13. WORK COMPLETION SCHEDULE:

13.1 PHYSICAL SCHEDULE:

In this regard, it is to mention that project is under execution from 2018-19. The overall Physical progress of the project up to 30 Nov, 2021 is 50%, which includes 70% of Headworks & 25% of Canal Works. Further Bar chart from next year onwards are at **Annexure-1.2.17.**

CHAPTER-II
SURVEYS AND INVESTIGATIONS

2.0 Background

The DPRs of KBLP, Phase-I and Phase-II were completed by NWDA in 2010 and 2014 respectively after carrying out detailed Surveys and Investigations (S&I). Lower Orr Dam and Kotha Barrage were also included in Phase-II. In respect of canal system under Daudhan Dam, enhanced CCA proposed by Government of MP from 2.87 lakh ha to 4.47 lakh ha**,** NWDA has carried out additional command area survey of 26500 ha (12500 ha in enroute command of the link canal and 14000 ha in command of Ken Left Bank Canal). In respect of additional command of 37564 ha in Mahoba district of UP, NWDA collected irrigation map of Mahoba district from irrigation department of UP showing dams tanks and canal system and adopted in study. and Mahoba district of UP has not been done at this stage. Irrigation planning has been provided by Government of MP and same is adopted in the Comprehensive Report. In respect of Bina Complex Multipurpose Project, surveys and investigations has been done by Government of MP and the same is adopted in Comprehensive Report. The component wise details of various surveys and investigations extracted from specific DPRs of above projects are furnished below:

2.1 Lower Orr Dam and Canal

2.1.1 Topographical and Other Allied Surveys

Various survey works like the dam axis survey, submergence area survey, river survey and the command area survey and other allied surveys were carried out by NWDA. The Environment Impact Assessment Studies (EIA) in respect of Lower Orr Dam and its canal was carried out by M/s Water and Power Consultancy Services (WAPCOS) Ltd., Gurgaon. The socio-economic studies for the project have been got done through Government of MP. Other allied surveys, archaeological surveys, mineral (useful and harmful) surveys in the catchment/reservoir areas, right of way surveys, communication surveys and drainage surveys have been carried out. Details of topographical and other allied surveys have been described in the DPR of Lower Orr Project, Volume-I, June-2017.

2.1.2 Geology, Geophysical & Seismic Investigations

As a part of DPR, the preconstruction stage geotechnical and geological investigation of Lower Orr Dam was carried out by GSI, Bhopal in association with CSMRS, Delhi. The note on pre-construction stage geotechnical investigation of dam site, regional geology, local geology, geotechnical assessment and foundation investigation, earthen dam, concrete dam in spillway portion, link canal and cross drainage works of the project area prepared by GSI, Bhopal is enclosed in the DPR of Lower Orr Project, Volume-II. Geophysical investigations in respect of Lower Orr Dam site was not required as geotechnical investigations based on direct drilling for sub-surface exploration were carried out.

2.1.3 Seismicity

The studies for site-specific design ground motion including earthquake parameters for the proposed Lower Orr Dam area have been carried out by the Central Water and Power Research Station (CWPRS), Pune. CWPRS Technical Report No. 4945, April 2012 entitled "Estimation of site-specific seismic design ground motion for Lower Orr Dam, MP" is furnished as Appendix-2.1.2 in DPR Lower Orr Project, Volume-II, June-2017.

According to the above studies, the proposed Lower Orr Dam site lies in the Bundelkhand gneissic terrain of Archaean- Proterozoic age and is bounded by the tectonic features associated with very low level of seismicity and lies in Zone II of the Seismic Zoning Map of India (BIS: 1893, part-1, 2002).

Conclusions and recommendations of above study have been furnished in DPR of Lower Orr Project, Volume-II.

2.1.4 Geo-technical Investigations and Borrow Area Surveys and Construction Material Survey

2.1.4.1 Borrow Area Survey

The work of borrow area investigations for the proposed Lower Orr Dam was carried out by CSMRS. The Borrow area report received from CSMRS is furnished as Appendix-2.1.7 in Volume-II of DPR of Lower Orr Project.

2.1.4.2 Construction Material Investigations

2.1.4.2.1 Sand, Rock and Aggregates

The CSMRS, New Delhi has carried out construction material survey and laboratory investigations of sand samples, rock samples for their use as coarse aggregate in concrete during investigation of the proposed Lower Orr Dam project. The test results of the same are enclosed as Appendix-2.1.7and Appendix-2.1.8 in Volume-II of DPR of Lower Orr Project.

2.1.4.2.2 Brick & Tiles, Cement, Steel and Any Other Materials

Detailed surveys for availability of the materials like brick & tiles, cement and steel have been carried out by NWDA through CSMRS, New Delhi and given in the DPR of Lower Orr Project.

2.1.4.3 Hydrological and Meteorological Investigations

Data on hydrological and meteorological investigations including rainfall, sunshine used for the Rajghat Dam for determining sedimentation profile has been considered. A sedimentation rate of 367.872 m^3/sqkm/year has been considered for Lower Orr Dam site as computed for Rajghat project. There is no pan evapometer installed near the dam site. Hence, evaporation values computed for Guna IMD observatory has been considered in the study.

CHAPTER-III
HYDROLOGY AND WATER ASSESSMENT

3.0 Background

This chapter deals with hydrology and water assessment of various projects components under KBLP. The hydrology and water assessment of Ken Basin upto Daudhan Dam was completed by NWDA and included in DPR of KBLP, Phase-I (2010) and techno-economically approved by CWC in 2017. The hydrology and water assessment of Lower Orr Dam and Kotha Barrage was completed by NWDA and included in DPR of KBLP, Phase-II (2014). Whereas, the hydrology of Bina Complex Multipurpose Project was completed by Water Resources Department, Government of MP. Separate DPRs of Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project have been approved by CWC in the 148th meeting held on 17.02.2022. The component wise details of hydrology, water assessment and latest water planning are covered in this Chapter.

3.1 Lower Orr Dam

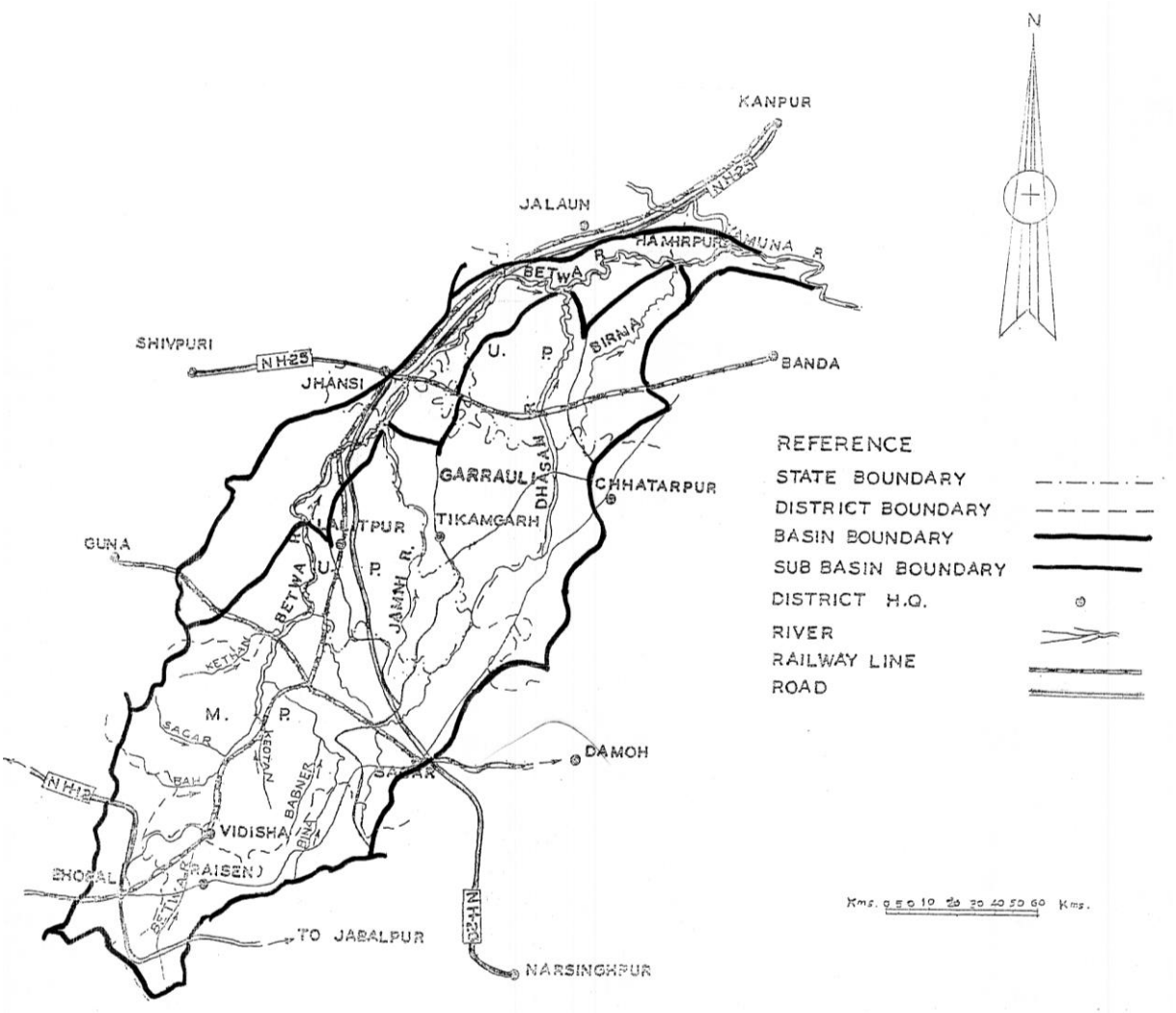
3.1.1 Brief Description of Betwa Basin

The Betwa river originates in the Raisen district of MP near Barkhera village south-west of Bhopal at an elevation of 576 m above mean sea level (MSL). It flows in a north-easterly direction through MP and enters into UP near village Bangawan of Jhansi district. The total length of the river from its origin to its confluence with the Yamuna river is 590 km, out of which, 232 km lies in MP and the rest 358 km in UP. The river joins the Yamuna near Hamirpur in UP at an elevation of about 106 m. The river basin lies between 22° 54' to 26° 00' N latitudes and 77° 10' to 80° 20' E longitudes. The total catchment area of the basin is 44335 sq km, out of which, 30238 sq km lies in MP and the remaining 14097 sq km lies in UP. The basin is saucer shaped with sandstone hills around the perimeter.

During its course from the source up to the confluence with the river Yamuna, the river is joined by a number of tributaries and sub-tributaries; the

important among them being the Bina, Jamini, Dhasan and Birma on the right bank and Kaliasot, Halali, Bah, Saga, Narain and Kaithan on the left bank. Out of the 14 principal tributaries, 11 lies completely in MP and 3 lies partly in MP and partly in UP. The Betwa river covers the areas of Bundelkhand uplands, the Malwa plateau and the Vindhyan scrap lands in the districts of Tikamgarh, Sagar, Vidisha, Raisen, Bhopal, Guna, Shivpuri and Chhatarpur of MP and Hamirpur, Jalaun, Jhansi and Banda districts of UP. A map of the Betwa river basin is shown below:

Map of Betwa River Basin



3.1.2 Lower Betwa Sub-Basin

The area of the Betwa basin falling below the Rajghat Dam up to its confluence with the Yamuna excluding the sub-basin areas of Jamni, Dhasan & Bina has been considered as the Lower Betwa sub-basin for the purpose of the water balance studies. The sub-basin lies between the East longitudes of $77^0$36' to $80^0$13' and the North latitudes of $24^0$19' to $26^0$03'. The length of the Betwa river from the Rajghat to the confluence with the Yamuna is about 334 km. The catchment area of the Lower Betwa sub-basin is 8635 sq km which is about 20% of the catchment area of the Betwa basin. Out of which, 4271 sq km (49%) catchment area lies in MP and the remaining 4364 sq km (51%) lies in UP.

3.1.3 Orr Sub-Basin

Orr river, a tributary of the Betwa river, originating near Amkhera Sukha village in Ashok Nagar tehsil of Ashok Nagar district, flows entirely in MP state and runs through Ashok Nagar and Shivpuri districts. The total length of river up to confluence with Betwa river is 110 km. The catchment area of Orr river from origin to its confluence with Betwa river is 2019 sq km. The length of the river up to proposed Lower Orr Dam site is 101.4 km.

3.1.4 Hydrology

NIH, Roorkee has carried out hydrological and water balance studies for assessment of diversion flood and design flood, sedimentation analysis, multi reservoir simulation studies and hydrodynamic modeling and related studies considering 10 structures. Accordingly, NIH divided the catchment of Betwa basin into ten sub catchments SB-1 to SB-10. Catchment of Lower Orr Dam is designated as SB-10 in the NIH study. The 75% and 50% dependable annual yield of the sub-catchment of Betwa basin up to the proposed Lower Orr Dam has been assessed as 363 MCM and 501 MCM respectively. From the simulation studies, it is revealed that about 329.67 MCM water can be utilized from the reservoir for irrigation (apart from 6 MCM for drinking water supply and 44.9 MCM for environmental releases). The gross storage capacity of proposed reservoir is 371.802 MCM.

3.2.5 Water Assessment

Assessment of water demands in foreseeable future for various purposes including domestic, industrial, irrigation, hydropower and navigation etc. is essential for planning of water resources development and management. Water needs are to be met either from surface flows or ground water resources or a combination of both. NIH, Roorkee has carried out the detailed study for assessment of water with flow irrigation for various purposes and are furnished in the DPR of Lower Orr Project (2017). The monthly demand for different purposes is given in **Table-3.5.**

Table-3.5

Monthly Demands for different Purposes with Flow Irrigation

Unit: MCM

Month	Irrigation Demand of Lower Orr Canal in Shivpuri District	Irrigation Demands of Lower Orr Canal in Datia District	Transmission Losses	Domestic Supply	Total Demand
January	53.79	6.01	2.079	0.500	62.39
February	38.22	4.27	1.477	0.500	44.47
March	22.29	2.49	0.861	0.500	26.14
April	4.02	0.45	0.155	0.500	5.12
May	4.89	0.55	0.189	0.500	6.12
June	38.19	4.27	1.832	0.500	44.79
July	13.73	1.54	1.132	0.500	16.90
August	14.41	1.61	1.157	0.500	17.68
September	14.05	1.57	1.106	0.500	17.23
October	13.79	1.54	0.775	0.500	16.60
November	38.44	4.30	1.486	0.500	44.73
December	36.99	4.14	1.430	0.500	43.06
Total	**292.81**	**32.74**	**13.680**	**6.000**	**345.23**

Further, Water Resources Department, Government of MP has carried out the study for assessment of water for various purposes through sprinkler irrigation under this project and is given in **Table-3.6**.

Table-3.6

Monthly Demands for different Purposes through Sprinkler Irrigation

Unit: MCM

Month	Irrigation Demand computed by Govt. of MP for Sprinkler Irrigation	Domestic Supply	Environmental Flow	Evaporation Losses	Total Demand
January	47.3	0.5	0.64	1.01	49.45
February	18.49	0.5	0.26	1.01	20.26
March	0.00	0.5	0.03	1.56	2.08
April	0.00	0.5	0.00	2.07	2.57
May	0.00	0.5	0.00	2.56	3.06
June	0.00	0.5	6.42	2.27	9.19
July	0.00	0.5	24.18	1.46	26.14
August	0.00	0.5	9.63	1.25	11.38
September	0.00	0.5	1.16	1.32	2.98
October	39.28	0.5	1.18	3.42	44.38
November	73.64	0.5	0.96	2.08	77.17
December	60.02	0.5	0.45	1.30	62.27
Total	**238.73**	**6**	**44.90**	**21.30**	**310.93**

Government of MP computed the demand of 238.73 MCM for the Lower Orr command (CCA 90,000 ha) for sprinkler irrigation. In addition, 6 MCM water is also proposed for domestic purpose. EAC of MoEF&CC also suggested about 44.90 MCM of water for environmental releases. As per Government of

MP, an evaporation loss from the reservoir is computed as 21.30 MCM. Thus, the total requirement from Lower Orr Dam works out to 310.92 MCM (255.61 MCM in non-monsoon from October to March and 55.31 MCM in monsoon season from April to September). Further, Government of MP mentioned in their modified proposal of Lower Orr Project that 0.35 litre/sec/ha duty is in practice in MP for pressurized pipe micro irrigation system. Accordingly, the crop water requirements for the Lower Orr command (CCA 90,000 ha) has also worked out by MP as 285.77 MCM. If this requirement is considered, then total requirement from Lower Orr Project works out to 357.96 MCM (302.65 MCM in non-monsoon from October to March and 55.31 MCM in monsoon season from April to September).

The 75% dependable yield and live storage capacity of Lower Orr Dam are 362.53 MCM and 328.17 MCM respectively. Details are given in **Annexure-3.1.** It can be seen that water demand in non-monsoon season in both cases is less than the live storage capacity of reservoir. Therefore, the requirement of Lower Orr can be easily met out.

The computed dependable flow at Lower Orr Dam site is given in **Table-3.7**.

Table-3.7
Computed Dependable Flow at Lower Orr Project Site

Unit: MCM

Name of Project	**Dependable Flow**		
	At 50%	**At 75%**	**At 90%**
Lower Orr Dam	501.15	362.53	263.98

3.2.6 Sedimentation Analysis for Lower Orr Reservoir

The KBLP (Phase-II) consists of Lower Orr Dam and other projects. Out of these projects, Lower Orr Dam is the only Dam for which sedimentation studies are carried out and the details are as follows.

No Sediment data is available either at the proposed project or nearby sediment site on Betwa River. Rajghat dam located upstream of the confluence of Orr river with Betwa river, Matatila dam and Dhukwan dams located at the downstream of the confluence of Orr river with the Betwa River are the nearest dams to the proposed Lower Orr Dam. As per CWC publication "Compendium on Silting of Reservoirs in India" in 2015, the silt rate at Matatila dam, Dhukwan dam and median value of the silt rate of Indo Gangetic plains are 0.483, 0.030 and 0.752 Th.cu.m/sqkm/year, respectively. Looking at the variability of sediment rate at above two projects, the median value of silt rate pertaining to Indo Gangetic plains (i.e.0.752 Th.cu.m/sqkm/year) is adopted as the design sediment rate for the project.

The Bed Level and FRL of the reservoir are 340.0 m and 380.0 m respectively.

The Trap efficiency has been calculated based on Brune's curve for every 5 years period and the sediment load is estimated for 50 and 100 years and the details are enclosed as Annexure-l. The type of the reservoir has been found to be Type-l. Sediment distribution has been studied based on Empirical Area Reduction method for 50 years and 100 years. For the proposed project the New Zero elevation after 100 years is estimated as 352.830 m and the revised area-elevation-capacity curve after 50 years is enclosed as **Annexure-1.2.5.** Further, the project authorities are suggested to establish hydro-metrological network in the catchment and start observing the data so that studies may be firmed up at later stage.

3.2.7 Evaporation Losses from Lower Orr Dam

For reservoir capacity of 371.802 MCM, monthly average evaporation loss from Lower Orr Dam is 31.39 MCM. Highest evaporation losses of 3.864 MCM took place during the month of December and the lowest evaporation losses of 1.804 MCM was in the month of August.

3.2.8 Design Flood

The design flood for Lower Orr Dam has been estimated using two approaches: (i) unit hydrograph and (ii) statistical approach. The peak for Lower Orr Dam (PMF) has been worked out as **12704 Cumec**. The diversion flood for the project is estimated as 4576 cumec. The detailed report on hydrological studies carried out by NIH, Roorke is given in Volume-III, Hydrology of DPR of Lower Orr Project (2017). Details of Design Flood are given in **Annexure-1.24.**

CHAPTER – IV

DESIGN ASPECTS

4.0 Background

The designs of Daudhan Dam, Ken-Betwa link canal, Ken Left Bank Canal, Lower Orr dam and Kotha Barrage were carried out by CWC as detailed in respective DPRs. The design of Bina Complex Multipurpose project has been done by Government of MP and adopted in this report. The component wise details of design are briefly described below:

4.1 Lower Orr Dam and Canals

Details of Design aspects of Headworks are described in the Chapter-IV "Design Aspects"of DPR of Lower Orr Project whichhave **been** submitted to CWC during June, 2017 for Techno-economical appraisal. This DPR of Lower Orr Project was prepared on the basis of DPR of KBLP, Phase-II (2014).Wherein the design of headworks was carried out by CWC. The details of design features of headworks are extracted from above DPR. The design of Lower Orr carrier canal, gravity main, rising main and pumping system etc for Pressuriesd pipe micro irrigation under canal system has been done by Govt. of MP and same are adopted in the Comprehensive Project Report.

4.1.1 Lower Orr Dam

In the proposed composite dam, the concrete dam portion is 487.00 m long with 247 m long spillway in the left bank and 240 m long Non-Overflow blocks. The earthen dam proposed is 1731 m long with a maximum height of 45.0 m. The gross storage capacity of Lower Orr Dam is 371.80 MCM.

4.1.1.1 Engineering Assessment

The works related with the design aspects of various components of the project were entrusted to CWC and carried out by different concerned Directorates of CWC, based on the inputs from NWDA, GSI, NIH, CSMRS etc. Design philosophy for the components, their preliminary design, along with underlying considerations, assumptions and parameters and the basis for selecting the parameters form the subject of the design aspects are discussed in

chapter -IV of Design Aspects of DPR of Lower Orr Project. Original and revised Elevation Area Capacity values of Lower Orr Reservoir are given in **Table-3.8 of Chapter -III**.

4.1.1.2 Design flood and sediment studies

a) Design Flood and Reservoir Sedimentation

The design flood and sedimentation computations which form the hydrological analysis of the project are discussed in the DPR of Lower Orr Project. The design flood for the Lower Orr Dam has been estimated using Unit Hydrograph (UH) approach using Probable Maximum Precipitation (PMP) values computed by IMD. Since sufficient historical data is not available at the project site for UH computation, synthetic unit hydrograph has been derived and is convoluted with a critical design (critical sequencing of PMP) to produce corresponding PMF hydrograph at the project site. The PMF at the project site is estimated to be 12704 cumec .

(b) Reservoir Sedimentation

The KBLP (Phase-II) consists of Lower Orr Dam and other projects. Out of these projects, Lower Orr Dam is the only Dam for which sedimentation studies are carried out and the details are as follows.

No Sediment data is available either at the proposed project or nearby sediment site on Betwa River. Rajghat dam located upstream of the confluence of Orr river with Betwa river, Matatila dam and Dhukwan dams located at the downstream of the confluence of Orr river with the Betwa River are the nearest dams to the proposed Lower Orr Dam. As per CWC publication "Compendium on Silting of Reservoirs in India" in 2015, the silt rate at Matatila dam, Dhukwan dam and median value of the silt rate of Indo Gangetic plains are 0.483, 0.030 and 0.752 Th.cu.m/sqkm/year, respectively. Looking at the variability of sediment rate at above two projects, the median value of silt rate pertaining to Indo Gangetic plains (i.e.0.752 Th.cu.m/sqkm/year) is adopted as the design sediment rate for the project.

The Bed Level and FRL of the reservoir are 340.0 m and 380.0 m respectively.

The Trap efficiency has been calculated based on Brune's curve for every 5 years period and the sediment load is estimated for 50 and 100 years and the details are enclosed as Annexure-l. The type of the reservoir has been found to be Type-l. Sediment distribution has been studied based on Empirical Area Reduction method for 50 years and 100 years. For the proposed project the New Zero elevation after 100 years is estimated as 352.830 m and the revised area-elevation-capacity curve after 50 years is enclosed as **Annexure-1.2.5**. Further, the project authorities are suggested to establish hydro-metrological network in the catchment and start observing the data so that studies may be firmed up at later stage.

4.1.1.3 Free Board

The procedure adopted for computing the free board is based on recommendations of IS: 10635-1993 (Reaffirmed 1998) "Guidelines for free board requirements in Embankment dams". For freeboard computations, the wind velocity at the dam site over land has been taken as 39 m/s. The computed free board comes out to be 2.94 m. Settlement consideration has been accounted for to arrive at the top of dam level 384.00 m.

4.1.2 Construction Materials

Report on Soil Investigation of borrow area and Report on Construction material survey for suitability of river bed samples for use are attached in Volume – II of DPR of lower Orr Project (Appendix 2.1.7 and 2.1.8).

4.1.3 Earth Dam - Design Criteria and Stability Analysis

The geometry of the earth dam has been provided taking into account the structural safety, Seismic aspects, seepage control and material properties etc. Detailed investigation and laboratory testing of the construction material was undertaken for determining the material properties. However, additional supplementary tests would have to be taken up before construction.

4.1.3.1 Estimation of Design Shear Strength Parameters.

For estimation of shear strength properties of overburden material in foundation, 100% dependable values were adopted. The evaluation of shear parameters of foundation overburden was carried out at the time of preparation

of DPR of KBLP Phase-II (2014) and same are also presented in the DPR of Lower Orr Project (2017).

4.1.3.2 Seismic Design Considerations

For seismic design Earthquake coefficient, αh as 0.03g and αv as 0.02g has been adopted for Pseudo-static analysis of the section. This has been got approved by the National Committee on Seismic Design Parameters (NCSDP) in 2012.

Adequate factor of safety has been provided against slip failure of slopes during earthquake combined with steady seepage. A wide abutment core-contact will ensure the safety against opening of joint during the earthquake.

4.1.3.3 Stability Analysis

The stability analysis has been carried out in accordance with IS 7894-1975 using a software made in-house based on Swedish slip circle or Felonious method. "Effective stress method" of analysis has been used. The results are presented in the DPR of Lower Orr Project 2017.

4.1.3.4 Zoning of Dam Section

The dam section comprises of 5 kinds of material viz. embankment material, sand drains, filter (Sand layer & crushed stone layer), compacted rockfill in rock toe and dumped riprap. At the time of construction, material excavated from the gravity dam foundation, if found suitable, could be used for rip rap/ filter.

The embankment material should be compacted to an average density of 100% of the standard proctor density subject to a minimum density of 98% of proctor density.

4.1.3.5 Protection of Slopes of Dam Section

The upstream slope protection has been ensured by providing riprap. The downstream slope protection is ensured by providing and turfing and suitable surface drainage. For surface drainage of the downstream slope of the earth dam, a system of open paved drains (chutes) along the sloping surface terminating in

the longitudinal collecting drains at the junction of berm and slope have been provided at 50 m c/c to collect and drain out the rain water.

4.1.3.6 Internal drainage system

The Vertical filter (Chimney filter), Horizontal filter, Rock toe and Toe drain have been provided as a part of internal drainage arrangement of the embankment dam.

The internal drainage arrangement has been worked out on the basis of provisions given in IS: 9429-1980.

The filter shall be compacted to an average relative density of 75% with a minimum acceptable relative density of 70%. The filter material shall satisfy the following criteria:

$$\frac{D_{15} \text{ of Filter material}}{D_{15} \text{ of base material}} < 0.5$$

$$\frac{D_{85} \text{ of filter material}}{D_{85} \text{ of base material}} < 0.5$$

Where $D_{15}$and $D_{85}$are 15% and 85% finer material by weight. Further, the grain size curve of the filter material will be parallel to that of the base material. The maximum particle size of the filter material shall not be more than 75 mm and it should not contain more that 5% of the material finer than 0.074 mm (200 mm Sieve).

4.1.3.7 Cut-off Trench (COT)

The design of cut-off trench has been done as per the guidelines of IS: 8414 -1977, taking into account the result of detailed geological investigations. The back-fill material for cut off trench have the same properties as those specified for impervious core.

4.1.3.8 Foundation Treatment

The foundation treatment has been decided based on the geological interpretation carried out from the data of drill holes and other investigations. The foundation treatment of the right and left abutment is based on limited

investigation carried out at DPR stage. Detailed investigation would have to be carried out at pre construction stage for evolving treatments to control seepage through the abutment.

4.1.4 Concrete dam, Non-Over Flow Section - Stability Analysis/spillway section

The Lowe Dam consists 140 m long NOF blocks on the left side, 100 m long on the right side with a 247.0 long spillway on the left bank (12 bays of 15.0 m with , a bay of 7.5 long each on both ends and 13 piers 4.0 m width to pass a discharge of 12067.67 cumec (PMF)

4.1.4.1 Non Over Flow Section

The stability analysis for Non Over Flow section has been done at the deepest foundation level i.e. 333.00 m as per IS-6512-1984.

The data adopted for the design of Non Over Flow sections is given in **Table 4.1**.

Table 4.1
Design Features of Non Over Flow Section

Sl. no	Details	Value(Unit)
a)	Maximum water Level (MWL)	380.408 m
b)	Full Reservoir Level (FWL)	380.000 m
c)	Maximum Tail Water Level (Max. TWL)	346.800 m
d)	Minimum Tail Water Level (Min. TWL)	333.000 m
e)	Silt Level	353.530 m
f)	Top width of dam	8.0 m
g)	U/S slope (H: 1)	0.100
h)	Horizontal seismic coefficient	0.051g
i)	Vertical seismic coefficient	0.041g
j)	D/S slope	0.85
k)	Cohesion of Dam & rock interface	50.0 t/m2
l)	Angle of internal friction of dam & rock	35^0
m)	Width and height of foundation gallery	2.5 m x 2.5 m

The proposed Lower Orr Dam falls in zone II, that has low seismicity as per IS: 1893-1984 "Criteria for earthquake resistant design of structure". The value of horizontal and vertical seismic coefficients, (as approved by National Committee on Seismic Design Parameters (NCSDP) adopted are 0.051g & 0.041g respectively. The cohesion and angle of internal friction of the concrete rock interface has been taken as 50 t/m^2 and 35^0 respectively.

4.1.4.2 Spillway

The overflow section has been designed to pass peak flood of 12067.67 cumec. The stability analysis for Over Flow Section has also been done at the deepest foundation level i.e. 333.0 m as per IS: 6512-1984 for all the seven load combination. The data used for design is given at **Table 4.2.**

Table 4.2
Design Features of Over Flow Section

Sl. No	Details	Value(Unit)
a)	Radial gate Trunnion (C.L) elevation level	373.33 m
b)	Bridge weight	15 t/m
c)	Top width	8.0 m
d)	Width of block	19.0 m
e)	Elevation of T.P. (d/s)	361.213 m
f)	Top Bridge level	384.0 m
g)	Cm	0.630
h)	Top of crest	370.00 m

The stresses obtained in all seven loading conditions are compressive and the factor of safety against sliding is more than 1 as per IS: 6512-1984. Therefore, structure is safe.

4.1.5 Foundation Treatment and Seepage Control

The provisions for Foundation treatment and seepage control have already been discussed in Chapter -IV of DPR of Lower Orr Project.

4.1.6 Energy Dissipation Arrangement (EDA)

Stilling basin has been provided for dissipation of the energy of the outflow. The proposed stilling basin with top at EL 335.0 m is 50 m long. Chute blocks and end sill (dentate) have been provided in accordance with codal provisions. The performance of the proposed EDA has to be checked through model studies during pre-construction stage.

4.1.7 Openings through Dam

Two sluices in the spillway portion have been provided for meeting the water requirements of e-flow in the downstream areas and for diversion during construction stage. Each sluice has a size of 2.5 m (W) x 3.0 m (H). These sluices are proposed to be provided in spillway block numbers 13 & 14. The invert level of the sluices has been kept at EL 352.00 m.

4.1.8 Gates, Types of gates and Hoist Bridge and Stoplogs Spillway Radial Gates

12 no. spillway Radial Gates of size 15000 mm X 10000 mm will be provided to control the flow of spillway. The Radial gate shall be designed in accordance with the provision of IS: 4623 (latest revision) in general. The gate shall be designed for a total head of 10.37 m corresponding to FRL of EL 380.00 m. The radial gate shall be operated with the help of Twin cylinder hydraulic hoist with minimum hoist capacity of 140 Tonne (approx.). The sill level of gate shall be 369.628 m and trunnion shall be installed at 373.33 m. The radius of gate leaf shall be kept as 11.5 m. Bottom seal of gate shall be provided as wedge type. The side seals shall be of Z type and will move on curved seal seat.

4.1.8.1 Spillway Stoplogs

One set of stoplog's for opening size of 1000 mm X 10482 mm shall be provided to carry out the maintenance of spillway Radial Gate. The stoplog's shall be connected to gravity crane through lifting Beam and Ramshorn Hook.

4.1.8.2 Gantry Crane

The spillway stoplogs shall be operated by moving Gantry Crane. The capacity of gantry crane shall be 30 T (approx.). The Gantry Crane shall have

hoist machinery mounted on trolley. The crane shall be designed as per IS: 3177 and IS: 807.

4.1.9 Lower Orr Water Carrier

4.1.9.1 Description of canal system including ridge/contour/lift canal capacity and considerations for fixing alignment etc.

The Lower Orr Carrier canal off takes from the left side NOF at RD 50.00 m of the proposed Lower Orr dam with discharge at head of 34.00 cumecuptoRD3.00 km and 20 cumec from RD 3.00 km to end (RD 50 km). The canal has been proposed for feeding the balancing reservoir at RL 350.00 m near village Bamera and the length of Carrier canal is about 50.00 km. The canal has been aligned as a contour canal. The alignment of the canal has been proposed on the basis of survey data. One point worth to mention that the canal alignment is tentative and shall be optimized at the time of construction stage planning.

4.1.9.2 Bed slope and side slopes

The canal is designed as contour canal with a bed slope of 1 in 5000 for whole canal. It has been tried to optimize the cutting and filling, through the proposed alignment. The side slope adopted in whole canal is 1:1.5(1H: 1.5V).

4.1.9.3 Free board

The free board has been taken as 0.90 m from RD 0 to RD 3.00 km and 0.75 m from RD 3.00 km to end (RD 50.00km).

4.1.9.4 Description of soil profile along the canal and canal alignment based on pit/auger holes.

Study of soil profile along the canal through trial pits and auger holes would be taken up at pre construction stage. It is assumed that expansive soil conditions are not met within canal alignment. However, if such conditions are found to exist at any location along the canal alignment, suitable Cohesive Non Swelling Soil layer shall be provided below canal lining as per codal provisions.

4.1.9.5 Details of lining

As per provision of IS 3873, laying cement concrete/Stone in canals the thickness of concrete of M-15 grade lining may be taken as 100 mm from RD 0 to RD 3.01 km and 75 mm from RD 30.00 km to end. The lining is concrete proposed to be unreinforced. There is a curvature provided with curvature angle of 34 degree at the junction of side slope and canal bed.

4.1.9.6 Transmission losses assumed for lined/unlined channel with justification for (cumec/millionsqm)

As per provision in IS: 4745-1964 transmission losses at 0.6 cumec/million sq m of wetted perimeter are to be considered in the carrier canal. However, there is no committed transfer of water from the project except for irrigation use under the Lower Orr project command. As such, transmission losses which form part of the conveyance losses are accounted for in the overall irrigation efficiency considered while working out monthly crop water requirement for the proposed cropping pattern.

4.1.9.7 Design calculations for adequacy of canal sections adopted

Considering the discharge requirements at various reaches of the canal, the canal sections have been worked out for the Lower Orr carrier canal and furnished atTable**-4.3**.

Table 4.3
Reach wise details of Lower Orr Carrier Canal Section

S. No.	Canal Reach	Bed width (m)	Depth (m)	Velocity (m/sec)	Design Discharge (cumec)
1	From RD 0 km to RD 3.0 km	5	3.10	1.19	34.00
2	From RD 3.0km to RD 5.0 km (end)	5	2.35	1.024	20.00

4.1.9.8 Design discharge data (irrigation requirement etc.)

The carrier canal is designed for 34.00 cumec from RD 0.0km to RD 3.0 km. Thereafter it is designed for 20 cumec.

Govt. of MP computed their demand of 238.73 MCM of water for the Lower Orr command (CCA 90000 ha) for Sprinkler irrigation. In addition, 6 MCM water is also proposed for domestic purpose. EAC of MoEF& CC suggested about 44.90 MCM of water for environmental releases. As per Govt. of MP, evaporation losses from reservoir is 21.30 MCM. Thus the total requirement from Lower Orr dam works out to 310.93 MCM (255.61 MCM in non-monsoon from October to March and 55.31 MCM in monsoon season from April to September). Further, Govt. of Madhya Pradesh mentioned in their DPR of Lower Orr Project that 0.35 liter/sec/ha duty are in practice in MP for pressurized irrigation. Accordingly, the crop water requirements for the Lower Orr command (CCA 90000 ha) has also worked out by MP as 285.77 MCM. If this, requirement is instead of 238.73 MCM computed ealken by Govt. of MP considered, then total requirement from Lower Orr dam works out to 357.96 MCM. (302.65 in non-monsoon from October to March and 55.31 MCM in monsoon season from April to September). The 75% dependability yield and live storage capacity of Lower Orr dam is 362.53 MCM and 328.17 MCM respectively. It can be seen that, the non-monsoon demand in above both cases is less than the live storage capacity of lower Orr dam. Therefore, the total requirement of Govt. of MP can easily meet out from Lower Orr dam. Month wise irrigation water requirement for the command area under the Lower Orr canal computed by Govt. of MP for the design of the canal is furnished in the **Table 4.4**.

Table 4.4

Monthly Irrigation and Domestic Water Requirement in Canal

Unit - MCM

Month	Irrigation demand computed by Govt of MP for Sprinkler irrigation	Domestic supply	Environmental flow	Evaporation Losses	Total
January	47.30	0.5	0.64	1.01	49.45

February	18.49	0.5	0.26	1.01	20.26
March	0	0.5	0.03	1.56	2.08
April	0	0.5	0.00	2.07	2.57
May	0	0.5	0.00	2.56	3.06
June	0	0.5	6.42	2.27	9.19
July	0	0.5	24.18	1.46	26.14
August	0	0.5	9.63	1.25	11.38
September	0	0.5	1.16	1.32	2.98
October	39.28	0.5	1.18	3.42	44.38
November	73.64	0.5	0.96	2.08	77.17
December	60.02	0.5	0.45	1.30	62.27
Total	**238.73**	**6.0**	**44.90**	**21.30**	**310.92**

4.1.10 Canal structures (Cross Drainage works/regulators etc.)

Cross communication i.e. bridges have been provided along the alignment of the canal. Further since the canal is proposed as contour canal, the canal shall have to cross a number of drains. Therefore, suitable CD works have been proposed as indicated in the longitudinal section of the canal and their probable head losses are also accounted for.

4.1.10.1 Bridges

Bridges shall be provided at suitable location along the canal alignment. Since the Maximum bed width of canal is only 5 m, slab type bridge by keeping the bed width of the canal and fluming the canal sides from sloping to vertical, is proposed.

4.1.10.2 CD works structures

The Lower Orr canal is a contour canal. It crosses several streams big drain. The type of CD works depend upon the catchment area of the streams and its bed level with reference the bed level of canal it crosses. In general, if the bed level of canal is well above the HFL of a drain, an aqueduct is the obvious

choice. Syphon aqueduct is provided if the HFL of a drain is higher than the canal bed canal system. The FSL of the canal is sufficiently above the bed level of the drainage so that canal can flow under symphonic action under the trough. However, this shall be required to be reviewed at construction stage planning.

4.1.10.3 Head Regulators

The head regulators are designed to pass design discharge at MDDL of dam. Some surplus capacity to cater to the increase in demand of irrigation at a later stage has also been provided.

4.1.11 Distribution Networks

All the irrigation is to be proposed to be done by pressurized pipe micro irrigation system with outlets at 0.60 to 1.20 ha with exit gradient of 20 m. The duty adopted is 0.35 lit/sec/ha as worked from CWR. There is lifting of water from the carrier canal at RD 3000 m to serve about 40000 ha of CCA in upper reaches for which pump house is proposed to be constructed requiring 14 MW of power. A captive solar plant of 19 MW has been proposed to meet the electrical demands of the project.

For lower reaches i.e. from RD 3.00 m to 50.00km of canal having a discharge of 20.00cumec delivers the water at balancing reservoir. From balancing reservoir the down surge pressurized system serves a CCA of 50000ha.

4.1.12 Navigation and Tourism Development

There is no provision for development of navigation aspect in the project. As far as the development of tourism is concerned the dam site has got full potential.

4.1.13 Operation and Maintenance

The proposed organizational set up at the construction stage of the dam can be made available for operation and maintenance of the project at post construction stage. A suitable operation and maintenance programme has to be developed for meeting the various objectives of the project.

4.1.14 Other Studies

The studies which are not covered in the DPR stage will be planned at the preconstruction stage. No other study was required to be done at DPR stage. However, if any study is suggested by Design organization of CWC, the same may be carried out at appropriate stage.

CHAPTER-V

RESERVOIR & POWER

5.0 Background

The present chapter deals with reservoir and power assessment of various projects components under KBLP. The reservoir simulation and power studies of Daudhan Dam was carried out by NIH, Roorkee and CEA and included in DPR of April, 2010. The reservoir simulation study of Lower Orr Project and Kotha Barrage were carried out by NIH, Roorkee and included in DPR of January, 2014. The reservoir simulation and power studies of Bina Complex Multipurpose Project were carried out by Water Resources Department, Government of MP. The DPRs of Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project are under techno-economic appraisal in CWC. The component wise details of reservoir capacity, simulation and power assessment are described in the subsequent paras.

5.1 Lower Orr Reservoir and Canals

5.1.1 Reservoir

Details of Lower Orr reservoir are described in the Chapter-V "Reservoir and Power" of DPR of KBLP, Phase-II (January, 2014). No parameters of Lower Orr Project are required to be changed.

FRL of the proposed reservoir is kept at 380.0 m and the deepest river bed level at project site is 339.00 m. The length of dam is 2250 m (including over flow and non-over flow sections) and height of dam is 45 m. The gross storage capacity of the reservoir at FRL is worked out to be 371.802 MCM with corresponding submergence area of 2723.70ha at FRL of Lower Orr Dam.

5.1.1.1 Fixation of Storage and Reservoir Levels Approach–Criteria

NIH, Roorkee was entrusted with water balance and water yield assessment under hydrological studies related to the Lower Orr reservoir. The 75% dependable annual yield of the sub basin upto Lower Orr reservoir site has been assessed as 362.53 MCM after considering u/s domestic, irrigation and

industrial water requirements and regeneration thereof. The hydrological controlling levels are fixed as per simulation study based on 24 Nos. of years of data used. Brief details are given in **Table-5.7.**

Table-5.7

Levels and Capacities fixed as per Simulation Study

Controlling Levels	**Elevation(m)/ Capacity (MCM)**
FRL	380.0 m
MWL	380.408m
MDDL	360.500m
Free Board	2.940 MCM
Gross Storage Capacity	371.802 MCM
Live Storage Capacity	328.173 MCM
Capacity at MWL	383.006 MCM
Capacity at FRL	371.802 MCM
Capacity at MDDL	43.629 MCM
Capacity at dead storage level	43.629 MCM
Submergence area at FRL	2723.70 ha

5.1.1.2 Type and Shape of Reservoir

The submergence area survey of the Lower Orr reservoir has been carried out and the original and revised Elevation–Area–Capacity table as considered for the simulation studies are furnished in the **Table-5.8**.

Table-5.8

Original and Revised Elevation-Area-Capacity Table of Lower Orr Reservoir

Elevation (m)	Original		Revised			
			After 50 Years		After 100 Years	
	Area (ha)	Capacity (MCM)	Area (ha)	Capacity (MCM)	Area (ha)	Capacity (MCM)
380 (FRL)	2724	371.802	2724	337.806	2724	303.79
379	2590	345.237	2535	311.425	2474	277.612
378	2472	319.929	2400	286.752	2320	253.64
377	2349	295.825	2265	263.429	2173	231.177
376	2241	272.874	2148	241.364	2046	210.087
375	2119	251.077	2018	220.535	1908	190.323
374	1946	230.758	1840	201.25	1723	172.178
373	1821	211.924	1710	183.506	1587	155.634
372	1709	194.275	1594	166.992	1466	140.372
371	1642	177.52	1523	151.412	1391	126.085
370	1588	161.371	1466	136.471	1331	112.473
369	1533	145.766	1409	122.1	1271	99.462
368	1469	130.753	1343	108.343	1203	87.089
367	1399	116.411	1271	95.275	1130	75.425
366	1297	102.93	1168	83.082	1026	64.649
365	1204	90.428	1074	71.877	930	54.872
364	1142	78.704	1011	61.456	867	45.886
363	1060	67.699	929	51.756	786	37.624
362	988	57.463	857	42.824	714	30.129
361	911	47.971	781	34.633	638	23.37
360	826	39.287	698	27.242	556	17.403
359	742	31.449	614	20.687	474	12.261
358	630	24.596	504	15.103	365	8.076
357	545	18.726	420	10.487	283	4.839
356	446	13.783	323	6.777	189	2.488

Elevation (m)	Original		Revised			
			After 50 Years		After 100 Years	
	Area (ha)	Capacity (MCM)	Area (ha)	Capacity (MCM)	Area (ha)	Capacity (MCM)
355	390	9.608	270	3.813	138	0.857
354	288	6.233	171	1.623	42	0
353	193	3.846	79	0.391	0	0
352	119	2.303	8	0.008	0	0
351.8	110	2.111	0	0	0	0
351	75	1.344	0	0	0	0
350	47	0.741	0	0	0	0
349	20	0.413	0	0	0	0
348	8	0.279	0	0	0	0
347	6	0.214	0	0	0	0
346	4	0.164	0	0	0	0
345	8	0.103	0	0	0	0
344	3	0.052	0	0	0	0
343	2	0.03	0	0	0	0
342	1	0.015	0	0	0	0
341	1	0.005	0	0	0	0
340	0	0	0	0	0	0

The Lower Orr reservoir is considered as flood plain to hill type and the standard classification is taken as Type-II.

5.1.1.3 Life of Reservoir

The life of the Lower Orr reservoir has been considered as 100 years.

5.1.1.4 Power House

No power house is proposed at Lower Orr Dam. About 14 MW power is required for developing pressurized pipe micro irrigation system in the canal system from Lower Orr Project.

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CHAPTER - VI
IRRIGATION PLANNING AND COMMAND AREA DEVELOPMENT

6.0 Background

The present chapter deals with irrigation planning and command area development of various project components under KBLP. The irrigation planning and command area development of KBLP, Phase-1 was completed by NWDA and included in DPR of 2010. The irrigation planning of Lower Orr dam was completed by NWDA and included in its DPR of 2017. The DPR are under techno-economic appraisal in CWC. The component wise details of irrigation planning and command area development of Betwa command are given in the following paras.

6.1 Betwa Command

During meeting convened by Hon'ble Minister (WR, RD & GR) held on 18th November, 2016 with NWDA and Government of MP, it was decided that Lower Orr Dam and Kotha Barrage with increased height will be retained under Phase-II. It was also agreed that DPR of Bina Complex Multipurpose Project already prepared by Government of MP will be included in KBLP, Phase-II. Details of command area under Lower Orr Project are given in **Table-6.1**.

Table 6.1
Details of Project Wise Command Area

S. No.	Name of Project	Command Area (ha)	Benefited Districts
1.	Lower Orr Project	90,000	Shivpuri and Datia

6.2 Lower Orr Dam Command

This component of the project will provide annual irrigation to 90,000 ha in Shivpuri and Datia districts of MP utilizing 389.53 MCM. Ground water use of 77.91 MCM (20% of 389.53 MCM) had also been considered in the Project. Besides, 6 MCM water will be provided for drinking water supply to the enroute villages and towns in the vicinity of the canal. Command area map of Lower Orr Project is shown at **Plate-1.**

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6.2.1 Location and Classification of Land in the Command Area

The command area of Lower Orr command is spread over Shivpuri and Datia districts of MP. The geographical area of Shivpuri district is 10, 27,700 ha as per land use statistics of the year 2008-09 (maximum of five years from 2007-08 to 2011-12). CCA of the Shivpuri district is 5,40,373 ha which is 52.58% of geographical area of the district. The details of the command area are given in **Table-6.2**.

Table - 6.2
Details of GCA, CCA of Lower Orr Dam

S. No.	Types of irrigation	Gross Command Area (ha)	CCA (ha)
1.	Lifting of water from carrier canal to RL 430.00 m, Irrigation Between RL 362.00 m to RL 320.00 m in Shivpuri district	61,538	40,000
2.	Pressurized irrigation through Gravity between RL 320.00 m to RL 240.00 m in Shivpuri and Datia districts.	76,924	50,000
	Total	**1,38,462**	**90,000**

6.2.2 Existing Cropping Pattern

Details of cropping pattern generally adopted in Shivpuri district are given in **Table-6.3**. The important crops grown in the command area of proposed Lower Orr Project are Wheat, Soya bean, Maize, Gram, Groundnut and Pulses, etc.

Table-6.3
Existing Cropping Pattern of Shivpuri District for Year 2015-16

CCA = 540373 ha

S. No.	Name of Crops	% of CCA
A	**Kharif**	
1.	Paddy	1.4
2.	Jowar	0.2
3.	Maize	3.5
4.	Bajra	1.5
5.	Other pulses	3.2
6.	Soyabean	24.6

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7.	Ground nut	15.3
8.	Vegetable	0.9
9.	Til (Sesamum)	2.0
B	**Rabi**	
1.	Wheat	28.8
2.	Barley	0.2
3.	Gram	7.7
4.	Mustard	5.9
5.	Other pulses	1.0
6.	Tur	0.2
7.	Fodder crops	3.4
8.	Vegetable	0.1
C	**Perennial**	
1.	Sugarcane	0.2
	Total	**100.0**

6.3 Soil Surveys

6.3.1 Soil Capability Classification

The land capability classification of Lower Orr command in Shivpuri district is furnished in **Annexure-6.1.1** of Volume–II of DPR (2017).

6.3.2 Land Irrigability Classification

The land irrigability classification of Lower Orr command in Shivpuri district is furnished in **Annexure-6.1.2** of Volume-II of DPR (2017).

6.4 Proposed Cropping Pattern

The proposed cropping pattern in the command of project approved for Shivpuri district by Agriculture Department of Madhya Pradesh has been considered in the study. Proposed cropping pattern in Lower Orr command is given in **Table-6.4**.

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Table-6.4
Proposed Cropping Pattern in Lower Orr Dam Command

S. No.	Crop	For Pressurized Pipe Micro Irrigation System	
		% of CCA	Area (ha)
	Rabi		
1.	Wheat (Hybrid)	43.45	39105
2.	Wheat (Ordinary)	35.55	31995
3.	Gram	7.89	7100
4.	Gram (Dollar)	11.11	10000
5.	Other /vegetable	2	1800
Total		**100**	90,000

6.4.1 Crop Water Requirement

As per the DPR of Lower Orr Dam Project under KBLP (Phase II), 45,047 ha of CCA were proposed to be irrigated. However, with same quantity of water, as per the revised DPR (submitted with comprehensive report in 2018), the total area to be irrigated was stated as 90,000 ha (50000 ha will be irrigated under gravity and 40000 ha under lift system). The reason for increase in the command area mentioned by the project authorities has been adoption of Micro Irrigation system for the entire command of 90000 ha of Lower Orr Dam Project. The working table submitted by the Project Authorities was examined in CWC and it has been found that the same has been prepared from period 1978-79 to 2008-09 (31 years). Further, the working table prepared by the project authorities considering the inflow series approved by CWC**,** Crop Water Requirement has been finalized as 389.53 MCM. Ground water use of 77.91 MCM (20% of 389.53 MCM) had also been considered in the Project. Subject to above, the working table has been examined and success rate thus worked out as 80.65 %.

Month wise irrigation water requirement for the command area under the Lower Orr canal computed by Government of MP for the design of the canal is given in **Table-6.5**.

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Table-6.5

Monthly Target Demands for different Purposes from Lower Orr Reservoir

Unit: MCM

Month	Irrigation Demand computed by Govt. of MP for Pressurized Pipe Micro Irrigation System	Domestic Supply	Environmental Flow	Evaporation Losses	Total
January	47.3	0.5	0.64	1.01	49.45
February	18.49	0.5	0.26	1.01	20.26
March	-	0.5	0.03	1.56	2.08
April	-	0.5	0.00	2.07	2.57
May	-	0.5	0.00	2.56	3.06
June	-	0.5	6.42	2.27	9.19
July	-	0.5	24.18	1.46	26.14
August	-	0.5	9.63	1.25	11.38
September	-	0.5	1.16	1.32	2.98
October	39.28	0.5	1.18	3.42	44.38
November	73.64	0.5	0.96	2.08	77.17
December	60.02	0.5	0.45	1.30	62.27
Total	**238.73**	**6.0**	**44.90**	**21.30**	**310.92**

6.4.2 Irrigation Efficiency

For crop under micro-irrigation system, the field application efficiency has been considered as 85%.

6.4.2.1 Irrigation Demand for Lower Orr Command

The crop water requirements for the Lower Orr command (CCA 90,000 ha) has been computed by taking duty of the command as 0.35 liter/sec/ha. The irrigation demand for Lower Orr command works out as 329.31 MCM.

6.4.3 Simulation Study of Lower Orr Command

The FRL and MDDL of Lower Orr Dam is 380 m and 360.50 m respectively. The total requirement from Lower Orr dam is 310.92 MCM (255.61 MCM in non-

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monsoon from October to March and 55.31 MCM in monsoon season from April to September) considering the crop water requirements for the Lower Orr command as mentioned in para **6.3.1.4.1**. Further, Government of MP mentioned in their modified proposal of Lower Orr Project that 0.35 litre/sec/ha duty is in practice in MP for pressurized pipe micro irrigation system. Accordingly, the crop water requirements for the Lower Orr command (CCA 90,000 ha) has also worked out by MP as 285.77 MCM. If this, requirement considered, then total requirement from Lower Orr dam works out to 357.96 MCM. (302.65 In non-monsoon from October to March and 55.31 MCM in monsoon season from April to September).

The 75% dependability yield and live storage capacity of Lower Orr Dam is 362.53 MCM and 328.17 MCM respectively. It can be seen that the non-monsoon demand in both cases is less than live storage capacity of Lower Orr reservoir. Therefore, the demand of Government of MP from Lower Orr Dam can easily be met out.

The net yield series for Lower Orr Dam site have been developed by NIH, Roorkee from Year 1901-02 to 2008-09. For assessing the success of the project in meeting the projected water demands, the working tables for period of 50 years are considered sufficient. Working tables for Lower Orr Dam have been prepared for 55 years (1954-55 to 2008-09) considering demand of Lower Orr dam computed during preparation of DPR of KBLP, Phase-I. At that time success rate of the project in meeting the irrigation demands is 75%. However, simulation of the Lower Orr Project need not to be carried out again as the live storage capacity of Lower Orr Dam i.e., 328.17 MCM is sufficient to meet out revised monthly water requirement for micro irrigation for 90,000 ha as explained above.

6.5 Water Planning

As per simulation study of Lower Orr reservoir, about 238.73 MCM of water can be utilized under pressurized pipe micro irrigation system from Lower Orr reservoir after meeting the upstream demand and releasing about 44.898 MCM water for environmental and ecological purposes. The evaporation losses 25.139 MCM for the reservoir have already been considered in the previous simulation study. Provision of 6 MCM (@ 0.5 MCM per month) of water is kept for drinking purpose in the enroute villages/towns.

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6.4.5 Introduction of Pressurized Pipe Micro Irrigation System in the Command Area

The pressurized pipe micro irrigation system consists of drip and sprinkler irrigation systems. One of the demand management strategies introduced recently to control water consumption in Indian agriculture is pressurized pipe micro irrigation system. Under pressurized pipe micro irrigation system, unlike flood methods of irrigation, water is supplied at a required interval and quantity using pipe network, emitters and nozzles. Therefore, the conveyance and distribution losses are reduced completely which results in higher water use efficiency under micro-irrigation. Incidentally the micro-irrigation also effectively controls the problem of water logging and salinity in the command area of an irrigation project. In view of the above cited advantage of pressurized pipe micro irrigation system over flood irrigation method, the Government of India is promoting pressurized pipe micro irrigation system in the command area of major and medium irrigation projects. So it is proposed to provide pressurized pipe micro irrigation system in 100% area of command of this project. Accordingly, 90,000 ha CCA is proposed under pressurized pipe micro irrigation system. Main crops namely Wheat, Gram and Vegetables suggested in Rabi irrigation in the proposed command area in Shivpuri and Datia districts of MP. Cropping pattern has been adopted as per the suggestion of State Agricultural Department.

6.5 Summing Up of Command Area and Water Requirement from KBLP

The abstract of component wise break up of command area and water requirement from Lower Orr Project as finalized in Comprehensive Report is given in **Table-6.6.**

Table-6.6

Component Wise break up of Command Area and Water Requirement from Lower Orr Project

Component	CCA (Lakh ha)	Water Requirement (MCM)				Environ-mental Releases
		Irrigation Demand	Transmission losses	Domestic & Industrial Demand	Total	
Lower Orr Project (MP)	0.9	389.53	---	6*	395.53	44.9

* Only Domestic Demand

CHAPTER-VII

CONSTRUCTION PROGRAMME, MANPOWER DEPLOYMENT & PLANT PLANNING

7.0 Background

The present chapter deals with construction methodology, manpower deployment &equipment planning for construction of various projects components under KBLP. The construction planning of KBLP, Phase-I was done by CWC and the same has included in DPR of 2010. The construction planning of Lower Orr Dam was done by CWC and the same has included in DPR of 2017 and under techno-economic appraisal in CWC. The construction planning of Kotha Barrage and Bina Complex Multipurpose Project have been done by Government of MP and included in the Comprehensive Report.

7.1 Lower Orr Project

7.1.1 Construction Methodology and Equipment Planning

The construction methodology and equipment planning for construction of the main components of the Lower Orr Project has been discussed in the Chapter-VII of DPR of Lower Orr Project. The construction methodology for the structure has been described under the relevant sub sections of this chapter. The type and sizes of the equipment to be used have also been indicated while describing the construction methodology.

As mentioned in para 7.1.1, major components are proposed to be executed through contract. Therefore, provision has been limited only to general propose equipment & inspection vehicle equipment for departmental ownership.

As per the Director (National Project), CWC, New Delhi vide their letter No. 4/9/2012/Lower Orr/NP-II/1712-14 dated 29thNov., 2017 and the Directorate (CMO), CWC, New Delhi vide their letter No. 21/MP/24/2017/437 dated 28thNov., 2017, the cost under Q-Special T&P has been approved to Rs. 174.50 Lakh (Rs. 69.00 Lakh for Unit-I and Rs. 105.50 Lakh for Unit-II). The list and cost of proposed equipment under sub-head Q-Special T&P are reproduced in **Table-7.1**.

Table-7.1

Sub-Head Q-Special T&P

S.No.	Name of Equipment	Nos.	Unit Rate (Rs. in Lakh)	Total Amount (Rs. in Lakh)
	Unit-I			
1.	Ambulance	1	10.00	10.00
2.	Bus	1	16.00	16.00
3.	Car	2	6.50	13.0
4.	Jeep	5	6.00	30.00
	Total Unit-I			**69.00**
	Unit-II			
1.	Ambulance	1	10.00	10.00
2.	Bus	1	16.00	16.00
3.	Car	3	6.50	19.50
4.	Jeep	10	6.00	60.00
5.	Truck	5	16.00	80.00
	Total Unit-II			**105.50**
	Grand Total			**174.50**

7.1.2 Scheduled Working Hours

The scheduled working hours has been considered same as mentioned in para 7.3.3.1 and month completed is given same as in **Table-7.**2 of Daudhan Dam.

The shifts working of equipment is same considered as given in para 7.3.3.1 of Daudhan Dam.

7.1.3 Construction Period

A total period of 5 years has been considered for completion of the project. The infra-structural development, pre-construction surveys and investigations, preparation of design/ specifications and tender documents are proposed to be taken up during the first year. As the works are to be executed

through award of contract, it is planned to award contracts for all major works by the end of 1st year. However, some of the works like river diversion, spillway channel and main canal may have to be undertaken from the 4th quarter of the 1st year itself and therefore award of work for these works may be planned accordingly. The work on infrastructure facilities like project colonies, approach roads, workshop, haul roads, stores, office buildings etc. will also start in the 1st year itself. Some of these activities will continue for some time during the second year also. The construction of all civil structures is proposed to be completed by the end of 1stquarter of year 5.

A total construction period of 48 months have been earmarked for completion of carrier canal including rising mains, pump house, distributaries and other canal structures like aqueducts, super passages, siphons, pipe culverts, road bridges and railway crossings.

7.1.4 Implementation Mechanism

The implementation of Ken Left Bank Canal which totally lies in Madhya Pradesh and all sub-canals and distribution network for irrigation and other purposes within Madhya Pradesh will be done by Government of Madhya Pradesh.

The implementation of Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project will be carried out by Government of Madhya Pradesh.

7.1.5 Year Wise Allocation of Cost

The total cost of the project is worked out to be Rs. **2864.76** crore. The yearly phasing of the same is given in **Table-7.2** and construction schedule for Lower Orr Project is placed at **Annexure-7.1.** Expenditure during first year is mainly for payment of NPV of PTR/Forest Land, CAMPA Fund, Partly Land acquisition and Development of Infrastructure for Construction etc.

Table-7.2
Yearly Phasing of the Cost of Project

Year	Lower Orr Project
1	401.08
2	343.77
3	687.54
4	888.07
5	544.30
6	0.00
7	0.00
8	0.00
Total	**2864.76**

7.1.6 Benefits

(i) Estimated Cost of Increased Production

The crop wise yields in pre and post project scenarios have been assessed. Based on the increased production, cost of increased production has been assessed in **Chapter-X of this report.**

(ii) **Likely Socio-Economic Aspects**

Due to increase in food grain production, the socio-economic condition of farmers will improve in general. Agricultural labourers will get employment in the nearby area of all four projects. Situation of livestock will improve. Farmers will try to establish agro-based industries in the area.

CHAPTER-VIII

ENVIRONMENTAL IMPACT ASSESSMENT & ENVIRONMENTAL MANAGEMENT PLAN

8.0 General

The present chapter deals with Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) of various projects components under KBLP. The EIA studies of KBLP as proposed earlier were done by Agriculture Finance Corporation (AFC) Ltd., Hyderabad and included in DPR of April, 2010. The EIA studies were further modified in 2015 considering latest data and in the accordance with provisions of the "Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013" and incorporating suggestions/comments of MOEF&CC. The EIA study of Lower Orr Project has been done by WAPCOS Ltd., Gurgaon and the project is recommended for EC by MoEF&CC subjected to Stage-I forest clearance.

8.1 Need for Impact Assessment

KBLP involves impoundment of water by construction of a dam across river Ken at Daudhan for irrigation, drinking and hydro-electric purpose besides transfer of water from Ken river to Betwa river in u/s of Parichha Weir. Water, so transported to Betwa river is further proposed to be utilized in Upper Betwa basin on substitution basis in KBLP. As it is well known, any water resources development project may result in both positive and negative impacts on the environment. Such projects require a detailed study of various aspects for identifying positive and negative impacts that may occur in the area and also to formulate a meaningful and applicable management plan to mitigate these adverse environmental impacts, or if possible completely eliminate.

8.1.1 Project Background

Ken and Betwa rivers have their origin in MP and the rivers flow through MP and UP. No major irrigation projects were taken up in the Ken River basin in MP up to Gangau Weir to harness the waters to irrigate the backward and drought prone areas in the districts of Chhatarpur, Panna, Damoh and Tikamgarh of MP and Jhansi & Mahoba districts of UP.

A large population in Chhatarpur, Tikamgarh, Panna & Damoh districts of MP and Jhansi, Mahoba & Lalitpur districts of UP experienced acute shortage of drinking water. In this context, the proposed Ken-Betwa Link Project finds significance. As the proposed project has been found to be techno-economically viable, it is expected that the proposed project is likely to meet the requirements to the tune of 6,98,432 ha besides providing drinking water of 60 MCM in MP, 67 MCM in UP and generating 78 MW of power which is an added advantage of the project from Daudhan Dam. Besides, 2,06,000 ha from Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project in Shivpuri, Datia, Sagar and Vidisha districts of MP will be irrigated.

8.1.2 Project Justification

The National Water Policy (2002) emphasizes the need for interlinking of rivers in the country from water surplus areas to water short areas based on NPP after taking into account the requirement of the surplus areas/basins. This shall be a significant step forward to achieve the objective of equitable distribution and utilization of our limited water resources.

8.1.3 Project Description

The Comprehensive Report of KBLP comprises the following:

8.1.3.1 Head Works &Distribution System

8.1.3.1.1 Daudhan Dam Comprises

(i) An earthen embankment cum concrete dam across Ken River at Daudhan with FRL/MWL 288 m.

(ii) An Upper Level Tunnel about 170 m from the left bank of Daudhan dam having length of 1.9 km for conveying water to the link water carrier.

(iii) A Lower Level Tunnel about 100 m from the left bank of Daudhan dam having length of 1.1 km for conveying water to the Power House-II and from there to the Left Bank Canal of MP through a connecting channel of about 2.5 km.

(iv) Power House-I (2x30 MW) to the right of spillway at the toe of Daudhan dam.
(v) Power House-II (3X6 MW) at the outlet of Lower Level Tunnel.

8.1.3.1.2 Kotha Barrage Comprises

(i) A barrage across Betwa river at village Kotha, Tehsil Ganj Basoda, district Vidisha, Madhya Pradesh.
(ii) Pump Houses and Rising Mains

8.1.3.1.3 Bina Complex Multipurpose Project Comprises

(i) Four storage dams: Madia & Chakarpur on Bina River,, Semra Ghat Diversion on Dhasan River and Dehra Dam on Dehra Nalla.
(ii) Pump Houses, Rising Mains and Power Houses.

8.1.3.1.4 Lower Orr Project Comprises

(i) An earthen embankment cum concrete dam across Orr River near village Didauni, in district Shivpuri, Madhya Pradesh.
(ii) Pump Houses, Rising Mains and link water carrier.

8.1.3.1.5 Repair/strengthening/remodeling of Bariyarpur pick up weir, Parichha weir, Barwa Sagar Dam along with appurtenant structures and 7.1km long Barwa Nallah to carry water from Barwa Sagar to Betwa river upstream of existing Parichha weir.

8.1.3.1.6 Construction of two new barrages along with appurtenant structures d/s of existing Bariyarpur Pick up weir in the territory of UP.

8.1.3.1.7 Renovation of existing tanks and their connecting links in Mahoba district and carrier system for transfer of water from Ken Betwa link canal to tanks in order to enable UP to store the monsoon water to use during non-monsoon season.

8.1.3.2 Canal Pipe Line and Command Networks

8.1.3.2.1 Ken Basin

(i) A link canal (220.624 Km long including 1.9 m length of Upper Level Tunnel) with off take FSL 257 m to existing Barwa Sagar with FRL 219.20 m across Barwa Nallah, a tributary of Betwa River.

(ii) A bye pass channel from exit of Lower Level Tunnel to connect proposed Ken Left Bank Canal of MP.

(iii) Pumping system arrangements for lifting of water to Upper Level Tunnel to ensure the water supply in the Ken-Betwa link canal whenever reservoir depletes below the crown level of Upper Level Tunnel.

(iv) Developing pumping system, pipe distribution network and micro irrigation system by lifting water from Daudhan reservoir/initial reach of Link water carrier to serve a part of high level command (43,678 ha.) of Chhatarpur District of MP.

(v) A 90 km long proposed ken Left Banal Canal of MP and developing pumping system, pipe distribution network and micro irrigation system for ken Left Bank Canal to serve 1,39,848 ha. CCA in Chhatarpur District.

(vi) From existing Bariyarpur LBC 38,890 ha. CCA will be covered by existing open canal network in Chhatarpur District of MP.

(vii) Developing pumping system, pipe distribution network and micro irrigation system for 90,101 ha. CCA by lifting water from Daudhan reservoir, out of which 70,000 ha. CCA will be in Panna District and 20,101 ha. CCA will be in Damoh District of MP.

(viii) Developing pumping system, pipe distribution network and micro irrigation system from Ken-Betwa link canal to serve left out area of 42,096 ha. of high level command & 96,751 ha. Enroute command of MP and 17,488 ha. of enroute command of UP.

(ix) Stabilization of irrigation in 1,92,479 ha. in Banda district in UP under existing Ken command by repair/strengthening of existing system. Enhancing command area of Bariyarpur Right Bank Canal (Ken Canal) system by utilizing pressurized pipe micro irrigation system.

8.1.3.2.2 Betwa Basin

(i) Kotha Barrage: - Pumping system, pipe distribution network and micro irrigation system for 20,000 ha. CCA of MP.

(ii) Bina Complex Multipurpose Project: - Pumping system, pipe distribution network and micro irrigation system for 96,000 ha. CCA of MP.

(iii) Lower Orr Project:-Pumping system, pipe distribution network and micro irrigation system for 90,000 ha. CCA of MP.

(iv) Development of existing command of 37,564 ha. in Mahoba district in UP with pressurized pipe micro irrigation system.

8.1.4 Study Area of the Project

The study area considered for the Comprehensive EIA studies and preparation of EMP comprise the following:

- 1 km on either side of the canal
- 10 km radius around the project area from periphery of the project site
- submergence area under the proposed reservoir
- Catchment area of dam/reservoir.
- command area on the d/s side of reservoir and en-route link canal
- areas of backwater influence on u/s side of dam

The EIA studies for newly proposed High level command and additional enroute command have not been carried out at this stage.

8.2 Lower Orr Project

The study for Lower Orr Project has been carried out by M/s WAPCOS, Ltd., Gurgaon (Haryana). The detailed environmental impact assessment and environmental management plan for project are briefly described in the Chapter-VIII of DPR of Lower Orr Project (2017).

8.2.1 Legal Status of Project

The separate DPR of Lower Orr Project is prepared by NWDA and same is under appraisal in CWC. The present legal status of the DPR is furnished in **Table-8.1**.

Table-8.1
Legal Status of Project

S. No.	Project/Activity	Present Status
1.	CCA as Proposed by MP	90,000 ha
2.	Techno-economic Clearance	Under appraisal in CWC.
3.	Environmental Clearance	EAC has recommended the project for EC on 02.05.2016 with certain conditions.
4.	Forest Land Diversion Clearance	Forest Advisory Committee (FAC) of MoEF&CC has also considered the project in its meeting held on 30th March, 2017 and recommended the project
5.	MoTA Clearance	Prescribed application form submitted to MoTA on 05.12.2017 for according clearance.

8.2.2 Environmental Monitoring Programme

An environmental monitoring programme would be undertaken during construction and operation phase of the project. The details of environmental monitoring programme are given in **Table-8.18 & 8.19** of Chapter-VIII of DPR of Lower Orr Project (2017).

8.3.3 Environmental Management Plan (EMP) Cost

The financial provision required for implementation of EMP has been estimated to be Rs. 181.06 crore. The details are given in **Table-8.2.** The cost outlined in this section is exclusion of the cost required for implementation of R&R plan.

Table-8.2
Environmental Management Plan Cost

S. No.	Item	Cost (Rs. in lakh)
1.	Fisheries management	809
2.	Environmental management in labour camp	1080
3.	Public health delivery system	519
4.	Restoration and landscaping of construction sites	466
5.	Greenbelt development	99
6.	Air, water and noise pollution control measures	97
7.	Energy conservation measures	50
8.	Local Area Development Plan	498
9.	Catchment area treatment plan	1079.32
10.	Disaster management plan	300
11.	Environmental monitoring during construction phase	130
12.	Live hood plan for PAFs	1690.60
13.	Monitoring & evaluation aspects for implementation of R&R plan	60
14	Purchase of instruments and equipment	10
	Sub-Total for EMP	**6888.52**
15	NPV for forest land under submergence of dam	6767.81
16	Compensatory afforestation and bio-diversity conservation	4450.00
	Sub-Total for NPV	**12217.81**
	Grand Total	**18106.33**

Note: Cost excludes budget for implementation of R & R Plan.

CHAPTER –IX
SOCIO-ECONOMIC ASPECTS AND R & R

9.0 Background

The present chapter deals with Socio-Economic Aspects and R & R studies of various projects components under KBLP. The studies of KBLP were done by M/s Agriculture Finance Corporation (AFC) Ltd., Hyderabad and included in DPR of 2010 and also techno-economically cleared by CWC in 2017. Environment clearance and 1st Stage forest clearances for the diversion of 6017 ha of forest land have been accorded by MoEF&CC vide its letters No.J-12011/20/2013-IA-I dated 25.08.2017 and letter No. F.No.8-49/2016-FC dated 25/05/2017 and same are appended as **Annexures-9.1 and 9.2** respectively.

The Socio-Economic Aspects and R & R studies of Lower Orr Dam have been done by WAPCOS, Gurgaon and EAC recommended the project subjected to Stage –I clearance of forest. Environment and 1st Stage clearances for the diversion of 1024.44 ha of forest land in respect of Ken-Betwa link have been accorded by MoEF&CC vide its letters No.J-12011/31/2014-IA-I dated 22.02.2017 and letter No. F.No.8-13/2015-FC dated 27/07/2016 and same are appended as **Annexures-9.3 and 9.4** respectively.

9.1 Lower Orr Dam and Canals

9.1.1 Socio-economic aspects

The total catchment area of Orr River up to Lower Orr Dam site is 1843 sq. km. The submergence area of the proposed project is spread over Ashok Nagar & Shivpuri districts of MP. The proposed construction of Lower Orr Dam will involve full submergence of 7 villages and partial submergence of 5 villages. The agriculture land of the people belonging in 5 villages will be adversely affected.

Environmental Impact Assessment & Socio-economic studies of the project have been carried out for the project command area with CCA of 45047 ha. Now, as per suggestion of Govt. of MP, CCA have been increased from

45047 ha to 90000 ha. Therefore, Environmental Impact Assessment & Socio-economic study for additional command area of about 45000 ha is required to be carried out.

9.1.2 Submergence Area

It has been estimated that a total submergence area of 2723.70 ha spread over 12 villages would be adversely affected once the dam is constructed. Out of which 1755.47 ha is revenue land spread over 12 villages. It is significant to note that no railway lines, telephone lines, main power lines, mineral deposits, historical and archaeological monuments are coming under submergence.

9.1.2.1 Category wise land coming under submergence

The category wise land coming under submergence due to constriction of Lower Orr Dam and canals are shown in **Table- 9.1**.

Table - 9.1

S. No.	Particulars	District	Area (ha)
1	Private Land	Shivpuri & Ashok Nagar	1429.51
2	Government Land	Shivpuri & Ashok Nagar	325.95
3	Forest Land	Shivpuri & Ashok Nagar	968.24
	Sub-total		**2723.70**
4	Canals	Shivpuri	300.00
	Total		**3023.70**

9.1.3 Project Affected Villages

It has been estimated that about 944 families will be affected in these villages. A small population of peripheral villages would also be affected as lands of the people belonging of these villages will also be adversely affected. The total population of these 12 villages shall be 2945. The percent of SC and ST population of the area at present is 6.84% and 31.36% respectively.No. of

villages affected in each Tehsil of Ashok Nagar and Shivpuri districts are given below:

Sl. No.	Tehsil	District	No. of Villages affected
1.	Chanderi	Ashok Nagar	6 (Fully affected)
2.	Khaniyadhana	Shivpuri	1 (Fully affected)
3.	Khaniyadhana	Shivpuri	5 (Partially affected)
	Total		**12**

9.1.3.1 Details of houses and other properties affected by submergence

Details of property coming under submergence due to Lower Orr Reservoir are given in **Table-9.2**.

Table-9.2

Property Coming under Submergence

S. No.	Details	Unit	Quantity
1	2	3	4
1	Private houses Kachcha (Plinth area of 20 sqm.)	Nos.	449
2	Private houses Pucca (Plinth area of 20 sqm.)	Nos.	209
3	Semi permanent	Nos.	211
4	Open well (Private)	Nos.	212
5	Tube well (Private)	Nos.	7
6	Private Trees :- (a) Fruit bearing (b) Non – Fruit bearing	 Nos. Nos.	 2557 3450

9.1.4 Inventory of Families & Demographic Features

A preliminary survey has been carried out by the department regarding families affected by submergence, details of which are summarized in **Table 9.3**.

Table – 9.3
Families Affected Due to Submergence

S. No.	Description	No. of families
1.	No. of families whose only houses are affected	462
2.	No. of families whose land and houses are affected	408
3.	No. of families whose only land is affected	74
4.	Total No. of affected families	944

Although total number of PAFs is 944, the total number of affected houses is 870. Therefore, at least as many plots would have to be developed in the proposed rehabilitation and resettlement sites. The rehabilitation and resettlement sites will be developed in the nearby vicinity of project area. During field survey information was also collected to assess the number of major sons and the vulnerable persons or claimants of the Annuity Plan and the position is given in **Table 9.4**.

Table – 9.4
Vulnerable Persons or Claimants of the Annuity Plan

No. of families affected	No. of adult sons	No. of unmarried daughters
944	294	47

Thus, all arrangements have to be made for providing residential plots to near about 1285 Project Affected Families (PAFs) in the proposed rehabilitation and resettlement sites to be developed in the adjoining areas. Based on the preliminary survey the following demographic features been observed:

Category	No. of Families
Agriculture & Non-Agriculture labours	939
Govt. jobs/Artisans	5
Total	**944**

9.1.5 Categories of PAF's for Rehabilitation

9.1.5.1 The PAFs would be classified under different categories as detailed in **Table – 9.5.**

Table – 9.5
Categories details of PAFs for Rehabilitation

S. No.	Description	No. of families need to be resettled
1.	Total No. of families affected	944
2.	Families living at far off places (out of village)	0
3.	Families whose "only houses are being submerged {excluding (2) above} – **i.** Land owners agriculturist. **ii.** Landless (other occupation).	 786 158
4.	Families whose only land is being submerged	74
5.	Families whose land (fully or partially) and huts both are coming under submergence	408
6.	Adult persons who are treated as separate family but they are with no house and landless. (Transfer of name not done).	341

9.1.5.2 Cast Profile of Respondents

The cast profile of respondents is given in **Table -9.6** below.

Table-9.6

Name of village	**Caste**				**Total**
Lidhora	22	13	20	39	94
Naroni	0	6	12	21	39
Pagra	2	43	23	22	90
Pahadpur	1	5	4	18	28
Kirraya	3	7	9	6	25
Khyawda	1	37	21	46	105
Bithala	0	22	0	21	43
Total	**29**	**133**	**89**	**173**	**424**

9.1.6 Proposals for Rehabilitation and Resettlement

The basic policy is to plan and execute Resettlement and Rehabilitation (R&R) operations in such a way that PAFs do not develop a feeling of dependency on the governmental agencies, and that they generate within themselves the capabilities, and confidence to take care of their own problems and affairs. The WRD would invariably adopt an integrated approach towards their problems and would synchronize the requirements of project development and those of resettlement of the PAFs. It will seek the co-operation of all related departments of the State Government. The policy parameters have been adopted from the provisions of "Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013" of Govt. of India. The majority of the PAFs belonging to OBC and scheduled tribe are willing to resettle wherever the Government makes arrangements for them, preferably in the vicinity of their present villages. Plan of Resettlement has already been discussed in the DPR of Lower Orr Project-2017.

9.1.7 Plan of Resettlement

In the present scenario, pressurize irrigation system is proposed in the entire command of project. Hence, area of land acquisition for canal reduced to 283.50 ha from of 1006 ha. Therefore, total area of 3007.20 ha (2723.70 ha + 283.50 ha) is proposed to be acquired for land acquisition for various developments under Resettlement Plan. The actual spot in the proposed host villages shall be decided by task force comprising representatives of PAFs and officers of WRD involving district administration. Each outsets family losing his homestead will be allotted a residential plot of maximum 250 sqm at the proposed rehabilitation and resettlement site. All the civic amenities as provided for in the Rehabilitation Policy 2013 of Govt. of India shall be developed at these sites for the benefit of the outsets families, barring such facilities as already exist in the nearby host villages provided they can cater to the needs of the out seen families without adversely affecting usage thereof by the host villagers. The same are mentioned below:-

1. Drinking Water Well / Tube well with trough
2. Link and approach roads and gutters.
3. Electricity.
4. Panchayat Bhawan cum Community Hall.
5. Play ground / Children Park.
6. Religious place of worship.
7. Seed store.
8. Tree platform.
9. Cremation and burial ground.
10. Any other facility if existing in the affected village which is coming under submergence.

9.1.8 Cost Estimates

Detailed cost estimates have been prepared for land acquisition and rehabilitation and resettlement including infra-structural facilities for the oustees. These are based on Environmental Management and R&R Plan prepared by the WAPCOS. The details are given in **Table 9.7**.

Table -9.7

Cost of Land Acquisition and Rehabilitation& Resettlement

Rs. in lakhs

Sl.No	Description	Amount
1	Land acquisition	23751
2	Rehabilitation and Resettlement	9652
3	NPV	6768
4	Compensatory afforestation plan	4555
	Total	**44726**

The estimate of land cost is based on the rates of District Registrar Chanderi of district Ashok Nagar and Khaniyadhana of district Shivpuri, 2017. The present rates provided in the estimate are as under:

Location	Total area acquired	Category of land	Estimated cost of land (Rs. / ha)
Submergence	1425.41 ha	Class B	4.40 lakh/ha for culturable and 3.0 lakh / ha for unculturable land

As per the provision in the R&R Act, 2013, the above rate is to be multiplied by factor two for rural area and Solatium charges has been considered 100%. The rate for preparation of Rehabilitation and Resettlement plan have adopted as mentioned in the **Table -9.2 & 9.3** under Para 9.1.7.1 and as per the provision in the "Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013".

CHAPTER-X

COST ESTIMATE, BENEFIT COST RATIO AND FINANCIAL ASPECTS

10.0 Background

The present chapter deals with cost estimate, benefit cost ratio and financial aspects of various project components under KBLP. The cost estimate and benefit cost ratio of Daudhan Dam and its canal system was completed by NWDA and included in DPR of 2010 and already techno-economically approved by Central Water Commission in 2016. The cost estimate of headwork of Lower Orr Dam was prepared by NWDA, while, the cost estimate of carrier canal, gravity pipeline and rising mains have been prepared by the WRD, Govt. of MP and the same are adopted in the estimate. The cost estimate of Kotha Barrage and Bina Complex Multipurpose Project was completed by WRD, Govt. of MP and the same are adopted in the estimate by escalating at price level 2017-18. All these three projects are under techno-economic appraisal with CWC. The component wise details of cost estimate are covered in this chapter.

10.1 KBLP

The KBLP envisages construction of a dam at Daudhan on Ken river, Ken-Betwa link canal, two tunnels, two power houses, Ken LBC, Panna & Hatta Lift Irrigation Schemes and their canal networks, Lower Orr Dam at Didauni on Orr river at the border of Shivpuri and Ashok Nagar districts, Kotha Barrage at Kotha village on Betwa river in Vidisha district, Bina Complex Multipurpose Project consisting of four projects (Semraghat diversion dam on Dhasan river, Dehra Dam on Dehra nala, Madia and Chakarpur dam on Bina river) in Sagar district and their canal networks, repair /strengthening of Bariyarpur Pick up Weir on Ken river, Parichha Weir on Betwa river, Barwa Sagar Dam and training works of 7.1 km long Barwa Nalla alongwith developments in command areas of the project.

The Working Group Report of erstwhile Ministry of Irrigation, Govt. of India had issued broad guidelines for preparation of Detailed Project Report for major irrigation and multipurpose projects in 1980. These are based on the IS: 4877-1968 which have subsequently been

updated with explanatory notes for each unit / minor head / sub-head. For preparing the cost estimates of KBLP, these guidelines have been followed.

The cost estimates have been worked out by calculating the quantities of different items of the works involved for the execution of the project components. Quantity of Daudhan Dam, Ken-Betwa link canal & Ken LBC under main project was computed by NWDA on the basis of design carried out by CWC, for which, DPR of KBLP, Phase-I was already techno-economically appraised by CWC during 2016. Parameters of Daudhan Dam have been kept intact in the Comprehensive Report. However, the parameters of Ken-Betwa link canal & Ken LBC has been changed according to the new planning for Pressurised pipe micro irrigation system and inclusion of new/additional command area of MP & UP. The quantity and cost of these two canal system and additional Panna & Hatta LIS have been provided by Govt. of MP & the same are incorporated in the report. However, quantity and costing of main canal were carried out by NWDA. The cost estimate of Lower Orr Dam was prepared by NWDA with appropriate cost escalation. The cost estimate of Kotha Barrage and Bina Complex Multipurpose Project were made available by Government of MP. The cost estimate of these project after escalation by considering the Unified Schedule of Rates (USOR – 2017) of Govt. of MP are adopted in the Comprehensive Report.

The rates for some principal items of various works have been adopted from USOR - 2017 of Govt. of MP. As per Government of MP letter dated 23.07.2015, the escalation on the rates of various items can be escalated by overall 18% over the USOR - 2009 of MP to arrive rate at price level 2015-16 for working out the cost estimate of KBLP, phase-I which is approved by CWC. Accordingly, rate of various items which are not available in USOR – 2017 are considered by escalating overall 18% over the 2008-09 SOR rate and further escalated by 6% per year to arrive at price level 2017-18. Further it is revised at 2020-21 price level.

10.2 Classification of units

The cost estimate of the project has been grouped into the following units and shown in **Table 10.1.**

Table-10.1

General Abstract of Cost Estimate of the Lower orr project

(Price level 2020-21)

(Rs. in Crore)

Sl.No.	Component	Unit-I	Unit-II	Unit-III	Total
		Head works	Canals	Power	
I	**Lower Orr Project & Canals**	1046.17	1707.55	111.05	**2864.76**

Thus, the total cost of the link project works out to **Rs. 2864.76 crore at price level 2020-21**. The general abstract of cost of the project is given at **Annexure: 10.1**. Relevant annexures pertaining to this chapter are placed in Volume-II: Cost Estimate. The details under various heads are described in the following paragraphs.

S.No.		Particulars	Amount (Rs. in Lakhs) 2020-21		
		Sub-head	Unit-I	Unit-II	Unit-III
A		**DIRECT CHARGES:**			
I		WORKS:			
	A	Preliminary	855.59	171.47	
	B	Land	27026.53	6375.85	
		(i) Land acquisition	17375.26	6375.85	
		(ii) NPV,CA Plan			
		(iii) Rehabilitation & Resettlement	9651.27		
		(iv) Lump sum amount proposed for Land aquisitution and R&R for proposed villages to be relocated to acquire 6017 ha revenue land.			
	C	Works	47931.36	63140.63	
	D	Regulators		36.14	
	E	Falls		0.00	
	F	Cross Drainage Structures		1889.51	
	G	Bridges		455.81	
	H	Escapes		96.80	
	K	Buildings	909.36	0.00	
		Temporary Buildings	696.36		
		Permanent Buildings	213.00		
		Hostel Accommodation (Temp.)			

	J	Civil Works		0.00	
	L	Earth work		4736.69	
	M	Plantation	54.73	94.68	
	N	Reservoir & DC Tanks		156.53	
	O	Miscellaneous	201.50	62.00	
	P	Maintenance	479.31	1550.08	
	Q	Special T&P	69.00	105.50	
	R	Communication	565.00	800.00	
	S	Power plant (Rs. 6Cr per MW)		598.14	10070
	T	Water Supply			
	U	Distributary & Minors		74799.90	
	V	Water Courses		0.00	
	X	Environment & Ecology	18211.40	0.00	
	Y	Losses on Stock & Unforeseen @ 0.25% on all heads excluding A, B,X & Q	125.35	371.04	25.18
		Total I-Works	**96429.12**	**155440.78**	**10095.18**
II		Establishment & Pensionary Charges @ 8%-10% of I-Works less B - Land	**5552.21**	**11925.19**	**807.61**
III		Ordinary T&P @ 1% of I - Works	**964.29**	**1554.41**	**100.95**
IV		**Receipts & Recoveries**			
	(a)	Recoveries on account of resale value of Q - Special T&P 25%	-17.25	-26.375	0
	(b)	Recoveries by resale/transfer of Generator sets, electric lines, telephone lines and other accessories under Capital Cost of O-Miscellaneous @20%	-40.30	-12.40	0.00
	(c)	Recoveries on account of resale value of Temporary Buildings @ 15%	-104.45	0.00	0.00
		Total Direct Charges	**102783.62**	**168881.61**	**11003.74**
B		**INDIRECT CHARGES**			
	(a)	Cost of abatement of Land Revenue on the area occupied by the Project @ 5% of (Rs 32399.20/68212.70	868.76	318.79	0.00
	(b)	Audit & Account Charges @ 1% of I - Works	964.29	1554.41	100.95
		Total Indirect Charges	**1833.05**	**1873.20**	**100.95**
		NET COST	**104616.67**	**170754.81**	**11104.69**
		Total (In Crores)		**2864.76**	

10.2.1 Unit – I: Head Works

Unit-I Head works mainly includes cost of the following structures of the project:

- Lower Orr Dam Project including earth dam, non-over flow section with irrigation sluices, over flow section with spillway & energy dissipation arrangements.

Cost of I-Works for each head works are given in **Table 10.2**

Table 10.2

(Rs. in Lakhs)

Head works	**Lower Orr Project**
Total I-Works	96429.32
Net Cost	104616.67
Total Cost	104616.67

The total cost of Unit-I: Head Works is estimated to be Rs. **1046.17** crore. Details are given in **Annexure-10.1**. The sub-head wise details are given below.

10.2.1.1 A - Direct Charges

In general, direct charges cover minor heads like I-Works, II-Establishment, III- Tools & Plants, IV- Suspense and V- Receipts & Recoveries.

I-Works

A. Preliminary

Provision under this sub-head has been made to cover the actual expenditure incurred on detailed survey & investigation works mentioned below for preparation of the project.

- Topographical surveys & investigations
- Hydrological & meteorological surveys
- Geological & Geotechnical surveys

- Construction material survey
- Seismic studies
- Construction of access roads to facilitate site investigations
- Charges for consultancy works for various studies and
- Preparation of Comprehensive Report

However, for detailed survey & investigations for establishing the final locations of different project components at pre-construction stage, a lump sum provision of 2 % of I-Works has been considered under this sub-head for Lower Orr Dam for which DPR was prepared by NWDA. The details are given in **Annexures- 10.1.2.1.** The cost component of Unit-I of Preliminaries are given in **Table 10.2.1**

Table 10.2.1
A. Preliminary

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr Dam	855.59

B. Land

Under this sub-head, provision for acquisition of land for construction of the project, colonies, offices, stores, stock yards, working area and approach roads etc. , compensation for houses, solatium charges, standing crops and other immovable properties, cost of resettlement colonies for displaced persons, economic rehabilitation of PAFs, training of R&R staff and PAFs etc. have been considered. The details are given in **Annexures- 10.1.2.2.** The cost component of Unit-I of B. Land is given in **Table 10.2.2**.

Table 10.2.2
B. Land

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr Dam	27026.53

C. Works

This sub head includes cost of construction of following components:

- Earth dam, cofferdam, concrete dam (Over Flow & Non Over Flow), intake structure for dam.
- The quantities and the cost of the components have been evaluated as per the design drawings supplied by the Specialized Directorates of CWC, New Delhi Lower Orr Dam. Necessary provisions have been made for Spillway radial gates with embedded parts, stop logs and hoisting arrangements etc. The details of works under this sub-head are given in **Annexures- 10.1.2.3.** The cost component of Unit-I of C. Works is given in **Table 10.2.3**.

Table 10.2.3

C. Works

Sl. No.	Component	Cost (Rs. in lakh)
I	Lower Orr Dam	47931.36

K. Buildings

Provision has been made under this sub-head for construction of temporary & permanent buildings for both residential & non-residential buildings and hostel accommodation for various categories of staff, offices, inspection bungalow, circuit house, workshops, stores, sheds as well as other service buildings like hospital, schools, police station, post office & welfare center etc. The details under this sub-head are given in **Annexures- 10.1.2.4.** The cost component of Unit-I of K. Buildings is given in **Table 10.2.4**.

Table 10.2.4

K. Buildings

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr Dam	909.36

M. Plantation

Under this sub-head, cost of proposed plantation in the colony, parks in the d/s of dams and along the approach roads to the dam sites have been considered. The details under this sub-head are given in **Annexures- 10.1.2.5.** The cost component of Unit-I of M. Plantation is given in **Table 10.2.5**.

Table 10.2.5
M. Plantation

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr Dam	54.73

O. Miscellaneous

Under this sub head provision has been made to cover the cost of the following works

- Capital cost of electrification, water supply purification and distribution system, sewage disposal, medical equipment, firefighting equipment, furniture and crockeries for inspection bungalow and circuit houses, initial camp equipment for hospital, primary & secondary schools, community center etc.
- R & M of above equipment/infrastructural facilities etc.
- R & M of inspection vehicles, market complex, police station, post office, pump house, telephone lines etc.

Provision has also been made for other miscellaneous items such as inaugural foundation laying ceremony, compensation to work men, visit of VIP dignitaries, anti-malaria measures, security arrangements for dam sites, flood lighting, model studies, data processing machines etc. The details are given in **Annexures- 10.1.2.6.** The cost component of Unit-I of O. Miscellaneous is given in **Table 10.2.6.**

Table 10.2.6
O. Miscellaneous

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr Dam	201.50

P. Maintenance

Under this sub-head provision has been made to cover the cost of maintenance of all works during the construction. A provision of 1% on cost of C-Works (Concrete Dam & Earthen Dam), Buildings and maintenance of roads has been considered For Lower Orr Dam, cost of P-Maintenance has been worked out in the DPRs prepared by Govt. of MP & Considered in the Estimate. The details are given in **Annexures-10.1.2.7.** The cost component of Unit-I of P. Maintenance is given in **Table 10.2.7**.

Table 10.2.7
P. Maintenance

Sl. No.	Component	Rs in **lakh**
I	Lower Orr Dam	479.31

Q. Special Tools & Plants

Under this sub-head provision has been made for the cost of inspection/ transportation equipment has been added to the above cost to arrive the total cost chargeable under this sub-head. The recoveries on account of resale value of Q-Spl. T&P are considered as 75% to 20% cost of inspection/transport equipment which works out to Rs 17.25 lakh. Detail of the equipment as suggested by CMO, CWC, New Delhi and the cost that to be chargeable to the project works is given in **Annexures-10.1.2.8.** The cost component of Unit-I of Q. Special Tools & plants is given in **Table 10.2.8.**

Table 10.2.8
Q. Special Tools & plants

Sl. No.	Component	Cost (Rs. in lakh)
I	Lower Orr Dam	69.00

R. Communication

Necessary provision has been made under this sub-head to cover the cost of widening of existing roads in the near vicinity of the project area, formation of approach roads to project area from the existing roads, W.B.M road from quarry sites to dam/barrage sites etc. The details of length of roads and costs are given in **Annexures- 10.1.2.9.** The cost component of Unit-I of R. Communication is given in **Table 10.2.9**.

Table 10.2.9
R. Communication

Sl. No.	Component	Cost (Rs. in lakh)
I	Lower Orr Dam	565.00

X. Environment and Ecology

This sub-head includes provision for extensive management measures to sustain environment and ecology such as catchment areas treatment, forestry & salve postural management/ afforestation/ deforestation, soil erosion control and water conservation measures, reservoirs rim treatment/green belt development, treatment of agricultural lands, compensatory afforestation, land management plan (stabilization of muck disposal management), restoration of quarry site, tourism development plan, provision for free fuel to department engaged labourers, bio-diversity management plan, restoration and land scrapping of project sites, fisheries development plan, ground water management plan, public health management, Environmental Monitoring Programme (EMP), dam break analysis and Disaster Management Plan. The details are given in **Annexure- 10.1.2.10.** The cost component of Unit-I of X. Environment and Ecology is given in **Table 10.2.10.**

Table 10.2.10
X. Environment and Ecology

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr Dam	18211.40

Y. Losses on Stock and Unforeseen Items

Provision has been made for losses on stock and unforeseen @ 0.25% on all sub-heads under I- works excluding sub – heads A-Preliminary, B- Land & Q-Spl. T&P & X-Environmental & Ecology for Lower Orr Project. The details are furnished in **Annexure 10.1.2**. The cost component of Unit-I of X. Losses on stock and unforeseen items is given in **Table 10.2.11.**

Table 10.2.11
Y. Losses on Stock and Unforeseen Items

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr Dam	125.35

II-Establishment

The project is planned to be completed in a period of 8 years. Provision has been made @ 8% of I-Works excluding B- Land towards establishment & pensioner charges. The details are furnished in **Annexure 10.1**. The cost component of Unit-I of II-Establishment is given in **Table 10.2.12.**

Table 10.2.12
II-Establishment

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr Dam	5552.21

III-Ordinary Tools & Plant

Provision has been made under this head for ordinary Tools & Plant @ 1% of I-Works. This provision is distinct from the Q-Spl. T&P and is meant to cover the cost of survey instruments, camp equipment and other small tools & plant. The details are furnished in **Annexure 10.1**. The cost component of Unit-I of III-Ordinary Tools & Plant is given in **Table 10.2.13.**

Table 10.2.13
III-Ordinary Tools & Plant

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr Dam	964.29

IV- Receipt & Recoveries

Under these head, estimated recoveries by way of resale or transfer of temporary buildings, special T&P and by resale or transfer of generator sets, electrical lines, telephone lines and other accessories are accounted for and provision has been made accordingly. The details are furnished in **Annexure 10.1**. The cost component of Unit-I of IV- Receipt & Recoveries is given in **Table 10.2.14.**

Table 10.2.14
IV- Receipt & Recoveries

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr Dam	162.00

10.2.1.2 B - Indirect Charges

Provisions for abatement of land revenue and audit & account charges are covered under 'Indirect Charges' at the following rates

- Abatement of land revenue - 5% of cost of land
- Audit and account charges - 1% of I-Works

The details are furnished in **Annexure 10.1**. The cost component of Unit-I of B - Indirect Charges is given in **Table 10.2.15.**

Table 10.2.15
B - Indirect Charges

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr Dam	1833.05

10.2.2 Unit – II: Canals

Unit-II Canal system of Lower Orr covers the cost of Lower Orr canal Gravity main with Pipe line and Rising mains.

Cost of I-Works for Lower Orr Canal system is given in **Table 10.3**.

Table 10.3
Cost of I-Works for each Canal system

(Rs. in Lakh)

Unit –II Canal system	**Lower Orr Canal**
Total I-Works	155440.78
Net Cost	170754.81

The total cost of Unit-II: Canal system is estimated to be Rs. 1707.55 crore at 2020-21 price level. Details are given in **Annexure- 10.1**. The sub-head wise details are discussed in the following paragraphs.

10.2.2.1 A - Direct Charges

I-Works

A. Preliminary

Provision under this sub-head has been made to cover the actual expenditure incurred on detailed survey & investigation works mentioned below for preparation of Comprehensive Report of the project.

- Topographical surveys & investigations
- Geological & Geotechnical surveys
- Construction material survey
- Vehicle charges for inspecting officers for site investigations
- Survey & Camp equipment
- Charges for consultation for various studies
- Actual expenditure on establishment and
- Preparation of Comprehensive Report

However, for detailed survey & investigations for establishing the final locations of different project components at pre-construction stage, a lump sum provision of 2% of I-Works has been considered under this sub-head for Lower Orr Project for which DPR was prepared by NWDA. The details are given in **Annexure - 10.2.4.** The cost component of Unit-II of A. Preliminary is given in **Table 10.3.1.**

Table – 10.3.1
A. Preliminary

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr canal	171.47

B. Land

Under this sub-head, provision for acquisition of land for construction of canals and approach roads, colonies, canal structures etc. , solatium charges, standing crops and other immovable properties, rent for use of land prior to acquisition, economic rehabilitation measures etc. have been considered. The details are given in **Annexure 10.2.4.** The cost component of Unit-II of B. Land is given in **Table 10.3.2.**

Table – 10.3.2

B. Land

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr canal	6375.85

C. Works

Under this sub-head the cost of Lower orr canal and their intake structures, have been considered. The quantities and the cost of the components have been worked out as per the designed drawings made available by the Central Water Commission, New Delhi. The details of works under this sub-head are given in **Annexure 10.2.4.** The cost component of Unit-II of C. Works is given in **Table 10.3.3.**

Table – 10.3.3

C. Works

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr canal	63140.63

D. Regulators

Under this sub-head, provision for head and cross regulators at intake / outfall of the canals and at appropriate locations where branch canals take off from main canal, Provision for cross regulators for branch canals has also been made. Estimate of a typical cross regulator is prepared based on the detailed drawings made available by CWC, New Delhi and the cost of other regulators are arrived based on the estimated cost of the typical regulator proportionate to discharges. The details are given in **Annexure 10.2.4.** The cost component of Unit-II of D. Regulators is given in **Table 10.3.4.**

Table – 10.3.4
D. Regulators

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr canal	36.14

E. Falls

No falls has been proposed along the lower Orr canal. The details are given in **Annexure- 10.2.4.** The cost component of Unit-II of E. Falls is given in **Table 10.3.5.**

Table – 10.3.5
E. Falls

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr canal	0.00

F. Cross Drainage Structures

The cross drainage works proposed across the main canals and branch canals are aqueducts, syphon aqueducts, canal syphons, super passages and culverts to facilitate the crossing of rivers/streams. Certain typical structures are estimated based on the designed drawings. The costs of the structures which are not actually priced are deduced from the cost curves. The details are given in **Annexure- 10.2.4.** The cost component of Unit-II of F. Cross drainage structures is given in **Table 10.3.6.**

Table – 10.3.6
F. Cross Drainage Structures

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr canal	1889.51

G. Bridges

The bridges (major & minor) are required to be constructed on the lower Orr canal of the project to facilitate crossing of various roads. Necessary Provision has been made for these bridges. The estimate is prepared based on the cost curves. The details are given in **Annexure-10.2.4.** The cost component of Unit-II of G. Bridges is given in **Table 10.3.7**

Table – 10.3.7

G. Bridges

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr canal	455.81

H. Escapes

Under this sub-head provision has been made for canal escapes at suitable locations where drainage facilities exist to take care of the discharge in the eventuality of canal breaches. The details are given in **Annexure- 10.2.4.** The cost component of Unit-II of H. Escapes is given in **Table 10.3.8.**

Table – 10.3.8

H. Escapes

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr canal	96.80

J. Power plant civil works

Under this sub head, provision has been made towards civil engineering structures. The details are given in **Annexure- 10.2.4.** The cost component of Unit-II of J Power plant civil works is given in **Table 10.3.9**

Table – 10.3.9

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr canal	0.00

K. Buildings

No Buildings has been proposed for the lower Orr canal. The details under this sub-head are given in **Annexure- 10.2.4.** The cost component of Unit-II of K. Buildings is given in **Table 10.3.10.**

Table – 10.3.10
K. Buildings

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr canal	0.00

L. Earthwork & Lining

The quantity of excavated earth motional from the project to locations based on the type of soils and the quantity of earthwork required for embankment from borrow areas are worked out separately. The detailed estimates are prepared considering the cross sections taken at 50 m interval along the canals and detailed drawings made available by CWC, New Delhi at various sections. Provision is also made for branch canals proportionate to the discharges of the main canal. Lining is provided for both main and branch canals at bed and side slopes in the entire length of canals as per the drawings. Provision is also made in the estimates for pressure relief and drainage arrangements under lining, expansion joints etc. The details under this sub-head are given in **Annexure- 10.2.4.** The cost component of Unit-II of L. Earthwork & Lining is given in **Table 10.3.11**

Table – 10.3.11

L. Earthwork & Lining

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr canal	4736.69

M. Plantation

Under this sub-head, cost of plantation in the colony areas and along the main canals & branch canals on both sides has been provided. The details are given in **Annexure - 10.2.4.** The cost component of Unit-II of M. Plantation is given in **Table 10.3.12.**

Table – 10.3.12

M. Plantation

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr canal	94.68

N. Reservoir & Tanks

Under this sub-head, cost of proposed reservoir & tanks under Lower Orr Project has been considered. The details under this sub-head are given in **Annexure- 10.2.4.** The cost component of Unit-II of N**.** Reservoir & Tanks is given in **Table 10.3.13.**

Table – 10.3.13

N. Reservoir & Tanks

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr canal	156.53

O. Miscellaneous

Under this sub head, provision has been made to cover the cost of the following works:

- Capital cost of electrification, water supply purification and distribution arrangements, sewage disposal, firefighting equipment, telephones, wireless sets, equipment for quality control and field labs, initial equipment and other accessories for hospitals etc.
- R & M of above equipments/infrastructural facilities etc.
- R & M of inspection vehicles, inspection bungalow etc.

Provision has also been made for other miscellaneous items such as inaugural foundation laying ceremony, compensation to work men, flood lighting, model exhibits etc. The details are given in **Annexures-10.2.4.** The cost component of Unit-II of O. Miscellaneous is given in **Table 10.3.14.**

Table – 10.3.14
O. Miscellaneous

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr canal	62.00
	Total	**62.00**

P. Maintenance

Under this sub-head, provision has been made to cover the cost of maintenance of all works during the construction. A provision of 1% on cost of C-Works, K-Buildings and R-maintenance of roads has been considered for Lower Orr Project, cost of P-Maintenance which are worked out in the respective DPRs prepared by Govt. of MP are considered in the estimate. The details are given in **Annexure- 10.2.4.** The cost component of Unit-II of P. Maintenance is given in **Table 10.3.15.**

Table – 10.3.15

P. Maintenance

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr canal	1550.08

Q. Special Tools & Plants

Under this sub-head, provision has been made at 25% of capital cost of major construction equipment and general purpose equipment. Cost of inspection/ transportation equipment has been added to the above cost in full to arrive the total cost chargeable under this sub-head. The recoveries on account of resale value of Q-Spl. T&P is considered as 75% of the capital cost of the major construction/general purpose equipment chargeable to Q-Spl. T&P and 75% on 20% cost of inspection/transport equipment chargeable to Q-Spl. T&P. Details of the equipment as suggested by CWC, New Delhi and the cost that to be chargeable to the canal works are given in **Annexure -10.2.4.** The cost component of Unit-II of Q. Special Tools & Plants is given in **Table 10.3.16.**

Table – 10.3.16

Q. Special Tools & Plants

Sl. No.	Component	Rs in **lakh**
I	Lower Orr canal	105.50

R. Communication

Under this sub-head, provision for construction of temporary roads and remodeling of existing roads for approach to canal and regulatory system, quarry sites and other working areas has been kept. The details are given in **Annexure 10.2.4.** The cost component of Unit-II of R. Communication is given in **Table 10.3.17.**

Table – 10.3.17

R. Communication

Sl. No.	Component	Cost (**Rs in lakh)**
IV	Lower Orr canal	800.00

S. Solar Power Plants

In Lower Orr Project, the cost towards providing power plant structures, pipes and other components is provided under this sub-head. The details are given in **Annexure 10.2.4.** The cost component of Unit-II of S. Power Plants is given in **Table 10.3.18.**

Table – 10.3.18

S. Power Plants

Sl. No.	Component	Cost (Rs. in lakh)
I	Lower Orr canal	598.14

U. Distributaries

Under this sub-head, provision has been made for providing distributaries pressurize irrigation network system for the total culturable command area of the project. The details are given in **Annexure- 10.2.4.** The cost component of Unit-II of U. Distributaries & Minors is given in **Table 10.3.19.**

Table – 10.3.19

U. Distributaries & Minors

Sl. No.	Component	Cost (**Rs in lakh)**
I	Lower Orr canal	74799.90

Y. Losses on Stock and Unforeseen

Provision has been made for losses on stock and unforeseen @ 0.25% on all sub-heads under I- Works excluding sub – heads A-

Preliminary, B- Land & Q-Spl. T&P & X-Environmental & Ecology for lower Orr canal. No cost under this head has been considered in Lower Orr Dam canal system by Govt. of MP. The details are given in **Annexure 10.2.4**. The cost component of Unit-II of Y. Losses on stock and unforeseen is given in **Table 10.3.20.**

Table – 10.3.20
Y. Losses on Stock and Unforeseen Items

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr canal	371.04

II-Establishment

Provision has been made as per norms i.e. @ 8% of I-Works excluding B- Land towards establishment & pensioner charges except for lower Orr canal. The details are given in **Annexure - 10.1.** The cost component of Unit-II of II-Establishment is given in **Table 10.3.21.**

Table – 10.3.21
II-Establishment

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr canal	11925.19

III- Tools & Plant

Provision has been made under this head for ordinary tools & plant @ 1% of I-Works. This provision is distinct from the Q-Spl. T&P and is meant to cover the cost of survey instruments, camp equipment and other small tools & plant. The details are given in **Annexure 10.1.** The cost component of unit II of III- Tools & Plant is given in **Table 10.3.22.**

Table – 10.3.22
III- Tools & Plant

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr canal	1554.41

IV- Receipt & Recoveries

Under this head, estimated recovery by way of resale or transfer of temporary buildings, special T&P and by resale or transfer of generator sets, electrical lines, telephone lines and other accessories are accounted for and provision has been made accordingly. The details are given in **Annexure 10.1**. The cost component of Unit-II of IV- Receipt & recoveries is given in **Table 10.3.23.**

Table – 10.3.23
IV- Receipt & Recoveries

Sl. No.	Component	Cost (Rs in lakh)
I	Lower Orr canal	38.78

10.2.2.2 B - Indirect Charges

Provisions for abatement of land revenue and audit & account charges are kept under 'Indirect Charges' at the following rates

- Abatement of land revenue - 5% of cost of land
- Audit and account charges - 1% of I-Works

The details are given in **Annexures 10.1.** The cost component of Unit-II of B- Indirect Charges is given in **Table 10.3.24.**

Table – 10.3.24
II of B- Indirect Charges

Sl. No.	Component	Cost(Rs in lakh)
I	Lower Orr canal	1873.20

10.2.3 Unit – III: Hydroelectric Installation

Solar power generation of 19 MW is proposed at the Lower Orr Dam. Cost of Solar Power Plant is estimated on proportionate basis of Kotha Barrage.

Cost of I-Works for Solar Power plant is given in **Table 10.4** as under:

Table 10.4
Cost of I-Works for each Power plant

(Rs. in Lakh)

Power Plant	**Lower Orr Dam**
Total I-Works	10095.18
Net Cost	11104.69

The details are given in **Annexure No.- 10.1.** The sub-head wise details are given below:

10.2.3.1 Direct charges

S. Power plant

Cost of Solar Power Plant is estimated on proportionate basis of Kotha Barrage. The details under this sub-head are given in **Annexure 10.1.** The cost component of Unit-III of Solar Power plant is given in **Table 10.4.1.**

Table – 10.4.1
Power Plant

Sl. No.	**Component**	**Cost (Rs in lakh)**
I	Lower orr Project	10070.00

Y. Losses on stock and unforeseen

Provision has been made for losses on stock and unforeseen @ 0.25% on all sub-heads under I- works excluding sub – heads A- preliminary, B- land & Q-Spl. T&P. The details are given in **Annexure**

10.1. The cost component of Unit-III of Power plant works is given in **Table 10.4.2.**

Table – 10.4.2
Y. Losses on Stock and Unforeseen

Sl. No.	Component	Cost (Rs in lakh)
I	Lower orr Project	25.18

II-Establishment

Provision has been made as per norms @ 8% of I-Works excluding B- land towards establishment & pensionary charges. The details are given in **Annexures 10.1.** The cost component of Unit-III of II-Establishment is given in **Table 10.4.3.**

Table – 10.4.3
II-Establishment

Sl. No.	Component	Cost (Rs in lakh)
I	Lower orr Project	807.61

III- Tools & Plant

Provision has been made under this head for ordinary Tools & Plant @ 1% of I-Works. This provision is distinct from the Q-Spl. T&P and is meant to cover the cost of survey instruments, camp equipment and other small tools & plant. The details are given in **Annexure No. 10.1**. The cost component of Unit-III of III- Tools & Plant is given in **Table 10.4.4.**

Table – 10.4.4
III- Tools & Plant

Sl. No.	Component	Cost (Rs in lakh)
I	Lower orr Project	100.95

10.2.3.2 Indirect charges

Provisions for abatement of land revenue and Audit & account charges are kept under 'Indirect charges'.

- Abatement of land revenue - 5% of cost of land
- Audit and account charges - 1% of I-Works.

The details are given in **Annexure 10.1**. The cost component of Unit-III of Indirect charges is given in **Table 10.4.13**

Table – 10.4.13
Indirect charges

Sl. No.	Component	Cost (Rs in lakh)
I	Lower orr Project	100.95

10.2.4 Unit – IV: Navigation works

Navigation is not proposed under this project. Hence, no provision is required under this sub head.

10.2.5 Unit – V: Water supply works

The project envisages providing drinking water in command areas as well as to the urban centers adjacent to canal alignment. Water will be supplied through main canals and various branch canals, whose cost is considered under Unit -II : Canal system. However, water supply network to the local areas will be the responsibility of the local development body / local administration. Hence, no provision towards water supply works at local level has been kept under this head.

10.2.6 Unit – VI: Command Area Development

The total culturable command area covered under the project is 90000 ha. The cost of command area development has already been covered under the subhead of X-Environmental under each head.

10.3 Revenues

10.3.1 Yearly programme of development

The Project is scheduled to be completed in 4 years. Yearly programme of construction schedule of the project has been discussed in detail in Chapter-VII "Construction Programme, Manpower Deployment & Plant Planning".

10.3.2 Sources of Revenue

Ken-Betwa link project has been planned to provide irrigation in water short areas directly as well as in exchange. Also, the project envisages power generation and domestic water supply in the command area and adjacent towns along the canal. Accordingly, following would be the sources of revenue from the KBLP as a whole.

- Irrigation water rates
- Irrigation cess
- Sale of water for domestic water supply
- Sale of power

Other than the above, tourism & fisheries development in the project areas as described in brief in the Volume- VI "Reservoir" can also be one of the major sources of revenue on account of this project.

10.3.3 Water Rates –Irrigation Cess

(a) Water rates

A large infrastructural network such as this project being created for making water available in the proposed command areas for irrigation and drinking purposes besides power generation, needs to be self-sustainable. Therefore, appropriate water pricing is quite necessary, so that cost of operation & management of project could be recovered from the beneficiaries of the project up to some extent. Water rates may be different for irrigation & non irrigation use. Water rates for irrigation use can be applied on the basis of per unit area irrigated. On the other hand, for drinking water supply, rates may be applied on the basis of per unit volume of water supplied, while power can be charged per unit basis.

The present range of water rates in MP is from Rs 50 to 960 per ha for both flow and lift irrigation. In Uttar Pradesh, it ranges from Rs.30 to 474 for flow irrigation & Rs 15 to 237 per ha for lift irrigation.

These charges are in addition to the irrigation cess & betterment levy to be paid and land revenue being paid by the land holder.

(b) Irrigation cess

As approved by the concerned State Govt., Irrigation cess would be recovered from all the land holders in the commands of the Ken-Betwa link project irrespective of whether the land holder takes irrigation water or not.

(c) Betterment levy

When a major project is constructed, it leads to appreciation of land prices in the areas lying in the vicinity of the project. In case of an irrigation project, better yields of crops are produced. On account of this appreciation in land prices and increased yields of produce, the land owners are required to pay some share to the Govt. as betterment levy.

10.3.4 Auction of Service, Land Lease, Auction and Navigational Permits.

Vacant lands on either side of canals may be leased for plantation of fruit bearing trees. Similarly, in project colony areas, land for shops may also be leased.

10.3.5 Power Rate

Installed capacity of Hydropower installed capacity of solar power plant at Lower Orr Dam is 19 MW. This energy can be sold at prevailing rate of Rs. 6.43 per Kwh or utilize for pressurize irrigation in the area. The power general at Lower Orr Dam Project is proposed to be utilized for development of pressurized irrigation micro system under these projects**.** 503.17 MU energy will be required for pressurized irrigation micro system in Ken-Betwa link (MP & UP), Ken LBC and Panna and Hatta LIS command area. Therefore, these energy is proposed to be purchased @ Rs. 6.43 per Kwh. Details are given in **Anneuxre-10.6 (b)**.

10.3.6 Navigation

No provision for development of navigation aspect has been kept in this project.

10.3.7 Other Sources (Pisciculture, Tourism, etc)

Revenue would occur from the project through allied benefits like pisciculture, tourism, etc. and these benefits have been considered in the benefit-cost analysis of the Project.

10.3.8 Concession in Water Rates (irrigation), Cargo and Passenger Rates, etc.

As the water rates (irrigation) prescribed by the States are highly subsidized, there appears to be no rationale for further concession of these rates in the project commands.

10.3.9 Administrative Charges for Supply of Water and Collection Of Revenues etc.

Suitable provision has been made for running and maintenance of the canals, which include administrative charges for supply of water.

10.3.10 If the Area to be Irrigated is Prone to Scarcity, The Expenditure Normally Incurred to Redress the Scarcity

The area proposed to be irrigated enroute though link canal under Ken LBC is water short and devoid of assured supply.

10.3.11 Year in Which the Revenue Would Start Accruing From Various Sources Counting From the First Year of Construction

The construction of project is scheduled to be completed in 4 years. Benefits from PH-II are linked with irrigation development in Ken LBC System and hence, can be realized after completion of the project. Power benefits from Bina Complex Multipurpose Project, Solar Power from Lower Orr and Kotha Barrage can be realized in the fifth year.

10.3.12 Total Income from Various Sources

The total revenue from various sources is furnished in **Table-10.5**.

Table – 10.5
Source of Revenue

Sl. No.	Source of Revenue	Rs in crore
1	Agricultural produce	454.44
2	Sale of power	36.65
3	Domestic water supply	0.00
4	Fisheries	52.99
	Total	**544.08**

10.3.13 Details of Staff Proposed for Collection of Revenue and its Basis

Revenue Department of Governments of MP & UP would strengthen their existing system for collection of revenues.

10.3.14 Net Revenue Expected From Different Components of Project

It is estimated that the net value of produce after irrigation will be Rs. 55698.72 Lakh whereas it is Rs. 10254.19 lakh before irrigation. Thus, the net annual irrigation benefits from the total command area works out to Rs. 45444.54 lakh. The average annual Solar energy at Lower Dam worked out as 57 MKWh would be generated, at 90% dependability. The revenue from the sale of this power considering Rs. 6.43 per unit works out to Rs. 3665.10 lakh. It is also proposed to develop fisheries in the reservoirs, by which Rs. 5298.50 lakh of revenue could be generated. Thus, the net income/benefit from various sources is estimated to be Rs. 54408.14 lakh. Details are given in **Annexure-10.8.**

10.3.15 Productivity of Project in Terms of Percentage Financial Returns

Project wise pre-project production and post-project production of the crop has been worked out on the basis of data collected from agriculture department of MP for Ken-Betwa link main project and Lower Orr Dam. However, for Kotha Barrage and Bina Complex Multipurpose Project, pre project and post project production of the each crop has been extracted from their respective DPR. The DPRs of above two projects are already under techno-economic-appraisal in CWC. The details of productivity in the command area at pre and post project scenarios are given in **Annexure No. 10.4.1.1, 10.4.1.2, 10.4.1.5, 10.4.2.1, 10.4.3.1 & 10.4.4.1**. Details of productivity in the command area are given in Table-**10.6.**

Table-10.6
Details of Productivity in the Command Area

Unit: Quintals

Name of Project	**Pre-project Production**			**Post Project Production**		
	Kharif	**Rabi**	**Perennial**	**Kharif**	**Rabi**	**Perennial**
Lower Orr Dam	511570	450860	0	0	4273848	0
Grand Total	**962430**			**4273848**		
Net increase in produce	**3311418 (344.07%)**					

10.4 Benefit– Cost (BC) Ratio and Internal Rate of Return (IRR)

The BC ratio and IRR has been worked out as detailed below:

10.4.1 Estimate of Annual Cost

Annual cost of the project as a whole has been worked out according to the guideline for preparation of Detailed Project Report of irrigating and multipurpose project of Ministry of Water Resources (2010) except the depreciation for pump system and rising main. In this guideline, the life of the pumping system and rising main is to be considered as 12 year and 30 years respectively. However, in present scenario, development

of new techniques such as lamination and improvement in the quality of rising main and pump items, the life of the pumps and rising main may be considered as 33 years and 50 years respectively. Accordingly, while working out annual cost of the project, depreciation for the pumps and rising main are considered as 3% and 2% of their cost respectively. Details of annual cost of the project are given in **Table-10.7.**

Table-10.7
Details of Annual Cost of the Project

Rs. in Lakh

Sl. No.	**Description**	**Annual Cost**
1	Interest on capital @ 10% (Estimated total cost of the project including cost of land development)	30557.32
2	Depreciation of the project @ 1% of the cost of project for 100 years life of the project and @ 2% for 50 years life of the project	3055.73
3	Annual operation and maintenance charges @ 1175 Rs Per Ha	1057.50
4	Maintenance of the head works @ 1% of H/W cost less B Land	694.03
5	Depreciation of the pumping system @3.33% of the estimated cost of the pumping system assuming life of the system as 33 years (Applicable to lift irrigation)	132.05
6	Depreciation of the rising mains @ 2% of the estimated cost of the rising mains assuming life of the system as years (Applicable to lift irrigation)	747.24
7	Power Charges for lift water Rs 4410 @ per Ha. (as per 5 rs /kw unit)	1764.00
8	Annual cost of tube well after assuming 12 year service life of pump	91.38
9	**Total annual costs (1 to 8)**	**38099.24**

10.4.2 Benefit Cost (BC) Ratio

As described in the above paras, the net annual benefits from various components of the project works out to Rs.**54408.14** lakh and the annual costs works out to Rs. **305573.17 lakh.** Thus the BC Ratio of the project works out to **1.43:1.** Detailed calculation is placed at **Annexure-10.5.**

10.4.3 Internal Rate of Return (IRR)

The project has been planned to be completed in a period of 4 years including pre-construction year. The phasing of the expenditure has been planned accordingly. The details of yearly expenditure chargeable to project have been given in **Table 7.2.** Considering life of the project as 100 years, the IRR of the KBLP has been computed as **11.15 %.** The detailed calculations of IRR are given at **Annexure-10.6**.

10.4.4 BC Ratio for Flood Control Component of the Projects

No cushion in the reservoir storage is provided exclusively for flood control. Flood control is only an incidental benefit from Daudhan Dam. Hence, no B.C. ratio for flood control component of the project is worked out.

10.4.5 Benefits Other Than those Considered in the BC Ratio and IRR

While calculating BC ratio, benefits from irrigation, power, water supply and fisheries have been considered. However, project will also provide other benefits such as tourism, employment generation, industrial development, infrastructure development, socio-economic condition of people in project area. These benefits have not been accounted for.

CHAPTER- XI

OTHER ASPECTS

11.1 Foreign Exchange Element

The Govt. of India has declared the KBLP as one of the National Projects. As such, 90% of the cost of the KBLP is expected to be borne by Central Government whereas the balance 10% will have to be borne by the beneficiary states viz. MP and UP. Further most of the required materials like plant and machinery, spares, instruments, etc. are proposed to be purchased /hired locally from internal resources thereby requiring no import under foreign grants/credits from other countries. Thus, prima facie, no foreign exchange element is required for the project. However, if implementing agency of the project decides at a later date to import 'Turbine' or any other item of the project from other country, foreign exchange element will come into picture.

11.2 Revenue

The source of revenue from the project is mainly from the benefits accrued from the following items.

11.2.1 Irrigation Water Rates

Annual O&M cost of the project works out to Rs. 105.57 Crore (excluding O & M of power component) whereas benefited area from irrigation is Rs. 8.98 Lakh ha. The irrigation water rates will be collected from land holders to recover O & M cost of the project. The present range of water rates in MP state is from Rs.50 to Rs. 960 per ha for both flow and lift irrigation. In UP, it ranges from Rs.30 to Rs. 474 per ha for flow irrigation and Rs.15 to Rs. 237 per ha for lift irrigation. The land owners are free either to enter into an agreement with the Project authorities or to get irrigation on demand from time to time. However, these charges are in addition to the land revenue paid by them.

11.2.2 Betterment Levy

With the introduction of irrigation and improved method of cultivation, the yield of the crops and value of the land will appreciably increase. Therefore, land owners are to pay some share to the government for this

increase in the value of their lands. Subsequently, betterment levy can be charged from beneficiaries of existing command in Banda district of UP who are not getting adequate water for their command from existing system.

11.2.3 Sale of Power

11.3 Financial Resources

After getting techno-economic clearance from CWC and obtaining necessary statutory clearance from MOEF, Ministry of Tribal Affairs, etc., the DPR of the project will be put up to Planning Commission for investment clearance. The concurrence of Ministry of Finance will also be obtained. This project will be covered under central sector since it has already been announced as a National project and 90% of funding will be borne by central govt. Further, no foreign assistance/ aid will be required for this project since the entire cost will be met from internal resources of Government of India and State Governments.

11.4 Future Utilisation of Facilities (Buildings)

For Lower Orr project existing building, offices and other infrastructures available nearby area will be utilized. Infrastructure required at site is proposed to be constructed only.

11.5 Legal Aspects of Inter basin Transfers Such as Impact on Existing Awards/Agreements/ Treaties

11.5.1 Existing Interstate Agreement on Sharing of Ken water

Since the Ken is an inter-state river between MP and UP, agreements were arrived at on Rangwan dam in the year 1972 on Ken canal and headworks of UP, Bariarpur left bank canal of MP and Urmil Project in the year 1977. In the meeting with Secretary, Irrigation & Power, Govt. of India held at New Delhi on 10.12.1981, it was decided that an upstream use of 80 TMC should be kept for the proposed KMPP. The **Table-11.1** furnishes the abstract of water use allocations as per the agreements and decision indicated above.

Table-11.1
Abstract of Water Allocation as per Earlier Agreements

Ken System	**Quantity**	
	MCM	**TMC**
Total 75% dependable yield at Ken dam	**4489.94**	**158356**
Water use by M.P. U/S of Ken	2265.60	80.00
Water use by M.P. ex-Ken	1375.22	48.56
Water use by U.P. ex-Ken	849.60	30.00
Total 75% dependable yield at Rangawan dam	**192.57**	**6.80**
Use by M.P. for Kharif crops (Existing use by M.P.)	56.64	2.00
Use by M.P. U/S of Rangawan dam	30.87	1.09
Use by M.P. from the balance water	8.78	0.31
Use by U.P. from the balance water	96.29	3.41
Water available to U.P. from the catchment between Ken, Rangawan Dam and Bariarpur barrage	**101.95**	**3.60**
Total water to be spared to U.P. from Ken system	**1047.84**	**37.00**

11.5.2 Proposed Memorandum of Agreement (MoA) amongst the states of MP, UP and Union Government on KBLP

The Clause-2 of the MoU dated 25.08.2005 indicates that specific MoUs as required will be entered into amongst the states of MP, UP and Union Govt. based on the DPR of KBLP and agreements reached on scope of the link, sharing of costs and benefits and arrangements for management and control of water etc. and that as DPR of KBLP has been prepared and to proceed further towards execution of the Link Project. The tripartite proposed MoA have been discussed several times amongst states of UP, MP and Union Govt. and have come to a mutual understanding on scope of the Link Project, sharing of water & Power, sharing of cost, benefits and mechanism for implementation of project as follows.

11.5.3 Existing interstate agreement on sharing of Betwa water between MP and UP

The river Betwa is an inter-state river between MP and UP. During British period two projects were constructed by Government of UP as early as in 1920. These are Dhukwan reservoir on the Betwa river upstream of Jhansi and Parichha weir downstream of Jhansi for Irrigation in UP. In order to supplement Dhukwan Reservoir, Matatila major project has been constructed by UP in the year 1953. The Matatila project was augmented for 0.45 lakh ha

(1.12 lakh acres) irrigation in MP through Bhander canal system and 1.07 lakh ha (2.64 lakh acres) irrigation in UP. Thereafter, Rajghat Dam has been constructed on river Betwa, upstream of Matatila Dam. Agreements between the two states of MP and UP have been drawn up for distribution of water at Matatila Dam and Rajghat Dam. The abstract of water use allocation without taking into consideration the regeneration is given in **Table 11.4** below:

Table – 11.4
Abstract of Water Use Allocation

S. No.	Description	MCM	TMC
1	Total 75% dependable surface water yield at Rajghat Dam	3370.08	119.00
2	Availability by inter valley water transfer upto Rajghat and being used directly for Bhopal Town water supply	-	-
3	Existing water use by MP 65.0 MCM, Future water use 65.00 MCM, Total (65+65)=130 MCM	130	4.59
	(a) For Irrigation purposes from Betwa Basin	900	31.78
	(b) For Domestic and Industrial proposes from Betwa Basin @ 214-130=84 MCM	84.00	2.966
	(c) For Domestic & Industrial proposes from Inter valley water transfer directly to Bhopal	130.00	4.590
4	Reservation for future use by MP in Betwa Basin upto Rajghat (A) For Irrigation purposes (B) For domestic and Industrial Purposes Committed	0	0
	(a) For irrigation purposes U/S of Rajghat Dam without considering any Regeneration	484.765	17.117
	(b) For domestic and Industrial purposes from basin water 595-(130+0.2x828)	299.4	10.57
5	Committed Irrigation use by MP from Rajghat	750.48	26.50
6	Committed Irrigation use by UP from Rajghat	750.48	26.50
7	Committed Irrigation use by MP on D/S of Rajghat from water of Rajghat Reservoir	84.96	3.00
8	Committed Irrigation use by UP on D/S of Rajghat from water of Rajghat Reservoir	169.92	6.00
9	Utilization by UP from Rajghat Dam project (6+8)	920.40	32.50
10	Contribution to be spared to UP from M.P.C.A. from Rajghat 578 sqkm @ 0.2077 MCM/sqkm or 19 MCFT/sq. miles	141.60	5.00
11	Water to be spared to UP from MP catchment area from Rajghat reservoir (920.40-141.60)	778.80	27.50
12	Water use by UP from Matatila Project for 264000 Acre Irrigation	526.75	18.60
13	Contribution by UP catchment area of 1854.49 Sq.km @ 0.2077 MCM/Sq. km	382.32	13.50
14	Water to be spared to UP from MP catchment area from Matatila (12-13)	144.43	5.00
15	Total quantity of water to be spared for other State @ UP from Rajghat and Matatila Reservoir (14+11)	923.23	32.60

11.6 Public Awareness Programme

KBLP is the first project in which public Awareness programme was organized at Uldhan village in Jhansi district lying in enroute commend in 08.05.2008 to explain benefits of the project to the beneficiaries and to remove their doubts about the project. However, it was found that people in general were very much supportive of this project and they wanted its early implementation. During survey & investigation of the project, summary of the project in Hindi along with salient features were distributed among the villagers for their awareness about the project.

KOTHA BARRAGE & CANALS

Chapter-I
INTRODUCTION

1.0 General:

National Water Development Agency (NWDA) identified Ken-Betwa Link as one of the 16 links under Peninsular Component of National Perspective Plan for Water Resources Development for which feasibility report was prepared by NWDA in the year 1995. Tripartite Memorandum of Understanding was signed by Madhya Pradesh (MP), Uttar Pradesh (UP) and the Union Government on 25th August 2005 for preparation of Detailed Project Report (DPR) of Ken-Betwa Link Project (KBLP). The work of preparation of DPR was entrusted to NWDA by Erstwhile Ministry of Water Resources (MoWR) in January 2006. The DPR was completed in December 2008 and was circulated to the Governments of Madhya Pradesh and Uttar Pradesh in February, 2009. To discuss various issues raised by the Govts. of MP and UP, a Secretary level meeting was convened by Erstwhile MoWR on 03.02.2010 at New Delhi. During the meeting, it was opined that the Survey & Investigation of the alternative projects/schemes proposed by Madhya Pradesh in Upper Betwa region will take about 2 years time. In order to avoid undue delay in implementation of KBLP, it was decided to reframe the DPR in two separate parts viz., DPR of KBLP (Phase-I) comprising components of Daudhan complex and DPR of KBLP (Phase-II) comprising Lower Orr Dam Project, Bina Complex Project and Kotha Barrage Project. Subsequently, during the meeting held under the Chairmanship of Secretary (WR), Govt. of India with the representatives of Govts of M.P. and U.P. on August 4, 2010 at New Delhi, it was decided that Survey and Investigations (S&I) works of proposed projects in Betwa Basin including Lower Orr Dam Project and preparation of Detailed Project Report (DPR) of KBLP (Phase-II) will be taken up by NWDA. The survey and investigations and preparation of DPR of KBLP (Phase-II) was taken up by NWDA in January, 2011.

The DPR of KBLP (Phase II) including Lower Orr Dam Projects and other barrages as proposed by Govt. of MP was completed in January, 2014.

Thereafter, from time to time discussions were held between Govt. of MP, Govt. of UP and NWDA to finalize DPR of KBLP (Phase-II). Subsequently, as per the suggestions of Govt. of MP, the projects under KBLP (Phase-II) have been finalised as Lower Orr Dam, Kotha Barrage and Bina Complex.

1.1 NATIONAL PROJECTS:

On 7th February 2008, Government of India approved a scheme of National Projects for implementation during XI Plan with a view to expedite completion of identified National projects for the benefit of the people. Such Projects are provided financial assistance of 90% of the cost of irrigation & drinking water component (as per original Guideline) of the project as central assistance by Government of India in the form of central grant for their completion in a time bound manner.

The Government of India initially declared 14 projects as National Projects in February 2008. Later, Cabinet Committee on Infrastructure approved inclusion of Saryu Nahar Pariyojna (Uttar Pradesh) in the scheme of National Project on 3rd August, 2012. Polavaram Irrigation Project (Andhra Pradesh) was included under the scheme of National Projects vide Gazette notification dated 01.03.2014.

1.2 HON'BLE SUPREME COURT DIRECTION IN RESPECT OF KEN BETWA LINK PROJECT

The Hon'ble Supreme Court in the matter of Writ Petition (Civil) No.512 of 2002 "In Re: Networking of Rivers" along with Writ Petition (Civil) No.688 of 2002 delivered a judgement dated 27.2.2012. The Hon'ble Supreme Court has directed that an appropriate body should be created to plan, construct and implement the interlinking of rivers programme for the benefit of the nation as a whole. The main direction of the Hon'ble Supreme Court are covered under Para 64 of judgement. Hon'ble Supreme Court has directed the Union of India and particularly the Erstwhile MoWR, Govt of India, to constitute forthwith a committee to be called "Special Committee for Interlinking of rivers" under the Chairmanship of Hon'ble Minister (Water Resources). The Hon'ble Supreme Court in its judgement (under Para 64(viii) dated 27.2.2012) directed the committee to take up the KBLP for implementation at the first instance itself.

The Cabinet in its meeting dated 24th July, 2014 has decided to implement the above direction of Hon'ble Supreme Court. In compliance of the above directions of the Hon'ble Supreme Court, the Erstwhile MoWR, RD&GR has constituted the Special Committee for Interlinking of rivers vide Notification

dated 23rd September, 2015. The Hon'ble Minister (Water Resources, RD&GR) is Chairman of the Committee and Water Resources Ministers of various States are members of the Committee. The Committee is regularly monitoring the progress of the interlinking river projects.

The salient features of the Projects are at **Annexure-1.3.1.** An index map showing the proposals is at Plate-I.

1.3 PROPOSAL:

Kotha Barrage Project is a part of KBLP (Phase-II). The proposed barrage site is about 8 km from Kurwai which is the nearest town and the nearest railway station. Bhopal is the nearest airport, which is about 115 km from the site. Left bank piped canal having a length of 11.50 km is proposed to be taken upto river Kethan and whole command will be served by laying Telescopic Pressurized Irrigation System at average level of 415.00 m. The single stage lift of 31 m has been proposed to serve the irrigation in Vidisha district of Madhya Pradesh. The capacity of canal is designed for 3.50 cumec. The GCA and CCA of left bank canal is 15,380 ha and 10,000 ha respectively.

Right bank piped canal having a length of 8.50 km and capacity of 3.50 cumec taken up to river Bina. Single stage lift of 26 m has been proposed to serve the irrigation in Vidisha and Sagar districts of Madhya Pradesh. The GCA and CCA of right bank canal is 15,380 ha and 10,000 ha respectively. The command area after confluence of Bina to Betwa is already included in Bina complex project.

The proposed Kotha Barrage site is located on Betwa river near the village Kotha in Kurwai tehsil, Vidisha district of MP. The total catchment area upto Kotha barrage site is 8711 Sq Km. The 75% dependable yield upto the proposed barrage site has been assessed as 1593.99 MCM as per DPR of Kotha Barrage prepared in 2017.

The pond level of the barrage is proposed to be kept as 395.00 m to restrict the submergence area to 1359 ha only and to allow passing of design flood without any considerable afflux. The gross storage capacity at pond level

works out to 63.51 MCM excluding recharge. The project will provide irrigation for CCA of 20000 ha in Vidisha and Sagar districts.

1.4 Command Area

The proposed command of Kotha Barrage is on the left and right bank of river Betwa. On right bank, the command boundary is formed by Bina river and district boundary of Sagar (some small area of Sagar district is included in command) whereas on left flank, command area is confined to Naren river on upstream side and Kethan river and by the district boundary of newly formed district Ashok Nagar on downstream side. The proposed command covers mostly Vidisha district with small coverage of areas in Sagar district.

As per the availability of water in barrage, a total CCA of 20,000 ha will be irrigated in Vidisha and Sagar districts of MP. The project will provide an annual irrigation of 25,500 ha by utilizing 109.64 MCM of water. Provision of 6.6 MCM of water has been kept for domestic water supply and environmental releases, respectively. The cropping pattern in the proposed command area has been adopted as per the suggestion of Madhya Pradesh Agriculture Department. Major crops of the command areas of the project are Soybean, Wheat (Ordinary and HYV) and Gram.

The other details viz. survey and investigation, hydrology, design, irrigation planning, socio-economic aspects, environment study, construction manpower planning, cost- estimate etc. are given in the respective Chapters of DPR of Kotha Barrage prepared in 2017. The total cost of the project works out to Rs 709.47 Cr at price level 2017-18.

2.0 TECHNO ECONOMIC APPRAISAL:

After detailed examination of estimates based on available data/records, the cost of Kotha Barrage Project has been finalized for Rs 761.35 Cr at Price Level (PL) 2020-21.

Corresponding to final cost estimate of the Kotha Barrage Project amounting Rs 761.35 Cr, the Benefit Cost (B. C.) ratio for the project has been finalized as 1.58:1 with Internal Rate of Return (IRR) as 16.22%.

3.0 HYDROLOGY:

The consultancy work was awarded to NIH, Roorkee covering the detailed hydrological studies for proposed projects in Betwa Basin in the ultimate development scenario besides multi reservoir simulation studies of the Ken-Betwa Link system. **(Annexure-1.3.2)**

3.1 Water Availability

Kotha Barrage is one of the barrages originally proposed to be constructed under the KBLP (Phase-II). The Catchment area of Kotha Barrage (8711 Sq Km) is divided into three independent sub basins for establishing the yield series at the proposed project.

One G&D site is existing at Basoda (CA: 7726 Sq Km) in the Upper Betwa Basin, where long term flow data is available for the period 1976-2009. The rainfall data of 15 rain gauge stations is available in the basin for variable time periods. The consistency of the rainfall data is carried out using the double mass curve technique and necessary corrections are made in the data. The missing rainfall data is filled up using nearby rainfall station data. Based on the refined rainfall data, the weighted areal monthly rainfall for the Kotha project and Basoda G&D site is computed for the period 1901-2009 using Thiessen Polygon method. Basoda G&D site is located at an aerial distance of 21.7 km downstream to the proposed Kotha Barrage.

Bhopal Lake with a catchment area of 354 Sq Km utilises water of Betwa River and contributes quite marginal quantity of spills downstream side. In view of this, the catchment area of Bhopal Lake is excluded in further water availability studies duly deducting the spills from Basoda discharge data and catchment area from relevant project's catchment areas. As per the DPR, 34 projects (1 Major, 2 Medium and 31 Minor Projects) utilise/withdraw water upstream of Basoda G&D site. Utilising the relevant inflow series, project operation, working tables of major and medium projects as well as utilisations of 31 minor projects, the virgin flows at Basoda are computed for the period 1976-2009.

Using the virgin flows and the weighted areal rainfall at Basoda G&D site, rainfall runoff relationship is established for the monsoon months (viz. June,

July, August, September and October). The non-monsoon flows are estimated as 4.264 % of the monsoon flows and further the flows are disaggregated into individual non-monsoon month flows in the ratio of relevant month average virgin flows and average non monsoon virgin flows at Basoda site. Based on the estimated rainfall- runoff relationship and weighted area monthly rainfall, the virgin flows are computed for Basoda site and the Kotha project for the period 1901-2009.

The net yield series has been derived after accounting for the diversions from the existing and future major, medium and minor projects and net domestic and industrial demands from surface water resources in various sub-basins.

The dependable flows for the Kotha Project shown in the table below may be adopted for planning and design purpose.

Project	Dependable Flow (MCM)		
	50%	75%	90%
Kotha Barrage Project	2181.03	1702.78	1287.90

3.2 Sedimentation Studies

There is no silt observation site required at proposed Kotha Barrage (being a barrage).

3.3 Evaporation

There is no pan evaporimeter installed near the Kotha barrage site. The monthly evaporation values computed at Raisen IMD observatory has been used for the hydrological study and the total evaporation value comes to 1.6190 m

3.4 Design Flood

Kotha Barrage having height of 16.5m qualifies for 100 year return period as design flood and SPF as check flood for design of free board as per codal provision. Catchment area of the barrages up to the barrage site is computed using GIS Analysis and found to be. 9262.51 Sq.Km.

The Peak Design Flood and Peak Check Flood for the Kotha Barrages have been worked out as:

S. No.	Project Name	Peak Design Flood (Cumec)	Peak Check Flood (Cumec)
1	Kotha Barrage	18698	26673

3.5 Diversion Flood

Diversion flood for Kotha Barage has been evaluated as the maximum of the following two criteria: a) Maximum non-monsoon flow observed at the barrage site OR; b) 25-year return period flow, calculated on the basis of non monsoon yearly peaks. The peak of daily flow for non-monsoon months, available for 35 years at Basoda G&D Site was provided by Project Authority and used in our analysis. The 25-year return period flow was calculated using the 'Pearson Type-III' frequency distribution. The diversion flood obtained and recommended are as follows:

Project Site	Flow(Cumec)		
	Max. Observed	25- Year return Period	Recommended
	Non Monsoon	Non Monsoon	Diversion Flood
Kotha Barrage	962.39	550.96	963

4.0 IRRIGATION ASPECTS AND WATER REQUIREMENT:

The pond level of the barrage is proposed to be kept as 395.00 m to restrict the submergence area to 1359 ha only and to allow passing of design flood without any considerable afflux. The total water storage capacity at pond level works out to 63.51 MCM excluding recharge of about 20.736 MCM (considered @ 5% of total u/s use). Being a medium height barrage, no hydro power generation is possible from the project. However, considering the requirement of power for Telescopic Pressurized Irrigation System, it is proposed to install solar power panels in the project area for generating about 8.00 MW power. Out of which, about 5.39 MW is required for developing pressurized irrigation in Kotha Barrage and the surplus power i.e. 2.61 MW can be diverted to National Power Grid as a clean green energy. However,

this is an opinion in project planning and is to be finalized during next stages of execution.

By providing micro irrigation between to 0.60 ha to 1.20 ha in 10,000 ha of left flank and 10,000 ha on right flank by lifting the water and providing water in a pressurized irrigation network through booster pumping. Annual irrigation in Kotha Barrage is planned for 25,500 ha.

Earlier, variable irrigation water demand (from 56.886 MCM to 88.629 MCM instead of consideration of irrigation demand worked out in the DPR as 99.92 MCM) under the project were considered by the project authorities for the purpose of preparation of working tables. The project authorities were asked to consider a firmed up irrigation water demand for the purpose of preparation of working tables to assess the desired success rate of the project. The project authorities have now reworked out the irrigation demand as 109.64 MCM and the same has been considered in the working tables. The irrigation water demand for the proposed cropping pattern worked out as 109.64 MCM by the project authorities is found to be in order.
The Irrigation Water Requirement vetted by Irrigation Planning (S) directorate is enclosed as **Annexure-1.3.3.**

5.0 PROVISION OF DRINKING WATER:

Provision of 6.6 MCM has been made for drinking water requirement in Kotha Barrage Project.

6.0 INTER-STATE ASPECTS:

The interstate agreement held between the state of MP and UP on dated 01.08.1972 for sharing of Betwa basin water in upper reaches that is from the origin of river to the Rajghat Dam provides use of 53 TMC (1500 MCM) of water for the new projects of MP on Upstream, against a 75 % dependable expected yield of 119 TMC (3370 MCM) upto Rajghat dam site.

The state of MP after the agreement has so far constructed 1 major and 8 medium schemes besides about 100/120 minor storage and lift irrigation schemes. The total water used by these schemes is about 900 MCM up to Kotha Barrage and about 1100 MCM up to Rajghat Dam whereas schemes of

about 200 - 300 MCM are either in the stage of construction or falls under the category of new proposed schemes.

Further the MP has been given authority to use about 591 MCM of water in upper Betwa basin in lieu of water being provided to UP in the agreement held between MP & UP from Ken River Basin to UP in Lower Betwa Basin. Thus, sufficient availability of water under the allocated share is available for taking up of the proposed project of Kotha barrage in the upper Betwa basin.

MoA on Comprehensive Project Report of KBLP (including Kotha Barrage Project) has been signed on 22.03.2021 between Madhya Pradesh, Uttar Pradesh and Union Govt. for implementation of KBLP. Thereafter, CWC vide letter dated 02.07.2021 has communicated that Comprehensive Project Report of KBLP (including Kotha Barrage Project under KBLP, Phase-II) may be considered acceptable from inter-state aspects. Details are annexed in (**Annexure-1.3.4**).

7.0 DESIGN ASPECTS:

The design aspects of the project have been examined in CWC and found to be generally in order. The Design Chapter of KBLP (Phase –II) was prepared in CWC. Kotha Barrage Project is a part of KBLP (Phase-II).

Barrage and canals Designs directorate (NW&S) issued its clearance on the said project vide letter dated 05.09.2017.

Gates Design (NW&S) directorate issued its clearance vide letter dated 18.12.2017 with the following comments: **(Annexure-1.3.5)**

1. ln the general arrangement of Barrage fixed Wheel Vertical Lift Gate Vide drawing no. KBL-7730-P-L5O7, Pier top level which is 398:0 m need to be raised by about 4.0 m at the location of barrage gate groove. Main gate groove size needs to be increased to 1000 mm instead of existing 800 mm.

2. Vide Volume-l of DPR in salient features, FRL mentioned is 395.0 M and vide drawing* no. , KBL-7730-P-1507 pond level mentioned is 396.0 M. This ambiguity need to be clarified,

3. ln order to minimize the operational difficulty as also to improve upon hydraulic performance, stoplog need to be shifted in upstream of Road Bridge.

4. The purpose of downstream stoplog groove is not clear and hence it's requirement needs to be brought out.
5. Downstream water Level needs to be represented in the relevant drawings.

8.0 ENVIRONMENTAL & FOREST CLEARANCE:

The environmental clearance of Kotha barrage has been accorded by State Environmental Impact Assessment Authority, MP on 21.08.2020 are enclosed as **Annexure 1.3.6.**

9.0 TRIBAL AFFAIRS & R&R:

The total Land requirement is 1359 ha which is comprised of 678 ha revenue land and 681 ha private land respectively. Owing to acquisition of land, 27 villages shall be partially affected. There shall be 638 project-affected families (Title holders) whose land only shall be acquired however none shall be displaced. The land acquisition shall be carried out as per RFCTLARRA 2013 (**Annexure-1.3.6**).

10.0 PLAN PROVISIONS:

Cabinet Committee of economic Affairs (CCEA) approved the Ken Betwa Project in its meeting held on 08.12.2021 and funding of the project shall be as per approved norms for this project.

11.0 COST ESTIMATE:

The cost estimate of Kotha Barrage Project was completed by WRD, Govt. of MP and the same are adopted in the estimate by escalating at price level 2017-18. Total cost of the project has been worked out as Rs. 709.47 Cr at price level 2017-18.

S. No.	Item	Cost in Rs. (Lakhs)
1	Unit I	34486.24
2	Unit II	32178.61

3	Unit III	4282.40
4	**Total**	**70947.25**

The Project Cost is provisional subject to the correctness of the quantities as per the detailed survey carried out and rates indicated in the cost estimates at Madhya Pradesh Unified Schedule of Rates 2017-18. The Project Authorities have also submitted a certificate regarding the correctness of quantities as per Design and Drawings proposed for preparation of Cost Estimate. The Abstract of final Cost of the Project at SoR 2017-18 vetted by CWC is enclosed as **Annexure-1.3.7**. In this regard, it is to mention that project is under execution. Expenditure up to 30 Nov, 2021 on the project is Rs. 151.06 Cr, which includes Rs 73.00 Cr on Land acquisition and Rs 78.06 Cr on works.

Further, The Cost Estimate is revised at 2020-21 price level which works out to be Rs. 76135.32 Lakhs.

12.0 ECONOMIC EVALUATION:

12.1 Benefit Cost Ratio:

Benefit cost ratio in case of Kotha Barrage Project was calculated by CWC in consideration of documents provided by Govt. of M.P. The observations of CWC in this regards are as under:

The cost of land development has not been considered by the project authorities in the BC Ratio computation. During the meeting held on 24.11.2021, WRD, Govt. of MP has requested to exclude the cost of land development for Kotha Barrage in BC Ratio calculation. WRD, Govt. of MP vide letter dated 23.11.2021 addressed to Chairman. CWC intimated that "Govt. of MP has undertaken about 40 nos. of pressurized irrigation projects using sprinkler system. In all these projects no land leveling and command area development cost is required because they serve upto 1 ha. Out of which 3 nos. of projects namely Garoth, Mohanpura, BanSujara irrigation projects are functioning well and irrigating 1.20 lakh ha by sprinkler system. In all these projects neither land leveling and Command Area Development cost has been considered nor any expenditure made on that. The water is delivered upto 1 ha with 20 mtr head, therefore the cost of command area development is already included in the project."

In view of above and considering the fact that, in case of Kotha Barrage project, micro-irrigation through pressurized pipe distribution network has

been adopted and the cost of providing underground pressurized pipe distribution network for micro irrigation system to facilitate pressurized irrigation have been taken upto 1.0 ha chak area, the land development charges have been taken as 'NIL' in the B.C. ratio computation.

Based on above and veracity of the documents submitted by the project authorities, the BC ratio computation has been checked and found to be 1.58.

13 WORK COMPLETION SCHEDULE:

13.1 Physical Schedule:

In this regard, it is to mention that project is under execution from 2018-19. The overall Physical progress of the project up to 30 Nov, 2021 is 20%, which includes 10% of Headworks & 25% of Canal Works. Further, the detailed construction schedule for the project in the form of a bar chart is attached as **Annexure – 1.3.9**.

CHAPTER-II
SURVEYS AND INVESTIGATIONS

2.0 Background

The DPRs of KBLP, Phase-I and Phase-II were completed by NWDA in 2010 and 2014 respectively after carrying out detailed Surveys and Investigations (S&I). Lower Orr Dam and Kotha Barrage were also included in Phase-II. In respect of canal system under Daudhan Dam, enhanced CCA proposed by Government of MP from 2.87 lakh ha to 4.47 lakh ha**,** NWDA has carried out additional command area survey of 26500 ha (12500 ha in enroute command of the link canal and 14000 ha in command of Ken Left Bank Canal). In respect of additional command of 37564 ha in Mahoba district of UP, NWDA collected irrigation map of Mahoba district from irrigation department of UP showing dams tanks and canal system and adopted in study. and Mahoba district of UP has not been done at this stage. Irrigation planning has been provided by Government of MP and same is adopted in the Comprehensive Report. In respect of Bina Complex Multipurpose Project, surveys and investigations has been done by Government of MP and the same is adopted in Comprehensive Report. The component wise details of various surveys and investigations extracted from specific DPRs of above projects are furnished below:

2.1 Kotha Barrage and Canal

2.1.1 Topographical and Other Allied Surveys

Various field surveys & investigations viz. topographical survey, geological, construction material, geo-technical investigations and borrow area surveys for barrage and canal, etc. in respect of Kotha Barrage have been carried out as per the ToR for preparation of DPR of KBLP, 2006 and Guidelines for preparation of Detailed Project Report of Irrigation and Multipurpose Projects of Ministry of Water Resources (2010).

Various survey works like the barrage axis survey, submergence area survey, river survey and the command area survey were carried out by NWDA. The investigation works like geological investigations, construction material survey, borrow area survey etc. along the proposed barrage axis were carried out by GSI, Bhopal/CSMRS, New Delhi.

2.1.2 Geology, Geophysical & Seismic Investigations

The geo technical and geological investigation of Kotha Barrage was carried out by GSI, Bhopal in association with CSMRS, New Delhi. The note on pre-construction stage geotechnical investigation of barrage site, regional geology, local geology, geotechnical assessment and foundation investigation, in spillway portion and canal &canal structures of the project area prepared by GSI, Bhopal is furnished in DPR. Geophysical investigation at this site was not needed as sub-surface exploration has been carried out by deep drilling at this site as recommended by GSI.

2.1.3 Seismicity

Seismo-tectonically, the Bundelkhand–Malwa area is a stable land mass with a history of least tectonic disturbances. The area of the Upper Betwa basin is practically devoid of active lineament, fault or shear. As per the Seismic Zoning Map of India (1990), the proposed layout of the Kotha Barrage including storage barrages/barrages in Upper Betwa falls under seismic zone-II which signifies low seismic events not exceeding magnitude 3 and hence seismo-tectonic hazards would be considered as minimum.

2.1.4 Borrow Area Surveys and Construction Material Survey

2.1.4.1 Borrow Area Survey

For proposed barrage which is a masonry/concrete structure, no investigations for borrow areas were required.

2.1.4.2 Sand, Rock and Aggregates

The CSMRS, New Delhi has carried out construction material survey and laboratory investigations of sand samples, rock samples for their use as coarse aggregate in concrete during investigation of the proposed Kotha Barrage project. The test results of the above sand and rock samples are furnished as Appendix-2.4.2 in Volume-II of DPR of Kotha Barrage.

2.1.4.3 Brick & Tiles Pozzolona

Soil of suitable quality is available near the proposed colony sites along the canal for manufacture of bricks and tiles for use in building construction. Also, brick kilns are available in the vicinity of project area at Raisen, Vidisha and other towns. Bricks can be transported from the nearest kilns to the colony sites for construction. Pozzolonic materials are not considered to be used in the construction of the project.

2.1.4.4 Cement and Steel

The requirement of cement for the construction of the project can be brought from nearest cement plants located at Narasinghgarh (Damoh), Banmore (Gwalior) of MP State to the nearest railhead i.e. Ganj Basoda. Similarly, the steel requirement of the project can be brought from steel plant located at Mandideep near Bhopal and Bhilai steel plant located in Chhattisgarh state.

2.1.5 Hydrological and Meteorological Investigations

Details on hydrological and meteorological investigations including rainfall, sunshine, cloud cover, wind and cyclones, humidity and temperature have been discussed in the DPR of KBLP, Phase-II (2014). The long period data available at the nearest Basoda Gauge & Dischange site established by CWC on main Betwa river has been considered for the hydrological study. There is no silt observation site required at proposed Kotha Barrage (being a barrage).

CHAPTER-III
HYDROLOGY AND WATER ASSESSMENT

3.0 Background

This chapter deals with hydrology and water assessment of various projects components under KBLP. The hydrology and water assessment of Ken Basin upto Daudhan Dam was completed by NWDA and included in DPR of KBLP, Phase-I (2010) and techno-economically approved by CWC in 2016. The hydrology and water assessment of Lower Orr Dam and Kotha Barrage was completed by NWDA and included in DPR of KBLP, Phase-II (2014). Whereas, the hydrology of Bina Complex Multipurpose Project was completed by Water Resources Department, Government of MP. Separate DPRs of Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project have been approved by CWC in the 148th meeting held on 17.02.2022. The component wise details of hydrology, water assessment and latest water planning are covered in this Chapter.

3.1 Kotha Barrage and Canal

3.1.1 Hydrology

The consultancy work awarded to NIH, Roorkee covered the detailed hydrological studies for proposed projects in Betwa basin in the ultimate development scenario besides multi reservoir simulation studies of the Ken-Betwa link system.

NIH, Roorkee has carried out hydrological and water balance studies for assessment of diversion flood and design flood, sedimentation analysis, multi reservoir simulation studies and hydrodynamic modeling and related studies considering 10 structures. Accordingly, NIH divided the catchment of Betwa basin in ten sub catchments SB-1 to SB-10. Catchment of Kotha Barrage is designated as SB-6 in the NIH study. The detailed report of NIH is given in Volume-III, Hydrology of DPR of KBLP, Phase-II (2014).

NIH, Roorkee assessed the 75% and 50% dependable annual yields of the sub-basin up to the proposed Kotha Barrage site as 1593.99 MCM and 2061.10 MCM respectively. But as per the DPR of Kotha Barrage prepared by Water Resources Department, Government of MP (according to master plan of Betwa basin of 1972-2004), the 75% dependable annual yield is 1794.47 MCM. However, the yield finalized by NIH, Roorkee has been considered in the Comprehensive Report. Salient features of proposed Kotha Barrage are given in **Table-3.1.**

Table-3.1

Salient Features of Proposed Kotha Barrage

Name of the Structure	Name of the River	Bed Level (m)	Pond Level (m)	Submergence Area (ha)	Gross Storage Capacity (MCM)	Districts Benefitted
Kotha Barrage	Betwa	383.52	395	1359	63.51	Vidisha & Sagar districts of MP

3.1.2 Water Assessment

Assessment of water demands in foreseeable future for various purposes including domestic, industrial, irrigation, hydropower and navigation etc. is essential for planning of water resources development and management. Water needs are to be met either from surface water flows or ground water resources or a combination of both. NIH, Roorkee has carried out the detailed study for assessment of water for various purposes is furnished in the DPR of KBLP Phase-II (2014). The monthly water demand pattern from Kotha Barrage is given in **Table-3.2.**

Table-3.2
Monthly Demands

Unit: MCM

Month	Irrigation Demands as per DPR of Kotha Barrage (2017)	Revised Irrigation Demands as per WRD, MP (Kotha Barrage) submitted to CWC during Appraisal
January	16.50	8.48
February	15.40	0
March	3.40	0
April	0	0
May	0	0
June	7.00	0
July	1.00	0
August	1.800	4.51
September	1.60	4.62
October	0.00	21.60
November	36.60	21.12
December	20.20	20.36
Total	**103.50**	**80.69**

Water Resources Department, Government of MP has carried out the study for assessment of water for various purposes is furnished in the DPR of Kotha Barrage-2017.

The computed dependable flow at Kotha Barrage site is given in **Table-3.3.**

Table-3.3
Computed Dependable Flow at Kotha Barrage Site

Project	Dependable Flow (MCM)		
	50%	75%	90%
Kotha Barrage Project	2181.03	1702.78	1287.90

3.1.3 Elevation-Area-Capacity Table

The Elevation-Area-Capacity table for Kotha Barrage is given in **Table-3.4.**

Table-3.4
Elevation-Area-Capacity Table of Kotha Barrage

Elevation (m)	Area (ha)	Capacity (MCM)
383.52	0.00	0.00
384.00	58.00	0.02
385.00	189.00	1.19
386.00	225.00	3.26
387.00	303.00	5.89
388.00	411.00	9.45
389.00	513.00	14.06
390.00	600.00	19.62
391.00	678.00	26.00
392.00	783.00	33.30
393.00	885.00	41.64
394.00	1070.00	51.40
395.00 Pond Level	**1359.00**	**63.51**
396.00	1861.00	79.55
397.00	2551.00	101.52

3.1.4 Sedimentation

There is no silt observation site required at proposed Kotha Barrage (being a barrage).

3.1.5 Evaporation

There is no pan evapometer installed near the Kotha barrage site. The monthly evaporation values computed at Raisen IMD observatory has been used for the hydrological study and the total evaporation value comes to 1.6190 m

3.1.6 Design Flood

Kotha Barrage having height of 16.5m qualifies for 100 year return period as design flood and SPF as check flood for design of free board as per codal provision. Catchment area of the barrages up to the barrage site is computed using GIS Analysis and found to be. 9262.51 Sq.Km.

The Peak Design Flood and Peak Check Flood for the Kotha Barrages have been worked out as:

S. No.	Project Name	Peak Design Flood (Cumec)	Peak Check Flood (Cumec)
1	Kotha Barrage	18698	26673

CHAPTER – IV

DESIGN ASPECTS

4.0 Background

The designs of Daudhan Dam, Ken-Betwa link canal, Ken Left Bank Canal, Lower Orr dam and Kotha Barrage were carried out by CWC as detailed in respective DPRs. The design of Bina Complex Multipurpose project has been done by Government of MP and adopted in this report. The component wise details of design are briefly described below:

4.1 Kotha Barrage and Canals

Details of Design aspects of Headworks, are described in the Chapter-IV "Design Aspects" of DPR of Kotha Barrage submitted by Govt. of MP to CWC during 2017 for Techno-economical appraisal. This DPR of Kotha Barrage was prepared by the Govt. of MP on the basis of DPR of KBLP, Phase-II (2014).Whereas the design of headworks was carried out by CWC. The details of design features of headworks is extracted from above DPR. The design of raising main and pumping system etc for Micro irrigation under canal system has been done by Govt. of MP and same are adopted in the Comprehensive Project Report.

4.1.1 Barrage

The proposed barrage site is located on Betwa river near the village Kotha in the tehsil of Kurwai of Vidisha district of MP. The total catchment area up to Kotha Barrage site is 8711 sqkm. The latitude and longitude of the barrage site are $24^0$3’28" N and $78^0$01'16" E respectively. The proposed barrage site is about 8 km from Kurwai which is the nearest town and the nearest railway station. Bhopal is the nearest airport, which is about 115 km from the site. The Kotha barrage envisages construction of a 16.50 m high and with 576 m long barrage waterway across the river Betwa with a pond level of 395 m.

The pond level of the barrage is proposed to be kept as 395.00 m to restrict the submergence area to 1359 ha only and to allow passing of design flood without any considerable afflux. The total water storage capacity at Pond level works out to 63.51 MCM excluding recharge of about 20.736 MCM

(considered @ 5% of total U/S use). The project will provide irrigation for CCA of 20,000 ha located in Vidisha and Sagar districts of MP.

4.1.2 Design Flood

Kotha Barrage having height of 16.5m qualifies for 100 year return period as design flood and SPF as check flood for design of free board as per codal provision. Catchment area of the barrages up to the barrage site is computed using GIS Analysis and found to be. 9262.51 Sq.Km.

The Peak Design Flood and Peak Check Flood for the Kotha Barrages have been worked out as:

S. No.	Project Name	Peak Design Flood (Cumec)	Peak Check Flood (Cumec)
1	Kotha Barrage	18698	26673

4.1.3 Barrage Sedimentation

No sediment data is available at the barrage site. However, Silt Factor value is required to access the depth of scour. In the present case as the barrage is founded on good quality rock, Scour is not critical design issue. However to be on conservative side, a silt factor of 1 has been assumed for the design Purposes.

4.1.3.1 Retrogression at Maximum and Minimum Discharges

Retrogression values have been assumed to consider retrogressed level as showing in**Table-4.2**

Table – 4.2
Retrogression values

S. No.	Discharge (cumec)	Retrogression (m)
1	Low flood	1.50
2	16457 (1 in 200 yr)	0.50

The provided water way are capable of passing the designed discharge, The crest level has been assumed 1.0 m higher than average floor level which is 384.59 m & assumed afflux is 1.50 m.

4.1.3.2 Scour Depth

The scour holes can be occurred both U/S & D/S of the floor. Therefore, cut-offs are provided in the U/S& D/S end of the floor to prevent failure by slipping of the soil in to the scour holes by simple earth pressure. The value of scour in U/S& D/S has been taken as R & 1.5 R respectively.

4.1.3.3 Exit Gradient Value

The exit gradient is very important aspect to be considered for a safe design of floor. It depends on the head of water at the point of consideration, length of barrage section and depth of downstream cut off. In this case the exit gradient has been taken as 1/6. The total floor length of barrage has been checked against exit gradient and it is found that it is safe.

4.1.4 Barrage Design Details

4.1.4.1 Waterway and HFL

32 bays of 15 m each are provided. The crest level for all the bays is kept at RL 384.50 m to have better control over sedimentation. The waterway provided is checked for 1 in 200 year design flood (16457 cumec). For determination of U/S affluxed HFL, it is assumed that all the gates are fully open and discharge coefficient (C_d) is based on Mallikpur curves as per drowning ratio. For D/S HFL corresponding to water level against Maximum design flood is considered design purpose of Kotha Barrage and its water bays. It is assumed that designed discharge will pass through barrage. The total length provided between left abutment & right abutment is 576 m against the width between banks of 579 m.

4.1.4.2 Piers

The 31 nos. of piers are provided in barrage out of which 3 nos. are double pier. The thickness of single pier is 3.0 m &thickness of double piers is 6.0 m.

The top thickness of abutment has been fixed same as thickness of pier i.e. 3.0 m & side slope 0.7:1.

4.1.4.3 Crest Width & Level

Width of crest depends upon height of barrage and depth of water over crest is depth of water over crest. The crest level of spillway of barrage is kept generally 1.0 to 1.5 m above the average u/s floor level. In this barrage the crest width is kept 5.0 m & crest level is kept 1.0 m above the u/s floor level.

4.1.4.4 R.C.C. Raft

3.0 m thick combined RCC Raft (M-30 grade concrete) has been provided throughout the length of barrage. The thickness of raft will increase up to 4.5 m below foundation of piers as well as in abutments. Construction joints of 50 mm thick have been provided throughout the raft after every 3 bays where double pier is provided.

4.1.4.5 Type (Concrete/Masonry)/Profile Cut Off, Upstream and Downstream Aprons, Uplift Pressure Relief Arrangements etc.

The U/S cut off is provided at EL 376.0 m which is about 7.60 m below U/S floor & D/S cut off is provided at EL 370.0 m which is 7.50 m below the cistern level.

4.1.4.6 Aprons and Protection Works

Since rock is available at shallow depth, scouring is not anticipated and therefore flexible protection work provided on the basis of scour depth is not warranted. However, flexible protection works in the form of CC blocks, and launching apron is proposed at downstream as well as at upstream as shown in the relevant drawings for required nominal distance. The extent and other details of flexible protection work may be finalized as per site conditions at the time of construction stage planning

Minimum weight of stone to be used in protection work should be such as to resist a flow velocity of 5 m/s or 50 kg whichever is more. If found economical, wire crates may also be used in place of stones. The Block protection in U/s is provided in 12 nos. of rows of C.C. block size 1.50 x 1.50 x

0.90 m over 0.6 m thick loose stone apron in 18.0 m length & launching apron 1.5m thick up to 27.0 m. The Block protection in D/S is provided in 24 nos. of rows of C.C. block size 1.50 x 1.50 x 0.90 m over 0.60 m thick inverted filter in 40.73 m length & launching apron 1.5 m thick up to 35.50 m with 0.50 m thick 2 nos. curtain walls.

4.1.4.7 Energy Dissipation Arrangement

To dissipate the energy of water coming out from the barrage a stilling basin type arrangement has been proposed so that it may not cause excessive scour immediately downstream of barrage. The level and length of stilling basin is so provided that the hydraulic jump formed under various possible flow conditions is contained within the stilling basin. As per design the length of cistern has been provided as 58 m and cistern level kept at EL 377.50 m. In this regard the following criteria are proposed:

The cistern level & length has been find out for the different flow condition such as (i) At HFL (without concentration retrogression) (ii) At HFL with 20% concentration & 0.5 m retrogression (iii) At pond level (without concentration retrogression) (iv) At pond level with 20% concentration & 0.5 m retrogression. The details design of cistern is given in Annexure.

4.1.4.8 Seepage Control

Since rock is available at shallow depth, the cut-offs may be taken 1 m deep into good quality rock. To relieve the seepage pressure built up underneath the floor, 75 mm dia. drainage pipes 4.5 m deep and 3 m c/c (two rows per bay) shall be provided in the sloping glacis. As the river bed is rocky, seepage may not pose much problem, provided presence of impermeable rock is confirmed by further exploration at the construction stage. However for preliminary design, upstream and downstream RCC cut-offs are provided. Some curtain grouting at upstream and drainage arrangement for the stilling basin may also be required which may be finalized at the construction stage.

4.1.5 Gates, Types of Gates and Hoist Bridge and Stoplogs

4.1.5.1 Spillway Fixed Wheel Vertical Lift Gates

32 Nos spillway fixed wheel vertical lift gates of size 15m X 115m. will be provide to control the flood of spillway. Sill level of the gate shall be EL 384.50 m. The gate shall be provided with upstream skin plate and upstream sealings to avoid silt on horizontal girders. Wedge type seal shall be provided for bottom sealing and music note solid bulb seals shall be provided for side sealings. The side seals shall remain in contact with stainless steel seal seat to make the gate water tight.

The gate structure shall consist of skin plate stiffened by vertical stiffeners and horizontal girders. The horizontal girders shall be supported by end vertical girders on each side. The water thrust will be transferred to concrete structures from the end vertical girder through wheels and wheel track. The wheels shall be mounted on self-lubricating bush bearings. The wheel shall be made up of corrosion resistant steel. The BHN of wheel track shall be 50 BHN higher than the wheel material. 32 mm guide and two number guide shoes shall be provided on each side to guide the gate in grooves.

The gates shall be operated by independent rope drum hoist of 220 Tonne (approx.) capacity. The Rope Drum Hoist shall consist of hoist machinery mounted on hoist support structure. Each hoist machinery will be equipped with two rope - drums, gears, pinions, couplings, shafts, worm reducer, motor and brakes. The hoist bridge shall be supported on trestles.

The maintenance of these gates are proposed to be carried out at level RL 398.00 m. The gate shall be designed in accordance with the provision of IS: 4622 (Third Revision) : Recommended has for structural design of fixed wheel gates. The design of Rope Drum Hoist shall conform to IS: 6938 (Second revision).

4.1.5.2 Barrage Stoplogs

Four sets of stoplogs of size 15m X 1450 m each set shall be provided to carry out the maintenance of spillway fixed wheel vertical lift gates. The stoplog's shall be operated under balanced water head conditions. except top most unit shall be lifted under unbalanced water head for one gate unit height water head. All units are interchangeable. The stoplog's shall be connect to Gantry Crane. The stoplog units shall be stored in stoplog groove above HFL.

The stoplog units shall have bronze pad sliding on stainless steel track. 32 mm guide shall also be provided to guide the stoplog units. The skin plate and sealing of stoplog gate shall be kept d/s side.

4.1.5.3 Gantry Crane

The spillway stoplog's shall be operated by moving Gantry Crane. The tentative m. capacity of gantry crane shall be 30Tonne. The Gantry Crane shall have hoist machinery mounted on trolley. The trolley shall of moving type. The crane structure along with trolley shall be capable of moving in longitudinal direction with the help of LT travel mechanism. Suitable counter weight shall be provided to make the crane stable for different stability conditions. The crane shall be designed as per IS: 3177 and IS: 807.

4.1.6 Detail of Spillway Bridge, Abutments etc.

4.1.6.1 Road Bridge & Gantry Bridge

Pier & abutment top has been provided at EL 400.00 m in U/s and 398.505 m in D/S which is 1.5 m above the U/S&D/S HFL level. A road cum gantry bridge has been proposed with deck level at 401.50 m. This approach bridge shall continue on either flank of the barrage. The bridge shall support gantry crane provided for operation of stop logs and also the single lanes of class 'A' vehicle loading with 55.4 R loading. Trestles for operation of service gates of barrage are provided at pier top level of 400.70 m.

4.1.6.2 Abutment

The top width of abutments is kept as 3.0 m and side slope is kept as 0.7:1. The length of abutment in U/S&U/S up to end of Floor i.e. 96.27 m. The return walls in the U/S&U/S is provided at the ends of abutment on both side with 0.7:1 slope. The purpose of return wall is for uniform flow and to make connection between abutments and banks of river.

4.1.6.3 Canal System

Left bank piped canal having a length of 11.50 km outfall into river Kethan and whole command is served by laying Telescopic Pressurized Irrigation System at Av. CCA Level of 415.00 m. Length of Rising main has

been kept 11.50 km whereas diameter of Telescopic Pipe (m) is 1.60 m. Single stage lift of 31m has been proposed to serve the irrigation in Vidisha district of Madhya Pradesh. The left bank pipe canal has been capacity of designed for 3.50 cumec. The GCA and CCA of left bank canal is 15380 ha and 10000 ha respectively.

Right bank piped canal having a length of 8.50 km outfalls into to river Bina. The right bank pipe canal has been designed for capacity of 3.50 cumec. Length of Rising main has been kept 8.50 km whereas diameter of Telescopic Pipe (m) is 1.60 m. Single stage lift of 26 m has been proposed to serve the irrigation in Vidisha and Sagar districts of MP. The GCA and CCA of right bank canal is 15380 ha and 10000 ha respectively. Command area after confluence of Bina river to Betwa river is already included in Bina complex project.

CHAPTER-V

RESERVOIR & POWER

5.0 Background

The present chapter deals with reservoir and power assessment of various projects components under KBLP. The reservoir simulation and power studies of Daudhan Dam was carried out by NIH, Roorkee and CEA and included in DPR of April,2010.The reservoir simulation study of Lower Orr Project and Kotha Barrage were carried out by NIH, Roorkee and included in DPR of January,2014.The reservoir simulation and power studies of Bina Complex Multipurpose Project were carried out by Water Resources Department, Government of MP. The DPRs of Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project are under techno-economic appraisal in CWC. The component wise details of reservoir capacity, simulation and power assessment are described in the subsequent paras.

5.1 Kotha Barrage and Canals

5.1.1 Area-Capacity of Kotha Barrage

The submergence area survey of the barrage has been carried out by NWDA. The original Elevation-Area-Capacity values of the proposed barrage with enhanced capacity have been prepared by the Water Resources Department, Government of MP and are given in **Table-5.1.**

Table-5.1
Area Capacity of Proposed Kotha Barrage across River Betwa

Contour (m)	Contour area (ha)	Capacity (MCM)	Cumulative Capacity (MCM)
383.9	0	0.00	0
384	58.00	0.02	0.02
385	189.00	1.17	1.19
386	225.00	2.07	3.26

387	303.00	2.63	5.89
388	411.00	3.56	9.45
389	513.00	4.61	14.06
390	600.00	5.56	19.62
391	678.00	6.39	26.00
392	783.00	7.30	33.30
393	885.00	8.33	41.64
394	1070.00	9.76	51.40
395	1359.00	12.12	63.51
396	1861.00	16.03	79.55
397	2551.00	21.97	101.52
398	3738.00	31.26	132.77
399	5378.00	45.33	178.10
400	8085.00	66.86	244.96

5.1.2 Power House

Being a medium height barrage, no power generation is possible from the project. However, considering the requirement of power for Telescopic pressurized pipe micro irrigation system, it is proposed to install solar power panels in the project area for generating about 8.00 MW power mainly during the period October to March. The total power requirement is 5.39 MW, thus the remaining power i.e. 2.61 MW can be diverted to National Power Grid as a clean green energy.

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CHAPTER - VI
IRRIGATION PLANNING AND COMMAND AREA DEVELOPMENT

6.0 Background

The present chapter deals with irrigation planning and command area development of various project components under KBLP. The DPR of Kotha Barrage was prepared by WRD, Govt. of MP. The DPR is under techno-economic appraisal in CWC. The component wise details of irrigation planning and command area development of Kotha Barrage is given in the following paras.

6.1 Betwa Command

During meeting convened by Hon'ble Minister (WR, RD & GR) held on 18th November, 2016 with NWDA and Government of MP, it was decided that Kotha Barrage with increased height will be retained under Phase-II. A detail of command area under Kotha Barrage is given in **Table-6.1**.

Table 6.1
Details of Project Wise Command Area

S. No.	Name of Project	Command Area (ha)	Benefited Districts
1.	Kotha Barrage	20,000	Vidisha
	Total	**20,000**	

6.1.1 Kotha Barrage

6.1.1.1 Location of Command

The proposed command of this barrage is situated on the left and right bank of river Betwa. On right bank, the command boundary is made by Bina river and district boundary of Sagar (some small area of Sagar district is included in command) whereas on left flank , command area is confined to Naren river on upstream side and Kethan river and by the district boundary of newly formed district Ashok Nagar on downstream side. The proposed command covers mostly Vidisha district with small coverage of areas in Sagar district. The irrigation to the proposed command is basically divided in two types. Command area map of Kotha Barrage is shown at **Plate-4.**

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6.1.1.2 Method of Irrigation

Pressurized pipe micro irrigation system in 10,000 ha of left flank and 10,000 ha on right flank by lifting the water through booster pumping has been used.

6.1.1.3 Type of Soil

The command on both of flanks which is basically a doab between Bina and Betwa on right flank and doab between Betwa and Kaithan are very fertile. The command is mainly consisting of medium to deep black cotton soil area and is having a good water retention capacity. The command on both of flanks, particularly on left flank is having good natural drainage in form of Naren river, Khariya Nalla, Kethan river and other number of local Nallas joining river Betwa at regular intervals. Thus, drainage will not be a severe problem.

6.1.1.4 Existing and Proposed Cropping Pattern

The farmers of command area are already practicing high yielding crops in Kharif and Rabi seasons. But due to absence of assured irrigation not only their productivity is low but they are also not getting encouragement for further adoption of new improved agriculture technology and advancement in agriculture.

The proposed command area is having a general leveled terrain with a gentle slope towards river Betwa but the fields are not subjected to leveling nor has chakbandi been exercised in this area. The quantum of water in river Betwa is limited as compared to large agriculture areas of Vidisha where Rabi crops are exercised in more than 5 lakhs ha and Kharif crops are also more than 2.50 lakhs ha. Thus, to have a maximum coverage of irrigation with limited water quantity available, micro irrigation system has been proposed for whole of command area between to 0.60 to 1.20 ha where water for irrigation will be provided through Pressurized pipe micro irrigation system with a available residual pressure head of about 15-20 m.

6.1.1.5 Command Area Development

The proposed command is having a very good network of CMGSY road, Prime Minister Gramin Sadak Yojna road, PWD road, state highway and main WCR railway network running all through the command area between Gulabganj and Kurwai railway station. Thus, post irrigation problems in terms of selling of increased agricultural produces, exercising other allied agricultural activities with the irrigation facility will not be a problem.

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6.1.1.6 Crop Water Requirement

By providing micro irrigation between to 0.60 ha to 1.20 ha in 10,000 ha of left flank and 10,000 ha on right flank by lifting the water and providing water in a pressurized irrigation network through booster pumping. Annual irrigation in Kotha Barrage is planned for 25,500 ha.

Earlier, variable irrigation water demand (from 56.886 MCM to 88.629 MCM instead of consideration of irrigation demand worked out in the DPR as 99.92 MCM) under the project were considered by the project authorities for the purpose of preparation of working tables. The project authorities were asked to consider a firmed up irrigation water demand for the purpose of preparation of working tables to assess the desired success rate of the project. The project authorities have now reworked out the irrigation demand as 109.64 MCM and the same has been considered in the working tables. The irrigation water demand for the proposed cropping pattern worked out as 109.64 MCM by the project authorities is found to be in order.

The Irrigation Water Requirement vetted by Irrigation Planning (S) directorate is enclosed as **Annexure-1.3.3.**

6.1.1.7 Pre-Paid Control and Meter System (Optional)

A prepaid smart farmer card system is proposed for the Kotha Barrage. The prepaid system is based on providing every farmer with a user card with a photo ID and user number. The cards are loaded with credit and are inserted into a slot in the prepaid meter and water pumps automatically with the charge levied against the credit on the card. The smart cards are topped up by a vendor who would collect payments from users (farmers) and deposit the collected funds into the bank account of the system operator. The vendor would be paid, typically on a commission basis, according to the amount of water sold. The process uses technology and management similar to cell phones.

The benefits of the prepaid system include:

i. Water use efficiency gains as farmers use the water more carefully.
ii. Flexible on-demand irrigation supply to farmers.
iii. 100% financial cost recovery from users (farmers) according to amount of water each used
iv. Elimination of any “rent seeking” from pump owners and operators or corruption or loss of funds.
v. The system is completely transparent with checks and balances to counter fraud.

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With buried pipes, paddy “lock-in” is averted and farmers may cultivate a range of crops in efforts to reduce water bills as well as increased incomes. Farmers can irrigate throughout the year including options for supplementary irrigation in the Kharif as well.

At first, this pre-paid smart card control system appears as a magic to the farmers in MP. The farmers would be able to implement irrigation after recharging this card. This is quite a surprising facility that farmers have had ever hoped for. The pre-paid meter usage in the irrigation program will entirely change the canvas of agriculture alike the cell phone prepaid system. Farmer receives the amount of water as much as he has recharged. Getting the irrigation facility through the taxation system is now under the complete control of the farmers. The farmers as well as the pre-paid card dealers now have hold of the total concept. Farmers can avail water for their cultivable lands while inserting the card at the right place. Even, they get to know their balance amount and what amount of water could he avail from the specific balance.

The farmers had to face a variety of harassment while roaming here and there to fetch irrigation facility. There were incidents of looting of the total payment for the irrigation tax and at the same time, incidents like farmers being cheated and devastated at the hands of the intermediaries. The technology has reached every corner and farmers getting easily access too.

Through this technological advancement, farmers are being benefited, the same way the waste of irrigation-water is being stopped. Agriculture is becoming technology reliant, which is the current tide of time worldwide. After buying pre-paid irrigation card, water is reaching the cultivable lands of the farmers through the pressurized pipe outlet. This is undoubted great innovative system for the farmers but it is responsibility to the respective authority to ensure the benefits all over Kotha Barrage command.

A pre-paid smart card control system have been considered which is comprising a smart card controlled volumetric water meter and valve which would be installed at the head of buried pipe system downstream of the header tank. This system would be new to Vidisha (even in MP and India too) is suited to locations where there is no / little electric power.

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The smart card with a volumetric water meter can be used if there is a diesel pump.

6.2 Summing Up of Command Area and Water Requirement from Kotha Barrage

The abstract of component wise break up of command area and water requirement from Kotha barrage as finalized in Comprehensive Report is given in **Table-6.3.**

Table-6.3
Component Wise break up of Command Area and Water Requirement from Kotha Barrage

Component	CCA (Lakh ha)	Water Requirement (MCM)				Environ-mental Releases
		Irrigation Demand	Transmission losses	Domestic & Industrial Demand	Total	
Kotha Barrage (MP)	0.2	109.64	---	6.6**	116.24	2.5

** Domestic & Industrial Demand

CHAPTER-VII

CONSTRUCTION PROGRAMME, MANPOWER DEPLOYMENT & PLANT PLANNING

7.0 Background

The present chapter deals with construction methodology, manpower deployment &equipment planning for construction of various projects components under KBLP. The construction planning of Kotha Barrage have been done by Government of MP and included in the Comprehensive Report.

7.1 Kotha Barrage

The construction methodology for the structure has been described under the relevant sub sections of this chapter. The type and sizes of the equipment to be used have also been indicated while describing the construction methodology. As mentioned in para 7.1.3 that major construction works are to be executed through award of contract. Therefore, no provision of major construction equipment has been kept under this head. Main activities to be undertaken for construction of Kotha Barrage are surface excavation and concreting.

7.1.1 Surface Excavation

Surface excavation involves common excavation in overburden. One working season has been considered for undertaking surface excavation pertaining to Kotha Barrage. The estimation of hourly quantity of excavation is given in **Table-7.1**.

Table-7.1
Estimation of Hourly Quantity of Excavation

Type / Description	Excavation
Total volume (cum)	6,44,000
Time period (months)	8
Shift proposed	2
Total operational hours (hr)	2,200

Volume to be handled in-situ (cum/hr)	293
Volume to be handled loose (cum/hr)	366
Peak Volume to be handled (cum/hr)	457
Total quantity	**457 cum/hr**

7.1.2 Concreting

For concreting of Kotha Barrage, total quantity of the order of 161000 cum, will have to be placed. A period of 3 working season has been planned for the placement of concrete. The rate of placement concrete works out to 30 cum/hour approximately. The concrete required for the barrage is proposed to be produced in batching and mixing plant of capacity 45 cum/hour at site. The plants shall be located in the vicinity of the barrage. The concrete from the plant will be transported with the help of transit mixers of 4.5 cum capacity. 2 nos. 15 cm/hr to 25 cm/hr concrete purpose will be used for concrete placement.

7.1.3 Construction Programme

The sequence of construction of Kotha Barrage across Betwa River takes into account the following aspects.

- Surface excavation of barrage to start during the 4^{th} quarter of Year 1 to complete within 5 months.
- Concreting of barrage to start in the 2^{nd} quarter of 2^{nd} year and the concreting upto river bed level will be completed before the monsoon season.
- Concreting of balance quantity will be completed in another 8months and total concreting will be completed by the end of 2^{nd} quarter of year 3.
- Gate installation work of barrage to start in the beginning of 1^{st} quarter of year 3 and will be completed by the end of 2^{nd} quarter of years.

It is proposed to carry out work in non-monsoon period for at least upto the floor for full length of barrage. A coffer dam of 4height may be required to divert the water river to facilitate construction of barrage. The construction of all civil structures is proposed to be completed by the end of 4^{th} quarter of 4^{th} year.

7.1.3 Implementation Mechanism

The implementation of Ken Left Bank Canal which totally lies in Madhya Pradesh and all sub-canals and distribution network for irrigation and other purposes within Madhya Pradesh will be done by Government of Madhya Pradesh.

The implementation of Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project will be carried out by Government of Madhya Pradesh.

7.2 Year Wise Allocation of Cost

The total cost of the Kotha Barrage is worked out to be Rs. **761.35** crore. The yearly phasing of the same is given in **Table-7.2** and construction schedule for Kotha Barrage is placed at **Annexure-7.1.** Expenditure during first year is mainly for payment of NPV of PTR/Forest Land, CAMPA Fund, Partly Land acquisition and Development of Infrastructure for Construction etc.

Table-7.2
Yearly Phasing of the Cost of Project

Year	Kotha Barrage
1	114.20
2	220.79
3	213.18
4	213.18
5	0.00
6	0.00
7	0.00
8	0.00
Total	**761.35**

7.3 Benefits

(i) Estimated Cost of Increased Production

The crop wise yields in pre and post project scenarios have been assessed. Based on the increased production, cost of increased production has been assessed in **Chapter-X of this report.**

(ii) Likely Socio-Economic Aspects

Due to increase in food grain production, the socio-economic condition of farmers will improve in general. Agricultural labourers will get employment in the nearby area of all four projects. Situation of livestock will improve. Farmers will try to establish agro-based industries in the area.

CHAPTER-VIII

ENVIRONMENTAL IMPACT ASSESSMENT & ENVIRONMENTAL MANAGEMENT PLAN

8.0 General

The present chapter deals with Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) of various projects components under KBLP. The EIA studies of KBLP as proposed earlier were done by Agriculture Finance Corporation (AFC) Ltd., Hyderabad and included in DPR of April, 2010. The EIA studies were further modified in 2015 considering latest data and in the accordance with provisions of the "Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013" and incorporating suggestions/comments of MOEF&CC. The EIA study of Kotha Barrage is under process with Government of MP.

8.1 Need for Impact Assessment

KBLP involves impoundment of water by construction of a dam across river Ken at Daudhan for irrigation, drinking and hydro-electric purpose besides transfer of water from Ken river to Betwa river in u/s of Parichha Weir. Water, so transported to Betwa river is further proposed to be utilized in Upper Betwa basin on substitution basis in KBLP. As it is well known, any water resources development project may result in both positive and negative impacts on the environment. Such projects require a detailed study of various aspects for identifying positive and negative impacts that may occur in the area and also to formulate a meaningful and applicable management plan to mitigate these adverse environmental impacts, or if possible completely eliminate.

8.1.1 Project Background

Ken and Betwa rivers have their origin in MP and the rivers flow through MP and UP. No major irrigation projects were taken up in the Ken River basin in MP up to Gangau Weir to harness the waters to irrigate the backward and drought prone areas in the districts of Chhatarpur, Panna, Damoh and Tikamgarh of MP and Jhansi & Mahoba districts of UP.

A large population in Chhatarpur, Tikamgarh, Panna & Damoh districts of MP and Jhansi, Mahoba & Lalitpur districts of UP experienced acute shortage of drinking water. In this context, the proposed Ken-Betwa Link Project finds significance. As the proposed project has been found to be techno-economically viable, it is expected that the proposed project is likely to meet the requirements to the tune of 6,98,432 ha besides providing drinking water of 60 MCM in MP, 67 MCM in UP and generating 78 MW of power which is an added advantage of the project from Daudhan Dam. Besides, 2,06,000 ha from Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project in Shivpuri, Datia, Sagar and Vidisha districts of MP will be irrigated.

8.1.2 Project Justification

The National Water Policy (2002) emphasizes the need for interlinking of rivers in the country from water surplus areas to water short areas based on NPP after taking into account the requirement of the surplus areas/basins. This shall be a significant step forward to achieve the objective of equitable distribution and utilization of our limited water resources.

8.1.3 Project Description

The Comprehensive Report of KBLP comprises the following:

8.1.3.1 Head Works &Distribution System

8.1.3.1.1 Daudhan Dam Comprises

(i) An earthen embankment cum concrete dam across Ken River at Daudhan with FRL/MWL 288 m.

(ii) An Upper Level Tunnel about 170 m from the left bank of Daudhan dam having length of 1.9 km for conveying water to the link water carrier.

(iii) A Lower Level Tunnel about 100 m from the left bank of Daudhan dam having length of 1.1 km for conveying water to the Power House-II and from there to the Left Bank Canal of MP through a connecting channel of about 2.5 km.

(iv) Power House-I (2x30 MW) to the right of spillway at the toe of Daudhan dam.
(v) Power House-II (3X6 MW) at the outlet of Lower Level Tunnel.

8.1.3.1.2 Kotha Barrage Comprises

(i) A barrage across Betwa river at village Kotha, Tehsil Ganj Basoda, district Vidisha, Madhya Pradesh.
(ii) Pump Houses and Rising Mains

8.1.3.1.3 Bina Complex Multipurpose Project Comprises

(i) Four storage dams: Madia & Chakarpur on Bina River,, Semra Ghat Diversion on Dhasan River and Dehra Dam on Dehra Nalla.
(ii) Pump Houses, Rising Mains and Power Houses.

8.1.3.1.4 Lower Orr Project Comprises

(i) An earthen embankment cum concrete dam across Orr River near village Didauni, in district Shivpuri, Madhya Pradesh.
(ii) Pump Houses, Rising Mains and link water carrier.

8.1.3.1.5 Repair/strengthening/remodeling of Bariyarpur pick up weir, Parichha weir, Barwa Sagar Dam along with appurtenant structures and 7.1km long Barwa Nallah to carry water from Barwa Sagar to Betwa river upstream of existing Parichha weir.

8.1.3.1.6 Construction of two new barrages along with appurtenant structures d/s of existing Bariyarpur Pick up weir in the territory of UP.

8.1.3.1.7 Renovation of existing tanks and their connecting links in Mahoba district and carrier system for transfer of water from Ken Betwa link canal to tanks in order to enable UP to store the monsoon water to use during non-monsoon season.

8.1.3.2 Canal Pipe Line and Command Networks

8.1.3.2.1 Ken Basin

(i) A link canal (220.624 Km long including 1.9 m length of Upper Level Tunnel) with off take FSL 257 m to existing Barwa Sagar with FRL 219.20 m across Barwa Nallah, a tributary of Betwa River.

(ii) A bye pass channel from exit of Lower Level Tunnel to connect proposed Ken Left Bank Canal of MP.

(iii) Pumping system arrangements for lifting of water to Upper Level Tunnel to ensure the water supply in the Ken-Betwa link canal whenever reservoir depletes below the crown level of Upper Level Tunnel.

(iv) Developing pumping system, pipe distribution network and micro irrigation system by lifting water from Daudhan reservoir/initial reach of Link water carrier to serve a part of high level command (43,678 ha.) of Chhatarpur District of MP.

(v) A 90 km long proposed ken Left Banal Canal of MP and developing pumping system, pipe distribution network and micro irrigation system for ken Left Bank Canal to serve 1,39,848 ha. CCA in Chhatarpur District.

(vi) From existing Bariyarpur LBC 38,890 ha. CCA will be covered by existing open canal network in Chhatarpur District of MP.

(vii) Developing pumping system, pipe distribution network and micro irrigation system for 90,101 ha. CCA by lifting water from Daudhan reservoir, out of which 70,000 ha. CCA will be in Panna District and 20,101 ha. CCA will be in Damoh District of MP.

(viii) Developing pumping system, pipe distribution network and micro irrigation system from Ken-Betwa link canal to serve left out area of 42,096 ha. of high level command & 96,751 ha. Enroute command of MP and 17,488 ha. of enroute command of UP.

(ix) Stabilization of irrigation in 1,92,479 ha. in Banda district in UP under existing Ken command by repair/strengthening of existing system. Enhancing command area of Bariyarpur Right Bank Canal (Ken Canal) system by utilizing pressurized pipe micro irrigation system.

8.1.3.2.2 Betwa Basin

(i) Kotha Barrage: - Pumping system, pipe distribution network and micro irrigation system for 20,000 ha. CCA of MP.

(ii) Bina Complex Multipurpose Project: - Pumping system, pipe distribution network and micro irrigation system for 96,000 ha. CCA of MP.

(iii) Lower Orr Project:-Pumping system, pipe distribution network and micro irrigation system for 90,000 ha. CCA of MP.

(iv) Development of existing command of 37,564 ha. in Mahoba district in UP with pressurized pipe micro irrigation system.

8.1.4 Study Area of the Project

The study area considered for the Comprehensive EIA studies and preparation of EMP comprise the following:

- 1 km on either side of the canal
- 10 km radius around the project area from periphery of the project site
- submergence area under the proposed reservoir
- catchment area of dam/reservoir.
- command area on the d/s side of reservoir and en-route link canal
- areas of backwater influence on u/s side of dam

The EIA studies for newly proposed High level command and additional enroute command have not been carried out at this stage.

8.2 Kotha Barrage

According to submergence survey, no villages are coming under submergence when the barrage will be constructed. The submergence area of barrage is in the gorge portion and the total area under submergence will be 689 ha. The whole area is coming under private land. The EMP studies are being carried out by Water Resources Department, Government of MP. Therefore, the details will be appended after completion of the study. However, a provision of Rs. 1200 lakh has been kept for EIA study and implementation of R&R plan and maintaining the environment & ecology of the project area.

CHAPTER –IX
SOCIO-ECONOMIC ASPECTS AND R & R

9.0 Background

The present chapter deals with Socio-Economic Aspects and R&R studies of various projects components under KBLP. The studies of KBLP were done by M/s Agriculture Finance Corporation (AFC) Ltd., Hyderabad and included in DPR of 2010 and also techno-economically cleared by CWC in 2017. Environment clearance and 1st Stage forest clearances for the diversion of 6017 ha of forest land have been accorded by MoEF&CC vide its letters No.J-12011/20/2013-IA-I dated 25.08.2017 and letter No. F.No.8-49/2016-FC dated 25/05/2017 and same are appended as **Annexures-9.1 and 9.2** respectively.

In respect of Kotha Barrage, the Socio-Economic Aspects studies are being carried out by Water Resources Department, Govt. of MP. Environment and 1st Stage clearances for the diversion of 1024.44 ha of forest land in respect of Ken-Betwa link have been accorded by MoEF& CC vide its letters No.J-12011/31/2014-IA-I dated 22.02.2017 and letter No. F.No.8-13/2015-FC dated 27/07/2016 and same are appended as **Annexures-9.3 and 9.4** respectively.

9.1 Kotha Barrage And Canals

According to submergence survey, no villages are coming under submergence due to construction proposed barrage. The submergence area of barrage is in the gorge portion only. 689 ha of private land are coming under submergence. The Socio-Economic Aspects studies are being carried out by WRD, Govt. of MP**.** Therefore, the details will be appended after completion of report.

CHAPTER-X

COST ESTIMATE, BENEFIT COST RATIO AND FINANCIAL ASPECTS

10.0 Background

The present chapter deals with cost estimate, benefit cost ratio and financial aspects of various project components under KBLP. The cost estimate and benefit cost ratio of Daudhan Dam and its canal system was completed by NWDA and included in DPR of 2010 and already techno-economically approved by Central Water Commission in 2016. The cost estimate of headwork of Lower Orr Dam was prepared by NWDA, while, the cost estimate of carrier canal, gravity pipeline and rising mains have been prepared by the WRD, Govt. of MP and the same are adopted in the estimate. The cost estimate of Kotha Barrage and Bina Complex Multipurpose Project was completed by WRD, Govt. of MP and the same are adopted in the estimate by escalating at price level 2017-18. All these three projects are under techno-economic appraisal with CWC. The component wise details of cost estimate are covered in this chapter.

10.1 KBLP

The KBLP envisages construction of a dam at Daudhan on Ken river, Ken-Betwa link canal, two tunnels, two power houses, Ken LBC, Panna & Hatta Lift Irrigation Schemes and their canal networks, Lower Orr Dam at Didauni on Orr river at the border of Shivpuri and Ashok Nagar districts, Kotha Barrage at Kotha village on Betwa river in Vidisha district, Bina Complex Multipurpose Project consisting of four projects (Semraghat diversion dam on Dhasan river, Dehra Dam on Dehra nala, Madia and Chakarpur dam on Bina river) in Sagar district and their canal networks, repair /strengthening of Bariyarpur Pick up Weir on Ken river, Parichha Weir on Betwa river, Barwa Sagar Dam and training works of 7.1 km long Barwa Nalla alongwith developments in command areas of the project.

The Working Group Report of erstwhile Ministry of Irrigation, Govt. of India had issued broad guidelines for preparation of Detailed Project Report for major irrigation and multipurpose projects in 1980. These are based on the IS : 4877-1968 which have subsequently been updated with explanatory notes for each unit / minor head / sub-head. For

preparing the cost estimates of KBLP, these guidelines have been followed.

The cost estimates have been worked out by calculating the quantities of different items of the works involved for the execution of the project components. Quantity of Daudhan Dam, Ken-Betwa link canal & Ken LBC under main project was computed by NWDA on the basis of design carried out by CWC, for which, DPR of KBLP, Phase-I was already techno-economically appraised by CWC during 2016. Parameters of Daudhan Dam have been kept intact in the Comprehensive Report. However, the parameters of Ken-Betwa link canal & Ken LBC has been changed according to the new planning for Pressurised pipe micro irrigation system and inclusion of new/additional command area of MP & UP. The quantity and cost of these two canal system and additional Panna & Hatta LIS have been provided by Govt. of MP & the same are incorporated in the report. However, quantity and costing of main canal were carried out by NWDA. The cost estimate of Lower Orr Dam was prepared by NWDA with appropriate cost escalation. The cost estimate of Kotha Barrage and Bina Complex Multipurpose Project were made available by Government of MP. The cost estimate of these project after escalation by considering the Unified Schedule of Rates (USOR – 2017) of Govt. of MP are adopted in the Comprehensive Report.

The rates for some principal items of various works have been adopted from USOR - 2017 of Govt. of MP. As per Government of MP letter dated 23.07.2015, the escalation on the rates of various items can be escalated by overall 18% over the USOR - 2009 of MP to arrive rate at price level 2015-16 for working out the cost estimate of KBLP, phase-I which is approved by CWC. Accordingly, rate of various items which are not available in USOR – 2017 are considered by escalating overall 18% over the 2008-09 SOR rate and further escalated by 6% per year to arrive at price level 2017-18. Further it is revised at 2020-21 price level.

10.2 Classification of units

The cost estimate of the project has been grouped into the following units and shown in **Table 10.1.**

Table-10.1

General Abstract of Cost Estimate of the Kotha project

(Price level 2020-21)

(Rs. in Crore)

Sl.No.	Component	Unit-I	Unit-II	Unit-III	Total
		Head works	Canals	Power	
I	**Kotha Barrage & Canals**	367.34	347.25	46.76	**761.35**

Thus, the total cost of the project works out to **Rs. 761.35 crore at price level 2021-22**. The general abstract of cost of the project is given at **Annexure-10.1**. Relevant annexures pertaining to this chapter are placed in Volume-II: Cost Estimate. The details under various heads are described in the following paragraphs.

S.No.		Particulars	Amount (Rs. in Lakhs) 2020-21		
		Sub-head	Unit-I	Unit-II	Unit-III
A		**DIRECT CHARGES:**			
I		WORKS:			
	A	Preliminary	29.57	43.98	
	B	Land	13178.64	196.60	
		(i) Land acquisition		196.60	
		(ii) NPV,CA Plan			
		(iii) Rehabilitation & Resettlement			
		(iv) Lump sum amount proposed for Land aquisitution and R&R for proposed villages to be relocated to acquire 6017 ha revenue land.			
	C	Works	18840.68	9449.21	
	D	Regulators		0.00	
	E	Falls		0.00	
	F	Cross Drainage Structures		0.00	
	G	Bridges		1189.09	
	H	Escapes			
	K	Buildings	24.12	17.98	
		Temporary Buildings		17.98	
		Permanent Buildings			
		Hostel Accommodation (Temp.)			
	J	Civil Works			
	L	Earth work	0.00	826.29	

	M	Plantation	18.15	0.00	
	N	Reservoir & DC Tanks			
	O	Miscellaneous	186.94	0.00	
	P	Maintenance	209.09	312.56	
	Q	Special T&P	0.00	0.00	
	R	Communication	1835.20	534.74	
	S	Power plant (Rs. 6Cr per MW)		149.40	4240.00
	T	Water Supply	0.00	0.00	
	U	Distributary & Minors	0.00	18778.40	
	V	Water Courses	0.00	0.00	
	X	Environment & Ecology	12.00	0.00	
	Y	Losses on Stock & Unforeseen @ 0.25% on all heads excluding A, B,X & Q	52.79	78.14	10.60
		Total I-Works	**34387.17**	**31576.41**	**4250.60**
II		Establishment & Pensionary Charges @ 8%-10% of I-Works less B - Land	**1696.68**	**2510.38**	**340.05**
III		Ordinary T&P @ 1% of I - Works	**343.87**	**315.76**	**42.51**
IV		**Receipts & Recoveries**			
	(a)	Recoveries on account of resale value of Q - Special T&P 25%	0	0	0
	(b)	Recoveries by resale/transfer of Generator sets, electric lines, telephone lines and other accessories under Capital Cost of O-Miscellaneous @20%	-37.39	0.00	0.00
	(c)	Recoveries on account of resale value of Temporary Buildings @ 15%	0.00	-2.70	0.00
		Total Direct Charges	**36390.34**	**34399.86**	**4633.15**
B		**INDIRECT CHARGES**			
	(a)	Cost of abatement of Land Revenue on the area occupied by the Project @ 5% of (Rs 32399.20/68212.70	0.00	9.83	0.00
	(b)	Audit & Account Charges @ 1% of I - Works	343.87	315.76	42.51
		Total Indirect Charges	**343.87**	**325.59**	**42.51**
		NET COST	**36734.21**	**34725.45**	**4675.66**
Total (In Crores)			**761.35**		

10.2.1 Unit – I: Head Works

Unit-I Head works mainly includes cost of the Kotha Barrages & its appurtenant Structures.

Cost of I-Works for Kotha Barrage head works are given in **Table 10.2**.

Table 10.2

(Rs. in Lakhs)

Head works	**Kotha Barrage**
Total I-Works	34387.17
Net Cost	36734.21

The total cost of Unit-I: Head Works is estimated to be Rs. **367.34** crore. Details are given in **Annexure-10.1**. The sub-head wise details are given below.

10.2.1.1 A - Direct Charges

In general, direct charges cover minor heads like I-Works, II-Establishment, III- Tools & Plants, IV- Suspense and V- Receipts & Recoveries.

I-Works

A. Preliminary

Provision under this sub-head has been made to cover the actual expenditure incurred on detailed survey & investigation works mentioned below for preparation of Comprehensive Report of the project.

- Topographical surveys & investigations
- Hydrological & meteorological surveys
- Geological & Geotechnical surveys
- Construction material survey
- Seismic studies
- Construction of access roads to facilitate site investigations
- Charges for consultancy works for various studies and
- Preparation of Comprehensive Report

DPR of Kotha Barrage was prepared by Govt of MP, therefore, cost under this sub head for this project has been considered as per their DPRs. The details are given in **Annexures- 10.1.3.1.** The cost component of Unit-I of Preliminaries are given in **Table 10.2.1**

Table 10.2.1
A. Preliminary

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage	29.57

B. Land

Under this sub-head, provision for acquisition of land for construction of the project, colonies, offices, stores, stock yards, working area and approach roads etc. , compensation for houses, solatium charges, standing crops and other immovable properties, cost of resettlement colonies for displaced persons, economic rehabilitation of PAFs, training of R&R staff and PAFs etc. have been considered. The details are given in **Annexures- 10.1.3.2.** The cost component of Unit-I of B. Land is given in **Table 10.2.2**.

Table 10.2.2
B. Land

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage	13178.64

C. Works

This sub head includes cost of construction of following components:

- Earth dam, cofferdam, concrete dam (Over Flow & Non Over Flow), intake structure of Kotha Barrage.

The quantities and the cost of the components have been evaluated as per the design drawings supplied by the Specialized Directorates of CWC, New Delhi. Necessary provisions have been made for Spillway radial gates with embedded parts, stop logs and hoisting arrangements etc. The quantities and the cost of the components of Kotha Barrage have been evaluated by WRD, Govt. of MP and same are adopted in the cost estimate of KBLP. The details of works under this sub-head are given in **Annexures- 10.1.3.3.** The cost component of Unit-I of C. Works is given in **Table 10.2.3**.

Table 10.2.3

C. Works

Sl. No.	Component	Cost (Rs. in lakh)
I	Kotha Barrage	18840.68

K. Buildings

Provision has been made under this sub-head for construction of temporary & permanent buildings for both residential & non-residential buildings and hostel accommodation for various categories of staff, offices, inspection bungalow, circuit house, workshops, stores, sheds as well as other service buildings like hospital, schools, police station, post office & welfare center etc. The details under this sub-head are given in **Annexures- 10.1.3.5.** The cost component of Unit-I of K. Buildings is given in **Table 10.2.4**.

Table 10.2.4

K. Buildings

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage	24.12

M. Plantation

Under this sub-head, cost of proposed plantation in the colony, parks in the d/s of dams and along the approach roads to the dam sites have been considered. The details under this sub-head are given in **Annexures- 10.1.3.6.** The cost component of Unit-I of M. Plantation is given in **Table 10.2.6**.

Table 10.2.6

M. Plantation

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage	18.15

O. Miscellaneous

Under this sub head provision has been made to cover the cost of the following works

- Capital cost of electrification, water supply purification and distribution system, sewage disposal, medical equipment, firefighting equipment, furniture and crockeries for inspection bungalow and circuit houses, initial camp equipment for hospital, primary & secondary schools, community centre etc.
- R & M of above equipments/infrastructural facilities etc.
- R & M of inspection vehicles, market complex, police station, post office, pump house, telephone lines etc.

Provision has also been made for other miscellaneous items such as inaugural foundation laying ceremony, compensation to work men, visit of VIP dignitaries, anti malaria measures, security arrangements for dam sites, flood lighting, model studies, data processing machines etc. The details are given in **Annexures- 10.1.3.7.** The cost component of Unit-I of O. Miscellaneous is given in **Table 10.2.7.**

Table 10.2.7
O. Miscellaneous

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage	186.94

P. Maintenance

Under this sub-head provision has been made to cover the cost of maintenance of all works during the construction. A provision of 1% on cost of C-Works (Concrete Dam & Earthen Dam), Buildings and maintenance of roads has been considered. For Kotha Barrage Project, cost of P-Maintenance has been worked out in the DPRs prepared by Govt. of MP & Considered in the Estimate. The details are given in **Annexures- 10.1.3.8.** The cost component of Unit-I of P. Maintenance is given in **Table 10.2.8**.

Table 10.2.8
P. Maintenance

Sl. No.	Component	Rs in **lakh**
I	Kotha Barrage	209.09

R. Communication

Necessary provision has been made under this sub-head to cover the cost of widening of existing roads in the near vicinity of the project area, formation of approach roads to project area from the existing roads, W.B.M road from quarry sites to dam/barrage sites etc. The details of length of roads and costs are given in **Annexures- 10.1.3.9.** The cost component of Unit-I of R. Communication is given in **Table 10.2.10**.

Table 10.2.10
R. Communication

Sl. No.	Component	Cost (Rs. in lakh)
I	Kotha Barrage	1835.20

X. Environment and Ecology

This sub-head includes provision for extensive management measures to sustain environment and ecology such as catchment areas treatment, forestry & salve postural management/ afforestation/ deforestation, soil erosion control and water conservation measures, reservoirs rim treatment/green belt development, treatment of agricultural lands, compensatory afforestation, land management plan (stabilization of muck disposal management), restoration of quarry site, tourism development plan, provision for free fuel to department engaged labourers, bio-diversity management plan, restoration and land scrapping of project sites, fisheries development plan, ground water management plan, public health management, Environmental Monitoring Programme (EMP), dam break analysis and Disaster Management Plan. The details are given in **Annexure- 10.1.3.10.** The cost component of Unit-I of X. Environment and Ecology is given in **Table 10.2.11.**

Table 10.2.11
X. Environment and Ecology

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage	12.00

II-Establishment

The project is planned to be completed in a period of 8 years. Provision has been made @ 8% of I-Works excluding B- Land towards establishment & pensioner charges. The details are furnished in **Annexure 10.1.** The cost component of Unit-I of II-Establishment is given in **Table 10.2.13.**

Table 10.2.13
II-Establishment

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage	1696.68

III-Ordinary Tools & Plant

Provision has been made under this head for ordinary Tools & Plant @ 1% of I-Works. This provision is distinct from the Q-Spl. T&P and is meant to cover the cost of survey instruments, camp equipment and other small tools & plant. The details are furnished in **Annexure 10.1.** The cost component of Unit-I of III-Ordinary Tools & Plant is given in **Table 10.2.14.**

Table 10.2.14
III-Ordinary Tools & Plant

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage	343.87

Suspense

It is assumed that all the outstanding suspense would be cleared by adjustment to appropriate heads on completion of the project. As such no provision has been kept under this head.

IV- Receipt & Recoveries

Under these head, estimated recoveries by way of resale or transfer of temporary buildings, special T&P and by resale or transfer of generator sets, electrical lines, telephone lines and other accessories are accounted for and provision has been made accordingly. The details are furnished in **Annexure- 10.1.** The cost component of Unit-I of V- Receipt & Recoveries is given in **Table 10.2.15.**

Table 10.2.15
IV- Receipt & Recoveries

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage	37.39

10.2.1.2 B - Indirect Charges

Provisions for abatement of land revenue and audit & account charges are covered under 'Indirect Charges' at the following rates

- Abatement of land revenue - 5% of cost of land
- Audit and account charges - 1% of I-Works

The details are furnished in **Annexure- 10.1.** The cost component of Unit-I of B - Indirect Charges is given in **Table 10.2.16**

Table 10.2.16
B - Indirect Charges

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage	343.87

10.2.2 Unit – II: Canals

Unit-II Canal system covers the cost of the following structures alongwith their appurtenant works.

- Kotha Left and Right bank Rising mains

Cost of I-Works for each Canal system is given in **Table 10.3**.

Table 10.3
Cost of I-Works for each Canal system

(Rs. in Lakh)

Unit –II Canal system	**Kotha Barrage**
Total I-Works	31576.41
Net Cost	34725.45

The total cost of Unit-II: Canal system is estimated to be Rs. 347.25 crore at 2020-21 price level. Details are given in **Annexure- 10.1**. The sub-head wise details are discussed in the following paragraphs.

10.2.2.1 A - Direct Charges

I-Works

A. Preliminary

Provision under this sub-head has been made to cover the actual expenditure incurred on detailed survey & investigation works mentioned below for preparation of Comprehensive Report of the project.

- Topographical surveys & investigations
- Geological & Geotechnical surveys
- Construction material survey
- Vehicle charges for inspecting officers for site investigations
- Survey & Camp equipment
- Charges for consultation for various studies
- Actual expenditure on establishment and
- Preparation of Comprehensive Report

However, for detailed survey & investigations for establishing the final locations of different project components at pre-construction stage, a lump sum provision of 2% of I-Works has been considered under this sub-head. While DPRs of Kotha Barrage were prepared by Govt of MP, therefore, cost under sub head for the projects has been considered as per their DPRs. The details are given in **Annexure 10.2.5.1.** The cost component of Unit-II of A. Preliminary is given in **Table 10.3.1.**

Table – 10.3.1
A. Preliminary

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage Canal System	43.98

B. Land

Under this sub-head, provision for acquisition of land for construction of canals and approach roads, colonies, canal structures etc. , solatium charges, standing crops and other immovable properties, rent for use of land prior to acquisition, economic rehabilitation measures etc. have been considered. The details are given in **Annexure 10.2.5.2.** The cost component of Unit-II of B. Land is given in **Table 10.3.2.**

Table – 10.3.2
B. Land

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage Canal System	196.60

C. Works

Under this sub-head the cost of their intake structures, and bypass arrangements from surge tank to connecting canal etc. have been considered. The quantities and the cost of the components have been worked out as per the designed drawings made available by the Central Water Commission, New Delhi. Necessary provisions have been made in

the estimate for service gates and emergency gates with embedded parts, stop logs and rope drum hoisting arrangements etc. The details of works under this sub-head are given in **Annexure 10.2.5.3.** The cost component of Unit-II of C. Works is given in **Table 10.3.3.**

Table – 10.3.3
C. Works

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage Canal System	9449.21

G. Bridges

The bridges (major & minor) are required to be constructed. Necessary Provision has been made for these bridges. The estimate is prepared based on the cost curves. The details are given in **Annexures-10.2.5.** The cost component of Unit-II of G. Bridges is given in **Table 10.3.4**

Table – 10.3.4

G. Bridges

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage Canal System	1189.09

K. Buildings

Provision has been made under this sub-head for construction of temporary & permanent buildings for both residential & non-residential buildings for various categories of staff, offices, inspection bungalow, stores, club-cum-welfare hall, laboratory & research station etc. Rates have been adopted for these buildings based on the plinth area and prevailing market rates. The details under this sub-head are given in **Annexure- 10.2.5.4.** The cost component of Unit-II of K. Buildings is given in **Table 10.3.5.**

Table – 10.3.5

K. Buildings

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage Canal System	17.98

L. Earthwork & Lining

The quantity of excavated earth motional from the project to locations based on the type of soils and the quantity of earthwork required for embankment from borrow areas are worked out separately. The detailed estimates are prepared considering the cross sections taken at 50 m interval along the canals and detailed drawings made available by CWC, New Delhi at various sections. Provision is also made for branch canals proportionate to the discharges of the main canal. Lining is provided for both main and branch canals at bed and side slopes in the entire length of canals as per the drawings. Provision is also made in the estimates for pressure relief and drainage arrangements under lining, expansion joints etc. The details under this sub-head are given in **Annexures- 10.2.5.5.** The cost component of Unit-II of L. Earthwork & Lining is given in **Table 10.3.6**

Table – 10.3.6

L. Earthwork & Lining

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage Canal System	826.29

M. Plantation

Under this sub-head, no provision of plantation in the colony areas and along the main canals & branch canals on both sides. The details are given in **Annexures - 10.2.5.** The cost component of Unit-II of M. Plantation is given in **Table 10.3.7.**

Table – 10.3.7
M. Plantation

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage Canal System	0.00

N. Reservoir & DC Tanks

Under this sub-head, no provision for reservoir & DC tanks under Kotha Project. The details under this sub-head are given in **Annexure- 10.2.5.** The cost component of Unit-II of N**.** Reservoir & DC Tanks is given in **Table 10.3.8.**

Table – 10.3.8
N. Reservoir & DC Tanks

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage Canal System	0.00

O. Miscellaneous

Under this sub head, no provision has been made. The details are given in **Annexures-10.2.5.6.** The cost component of Unit-II of O. Miscellaneous is given in **Table 10.3.9.**

Table – 10.3.9
O. Miscellaneous

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage Canal System	0.00
	Total	**0.00**

P. Maintenance

Under this sub-head, provision has been made to cover the cost of maintenance of all works during the construction. A provision of 1% on cost of C-Works, K-Buildings and R-maintenance of roads has been considered for Kotha Barrage Project, cost of P-Maintenance which are worked out in the respective DPRs prepared by Govt. of MP are considered in the estimate. The details are given in **Annexure-10.2.5.7.** The cost component of Unit-II of P. Maintenance is given in **Table 10.3.10.**

Table – 10.3.10
P. Maintenance

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage Canal System	312.56

R. Communication

Under this sub-head, provision for construction of temporary roads and remodeling of existing roads for approach to canal and regulatory system, quarry sites and other working areas has been kept. The details are given in **Annexure 10.2.5.8.** The cost component of Unit-II of R. Communication is given in **Table 10.3.11.**

Table – 10.3.11
R. Communication

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage Canal System	534.74

S. Power Plants & Electric System

In Kotha Barrage Project, the cost towards providing power plant structures, pipes and other components is provided under this sub-head. The details are given in **Annexure 10.2.5.9.** The cost component of Unit-II of S. Power Plants is given in **Table 10.3.12.**

Table – 10.3.12

S. Power Plants & Electric System

Sl. No.	Component	Cost (Rs. in lakh)
I	Kotha Barrage Canal System	149.40

U. Distributaries up to 1.2 to 0.6 ha.

Under this sub-head, provision has been made for providing distributaries pressurize irrigation network system for the total culturable command area of the project. The details are given in **Annexure-10.2.5.10.** The cost component of Unit-II of U. Distributaries & Minors is given in **Table 10.3.13.**

Table – 10.3.13

U. Distributaries & Minors up to 1.2 to 0.6 ha.

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage Canal System	18778.40

II-Establishment

Provision has been made as per norms i.e. @ 8% of I-Works excluding B- Land towards establishment & pensioner charges except for Ken-Betwa Link canal. However, Establishment charges @ 10% considered by CWC for Ken – Betwa Link Canal has been adopted. The details are given in **Annexure-10.1** for Kotha Barrage Canal System. The cost component of Unit-II of II-Establishment is given in **Table 10.3.14.**

Table – 10.3.14

II-Establishment

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage Canal System	2510.38

III- Tools & Plant

Provision has been made under this head for ordinary tools & plant @ 1% of I-Works. This provision is distinct from the Q-Spl. T&P and is meant to cover the cost of survey instruments, camp equipment and other small tools & plant. The details are given in **Annexures – 10.1** for Kotha Barrage Project The cost component of Unit-II or III- Tools & Plant is given in **Table 10.3.15.**

Table – 10.3.15
III- Tools & Plant

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage Canal System	315.76

IV- Receipt & Recoveries

Under this head, estimated recovery by way of resale or transfer of temporary buildings, special T&P and by resale or transfer of generator sets, electrical lines, telephone lines and other accessories are accounted for and provision has been made accordingly. The details are given in **Annexures – 10.1** for Kotha Barrage Canal. The cost component of Unit-II of IV- Receipt & recoveries is given in **Table 10.3.16.**

Table – 10.3.16
IV- Receipt & Recoveries

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage Canal System	2.70

10.2.2.2 B - Indirect Charges

Provisions for abatement of land revenue and audit & account charges are kept under 'Indirect Charges' at the following rates

- Abatement of land revenue - 5% of cost of land
- Audit and account charges - 1% of I-Works

The details are given in **Annexures – 10.1** for Kotha Barrage Canal System. The cost component of Unit-II of B- Indirect Charges is given in **Table 10.3.17.**

Table – 10.3.17

II of B- Indirect Charges

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Barrage Canal System	325.59

10.2.3 Unit – III: Hydroelectric Installation

Solar Power plants of 8 MW is proposed in the Kotha Barrage wherein power generated by this plant to be utilized for pumping water for irrigation.

Unit-III "Hydro electric installation" contains the provisions for expenditure on installation of these power houses, penstocks, switch yards, tail race channel, various electromechanical equipments, transmission lines etc. The total cost of unit – III for Kotha Barrage is estimated to be Rs 46.76 crore respectively at 2020-21 price level.

Cost of I-Works for each Power plant is given Table **10.4** as under:

Table 10.4

Cost of I-Works for each Power plant

(Rs. in Lakh)

Power Plant	Kotha Barrage
Total I-Works	4250.60
Net Cost	4675.66

The details are given at **Annexure - 10.1.** The sub-head wise details are given below:

10.2.3.1 Direct charges

S. Power plant & electromechanical works

Cost of Power plant at Kotha Barrage by Govt. of MP has been considered in the Estimate. The details under this sub-head are given in **Annexure – 10.1 & 10.3.4.** The cost component of Unit-III of Power plant & electromechanical works is given in **Table 10.4.1.**

Table – 10.4.1
Power Plant & Electric System

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Solar Power Plants	4240.00

II-Establishment

Provision has been made as per norms @ 8% of I-Works excluding B- land towards establishment & pensionary charges. The details are given in **Annexures 10.1.** The cost component of Unit-III of II-Establishment are given in **Table 10.4.2.**

Table – 10.4.2
II-Establishment

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Solar Power Plants	340.05

III- Tools & Plant

Provision has been made under this head for ordinary Tools & Plant @ 1% of I-Works. This provision is distinct from the Q-Spl. T&P and is meant to cover the cost of survey instruments, camp equipment and other small tools & plant. The details are given in **Annexure 10.1.** The cost component of Unit-III of III- Tools & Plant is given in **Table 10.4.3.**

Table – 10.4.3
III- Tools & Plant

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Solar Power Plants	42.51

IV- Receipt & recoveries

Under this head, estimated recovery by way of resale or transfer of special T&P and by resale or transfer of generator sets, electrical lines, telephone lines and other accessories are accounted for and provision has been made accordingly. The details are given in **Annexure No. 10.1**. The cost component of Unit-III of IV- Receipt & recoveries is given in **Table 10.4.4.**

Table – 10.4.4
IV- Receipt & Recoveries

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Solar Power Plants	0.00

10.2.3.2 Indirect charges

Provisions for abatement of land revenue and Audit & account charges are kept under 'Indirect charges'.

- Abatement of land revenue - 5% of cost of land
- Audit and account charges - 1% of I-Works.

The details are given in **Annexure 10.1**. The cost component of Unit-III of Indirect charges is given in **Table 10.4.5**

Table – 10.4.5
Indirect charges

Sl. No.	Component	Cost (Rs in lakh)
I	Kotha Solar Power Plants	42.51

10.2.4 Unit – IV: Navigation works

Navigation is not proposed under this project. Hence, no provision is required under this sub head.

10.2.5 Unit – V: Water supply works

The project envisages providing drinking water in command areas as well as to the urban centers adjacent to canal alignment. Water will be supplied through main canals and various branch canals, whose cost is considered under Unit -II: Canal system. However, water supply network to the local areas will be the responsibility of the local development body / local administration. Hence, no provision towards water supply works at local level has been kept under this head.

10.2.6 Unit – VI: Command Area Development

The total culturable command area covered under the project is 20000 ha. The cost of command area development has already been covered under the subhead of X-Environmental under each head.

10.3 Revenues

10.3.1 Yearly programme of development

The link Project is scheduled to be completed in 4 years. Yearly programme of construction schedule of the project has been discussed in detail in Chapter-VII "Construction Programme, Manpower Deployment & Plant Planning".

10.3.2 Sources of Revenue

Ken-Betwa link project has been planned to provide irrigation in water short areas directly as well as in exchange. Also, the project envisages power generation and domestic water supply in the command area and adjacent towns along the canal. Accordingly, following would be the sources of revenue from the KBLP as a whole.

- Irrigation water rates
- Irrigation cess
- Sale of water for domestic water supply
- Sale of power

Other than the above, tourism & fisheries development in the project areas as described in brief in the Volume- VI "Reservoir" can also be one of the major sources of revenue on account of this project.

10.3.3 Water Rates –Irrigation Cess

(a) Water rates

A large infrastructural network such as this project being created for making water available in the proposed command areas for irrigation and drinking purposes besides power generation, needs to be self sustainable. Therefore, appropriate water pricing is quite necessary, so that cost of operation & management of project could be recovered from the beneficiaries of the project up to some extent. Water rates may be different for irrigation & non irrigation use. Water rates for irrigation use can be applied on the basis of per unit area irrigated. On the other hand, for drinking water supply, rates may be applied on the basis of per unit volume of water supplied, while power can be charged per unit basis.

The present range of water rates in MP is from Rs 50 to 960 per ha for both flow and lift irrigation. In Uttar Pradesh, it ranges from Rs.30 to 474 for flow irrigation & Rs 15 to 237 per ha for lift irrigation.

These charges are in addition to the irrigation cess & betterment levy to be paid and land revenue being paid by the land holder.

(b) Irrigation cess

As approved by the concerned State Govt., Irrigation cess would be recovered from all the land holders in the commands of the Ken-Betwa link project irrespective of whether the land holder takes irrigation water or not.

(c) Betterment levy

When a major project is constructed, it leads to appreciation of land prices in the areas lying in the vicinity of the project. In case of an irrigation project, better yields of crops are produced. On account of this appreciation in land prices and increased yields of produce, the land owners are required to pay some share to the Govt. as betterment levy.

10.3.4 Auction of Service, Land Lease, Auction and Navigational Permits.

Vacant lands on either side of canals may be leased for plantation of fruit bearing trees. Similarly, in project colony areas, land for shops may also be leased.

10.3.5 Power Rate

Installed capacity of solar power plant at Kotha Barrage is 8 MW. The average annual solar energy at Kotha Barrage worked out as 16080 MWh would be generated, at 90% dependability. This energy can be sold at prevailing rate of Rs. 6.43 per Kwh or utilize for pressurize irrigation in the area. The power generated at Kotha Barrage is proposed to be utilized for development of pressurized irrigation micro system under this project**.** Therefore, these energy is proposed to be purchased @ Rs. 6.43 per Kwh. Details are given in **Anneuxre-10.6 (b)**.

10.3.6 Navigation

No provision for development of navigation aspect has been kept in this project.

10.3.7 Other Sources (Pisciculture, Tourism, etc)

Revenue would occur from the project through allied benefits like pisciculture, tourism, etc. and these benefits have been considered in the benefit-cost analysis of the Project.

10.3.8 Concession in Water Rates (irrigation), Cargo and Passenger Rates, etc.

As the water rates (irrigation) prescribed by the States are highly subsidized, there appears to be no rationale for further concession of these rates in the project commands.

10.3.9 Administrative Charges for Supply of Water and Collection of Revenues etc.

Suitable provision has been made for running and maintenance of the canals, which include administrative charges for supply of water.

10.3.10 If the Area to be Irrigated is Prone to Scarcity, The Expenditure Normally Incurred to Redress the Scarcity

The area proposed to be irrigated enroute though link canal under Ken LBC is water short and devoid of assured supply.

10.3.11 Year in Which the Revenue Would Start Accruing From Various Sources Counting From the First Year of Construction

The construction of project is scheduled to be completed in 4 years. Benefits from PH-II are linked with irrigation development in Ken LBC System and hence, can be realized after completion of the project. Power benefits from Bina Complex Multipurpose Project, Solar Power from Lower Orr and Kotha Barrage can be realized in the fifth year.

10.3.12 Total Income from Various Sources

The total revenue from various sources is furnished in **Table-10.4**.

Table – 10.5
Source of Revenue

Sl. No.	Source of Revenue	Rs in crore
1	Agricultural produce	122.56
2	Sale of power	10.34
3	Domestic water supply	0.00
4	Fisheries	20.49
	Total	**153.39**

10.3.13 Details of Staff Proposed for Collection of Revenue and its Basis

Revenue Department of Governments of MP & UP would strengthen their existing system for collection of revenues.

10.3.14 Net Revenue Expected From Different Components of Project

It is estimated that the net value of produce after irrigation will be Rs. 12813.71 Lakh whereas it is Rs. 557.64 lakh before irrigation. Thus, the net annual irrigation benefits from the total command area works out to Rs. 12256.07 lakh. The average annual energy at Kotha Barrage worked out as 16080 MWh would be generated, at 90% dependability. The revenue from the sale of this power considering Rs. 6.43 per unit works out to Rs. 1033.94 lakh. It is also proposed to develop fisheries in the reservoirs, by which Rs. 2048.52 lakh of revenue could be generated. Thus, the net income/benefit from various sources is estimated to be Rs. 15338.53 lakh. Details are given in **Annexure-10.8.**

10.3.15 Productivity of Project in Terms of Percentage Financial Returns

For Kotha Barrage, pre project and post project production of the each crop has been extracted from their respective DPR. The DPRs of above two projects are already under techno-economic-appraisal in CWC. The details of productivity in the command area at pre and post project scenarios are given in **Annexure No. 10.4.1.1, 10.4.1.2, 10.4.1.5, 10.4.2.1, 10.4.3.1 & 10.4.4.1**. Details of productivity in the command area are given in Table**-10.6.**

Table-10.6
Details of Productivity in the Command Area

Unit: Quintals

Name of Project	Pre-project Production			Post Project Production		
	Kharif	**Rabi**	**Perennial**	**Kharif**	**Rabi**	**Perennial**
Kotha Barrage	53280	134030	0	137500	780000	0
Grand Total	**187310**			**917500**		
Net increase in produce	**730190 (389.83%)**					

10.4 Benefit– Cost (BC) Ratio and Internal Rate of Return (IRR)

The BC ratio and IRR has been worked out as detailed below:

10.4.1 Estimate of Annual Cost

Annual cost of the project as a whole has been worked out according to the guideline for preparation of Detailed Project Report of irrigating and multipurpose project of Ministry of Water Resources (2010) except the depreciation for pump system and rising main. In this guideline, the life of the pumping system and rising main is to be considered as 12 year and 30 years respectively. However, in present scenario, development of new techniques such as lamination and improvement in the quality of rising main and pump items, the life of the pumps and rising main may be considered as 33 years and 50 years respectively. Accordingly, while working out annual cost of the project, depreciation for the pumps and rising main are considered as 3.33% and 2% of their cost respectively. Details of annual cost of the project are given in **Table-10.7.**

Table-10.7
Details of Annual Cost of the Project

Rs. in Lakh

Sl. No.	Description	Annual Cost
1	Interest on capital @ 10% (Estimated total cost of the project including cost of land development)	7613.53
2	Depreciation of the project @ 1% of the cost of project for 100 years life of the project and @ 2% for 50 years life of the project	761.35
3	Annual operation and maintenance charges @ 1175 Rs Per Ha	235.00
4	Maintenance of the head works @ 1% of H/W cost less B Land	212.09
5	Depreciation of the pumping system @ 3.33% of the estimated cost of the pumping system assuming life of the system as 30 years (Applicable to lift irrigation)	71.16
6	Depreciation of the rising mains @ 2% of the estimated cost of the rising mains assuming life of the system as years (Applicable to lift irrigation)	168.92
7	Power Charges for lift water Rs 3376.8 @ per Ha.	675.36
8	**Total Annual Costs (G) = Sum (1 to 7)**	**9737.42**

10.4.2 Benefit Cost (BC) Ratio

As described in the above paras, the net annual benefits from various components of the project works out to Rs.**15338.53** lakh and the annual costs works out to Rs. **76135.32 lakh.** Thus the BC Ratio of the project works out to **1.58:1.** Detailed calculation is placed at **Annexure-10.5.**

10.4.3 Internal Rate of Return (IRR)

The project has been planned to be completed in a period of 4 years including pre-construction year. The phasing of the expenditure has been planned accordingly. The details of yearly expenditure chargeable to link project have been given in **Table 7.2.** Considering life of the project as 100 years, the IRR of the KBLP has been computed as **16.22 %.** The detailed calculations of IRR are given at **Annexure-10.6**.

10.4.4 BC Ratio for Flood Control Component of the Projects

No cushion in the reservoir storage is provided exclusively for flood control. Flood control is only an incidental benefit from Daudhan Dam. Hence, no B.C. ratio for flood control component of the project is worked out.

10.4.5 Benefits Other Than those Considered in the BC Ratio and IRR

While calculating BC ratio, benefits from irrigation, power, water supply and fisheries have been considered. However, project will also provide other benefits such as tourism, employment generation, industrial development, infrastructure development, socio-economic condition of people in project area. These benefits have not been accounted for.

CHAPTER- XI

OTHER ASPECTS

11.1 Foreign Exchange Element

The Govt. of India has declared the KBLP as one of the National Projects. As such, 90% of the cost of the KBLP is expected to be borne by Central Government whereas the balance 10% will have to be borne by the beneficiary states viz. MP and UP. Further most of the required materials like plant and machinery, spares, instruments, etc. are proposed to be purchased /hired locally from internal resources thereby requiring no import under foreign grants/credits from other countries. Thus, prima facie, no foreign exchange element is required for the project. However, if implementing agency of the project decides at a later date to import 'Turbine' or any other item of the project from other country, foreign exchange element will come into picture.

11.2 Revenue

The source of revenue from the project is mainly from the benefits accrued from the following items.

11.2.1 Irrigation Water Rates

Annual O&M cost of the project works out to Rs. 105.57 Crore (excluding O & M of power component) whereas benefited area from irrigation is Rs. 8.98 Lakh ha. The irrigation water rates will be collected from land holders to recover O & M cost of the project. The present range of water rates in MP state is from Rs.50 to Rs. 960 per ha for both flow and lift irrigation. In UP, it ranges from Rs.30 to Rs. 474 per ha for flow irrigation and Rs.15 to Rs. 237 per ha for lift irrigation. The land owners are free either to enter into an agreement with the Project authorities or to get irrigation on demand from time to time. However, these charges are in addition to the land revenue paid by them.

11.2.2 Betterment Levy

With the introduction of irrigation and improved method of cultivation, the yield of the crops and value of the land will appreciably increase. Therefore, land owners are to pay some share to the government for this

increase in the value of their lands. Subsequently, betterment levy can be charged from beneficiaries of existing command in Banda district of UP who are not getting adequate water for their command from existing system.

11.2.3 Sale of Power

11.3 Financial Resources

After getting techno-economic clearance from CWC and obtaining necessary statutory clearance from MOEF, Ministry of Tribal Affairs, etc., the DPR of the project will be put up to Planning Commission for investment clearance. The concurrence of Ministry of Finance will also be obtained. This project will be covered under central sector since it has already been announced as a National project and 90% of funding will be borne by central govt. Further, no foreign assistance/ aid will be required for this project since the entire cost will be met from internal resources of Government of India and State Governments.

11.4 Future Utilisation of Facilities (Buildings)

For Kotha Barrage existing building, offices and other infrastructures available nearby area will be utilized. Infrastructure required at site is proposed to be constructed only.

11.5 Legal Aspects of Inter basin Transfers Such as Impact on Existing Awards/Agreements/ Treaties

11.5.1 Existing Interstate Agreement on Sharing of Ken water

Since the Ken is an inter-state river between MP and UP, agreements were arrived at on Rangwan dam in the year 1972 on Ken canal and headworks of UP, Bariarpur left bank canal of MP and Urmil Project in the year 1977. In the meeting with Secretary, Irrigation & Power, Govt. of India held at New Delhi on 10.12.1981, it was decided that an upstream use of 80 TMC should be kept for the proposed KMPP. The **Table-11.1** furnishes the abstract of water use allocations as per the agreements and decision indicated above.

Table-11.1
Abstract of Water Allocation as per Earlier Agreements

Ken System	**Quantity**	
	MCM	**TMC**
Total 75% dependable yield at Ken dam	**4489.94**	**158356**
Water use by M.P. U/S of Ken	2265.60	80.00
Water use by M.P. ex-Ken	1375.22	48.56
Water use by U.P. ex-Ken	849.60	30.00
Total 75% dependable yield at Rangawan dam	**192.57**	**6.80**
Use by M.P. for Kharif crops (Existing use by M.P.)	56.64	2.00
Use by M.P. U/S of Rangawan dam	30.87	1.09
Use by M.P. from the balance water	8.78	0.31
Use by U.P. from the balance water	96.29	3.41
Water available to U.P. from the catchment between Ken, Rangawan Dam and Bariarpur barrage	**101.95**	**3.60**
Total water to be spared to U.P. from Ken system	**1047.84**	**37.00**

11.5.2 Proposed Memorandum of Agreement (MoA) amongst the states of MP, UP and Union Government on KBLP

The Clause-2 of the MoU dated 25.08.2005 indicates that specific MoUs as required will be entered into amongst the states of MP, UP and Union Govt. based on the DPR of KBLP and agreements reached on scope of the link, sharing of costs and benefits and arrangements for management and control of water etc. and that as DPR of KBLP has been prepared and to proceed further towards execution of the Link Project. The tripartite proposed MoA have been discussed several times amongst states of UP, MP and Union Govt. and have come to a mutual understanding on scope of the Link Project, sharing of water & Power, sharing of cost, benefits and mechanism for implementation of project as follows.

11.5.3 Existing interstate agreement on sharing of Betwa water between MP and UP

The river Betwa is an inter-state river between MP and UP. During British period two projects were constructed by Government of UP as early as in 1920. These are Dhukwan reservoir on the Betwa river upstream of Jhansi and Parichha weir downstream of Jhansi for Irrigation in UP. In order to supplement Dhukwan Reservoir, Matatila major project has been constructed by UP in the year 1953. The Matatila project was augmented for 0.45 lakh ha

(1.12 lakh acres) irrigation in MP through Bhander canal system and 1.07 lakh ha (2.64 lakh acres) irrigation in UP. Thereafter, Rajghat Dam has been constructed on river Betwa, upstream of Matatila Dam. Agreements between the two states of MP and UP have been drawn up for distribution of water at Matatila Dam and Rajghat Dam. The abstract of water use allocation without taking into consideration the regeneration is given in **Table 11.4** below:

Table – 11.2
Abstract of Water Use Allocation

S. No.	Description	MCM	TMC
1	Total 75% dependable surface water yield at Rajghat Dam	3370.08	119.00
2	Availability by inter valley water transfer upto Rajghat and being used directly for Bhopal Town water supply	-	-
3	Existing water use by MP 65.0 MCM, Future water use 65.00 MCM, Total (65+65)=130 MCM	130	4.59
	(a) For Irrigation purposes from Betwa Basin	900	31.78
	(b) For Domestic and Industrial proposes from Betwa Basin @ 214-130=84 MCM	84.00	2.966
	(c) For Domestic & Industrial proposes from Inter valley water transfer directly to Bhopal	130.00	4.590
4	Reservation for future use by MP in Betwa Basin upto Rajghat (A) For Irrigation purposes (B) For domestic and Industrial Purposes Committed	0	0
	(a) For irrigation purposes U/S of Rajghat Dam without considering any Regeneration	484.765	17.117
	(b) For domestic and Industrial purposes from basin water 595-(130+0.2x828)	299.4	10.57
5	Committed Irrigation use by MP from Rajghat	750.48	26.50
6	Committed Irrigation use by UP from Rajghat	750.48	26.50
7	Committed Irrigation use by MP on D/S of Rajghat from water of Rajghat Reservoir	84.96	3.00
8	Committed Irrigation use by UP on D/S of Rajghat from water of Rajghat Reservoir	169.92	6.00
9	Utilization by UP from Rajghat Dam project (6+8)	920.40	32.50
10	Contribution to be spared to UP from M.P.C.A. from Rajghat 578 sqkm @ 0.2077 MCM/sqkm or 19 MCFT/sq. miles	141.60	5.00
11	Water to be spared to UP from MP catchment area from Rajghat reservoir (920.40-141.60)	778.80	27.50
12	Water use by UP from Matatila Project for 264000 Acre Irrigation	526.75	18.60
13	Contribution by UP catchment area of 1854.49 Sq.km @ 0.2077 MCM/Sq. km	382.32	13.50
14	Water to be spared to UP from MP catchment area from Matatila (12-13)	144.43	5.00
15	Total quantity of water to be spared for other State @ UP from Rajghat and Matatila Reservoir (14+11)	923.23	32.60

11.6 Public Awareness Programme

KBLP is the first project in which public Awareness programme was organized at Uldhan village in Jhansi district lying in enroute commend in 08.05.2008 to explain benefits of the project to the beneficiaries and to remove their doubts about the project. However, it was found that people in general were very much supportive of this project and they wanted its early implementation. During survey & investigation of the project, summary of the project in Hindi alongwith salient features were distributed among the villagers for their awareness about the project.

BINA COMPLEX MULTIPURPOSE PROJECT & CANALS

Chapter-I

INTRODUCTION

1. BACKGROUND

The programme of Interlinking of rivers (ILR) is being considered by Govt. of India on highest priority. National Water Development Agency (NWDA) was set up by Government of India as an Autonomous Society under Ministry of Water Resources (MoWR) in July, 1982 to study the feasibility of ILR under National Perspective Plan (NPP) prepared by the erstwhile Union Ministry of Irrigation & Power and Central Water Commission (CWC) and gave a concrete shape to it. Accordingly, after carrying out detailed technical studies, NWDA has identified 16 links under Peninsular Component and 14 links under Himalayan Component in the country for feasibility studies.

Ken-Betwa link is one of the 16 links under Peninsular Component of NPP for Water Resources Development. The feasibility report of Ken-Betwa link was prepared by NWDA in the year 1995 and circulated among all concerned. Since then, continuous efforts were made by NWDA, CWC and MoJS to arrive at consensus between two beneficiary States of Madhya Pradesh (MP) and Uttar Pradesh (UP). Finally, consensus was arrived among Union Government and concerned States and a tripartite Memorandum of Understanding (MoU) was signed by MP, UP and the Union Government on 25th August 2005 for preparation of Detailed Project Report (DPR) of Ken-Betwa link. Subsequently, the work of preparation of DPR was entrusted to NWDA by MoJS in January, 2006.

The DPR of Ken-Betwa Link Project (KBLP) was completed by NWDA in December, 2008 and in February, 2009the copy of DPR was sent to Governments of MP and UP for their examination and comments. Keeping in view the comments of Governments of MP and UP, Secretary, DoWR, RD&GR convened a meeting with concerned Principal Secretaries of MP and UP on 3rd February 2010 to sort out various issues raised by them. It was decided in the said meeting that the DPR of the project will be prepared in two Phases. In Phase-I, Daudhan Dam, two power houses and link canal were included and in Phase-II, projects proposed in Betwa basin by Government of MP were included.

The DPR of KBLP, Phase-I was completed by NWDA in April, 2010 after incorporating the inputs as received from Governments of MP and UP and circulated to concerned State Governments.

After firming up the feasibility of the projects in close association with the officials of Water Resources Department, Govt. of MP, NWDA carried out the S&I works of the Lower Orr Dam, Babnai, Tharr Dam and five barrages namely Neemkheda, Parariya (Madhopur), Narkheraghat, Kotha and Bijrotha (Rajkhera) under KBLP, Phase-II. In addition, the Barari and Kesari barrages proposed in Upper Betwa basin and surveyed during preparation of DPR of KBLP, Phase-I were also included in Phase-II of the project. During the November 20-22, 2013, the CWC design team headed by Chief Engineer, Design (NW&S) and officers of NWDA inspected the proposed Dam/Barrage sites under KBLP to review design features and feasibility of the locations of Dams/Barrage sites. After visiting the various proposed sites by CWC team, Lower Orr Dam, Kotha Barrage, Neemkheda Barrage, Barari Barrage and Kesari Barrage were included in DPR of Phase-II and same was circulated in November, 2014.

Thereafter, discussions were held between Government of MP and NWDA from time to time to finalize the DPR of KBLP, Phase-II. During the meeting convened by Hon'ble Minister, WR, RD&GR on 18th November, 2016 with NWDA and Government of MP officials to review the status of KBLP, it was decided that Lower Orr Dam and Kotha Barrage with increased height will be retained under Phase-II. Also, it was agreed that DPR of Bina Complex Multipurpose Project already prepared by Government of MP will be included in KBLP, Phase-II. The DPR of Lower Orr Project was prepared by NWDA and DPR of Kotha Barrage &Bina Complex Multipurpose Projects were prepared by Government of MP.

In the meantime, the proposal of KBLP, Phase-I was accepted by the Advisory Committee of MoWR, RD & GR in July, 2016. Further, the project proposal has been considered acceptable for investment clearance in June, 2017.After obtaining various statutory clearances, the Cabinet Note for KBLP, Phase-I was circulated to various Ministries and concerned State Governments in May, 2017.During the review meeting taken by the Principal Secretary to Hon'ble Prime Minister on 4th July, 2017, it was decided that both Phases of KBLP should be taken up concurrently for implementation. Hon'ble Minister, WR, RD&GR during review meeting held on 25th September, 2017 decided that Comprehensive Report of KBLP should be prepared including KBLP Phase-I, enhanced CCA under KBLP, Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project for early implementation. However, the separate DPRs of Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project were appraised in CWC.

1.1.1 Hon'ble Supreme Court direction in respect of ken Betwa link project

The Hon'ble Supreme Court in the matter of Writ Petition (Civil) No.512 of 2002 "In Re: Networking of Rivers" along with Writ Petition (Civil) No.688 of 2002 delivered a judgement dated 27.2.2012. The Hon'ble Supreme Court has directed that an appropriate body should be created to plan, construct and implement the interlinking of rivers programme for the benefit of the nation as a whole. The main direction of the Hon'ble Supreme Court are covered under Para 64 of judgement. Hon'ble Supreme Court has directed the Union of India and particularly the erstwhile MoWR, Govt of India, to constitute forthwith a committee to be called "Special Committee for Interlinking of rivers" under the Chairmanship of Hon'ble Minister (Water Resources). The Hon'ble Supreme Court in its judgement (under Para 64(viii) dated 27.2.2012) directed the committee to take up the KBLP for implementation at the first instance itself.

The Cabinet in its meeting dated 24th July, 2014 has decided to implement the above direction of Hon'ble Supreme Court. In compliance of the above directions of the Hon'ble Supreme Court, the Erstwhile MoWR, RD&GR has constituted the Special Committee for Interlinking of Rivers vide Notification dated 23rd September, 2015. The Hon'ble Minister (Water Resources, RD&GR) is Chairman of the Committee and Water Resources Ministers of various States are members of the Committee. The Committee is regularly monitoring the progress of the interlinking river projects.

1.1.2 National Projects

On 7th February 2008, Government of India approved a scheme of National Projects for implementation during XI Plan with a view to expedite completion of identified National projects for the benefit of the people. Such Projects are provided financial assistance of 90% of the cost of irrigation & drinking water component (as per original Guideline) of the project as central assistance by Government of India in the form of central grant for their completion in a time bound manner. The proposal for continuation of Scheme of National Project in XII Plan was approved by CCEA on 12.09.2013.

The Government of India initially declared 14 projects as National Projects in February 2008. Later, Cabinet Committee on Infrastructure approved inclusion of Saryu Nahar Pariyojna (Uttar Pradesh) in the scheme of National Project on 3rd August, 2012. Polavaram Irrigation Project (Andhra Pradesh) was included under the scheme of National Projects vide Gazette notification dated 01.03.2014.

1.2 INTRODUCTION OF THE PROJECT

Bina Complex Multipurpose Project consists of four storage dams viz. Madia and Chakarpur on Binariver, and Semra Ghat Weir on Dhasan river and Dehera Nalla, a water conductor/ feeder from Semra Ghat Feeder dam to Dehra and canal off take at Chakarpur.

The dam near Chakarpur village is provided to serve as head works for irrigation canals. The command area is surrounded by Bina river in the east that joins Betwa river and Narain river in the west. The whole command area to be served through a pressurised piped network is divided into Khurai, Bina and Malthone tehsil to Sagar District.

The project having Culturable Command Area (CCA) 96,000 Ha is designed to irrigate 96,000 Ha land annually including 6,000 ha land to be irrigated by local farmers by direct lift from reservoir. Provision of 19.2 MCM, 25 MCM & 6 MCM of water has been kept for drinking purpose, industrial use and environmental releases respectively. 25 MW of hydro power is also proposed to be generated through this project.

1.3 PROJECT PROPOSAL

Bina Complex Multipurpose Project consists of four storage dams viz. Madia and Chakarpur on Binariver, Semra Ghat Diversion Dam on Dhasan River and Dehra Dam on Dehra Nalla, a water conductor/feeder from Semra Ghat Diversion Dam to Dehra Nalla and canal off-take from Chakarpur Dam.

Components of the Bina Complex Multipurpose Project are given in Table:

S. No	Name of the Structure	Name of the River	Height of Dam	FRL (m)	Submergence Area (ha)	Gross Storage Capacity (MCM)	Live Storage Capacity (MCM)	Districts Benefitted
1.	Madia Dam	Bina	23.55	500.55	6435.60	270.10	267.67	Sagar& Vidisha Districts of MP
2.	Semra Ghat Diversion Dam	Dhasan	11.32	499.70	575.00	6.46	6.00	
3.	Dehra Dam	Dehra Nalla	35.0	491.60	754.60	72.36	72.35	
4.	Chakarpur Dam	Bina	25.0	451.50	1349.50	74.31	73.84	

Other details of the components are as follows:-

1.3.1 Madia Dam

The proposed Madia Dam is situated across Bina river in Sagar district. The 75% dependable yield works out to 294.04 MCM. The FRL of the dam is 500.55 m and live storage capacity is 267.67 MCM. The length of main dam is 2070m and height of dam is 23.55 m. Total submergence area is 6435.60ha.

1.3.2 Semra Ghat Diversion Dam

The proposed Semra Ghat Diversion Dam is situated across Dhasan river. The 75% dependable yield works out to 89.30MCM. The FRL of the dam is 499.7 m and live storage capacity is 6.00 MCM. The length of main dam is 1440m and height of dam is 11.32m. Total submergence area is 575 ha.

1.3.3 Dehra Dam

The proposed Dehra Dam is situated across Dehra Nalla. The 75% dependable yield works out to 17.10MCM. The FRL of the dam is 491.60 m and live storage capacity is 72.35MCM. The length of main dam is 3509m and height of dam is 35m. Total submergence area is 754.60ha.

1.3.4 Chakarpur Dam

The proposed Chakarpur Dam is situated across Bina river. The 75% dependable yield works out to 51.00 MCM. The FRL of the dam is 451.50 m and live storage capacity is 73.84 MCM. The length and height of dam are 751.68m and 25m respectively. Total submergence area is 1349.50ha.

Provision of pressurised pipe micro irrigation system has been proposed for better irrigation efficiency.

Two power houses proposed at Madia Dam with installed capacity of 21 MW (2x10.5 MW each) and at Dehra Dam with installed capacity of 4 MW.

The salient features of the Project are at **Annexure-1.4.1.** An index map showing the proposals is at **Plate-IV.**

1.4 HYDROLOGY

1.4.1 Water Availability

Assessment of water demands in foreseeable future for various purposes including domestic, industrial, irrigation, hydropower and navigation etc. are

essential for planning of water resources development and management. Water needs are to be met either from surface water flows or ground water resources or a combination of both. Water use allocations were worked out in the DPR of Bina Complex Irrigation and Multipurpose Project prepared by Water Resources Department, Government of MP and is given under in Table.

Unit: MCM

S. No.	Sub-Catchment	Mean Annual Runoff	Contribution to 75% Dependable Yield	U/s Reserve	Minimum D/s Environ-mental Releases	Net Yield
1.	Bina up to Madia Dam	476.11	294.04	24.00	6.00	264.10
2.	Dehra up to Dehra Dam	27.66	17.10	0	0	17.1
3.	Chakarpur free catchment	82.58	51.00	0	0	51
	Sub Total Bina River up to Chakarpur Dam	**586.35**	**362.14**	**24.00**	**6.00**	**332.20**
4.	Semra Ghat Diversion Dam up to storage cum diversion site	144.63	89.30	0	0	86.30
	Total From four catchments	**730.98**	**457.44**	**24.00**	**6.00**	**418.50**

Thus, a net dependable yield of about 418.50 MCM is available from all four sub catchments and is proposed to be utilized ex-Chakarpur under the Bina Complex Multipurpose Project, of this about 60 MCM will be contributed by the proposed diversion of Dhasan river through Dehra. Environmental water releases are assumed as 6 MCM of the gross dependable yields of respective catchments. It is anticipated that up to about 20% of net yield allocated for the project will be lost though evaporation and seepage at the four reservoir sites leaving only about 334.80 MCM of water for diversion for irrigation and domestic and industrial water demands ex-Chakarpur.

1.4.2 Design Flood studies

Design floods are based on gross storage and hydraulic height of dam. Following design floods have been selected for design of spillway for checking safety of

dams against overturning. The details of design floods of four dams are given in Table as follows: **(Annexure 1.4.2)**

S. No.	Dam	Designed Flood in Cumec
1.	Madia Dam	6647.00
2.	Semra Ghat Diversion Dam	2310.00
3.	Dehra Dam	932.00
4.	Chakarpur Dam	8241.00

1.4.3 Sedimentation Studies

Silting not only occurs in the so called "dead storage" but also encroaches into the "live storage" space, which eventually inspires benefits from the regulation afforded by the reservoir. A trapping efficiency of 97% has been used notionally in the present study for calculating the total volume. Total volumes of deposits estimated are as given in Table.

Name of reservoir	Catchment Area (sqkm)	Sediment Inflow (MCM)		Trapped Sediment Volume (MCM)	
		50 Years	100 Years	50 Years	100 Years
Madia	1109.84	27.75	55.50	26.64	53.27
SemraGhat Diversion Dam	314.00	0	0	0	0
Dehra	62.90	1.56	3.12	1.54	3.08
Chakarpur	187.80	4.68	9.36	5.73	11.45

The New Zero Elevation expected after 100 years of sedimentation works out as 487.62 m for Madia Dam, 465.35 m for Dehra Dam and 435.75 m for Chakarpur Dam. Total live storage of above dams is 419.86 MCM. After 50 years siltation, the live storage capacity would reduce to 385.95 MCM.

1.5 IRRIGATIONPLANNING

Total CCA of this project is 96,000 ha in Khurai, Malthone and Bina tehsil of Sagar district. Crop water requirement for 96,000 ha of the command worked out as 399.91 MCM. Project authorities have informed that there is no u/s use of water in case of Madia, Chakarpur, Dehra and Semra Ghat Dam.

19.2 MCM water is kept for drinking purpose and 25 MCM water is kept for

industrial use. 25 MW of hydro power is also proposed to be generated through this project. **(Annexure 1.4.3)**

1.5.1 Existing Cropping Pattern

Presently only rain fed cultivation is going on the proposed command area comprising parts of Khurai and Bina and Malthone Blocks. Existing cropping pattern is as follows: (As per State Agr. Deptt. - **Annexure 1.4.4**)

Sl. No.	**Name of the Crops**	**Crop-wise Area (in Ha)**
	Existing Crop Grow in the Command Area at Present	
(a)	**Kharif Crops**	
1.	Soyabean	3500
(b)	**Rabi Crops**	
1.	Wheat (Hyd.)	35000
2.	Gram	28000
	TOTAL	63000

1.5.2 Proposed cropping pattern

Sl. No.	**Name of the Crops**	**Crop-wise Area (in Ha)**
	Crop likely to be Grown after Completion of the Irrigation Project	
Rabi Crops		
1.	Wheat (Hyd.)	56000
2.	Gram	40000
	TOTAL	96000

1.5.3 Success Rate

The success rate for meeting the irrigation demands for Madia dam, Chakarpur dam, Dehra dam and Semraghat weir comes out as 100 % (out of 32 years, success in 32 years), 81.25 % (out of 32 years, success in 26 years), 100 % (out of 32 years, success in 32 years) and 81.25 % (out of 32 years, success in 26 years) respectively.

1.5.4 Conjunctive Use of Ground Water

On an average 12 percentage of ground water is available for conjunctive use for irrigation which has been used in working table calculations as well.

1.6 DESIGN

CDO certificate for the project is enclosed as **Annexure 1.4.5.**

1.7 DRINKINGANDINDUSTRIALWATERPROVISION

19.2 MCM of water is proposed for Drinking Water and 25 MCM for industrial use.

1.8 PROVISIONFORHYDROPOWERGENERATION

Project is also devised to generate hydroelectric power by two power plants with installed capacity of 2x10.5 MW and 2x2 MW at Madia and Dehra dams respectively. (**Annexure 1.4.6)**

1.9 INTER-STATEASPECTSANDINTERNATIONALASPECTS

Memorandum of Agreement on Comprehensive Project Report of Ken-Betwa Link Project was signed on 22.03.2021 between Madhya Pradesh, Uttar Pradesh and Union Govt, for implementation of Ken-Betwa Link Project and Bina complex multi-purpose project is part of KBLP, the project proposal may be considered acceptable from inter-state aspects.

Letter from ISM-2 Dte, CWC is enclosed as **Annexure 1.4.7.**

1.10 ENVIRONMENTAL,WILD LIFE AND FOREST CLEARANCE

The Environmental Clearance has been accorded by MoEF&CC on 22.02.2017.(**Annexure 1.4.8&Annexure 1.4.9).** However, the modified proposal envisages construction of Semraghat Weir of 6 MCM capacity instead of earlier proposed Dhasan Diversion Dam of 80.50 MCM capacity at Bhainsa and provisions for pressurized irrigation in place of gravity flow by open channel proposed earlier. NoC or revised clearances in this regard may be required for the project from MoEF&CC.

Stage-I&II Forest Clearance have been accorded by MoEF&CC on 27.07.2016 & 11.07.2018 respectively for the proposed project which envisaged construction off our dams namely Madia reservoir, Dehra dam, Dhasan dam and Chakarpur dam in Sagar district and irrigation with gravity canal. (**Annexure 1.4.10 & Annexure 1.4.11).** However, the modified proposal envisages construction of Semraghat Weir of 6 MCM capacity instead of earlier proposed Dhasan

Diversion Dam of 80.50 MCM capacity at Bhainsa and provisions for pressurized irrigation in place of gravity flow by open channel proposed earlier. NoC or revised clearances in this regard may be required for the project from MoEF&CC.

1.11 REHABILITATIONANDRESETTLEMENTASPECT

1.11.1 Submergence

Total submergence area under the project is 9114.7 ha. The details of submergence land are as under:

(In Ha.)

S. N.	Particulars	Madia	Dehra	Chhakarpur	Semra Ghat Feeder	Total
	Submergence area, ha.	6435.6	754.6	1349.50	575	9205.73

1.11.2 Rehabilitation and Resettlement

The R&R plan has been devised using the norms and guide lines of the "Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013". Total number of 2290 families from 84 villages will be affected due to submergence. The details of total no. of households being affected, private land to be acquired along with their current market rates are as under:

PRIVATE LAND TO BE ACQUIRED								
S.No.		Dam	No of Affected Villages	Total Area to be acquired (Ha)	Acquired So far(Ha)	Balance (Ha)	Amount (Rs In Lakhs)	Remark
1	A	Madia Dam	59	5624	0	5624.152	66728	
2		Chakarpur	11	910	0	909.7	8446	
3		Dehra	6	336	0	335.96	2852	
4		Semraghat	8	525	0	525	6301.76	
			84	7395			843,27	
R.R.Works.								
S.No.		Dam	Affected families		Rate lakhs per family*		Amount (Rs In Lakhs)	Remark
1	B	Madia	1778		7.17		12748	

		Dam					
2		Chakarpur	204		7.17	1463	
3		Dehra	308		7.17	2208	
4		Semraghat	0		7.17	0	
		Total	2290			16419	
	G-Total A+B					1007,47	

However a Revised R&R Plan may be devised by the project authorities with respect to changes made in the proposal after Env. Clearance as in the table given above which is enclosed at **Annexure 1.4.12**.

1.11.3 Clearance in respect of R&R of Tribal population from MoTA

Project authority vide its letter dated 29.06.2017 has informed that action for obtaining the clearance in respect of R&R of Tribal population has been started and being pursued. Neither any clearance nor any information regarding the tribal families being affected is submitted till date. The project authority is requested to obtain said clearance.

1.12 COSTESTIMATEANDECONOMICEVALUATION

1.12.1 Cost estimate

The Cost Estimate of Bina Complex Project has been finalised for Rs 3353.62 crore. The Unit wise finalised cost of the project is as under:

S. No.	Item	Cost (Rs. in Lakhs)
1	Unit I	175308.90
2	Unit II	143745.59
3	Unit III	16307.66
	Total cost	335362.14

The Project Cost is provisional subject to the correctness of the quantities as per the detailed survey carried out and rates indicated in the cost estimates at Madhya Pradesh Unified Schedule of Rates 2017-18. The Project Authorities has also submitted a certificate regarding the correctness of quantities as per Design and Drawings proposed for preparation of Cost Estimate. The Abstract of Cost of the Project at Price level 2017-18 is enclosed attached as **Annexure 1.4.13.**Total expenditure on Bina complex multipurpose project is 1036.35 crore rupees till November, 2021. (Annexure 1.4.17)

Further, The Cost Estimate is revised at 2020-21 price level which works out to be Rs. 323952.79 Lakhs.

1.12.2 Benefit cost ratio

WRD, Govt. of MP has requested to exclude the cost of land development for Kotha Barrage in BC Ratio calculation. In view of above and considering the fact that, in case of Bina Complex project also, micro-irrigation through pressurized pipe distribution network has been adopted and the cost of providing underground pressurized pipe distribution network for micro irrigation system to facilitate pressurized irrigation have been taken upto 1.0 ha chak area, the land development charges have been taken as 'NIL' in the B.C. ratio computation. Therefore, the cost of land development has not been considered by the project authorities in the BC Ratio computation.

Total CCA of this project is 96,000 ha in Khurai, Malthone and Bina tehsil of Sagar district. Crop water requirement for 96,000 ha of the command worked out as 399.91 MCM. 19.2 MCM of water is kept for drinking purpose and 25 MCM of water is kept for industrial use. 25 MW of hydro power is also proposed to be generated through this project.

The benefits of drinking and Industrial water are considered @ Rs. 5.6 lakh/ MCM and 80 lakh/ MCM amounting to Rs. 107.52 lakhs and Rs.2000 lakhs respectively. The rates for drinking water and industrial use are considered as per the letter of Govt. of MP. The rates of industrial water have been considered for 2021 price level. The project authorities have provided the certificate in respect of benefits of fisheries duly authenticated by Assistant Director, State Fisheries Department, MP and the production rate (in kg/ha) and rate per kg of fish has been considered @ Rs. 600 kg/ha and @ Rs. 504.68/ kg (as per 2017 rates with 3 % depreciation each year) respectively as per the figures provided by Govt. of MP. The benefits from hydro power generation of 25 MW has been considered @ Rs. 6000 lakhs, and the rate has been considered as Rs. 0.05 lakh/Mwhr. The quantum of power requirement for lift have been assessed as Rs. 3281 per ha by the project authorities. As per the Retail Supply Tariff Order FY 2017-18 of Madhya Pradesh Electricity Regulatory Commission, the energy charges are Rs.5 per unit. Considering the overhead charges @ 10%, the energy charges have been re- worked out as Rs. 4.50 per unit. The project authorities have submitted the certificate of computation of cost towards tube-wells as Rs. 849.44 lakhs and the same has been used in the BC Ratio computation. The project authorities have submitted the yield, rates and cost of cultivation (viz. seeds, manure, labour etc.) of crops in pre and post project scenario approved by the Deputy Director, State Agriculture Department, MP for the purpose of estimating the agricultural benefits which has been used in the BC ratio computation. The rates and cost of cultivation (viz. seeds, manure, labour etc.) of crops in pre-project and post

project scenario has been revised for PL 2017-18 for benefits calculation.

Accordingly, the benefit cost ratio for the project has been worked out to 1.60:1.

1.12.3 Internal Rate of Return (IRR)

Internal rate of the project comes out to be 12.21.

1.12.4 Tariff for the power component

CEA, while finalizing the financial & commercial aspects, has raised some queries mainly regarding source of funding, funding pattern - central share: state share, details of loan component, if any, etc. Since, these details are under finalization, tariff for the Power Component will be finalized after the requisite details are provided to CEA.

1.12.5 State Finance concurrence

The concurrence of the state finance department for the estimated Cost of Rs. 3735.90 crore has been conveyed vide letter dated 01/06/2017 (copy enclosed at **Annexure 1.4.15**).

1.13 PHYSICAL AND FINANCIAL PROGRESS AND FINANCIAL PLANNING

The detailed construction schedule for the project in the form of a bar chart is attached as **Annexure 1.4.16.**

Total expenditure on Bina complex multipurpose project is Rs. 1036.35 crore & physical progress reported as 10% till November, 2021(**Annexure 1.4.17**). Physical and financial program for completion of the project up to 2027-28 are enclosed at **Annexure 1.4.18**.

CHAPTER-II
SURVEYS AND INVESTIGATIONS

2.0 Background

The DPRs of KBLP, Phase-I and Phase-II were completed by NWDA in 2010 and 2014 respectively after carrying out detailed Surveys and Investigations (S&I). Lower Orr Dam and Kotha Barrage were also included in Phase-II. In respect of canal system under Daudhan Dam, enhanced CCA proposed by Government of MP from 2.87 lakh ha to 4.47 lakh ha**,** NWDA has carried out additional command area survey of 26500 ha (12500 ha in enroute command of the link canal and 14000 ha in command of Ken Left Bank Canal). In respect of additional command of 37564 ha in Mahoba district of UP, NWDA collected irrigation map of Mahoba district from irrigation department of UP showing dams tanks and canal system and adopted in study. and Mahoba district of UP has not been done at this stage. Irrigation planning has been provided by Government of MP and same is adopted in the Comprehensive Report. In respect of Bina Complex Multipurpose Project, surveys and investigations has been done by Government of MP and the same is adopted in Comprehensive Report. The component wise details of various surveys and investigations extracted from specific DPRs of above projects are furnished below:

2.1 Bina Complex Multipurpose Project

2.1.1 Topographical and Other Allied Surveys

Topographical and other allied surveys of Bina Complex Multipurpose Project were carried out by the Water Resources Department, Government of MP and details are furnished in the DPR of Bina Complex Irrigation and Multipurpose Project.

2.1.2 Geology and Geotechnics of Dam Sites

Project region is characterized by presence of vindhyan sandstones, quartzite, deccan traps, and at a few places by laterite capping on the traps. Vindhyan of upper Rewa stage occupy small part. Deccan traps which occupy most of the hilly areas are grayish black with lowest level of about 1500 ft. The weathered rock zone (the vesicular deccan trap/weathered basalt) underlain the deep to medium deep soils may act as aquifer with limited storage and yield

rates. Sagar district generally exposes rock formations ranging from Bundelkhand granite gneissic complex of Archaean age to alluvium of Pleistocene Recent age. Granite rocks, gneisses and magnetite occur in the northernmost part of Sagar district. Overlying the Archaean rock, semri, the northernmost part in Juxtaposition with the Archaean rocks occupy comparatively larger area in the northern half of Sagar district. The rocks of Rewa group are seen occupying the central parts of the district north of Sagar. This group consists mainly of alternating shale and sandstone beds. The sandstone is generally massive, pink, purple, medium to coarse grained and compact. In Sagar area, the base is at about 440m above Mean Sea Level and a maximum of nine 'aa' type covering a total thickness of about 215 m have been reported. The thicknesses of the trap very between a few metres to a much as 35 metres Majority of them is being of the order of 15 meters. Presence of amygdales or empty vesicles are common; the vesicles being more concentrated in the upper and lower parts, the middle part being almost devoid of it. The flow rocks are basaltic or doleritic, medium to fine grained porphyritic and non-porphyritic in nature.

2.1.3 Seismicity

The concentration of epicenters in central peninsula is confined mainly along the Sonata and Sahyadri belts and Godavari Graben with isolated incidences scattered in the intervening blocks. The important earthquakes of Sonata Zone include that of Son Valley-1927, Satpura 1938 Balaghat-1959, Broach-1970 and Jabalpur-1997.

The project area lies in a seismic terrain that is within seismic zone-II of Seismic Zoning Map of India (BIS 1893 part-I 2002). In this zone, it is expected that occasional shocks of magnitude 5-6 with few centers which may have magnitude 6-6.5 and may be related to boundary faults of the Gondwana basin and faults of limited extent in Mesozoic- Cenozoic cover on the platform may occur.

2.1.4 Geology of Project Area

2.1.4.1 Madia Dam

The site geology in the area is fine grained hard, compact and highly jointed sandstone belonging to vindhyan super group is exposed in the river bed section. The trend of the bedding is $N35^0W$-$S35^0E$ with dips ranging from 5^0 to 8^0 in N 55^0E direction. The following set of joints has been recorded in the river bed section:

Joint Sets	Strike & Dip Quadrant	Spacing (cm)	Continuity (m)	Opening
(i)	N 40^0 W-S40^0 E/Vertical	30-50	Long continuity (5-7)	Up to 0.5 cm
(ii)	N 60^0 E – S 60^0 W/Vertical	15-30	4-5	Up to 0.5 cm
(iii)	N 40^0 E – S 40^0 W/15^0-18^0N 50^0 W	40-50	4-5	Up to 0.5 cm

The required rock mechanic tests for the design of dam such as in situ compressive and shear strength of rock mass shall have to be conducted in deep trial pits in rock to ascertain the competency of the rock exposure at site. Groutability tests are also to be conducted. Permeability tests carried out reveal that the permeability of the rock is on the higher side and considerable grouting shall be required to form the grout curtain/cut off in the foundation or upstream blanketing may be considered for the purpose.

2.1.4.2 Dehra Dam Site

At the proposed site, fractured, jointed but hard and compact fine to medium grained sandstone belonging to vindhyan super group is exposed. The trend of sandstone in general is N 72^0 W – S 72^0 E to E-W with the dips ranging from 15^0 to 19^0 in the upstream direction which is a favorable situation.

Joint Sets	Strike & Dip Quadrant	Spacing (cm)	Continuity (m)	Opening (cm)
(i)	N 35^0 W-S35^0E/60^0N55^0E	30-50	4-5	2-3
(ii)	N 40^0 W-S40^0E/84^0N50^0E	30-50	4-5	2-3
(iii)	N 80^0 E-S80^0W/73^0S10^0E	50	2-3	5-4
(iv)	N 50^0 W-S50^0E/Vertical	40-50	5-7	1-2
(v)	E-W/Vertical	50-60	3-5	5-10
(vi)	N-S/Vertical	40-50	0.5 – 0.6	2-4

Required rock mechanics tests for in site compressive and shear strength of rock mass shall have to be conducted to ascertain the competency of the rock and stability of the dam. Permeability of the bed rock is quite high and is likely to accept lot of grout. The testing of Groutability is also to be carried out. It will not be out of place to consider blanketing upstream for the purpose.

2.1.5 Geo-technical Investigations and Borrow Area Surveys and Construction Material Survey

2.1.5.1 Foundation

The bed rock exposed at the side are is highly fractured, jointed vesicular, hard and compact Malwa traps. It is expected that after excavating the weathered i.e. 2m depth the trap would be competent enough to take the load of the structure.

2.1.5.2 Borrow Area

Borrow area materials for embankment were investigated by soil engineering consultants. Thirty samples have been tested for casing and hearting materials.

2.1.6 Hydrological and Meteorological Investigations

Details on hydrological and meteorological investigations including rainfall, sunshine, cloud cover, wind and cyclones, humidity and temperature have been discussed in the DPR of Bina Complex Irrigation and Multipurpose

Project prepared by Water Resources Department, Government of MP. Brief discussions of climate conditions, rainfall, temperature, humidity cloudiness and wind are given below.

2.1.6.1 Climatic Conditions

The climate of the project region is characterized by the hot summer and moderately cold winter. Three different seasons viz. The summer from March to May, monsoon or rainy season from June to October and winter from November to February prevail in the area. Agro-climatically, the area is part of Sagar Division, Zone-V called the Vindhyan Plateau, Evapo-Transpiration (ET_0) varies from a low of 3.2 mm/day in January to a high of 8.8 mm/day in the month of May.

2.1.6.2 Rainfall

This region experiences rainfall from south-west monsoons from June to early October and due to western disturbances during winter. Nearly 85% of the annual rainfall is recorded during the monsoon season. Average annual rainfall in the project region is around 1200 mm.

2.1.6.3 Temperature

Moderate heat is experienced during summer, during winter the climate is cool. Summer temperature as observed at Sagar meteorological observatory has touched a maximum of 49.4^0C in April 1970 while the minimum winter temperature was observed as 7.4^0C in January 1969.

2.1.6.4 Humidity

Humidity of the area as observed at Sagar observatory reveals that it is low in dry weather minimum being 11% while in monsoon season, it is about 93%.

2.1.6.5 Cloudiness

During monsoon season sky is generally overcast while in rest of the period it is partly clouded or clear.

2.1.6.6 Winds

The wind speed ranges from 170 km/day in December to 288 km/day in June.

CHAPTER-III
HYDROLOGY AND WATER ASSESSMENT

3.0 Background

This chapter deals with hydrology and water assessment of various projects components under KBLP. The hydrology and water assessment of Ken Basin upto Daudhan Dam was completed by NWDA and included in DPR of KBLP, Phase-I (2010) and techno-economically approved by CWC in 2017. The hydrology and water assessment of Lower Orr Dam and Kotha Barrage was completed by NWDA and included in DPR of KBLP, Phase-II (2014). Whereas, the hydrology of Bina Complex Multipurpose Project was completed by Water Resources Department, Government of MP. Separate DPRs of Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project have been approved by CWC in the 148th meeting held on 17.02.2022. The component wise details of hydrology, water assessment and latest water planning are covered in this Chapter.

3.1 Bina Complex Multipurpose Project and Canal

Bina Complex Multipurpose Project consists of four storage dams viz. Madia and Chakarpur on Bina river, Semra Ghat Diversion Dam on Dhasan River and Dehra Dam on Dehra Nalla, a water conductor/feeder from Semra Ghat Diversion Dam to Dehra Nalla and canal off-take from Chakarpur Dam.

Components of the Bina Complex Multipurpose Project are given in Table:

S. No	Name of the Structure	Name of the River	Height of Dam	FRL (m)	Submergence Area (ha)	Gross Storage Capacity (MCM)	Live Storage Capacity (MCM)	Districts Benefitted
1.	Madia Dam	Bina	23.55	500.55	6435.60	270.10	267.67	Sagar &
2.	Semra Ghat Diversion	Dhasan	11.32	499.70	575.00	6.46	6.00	

	Dam							Vidisha Districts of MP
3.	Dehra Dam	Dehra Nalla	35.0	491.60	754.60	72.36	72.35	
4.	Chakarpur Dam	Bina	25.0	451.50	1349.50	74.31	73.84	

Other details of the components are as follows:-

Madia Dam

The proposed Madia Dam is situated across Bina river in Sagar district. The 75% dependable yield works out to 294.04 MCM. The FRL of the dam is 500.55 m and live storage capacity is 267.67 MCM. The length of main dam is 2070 m and height of dam is 23.55 m. Total submergence area is 6435.60 ha.

Semra Ghat Diversion Dam

The proposed Semra Ghat Diversion Dam is situated across Dhasan river. The 75% dependable yield works out to 89.30 MCM. The FRL of the dam is 499.7 m and live storage capacity is 6.00 MCM. The length of main dam is 1440 m and height of dam is 11.32 m. Total submergence area is 575 ha.

Dehra Dam

The proposed Dehra Dam is situated across Dehra Nalla. The 75% dependable yield works out to 17.10 MCM. The FRL of the dam is 491.60 m and live storage capacity is 72.35 MCM. The length of main dam is 3509 m and height of dam is 35 m. Total submergence area is 754.60 ha.

Chakarpur Dam

The proposed Chakarpur Dam is situated across Bina river. The 75% dependable yield works out to 51.00 MCM. The FRL of the dam is 451.50 m and live storage capacity is 73.84 MCM. The length and height of dam are 751.68 m and 25 m respectively. Total submergence area is 1349.50 ha.

Provision of pressurised pipe micro irrigation system has been proposed for better irrigation efficiency.

Two power houses proposed at Madia Dam with installed capacity of 21 MW (2x10.5 MW each) and at Dehra Dam with installed capacity of 4 MW.

The salient features of the Project are at **Annexure-1.4.1.** An index map showing the proposals is at **Plate-IV.**

3.1.1 Description of Upper Betwa Basin, Bina Sub-Basin, Dhasan Sub-Basin and Dehra Nalla

3.4.1.1 Upper Betwa Basin

The area of the Betwa river from the source up to the Rajghat Dam has been considered as Upper Betwa basin for the purpose of water balance study. All structures proposed under Bina Complex Multipurpose Project lies in Upper Betwa basin. The basin description up to each dam/diversion site described in the following paras.

3.1.1.2 Bina Sub-Basin

Bina river rises at an elevation of about 596 m near Dahgaon village of Gairatganj tehsil of Raisen district of MP. It traverses a distance of about 146 km before its confluence with Betwa river near village Perotha in Kurwai tehsil of Vidisha district. The main sub-tributaries of Bina river are Penti, Bagana and Dhadhar. The proposed Madia Dam is located on Bina river around 1.5 km upstream of Rahatgarh falls near village Madia Dam in Rahatgarh tehsil of the Sagar district. Another proposed storage dam namely Chakarpur Dam, canal head works is located near village Chakarpur (village Bhulnabhangarh), about 22.95 km downstream of the Madia Dam. The catchment area of Bina river up to Madia Dam site and up to Chakarpur Dam network near Chakarpur are 1109.84 sq km and 1359.34 sq km respectively.

3.1.1.3 Dhasan Sub-Basin

The Dhasan river is a major tributary of Betwa river originates at an elevation of 714 m in village Jasarathi of Begumganj tehsil of Raisen district of MP. The proposed Semra Ghat Diversion Dam across Dhasan river is located

upstream of village Semra in Sagar tehsil of Sagar district. The river catchment area of Dhasan river up to the dam site is 314.5 sq km.

3.1.1.4 Dehra Nalla

The Dehra Nalla originates at an elevation of about 643 m near Kalipathar reserved forest and after flowing for a length of about 27.4 km meets the Bina river at an elevation of about 440 m. It drains a catchment area of about 62.5 sq km up to the proposed Dehra Dam site on Dehra Nalla.

Bina Complex Multipurpose Project will provide an annual irrigation of 96,000 ha in Sagar and Vidisha districts of MP with an irrigation intensity of 100% utilizing 329.67 MCM of water. Besides, 57 MCM water is also kept for drinking water supply to the enroute villages and towns in the vicinity of the canal. 296 villages will be benefited in Khurai, Malthone and Bina tehsils of Sagar district.

3.1.2 Details of Proposed Bina Complex Multipurpose Project

Salient features of projects under Bina Complex Multipurpose Project are given in **Table-3.1.**

Table-3.1

Salient Features of Projects under Bina Complex Multipurpose Project

S. No.	Name of the Structure	Name of the River	Bed Level (m)	FRL (m)	Submer-gence Area (ha)	Gross Storage Capacity (MCM)	Districts Benefitted
1.	Madia Dam	Bina	481.00	500.55	6435.60	270.10	Sagar & Vidisha of MP
2.	Semra Ghat Diversion Dam	Dhasan	490.48	499.70	575.00	6.46	
3.	Dehra Dam	Dehra Nalla	459.00	491.60	754.60	72.36	
4.	Chakarpur Dam	Bina	429.00	451.50	1349.50	74.31	

3.1.3 Betwa Basin Development (As per DPR of Bina Complex Irrigation and Multipurpose Project, Government of MP)

An interstate agreement for sharing Betwa river water was reached in the year 1972 in between UP and MP states for implementing the Rajghat Dam Project located on the main Betwa river. This allocates 53 TMC of water (1500 MCM) for use by MP upstream of Rajghat Dam. As per the indicative master plan prepared by the MP state for Betwa river, the status of committed water use is given in **Table-3.2.**

Table-3.2

Status of Committed Use for Betwa Baisn

S. No.	Schemes	Utilization (MCM)	Utilization (TMC)
1.	Existing Schemes	536.45	18.94
2.	Under Construction Schemes	364.76	12.88
	Total	**901.21**	**31.82**

There are four medium schemes proposed by Government of MP, besides the Bina Complex Irrigation Schemes. Details of these schemes are given in **Table-3.3.**

Table-3.3

Details of Four Medium Schemes proposed by Government of MP

S. No.	Name of Schemes	District	Annual Irrigation (ha)	Water Use (MCM)
1.	Kherkhedi	Vidisha	3082	30.82
2.	Daghikheda	Vidisha	5463	54.63
3.	Bhutakhera	Vidisha	3055	19.71
4.	Semri Bagrod	Vidisha	2534	24.34
	Total		**14134**	**129.50 (4.57 TMC)**

Out of the total utilization of 684 MCM proposed under the Bina Complex Multipurpose Project, about 165 MCM water will be from Semra Ghat Diversion Dam and remaining 519 MCM from Bina river. Since, Dhasan river joins the river Betwa d/s of Rajghat Dam site, the use of Semra Ghat Diversion Dam water is excluded while assessing the total water use u/s of Rajghat Dam. Ignoring reservation for minor schemes upstream of Madia Dam on river Bina, the total water use under the proposed major and medium schemes u/s of Rajghat dam including this project will be 648 MCM (129 + 519) i.e. 22.89 TMC. Adding the committed water use of 901 MCM to that proposed under the future schemes, the total planned use u/s of Rajghat works out to 1549 MCM or about 54.7 TMC against the present allocation of 53 TMC.

3.1.4 Betwa Basin Development (As informed to CWC by MP)

Further, Water Resources Department Government of MP informed to CWC vide their Memo No. 3741026/Inter-State/2017-19, Bhopal dated

26.10.2017 that the total water use by MP upstream of Rajghat Dam is 54.7 TMC, which includes 1.95 TMC water transfer from Dhasan river through Semra Ghat Diversion Dam under Bina Multipurpose Project to Bina river. Thus, net water use upstream of Rajghat Dam comes to 52.75 TMC (54.7 – 1.95) which is well within agreement share 53 TMC for MP, as per agreement drawn in the year 1972 between MP and UP States. Details are given in **Table-3.14**.

Table-3.4
Water Uses in Betwa Basin up to Rajghat Dam by MP

S. No.	Status	Type	Name	Number	Capacity (MCM)	Capacity (TMC)
1.	Existing projects	Major	SAS (Halali)	1	252.13	8.90
2.		Medium	Kerwan	1	22.6	0.80
3.			Kaliasoth	1	34.41	1.22
4.			Naren Dam	1	18.82	0.66
5.			Sagad	1	91.58	3.23
6.			Sanjay Sagar Bah Project	1	86.4	3.05
7.			Kethan Dam	1	21.67	0.77
8.			Rehti Dam	1	10.97	0.39
9.			Bagharru Tank	1	10.36	0.37
10.			Koncha Dam	1	21.55	0.76
11.			Semri	1	29.85	1.05
12.			Mola Dam	1	13.05	0.46
13.		Minor		266	350.46	12.38
	Total			**278**	**963.85**	**34.03**
14.	Pin-Pointed Surveyed Ongoing	Major	Kotha	1	63.51	2.24
15.			Bina Complex	1	419.86	14.83
16.		Minor		65	101.82	3.60
	Total			**67**	**585.19**	**20.66**
	Grand Total			**345**	**1549.04**	**54.70**
17.	Inter basin transfer from Dhasan				(-) 55.22	(-) 1.95
18.	Net Water use				1493.82	52.75

Accordingly, water planning of Ken-Betwa link canal has been carried out in this report. Water uses by MP in upper Betwa basin is limited to 53 TMC which is within share of MP at Rajghat Dam. Hence, no water transfer is

proposed from Ken basin to Betwa basin against water uses by MP in Upper Betwa Basin.

3.1.5 Water Assessment

Assessment of water demands in foreseeable future for various purposes including domestic, industrial, irrigation, hydropower and navigation etc. is essential for planning of water resources development and management. Water needs are to be met either from surface water flows or ground water resources or a combination of both. Water use allocations were worked out in the DPR of Bina Complex Irrigation and Multipurpose Project prepared by Water Resources Department, Government of MP and is given under in **Table-3.5.**

Table-3.5
Water Use Allocation and Runoff Details

Unit: MCM

S. No.	Sub-Catchment	Mean Annual Runoff	Contribution to 75% Dependable Yield	U/s Reserve	Minimum D/s Environ-mental Releases	Net Yield
1.	Bina up to Madia Dam	476.11	294.04	24.00	6.00	264.10
2.	Dehra up to Dehra Dam	27.66	17.10	0	0	17.1
3.	Chakarpur free catchment	82.58	51.00	0	0	51
	Sub Total Bina River up to Chakarpur Dam	**586.35**	**362.14**	**24.00**	**6.00**	**332.20**
4.	Semra Ghat Diversion Dam up to storage cum diversion site	144.63	89.30	0	0	86.30
	Total From four catchments	**730.98**	**457.44**	**24.00**	**6.00**	**418.50**

Thus, a net dependable yield of about 418.50 MCM is available from all four sub catchments and is proposed to be utilized ex-Chakarpur under the Bina Complex Multipurpose Project, of this about 60 MCM will be contributed by the proposed diversion of Dhasan river through Dehra. Environmental water releases are assumed as 6 MCM of the gross dependable yields of respective catchments. It is anticipated that up to about 20% of net yield allocated for the project will be lost though evaporation and seepage at the four reservoir sites leaving only about 334.80 MCM of water for diversion for irrigation and domestic and industrial water demands ex-Chakarpur.

3.1.6 Sedimentation Analysis for Bina Complex Multipurpose Project

Silting not only occurs in the so called "dated storage" but also encroaches into the "live storage" space, which eventually inspires benefits from the regulation afforded by the reservoir. A trapping efficiency of 97% has been used notionally in the present study for calculating the total volume. Total volumes of deposits estimated are as given in **Table-3.6**.

Table-3.6

Volume of Sediment Deposits

Name of reservoir	Catchment Area (sqkm)	Sediment Inflow (MCM)		Trapped Sediment Volume (MCM)	
		50 Years	100 Years	50 Years	100 Years
Madia	1109.84	27.75	55.50	26.64	53.27
Semra Ghat Diversion Dam	314.00	0	0	0	0
Dehra	62.90	1.56	3.12	1.54	3.08
Chakarpur	187.80	4.68	9.36	5.73	11.45

The entire sediment study is computer based on microsoft excel platform and details are contained in separate Hydrology Report Volume. The New Zero Elevation expected after 100 years of sedimentation works out as 487.62 m for Madia Dam, 465.35 m for Dehra Dam and 435.75 m for Chakarpur Dam. Total live storage of above dams is 419.86 MCM. After 50 years siltation, the live storage capacity would reduce to 399.00 MCM. The original and revised elevation-area-capacity table after 50 years and after 100 years of Madia Dam, Dehra Dam and Chakarpur Dam are given in **Table-5.3, 5.4 & 5.5.** The original elevation-area-capacity table of Semara Ghat Diversion Dam is given in **Table-5.6 under Chapter-5 of this report.**

3.1.7 Evapo-Transpiration

Reference evapo-transpiration (ETo) is the rate of evapo-transpiration from an extensive surface of 8 cm to 15 cm tall green grass cover of uniform height actively growing, completely shading the ground and not short of water. There are mainly four well known methods to predict evapo-transpiration for different climatic condition viz. (i) Blaney Criddle (ii) Radiation method (iii) Penman method (iv) PAN evaporation method.

For the present study, Penman-Monteith method has been used for estimating (ETo latest modified version of Penman method). The details are given in **Table-3.7.**

Table-3.7
Reference Evapo-transpiration (ETo) according to Penman-Monteith Method

Month	Max Temp in ^{o}C	Min Temp in ^{o}C	Humidity %	Wind Speed km/day	Sunshine Hours	Solar Radiation Million Joules/sq m/day	ETo mm/day
January	24.80	11.10	48	192	9.00	16.30	3.20
February	27.80	13.40	38	187	9.70	19.40	4.70
March	32.80	18.00	31	197	10.20	22.90	6.20

April	37.80	22.60	25	211	10.80	25.50	7.80
May	40.80	26.00	25	223	11.00	26.50	8.80
June	37.50	24.60	52	288	8.80	23.30	8.00
July	30.30	22.80	81	274	6.40	19.60	4.80
August	28.50	22.00	86.00	257.00	5.80	18.20	4.00
September	30.00	21.60	77.00	221.00	7.40	19.30	4.50
October	31.60	19.70	55.00	178.00	9.40	19.90	5.00
November	28.60	15.90	43.00	170.00	9.50	17.40	4.30
December	25.30	12.60	47.00	175.00	9.10	15.80	3.60
Year	31.30	19.20	51.00	214.00	8.90	20.30	1975

3.1.8 Design Flood against Safety of Structures

Bina Complex Multipurpose Project consists of four dam structures i.e. Madia and Chakarpur Dams on Bina river, Semra Ghat Diversion Dam on Dhasan river and Dehra Dam on Dehra Nalla. Design floods are based on gross storage and hydraulic height of dam. Following design floods have been selected for design of spillway for checking safety of dams against overturning. The details of design floods of four dams are given in **Table-3.8**.

Table-3.8
Design Flood

S. No.	**Dam**	**Designed Flood in Cumec**
1.	Madia Dam	6647.00
2.	SemraGhat DiversionDam	2310.00
3.	Dehra Dam	932.00
4.	Chakarpur Dam	8241.00

CHAPTER – IV

DESIGN ASPECTS

4.0 Background

The designs of Daudhan Dam, Ken-Betwa link canal, Ken Left Bank Canal, Lower Orr dam and Kotha Barrage were carried out by CWC as detailed in respective DPRs. The design of Bina Complex Multipurpose project has been done by Government of MP and adopted in this report. The component wise details of design are briefly described below:

4.1 Bina Complex Multipurpose Projects

Details of Design aspects of Headworks and canal system of Bina Complex Multipurpose Projectare described in the Chapter-IV "Design Aspects" of DPR of Bina Complex submitted by Govt. of MP to CWC for Techno-economical appraisal. The detail of design features of head works is extracted from above DPR.

There is no water source in the project area which is a part of Sagar district. At present irrigation in the project area from all sources is only 23 % of net cropped area. Since the area is dependent on rains, scarcity conditions exist all the time. Crop yield are low. People in the area are poor. The project area needs water for domestic and agriculture purpose. Studies carried out earlier show that some unutilized flows are available and the physiographical conditions are also suitable for harnessing the water resources.

As per share of MP under Rajghat Agreement with UP an unutilized flow balance of 483.9 MCM (17.09 TMC) is available for utilization in this project and the same proposed to be utilized in the project area which has not received any water so far. Physio graphically, also the project catchment comprises of isolated hills and pediment plain with major area forming part of the Sagar plateau. There are a number of rivers,Nallasand big streams like Dhasan, Dehra, Kurwai river. The average annual rainfall in the project area is around 1200 mm which results in ample flows in these segments. The available water resources will be interlinked for optimum benefits. These resources have not been harnessed though efforts have been going on since 1980 or even before. Apart

from irrigation facilities, certain falls are also available which could be used for generation of hydro power.

4.1.1 The Current Studies

Based on detailed studies, survey and investigations by the consultant, the scheme, location, capacity and type of hydraulic structures has been evaluated, in close consultation with the project officials of Water Resources department Govt. of MP. This has led to the finalization of scheme components, alignment of dam axis and project features. Bina Complex and Multipurpose Irrigation Project is now characterized by four storage Dams; i.e. Madia, Dhassan, Dehra and Chakarpur and two PUWs. The PUWs are at Dhassan on Dhassan – Dehra link and at Chakarpur for diversion of water to Irrigation command. Madia Dam on main Bina River has the largest storage (270.10 MCM).

The project makes provision for deriving benefits from hydropower generation. Two small Hydropower plants at Madia and Dehra have been proposed. These plants are run-of-river schemes but the benefit of storages upstream has been obtain to optimize peak hour generation. The capacity of these small hydro power plants has been fixed as 25 MW. These plats draw their strength from the flexibility for diurnal pondage available for operations. Total live storage of 419.86 MCM in all four reservoirs would provide irrigation to 90,000 haof CCA in Bina and Khurai tehsils.

4.1.2 General Topography

Bina Complex Irrigation & Multipurpose Project envisages construction of four dams near village Madia (upstream of Rahatgrah falls) on Bina river, Chakarpur Dam is a terminal structure, the provision of storage is considered essential to harness the field from its own free catchment and to balance the hydro power releases and spills from upper dams. The gorge on river Bina near the site could be exploited as dam storage and irrigation headworks besides balance releases for hydro power and d/s for environment and spills from Dehra and Madia dams. The Design features of Bina Complex project are furnished at Table 4.1.

Table – 4.1
Design Features of Bina Complex Projects

Sl No	Particulars	Chakarpur Dam	Madia Dam	Semraghat Dam	Dehra Dam
1.	Location	Sagar	Sagar	Sagar	Sagar
2.	River	Bina	Bina	Dhasan	Dehra
3.	Latitude	23°50’27”N	23°45’11” N	23°46’17” N	23°48’11” N
4.	Longitude	78°23’16”E	78°23’24”E	78°32’43”E	78°26’37”F
5	Max. Height				
a)	Earth & Rock fill Dam in m	25.00	23.50	11.32	35.00
b)	Concrete Dam in m	24.50	10.90	3.220	11.00
6.	Length of Spillway in m	110 .00	216.00	78.00	78.00
7	Length of earth Dam in m	1400.21	3569.69	1440	5687
a)	Main Dam in m	751.68	2069.69	1440	3509
b)	Saddle – I in m	516.65	1500.00	-	30
c)	Saddle – II in m	131.88	-	-	2148
8.	Top of Dam in m	455.00	505.50	501.80	494.00
9.	MWL in m	452.50	500.65	499.80	492.00
10.	FRL in m	451.50	500.55	499.70	491.60
11.	MDDL in m	439.50	492.50	-	484.00
12.	Lowest Bed Level in m	430.0	481.00	490.48	459.00
13.	PMF in cumec	8241.00	7341.10	2115.82	932.00

4.1.3 Geology

4.1.3.1 Chakarpur Dam Site

Fine to medium grained hard, compact but jointed and fractured sandstone belonging to Vindhyan super Group is expected in the river bed and on both the abutments. The trend of the sandstone in general is N 60^0– S 60^0 E to E– 2 which is nearly horizontally bedded.

Site investigations are done to know the physical conditions and permeability of the bed rock and to decipher the depth of curtain grouting / cut – off etc. Seven drill holes have been drilled in the site with 1 in the center of river bed, 1 downstream of axis 1 upstream of axis and remaining 4. Remaining drill holes on the banks of the river on the Dam axis. It is found that permeability of the rooks in on higher side and considerable grouting shall be required. The height of the proposed earth dam is 25.0 m and its length is 1400.216 m.

4.1.3.2 Madia Dam Site

This is the main storage dam proposed on Bina river. At this site fine grained hard, compact but highly jointed sandstone belonging to Vindhyan super group is exposed in the river bed section and on both the abutments. The trend of the sandstone in general is N35°W-S35°E with dips ranging from 5° to 8° inN55° Edirection.

4.1.3.3 Semra Ghat Diversion Dam

Semra Ghat Diversion Dam is proposed across Dhasan River. The surface geological mapping of the proposed dam site reveals that the river bed is occupied by Deccan trap locally known Malwa trap, which is highly fractured, vesicular but hard and compact, blackish in colour. In the rest of that proposed dam section mainly black soil is present.

4.1.3.4 Dehra Dam site

Dehra dam is proposed across Dehra Nalla. At the proposed site fractured, jointed but hard and compacted fine to medium grained sand stone belonging to Vidhyan super group is exposed. The trend of sand stone is 72°W - S72°E to E-W with the dips ranging from 15° to 19° in the U/S direction which is favourable location. It is expected that the after excavating about 2m depth the rock shall be competent enough to take load of structure. The permeability test carried out after exploratory drilling in - situ reveals that permeability of bed rock is quite high and it is likely to bear a load of grout. On the left side of the saddle dam fine grained hard and compact moderately jointed quartzatic sand stone is exposed belonging to Vidhyan super group which seems to be permeable.

4.1.4 Seismicity and Seismic Coefficient

The dam sites namely Chakarpurpur Dam, Madia Dam, Semra Ghat and Dehra Dam are located in the zone II & III of the seismic zoning map of India which basis horizontal seismic coefficient$\alpha 0 = 0.04$ and $\alpha h = 0.04 \times 3 = 0.12$ has been adopted, where 3 is the importance factor and $\alpha v = 2/3, \alpha h = 2/3 \times 0.12 = 0.08$ has been adopted.

4.1.5 Design Flood and Reservoir Sedimentation

The Design flood and Reservoir sedimentation have already been discussed in previous Para under hydrology. The sediment deposits and the new zero elevation is worked out and given in **Table-4.2.**

Table- 4.2
Sediment Deposition and the New Zero Elevation of Bina Complex

Sl No	Particulars	Chakarpur Dam	Madia Dam	Semra Ghat Diversion Dam	Dehra Dam
1	Design flood in cumec	8241	6647	2310	932
2	Sediment deposition in MCM				
a	After 50 year	5.73	26.64	Not applicable	1.54
b	After100Year	11.45	53.27	Not applicable	3.08
3	New zero elevation after 100 Years in m	435.75	487.62	-	465.350

4.1.6 Free Board:

The computed free board accordingly the top of dam for the four dam are given in **Table 4.3.**

Table 4.3
Free Board and Top of the Dam for Bina Complex

Sl No	Name of Dam	Free Board	Top of dam
1	Chakarpur Dam	3.50 m	455.00 m
2	Madia Dam	2.00 m.	505.50 m
3	SemraGhat Diversion Dam	2.00 m.	503.60 m
4	Dehra Dam	2.40 m.	494.00 m

4.1.7 Construction Materials

Borrow area materials for embankment were investigated by Soil Engineering Consultants. Forty representative soil samples each for Chakarpur dam and Dehra dam and thirty soil samples each for Madia dam and Dhasan dam have been collected and tested for their suitability construction materials for the embankment as well as casing and hearting. Most of the soils for core materials found in borrow area falls in CH or CI group which are suitable for construction of earthen embankment. The borrow area materials have been tested for mechanical analysis, Atterberg's Limit, Soil Classification, Optimum Moisture Context (OMC), Maximum Dry Density (MDD), Specific gravity and Shear Parameters.

4.1.8 Earth Dam -Design Criteria

The geometry of the homogeneous/zoned earth dam has been evolved taking into account the structural safety, Seismic aspects, seepage control and material properties etc. Detailed investigation for construction material is to be undertaker actual construction is taken up. The total length of the Chakarpur Dam is 1400.216 m including the length of main dam (751.682 m) and two number saddle viz. (516.65m and 131.884 m). Length of Madia Dam is 3569.694m including the length of main dam (2069.694 m) and one saddle2069.694 m (1500m).The total length of the Semra Ghat Dversion Dam is

1440 m. The total length of the Dehra Dam is 5687.00 m including the length of main dam (3509.00 m) and two number saddles is (30.00m and 2148.00 m).

4.1.8.1 Stability Analysis

Stability analysis for the four dams has been carried out by a software made in house based on Swedish Slip Circle method as per IS 7894-1975 " code of practice for stability of earth dam". The factor of safety for various loading conditions for upstream and downstream slope at various elevations has been worked out and are given in DPR of Bina complex irrigation and multipurpose project.

4.1.8.2 Zoning of Dam Section

Keeping in view the properties of soil, a Zoning section with selected impervious material for the core and semi – proposed that the materials for core, with permeability shall be $(1x10)^{-6}$ cm/second or less with selected impervious material for the core and semi – pervious / pervious materials for the casing has been provided. A chimney and horizontal filter connected with the drain have also been provided to take care of any seepage through the dam. A chimney filter on the transition zone in between core and shell in the upstream has also been provided to take care of any piping on the upstream site at the time of sudden drawdown of any time. A toe drain is also provided.

4.1.8.3 Protection of slope of Dam Section

(a) Chakarpur Dam

Upstream slopeis protected by hand placed riprap of 450 mm thickness from top to 1.5 m below MDDL.

Downstream slope is protected by hand placed riprap of 250 mm thickness on the entire downstream slope.

(b) Madia Dam

Upstream slope is protected by hand placed riprap of 450 mm thickness load over two layers of filter from top to 1.5 m below MDDL.

Downstream slope: Turfing has been provided on the D/S face. Further releasing the rain water for the collection of rainfall water and seepage water surface drainage and a toe drain has been provided.

(c) Dhasan Dam

Upstream slope is protected by a hand place of 600 mm thick riprap from the top of dam to 1.5 m below MDDL.

Downstream slope: is protected by hand placed riprap of 250 mm thickness has been on the D/s face.

(d) Dehra Dam

Upstream slope: 450 mm thick hand placed riprap up to elevation 478.00 m (below MDDL) has been provided.

Downstream slope: 250 mm thick hand placed riprap has been provided to the entire dam slope.

4.1.8.4 Internal drainage system

The Vertical filter (Chimney filter), Horizontal filter, Rock toe and Toe drain have been provided as a part of internal drainage arrangement of the embankment dam.

The internal drainage arrangement has been worked out as per IS: 9429-1980.

4.1.8.5 Filter

Two layers each 1500 mm well graded sand & 1500 mm coarse filter in conjunction with core and shell materials have been provided. The materials shall confirm to the following criteria:

$$\frac{D_{15\text{of}}\ \text{Filter material}}{D_{15}\ \text{of base material}} < 0.5$$

$$\frac{D_{85}\ \text{of Filter material}}{D_{85}\ \text{of base material}} < 0.5$$

Where $D_{15}$and $D_{85}$are 15% and 85% finer material by weight. Further, the grain size curve of the filter material will be parallel to that of the base material. The maximum particle size of the filter material shall not be more than 75 mm and it should not contain more that 5% of the material finer than 0.074 mm (200 mm Sieve).

4.1.8.6 Cut off Trench (COT)

The design of cut-off trench has been done as per the guidelines of IS: 8414 -1977, taking into account the result of detailed geological investigations. The back-fill material for cut off trench has the same properties as those specified for impervious core.

4.1.8.7 Foundation Treatment

A positive cut off extending to a depth of 1 m inside the fresh rock is provided as there is not available of sufficient quantity of clay. Therefore, clay blanket is not proposed. Curtain grout in two rows staggered at 3 m c/c upto a depth half the hydraulic head measured above the base of the cut-off treatment up to FRL have been provided. The minimum depth of curtain grouting shall be 10 m. In addition consolidation grout holes in two rows staggered at 3.0 m c/c up to depth of 6 m have been provided. .

4.1.8.8 Instrumentation

The following instruments to the earth dam have been proposed:

Surface settlement point
Parapet settlement point
Open stand pipe piezometers
Other miscellaneous arrangements will be provided as per BIS code

4.1.8.9 Concrete Dam/Non Over Flow Section/Stability Analysis/ Spillway Section

(a) Chakarpur Dam

A concrete dam (Over Flow Section &Non over Flow Section) of maximum height 25 m and 110 m length is proposed across river Bina near

village Chakarpur in Sagar districts of MP. Total PMF is 9303.9 cumec. Ogee shaped spillway has been designed to pass peak flow of 9303.9 cumec PMF keeping crest level at 439.50 m and MWL 452.50 m.5 bays of 20 m each and 4 nos of pies of 2.5 m thickness each have been provided. As per site condition a bucket type stilling basin is also provided to dissipate the energy. A foundation gallery is also proposed to inspect the dam as well as grouting operation. One row of curtain grouting, up to 80% of head but not less than 10 m @ 3 m c/c, have been provided. In addition, consolidation grouting @ 3.0 m c/c and 6 m depth has been proposed. Drainage holes @ 3.0 m c/c and depth of 70% of curtain grout holes have been proposed.

(b) Madia Dam

A concrete dam (Over Flow section& Non over Flow section) of 216 m length is proposed across river Bina near village Madia in Sagar district of MP. Spillway is proposed the centre of river. Ogee shaped spillway is considered to pass break flood of 7341.10 cumec (PMF).10 of bays of 15 m each are provided. Out of which, 9 bays will pass the discharge and one extra gate is provided for emergency purpose. Two numbers of non-overflow blocks are also provided adjacent to over flow section to accommodate the power intake.

(c) Semra Ghat Diversion Dam

Spillway is proposed at the center of river. 6 of bays of 13m each are provided. Ogee shaped spillway is considered to pass break flood of 2116 cumec (PMF).

(d) Dehra Dam

Spillway is provided on the right flank of river. 2 of bays of 14m each have been provided. Ogee spillway is considered to pass break flood of 1062.80 cumec (PMF).

4.1.8.9.1 Non Over Flow Sections - Design Criteria

The stability analysis for Non over Flow Section has been done at the deepest foundation level as per IS-6512-1984. The data used for the design of Non over Flow Section is given at **Table- 4.4**.

Table-4.4

Design of Non Over Flow Section for Stability Analysis

Sl. No.	Particulars	Chakarpur Dam	Madia Dam	Semraghat Dam
a)	Top width of dam in m	8.00	8.00	6.50
b)	SG of Masonry / Concrete	2.40	2.40	2.40
c)	U/S slope (H: 1)	0.10	0.10	0.10
d)	D/S slope (H: 1)	0.90	0.90	0.70
e)	Horizontal Seismic Co-efficient Vertical seismic Co-efficients	0.120 g	0.120 g	0.120 g
f)	Foundation Level in m	432.00	482.00	487.50
g)	Sill Level in m	436.00	487.79	493.40
h)	Full Reservoir Level (FRL) in m	451.50	500.55	499.70
i)	Maximum Water Level (MWL)in m	452.50	500.65	499.80
j)	Top of Dam in m	455.00	505.50	501.80
k)	Maximum Tail Water Level in m	434.00	487.20	-
l)	Minimum Tail Water Level in m	433.00	485.00	-
M)	Cohesion in t/sqm	100	100	100
n)	Angle of Internal Frichon	35°	35°	35°

The proposed Chakarpur dam, Madia dam and Semra Ghat Diversion Dam lies in seismic zone II and zone III as per the seismic zoning map of India given in the IS: 1893(Part-1) -2002 “Criteria for earthquake resistant design of structure”. Zone II and Zone III indicate low seismicity of the area. The value of horizontal seismic coefficients, (as approved by National Committee on Seismic Design Parameters) adopted is 0.120g. The cohesion and angle of internal friction of the concrete rock interface has been taken as 100 t/sq m and 35°respectively.

4.1.8.9.2 Spillway

The stability analysis for Overflow section has also been done at the deepest foundation as per IS: 6512-1984 for all the seven load combination. The data used for design is given at **Table 4.16**.

Table-4.16

Design of Over Flow Sections for Stability Analysis

Sl. No.	Particulars	Chakarpur dam	Madia Dam	Semra Ghat	Dehra dam
a)	Radial gate Trunnion Elevation level in m	443.500	498.370	494.920	486.400
b)	Bridge weight in t/m	10	10	10	10
c)	Top width in m	7.540	8.000	6.500	6.000
d)	Width of block in m	20.0	15.0	11.0	11.0
e)	Elevation of T.P. (D/S) in m	430.400	487.430	-	-
f)	Top Bridge level in m	456.00	505.50 m	502.40	496.00
g)	Cm(Maximum value of	0.735	0.735	0.735	0.735
h)	Seismic co-efficient (h)	0.120	0.120	0.120	0.120
i)	Top of Crest in m	439.50	492.90 m	493.70	484.00
j)	Foundation Level in m	432.00	482.00	487.50	473.00

The stresses obtained in all seven loading conditions are compressive and the factor of safety against sliding is more than 1 as per IS: 6512-1984. Hence structures are safe.

4.1.8.9.3 Design of Semra Ghat Feeder channel

A water conductor channel having a length of 7.00 km to work as feeder channel from Semra Ghat Diversion Dam to Dehra dam. The design features of Semra Ghat Feeder channel are furnished in **Table4.5.**

Table 4.5

Design Features Semra Ghat Feeder channel

Sl. No.	Particulars	Values
1	Total Quantum of water released to Dehra dam in MCM (canal to run for 2 months)	100
2	Length of Feeder Channel in m	7000
3	Bed Level of channel at RD 0.00 in m	495.00
4	Bed Level of channel at RD 7000 in m	491.00
5	FTL of Dehra Dam in m	491.00
6	Bed width in m	10.00
7	Depth of water in m	1.50
8	Side slope	1.50:1
9	Bed Gradient	1in 1750
10	Free board in m	0.75
11	Quantity diverted to Dehra Dam in MCM	50
12	Period for Running channel in a month	30 days
13	Velocity in m/sec	1.07
14	Discharge in cumec	19.67Cumec in another copy

4.1.8.9.4 Design of Canal system

Irrigation system consist of pressurized pipe micro irrigation in Khurai, Malthone and Bina Tehsils. Conveyance system of the Bina Main canal starting from south moves towards various segments of the command area after crossing the railway lines at desired locations. Almost all the command area served by the pressurized pipe micro irrigation system. The design features of pressure pipe canal system and total power requirement are given in **Table-4.6.**

Table-4.6

Design Features of Pressurised Pipe micro irrigation system and Total Power Requirement

Sl. No.	Particulars	Bina	Malthone-I	Malthone-II	Unit
1	CCA	60000	15000	15000	ha
2	Duty	0.35	0.35	0.35	lit./sec/ha
3	Discharge	21.00	5.25	5.25	Cumec
4	Max. level of Distribution Chamber	491.5	481.0	519.5	m
5	MDDL	435.75	435.75	435.75	m
6	Velocity	1.9	1.6	1.6	m/sec
7	Diameter	3.75	2.04	2.04	m
8	Length of Rising Main	2000	2000	2000	m
9	Static Head	57.6	46.3	84.8	m
10	Frictional Loss in Rising Main	1.13	1.47	1.47	m
11	Head in Rising Main	58.75	47.74	86.24	m
12	Length of Gravity Main (GM)	30000	20000	30000	m
13	Max Command area Level	435	435	460	m
14	Head Available	57	46	60	
15	Frictional Loss in GM	21.00	14.00	21.00	m
16	Command area Loss in GM	10.50	7.00	10.50	m
17	Provision for exit gradient and filter losses	25.00	25.00	28.00	m
18	Head in GM	56.50	46.00	59.50	m
19	Design Head	58.75	47.74	86.24	m
20	Power Requirement	15130	3073.42	5551.98	KW
21	Considering 8% for Transmission loss, other loss & Auxiliary , the total power requirement	16340	3319	5996	KW
	Total Power requirement		**25.66 MW**		

4.1.9 Bridges

Bridges shall be provided at suitable location along the Pipeline.

4.1.10 Energy Dissipation Arrangement (EDA)

Bucket type-II stilling basin has been provided for dissipation of the energy of the outflow. Below the stilling basin consolidation grouting and anchor bolts are provided. Provision of training wall on both side of stilling basin has been kept.

4.1.11 Navigation and Tourism Development

There is no provision for development of navigation aspect in the project. As far as the development of tourism is concerned the dam site has got full potential. Appropriate provision for development of tourist huts, picnic spots etc., has been made in the estimates.

CHAPTER-V

RESERVOIR & POWER

5.0 Background

The present chapter deals with reservoir and power assessment of various projects components under KBLP. The reservoir simulation and power studies of Daudhan Dam was carried out by NIH, Roorkee and CEA and included in DPR of April, 2010.The reservoir simulation study of Lower Orr Project and Kotha Barrage were carried out by NIH, Roorkee and included in DPR of January,2014.The reservoir simulation and power studies of Bina Complex Multipurpose Project were carried out by Water Resources Department, Government of MP. The DPRs of Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project are under techno-economic appraisal in CWC. The component wise details of reservoir capacity, simulation and power assessment are described in the subsequent paras.

5.1 Bina Complex Multipurpose Project

The Bina Complex Multipurpose Project comprises of four storage dams viz. Madia & Chakarpur Dams on Bina river, Semra Ghat Diversion Dam on Dhasan river and Dehra Dam on Dehra Nalla. Bina Complex Multipurpose Project includes generation of hydro-electric power having installed capacities of 2x10 MW and 1x5MW at Madia and Dehra Dams respectively. Water From Semra Ghat Diversion Dam will be released to Dehra Dam through a feeder channel having a length of 7km. Water will be stored at Chakarpur Dam and used for irrigation purpose through pressurized pipe micro irrigation system. The underground power house is proposed at Madia Dam on the left bank side of Bina river and surface power house is proposed at d/s of Dehra Dam.

5.1.1 Fixation of Storage and Reservoir Levels Approach-Criteria

The 75% dependable annual yield up to proposed Madia Dam, Semra Ghat Diversion Dam, Dehra and Chakarpur Dams have been worked out as 294.10 MCM, 86.30 MCM, 17.10MCM and 51.00 MCM respectively. The

hydrological controlling levels of the dams are fixed as per simulation study and are given below in**Table-5.1.**

Table-5.1

Levels and Capacities fixed as per Simulation Study

S. No.	Controlling Level/Capacity	Madia Dam	Semra Ghat Diversion Dam	Dehra Dam	Chakarpur Dam
1.	Top of dam in m	505.50	501.80	494.00	455.00
2.	FRL in m	501.10	499.70	491.60	451.50
3.	MWL in m	501.20	499.80	492.00	453.00
4.	MDDL in m	492.50	-	484.00	439.50
5.	Dead storage level in m	487.62	495.00	465.35	435.75
6.	Lowest bed level in m	481.00	490.480	459.00	430.00
7.	Gross storage capacity in MCM	270.10	6.46	72.36	74.31
8.	Live storage capacity in MCM	267.67	6.00	72.35	73.84
9.	Dead storage capacity in MCM	2.43	0.46	0.01	0.47
10.	Free board in m	2.00	2.00	2.40	3.50
11.	Submergence area at FRL in ha	6435.60	575.00	754.60	1349.50

5.1.2 Pressurized Pipe Micro Irrigation System

The details of pressurized pipe micro irrigation system in Bina, Malthone-I and Malthone-II areas pipe line system are furnished in **Table-5.2.**

Table-5.2

Features of Pressurized Pipe Micro Irrigation System

S. No.	Particulars	Bina	Malthone-I	Malthone-II	Unit
1.	Discharge	21.00	5.25	5.25	cumec
2.	Max. level of Distribution Chamber (DC)	491.5	481.0	519.5	m
3.	MDDL	435.75	435.75	435.75	m
4.	Max.command area level	435	435	460	m
5.	Head available	57	46	60	m
6.	Head in Gravity Main (GM)	56.50	46.00	59.50	m
7.	Design head	58.75	47.74	86.24	m
8.	power requirement	15130	3073.42	5551.98	KW
9.	Considering 8% for transmission loss, other loss & auxiliary, the total power requirement	16340	3319	5996	KW
	Grand Total power requirement		**25.66**		**MW**

5.1.3 Sedimentation Data and Studies

The sediment distribution is worked out for two periods viz. 50 years and 100 years by Empirical Area Reduction method. Considering the large presence of heavy soils and forested nature of upper water shade and in view of the sediment control measures proposed, an average annual sediment inflow rate of 5 ha-m per 100 sqkm/year has been considered. The sediment volume of Madia, Dehra and Chakarpur Dams have been estimated after50 years as 27.75 MCM, 1.56 MCM and 4.68 MCM respectively and after 100 years as 55.50 MCM, 3.12 MCM and 9.36 MCM respectively. As per sediment study, the category of

Madia Dam is taken as Type-III (Hill) and Dehra &Chakarpur Dams as Type-I (Lake).

Original and revised (after 50 years and 100 years)Elevation-Area-Capacity table of Madia, Dehra and Chakarpur Dams are given in **Table-5.3, 5.4& 5.5**.Whereas, only original Elevation-Area-Capacity values of Semra Ghat Diversion Dam have been considered by Government of MP and are given in **Table-5.6.**

Table-5.3

Original and Revised Elevation-Area-Capacity Table of Madia Dam

Elevation (m)	Original		Revised			
	Area (ha)	Capacity (MCM)	After 50 years		After 100 years	
			Area (ha)	Capacity (MCM)	Area (ha)	Capacity (MCM)
501.1	7120	313.11	7120.00	286.45	7120.00	259.82
501	6998.6	305.51	6898.97	278.90	6795.08	252.32
500.55	**6435.60**	**276.83**	**6284.13**	**250.93**	**6126.19**	**225.09**
500	5747.5	241.78	5532.67	216.74	5308.66	191.80
499	4627.6	189.9	4382.27	167.16	4126.46	144.62
498	3750	148.01	3496.06	127.77	3231.28	107.83
497	3026	114.13	2774.97	96.41	2513.22	79.11
496	2511	86.45	2270.01	71.19	2018.73	56.45
495	2028	63.75	1801.76	50.83	1565.87	38.53
494	1539.7	45.91	1331.37	35.16	1114.14	25.12
493	1201.9	32.2	1013.52	23.43	817.09	15.47
492	886.2	21.76	718.96	14.77	544.58	8.66
491	624.7	14.21	479.13	8.79	327.35	4.30
490	438.5	8.89	314.57	4.81	185.35	1.73
489	280.4	5.3	177.59	2.36	70.4	0.46
488	184.4	2.98	101.77	0.96	15.61	0.03
487.62	**153.81**	**2.43**	**78.33**	**0.69**	**9.68**	**0.02**
487	103.9	1.53	40.10	0.25	0	0
486	52.1	0.75	5.43	0.02	0	0
485	30.3	0.34	0	0	0	0
484	15.2	0.11	0	0	0	0
483	3.4	0.02	0	0	0	0
482	0.4	0	0	0	0	0
481	0	0	0	0	0	0

Table-5.4

Original and Revised Elevation-Area-Capacity Table of Dehra Dam

Elevation (m)	Original		Revised			
	Area (ha)	Capacity (MCM)	After 50 years		After 100 years	
			Area (ha)	Capacity (MCM)	Area (ha)	Capacity (MCM)
491.6	**747.4**	**72.4**	**747.40**	**70.86**	**747.40**	**69.31**
491	714.9	67.9	708.63	66.38	702.31	64.85
490	662.3	61	653.93	59.55	645.51	58.09
489	603.1	54.7	593.78	53.34	584.4	51.97
488	547.2	48.9	537.43	47.63	527.59	46.36
487	498.1	43.7	488.17	42.53	478.18	41.36
486	457.4	38.9	447.52	37.83	437.58	36.76
485	418.4	34.6	408.71	33.63	398.96	32.66
484	382	30.6	372.61	29.73	363.16	28.55
483	346.4	26.9	337.39	26.12	328.33	25.33
482	329.8	23.5	321.24	22.80	312.62	22.11
481	303.4	20.4	295.33	19.79	287.21	19.18
480	278.1	17.5	270.56	16.97	262.97	16.43
479	256.4	14.8	249.41	14.34	242.38	13.88
478	234.9	12.3	228.48	11.91	222.01	11.51
477	209.1	10.1	203.25	9.77	197.37	9.44
476	**187.9**	**8.1**	**182.63**	**7.82**	**177.32**	**7.55**
475	169.8	6.2	165.10	6.07	160.37	5.85
474	149.1	4.7	144.96	4.52	140.80	4.34
473	128.4	3.4	124.81	3.26	121.19	3.11
472	97.6	2.2	94.53	2.09	91.44	1.98
471	74	1.4	71.43	1.32	68.84	1.24
470	49.8	0.3	47.70	0.74	45.58	0.68
469	27.7	0.4	26.03	0.36	24.35	0.32
468	14.1	0.2	12.82	0.17	11.54	0.15
467	5.8	0.1	4.88	0.09	3.95	0.07
466	2.4	0.0123	1.78	0.01	1.15	0
465	0.1	0.0023	0	0	0	0
464	0.1	0.0013	0	0	0	0

Table-5.5

Original and Revised Elevation-Area-Capacity Table of Chakarpur Dam

Elevation (m)	Original		Revised			
	Area (ha)	Capacity (MCM)	After 50 years		After 100 years	
			Area (ha)	Capacity (MCM)	Area (ha)	Capacity (MCM)
451.5	**1349.58**	**74.31**	**1349.58**	**68.57**	**1349.58**	**62.86**
451	1280.1	67.57	1248.36	61.91	1216.03	56.28
450	1141.54	55.46	1098.29	50.18	1054.24	44.92
449	1004.38	44.73	956.88	39.90	908.51	35.11
448	823.19	35.59	774.43	31.24	724.77	26.94
447	694.04	28	645.74	24.14	596.55	20.33
446	572.21	21.67	525.5	18.28	477.94	14.56
445	474.5	16.44	430.16	13.51	385.00	10.65
444	377.39	12.18	335.96	9.68	293.77	7.25
443	284.87	8.87	246.72	6.76	207.88	4.75
442	214.37	6.37	179.75	4.63	144.5	2.38
441	154.53	4.53	123.58	3.11	92.06	1.8
440	114.31	3.18	87.09	2.06	59.36	1.04
439	87.07	2.18	63.55	1.31	39.60	0.55
438	60.51	1.44	40.61	0.79	20.35	0.15
437	47.54	0.9	31.12	0.43	14.40	0.08
436	**27.14**	**0.53**	**14**	**0.21**	**0.63**	**0.01**
435	18.31	0.3	8.21	0.09	0	0
434	11.55	0.15	4.19	0.03	0	0
433	5.85	0.06	0.91	0	0	0
432	1.84	0.02	0	0	0	0
431	0.89	0.01	0	0	0	0
430	0.43	0	0	0	0	0
429	0	0	0	0	0	0

Table-5.6
Original Elevation-Area-Capacity Table of Semra Ghat Diversion Dam

Elevation (m)	Original Area (ha)	Original Capacity (MCM)
490.5	0.00	0.00
491	0.50	0.0042
492	1.00	0.0354
493	1.00	0.1051
494	1.00	0.2484
495	1.00	0.4661
496	1.00	0.8199
497	1.00	1.4696
498	1.00	2.5869
499	1.00	4.3344
499.65	**1.00**	**6.0353**
500	1.00	6.9511
501	1.00	10.7447
502	1.00	15.7299

5.1.4 Life of Reservoirs

The life of all the four reservoirs has been considered as 100 years.

5.1.5 Reservoir Capacity

The storage capacity of the reservoirs at their FRL are given in **Table 5.7**

Table-5.7
Storage Capacity of the Reservoirs at FRL

S. No.	Reservoir Level	Capacity (MCM)		
		Original	Revised	
			After 50 Years	After 100 Years
1.	Madia Dam (500.10 m)	276.830	250.93	225.09
2.	Semra Ghat Diversion Dam (499.70 m)	6.035	Not Applicable	Not Applicable
3.	Dehra Dam (491.600 m)	72.400	70.86	69.31
4.	ChakarpurDam(451.500m)	74.310	68.57	62.86

5.1.6 Submergence Ratio

Total area under submergence of four reservoirs at FRL and distribution of land use under different types of land are given in **Table-5.17.**

Table-5.8
Land Use Classification of the Submerged Area

Unit: ha

S. No.	Particulars	Madia Dam	Semra Ghat Diversion Dam	Dehra Dam	Chakarpur Dam	Total
1.	Submergence area	6435.60	575.00	754.60	1349.50	9114.70
2.	Forest area	130.98	0.00	378.64	462.52	972.14
3.	Private Land area	5624.17	525.00	335.96	818.97	7304.10
4.	Other Land area	680.45	50.00	40.00	68.01	838.46

Total CCA of Bina Complex Multipurpose Project=96,000 ha

Therefore, Submergence Ratio: Cultivated Submerged Area/CCA

: 8142.56 (9114.70-972.14)/96000 =**0.085**

5.1.7 Power House

The proposed Bina Complex Project is irrigation and multipurpose project, which will include generation of hydro-electric power having installed capacities of 2x10 MW and 1x5 MW at Madia and Dehra Dams respectively. However, 25.66 MW power is required for lift irrigation in Bina and Malthone areas.

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CHAPTER - VI
IRRIGATION PLANNING AND COMMAND AREA DEVELOPMENT

6.0 Background

The present chapter deals with irrigation planning and command area development of various project components under KBLP. The DPR Bina Complex Multipurpose Project was prepared by WRD, Govt. of MP. The DPR is under techno-economic appraisal in CWC. The component wise details of irrigation planning and command area development of Bina Complex Multipurpose Project are given in the following paras.

6.1 Betwa Command

During meeting convened by Hon'ble Minister (WR, RD & GR) held on 18th November, 2016 with NWDA and Government of MP, it was decided that DPR of Bina Complex Multipurpose Project already prepared by Government of MP will be included in KBLP, Phase-II. Details of command area under Bina Complex Multipurpose Project are given in **Table-6.1**.

Table 6.1
Details of Project Wise Command Area

S. No.	Name of Project	Command Area (ha)	Benefited Districts
1.	Bina Complex Multipurpose Project	96,000 (90000 + 6000 pumping by local farmers)	Sagar and Raisen
	Total	**96,000**	

6.1.1 Bina Complex Multipurpose Project

Bina Complex Multipurpose Project consists of four storage dams viz. Madia and Chakarpur Dams on Bina river and Semra Ghat Diversion Dam on Dhasan river and Dehra Dam on Dhera Nalla (tributary of Bina river), a water conductor/feeder from Semra Ghat Diversion Dam to Dehra Dam and canal off takes at Chakarpur. The project is located in Sagar district, partly in Raisen district. Bina and Dhasan rivers are tributaries of Betwa river. It is also proposed to construct a 11.32 m high

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dam on Dhasan river and a 36 m high dam on Dehra Nalla. Water stored by Semra Ghat diversion Dam would be transferred to Dehra Dam. Tail water from Madia Dam and Dehra Dam would flow in Bina river and stored at Chakarpur reservoir.

6.1.1.1 Need for Irrigation

Project area which is part of Sagar district has irrigation facilities from all sources to the extent of only 23% of net cropped area. Since, the area is dependent on rains, scarcity condition exist all the time. Crop yield are low, people in the area are poor. Agriculture is the main occupation of around 75% of the surveyed households in the catchment villages. Around 16% of the households earn their livelihoods by workings agriculture labour whereas 10% of the total households are involved in other occupations such as livestock raising, dairy, grocery shop, trading etc. to sustain their lively hoods., above 73% of the total land is under cultivation.

Above 90% of the houses are kachha and less than 10% of them are pucca or semi pacca.

The bus stands exist in around 20% of the surveyed villages and around one fourth of the villages avail the facilities of post office. One third of the surveyed villages access to telephone services. Almost half of the villages avail the facility of PDS whereas people in other villages have to travel to other villages to avail these services.

The average number of hand pumps, open well and tube well in a village are 7, 11 and 14 respectively. Around 30% of the villages access to piped water supply which is very low. Around 20% of the surveyed villages access to canal water.

Out of cultivable land 37% area is under irrigation and the remaining area is rainfed. More than 83% of the cultivated land used for Ravi cultivation. Soyabean is the main crop in kharif season in the villages of catchments of all 4 reservoirs. More than 50% of Rabi cultivation in catchment villages is covered by wheat which is followed by 30% area under gram and 10% under lintel cultivation. Gram is grown in around 38% of area Cultivated in Ravi season.

The share cropping in the catchment villages is practiced by less than 10% of the households surveyed. Above 95% of these households share 50% expenses with the land owners and distribute the production is the same proportion. Major crop are wheat and soyabean. Yield are 35% below the national average. With low fertilizer input of 35kg/ha. Which is low compared to national average of 70 kg/ha. Above 65% of the farmers surveyed in the villages of catchments of 5 reservoirs use

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chemical fertilizer whereas 45% of the surveyed farmers use pesticides.

Around 58% of the surveyed farmers have got pump sets or tubewell for multipurpose including lifting of water from the source which is also meager. Above 60% of the cultivators community has got tube wells for irrigation.

The Overall literacy rate in the catchment area on the basis of secondary information is around 40% of which the percentage of literate males is above 63% whereas the female literacy is less than 40%.

The project is essentially aimed at raising agriculture production and from incomes by providing irrigation to new areas. This will increase the general standard of living of the people in the project area. Command area map of Bina Complex Multipurpose Project is shown at **Plate-5.**

6.1.1.2 Existing Cropping Pattern

Presently only rain fed cultivation is going on the proposed command area comprising parts of Khurai, Bina and Malthone blocks. The main crop grown in Kharif season is Soyabean and Pulses, Jower is usually been taken as a mixture with some pulses like Moong, Arhar, Urd etc. or Jower as a pure crop. Maize crop is also common. In low lying areas paddy is being grown. Though at present Soyabean is grown in very limited area but looking to the suitability of climate, soil and their utility the Sagar district has been declared as Soyabean district. Existing cropping pattern is as follows (Average 1997-2011) in **Table-6.2.**

Table-6.2
Existing Cropping Pattern

Name of Crop	Area under Cultivation (ha)	Cost of Cultivation (Rs./ha)	Total cost of Cultivation (Rs. lakh)	Yield per hectare (Qt)	Rate per Qt (Rs.)	Total Yield (Qt)	Total Value of Produce (Rs. lakh)	Remark
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
PRE DEVELOPMENT								
Kharif								
Soyabeen	3500	4500	157.50	10	2800	35000	980.00	
RABI								
Wheat	35000	4500	1575.00	15	1600	525000	8400.00	
Gram	28000	4500	1260.00	10	2500	280000	7000.00	
TOTAL	**66500**	**13500**	**2992.50**			**840000**	**16380.00**	

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Presently there is no major or medium project in the command area except for six small tanks/schemes, which are now in a poor condition, and enable a little support to irrigation.

The area covered by the existing schemes in the command is 1000 hectares only.

6.1.1.3 Soil Suitability

In broad soil classification the soil texture is grouped under deep medium black soil and locally it is called as Mar & Kabar. 79.58% of the command area is occupied by clay texure, the next type of soil is clay loam and miscellaneous i.e. hillock, rock shrubs inhabitation and road etc.

The soil of the command area mostly very deep to deep, few area is having moderately deep to shallow deep and very limited area under very shallow deep soil. With characteristics as below:-

- Soil of the command area is mostly clay (80%) and next is clay loam (13%)
- Soil is very deep (86%)
- Majority of the soil have got very low infiltration and permeability rate.
- Most of the area is occupied by II class i.e. 68.65% of land capability class.
- 86.95% area fall under class “B” of the soil irrigability classes.
- In land irritability class 68.85% of the area comes under 2^{nd} class.

6.1.1.4 Existing Cropping Pattern

Factors and constraints affecting choice of cropping pattern are as follow:

- Existing cropping practice
- Type of soil
- Habits of cultivator
- Availability of water during cropping season
- Adaptation of irrigation facilities by farmers
- Local needs of people
- Policy of government as regards intensive and extensive irrigation
- Percolation and drain ability condition
- Availability of market and socio-economic condition of region.

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6.1.1.5 Proposed Cropping Pattern

In view of the natural endowments of soil and water (i.e. the relatively large amount of rain and available water holding capacity of the soils) and traditional agriculture practices, it will be prudent to preserve the crop diversity of this agro-climatic zone. Larger areas need to be brought under Soyabean and Oilseeds, and some fruit crops need to be introduced in order to improve the farm economics.

Following cropping pattern and irrigation intensities are recommended and given in **Table-6.3.**

Table-6.3
Proposed Cropping Pattern and Irrigation Intensities

Crop and Crop Season	Irrigation Intensity %	Crop area for Unit Command CCA 1000 ha	Crop Area for Tentative Command (CCA 90,00 ha & Basin Lift 6,000 ha
A. Rabi			
1. Wheat	58.33	583.30	56,000
2. Gram	41.67	416.70	40,000
Total Rabi	**100**	**1000**	**96,000**
Total Annual	**100**	**1000**	**96,000**

The above selection of crops and cropping pattern is based on the preliminary discussions with the joint Director, Agriculture Department, Sagar district.

6.1.1.6 Water Requirement of Crops

The procedure adopted for the calculation of crop water requirement is base on methodologies presented in FAO irrigation and drainage paper No. 56 " Crop evaporation transpiration" and paper No. 46, " Crop water : A computer program for irrigation planning and management "Calculation for gross and net crop water requirements involves determination of

- Reference potential evapotranspiration (ETo) penman-modified method has been used which is the latest modified version of penman method. The annual ETO is estimated at 1975 mm with daily rate varying from about 3.2 mm/day in January to 8.8 mm/day in the month of may.

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- Crop factor (Kc) for crops at different stages of its growth.(Etc) is given by the equation Etc=kc. ETo. Kc values for all the four stages are given in FAO publication No 33 and 24. For the present studies. Crop factors are adopted as per the standard data given in these publications.
- Effective rainfall contribution Planting data and Growth period.
- Irrigation system efficiency. Most of the command area of this project has clay and clay loam soils therefore, percolation losses@2.5 mm/day are considered.

The rainfall used for calculating effective rainfall is the 75% dependable rainfall calculated after finding average rainfall of the command.

System efficiency takes into consideration the field efficiency conveyance efficiency and operational efficiency. For the present study and overall efficiency of about 64% is adopted for the preliminary studies. With the proposal of bringing a part of upper command under sprinkler system, the figure is likely to be achieved for the composite system. Details are given in **Table-6.4**.

Table-6.4
Crop Wise Irrigation Requirements

Crop	Net Irrigation Requirement (mm)
Rabi Crops	
Wheat I	487.1
Gram	431.7

Main details of computation are given in Annexure-III in Volume-VIII of DPR of Bina Complex Irrigation and Multipurpose Project prepared by Government of MP. The net irrigation (at plant Root) and gross irrigation water requirements (at Canal Head) are next assessed for the unit command (1000 ha) for the selected irrigation intensities of cropping on a 10 daily scale. The requirements corresponding to a dependable (dry) year are summarized.

6.1.1.7 Water Consumed for Proposed Irrigation

The amount of water consumed depends upon actual area which is brought under irrigation in each season. Rabi irrigation extent is dependent on amount water which can be stored. Therefore the water consumed for different alternatives is a foundation of the area under each crop.

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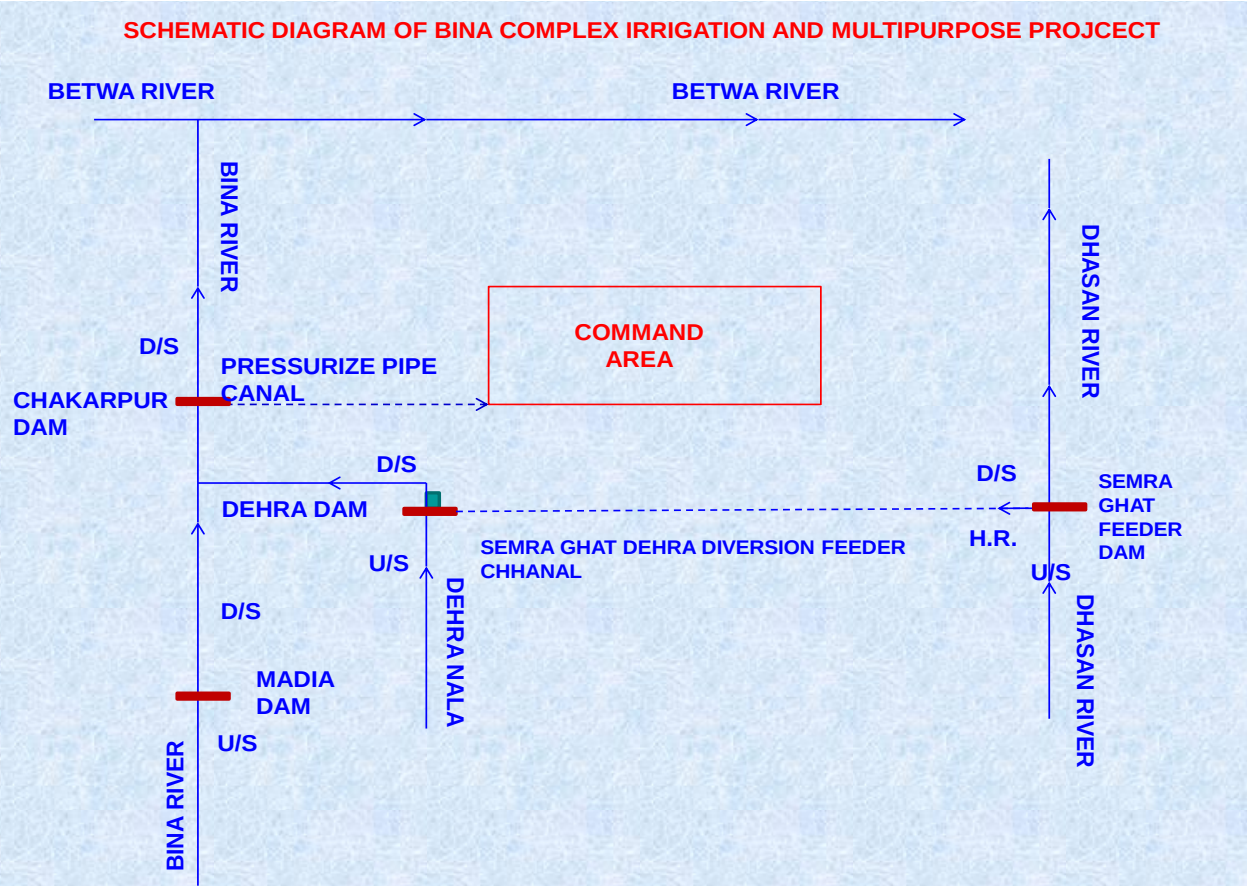


6.2 Summing Up of Command Area and Water Requirement from Bina Complex Multipurpose Project

The abstract of component wise break up of command area and water requirement from Bina Complex Multipurpose Project as finalized in Comprehensive Report is given in **Table-6.5.**

Table-6.5

Component Wise break up of Command Area and Water Requirement from Bina Complex Multipurpose Project

Component	CCA (Lakh ha)	Water Requirement (MCM)				Environ-mental Releases
		Irrigation Demand	Transmission losses	Domestic & Industrial Demand	Total	
Bina Complex Multipurpose Project (MP)	0.96	399.91	---	44.2**	444.11	6.51
Grand Total	**0.96**	**399.91**	**---**	**44.2****	**444.11**	**6.51**

** Domestic & Industrial Demand

CHAPTER-VII

CONSTRUCTION PROGRAMME, MANPOWER DEPLOYMENT & PLANT PLANNING

7.0 Background

The present chapter deals with construction methodology, manpower deployment &equipment planning for construction of various projects components under KBLP. The construction planning of Bina Complex Multipurpose Project have been done by Government of MP and included in the Comprehensive Report.

7.1 Bina Complex Multipurpose Project

As mention in para 7.1.3, the major components are proposed to be executed through award of contract. The existing resources available with Water Resources Department, Government of MP will be utilised for implementation of project. Therefore, no provision has been made for Special T&P and infrastructures.

7.1.1 Scheduled Working Hours

The scheduled working hours has been considered same as mentioned in para 7.3.3.1 and month completed is given same as in **Table-7.**2 of Daudhan Dam.

The shifts working of equipment is same considered as given in para 7.3.3.1 of Daudhan Dam.

7.1.2 Construction Period

A total period of 5 years has been considered for completion of the project. All the related works including construction of four dams, canals system power houses etc. under Bina Complex Multipurpose Project will be started simultaneously. The infra-structural development, pre-construction surveys and investigations, preparation of design/specifications and tender documents are

proposed to be taken up during the first years. As works are to be executed through award of contract, it is planned to award contracts for all major works by the end of 1st year. However, some of the works like River diversion, spillway channel and main canal may have to be undertaken from the 4th quarter of the 1st year itself and therefore award of work for these works may be planned accordingly. The work on infrastructure facilities like colonies, approach roads, workshop, haul roads, stores, office buildings etc. will also start in the 1st year itself. Some of these activities will continue for some time during the second year also. The construction of all civil structures and power houses are proposed to be completed by the end of 1stquarter of year 5.

A total construction period of 48 months have been earmarked for completion of rising mains, pump house, distributaries and other canal structures like aqueducts, super passages, syphons, pipe culverts, road bridges and railway crossings etc.

7.1.3 Implementation Mechanism

The implementation of Ken Left Bank Canal which totally lies in Madhya Pradesh and all sub-canals and distribution network for irrigation and other purposes within Madhya Pradesh will be done by Government of Madhya Pradesh.

The implementation of Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project will be carried out by Government of Madhya Pradesh.

(b) Works to be implemented by Government of Uttar Pradesh

The repair and strengthening of Bariyarpur Pick Up Weir, Parichha Weir and Barwa Sagar Dam etc. will be carried out by Government of Uttar Pradesh.

The implementation of all sub-canals and distribution network for irrigation and other purposes within Uttar Pradesh will be done by Government of Uttar Pradesh.

7.2 Year Wise Allocation of Cost

The total cost of the project is worked out to be Rs. **3259.53** crore. The yearly phasing of the same is given in **Table-7.7** and construction schedule for Daudhan Dam, Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project are placed at **Annexure-7.1.** Expenditure during first year is mainly for payment of NPV of PTR/Forest Land, CAMPA Fund, Partly Land acquisition and Development of Infrastructure for Construction etc.

Table-7.7
Yearly Phasing of the Cost of Project

Year	Bina Complex Multipurpose Project
1	1206.03
2	488.93
3	488.93
4	651.90
5	423.74
6	0.00
7	0.00
8	0.00
Total	**3259.53**

7.3 Benefits

(i) Estimated Cost of Increased Production

The crop wise yields in pre and post project scenarios have been assessed. Based on the increased production, cost of increased production has been assessed in **Chapter-X of this report.**

(ii) Likely Socio-Economic Aspects

Due to increase in food grain production, the socio-economic condition of farmers will improve in general. Agricultural labourers will get employment in the nearby area of all four projects. Situation of livestock will improve. Farmers will try to establish agro-based industries in the area.

CHAPTER-VIII

ENVIRONMENTAL IMPACT ASSESSMENT & ENVIRONMENTAL MANAGEMENT PLAN

8.0 General

The present chapter deals with Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) of various projects components under KBLP. The EIA studies of KBLP as proposed earlier were done by Agriculture Finance Corporation (AFC) Ltd., Hyderabad and included in DPR of April, 2010. The EIA studies were further modified in 2015 considering latest data and in the accordance with provisions of the "Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013" and incorporating suggestions/comments of MOEF&CC. The EIA study for Bina Complex Multipurpose Project have been done by Water Resources Department, Government of MP.

8.1 Need for Impact Assessment

KBLP involves impoundment of water by construction of a dam across river Ken at Daudhan for irrigation, drinking and hydro-electric purpose besides transfer of water from Ken river to Betwa river in u/s of Parichha Weir. Water, so transported to Betwa river is further proposed to be utilized in Upper Betwa basin on substitution basis in KBLP. As it is well known, any water resources development project may result in both positive and negative impacts on the environment. Such projects require a detailed study of various aspects for identifying positive and negative impacts that may occur in the area and also to formulate a meaningful and applicable management plan to mitigate these adverse environmental impacts, or if possible completely eliminate.

8.1.1 Project Background

Ken and Betwa rivers have their origin in MP and the rivers flow through MP and UP. No major irrigation projects were taken up in the Ken River basin in MP up to Gangau Weir to harness the waters to irrigate the backward and drought prone areas in the districts of Chhatarpur, Panna, Damoh and Tikamgarh of MP and Jhansi & Mahoba districts of UP.

A large population in Chhatarpur, Tikamgarh, Panna & Damoh districts of MP and Jhansi, Mahoba & Lalitpur districts of UP experienced acute shortage of drinking water. In this context, the proposed Ken-Betwa Link Project finds significance. As the proposed project has been found to be techno-economically viable, it is expected that the proposed project is likely to meet the requirements to the tune of 6,98,432 ha besides providing drinking water of 60 MCM in MP, 67 MCM in UP and generating 78 MW of power which is an added advantage of the project from Daudhan Dam. Besides, 2,06,000 ha from Lower Orr Project, Kotha Barrage and Bina Complex Multipurpose Project in Shivpuri, Datia, Sagar and Vidisha districts of MP will be irrigated.

8.1.2 Project Justification

The National Water Policy (2002) emphasizes the need for interlinking of rivers in the country from water surplus areas to water short areas based on NPP after taking into account the requirement of the surplus areas/basins. This shall be a significant step forward to achieve the objective of equitable distribution and utilization of our limited water resources.

8.1.3 Project Description

The Comprehensive Report of KBLP comprises the following:

8.1.3.1 Head Works &Distribution System

8.1.3.1.1 Daudhan Dam Comprises

(i) An earthen embankment cum concrete dam across Ken River at Daudhan with FRL/MWL 288 m.

(ii) An Upper Level Tunnel about 170 m from the left bank of Daudhan dam having length of 1.9 km for conveying water to the link water carrier.

(iii) A Lower Level Tunnel about 100 m from the left bank of Daudhan dam having length of 1.1 km for conveying water to the Power House-II and from there to the Left Bank Canal of MP through a connecting channel of about 2.5 km.

(iv) Power House-I (2x30 MW) to the right of spillway at the toe of Daudhan dam.
(v) Power House-II (3X6 MW) at the outlet of Lower Level Tunnel.

8.1.3.1.2 Kotha Barrage Comprises

(i) A barrage across Betwa river at village Kotha, Tehsil Ganj Basoda, district Vidisha, Madhya Pradesh.
(ii) Pump Houses and Rising Mains

8.1.3.1.3 Bina Complex Multipurpose Project Comprises

(i) Four storage dams: Madia & Chakarpur on Bina River,, Semra Ghat Diversion on Dhasan River and Dehra Dam on Dehra Nalla.
(ii) Pump Houses, Rising Mains and Power Houses.

8.1.3.1.4 Lower Orr Project Comprises

(i) An earthen embankment cum concrete dam across Orr River near village Didauni, in district Shivpuri, Madhya Pradesh.
(ii) Pump Houses, Rising Mains and link water carrier.

8.1.3.1.5 Repair/strengthening/remodeling of Bariyarpur pick up weir, Parichha weir, Barwa Sagar Dam along with appurtenant structures and 7.1km long Barwa Nallah to carry water from Barwa Sagar to Betwa river upstream of existing Parichha weir.

8.1.3.1.6 Construction of two new barrages along with appurtenant structures d/s of existing Bariyarpur Pick up weir in the territory of UP.

8.1.3.1.7 Renovation of existing tanks and their connecting links in Mahoba district and carrier system for transfer of water from Ken Betwa link canal to tanks in order to enable UP to store the monsoon water to use during non-monsoon season.

8.1.3.2 Canal Pipe Line and Command Networks

8.1.3.2.1 Ken Basin

(i) A link canal (220.624 Km long including 1.9 m length of Upper Level Tunnel) with off take FSL 257 m to existing Barwa Sagar with FRL 219.20 m across Barwa Nallah, a tributary of Betwa River.

(ii) A bye pass channel from exit of Lower Level Tunnel to connect proposed Ken Left Bank Canal of MP.

(iii) Pumping system arrangements for lifting of water to Upper Level Tunnel to ensure the water supply in the Ken-Betwa link canal whenever reservoir depletes below the crown level of Upper Level Tunnel.

(iv) Developing pumping system, pipe distribution network and micro irrigation system by lifting water from Daudhan reservoir/initial reach of Link water carrier to serve a part of high level command (43,678 ha.) of Chhatarpur District of MP.

(v) A 90 km long proposed ken Left Banal Canal of MP and developing pumping system, pipe distribution network and micro irrigation system for ken Left Bank Canal to serve 1,39,848 ha. CCA in Chhatarpur District.

(vi) From existing Bariyarpur LBC 38,890 ha. CCA will be covered by existing open canal network in Chhatarpur District of MP.

(vii) Developing pumping system, pipe distribution network and micro irrigation system for 90,101 ha. CCA by lifting water from Daudhan reservoir, out of which 70,000 ha. CCA will be in Panna District and 20,101 ha. CCA will be in Damoh District of MP.

(viii) Developing pumping system, pipe distribution network and micro irrigation system from Ken-Betwa link canal to serve left out area of 42,096 ha. of high level command & 96,751 ha. Enroute command of MP and 17,488 ha. of enroute command of UP.

(ix) Stabilization of irrigation in 1,92,479 ha. in Banda district in UP under existing Ken command by repair/strengthening of existing system. Enhancing command area of Bariyarpur Right Bank Canal (Ken Canal) system by utilizing pressurized pipe micro irrigation system.

8.1.3.2.2 Betwa Basin

(i) Kotha Barrage: - Pumping system, pipe distribution network and micro irrigation system for 20,000 ha. CCA of MP.

(ii) Bina Complex Multipurpose Project: - Pumping system, pipe distribution network and micro irrigation system for 96,000 ha. CCA of MP.

(iii) Lower Orr Project:-Pumping system, pipe distribution network and micro irrigation system for 90,000 ha. CCA of MP.

(iv) Development of existing command of 37,564 ha. in Mahoba district in UP with pressurized pipe micro irrigation system.

8.1.4 Study Area of the Project

The study area considered for the Comprehensive EIA studies and preparation of EMP comprise the following:

- 1 km on either side of the canal
- 10 km radius around the project area from periphery of the project site
- submergence area under the proposed reservoir
- catchment area of dam/reservoir.
- command area on the d/s side of reservoir and en-route link canal
- areas of backwater influence on u/s side of dam

The EIA studies for newly proposed High level command and additional enroute command have not been carried out at this stage.

8.2 Bina Complex Multipurpose Project

8.2.1 Environmental Issues

Environmental issues related to water resources encompass a wide range of concerns, including public health, pollution of surface and ground waters, ground water level fluctuations, salt water intrusion, reduced sedimentation in flood plains, changes in river hydrographs, reduction of wetland area, increased riverbed erosion.

The first one is disruption of human settlements and human activities. A second type of environmental effects associated with water development is the relation of factorable habitats for the parasitic and water-borne diseases, such as schistosomiasis, malaria, filiariasis hepatitis.

A third type of environmental disruption is of physical of chemical nature, resulting from the alteration of land use, anaor changes in the surface and ground water regimes, as a consequence of the construction of irrigation projects or flood control works, such as dam or levees, soil stalinization and water logging due to the lack of adequate drainage facilities.

Most serious environmental disruption of this category is siltation. At times reservoirs that were built for flow control where the rate of accumulation of sediment was so rapid that a major reduction of reservoir capacity occurred within a few years of the construction.

Fourth category of environmental effects of water resources development deals with flora and fauna, including impacts on ecological systems taken in a broad sense in this term.

From the environmental point of view much unhappiness with water projects stems from the casual way in which environmental consequences are handled as a last minute consideration, rather than being integrated in to project design from the beginning fisheries. In all of these cases adequate pre-planning guidelines could substantially reduce the environmental impacts there are other projects, for example large dams, which have major environment impacts that cannot be mitigated, such as loss of habitat, loss of fertile bottom lands, destruction of forests, and sediment trapping, in addition

to the social impacts of moving large numbers of people. From their homes and farms. The construction of large reservoirs for water storage can have a serious and complex impact on the environment that is often difficult to quaintly and identify. When large dam are built, the river regime changes and influences the behavior of the whole hydraulic system from the headwaters to the outflow.

Flora and fauna living along the river suffer the effects of this change, while the population living in the area to be flooded must move elsewhere permanently. Some adverse effects can sometimes appear after the construction. of the project.

Reservoirs are also vulnerable to the inflow of nitrates and phosphates and toxic chemicals. Fertilizers, such as phosphates, are creating entropic systems in reservoirs and the degraded water quality makes for inferior water supplies.

8.2.2 Biodiversity Management Plan

The biodiversity management plan for the proposed Bina Complex Multipurpose Project has been formulated considering the existing fauna and flora profile of the region, custom cultures and traditional rights of local people, conservation significance of the area, State Biodiversity Conservation Strategy Action Plans (SBCSAP) and Biological Diversity Act 2002. It may be stressed here that during, the primary flora/fauna survey in the project area where construction activities are proposed none of the species of rare threatened or endangered category was recorded. However, recognizing the need for conservation and liked hood of their existence in the vicinity area, a Comprehensive Biodiversity Management Plan is drawn.

Following objectives have been taken into consideration for the preparation of biodiversity management plan for the proposed Bina Complex Multipurpose Project.

- To maintain a sustainable approach between customs and culture of the local communities and biodiversity

- To establish gardens for the vulture specimens of the recorded and endemic
- Special efforts for in situ or ex situ conservation of critical/ important plant/animal species if any, affected by the project
- To project the traditional knowledge of the local people regarding biodiversity and its value and to prepare peoples Biodiversity register
- To create a data bank on 'VAIDS' and their traditional knowledge on biodiversity
- To provide incentives for research, training and public education to increase awareness with respect to biodiversity
- Noise mitigation and wildlife management of habitats and ecosystem.

8.2.3 Need for Impact Assessment

Environmental monitoring shall be performed during construction, commissioning, and operation phases to ensure that the adverse impact have been mitigated and to verify the impact predictions. The monitoring program will indicate where changes to procedures or operations are required, in order to reduce impacts on the environment or local population. The monitoring program for the Bina Complex Multipurpose Project will be undertaken to meet the following objectives:

- To monitor the environmental conditions of reservoirs areas, power houses and command area as impacted by the project
- To check on whether mitigation and benefit enhancement measures have actually been adopted, and are proving effective in practice
- To provide information on the actual nature and extent of key impacts
- Effectiveness of mitigation and benefit enhancement measures which through a feedback mechanism, can improve the planning and execution of future similar projects
- During construction and operational phase of the Bina Complex Multipurpose Project, environmental monitoring programme will be undertaken. The details are given in **Table-8.1** & **8.2**.

Table-8.1
Environmental Monitoring Programme of Bina Complex Multipurpose Project during Construction Phase

S. No.	Particulars	Parameters	Frequency	Location
1.	Treated waste water from STPs	PH, BOD, COD, TSS and Oil & Grease	Once every month	Before and after treatment from the STPs at various labour camps
2.	Air quality	SPM, RPM, SO_2, NO_2 and CO	Once every season	At major construction sites
3.	Noise	Equivalent noise level (leq)	Every month	At major construction sites
4.	Water related diseases	Identification of water related diseases, adequacy of local control and curative measure, etc.	Once every season	Labour camps and nearby settlements

Table-8.2
Environmental Monitoring Programme of Bina Complex Multipurpose Project during Operation Phase

S. No.	Particulars	Parameters	Frequency	Location
1.	Water	PH, Turbidity, Total dissolved solids, Calcium, magnesium, chlorides, sulphate, Nitrates, Iron, DO, BOD, COD, etc.	Pre monsoon season and post monsoon season	Madia, Semra Ghat Diversion Dam, Dehra and Chakarpur Dams

2.	Treated waste water from STPS	PH, BOD, COD, TSS and Oil & Grease.	Once every month	Before and after treatment from STP
3.	Erosion & Siltation	Soil erosion rates, stability of bank embankment	Twice a year (Pre & Post monsoon)	---
4.	Ecology	Status of afforestation programmes	Once in 5 years	---
5.	Fisheries	Phytoplanktons, zooplanktons, benthic life fish composition	Twice a year	Madia, Semra Ghat Diversion Dam, Dehra and Chakarpur Dams
6.	Incidence of water related diseases	Cause and control measures for various diseases.	Once in a year	Settlements around reservoirs and in command areas
7.	Meteorological Parameters	Temperature, rainfall, humidity, cloud, cover, wind, speed and direction, Solar Insolation Evaporation Rate	Continuous	Madia Power House
8.	Flow Monitoring	Discharge in Bina & Semra Ghat rivers and Dehra Nalla	Continuous	Downstream of Reservoir sites.

8.2.4 Recommendations

Specific recommendations regarding the project are as follows:

1. Even as there are no pristine natural ecosystems present in the project area. However, submergence of 1024.44 ha forest land may have potential environmental impact on biodiversity and system.
2. Most of the species found in the proposed submergence area are common and widely distributed.

3. It may be stressed here that during the primary flora/fauna survey in the project area where construction activities are proposed, none of the species of rare, threatened or endangered category was recorded.
4. The local people of the region have a unique way of life and have developed their own, system of medicine and food. Local people use many plant species to cure some of the prevalent diseases viz. fruits of Terminalia belerica (Bahera) and Terminalia chebula (Harra) for treatment of gastric problems, root and leves of Catharanthus roseus (Sadabahar) as anti-diabetic, whole plant of Centellaasiatica (Jal brahmi) as brain tonic, root and leaves of calotropisprocera (Safed madar) as detergent & snake bites, fruits of Emblica officinalis (Amla) for stomach disorders, fruit pulp of Madhucaindica (Mahua) as snake bite, seeds of Pongamia Pinnata (Karanj) as skin eruptions, bark of Terminalia arjuna (kahara) for treatment of cardiac problems, seed power for syzygiumcuminl (jamun) for diabetea, leaves of ocimum sanctum (tulsi) for cough, fever, whole plant of Eclipta alba (Ghamira) as liver tonic, antiseptic, whole plant of Azadiachtaindica (Neem) as vermifuge & antiseptic, etc.
5. The total forest land including submergence area and other project appurtenance is about 1024.44 ha. It is proposed to afforest, double the amount of forest land will be acquired for the project. Thus, a total of 1440 ha of land needs to be afforested. The compensatory afforestation work is to be done by Forest Department.
6. The proposed project area is not under severe anthropogenic pressure. However, problems of exotic weed Lantana Camara is one of the invasive species that have been introduced unintentionally or by natural means in this area. Endemics in future in order to understand this problem and manage it successfully the following measures are suggested.

a) Identify the area where biological invasions have occurred and are threatening.
b) Indentify the exotic invasive species that are invading these habitats.
c) Indentify the institutions/expends who can undertake inventor researches to suggest management measures to control this negative impact of invasive species.
d) Inventories the native species which are threatened by invasions and that require rehabilitation and management.

e) Researches on control of weed including bio-control measures and total biology

f) Removal of exotic invasive plant species and obnoxious weeds.

g) The tree species which seem to be disappearing in the forest areas are bans, chandan, kher, kullu and khamer whereas the diminishing shrubs are siharoo, ban tulsi and rengar. Kell and mushyal grasses are also reducing day by day. These species have been considered rare and endangered species. It is proposed to afforest an area of 50 ha. @ 1100 trees/ha with these species.

h) In the Madia, Dehra and Chakarpur reservoirs, forest area of 1024.44 ha is coming under submergence. Some settlements are also located close to forest area and locals people are collecting of fire wood and forest produce. Under the reward for informers programme it is proposed to engage the workers who are well acquainted with area and will be resourceful in gathering information for anti-poaching (particularly medicinal herbs and threaten species) and better vigilance.

i) During the project construction phase, various adverse impacts on the forests and wildlife are anticipated in the surrounding area of the proposed project in terms of increased noise levels, land vibrations during controlled blasting, release of air and water pollutants, etc. Mammals are the most vulnerable group affected by these negative impacts, which affect their movement, behavior and breeding habit. Strict restrictions shall be imposed on the workers at project sites to ensure that they do not harvest any species/ produce from the forests and cause any danger or harm to the animals and birds in the wild.

j) There is no major wildlife available in the catchments of Madia, Dehra and Chakarpur and Semra Ghat reservoirs. However, small number of animals like, rabbit, dear, Blue bull, etc. observed in the area. Since there is no major wildlife and hence there are no certain routes for the same. The forest Department policy do exists for the protection in wild life as application throughout the forest Department in the state. As some wildlife movement is observed in forest area in and around reservoir area wildlife Management plan has been proposed with respect to the conservation.

k) There are no ecologically sensitive areas around the project sites. However, the forests at the site and in the vicinity serve as a habitat for wildlife. Due to construction activities and increased human interferences, as a result of immigration of large labour population and their family members, some

adverse impacts may take place wildlife during construction phase, the increased human interferences can have adverse impact on wildlife in and around the project area. It is recommended that check posts should be installed near major construction sites and labour camps which shall be operational during construction phase.

For implementation of the above recommendations, a provision of Rs. 17600 lakh has been kept for payment of NPV and CAMPA Fund etc.

8.2.5 Legal Status of Project

The separate DPR of Bina Complex Multipurpose project prepared by Water Resources Department, Government of MP is under appraisal in CWC. The present legal status of the DPR is given in **Table-8.3**.

Table-8.3
Legal Status of Project

S. No.	Clearances	Present Status
1.	Techno-economic Clearance	Under appraisal in CWC
2.	Environmental Clearance	Completed
3.	Forest Land Diversion Clearance	Stage-I clearance accorded by MoEF&CC. Stage-II clearance is under process.

CHAPTER –IX
SOCIO-ECONOMIC ASPECTS AND R & R

9.0 Background

The present chapter deals with Socio-Economic Aspects and R & R studies of various projects components under KBLP. The studies of KBLP were done by M/s Agriculture Finance Corporation (AFC) Ltd., Hyderabad and included in DPR of 2010 and also techno-economically cleared by CWC in 2017. Environment clearance and 1st Stage forest clearances for the diversion of 6017 ha of forest land have been accorded by MoEF&CC vide its letters No.J-12011/20/2013-IA-I dated 25.08.2017 and letter No. F.No.8-49/2016-FC dated 25/05/2017 and same are appended as **Annexures-9.1 and 9.2** respectively.

The studies of Bina Complex Multipurpose Project have also been done by WRD, Govt. of MP. Environment and 1st Stage clearances for the diversion of 1024.44 ha of forest land in respect of Ken-Betwa link have been accorded by MoEF& CC vide its letters No.J-12011/31/2014-IA-I dated 22.02.2017 and letter No. F.No.8-13/2015-FC dated 27/07/2016 and same are appended as **Annexures-9.3 and 9.4** respectively.

9.1 Bina Complex Project

This information given below in related to Ken basin in general

Area (sq.km)	1109.84 sq.km
Principal districts covered	Sagar and Raisen districts
Approximate Population	1.162 millions
Approximate ST. Population	90376
Average annual rainfall	1222.1 mm
Soil type	Deep Medium Black soil (mar & Kabar)
Soil Quality (N/P/K)	Low/Medium/Medium
Water Quality	River water fall in C-Class
Major Crops	Wheat and Soyabean
Average Fertilizer consumption	30 Kg/ha

Average % of workers in agricultural Sector	Cultivators account about 26% of total population while agricultural labours about 21% of total population
Average land holding size (ha)	0.5 ha
Average Human Development Index	0.5

9.1.1 Submergence Area

It has been estimated that 9114.60 ha of land spread over 78 (9 fully & 69 partially) villages shall come under submergence.

9.1.1.1 Category Wise Land Coming Under Submergence

The category wise land coming under submergence due to construction of Kotha Barrage and canal are shown in **Table 9.1**.

Table No. 9.1

Category Wise and Land Coming Under Submergence

S. No.	Particulars	Area (ha)
1	Land under Dam	5732.00
2	Land under Canals	111.00
	Total	**5843.00**

9.1.1.2 Project Affected Villages

It has been estimated that about 1404 families will be affected in these villages. A small population of peripheral villages would also be affected as lands of the people belonging of these villages will also be adversely affected.

9.1.1.3 Household Survey Findings

A general socio-economic scenario of the households and a base line status is presented and is based on findings of household surveys undertaken through preliminary consultations and questionnaire surveys. Approx population of Basin is 21000.

9.1.2 Social Categories

A sample of 20 households was decided for primary level information in each of the surveyed villages. In the command area, 4520 families of 226 villages were surveyed. Above 98% of the surveyed household belong to Hindu community and remaining 2% of the families belong to Muslim, Sikh and Christian communities. ST families covered in the study are less than 10% of total PAF's in the command villages. In the command villages, more than 50% of the total PAF's belong to OBC whereas the household belonging to general category and SC are 16% and 23% respectively.

Table No. 9.2
Castwise distribution of Affected Families in the Kotha Barrage area

Sl.No.	Social Categories	Percentage to total
1	ST	8
2	SC	24
3	OBC	41
4	General Caste	22
5	Others	5

9.1.3 Income Level

The percent of families earning a total income of below or up to Rs 17000/- per annumn is about 7 % . Suitable measures should be taken under this project to address this situation, so that certain income generating schemes can be designed and some programs from other Government Departments integrated to supplement the income levels in this region. Percent of households belonging to various income groups are as follows:-

Table No. 9.3
Income wise distribution of Affected Families

Sl.No.	Households	Percentage to total
1	Up to Rs 17000 per annum	7
2	From Rs 17000 to Rs 50000 per annum	75
3	From Rs 50000 up to Rs 100000 per annum	13
4	More than Rs 100000 per annum	5

9.1.4 Occupation Pattern

Agriculture is the main occupation of around 75% of the surveyed households in the catchment villages. Around 16% of the households earn their livelihoods by working as agriculture labour whereas 10% of the total households are involved in other occupations such as livestock rearing, dairy, grocery shop, trading etc. to sustain their livelihoods. In the catchment area of Madia reservoir, above 15% of the families are involved in other activities to earn their livelihood. In Dehra village where the percentage of such households is 8% total main workers account for only 40% (68% male and 32% female) whereas marginal and non-workers, account for 9% (37% male and 63% female) and 61% (44% male and 56% female), respectively. Out of total main workers, cultivators account for 26% followed by household industry workers (23%), agricultural labourers (21%) and the rest are other workers (31%) Most of the persons classified as other workers are engaged in the rearing of livestock mainly buffalo, goat, sheep, cow, etc.

9.1.5 Household Assets

As per the details given in the table below, more than 75% of the surveyed households in the catchment area possess TV sets whereas around 90% of the

households are having radio. Above 55% of the households are having tape recorders. The percentage of families possessing refrigerators and LPG is more or less same with a figure of 17.

Housing Details

The details of 1404 families surveyed in the villages of catchments of four reservoirs are given below:-

1. Above 98% of the households have got their own houses whereas the remaining respondents were tenant.
2. Above 90% of the houses are kachha and remaining are pucca of semi pucca houses.
3. Around 84% of the families have got electricity connections in their houses
4. There is only one single floor in around 77% of the houses. Around 22% houses have got double storey whereas only 1% of the houses have got the third floor.

9.1.6 Educational Facilities

9.1.6.1 Anganwadi to Middle Level

Anganwadi centers exist in more than 81% of the surveyed villages. In remaining villages, persons have to access to these services within a distance 1-5 kms.

9.1.6.2 Secondary Degree level School/College

9 secondary and 4 senior secondary school were found in the catchment villages whereas there is only 1 degree college in the surveyed villages.

9.1.6.3 Professional Training Institutes

There is only one Industrial Training Institute (ITI) in the surveyed villages of catchment area.

9.1.7 Crops Grown

Main crop grown in the area in Kharif season are Jowar, Arhar and Paddy, Maize, Millets, Soyabean, Till, Ramtil and Groundnut are the other crops grown in Kharif. In the Rabi season, main crop are Wheat, and Wheat-Gram, Gram, Lintil, Linseed.

9.1.8 Migration

Migration from rural to urban area is definitely there in search of greener pastures and for better and reliable income.

9.1.9 Infrastructure

In most of the tehsils and villages the basic infrastructural facilities are not available. Like metalled road, public Transport, Hospital, Secondary Schools, colleges.

9.1.10 Medical Facilities

Medical facilities are very poor in most of the affected villages. Primary Health Centre and Dispensaries are available at Rahatgarh, Begamganjand Sihora villages. Villages in the most of the affected villages have to travel more than 5 km to avail Medical facilities.

9.1.11 Drinking Water Supply

All the affected villages have drinking water facility. Well handpump, water tank, Tubeswells and river water are a source of drinking water.

9.1.12 Power Supply

Electricity facility exists in all the villages for domestic and commercial purposes.

9.1.13 Cost Estimates

Detailed cost estimates have been prepared for land acquisition and rehabilitation& Resettlement including infra-structural facilities for the oustees.

These are based on Environmental Management and Rehabilitation and Resettlement Plan prepared by the WRD, Govt. of MP. The details are given in **Table 9.4.**

Table -9.4

Expenditure for Land Acquisition, Rehabilitation and Resettlement Plan

Rs. in lakhs

Sl. No	**Description**	**Amount**
1	Land acquisition	64911
2	Forest land	17589
3	Rehabilitation and Resettlement	79955
4	CAT Plan	500
5	Cost of diversion of Sagar- Bhopal Highway No. 4 length 12 km	13250.04
6	Cost of diversion of Sagar- Vidisha Highway No. 4 length 20km	22083.40
	Total	**199288.44**

CHAPTER-X

COST ESTIMATE, BENEFIT COST RATIO AND FINANCIAL ASPECTS

10.0 Background

The present chapter deals with cost estimate, benefit cost ratio and financial aspects of various project components under KBLP. The cost estimate and benefit cost ratio of Daudhan Dam and its canal system was completed by NWDA and included in DPR of 2010 and already techno-economically approved by Central Water Commission in 2016. The cost estimate of headwork of Lower Orr Dam was prepared by NWDA, while, the cost estimate of carrier canal, gravity pipeline and rising mains have been prepared by the WRD, Govt. of MP and the same are adopted in the estimate. The cost estimate of Kotha Barrage and Bina Complex Multipurpose Project was completed by WRD, Govt. of MP and the same are adopted in the estimate by escalating at price level 2017-18. All these three projects are under techno-economic appraisal with CWC. The component wise details of cost estimate are covered in this chapter.

10.1 KBLP

The KBLP envisages construction of a dam at Daudhan on Ken river, Ken-Betwa link canal, two tunnels, two power houses, Ken LBC, Panna & Hatta Lift Irrigation Schemes and their canal networks, Lower Orr Dam at Didauni on Orr river at the border of Shivpuri and Ashok Nagar districts, Kotha Barrage at Kotha village on Betwa river in Vidisha district, Bina Complex Multipurpose Project consisting of four projects (Semraghat diversion dam on Dhasan river, Dehra Dam on Dehra nala, Madia and Chakarpur dam on Bina river) in Sagar district and their canal networks, repair /strengthening of Bariyarpur Pick up Weir on Ken river, Parichha Weir on Betwa river, Barwa Sagar Dam and training works of 7.1 km long Barwa Nalla alongwith developments in command areas of the project.

The Working Group Report of erstwhile Ministry of Irrigation, Govt. of India had issued broad guidelines for preparation of Detailed Project Report for major irrigation and multipurpose projects in 1980. These are based on the IS : 4877-1968 which have subsequently been updated with explanatory notes for each unit / minor head / sub-head. For preparing the cost estimates of KBLP, these guidelines have been

followed.

The cost estimates have been worked out by calculating the quantities of different items of the works involved for the execution of the project components. Quantity of Daudhan Dam, Ken-Betwa link canal & Ken LBC under main project was computed by NWDA on the basis of design carried out by CWC, for which, DPR of KBLP, Phase-I was already techno-economically appraised by CWC during 2016. Parameters of Daudhan Dam have been kept intact in the Comprehensive Report. However, the parameters of Ken-Betwa link canal & Ken LBC has been changed according to the new planning for Pressurised pipe micro irrigation system and inclusion of new/additional command area of MP & UP. The quantity and cost of these two canal system and additional Panna & Hatta LIS have been provided by Govt. of MP & the same are incorporated in the report. However, quantity and costing of main canal were carried out by NWDA. The cost estimate of Lower Orr Dam was prepared by NWDA with appropriate cost escalation. The cost estimate of Kotha Barrage and Bina Complex Multipurpose Project were made available by Government of MP. The cost estimate of these project after escalation by considering the Unified Schedule of Rates (USOR – 2017) of Govt. of MP are adopted in the Comprehensive Report.

The rates for some principal items of various works have been adopted from USOR - 2017 of Govt. of MP. As per Government of MP letter dated 23.07.2015, the escalation on the rates of various items can be escalated by overall 18% over the USOR - 2009 of MP to arrive rate at price level 2015-16 for working out the cost estimate of KBLP, phase-I which is approved by CWC. Accordingly, rate of various items which are not available in USOR – 2017 are considered by escalating overall 18% over the 2008-09 SOR rate and further escalated by 6% per year to arrive at price level 2017-18. Further it is revised at 2020-21 price level.

10.2 Classification of units

The cost estimate of the project has been grouped into the following units and shown in **Table 10.1.**

Table-10.1

General Abstract of Cost Estimate of the Bina Complex project

(Price level 2020-21)

(Rs. in Crore)

Sl.No.	Component	Unit-I	Unit-II	Unit-III	Total
		Head works	**Canals**	**Power**	
I	**Bina Complex Multipurpose Project & Canals**	1687.65	1389.67	162.21	**3239.53**

Thus, the total cost of the project works out to **Rs. 3239.53 crore at price level 2021-22**. The general abstract of cost of the project is given at **Annexure-10.1**. Relevant annexures pertaining to this chapter are placed in Volume-II: Cost Estimate. The details under various heads are described in the following paragraphs.

S.No.		Particulars	Amount (Rs. in Lakhs) 2020-21		
		Sub-head	**Unit-I**	**Unit-II**	**Unit-III**
A		**DIRECT CHARGES:**			
I		WORKS:			
	A	Preliminary	128.37	208.15	
	B	Land	79954.70	1376.07	
		(i) Land acquisition		1376.07	
		(ii) NPV,CA Plan			
		(iii) Rehabilitation & Resettlement			
		(iv) Lump sum amount proposed for Land aquisitution and R&R for proposed villages to be relocated to acquire 6017 ha revenue land.			
	C	Works	25544.11	44940.68	
	D	Regulators	0.00	0.20	
	E	Falls		0.00	
	F	Cross Drainage Structures		0.00	
	G	Bridges		2714.85	
	H	Escapes			
	K	Buildings	1181.10	250.50	
		Temporary Buildings	376.18	250.50	
		Permanent Buildings	718.42		
		Hostel Accommodation (Temp.)			

	J	Civil Works			
	L	Earth work	0.00	842.17	
	M	Plantation	213.65	0.00	
	N	Reservoir & DC Tanks			
	O	Miscellaneous	190.00	0.00	
	P	Maintenance	590.00	480.82	
	Q	Special T&P	0.00	0.00	
	R	Communication	30068.51	250.00	
	S	Power plant (Rs. 6Cr per MW)		870.39	14709.80
	T	Water Supply		0.00	
	U	Distributary & Minors	0.00	74160.00	
	V	Water Courses	0.00	0.00	
	X	Environment & Ecology	21308.37	0.00	
	Y	Losses on Stock & Unforeseen @ 0.25% on all heads excluding A, B,X & Q	144.47	311.27	36.77
		Total I-Works	**159323.28**	**126405.11**	**14746.57**
II		Establishment & Pensionary Charges @ 8%-10% of I-Works less B - Land	**6349.49**	**10002.32**	**1179.73**
III		Ordinary T&P @ 1% of I - Works	**1593.23**	**1264.05**	**147.47**
IV		**Receipts & Recoveries**			
	(a)	Recoveries on account of resale value of Q - Special T&P 25%	0	0	0
	(b)	Recoveries by resale/transfer of Generator sets, electric lines, telephone lines and other accessories under Capital Cost of O-Miscellaneous @20%	-38.00	0.00	0.00
	(c)	Recoveries on account of resale value of Temporary Buildings @ 15%	-56.43	-37.58	0.00
		Total Direct Charges	**167171.57**	**137633.91**	**16073.77**
B		**INDIRECT CHARGES**			
	(a)	Cost of abatement of Land Revenue on the area occupied by the Project @ 5% of (Rs 32399.20/68212.70	0.00	68.80	0.00
	(b)	Audit & Account Charges @ 1% of I - Works	1593.23	1264.05	147.47
		Total Indirect Charges	**1593.23**	**1332.85**	**147.47**
		NET COST	**168764.80**	**138966.76**	**16221.23**
		Total (In Crores)		**3239.53**	

10.2.1 Unit – I: Head Works

Unit-I Head works mainly includes cost of the following structures of the project:

- Bina Complex Multipurpose Project including earth dam, non-over flow section with irrigation sluices, over flow section with spillway & energy dissipation arrangements.

Cost of I-Works for Bina Complex Multipurpose Project head works are given in **Table 10.2**

Table 10.2

(Rs. in Lakhs)

Head works	**Bina Complex Multipurpose Project**
Total I-Works	159323.28
Net Cost	168764.80

The total cost of Unit-I: Head Works is estimated to be Rs. **1687.65** crore. Details are given in **Annexure-10.1**. The sub-headwise details are given below.

10.2.1.1 A - Direct Charges

In general, direct charges cover minor heads like I-Works, II-Establishment, III- Tools & Plants, IV- Receipts & Recoveries.

I-Works

A. Preliminary

Provision under this sub-head has been made to cover the actual expenditure incurred on detailed survey & investigation works mentioned below for preparation of Comprehensive Report of the project.

- Topographical surveys & investigations
- Hydrological & meteorological surveys
- Geological & Geotechnical surveys
- Construction material survey
- Seismic studies
- Construction of access roads to facilitate site investigations
- Charges for consultancy works for various studies and
- Preparation of Comprehensive Report

However, for detailed survey & investigations for establishing the final locations of different project components at pre-construction stage, a lump sum provision of 2 % of I-Works has been considered under this sub-head. While DPR of Bina Complex Multipurpose Project was prepared by Govt of MP, therefore, cost under this sub head for the

projects has been considered as per their DPRs. The details are given in **Annexure- 10.1.4.** The cost component of Unit-I of Preliminaries are given in **Table 10.2.1**

Table 10.2.1
A. Preliminary

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project	128.37

B. Land

Under this sub-head, provision for acquisition of land for construction of the project, colonies, offices, stores, stock yards, working area and approach roads etc. , compensation for houses, solatium charges, standing crops and other immovable properties, cost of resettlement colonies for displaced persons, economic rehabilitation of PAFs, training of R&R staff and PAFs etc. have been considered. The details are given in **Annexure- 10.1.4.2.** The cost component of Unit-I of B. Land is given in **Table 10.2.2**.

Table 10.2.2
B. Land

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project	79954.70

C. Works

This sub head includes cost of construction of following components:

- Earth dam, cofferdam, concrete dam (Over Flow & Non Over Flow), Irrigation sluices etc. of Bina Complex Multipurpose Project.

The quantities and the cost of the components have been evaluated as per the design drawings supplied by the Specialized Directorates of CWC, New Delhi. Necessary provisions have been made for Spillway radial gates with embedded parts, stop logs and hoisting arrangements etc. The quantities and the cost of the components of Bina Complex Multipurpose Project Projects have been evaluated by WRD, Govt. of MP

and same are adopted in the cost estimate of KBLP. The details of works under this sub-head are given in **Annexure 10.1.4.3.** The cost component of Unit-I of C. Works is given in **Table 10.2.3**.

Table 10.2.3

C. Works

Sl. No.	Component	Cost (Rs. in lakh)
I	Bina Complex Multipurpose Project	25544.11

K. Buildings

Provision has been made under this sub-head for construction of temporary & permanent buildings for both residential & non-residential buildings and hostel accommodation for various categories of staff, offices, inspection bungalow, circuit house, workshops, stores, sheds as well as other service buildings like hospital, schools, police station, post office & welfare center etc. The details under this sub-head are given in **Annexure 10.1.4.4.** The cost component of Unit-I of K. Buildings is given in **Table 10.2.4**.

Table 10.2.4

K. Buildings

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project	1181.10

L. Earth work

Under this sub-head, the cost of earth work and lining involved in the upstream diversion channel and downstream spillway channel of all the dams has been considered. The details under this sub-head are given in **Annexure - 10.1.4.** The cost component of Unit-I of L. Earth work is given in **Table 10.2.5**.

Table 10.2.5

L. Earth work

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project	0.00

M. Plantation

Under this sub-head, cost of proposed plantation in the colony, parks in the d/s of dams and along the approach roads to the dam sites have been considered. The details under this sub-head are given in **Annexure 10.1.4.5.** The cost component of Unit-I of M. Plantation is given in **Table 10.2.6**.

Table 10.2.6
M. Plantation

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project	213.65

O. Miscellaneous

Under this sub head provision has been made to cover the cost of the following works

- Capital cost of electrification, water supply purification and distribution system, sewage disposal, medical equipment, firefighting equipment, furniture and crockeries for inspection bungalow and circuit houses, initial camp equipment for hospital, primary & secondary schools, community centre etc.
- R & M of above equipments/infrastructural facilities etc.
- R & M of inspection vehicles, market complex, police station, post office, pump house, telephone lines etc.

Provision has also been made for other miscellaneous items such as inaugural foundation laying ceremony, compensation to work men, visit of VIP dignitaries, anti malaria measures, security arrangements for dam sites, flood lighting, model studies, data processing machines etc. The details are given in **Annexure 10.1.4.6.** The cost component of Unit-I of O. Miscellaneous is given in **Table 10.2.7.**

Table 10.2.7
O. Miscellaneous

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project	190.00

P. Maintenance

Under this sub-head provision has been made to cover the cost of maintenance of all works during the construction. A provision of 1% on cost of C-Works (Concrete Dam & Earthen Dam), Buildings and maintenance of roads has been considered. For Bina Complex Multipurpose Project, cost of P-Maintenance has been worked out in the DPRs prepared by Govt. of MP & Considered in the Estimate. The details are given in **Annexure- 10.1.4.7.** The cost component of Unit-I of P. Maintenance is given in **Table 10.2.8**.

Table 10.2.8
P. Maintenance

Sl. No.	**Component**	Rs in **lakh**
I	Bina Complex Multipurpose Project	590.00

Q. Special Tools & Plants

Under this sub-head provision has been made for the cost of inspection/ transportation equipment has been added to the above cost to arrive the total cost chargeable under this sub-head. The cost component of Unit-I of Q. Maintenance is given in **Table 10.2.9**

Table 10.2.9
Q. Special Tools & plants

Sl. No.	**Component**	**Cost (Rs. in lakh)**
I	Bina Complex Multipurpose Project	0.00

R. Communication

Necessary provision has been made under this sub-head to cover the cost of widening of existing roads in the near vicinity of the project area, formation of approach roads to project area from the existing roads, W.B.M road from quarry sites to dam/barrage sites etc. The details of length of roads and costs are given in **Annexure- 10.1.4.9.** The cost component of Unit-I of R. Communication is given in **Table 10.2.10**.

Table 10.2.10
R. Communication

Sl. No.	Component	Cost (Rs. in lakh)
I	Bina Complex Multipurpose Project	30068.51

X. Environment and Ecology

This sub-head includes provision for extensive management measures to sustain environment and ecology such as catchment areas treatment, forestry & salve postural management/ afforestation/ deforestation, soil erosion control and water conservation measures, reservoirs rim treatment/green belt development, treatment of agricultural lands, compensatory afforestation, land management plan (stabilization of muck disposal management), restoration of quarry site, tourism development plan, provision for free fuel to department engaged labourers, bio-diversity management plan, restoration and land scrapping of project sites, fisheries development plan, ground water management plan, public health management, Environmental Monitoring Programme (EMP), dam break analysis and Disaster Management Plan. The details are given in **Annexure- 10.1.4.10.** The cost component of Unit-I of X. Environment and Ecology is given in **Table 10.2.11.**

Table 10.2.11
X. Environment and Ecology

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project	21308.37

Y. Losses on Stock and Unforeseen Items

Provision has been made for losses on stock and unforeseen @ 0.25% on all sub-heads under I- works excluding sub – heads A-Preliminary, B- Land & Q-Spl. T&P & X-Environmental & Ecology. Cost of this head has been calculated considering 0.25% of C-Works, K-Building, M- Plantation, P-Maintenance & O-Miscellaneous & R-Communication for Bina Complex by Govt. of M.P. The details are furnished in **Annexure 10.1.4.** The cost component of Unit-I of X. Losses on stock and unforeseen items is given in **Table 10.2.12**

Table 10.2.12
Y. Losses on Stock and Unforeseen Items

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project	144.47

II-Establishment

The project is planned to be completed in a period of 8 years. Provision has been made @ 8% of I-Works excluding B- Land towards establishment & pensioner charges. The details are furnished in **Annexure 10.1.** The cost component of Unit-I of II-Establishment is given in **Table 10.2.13.**

Table 10.2.13
II-Establishment

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project	6349.49

III-Ordinary Tools & Plant

Provision has been made under this head for ordinary Tools & Plant @ 1% of I-Works. This provision is distinct from the Q-Spl. T&P and is meant to cover the cost of survey instruments, camp equipment and other small tools & plant. The details are furnished in **Annexure 10.1.** The cost component of Unit-I of III-Ordinary Tools & Plant is given in **Table 10.2.14.**

Table 10.2.14
III-Ordinary Tools & Plant

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project	1593.23

IV- Receipt & Recoveries

Under these head, estimated recoveries by way of resale or transfer of temporary buildings, special T&P and by resale or transfer of generator sets, electrical lines, telephone lines and other accessories are accounted for and provision has been made accordingly. The details are furnished in **Annexure 10.1.** The cost component of Unit-I of IV- Receipt & Recoveries is given in **Table 10.2.15.**

Table 10.2.15
IV- Receipt & Recoveries

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project	94.43

10.2.1.2 B - Indirect Charges

Provisions for abatement of land revenue and audit & account charges are covered under 'Indirect Charges' at the following rates

- Abatement of land revenue - 5% of cost of land
- Audit and account charges - 1% of I-Works

The details are furnished in **Annexure 10.1.**

The cost component of Unit-I of B - Indirect Charges is given in **Table 10.2.16**

Table 10.2.16
B - Indirect Charges

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project	1593.23

10.2.2 Unit – II: Canals

Unit-II Canal system covers the cost of the following structures alongwith their appurtenant works.

- Bina Complex Right bank Rising mains

Cost of I-Works for Canal system is given in **Table 10.3**.

Table 10.3
Cost of I-Works for each Canal system

(Rs. in Lakh)

Unit –II Canal system	**Bina Complex Multipurpose Project**
Total I-Works	126405.11
Net Cost	138966.76

The total cost of Unit-II: Canal system is estimated to be Rs. 1389.67 crore at 2020-21 price level. Details are given in **Annexures-10.1**. The sub-head wise details are discussed in the following paragraphs.

10.2.2.1 A - Direct Charges

I-Works

A. Preliminary

Provision under this sub-head has been made to cover the actual expenditure incurred on detailed survey & investigation works mentioned below for preparation of Comprehensive Report of the project.

- Topographical surveys & investigations
- Geological & Geotechnical surveys
- Construction material survey
- Vehicle charges for inspecting officers for site investigations
- Survey & Camp equipment
- Charges for consultation for various studies
- Actual expenditure on establishment and
- Preparation of Comprehensive Report

However, for detailed survey & investigations for establishing the final locations of different project components at pre-construction stage, a

lump sum provision of 2% of I-Works has been considered under this sub-head for which DPR was prepared by NWDA. While DPRs of Bina Complex Multipurpose Project was prepared by Govt of MP, therefore, cost under sub head for this project has been considered as per their DPR. The details are given in **Annexure 10.2.6.1.** The cost component of Unit-II of A. Preliminary is given in **Table 10.3.1.**

Table – 10.3.1
A. Preliminary

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project System	208.15

B. Land

Under this sub-head, provision for acquisition of land for construction of canals and approach roads, colonies, canal structures etc. , solatium charges, standing crops and other immovable properties, rent for use of land prior to acquisition, economic rehabilitation measures etc. have been considered. The details are given in **Annexure 10.2.6.2.** The cost component of Unit-II of B. Land is given in **Table 10.3.2.**

Table – 10.3.2
B. Land

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project System	1376.07

C. Works

Under this sub-head the cost of bypass arrangements from surge tank to connecting canal etc. has been considered. The quantities and the cost of the components have been worked out as per the designed drawings made available by the Central Water Commission, New Delhi. Necessary provisions have been made in the estimate for service gates and emergency gates with embedded parts, stop logs. The details of works under this sub-head are given in **Annexure 10.2.6.3.** The cost component of Unit-II of C. Works is given in **Table 10.3.3.**

Table – 10.3.3
C. Works

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project System	44940.68

D. Regulators

Under this sub-head, provision for head and cross regulators at intake / outfall of the canals and at appropriate locations where branch canals take off from main canal, service gates with embedded parts, stop logs and rope drum hoists, monorail arrangements, etc. at regulators have been made. Provision for cross regulators for branch canals has also been made. Estimate of a typical cross regulator is prepared based on the detailed drawings made available by CWC, New Delhi and the cost of other regulators are arrived based on the estimated cost of the typical regulator proportionate to discharges. The details are given in **Annexure - 10.2.6.4.** The cost component of Unit-II of D. Regulators is given in **Table 10.3.4.**

Table – 10.3.4
D. Regulators

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project System	0.20

E. Falls

Provision of falls is not kept under this sub-head for Bina Complex Multipurpose Project. The details are given in **Annexure- 10.2.6.** The cost component of Unit-II of E. Falls is given in **Table 10.3.5.**

Table – 10.3.5
E. Falls

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project System	0.00

F. Cross Drainage Structures

No cross drainage Structures proposed across the main canals and branch canals. The details are given in **Annexure- 10.2.6.** The cost component of Unit-II of F. Cross drainage structures is given in **Table 10.3.6.**

Table – 10.3.6

F. Cross Drainage Structures

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project System	0.00

G. Bridges

The bridges (major & minor) are required to be constructed on the Bina Complex Multipurpose Project to facilitate crossing of various roads. Necessary Provision has been made for these bridges. The estimate is prepared based on the cost curves. The details are given in **Annexure-10.2.6.5.** The cost component of Unit-II of G. Bridges is given in **Table 10.3.7**

Table – 10.3.7

G. Bridges

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project System	2714.85

K. Buildings

Provision has been made under this sub-head for construction of temporary & permanent buildings for both residential & non-residential buildings for various categories of staff, offices, inspection bungalow, stores, club-cum-welfare hall, laboratory & research station etc. Rates have been adopted for these buildings based on the plinth area and prevailing market rates. The details under this sub-head are given in **Annexure- 10.2.6.6.** The cost component of Unit-II of K. Buildings **is** given in **Table 10.3.8.**

Table – 10.3.8

K. Buildings

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project System	250.50

L. Earthwork & Lining

The quantity of excavated earth motional from the project to locations based on the type of soils and the quantity of earthwork required for embankment from borrow areas are worked out separately. The detailed estimates are prepared considering the cross sections taken at 50 m interval along the canals and detailed drawings made available by CWC, New Delhi at various sections. Provision is also made for branch canals proportionate to the discharges of the main canal. Lining is provided for both main and branch canals at bed and side slopes in the entire length of canals as per the drawings. Provision is also made in the estimates for pressure relief and drainage arrangements under lining, expansion joints etc. The details under this sub-head are given in **Annexure- 10.2.6.7.** The cost component of Unit-II of L. Earthwork & Lining is given in **Table 10.3.9**

Table – 10.3.9

L. Earthwork & Lining

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project System	842.17

M. Plantation

Under this sub-head, no provision has been made for plantation in the colony areas and along the main canals & branch canals. The details are given in **Annexure - 10.2.6.** The cost component of Unit-II of M. Plantation is given in **Table 10.3.10.**

Table – 10.3.10
M. Plantation

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project System	0.00

O. Miscellaneous

Under this sub head, no provision has been made to cover the cost of the following works:

- Capital cost of electrification, water supply purification and distribution arrangements, sewage disposal, firefighting equipment, telephones, wireless sets, equipment for quality control and field labs, initial equipment and other accessories for hospitals etc.
- R & M of above equipments/infrastructural facilities etc.
- R & M of inspection vehicles, inspection bungalow etc.

The details are given in **Annexures-10.2.6.** The cost component of Unit-II of O. Miscellaneous is given in **Table 10.3.13.**

Table – 10.3.11
O. Miscellaneous

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project System	0.00

P. Maintenance

Under this sub-head, provision has been made to cover the cost of maintenance of all works during the construction. A provision of 1% on cost of C-Works, K-Buildings and R-maintenance of roads has been considered Bina Complex Multipurpose project cost of P-Maintenance which are worked out in the respective DPRs prepared by Govt. of MP are considered in the estimate. The details are given in **Annexure -10.2.6.8.** The cost component of Unit-II of P. Maintenance is given in **Table 10.3.12.**

Table – 10.3.12
P. Maintenance

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project System	480.82

Q. Special Tools & Plants

Under this sub-head, provision has been made at 25% of capital cost of major construction equipment and general purpose equipment. Cost of inspection/ transportation equipment has been added to the above cost in full to arrive the total cost chargeable under this sub-head. The recoveries on account of resale value of Q-Spl. T&P is considered as 75% of the capital cost of the major construction/general purpose equipment chargeable to Q-Spl. T&P and 75% on 20% cost of inspection/transport equipment chargeable to Q-Spl. T&P. Details of the equipment as suggested by CWC, New Delhi and the cost that to be chargeable to the canal works are given in **Annexure -10.2.6.** The cost component of Unit-II of Q. Special Tools & Plants is given in **Table 10.3.13.**

Table – 10.3.13
Q. Special Tools & Plants

Sl. No.	Component	Rs in **lakh**
I	Bina Complex Multipurpose Project System	0.00

R. Communication

Under this sub-head, provision for construction of temporary roads and remodeling of existing roads for approach to canal and regulatory system, quarry sites and other working areas has been kept. The details are given in **Annexure 10.2.9.** The cost component of Unit-II of R. Communication is given in **Table 10.3.14.**

Table – 10.3.14
R. Communication

Sl. No.	Component	Cost (**Rs in lakh)**
I	Bina Complex Multipurpose Project System	250.00

S. Power Plants (Hydro)

In Bina Complex Multipurpose Project the cost towards providing power plant structures, pipes and other components is provided under this sub-head. The details are given in **Annexure 10.2.6.10.** The cost component of Unit-II of S. Power Plants is given in **Table 10.3.15.**

Table – 10.3.15

S. Power Plants (Hydro)

Sl. No.	Component	Cost (Rs. in lakh)
I	Bina Complex Multipurpose Project System	870.39

U. Distributaries

Under this sub-head, provision has been made for providing distributaries pressurize irrigation network system for the total culturable command area of the project. The details are given in **Annexure-10.2.6.11.** The cost component of Unit-II of U. Distributaries & Minors is given in **Table 10.3.16.**

Table – 10.3.16

U. Distributaries & Minors

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project System	74160.00

II-Establishment

Provision has been made as per norms i.e. @ 8% of I-Works excluding B- Land towards establishment & pensioner charges. The details are given in **Annexures 10.1** for Bina Complex Multipurpose Project System. The cost component of Unit-II of II-Establishment is given in **Table 10.3.17.**

Table – 10.3.17

II-Establishment

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project System	10002.32

III- Tools & Plant

Provision has been made under this head for ordinary tools & plant @ 1% of I-Works. This provision is distinct from the Q-Spl. T&P and is meant to cover the cost of survey instruments, camp equipment and other small tools & plant. The details are given in **Annexures -10.1** for Bina Complex Multipurpose Project System. The cost component of Unit-II or III- Tools & Plant is given in **Table 10.3.18.**

Table – 10.3.18
III- Tools & Plant

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project System	1264.05

IV- Receipt & Recoveries

Under this head, estimated recovery by way of resale or transfer of temporary buildings, special T&P and by resale or transfer of generator sets, electrical lines, telephone lines and other accessories are accounted for and provision has been made accordingly. The details are given in **Annexures 10.1**. The cost component of Unit-II of IV- Receipt & recoveries is given in **Table 10.3.19.**

Table – 10.3.19
IV- Receipt & Recoveries

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project System	37.58

10.2.2.2 B - Indirect Charges

Provisions for abatement of land revenue and audit & account charges are kept under 'Indirect Charges' at the following rates

- Abatement of land revenue - 5% of cost of land
- Audit and account charges - 1% of I-Works

The details are given in **Annexures 10.1** for Bina complex Multipurpose Project System. The cost component of Unit-II of B-Indirect Charges **is** given in **Table 10.3.20.**

Table – 10.3.20

II of B- Indirect Charges

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Multipurpose Project System	1332.85

10.2.3 Unit – III: Hydroelectric Installation

Two surface power houses of installed capacity of 25 MW are proposed at the Madia Dam (2x10=20 MW) and Dehra Dam (5 MW) respectively under Bina Complex Multipurpose project.

Unit-III "Hydro electric installation" contains the provisions for expenditure on installation of these power houses, penstocks, switch yards, tail race channel, various electromechanical equipments, transmission lines etc. The total cost of unit – III for Power houses in Bina complex project is estimated to be Rs 162.21 crore at 2021-22 price level.

Cost of I-Works for Power plant is given in Table **10.4** as under:

Table 10.4

Cost of I-Works for each Power plant

(Rs. in Lakh)

Power Plant	Bina complex
Total I-Works	14746.57
Net Cost	16221.23

The details are given at **Annexure No. - 10.1.** The sub-head wise details are given below:

10.2.3.1 Direct charges

S. Power plant

This sub-head covers the cost of power plant equipment and electrical system to be installed the power houses. Provision made under this sub-head for various components are based on the drawings and costs supplied by CEA, New Delhi. Cost of Power plant of Bina complex supplied by Govt. of MP has been considered in the Estimate. The details under this sub-head are given in **Annexure 10.3.4.** The cost component of

Unit-III of Power plant & electromechanical works is given in **Table 10.4.1.**

Table – 10.4.1
Power Plant

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Power Plants	14709.80

Y. Losses on stock and unforeseen

Provision has been made for losses on stock and unforeseen @ 0.25% on all sub-heads under I- works excluding sub – heads A- preliminary, B- land & Q-Spl. T&P. The details are given in **Annexure 10.1.** The cost component of Unit-III of Power plant & electromechanical works is given in **Table 10.4.2.**

Table – 10.4.2
Y. Losses on Stock and Unforeseen

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Power Plants	36.77

II-Establishment

Provision has been made as per norms @ 8% of I-Works excluding B- land towards establishment & pensionary charges. The details are given in **Annexures 10.1.** The cost component of Unit-III of II-Establishment is given in **Table 10.4.3.**

Table – 10.4.3
II-Establishment

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Power Plants	1179.73

III- Tools & Plant

Provision has been made under this head for ordinary Tools & Plant @ 1% of I-Works. This provision is distinct from the Q-Spl. T&P and is meant to cover the cost of survey instruments, camp equipment and other small tools & plant. The details are given in **Annexure No. 10.1.** The cost component of Unit-III of III- Tools & Plant is given in **Table 10.4.4.**

Table – 10.4.4
III- Tools & Plant

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Power Plants	147.47

IV- Receipt & recoveries

Under this head, estimated recovery by way of resale or transfer of special T&P and by resale or transfer of generator sets, electrical lines, telephone lines and other accessories are accounted for and provision has been made accordingly. The details are given in **Annexure No. 10.1**. The cost component of Unit-III of IV- Receipt & recoveries is given in **Table 10.4.5.**

Table – 10.4.5
IV- Receipt & Recoveries

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Power Plants	0.00
	Total	**0.00**

10.2.3.2 Indirect charges

Provisions for abatement of land revenue and Audit & account charges are kept under 'Indirect charges'.

- Abatement of land revenue - 5% of cost of land
- Audit and account charges - 1% of I-Works.

The details are given in **Annexure 10.1**. The cost component of Unit-III of Indirect charges is given in **Table 10.4.6**

Table – 10.4.6
Indirect charges

Sl. No.	Component	Cost (Rs in lakh)
I	Bina Complex Power Plants	147.47

10.3 Revenues

10.3.1 Yearly programme of development

The link Project is scheduled to be completed in 8 years. Yearly programme of construction schedule of the project has been discussed in detail in Chapter-VII "Construction Programme, Manpower Deployment & Plant Planning".

10.3.2 Sources of Revenue

Ken-Betwa link project has been planned to provide irrigation in water short areas directly as well as in exchange. Also, the project envisages power generation and domestic water supply in the command area and adjacent towns along the canal. Accordingly, following would be the sources of revenue from the KBLP as a whole.

- Irrigation water rates
- Irrigation cess
- Sale of water for domestic water supply
- Sale of power

Other than the above, tourism & fisheries development in the project areas as described in brief in the Volume- VI "Reservoir" can also be one of the major sources of revenue on account of this project.

10.3.3 Water Rates –Irrigation Cess

(a) Water rates

A large infrastructural network such as this project being created for making water available in the proposed command areas for irrigation and drinking purposes besides power generation, needs to be self sustainable. Therefore, appropriate water pricing is quite necessary, so that cost of operation & management of project could be recovered from the

beneficiaries of the project up to some extent. Water rates may be different for irrigation & non irrigation use. Water rates for irrigation use can be applied on the basis of per unit area irrigated. On the other hand, for drinking water supply, rates may be applied on the basis of per unit volume of water supplied, while power can be charged per unit basis.

The present range of water rates in MP is from Rs 50 to 960 per ha for both flow and lift irrigation. In Uttar Pradesh, it ranges from Rs.30 to 474 for flow irrigation & Rs 15 to 237 per ha for lift irrigation.

These charges are in addition to the irrigation cess & betterment levy to be paid and land revenue being paid by the land holder.

(b) Irrigation cess

As approved by the concerned State Govt., Irrigation cess would be recovered from all the land holders in the commands of the Ken-Betwa link project irrespective of whether the land holder takes irrigation water or not.

(c) Betterment levy

When a major project is constructed, it leads to appreciation of land prices in the areas lying in the vicinity of the project. In case of an irrigation project, better yields of crops are produced. On account of this appreciation in land prices and increased yields of produce, the land owners are required to pay some share to the Govt. as betterment levy.

10.3.4 Auction of Service, Land Lease, Auction And Navigational Permits.

Vacant lands on either side of canals may be leased for plantation of fruit bearing trees. Similarly, in project colony areas, land for shops may also be leased.

10.3.5 Power Rate

Installed capacity of Hydropower at Bina Complex Multipurpose Project is 25 MW. The average annual energy at Bina Complex Multipurpose Project worked out as 120 MKWh would be generated, at 90% dependability. This energy can be sold at prevailing rate of Rs. 5.00 per Kwh or utilize for pressurize irrigation in the area. The power generated at Bina Complex Multipurpose Project is proposed to be utilized for development of pressurized irrigation micro system under

these projects**.** Therefore, these energy is proposed to be purchased @ Rs. 5 per Kwh. Details are given in **Anneuxre-10.6 (b)**.

10.3.6 Navigation

No provision for development of navigation aspect has been kept in this project.

10.3.7 Other Sources (Pisciculture, Tourism, etc)

Revenue would occur from the project through allied benefits like pisciculture, tourism, etc. and these benefits have been considered in the benefit-cost analysis of the Project.

10.3.8 Concession in Water Rates (irrigation), Cargo and Passenger Rates, etc.

As the water rates (irrigation) prescribed by the States are highly subsidized, there appears to be no rationale for further concession of these rates in the project commands.

10.3.9 Administrative Charges for Supply of Water and Collection Of Revenues etc.

Suitable provision has been made for running and maintenance of the canals, which include administrative charges for supply of water.

10.3.10 If the Area to be Irrigated is Prone to Scarcity, The Expenditure Normally Incurred to Redress the Scarcity

The area proposed to be irrigated enroute though link canal under Ken LBC is water short and devoid of assured supply.

10.3.11 Year in Which the Revenue Would Start Accruing From Various Sources Counting From the First Year of Construction

The construction of project is scheduled to be completed in 4 years. Benefits from PH-II are linked with irrigation development in Ken LBC System and hence, can be realized after completion of the project. Power benefits from Bina Complex Multipurpose Project can be realized in the fifth year.

10.3.12 Total Income from Various Sources

The total revenue from various sources is furnished in Table-**10.5**.

Table – 10.5
Source of Revenue

Sl. No.	Source of Revenue	Rs in crore
1	Agricultural produce	462.30
2	Sale of power	60.00
3	Domestic water supply	1.08
4	Industrial water supply	14.00
5	Fisheries	133.93
	Total	**671.31**

10.3.13 Details of Staff Proposed for Collection of Revenue and its Basis

Revenue Department of Governments of MP & UP would strengthen their existing system for collection of revenues.

10.3.14 Net Revenue Expected From Different Components of Project

It is estimated that the net value of produce after irrigation will be Rs. **48319.20 Lakh** whereas it is Rs. **2089.40 lakh** before irrigation. Thus, the net annual irrigation benefits from the total command area works out to Rs. **46229.81 lakh.** The average annual energy at Daudhan Dam worked out as 120 MKWh would be generated, at 90% dependability. The revenue from the sale of this power considering Rs. 5.00 per unit works out to Rs. 6000.00 lakh. It is estimated that the revenue generated from 19.2 MCM of domestic water supply @ Rs. 0.56 per cum and 25 MCM of industrial water supply @ Rs. 5.6 per cum will be Rs. 1507.52 lakh. It is also proposed to develop fisheries in the reservoirs, by which Rs. 13393.32 lakh of revenue could be generated. Thus, the net income/benefit from various sources is estimated to be Rs. 67130.64 lakh. Details are given in **Annexure-10.8.**

10.3.15 Productivity of Project in Terms of Percentage Financial Returns

For Bina Complex Multipurpose Project, pre project and post project production of the each crop has been extracted from its DPR. The DPRs of above project is already under techno-economic-appraisal in CWC. The details of productivity in the command area at pre and post project scenarios are given in **Annexure No. 10.4.1.1, 10.4.1.2, 10.4.1.5, 10.4.2.1, 10.4.3.1 & 10.4.4.1**. Details of productivity in the command area are given in Table**-10.6.**

Table-10.6
Details of Productivity in the Command Area

Unit: Quintals

Name of Project	Pre-project Production			Post Project Production		
	Kharif	**Rabi**	**Perennial**	**Kharif**	**Rabi**	**Perennial**
Bina Complex Multipurpose Project	35000	805000	0	0	3320000	0
Grand Total	**840000**			**3320000**		
Net increase in produce	**2480000 (295.24%)**					

10.4 Benefit– Cost (BC) Ratio and Internal Rate of Return (IRR)

The BC ratio and IRR has been worked out as detailed below:

10.4.1 Estimate of Annual Cost

Annual cost of the project has been worked out according to the guideline for preparation of Detailed Project Report of irrigating and Multipurpose project of Ministry of Water Resources (2010) except the depreciation for pump system and rising main. In this guideline, the life of the pumping system and rising main is to be considered as 12 year and 30 years respectively. However, in present scenario, development of new techniques such as lamination and improvement in the quality of rising main and pump items, the life of the pumps and rising main may be considered as 33 years and 50 years respectively. Accordingly, while working out annual cost of the project, depreciation for the pumps and

rising main are considered as 3% and 2% of their cost respectively. Details of annual cost of the project are given in **Table-10.7.**

Table-10.7
Details of Annual Cost of the Project

Rs. in Lakh

Sl. No.	Description	Annual Cost
1	Interest on capital @ 10% (Estimated total cost of the project including cost of land development)	32480.22
2	Depreciation of the project @ 1% of the cost of project for 100 years life of the project and @ 2% for 50 years life of the project	3248.02
3	Annual operation and maintenance charges @ 1175 Rs Per Ha	1128.00
4	Maintenance of the head works @ 1% of H/W cost less B Land	793.69
5	Depreciation of the pumping system @ 8.33% of the estimated cost of the pumping system assuming life of the system as 12 years (Applicable to lift irrigation)	995.41
6	Depreciation of the rising mains @ 3.33% of the estimated cost of the rising mains assuming life of the system as years (Applicable to lift irrigation)	1213.68
7	Annual cost of tubewell after assuming 12 year service life of pump	70.76
8	Power Charges for lift water Rs 3281.0 @ per Ha.	3149.76
9	Total Annual Costs (G) = Sum (1 to 7)	**43079.54**

10.4.2 Benefit Cost (BC) Ratio

As described in the above paras, the net annual benefits from various components of the project works out to Rs.**67130.64 lakh** and the annual costs works out to Rs. **324802.23 Lakh.** Thus the BC Ratio of the project works out to **1.60:1.** Detailed calculation is placed at **Annexure-10.5.**

10.4.3 Internal Rate of Return (IRR)

The project has been planned to be completed in a period of 4 years including pre-construction year. The phasing of the expenditure has been planned accordingly. The details of yearly expenditure chargeable to link project have been given in **Table 7.2.** Considering life of the project as 100 years, the IRR of the KBLP has been computed as **12.21 %.** The detailed calculations of IRR are given at **Annexure-10.6**.

10.4.4 BC Ratio for Flood Control Component of the Projects

No cushion in the reservoir storage is provided exclusively for flood control. Flood control is only an incidental benefit from Daudhan Dam. Hence, no B.C. ratio for flood control component of the project is worked out.

10.4.5 Benefits Other Than those Considered in the BC Ratio and IRR

While calculating BC ratio, benefits from irrigation, power, water supply and fisheries have been considered. However, project will also provide other benefits such as tourism, employment generation, industrial development, infrastructure development, socio-economic condition of people in project area. These benefits have not been accounted for.

CHAPTER- XI

OTHER ASPECTS

11.1 Foreign Exchange Element

The Govt. of India has declared the KBLP as one of the National Projects. As such, 90% of the cost of the KBLP is expected to be borne by Central Government whereas the balance 10% will have to be borne by the beneficiary states viz. MP and UP. Further most of the required materials like plant and machinery, spares, instruments, etc. are proposed to be purchased /hired locally from internal resources thereby requiring no import under foreign grants/credits from other countries. Thus, prima facie, no foreign exchange element is required for the project. However, if implementing agency of the project decides at a later date to import 'Turbine' or any other item of the project from other country, foreign exchange element will come into picture.

11.2 Revenue

The source of revenue from the project is mainly from the benefits accrued from the following items.

11.2.1 Irrigation Water Rates

Annual O&M cost of the project works out to Rs. 105.57 Crore (excluding O & M of power component) whereas benefited area from irrigation is Rs. 8.98 Lakh ha. The irrigation water rates will be collected from land holders to recover O & M cost of the project. The present range of water rates in MP state is from Rs.50 to Rs. 960 per ha for both flow and lift irrigation. In UP, it ranges from Rs.30 to Rs. 474 per ha for flow irrigation and Rs.15 to Rs. 237 per ha for lift irrigation. The land owners are free either to enter into an agreement with the Project authorities or to get irrigation on demand from time to time. However, these charges are in addition to the land revenue paid by them.

11.2.2 Betterment Levy

With the introduction of irrigation and improved method of cultivation, the yield of the crops and value of the land will appreciably increase. Therefore, land owners are to pay some share to the government for this

increase in the value of their lands. Subsequently, betterment levy can be charged from beneficiaries of existing command in Banda district of UP who are not getting adequate water for their command from existing system.

11.2.3 Sale of Power

The average annual generation of power from PH-I and PH-II proposed at the toe of Duadhan Dam and exit of lower level tunnel has been worked out as 219.03 MU. The annual revenue from this power component has been worked out to be Rs.87.61 crores at the rate of Rs.4.03 per kwh as per the prevailing rates for domestic consumption in MP state. Considering a depreciation of 5% (for a life period of 30 years) for E&M of power houses and a depreciation of 1.2% for power component, the annual cost of maintenance has been worked out to Rs.40.66 crore. As such, the cost of installation i.e. Rs.898 crore, can be recovered fully within 15 years in the form of the revenue even after meeting maintenance charge.

11.3 Financial Resources

After getting techno-economic clearance from CWC and obtaining necessary statutory clearance from MOEF, Ministry of Tribal Affairs, etc., the DPR of the project will be put up to Planning Commission for investment clearance. The concurrence of Ministry of Finance will also be obtained. This project will be covered under central sector since it has already been announced as a National project and 90% of funding will be borne by central govt. Further, no foreign assistance/ aid will be required for this project since the entire cost will be met from internal resources of Government of India and State Governments.

11.4 Future Utilisation of Facilities (Buildings)

Two categories of buildings i.e. permanent and semi-permanent/ temporary are proposed at Daudhan Dam site, Chhatarpur & Jhansi. Further, the Permanent buildings already available at Jhansi under the control of Betwa River Board are also proposed to be utilized for the KBLP to the extent possible. Most of the permanent buildings proposed at Daudhan dam site, Chhatarpur and Jhansi will be utilized for operation and maintenance of the project, whereas the remaining buildings can be utilized for the future projects likely to come up in the vicinity or for offices of other State/Central Govt. organizations. Regarding Lower Orr project, Kotha Barrage and Bina

Complex Multipurpose Projects, existing building, offices and other infrastructures available nearby area will be utilized. Infrastructure required at site is proposed to be constructed only.

11.5 Legal Aspects of Inter basin Transfers Such as Impact on Existing Awards/Agreements/ Treaties

11.5.1 Existing Interstate Agreement on Sharing of Ken water

Since the Ken is an inter-state river between MP and UP, agreements were arrived at on Rangwan dam in the year 1972 on Ken canal and headworks of UP, Bariarpur left bank canal of MP and Urmil Project in the year 1977. In the meeting with Secretary, Irrigation & Power, Govt. of India held at New Delhi on 10.12.1981, it was decided that an upstream use of 80 TMC should be kept for the proposed KMPP. The **Table-11.1** furnishes the abstract of water use allocations as per the agreements and decision indicated above.

Table-11.1
Abstract of Water Allocation as per Earlier Agreements

Ken System	**Quantity**	
	MCM	**TMC**
Total 75% dependable yield at Ken dam	**4489.94**	**158356**
Water use by M.P. U/S of Ken	2265.60	80.00
Water use by M.P. ex-Ken	1375.22	48.56
Water use by U.P. ex-Ken	849.60	30.00
Total 75% dependable yield at Rangawan dam	**192.57**	**6.80**
Use by M.P. for Kharif crops (Existing use by M.P.)	56.64	2.00
Use by M.P. U/S of Rangawan dam	30.87	1.09
Use by M.P. from the balance water	8.78	0.31
Use by U.P. from the balance water	96.29	3.41
Water available to U.P. from the catchment between Ken, Rangawan Dam and Bariarpur barrage	**101.95**	**3.60**
Total water to be spared to U.P. from Ken system	**1047.84**	**37.00**

11.5.2 Proposed Water Sharing of Ken Basin upto Daudhan Dam as per MoU dated 25th August, 2005

The power generation from Bina Complex Multipurpose Project will meet the requirement of pressurised pipe micro irrigation system.

11.5.3 Proposed Memorandum of Agreement (MoA) amongst the states of MP, UP and Union Government on KBLP

The Clause-2 of the MoU dated 25.08.2005 indicates that specific MoUs as required will be entered into amongst the states of MP, UP and Union Govt. based on the DPR of KBLP and agreements reached on scope of the link, sharing of costs and benefits and arrangements for management and control of water etc. and that as DPR of KBLP has been prepared and to proceed further towards execution of the Link Project. The tripartite proposed MoA have been discussed several times amongst states of UP, MP and Union Govt. and have come to a mutual understanding on scope of the Link Project, sharing of water & Power, sharing of cost, benefits and mechanism for implementation of project as follows.

11.5.4 Existing interstate agreement on sharing of Betwa water between MP and UP

The river Betwa is an inter-state river between MP and UP. During British period two projects were constructed by Government of UP as early as in 1920. These are Dhukwan reservoir on the Betwa river upstream of Jhansi and Parichha weir downstream of Jhansi for Irrigation in UP. In order to supplement Dhukwan Reservoir, Matatila major project has been constructed by UP in the year 1953. The Matatila project was augmented for 0.45 lakh ha (1.12 lakh acres) irrigation in MP through Bhander canal system and 1.07 lakh ha (2.64 lakh acres) irrigation in UP. Thereafter, Rajghat Dam has been constructed on river Betwa, upstream of Matatila Dam. Agreements between the two states of MP and UP have been drawn up for distribution of water at Matatila Dam and Rajghat Dam. The abstract of water use allocation without taking into consideration the regeneration is given in **Table 11.2** below:

Table – 11.2
Abstract of Water Use Allocation

S. No.	Description	MCM	TMC
1	Total 75% dependable surface water yield at Rajghat Dam	3370.08	119.00
2	Availability by inter valley water transfer upto Rajghat and being used directly for Bhopal Town water supply	-	-
3	Existing water use by MP 65.0 MCM, Future water use 65.00 MCM, Total (65+65)=130 MCM	130	4.59
	(a) For Irrigation purposes from Betwa Basin	900	31.78
	(b) For Domestic and Industrial proposes from Betwa Basin @ 214-130=84 MCM	84.00	2.966
	(c) For Domestic & Industrial proposes from Inter valley water transfer directly to Bhopal	130.00	4.590
4	Reservation for future use by MP in Betwa Basin upto Rajghat (A) For Irrigation purposes (B) For domestic and Industrial Purposes Committed	0	0
	(a) For irrigation purposes U/S of Rajghat Dam without considering any Regeneration	484.765	17.117
	(b) For domestic and Industrial purposes from basin water 595-(130+0.2x828)	299.4	10.57
5	Committed Irrigation use by MP from Rajghat	750.48	26.50
6	Committed Irrigation use by UP from Rajghat	750.48	26.50
7	Committed Irrigation use by MP on D/S of Rajghat from water of Rajghat Reservoir	84.96	3.00
8	Committed Irrigation use by UP on D/S of Rajghat from water of Rajghat Reservoir	169.92	6.00
9	Utilization by UP from Rajghat Dam project (6+8)	920.40	32.50
10	Contribution to be spared to UP from M.P.C.A. from Rajghat 578 sqkm @ 0.2077 MCM/sqkm or 19 MCFT/sq. miles	141.60	5.00
11	Water to be spared to UP from MP catchment area from Rajghat reservoir (920.40-141.60)	778.80	27.50
12	Water use by UP from Matatila Project for 264000 Acre Irrigation	526.75	18.60
13	Contribution by UP catchment area of 1854.49 Sq.km @ 0.2077 MCM/Sq. km	382.32	13.50
14	Water to be spared to UP from MP catchment area from Matatila (12-13)	144.43	5.00
15	Total quantity of water to be spared for other State @ UP from Rajghat and Matatila Reservoir (14+11)	923.23	32.60

11.6 Public Awareness Programme

KBLP is the first project in which public Awareness programme was organized at Uldhan village in Jhansi district lying in enroute commend in 08.05.2008 to explain benefits of the project to the beneficiaries and to remove their doubts about the project. However, it was found that people in general were very much supportive of this project and they wanted its early implementation. During survey & investigation of the project, summary of the project in Hindi alongwith salient features were distributed among the villagers for their awareness about the project.

TWO NEW BARRAGES OF UTTAR PRADESH

DPR of proposed two new Barrages of UP in the d/s of existing Bariyarpur Pickup Weir

Preparation of Detailed Project Report (DPR) of proposed two new Barrages of UP in the d/s of existing Bariyarpur Pickup Weir is under progress in NWDA and cost of this component is kept as Rs. 2000.00 crores on Lump sum basis.

RENOVATION OF MAHOBA TANK WITH ITS CONNECTING CANAL

DPR for the Renovation of Mahoba Tanks with its connecting system

Preparation of Detailed Project Report (DPR) for the Renovation of Mahoba Tanks with its connecting system is under progress in NWDA and cost of this component is kept as Rs. 500.00 crores on Lump sum basis.

REPAIRING/ RENOVATION OF KEN CANAL SYSTEM OF UTTAR PRADESH

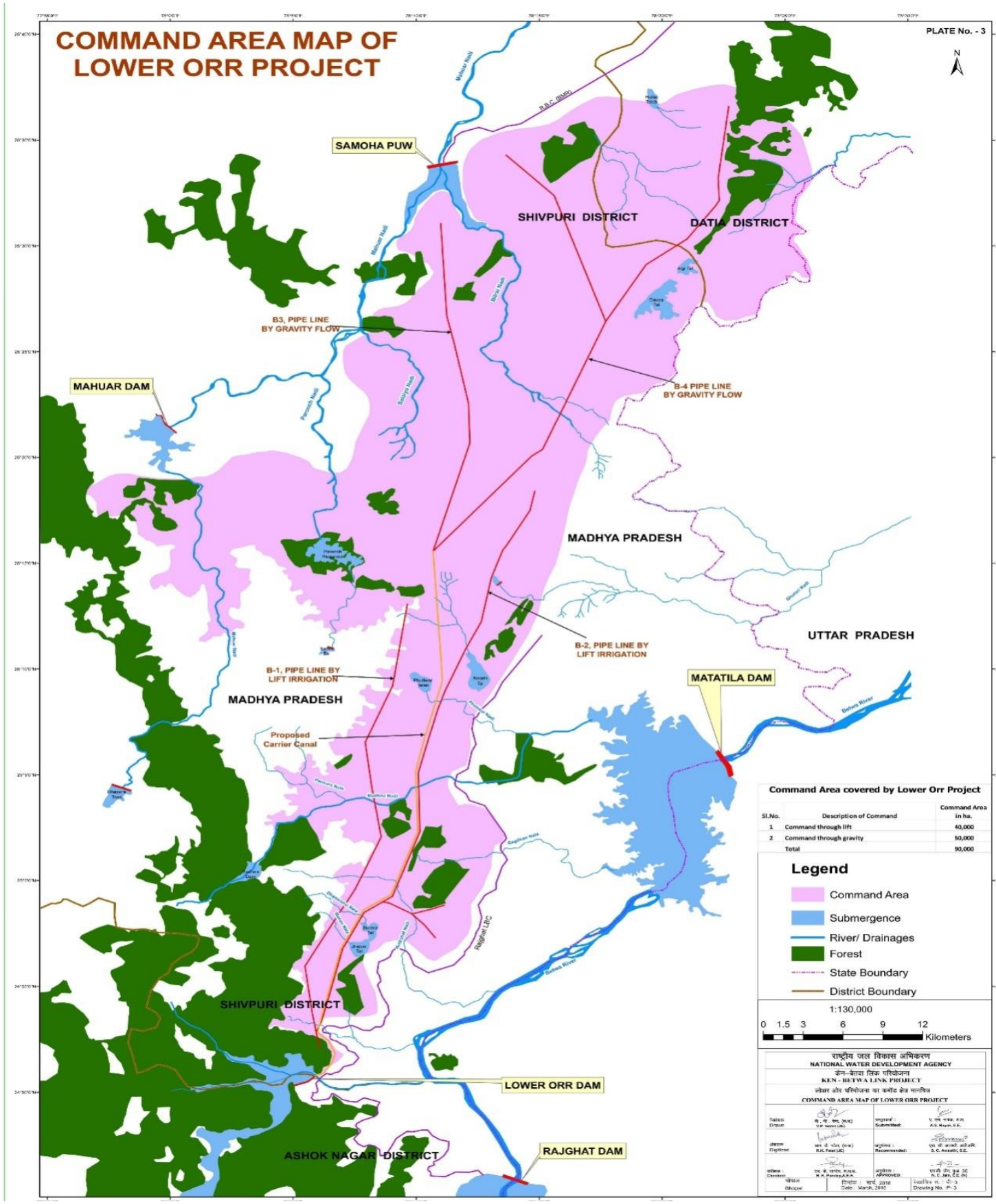
DPR for the Repairing/Renovation of Ken Canal system

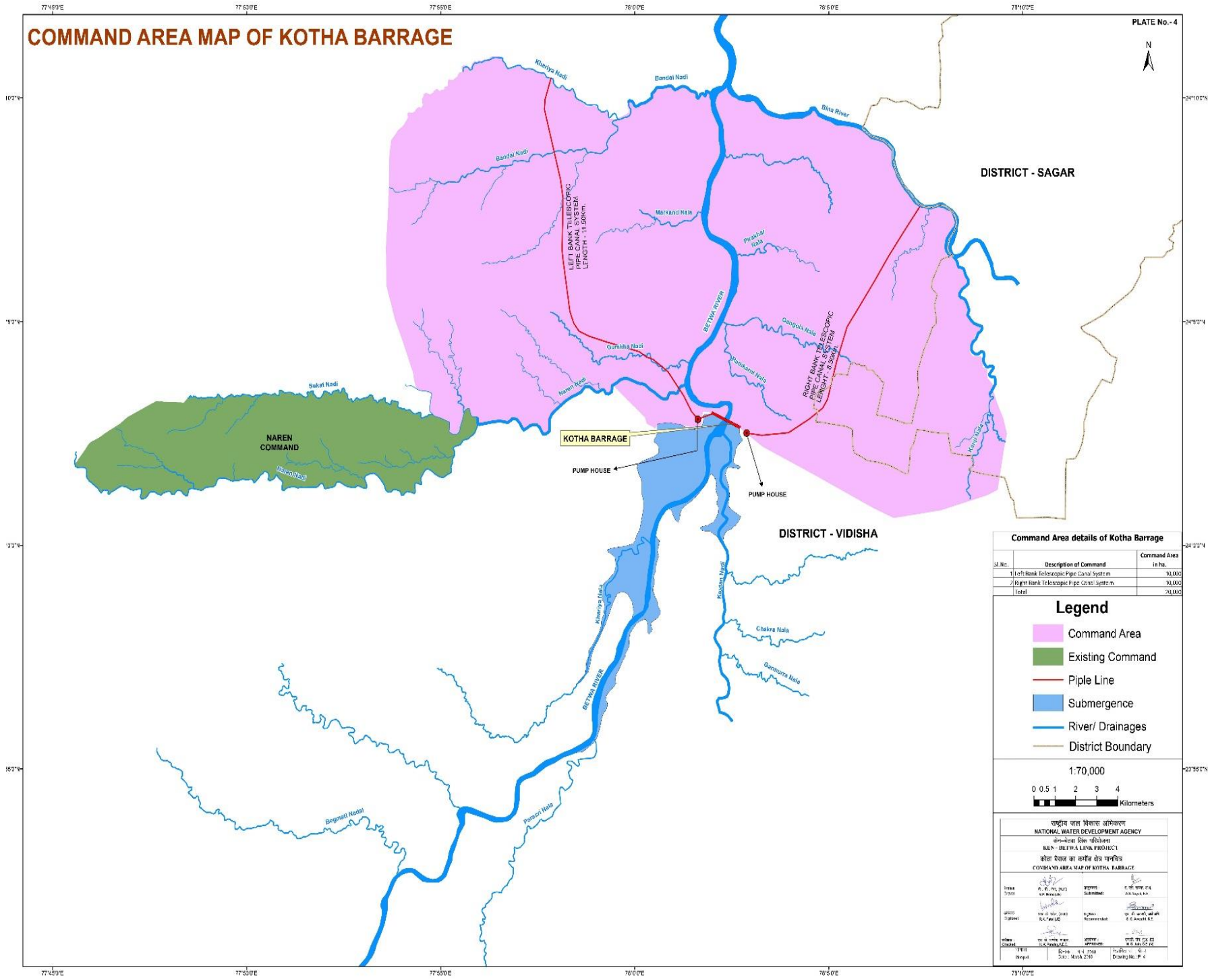
Preparation of Detailed Project Report (DPR) for the Repairing/Renovation of Ken Canal system is under progress in I&WRD, UP and cost of this component is kept as Rs. 1000.00 crores on Lump sum basis.

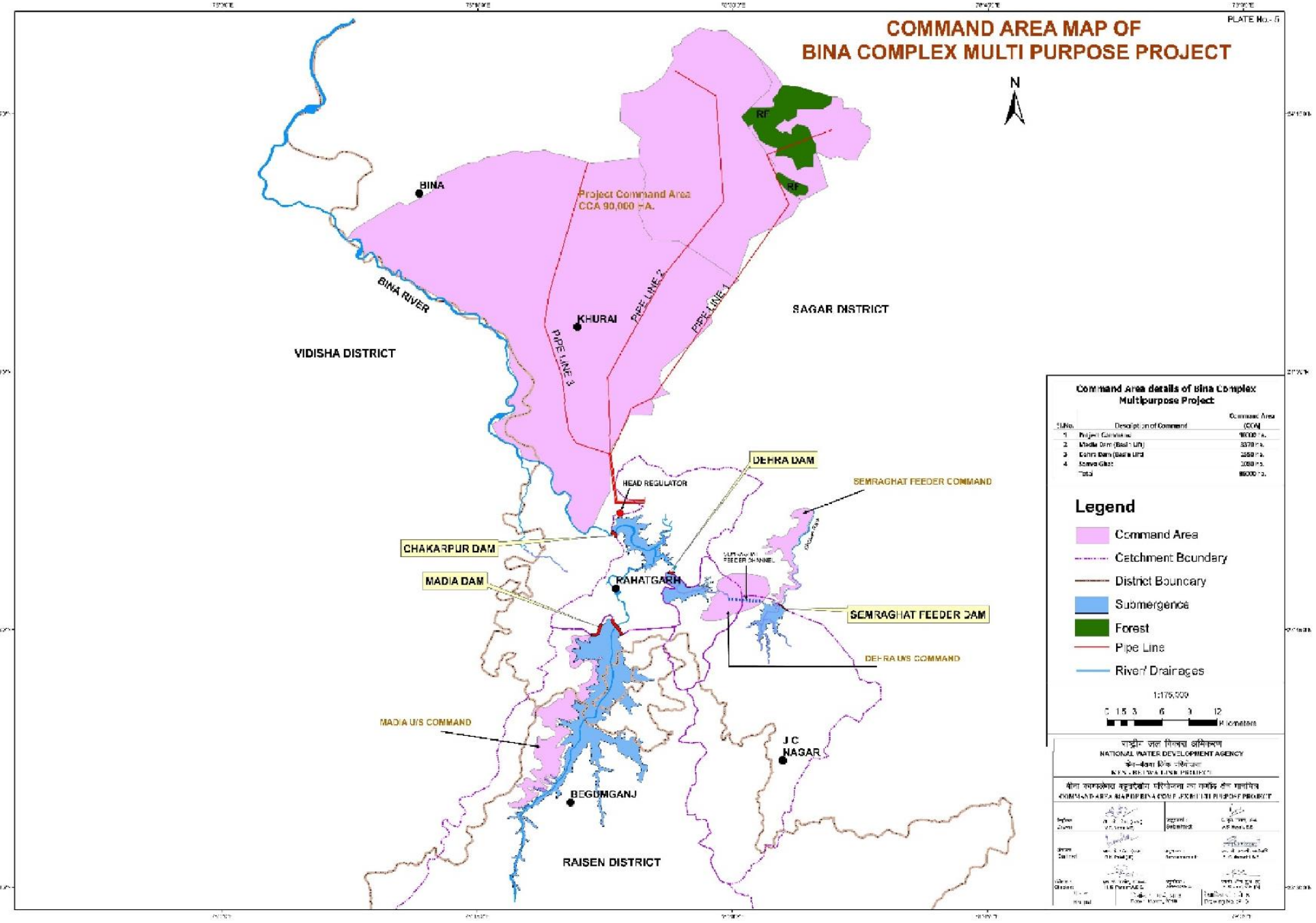
REPAIRING/ STRENGTHEN OF BARIYARPUR PU, PARICHHA WEIR, BARWA SAGAR

DPR for the Repairing/Strengthening of Bariyarpur PUW, Parichha Weir, Barwa Sagar etc.

Preparation of Detailed Project Report (DPR) for the Repairing/Strengthening of Bariyarpur PUW, Parichha Weir, Barwa Sagar etc. is under progress in I&WRD, UP and cost of this component is kept as Rs. 220.00 crores on Lump sum basis.


COMMAND AREA MAP OF LOWER ORR PROJECT
PLATE No. - 3
N
SAMOHA PUW
SHIVPURI DISTRICT
DATIA DISTRICT
B3, PIPE LINE BY GRAVITY FLOW
B-4 PIPE LINE BY GRAVITY FLOW
MAHUAR DAM
MADHYA PRADESH
UTTAR PRADESH
B-2, PIPE LINE BY LIFT IRRIGATION
B-1, PIPE LINE BY LIFT IRRIGATION
MATATILA DAM
Proposed Carrier Canal
Command Area covered by Lower Orr Project
Sl.No. | Description of Command | Command Area in ha.
1 | Command through lift | 40,000
2 | Command through gravity | 50,000
Total | 90,000
Legend
Command Area
Submergence
River/ Drainages
Forest
State Boundary
District Boundary
1:130,000
0 1.5 3 6 9 12 Kilometers
राष्ट्रीय जल विकास अभिकरण
NATIONAL WATER DEVELOPMENT AGENCY
केन–बेतवा लिंक परियोजना
KEN - BETWA LINK PROJECT
लोअर ऑर परियोजना का कमांड क्षेत्र मानचित्र
COMMAND AREA MAP OF LOWER ORR PROJECT
Bhopal
दिनांक : मार्च, 2018
Date : March, 2018
Drawing No. :P- 3
SHIVPURI DISTRICT
ASHOK NAGAR DISTRICT
LOWER ORR DAM
RAJGHAT DAM


COMMAND AREA MAP OF KOTHA BARRAGE
PLATE No.- 4
N
DISTRICT - SAGAR
DISTRICT - VIDISHA
NAREN COMMAND
KOTHA BARRAGE
PUMP HOUSE
PUMP HOUSE
LEFT BANK TELESCOPIC PIPE CANAL SYSTEM LENGTH - 11.50Km
RIGHT BANK TELESCOPIC PIPE CANAL SYSTEM LENGTH - 8.50Km
BETWA RIVER
Khariya Nadi
Bandal Nadi
Bina River
Markand Nala
Piyakhar Nala
Gangola Nala
Gumkha Nadi
Ronkarni Nala
Sukat Nadi
Naren Nadi
Kharia Nala
Kuchni Nadi
Chakra Nala
Gamnura Nala
Begmati Nadal
Pansri Nala
Command Area details of Kotha Barrage
Sl.No.
Description of Command
Command Area in ha.
1 Left Bank Telescopic Pipe Canal System
10,000
2 Right Bank Telescopic Pipe Canal System
10,000
Total
20,000
Legend
Command Area
Existing Command
Piple Line
Submergence
River/ Drainages
District Boundary
1:70,000
0 0.5 1 2 3 4
Kilometers
राष्ट्रीय जल विकास अभिकरण
NATIONAL WATER DEVELOPMENT AGENCY
केन-बेतवा लिंक परियोजना
KEN - BETWA LINK PROJECT
कोठा बैराज का कमांड क्षेत्र मानचित्र
COMMAND AREA MAP OF KOTHA BARRAGE


COMMAND AREA MAP OF
BINA COMPLEX MULTI PURPOSE PROJECT
PLATE No.- 5
N
BINA
Project Command Area
CCA 90,000 HA.
RF
RF
BINA RIVER
KHURAI
PIPE LINE 2
PIPE LINE 1
PIPE LINE 3
SAGAR DISTRICT
VIDISHA DISTRICT
DEHRA DAM
HEAD REGULATOR
SEMRAGHAT FEEDER COMMAND
CHAKARPUR DAM
MADIA DAM
RAHATGARH
SEMRAGHAT FEEDER DAM
DEHRA U/S COMMAND
MADIA U/S COMMAND
J C NAGAR
BEGUMGANJ
RAISEN DISTRICT
Command Area details of Bina Complex Multipurpose Project
Sl.No.
Description of Command
Command Area (CCA)
1 Project Command 90000 Ha.
2 Madia Dam (Basin Utl) 3370 Ha.
3 Dehra Dam (Basin Utl) 2550 Ha.
4 Semra Ghat 2080 Ha.
Total 98000 Ha.
Legend
Command Area
Catchment Boundary
District Bouncary
Submergence
Forest
Pipe Line
River/ Drainages
1:175,000
0 1.5 3 6 9 12
Kilometers
राष्ट्रीय जल विकास अभिकरण
NATIONAL WATER DEVELOPMENT AGENCY
KEN - BETWA LINK PROJECT
COMMAND AREA MAP OF BINA COMPLEX MULTI PURPOSE PROJECT

Annexures

MEMORANDUM OF UNDERSTANDING AMONG THE STATE OF MADHYA PRADESH, THE STATE OF UTTAR PRADESH AND THE UNION GOVERNMENT ON KEN-BETWA LINK PROJECT

Name & Address of Parties

1. State of Madhya Pradesh, Water Resources Department, Vallabh Bhawan, Bhopal.
2. State of Uttar Pradesh, Irrigation Department, Secretariat, Lucknow.
3. Union Government, Ministry of Water Resources, Shram Shakti Bhawan, Rafi Marg, New Delhi.

(A) Whereas the Union Government considers the programme for interlinking of rivers as of national importance and work out ways and means for project funding mechanism including share of the States etc., so as to be able to complete the project within the stipulated time frame.

(B) And whereas the Union Government, in consultation with the States, create appropriate institutional arrangements involving States/Union Government for operation and control of waters in accordance with Agreements reached.

(C) And whereas the States full cooperation towards this task of linking of rivers in the overall interest of the Nation are required:

NOW, THEREFORE, IT IS HEREBY ENTERED INTO UNDERSTANDING BY THE PARTIES AS FOLLOWS:

1. Union Government shall identify and decide the organizational framework necessary for completion of the 'Detailed Project Report' (DPR) and 'Implementation of the Link Projects'

2. Specific MOUs as required will be entered into amongst the States of Uttar Pradesh, Madhya Pradesh and Union Government based on the DPR and Agreements reached on scope of the link, sharing of costs and benefits and arrangements for management and control of water etc.

3. Both the State Governments will gain multipurpose benefits through the Ken-Betwa Link Project as per the Feasibility Studies completed by National

Water Development Agency. In pursuance of the said objective, broad consensus and 'in principle' understanding was arrived at through consensus building efforts of the Union Government and the States as reflected in the Chief Engineer (HQ), NWDA letter No. NWDA/TECH-III/122/17/2004 (Vol. V) dated 5.1.2005 in order to ensure optimum and integrated planning, successful implementation and effective monitoring and operation of Ken-Betwa interlinking project under National Perspective Plan. The apprehensions on water sharing, control mechanism and compensation of power loss etc. raised by States will be addressed at DPR stage.

4. Both the States shall enter into and abide by Agreements with the Union Government and amongst themselves in the larger interest of combating natural calamities of floods and droughts in different regions of the country.

5. Any review/amendment of the MOU shall be done if agreeable to by all the parties.

6. This is being concluded amongst the State of M.P., State of U.P. and Union Government for proceeding ahead on the Ken-Betwa Link Project and taking up the project for preparation of DPR.

Signed at New Delhi on this day of 25th August, 2005.

(BABULAL GAUR)
Chief Minister of Madhya Pradesh
FOR STATE OF M.P.

(MULAYAM SINGH YADAV)
Chief Minister of Uttar Pradesh
FOR STATE OF U.P.

(PRIYA RANJAN DASMUNSI)
Minister of Water Resources
FOR UNION GOVERNMENT

तार : जलविकास
Grams : JALVIKAS

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राष्ट्रीय जल विकास अभिकरण
(भारत सरकार जल संसाधन मंत्रालय के अधीनस्थ सोसाइटी)
NATIONAL WATER DEVELOPMENT AGENCY
(A Govt. of India Society under the Ministry of Water Resources)

18-20, सामुदायिक केन्द्र,
18-20, Community Centre,
साकेत, नई दिल्ली-110017
Saket, New Delhi-110017

NWDA/Tech.III/122/17/2004 (Vol.V)

dated: 5th January, 2005

To

1. Shri Jai Prakash,
Chief Engineer (Betwa),
UP Irrigation Dept.,
Jhansi

2. Shri S.K.Tiwari,
Chief Engineer (Dhasan-Ken Basin),
Water Resources Dept.,
Govt. of MP,
Sagar (MP)

Sub: Proposed Water requirements of UP & MP in downstream and upstream of Daudhan dam in respect of Ken-Betwa link

Sir,

Kindly recall our discussion of 5th January, 2005 after the meeting of CE (IMO), CWC where further possibilities of reaching consensus on water sharing between UP & MP in respect of Ken-Betwa link were explored. Accordingly, a fresh proposal of sharing of water between UP & MP is being sent for consideration and taking the approval of your Government. I am waiting for an early response in this regard.

Yours faithfully,

05/01/2005

(N.K. Bhandari)
Chief Engineer (HQ)

Encl: As above

PROPOSED WATER SHARING OF KEN BASIN UPTO DAUDHAN DAM

S. No.	Particulars		Proposed by NWDA after Meeting (MCM [TMC])
1.	Gross Water available at proposed Dam		6188 [218.54]
2.	Madhya Pradesh (MP) requirement in U/S of dam		2266 [80.03]
3.	Balance Water available		3922 [138.51]
	Regeneration (+)		442 [15.61]
	Net Water Balance Available		4364 [154.12]
4.	Total requirement of MP		
	(a) D/s of Ex Daudhan		1375 [48.56]
	(b) Enroute use		263 [9.29]
	(c) domestic enroute utilisation & transmission losses		49 [1.73]
	Total:		1687 [59.58]
5.	Total Requirement of Uttar Pradesh (UP)		
	D/s of Daudhan including enroute command		1700 [60.04]
6.	Proposed Water Transfer to Betwa Basin		659 [23.27]
7	Requirement for D/s of dam for ecological needs		318 [11.23]

/SE-III/ WS-Ken.

Annexure- 1.2

E- 470899/2012/ch 14.7 *Out Today*

PRIME MINISTER'S OFFICE

******

South Block,
New Delhi – 110 011

Please find enclosed, for information and further necessary action, copy of Minutes of the meeting chaired by the Principal Secretary to PM on 04.07.2017 to discuss 'Ken Betwa Link Project'.

(Dr. Shrikar Pardeshi)
Director
Tel. No. 2301 8040

Secretary, M/o Water Resources, River Development & Ganga Rejuvenation
PMO ID no. 4656923/PMO/2017-ES-2 Dated: 13.07.2017

Copy, for information and further necessary action, to:

Chief Secretary, Government of Madhya Pradesh
Chief Secretary, Government of Uttar Pradesh

Minutes of the Meeting chaired by Principal Secretary to PM to discuss 'Ken Betwa Link Project', 4th July 2017, 3:00 p.m., South Block

Principal Secretary to PM chaired a meeting to discuss 'Ken Betwa Link Project' (KBLP). The list of the participants is attached.

2. Chief Secretary, Madhya Pradesh (MP) presented the following issues on behalf of Government of MP:

i. The Phase-I of KBLP focusses on transferring surplus water of Ken basin to water deficit Betwa basin along with power generation. Actually Betwa basin is presently surplus with 34 TMC water. By delinking Phase-I from Phase-II of the KBLP, the very rationale of KBLP becomes questionable and is not likely to withstand judicial scrutiny.

ii. The proposed Phase-I of the KBLP goes beyond the mandate given by the MoU signed on 25.08.2015. Requisite mandate would come after the DPR for the project is finalized, which would be possible only after combining both the Phases, and a water share agreement is reached.

iii. As per the MoU on 13.1.1977, UP was not supposed to increase irrigation from Ken canal beyond 2.10 lakh acres during *Kharif* and 1.60 lakh acres during *Rabi*. Therefore, the total CCA of UP including en-route CCA of 13,763 ha cannot exceed 97,763 ha, whereas the Cabinet note mentions 2,22,373 ha CCA in UP.

3. Secretary, MoWR responded to these issues as below:

i. As per the MoU signed on 25.8.2005, 1700 MCM (60.04 TMC) of water is allocated to UP without mentioning any CCA in MoU.

ii. The DPR of Phase-II could not be finalised due to frequent changes in the project by MP. Bina complex was added, after 2014 by MP. Now, the DPR is under finalization incorporating the Lower Orr, Kotha barrage and Bina complex.

iii. At the moment, approval for Phase-I may be granted.

4. It was decided that since the project is beneficial to both MP and UP, both the State Administrations should work out an agreement on mutual water sharing to take the KBLP forward. Once the agreement is reached, both the States may approach Government of India for further action.

LIST OF PARTICIPANTS

Govt. of India

1. Dr. Amarjit Singh, Secretary, M/o Water Resources, RD & GR
2. Mr. Masood Husain, Member, Central Water Commission

Madhya Pradesh

3. Shri Basant Pratap Singh, Chief Secretary
4. Shri Rajneesh Vaish, ACS, NVDA
5. Shri R S Julaniya, ACS, Panchayat & RD
6. Shri Pankaj Agarwal, Principal Secretary, WRD
7. Shri Rajiv Suklikar, Engineer-in-Charge, WRD

Uttar Pradesh

1. Shri Suresh Chandra, Principal Secretary, Irrigation & Water Resources
2. Shri Pradeep Kumar Singh, CE & HoD, Irrigation & Water Resources
3. Shri J P Dwivedi, CE, Irrigation & Water Resources
4. Shri A K Shrivastava, CE (Betwa), Irrigation & Water Resources

Prime Minister's Office

1. Shri Anurag Jain, Joint Secretary to PM
2. Ms. Debashree Mukherjee, Joint Secretary to PM
3. Dr. Shrikar Pardeshi, Director, PMO
4. Shri Mayur Maheshwari, Deputy Secretary to PM

Annexure-1.3

क्रमांक/डी.ओ. पत्र क्र. 1006 /मुमंका/
दिनांक 11 OCT 2017

शिवराज सिंह चौहान
मुख्यमंत्री
मध्यप्रदेश

आपके द्वारा केन बेतवा परियोजना के संदर्भ में दिनांक 25-9-2017 को मध्यप्रदेश एवं उत्तरप्रदेश के मुददों के निम्नानुसार समाधान के लिये मैं आपका आभारी हूँ :-

I. केन एवं बेतवा दोनों कछारों में परियोजनाओं की एकजाई स्वीकृति दी जाकर साथ-साथ क्रियान्वित किया जाएगा ।

II. सम्पूर्ण परियोजना राष्ट्रीय परियोजना के रूप में मान्य होगी । परियोजना की कुल लागत का 90 प्रतिशत केन्द्रीय अनुदान दिया जाएगा ।

III. केन कछार में मध्यप्रदेश का 4.47 लाख हेक्टर (पन्ना जिले के 70000 हेक्टर सहित) एवं उत्तरप्रदेश का 2.27 लाख हेक्टर सी.सी.ए लिया जाएगा । बेतवा कछार में मध्यप्रदेश में बीना काम्प्लेक्स, लोअर ओर एवं कोठा बैराज परियोजनाओं से 2.00 लाख हे. सी.सी.ए में सिंचाई की जाएगी ।

IV. केन कछार से उत्तर प्रदेश 60 टी.एम.सी तक जल उक्त क्षेत्र में सिंचाई एवं पेयजल हेतु उपयोग कर सकेगा ।

V. दोनों राज्य अधिकाधिक माइक्रो इरीगेशन अपनांएगे एवं इसके फलस्वरूप आवंटित जल में प्राप्त बचत का परस्पर उपयोग कर सकेंगे ।

VI. परियोजना से उत्पन्न जल विद्युत पर मध्यप्रदेश का स्वत्व होगा ।

VII. मध्य प्रदेश के विस्थापितों का पुनर्वास आदर्श रूप में पारदर्शी प्रक्रिया द्वारा किया जाएगा।

VIII. वन व्यपवर्तन हेतु 6017 हेक्टर गैर वनभूमि पन्ना नेशनल पार्क को हस्तांतरित किए जाने की शर्त को शिथिल कराया जाएगा ।

आपसे अनुरोध है कि उपरोक्त सहमति के अनुसार यथाशीघ्र संपूर्ण परियोजना की डी.पी.आर एकजाई कर अंतिम करने के लिए निर्देश देने का कष्ट करें । आप सहमत होंगे कि परियोजना के सुगम क्रियान्वयन की दृष्टि से दोनों राज्यों द्वारा अपने-अपने क्षेत्र में परियोजना का निर्माण कार्य करना आवश्यक है ।

उपरोक्तानुसार अनुबंध का प्रारूप उत्तरप्रदेश के अधिकारियों के साथ समन्वय कर तैयार करने के निर्देश मैंने मध्यप्रदेश के अधिकारियों को दिए हैं ताकि चारों परियोजनाओं के बांधों (केन नदी पर दोधन एवं बेतवा कछार की तीनों परियोजनाओं के बांध) का निर्माण कार्य यथाशीघ्र प्रारंभ कराया जा सके ।

भवदीय,

(शिवराज सिंह चौहान)

माननीय श्री नितिन गडकरी जी
मंत्री
भारत सरकार,
जल संसाधन मंत्रालय,
नई दिल्ली

490981

02/11/17

सुरेश चन्द्रा,
प्रमुख सचिव

अर्द्धशा0प0सं0–3627 / 17–27–सिं–9
65एसएवी / 15

उत्तर प्रदेश शासन
सिंचाई एवं जल संसाधन अनुभाग–9
लखनऊ : दिनांक : 02 नवम्बर, 2017

प्रिय महोदय,

केन बेतवा लिंक परियोजना की पुनरीक्षित ड्राफ्ट एम0ओ0यू0 के सम्बन्ध में अपने जी–मेल पत्र दिनांक 26.10.2017 एवं उत्तर प्रदेश राज्य के अर्द्धशा0प0सं0–3208 / 17–27–सिं–9–65एसएवी / 15टीसी, दिनांक 10.10.2017 का सन्दर्भ ग्रहण करने का कष्ट करें।

2– केन बेतवा लिंक परियोजना की पुनरीक्षित ड्राफ्ट एम0ओ0यू0 के सम्बन्ध में प्रमुख अभियन्ता एवं विभागाध्यक्ष, सिंचाई एंव जल संसाधन विभाग, उत्तर प्रदेश, लखनऊ के पत्र संख्या–सी–306 / EinC(Irr)KEN-BETWA दिनांक 01.11.2017 (छायाप्रति संलग्नक सहित संलग्न) का अवलोकन करने का कष्ट करें, जिसके द्वारा प्रस्तरों में दिये गये सुझाव पर विचार किये जाने का अनुरोध किया गया है।

3– अतः अनुरोध है कि प्रमुख अभियन्ता एंव विभागाध्यक्ष, सिंचाई एंव जल संसाधन विभाग, उत्तर प्रदेश, लखनऊ द्वारा उक्त उपलब्ध करायी गयी आख्या में उल्लिखित प्रस्तरों में दिये गये सुझावों पर विचार कर अग्रेतर कार्यवाही करते हुए, कृत कार्यवाही से प्रदेश सरकार को अवगत कराने का कष्ट करें।

संलग्नकःयथोक्त।

भवदीय,

(सुरेश चन्द्रा)

श्री संजय कुंदू
संयुक्त सचिव (आर0डी0 एण्ड पी0पी0),
भारत सरकार,
जल संसाधन, नदी विकास और गंगा संरक्षण मंत्रालय,
श्रम शक्ति भवन, रफी मार्ग,
नई दिल्ली–110001

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RM362/17-22-CRF/

From,

Engineer- in-Chief and Head of Department
Irrigation & Water Resources Department.
Lucknow.

To,

Principal Secretary
Irrigation & Water Resources
Govt. of U.P., Lucknow.

Letter No-C-39 /EinC (Irri)/KEN-BETWA Dated: 1/11/2017

Sub:- **Comments on revised draft MoU on Ken-Betwa Link Project.**

Sir,

Kindly refer to revised draft of " **Memorandum of Understanding Amongst the State of Madhya Pradesh, Uttar Pradesh and the Union Govt.**" on Ken-Betwa Link Project. The comments on above subject were received by Chief Engineer (Pariyojana-Betwa), I&WR department UP, Jhansi. Photocopy letter of C.E. (Pariyojana-Betwa) is attached here with. According to his letter the comments are as follows :

1.0 Ken Betwa Link Project (KBLP)

U.P. agree with the proposed water sharing of Ken basin up to Dodhan Dam as decided in tripartite MoU signed on 25th August 2005. attached as **Annexure-I** of revised draft MoU But does'not agree with proposed water transfer to Betwa basin up to 659MCM (23.27TMC) It was previously agreed in cabinet note that proposed water transfer to Betwa basin is up to 254.87 MCM (9 TMC). Since water can not be stored at Parichha weir.

In this draft it is written that 1700 MCM of water will be allotted to UP and balance water shall be used by MP. Since as per MoU both the state have equal share of 1700 MCM of water. If availability of water at Daudhan Dam is more then 6188 MCM (218.54TMC) it should be distributed equal share because requirement of water in UP is more than the allotted share.

I	**Head Works**		
I	Daudhan Dam	-	No Comments.
II	Canal Network	-	No Comments
III	**Details of CCA in MP & U.P. (in ha)**		
(a)-	**Madhya Pradesh**		
i.	241306 ha CCA in Ken command (As per DPR)	-	No Comments
ii.	46531 ha CCA in enroute command (As per DPR)	-	No Comments
iii.	70,000 ha left out areas under KBLP.	-	No Comments
iv.	However, MP is free to utilize the water allocated for the above three components with latest fficiency techniques, waters thus saved can be utilized for any additional area of irrigation within the state.	-	No comments
v.	(a) Lower Orr, (b) Bina Complex and (c) Kotha Barrage projects will be taken as part of KBLP once all approvals with respect to these projects are in place	-	No comments

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(b)- **Uttar Pradesh**

(ii) 1539 MCM of water through Daudhan dam will also be released for stabilization of irrigation in 2.13 lakh ha in Banda district in Uttar Pradesh under existing Ken command with 118% intensity of irrigation. - No comments

(iii) About 17488 ha area of Mahoba and Jhansi district of UP is proposed in the enroute of Ken-Betwa link canal with an utilisation of 81 MCM. - No comments

IV **Details of drinking water supply**

38 MCM of water is proposed to be provided to Chhatarpur, Khajurao, Nowgong & Tikamgarh towns of Madhya Pradesh.

For Uttar Pradesh the requirements of water shall be 80MCM out of which 11 MCM for Jhansi district, 13 MCM for Mahoba district and 56 MCM for Lalitpur district.

1.1 **Cost of Project :**

It was requested in earlier draft that the old structures such as Bariyarpur Weir and Parichha Weir are very old and they should be reconstructed as Bariyarpur barrage and Parichha barrage instead of weir. It is to be noted that they were earlier considered in DPR but in revised DPR the above works are not included. In additional to this linking of main Ken canal to proposed barrage is also not considered. The lining of main Ken canal system is also essential and it should be considered for financial assistance.

1.2 Sharing of Hydro Power - No Comments

1.3 Funding of the Project - No Comments

1.4 Implementation Mechanism - No Comments

1.5 R&R of Project Affected Families (PAFs) - No Comments

1.6 Implementation of projects proposed in KBLP- No Comments

Thanking You

Hence the draft MoU may be amended as above.

Enclosure : Photo copy letter of C.E. (Pariyojana-Betwa), Jhansi.

Your's faithfully,

01/11/17

(Bhupendra Sharma)
Engineer in Chief and Head of Department

Letter No- C-300 (1)/EinC (Irri)/KEN-BETWA 1-11-2017 Dated:

Copy forwarded to Chief Engineer (Pariyojana-Betwa) Irrigation &W.R. Department, UP, Jhansi to information and necessary action in reference to your letter No- 7842/CE(P-B)/KEN-BETWA, date 01-11-2017.

(Bhupendra Sharma)
Engineer in Chief and Head of Department

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From,

Chief Engineer
(Parvojana Betwa)
Irrigation & Water Resources Department
Jhansi

To

Engineer -in-Chief and Head of Department
Irrigation & Water Resources Department
Lucknow

Letter No. /Ware/ UP/BP/Betwa/WA - Dated: Jhansi the 01/2017

Sub: **Comments on revised draft MoU on Ken-Betwa Link Project.**

Sir

Kindly refer to revised draft of "**Memorandum of Understanding Amongst the State of Madhya Pradesh, Uttar Pradesh and the Union Govt.**" on Ken-Betwa Link Project. The comments are as follows

1.0 **Ken Betwa Link Project (KBLP)**

UP agree with the proposed water sharing of Ken basin up to Dodhan Dam as decided in tripartite MoU signed on 25th August 2005, attached as **Annexure-I** of revised draft MoU But does not agree with proposed water transfer to Betwa basin up to 659MCM (23.27TMC) It was previously agreed in cabinet note that proposed water transfer to Betwa basin is up to 1443 MCM (49 TMC). Since water can not be stored at Parichha weir.

In this draft it is written that 1700 MCM of water will be allotted to UP and balance water shall be used by MP. Since as per MoU both the state have equal share of 1700 MCM of water. If availability of water at Daudhan Dam is more then 6188 MCM (218.54TMC) it should be distributed equal share because requirement of water in UP is more than the allotted share.

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(a)-	**Madhya Pradesh**		
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	ii. 46531 ha CCA in enroute command (As per DPR)	-	No Comments
	iii. 70,000 ha left out areas under KBLP.	-	No Comments
	iv. However, MP is free to utilize the water allocated for the above three components with latest efficiency techniques, waters thus saved can be utilized for any additional area of irrigation within the state.	-	No comments
	v. (a) Lower Orr, (b) Bina Complex and (c) Kotha Barrage projects will be taken as part of KBLP once all approvals with respect to these projects are in place	-	No comments

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(ii) 1539 MCM of water through Daudhan dam will also be released for stabilization of irrigation in 2.13 lakh ha in Banda district in Uttar Pradesh under existing Ken command with 118% intensity of irrigation. - No comments

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1.2 Sharing of Hydro Power - No Comments

1.3 Funding of the Project - No Comments

1.4 Implementation Mechanism - No Comments

1.5 R&R of Project Affected Families (PAFs) - No Comments

1.6 Implementation of projects proposed in KBLP- No Comments

Thanking You

Your's faithfully

01/11/12

(Anil Kumar Srivastava)
Chief Engineer (Pariyojana-Betwa)

Letter No- /CE(P-B)/KEN-BETWA Dated:

1- Copy forwarded to Engineer in Chief (Pariyojana) Irrigation &W.R. Department, UP, Lucknow to information and necessary action.

2- Chief Engineer, Lvel-I, (Design & Research), Irrigation &W.R. Department, UP. Lucknow.

3- Chief Engineer (WR), Irrigation &W.R. Department, UP, Lucknow.

(Anil Kumar Srivastava)
Chief Engineer (Pariyojana-Betwa)

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Subject: **Comments requested on draft National Coastal Mission by Nov 10, 2017**

To: ramesh_an@yahoo.com, soma-dod@nic.in, ramana.murm@gmail.com, sdave.cpcb@gmail.com, raghuksc@rediffmail.com, adnfdmc3@fsi.nic.in, c.palpandi@gov.in, jrbhatt@nic.in, md.nwm@gov.in, spgotmare@gov.in, gopinath.lagudu@nic.in, w.bharat@nic.in, shard.sapra@nic.in, igfwi-mef@nic.in, sp.vashishth@nic.in, yashvir@nic.in, kothanbhim@gmail.com, rohitkakkarud@gmail.com, rajiv.nayan@nic.in, fric-ahd@gov.in, ramkumarv@nic.in, garima.kapoor25@gov.in, sandeep.chauhan@rediffmail.com, ddgpss.gsi@gov.in, dg.gsi@gov.in

Cc: amitabh.kant@nic.in, ceo-niti@gov.in, secretary@moes.gov.in, Arvind.p@nic.in, secy-mowr@nic.in, sectour@nic.in, secyahd@nic.in, pps2secy-ahd@nic.in, secyship@nic.in, param.iyer@gov.in, ppsdws@nic.in, secy-agri@nic.in, hshso@nic.in, secretary-msme@nic.in, pstosecy-msme@gov.in, secyrd@nic.in, sinhaa5@nic.in, rama.krishnan67@nic.in, secy-msde@nic.in, wahid@nic.in, karn.bipin@nic.in, secy-tribal@nic.in, ts.negi@nic.in, cga-dg@indiancoastguard.nic.in, bsi.headquarter@gmail.com, "ccb.cpcb" <ccb.cpcb@nic.in>, yashvir@nic.in, ravis.prasad@nic.in, sujata@nic.in, b.sikka@gov.in, dgfsi@fsi.nic.in, pchanna@gmail.com, bsi.headquarter@gmail.in, kailash611@rediffmail.com, akmehta@nic.in, nteshkumar.singh@nic.in, nayanika.singh@nic.in

Date: 11/02/17 13:19

From: ARVIND KUMAR NAUTIYAL <arvind.nautiyal@gov.in>

Dear Madam/ Sir,

This is in continuation to inter-ministerial consultation on the working draft of National Coastal Mission (NCM) document (attached) under the chairmanship of Shri Arun Kumar Mehta, Additional Secretary, MoEF&CC yesterday.

As decided, it is kindly requested to communicate your divisions/ Ministry's detailed comments on the working draft of NCM **latest by Nov 10, 2017 (Friday)** to the undersigned with a copy to nayanika.singh@nic.in. Please also send us a write up on the work done/ being done by your division/ Ministry in coastal and marine sector (activities, geographical coverage and budget allocated etc.) and the possibility of linking it with NCM.

Warm regards

Arvind Kumar Nautiyal
Director (CRZ/SICOM)
Ministry of Environment, Forest and Climate Change
Government of India

सुरेश चन्द्रा
प्रमुख सचिव

अर्द्धशा0प0सं0–4026 / 17–27–सिं–9
65एसएवी / 15

उत्तर प्रदेश शासन
सिंचाई एवं जल संसाधन अनुभाग–9
लखनऊ : दिनांक 24 दिसम्बर, 2017

प्रिय महोदय,

केन बेतवा लिंक परियोजना की पुनरीक्षित ड्राफ्ट एम0ओ0यू0 के सम्बन्ध में मा0 मंत्री, केन्द्रीय जल आयोग, जल ससाधन, नदी विकास एवं गंगा संरक्षण, भारत सरकार, नई दिल्ली के पत्र दिनांक 20.11.2017 एवं उत्तर प्रदेश राज्य के अर्द्धशा0प0सं0–3627 / 17–27–सिं–9–65एसएवी / 15, दिनांक 02.11.2017 का सन्दर्भ ग्रहण करने का कष्ट करें।

2– केन बेतवा लिंक परियोजना की पुनरीक्षित ड्राफ्ट एम0ओ0यू0 के सम्बन्ध में प्रमुख अभियन्ता (परियोजना) सिंचाई एंव जल संसाधन विभाग, उत्तर प्रदेश, लखनऊ के पत्र संख्या–सी–392 / EinC(P)/(Irr)/KEN-BETWA दिनांक 29.11.2017 (छायाप्रति संलग्न) का अवलोकन करने का कष्ट करें, जिसके द्वारा प्रस्तरों में दिये गये सुझाव पर विचार किये जाने का अनुरोध किया गया है।

3– अतः अनुरोध है कि प्रमुख अभियन्ता (परियोजना), सिंचाई एंव जल संसाधन विभाग, उत्तर प्रदेश, लखनऊ द्वारा उक्त उपलब्ध करायी गयी आख्या में उल्लिखित प्रस्तरों में दिये गये सुझावों पर विचार कर अग्रेतर कार्यवाही करते हुए, कृत कार्यवाही से प्रदेश सरकार को अवगत कराने का कष्ट करें।

संलग्नकःयथोक्त।

भवदीय,

(सुरेश चन्द्रा)

श्री संजय कुंदू
संयुक्त सचिव (आर0डी0 एण्ड पी0पी0),
भारत सरकार,
जल संसाधन, नदी विकास और गंगा संरक्षण मंत्रालय,
श्रम शक्ति भवन, रफी मार्ग,
नई दिल्ली–110001

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Annexure-1.4 Contd.

NOW, THEREFORE, IT IS HEREBY ENTERED INTO UNDERSTANDING BY THE PARTIES AS FOLLOWS:

2.0 **Ken-Betwa Link Project (KBLP) :**

The water sharing as decided in tripartite MOU signed on 25th August, 2005 shall be adhered to and 1700 MCM of water will be allotted to Uttar Pradesh. (Table attached)

i.	Further as per hydrological studies made in DPR (2008) 75% dependable yield of Ken river at Daudhan dam site is 6590 MCM (232.70 TMC). After accounting for upstream reserves 2266 MCM (80 TMC), mandatory flows and reservoir losses, share of Madhya Pradesh shall be 2350 MCM (83 TMC) and share of Uttar Pradesh shall be 1700 MCM (60 TMC) including agreed share of Uttar Pradesh as per the inter-state agreement of year 1977. In case of surplus yield, Madhya Pradesh shall have all rights to use such surplus yield. In years of scarcity, after reserving 2266 MCM (80 TMC) for upstream uses in Madhya Pradesh and deducting quantities for mandatory flows and reservoir losses, the remaining water shall be shared by the two States in the ratio of 83 MP: 60 UP.	-	As per agreement of 1977 it was agreed that total utilization of UP from existing system shall not be more than 37 TMC and MP can utilize surplus water beyond 2500 cusecs and/or 37 TMC from the existing system. Since the arrangement is proposed to be modified so this agreement can't be applied. However, this agreement is superseded by the agreement drawn on 25th august 2005. As per MOU drawn on 25th August 2005, the share for UP was 1700 MCM (60 TMC) against water availability of 6188 MCM (218.5 TMC). So, when water availability is 6590 MCM (232.70 TMC), then extra water i.e. 402 MCM should be distributed equally among U.P. and M.P. i.e. UP should get total 1900 MCM of water. Accordingly modification in the water distribution is desired. If water is available in excess then it should be distributed equally among both states. Priority should be to fill Dhaudhan dam first, then only upstream usage shall be allowed. During scarcity, water shall be distributed proportionately between U.P. and M.P. and in the same way reservoir losses and mandatory flow to be proportioned.
ii.	All components of Ken-Betwa Link Project will be developed concurrently.	-	Phase I of the project should be implemented first and after 50% completion of works of Phase I the Phase II should be taken in such a manner that the existing system could not suffer.

2. List of works included in Ken-Betwa Link Project (KBLP)

2.1 Head Works

2.1.1 Daudhan Dam

1	An earthen embankment cum concrete dam across Ken River at Daudhan with FRL 288 m.	-	No comments
2	An Upper Level Tunnel about 170 m from the left bank of Daudhan dam for taking water to the link canal.		
3	A Lower Level Tunnel about 100 m from the left bank of Daudhan dam for taking water to the Power House-II and from there to the Lower Canal.		
4	Power House-I (2x30 MW) to the right of spillway at the toe of Daudhan dam.		
5	Power House-II (3X6 MW) at the outlet of Lower Level Tunnel.		

2.1.2 Kotha Barrage :-

1	A barrage across Betwa river at village Kotha, Tehsil Ganj Basoda, District Vidisha, Madhya Pradesh.	-	Water allotted to these project in August 1972 while agreement was drawn for sharing of water of Betwa river up to Rajghat Dam. So this project has no linkage with KBLP.
2	Pump Houses and Rising Mains		

2.1.3 Bina Complex: -

1	Four storage dams Madia & Chakarpur on Ina river, Semra Ghat Diversion on Dhasan river and Dehra dam on Dehra Nalla, a water conductor/feeder canal from Semra Ghat to Dehara dam and canal off take from Chakarpur Dam.	-	Water allotted to these project in August 1972 while agreement was drawn for sharing of water of Betwa river up to Rajghat Dam. So this project has no linkage with KBLP.
2	Pump Houses, Rising Mains and Power Houses.		

2.1.4 Lower Orr Project: -

1	An earthen embankment cum concrete dam across Orr river near village Didaun, Tehsil Khaniyadhana, District Shivpuri, Madhya Pradesh.	-	This Project is proposed in the catchment of Matatila Dam. The water required for Lower Orr Project will reduce the water availability of Matatila dam. So it will disturb committed use of this project. Therefore water to be utilized in Lower Orr Project should be deducted from reserve share of water of MP and supplemented to Matatila dam from Rajghat Dam. However, water sharing at Matatila Dam between U.P. & M.P. is in 70:30. Therefore this project should be reconsidered accordingly.
2	Pump Houses, Rising Mains and link canal of 91Km long.		

2.2 Canal Networks

2.2.1 Ken Basin:-

	Statement		Comments
1	A link canal 221 km long from Daudhan dam to existing Barwasagar across Barwa Nallah, a tributary of Betwa River.	-	No Provision for remodelling of Barwasagar is made; since this reservoir has its own catchment and stores water for its designated command area, so to store water available from KBLP, the capacity of this reservoir is to be enhanced and subsequently its structures are to be modified. This work needs to be incorporated in DPR of KBLP. No provision for reconstruction of Bariyarpur Barrage has been made. This structure has already outlived its life and does not meets the latest design standard so, it needs replacement.
2	Pumping system and Pressurised pipe network system for 1,82,525 hectare (ha.) CCA of enroute commands of Madhya Pradesh and 17,488 ha. of enroute commands of Uttar Pradesh.	-	Ken Canal system needs to be upgraded and remodelled to provide water to the enhanced command, along with pressurised irrigation arrangement, which is the need of the hour, so a provision for complete system upgradation with pressurised irrigation arrangement should be included in the KBLP. Enroute commend of U.P., 17488 ha should also considered for pressurised irrigation arrangement.
3	2.2 km long canal for connecting Power House-II to Lower Canal at FSL 246.00 m.	-	No Comment
4	A bye pass channel from Lower Level Tunnel to meet irrigation requirements of Lower Canal.	-	No Comment
5	Ken Lower Canal from Daudhan dam for irrigating 1,39,848 ha. CCA of Madhya Pradesh.	-	No Comment

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6	7.5 km long Barwa Nallah remodelling only to carry water from Barwa Sagar to Betwa river at 12.75 km u/s of existing Parichha weir.	-	Parichha weir which is key structure for Betwa Canal System of U.P., needs immediate replacement since it has outlived its life and needs hydro mechanically operated gated system for controlling water during floods. So this structure needs a complete replacement.
7	Pressurised pipe network system for 90,101 ha. CCA of command area of Panna and Damoh districts of Madhya Pradesh.	-	No Comment
8	Pumping system arrangements for lifting water for lower and upper level tunnel and arrangements for commands for direct lifts.	-	No Comment

2.2.2 Betwa Basin:-

1	Kotha Barrage:- Pressurised pipe micro irrigation system for 20,000 ha. CCA of Madhya Pradesh.	-	Water allotted to these project in August 1972 while agreement between UP and MP was drawn for sharing of water of Betwa river upto Rajghat Dam. So this project has no linkage with KBLP.
2	Bina Complex: - Pressurised pipe micro irrigation system for 90,000 ha. CCA of Madhya Pradesh.	-	Water allotted to these project in August 1972 while agreement between UP and MP was drawn for sharing of water of Betwa river up to Rajghat Dam. So this project has no linkage with KBLP.
3	Lower Orr Project:- Pressurised pipe micro irrigation system for 45000 ha. CCA of Madhya Pradesh.	-	This Project is proposed in the catchment of Matatila Dam. The water required for Lower Orr Project will reduce the water availability of Matatila dam. So it will disturb committed use of this project. Therefore water to be utilized in Lower Orr Project should be deducted from reserve share of water of MP and supplemented to Matatila dam from Rajghat Dam. However, water sharing at Matatila Dam between U.P. & M.P. is in 70:30. Therefore this project should be reconsidered accordingly. **Project to be included in KBLP** 1- Parichha weir which is key structure for Betwa Canal System of U.P., needs immediate replacement since it has outlived its life and needs hydro mechanically operated gated system for controlling water during floods. So this structure needs a complete replacement. 2- A Proposal for water to be utilized from Rajghat dam for meeting drinking and irrigation requirement of Lalitpur, is being incorporated in the KBLP, so cost for this work should be included in this project.

3. **Command area in Madhya Pradesh and Uttar Pradesh**

The details of command area are as under:

3.1 **Madhya Pradesh:-**

3.1.1 Ken Basin: -

The details of 4.47 lakh ha. culturable command area (CCA) under KBLP with 134% intensity of irrigation (100% Rabi & 34% Kharif) are as following: -

1	In KBL Canal, total CCA covered by pressurised pipe micro irrigation system will be 1,82,525 ha. in Chhattarpur and Tikamgarh Districts.	-	-
2	In Ken Lower Canal, total CCA covered by pressurised pipe micro irrigation system will be 1,39,848 ha. in Chhattarpur District.	-	-
3	In Bariyarpur LBC (from Bariyarpur PUW) 34,894 ha. CCA will be covered by existing open canal network in Chhattarpur District.	-	-

4	An area of 90,101 ha. CCA will be irrigated by pressurised pipe micro irrigation system by lifting water from Daudhan reservoir, out of which 70,000 ha. CCA will be in Panna District and 20,101 ha. CCA will be in Damoh District	-	-

3.1.2 Betwa Basin:-

Total CCA covered by projects under KBLP in Betwa Basin as per DPR will be 1, 55,000 ha. By pressurised pipe micro irrigation system as following:-

1	Lower Orr 45,000 ha. CCA in Shivpuri &Datia districts.	-	1- This Project is proposed in the catchment of Matatila Dam so it will disturb committed use of this project. However, here is water sharing at Matatila Dam between U.P. & M.P. in 70:30 Therefore this project is to be reconsidered.
2	Bina Complex 90,000 ha. CCA in Sagar district.	-	-
3	Kotha Barrage 20,000 ha. CCA in Vidisha district.	-	-

3.2 Uttar Pradesh: -

1	Stabilisation of irrigation in 2.13 lakh ha in Banda district in Uttar Pradesh under existing Ken command with 118% intensity of irrigation.	-	1- Pressurised irrigation arrangement, remodelling of Ken canal system and appurtenant structures needs to be included. 2- Enroute command of U.P. shall be proposed with pressurised irrigation arrangement. 3- Replacement of Bariyarpur weir needs to be incorporated in the KBLP. 4- Replacement of Parichha weir needs to be incorporated. 5- Remodelling of Barwasagar should be incorporated. 6- Project for providing water from Rajghat Dam to Goving Sagar Dam and enhancement of capacity of Govind Sagar Dam needs to be incorporated in the project.
2	Enroute command of 17,488 ha. CCA of Mahoba and Jhansi districts of Uttar Pradesh.	-	Enroute command of 17,488 ha needs to be incorporated with pressurised irrigation arrangement.

3. Details of drinking water supply:-

	Drinking water supplies shall be part of States' overall share. 60 MCM of water is proposed to be provided for Panna, Chhatarpur and Tikamgarh districts of Madhya Pradesh. 67 MCM of water is proposed to be provided for Jhansi and Lalitpur districts of Uttar Pradesh.	-	Drinking water for Mahoba is not incorporated which is adversely affected area of U.P. needs special attention. Provision should be made for district Mahoba to meet drinking and irrigation water needs.

4. Sharing of Hydro Power: -

	The Government of Madhya Pradesh shall enjoy sole benefit of Hydro-power generated by Power Houses. No part of the cost of dam shall be apportioned on power component.	-	Benefits from power generation shall be shared for maintenance of the project.

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6. Transmission Losses: -

	Transmission loss in KBL canal shall be shared by Madhya Pradesh and Uttar Pradesh in ratio of water used from this link canal.	-	No comments. A Mechanism for quantification should be devised.

7. Sharing of Cost:-

7.1 The cost of KBLP shall include the cost of works listed in para 2 of this MOU including the cost of land acquisition, R&R and diversion of forest land. The Ken-Betwa Link Project will be funded as National Project by the Union Government with 90% (Centre) & 10% (States) funding pattern after the approval of Union Cabinet.

7.1.1 After accounting for central share, the remaining cost of works shall be shared by the States of MP and UP as under: -

1.	Head works of Daudhan dam: in the ratio of water share: 83 MP: 60 UP.	-	Proportion shall be redefined after modification proposed in 1. (i)
2.	KBLC: in the ratio of water to be used by respective states.	-	No Comments.
3.	For works exclusively serving either of the states, by the State concerned.	-	No Comments.

7.1.2	The cost of affected revenue and forest land of Madhya Pradesh will be treated as its State share.	-	No comment

7.2 The Operation and Maintenance cost of the project shall be borne by the States as per details below

1.	Head works of Daudhan dam: in the ratio of water share: 83 MP : 60 UP.	-	Shall be Redefined as per observation 1.0 and 5.0. Operation and maintenance cost of head works such as Parichha Bariyarpur, Matatila and Dhukwa shall also to be born by M.P. in the ratio of water utilized by Madhya Pradesh.
2.	KBLC in the ratio of water used by respective States	-	No comments
3.	For Works exclusively serving either of the states, by the concerned State.	-	No comments

8. **Implementation Mechanism:-**

Three-tier mechanism proposed for implementation of Ken-Betwa link project is as under:

(i)	A High Level Committee headed by Hon'ble Union Minister (WR, RD&GR) for taking decisions on the matters related to implementation of the project. All efforts will be made to get the project executed in a fixed cost turnkey tender basis. Decision of this High Level Committee will be final. However, any dispute arising out at the level of High Level Committee will have to be referred to Hon'ble Prime Minister for resolution.	-	No Comments
(ii	The Steering Committee headed by Secretary (WR,RD&GR), Govt. of India to review the overall implementation of project including progress, policies, procedure, documents, funding and other related matters. Any issue arising out at implementation stage will be resolved at the level of Steering Committee. In case of dispute arising out at Steering Committee level will have to be referred to High Level Committee headed by Hon'ble Union Minister (WR, RD&GR).	-	No Comments

Cont.....7

(ii)	Implementation of the Project by the Executing Organization under the Ken-Betwa Link Project Authority. Special Purpose Vehicle (SPV) of Ken-Betwa Link Project Authority (KBLPA) is proposed along the lines of NHDC with participation of NHPC, Governments of Madhya Pradesh and Uttar Pradesh. The SPV will undertake execution of dam, tunnels and power houses. The State Governments will execute works of canals, other conveyance systems, command area development, land acquisition, compensatory afforestation, R&R issues etc. in their respective jurisdictions. The Chief Executive Officer (CEO) of the Executing Organization will work under Steering Committee of KBLP. He will be responsible for overall execution of Ken-Betwa Link Project for works both under the SPV and the State Governments	-	It shall also include KBLC be executed by KBLPA. KBLPA should includes Engineers from both state in equal proportion.

9. **R&R of Project Affected Families (PAFs): -**

On the issue of rehabilitation and resettlement, it was decided in the joint meeting held on 25.9.2017amongst Hon'ble Minister of Water Resources, River Development and Ganga Rejuvenation (Mowr,RD&GR) and Hon'ble Chief Minsters of Madhya Pradesh and Uttar Pradesh that R&R may be done in a transparent and time bound manner as per Land Acquisition, Rehabilitation and Resettlement Act, 2013.The condition imposed by Ministry of Environment, Forest &Climate Change (MoEF&CC) in stage-I forest clearance for transferring 6017 Ha of revenue land to Panna Tiger Reserve/Forest Department will entail displacement of almost 30 villages inhabited by 2500 families. MoWR,RD & GR will extend full support to Government of Madhya Pradesh for relaxation in this condition

10. **Implementation of projects proposed in KBLP:-**

	The work of Ken-Betwa Link Project in Ken Basin and Betwa Basin will be taken up concurrently.	-	Phase I of the project should be implemented first and after 50% completion of works of Phase I the Phase II should be taken in such a manner that the existing system could not suffer.

11. **Operation of the project:-**

	Operation of the project components serving both the states i.e., Daudhan Dam, KBLC and associated pumping system shall be carried out under supervision of a committee comprising of Water Resources Ministers of both the states. The composition, terms of reference and other related issues will be decided in due course.	-	The board/authority should be formed for operation and maintenance of the project. In line to Betwa river board.

Thanking You

Hence the drafi MoU may be amended as above.

Enclosure: Photo copy letter of C.E. (Pariyojana-Betwa), Jhansi.

Your's faithfully

(Kunal Kulshreshtha)
Engineer in Chief (Pariyojna)

Letter No- (1)/EinC (P)/(Inv)/KEN-BETWA Dated:

Copy forwarded to Chief Engineer (Pariyojana-Betwa) Irrigation &W.R. Department, UP, Jhansi to information and necessary action in reference to your letter No- 8512/CE (P-B)/KEN-BETWA, date 27-11-2017.

(Kunal Kulshreshtha)
Engineer in Chief (Pariyojna)

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Record of Discussions held in the Chamber of Hon'ble Minister (WR, RD & GR) on 25.09.2017

The following were present: -

i. Sh. Nitin Gadkari, Hon'ble Minister (WR, RD & GR)
ii. Sh. Shivraj Singh Chouhan, Hon'ble Chief Minister, M.P.
iii. Sh. Yogi Adityanath, Hon'ble Chief Minister, U.P.
iv. Dr. Amarjit Singh, Secretary (WR, RD & GR)
v. Sh. Masood Husain, DG, NWDA
vi. Sh. R.K. Jain, CE, NWDA
vii. Sh. Sanjay Kundu, JS (RD&PP)
viii. Sh. Radhey Shyam Julania, Addl. Chief Secretary, M.P.
ix. Sh. Pankaj Aggarwal, Principal Secretary (WR) Govt. of M.P.
x. Sh. Suresh Chandra, Principal Secretary (WR) Govt. of U.P. and others

The issue of Ken-Betwa Link Project was discussed. The following decisions were taken: -

i. There will be no change in the water sharing agreement signed in the year 2005by the then Chief Ministers of U.P. and M.P. in the presence of the then Water Resources Minister and Prime Minister. This was agreed to by both the Hon'ble Chief Ministers.
ii. Hon'ble Chief Minister of M.P. brought out that relief and rehabilitation has to be done properly. On this, Hon'ble Minister (WR, RD & GR) said that R&R should be done in a transparent, corruption free and time-bound manner. The Ministry will facilitate that all the payments to the Project Affected Families (PAFs) will be made through electronic transfer.
iii. On the issue of forest clearance, the Hon'ble Chief Minister, M.P. brought to the notice of the House that it is proposed to shift 30 villages in the buffer zone which would cost considerable hardship to these people. On this, Hon'ble Minister (WR, RD & GR) said that the Committee on Infrastructure would be able to work a way out on this to ameliorate the hardship on account of such proposed shifting. Hon'ble Minister (WR, RD & GR) is the head of the Cabinet Committee on Infrastructure and the proposal should be moved to him for forest clearance and he will ensure the speedy approval of the same.
iv. The Additional Chief Secretary, M.P. brought out the issue of additional irrigation to be provided to 70000 hectares left out area in Panna

District. On which, the Hon'ble CM M.P. said that this would be carried out within the share of water allotted to M.P. Govt. of M.P. will try to ensure micro and drip irrigation to ensure better efficiency and full utilisation of water resources.

v. With respect to three projects, namely, Bina Complex, Lower Orr and Kotha Barrage, Uttar Pradesh agreed to these three projects as they were not encroaching upon their right to use overall waters of Betwa river.

vi. With regard to PMKSY proposals of U.P., the Hon'ble Chief Minister U.P. directed his Principal Secretary to complete these proposals in all respects and submit the same to the MoWR, RD & GR by first week of October, 2017.

M.P. & Maharashtra

xi. Sh. Nitin Gadkari, Hon'ble Minister (WR, RD & GR)
xii. Sh. Shivraj Singh Chouhan, Hon'ble Chief Minister, M.P.
xiii. Sh. Devender Phadnavis, Hon'ble Chief Minister, Maharashtra
xiv. Dr. Amarjit Singh, Secretary (WR, RD & GR)
xv. Sh. Masood Husain, DG, NWDA
xvi. Sh. R.K. Jain, CE, NWDA
xvii. Sh. Sanjay Kundu, JS (RD&PP)
xviii. Sh. Radhey Shyam Julania, Addl. Chief Secretary, M.P.
xix. Sh. Pankaj Aggarwal, Principal Secretary (WR) Govt. of M.P.
And others

Discussions were held Pench river Project and Kanhan river Project. The officials of both the Governments stated that a meeting scheduled on 5.10.2017 between M.P. and Maharashtra officials to discuss these Inter-State sharing agreements. They are hopeful to address the issues raised by Hon'ble CM, Maharashtra regarding Pench river Project and Kanhan river Project during that meeting. Inter-State Projects and water sharing thereof.

With regard to issue raised by Hon'ble CM, Maharashtra regarding original water resource availability being 60 TMC and the proportion of Maharashtra and M.P. being decided in respect of that availability, it was brought to knowledge that as of now, the water resource availability has reduced.

The decision taken was that the water flow to both the States would be distributed as per ratio of water sharing agreed on the basis of present flow available.

In respect of supply of drinking water to Maharashtra, M.P. assured that they will supply drinking water to Maharashtra.

Annexure-1.6

No. 2/15/2007-BM/(Pt-III)/ 1652-58
Government of India
Ministry of Water Resources
(BM Division)

Dated : 1 . 12.2016

Sub: Minutes of the meeting taken by Hon'ble Minister (WR,RD&GR) on 18th November, 2016 with the officials of the MoWR,RD&GR, NWDA and Govt. of M.P. regarding the implementation of Ken-Betwa Link Project.

A meeting was taken by Hon'ble Minister (WR,RD&GR) on 18th November, 2016 with the officials of the MoWR,RD&GR, NWDA and Govt. of M.P. regarding the implementation of Ken-Betwa Link Project, minutes of the same is enclosed for information and further necessary action please.

Encl; as above

1/12/16

(Virendra Sharma)
Sr. Joint Commissioner (BM)
PH:24367109

To

1. The Principal Secretary,
   Water Resources Department,
   Government of Madhya Pradesh,
   Bhopal.

2. The Principal Secretary (Irrigation),
   Government of UP,
   Lucknow Uttar Pradesh.

3. The Director General,
   National Water Development Agency,
   Saket, New Delhi.

Copy alongwith enclosures for information to :

1. PS to Hon'ble Minister (WR,RD&GR), New Delhi.
2. PPS to Secretary (WR,RD&GR), New Delhi.
3. PS to OSD (WR,RD&GR), New Delhi.
4. PS to Chairman, CWC, R.K. Puram, New Delhi.

Estimate of KBLink.doc

Figure 1

Minutes of the meeting taken by Hon'ble Minister (WR,RD&GR) on 18th November, 2016 with the officials of the MoWR,RD&GR, NWDA and Govt. of M.P. regarding the implementation of Ken-Betwa Link Project.

The Hon'ble Minister(WR,RD&GR) reviewed the present status of Ken-Betwa Link Project on 18.11.2016. Secretary (WR,RD&GR), OSD (WR,RD&GR), Principal Secretary(WRD), Govt. of MP, DG(NWDA), PS to Hon'ble Minister (WR,RD&GR) and other officials were present.

Gist of important discussions and decision taken are furnished below:

a) Funding Mechanism

1. Funding pattern of Ken-Betwa Project

It was informed that criteria for funding for execution of National Project was earlier 90:10. As the Ken-Betwa Link lies in drought prone Bundelkhand region and is the first project under ILR, 100% funding by Centre is being proposed. If above is not agreed, then funding ratio of 90:10 may be considered. The Hon'ble Minister (WR,RD&GR) has written a D.O. letter dated 27.10.2016 to Hon'ble Finance Minister, Govt. of India in this regard.

b) Implementation Mechanism

i) A Steering Committee headed by Hon'ble Minister(WR,RD&GR) with an overall responsibility for the implementation of the project will be constituted. The composition, the terms of reference and other related issues will be decided in due course.

ii) A Standing Committee headed by Secretary(WR,RD&GR) for taking decisions on the matters related to implementation and monitoring of the project will be constituted. The composition, the terms of reference and other related issues will be decided in due course. All efforts should be made to get the project executed in a fix cost turnkey tender.

iii) Implementing Organisations for project components in Madhya Pradesh shall be decided by the Govt. of Madhya Pradesh.

iv) Implementing Organisation for project components in Uttar Pradesh portion shall be decided by Govt. of Uttar Pradesh.

Annexure-1.6 Contd.

c) Ken Betwa Link Project – Phase I – Additional Component

i) The proposal to be included under Ken-Betwa Link Project (Phase-I) namely, High Level Canal (HLC) including Satai and Panautha Lifts including left out areas to be completed by NWDA and submitted to CWC by 26th December, 2016.

d) Preparation of Detailed Project of Ken-Betwa Link (Phase-II)

i) The DPR of Kotha Barrage is to be revised by Water Resources Department (WRD), Govt. of, Madhya Pradesh and handed over to NWDA by 15th December, 2016.

ii) The DPR of Beena Complex is to be included in Ken-Betwa Phase-II and to be submitted in 8 copies by WRD, MP to Central Water Commission for appraisal by 25th November, 2016.

iii) DPR of Lower Orr Dam under Ken-Betwa (Phase-II) is to be submitted separately by NWDA to CWC by 10th December, 2016.

iv) The entire DPR of Ken-Betwa Link (Phase-II) to be completed and submitted by NWDA to CWC by 31st January, 2017 for techno-economic appraisal.

Considering the importance of Ken-Betwa link project, it was decided to obtain its various clearances on priority, so that both Phase-I and Phase-II may be taken up simultaneously.

The meeting ended with a vote of thanks to the Chair.

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केन-बेतवा लिंक परियोजना (केबीएलपी)
के क्रियान्वयन पर मध्य प्रदेश, उत्तर प्रदेश और संघ सरकार
के मध्य सहमति ज्ञापन (एम.ओ.ए.)

MEMORANDUM OF AGREEMENT (MoA)
AMONGST THE STATES OF MADHYA PRADESH, UTTAR PRADESH AND THE UNION GOVERNMENT ON THE IMPLEMENTATION OF KEN-BETWA LINK PROJECT (KBLP)

22 मार्च, 2021

22nd March, 2021

केन-बेतवा लिंक परियोजना (के.बी.एल.पी.)
के क्रियान्वयन पर मध्य प्रदेश, उत्तर प्रदेश और संघ सरकार
के मध्य सहमति ज्ञापन (एम.ओ.ए.)

I. पक्षकारों के नाम और पते

1. मध्य प्रदेश सरकार (म.प्र. सरकार), जल संसाधन विभाग, वल्लभ भवन, मंत्रालय, भोपाल।

2. उत्तर प्रदेश सरकार (उ.प्र. सरकार), जल शक्ति मंत्रालय, सिंचाई एवं जल संसाधन विभाग, बापू भवन, लखनऊ, उत्तर प्रदेश।

3. संघ सरकार की ओर से जल शक्ति मंत्रालय, जल संसाधन, नदी विकास और गंगा संरक्षण विभाग, श्रम शक्ति भवन, रफी मार्ग, नई दिल्ली।

II. भूमिका

क. जबकि संघ सरकार नदियों के अंतर्योजन के कार्यक्रम को राष्ट्रीय महत्व का समझती है और इसके कार्यान्वयन और निधियन (Funding) के तरीकों और साधनों, जिसमें राज्यों का हिस्सा भी शामिल है, पर कार्य करेगी जिससे कि परियोजनाओं को समयबद्ध रूप से पूरा किया जा सके।

ख. और जबकि दिनांक 25 अगस्त, 2005 को माननीय प्रधानमंत्री की विशिष्ट उपस्थिति में मुख्यमंत्री मध्य प्रदेश, मुख्यमंत्री उत्तर प्रदेश एवं संघ सरकार के मध्य हस्ताक्षरित समझौता ज्ञापन के आधार पर राष्ट्रीय जल विकास अभिकरण (राजविअ) जो जल शक्ति मंत्रालय के अधीन ऑटोनामस बाडी है, ने केन-बेतवा लिंक परियोजना की विस्तृत परियोजना रिपोर्ट (डीपीआर) अप्रैल, 2010 में तैयार की।

ग. और जबकि राजविअ द्वारा तैयार किए गए समेकित डीपीआर के आधार पर केन-बेतवा लिंक परियोजना का क्रियान्वयन किया जाएगा। इस परियोजना का उद्देश्य दोनों राज्यों में लगभग 6.2 मिलियन लोगों को पेयजल उपलब्ध कराने के अतिरिक्त मध्य प्रदेश में 6.57 लाख हेक्टेयर तथा उत्तर प्रदेश में 2.51 लाख हेक्टेयर सिंचाई विकसित और स्थिर करना है।

घ. और जबकि संघ सरकार किए गए अनुबंधों के अनुसार राज्यों के परामर्श से केन तथा बेतवा बेसिनों में समुचित जल नियंत्रण क्रियाविधि, जल का लेखा-जोखा तथा जल विनियमन के लिए राज्यों को शामिल करते हुए एक उचित संस्थानिक व्यवस्था का निर्माण करेगी। इस संस्थान के संबंध में इसकी संघटना, संदर्भ की शर्तें तथा संबंधित अन्य मुद्दों पर उचित समय पर निर्णय लिया जाएगा।

MEMORANDUM OF AGREEMENT (MoA) AMONGST THE STATES OF MADHYA PRADESH, UTTAR PRADESH AND THE UNION GOVERNMENT ON THE IMPLEMENTATION OF KEN-BETWA LINK PROJECT (KBLP)

I. NAME & ADDRESS OF PARTIES

1. Government of Madhya Pradesh (GoMP), Water Resources Department, Vallabh Bhawan, Mantralaya, Bhopal.

2. Government of Uttar Pradesh (GoUP), Ministry of Jal Shakti, Irrigation & Water Resources Department, Bapu Bhawan, Lucknow, Uttar Pradesh.

3. Union Government through Ministry of Jal Shakti, Department of WR, RD & GR, Shram Shakti Bhawan, Rafi Marg, New Delhi.

II. INTRODUCTION

A. WHEREAS the Union Government considers the programme for interlinking of rivers (ILR) of national importance and will work out ways and means for implementation and funding including share of the States, etc. to enable completion of the projects within the stipulated time frame.

B. AND WHEREAS the National Water Development Agency (NWDA), an autonomous body under the Ministry of Jal Shakti has prepared Detailed Project Report (DPR) of Ken-Betwa Link Project in April, 2010 as per the Memorandum of Understanding (MoU) signed by Chief Ministers of Madhya Pradesh and Uttar Pradesh with Union Minister for Water Resources on 25th August, 2005 in the august presence of the Hon'ble Prime Minister.

C. AND WHEREAS the implementation of Ken-Betwa Link Project shall be carried out as per the comprehensive DPR prepared by NWDA. The project is intended to develop and stabilize irrigation to the tune of 6.57 lakh ha in MP and 2.51 lakh ha in UP, besides providing drinking water to about 6.2 million people in the two States.

D. AND WHEREAS, the Union Government, in consultation with the States, will create an appropriate institutional arrangement involving States for control mechanism, water accounting and regulation of water in Ken and Betwa basins in accordance with agreement reached. The composition, terms of reference and other related issues in respect of this institution shall be decided in due course.

III. <u>अब, इसलिए, के.बी.एल.पी. के क्रियान्वयन के लिए पक्षकारों द्वारा निम्नानुसार अनुबंध किया जाता है:</u>

1.0 केन-बेतवा लिंक परियोजना (के.बी.एल.पी.) में जल बंटवारा

1.1 बेतवा नदी पर राजघाट तथा माताटीला बांध तथा केन बेसिन में रंगवान बांध और उर्मिल बांध के वर्तमान अंतर राज्यीय समझौतों पर बिना कोई प्रभाव डाले केबीएलपी में जल बंटवारा पूर्वाग्रह के बिना किया जाएगा।

1.2 25 अगस्त, 2005 को हस्ताक्षरित समझौता ज्ञापन में तय किये गए जल के बंटवारे को यथावत रखा जाएगा। केन बेसिन से मध्य प्रदेश (एम.पी.) दौधन बांध के अपस्ट्रीम में उपयोग करने के लिए 2,266 एमसीएम जल संरक्षित किये जाने तथा दौधन बांध पर पर्यावरण एवं जलाशय में वाष्पन हानि के लिए छोड़े जाने वाले जल की आवश्यक गणना के बाद शेष जल केन एवं बेतवा बेसिनों में केन बेसिन से बरियारपुर पिकप वीयर तक मध्य प्रदेश और उत्तर प्रदेश राज्यों द्वारा उपयोग किया जाएगा। एक सामान्य वर्ष में (केन बेसिन से दौधन बांध तक 6,590 एमसीएम या अधिक वार्षिक ग्रौस यील्ड (Gross Yield) या अधिक होने पर), केन-प्रणाली से मध्य प्रदेश राज्य कुल 2,350 एमसीएम (83 टीएमसी) जल का उपयोग करेगा जब कि उत्तर प्रदेश राज्य कुल 1,700 एमसीएम (60 टीएमसी) जल का वार्षिक उपयोग करेगा। गैर मानसून अवधि में (नवंबर से मई) दौधन जलाशय के भंडारण से मध्य प्रदेश तथा उत्तर प्रदेश को क्रमश: 1,834 एमसीएम तथा 750 एमसीएम जल का कमिटेड रिलीज (Committed Releases) किया जाएगा। उत्तर प्रदेश गैर मानसून अवधि के दौरान अपनी आवश्यकताओं के अनुसार बरियारपुर पिकप वीयर के नीचे अपने राज्य क्षेत्र की सीमा में अतिरिक्त भंडारण करने के लिए स्वतंत्र होगा।

1.3 जिस वर्ष जल की मात्रा कम होगी (केन बेसिन से दौधन बांध तक 6,590 एमसीएम से कम वार्षिक यील्ड होगी) तो उस वर्ष मध्य प्रदेश एवं उत्तर प्रदेश राज्यों द्वारा केन प्रणाली से उनके जल उपयोग के अनुपात में उत्तर प्रदेश द्वारा 1,700 एमसीएम (27%) तथा मध्य प्रदेश द्वारा 2,266 एमसीएम + 2,350 एमसीएम (73%) जल के अंतर को वहन किया जाएगा। यदि 1 नवम्बर को दौधन जलाशय के भंडारण में जल की कमी होती है तो उक्त कमी को दोनों राज्यों द्वारा दौधन जलाशय भंडारण से उनके जल अंश के अनुपात में उत्तर प्रदेश द्वारा 750 एमसीएम (29%) तक तथा मध्य प्रदेश द्वारा 1,834 एमसीएम (71%) बांटा जाएगा।

2.0 केन-बेतवा लिंक परियोजना के घटक (के.बी.एल.पी.)

केबीएलपी के सभी घटक हेड वर्क्स एवं उसकी वितरण प्रणाली तथा कैनाल पाइपलाइन एवं कमान नेटवर्क सहित **अनुलग्नक-I** पर दिए गए हैं।

III. **NOW, THEREFORE, IT IS HEREBY ENTERED INTO AGREEMENT BY THE PARTIES AS FOLLOWS FOR THE IMPLEMENTATION OF KBLP:**

1.0 WATER SHARING IN KEN-BETWA LINK PROJECT (KBLP)

1.1 The water sharing in KBLP will be without prejudice to existing inter-State agreements on Betwa river basin including Rajghat and Matatila dam on Betwa River, Rangwan dam and Urmil dam in Ken basin between States of Madhya Pradesh (MP) and Uttar Pradesh (UP).

1.2 The water sharing as decided in tripartite MoU signed on 25th August, 2005 shall be adhered to. After reserving 2,266 MCM for upstream uses in Madhya Pradesh (MP) in Ken basin upstream of Daudhan dam, and accounting for mandatory releases for environment and reservoir losses at Daudhan dam, the rest of the water in Ken basin upto Bariyarpur Pick Up Weir shall be utilised by the States of MP and UP in Ken and Betwa basins. In a normal year (annual gross yield in Ken basin upto Daudhan dam being 6,590 MCM or more), the State of MP shall utilise total of 2,350 MCM (83 TMC) while State of UP shall utilise total of 1,700 MCM (60 TMC) annually from the Ken system. The committed releases to MP and UP from the storages in Daudhan reservoir during non monsoon period (November to May) shall be 1,834 MCM and 750 MCM respectively. UP shall be free to create additional storages in its own territory downstream of Bariyarpur PUW to store monsoon water as per its requirement during non monsoon period.

1.3 In the years of scarcity (gross annual yield being below 6,590 MCM in Ken basin upto Daudhan dam), the deficit shall be borne by both the States in the ratio of their respective utilisation from Ken system i.e. 1,700 MCM (27%) by UP and 2,266 MCM+2,350 MCM (73%) by MP. Also any deficit in the storage of Daudhan reservoir as on 1st November shall be shared by both the States in the ratio of their share from Daudhan reservoir storage i.e. 750 MCM (29%) by UP and 1,834 MCM (71%) by MP.

2.0 COMPONENTS OF KEN-BETWA LINK PROJECT (KBLP)

The components of KBLP including head works and their distribution system and canal pipeline and command networks are given as **Annexure-I.**

3.0 पेय जल आपूर्ति का प्रावधान

इस परियोजना से क्षेत्र को पेयजल की आपूर्ति प्राथमिकता के आधार पर की जाएगी। लाभान्वित होने वाले जिलों सहित पेयजल आपूर्ति के लिए परियोजना के अनुसार किए गए प्रावधान **अनुलग्नक-II** पर दिए गए हैं। तथापि, पेयजल आपूर्ति के प्रावधान प्रत्येक राज्य की समग्र हिस्सेदारी के भीतर होंगे।

4.0 हाइड्रोपावर का बंटवारा

पावर हाउसों तथा उसके ओ. एंड एम. की लागत का वहन मध्य प्रदेश सरकार करेगी और इस हाइडेल पावर का लाभ मध्यप्रदेश को मिलेगा। हालांकि, बिजली उत्पादन के लाभ को दौधन के हेड वर्क्स के प्रचालन एवं रखरखाव खर्चों में नहीं लिया जाएगा, क्योंकि बिजली उत्पादन बहुत कम है।

5.0 ट्रांसमिशन हानि

लिंक कैनाल की ट्रांसमिशन हानि का वहन मध्य प्रदेश और उत्तर प्रदेश द्वारा इस लिंक से वास्तविक जल उपयोग के हिस्से के अनुपात में किया जाएगा।

6.0 लागत बंटवारा

6.1 केबीएलपी की लागत में भूमि अधिग्रहण, आर एवं आर तथा फॉरेस्ट लैंड डायवर्जन आदि की लागत सहित इस एम.ओ.ए. के **पैरा 2.0 (विवरण अनुलग्नक-I पर संलग्न)** में सभी सूचीबद्ध घटकों की लागत शामिल होगी। केन्द्रीय कैबिनेट के अनुमोदन के बाद केबीएलपी को एक राष्ट्रीय परियोजना के रूप में केन्द्र सरकार द्वारा 90% (केन्द्र) तथा राज्य सरकार द्वारा 10% (राज्यों) के अनुपात में निधियन किया जाएगा।

केन्द्रीय हिस्सेदारी के लेखांकन के बाद कार्य की शेष लागत की राशि का वहन मध्य प्रदेश और उत्तर प्रदेश राज्यों द्वारा इस प्रकार किया जाएगा:-

6.1.1 दौधन बांध का हैड वर्क: मध्य प्रदेश एवं उत्तर प्रदेश के मध्य 71% मध्य प्रदेश: 29% उत्तर प्रदेश के अनुपात में।

6.1.2 केन-बेतवा लिंक कैनाल: संबंधित राज्यों द्वारा आहरित जल के अनुपात में।

6.1.3 दोनों राज्यों में से केवल एक राज्य को लाभ देने वाले कार्यों के लिए, संबंधित राज्य द्वारा।

6.1.4 मध्य प्रदेश की वन भूमि और प्रभावित राजस्व की कीमत केबीएलपी की लागत का एक भाग होगी तथा मध्य प्रदेश के अंश में इसे समायोजित किया जाएगा।

3.0 PROVISION FOR DRINKING WATER SUPPLY

The drinking water supply from project to region shall be given priority. The project wise provisions made for drinking water supply along with districts to be benefitted are given at **Annexure-II.** However, the provisions for drinking water supplies shall be within the overall share of each State.

4.0 SHARING OF HYDROPOWER

The cost of the power houses and its O&M cost shall be borne by Govt. of MP and the benefits of the hydel power shall go to Madhya Pradesh. However, the benefits of hydel power shall not be taken into reckoning for O&M expenditure of the Daudhan head works, as the power generation is meagre.

5.0 TRANSMISSION LOSSES

Transmission losses in the Ken-Betwa link canal shall be shared by MP and UP in the ratio of actual water used from this link canal.

6.0 SHARING OF COST

6.1 The cost of KBLP shall include all the components listed in **para 2.0 (details enclosed at Annexure-I)** of this MoA including the cost of land acquisition, R&R and diversion of forest land etc. The KBLP will be funded as a National Project by the Union Government with 90% (Centre) & 10% (States) funding pattern after the approval of the Union Cabinet.

After accounting for the Central share, the remaining cost of works shall be shared by the States of MP and UP as under:-

6.1.1 Headworks of Daudhan dam: between MP and UP in the ratio of 71% MP: 29% UP.

6.1.2 K-B Link Canal: In the ratio of water to be drawn by respective State.

6.1.3 For works exclusively serving either of the States, by the State concerned.

6.1.4 The value of affected revenue and forest land of Madhya Pradesh will form part of the cost of the KBLP and adjusted against share of Madhya Pradesh.

6.2 परियोजना की ऑपरेशन एवं मेंटिनेंस (ओ. एंड एम.) लागत का वहन राज्यों द्वारा इस प्रकार किया जाएगा:

6.2.1 दौधन बांध का हैड वर्क तथा पीटीआर (पन्ना टाइगर रिजर्व) के डूब क्षेत्र तथा आर एंड आर स्थलों पर होने वाले किसी प्रकार के प्रतिपूरक कार्य, मध्य प्रदेश एवं उत्तर प्रदेश के मध्य 71% मध्य प्रदेश: 29% उत्तर प्रदेश के अनुपात में।

6.2.2 केन-बेतवा लिंक कैनाल से संबंधित राज्यों द्वारा आहरित जल के अनुपात में।

6.2.3 दोनों राज्यों में से केवल एक राज्य को लाभ देने वाले कार्यों के लिए, संबंधित राज्य द्वारा।

7.0 क्रियान्वयन क्रियाविधि

केन-बेतवा लिंक परियोजना का क्रियान्वयन निम्नानुसार होगा:

7.1 केबीएलपी के क्रियान्वयन के लिए मध्य प्रदेश और उत्तर प्रदेश सरकार की भागीदारी से एक स्पेशल परपज व्हीकल (एस.पी.वी.) का गठन किया जाएगा। एस.पी.वी. **अनुलग्नक-I में दिए पैरा 1.1, 2.1.1, 2.1.2 एवं 2.1.3** के अनुसार दौधन बांध, पावर हाउस, टनल तथा केन-बेतवा लिंक वाटर कैरियर के निष्पादन के लिए उत्तरदायी होगा।

के.बी.एल.पी के शेष घटकों का क्रियान्वयन संबंधित राज्य सरकार द्वारा किया जाएगा।

7.2 केबीएलपी के क्रियान्वयन के लिए एस.पी.वी समग्र रूप से उत्तरदायी होगा। पैरा 2 में दर्शाए गए केबीएलपी के सभी घटकों को एस.पी.वी. द्वारा तैयार की गई कार्य योजना के अनुसार साथ-साथ आरंभ किया जाएगा। एस.पी.वी. के सी.ई.ओ. राज्य सरकारों द्वारा पूरे किए जाने वाले कार्यों के लिए वित्तीय तथा कार्यों की योजना, निधियन जारी करने एवं पर्यवेक्षण आदि के लिए उनके साथ निरंतर समन्वय बनाए रखेंगे।

8.0 परियोजना से प्रभावित परिवारों (पी.ए.एफ.एस.) के पुनर्वास एवं पुन: स्थापना (आर एंड आर)

संबंधित राज्य सरकारें अपने प्रादेशिक क्षेत्राधिकार के अंतर्गत परियोजना से प्रभावित परिवारों के पुनर्वास एवं पुन: स्थापना तथा परियोजना के लिए भूमि अधिग्रहण का कार्य, पुनर्वास एवं पुन: स्थापना अधिनियम, 2013 या संबंधित राज्य की नीति के अनुसार या अनुमोदित पर्यावरणीय प्रबंधन योजना के अनुसार समयबद्ध और पारदर्शी ढ़ंग से करेंगी।

6.2 The Operation and Maintenance (O&M) cost of the project shall be borne by the States as per details below:-

6.2.1 Headworks of Daudhan dam and any compensatory works arising out of PTR submergence and R&R sites: between MP and UP in the ratio of 71% MP : 29% UP.

6.2.2 K-B Link Canal in the ratio of water drawn by respective State.

6.2.3 For works exclusively serving either of the States, by the concerned State.

7.0 IMPLEMENTATION MECHANISM

The execution of Ken-Betwa Link Project shall be as under:

7.1 A Special Purpose Vehicle (SPV) shall be created with participation of Government of MP and UP for the execution of KBLP. The SPV will be responsible for execution of the Daudhan Dam, power houses, tunnels and Ken-Betwa Link water carrier as elaborated in **paras 1.1, and 2.1.1, 2.1.2 & 2.1.3 of Annexure-I.**

The remaining components of KBLP shall be executed by respective State Government.

7.2 The SPV shall be responsible for overall implementation of KBLP. All the components of KBLP as elaborated in para 2.0, shall be taken up concurrently as per work plan devised by SPV. For works under implementation by the State Governments, the CEO of SPV will coordinate regularly with them for financial and works planning, fund releases and supervision.

8.0 REHABILITATION AND RESETTLEMENT (R & R) OF PROJECT AFFECTED FAMILIES (PAFs)

R & R of project affected families and land acquisition for the projects within their territorial jurisdiction would be carried out by respective State Governments in a time bound and transparent manner as per Land Acquisition, Rehabilitation and Resettlement Act, 2013 or as per the respective State Policy and as per approved Environmental Management Plan.

9.0 मॉनीटरिंग क्रियाविधि

9.1 सचिव (ज.सं., न.वि. व गं.सं.वि.), भारत सरकार की अध्यक्षता एवं राज्य सरकारों के प्रतिनिधित्व वाली एक **स्टीयरिंग कमेटी** समय-समय पर नीतियों, प्रगति, निधियन एवं अन्य संबंधित मामलों सहित परियोजना के समग्र क्रियान्वयन की समीक्षा करेगी। क्रियान्वयन स्तर पर उभरे किसी भी मुद्दे को स्टीयरिंग कमेटी हल करेगी। स्टीयरिंग कमेटी के स्तर पर उभरे विवाद को **उच्च स्तरीय समिति** को भेजा जाएगा जिसके अध्यक्ष केन्द्रीय मंत्री (जल शक्ति) तथा जिसके प्रतिनिधि दोनों राज्यों के जल संसाधन/जल शक्ति मंत्री होंगे।

दिनांक : 22 मार्च, 2021 को हस्ताक्षरित।

(शिवराज सिंह चौहान)
मुख्यमंत्री, मध्य प्रदेश
मध्य प्रदेश राज्य के लिए

(योगी आदित्यनाथ)
मुख्यमंत्री, उत्तर प्रदेश
उत्तर प्रदेश राज्य के लिए

(गजेन्द्र सिंह शेखावत)
जल शक्ति मंत्री
संघ सरकार के लिए

9.0 MONITORING MECHANISM

9.1 A **Steering Committee** headed by Secretary (DoWR, RD&GR), Govt. of India with representatives from State Governments shall periodically review the overall implementation of project including policies, progress, funding and other related matters. Any issue arising out at implementation stage shall be resolved by the Steering Committee. Dispute arising out at Steering Committee level, shall be referred to **High Level Committee** headed by Union Minister (Jal Shakti) and represented by Water Resources/Jal Shakti Ministers of both the States.

Signed on this day of 22nd March, 2021.

(SHIVRAJ SINGH CHOUHAN)
Chief Minister of Madhya Pradesh
FOR THE STATE OF
MADHYA PRADESH

(YOGI ADITYANATH)
Chief Minister of Uttar Pradesh
FOR THE STATE OF
UTTAR PRADESH

(GAJENDRA SINGH SHEKHAWAT)
Minister for Jal Shakti
FOR UNION GOVERNMENT

अनुलग्नक-I

केन-बेतवा लिंक परियोजना (के.बी.एल.पी.) में शामिल किए गए कार्य

1. हैड वर्क्स एवं डिस्ट्रीब्यूशन प्रणाली

1.1 दौधन बांध में शामिल हैं

1.1.1 दौधन में केन नदी पर 288 मी. एफ.आर.एल./एम.डब्लू.एल. पर मृदा तटबंध सह कांक्रीट बांध।

1.1.2 1.9 कि.मी. लम्बाई की लिंक वॉटर कैरियर तक जल पहुंचाने के लिए दौधन बांध के बांयें तट से लगभग 170 मी. अपर लेवल की टनल।

1.1.3 पावर हाउस-II को जल पहुंचाने के लिए दौधन बांध के बायें तट से लगभग 100 मी. पर एक लोअर लैवल सुरंग तथा वहां से लगभग 2.5 कि.मी. कनैक्टिंग चैनल के माध्यम से मध्य प्रदेश के लैफ्ट बैंक कैनाल तक।

1.1.4 दौधन बांध की तली में स्पिलवे के दांयी ओर पावर हाउस-I (2×30 मेगावाट)।

1.1.5 लोअर लेवल टनल के आउटलेट पर पावर हाउस-II (3×6 मेगावाट)।

1.2 कोठा बैराज में शामिल हैं

1.2.1 गांव-कोठा, तहसील गंज बसोदा, जिला विदिशा, मध्य प्रदेश में बेतवा नदी पर बैराज।

1.2.2 पम्प हाउस और राइजिंग मेन्स

1.3 बीना कॉम्प्लैक्स में शामिल हैं

1.3.1 चार भंडारण बांध: बीना नदी पर मादिया एवं चकरपुर, धसान नदी पर सेमरा घाट डायवर्जन तथा देहरा नाला पर देहरा बांध।

1.3.2 पम्प हाउस, राइजिंग मेन्स तथा पावर हाउस।

1.4 लोवर ओर परियोजना में शामिल हैं

1.4.1 गांव-दिदौनी, जिला-शिवपुरी, मध्य प्रदेश के निकट ओर नदी पर एक मृदा तटबंध सह कांक्रीट बांध।

1.4.2 पम्प हाउस, राइजिंग मेन्स तथा लिंक वाटर कैरियर।

Annexure-I

Works included in Ken-Betwa Link Project (KBLP)

1. **Head Works & Distribution System**

1.1 Daudhan Dam Comprises

1.1.1 An earthen embankment cum concrete dam across Ken River at Daudhan with FRL/MWL 288 m.

1.1.2 An Upper Level Tunnel about 170 m from the left bank of Daudhan dam having length of 1.9 km for conveying water to the link water carrier.

1.1.3 A Lower Level Tunnel about 100 m from the left bank of Daudhan dam having length of 1.1 km for conveying water to the Power House-II and from there to the Left Bank Canal of MP through a connecting channel of about 2.5 km.

1.1.4 Power House-I (2x30 MW) to the right of spillway at the toe of Daudhan dam.

1.1.5 Power House-II (3X6 MW) at the outlet of Lower Level Tunnel.

1.2 Kotha Barrage Comprises

1.2.1 A barrage across Betwa river at village Kotha, Tehsil Ganj Basoda, District Vidisha, Madhya Pradesh.

1.2.2 Pump Houses and Rising Mains

1.3 Bina Complex Comprises

1.3.1 Four storage dams: Madia & Chakarpur on Bina River, Semra Ghat Diversion on Dhasan River and Dehra Dam on Dehra Nalla.

1.3.2 Pump Houses, Rising Mains and Power Houses

1.4 Lower Orr Project Comprises

1.4.1 An earthen embankment cum concrete dam across Orr River near village Didauni, in District Shivpuri, Madhya Pradesh.

1.4.2 Pump Houses, Rising Mains and link water carrier.

1.5 विद्यमान परीछा वीयर के बेतवा नदी के अपस्ट्रीम तक बरवा सागर से जल पहुंचाने के लिए 7.1 किमी. लम्बा बरवा नाला उपयुक्त संरचना सहित बरवा सागर बांध बरियारपुर पिकअप वीयर की मरम्मत/मजबूत करना/रिमॉडलिंग करना।

1.6 उत्तर प्रदेश के अधिक्षेत्र में, विद्यमान बरियारपुर पिकप वीयर के डाउनस्ट्रीम में उपयुक्त बाँधों सहित दो नए बैराजों का निर्माण।

1.7 गैर मानसून अवधि के दौरान जल का उपयोग करने के लिए मानसूनी जल का भंडारण करने के लिए केन-बेतवा लिंक नहर से जल अंतरण करने के लिए कैरियर प्रणाली तथा महोबा जिले में विद्यमान टैंक तथा उसके कनेक्टिंग लिंक का नवीकरण।

2. <u>कैनाल पाइप लाइन और कमान नेटवर्क</u>

2.1 केन बेसिन

2.1.1 बेतवा बेसिन में ऊपरी सुरंग से विद्यमान बरवा सागर/बरवा नाला तक 221 कि.मी./176 किमी. (जैसा कि के.ज.आ. द्वारा तय किया गया) लम्बी लिंक वॉटर कैरियर।

2.1.2 मध्य प्रदेश के प्रस्तावित केन-लेफ्ट बैंक कैनाल को जोड़ने वाली विद्यमान लोवर लेवल टनल से एक बाई पास चैनल।

2.1.3 जब कभी जलाशय का जल अपर लेवल टनल के क्राउन लेवल से नीचे आ जाए तो केन-बेतवा लिंक कैनाल में जल आपूर्ति सुनिश्चित करने के लिए अपर लेवल टनल को जल लिफ्टिंग करने के लिए पम्पिंग सिस्टम की व्यवस्था करना।

2.1.4 मध्य प्रदेश के छतरपुर जिले के हाई लेवल कमान (43,678 हैक्टेयर) के एक भाग को जल पहुंचाने के लिए दौधन जलाशय प्राथमिक पहुँच से जल लिफ्टिंग के माध्यम से पम्पिंग सिस्टम, पाइप डिस्ट्रीब्यूशन नेटवर्क एवं माइक्रो इरीगेशन सिस्टम विकसित करना।

2.1.5 मध्य प्रदेश की 90 किलोमीटर लम्बी प्रस्तावित केन लेफ्ट बैंक नहर तथा छतरपुर जिले में 1,39,848 हैक्टेयर सी.सी.ए. क्षेत्र को जल पहुंचाने के लिए केन-लेफ्ट बैंक कैनाल पर पम्पिंग सिस्टम, पाइप डिस्ट्रीब्यूशन नेटवर्क तथा माइक्रो इरीगेशन सिस्टम विकसित करना।

2.1.6 मध्य प्रदेश के छतरपुर जिले में विद्यमान ओपन कैनाल नेटवर्क द्वारा विद्यमान बरियारपुर एल.बी.सी. से 38,890 हैक्टेयर सी.सी.ए. के अंतर्गत आ जाएगा।

1.5 Repair/strengthening/remodelling of Bariyarpur pick up weir, Parichha weir, Barwa Sagar Dam along with appurtenant structures and 7.1km long Barwa Nallah to carry water from Barwa Sagar to Betwa river upstream of existing Parichha weir.

1.6 Construction of two new barrages along with appurtenant structures d/s of existing Bariyarpur Pick up weir in the territory of UP.

1.7 Renovation of existing tanks and their connecting links in Mahoba district and carrier system for transfer of water from Ken Betwa link canal to tanks in order to enable UP to store the monsoon water to use during non-monsoon season.

2. **Canal Pipe Line and Command Networks**

2.1 Ken Basin

2.1.1 A 221 km/176 km (as decided by CWC) long link water carrier from Upper Level Tunnel to existing Barwa Sagar/Barwa Nallah, in Betwa Basin.

2.1.2 A bye pass channel from exit of Lower Level Tunnel to connect proposed Ken Left Bank Canal of MP.

2.1.3 Pumping system arrangements for lifting of water to Upper Level Tunnel to ensure the water supply in the Ken-Betwa link canal whenever reservoir depletes below the crown level of Upper Level Tunnel.

2.1.4 Developing pumping system, pipe distribution network and micro irrigation system by lifting water from Daudhan reservoir/initial reach of Link water carrier to serve a part of high level command (43,678 ha.) of Chhatarpur District of MP.

2.1.5 A 90 km long proposed Ken Left Bank Canal of MP and developing pumping system, pipe distribution network and micro irrigation system for Ken Left Bank Canal to serve 1,39,848 ha. CCA in Chhatarpur District.

2.1.6 From existing Bariyarpur LBC 38,890 ha. CCA will be covered by existing open canal network in Chhatarpur District of MP.

2.1.7 दौधन जलाशय से जल लिफ्टिंग द्वारा 90,101 हैक्टेयर सी.सी.ए. के लिए पम्पिंग सिस्टम, पाइप डिस्ट्रीब्यूशन नेटवर्क तथा माइक्रो सिंचाई सिस्टम विकसित करना जिसमें से मध्य प्रदेश के पन्ना जिले में 70,000 हैक्टेयर सी.सी.ए. आएगा तथा दमोह जिले में 20,101 हैक्टेयर सी.सी.ए. आएगा।

2.1.8 उत्तर प्रदेश के 17,488 हैक्टेयर मार्गस्थ कमान क्षेत्र तथा मध्य प्रदेश के 96,751 हैक्टेयर मार्गस्थ कमान क्षेत्र के साथ ऊंचाई पर स्थित 42,096 हैक्टेयर छूटे हुए कमान क्षेत्र को केन बेतवा लिंक नहर से सिंचित करने के लिए पंपिंग सिस्टम, पाईप डिस्ट्रीब्यूशन नेटवर्क तथा माइक्रो इरीगेशन सिस्टम विकसित करना।

2.1.9 विद्यमान सिस्टम को मरम्मत/मजबूत करके विद्यमान केन कमान के अंतर्गत उत्तर प्रदेश के बांदा जिले में 1,92,479 हैक्टेयर क्षेत्र में सिंचाई का स्थिरीकरण करना। दाबयुक्त पाइप माइक्रो इरीगेशन सिस्टम का उपयोग करते हुए बरियारपुर राइट बैंक कैनाल (केन-कैनाल) के कमान क्षेत्र को बढ़ाना।

2.2 बेतवा बेसिन

2.2.1 कोठा बैराज- मध्य प्रदेश के 20,000 हैक्टेयर सी.सी.ए. के लिए पंम्पिग सिस्टम, पाइप डिस्ट्रीब्यूशन नेटवर्क तथा माइक्रो इरीगेशन सिस्टम।

2.2.2 बीना कॉम्पलेक्स-मध्य प्रदेश के 96,000 हैक्टेयर सी.सी.ए. के लिए पंम्पिग सिस्टम, पाइप डिस्ट्रीब्यूशन नेटवर्क तथा माइक्रो इरीगेशन सिस्टम।

2.2.3 लोवर ओर प्रोजेक्ट-मध्य प्रदेश के 90,000 हैक्टेयर सी.सी.ए. के लिए पम्पिंग सिस्टम, पाइप डिस्ट्रीब्यूशन नेटवर्क तथा माइक्रो इरीगेशन सिस्टम।

2.2.4 दाबयुक्त पाइप माइक्रो इरीगेशन सिस्टम से उत्तर प्रदेश के महोबा जिले में विद्यमान 37,564 हैक्टेयर कमान का विकास करना।

2.1.7 Developing pumping system, pipe distribution network and micro irrigation system for 90,101 ha. CCA by lifting water from Daudhan reservoir, out of which 70,000 ha. CCA will be in Panna District and 20,101 ha. CCA will be in Damoh District of MP.

2.1.8 Developing pumping system, pipe distribution network and micro irrigation system from Ken-Betwa link canal to serve left out area of 42,096 ha. of high level command & 96,751 ha. enroute command of MP and 17,488 ha. of enroute command of UP .

2.1.9 Stabilisation of irrigation in 1,92,479 ha. in Banda district in UP under existing Ken command by repair/strengthening of existing system. Enhancing command area of Bariyarpur Right Bank Canal (Ken Canal) system by utilizing pressurised pipe micro irrigation system.

2.2 Betwa Basin

2.2.1 Kotha Barrage: Pumping system, pipe distribution network and micro irrigation system for 20,000 ha. CCA of MP.

2.2.2 Bina Complex: Pumping system, pipe distribution network and micro irrigation system for 96,000 ha. CCA of MP.

2.2.3 Lower Orr Project: Pumping system, pipe distribution network and micro irrigation system for 90,000 ha. CCA of MP.

2.2.4 Development of existing command of 37,564 ha in Mahoba district in UP with pressurised pipe micro irrigation system.

अनुलग्नक-II

के.बी.एल.पी. से घरेलू जल आपूर्ति का विवरण

क्र. सं.	के.बी.एल.पी. के घटक	लाभान्वित होने वाले जिले	राज्य	घरेलू जल की आवश्यकता (एमसीएम)
1.	दौधन बांध	दमोह	मध्य प्रदेश	1.15
		छत्तरपुर	मध्य प्रदेश	51.07
		पन्ना	मध्य प्रदेश	3.14
		टीकमगढ़	मध्य प्रदेश	4.64
	उपकुल			***60***
		बांदा	उत्तर प्रदेश	0.00
		झांसी	उत्तर प्रदेश	14.66
		ललितपुर	उत्तर प्रदेश	31.98
		महोबा	उत्तर प्रदेश	20.13
	उपकुल			***67***
	दौधन बांध का योग			**127 एमसीएम**
2.	लोअर ओर डैम	दतिया	मध्य प्रदेश	1.13
		शिवपुरी	मध्य प्रदेश	4.36
	लोअर ओर डैम का योग			5.49 **लगभग 6 एमसीएम**
3.	कोठा बैराज	विदिशा	मध्य प्रदेश	3.75
	कोठा बैराज का योग			**3.75 एमसीएम**
4.	बीना कॉम्पलेक्स बहुउद्देशीय परियोजना	रायसेन	मध्य प्रदेश	0.14
		सागर	मध्य प्रदेश	56.62
	बीना कॉम्पलेक्स बहुउद्देशीय परियोजना का योग			**56.76** **लगभग 57 एमसीएम**

कुल घरेलू आवश्यकता मध्य प्रदेश: 126.75 एमसीएम

कुल घरेलू आवश्यकता उत्तर प्रदेश: 67.00 एमसीएम

कुल योग (मध्य प्रदेश + उत्तर प्रदेश): 193.75 एमसीएम लगभग 194 एमसीएम

Annexure-II

Details of Domestic Water Supply from KBLP

Sl. No.	Components of KBLP	Districts Benefitted	State	Domestic Water Requirement (MCM)
1.	Daudhan Dam	Damoh	Madhya Pradesh	1.15
		Chhatarpur	Madhya Pradesh	51.07
		Panna	Madhya Pradesh	3.14
		Tikamgarh	Madhya Pradesh	4.64
	Sub-Total			***60***
		Banda	Uttar Pradesh	0.00
		Jhansi	Uttar Pradesh	14.66
		Lalitpur	Uttar Pradesh	31.98
		Mahoba	Uttar Pradesh	20.13
	Sub-Total			***67***
	Total of Daudhan Dam			**127 MCM**
2.	Lower Orr Dam	Datia	Madhya Pradesh	1.13
		Shivpuri	Madhya Pradesh	4.36
	Total of Lower Orr Dam			**5.49 Say 6 MCM**
3.	Kotha Barrage	Vidisha	Madhya Pradesh	3.75
	Total of Kotha Barrage			**3.75 MCM**
4.	Bina Complex Multipurpose Project	Raisen	Madhya Pradesh	0.14
		Sagar	Madhya Pradesh	56.62
	Total of Bina Complex Multipurpose Project			**56.76 Say 57 MCM**

Total domestic requirement for MP: 126.75 MCM
Total domestic requirement for UP: 67.00 MCM
Grand Total (MP + UP): 193.75 MCM Say 194 MCM

NATIONAL PROJECTS

Sl. No	Name of the Project	State (River/Basin)	1) Irrigation Potential (ha.) 2) Power (MW) 3) Storage (MCM)
1	2	3	4
1	Indira Sagar Polavaram Project	Andhra Pradesh (Godavari)	1) 4.36 lakh 2) 960 MW 3) 663.59 MCM of water to Vizag city for drinking and industrial purpose and Diversion of 2264.80 MCM to Krishna basin
2	Gosikhurd Irrigation Project	Maharashtra (Wainganga/ Godavari)	1) 2.50 lakh 2) 3 MW 3) 1147.14 MCM (Gross)
3	Shahpurkandi Dam Project	Punjab (Ravi)	1) 0.37 lakh 2) 206 MW 3) 120.71 MCM (Gross)
4	Saryu Nahar Pariyojna	Uttar Pradesh (Diversion Scheme among Rivers Ghaghara, Saryu, Rapti & Bansagar/ Ganga)	1) 14.04(NP Component:4.73) 2) – 3) Barrage
5	Teesta Barrage Project	West Bengal (Teesta)	1) 9.23 lakh (NP component :5.27 lakh) 2) 1000 MW 3) Barrage
6	Ujh Multipurpose project	J&K (Ujh / Ravi)	1) 0.32 lakh 2) 196 MW 3) 925 MCM (Gross)

7	Lakhwar Multipurpose Project	Uttarakhand (Yamuna)	1) 0.338 lakh 2) 300 MW 3) 587.84 MCM (Gross)
8	Noa-Dihing Dam Project	Arunachal Pradesh (Noa-Dihing)	1) 0.069 lakh 2) 72 MW 3) 322.00 MCM (Gross)
9	Kulsi Dam Project	Assam (Kulsi) Tributary of Brahamputra	1) 0.395 lakh 2) 55 MW 3) 525.64 MCM (Gross)
10	Renuka Dam Project	HP (Giri/Yamuna)	1) Drinking water 2) 40 MW 3) 498.33 MCM (Live)
11	Kishau Multipurpose Project	HP/ Uttarakhand	1) 0.97 lakh 2) 660 MW 3) 1824 MCM (Gross)
12	Bursar HE Project	J&K (Marusudar/ Chenab / Indus)	1) 1.74 lakh 2) 800 MW 3) 616.74 MCM (Gross)
13	Ken Betwa Link Project	Madhya Pradesh & Uttar Pradesh (Ken & Betwa/ Yamuna basin)	1) 10.62 lakh 2) 103 MW 3) 3711.55 MCM (Gross)
14	2nd Ravi Vyas Link Project	Punjab (Ravi Beas Link)	Harness water flowing across border (about 715.42 MCM in non-monsoon period)
15	Upper Siang Project	Arunachal Pradesh (Siang)	1) Indirect 2) 9750 MW 3) 1776.21 MCM (Gross) 4) Flood moderation
16	Gyspa HE Project	HP (Bhaga / Chenab / Indus)	1) 0.50 lakh ha 2) 300 MW 3) 912.78 MCM (Live)
Source: National Projects Directorate, Central Water Commission			
MCM- Million Cubic Meter			MW- Mega Watt

SALIENT FEATURES					
1	Name of the project		Lower Orr Project		
	Type of project		Multipurpose		
	Location		Ashok Nagar, Shivpuri Madhya Pradesh		
2	River Basin		Betwa		
	Name		Orr		
	Located in State(s):		Madhya Pradesh		
	i) Countries (if international river)		NIL		
	River/Tributary		Orr		
			Tributaries - Makua, Reba		
3	State(s)/ District(s)/ Taluka(s) or Tehsils in which following are located		State	District	Tehsils
		(a) Reservoir	M.P	Ashok Nagar, Shivpuri	Chanderi/ khaniadhana
		(b) Headwork	M.P	Ashok Nagar, Shivpuri	Chanderi/ khaniadhana
		(c) Command Area	M.P	Shivpuri Datia	Khaniadhana, Pichhore Kakera, Narwar Datia
		(d) Power House	No Power House		
3.1	Name of Village near the Head-Works		Village: Didauni Tehsil: Khaniadhana		
3.2	Location of Head-Works				
		(a) Longitude	78^0 05' 55"E		
		(b) Latitude	24^0 50' 50"N		
		(c) Seismic	Zone II		
3.3	Access to the Project	Name	Distance		
	Airport	Gwalior, Bhopal	195 km 240 km		
	Rail Head	Lalitpur	60 km		
	Road head (from Rajbagh)	Chanderi	22 km		
4	International/Interstate aspects of the Project : NIL				
5	Catchment area of the basin		1843 sq. km		
	Submergence due to projects	In M.P.	2723.70 ha (Whole in M.P.)		
	Proposed annual	(i) Drinking water	6.00 MCM		

	utilization by the project		
		(ii)Environmental Flow	44.90 MCM
		(iii)Evaporation Loss	21.30 MCM

	Minimum agreed/proposed flow in the river for maintaining ecology			44.90 MCM.	
6	Estimated life of the project (years)			100 yrs.	
7	Irrigation	(Ha.)			
		Area under irrigation (break up)			
		(i) Kharif		Nil	
		(ii) Rabi		90000 hectare	
		(iii) Zaid		Nil	
		District(s) benefited		Shivpuri, Datiaof M.P.	
8	Water Supply	annual		6.00 MCM Drinking	
9	Data(averageof all stations in command area)				
				Maximum	Minimum
			(a) Air temp.(^{O}C)	45	3.8
			(b) Seismic Zone	Zone– II	
			(c) Maximum probable flood	12704 Cumec(m^3/s)	
10	River flows (minimum observed)				
			(a)Water level (El-m)	339.00 m	
			(b) Discharge(m^3/s)	0.02 Cumecs (April, 1995	
			(c) Months of 'nil' flow. If any	NA May, June	
10.1	Reservoir				
10.2	Water levels (El-m)				
			(a) Maximum Water Level (MWL)	380.40 m	
			(b) Full Reservoir Level (FRL)	380.00m	
			(c)Minimum Drawdown Level	360.50m	
			(d) Dead Storage Level	360.50m	
10.3	Outlet levels				
			(a) Irrigation	360m	
			(b) Power	No Hydro Power	
10.4	Other parameters				
			(a) Free board	2.94 m	
			(b) Live storage	328.17 MCM	

			(c) Gross storage		371.80 MCM	
10.5	Sedimentation rate and levels					
			(a) Rate		0.33 mm/Year	
			(b) New zero elevation after 50yrs.		351.80m	
			(c) New zero elevation after 100yrs.		353.53m	
11	Submergence					
11.1	Land and property submerged at MWL					
		(a) Revenue villages affected (no.)			Submergence	Canal System
				(i) Fully	7	
				(ii) Partially	5	
		(b) Land affected (ha)				
				(i) Gross	2723.70	
				(ii)Culturable	853.00	
				(iii Un-Culturable	576.18	
				(iv)Forest	968.24	
				(v) Others	State Land:326.00 ha	Pvt agri land=240.2 ha State revenue land=23.52 ha, Forest land=23.52 ha
		(c)Buildings/houses(No.)				
				(i) Houses	869	
				(ii) Govt.		
				(iii)Temples		
				(iv) Mosques		
				(v)Govt/Pvt schools		
				(vi) Cattle Shed		
				(vii) Structure of cultural		
				(viii) Lift Irrigation		
		(d)Tube Wells/Bore Wells (No.)			93/257	
		(e) Road(km) under submergence				
		(f)Transmission lines (km.) under submergence			NA	
11.2	Total Population under Submergence					
					Families	
		(a) Total			944	
		(b) Scheduled Castes			Not Available	
		(c) Scheduled Tribes			Not Available	
11.3	Population effected under Main Canals and under distributaries					
12	Head works					
12.1	Dam (Non-overflow section)					
		(a) Type of dam			Composite earthen and concrete dam	

		(b) EL of top(m)		384.00m
		(c) Length of Over Flow section		247.00 m
		(d) Length at the river bed(m)		180.00m
		(e)Width at top(m)		8.00 m
12.2	Spillway(overflow section)			
		(a) Location of spillway		Provided within the body of dam
		(b) Type of Spillway		Ogee
		(e) Max height above the deepest foundation(m)		45.00 m
		(f) Crest level (EL-m)		370m
		(g) Number of gates		12
		(h) Type of gate		Radial
			(i) Size of gate	15m(W)x10m(H)
			(ii) FRL	380.00 m
			(i) MWL	380.40 m
		(j) Tail water level (EL)		
			(i) Maximum	-
			(ii) Minimum	-
		(k)Type of energy dissipation arrangement		Stilling basin
12.3	U/S Coffer Dam			
		(a) Height of U/S coffer dam		-
		(b) EL of top		-
12.4	D/S Coffer Dam			
		(a) Height of D/S coffer dam		-
		(b) EL of top		-

12.5	Head Regulator(s)	Left side	Right side
	(a) Total length	104.95	Not provided
	(b) Height above deepest	40.50m	
	(c) Length of bay(m)	5.00m	
	(d) Sill level (EL-m)	360m	
	(e) Number of	2	
	(f)Type of gates	Vertical type	
	(g) Size of gate	2.5x 4.0 m	
	(h) Type of hoisting arrangement	Rope & Drum	
13	Canal System		
	14.1 Main canal	Left bank canal	
		14.1.1Purpose of canal	Irrigation & water supply
		14.1.2 Type of canal	Carrier contour
		(a) Flow/lift	Both
		(b) Lined/unlined	Lined
		(d) Type of lining	100mm thick M15 PCC (0 to 3.1 km) 75mm thick M15 PCC (3.1 to 50.00 km)
	14.2Design data	Left Bank Canal	
	(a) Length (km)	66.67 km	
	(b) Full supply level at head	361.80 m	
	(c) Full supply depth at head	3.80 m	
	(d) Side slope(EL-m)	1.5:1	
	(e) Bottom width of canal upto spill channel	4.35 m	
	(f) Maximum discharging	NA	
	(i) At head	34.00 (0 to 3km) cumec	
	(ii) At tail	20.00 (3 to 66.67 km)cumec	

14.	Cropping Pattern	Name of crop (season- wise)	Area (ha)
	(i) Rabi Season	(a) Wheat (HYV)	39105
		(b) Wheat (ORD)	31995
		(c) Gram N2	7101
		(d) Gram N1 (Peas)	9999
		(e) Other Vegetables	1800
15.	Power	Type	Solar Power
		Installed capacity (MW)	19 MW about 36 ha over submergence Area in the reservoir
16	Total Project Cost (Rs in Crore)	2657.03	
17	BC Ratio	1.54	
	IRR	10.10	
18	Total Project Cost (Rs in Crores)		2657.04
19	BC Ratio		1.54

Annexure-1.2.3

भारत सरकार
केंद्रीय जल आयोग
जल विज्ञान (मध्य) निदेशालय
कमरा नंबर 504 (दक्षिण), सेवा भवन,
आर के पुरम, नई दिल्ली
फ़ोन अंक: 26106432

विषय: Comments on Water Availability Studies of Ken-Betwa link (Phase-II)

The Supplementary Report of Ken-Betwa link (Phase-II) which has been received on 07.10.2015 has been examined in this office. In this regard please find enclosed the comments on the Water availability studies.

(एम रघुराम)
निदेशक

निदेशक, (NP-II), केंद्रीय जल आयोग

पत्र संख्या: 1/82/2013/Hyd(C)/ 128 दिनांक: 26 :04:2016

Project Background

Ken Betwa link project - Phase I envisages diversion of 1074 MCM of water from the proposed Daudhan dam on Ken River. Out of diverted water, after en route utilisations, 659 MCM of water will be diverted to Betwa River upstream of existing Parichha weir. As part of Phase-II work it is proposed to utilise equal quantity of water in upper Betwa sub basin upstream of Raghat Dam through construction of 5 projects namelyNeemkhedaBarrage, Barari Barrage, Kesari Barrage,Kotha Barrage and Lower Orr Dam. The hydrological studies of the above five projects have been incorporated in the DPR of Phase-II.

Water Availability Studies

One Gauge &Discharge site is existing at Basoda(CA:7726sqkm) in the Upper Betwa Basin where long term flow data is available for the period 1976-2009. The rainfall data of 15 rain gauge stations is available in the Basin for variable time periods. The consistency of the rainfall data is carried out using the double mass curve technique and necessary corrections are made in the data. The missingrainfall data is filled up using nearby rainfall station data. Based on the refined rainfall data, the weighted areal monthly rainfall for all the five projects and Basoda G&D site is computed for the period 1901-2009 using Thiessen polygon method.

Bhopal Lake with a catchment area of 354 sqkm utilises water of Betwa River and contributes quite marginal quantity of spills downstream side. In view of this, the catchment area of Bhopal Lake is excluded in further water availability studies duly deducting the spills from Basoda discharge data and catchment area from relevant projects' catchment areas. As per the DPR, 34 projects (1 Major, 2 Medium and 31 Minor Projects) utilise/withdraw water upstream of BasodaG&D site.Utilising the relevant inflow series, project operation/ working tables of major and medium projects as well as utilisations of 31 minor projects the virgin flows at Basoda are computed for the period 1976-2009 using the following relationship

$$Basoda_{virgin_flows} = Basoda_{observed\ flows} - Bhopal_{spills} + Halali_{inflow} - Halali_{spills} - Halali_{10\%\ Diversions} + Kerwan_{90\%\ utilisations} + Kalisot_{90\%\ utilisations} + Minor\ Projects_{\ monthly_utilisations}$$

Using the Virgin flows and the weighted areal rainfall at Basoda G & D site, rainfall-runoff relationship is established for the monsoon months (viz. June, July, August, September and October). The non-monsoon flows are estimated as 4.264% of the monsoon flows and further the flows are disaggregated into individual non-monsoon month flows in the ratio of relevant month average virgin flows and average non-monsoon virgin flows at Basoda site. Based on the estimated rainfall-runoff relationship and weighted areal monthly rainfall, the virgin flows are computed for Basoda site and all the proposed projects for the period 1901-2009.

The net water yield series at the proposed five projects is estimated after accounting the diversions from the existing /proposed projects, net domestic and industrial demands in the sub-basins using the following relationship.

Net flow at the proposed project

= virgin flows from free catchment area
+ spills form upstream proposed project
+ spills and 10% of diversion of medium projects in the catchmnet
– diversions for minor projects + upstream environmental flows
– withdrawal for domestic industrial demands

In general, the methodology followed is found to be in order. The estimated dependable flows for four projects viz. Neemkheda, Barari, Kesari and Lower Orr given in Table-1 and net flow series enclosed at Annexure 2.4.1, 2.4.4, 2.4.7, 2.4.10 of the supplementary report may be adopted for planning and design purpose subjected to following observations.

Table 1: Dependable Flows

Sl no	Project Name	Dependable Flow (MCM)		
		50%	75%	90%
1	Neemkheda	448.80	334.27	262.16
2	Barari	1423.08	1131.45	831.15
3	Kesari	158.79	123.03	94.20
4	Lower Orr	501.15	362.53	263.98

Observations

1. Out of five projects, Neemkheda, Barari, Kesari and Kotha are barrages and usually the water availability series for barrages is to be estimated on 10 daily bases. In the report, the same is estimated on monthly basis. The same may be updated accordingly.
2. In respect of Kotha barrage, the important levels such as MDDL and Pond Levels are drastically changed from the earlier design levels of 396.5 m and 403.10 m to 384.50m and 396.0m respectively. The Area-Capacity curve given in the supplementary report is deviating from the earlier curve. Further, the design demands of the project are revised from 3.81 MCM to 72 MCM. The correctness of above changes and reasons may be provided.
3. As per the supplementary report, 20% of the 75% dependable flows of monsoon monthsand 15% of the average monthly flows in non-monsoon months are reserved for environmental and ecological purposes and accordingly considered in simulation studies of the projects. However, environmental releases are subject to the approval by the Ministry of Environment and Forests (MoEF). Accordingly, the studies are required to be revised as per the approved environmental flows.
4. As the proposed projects are cascading in nature, the water availability studies of downstream proposed projects depend upon spills/ water demands of the upstream proposed projects. The demands considered in the report may be got vetted by the concerned Irrigation Planning Directorate of CWC and accordingly studies may be revised, if needed.
5. Integrated simulation analysis of Ken-Betwa system is carried out considering the six proposed projects (viz. one project on Ken river and five projects on Betwa river) and

four existing projects in Betwa river basin (viz. Rajghat dam, Matatila dam, Dhukwn dam and Parichha Weir) with multi reservoir simulation studies. The inflow series for the existing four projects is computed by adding the flows from the intervening catchment area, environmental flows, spills and 10% of withdrawals from the upstream projects. The flow from the intervening catchment area is estimated in catchment area proportion using virgin flows of Basoda site, which seems to be generally in order. However, the relevant simulation studies may be got vetted by the concerned Irrigation Planning directorate of CWC.

ANNEXURE-II

Revised Area Capacity curve after 50 years

Elevation in m	Area in (Ha)	Capacity in (Ha.m)	Revised Area (Ha)	Revised Capacity (Ha.m)
380	2723.70	37180.20	2723.70	30398.96
379	2589.90	34523.70	2366.70	27854.06
378	2472.10	31992.90	2199.07	25571.37
377	2349.30	29582.50	2048.58	23447.85
376	2241.30	27287.40	1924.25	21461.64
375	2118.70	25107.70	1792.57	19603.53
374	1946.30	23075.80	1616.23	17899.73
373	1821.10	21192.40	1490.94	16346.44
372	1709.40	19427.50	1382.16	14910.24
371	1641.90	17752.00	1319.96	13559.33
370	1587.90	16137.10	1273.19	12262.76
369	1533.40	14576.60	1227.51	11012.56
368	1469.30	13075.30	1173.51	9812.10
367	1399.40	11641.10	1114.77	8668.10
366	1297.40	10293.00	1024.79	7598.62
365	1203.60	9042.80	943.70	6614.68
364	1141.50	7870.40	894.84	5695.56
363	1060.00	6769.90	826.98	4834.90
362	987.70	5746.30	768.62	4037.36
361	911.10	4797.10	706.13	3300.18
360	826.40	3928.70	635.63	2629.65
359	742.00	3144.90	565.43	2029.52
358	630.20	2459.60	467.74	1513.74
357	544.70	1872.60	396.18	1082.24
356	445.60	1378.30	310.79	729.60
355	390.00	960.80	268.59	440.21
354	287.60	623.30	179.22	217.61
353	193.00	384.60	97.21	81.00
352	118.60	230.30	34.91	16.44
351	74.80	134.40	2.64	0.00
350	47.00	74.10	0.00	0.00
349	20.30	41.30	0.00	0.00
348	7.60	27.90	0.00	0.00
347	5.50	21.40	0.00	0.00
346	4.40	16.40	0.00	0.00
345	8.00	10.30	0.00	0.00
344	2.70	5.20	0.00	0.00
343	1.80	3.00	0.00	0.00
342	1.20	1.50	0.00	0.00
341	0.70	0.50	0.00	0.00
340	0.40	0.00	0.00	0.00

Government of India
Central Water Commission
Hydrology (Central) Directorate
Room no. -504 (S),
Sewa Bhawan, R.K.Puram,
New Delhi-110066
Dated: 17.06.2016

विषयः– Ken Betwa Link (Phase-II)- Flood Studies of Lower Orr Dam.
संदर्भ– Lr.No 4/9/2012/NP-II/ dated 07.10.2015

Kindly refer to above cited letter vide which the project authority has forwarded the supplementary report on Ken-Betwa link (phase-II) for examination from Hydrological angle. The observations on Yield study and Sedimentation study has already been conveyed vide this office letter of even number dated 26-04-2016 & 17-05-2016. This office has now examined the flood study of Ken-Betwa Link (Phase-II) and observation of this office area as under:

Introduction: The Ken- Betwa link project envisages diversion of surplus water of Ken basin to water deficit Betwa basin. The Ken-Betwa link (Phase-II) consists of five projects namely Neemkheda Barrage, Barari Barrage, Kesari Barrage, Kotha Barrage and Lower Orr Dam. Lower Orr dam qualifies for PMF studies whereas others are barrages qualifies for 100 year return period as design flood and SPF as check flood. The catchment area of Lower Orr dam up to the dam site is 1843sq Km.

Design Flood Study of Lower Orr dam carried out by project authority:

In absence of short interval rainfall runoff data, unit hydrograph for the Lower Orr dam has been derived synthetically using Flood Estimation report for sub zone 1 (c). IMD has carried out the PMP studies of Lower Orr dam and recommended Two day & One day PMP values as 758mm & 589mm respectively. 24 hr & 48 hr Time distribution (3-hourly) has also been given by IMD.

The loss rate has not been taken into account while calculating the effective rainfall i.e excess rainfall in the basin. The base flow has been taken from FER of sub zone-1 (c) as 0.018m^3/s/Sq. Km. The peak design flood (PMF) has been worked out as **12067m^3/s.**

Observation:

(i) In the absence of short interval rainfall-runoff data the unit hydrograph derived as per Flood Estimation Report of Sub zone 1(c) is appears to be in order. Project authorities has not smoothened and not adjusted the volume of Unit Hydrograph and also not given the ordinates at 15hr of hourly unit hydrograph. The UG needs to be smoothened before using in convolution.

(ii) Temporal distribution of storm pattern is provided by IMD in 3 hour interval. However, project authorities converted the distribution factor on

hourly basis without smoothening the curve supplied by IMD. The same may be smoothened before converted into 12 hr from 24 hour time distribution.

(iii) The two day and one day PMP as 75.8cm & 58.9 cm supplied by IMD has been considered as design storm appears to be in order.

(iv) The loss rate has not been taken into account while computing the excess rainfall. The same may be taken from concerned FER.

Recommendation:

This office has modified the flood study for the Lower Orr Dam addressing above observation. The Unit hydrograph has been smoothened and adjusted the volume of Unit Hydrograph. The time distribution of 24-hr (3 hourly) as supplied by IMD has been converted into hourly distribution with duly smoothened the curve. The 12 hr temporal distribution has been used to assess the incremental rain fall. The loss rate and base flow have been taken as 0.1cm/hr and 0.018 cumec/sq km respectively from Flood Estimation Report of subzone-1(C) for the calculation of excess rainfall. The excess rainfall has been critically arranged in the two bells per day and convoluted with the Unit Hydrograph. The Peak PMF for the Lower Dam has been worked out as **12354 m^3/s**. Details of the flood study is enclosed at Annex1/1 to 1/7.

The flood studies of other four barrages namely Neemkheda Barrage, Barari Barrage, Kesari Barrage and Kotha Barrage are under examination.

This issues with the approval of CE, HSO,CWC.

(एम॰ रघुराम)
(क्रा॰प्र॰) निदेशक
ज॰वि॰(म॰)

निदेशक, राष्ट्रीय परियोजना–2, निदेशालय, के॰ज॰आ॰ नई दिल्ली–66
पत्र संख्या:1 /82/2013/ज॰वि॰(म॰)/ 255 दिनांक: 17/06/2016

भारत सरकार
केन्द्रीय जल आयोग
जलविज्ञान (मध्य) निदेशालय

CORRIGENDUM

विषयः– Ken Betwa Link (Phase-II)- Flood Studies of Lower Orr Dam.

संदर्भः- 1. Letter No. 4/9/2012/NP-II/ dated 07.10.2015
2. Letter No. 1/82/2013/Hyd.(C)/ 255 dated 17/06/2016

Kindly refer to above cited letter (Ref.1) vide which the project authority has forwarded the supplementary report on Ken-Betwa link (phase-II) for examination from Hydrological angle. This office had examined the Design Flood Study of Lower Orr Dam of Ken-Betwa Link (Phase-II) and observations were conveyed vide this office Letter mentioned above (Ref. 2). The Peak PMF for the Lower Orr Dam had been worked out and recommended as **12,354 m^3/s.**

However, due to some error found in the calculation of Peak PMF, this office is now revising the Peak PMF for the Lower Orr Dam to **12,704 m^3/s.** No changes have been made in the Design Parameters adopted while calculating the Peak PMF for the Lower Orr Dam. Details of the revised flood study are enclosed at Annex1/1 to 1/7.

Thus, upon correction, Peak PMF for Lower Orr Dam is now recommended as **12,704 m^3/s.**

This issues with the approval of CE, HSO, CWC.

22/7/2016.
(एस. के. सिन्हा)
निदेशक

o/c

निदेषक, राष्ट्रीय परियोजना–2, निदेषालय, के॰ज॰आ॰ नई दिल्ली–66
पत्र संख्याः1 /82/2013/ज॰वि॰(म॰)/ २९४ दिनांकः 19/07/2016

कमरा संख्या 504 (द.), सेवा भवन, आर. के. पुरम सैक्टर-1, नई दिल्ली-110066
दूरभाष: 011-26106432

भारत सरकार
केन्द्रीय जल आयोग
जलविज्ञान (मध्य) निदेशालय

विषयः— **Detailed Project Report of Lower Orr Project (Part of Ken-Betwa Link Project Phase-II) – reg.**

संदर्भः— 1. CWC U.O. No. 4/9/2012/NP-II/1359 dated 31.08.2017
2. Lr. No. 1/82/2013/ज•वि•(म•)/586 dated 21.07.2017

Kindly refer the above cited letter at sl. (1), vide which compliances to the observations of this office, in respect of Lower Orr Project, were communicated. In this regard, it is observed that, since there is no change in the parameters of Lower Orr dam from the previously submitted combined DPR of Ken-Betwa Link (Phase-II) Project, this office has no further comments to offer regarding water availability, design/ diversion flood and sedimentation studies as communicated earlier vide this office letter dated 26.04.2016, 17.05.2016, 17.06.2016, 22.07.2016 & 14.09.2016.

It is, however, advised to carry out an analysis at an appropriate stage subsequently to assess the impact of all the structures now being proposed under Ken-Betwa Link (Phase-II) on the major regulating structures in the downstream on Betwa river.

This issues with the approval of CE, HSO, CWC.

26/9/17
(एस.के.सिन्हा)
निदेशक

निदेषक, राष्ट्रीय परियोजना, निदेषालय, के•ज•आ• नई दिल्ली–66
पत्र संख्याः 1/82/2013/ज•वि•(म•)/441 दिनांकः 26.09.17

DD
3/10/2017

कमरा संख्या 504 (द.), सेवा भवन, आर. के. पुरम सैक्टर-1, नई दिल्ली-110066
दूरभाषः 011-26106432

Lower Orr

Computation of Unit Hydrograph Parameters

As per flood estimation report sub-zone 1 (C)

A	1843	Sq km
L	105.50	km
Lc	47.64	Km
S	1.63	m/km

tp = 2.195*(qp)^-0.944

11.61 **11.50** hrs

qp= 1.331*(L/S)^-0.492

0.171219 **0.171** cumec

W50 = 2.04*(qp)^-1.0265

12.48 **12.48** hrs

W75 = 1.25*(qp)^-0.864

5.74 **5.74** hrs

WR50 = 0.739*(qp)^-0.986

4.21 **4.21** hrs

WR75= 0.500*(qp)^-0.813

2.10 **2.10** hrs

TB = 3.917*(tp)^0.99

44.0 **44.0** hrs

Tm = tp+tr/2

12 **12** hrs

Qp = qp*A

315.56 **315.56** cumecs

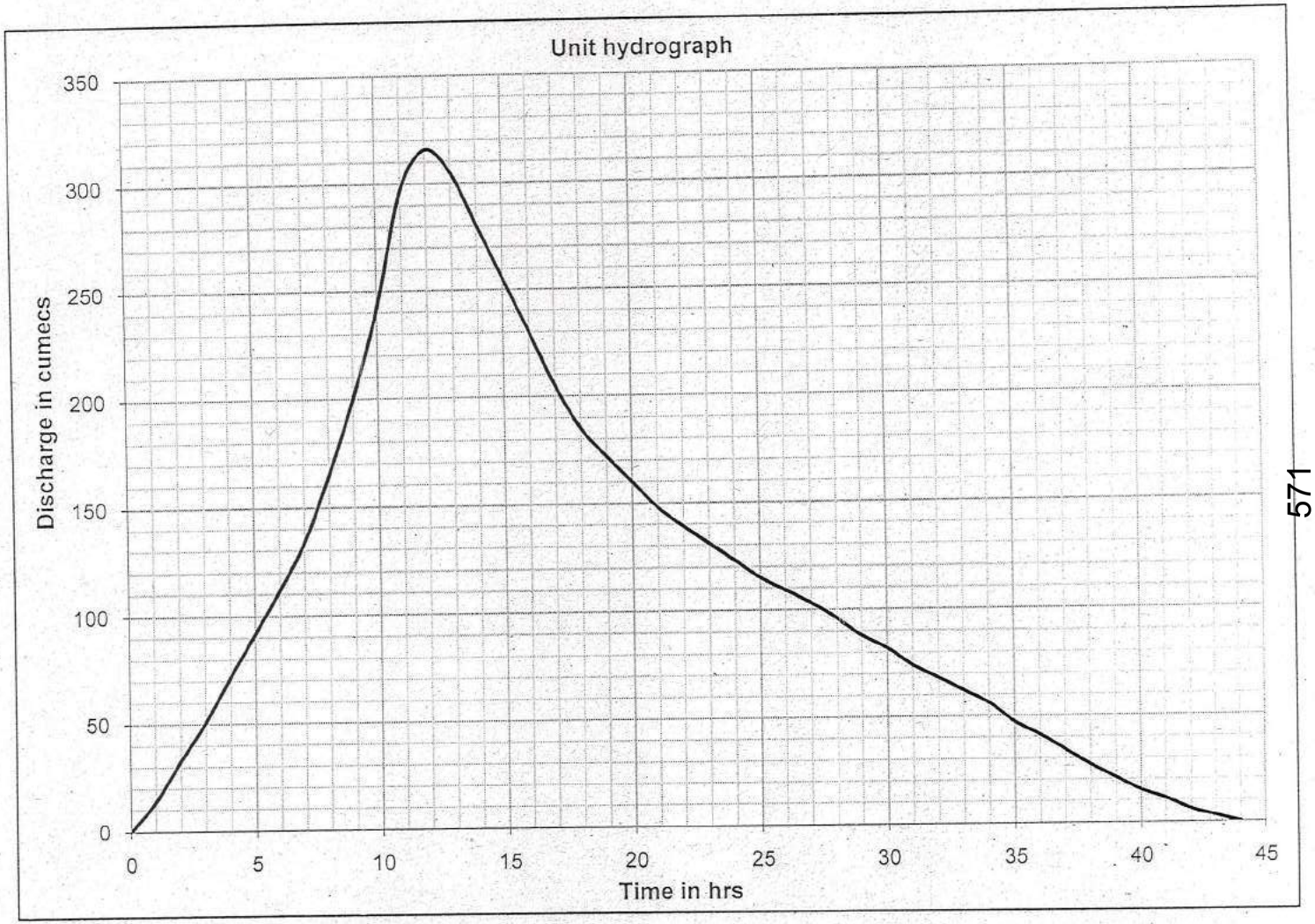
∑Qi = A*d/tr*0.36

d=1.00cm ,tr=1hrs

5119.44 **5119.4** cumecs

UNIT HYDROGRAPH FOR LOWER ORR DAM

Time	Ordinate	Time	Ordinate
0	0.0	30	82.0
1	14.0	31	74.0
2	33.0	32	68.0
3	51.0	33	62.0
4	72.0	34	56.0
5	92.0	35	47.0
6	112.0	36	41.0
7	134.0	37	34.0
8	165.0	38	27.0
9	200.0	39	21.0
10	242.0	40	15.0
11	297.0	41	11.0
12	315.6	42	6.0
13	305.0	43	3.0
14	280.0	44	0.0
15	255.0		
16	230.0		
17	205.0		
18	185.0		
19	172.0		
20	160.0		
21	148.0		
22	139.0		
23	131.0		
24	123.0		
25	115.0		
26	109.0		
27	103.0		
28	96.0		
29	88.0		



Lower Orr
Temporal Distribution of Rainfall

Temporal Distribution (24 hr) of Rainfall

Time (hrs)	Td %
1	17
2	26
3	33
4	38
5	43
6	47
7	51
8	55
9	59
10	63
11	66
12	69
13	72
14	75
15	78
16	81
17	84
18	87
19	90
20	92
21	94
22	96
23	98
24	100

Temporal Distribution (12 hr) of Rainfall

Time (hrs)	Td %
1	25
2	38
3	48
4	55
5	62
6	68
7	74
8	80
9	86
10	91
11	96
12	100

Lower Orr

Computation of Rainfall Excess (PMP)

2- day PMP value	75.8	cm
Ist day PMP value	58.90	cm
IInd day PMP value	16.90	cm

1st Day	Total 1st day rainfall	58.90	cm
	First bell (12 hour)	40.64	cm
	Second bell (12 hour)	18.26	cm
2nd Day	Total 2nd day rainfall	16.90	cm
	First bell (12 hour)	11.66	cm
	Second bell (12 hour)	5.24	cm

Time in hr	Time distribution coeff	% storm distribution	First Day							Second Day					
			I st Bell				2nd Bell			1st Bell			2nd Bell		
			Cum. Rain fall (cm)	Incremental Rainfall (cm)	Loss Rate (cm)	Rainfall Excess (cm)	Cum. Rain fall (cm)	Incremental Rainfall (cm)	Rainfall Excess (cm)	Cum. Rain fall (cm)	Incremental Rainfall (cm)	Rainfall Excess (cm)	Cum. Rain fall (cm)	Incremental Rainfall (cm)	Rainfall Excess (cm)
1	17	25	10.01	10.01	0.10	**9.91**	4.50	4.50	**4.40**	2.87	2.87	**2.77**	1.29	1.29	1.19
2	26	38	15.31	5.30	0.10	**5.20**	6.88	2.38	**2.28**	4.39	1.52	**1.42**	1.97	0.68	0.58
3	33	48	19.44	4.13	0.10	**4.03**	8.73	1.85	**1.75**	5.58	1.18	**1.08**	2.51	0.53	0.43
4	38	55	22.38	2.94	0.10	**2.84**	10.06	1.33	**1.23**	6.42	0.84	**0.74**	2.89	0.38	0.28
5	43	62	25.33	2.95	0.10	**2.85**	11.38	1.32	**1.22**	7.27	0.85	**0.75**	3.26	0.38	0.28
6	47	68	27.68	2.35	0.10	**2.25**	12.44	1.06	**0.96**	7.94	0.68	**0.58**	3.57	0.30	0.20
7	51	74	30.04	2.36	0.10	**2.26**	13.50	1.06	**0.96**	8.62	0.68	**0.58**	3.87	0.30	0.20
8	55	80	32.39	2.35	0.10	**2.25**	14.55	1.05	**0.95**	9.29	0.68	**0.58**	4.18	0.30	0.20
9	59	86	34.75	2.36	0.10	**2.26**	15.61	1.06	**0.96**	9.97	0.68	**0.58**	4.48	0.30	0.20
10	63	91	37.11	2.36	0.10	**2.26**	16.67	1.06	**0.96**	10.65	0.68	**0.58**	4.78	0.30	0.20
11	66	96	38.87	1.76	0.10	**1.66**	17.46	0.79	**0.69**	11.15	0.51	**0.41**	5.01	0.23	0.13
12	69	100	40.64	1.77	0.10	**1.67**	18.26	0.80	**0.70**	11.66	0.51	**0.41**	5.24	0.23	0.13

Lower Orr
Temporal Distribution of Rainfall

Temporal Distribution (24 hr) of Rainfall

Time (hrs)	Td %
1	17
2	26
3	33
4	38
5	43
6	47
7	51
8	55
9	59
10	63
11	66
12	69
13	72
14	75
15	78
16	81
17	84
18	87
19	90
20	92
21	94
22	96
23	98
24	100

Temporal Distribution (12 hr) of Rainfall

Time (hrs)	Td %
1	25
2	38
3	48
4	55
5	62
6	68
7	74
8	80
9	86
10	91
11	96
12	100

Lower Orr

Computation of Rainfall Excess (PMP)

2- day PMP value	75.8	cm
Ist day PMP value	58.90	cm
IInd day PMP value	16.90	cm

1st Day	Total 1st day rainfall	58.90	cm
	First bell (12 hour)	40.64	cm
	Second bell (12 hour)	18.26	cm
2nd Day	Total 2nd day rainfall	16.90	cm
	First bell (12 hour)	11.66	cm
	Second bell (12 hour)	5.24	cm

Time in hr	Time distribution coeff	% storm distribution	First Day							Second Day					
			1st Bell				2nd Bell			1st Bell			2nd Bell		
			Cum. Rain fall (cm)	Incremental Rainfall (cm)	Loss Rate (cm)	Rainfall Excess (cm)	Cum. Rain fall (cm)	Incremental Rainfall (cm)	Rainfall Excess (cm)	Cum. Rain fall (cm)	Incremental Rainfall (cm)	Rainfall Excess (cm)	Cum. Rain fall (cm)	Incremental Rainfall (cm)	Rainfall Excess (cm)
1	17	25	10.01	10.01	0.10	**9.91**	4.50	4.50	**4.40**	2.87	2.87	**2.77**	1.29	1.29	**1.19**
2	26	38	15.31	5.30	0.10	**5.20**	6.88	2.38	**2.28**	4.39	1.52	**1.42**	1.97	0.68	**0.58**
3	33	48	19.44	4.13	0.10	**4.03**	8.73	1.85	**1.75**	5.58	1.18	**1.08**	2.51	0.53	**0.43**
4	38	55	22.38	2.94	0.10	**2.84**	10.06	1.33	**1.23**	6.42	0.84	**0.74**	2.89	0.38	**0.28**
5	43	62	25.33	2.95	0.10	**2.85**	11.38	1.32	**1.22**	7.27	0.85	**0.75**	3.26	0.38	**0.28**
6	47	68	27.68	2.35	0.10	**2.25**	12.44	1.06	**0.96**	7.94	0.68	**0.58**	3.57	0.30	**0.20**
7	51	74	30.04	2.36	0.10	**2.26**	13.50	1.06	**0.96**	8.62	0.68	**0.58**	3.87	0.30	**0.20**
8	55	80	32.39	2.35	0.10	**2.25**	14.55	1.05	**0.95**	9.29	0.68	**0.58**	4.18	0.30	**0.20**
9	59	86	34.75	2.36	0.10	**2.26**	15.61	1.06	**0.96**	9.97	0.68	**0.58**	4.48	0.30	**0.20**
10	63	91	37.11	2.36	0.10	**2.26**	16.67	1.06	**0.96**	10.65	0.68	**0.58**	4.78	0.30	**0.20**
11	66	96	38.87	1.76	0.10	**1.66**	17.46	0.79	**0.69**	11.15	0.51	**0.41**	5.01	0.23	**0.13**
12	69	100	40.64	1.77	0.10	**1.67**	18.26	0.80	**0.70**	11.66	0.51	**0.41**	5.24	0.23	**0.13**

Nov Orr

Critical Sequencing of rainfall excess

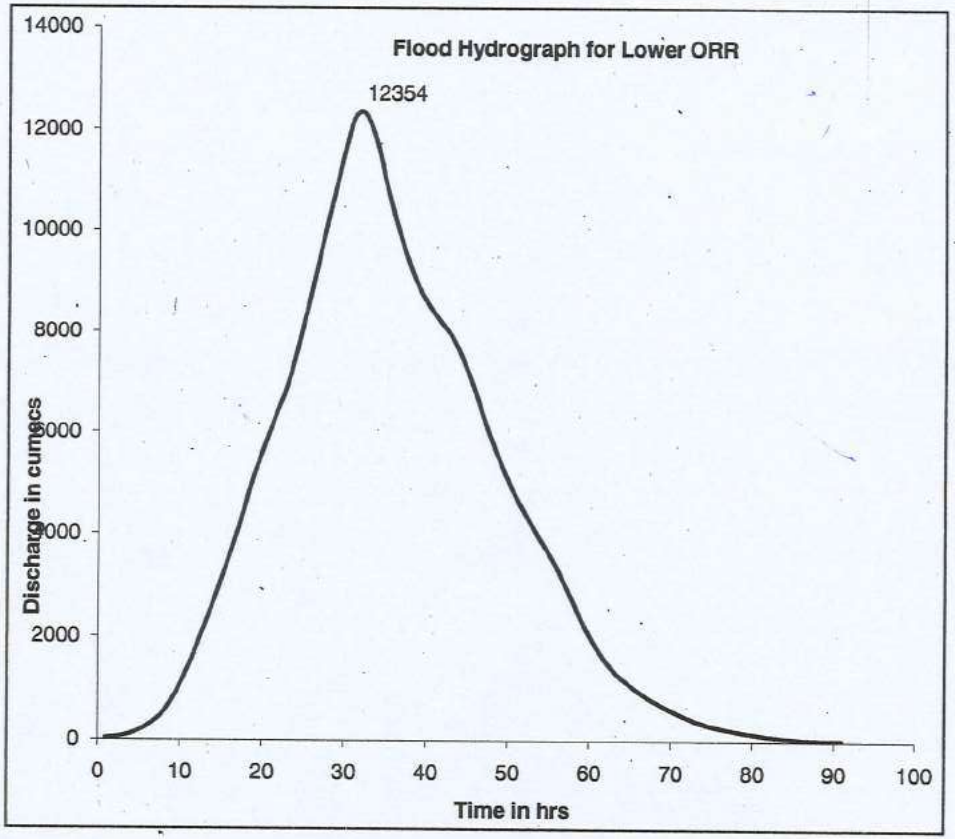
Unit : cm

Time (hrs)	UG ORD (cumecs)	Critical Sequencing				Reverse Order			
		1st Bell	IInd Bell	IIIrd Bell	IVth Bell	1st Bell	IInd Bell	IIIrd Bell	IVth Bell
0	0.0					1.67	0.70	0.41	0.13
1	14.0					2.25	0.96	0.58	0.20
2	33.0					2.26	0.96	0.58	0.20
3	51.0					2.26	0.96	0.58	0.20
4	72.0					2.84	1.22	0.75	0.28
5	92.0					2.85	1.23	0.74	0.28
6	112.0					5.20	2.28	1.42	0.58
7	134.0					9.91	4.40	2.77	1.19
8	165.0	1.66	0.69	0.41	0.13	4.03	1.75	1.08	0.43
9	200.0	2.25	0.96	0.58	0.20	2.26	0.96	0.58	0.20
10	242.0	2.26	0.96	0.58	0.20	2.25	0.96	0.58	0.20
11	297.0	4.03	1.75	1.08	0.43	1.66	0.69	0.41	0.13
12	**315.6**	9.91	4.40	2.77	1.19				
13	305.0	5.20	2.28	1.42	0.58				
14	280.0	2.85	1.23	0.74	0.28				
15	255.0	2.84	1.22	0.75	0.28				
16	230.0	2.26	0.96	0.58	0.20				
17	205.0	2.26	0.96	0.58	0.20				
18	185.0	2.25	0.96	0.58	0.20				
19	172.0	1.67	0.70	0.41	0.13				
20	160.0								
21	148.0								
22	139.0								
23	131.0								
24	123.0								
25	115.0								
26	109.0								
27	103.0								
28	96.0								
29	88.0								
30	82.0								
31	74.0								
32	68.0								
33	62.0								
34	56.0								
35	47.0								
36	41.0								
37	34.0								
38	27.0								
39	21.0								
40	15.0								
41	11.0								
42	6.0								
43	3.0								
44	0.0								

Lower Orr
Flood hydrograph

Unit : cumec

Time in Hours	Total Flood	Time in Hours	Total Flood
0	33	46	6332
1	43	47	5880
2	70	48	5472
3	114	49	5092
4	178	50	4753
5	264	51	4460
6	375	52	4185
7	527	53	3913
8	761	54	3662
9	1055	55	3368
10	1391	56	3044
11	1786	57	2707
12	2206	58	2366
13	2638	59	2063
14	3092	60	1792
15	3572	61	1560
16	4071	62	1366
17	4611	63	1217
18	5164	64	1089
19	5610	65	971
20	6052	66	869
21	6491	67	775
22	6916	68	687
23	7502	69	606
24	8175	70	531
25	8863	71	463
26	9554	72	401
27	10250	73	347
28	10921	74	301
29	11590	75	265
30	12179	76	233
31	12354	77	202
32	12161	78	175
33	11686	79	150
34	10974	80	126
35	10343	81	105
36	9793	82	87
37	9320	83	71
38	8926	84	58
39	8624	85	47
40	8373	86	40
41	8156	87	36
42	7943	88	35
43	7634	89	34
44	7258	90	33
45	6825		



भारत सरकार
केंद्रीय जल आयोग
जल विज्ञान (मध्य) निदेशालय

कमरा नंबर 504 (दक्षिण), सेवा भवन,
आर के पुरम, नई दिल्ली
फ़ोन अंक: 26106432

विषय: Comments on Sedimentation Studies of Ken-Betwa link (Phase-II)

The Supplementary Report of Ken-Betwa link (Phase-II) which has been received on 07.10.2015 has been examined in this office. In this regard please find enclosed the comments on the Sedimentation studies.

(एम रघुराम)
निदेशक

निदेशक, (NP-II), केंद्रीय जल आयोग

पत्र संख्या: 1/82/2013/Hyd(C)/ 420 दिनांक: 17:05:2016

Sedimentation Analysis of Ken Betwa Link (Phase-II)

The Ken BetwaLink (Phase-II) consists of five projects, Neemkheda Barrage, Barari Barrage, Kesari Barrage, Kotha Barrage and Lower Orr Dam. Out of the five projects Lower Orr is the only Dam for which sedimentation studies are carried out and the details are as follows:

No Sediment data is available either at the proposed project or nearby sediment site on Betwa river. Rajghat dam located upstream of the confluence of Orr river with Betwa river, Matatila dam and Dhukwan dams located at the downstream of the confluence of Orr river with the Betwa River are the nearest dams to the proposed Lower Orr Dam. As per CWC publication "Compendium on Silting of Reservoirs in India -2015" the silt rate at Matatila dam, Dhukwan dam, medium value of the silt rate of Indo Gangetic plains are 0.483, 0.030 and 0.752 Th.cu.m/sqkm/year respectively. Looking at the variability of sediment rate at above two projects, the medium value of silt rate pertaining to Indo Gangetic plains (i.e.0.752 Th.cu.m/sqkm/year) is adopted as the design sediment rate for the project.

The Bed Level and FRL of the reservoir are 340.0m and 380.0 m respectively.

The Trap efficiency has been calculated based on Brune's curve for every 5 years period and the sediment load is estimated for 50 and 100 years and the details are enclosed as Annexure-I. The type of the reservoir found to be Type-I. Sediment distribution has been studied based on Empirical Area Reduction method for 50 years and 100 years. For the proposed project the New Zero elevation after 100 years is estimated as 352.830 m and the revised area-elevation-capacity curve after 50 years is enclosed as Annexure-II.

Further, the project authorities are suggested to establish hydro-metrological network in the catchment start observing the data so that studies may be firmed up at later stage. It is also suggested that, all corrections carried out in the computations and changes mentioned in the compliance should be incorporated in the DPR.

ANNEXURE-I

SEDIMENT LOAD FOR LOWER ORR PROJECT

FRL = 380 m

Gross storage at FRL (given) C = 371.802 Mm^3 Average Annual Inflow I = 519.11 Mm^3

51911 Ha.m

CA= 1843 sq km

Rate= 0.0752 Ham/sq.km/year 0.752 mm/yr

Average annual sediment load = 138.5936 Ham / yr

1.385936 MCM /yr

LOWER ORR

COMPUTATION OF TOTAL SEDIMENT

ANNUAL SEDIMENT (HAM/YEAR) 138.5936

Period	Sed Inflow Ha.m	Initial Capacity Ha.m	Trap Efficiency	Annual trapped Volume Ha.m	5 Year Trapped Volume Ha.m	Cumulative Trapped volume Ha.m	Final Capacity Ha.m	C/I Ratio
Start							37180.2	0.7162
1-5	138.59	37180.20	98.03%	135.86	679.31	679.31	36500.89	0.7031
6-10	138.59	36500.89	97.99%	135.81	679.07	1358.37	35821.83	0.6901
11-15	138.59	35821.83	97.96%	135.76	678.82	2037.20	35143.00	0.6770
16-20	138.59	35143.00	97.92%	135.71	678.57	2715.77	34464.43	0.6639
21-25	138.59	34464.43	97.88%	135.66	678.30	3394.07	33786.13	0.6508
25-30	138.59	33786.13	97.84%	135.61	678.03	4072.10	33108.10	0.6378
31-35	138.59	33108.10	97.80%	135.55	677.74	4749.85	32430.35	0.6247
36-40	138.59	32430.35	97.76%	135.49	677.45	5427.29	31752.91	0.6117
41-45	138.59	31752.91	97.72%	135.43	677.14	6104.43	31075.77	0.5986
46-50	138.59	31075.77	97.67%	135.36	676.82	6781.25	30398.95	0.5856
51-55	138.59	30398.95	97.62%	135.30	676.48	7457.73	29722.47	0.5726
56-60	138.59	29722.47	97.57%	135.23	676.13	8133.87	29046.33	0.5595
61-65	138.59	29046.33	97.52%	135.15	675.77	8809.64	28370.56	0.5465
66-70	138.59	28370.56	97.46%	135.08	675.39	9485.02	27695.18	0.5335
71-75	138.59	27695.18	97.41%	135.00	674.99	10160.01	27020.19	0.5205
76-80	138.59	27020.19	97.34%	134.91	674.57	10834.58	26345.62	0.5075
81-85	138.59	26345.62	97.28%	134.83	674.13	11508.71	25671.49	0.4945
86-90	138.59	25671.49	97.21%	134.73	673.67	12182.37	24997.83	0.4816
91-95	138.59	24997.83	97.15%	134.64	673.18	12855.56	24324.64	0.4686
96-100	138.59	24324.64	97.07%	0.00	0.00	12855.56	24324.64	0.4686

भारत सरकार
केन्द्रीय जल आयोग
जलविज्ञान (मध्य) निदेशालय

विषयः– **Ken Betwa Link (Phase-II)- Flood Studies of Neemkheda, Barari, Kesari, Kotha Barrages and Diversion Flood Studies of Lower Orr Dam.**

संदर्भः– Lr. No. 4/9/2012/NP-II/ dated 07.10.2015

Kindly refer to above cited letter vide which the project authority has forwarded the supplementary report on Ken-Betwa Link (phase-II) for examination from Hydrological angle. The observations on Yield study and Sedimentation study had been conveyed vide this office letter of even number dated 26-04-2016 & 17-05-2016. The observations on the design flood study of Lower Orr Dam, Ken-Betwa Link (Phase-II) were also conveyed vide Letter dated 17.06.2016 and subsequently vide Letter dated 22.07.2016. This office has now examined the Flood Studies (including Diversion Flood) of the remaining four Barrages viz. Neemkheda, Barari, Kesari and Kotha Barrages; and Diversion Flood Studies of the Lower Orr Dam for which observations of this office are as under:

Introduction: The Ken- Betwa link project envisages diversion of surplus water of Ken basin to the water deficit Betwa basin. The Ken-Betwa Link (Phase-II) consists of five projects namely Neemkheda Barrage, Barari Barrage, Kesari Barrage, Kotha Barrage and Lower Orr Dam. Lower Orr dam qualifies for PMF studies whereas the four Barrages qualify for 100 year return period as design flood and SPF as check flood. Catchment area of the barrages up to the barrage site is computed using GIS Analysis and found to be as:

Table 1:- Catchment Areas (Sq.Km.) for the Project Sites

S.No.	Project Name	Computed using GIS Analysis (Sq. Km.)
1	Neemkheda Barrage	1965.00
2	Barari Barrage	5387.92
3	Kesari Barrage	518.00
4	Kotha Barrage	9262.51

Design Flood Study of Neemkheda, Barari, Kesari and Kotha Barrages carried out by project authority:

In absence of short interval rainfall runoff data, unit hydrograph for the Neemkheda, Barari, Kesari and Kotha Barrages has been derived synthetically using Flood

Estimation report for sub zone 1 (c). IMD has carried out the SPS studies of Neemkheda, Barari and Kesari Barrages and recommended Two day & One day SPS values as:

Table 2:- SPS Values (mm) recommended by IMD

S.No.	Project Name	SPS Values (mm)	
		1-day	2-day
1	Neemkheda Barrage	355	593
2	Barari Barrage	306	567
3	Kesari Barrage	431	-

The 24 hr & 48 hr Time distribution (3-hourly) has also been given by IMD.

Loss rate of 2.3 mm/hr has been taken into account from FER of sub zone- 1 (c) while calculating the effective rainfall i.e. excess rainfall in the basin. The base flow has been taken from FER of sub zone- 1 (c) as 0.018 m^3/s/Sq. Km. Further, for Barari and Kotha Barrages the flood hydrograph from upper basins have been routed to the outlet using Muskingum- Cunge routing technique and the downstream flood hydrographs are added to the routed hydrograph in order to derive the SPF at the respective project sites. The peak design flood (SPF) has been worked out as:

Table 3:- SPF (cumec) Computed by Project Authority

S.No.	Project Name	SPF (cumec)
1	Neemkheda Barrage	6654.60
2	Barari Barrage	16449
3	Kesari Barrage	2690.14
4	Kotha Barrage	22486

Analysis:

(i) Project Authorities have submitted the Design Flood studies considering 10 Project Sites. However, the Project Authorities subsequently reduced the Project Sites to 5 in number consisting of Lower Orr Dam and four barrages namely Neemkheda, Barari, Kesari and Kotha. This office has now carried out the flood studies considering the above mentioned four barrages and is issuing its recommendations.

(ii) In the absence of short interval rainfall-runoff data the unit hydrographs derived as per Flood Estimation Report of Sub zone 1(c) appears to be in order. Project authorities have not smoothened the Unit Hydrographs. The UG_s needs to be smoothened before using in convolution.

(iii) Temporal distribution of storm pattern is provided by IMD in 3 hour interval. However, project authorities converted the distribution factor on hourly basis

without smoothening the curve supplied by IMD. The same has been smoothened before converting into 12 hr from 24 hour time distribution.

(iv) 1 in 100 Year Return Period Storm has been considered for computing the Design Flood for all the barrages. Isopluvial map of 24- hr 100 Year return period storm as provided by IMD has been used and the following values of point rainfall depth are obtained and used in further analysis:

Table 4:- 24- hr Point Rainfall Depth (mm) Obtained from 100-yr Isopluvial Map

S.No.	Project Name	24- hr Point Rainfall (mm)
1	Neemkheda Barrage	400
2	Barari Barrage	380
3	Kesari Barrage	360
4	Kotha Barrage	380

To convert the point rainfall obtained from isopluvial map into areal rainfall following Area Reduction Factors (ARF); as per FER-1(C) are applied:

Table 5:- Areal Rainfall (mm) after applying ARF

S.No.	Project Name	Point Rainfall (mm)	ARF	Areal Rainfall (mm)
1	Neemkheda Barrage	400	0.7707	308.3
2	Barari Barrage	380	0.76	288.8
3	Kesari Barrage	360	0.858	308.9
4	Kotha Barrage	380	0.76	288.8

(v) The two day and one day SPS values supplied by IMD for the project areas and as mentioned in the DPR have been considered for computing the Check Flood for all the barrages. The SPS value for Kotha Barrage has been taken same as that of Barari Barrage as mentioned in the DPR.

(vi) The loss rate of 2.3 mm/hr has been taken into account while computing the excess rainfall in case of design flood and 1.0 mm /hr has been adopted for check flood. These values have been taken from concerned FER of sub zone- 1 (c).

Recommendation:

This office has modified the flood study for the Neemkheda, Barari, Kesari and Kotha Barrages addressing above observation. The Unit hydrograph has been smoothened and adjusted for the volume of Unit Hydrograph. The time distribution of 24-hr (3 hourly) as supplied by IMD has been converted into hourly distribution with duly smoothening the curve. The 12 hr temporal distribution has been used to assess the incremental rain fall. The loss rate as mentioned in the observations (v) and base flow of 0.018 cumec/sq km have been taken from Flood Estimation Report of subzone-1(C) for the calculation of excess rainfall. The excess rainfall has been critically arranged in the two bells per day and convoluted with the Unit Hydrographs.

The Peak Design Flood and Peak Check Flood for the Neemkheda, Barari, Kesari and Kotha Barrages have been worked out as follows:

Table 6:- Peak Design Flood and Peak Check Flood

S.No.	Project Name	Peak Design Flood (cumec)	Peak Check Flood (cumec)
1	Neemkheda Barrage	**5298**	8345
2	Barari Barrage	**11983**	16439
3	Kesari Barrage	**1856**	2866
4	Kotha Barrage	**18698**	26673

Flood frequency analysis has also been performed as a check to the derived Design Flood values. Results obtained from the 'Log Pearson Type-III' Frequency Distribution of Basoda G&D Site have been used to compute the various return period floods for all the four Projects in the proportion to the ratio of (Catchment area) $^{0.75}$ and the same are tabulated below:

Table 7:- Return Period Floods from Flood Frequency Analysis

S.No.	Project Name	Return Period Flood transferred from Basoda G&D Site	
		100- Years	500- Years
1	Neemkheda Barrage	4801.36	6578.46
2	Barari Barrage	10230.76	14017.42
3	Kesari Barrage	1766.40	2420.19
4	Kotha Barrage	15359.90	21045

The Values of the Peak Design Flood computed are found to be in order with the values obtained from Flood Frequency analysis. Hence, the values of Peak Design Flood and Peak Check Flood tabulated in Table 6 are recommended for planning and design purpose.

Diversion Flood:

a) For Neemkheda, Barari, Kesari and Kotha Barrages

Diversion flood for all the four barrages has been evaluated as the maximum of the following two criteria: a) Maximum non-monsoon flow observed at the barrage site OR; b) 25-year return period flow, calculated on the basis of non-monsoon yearly peaks. The peak of daily flow for non-monsoon months, available for 35 years at Basoda G&D Site was provided by Project Authority and used in our analysis. The 25-year return period flow was calculated using the 'Pearson Type-III' frequency distribution. The diversion flood obtained and recommended are as follows:

Table 8:- Recommended Diversion Flood for all the Barrages

Project Site	Flow (cumec)		
	Max. Observed	25-year return period	Recommended

	(non-monsoon)	(non-monsoon)	Diversion Flood
Neemkheda Barrage	300.84	172.22	**301**
Barari Barrage	641.02	366.98	**641**
Kesari Barrage	110.68	63.36	**111**
Kotha Barrage	962.39	550.96	**963**

b) For Lower Orr Dam

Lower Orr being a large dam, it is desirable that 100-year return period flood should be adopted for diversion works. Accordingly, the annual peaks of daily flow provided by Project Authority for Basoda G&D Site have been used for computing the 100-year return period flood for Lower Orr Dam. Peak flows were adjusted in proportion to the ratio of (Catchment area)$^{0.75}$. 'Log Pearson Type-III' frequency distribution has been used to compute the 100-year flood for the Dam site. The Diversion Flood for Lower Orr Dam computed and recommended is **4576 cumec**.

Details of the flood study are enclosed at Annex 1 to 119.

This issues with the approval of CE, HSO, CWC.

14/9/2016

(एस.के.सिन्हा)
निदेशक
ज•वि•(म•)

O/C

निदेषक, राष्ट्रीय परियोजना–2, निदेषालय, के•ज•आ• नई दिल्ली–66
पत्र संख्या:1 /82/2013/ज•वि•(म•)/311 दिनांक: 14/09/2016

कमरा संख्या 504 (द.), सेवा भवन, आर. के. पुरम सैक्टर-1. नई दिल्ली-110066
दूरभाष: 011-26106432

Annexure-1.2.7

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास और गंगा संरक्षण विभाग
केन्द्रीय जल आयोग
सिंचाई आयोजन (दक्षिण(निदेशालय

सत्यमेव जयते

Government of India
Ministry of Jal Shakti
Deptt. of Water Resources, RD&GR
Central Water Commission
Irrigation Planning (South) Directorate

विषय: Lower Orr dam project- Part of Comprehensive Report of Ken-Betwa Link project-reg.

संदर्भ: (i) File No.T-26030/2/2020-IP(S) DTE I/75508/2021 dated 08.11.2021.
(ii) Email from Project Authorities dated 12.11.2021.
(iii) Email from Project Authorities dated 15.11.2021.
(iv) Email from NP Dte. dated 18.11.2021

May please refer to the email received under reference (iv) above vide which NP Dte. of CWC has forwarded the copy of minutes of the meeting held on 02.11.2021 under the chairmanship of Member, WP&P,CWC. Based on the above, the BC ratio of the project has been revised and reworked out. Further, vide email under reference (ii) above the Project Authorities has submitted the revised BC ratio computation for examination. The same has been examined and the observations thereon are as under:

Observations:

1. The project authorities have now submitted the documents for ground water availability of 94.08 MCM in the command of the project duly authenticated by the Superintending Geohydrologist, Ground Water Survey Circle, Bhopal.
2. The project authorities have now provide the certificate in respect of benefits of fisheries duly authenticated by Assistant Director, State Fisheries Department, MP and now the production rate (in kg/ha) and rate per kg of fish has been considered @ Rs. 600 kg/ha and @ Rs. 570/ kg (as per 2021 price level) respectively. The rate per kg of fish has been revised by the project authorities at 2017-18 price level with 3 % depreciation each year as Rs. 504.68 / kg and the same has been used for calculating the benefits of fisheries. However, on examination of the documents, the benefits of fisheries have been applicable to Kotha Barrage project only. In this regard, the project authorities vide their letter dated 15.11.2021 have clarified that the yield and rates of fisheries for Kotha Barrage is applicable to Lower Orr also. Based on this, the benefits of fisheries have been considered in the BC Ratio computation.
3. Based on the meeting held on 02.11.2021 under the chairmanship of Member, WP&P,CWC, it was decided to consider the crop rates for Lower Orr project for the year 2017 by arriving at from that of year 2021 after taking into account inflation. Accordingly, the rates and cost of cultivation (viz. seeds, manure, labour etc.) of crops in pre-project and post project scenario has been revised.

Subject to the above and based on veracity of the documents submitted by the

project authorities, the BC ratio computation has been reworked out as 1.54.

This issues with approval of CE (IMO), CWC, New Delhi.

Signed by Vineet Gupta
Date: 29-11-2021 13:26:02
Reason: Approved

विनीत गुप्ता

निदेशक - सिंचाई आयोजन (दक्षिण)

To.

i. Director, NP Dte., CWC, Sewa Bhawan, R.K Puram, New Delhi.
ii. Director, PA (C) Dte., CWC, Sewa Bhawan, R.K Puram, New Delhi.

Copy for kind information to :

(i) CE, PAO, CWC, Sewa Bhawan, R.K Puram, New Delhi.
(ii) CE, PPO, CWC, Sewa Bhawan, R.K Puram, New Delhi.

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास और गंगा संरक्षण विभाग
केन्द्रीय जल आयोग
सिंचाई आयोजन (दक्षिण) निदेशालय

सत्यमेव जयते

Government of India
Ministry of Jal Shakti
Deptt. of Water Resources, RD&GR
Central Water Commission
Irrigation Planning (South) Directorate

विषय**:** Comprehensive Report of Ken-Betwa Link project - reg.
Ref: (i) No. 4/11/2019/NP-II/Vol-I/3055 dated 19.08.2019
(ii) No. 4/11/2019/NP-II/Vol-I/3040-51 dated 03.09.2019

May please refer to the letter under reference (i) above vide which Comprehensive Report of Ken-Betwa Link project has been forwarded for examination which consists of Dhaudhan dam, Lower Orr dam, Bina complex multipurpose project, Kotha Barrage, the additional CCA, repair / strengthening of Bariyarpur Pickup weir, Paricha Weir and Barwa Sagar dam. Further, under reference (ii) above, NP Directorate of CWC, informed that some changes are likely to be expected in the Comprehensive Report of Ken-Betwa Link project after resolving of water sharing issues related to non-monsoon season between MP & UP state. However, no revised Comprehensive Report of Ken-Betwa Link project has been received till now.

Further, NWDA vide their letter dated 09.07.2019 provided the comparative statement including changes between the proposed components as envisaged in the Comprehensive Report of Ken-Betwa Link Project viz a viz earlier submitted DPR of Phase-I & Phase-II. The details are as under.

	Provisions in DPRs of Ken Betwa Link project, Phase-I & Phase-II	**Provisions in Comprehensive Report, October 2018**	**Changes [column (2) –(1)]**
	(1)	**(2)**	**(3)**
a.	**Daudhan Dam**		
(i)	Command area in MP-287837 ha	Command area in MP-447368 ha	***Increase in command area by 1,59,531 ha***
(ii)	Command area in UP-227373 ha	Command area in UP-251064 ha	***Increase in command area by 23,691 ha***
(iii)	Annual utilisation in MP - 1788 MCM and 591 MCM by substitution	Annual utilisation in MP-2349.87 MCM	***Change in Annual water utilisation***
(iv)	Annual utilisation in UP - 1700 MCM	Annual utilisation in UP-1700.08 MCM	***No change***

b.	**Lower Orr dam**		
(i)	Command area in MP-45047 ha	Command area in MP-90000 ha	***Increase in command area by 44,953 ha***
(ii)	Annual utilisation in MP-329.67 MCM	Annual utilisation in MP-291.77 MCM	***Decrease in Annual water utilisation by 37.90 MCM***
c.	**Kotha Barrage**		
(i)	Command area in MP-20000 ha	Command area in MP-20000 ha	***No change***
(ii)	Annual utilisation in MP-88.19 MCM	Annual utilisation in MP-88.19 MCM	
d.	**Bina Complex**		
(i)	Command area in MP-96000 ha	Command area in MP-96000 ha	***No change***
(ii)	Annual utilisation in MP-413.35 MCM	Annual utilisation in MP-413.35 MCM	

From the above table, it may be seen that no change in irrigation planning parameters i.e. command area and water utilisation has been proposed for Kotha Barrage and Bina complex Multipurpose project respectively. **Therefore, the observations in respect of Kotha Barrage submitted to CE, PPO, CWC vide this office letter dated 27.08.2018 (copy enclosed) and the observations in respect of Bina complex Multipurpose project submitted to CE, PAO, CWC vide this office letter dated 10.09.2018 (copy enclosed) stands valid. The project authorities are requested to submit the compliance of the observations in respect of these two projects at earliest to this office.**

The Comprehensive Report of Ken-Betwa Link project has been examined and comments / observations are as under.

A. **Ken-Betwa Link Canal Command**

At page no. 133 of the Comprehensive Report of Ken-Betwa Link project, Vol-I, the details of command area of MP under Ken-Betwa Link project has been provided, which is as under.

S. No.	Canal System	CCA as per Comprehensive Project report in MP	CCA as per Comprehensive Project report in UP
1.	K-B Link Main Canal	96751 ha	58585 ha
2.	High Level command through K-B link through pumping of water	85774 ha	0
3.	Bariyarpur PUW through Dam		

	i. Chhatarpur ii. Panna	34894 ha	192479
4.	Ken left bank canal	139848 ha	0
5.	Lift from Daudhan dam	90101 ha	0
	Total	447368 ha	251064 ha

From the above, it has been seen that the Ken-Betwa Link Canal Command is lying in MP and UP with 447368 ha and 251064 ha of CCA respectively. **At page no. 141 of the Comprehensive Report of Ken-Betwa Link project, Vol-I, it has been stated that no details have been submitted by the Government of UP for computation of crop water requirement. It is, therefore, requested that the details may be furnished so that the crop water requirement may be finalized for UP portion.**

The other observations are given as under.

i. The net hydrological yield series/flow series is considered for the period from 1981-82 to 2003-04 and the same has been developed by NIH, Roorkee. Therefore, it is suggested that net hydrological yield series/flow series may be got approved from the concerned Hydrology Directorate of CWC to establish the water availability for the project and the same may be furnished.

ii. The proposed cropping pattern has been given on Page no. 139 & 140 of Vol-I. It is suggested that the proposed cropping pattern may be got approved by the Director, State Agriculture Department (UP & MP) and a copy of the same may be furnished.

iii. At page no. 141 of the Comprehensive Report of Ken-Betwa Link project, Vol-I, the crop water requirement has been worked out as 2238.76 MCM (441.64 MCM for Kharif season & 1797.12 MCM for Rabi season). However, on page 147 of the same report, the water requirement has been mentioned as 2349.87 MCM. The discrepancy may be rectified.

iv. The following observations may please be clarified/ complied for better appraisal of the crop water requirement.

a. **Reference station for computation of Eto & effective rainfall has not been given.** The details of the station may be provided so as Eto and effective rainfall value may be considered suitably.

b. Percolation losses for paddy crop have been considered as 2 mm per day by the project authorities. **It is suggested that the same may be used in the range of 3-6 mm per day depending upon the type of the soil in the command**.

c. **The details in respect of field application and conveyance efficiency have not been mentioned separately in the report.** It is suggested that irrigation efficiencies may be considered as per CWC guidelines of “Piped irrigation network (PIN) planning” which is available on CWC website.

v. **Considering the comments under paras (i) to (iv) above, the irrigation demand table may be worked out and furnished**.

vi. **The working tables/simulation study using the net yield series at dam site duly approved by the concerned Hydrology Directorate of CWC and**

the revised irrigation demand table may be prepared and furnished to assess the success rate of the project.

vii. For irrigation planning aspects, reference material "A guide to prepare chapter on irrigation planning aspects of detailed project report" may also be referred which is available on CWC website.

B. Betwa Basin Command

Lower Orr dam project:

As per the Comprehensive Report of Ken-Betwa Link project, the project envisages construction of Lower Orr dam (on Orr River about 9 km u/s of confluence with river Betwa) and a 91.26 km long left main canal. The gross and live storage capacity of dam has been considered as 372 MCM and 328.17 MCM respectively. The 75% dependable yield at dam site has been assessed as 362.53 MCM. The culturable command area (CCA) of the project is 90,000 ha lying in Shivpuri and Datia district of MP. The proposed cropping pattern in the command is wheat, gram and vegetables. The total cost of the project has been estimated as Rs.3065.14 crore @ price level 2017-18.

Comments:

1. **Irrigation Planning aspects:**

i. The net hydrological yield series/flow series for Lower Orr dam is considered for the period from 1954-55 to 2008-09 and the same has been developed by NIH, Roorkee. Therefore, it is suggested that net hydrological yield series/flow series may be got approved from the concerned Hydrology Directorate of CWC to establish the water availability for the project and the same may be furnished.

ii. The proposed cropping pattern has been given on Page no. 159 of Vol-I and the same has been vetted by the Assistant Director, Sate Agriculture Department. It is suggested that the proposed cropping pattern may be got approved by the Director, State Agriculture Department and a copy of the same may be furnished.

iii. The crop water requirement had been computed for Rabi period (October-February) and the crop considered for 90,000 CCA are Wheat, Gram and Vegetables/others (table 6.17). In computation of crop water requirement, there are certain deficiencies that should be cleared for better appraisal of the crop water requirement.

a. **Reference station for computation of Eto & effective rainfall has not been given**. However, after considering Guna station (approx. 100 km from Shivpuri District), it has been observed that there is huge difference in the value of ETo and effective rainfall as considered in the computation of crop water requirement (Annex 6.14). The details of the station may be provided so as Eto and effective rainfall value may be considered accordingly.

b. Earlier, as per the DPR of Lower Orr Project under Ken Betwa Link project Phase II, 329.67 MCM of water was required to irrigate 45,047 ha of CCA. However, with the same quantity of water, the project authorities have now proposed to irrigate 90,000 ha of CCA. It has been observed (page 162 of Vol-I) that the field application efficiency has been considered as 85%. However, in the crop water computation, the overall efficiency has also been considered as 85%. The details in respect of conveyance efficiency have not been mentioned in the report, which may be provided.

It may be noted that as per CWC guidelines "A guide to prepare chapter on irrigation planning aspects of detailed project report", conveyance efficiency for canal based conveyance system (fully lined) may be considered as 70% to 75%. As per CWC guidelines on "Piped Irrigation Network (PIN) planning", conveyance efficiency for pipe based conveyance system may be considered as 95%. The field application efficiency for DRIP irrigation can be assumed upto 90% as per CWC guideline "Piped irrigation network (PIN) planning".

c. CCA of Lower Orr Dam is 90,000 ha with following two components.

- One component involves first water transport though carrier canal for a length of 50 km (refer page xii of executive summary) and afterwards water is lifted from carrier canal to provide irrigation to 40,000 ha (as per table 6.15, page 159) through pipeline by gravity flow. In this scenario, first crop water requirement has to be calculated at the terminal point of carrier canal. After that, water demand at Headwork may be calculated by multiplying crop water requirement (calculated at the terminal point of carrier canal) by the conveyance efficiency of carrier canal. In case of lined carrier canal, the conveyance efficiency may be considered in the range of 70 to 75% and in case of unlined carrier canal, the conveyance efficiency may be considered in the range of 55 to 60% as per CWC guidelines "A guide to prepare chapter on irrigation planning aspects of detailed project report". The project authorities may clarify whether carrier canal is lined or unlined and the conveyance efficiency may be considered accordingly. The field application efficiency for DRIP irrigation has been assumed as 85% by the Project Authorities (vide Page No 162 of Vol -1).
- Second component involves irrigation to 50,000 ha (as per table 6.15, page 159) only through pipeline. In this scenario, as per CWC guideline "Piped irrigation network (PIN) planning", water demand at Headwork may be calculated taking pipe based conveyance efficiency (using Drip) as 95%, while field application efficiency has already been assumed by Project Authorities as 85%.

iv. Considering the comments under para (i) to (iii) above, the irrigation demand table may be worked out and furnished.

v. The working tables/simulation study using the net yield series at dam site duly approved by the concerned Hydrology Directorate of CWC and the revised irrigation demand table (as per Para 1. (iv) above) may be prepared and furnished to assess the success rate of the project.

vi. For irrigation planning aspects, reference material "A guide to prepare chapter

on irrigation planning aspects of detailed project report" may also be referred which is available on CWC website.

2. **B C Ratio**

The B.C. ratio has been worked out as 1.58 by the project authorities. The project authority may provide the compliance/clarifications to the following observations.

i. The BC Ratio computation has not been done as per the CWC guideline. It is suggested that the same may be worked out using the proforma attached in the "Guidelines for preparation of Detailed Project Reports of Irrigation & Multipurpose projects" of the Ministry published in 2010.
ii. The cost of the project may also be got approved by the Cost Appraisal (I) Dte. of CWC. The price level for the cost of the project and benefits from agricultural produces may be considered at same price-level while carrying out the B.C. Ratio computation.
iii. The interest @ 10% on the estimated cost of the project including the cost of land development may be considered for carrying out the B.C. ratio computation. The cost of land development @ Rs.20,000 per ha of CCA may be considered for the purpose.
iv. The yield, rates and cost of cultivation (viz. seeds, manure, labour etc.) of crops in pre-project and post project scenario may be got approved by the Director, State Agriculture Department in the format given in the "Guidelines for Submission, Appraisal and Acceptance of Irrigation and Multipurpose Projects, 2017" of CWC *(Appendix F (1) and F(2))* for the purpose of estimating the agricultural benefits.
v. Since, repair / strengthening of Bariyarpur Pickup weir, Paricca Weir and Barwa Sagar dam is part of K-B link project, project authorities may confirm whether there is any increase in discharge through regulators of these weirs due to repair / strengthening works. If so, then details of the corresponding increase in irrigation potential and consequent additional benefits may be furnished.

This issues with the approval of Chief Engineer, IMO, CWC, New Delhi.

Signature Not Verified
Digitally signed by BHUPESH KUMAR
Date: 2020.11.05 12:07:40 IST

भूपेश कुमार
(निदेशक)

To.

i. Director, NP Dte., CWC, Sewa Bhawan, R.K Puram, New Delhi.
ii. Director, PA (C) Dte., CWC, Sewa Bhawan, R.K Puram, New Delhi.

Copy for kind information to :

i. CE, PAO, CWC, Sewa Bhawan, R.K Puram, New Delhi.
ii. CE, PPO, CWC, Sewa Bhawan, R.K Puram, New Delhi.

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास और गंगा संरक्षण विभाग
केन्द्रीय जल आयोग
सिंचाई आयोजन)दक्षिण (निदेशालय

Government of India
Ministry of Jal Shakti
Deptt. of Water Resources, RD&GR
Central Water Commission
Irrigation Planning (South) Directorate

विषय: Lower Orr dam project- Part of Comprehensive Report of Ken-Betwa Link project-reg.

संदर्भ: (i) Email from Project Authorities dated 03.11.2021.
(ii) Email from NP Dte. dated 03.11.2021
(iii) Email from NP Dte. dated 05.11.2021
(iv)Email from Project Authorities dated 05.11.2021.

May please refer to the email received under reference (iii) above vide which NP Dte. of CWC has forwarded the revised finalized cost of the Lower Orr dam project. Further, vide email under reference (ii) above the Project Authorities, Govt. of M.P. has submitted the revised working table and BC ratio computation for examination. The same has been examined and the observations thereon are as under:

Observations:

1. The working table submitted by the project authorities has been examined and it has been found that the same has been prepared from period 1978-79 to 2008-09 (31 years). Further, the working table has been prepared by the project authorities considering the inflow series approved by Hydrology (C) Dte. letter dated 26.04.2016. It has been found that the project authorities have considered the ground water use as 77.91 MCM (20% of 389.53 MCM). This office has earlier vide letter dated 18.10.2021 has asked the project authorities to furnish the letter for the quantum of ground water availability in the command authenticated by the CGWB/State Ground water board. However, no such documents have been furnished to this office yet. It is therefore once again suggested that the project authorities may submit the documents for ground water availability of 77.91 MCM in the command of the project duly authenticated by the CGWB/State Ground water board to this office for reference and record.

   Subject to above, the working table has been examined and success rate thus worked out as 80.65 %. However, if there is any change in points mentioned in para 1 above, the working tables will also need a review to assess the success rate of the project.

2. The cost of the project has now been finalised by the Cost Appraisal (I) Dte. of CWC as Rs. 265703.68 lakhs (at Price level 2017-18) and the same has been forwarded by NP Dte. of CWC vide under reference (iv) above. Based on this, the BC Ratio computation has been worked out by the project authorities as 1.81. The same has

been examined and following observations have been made.

a. The project authorities have considered the benefits of fisheries as Rs. 10500.815 lakhs. The production rate (in kg/ha) and rate per kg of fish has been considered @ Rs. 2000 kg/ha and @ Rs. 300/ kg respectively. However, no supporting documents in respect of production rate (in kg/ha) and rate per kg of fish has been furnished by the project authorities. The project authorities may substantiate these components of cost and benefits by their experience in similar sized reservoirs in MP State. It is suggested that the supporting documents in respect of the benefits related to fisheries may be got approved from the State Fishery Department, MP and a copy of the same may be submitted to this Directorate for reference and record.
b. The benefits from solar power generation of 19 MW has been considered as Rs. 3665.1 lakhs and the solar power purchase rate has been considered @ Rs. 6.43/ Kwhr as per the Retail Supply Tariff Order FY 2017-18 of Madhya Pradesh Electricity Regulatory Commission. However, it is suggested that the solar power purchase rate considered above may also be got vetted by the Central Electricity Authority, New Delhi. PAO may also clarify that the cost of the Power component includes the cost of transmission and distribution also, as the benefit is considered at the retail consumer level.
c. The quantum of power requirement for lift have been assessed as Rs. 4410 per ha by the project authorities. The energy charges have been considered as Rs. 5 per unit as per the Retail Supply Tariff Order FY 2017-18 of Madhya Pradesh Electricity Regulatory Commission. However, it is suggested that the energy charges considered above may also be got vetted by the Central Electricity Authority, New Delhi.
d. The project authorities under reference (iv) above have submitted the certificate of computation of cost towards tubewells as Rs. 1097 lakhs and and the same has been used in the BC Ratio computation.
e. The yield, rates and cost of cultivation (viz. seeds, manure, labour etc.) of crops in pre-project and post project scenario has been forwarded by the NP Dte. of CWC vide reference (iii) above. On examination, it is found that the same has been got approved by the Deputy Director, State Agriculture Department in the format given in the "Guidelines for Submission, Appraisal and Acceptance of Irrigation and Multipurpose Projects, 2017" of CWC *(Appendix F (1) and F(2))* for the purpose of estimating the agricultural benefits. However, as per 2017 guideline of PAO, CWC, the same has to be signed from the Director, State Agriculture Department. PAO, CWC may take a view on this.

Subject to the above and based on veracity of the documents submitted by the project authorities, the BC ratio computation has been checked and found to be 1.81.

This issues with approval of CE (IMO), CWC, New Delhi.

I/75508/2021

Signed by Vineet Gupta
Date: 08-11-2021 10:17:00
Reason: Approved
विनीत गुप्ता
निदेशक - सिंचाई आयोजन (दक्षिण)

To.

i. Director, NP Dte., CWC, Sewa Bhawan, R.K Puram, New Delhi.

(ii) Director, PA (C) Dte., CWC, Sewa Bhawan, R.K Puram, New Delhi.

Copy for kind information to :

(i) CE, PAO, CWC, Sewa Bhawan, R.K Puram, New Delhi.

(ii) CE, PPO, CWC, Sewa Bhawan, R.K Puram, New Delhi.

Annexure-1.2.8

Government of India
भारत सरकार
Central Water Commission
केन्द्रीय जल आयोग
Inter State Matters-2 Dte.
अंतरराज्यीय मामले निदेशालय

204(S), SewaBhawan
204 (द.), सेवा भवन
R.K.Puram, New Delhi-66
रामा कृष्ण पुरम, नई दिल्ली -६६
Telephone No: 011-29583207
Email: ism2dte@gmail.com

Sub: Completion of Techno-economic appraisal of Kotha Barrage Project and Lower Orr Project under Ken-Betwa Link Project (Phase II) – Reg

DPRs of Kotha Barrage Project, Lower Orr Project, Bina Complex Project proposed under phase II of Ken Betwa Link Projects as received from NWDA are under currently under examination from inter-State angle.

In respect of examination of DPR of Kotha Barrage Project, this office had asked the Project Authority vide letter no 2/1/ISM-2/2017/93 dated 17/7/2017 to provide details of approved water utilisation from existing, ongoing and proposed schemes in the entire Betwa sub-basin and/or a copy of updated master plan duly authenticated by Govt. of Madhya Pradesh, to enable this Directorate maintain an account of utilisation of Betwa river waters. Betwa River upstream of Rajghat dam vide their Memo no 372 dated 18/12/2017. In the revised abstract of water use of Betwa River upstream of Rajghat dam, total water utilisation from existing, proposed and ongoing projects in Betwa basin U/S of Rajghat dam including Kotha Barrage and Bina Complex projects has been shown as 52.721 TMC, wherein, inter basin transfer of 1.95 TMC from Dhasan river for Bina complex project has been envisaged. Accordingly the total utilisation as proposed by Govt. of Madhya Pradesh is well within the agreed share of 53 TMC for Madhya Pradesh for new projects U/S of Rajghat dam as per Inter-state agreement dated 1/08/1972 between state of Uttar Pradesh and Madhya Pradesh. However, water utilisation under Kotha Barrage Project as informed by NWDA officials during discussion on 14.11.2017 would be on substitution basis in lieu of transfer of water through Ken-Betwa Link Project (Phase I).

In view of different stand taken by NWDA and Govt. of Madhya Pradesh, this Directorate asked NWDA and Govt. of Madhya Pradesh vide letter no 2/1/ISM-2/2017/16-18 dated 10/1/2018 to reconcile their positions on water utilisation under Kotha Barrage Project. However, the same has not been complied so far.

In respect of Bina Complex Project and Lower Orr dam Projects, this Directorate has asked NWDA vide letter no 2/1/ISM-2/2017/276-78 dated 16/11/2017 to conduct integrated operation study based on 25-30 year inflow series and had requested both the States to confirm/vett the present allocation of water to various canal systems offtaking from Rajghat Dam and downstream structures upto Parichha PUW as submitted by NWDA and also furnish requisite data to NWDA for conducting integrated operation study. Further, Irrigation & WRD, Govt. of Uttar Pradesh was requested to furnish its views/comments on Lower Orr and Bina Complex Project proposals, if any, at the earliest.

However, no comments from either from Madhya Pradesh or Uttar Pradesh have been received so far.

Further, Memorandum of Understanding (MoU) to be signed amongst States of Madhya Pradesh, Uttar Pradesh and Union Government for implementation of Ken-Betwa Link Project is also under discussion/ finalisation. In this regard, CWC has recently furnished its views on modified draft Memorandum of Understanding (MoU) vide letter no 2/1/ISM-2/2017/37 dated 19/1/2018 as asked by NWDA Lr no. NWDA/Tech-II/153/27/2017/23 dated 09.01.2018.

It is also learnt that in order to sort out Inter - state issues, Hon'ble Union Minister of WR, RD & GR has been regularly reviewing the project and also has held meetings with the political leadership of both the States as well as the State govt. officials.. Therefore, it is expected that all outstanding inter-State aspects of Lower Orr project and Bina Complex projects will be brought to a logical conclusion before the further action on the project is initiated by the concerned authorities.

As mentioned above, MoU is also expected to be signed among the States of Madhya Pradesh, Uttar Pradesh and Union Government for implementation of Ken-Betwa Link Project. Therefore, subject to signing of requisite MoU, Kotha Barrage, Lower Orr and Bina Complex Projects may be considered acceptable from inter-State angle.

This issues with approval of Member (WP&P) please.

(Rajesh Kumar)
Director

To:-

1. Chief Engineer (PAO), Central Water Commission, Sewa Bhawan, New Delhi.
2. Chief Engineer (PPO), Central Water Commission, Sewa Bhawan, New Delhi.
3. Director, National Projects Directorate, Central Water Commission, Sewa Bhawan, New Delhi
4. Director, PA © Directorate, Central Water Commission, Sewa Bhawan, New Delhi

CWC U.O. No.2/1/ISM-2/2017/ 40-43 dated 30.1.2018

30.01.18
Dir (ND)
30.01.18
DD S. Kumar 31.1.18
AD-II (NP) Sh. Ziaul Haque

Annexure-1.2.9

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन नदी विकास एवं गंगा संरक्षण विभाग
केंद्रीय जल आयोग
अंतरराज्यीय मामले निदेशालय-2

सत्यमेव जयते

Government of India
Ministry of Jal Shakti
Dept. of Water Resources, RD&GR
Central Water Commission
ISM-2 Directorate

Sub: Examination of Comprehensive Project Report of Ken-Betwa Link Project - Reg.

May kindly refer to Memorandum of Agreement (MoA) amongst the states of Madhya Pradesh, Uttar Pradesh and the Union Government on the implementation of Ken-Betwa link project (KBLP) signed on 22nd March, 2021.

Earlier, this office vide letter dated 20.04.2020 (copy attached) considered Comprehensive Project Report of KBLP acceptable from inter-state angle subject to signing of MoU among the States of Madhya Pradesh, Uttar Pradesh and Union Govt. for implementation of Ken-Betwa Link Project.

Since, MoA on Comprehensive Project Report of Ken-Betwa Link Project has been signed on 22.03. 2021 between Madhya Pradesh, Uttar Pradesh and Union Govt. for implementation of Ken-Betwa Link Project, the project proposal may be considered acceptable from inter-state aspects.

This issues with the approval of Chief Engineer (IMO), CWC.

Encl.: As Above.

(Rajesh Kumar)
Director (ISM-2)

Chief Engineer, PAO, CWC, Sewa Bhawan(S), R.K. Puram, New Delhi
File No. 2/ 1/ ISM-2/ 2017/ 15 2 Date: 02 .07.2021

Signature Not Verified

Digitally signed by RAJESH KUMAR
Date: 2021.07.02 16:26:14 IST

5वां तल, सेवा भवन (द),
राम कृ[illegible]म, नई दिल्ली -110066
दूरभाष: 011-29583268,
ई मेल: [illegible]2dte-cwc@nic.in
ism2d[illegible]mail.com

5th Floor(South), SewaBhawan,
R.K. Puram, New Delhi-110066
Tel: 011-29583268,
E-mail: ism-2dte-cwc@nic.in
ism2dte@gmail.com

NO.2/56/2003-BM / 795-800
GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES
(BM DIVISION)

New Delhi, dated the 7th June, 2006

OFFICE ORDER

Subject:- Steering Committee on Ken-Betwa Link.

A Memorandum of Understanding(MoU) was signed between Union Minister of Water Resources, Chief Ministers of Government of Madhya Pradesh and Uttar Pradesh on 25th August, 2005 in the presence of Dr. Manmohan Singh, Hon'ble Prime Minister of India for preparation of Detailed Project Report(DPR) of Ken-Betwa Link by Central Government. The Ministry of Water Resources, subsequently decided that the DPR of Ken-Betwa Link under National Perspective Plan(NPP) shall be prepared by Natinal Water Development Agency(NWDA). It also decided that a Committee headed by Chairman, Central Water Commission will monitor and supervise the overall work of preparation of DPR of Ken-Betwa link. Accordingly, a Committee to monitor and supervise the overall work of preparation of DPR of Ken-Betwa link was constituted on 16.2.2006. With a view to review the progress of preparation of DPR works of Ken-Betwa Link, a Steering Committee with the following composition is hereby constituted.

i)	Secretary(WR), MoWR	-	Chairman
ii)	Chairman, CWC	-	Member
iii)	Addl.Secretary(WR), MoWR	-	Member
iv)	Director General, NWDA	-	Member
v)	JS & FA, MoWR	-	Member
vi)	Commissioner(Pr.)	-	Member

The Committee shall review the progress of preparation of DPR of Ken-Betwa link on quarterly basis.

(K. VOHRA)
SR.JOINT COMMISSIONER(BM)
☎ 2371 4129

Copy to.

Chairman and All Members

MEMORANDUM OF UNDERSTANDING AMONG THE STATE OF MADHYA PRADESH, THE STATE OF UTTAR PRADESH AND THE UNION GOVERNMENT ON KEN-BETWA LINK PROJECT

Name & Address of Parties

1. State of Madhya Pradesh, Water Resources Department, Vallabh Bhawan, Bhopal.
2. State of Uttar Pradesh, Irrigation Department, Secretariat, Lucknow.
3. Union Government, Ministry of Water Resources, Shram Shakti Bhawan, Rafi Marg, New Delhi.

(A) Whereas the Union Government considers the programme for interlinking of rivers as of national importance and work out ways and means for project funding mechanism including share of the States etc., so as to be able to complete the project within the stipulated time frame.

(B) And whereas the Union Government, in consultation with the States, create appropriate institutional arrangements involving States/Union Government for operation and control of waters in accordance with Agreements reached.

(C) And whereas the States full cooperation towards this task of linking of rivers in the overall interest of the Nation are required:

NOW, THEREFORE, IT IS HEREBY ENTERED INTO UNDERSTANDING BY THE PARTIES AS FOLLOWS:

1. Union Government shall identify and decide the organizational framework necessary for completion of the 'Detailed Project Report' (DPR) and 'Implementation of the Link Projects'

2. Specific MOUs as required will be entered into amongst the States of Uttar Pradesh, Madhya Pradesh and Union Government based on the DPR and Agreements reached on scope of the link, sharing of costs and benefits and arrangements for management and control of water etc.

3. Both the State Governments will gain multipurpose benefits through the Ken-Betwa Link Project as per the Feasibility Studies completed by National

Water Development Agency. In pursuance of the said objective, broad consensus and 'in principle' understanding was arrived at through consensus building efforts of the Union Government and the States as reflected in the Chief Engineer (HQ), NWDA letter No. NWDA/TECH-III/122/17/2004 (Vol. V) dated 5.1.2005 in order to ensure optimum and integrated planning, successful implementation and effective monitoring and operation of Ken-Betwa interlinking project under National Perspective Plan. The apprehensions on water sharing, control mechanism and compensation of power loss etc. raised by States will be addressed at DPR stage.

4. Both the States shall enter into and abide by Agreements with the Union Government and amongst themselves in the larger interest of combating natural calamities of floods and droughts in different regions of the country.

5. Any review/amendment of the MOU shall be done if agreeable to by all the parties.

6. This is being concluded amongst the State of M.P., State of U.P. and Union Government for proceeding ahead on the Ken-Betwa Link Project and taking up the project for preparation of DPR.

Signed at New Delhi on this day of 25th August, 2005.

24-8-2005

(BABULAL GAUR)
Chief Minister of Madhya Pradesh
FOR STATE OF M.P.

25.8.2005

(MULAYAM SINGH YADAV)
Chief Minister of Uttar Pradesh
FOR STATE OF U.P.

(PRIYA RANJAN DASMUNSI)
Minister of Water Resources
FOR UNION GOVERNMENT

Annexure-1.2.10

भारत सरकार
केन्द्रीय जल आयोग
बैराज एवं नहर अभिकल्प (उ. प. एवं द.) निदेशालय

तल-6, सेवा भवन
आर० के० पुरम, नई दिल्ली-66

Subject: Detailed Project Report of Lower Orr Project (Part of Ken Betwa Link Project Phase II) - regd.

Ref: CWC U.O. 4/9/2012/NP-II/1444 dated 25th September 2017

With reference to the letter cited above the DPR of Lower Orr Project has been received for technical examination.

It is observed that the current DPR is part of combined DPRs of Ken-Betwa Link Project Phase-II. The Design chapter of Ken-Betwa Link Project Phase-II was prepared by CWC. The design chapter and drawings had been issued to NWDA vide letter no. 5/23/2013-BCD(NW&S)/201-202. Various components like total length of canal, side slope, bed slope etc. are same.

In view of above, there are no comments on current DPR and the project may be considered technically cleared from this directorate.

This issues with the approval of CE Designs (NW&S).

(अनिल जैन)
निदेशक
बी.पी.एल. स. - 3489

Director, National Projects (NP) Dte., CWC, Sewa Bhawan, R.K.Puram, New Delhi
No. 5/49/2017/BCD(NW&S)/ 681 Dated: 09.10.2017

S. Kumar 20.10.17 AD(NP)

भारत सरकार
Government of India
जलसंसाधन, नदीविकासऔरगंगासंरक्षणमंत्रालय
Ministry of Water Resources, River Development & Ganga Rejuvenation
तटबन्ध (उत्तर-पश्चिम एवं दक्षिण) निदेशालय, केन्द्रीय जल आयोग
Embankment Dams (NW&S) Directorate, Central Water Commission

जल बचत - जल संचय

Sub.: Detailed Project Report of **Lower ORR Project** (Part of Ken-Betwa Link Project Phase-II) –reg

Reference is invited to the CWC U.O. No. 4/9/2012/NP-II/1368-70 dated 05-09 -2017 on the above cited subject. The Detailed Project Report of **Lower ORR Project** (Part of Ken-Betwa Link Project Phase-II) is received for appraisal.

Design Chapter and drawings of earthen dam for Ken-Betwa Link Project Phase-II was prepared in CWC in January 2014. The **Lower ORR Project** is part of Ken-Betwa Link Project Phase-II. The proposal present in the submitted DPR is at the same location for which design chapter was prepared. In view of the above this directorate has no comments on earthen dam part of DPR.

14/9/17

Anil Jain
Director, Emb.(NW&S)

o/c

Director, National Projects Dte., CWC, 2B, 8th Floor(N), Sewa Bhawan ,
CWC U. O. No. 2 / 5 / 2017/ Emb. (NW&S) /960 Dated: 14 /09 /2017

Lower ORR Balance failed

सेवाभवन (दक्षिण), छठवींमंजिल, आर०के०पुरमसेक्टर-१, नईदिल्ली-११००६६
फ़ोन: 011-29583494, Fax.-011-26102420, ई-मेल:embnwsdte@nic.in

भारत सरकार
केंद्रीय जल आयोग
यंत्रीकरण निदेशालय

सातवाँ तल (द॰) सेवा भवन,
आर॰ के॰ पुरम नई दिल्ली

विषय: मध्य प्रदेश की लोअर ओर परियोजना (केन – बेतवा लिंक परियोजना फेज –II) के अनुपालन रिपोर्ट की जांच। Lower Orr Project (Ken - Betwa Link Project Phase - II) Madhya Pradesh Examination of Compliance report.

संदर्भ: No. 4 / 9 / 2012 / NP – II / 1710 दिनांक 29.11. 2017

Reference is invited to the letter cited above vide which compliance report of **Lower Orr Project** (Ken - Betwa Link Project Phase- II) Madhya Pradesh, on this office letter no. CWC/Inst./1-198/2017/355 dated 16.11.2017 has been forwarded for examination.

Compliance report has been examined in this directorate and found, generally, in order. However some observations are as below:

Concrete dam:

1. Instrumentation will be provided only in dam portion not in training wall. Stress meter and No stress strain meter will be install along with strain meters (Group of five) and vertical distance of temperature meter will be about 15 meters as shown in Max. non-overflow section.
2. Plumb lines have been shown in the drawing of upstream elevation section but not shown in Max. Overflow and Max. non-overflow section which may be done.
3. On the upstream and down stream faces, four number temperature meters will be install at the distance of 15 cm, 1 m,2 m, and 3 m from the face.

Earthen dam:

1. Embankment Piezometer may also be installed in impervious soil.

A mechanism for monitoring the observations, data analysis and its availability may also be insured.

Subject to incorporating the above suggestions / observations in the DPR, Lower Orr Project (Ken - Betwa Link Project Phase - II) Madhya Pradesh, stand cleared with respect to instrumentation aspects.

This issues with the approval of Chief Engineer (DSO), CWC.

(निरंजन घर) 4/12/2017
निदेशक

निदेशक, राष्ट्रीय परियोजना निदेशालय, केंद्रीय जल आयोग, नई दिल्ली।

यू॰ओ॰ संख्या यंत्री॰ /1-198/2017/376 दिनांक 04/12/2017

DD
4/12/2017

भारत सरकार
केन्द्रीय जल आयोग
निर्माण मशीनरी सलाहकारी निदेशालय
छठवॉ तल (द•), सेवा भवन, आर. के. पुरम, नई दिल्ली-110066, दूरभाष- 011-29583214, ईमेल: cmcdte@nic.in

Sub: Detailed Project Report of Lower Orr Project (Part of Ken Betwa Phase-II)-reg.
Ref: CWC U.O. No. 4/9/2012/NP-II/1352-53 Dated 29 August, 2017

Reference is invited to the letter cited above vide which DPR of the subject project was sent to this office for examination from plant planning aspects. The DPR has been examined and it is found to be general in order from plant planning aspects.

As far as provision under 'Q-Special T & P' sub head of the cost estimate is concerned, it is observed that a total provision of equipment worth Rs. 5391.08 Lakh (Rs. 3132.75 Lakh for Unit-I and Rs. 2258.33 Lakh for Unit-II) has been made by the Project Authorities which includes major construction equipment of worth Rs. 4969.23 Lakh (Rs. 2796.45 Lakh for Unit-I and Rs. 2172.78 Lakh for Unit-II) and general purpose construction equipment & transport/inspection vehicles worth Rs. 421.85 Lakh (Rs. 336.30 Lakh for Unit-I and Rs. 85.55 Lakh for Unit-II).

It is pertinent to mention here that now-a-days, major construction works are being executed through award of contract by contracting agencies. It is to say that the ownership cost of all the construction equipment for any major contractual work is borne by the contractor and that cost of the machineries is built in the item rate of works. As the major components are proposed to be executed through contract in the project, the provision should be limited only to general purpose equipment & inspection vehicles equipment for departmental ownership. Accordingly, the list of proposed equipment has been reviewed & revised and prices corrected, wherever required. Hence, total provision for equipments under Q-special T&P works out to **Rs. 174.50 Lakh (Rs. 69.00 Lakh for Unit-I and Rs. 105.50 Lakh for Unit-II)** & list is given at Annexure-I.

In view of the above, the project is considered acceptable from plant planning aspects with equipment worth of Rs 174.50 Lakh under Q-Spl. T&P sub head of the cost estimate of the project.

This issues with the approval of CE (CMO), CWC.

Encl: As above

28/11/2017
(Sureshwar Singh Bonal)
Director

Director, National Project Directorate, CWC, Sewa Bhawan, R K Puram, New Delhi
CWC U.O. No. 21/MP/24/2017/437 Dated: 28/11/2017

Annexure-I

Lower Orr Project				
Q-Special T&P sub-head				
Sr. No.	Name of Equipments	Nos.	Unit rate (Rs. in lacs)	As accepted by CMC Dte. (Rs. in Lacs)
For Unit-I				
1	Ambulance	1	10.00	10.00
2	Bus	1	16.00	16.00
3	Car	2	6.50	13.00
4	Jeep	5	6.00	30.00
			Total for Unit-I	**69.00**
For Unit-II				
1	Ambulance	1	10.00	10.00
2	Bus	1	16.00	16.00
3	Car	3	6.50	19.50
4	Jeep	10	6.00	60.00
			Total for Unit-II	**105.50**

Total Cost	**174.50**

Minutes of the 93rd Meeting of the Expert Appraisal Committee (EAC) for River Valley and Hydroelectric Projects held on 2nd May, 2016 at Indus Meeting Hall, Ground Floor, Jal Wing, Indira Paryavaran Bhawan, Jor Bagh Road, New Delhi – 110003.

The 93rd Meeting of the EAC for River Valley and Hydroelectric Projects (RV &HEPs) was held on 2nd May, 2016 at Indus Meeting Hall, Ground Floor, Jal Wing, Indira Paryavaran Bhawan, Jor Bagh Road, New Delhi – 110003. The meeting was chaired by Shri Alok Perti, Chairman, RV &HEPs. The list of EAC members and officials/consultants associated with various projects and who attended the meeting is at Appendix.

The following Agenda items were taken-up in that order for discussions:

Agenda Item No.1: Welcome by Chairman and confirmation of Minutes of the 92nd Meeting of EAC held on 28th -29th March, 2016. Thereafter, following agenda items were taken-up:

Agenda Item No 2.1: Nandprayag-Langasu HEP (100 MW) on Alaknanda River in Dist. Chamoli, Uttarakhand by M/s UJVN Limited- for consideration of Environmental Clearance.

1. The Nandprayag-Langasu HEP (100 MW) is proposed in the middle reach of the Alaknanda Basin to meet the requirement of power shortage in the Northern region in general and in the country as whole. The project has been conceptualized as a Run-of-the-River (RoR) scheme with 162 m wide gated barrage comprising of one under sluice (11.6 m wide) and 7 barrage bays of 18m width each with 10.3m height above the river bed and utilising a design discharge of 268.46 cumecs of Alaknanda river for power generation. The Project Site is located on NH-58 (New Delhi-Badrinath) almost midway between Karanprayag and Nandprayag in district Chamoli of Uttarakhand State and is about 190 Kms from the nearest railhead Rishikesh. The nearest airfield Jolly Grant is about 210 km from the barrage site. The barrage site is approachable from NH-58 (Delhi-Badrinath Road) upto Nandprayag and thereafter by Nandprayag – Devikhal – Gopeshwar district road.

2. During the presentation, Project Proponent (PP) informed that Hon'ble Supreme Court vide orders dated 12-08-2014 and dated 12.10.2015 clarified that ban imposed on Hydroelectric Power Projects (HEPs) was applicable to 24 HEPs mentioned in the report of Wildlife Institute of India, Dehradun (WII). Further as Nand Prayag Langasu HEP is not listed in the said 24 project, this project may be considered for Environment Clearance.
3. It was informed that Terms of Reference (ToR) for the project was issued in October 2010 for 2 years. Repeated communications were made with MoEF & CC for extension of TOR from October 2012 onwards upto December 2016 by the Project Proponent, but no communication was received from MoEF & CC. Therefore, in

- NMCG has further informed that the ban on environmental clearance to Hydro Power Projects in Uttarakhand was applicable only to the projects in Bhagirathi and Alaknanda River Basins. Whereas, the Pancheshwar Multipurpose Project is located in Sarada River Basin. As such the ban is not pertaining to it.

- EAC recommended that an Integrated EIA study covering Indian and Nepal portion be presented for obtaining Environmental Clearance.

After the detailed deliberations, the EAC noted that under the present dispensation there is no provision for giving TORs for part of any project. Since this is a special case where a project is proposed to be implemented by a joint establishment agreed to by India and Nepal the matter needs a special consideration. In order to ensure that studies on preparation of EIA/EMP are not delayed the EAC recommends that TOR for the portion of project falling in India subject to the following conditions:

i. A joint mechanism be set-up for considering the assessment of environmental impact of the full project. While considering the full project by the proposed joint mechanism a need arises to modify the TORs the same may be consider by the EAC for modification of TORs. The EIA/EMP prepared for the full project by the Project Proponent should be placed before the entity established through the joint mechanism mentioned earlier for examination and for recommendation to be given to the Ministries of Environment in both countries for acceptance.
ii. The EIA/EMP studies as depicted in the model ToR of MoEF&CC effective from April 2015 shall be carried out.
iii. Skill mapping of project affected families shall be carried out and suitable provisions shall be made in R&R plan.
iv. Minimum e-flow discharge of 20%, 25% and 30% should be planned for Lean season, Non-lean season and monsoon.

Agenda Point 2.6: Lower Orr Dam under Ken-Betwa Link Project-Phase-II, Water Resources Department, Govt. Of Madhya Pradesh and M/s National Water Development Agency for reconsideration of EC.

The project proponent made a detailed presentation on the project and informed the Expert Appraisal Committee for River Valley and Hydroelectric Projects that project was appraised in 91st meeting held on 8-9 February, 2016. It was clarified that the Lower Orr is an independent project of Govt. of M.P and is not related to Ken-Betwa link project, however, as and when Ken-Betwa link project materializes, the Lower Orr project shall become an integral part of Ken-Betwa Link Project Phase-II.

2. It was noted that the project is proposed across Orr River which is a tributary to Betwa River near the village Didauni on the border of Shivpuri & Ashok Nagar Districts in Madhya Pradesh. The main objective of the Lower Orr project is to provide irrigation and domestic water supply to water deficit areas of Shivpuri and Datia Districts of Madhya Pradesh. The proposed dam site is located at a distance of about 6 km

from Chanderi - Pichhore Road. The total catchment area of Orr river upto Lower Orr dam is 1843 Sq. km. The 75% & 50% dependable annual yield of the sub-basin upto the proposed dam site has been assessed as 362.53 MCM and 501.15 MCM respectively.

3. The project envisages construction of a composite dam. In the proposed composite dam, the concrete dam portion is 487 m long with 247 m long spillway & 240 m long Non Overflow blocks. The earthen portion of dam is 1731 m long with a maximum height of 45 m. A 91.260 Km long main canal has been proposed on the left bank of river. The FRL of the Lower Orr project is kept as 380 m. The total submergence area is about 2723.70 ha. It is proposed to provide irrigation facility to 67,570 ha in Shivpuri and Datia Districts with 150% irrigation intensity utilizing 329.67 MCM. Beside 6 MCM water will be provided for drinking water supply to the enroute villages and towns in the vicinity of the canal. About 1.65 lakh people will get drinking water facility.

3. The total land requirement for proposed project is 3730 ha. The total land coming under submergence area and canal network is 2723.70 ha and 1006 ha respectively.

4. The flows for various dependable years like 50%, 75 % and 90% are 501.15 MCM, 361.965 MCM and 263.98 MCM respectively. A provision of 6 MCM of water has been kept for providing drinking water to enroute villages and towns of Lower Orr canal off taking from proposed Lower Orr dam.

5. The project proponent made a detailed presentation in response to issues raised during the 91st EAC meeting. The key issues raised covered were:

- A detailed Livelihood Plan has been prepared as a part of SIA Report and is outlined as Chapter-6 of Volume-II covering Social impact Assessment Report. As a part of the plan, training to one member from each PAF is envisaged
- Skill mapping shall be done during the implementation of Livelihood Plan
- It was confirmed that as a part of SIA report, R&R plan has been prepared as per Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013. The approval for R&R plan shall be taken at the time of implementation from the State Government, who are also the implementing agency.
- Fisheries reported from the study area are mainly carps, cat fishes, murrels and trace fishes, which belongs to 12 families, 16 genera and 22 species. The fish communities occurring in the area are broadly categorized in to four groups. Among them murrels are the dominant group which constitute 52% followed by carps (28%), cat fishes (7 %) and miscellaneous /trash fishes (13%).
- As a part of the study, the recommended Environmental Flows for Lower Orr Project are given below:

Month	Average Monthly discharge for 75% Dependable Year (Mm^3)
June	6.422
July	24.180
August	9.633
September	1.157
October	1.179
November	0.956
December	0.449
January	0.635
February	0.260
March	0.026
April	0.001
May	0.000
Total	44.898

- An amount of Rs. 8.09 crores earmarked for Environmental Management Plan includes:

  a) Rs. 2.50 crores for fish hatcheries;

  b) Rs. 2.20 crores for fishing boats, fish nets, training, etc.

  c) Rs. 2.75 crores for fish transport and post harvest facilities; and

  d) Rs. 64 lakhs for other aspects

  Thus, it was clarified that a detailed Fisheries Management Plan covering fish hatcheries, fishing boats, fish nets, training, fish transport and post harvest facilities has been prepared.

- The Lower Orr dam is an independent project of state government of Madhya Pradesh proposed on a tributary of Betwa and decided to include under Ken-Betwa link project, Phase-II. There will not be any adverse impact of this project on Ken-Betwa link project and vice-versa. The recommendation of EIA study for Ken Betwa Link Project pertaining to Lower Orr Project shall be adhere to.

- It is requested that the Environmental Clearance (EC) for the project may kindly be accorded as per the approved TOR for which final EIA & EMP report has already been submitted and appraised in the 91st EAC meeting held on 8-9 February, 2016. For additional command area considering the pressurized irrigation, the case will be processed separately.

- EIA Report has been prepared as per the approved ToR and EIA report for additional command area shall be prepared separately and then public hearing through SPCB shall be conducted.

After detailed deliberations, the EAC recommended the project for grant of Environmental Clearance as per the ToR approved for Lower Orr Project.

F. No. 8-08/2016-FC
Government of India
Ministry of Environment, Forest and Climate Change
(Forest Conservation Division)
****

Indira Paryavaran Bhawan
Jorbagh Road, Aliganj
New Delhi – 110 003
Dated: 12th February, 2019

To,

The Principal Secretary (Forests)
Forest Department
Government of Madhya Pradesh
Bhopal.

Sub: Diversion of 968.24 hectares of forest land in favour of National Water Development Agency, Ashoknagar and Shivpuri District for construction of Lower Orr Major Irrigation Project (Ken- Betwa link project), Madhya Pradesh State (Online Proposal No. FP/MP/IRRIG/7403/2014) regarding.

Sir,

I am directed to refer to the Addl. Principal Chief conservator of Forests (Land Management) and Nodal Officer, Forest (Conservation) Act, 1980, State Government of Madhya Pradesh's letter No. F-3/50/2014/10-11/15/886 dated 25.04.2016 on the above cited subject, seeking prior approval of Central Government under Section-2 of the Forest (Conservation) Act, 1980, and to say that the said proposal has been examined by the Forest Advisory Committee constituted by the Central Government under Section-3 of the aforesaid Act.

2. After careful consideration of the proposal of the State Government of Madhya Pradesh and on the basis of the recommendations of the Forest Advisory Committee, the Central Government hereby agrees ***to accord stage-I / In-principle*** approval under Section 2 of the Forest (Conservation) Act, 1980 for the diversion of 968.24 hectares of forest land in favour of National Water Development Agency, Ashoknagar and Shivpuri District for construction of Lower Orr Major Irrigation Project (Ken- Betwa link project), Madhya Pradesh State, subject to the following conditions:-

(i) Legal status of the diverted forest land shall remain unchanged;

(ii) The Compensatory Afforestation shall be done over equal non-forest land (NFL) to the forest area proposed to be diverted within a period of three years with effect from the date of issue of Stage-II clearance and maintained thereafter in accordance with the approved Plan in consultation with the State Forest Department at the cost of the user agency. At least 1000 saplings per hectares shall be planted over 968.24 ha. (968240 plants). If this is not possible to plant these many seedlings in the identified NFL, the balance seedlings will be planted in degraded forest land as per the prescriptions of the Working Plan at the cost of the User agency. In such case CA cost will be revised and duly approved by competent authority and deposited online in the CAF managed by CAMPA;

(iii) The user agency shall submit the revised cost benefit analysis, after considering the ecological cost of being diverted forest area;

(iv) The State Government and the user agency shall ensure that the water flow downstream shall be regulated in line with the natural flow regime

and, in the lean period, 100% of the existing flow regime should be maintained while in the non-lean period, the prescribed minimum flow of water by hydrology and aquatic biodiversity experts should be ensured. The minimum flow of water in the Ken River will be maintained till it joins the Yamuna to save wildlife including crocodiles and other aquatic animals. The user agency shall also construct a number of concrete dykes across smaller streams going off from the main reservoir which during FRL shall be over flown but which during lean season shall dam up small isolated water bodies for the benefit of the wildlife;

(v) The State Government and the user agency shall ensure that the canal should be realigned to minimize the use of forest land for construction of canal;

(vi) Along the canal alignment, structural interventions, shall be carried out at wildlife cross over points, which are duly camouflaged and mimic nature, at cost to the user agency, so that dispersal is not hindered;

(vii) The land identified for the purpose of CA shall be clearly depicted on a Survey of India toposheet of 1:50,000 scale;

(viii) The identified non-forest land to be transferred and mutated in favour of the State Forest Department for raising Compensatory Afforestation shall be notified as reserved Forest under Section-4 or Protected Forest under Section-29 of the Indian Forest Act, 1927 or under the relevant Section(s) of the local Forest Act. The Nodal officer must report compliance within a period of 6 month from the date of grant of final approval and send a copy of the notification declaring the non-forest land under Section 4 or Section 29 of the Indian Forest Act, 1927, or under the relevant section of the local Forest Act as the case may be, to this Ministry for information and record;

(ix) The User Agency shall transfer the cost of raising and maintaining the compensatory afforestation at the current wage rate in consultation with State Forest Department in the account of Ad-hoc CAMPA of the concerned State through online portal. The scheme may include appropriate provision for anticipated cost increase for works scheduled for subsequent years;

(x) The User Agency shall provide additionally 25% of the CA cost towards Soil and Moisture Conservation measures in the proposed CA area as per site requirement and the said amount may be deposited in the account of Ad-hoc CAMPA of the concerned State through online e-portal only;

(xi) The User Agency shall transfer online, the Net Present Value (NPV) of the forest land being diverted under this proposal, as per the orders of the Hon'ble Supreme Court of India dated 28.03.2008, 24.04.2008 and 09.05.2008 in Writ Petition (Civil) No. 202/1995 and the guidelines issued by this Ministry vide its letter No. 5-3/2007-FC dated 05.02.2009. The requisite funds shall be transferred through online portal into Ad-hoc CAMPA account of the State Concerned;

(xii) Any fund received from the user agency under the project and deposited in the State Forest Department account, except the funds realized for regeneration/ demarcation of safety zone, shall be transferred through online portal into Ad-hoc CAMPA account of the State Concerned;

(xiii) The user agency should ensure that the compensatory levies (CA cost, NPV etc.) are deposited through challan generated online on web portal and

deposited in appropriate bank online only. Amount deposited through other mode will not be accepted as compliance of the Stage –I clearance;

(xiv) At the time of payment on the Net Present Value (NPV) at the then prevailing rate, the User Agency shall furnish an undertaking to pay the additional amount of NPV, if so determined, as per the final decision of the Hon'ble Supreme Court of India;

(xv) The approved Catchment Area Treatment (CAT) Plan shall be implemented at the cost of user agency. The commensurate cost of CAT plan will be deposited in Compensatory Afforestation Fund of the State;

(xvi) The State Govt. shall submit a certificate, that site for CA is suitable and free from all encroachments and other encumbrances, under the signature not below the rank of Nodal Officer (FCA) in the State Government;

(xvii) User agency shall obtain the Environment Clearance as per the provisions of the Environment (Protection) Act, 1986, if required;

(xviii) The State Government shall ensure that the forest land located between FRL and the FRL-4 meters may be afforested by planting appropriate indigenous tree species;

(xix) The User Agency shall undertake afforestation along the periphery of the reservoir;

(xx) User agency shall provide free water for the forestry related projects;

(xxi) Layout plan of the proposal shall not be changed without the prior approval of the Central Government;

(xxii) No labour camp/huts shall be established on the forest land;

(xxiii) The forest land shall not be used for any purpose other than that specified in the proposal and under no circumstances be transferred to any other agency, department or person;

(xxiv) Felling of trees, if unavoidable on the forest land being diverted shall be reduced to the bare minimum and trees should be felled under strict supervision of the State Forest Department. Moreover it shall be ensure that wherever possible maximum marked trees for felling should be translocated in the consultation of the State Forest Department;

(xxv) The State Government ensure that the user agency shall implement the R&R Plan as per the R&R Policy of State Government in consonance with National R&R Policy, Government of India before the commencement of the project work. The said R&R Plan will be monitored by the State Government / Regional Office of MoEF&CC along with indicators for monitoring and expected observable milestones;

(xxvi) To prevent illegal occupation /encroachment of the forest land by the families to be displaced from the project site, the user agency shall ensure that each family being displaced from the project site actually acquires and settles on non-forest land. Apart from taking other measures to achieve the said objective, as a measure to discourage the project affected families from encroachment on the forest land, payment of annuity for a period of atleast five years at the rate of the minimum wages payable to the unskilled person for 200 person –days per annum to each adult member of the project affected families, on receipt of a certificate signed by a forest officer not below the rank of a Range Officer having jurisdiction over the area where such person has settled after displacement from the project site,

should be incorporated in the R & R plan. Payment of the said annuity should be an additionality and not in replacement of any of the benefits to be accrued to the project affected persons, as per the approved R&R plan;

(xxvii) The User Agency shall track location of each displaced family and ensure none of them encroach/occupy forest land. In support of compliance to the said condition at least for five years from the date of taking possession of the forest land, the user agency shall submit an annual certificate to the PCCF, Madhya Pradesh that none of the persons displaced from the project land has encroached / settled on the forest land during the year;

(xxviii) The Forest Department shall prepare a plan of Action to utilize the water potential available nearby for the benefit of forest crop and also to the Wild animals at the cost of user agency;

(xxix) A plan for conservation of Wildlife will be made by the user agency in consultation with the PCCF (Wildlife) to be implemented at the cost of user agency;

(xxx) User agency in consultation with the State Forest Department shall create and maintain alternate habitat/home for the avifauna, whose nesting tress are to be cleared in this project. Bird nests artificially made out of eco-friendly materials shall be used in the area, including forest area and human settlements, adjoining the forest area being diverted for the project;

(xxxi) State Government shall complete settlement of rights, in terms of the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, if any, on the forest land to be diverted and submit the documentary evidence as prescribed by this Ministry in its letter No. 11-9/1998-FC (pt.) dated 03.08.2009 read with 05.07.2013 in support thereof;

(xxxii) The user agency shall provide alternate fuels to the labourers and the staff working at the site so as to avoid any damage and pressure on the nearby forest areas;

(xxxiii) Boundary of the forest land proposed to be diverted shall be demarcated on ground at the project cost, by erecting four feet high reinforced cement concrete pillars, each inscribed with its serial number, forward and back bearing, distance from pillar to pillar and GPS co-ordinates;

(xxxiv) The State Government shall maintain the character of the projects as an irrigation project and to ensure continued benefit to the farmers in the command area, no more diversion of water from the project for industrial projects will be permitted in future;

(xxxv) Any other condition that the concerned Regional Office of this Ministry may stipulate, from time to time, in the interest of conservation, protection and development of forests & wildlife with the approval of the competent authority;

(xxxvi) The user agency shall submit the annual self-compliance report in respect of the above conditions to the State Government, concerned Regional Office and this Ministry by the end of March of every year regularly; and

(xxxvii) The user agency and the State Government shall ensure compliance to provisions of the all Acts, Rules, Regulations, Guidelines, relevant Hon'ble Court Order (s) and National Green Tribunal (NGT) Order(s), if any,

pertaining to this project for the time being in force, as applicable to the project

3. After receipt of the report on compliance to the conditions stipulated in the paragraph-2 above, from the State Government of Madhya Pradesh, final / stage-II approval for diversion of the said forest under Section-2 of the Forest (Conservation) Act, 1980 will be issued by this Ministry. Transfer of the said forest land to the user agency shall not be effected by the State Government of Madhya Pradesh till final/stage-II approval for its diversion is issued by this Ministry.

Yours faithfully,

(Shrawan **Kumar Verma**)
Dy. Inspector General of Forests

Copy to:-

1. The Principal Chief Conservator of Forests, Government of Madhya Pradesh, Bhopal.
2. The Addl Principal Chief Conservator of Forests (Central), Regional Office (Western Zone), Bhopal.
3. The Nodal Officer, under the forest (Conservation) Act, 1980, Forest Department, Government of Madhya Pradesh, Bhopal.
4. User Agency.
5. Monitoring Cell, FC Division, MoEF & CC, New Delhi, for uploading
6. Guard File.

(Shrawan **Kumar Verma**
Dy. Inspector General of Forests

Government of India
Ministry of Environment, Forest and Climate Change
(Forest Conservation Division)
****

Indira Paryavaran Bhawan,
Jor Bagh Road, Aliganj,
New Delhi – 110003.
Dated: 06th May, 2021

To,
The Principal Secretary (Forests),
Department of Forests and Environment,
Government of Madhya Pradesh,
Bhopal.

Sub: Diversion of 968.24 hectares of forest land in favour of National Water Development Agency, Ashoknagar and Shivpuri District for construction of Lower Orr Major Irrigation Project (Ken- Betwa link project), Madhya Pradesh State (Online Proposal No. FP/MP/IRRIG/7403/2014) - regarding.

Sir,

I am directed to refer to the Addl. Principal Chief conservator of Forests (Land Management) and Nodal Officer, Madhya Pradesh's letter No. F-3/50/2014/10-11/15/886 dated 25.04.2016 on the above cited subject, seeking prior approval of Central Government under Section2 (ii) of the Forest (Conservation) Act, 1980. After careful consideration of the proposal by the Forest Advisory Committee (FAC) constituted by the Central Government under Section-3 of the said Act, ***'In-principle /Stage –I'*** approval to the proposal was accorded vide this Ministry's letter dated 12.02.2019 subject to fulfillment of certain conditions prescribed therein.

2. In this connection, on the basis of the compliance report furnished by the Addl. Principal Chief Conservator of Forests (Land Management) and Nodal Officer, Madhya Pradesh vide letter No. F-3/50/2014/10-11/15/3284 dated 30.09.2020, letter No. F-3/50/2014/10-11/15/3757 dated 07.11.2020, letter No. F-3/50/2014/10-11/15/259 dated 15.01.2021, letter No. F-3/50/2014/10-11/15/1015 dated 16.03.2021, letter No. F-3/50/2014/10-11/15/1129 dated 24.03.2021 and letter No. F-3/50/2014/10-11/15/1357 dated 15.04.2021 ***'Stage-II/Final approval'*** of the Central Government is hereby accorded under Section-2(ii) of the Forest (Conservation) Act, 1980 for diversion of 968.24 hectares of forest land in favour of National Water Development Agency (NDWA), Ashoknagar and Shivpuri District for construction of Lower Orr Major Irrigation Project (Ken- Betwa link project), in Madhya Pradesh State, subject to fulfillment of the following conditions:

A: Conditions which need to be complied prior to handing over of forest land to user agency by the State Govt.:

i. The State Government shall ensure that the user agency shall implement the R&R Plan as per the R&R Policy of State Government in consonance with National R&R Policy, Government of India before the commencement of the project work. The said R&R Plan will be monitored by the State Government / Regional Office of MoEF&CC along with indicators for monitoring and expected observable milestones;

06/05/2021

ii. The State Government shall ensure that compliance of Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 has been completed in accordance with the relevant Rules and Guidelines issued by the MoEF&CC in this regard, before handing over of forest land to the user agency;

iii. The State Government shall ensure that proposed forest land i.e. 968.24 ha shall be handed over to the user agency only when the user agency has acquired the required non-forest land, if any, for the project;

iv. The User Agency shall obtain the Environment Clearance as per the provisions of the Environmental (Protection) Act, 1986, if required;

v. The State Government shall upload the KML files of the area under diversion and the accepted area for raising compensatory afforestation in the E-Green Watch portal of FSI, before handing over forest land to the user agency;

B: Conditions which need to be complied after handing over of forest land to the user agency by the State Govt.:

i. Legal status of the forest land shall remain unchanged;

ii. The identified non-forest land transferred and mutated in favour of the State Forest Department for raising Compensatory Afforestation shall be notified as reserved Forest under Section-4 or Protected Forest under Section-29 of the Indian Forest Act, 1927 or under the relevant Section(s) of the local Forest Act. The Nodal officer must report compliance within a period of 6 month from the date of grant of final approval and send a copy of the notification declaring the non-forest land under Section 4 or Section 29 of the Indian Forest Act, 1927, or under the relevant section of the local Forest Act as the case may be, to this Ministry for information and record;

iii. The State Government and the user agency shall ensure that the water flow downstream shall be regulated in line with the natural flow regime and, in the lean period, 100% of the existing flow regime should be maintained while in the non-lean period, the prescribed minimum flow of water by hydrology and aquatic biodiversity experts should be ensured. The minimum flow of water in the Ken River will be maintained till it joins the Yamuna to save wildlife including crocodiles and other aquatic animals. The user agency shall also construct a number of concrete dykes across smaller streams going off from the main reservoir which during FRL shall be over flown but which during lean season shall dam up small isolated water bodies for the benefit of the wildlife;

iv. Along the canal alignment, structural interventions, shall be carried out at wildlife cross over points, which are duly camouflaged and mimic nature, at cost to the user agency, so that dispersal is not hindered;

v. The State Government shall ensure approved Catchment Area Treatment (CAT) Plan shall be implemented at the cost of user agency;

vi. The State Government shall ensure that the forest land located between FRL and the FRL-4 meters shall be afforested by planting appropriate indigenous tree species;

vii. The User Agency shall undertake afforestation along the periphery of the reservoir;

viii. User agency shall provide free water for the forestry related projects;

06/05/2021

ix. Layout plan of the proposal shall not be changed without the prior approval of the Central Government;

x. No labour camp/huts shall be established on the forest land;

xi. The forest land shall not be used for any purpose other than that specified in the proposal and under no circumstances be transferred to any other agency, department or person;

xii. Boundary of the forest land proposed to be diverted shall be demarcated on ground at the project cost, by erecting four feet high reinforced cement concrete pillars, each inscribed with its serial number, forward and back bearing, distance from pillar to pillar and GPS co-ordinates;

xiii. Felling of trees, if unavoidable on the forest land being diverted shall be reduced to the bare minimum and trees should be felled under strict supervision of the State Forest Department. Moreover it shall be ensure that wherever possible maximum marked trees for felling should be translocated in the consultation of the State Forest Department;

xiv. To prevent illegal occupation/encroachment of the forest land by the families to be displaced from the project site, the user agency shall ensure that each family being displaced from the project site actually acquires and settles on non-forest land. Apart from taking other measures to achieve the said objective, as a measure to discourage the project affected families from encroachment on the forest land, payment of annuity for a period of at-least five years at the rate of the minimum wages payable to the unskilled person for 200 person -days per annum to each adult member of the project affected families, on receipt of a certificate signed by a forest officer not below the rank of a Range Officer having jurisdiction over the area where such person has settled after displacement from the project site, should be incorporated in the R&R plan. Payment of the said annuity should be an addition and not in replacement of any of the benefits to be accrued to the project affected persons, as per the approved R&R plan;

xv. The User Agency shall track location of each displaced family and ensure none of them encroach/occupy forest land. In support of compliance to the said condition at least for five years from the date of taking possession of the forest land, the user agency shall submit an annual certificate to the PCCF, Madhya Pradesh that none of the persons displaced from the project land has encroached/settled on the forest land during the year;

xvi. The User Agency in consultation with the State Forest Department shall create and maintain alternate habitat/home for the avifauna, whose nesting tress are to be cleared in this project. Bird nests artificially made out of eco friendly materials shall be used in the area, including forest area and human settlements, adjoining the forest area being diverted for the project;

xvii. The User Agency shall provide alternate fuels to the labourers and the staff working at the site so as to avoid any damage and pressure on the nearby forest areas;

xviii. The State Government shall maintain the character of the projects as an irrigation project and to ensure continued benefit to the farmers in the command area, no more diversion of water from the project for industrial projects will be permitted in future;

xix. The User Agency shall pay the additional amount of NPV, if so determined, as per

06/05/2021

the final decision of the Hon'ble Supreme Court of India;

xx. The layout plan of the proposal shall not be changed without prior approval of Central Government;

xxi. No additional or new path will be constructed inside the forest area for transportation of construction materials for execution of the project work;

xxii. The period of diversion under this approval shall be co-terminus with the period of lease to be granted in favour of the user agency or the project life, whichever is less;

xxiii. No damage to the flora and fauna of the area shall be caused;

xxiv. The Violation of any of these conditions will amount to violation of Forest (Conservation) Act, 1980 and action would be taken as per the para 1.21 of comprehensive guidelines issued vide this Ministry F. No.5-2/2017-FC dated 28th March, 2019;

xxv. Any other condition that the Ministry of Environment, Forests & Climate Change may stipulate from time to time in the interest of conservation, protection and development of forests & wildlife shall be carried out by the State Government and User Agency; and

xxvi. The State Government and User Agency shall ensure compliance of all conditions stipulated in the Stage-I approval letter dated 10.07.2019 for which undertakings have been obtained from the user agency and also the provisions of the all Acts, Rules, Regulations and Guidelines, relevant Hon'ble Court Order (S) and NGT Order (S), if any, pertaining to this project for the time being in force, as applicable to the project;

Yours sincerely,

06/05/2021

(Shrawan Kumar Verma)
Dy. Inspector General of Forests

Copy to: -

1. The Principal Chief Conservator of Forests & HoFF, Department of Forest, Government of Madhya Pradesh, Bhopal;
2. The Regional Officer, Integrated Regional Office, MoEF&CC, Bhopal;
3. The Nodal Officer (FCA), Department of Forest, Government of Madhya Pradesh, Bhopal;
4. The User Agency;
5. The Monitoring Cell, FC Division, MoEF & CC, New Delhi, for uploading on PARIVSEH portal.

Annexure-1.2.13

No. 17014/04/2018-FRA
Government of India
Ministry of Tribal Affairs

Room No. F280,
August Kranti Bhawan
New Delhi-110066
Dated: 3rd October, 2018

To

The Executive Engineer & Authority,
National Water Development Agency,
(Ministry of Water Resources, River Development and Ganga Rejuvenation),
A-3 Saqhyog Parisar, E-8, Shahpura, Main Road,
Bhopal.

Subject:- Clearance of the Rehabilitation and Resettlement Plan for Lower Orr Project under Ken-Betwa Link Project, near Didauni village in Khaniyadhana/Chanderi Tehsil of Shivpuri/Ashoknagar, Madhya Pradesh- regarding.

Sir,

I am directed to refer to letter No. NWDA/ID/BPL/T-40/1892 dated 01.12.2017 on the subject mentioned above and to say that while the proposed R & R plan complies with the general requirements of RFCTLARR Act, 2013 and Forest Rights Act, 2006, this Ministry feels that it is necessary to take care of interests of the Project Affected Families (PAFs) so that actual benefits of the Project can reach them and any negative consequences can be prevented and/or mitigated at the very initial stage.

2. In order to effectively monitor the implementation of the project, a Monitoring Committee through the Commissioner Rehabilitation and Resettlement (R&R) may be set up to oversee and monitor implementation of the R&R package including additional measures suggested by this Ministry. This Ministry may also please be provided feedback at half-yearly intervals. Further, the R&R Plan may be disclosed not only to the Project Affected Families (PAFs), but also to the residents of the project affected area. The R&R Plan may be uploaded on the website of the Project Authority and a copy of the same may please be sent to this Ministry through e-mail for putting it up on the web-site of this Ministry as well.

3. Subject to the condition that the proposed R&R Plan will be followed in totality as well as implementation of additional measures (copy enclosed) are ensured by State Government/Project Authority, this Ministry conveys its approval to the proposal.

4. This issues with the approval of the competent authority.

Encl: As Above

Yours faithfully,

(Shyla Titus)
Deputy Secretary to the Government of India
Tel. no. 011 26182428

Copy to:-

(i) Director General, National Water Development Agency, Ministry of Water Resources, River Development and Ganga Rejuvenation, Government of India, 205, Palika Bhavan, R.K. Puram, New Delhi.

(ii) Director (NIC) with request to upload the said letter on the website of Ministry of Tribal Affairs

Lower Orr Project under Ken-Betwa Link Project, near Didauni village in Khaniyadhana/Chanderi Tehsil of Shivpuri/Ashoknagar, Madhya Pradesh.

Measures in addition to R&R Plan

1. Small contracts up to Rs. 30 lakhs should be reserved for PAFs. Registration as contractor may not be insisted upon.
2. Vehicle hiring rates to be at least 25% higher than those fixed by the DC for the area.
3. All PAFs should be allowed free of cost lifting of spare utilizable debris and other material.
4. Scrap disposal from HEP- In the construction phase as also in the operation phase, allow/reserve the auction only for PAFs.
5. Foreshore Cultivation should be allowed to PAFs exclusively without any charge, provided it is safe for them.
6. Preventive measures as well as remedial measures must be taken at project cost for water charging induced slope destabilization- i.e. land sinking, slope failure around reservoir. All such contracts to be assigned to PAFs.
7. Preferential allotment of Shops/ commercial plots in the project colony should be made only to PAFs. Same arrangement should be done for R&R colony, if any.
8. Present and future need of drinking water for the PAFs to be met even if tapping is required from the proposed reservoir. It must be treated as a matter of their right.
9. Following arrangements should be made to ensure health facilities to PAFs-
   (i) Periodic free of cost health check- up for PAFs.
   (ii) Project staff and labour to undergo periodic health check- up to prevent spread of any possible communicable diseases.
   (iii) Arrangements for running mobile health facilities with qualified personnel and necessary equipment should be made, until health infrastructure improves. Frequency and places (with timings) must be decided in consultation with PAFs or their Gram Sabha and displayed prominently at appropriate places.
10. Training in life saving skills- Since reservoir would be a new geomorphological feature in the local habitat, most of the villagers and children need to learn swimming, lessons for which may be arranged by the project. Further, it will help in boating and recreation related activities, besides in fishing (new proposed occupation/ supplement to livelihood). Assistance in acquiring boats with Life guards/ buoy should be provided.
11. Introduce scholarship scheme to address low literacy /education levels.
12. R&R Cells can be staffed before starting work with a mix of experienced and young staff from social science educational qualification in which local youth may also be engaged.
13. If revenue from the project is to be shared with people in PAAs/PAFs, all the BPL families (PAFs) may be given 20% more than other PAFs.

14. Access to project communication facilities may be extended to PAFs in emergency and in the case of dire need.
15. PAFs must be part of disaster preparedness and requisite training must be given to them in this regard.
16. Prior to releasing water from dam/ barrage, adequate and effective warning system has to be put in place so that local communities and visitors may be made aware to avert Larji HEP type (June 2014, Kullu HP) tragedies.
17. Mandatory disclosure- The R&R plan along with relevant Chapter of EIA (Socio-economic profile) is to be disclosed not only to PAFs but also to the residents of Project Affected Area besides putting it (on permanent basis) on the website of the Project. Similarly, the monthly /periodic implementation progress report of R&R plan has to be disclosed regularly.
18. Project may like to assist digital outreach in the Project Affected Areas.
19. The Swachchh Bharat Mission requirements be also weaved in the R&R Plan.

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Summary Record of Discussions during Public Investment Board (PIB) meeting on Ken-Betwa Link Project held on 01.10.2021.

Meeting of Public Investment Board (PIB) for appraisal of Ken-Betwa Link Project (KBLP)was held on 01.10.2021 in the Ministry of Finance, North Block, New Delhi under the Chairmanship of Finance Secretary & Secretary(Expenditure), Ministry of Finance, Govt. of India. List of the participants is enclosed at Appendix-I.

At the outset, Chairman of the Board welcomed all the members present. Thereafter, Secretary (WR, RD&GR), Ministry of Jal Shakti gave a brief overview of the project and emphasized the importance and need of this project for the drought prone Bundelkhand region. Chairman, PIB further sought to know whether KBLP is really justified techno-economically. This was clarified by Additional Secretary, Ministry of Jal Shakti. DG, NWDA subsequently made a presentation on KBLP briefly covering the need for the project and its features, status of various clearances, cost estimates, implementation mechanism, approvals sought etc. Detailed deliberations were held on various aspects of the project, as under:

1. DG, NWDA explained that that the Bundelkhand region faces frequent drought conditions and KBLP would provide enormous benefits to the water starved Buldelkhand region in Madhya Pradesh and Uttar Pradesh States. The project will provide annual irrigation to an area of 10.62 lakh ha (8.11 lakh ha in MP and 2.51 lakh ha in UP) in the Chhattarpur, Tikamgarh, Panna, Sagar, Damoh and Datia districts of Madhya Pradesh and Banda, Mahoba, Jhansi and Lalitpur districts of Uttar Pradesh in Bundelkhand region as well as to the Vidisha, Shivpuri and Raisen districts of Madhya Pradesh. The project will also provide 194 million cubic metre (MCM) of water for drinking water supply in the region to a population of about 62 lakh (41 lakh in MP and 21 lakh in UP). The project will also generate 103 MW of hydropower on 27 MW of solar power.
2. DG, NWDA further informed the Board that Ken-Betwa Link Project was declared as a National Project in the year 2008 and was included in the Prime Minister's Bundelkhand package. The total cost of the project as per the

comprehensive DPR works out to Rs. 37,611 crore (Rs. 35,111 cr + 2,500 cr for two new barrages and rennovations of tanks) at 2017-18 price level. The updated cost at 2020-21 price levels of KBLP is assessed as Rs. 44,605 crore.

3. DG, NWDA also informed the Board that Ken-Betwa Link Project is the first project under NPP which is ready for implementation as a joint project of centre and States. A tripartite Memorandum of Agreement (MoA) for the implementation of the project jointly has been signed by the Hon'ble Union Minister for Jal Shakti and Hon'ble Chief Ministers of Madhya Pradesh and Uttar Pradesh on 22nd March, 2021 in the august presence of Hon'ble Prime Minister. He also intimated that funding pattern has been proposed as 90:10 (90 Centre, 10 State) in the MoA signed on 22.03.2021.
4. Representative from Ministry of Land Resources mentioned about gestation period and requested to avoid cost and time overruns in this project.
5. Representative from Ministry of Tribal Affairs stressed on making liberal R&R plan for tribal people and its proper implementation in a time bound manner. He also stressed the need for participation of local people, particularly tribals, during the planning and implementation phases and even afterwards.
6. Representative from MoSPI informed that their Ministry is engaged in monitoring large infrastructure projects. She requested that as and when KBLP is taken up for implementation, its mile stones should be uploaded on their portal.
7. Senior Advisor NITI Ayog raised the issue of increasing cost of project from Rs. 18,057 crore to Rs. 44,605 crore and mentioned that it even now does not include future cost escalations. The cost escalation during construction phase should also be estimated. He was concerned about timely completion of project and requested that the process of getting clearances from various departments should be expedited. He recommended that funds may be released first for the land acquisition and preparatory works. Major works should be taken up only after acquisition of substantial land.
8. The Joint Secretary, MoEF&CC expressed his concerns about views of Central Empowered Committee (CEC) of Hon'ble Supreme Court on the issues related to Wildlife and Environmental clearances. It was clarified that CEC recommendations have been suitably replied to by NWDA after deliberating in the meeting of Special Committee-ILR. DG NWDA also

explained about Landscape Management Plan (LMP) being prepared by Wildlife Institute of India (WII), Dehradun for mitigating wildlife issues in a holistic manner.

9. Advisor (Cost), Ministry of Finance mentioned that cost of KBLP was about Rs. 18,000 crore in 2016 and now increased to Rs. 44,605 crore. It was explained by DG NWDA that initially DPR was prepared for Ken-Betwa link Phase-I covering Daudhan Dam and Ken-Betwa link. Later, based on the suggestions of both the States, the components viz. Lower Orr Project, Bina Complex Project, Kotha Barrage, Panna&Hatta Lift Project in M.P. and the repairing, strengthening of Bariyarpur PUW, Parichha Weir, Barwasagar Dam, two new barrages and renovation of existing tanks in Mahoba district in UP were also included in the project and a comprehensive DPR incorporating all the components was prepared during 2018. The revised cost was assessed as Rs. 37,611 crore (2017). At the time of preparation of PIB (2021) the cost has been updated to 2020-21 price level (Rs. 44,605 crore).
10. Advisor (Cost), MoF also pointed to the significant increase in yearly irrigation benefits as assessed in year 2021 as compared to year 2017 figures. The post project benefits taken are significantly higher as compared to pre project benefits. In this regard, DG, NWDA informed that increase is mainly due to revised benefits considering latest support price and prevailing market price of crops proposed and increased irrigation benefits due to micro irrigation and canal lining in Ken LBC. He informed that all the estimates of cost and benefits have been prepared as per standard guidelines for the preparation of DPR of Irrigation and Multipurpose Projects, 2010 of MoJS. The requisite details and references of the assessment made shall be shared with MoF. (A comprehensive note explaining all the issues raised during the meeting is enclosed herewith).

After detailed deliberations by the participants on the Ken-Betwa Link Project proposal and considering the challenges involved in the implementation of such mega projects having inter-state ramifications, the Chairman of the PIB concluded as under:

1. Assuming that the estimated cost and benefits of project as given in the PIB memorandum are correct, PIB recommends the central funding of Ken-Betwa Link Project on the following conditions:

i. 90% : 10% (C : S) funding pattern shall be applicable for Daudhan Dam and Ken-Betwa link canal proposed to be implemented by Ken-Betwa link authority (KBLPA), excluding the power component.
ii. Other State specific components as being implemented by the States including the cost of land acquisition and R&R for these components shall be funded as 60% Central grant, 30% Central loan to States and 10% by States.
iii. The escalation on land acquisition cost shall be limited to three years say @ 5 percent per annum. Any further escalation on land acquisition shall be borne by the States.
iv. The expenditure only on preparatory works shall be allowed before all clearances are in place. The work on major works shall be taken up only after land acquisition of significant portion.
v. All funds shall be routed through proposed Ken-Betwa Link Project Authority (KBLPA).
vi. Time line for commencement of various activities should be strictly adhered to.

2. The proposed central support and funding pattern as above shall be limited to Ken-Betwa Link Project only and not form a precedence.

The meeting ended with a vote of thanks to the Chair.

Appendix-I

LIST OF PARTICIPANTS

Ministry of Finance

Secretary, DoE, Mo Finance – In Chair

Ministry of Jal Shakti

1. Shri Pankaj Kumar, Secretary, DoWR,RD&GR
2. Ms. Debashree Mukherjee, Additional Secretary, DoWR,RD&GR
3. Shri Sanjay Awasthi, Joint Secretary (RD&PP), DoWR,RD&GR
4. Shri Bhopal Singh, Director General, NWDA
5. Shri ManojSethi, Joint Secretary (JS&FA), DoWR,RD&GR
6. Shri Rakesh Kumar, Sr. Joint Commissioner (BM), DoWR,RD&GR

Note: Representatives from MoEF&CC, NITI Aayog, Mo Agriculture, Mo Tribal Affairs, etc also attended the PIB meeting.

Annexure-1.2.15

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन नदी विकास एवं गंगा संरक्षण विभाग
केंद्रीय जल आयोग
लागत मूल्यांकन) सिंचाई-)-2 निदेशालय

Government of India
Ministry of Jal Shakti
Dept. of water Resources, RD & GR
Central Water Commission
Cost Appraisal(Irrigation)-2 Directorate

Sub: - Finalised Cost of "Lower ORR Major Irrigation Project" (Part of Ken Betwa Link Project Phase-II) – regarding.

Ref:- 1. CWC Lr. No. 4/11/2019/NP-II/Vol-I/3040-51 dated:16.08.2019.
2. NWDA Lr. No. CE(N)/LKO/T-16(54)/Phase-II/Lower Orr dated 25.10.2019
3. CWC Letter No T-49030/1/2020-CA(I)-II DTE dated 12.10.2020
4. NWDA Lr. No. राजविअ /अप्रभो/तक-45/901 दिनांक 12.11.2020
5. CWC Letter No T-49030/1/2020-CA(I)-II DTE/I/72914/2021 dated 11.10.2021
6. NWDA Letter No राजविअ /अप्रभो/तक-45/835-837 दिनांक 18.10.2021

The Cost Estimate of Comprehensive Project Report of Ken-Betwa Link Project for an amount of Rs.35111.24 crore at PL 2017-18 has been received vide letter under reference (1) for examination of Cost aspects. In this Report, the Cost Estimate of "Lower Orr Major Irrigation Project" (Part of Ken-Betwa link Project Phase-II) amounting Rs.3065.14 Cr. has also been submitted. The discussion on the Cost Estimate of Lower Orr Major Irrigation Project was held with the Project Officials from 25th to 29th October, 2021. NWDA has submitted revised cost estimate of Rs 3013.51 crores at 2017-18 Price Level on 20.10.2021.

After detailed examination of estimates, and the data available, the cost of Lower Orr Major Irrigation Project have been finalised for Rs 265703.68 lakhs (Rs 2657.04 crores) at SoR 2017-18. The Unit wise finalised cost of the project is as under-

Sl No	Item	Cost (in lakhs)
1	Unit I	104521.08
2	Unit II	151011.91
3	Unit III	10170.70
	Total Cost	265703.68

The Project Cost is provisional subjected to the correctness of the quantities as per the detailed survey carried out and rates indicated in the cost estimates at Madhya Pradesh Unified Schedule of Rates 2017-18. NWDA have also submitted a certificate regarding the correctness of quantities as per Design and Drawings proposed for preparation of Cost Estimate. The Abstract of Cost of the Project at SoR 2017-18 is enclosed.

This issue with the approval of the Chief Engineer (PAO), CWC, New Delhi.

Signed by Ajay Shivlal Banode
Date: 02.11.2021 11:48:44
Reason: Approved

(Ajay Shivlal Banode)
Director

Annexure

GENERAL ABSTRACT

Amount in Lakh

Sl. No.		Sub-head	UNIT-I (Head Works like Dam, Barrage etc.)			UNIT-II (Canal Works)			UNIT-III			Grand Total		
			Expenditure incurred upto Sept- 2021	Balance Cost	Total Cost	Expenditure incurred upto Sept- 2021	Balance Cost	Total Cost	Expenditure incurred upto Sept- 2021	Balance Cost	Total Cost	Expenditure incurred upto Sept- 2021	Balance Cost	Total Cost
A		**DIRECT CHARGES:**												
I		**WORKS:**												
1	A	Preliminary	402.13	453.46	855.59	126.53	44.94	171.47				528.66	498.40	1027.06
2	B	Land	26685.96	268.41	26954.37	4328.04	2047.81	6375.85				31014.00	2316.22	33330.22
3	C	Works	22552.93	18209.89	40762.82	36061	9083.02	45144.02				58613.93	27292.91	85906.84
4	D	Regulators and Measuring Devices					31.57	31.57					31.57	31.57
5	E	Falls					0.00	0.00					0.00	0.00
6	F	Cross Drainage Works					2816.91	2816.91					2816.91	2816.91
7	G	Bridges					376.75	376.75					376.75	376.75
8	H	Escaps					85.20	85.20					85.20	85.20
9	I	Navigation Works					0	0					0	0
10	J	Power plant & Civil works					0.00	0.00					0.00	0.00
11	K	Buildings												
		Temporary Buildings		696.36	696.36								696.36	696.36
		Permanent Buildings		213.00	213.00		0.00	0.00					213.00	213.00
12	L	Earth work & Lining			0	3000.00	1188.23	4188.23				3000.00	1188.23	4188.23
		a) Earth work			0									
		b) Lining			0									
		c) Service road			0									
		d) Tunnel												
13	M	Plantation		54.73	54.73		94.68	94.68					149.41	149.41
14	N	Tanks & Reservoir			0.00		365.99	365.99					365.99	365.99
15	O	Miscellaneous		201.50	201.50		0.00	0.00					201.50	201.50
16	P	Maintainance		429.87	429.87		1187.13	1187.13			0.00		1617.00	1617.00
17	Q	Special T&P		69.00	69.00		105.50	105.50					174.50	174.50
18	R	Communication		565.00	565.00		800.00	800.00					1365.00	1365.00
19	S	Power plant & Electric system			0.00		598.14	598.14			10070.00			
20	T	Water supply works			0.00									
21	U	Distributories and Minors			0.00	61350.00	658.20	62008.20				61350.00	658.20	62008.20
22	V	Water Courses			0.00		0.00	0.00					0.00	0.00
23	W	Drainage			0.00									
24	X	Environment & Ecology	12507.84	5703.56	18211.40							12507.84	5703.56	18211.40
25	Y	Losses on Stock & Unforeseen @ 0.25% on all heads excluding A, B , Q & X		106.23	106.23		294.98	294.98					401.21	401.21
		Total of I- Works	**62148.86**	**26971.00**	**89119.86**	**104865.57**	**19779.06**	**124644.63**			**10070.00**	**167014.433**	**56820.05**	**223834.49**
		Add GST @ 12% of (I-Works-B land- S Power)	4255.55	3204.31	7459.86	12064.50	2055.97	14120.47	0.00	0.00	0.00	16320.05	9515.83	21580.33
II		Establishment & Pensionary Charges @ 8% of I-Works less B - Land		4973.24	4973.24		9461.50	9461.50	0.00	0.00	0.00		16594.88	14434.74
III		Ordinary T&P @ 1% of I - Works		891.20	891.20		1246.45	1246.45	0.00	0.00	0.00		2768.65	2137.65

		Total	**66404.41**	**36039.75**	**102444.16**	**116930.07**	**32542.98**	**149473.05**	**0.00**	**0.00**	**10070.00**	**183334.48**	**85699.41**	**261987.21**
IV		**Receipts & Recoveries(-)**												
	(a)	Recoveries on account of resale value of Q - Special T&P 25%			17.25	26.38	0	26.38						43.63
	(b)	Recoveries by resale/transfer of Generator sets, electric lines, telephone lines and other accessories under Capital Cost of Q-Miscellaneous @20%			40.30	0	0	0.00						40.30
	(c)	Recoveries on account of resale value of Temporary Buildings @ 15%			104.45	0	0	0.00						104.45
		Total deduction	**0.00**	**162.00**	**162.00**			**26.38**						**188.38**
		Total Direct Charges	66404.41	35877.74	**102282.16**	116930.07	32516.60	**149446.67**		10070.00	**10070.00**	183334.48	78464.34	**261798.83**
B		**INDIRECT CHARGES**												
	(a)	Abatement of Land Revenue on the area occupied by the Project @ 5% of B-Cost of Land (Item(1))	0	1347.719	1347.719		318.79	318.79		0.00	0.00		1666.51	1666.51
	(b)	Audit & Account Charges @ 1% of I - Works	0	891.2	891.20	1048.6557	197.79	1246.45		100.70	100.70		2238.35	2238.35
		Total Indirect Charges	**0.00**	**2238.92**	**2238.92**	**1048.66**	**516.58**	**1565.24**	**0.00**	**100.70**	**100.70**		3904.85	**3904.85**
		NET COST	**66404.41**	**38116.66**	**104521.08**	**117978.73**	**33033.18**	**151011.91**	**0.00**	**10170.70**	**10170.70**	**183334.48**	**82369.20**	**265703.68**

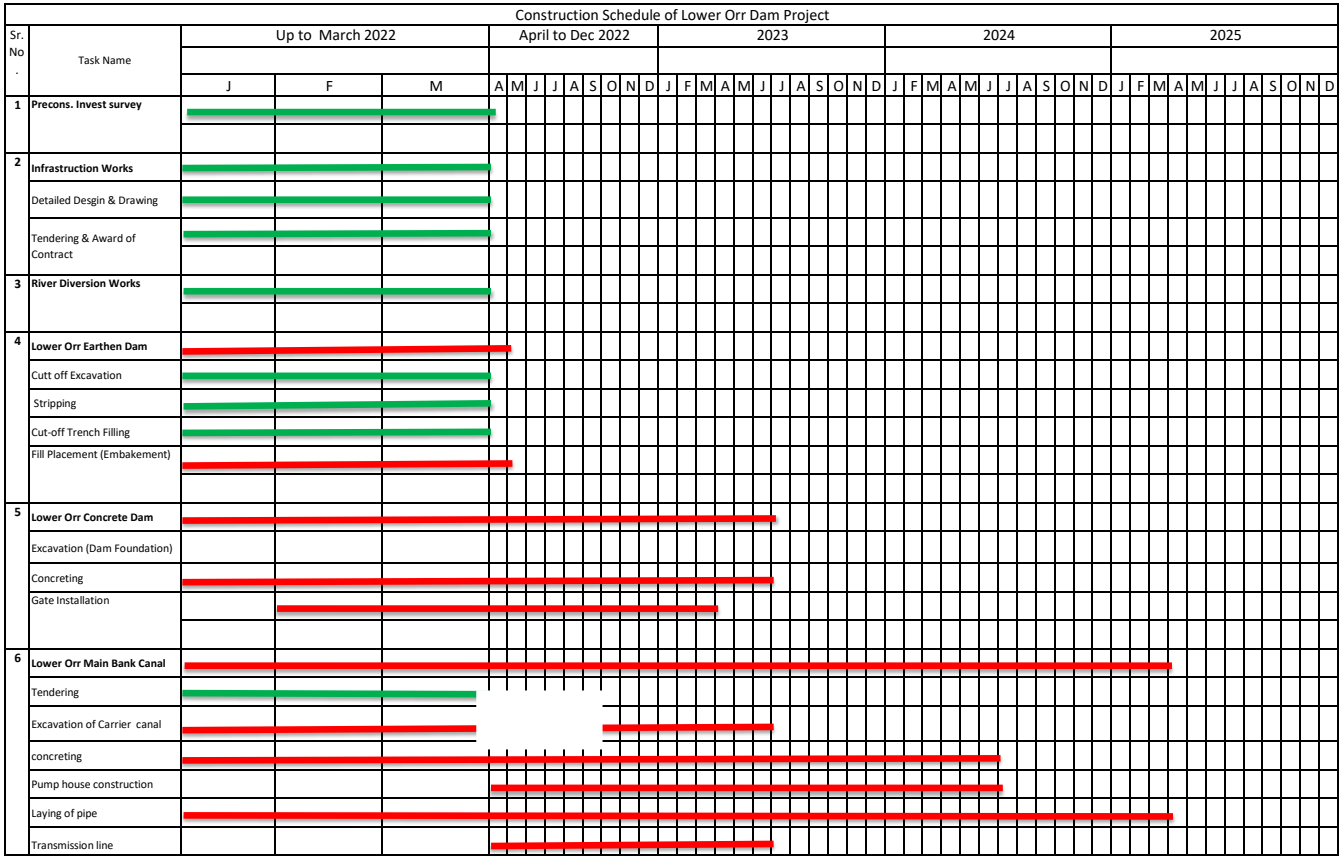
GOVERNMENT OF MADHYA PRADESH
WATER RESOURCES DEPARTMENT
LOWER ORR PROJECT

(Rs. In Lakhs)

BC Ratio Calculation

		Before Irrigation(Without Project)	After Irrigation (With Project)
A.	Gross Receipt		
1.0	Gross value of farm produce	28013.68	92288.00
2.0	Dung receipts (at 30% of the fodder expenditure)	1260.62	2768.64
3.0	**Total Gross Receipts (A) = (1+2)**	**29274.30**	**95056.64**
B.	**EXPENSES**		
1.0	Expenditure on Seeds	1935.37	5192.32
2.0	Expenditure on Fertilizers,Chemicals etc.	3444.27	6067.70
3.0	Expenditure on hired labour (human, animal & machinery) & Misc	6721.09	11762.92
4.0	Fodder expenses (as percentage of gross value of produce)		
	a) 15% Gross value of farm produce before irrigation	4202.05	
	b) 10% Gross value of farm produce after irrigation		9228.80
5.0	Depreciation on implements at 2.7% of the gross value of farm produce	756.37	2491.78
6.0	Share and Cash Rent		
	a) 5% Gross value of farm produce before irrigation	1400.68	
	b) 3% Gross value of farm produce after irrigation		2768.64
7.0	(x) Land Revenue at 2% of gross value of farm produce	560.27	1845.76
8.0	Total Expenses (B) = (Sum 1 to 7)	19020.11	39357.92
C.	NET VALUE OF PRODUCE		
1.0	Total Gross receipts (Total A.3)	29274.30	95056.64
2.0	Total Expenses (Total B.8)	19020.11	39357.92
3.0	Net value of produce (C) = (1-2)	**10254.19**	**55698.72**
D.	ANNUAL AGRICULTURAL BENEFITS		
1.0	Net value after irrigation (C.3)		55698.72
2.0	Minus Net value before irrigation(C.3)		10254.19
3.0	**Net Annual Benefits (D) = (1-2)**		**45444.54**
	(i) from Fish production		5298.50
	(ii) from Power production		3665.10
E.	(iii) from Water Supply		0.00
	a) Domestic		0.00
	b) Industrial		0.00
F.	Total Net Annual Benefits (D.3+E)		**54408.14**
	General Costs		
	(i) Estimated cost of the Project		265703.68
G.	(ii) Land Development Cost @Rs 20000 per Ha		18000.00
	(iii) cost of tubewell		1097.00
	General Costs Total (G)		**284800.68**
	ANNUAL COSTS		
1	Interest on capital @ 10% (Estimated total cost of the project including cost of land development)		28480.07
2	Depreciation of the project @ 1% of the cost of project for 100 years life of the project and @ 2% for 50 years life of the project		2848.01
3	Annual operation and maintenance charges @ 1175 Rs Per Ha		1057.50
4	Maintenance of the head works @ 1% of H/W cost less B Land		703.55
5	Depreciation of the pumping system @ 8.33% of the estimated cost of the pumping system assuming life of the system as 12 years (Applicable to lift irrigation)		254.09
6	Depreciation of the rising mains @ 3.33% of the estimated cost of the rising mains assuming life of the system as years (Applicable to lift irrigation)		90.44
7	Power Charges for lift water Rs 4410 @ per Ha. (as per 5 rs /kw unit)		1764.00
8	Annual cost of tubewell after assuming 12 year service life of pump		91.38
8	Total Annual Costs (G) = Sum (1 to 7)		**35289.02**
	Average Benefit Cost Ratio = Annual Benefits (F) / Annual Costs (G)		**1.54**

4410


Construction Schedule of Lower Orr Dam Project
Sr. No.
Task Name
Up to March 2022
April to Dec 2022
2023
2024
2025
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1 Precons. Invest survey
2 Infrastruction Works
Detailed Desgin & Drawing
Tendering & Award of Contract
3 River Diversion Works
4 Lower Orr Earthen Dam
Cutt off Excavation
Stripping
Cut-off Trench Filling
Fill Placement (Embakement)
5 Lower Orr Concrete Dam
Excavation (Dam Foundation)
Concreting
Gate Installation
6 Lower Orr Main Bank Canal
Tendering
Excavation of Carrier canal
concreting
Pump house construction
Laying of pipe
Transmission line

Annexure-1.2.17

संचालनालय
किसान कल्याण तथा कृषि विकास
मध्यप्रदेश भोपाल

कमांक/ल.सिं./1/सिं.क्षे./2018/ भोपाल दिनांक /11/2021.

प्रति,

परियोजना संचालक,
बेतवा परियोजना प्रबंधक इकाई **(बी.पी.एम.यू.)**
जल संसाधन विभाग, तुलसी नगर, भोपाल **(म.प्र.)**

विषयः– **केन–बेतवा लिंक राष्ट्रीय परियोजना के अन्तर्गत "लोअर ओर" परियोजना को मौजूदा फसल पद्धति (Crop pattern) और उत्पादकता (production) परियोजनाओं के पूर्व (pre-project) तथा परियोजनोपरांत (crop pattern) और उत्पादकता (production) के अनुमोदन बाबत्।**

संदर्भः– आपका पत्र क0 38/तक/**बी.पी.एम.यू./344** दिनांकः 29/10/2021.

––000––

विषयान्तर्गत संदर्भित पत्र के अनुसार केन–बेतवा लिंक राष्ट्रीय परियोजना के अन्तर्गत "लोअर ओर" परियोजना को मौजूदा फसल पद्धति (Crop pattern) और उत्पादकता (production) **परियोजनाओं के पूर्व (pre-project)** तथा परियोजनोपरांत (crop pattern) और उत्पादकता (production) **के अनुमोदन** के संबंध में प्रस्तावित कांपिंग पैटर्न जिलो की सिंचाई प्रतिशत की गणना के लिये खरीफ एवं रबी फसलों की प्रस्तावित सिंचाई की जानकारी अनुमोदन कर संलग्न प्रेषित है।

संलग्नः– उपरोक्तानुसार ।

संचालक
किसान कल्याण तथा कृषि विकास
म0प्र0 भोपाल

क कमांक/ल.सिं./1/सिं.क्षे./2018/ भोपाल दिनांक /11/2021.

प्रतिलिपिः–

1. प्रमुख अभियंता, जल संसाधन विभाग, तुलसी नगर भोपाल ।
2. संयुक्त संचालक, किसान कल्याण तथा कृषि विकास संभाग सागर एवं ग्वालियर म.प्र.।
3. उप संचालक कृषि, किसान कल्याण तथा कृषि विकास, जिला छतरपुर,दमोह, टीकमगढ़, निवाड़ी,पन्ना, शिवपुरी, एवं दतिया (म0प्र0)

संचालक
किसान कल्याण तथा कृषि विकास,
म0प्र0 भोपाल.

GOVERNMENT OF MADHAYA PRADESH
WATER RESOURCES DEPARTMENT
LOWER ORR PROJECT
EXISTING CROP PATTERN AND PRODUCTIVITY PRE- PROJECT

(All rates in Rs., Amount in Rs. Lakh and Area in Ha.)

o.	Crop	Area	Yield (Qtl/ Ha)	Yield (Qtl)	Price per Qtl.	Gross Income	Breakup of Expenditure						Total Expenditure (Amount in Lakhs)	Net Income (Amount in Lakhs)
							Seed		Fertilizers, Chemicals etc.		Human, Animal & Machinery & Misc			
							Rate/ Ha (Rs.)	Amount (in Rs Lakh)	Rate/ Ha (Rs.)	Amount (in Rs Lakh)	Rate/ Ha (Rs.)	Amount (in Rs Lakh)		
rif														
	Jowar	180	12	2160	1725	37.26	1800	3.24	3564	6.42	6776	12.20	21.85	15.41
	Maize	3150	15	47250	1425	673.31	6000	189.00	3582	112.83	6300	198.45	500.28	173.03
	Soyabean	17050	10	170500	3050	5200.25	4500	767.25	4158	708.94	9000	1534.50	3010.69	2189.56
	Ground nut	28770	8	230160	4000	9206.40	1400	402.78	5940	1708.94	9240	2658.35	4770.07	4436.33
	Vegetable	1810	30	54300	3500	1900.50	375	6.79	1500	27.15	2160	39.10	73.03	1827.47
	Til (Sesamum)	1800	4	7200	8000	576.00	450	8.10	1188	21.38	6000	108.00	137.48	438.52
	Total	52760		511570		17593.72		1377.1575		2585.66		4550.59	8513.41	9080.32
bi														
1	Wheat(Local)	12400	20	248000	2000	4960	3600	446.40	4050	502.20	8100	1004.4	1953.00	3007.00
2	Gram	11930	10	119300	4000	4772	2250	268.43	2500	298.25	8300	990.19	1556.87	3215.14
3	Mustard	10310	8	82480	3800	3134.24	160	16.50	3500	360.85	7500	773.25	1150.60	1983.64
4	Tur	180	6	1080	6940	74.952	600	1.08	4050	7.29	4200	7.56	15.93	59.02
	Total	34820		450860		12941		732		1169		2775	4676	8265
	Grand Total	87580.00		962430.00		30534.91		2109.56		3754.25		7325.99	13189.80	17345.12

636

O.P.Singh Khushwah 28/10/2021
SE & Expert Consultant
WRD, o/o E-in-C, Bhopal

shirish Mishra 29/10
Project Director
Betwa Project Management Unit
Bhopal

01/11

LOWER ORR PROJECT

PROPOSED CROP PATTERN AND PRODUCTIVITY POST PROJECT

(All rates in Rs., Amount in Rs. Lakh and Area in Ha.)

Sr.No.	Crop	Area	Yield (Qtl/ Ha)	Total yield (Qtl)	Price per Qtl. (in Rs.)	Gross Income (in Lac)	Breakup of Expenditure						Total Expenditure	Net Income (in Lac)
							Seed		Fertilizers, Chemicals etc.		Human, Animal & Machinery & Misc			
							Rate/ Ha (Rs.)	Amt. (in lac)	Rate/ Ha (Rs.)	Amt. (in lac)	Rate/ Ha (Rs.)	Amt. (in lac)		
Rabi														
1	Wheat (HYV)	39105.00	55	2150775	2000	43016	7200	2815.56	8000	3128.40	15000	5865.75	11809.71	31206.29
2	Wheat (OLV)	31995.00	45	1439775	2000	28796	5000	1599.75	7200	2303.64	13000	4159.35	8062.74	20733.26
3	Gram N1 (Peas)	9999.00	25	249975	3500	8749	8500	849.92	7500	749.93	15500	1549.85	3149.70	5599.30
4	Gram N2	7101.00	23	163323	4000	6533	5250	372.80	3800	269.84	13500	958.64	1601.28	4931.72
5	Vegetables RA	1800.00	150	270000	5000	13500	1200	21.60	9000	162.00	16000	288.00	471.60	13028.40
	Total	90000.00		4273848		100594		5659.63		6613.81		12821.59	25095.03	75498.97

O.P.Singh 28/10/2021

O.P.Singh Khushwah
SE & Expert Consultant
WRD, o/o E-in-C, Bhopal

shirish Mishra 29/10

Project Director
Betwa Project Management Unit
Bhopal

01/11

राष्ट्रीय जल विकास अभिकरण
जल शक्ति मंत्रालय, भारत सरकार
(जल संसाधन, नदी विकास और गंगा संरक्षण विभाग)
National Water Development Agency
Ministry of Jal Shakti, Government of India
(Department of Water Resources, River Development and Ganga Rejuvenation)

No. NWDA/Tech-II/152/1/2021//80 Date: 05.04.2021

To,

The Chief Engineer
Project Appraisal Organization
Central Water Commission,
Sewa Bhawan, R.K. Puram,
New Delhi-110066.

Sub: Submission of Memorandum of Agreement amongst Government of Madhya Pradesh, Government of Uttar Pradesh and Union Government for implementation of Ken-Betwa Link Project-regarding.

Ref: NWDA letter no. NWDA/Tech-II/152/23/2020/450-53 dated 23.12.2020

Sir,

Kindly refer to the letter cited above vide which it was requested to consider the clearance of all the three Phase-II projects of Ken-Betwa Link Project (KBLP) from Interstate angle. It was also requested that the other issues as discussed during the review meeting held in November, 2020 may also be examined expeditiously for early appraisal/clearance of TAC.

In this regard, it is to state that a tripartite Memorandum of Agreement (MoA) for the implementation of the Ken-Betwa Link Project has been recently signed by the Hon'ble Union Minister for Jal Shakti and Hon'ble Chief Ministers of Madhya Pradesh and Uttar Pradesh on 22nd March, 2021 in the august presence of Hon'ble Prime Minister. A signed copy of the MoA is enclosed for ready reference please.

Keeping in view of the above, it is again requested that appraisal of DPRs of all the three projects viz. Lower Orr, Kotha Barrage and Bina Complex Multipurpose Project may please be expedited for early implementation of KBLP.

This issues with the approval of Director General, NWDA.

Yours faithfully,

Encl: As above

(D.K. Sharma)
Superintending Engineer

205, पालिका भवन, आर. के. पुरम, नई दिल्ली–110066
दूरभाष / 011-24671681, 24674855, 24195731
फैक्स: 011-24671681 | वेबसाइट : www.nwda.gov.in
ईमेल: se2delhi-nwda@gov.in

205, Palika Bhawan, R.K. Puram, New Delhi-110066
Phone : 011-24671681, 24674855, 24195731
Fax : 011-24671681 | Website : www.nwda.gov.in
E-mail: se2delhi-nwda@gov.in

केन-बेतवा लिंक परियोजना (केबीएलपी)
के क्रियान्वयन पर मध्य प्रदेश, उत्तर प्रदेश और संघ सरकार
के मध्य सहमति ज्ञापन (एम.ओ.ए.)

MEMORANDUM OF AGREEMENT (MoA)
AMONGST THE STATES OF MADHYA PRADESH, UTTAR PRADESH AND THE UNION GOVERNMENT ON THE IMPLEMENTATION OF KEN-BETWA LINK PROJECT (KBLP)

22 मार्च, 2021

22nd March, 2021

केन-बेतवा लिंक परियोजना (के.बी.एल.पी.)
के क्रियान्वयन पर मध्य प्रदेश, उत्तर प्रदेश और संघ सरकार
के मध्य सहमति ज्ञापन (एम.ओ.ए.)

I. पक्षकारों के नाम और पते

1. मध्य प्रदेश सरकार (म.प्र. सरकार), जल संसाधन विभाग, वल्लभ भवन, मंत्रालय, भोपाल।

2. उत्तर प्रदेश सरकार (उ.प्र. सरकार), जल शक्ति मंत्रालय, सिंचाई एवं जल संसाधन विभाग, बापू भवन, लखनऊ, उत्तर प्रदेश।

3. संघ सरकार की ओर से जल शक्ति मंत्रालय, जल संसाधन, नदी विकास और गंगा संरक्षण विभाग, श्रम शक्ति भवन, रफी मार्ग, नई दिल्ली।

II. भूमिका

क. जबकि संघ सरकार नदियों के अंतर्योजन के कार्यक्रम को राष्ट्रीय महत्व का समझती है और इसके कार्यान्वयन और निधियन (Funding) के तरीकों और साधनों, जिसमें राज्यों का हिस्सा भी शामिल है, पर कार्य करेगी जिससे कि परियोजनाओं को समयबद्ध रूप से पूरा किया जा सके।

ख. और जबकि दिनांक 25 अगस्त, 2005 को माननीय प्रधानमंत्री की विशिष्ट उपस्थिति में मुख्यमंत्री मध्य प्रदेश, मुख्यमंत्री उत्तर प्रदेश एवं संघ सरकार के मध्य हस्ताक्षरित समझौता ज्ञापन के आधार पर राष्ट्रीय जल विकास अभिकरण (राजविअ) जो जल शक्ति मंत्रालय के अधीन ऑटोनामस बाडी है, ने केन-बेतवा लिंक परियोजना की विस्तृत परियोजना रिपोर्ट (डीपीआर) अप्रैल, 2010 में तैयार की।

ग. और जबकि राजविअ द्वारा तैयार किए गए समेकित डीपीआर के आधार पर केन-बेतवा लिंक परियोजना का क्रियान्वयन किया जाएगा। इस परियोजना का उद्देश्य दोनों राज्यों में लगभग 6.2 मिलियन लोगों को पेयजल उपलब्ध कराने के अतिरिक्त मध्य प्रदेश में 6.57 लाख हेक्टेयर तथा उत्तर प्रदेश में 2.51 लाख हेक्टेयर सिंचाई विकसित और स्थिर करना है।

घ. और जबकि संघ सरकार किए गए अनुबंधों के अनुसार राज्यों के परामर्श से केन तथा बेतवा बेसिनों में समुचित जल नियंत्रण क्रियाविधि, जल का लेखा-जोखा तथा जल विनियमन के लिए राज्यों को शामिल करते हुए एक उचित संस्थानिक व्यवस्था का निर्माण करेगी। इस संस्थान के संबंध में इसकी संघटना, संदर्भ की शर्तें तथा संबंधित अन्य मुद्दों पर उचित समय पर निर्णय लिया जाएगा।

MEMORANDUM OF AGREEMENT (MoA)
AMONGST THE STATES OF MADHYA PRADESH, UTTAR PRADESH AND THE UNION GOVERNMENT ON THE IMPLEMENTATION OF KEN-BETWA LINK PROJECT (KBLP)

I. NAME & ADDRESS OF PARTIES

1. Government of Madhya Pradesh (GoMP), Water Resources Department, Vallabh Bhawan, Mantralaya, Bhopal.

2. Government of Uttar Pradesh (GoUP), Ministry of Jal Shakti, Irrigation & Water Resources Department, Bapu Bhawan, Lucknow, Uttar Pradesh.

3. Union Government through Ministry of Jal Shakti, Department of WR, RD & GR, Shram Shakti Bhawan, Rafi Marg, New Delhi.

II. INTRODUCTION

A. WHEREAS the Union Government considers the programme for interlinking of rivers (ILR) of national importance and will work out ways and means for implementation and funding including share of the States, etc. to enable completion of the projects within the stipulated time frame.

B. AND WHEREAS the National Water Development Agency (NWDA), an autonomous body under the Ministry of Jal Shakti has prepared Detailed Project Report (DPR) of Ken-Betwa Link Project in April, 2010 as per the Memorandum of Understanding (MoU) signed by Chief Ministers of Madhya Pradesh and Uttar Pradesh with Union Minister for Water Resources on 25th August, 2005 in the august presence of the Hon'ble Prime Minister.

C. AND WHEREAS the implementation of Ken-Betwa Link Project shall be carried out as per the comprehensive DPR prepared by NWDA. The project is intended to develop and stabilize irrigation to the tune of 6.57 lakh ha in MP and 2.51 lakh ha in UP, besides providing drinking water to about 6.2 million people in the two States.

D. AND WHEREAS, the Union Government, in consultation with the States, will create an appropriate institutional arrangement involving States for control mechanism, water accounting and regulation of water in Ken and Betwa basins in accordance with agreement reached. The composition, terms of reference and other related issues in respect of this institution shall be decided in due course.

III. अब, इसलिए, के.बी.एल.पी. के क्रियान्वयन के लिए पक्षकारों द्वारा निम्नानुसार अनुबंध किया जाता है:

1.0 केन-बेतवा लिंक परियोजना (के.बी.एल.पी.) में जल बंटवारा

1.1 बेतवा नदी पर राजघाट तथा माताटीला बांध तथा केन बेसिन में रंगवान बांध और उर्मिल बांध के वर्तमान अंतर राज्यीय समझौतों पर बिना कोई प्रभाव डाले केबीएलपी में जल बंटवारा पूर्वाग्रह के बिना किया जाएगा।

1.2 25 अगस्त, 2005 को हस्ताक्षरित समझौता ज्ञापन में तय किये गए जल के बंटवारे को यथावत रखा जाएगा। केन बेसिन से मध्य प्रदेश (एम.पी.) दौधन बांध के अपस्ट्रीम में उपयोग करने के लिए 2,266 एमसीएम जल संरक्षित किये जाने तथा दौधन बांध पर पर्यावरण एवं जलाशय में वाष्पन हानि के लिए छोड़े जाने वाले जल की आवश्यक गणना के बाद शेष जल केन एवं बेतवा बेसिनों में केन बेसिन से बरियारपुर पिकप वीयर तक मध्य प्रदेश और उत्तर प्रदेश राज्यों द्वारा उपयोग किया जाएगा। एक सामान्य वर्ष में (केन बेसिन से दौधन बांध तक 6,590 एमसीएम या अधिक वार्षिक ग्रौस यील्ड (Gross Yield) या अधिक होने पर), केन-प्रणाली से मध्य प्रदेश राज्य कुल 2,350 एमसीएम (83 टीएमसी) जल का उपयोग करेगा जब कि उत्तर प्रदेश राज्य कुल 1,700 एमसीएम (60 टीएमसी) जल का वार्षिक उपयोग करेगा। गैर मानसून अवधि में (नवंबर से मई) दौधन जलाशय के भंडारण से मध्य प्रदेश तथा उत्तर प्रदेश को क्रमश: 1,834 एमसीएम तथा 750 एमसीएम जल का कमिटेड रिलीज (Committed Releases) किया जाएगा। उत्तर प्रदेश गैर मानसून अवधि के दौरान अपनी आवश्यकताओं के अनुसार बरियारपुर पिकप वीयर के नीचे अपने राज्य क्षेत्र की सीमा में अतिरिक्त भंडारण करने के लिए स्वतंत्र होगा।

1.3 जिस वर्ष जल की मात्रा कम होगी (केन बेसिन से दौधन बांध तक 6,590 एमसीएम से कम वार्षिक यील्ड होगी) तो उस वर्ष मध्य प्रदेश एवं उत्तर प्रदेश राज्यों द्वारा केन प्रणाली से उनके जल उपयोग के अनुपात में उत्तर प्रदेश द्वारा 1,700 एमसीएम (27%) तथा मध्य प्रदेश द्वारा 2,266 एमसीएम + 2,350 एमसीएम (73%) जल के अंतर को वहन किया जाएगा। यदि 1 नवम्बर को दौधन जलाशय के भंडारण में जल की कमी होती है तो उक्त कमी को दोनों राज्यों द्वारा दौधन जलाशय भंडारण से उनके जल अंश के अनुपात में उत्तर प्रदेश द्वारा 750 एमसीएम (29%) तक तथा मध्य प्रदेश द्वारा 1,834 एमसीएम (71%) बांटा जाएगा।

2.0 केन-बेतवा लिंक परियोजना के घटक (के.बी.एल.पी.)

केबीएलपी के सभी घटक हेड वर्क्स एवं उसकी वितरण प्रणाली तथा कैनाल पाइपलाइन एवं कमान नेटवर्क सहित **अनुलग्नक-I** पर दिए गए हैं।

III. NOW, THEREFORE, IT IS HEREBY ENTERED INTO AGREEMENT BY THE PARTIES AS FOLLOWS FOR THE IMPLEMENTATION OF KBLP:

1.0 WATER SHARING IN KEN-BETWA LINK PROJECT (KBLP)

1.1 The water sharing in KBLP will be without prejudice to existing inter-State agreements on Betwa river basin including Rajghat and Matatila dam on Betwa River, Rangwan dam and Urmil dam in Ken basin between States of Madhya Pradesh (MP) and Uttar Pradesh (UP).

1.2 The water sharing as decided in tripartite MoU signed on 25th August, 2005 shall be adhered to. After reserving 2,266 MCM for upstream uses in Madhya Pradesh (MP) in Ken basin upstream of Daudhan dam, and accounting for mandatory releases for environment and reservoir losses at Daudhan dam, the rest of the water in Ken basin upto Bariyarpur Pick Up Weir shall be utilised by the States of MP and UP in Ken and Betwa basins. In a normal year (annual gross yield in Ken basin upto Daudhan dam being 6,590 MCM or more), the State of MP shall utilise total of 2,350 MCM (83 TMC) while State of UP shall utilise total of 1,700 MCM (60 TMC) annually from the Ken system. The committed releases to MP and UP from the storages in Daudhan reservoir during non monsoon period (November to May) shall be 1,834 MCM and 750 MCM respectively. UP shall be free to create additional storages in its own territory downstream of Bariyarpur PUW to store monsoon water as per its requirement during non monsoon period.

1.3 In the years of scarcity (gross annual yield being below 6,590 MCM in Ken basin upto Daudhan dam), the deficit shall be borne by both the States in the ratio of their respective utilisation from Ken system i.e. 1,700 MCM (27%) by UP and 2,266 MCM+2,350 MCM (73%) by MP. Also any deficit in the storage of Daudhan reservoir as on 1st November shall be shared by both the States in the ratio of their share from Daudhan reservoir storage i.e. 750 MCM (29%) by UP and 1,834 MCM (71%) by MP.

2.0 COMPONENTS OF KEN-BETWA LINK PROJECT (KBLP)

The components of KBLP including head works and their distribution system and canal pipeline and command networks are given as **Annexure-I.**

3.0 पेय जल आपूर्ति का प्रावधान

इस परियोजना से क्षेत्र को पेयजल की आपूर्ति प्राथमिकता के आधार पर की जाएगी। लाभान्वित होने वाले जिलों सहित पेयजल आपूर्ति के लिए परियोजना के अनुसार किए गए प्रावधान **अनुलग्नक-II** पर दिए गए हैं। तथापि, पेयजल आपूर्ति के प्रावधान प्रत्येक राज्य की समग्र हिस्सेदारी के भीतर होंगे।

4.0 हाइड्रोपावर का बंटवारा

पावर हाउसों तथा उसके ओ. एंड एम. की लागत का वहन मध्य प्रदेश सरकार करेगी और इस हाइडेल पावर का लाभ मध्यप्रदेश को मिलेगा। हालांकि, बिजली उत्पादन के लाभ को दौधन के हेड वर्क्स के प्रचालन एवं रखरखाव खर्चों में नहीं लिया जाएगा, क्योंकि बिजली उत्पादन बहुत कम है।

5.0 ट्रांसमिशन हानि

लिंक कैनाल की ट्रांसमिशन हानि का वहन मध्य प्रदेश और उत्तर प्रदेश द्वारा इस लिंक से वास्तविक जल उपयोग के हिस्से के अनुपात में किया जाएगा।

6.0 लागत बंटवारा

6.1 केबीएलपी की लागत में भूमि अधिग्रहण, आर एवं आर तथा फॉरेस्ट लैंड डायवर्जन आदि की लागत सहित इस एम.ओ.ए. के **पैरा 2.0 (विवरण अनुलग्नक-I पर संलग्न)** में सभी सूचीबद्ध घटकों की लागत शामिल होगी। केन्द्रीय कैबिनेट के अनुमोदन के बाद केबीएलपी को एक राष्ट्रीय परियोजना के रूप में केन्द्र सरकार द्वारा 90% (केन्द्र) तथा राज्य सरकार द्वारा 10% (राज्यों) के अनुपात में निधियन किया जाएगा।

केन्द्रीय हिस्सेदारी के लेखांकन के बाद कार्य की शेष लागत की राशि का वहन मध्य प्रदेश और उत्तर प्रदेश राज्यों द्वारा इस प्रकार किया जाएगा:-

6.1.1 दौधन बांध का हैड वर्क: मध्य प्रदेश एवं उत्तर प्रदेश के मध्य 71% मध्य प्रदेश: 29% उत्तर प्रदेश के अनुपात में।

6.1.2 केन-बेतवा लिंक कैनाल: संबंधित राज्यों द्वारा आहरित जल के अनुपात में।

6.1.3 दोनों राज्यों में से केवल एक राज्य को लाभ देने वाले कार्यों के लिए, संबंधित राज्य द्वारा।

6.1.4 मध्य प्रदेश की वन भूमि और प्रभावित राजस्व की कीमत केबीएलपी की लागत का एक भाग होगी तथा मध्य प्रदेश के अंश में इसे समायोजित किया जाएगा।

3.0 PROVISION FOR DRINKING WATER SUPPLY

The drinking water supply from project to region shall be given priority. The project wise provisions made for drinking water supply along with districts to be benefitted are given at **Annexure-II.** However, the provisions for drinking water supplies shall be within the overall share of each State.

4.0 SHARING OF HYDROPOWER

The cost of the power houses and its O&M cost shall be borne by Govt. of MP and the benefits of the hydel power shall go to Madhya Pradesh. However, the benefits of hydel power shall not be taken into reckoning for O&M expenditure of the Daudhan head works, as the power generation is meagre.

5.0 TRANSMISSION LOSSES

Transmission losses in the Ken-Betwa link canal shall be shared by MP and UP in the ratio of actual water used from this link canal.

6.0 SHARING OF COST

6.1 The cost of KBLP shall include all the components listed in **para 2.0 (details enclosed at Annexure-I)** of this MoA including the cost of land acquisition, R&R and diversion of forest land etc. The KBLP will be funded as a National Project by the Union Government with 90% (Centre) & 10% (States) funding pattern after the approval of the Union Cabinet.

After accounting for the Central share, the remaining cost of works shall be shared by the States of MP and UP as under:-

6.1.1 Headworks of Daudhan dam: between MP and UP in the ratio of 71% MP: 29% UP.

6.1.2 K-B Link Canal: In the ratio of water to be drawn by respective State.

6.1.3 For works exclusively serving either of the States, by the State concerned.

6.1.4 The value of affected revenue and forest land of Madhya Pradesh will form part of the cost of the KBLP and adjusted against share of Madhya Pradesh.

6.2 परियोजना की ऑपरेशन एवं मेंटिनेंस (ओ. एंड एम.) लागत का वहन राज्यों द्वारा इस प्रकार किया जाएगा:

6.2.1 दौधन बांध का हैड वर्क तथा पीटीआर (पन्ना टाइगर रिजर्व) के डूब क्षेत्र तथा आर एंड आर स्थलों पर होने वाले किसी प्रकार के प्रतिपूरक कार्य, मध्य प्रदेश एवं उत्तर प्रदेश के मध्य 71% मध्य प्रदेश: 29% उत्तर प्रदेश के अनुपात में।

6.2.2 केन-बेतवा लिंक कैनाल से संबंधित राज्यों द्वारा आहरित जल के अनुपात में।

6.2.3 दोनों राज्यों में से केवल एक राज्य को लाभ देने वाले कार्यों के लिए, संबंधित राज्य द्वारा।

7.0 क्रियान्वयन क्रियाविधि

केन-बेतवा लिंक परियोजना का क्रियान्वयन निम्नानुसार होगा:

7.1 केबीएलपी के क्रियान्वयन के लिए मध्य प्रदेश और उत्तर प्रदेश सरकार की भागीदारी से एक स्पेशल परपज व्हीकल (एस.पी.वी.) का गठन किया जाएगा। एस.पी.वी. **अनुलग्नक-I में दिए पैरा 1.1, 2.1.1, 2.1.2 एवं 2.1.3** के अनुसार दौधन बांध, पावर हाउस, टनल तथा केन-बेतवा लिंक वाटर कैरियर के निष्पादन के लिए उत्तरदायी होगा।

के.बी.एल.पी के शेष घटकों का क्रियान्वयन संबंधित राज्य सरकार द्वारा किया जाएगा।

7.2 केबीएलपी के क्रियान्वयन के लिए एस.पी.वी समग्र रूप से उत्तरदायी होगा। पैरा 2 में दर्शाए गए केबीएलपी के सभी घटकों को एस.पी.वी. द्वारा तैयार की गई कार्य योजना के अनुसार साथ-साथ आरंभ किया जाएगा। एस.पी.वी. के सी.ई.ओ. राज्य सरकारों द्वारा पूरे किए जाने वाले कार्यों के लिए वित्तीय तथा कार्यों की योजना, निधियन जारी करने एवं पर्यवेक्षण आदि के लिए उनके साथ निरंतर समन्वय बनाए रखेंगे।

8.0 परियोजना से प्रभावित परिवारों (पी.ए.एफ.एस.) के पुनर्वास एवं पुन: स्थापना (आर एंड आर)

संबंधित राज्य सरकारें अपने प्रादेशिक क्षेत्राधिकार के अंतर्गत परियोजना से प्रभावित परिवारों के पुनर्वास एवं पुन: स्थापना तथा परियोजना के लिए भूमि अधिग्रहण का कार्य, पुनर्वास एवं पुन: स्थापना अधिनियम, 2013 या संबंधित राज्य की नीति के अनुसार या अनुमोदित पर्यावरणीय प्रबंधन योजना के अनुसार समयबद्ध और पारदर्शी ढंग से करेंगी।

6.2 The Operation and Maintenance (O&M) cost of the project shall be borne by the States as per details below:-

6.2.1 Headworks of Daudhan dam and any compensatory works arising out of PTR submergence and R&R sites: between MP and UP in the ratio of 71% MP : 29% UP.

6.2.2 K-B Link Canal in the ratio of water drawn by respective State.

6.2.3 For works exclusively serving either of the States, by the concerned State.

7.0 IMPLEMENTATION MECHANISM

The execution of Ken-Betwa Link Project shall be as under:

7.1 A Special Purpose Vehicle (SPV) shall be created with participation of Government of MP and UP for the execution of KBLP. The SPV will be responsible for execution of the Daudhan Dam, power houses, tunnels and Ken-Betwa Link water carrier as elaborated in **paras 1.1, and 2.1.1, 2.1.2 & 2.1.3 of Annexure-I.**

The remaining components of KBLP shall be executed by respective State Government.

7.2 The SPV shall be responsible for overall implementation of KBLP. All the components of KBLP as elaborated in para 2.0, shall be taken up concurrently as per work plan devised by SPV. For works under implementation by the State Governments, the CEO of SPV will coordinate regularly with them for financial and works planning, fund releases and supervision.

8.0 REHABILITATION AND RESETTLEMENT (R & R) OF PROJECT AFFECTED FAMILIES (PAFs)

R & R of project affected families and land acquisition for the projects within their territorial jurisdiction would be carried out by respective State Governments in a time bound and transparent manner as per Land Acquisition, Rehabilitation and Resettlement Act, 2013 or as per the respective State Policy and as per approved Environmental Management Plan.

9.0 मॉनीटरिंग क्रियाविधि

9.1 सचिव (ज.सं., न.वि. व गं.सं.वि.), भारत सरकार की अध्यक्षता एवं राज्य सरकारों के प्रतिनिधित्व वाली एक **स्टीयरिंग कमेटी** समय-समय पर नीतियों, प्रगति, निधियन एवं अन्य संबंधित मामलों सहित परियोजना के समग्र क्रियान्वयन की समीक्षा करेगी। क्रियान्वयन स्तर पर उभरे किसी भी मुद्दे को स्टीयरिंग कमेटी हल करेगी। स्टीयरिंग कमेटी के स्तर पर उभरे विवाद को **उच्च स्तरीय समिति** को भेजा जाएगा जिसके अध्यक्ष केन्द्रीय मंत्री (जल शक्ति) तथा जिसके प्रतिनिधि दोनों राज्यों के जल संसाधन/जल शक्ति मंत्री होंगे।

दिनांक : 22 मार्च, 2021 को हस्ताक्षरित।

(शिवराज सिंह चौहान)
मुख्यमंत्री, मध्य प्रदेश
मध्य प्रदेश राज्य के लिए

(योगी आदित्यनाथ)
मुख्यमंत्री, उत्तर प्रदेश
उत्तर प्रदेश राज्य के लिए

(गजेन्द्र सिंह शेखावत)
जल शक्ति मंत्री
संघ सरकार के लिए

9.0 MONITORING MECHANISM

9.1 A **Steering Committee** headed by Secretary (DoWR, RD&GR), Govt. of India with representatives from State Governments shall periodically review the overall implementation of project including policies, progress, funding and other related matters. Any issue arising out at implementation stage shall be resolved by the Steering Committee. Dispute arising out at Steering Committee level, shall be referred to **High Level Committee** headed by Union Minister (Jal Shakti) and represented by Water Resources/Jal Shakti Ministers of both the States.

Signed on this day of 22nd March, 2021.

(SHIVRAJ SINGH CHOUHAN)
Chief Minister of Madhya Pradesh
FOR THE STATE OF
MADHYA PRADESH

(YOGI ADITYANATH)
Chief Minister of Uttar Pradesh
FOR THE STATE OF
UTTAR PRADESH

(GAJENDRA SINGH SHEKHAWAT)
Minister for Jal Shakti
FOR UNION GOVERNMENT

अनुलग्नक-I

केन-बेतवा लिंक परियोजना (के.बी.एल.पी.) में शामिल किए गए कार्य

1. हैड वर्क्स एवं डिस्ट्रीब्यूशन प्रणाली

1.1 दौधन बांध में शामिल हैं

1.1.1 दौधन में केन नदी पर 288 मी. एफ.आर.एल./एम.डब्लू.एल. पर मृदा तटबंध सह कांक्रीट बांध।

1.1.2 1.9 कि.मी. लम्बाई की लिंक वॉटर कैरियर तक जल पहुंचाने के लिए दौधन बांध के बायें तट से लगभग 170 मी. अपर लेवल की टनल।

1.1.3 पावर हाउस-II को जल पहुंचाने के लिए दौधन बांध के बायें तट से लगभग 100 मी. पर एक लोअर लैवल सुरंग तथा वहां से लगभग 2.5 कि.मी. कनैक्टिंग चैनल के माध्यम से मध्य प्रदेश के लैफ्ट बैंक कैनाल तक।

1.1.4 दौधन बांध की तली में स्पिलवे के दांयी ओर पावर हाउस-I (2×30 मेगावाट)।

1.1.5 लोअर लेवल टनल के आउटलेट पर पावर हाउस-II (3×6 मेगावाट)।

1.2 कोठा बैराज में शामिल हैं

1.2.1 गांव-कोठा, तहसील गंज बसोदा, जिला विदिशा, मध्य प्रदेश में बेतवा नदी पर बैराज।

1.2.2 पम्प हाउस और राइजिंग मेन्स

1.3 बीना कॉम्प्लैक्स में शामिल हैं

1.3.1 चार भंडारण बांध: बीना नदी पर मादिया एवं चकरपुर, धसान नदी पर सेमरा घाट डायवर्जन तथा देहरा नाला पर देहरा बांध।

1.3.2 पम्प हाउस, राइजिंग मेन्स तथा पावर हाउस।

1.4 लोवर ओर परियोजना में शामिल हैं

1.4.1 गांव-दिदौनी, जिला-शिवपुरी, मध्य प्रदेश के निकट ओर नदी पर एक मृदा तटबंध सह कांक्रीट बांध।

1.4.2 पम्प हाउस, राइजिंग मेन्स तथा लिंक वाटर कैरियर।

Annexure-I

Works included in Ken-Betwa Link Project (KBLP)

1. **Head Works & Distribution System**

1.1 Daudhan Dam Comprises

1.1.1 An earthen embankment cum concrete dam across Ken River at Daudhan with FRL/MWL 288 m.

1.1.2 An Upper Level Tunnel about 170 m from the left bank of Daudhan dam having length of 1.9 km for conveying water to the link water carrier.

1.1.3 A Lower Level Tunnel about 100 m from the left bank of Daudhan dam having length of 1.1 km for conveying water to the Power House-II and from there to the Left Bank Canal of MP through a connecting channel of about 2.5 km.

1.1.4 Power House-I (2x30 MW) to the right of spillway at the toe of Daudhan dam.

1.1.5 Power House-II (3X6 MW) at the outlet of Lower Level Tunnel.

1.2 Kotha Barrage Comprises

1.2.1 A barrage across Betwa river at village Kotha, Tehsil Ganj Basoda, District Vidisha, Madhya Pradesh.

1.2.2 Pump Houses and Rising Mains

1.3 Bina Complex Comprises

1.3.1 Four storage dams: Madia & Chakarpur on Bina River, Semra Ghat Diversion on Dhasan River and Dehra Dam on Dehra Nalla.

1.3.2 Pump Houses, Rising Mains and Power Houses

1.4 Lower Orr Project Comprises

1.4.1 An earthen embankment cum concrete dam across Orr River near village Didauni, in District Shivpuri, Madhya Pradesh.

1.4.2 Pump Houses, Rising Mains and link water carrier.

1.5 विद्यमान परीछा वीयर के बेतवा नदी के अपस्ट्रीम तक बरवा सागर से जल पहुंचाने के लिए 7.1 किमी. लम्बा बरवा नाला उपयुक्त संरचना सहित बरवा सागर बांध बरियारपुर पिकअप वीयर की मरम्मत/मजबूत करना/रिमॉडलिंग करना।

1.6 उत्तर प्रदेश के अधिक्षेत्र में, विद्यमान बरियारपुर पिकप वीयर के डाउनस्ट्रीम में उपयुक्त बाँधों सहित दो नए बैराजों का निर्माण।

1.7 गैर मानसून अवधि के दौरान जल का उपयोग करने के लिए मानसूनी जल का भंडारण करने के लिए केन-बेतवा लिंक नहर से जल अंतरण करने के लिए कैरियर प्रणाली तथा महोबा जिले में विद्यमान टैंक तथा उसके कनेक्टिंग लिंक का नवीकरण।

2. <u>कैनाल पाइप लाइन और कमान नेटवर्क</u>

2.1 केन बेसिन

2.1.1 बेतवा बेसिन में ऊपरी सुरंग से विद्यमान बरवा सागर/बरवा नाला तक 221 कि.मी./176 किमी. (जैसा कि के.ज.आ. द्वारा तय किया गया) लम्बी लिंक वॉटर कैरियर।

2.1.2 मध्य प्रदेश के प्रस्तावित केन-लेफ्ट बैंक कैनाल को जोड़ने वाली विद्यमान लोवर लेवल टनल से एक बाई पास चैनल।

2.1.3 जब कभी जलाशय का जल अपर लेवल टनल के क्राउन लेवल से नीचे आ जाए तो केन-बेतवा लिंक कैनाल में जल आपूर्ति सुनिश्चित करने के लिए अपर लेवल टनल को जल लिफ्टिंग करने के लिए पम्पिंग सिस्टम की व्यवस्था करना।

2.1.4 मध्य प्रदेश के छतरपुर जिले के हाई लेवल कमान (43,678 हैक्टेयर) के एक भाग को जल पहुंचाने के लिए दौधन जलाशय प्राथमिक पहुँच से जल लिफ्टिंग के माध्यम से पम्पिंग सिस्टम, पाइप डिस्ट्रीब्यूशन नेटवर्क एवं माइक्रो इरीगेशन सिस्टम विकसित करना।

2.1.5 मध्य प्रदेश की 90 किलोमीटर लम्बी प्रस्तावित केन लेफ्ट बैंक नहर तथा छतरपुर जिले में 1,39,848 हैक्टेयर सी.सी.ए. क्षेत्र को जल पहुंचाने के लिए केन-लेफ्ट बैंक कैनाल पर पम्पिंग सिस्टम, पाइप डिस्ट्रीब्यूशन नेटवर्क तथा माइक्रो इरीगेशन सिस्टम विकसित करना।

2.1.6 मध्य प्रदेश के छतरपुर जिले में विद्यमान ओपन कैनाल नेटवर्क द्वारा विद्यमान बरियारपुर एल.बी.सी. से 38,890 हैक्टेयर सी.सी.ए. के अंतर्गत आ जाएगा।

1.5 Repair/strengthening/remodelling of Bariyarpur pick up weir, Parichha weir, Barwa Sagar Dam along with appurtenant structures and 7.1km long Barwa Nallah to carry water from Barwa Sagar to Betwa river upstream of existing Parichha weir.

1.6 Construction of two new barrages along with appurtenant structures d/s of existing Bariyarpur Pick up weir in the territory of UP.

1.7 Renovation of existing tanks and their connecting links in Mahoba district and carrier system for transfer of water from Ken Betwa link canal to tanks in order to enable UP to store the monsoon water to use during non-monsoon season.

2. Canal Pipe Line and Command Networks

2.1 Ken Basin

2.1.1 A 221 km/176 km (as decided by CWC) long link water carrier from Upper Level Tunnel to existing Barwa Sagar/Barwa Nallah, in Betwa Basin.

2.1.2 A bye pass channel from exit of Lower Level Tunnel to connect proposed Ken Left Bank Canal of MP.

2.1.3 Pumping system arrangements for lifting of water to Upper Level Tunnel to ensure the water supply in the Ken-Betwa link canal whenever reservoir depletes below the crown level of Upper Level Tunnel.

2.1.4 Developing pumping system, pipe distribution network and micro irrigation system by lifting water from Daudhan reservoir/initial reach of Link water carrier to serve a part of high level command (43,678 ha.) of Chhatarpur District of MP.

2.1.5 A 90 km long proposed Ken Left Bank Canal of MP and developing pumping system, pipe distribution network and micro irrigation system for Ken Left Bank Canal to serve 1,39,848 ha. CCA in Chhatarpur District.

2.1.6 From existing Bariyarpur LBC 38,890 ha. CCA will be covered by existing open canal network in Chhatarpur District of MP.

2.1.7 दौधन जलाशय से जल लिफ्टिंग द्वारा 90,101 हैक्टेयर सी.सी.ए. के लिए पम्पिंग सिस्टम, पाइप डिस्ट्रीब्यूशन नेटवर्क तथा माइक्रो सिंचाई सिस्टम विकसित करना जिसमें से मध्य प्रदेश के पन्ना जिले में 70,000 हैक्टेयर सी.सी.ए. आएगा तथा दमोह जिले में 20,101 हैक्टेयर सी.सी.ए. आएगा।

2.1.8 उत्तर प्रदेश के 17,488 हैक्टेयर मार्गस्थ कमान क्षेत्र तथा मध्य प्रदेश के 96,751 हैक्टेयर मार्गस्थ कमान क्षेत्र के साथ ऊंचाई पर स्थित 42,096 हैक्टेयर छूटे हुए कमान क्षेत्र को केन बेतवा लिंक नहर से सिंचित करने के लिए पंपिंग सिस्टम, पाईप डिस्ट्रीब्यूशन नेटवर्क तथा माइक्रो इरीगेशन सिस्टम विकसित करना।

2.1.9 विद्यमान सिस्टम को मरम्मत/मजबूत करके विद्यमान केन कमान के अंतर्गत उत्तर प्रदेश के बांदा जिले में 1,92,479 हैक्टेयर क्षेत्र में सिंचाई का स्थिरीकरण करना। दाबयुक्त पाइप माइक्रो इरीगेशन सिस्टम का उपयोग करते हुए बरियारपुर राइट बैंक कैनाल (केन-कैनाल) के कमान क्षेत्र को बढ़ाना।

2.2 बेतवा बेसिन

2.2.1 कोठा बैराज- मध्य प्रदेश के 20,000 हैक्टेयर सी.सी.ए. के लिए पंम्पिग सिस्टम, पाइप डिस्ट्रीब्यूशन नेटवर्क तथा माइक्रो इरीगेशन सिस्टम।

2.2.2 बीना कॉम्पलेक्स-मध्य प्रदेश के 96,000 हैक्टेयर सी.सी.ए. के लिए पंम्पिग सिस्टम, पाइप डिस्ट्रीब्यूशन नेटवर्क तथा माइक्रो इरीगेशन सिस्टम।

2.2.3 लोवर ओर प्रोजेक्ट-मध्य प्रदेश के 90,000 हैक्टेयर सी.सी.ए. के लिए पम्पिंग सिस्टम, पाइप डिस्ट्रीब्यूशन नेटवर्क तथा माइक्रो इरीगेशन सिस्टम।

2.2.4 दाबयुक्त पाइप माइक्रो इरीगेशन सिस्टम से उत्तर प्रदेश के महोबा जिले में विद्यमान 37,564 हैक्टेयर कमान का विकास करना।

2.1.7 Developing pumping system, pipe distribution network and micro irrigation system for 90,101 ha. CCA by lifting water from Daudhan reservoir, out of which 70,000 ha. CCA will be in Panna District and 20,101 ha. CCA will be in Damoh District of MP.

2.1.8 Developing pumping system, pipe distribution network and micro irrigation system from Ken-Betwa link canal to serve left out area of 42,096 ha. of high level command & 96,751 ha. enroute command of MP and 17,488 ha. of enroute command of UP .

2.1.9 Stabilisation of irrigation in 1,92,479 ha. in Banda district in UP under existing Ken command by repair/strengthening of existing system. Enhancing command area of Bariyarpur Right Bank Canal (Ken Canal) system by utilizing pressurised pipe micro irrigation system.

2.2 Betwa Basin

2.2.1 Kotha Barrage: Pumping system, pipe distribution network and micro irrigation system for 20,000 ha. CCA of MP.

2.2.2 Bina Complex: Pumping system, pipe distribution network and micro irrigation system for 96,000 ha. CCA of MP.

2.2.3 Lower Orr Project: Pumping system, pipe distribution network and micro irrigation system for 90,000 ha. CCA of MP.

2.2.4 Development of existing command of 37,564 ha in Mahoba district in UP with pressurised pipe micro irrigation system.

अनुलग्नक-II

के.बी.एल.पी. से घरेलू जल आपूर्ति का विवरण

क्र. सं.	के.बी.एल.पी. के घटक	लाभान्वित होने वाले जिले	राज्य	घरेलू जल की आवश्यकता (एमसीएम)
1.	दौधन बांध	दमोह	मध्य प्रदेश	1.15
		छत्तरपुर	मध्य प्रदेश	51.07
		पन्ना	मध्य प्रदेश	3.14
		टीकमगढ़	मध्य प्रदेश	4.64
	उपकुल			***60***
		बांदा	उत्तर प्रदेश	0.00
		झांसी	उत्तर प्रदेश	14.66
		ललितपुर	उत्तर प्रदेश	31.98
		महोबा	उत्तर प्रदेश	20.13
	उपकुल			***67***
	दौधन बांध का योग			**127 एमसीएम**
2.	लोअर ओर डैम	दतिया	मध्य प्रदेश	1.13
		शिवपुरी	मध्य प्रदेश	4.36
	लोअर ओर डैम का योग			5.49 लगभग 6 एमसीएम
3.	कोठा बैराज	विदिशा	मध्य प्रदेश	3.75
	कोठा बैराज का योग			**3.75 एमसीएम**
4.	बीना कॉम्पलेक्स बहुउद्देशीय परियोजना	रायसेन	मध्य प्रदेश	0.14
		सागर	मध्य प्रदेश	56.62
	बीना कॉम्पलेक्स बहुउद्देशीय परियोजना का योग			**56.76** **लगभग 57 एमसीएम**

कुल घरेलू आवश्यकता मध्य प्रदेश: 126.75 एमसीएम

कुल घरेलू आवश्यकता उत्तर प्रदेश: 67.00 एमसीएम

कुल योग (मध्य प्रदेश + उत्तर प्रदेश): 193.75 एमसीएम लगभग 194 एमसीएम

Annexure-II

Details of Domestic Water Supply from KBLP

Sl. No.	Components of KBLP	Districts Benefitted	State	Domestic Water Requirement (MCM)
1.	Daudhan Dam	Damoh	Madhya Pradesh	1.15
		Chhatarpur	Madhya Pradesh	51.07
		Panna	Madhya Pradesh	3.14
		Tikamgarh	Madhya Pradesh	4.64
	Sub-Total			***60***
		Banda	Uttar Pradesh	0.00
		Jhansi	Uttar Pradesh	14.66
		Lalitpur	Uttar Pradesh	31.98
		Mahoba	Uttar Pradesh	20.13
	Sub-Total			***67***
	Total of Daudhan Dam			**127 MCM**
2.	Lower Orr Dam	Datia	Madhya Pradesh	1.13
		Shivpuri	Madhya Pradesh	4.36
	Total of Lower Orr Dam			**5.49 Say 6 MCM**
3.	Kotha Barrage	Vidisha	Madhya Pradesh	3.75
	Total of Kotha Barrage			**3.75 MCM**
4.	Bina Complex Multipurpose Project	Raisen	Madhya Pradesh	0.14
		Sagar	Madhya Pradesh	56.62
	Total of Bina Complex Multipurpose Project			**56.76 Say 57 MCM**

Total domestic requirement for MP: 126.75 MCM
Total domestic requirement for UP: 67.00 MCM
Grand Total (MP + UP): 193.75 MCM Say 194 MCM

Annexure-1.2.19

मध्यप्रदेश शासन
जल संसाधन विभाग
मंत्रालय

क्रमांक 22 (A) 337/MPS/31/737 भोपाल, दिनांक 25/04/2017

प्रति,

प्रमुख अभियन्ता,
जल संसाधन विभाग,
भोपाल (म.प्र.)

विषयः— शिवपुरी जिले की लोअर ओर वृहद सिंचाई परियोजना की प्रशासकीय स्वीकृति।

——00——

मंत्रि–परिषद की बैठक दिनांक 11 अप्रैल 2017 में शिवपुरी जिले की लोअर ओर वृहद सिंचाई परियोजना की प्रशासकीय स्वीकृति प्रदान किये जाने के लिए गए निर्णय के परिप्रेक्ष्य में राज्य शासन एतद द्वारा लोअर ओर वृहद सिंचाई परियोजना सैच्य क्षेत्र 90,000 हेक्टर (रबी) हेतु राशि रूपये 2208.03 करोड़ (रूपये बाइस अरब आठ करोड़ तीन लाख) की प्रशासकीय स्वीकृति प्रदान करता है।

2. परियोजना पर व्यय मांग संख्या 23/4700 (मुख्य सिंचाई पर पूँजीगत परिव्यय) के अन्तर्गत विकलनीय होगा।

3. यह परियोजना केन बेतवा लिंक (राष्ट्रीय परियोजना) में सम्मिलित है। अतः सभी अभीष्ठ औपचारिकताएं पूर्ण कर ली जाए।

मध्यप्रदेश के राज्यपाल के नाम से
तथा आदेशानुसार

25/4/17
(व्ही.एस. टेकाम)
उप सचिव,
म.प्र. शासन, जल संसाधन विभाग

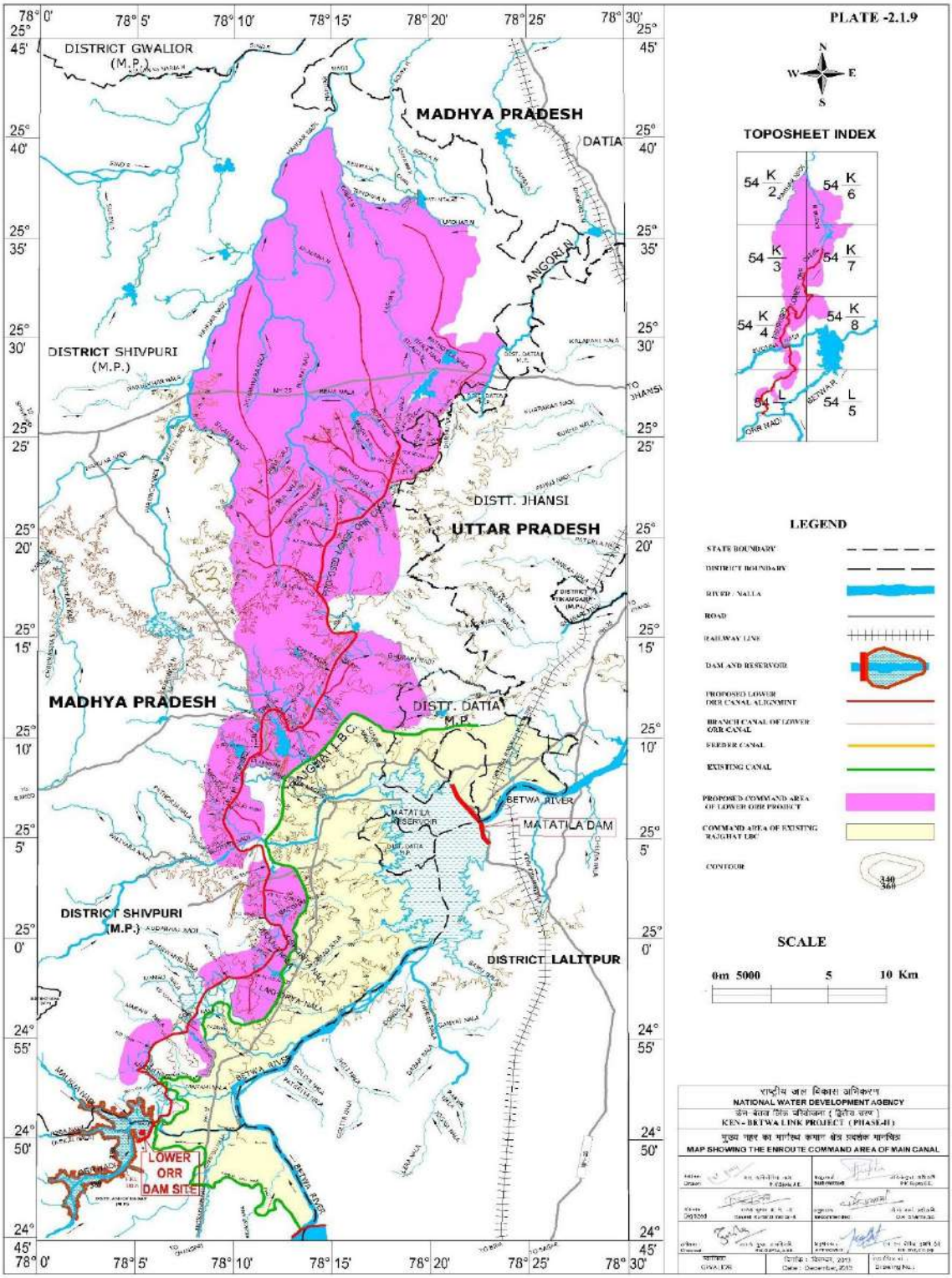
पृ. क्रमांक 22 (A) 337/MPS/31/738 भोपाल, दिनांक 25/04/2017

प्रतिलिपिः—

(1) अपर मुख्य सचिव, मध्यप्रदेश शासन, वित्त विभाग, मंत्रालय, भोपाल।
(2) अपर मुख्य सचिव, मध्यप्रदेश शासन, योजना आर्थिक एवं सांख्यिकी मंत्रालय, भोपाल।
(3) मुख्य अभियन्ता (बोधी) जल संसाधन विभाग, भोपाल।
(4) मुख्य अभियन्ता, राजघाट परियोजना, जल संसाधन विभाग, दतिया।
(5) अधीक्षण यंत्री, राजघाट नहर मण्डल, झॉसी (उ.प्र.)
(6) विशेष कर्त्तव्यस्थ अधिकारी, वृहद परियोजना नियंत्रण मण्डल, जल संसाधन विभाग, भोपाल।
(7) कार्यपालन यंत्री, राजघाट वाई तट नहर संभाग, खनियाधाना (शिवपुरी)।
(8) निज सचिव, मा. मंत्री जी, जल संसाधन विभाग, भोपाल।
(9) बैव मैनेजर, कार्यालय परियोजना संचालक, पाइकू, जल संसाधन विभाग, भोपाल को आदेश विभागीय वेबसाईट पर दर्ज करने हेतु।

25/4/17
उप सचिव,
म.प्र. शासन, जल संसाधन विभाग

INDEX MAP OF LOWER ORR WITH DETAILS OF AREA PROPOSED TO BE IRRIGATED



SALIENT FEATURES OF KOTHA BARRAGE PROJECT

S. No.	Particulars	
I	**Location**	
1.	State	Madhya Pradesh
2.	District	Sagar
3.	River	Betwa
4.	Accessibility	Kotha dam site is situated near village Kotha30 km from Kurwaidistt. Vidisha
5.	Toposheet	54L/4
6.	Latitude	$24^0$03'28" N
7.	Longitude	$78^0$01'16" E
8.	Nearest railway station	Mandi, Bamora/Kurwai
9.	Nearest airport	Bhopal
II	**Hydrology**	
1.	Catchment area in sqkm	8711
2.	Maximum annual rainfallin mm	1645.8
3.	Minimum annual rainfallin mm	779.4
4.	Average annual rainfall in mm	1170.60
5.	Designed flood (PMF) cumec	16457
6.	75% dependable yieldin MCM	1593.99
7.	50% dependable yieldin MCM	2016.10
III	**Reservoir Data**	
1.	Gross storage in MCM	63.51
2.	Live storage in MCM	63.22
3.	Dead storage in MCM	0.29
4.	Gross area of submergence at FRL in ha	1359
	Private land in ha	681
	Revenue land in ha	678
	Forest land in ha	0.0
IV	**Barrage Data**	
1.	Type of barrage	Concrete
2.	Total length of barrage in m	576
3.	Height of barrage in m	16.50
4.	Number of openings	32
5.	Size of gates in m	15.00 x 11.50
6.	Crest level in m	384.50

7.	Thickness of pier in m	3
8.	Top of bund level in m	398.00
9.	Full Reservoir Level in m	395.00
V	**Canals**	
1.	Length of rising main (Left) in km	11.50
2.	Length of rising main (Right) in km	8.50
3.	Dia. of rising main (Left) in m	1.60
4.	Dia. of rising main (Right) in m	1.60
5.	Lift (Left) in m	31
6.	Lift (Right) in m	26
VI	**Irrigation**	
1.	GCA (Left) in ha	15380
2.	GCA (Right) in ha	15380
	Total GCA in ha	30760
3.	CCA (Left) in ha	10000
4.	CCA (Right) in ha	10000
	Total CCA in ha	**20000**
5.	Annual Irrigation	
	(a)Kharif in ha	5500
	(b) Rabi in ha	20000
	(c) perennial	Nil
	Total Annual irrigation in ha	25500
10.	Benefited districts	Vidisha and very small area of Sagar
11.	Solar Power Generation	8 MW
12.	Power Requirement	

Annexure-1.3.2

Kotha Barrage

भारत सरकार
केन्द्रीय जल आयोग
जलविज्ञान (मध्य) निदेशालय

विषयः— Ken Betwa Link (Phase-II)- Flood Studies of Neemkheda, Barari, Kesari, Kotha Barrages and Diversion Flood Studies of Lower Orr Dam.

संदर्भः— Lr. No. 4/9/2012/NP-II/ dated 07.10.2015

Kindly refer to above cited letter vide which the project authority has forwarded the supplementary report on Ken-Betwa Link (phase-II) for examination from Hydrological angle. The observations on Yield study and Sedimentation study had been conveyed vide this office letter of even number dated 26-04-2016 & 17-05-2016. The observations on the design flood study of Lower Orr Dam, Ken-Betwa Link (Phase-II) were also conveyed vide Letter dated 17.06.2016 and subsequently vide Letter dated 22.07.2016. This office has now examined the Flood Studies (including Diversion Flood) of the remaining four Barrages viz. Neemkheda, Barari, Kesari and Kotha Barrages; and Diversion Flood Studies of the Lower Orr Dam for which observations of this office are as under:

Introduction: The Ken- Betwa link project envisages diversion of surplus water of Ken basin to the water deficit Betwa basin. The Ken-Betwa Link (Phase-II) consists of five projects namely Neemkheda Barrage, Barari Barrage, Kesari Barrage, Kotha Barrage and Lower Orr Dam. Lower Orr dam qualifies for PMF studies whereas the four Barrages qualify for 100 year return period as design flood and SPF as check flood. Catchment area of the barrages up to the barrage site is computed using GIS Analysis and found to be as:

Table 1:- Catchment Areas (Sq.Km.) for the Project Sites

S.No.	Project Name	Computed using GIS Analysis (Sq. Km.)
1	Neemkheda Barrage	1965.00
2	Barari Barrage	5387.92
3	Kesari Barrage	518.00
4	Kotha Barrage	9262.51

Design Flood Study of Neemkheda, Barari, Kesari and Kotha Barrages carried out by project authority:

In absence of short interval rainfall runoff data, unit hydrograph for the Neemkheda, Barari, Kesari and Kotha Barrages has been derived synthetically using Flood

Estimation report for sub zone 1 (c). IMD has carried out the SPS studies of Neemkheda, Barari and Kesari Barrages and recommended Two day & One day SPS values as:

Table 2:- SPS Values (mm) recommended by IMD

S.No.	Project Name	SPS Values (mm)	
		1-day	2-day
1	Neemkheda Barrage	355	593
2	Barari Barrage	306	567
3	Kesari Barrage	431	-

The 24 hr & 48 hr Time distribution (3-hourly) has also been given by IMD.

Loss rate of 2.3 mm/hr has been taken into account from FER of sub zone- 1 (c) while calculating the effective rainfall i.e. excess rainfall in the basin. The base flow has been taken from FER of sub zone- 1 (c) as 0.018 $m^3/s/Sq.$ Km. Further, for Barari and Kotha Barrages the flood hydrograph from upper basins have been routed to the outlet using Muskingum- Cunge routing technique and the downstream flood hydrographs are added to the routed hydrograph in order to derive the SPF at the respective project sites. The peak design flood (SPF) has been worked out as:

Table 3:- SPF (cumec) Computed by Project Authority

S.No.	Project Name	SPF (cumec)
1	Neemkheda Barrage	6654.60
2	Barari Barrage	16449
3	Kesari Barrage	2690.14
4	Kotha Barrage	22486

Analysis:

(i) Project Authorities have submitted the Design Flood studies considering 10 Project Sites. However, the Project Authorities subsequently reduced the Project Sites to 5 in number consisting of Lower Orr Dam and four barrages namely Neemkheda, Barari, Kesari and Kotha. This office has now carried out the flood studies considering the above mentioned four barrages and is issuing its recommendations.

(ii) In the absence of short interval rainfall-runoff data the unit hydrographs derived as per Flood Estimation Report of Sub zone 1(c) appears to be in order. Project authorities have not smoothened the Unit Hydrographs. The UG_s needs to be smoothened before using in convolution.

(iii) Temporal distribution of storm pattern is provided by IMD in 3 hour interval. However, project authorities converted the distribution factor on hourly basis

without smoothening the curve supplied by IMD. The same has been smoothened before converting into 12 hr from 24 hour time distribution.

(iv) 1 in 100 Year Return Period Storm has been considered for computing the Design Flood for all the barrages. Isopluvial map of 24- hr 100 Year return period storm as provided by IMD has been used and the following values of point rainfall depth are obtained and used in further analysis:

Table 4:- 24- hr Point Rainfall Depth (mm) Obtained from 100-yr Isopluvial Map

S.No.	Project Name	24- hr Point Rainfall (mm)
1	Neemkheda Barrage	400
2	Barari Barrage	380
3	Kesari Barrage	360
4	Kotha Barrage	380

To convert the point rainfall obtained from isopluvial map into areal rainfall following Area Reduction Factors (ARF); as per FER-1(C) are applied:

Table 5:- Areal Rainfall (mm) after applying ARF

S.No.	Project Name	Point Rainfall (mm)	ARF	Areal Rainfall (mm)
1	Neemkheda Barrage	400	0.7707	308.3
2	Barari Barrage	380	0.76	288.8
3	Kesari Barrage	360	0.858	308.9
4	Kotha Barrage	380	0.76	288.8

(v) The two day and one day SPS values supplied by IMD for the project areas and as mentioned in the DPR have been considered for computing the Check Flood for all the barrages. The SPS value for Kotha Barrage has been taken same as that of Barari Barrage as mentioned in the DPR.

(vi) The loss rate of 2.3 mm/hr has been taken into account while computing the excess rainfall in case of design flood and 1.0 mm /hr has been adopted for check flood. These values have been taken from concerned FER of sub zone- 1 (c).

Recommendation:

This office has modified the flood study for the Neemkheda, Barari, Kesari and Kotha Barrages addressing above observation. The Unit hydrograph has been smoothened and adjusted for the volume of Unit Hydrograph. The time distribution of 24-hr (3 hourly) as supplied by IMD has been converted into hourly distribution with duly smoothening the curve. The 12 hr temporal distribution has been used to assess the incremental rain fall. The loss rate as mentioned in the observations (v) and base flow of 0.018 cumec/sq km have been taken from Flood Estimation Report of subzone-1(C) for the calculation of excess rainfall. The excess rainfall has been critically arranged in the two bells per day and convoluted with the Unit Hydrographs.

The Peak Design Flood and Peak Check Flood for the Neemkheda, Barari, Kesari and Kotha Barrages have been worked out as follows:

Table 6:- Peak Design Flood and Peak Check Flood

S.No.	Project Name	Peak Design Flood (cumec)	Peak Check Flood (cumec)
1	Neemkheda Barrage	5298	8345
2	Barari Barrage	11983	16439
3	Kesari Barrage	1856	2866
4	Kotha Barrage	18698	26673

Flood frequency analysis has also been performed as a check to the derived Design Flood values. Results obtained from the 'Log Pearson Type-III' Frequency Distribution of Basoda G&D Site have been used to compute the various return period floods for all the four Projects in the proportion to the ratio of (Catchment area)$^{0.75}$ and the same are tabulated below:

Table 7:- Return Period Floods from Flood Frequency Analysis

S.No.	Project Name	Return Period Flood transferred from Basoda G&D Site	
		100- Years	500- Years
1	Neemkheda Barrage	4801.36	6578.46
2	Barari Barrage	10230.76	14017.42
3	Kesari Barrage	1766.40	2420.19
4	Kotha Barrage	15359.90	21045

The Values of the Peak Design Flood computed are found to be in order with the values obtained from Flood Frequency analysis. Hence, the values of Peak Design Flood and Peak Check Flood tabulated in Table 6 are recommended for planning and design purpose.

Diversion Flood:

a) For Neemkheda, Barari, Kesari and Kotha Barrages

Diversion flood for all the four barrages has been evaluated as the maximum of the following two criteria: a) Maximum non-monsoon flow observed at the barrage site OR; b) 25-year return period flow, calculated on the basis of non-monsoon yearly peaks. The peak of daily flow for non-monsoon months, available for 35 years at Basoda G&D Site was provided by Project Authority and used in our analysis. The 25-year return period flow was calculated using the 'Pearson Type-III' frequency distribution. The diversion flood obtained and recommended are as follows:

Table 8:- Recommended Diversion Flood for all the Barrages

Project Site	Flow (cumec)			
	Max. Observed		25-year return period	Recommended

	(non-monsoon)	(non-monsoon)	Diversion Flood
Neemkheda Barrage	300.84	172.22	**301**
Barari Barrage	641.02	366.98	**641**
Kesari Barrage	110.68	63.36	**111**
Kotha Barrage	962.39	550.96	**963**

b) For Lower Orr Dam

Lower Orr being a large dam, it is desirable that 100-year return period flood should be adopted for diversion works. Accordingly, the annual peaks of daily flow provided by Project Authority for Basoda G&D Site have been used for computing the 100-year return period flood for Lower Orr Dam. Peak flows were adjusted in proportion to the ratio of (Catchment area)$^{0.75}$. 'Log Pearson Type-III' frequency distribution has been used to compute the 100-year flood for the Dam site. The Diversion Flood for Lower Orr Dam computed and recommended is **4576 cumec**.

Details of the flood study are enclosed at Annex 1 to 119.

This issues with the approval of CE, HSO, CWC.

14/9/2016

(एस.के.सिन्हा)
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O/C

निदेषक, राष्ट्रीय परियोजना–2, निदेषालय, के•ज•आ• नई दिल्ली–66
पत्र संख्या:1 /82/2013/ज•वि•(म•)/311 दिनांक: 14/09/2016

कमरा संख्या 504 (द.), सेवा भवन, आर. के. पुरम सैक्टर-1, नई दिल्ली-110066
दूरभाष: 011-26106432

भारत सरकार
केन्द्रीय जल आयोग
जलविज्ञान (मध्य) निदेशालय

विषयः– **Ken Betwa Link (Phase-II)- Water Availability Studies of Kotha Barrage-reg.**

संदर्भः– Lr. No. 4/9/2012/NP-II/ dated 07.10.2015

PROJECT BACKGROUND

The Ken Betwa link project (Phase-II) proposes to utilize equal quantity of water saved from diversion of 1074 MCM of water from the proposed Daudhan Dam on Ken River, out of which after enroute utilization, 659 MCM of water is to be diverted to Betwa River upstream of Parichha weir. As part of phase-II works it is proposed to utilise this water in Upper Betwa Sub basin, upstream of Rajghat Dam, through construction of five projects viz., Lower Orr Dam, Neemkheda barrage, Barari Barrage, Kesari Barrage and Kotha Barrage.

In the Comments submitted by this office Lr. No. 1/82/2013/Hyd(C)/128 dated 26.04.2016 on the Detailed Project Report of Ken Betwa link (Phase-II), the net flow series to be adopted for planning and design purposes have been approved for the four projects namely Neemkheda Barrage, Barari Barrage, Kesari Barrage and Lower Orr Dam subject to certain observations. The reply of the comments regarding Kotha Barrage was received vide letter dated 16.06.2016.

WATER AVAILABILITY STUDIES OF KOTHA BARRAGE

Kotha Barrage is one of the five barrages proposed to be constructed under the Ken Betwa link (Phase-II). The Catchment area of Kotha Barrage (8711 Sq.Km.) is divided into three independent sub basins for establishing the yield series at the proposed project.

One G&D site is existing at Basoda (CA:7726 Sq.Km.) in the Upper Betwa Basin where long term flow data is available for the period 1976-2009. The rainfall data of 15 rain gauge stations is available in the basin for variable time periods. The consistency of the rainfall data is carried out using the double mass curve technique and necessary corrections are made in the data. The missing rainfall data is filled up using nearby rainfall station data. Based on the refined rainfall data, the weighted areal monthly rainfall for the Kotha project and Basoda G&D site is computed for the period 1901-2009 using Thiessen Polygon method. Basoda G&D site is located at an aerial distance of 21.7 km downstream to the proposed Kotha Barrage.

Bhopal Lake with a catchment area of 354 Sq.Km. utilises water of Betwa River and contributes quite marginal quantity of spills downstream side. In view of this, the catchment area of Bhopal Lake is excluded in further water availability studies duly deducting the spills from Basoda discharge data and catchment area from relevant

project's catchment areas. As per the DPR, 34 projects (1 Major, 2 Medium and 31 Minor Projects) utilise/withdraw water upstream of Basoda G&D site. Utilising the relevant inflow series, project operation/ working tables of major and medium projects as well as utilisations of 31 minor projects, the virgin flows at Basoda are computed for the period 1976-2009 using the following relationship

$$Basoda_{virgin_flows} = Basoda_{observed_flows} - Bhopal_{spills} + Halali_{inflow} - Halali_{spills} - Halali_{10\%\ Diversions} + Kerwan_{90\%\ utilisations} + Kalisot_{90\%\ utilisations} + Minor\ Projects_{\ monthly_utilisations}$$

Using the virgin flows and the weighted areal rainfall at Basoda G&D site, rainfall-runoff relationship is established for the monsoon months (viz. June, July, August, September and October). The non-monsoon flows are estimated as 4.264% of the monsoon flows and further the flows are disaggregated into individual non-monsoon month flows in the ratio of relevant month average virgin flows and average non-monsoon virgin flows at Basoda site. Based on the estimated rainfall- runoff relationship and weighted areal monthly rainfall, the virgin flows are computed for Basoda site and the Kotha project for the period 1901-2009.

The net yield series has been derived after accounting for the diversions from the existing and future major, medium and minor projects and net domestic and industrial demands from surface water resources in various sub-basins. The following relation gives the net flow at the proposed project site.

$$Net\ flow = virgin\ flows\ for\ free\ catchment\ area + spills\ projects\ upstream + spills\ medium\ projects + 10\%\ diversions\ of\ \ medium\ projects - diversions\ for\ minor\ projects + upstream\ environmental\ flows - withdrawal\ for\ domestic\ industrial\ demands$$

The dependable flows for the Kotha Project in the table below along with the net flow series enclosed at Annexure 2.4.8 of the supplementary report may be adopted for planning and design purpose.

	Dependable Flow (MCM)		
	50%	75%	90%
Kotha Barrage Project	2181.03	1702.78	1287.90

OBSERVATIONS

1. It has been intimated by NWDA that the MDDL and pond level of Kotha project has been changed from earlier design levels of 396.50 m and 403.10 m respectively to 384.50 m and 396.00 m respectively as the location of this barrage site has been changed. Further the design demands of Kotha barrage has been changed due to dropping of earlier proposed Bijrotha barrage. However there is no indication of any change in the catchment area (374.58 Sq. Km.) of this project site despite change in its location, which has also resulted in the change in Elevation Area Capacity curve. Recommendations

have been made based on the assumption that there is no change in the catchment area of the proposed Kotha Barrage project.

2. The environmental flow of Lower Orr Dam has been accepted by the expert appraisal committee in their 91st meeting held on 8-9 February 2016. However for the other four Barrages, the environmental releases are subject to the approval by the Ministry of Environment and Forests (MoEF). Accordingly, the studies may need to be revised as per the approved environmental flows.
3. As the proposed projects are cascading in nature, the water availability studies of downstream proposed projects depend upon spills/water demands of the upstream proposed projects. The demands considered in the report may be got vetted by the concerned Irrigation Planning Directorate of CWC and accordingly the studies may be revised, if needed.
4. Integrated simulation analysis of Ken-Betwa system is carried out considering the six proposed projects (Viz. one project on Ken river and five projects on Betwa river) and four existing projects in Betwa river basin (Viz. Rajghat dam, Matatila dam, Dhukwan dam and Parichha Weir) with multi reservoir simulation studies. The inflow series for the existing four projects is computed by adding the flows from the intervening catchment area, environmental flows, spills and 10% of withdrawals from the upstream projects. The flow from the intervening catchment area is estimated in catchment area proportion using virgin flows of Basoda site, which seems to be generally in order. However relevant simulation studies may be got vetted by concerned Irrigation Planning directorate of CWC.

This issues with the approval of CE, HSO, CWC.

20/1/2017

(एस.के.सिन्हा)
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ज•वि•(म•)

o/c

निदेषक, राष्ट्रीय परियोजना–2, निदेषालय, के•ज•आ• नई दिल्ली–66
पत्र संख्याः 1/82/2013/ज•वि•(म•)/65 दिनांकः 20/1/2017

कमरा संख्या 504 (द.), सेवा भवन, आर. के. पुरम सैक्टर-1, नई दिल्ली-110066
दूरभाष: 011-26106432

Kotha Barrage.

Government of India
Central Water Commission
Hydrological (Central) Directorate

7th Floor, South Wing
Sewa Bhavan, R K Puram
New Delhi – 110066

Subject: Water Availability Study of Kotha barrage project – regarding.

Ref: (i) Letter No. 303/D-6/Ken-Betwa Link /W./CB/2018 dated 3rd /13th Aug, 2018

(ii) Letter No. Q1/TS/Kotha barrage/2018 dated 13th Aug, 2018-08-16

This office is in receipt of letter no. 303/D-6/Ken-Betwa Link/W./CB/2018 dated 3rd /13th Aug, 2018 from the Office of Chief Engineer, Chambal Betwa Basin, WRD, Bhopal addressed to Chief Engineer (PAO), CWC, New Delhi and a copy endorsed to this Directorate, as well as letter no. Q-1/TS/Kotha barrage/2018 dated 13th Aug, 2018 from Office of the Executive Engineer, Sanjay Sagar Project, Bah River Diversion, Ganjbasoda, addressed directly to this directorate in connection with water availability of Kotha barrage project. The copies of both these letters are enclosed herewith for ready reference. Vide letter dated 3rd /13th Aug, 2018, a request has been made for approval of final inflow series for Kotha barrage from this Directorate as desired by Irrigation Planning Directorate of CWC. As regards Government of Madhya Pradesh letter dated 13th Aug, 2018, the issues raised therein do not pertain to HSO and the same may be got examined from the concerned Directorates in CWC.

In this connection, it may be noted that the water availability of Kotha barrage as part of Ken Betwa link (Ph-II) was examined earlier in Hydrological Studies Organization (HSO), and the net yield series for 4 out of 5 proposed structures, namely Neemkheda barrage, Barari barrage, Kesari barrage, and Lower Orr dam were finalized for adopting the same for planning and design purpose subject to certain observations, and communicated to your office vide this office letter no. 1/82/2013/Hyd(C)/128 dated 26th April, 2016. The net yield series for the 5th structure, namely Kotha barrage project, as given in the Annexure 2.4.8 of the "NIH Supplementary Report on Hydrological Studies and Multi-reservoir Simulation Studies for DPR of Ken Betwa Link (Ph-II), 2014" was also finalized for adopting the same for planning and design purpose subject to certain observations, and communicated to your office vide this office letter no. 1/82/2013/Hyd(C)/65 dated 20th Jan, 2017. This office had made certain observations regarding the cascading nature of proposed structures in the project as per DPR submitted, and also that since the water availability studies of downstream proposed projects

under Ken Betwa Link (Ph-II) depended upon spills / water demands of the upstream proposed projects, the demands considered in the NIH Supplementary Report (2014) needed to be vetted from the concerned Irrigation Planning Directorate of CWC and studies revised accordingly, if needed. However, this office has no information, whether the net yield series was communicated to concerned Irrigation Planning Directorate in CWC or not for doing further needful in the matter, or comments / observations were issued by the concerned Directorate, if any.

Subsequently, vide your letter no. 4/9/2012/NP-II dated 31st March 2017, the DPR of Kotha barrage major project was again submitted to this office for examination of hydrological aspects. As there was no clarity in the proposal whether this is a standalone structure proposed in lieu of all the 5 structures earlier proposed as part of Ken Betwa link (Ph-II), whose hydrology was already examined by this office as per letters referred in the above para, the clarifications were sought on this aspect as well as the changed virgin flow series of Basoda G&D site vide this office letter dated 2nd June, 2017. The same was replied by the Office of the Chief Engineer, Chambal Betwa Basin, WRD, Bhopal vide letter no. 272/D-6/Ken Betwa Link/W./CB/ dated 21st Aug, 2017. In the said letter, it was informed that out of 5 structures earlier proposed in the Ken Betwa link (Ph-II), only Barari barrage and Kesari barrage were dropped, and the rest 3, namely Neemkheda barrage, Kotha barrage and Lower Orr dam were still part of the link project.

As there was no clarification offered by the Project Authorities on the changed virgin flow series of Basoda G&D site from that provided in the combined DPR of Ken Betwa link (Ph-II), whose data was used for the computation of water availability of Kotha barrage, the clarifications were sought on this aspect vide this office letter dated 26th Sep, 2017. The same was replied by the Office of the Chief Engineer, Chambal Betwa Basin, WRD, Bhopal vide letter no. 327/D-6/Ken Betwa Link/W./CB/ dated 26th Oct, 2017. In the said letter, though no explanation was offered for the changed virgin flow series of Basoda G&D site, a revised simulation analysis carried out for Kotha barrage was submitted to this office.

While examining the revised simulation analysis for Kotha barrage project submitted by the Project Authorities, it was noticed that some structures, which were earlier part of the Ken Betwa link (Ph-II), but were declared to be dropped as per revised DPR of Kotha barrage project, were also considered in the revised simulation analysis and for computation of net flow series of Kotha barrage. As the net flow series of Kotha barrage project in association with these projects planned in the upstream had already been examined earlier, it was communicated to your office vide this office letter no. 1/82/2013/Hyd(C)/447 dated 10th Nov, 2017 that the observations / comments of Hydrological Studies Organization on the net flow

series of Kotha barrage conveyed vide this office letter dated 20th Jan, 2017 as referred to above, stand valid and there was no further comments to offer.

Now, the State Government has informed differently once again vide its letter dated 3rd Aug 2018, that "at present Kotha barrage is the only proposed project on main Betwa river upstream of Rajghat dam as other proposed barrages on main stream have been dropped by Governemnt of Madhya Pradesh, and therefore, there is no possibility of negative impact on the system due to cascading effect". As the studies related to water availability of Kotha barrage have not been revised by the State Governnment, nor any additional details have been provided in this regard, it is clear from the explanation offered by the State Government above that the net water availability at Kotha barrage as communicated earlier vide this office letter dated 20th Jan, 2017 is on conservative side. Accordingly, the net flow series enclosed at Annexure 2.4.8 of the NIH Supplementary Report (2014) based on information and details contained therein may be adopted for planning and design purposes.

This issues with the approval of Chief Engineer (HSO), CWC.

Encl: As above

17/8/2018

d/c (S K Sinha)
Director

Director, NP-II, CWC, New Delhi. 17/8/18

No. 1/82/2013/Hyd(c)/ 1306-1309 Dated: 17 Aug, 2018

Copy for information to:

1. PPS to Member (D&R), CWC, New Delhi. 17/8/18
2. Chief Engineer (PPO), CWC, New Delhi 17/8/18
3. Chief Engineer (PAO), CWC, New Delhi 17/8

Annexure – III

भारत सरकार
केंद्रीय जल आयोग
जल विज्ञान (मध्य) निदेशालय

सप्तवीं मंजिल (दक्षिण), सेवा भवन,
आर.के पुरम, नई दिल्ली
फ़ोन अंक: 26106432

विषय: **Detailed Project Report (DPR) of Kotha Barrage Major Project (Part of Ken-Betwa Link Project Phase-II)-reg**

संदर्भ
1. पत्र संख्या. 4/9/2012/NP-II/1573 दिनांक 30.10.2017
2. पत्र संख्या. 1/82/2013/ ज. वि. (म)/440 दिनांक 26.09.2017
3. पत्र संख्या. 27/D-6/Ken-Betwa link/W./CB/ दिनांक 21.08.2017
4. पत्र संख्या. 1/82/2013/ ज. वि. (म)/454 दिनांक 2.06.2017

Please refer to the above cited letter at ref (1) sending the compliance of the Kotha barrage major project in response to this office letter at ref (2). Earlier communications in this regard at ref (3) & ref (4) may also be referred to. On examination of the letter dated 30.10.2017 and the revised simulation analysis for Kotha barrage submitted along with the letter, it is seen that the projects which were earlier proposed to be dropped from the Ken Betwa Link Ph-II, i.e Neemkheda, Barari and Kesari as per revised DPR of Kotha Barrage Project submitted during March/April, 2017, have been considered for the computation of net flow series of Kotha Barrage Project. The net flow series of Kotha project in association with these three projects planned in the upstream has already been examined earlier by HSO.

Therefore, in view of the above the comments sent vide letter no 1/82/2013/Hyd (C)/65 dated 20.01.2017 may be considered and no further comments are required to be made by this office.

This issues with the approval of Chief Engineer (HSO)

भवदीय
(एस. के. सिन्हा)
निदेशक

निदेशक, राष्ट्रीय परियोजना निदेशालय, केंद्रीय जल आयोग
पत्र संख्या. 1/82/2013/Hyd. (C)/ दिनांक: 11.2017

Table – 17 : Computed monthly net flow (MCUM) series at Kotha project site

Year	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1901-02	0	167.72	1679.6	154.45	5.25	19.984	15.97	7.037	7.913	3.356	0.307	0.12
1902-03	0	564.05	394.54	752.56	135.43	20.367	14.908	6.494	7.193	3.003	0.224	0.072
1903-04	0	210.99	793.71	1372.6	139.28	24.493	18.318	7.516	8.708	3.495	0.316	0.125
1904-05	0	428.99	411.74	319.24	13.347	15.735	10.854	5.927	6.439	2.319	0.165	0.037
1905-06	0	34.427	480.89	717.57	48.383	16.258	11.509	5.546	5.934	2.385	0.077	0
1906-07	0.566	611.7	112.68	887.56	61.289	19.913	14.531	6.851	7.667	3.235	0.295	0.113
1907-08	0	67.517	1498.4	42.389	2.134	14.007	11.622	6.323	6.92	2.653	0.183	0.047
[illegible]-09	0	786.63	1017.2	150.36	6.952	15.648	15.406	7.011	7.879	3.339	0.306	0.119
1909-10	6.828	195.42	1212.4	89.489	2.146	16.415	12.924	5.858	6.34	2.405	0.096	0.003
1910-11	3.193	23.902	684.36	1137.3	102.27	20.641	15.133	6.882	7.707	3.255	0.246	0.085
1911-12	0	83.472	647.1	996.02	79.939	20.96	15.396	6.554	7.272	3.041	0.199	0.057
1912-13	0	290.55	967.79	433.17	20.927	18.442	13.315	6.206	6.81	2.815	0.18	0.046
1913-14	38.457	39.967	814.54	64.508	2.82	10.363	8.61	4.769	4.662	0.803	0	0
1914-15	3.827	744.54	590.02	356.58	17.474	19.962	14.571	6.115	6.69	2.756	0.144	0.025
1915-16	49.735	83.283	921.97	250.09	117.97	16.269	11.518	5.494	5.865	2.352	0.071	0
1916-17	52.671	224.8	2197.4	498.59	139.75	29.593	22.87	9.651	11.542	4.584	0.535	0.252
1917-18	53.649	494.44	1824.8	1034.8	111.85	33.704	26.626	10.34	12.48	4.665	0.558	0.266
1918-19	16.947	25.89	687.95	205.91	7.151	13.506	9.494	5.225	5.493	1.206	0.039	0
1919-20	0	389.22	2769.5	535.58	92.273	36.736	29.319	11.247	14.616	4.619	0.503	0.234
1920-21	8.103	469.93	172.68	108.49	1.973	12.16	8.747	4.625	4.617	0.829	0	0
1921-22	11.713	23.62	1336.3	969.51	64.015	23.124	18.066	6.867	7.688	3.245	0.263	0.094
[illegible]-23	1.948	563.39	265.38	863.92	56.626	20.288	14.841	6.848	7.662	3.233	0.251	0.087
1923-24	0	1532.3	1344.5	981.6	54.733	38.807	31.031	11.076	17.008	4.446	0 52	0.243
1924-25	0	212	891.59	849.99	92.427	21.474	15.822	6.661	7.415	3.111	0.209	0.063
1925-26	21.097	264.23	454.74	162.01	5.154	12.777	9.139	5.042	5.121	1.276	0.032	0
1926-27	0	454.49	1618.6	856.23	101.82	29.906	23.652	8.528	10.527	3.73	0.334	0.135
1927-28	2.688	620.88	667.35	187.45	46.245	18.58	13.43	6.203	6.806	2.767	0.135	0.025
1928-29	0	943.42	348.68	50.846	19.71	15.503	10.886	5.419	5.765	2.267	0.047	0
1929-30	1.211	440.79	962.18	282.21	10.573	20.164	14.739	6.745	7.526	3.166	0.253	0.089
1930-31	0.21	893.22	424.15	352.1	39.281	18.602	13.448	6.051	6.604	2.714	0.149	0.028
1931-32	0	282.56	1072	1233	238.94	27.889	21.95	7.699	9.35	3.408	0.27	0.098
1932-33	0	1655.9	146.31	1627.5	127.99	34.455	27.343	10.394	13.168	4.231	0.452	0.204
1933-34	44.822	333.46	1038.8	1224.5	97.787	26.22	20.289	7.599	8.817	3.523	0.297	0.114
1934-35	23.459	325.4	1241.8	2552.6	188.71	43.934	35.402	12.283	19.44	5.243	0.733	0.367
1935-36	11.532	555.44	331.99	985.75	95.9	20.744	15.219	6.563	7.285	3.048	0.201	0.059
1936-37	19.259	250.51	949.47	1086.8	69.348	23.166	17.221	6.95	7.956	3.005	0.172	0.042
1937-38	20.126	1019.1	522.71	621.67	55.391	23.346	17.37	7.027	8.058	3.329	0.25	0.087
1938-39	124.87	731.83	876.35	162.48	125.19	20.76	15.231	6.162	6.752	2.787	0.157	0.033
1939-40	0	744.96	1038.9	825.46	43.208	25.339	19.561	7.585	8.8	3.304	0.255	0.09
1940-41	26.128	1115.6	1288.9	326.53	34.457	26.012	19.575	8.165	9.569	3.852	0.376	0.16
1941-42	0	26.897	1200.3	352.61	14.022	18.528	13.386	6.056	6.611	2.717	0.141	0.024
1942-43	26.868	1495	860.77	569.39	26.706	28.974	22.644	8.919	10.571	4.092	0.475	0.217
1943-44	0.358	729.4	458.16	497.86	106.18	19.818	14.453	6.744	7.524	3.165	0.256	0.09
1944-45	0	1463.9	1551.4	399.16	56.822	35.281	28.116	9.384	15.361	3.406	0.223	0.071

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Year	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1945-46	221.22	1029	343.94	650.89	36.693	22.783	16.905	6.945	7.792	3.296	0.208	0.063
1946-47	135.89	680.44	1641	220.54	11.786	25.546	19.189	8.061	9.274	4.022	0.453	0.204
1947-48	0	647.14	1635.6	1503.9	133.72	38.437	30.726	11.229	16.308	4.638	0.53	0.249
1948-49	21.736	984.58	1461.9	1321.9	104.69	37.646	30.035	11.373	14.769	4.874	0.604	0.292
1949-50	15.294	347.04	328.01	2005.7	249.32	28.667	21.901	8.949	10.61	4.276	0.498	0.231
1950-51	0	452.23	452.29	531.72	32.575	14.998	10.468	5.141	5.396	2.122	0.04	0
1951-52	0	195.41	668.87	78.778	4.055	11.929	9.604	5.282	5.5	1.238	0.014	0
1952-53	27.146	516.4	822.71	49.191	1.783	13.76	11.417	6.218	6.826	2.534	0.204	0.06
1953-54	0	506.8	935.31	366.64	32.289	19.071	13.836	6.379	7.04	2.928	0.236	0.079
1954-55	0	497.78	292.65	1750.7	153.98	25.599	19.835	7.741	9.007	3.355	0.234	0.078
[illegible]	27.223	25.89	1872.1	1822.1	264.25	38.41	30.925	10.59	17.073	4.551	0.498	0.231
1956-57	4.566	1356.9	1044.2	609.09	66.073	30.042	23.038	9.478	11.314	4.734	0.591	0.285
1957-58	0	139.24	850.83	317.91	29.561	16.345	11.582	5.9	6.404	2.514	0.107	0.009
1958-59	0	520.21	792.1	896.43	138.32	23.776	17.725	7.21	8.301	3.366	0.276	0.102
1959-60	1.19	834.09	1303.3	978.58	161.4	31.653	24.957	9.697	11.604	4.343	0.498	0.231
1960-61	4.725	230.63	1481	90.857	78.938	20.521	15.034	6.408	7.078	2.947	0.173	0.042
1961-62	0	604.35	1249	2554.3	360.44	48.113	39.021	14.386	21.888	5.363	0.67	0.33
1962-63	0	260.95	565.14	1225.4	85.265	21.95	16.216	7.049	7.93	3.364	0.255	0.09
1963-64	0	64.116	1431.8	547.68	37.736	20.657	15.147	6.588	7.317	3.064	0.215	0.067
1964-65	1.355	600.29	1304.5	844.61	44.257	26.398	20.317	7.969	9.31	3.512	0.277	0.102
1965-66	0	861.19	172.87	488.67	33.003	17.234	12.318	5.847	6.333	2.581	0 105	0.003
1966-67	0.428	368.23	450.97	138.13	3.8	13.272	9.529	5.243	5.221	1.1	0.046	0
1967-68	7.397	268.78	835.64	1087.7	78.094	23.115	17.179	7.155	8.07	3.432	0.264	0.095
1968-69	0	551.94	1008.7	284.59	11.003	20.154	14.731	6.32	6.962	2.889	0.142	0.024
[illegible]	0	1450.2	1967.8	564.63	27.529	38.278	30.831	11.494	15.719	4.883	0.581	0.279
1970-71	47.813	636.11	1921.6	1295	93.465	39.012	31.333	10.976	17.347	4.541	0.473	0.216
1971-72	74.599	1049.4	379.69	906.65	137.95	25.754	19.361	8.276	9.559	4.162	0.464	0.211
1972-73	0	20.541	1461.8	146.86	4.406	17.156	12.252	5.716	6.159	2.426	0.08	0
1973-74	0	1410.4	2360.4	794.27	55.174	45.945	37.171	13.924	21.245	5.226	0.64	0.313
1974-75	0	341.68	1959.6	79.185	47.545	22.763	16.888	7.146	8.058	3.427	0.303	0.118
1975-76	45.989	437.77	1318.2	1093.2	144.55	28.93	22.598	9.188	10.928	4.523	0.564	0.269
1976-77	11.648	67.072	729.33	660.34	52.686	16.823	11.977	5.373	5.704	2.206	0.022	0
1977-78	56.404	656.22	1742.3	914.7	76.668	32.84	26.011	9.925	11.959	4.299	0.431	0.192
1978-79	54.012	661.18	1610.7	218.53	7.219	24.305	18.483	7.623	8.793	3.737	0.344	0.141
1979-80	0	16.704	237.77	53.082	1.895	8.835	5.395	2.48	0.686	0.051	0	0
1980-81	55.518	25.891	1289.2	221.67	8.551	18.173	13.093	6.054	6.608	2.716	0.135	0.02
1981-82	0	126.06	984.36	282.94	23.669	17.563	12.589	6.136	6.717	2.759	0.145	0.031
1982-83	0	111.73	2280.7	452.05	48.614	27.222	20.99	8.599	10.147	4.312	0.519	0.243
1983-84	0	232.57	1577.8	2047.4	210.93	40.421	32.366	11.591	18.273	4.827	0.632	0.309
1984-85	0	20.818	1769.4	101.27	2.696	15.434	12.119	5.471	5.834	2.28	0.037	0
1985-86	0	356.29	1467.2	1105.5	298.45	30.859	24.185	9.266	11.031	4.35	0.497	0.23
1986-87	22.425	1740.4	567.59	126.38	3.655	23.8	18.762	6.322	6.885	2.737	0.094	0.001
1987-88	0	121.58	1550.4	449.73	118.54	24.155	18.039	8.109	9.337	4.053	0.536	0.253
1988 89	28.296	515.95	725.8	209.33	23.332	18.609	13.453	6.193	6.793	2.751	0.157	0.038
1989 90	11.563	19.371	870.83	506.26	26.839	16.595	11.789	6.041	6.592	2.592	0.148	0.028
1990 91	64.89	396.73	1170.7	643.82	60.151	22.319	16.975	6.5	7.36	2.905	0 101	0
1991 92	35.887	271.17	1331.1	32.384	1.783	14.3	12.86	5.845	6.331	2.58	0.097	0

Year	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1992-93	0	336.07	1194.8	350.07	25.668	19.613	14.284	6.233	6.846	2.832	0.167	0.039
1993-94	0.117	327.51	1028.9	1798.7	163.65	31.288	24.463	9.933	11.917	4.776	0.618	0.3
1994-95	159.23	731.19	1757.5	406.61	18.549	28.994	22.598	8.932	10.588	3.964	0.39	0.168
1995-96	0	535.29	809.42	518.17	63.785	20.91	15.356	6.694	7.459	3.133	0.256	0.09
1996-97	0	1105.4	1835	558.32	106.48	34.224	26.981	10.285	13.032	4.374	0.487	0.224
1997-98	0.235	718	958.15	401.26	111.05	21.419	15.776	6.484	7.18	2.996	0.182	0.047
1998-99	20.435	585.32	586.56	839.34	78.296	20.562	15.068	6.222	6.832	2.826	0.134	0.019
1999-00	3.587	704.95	820.31	2540.3	360.82	44.922	36.381	12.914	20.093	4.606	0.553	0.263
2000-01	6.418	1251	330.59	40.056	1.783	14.946	12.399	6.724	7.498	3.152	0.294	0.113
2001-02	52.971	424.71	745.59	81.522	42.434	16.893	12.035	6.063	6.62	2.671	0.164	0.037
2002-03	0	0.528	1668.8	221.93	9.136	19.219	13.958	6.681	7.441	3.124	0.254	0.089
2003-04	0	418.68	870.86	936.3	62.228	23.572	17.557	7.747	8.856	3.818	0.357	0.149
2004-05	13.318	196.42	1350.7	135.46	52.376	19.049	13.817	6.471	7.161	2.987	0.16	0.035
2005-06	0.811	1215.6	308.65	537.79	32.415	21.434	15.789	6.907	7.741	3.271	0.26	0.093
2006-07	0	523.37	2094.2	1241.4	89.834	39.069	31.248	11.22	17.364	4.869	0.464	0.202
2007-08	4.942	331.54	319.33	511.91	27.698	15.448	10.777	5.756	6.212	2.237	0.074	0
2008-09	79.236	79.172	414.3	325.37	25.46	13.649	9.855	5.411	5.586	1.325	0.091	0

Elevation Area Capacity (EAC) Table

The elevation area capacity table for Kotha barrage is as given in Table 18

Table 18: Elevation Area Capacity Table

Elevation (m)	Area (ha.)	Capacity (MCUM)
383.52	0.00	0.00
384.00	58.00	0.02
385.00	189.00	1.19
386.00	225.00	3.26
387.00	303.00	5.89
388.00	411.00	9.45
389.00	513.00	14.06
390.00	600.00	19.62
391.00	678.00	26.00
392.00	783.00	33.30
393.00	885.00	41.64
394.00	1070.00	51.40
395.00	**1359.00**	**63.51**
396.00	1861.00	79.55
397.00	2551.00	101.52

Estimation of Design Flood

Two approaches are generally practiced for design flood calculations: (i) unit hydrograph (UH) approach and (ii) statistical approach. In case the UH approach is followed, it

Reference Evapo-Transpiration (ET_0) as per TC 25

District: Vidisha

Month	Fortnight	ET_0 in mm
January	1	42
	2	47
February	3	51
	4	60
March	5	76
	6	91
April	7	99
	8	114
May	9	126
	10	128
June	11	135
	12	109
July	13	94
	14	76
August	15	65
	16	64
September	17	70
	18	79
October	19	78
	20	74
November	21	52
	22	45
December	23	41
	24	40

001

भारत सरकार
केन्द्रीय जल आयोग
जलविज्ञान (मध्य) निदेशालय

विषयः— **Ken Betwa Link (Phase-II)- Water Availability Studies of Kotha Barrage-reg.**

संदर्भः— Lr. No. 4/9/2012/NP-II/ dated 07.10.2015

PROJECT BACKGROUND

The Ken Betwa link project (Phase-II) proposes to utilize equal quantity of water saved from diversion of 1074 MCM of water from the proposed Daudhan Dam on Ken River, out of which after enroute utilization, 659 MCM of water is to be diverted to Betwa River upstream of Parichha weir. As part of phase-II works it is proposed to utilise this water in Upper Betwa Sub basin, upstream of Rajghat Dam, through construction of five projects viz., Lower Orr Dam, Neemkheda barrage, Barari Barrage, Kesari Barrage and Kotha Barrage.

In the Comments submitted by this office Lr. No. 1/82/2013/Hyd(C)/128 dated 26.04.2016 on the Detailed Project Report of Ken Betwa link (Phase-II), the net flow series to be adopted for planning and design purposes have been approved for the four projects namely Neemkheda Barrage, Barari Barrage, Kesari Barrage and Lower Orr Dam subject to certain observations. The reply of the comments regarding Kotha Barrage was received vide letter dated 16.06.2016.

WATER AVAILABILITY STUDIES OF KOTHA BARRAGE

Kotha Barrage is one of the five barrages proposed to be constructed under the Ken Betwa link (Phase-II). The Catchment area of Kotha Barrage (8711 Sq.Km.) is divided into three independent sub basins for establishing the yield series at the proposed project.

One G&D site is existing at Basoda (CA:7726 Sq.Km.) in the Upper Betwa Basin where long term flow data is available for the period 1976-2009. The rainfall data of 15 rain gauge stations is available in the basin for variable time periods. The consistency of the rainfall data is carried out using the double mass curve technique and necessary corrections are made in the data. The missing rainfall data is filled up using nearby rainfall station data. Based on the refined rainfall data, the weighted areal monthly rainfall for the Kotha project and Basoda G&D site is computed for the period 1901-2009 using Thiessen Polygon method. Basoda G&D site is located at an aerial distance of 21.7 km downstream to the proposed Kotha Barrage.

Bhopal Lake with a catchment area of 354 Sq.Km. utilises water of Betwa River and contributes quite marginal quantity of spills downstream side. In view of this, the catchment area of Bhopal Lake is excluded in further water availability studies duly deducting the spills from Basoda discharge data and catchment area from relevant

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project's catchment areas. As per the DPR, 34 projects (1 Major, 2 Medium and 31 Minor Projects) utilise/withdraw water upstream of Basoda G&D site. Utilising the relevant inflow series, project operation/ working tables of major and medium projects as well as utilisations of 31 minor projects, the virgin flows at Basoda are computed for the period 1976-2009 using the following relationship

$$Basoda_{virgin_flows} = Basoda_{observed_flows} - Bhopal_{spills} + Halali_{inflow} - Halali_{spills} - Halali_{10\%\ Diversions} + Kerwan_{90\%\ utilisations} + Kalisot_{90\%\ utilisations} + Minor\ Projects_{\ monthly_utilisations}$$

Using the virgin flows and the weighted areal rainfall at Basoda G&D site, rainfall-runoff relationship is established for the monsoon months (viz. June, July, August, September and October). The non-monsoon flows are estimated as 4.264% of the monsoon flows and further the flows are disaggregated into individual non-monsoon month flows in the ratio of relevant month average virgin flows and average non-monsoon virgin flows at Basoda site. Based on the estimated rainfall- runoff relationship and weighted areal monthly rainfall, the virgin flows are computed for Basoda site and the Kotha project for the period 1901-2009.

The net yield series has been derived after accounting for the diversions from the existing and future major, medium and minor projects and net domestic and industrial demands from surface water resources in various sub-basins. The following relation gives the net flow at the proposed project site.

$$Net\ flow = virgin\ flows\ for\ free\ catchment\ area + spills\ projects\ upstream + spills\ medium\ projects + 10\%\ diversions\ of\ \ medium\ projects - diversions\ for\ minor\ projects + upstream\ environmental\ flows - withdrawal\ for\ domestic\ industrial\ demands$$

The dependable flows for the Kotha Project in the table below along with the net flow series enclosed at Annexure 2.4.8 of the supplementary report may be adopted for planning and design purpose.

	Dependable Flow (MCM)		
	50%	75%	90%
Kotha Barrage Project	2181.03	1702.78	1287.90

OBSERVATIONS

1. It has been intimated by NWDA that the MDDL and pond level of Kotha project has been changed from earlier design levels of 396.50 m and 403.10 m respectively to 384.50 m and 396.00 m respectively as the location of this barrage site has been changed. Further the design demands of Kotha barrage has been changed due to dropping of earlier proposed Bijrotha barrage. However there is no indication of any change in the catchment area (374.58 Sq. Km.) of this project site despite change in its location, which has also resulted in the change in Elevation Area Capacity curve. Recommendations

have been made based on the assumption that there is no change in the catchment area of the proposed Kotha Barrage project.

2. The environmental flow of Lower Orr Dam has been accepted by the expert appraisal committee in their 91st meeting held on 8-9 February 2016. However for the other four Barrages, the environmental releases are subject to the approval by the Ministry of Environment and Forests (MoEF). Accordingly, the studies may need to be revised as per the approved environmental flows.
3. As the proposed projects are cascading in nature, the water availability studies of downstream proposed projects depend upon spills/water demands of the upstream proposed projects. The demands considered in the report may be got vetted by the concerned Irrigation Planning Directorate of CWC and accordingly the studies may be revised, if needed.
4. Integrated simulation analysis of Ken-Betwa system is carried out considering the six proposed projects (Viz. one project on Ken river and five projects on Betwa river) and four existing projects in Betwa river basin (Viz. Rajghat dam, Matatila dam, Dhukwan dam and Parichha Weir) with multi reservoir simulation studies. The inflow series for the existing four projects is computed by adding the flows from the intervening catchment area, environmental flows, spills and 10% of withdrawals from the upstream projects. The flow from the intervening catchment area is estimated in catchment area proportion using virgin flows of Basoda site, which seems to be generally in order. However relevant simulation studies may be got vetted by concerned Irrigation Planning directorate of CWC.

This issues with the approval of CE, HSO, CWC.

20/1/2017

(एस.के.सिन्हा)
निदेशक
ज•वि•(म•)

निदेषक, राष्ट्रीय परियोजना–2, निदेषालय, के•ज•आ• नई दिल्ली–66
पत्र संख्याः 1/82/2013/ज•वि•(म•)/ 65 दिनांकः 20/1/2017

NATIONAL PROJECTS DIRECTORATE
CENTRAL WATER COMMISSION
2A, 8th Floor (N), Sewa Bhawan, R.K. Puram
Sector-1, New Delhi-110066

राष्ट्रीय परियोजना निदेशालय
केन्द्रीय जल आयोग
Tele / Fax : 011 - 29583395
Email: np1dte@gmail.com

No. 4/9/2012/NP-II/Vol-II/ 1282-83 Date: 29th August 2018

To,

The Chief Engineer,
Chambal Betwa Basin,
Water Resources Department,
Shivaji Nager,
Bhopal.

Sub: Examination of DPR of Kotha Barrage Major Project (Part of Ken-Betwa Link Project Phase-II) - regarding.

Ref: CWC ID. No. 2/1531/IP-S/2017/601 dated 27.08.2018

Sir,

Please find enclosed herewith a copy of the letter under reference received from Irrigation Planning (S) Directorate, CWC communicating the clearances/observations in respect of irrigation planning aspects of the project.

It is requested to submit the compliances to the observations at the earliest for further examination.

Yours faithfully,

G Bansal 29/8/18

(G. L. Bansal)
Director

Encl.: As Above.

Copy for information to:
Director, Irrigation Planning (S) Directorate, CWC, Sewa Bhawan, New Delhi.

भारत सरकार
केन्द्रीय जल आयोग
सिंचाई आयोजन । दक्षिण । निदेशालय

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नई दिल्ली 110066
Ph. No. 011-29583236
Email: ipdte@nic.in

Office of Chief Engineer (P&D) CWC
Dy. No. 5494
Date 28/8/18

Sub: Detailed project report of Kotha Barrage Major Project (Part of Ken-Betwa LinkProject Phase-II) - reg.

Ref: (i) State Govt. of MP Lr. No. 305/D-6/Ken-Betwa Link/W./CB/2018 dated 03/08/2018.
(ii) CWC U.O.4/9/2012/NP-II/Vol.II/1241-42 dated 20.08.2018

The details in respect of irrigation planning of the project vide State Govt. of MP letter under reference (i) above, stated as per the discussion held in this Directorate with the project authorities in July, 2018, have been submitted in this Directorate directly by the project authorities on 13.08.2018. Subsequently, a copy of letter dated 17.08.2018 from Hydrology (Central) Dte. of CWC regarding hydrological studies of Kotha barrage project has also been received from NP Dte. vide letter under reference (ii) above. The point-wise specific reply to the observations of this Directorate dated 27.06.2018 have not been furnished by the project authorities. However, the details submitted by the project authorities and observations of Hydrology (Central) Dte. of CWC regarding hydrological studies of Kotha barrage project have been examined and comments thereon in respect of irrigation planning aspects are as under.

1. Earlier, variable irrigation water demand *(from 56.886 MCM to 88.629 MCM instead of consideration of irrigation demand worked out in the DPR as 99.92 MCM)* under the project were considered by the project authorities for the purpose of preparation of working tables. The project authorities were asked to consider a firmed up irrigation water demand for the purpose of preparation of working tables to assess the desired success rate of the project. The project authorities have now re-worked out the irrigation demand as 109.64 MCM and the same has been considered in the working tables. The irrigation water demand for the proposed cropping pattern worked out as 109.64 MCM by the project authorities is found to be in order. No further comments.

2. Earlier, it was asked to furnish a copy of approval of concerned Hydrology Directorate of CWC for the inflow series for the period 1989-90 to 2008-09 used for preparation of working tables and the same was not furnished by the project authorities. The copy of approved inflow series for the period 1989-90 to 2008-09 from concerned Hydrology Directorate of CWC dated 20.01.2017 was collected by this Directorate in July, 2018. The Hydrology (Central) Dte. of CWC had made following observations *(para 3&4 respectively of the observations)* in their letter dated 20.01.2017.

"As the proposed projects are cascading in nature, the water availability studies of downstream proposed projects depend upon spill/ water demands of the upstream proposed projects. The demands considered in the report may be got vetted by the concerned Irrigation Planning Directorate of CWC and accordingly the studies may be revised, if needed".

and

"Integrated simulation analysis of Ken-Betwa system is carried out considering the six proposed projects (Viz. one project on Ken river and five projects on Betwa river) and four existing projects in Betwa river basin (viz. Rajghat dam, Matatila dam, Dhukwan dam and Parichha weir) with multi reservoir simulation studies. The inflow series for the existing four existing four projects is computed by adding the flows from the intervening catchment area, environmental flows, spills and 10% of withdrawals from the upstream projects. The flow from the intervening catchment area is estimated in catchment area proportion using virgin flows of Basoda site, which seems to be generally in order. However, relevant simulation studies may be got vetted by concerned Irrigation Planning Directorate of CWC".

In respect of observations of Hydrology (Central) Directorate of CWC for vetting of demands under various projects as well as integrated simulation studies by Irrigation Planning Directorate of CWC as mentioned above, ***it is to intimate that this Directorate had never been referred for the same. The NIH Supplementary report (2014) also not received in this Directorate. In the absence of any details of demands under various projects, integrated simulation studies and NIH Supplementary report (2014), the same cannot be examined and confirmed by Irrigation Planning Directorate.*** This issue was brought out to the notice of the project authorities during their visit in July, 2018 in the presence of Director, Hydrology (Central), CWC.

It appears that the project authorities have submitted some clarifications/ details in above respect to the Hydrology (Central) Directorate of CWC for finalisation of net flow series of Kotha barrage and Hydrology (C) Directorate of CWC has conveyed their observations on the same vide their letter dated 17/08/2018 *(received from NP Directorate vide letter under reference (ii) above).* The Hydrology (Central) Directorate of CWC has concluded their observations as under.

"Now, the State Government has informed them differently once again vide its letter dated 3rd Aug 2018, that 'at present Kotha barrage is the only proposed project on main Betwa river upstream of Rajghat dam as other proposed barrages on main stream have been dropped by Government of Madhya Pradesh, and therefore, there is no possibility of negative impact on the system due to cascading effect'. As the studies related to water availability of Kotha barrage have not been revised by the State Government, nor any additional details have been provided in this regard, it is clear from the explanation offered by the State Government above that the net water availability at Kotha barrage as communicated earlier vide this office letter dated 20th Jan, 2017 is on conservative side. Accordingly, the net flow series enclosed at Annexure 2.4.8 of the NIH Supplementary Report (2014) based on information and details contained therein may be adopted for planning and design purposes".

Considering the aforesaid observations dated 17/08/2018 of Hydrology (Central) Directorate of CWC in respect of use of net flow series for planning and design purposes, the working tables prepared by the project authorities with the net flow series approved by the Hydrology (Central) Directorate of CWC vide its letter dated 20th Jan, 2017 and with the irrigation demand as 109.64 MCM have been examined. From the same, it has been found that the project is successful in meeting the irrigation demands in 16 years out

of 20 years and the success rate of the project accordingly comes out as 80%. ***However, if there is any change in water availability / net flow series for the Kotha Barrage in future owing to different stands of Govt. of Madhya Pradesh regarding proposed / future projects on Betwa River, the working tables will also need a review to assess the success rate of the project.***

3. The computation sheet of BC Ratio has not been submitted by the project authorities. Further, no specific compliance on BC Ratio has been furnished to the comments on BC Ratio (issued vide letter dated 13/07/2017). However, the project authorities have submitted only the approved Appendix F(1) & F(2). On examination of the same following observations have been made.

(i) Though, the yield and rate of produces have been got vetted by the Director, State Agriculture Department, yet the yield and rate of produces of some crops like Wheat, Masoor seems on higher side.

(ii) Further, the rate of seeds for soyabean crops is considered higher in before irrigation as compared to after irrigation rates. These discrepancies may be reconciled.

Revised BC Ratio computation based on above observation as well as compliance to the earlier comments issued vide letter dated 13/07/2017 may be re-worked out and the same may be submitted for BC Ratio examination.

यह मुख्य अभियन्ता (सिंचाई प्रबन्ध), केन्द्रीय जल आयोग के अनुमोदन से जारी किया जाता है.

भालचन्द्र 27/08/2018

(भालचन्द्र विश्वकर्मा)
निदेशक, सिंचाई आयोजन (दक्षिण)

Chief Engineer (PPO), CWC, New Delhi

के.ज.आ.आई डी.सं. 2/1531/IP-S/2017/601 दिनांक: 27/08/2018

Copy to:

Director (National Projects),CWC, New Delhi.

27/08/18

28/8

28/8

सत्यमेव जयते

Government of India
भारत सरकार
Central Water Commission
केन्द्रीय जल आयोग
Inter State Matters-2 Dte.
अंतरराज्यीय मामले निदेशालय

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204 (द.), सेवा भवन
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रामा कृष्ण पुरम, नई दिल्ली -६६
Telephone No: 011-29583207
Email: ism2dte@gmail.com

Sub: DPR of Kotha Barrage major Project proposed in Ken-Betwa Link Project (Phase II)- Reg.
Ref: Lr no.4/9/2012/NP-II/1028 dated 15.06.2017

Please refer to the letter mentioned above forwarding therewith DPR of Kotha Barrage Major Project submitted by NWDA for examination from inter-State angle. The proposal in brief is as follows:

Project proposal:

Kotha Barrage project is proposed in the phase-II of the Ken-Betwa Link Project apart from construction of Lower Orr Dam and 3 barrages viz., Neemkheda, Barari and Kesari in the Upper Betwa Basin in lieu of water proposed to be transferred from river Ken to river Betwa in the phase I of Ken-Betwa Link Project. Kotha Barrage project proposal includes 16.5 m high barrage in Kurwai tehsil, Vidisha district of Madhya Pradesh on the junction of river Betwa and river Keotan just u/s of confluence of river Bina with Betwa and two main telescopic pressurised pipes off taking from left and right bank of length 11.50 km and 8.50 km respectively for irrigating an area of 20000 ha through micro irrigation. It is proposed to be a river bank confined storage scheme with live storage of 63.22 MCM and submergence of about 681 ha of private land and about 678 ha of Govt. land lying within Madhya Pradesh. Total water utilisation under the proposal is mentioned as 84.246 MCM including 73.651 MCM for irrigation. The DPR been examined in this Directorate from inter-State angle and comments are as follows:

Comments:

1. Both Ken and Betwa are inter-State rivers in Yamuna sub-basin of Ganga basin. Inter-State aspects are discussed on pages 20-21 of the DPR. It is mentioned in the DPR that inter-State agreement dated 01.08.1972 between the States of Madhya Pradesh and Uttar Pradesh on irrigation provides for use of 53 TMC of water for new projects of Madhya Pradesh on the upstream of Rajghat dam and so far Madhya Pradesh had constructed 1 major,8 medium schemes besides about 100/120 minor storage and lift irrigation schemes with utilisation of about 900 MCM upto Kotha barrage and about 1100 MCM upto Rajghat dam whereas schemes of about 200-300 MCM are either under construction or proposed. Further, it is mentioned that the State of Madhya Pradesh has been given authority to use about 591 MCM of water in Upper Betwa basin in lieu of water being transferred under Ken-Betwa Link Project (phase I). It is stated that the present and likely future use in Upper Betwa basin will be well within the allowed limit even after execution of all future proposed projects.

DD
11/7/2017

Aforementioned agreement dated 01.08.1972 provides for 53 TMC use by Madhya Pradesh for new projects upstream of Rajghat project and also mandates that Uttar Pradesh will be entitled to use 9 TMC for committed uses d/s of Rajghat dam in its area and also for use in Bhander canal of Madhya Pradesh apart from usage of 26.5 TMC each from Rajghat reservoir by both States of Madhya Pradesh and Uttar Pradesh.

In this regard, the Project authority may be asked to provide authenticated details of water utilisation from existing, ongoing and proposed schemes in Upper Betwa basin of Madhya Pradesh and/or a copy of master plan of 2004 mentioned in the DPR containing such details so as to enable this Directorate maintain an account of utilisation of Betwa river waters.

2. Further, it is mentioned that during appraisal of DPR of Ken-Betwa Link Project (Phase I), IP(N) Directorate, CWC had commented that transfer of Ken water to Betwa will enhance the water availability in Betwa d/s of Rajghat dam and is likely to reduce inflow to Rajghat dam due to construction of dams in upper reaches by Madhya Pradesh. Consequently, agreement on Rajghat dam between Madhya Pradesh and Uttar Pradesh will be required to be reworked/renegotiated and a fresh agreement need to be arrived at. In response, NWDA had commented that the exact utilization in upper reaches of Betwa river could be finalised on completion of DPR of Ken-Betwa Link Project (Phase II) and as such, the extent of resultant change in sharing of water at Rajghat between Madhya Pradesh and Uttar Pradesh could be arrived at only on completion of DPR of phase –II of Ken-Betwa Link Project.

   Project Authority may be asked to take up the issue now as per para 2 of tripartite MoU on Ken-Betwa Link Project dated 25.08.2005 which states that 'Specific MoUs as required will be entered into amongst the States of Uttar Pradesh, Madhya Pradesh and Union Government based on the DPR and Agreements reached on scope of the link, sharing of costs and benefits and arrangements for management and control of water etc.'

This issues with the approval of Chief Engineer (IMO), CWC

17/7/17

(Rajesh Kumar)
Director

Director, National Projects Directorate, Central Water Commission, Sewa Bhawan, New Delhi
CWC U.O. No.2/1/ISM-2/2017/93 dated 17.07.17

सत्यमेव जयते

Government of India
भारत सरकार
Central Water Commission
केन्द्रीय जल आयोग
Inter State Matters-2 Dte.
अंतरराज्यीय मामले निदेशालय

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रामा कृष्ण पुरम, नई दिल्ली -६६
Telephone No: 011-29583207
Email: ism2dtc@gmail.com

Sub: DPRs of Lower Orr and Kotha Barrage Projects (part of Ken-Betwa Link Project Phase II) - Reg.

Ref: (i) Lr no. 4/9/2012/NP-II/1481 dated 03.10.2017
(ii) Lr.no. 3741026/Inter-State/2017-18/ Bhopal dated 26.10.2017

Please refer to the letter under reference (i) mentioned above forwarding therewith compliance of this Directorate's comments dated 18.08.2017 on DPR of Lower Orr Project submitted by NWDA for further examination from inter-State angle. E-n-C, WRD, Govt. of Madhya Pradesh vide letter under reference (ii) forwarded an Abstract of Water use of Betwa River upstream of Rajghat Dam against agreed share of 53 TMC for Madhya Pradesh. The same have been examined and further comments of this Directorate are as under:

Kotha Barrage Project

1. As per the abstract of water use of Betwa river upstream of Rajghat Dam, against agreed share of 53 TMC for Madhya Pradesh, utilisation under Kotha barrage is shown as 63.51 MCM (2.24 TMC) whereas in the DPR of Kotha Barrage Project, earlier examined by this Directorate, total water utilisation was mentioned as 84.246 MCM including 73.651 MCM for irrigation. This discrepancy needs to be reconciled. Subject to utilization of Betwa river waters remaining within the share of 53 TMC for projects taken up by Madhya Pradesh (including Kotha Barrage and Bina Complex projects) in the u/s of Rajghat after 01.08.1972, proposal of Kotha Barrage project may be considered acceptable from inter-State angle.

Lower Orr Project

2. As per the Matatila agreement dated 15.04.1953, total acreage to be irrigated from the Matatila reservoir is mentioned as 2,64,000 acres, 69,000 acres and 43,000 acres in the territories of Uttar Pradesh, Madhya Bharat and Vindya Pradesh respectively. Further, as per 1951 report of Matatila Project, irrigation requirement for 3,73,000 acres is mentioned as 34 TMC out of Gross storage of 46 TMC. There is no reference to figures of yield of 0.2077 MCM/Sq.km and utilization of 526.75MCM (18.6 TMC) by Uttar Pradesh as mentioned in the compliance report. It is however informed that annual flow of 119 TMC was considered at Rajghat Project in the inter-State agreement dated 01.08.1972 between the States of Madhya Pradesh and Uttar Pradesh. Concerned Hydrology Directorate may be asked to examine the claim made by the Project Authority that the construction of Lower Orr dam doesn't impose any adverse impact on the contribution at Matatila Dam. Also, views of the State of Uttar Pradesh in this regard may be obtained in a time bound manner as per "Guidelines for Submission, Appraisal and Acceptance of Irrigation and Multipurpose project, 2017" of MoWR RD & GR.

6/11/2017
8-11-2017
AD(NP)

3. Regarding obtaining international clearance in view of the Indo-Bangladesh Ganga Water Treaty (1996), Project Authority may refer the proposal of Lower Orr Project to FM wing, MoWR, RD & GR for further necessary action.

Rajesh Kumar

(Rajesh Kumar)
Director

Director, National Projects Directorate, Central Water Commission, Sewa Bhawan, New Delhi
CWC U.O. No.2/1/ISM-2/2017/ 266 dated 06.10.17

Annexure-1.3.5

Government Of India
Gates Design (NW&S) Directorate
Central Water Commission
6th Floor(S), Sewa Bhawan, R.K. Puram
Sector-1, New Delhi-110066

भारत सरकार
फाटक अभि. (उ.प.एवं द.) निदेशालय
केन्द्रीय जल आयोग
Tele/Fax: 011-29583393
Email : gdnwsdte@nic.in

Subject: **Technical examination of Detailed Project Report of Kotha Barrage Major Project (Part of Ken-Betwa Link Project Part-II) in Vidisha district in Madhya Pradesh.**

Reference: 1. CWC No. 27/04/2009/GD (NW&S)/276-78 Dated: 27/09/17.

2. CWC U.O. No. 04/09/2012/NP-II/1624 Dated: 10/11/2017.

3. CWC UO No. 5/49/2017-BCD (NW&S)/708 Dated: 21/11/2017.

Please refer to the CWC letter dated: 27/09/17, vide which observations on provisions of Hydro-Mechanical equipment in respect of DPR of Kotha Barrage Major Project (Part of Ken-Betwa Link Project Part-II) were issued.

Project authority has submitted the compliance of the comments vide letter dated: 10/11/17 and further clarification from Barrage & Canal Directorate, CWC were also received vide letter dated:21/11/17.

The compliance has been examined and DPR is considered acceptable as far as this directorate is concerned and there are no further comments/observations. However it shall be ensured that observations of this office issued vide letter dated: 27/09/17 shall be duly taken care at the detailed design stage as communicated by BCD (NW&S) Directorate.

Adequacy of cost estimates in respect of Hydro-Mechanical equipment may have to be got examined by the Cost Appraisal Directorate, CWC.

This issues with the approval of Chief Engineer, Designs (NW&S).

(हरकेश कुमार)
(Harkesh Kumar)
निदेशक /Director

Director, National Projects, Sewa Bhawan, CWC, New Delhi – 110066
CWC U.O. No. 27/04/2009/GD (NW&S)/ 348 Dated: 18/12/17

Copy for information to:
Director, BCD (NW&S), Sewa Bhawan, CWC, New Delhi – 110066

संख्या : 27/04/2009/फाटक(उ.प.एवंद.)/ 276

भारत सरकार/Govt. Of India

केन्द्रीय जल आयोग/Central Water Commission

फाटक अभिकल्प (उ.प.एवं द.) निदेशालय/GD (NW&S) Dte.

****

षष्ठम तल, सेवा भवन
रा. कृ. पुरम, नई दिल्ली-110066
दिनांक: 27/9/17

Sub : Technical Examination of Detailed Project Report of Kotha Barrage Major Project (Part of Ken-Betwa Link Project Part-II) in Vidisha district of Madhya Pradesh.

Ref: CWC U.O. No. 04/09/2012-NP/1321-23 dated: 28.08.2017.

The Detailed Project Report has been examined from the point of view of Hydro-mechanical equipment (gates & hoisting equipment) and the following observations are made.

Observations:

Ref:

1. Drg. No. KBL-7730-P-1507 FIXED WHEEL GATES GENERAL INSTALLATION.
2. Drg. No. KBL-7730-P-1508 STOPLOG UNIT GENERAL INSTALLATION.
3. Drg. No. KBL-7730-P-1509 GANTRY CRANE FOR STOPLOG GENERAL INSTALLATION.

i. In the general arrangement of Barrage fixed Wheel Vertical Lift Gate Vide drawing no. KBL-7730-P-1507, Pier top level which is 398.0 m need to be raised by about 4.0 m at the location of barrage gate groove. Main gate groove size needs to be increased to 1000 mm instead of existing 800 mm.

ii. Vide Volume-I of DPR in salient features, FRL mentioned is 395.0 M and vide drawing no. KBL-7730-P-1507 pond level mentioned is 396.0 M. This ambiguity need to be clarified.

iii. In order to minimize the operational difficulty as also to improve upon hydraulic performance, stoplog need to be shifted in upstream of Road Bridge.

iv. The purpose of downstream stoplog groove is not clear and hence it's requirement needs to be brought out.

v. Downstream water Level needs to be mentioned in the relevant drawings.

The adequacy of cost estimates of Gates & Hoists may be got examined by Cost Appraisal Directorate of CWC.

The above observations need to be complied with.

This issues with the approval of Chief Engineer, Designs (NW&S).

S.Kumar 6.10.17.

DD
6/10/2017

AD-II/NP/SK-Haque

(हरकेश कुमार)
(Harkesh Kumar)
निदेशक /Director

Director, National Projects, Sewa Bhawan, CWC, New Delhi – 110066
CWC U.O. No. 27/04/2009/GD (NW&S)/ 276- Dated: 27/9/17

Copy to:

1. Director, BCD (N&W), Sewa Bhawan, CWC, New Delhi – 110066
2. Director, BCD (NW&S), Sewa Bhawan, CWC, New Delhi – 110066

भारत सरकार

केन्द्रीय जल आयोग

बैराज एवं नहर अभिकल्प (एन. डब्ल्यू. एंड एस.) निदेशालय

तल-6, सेवा भवन,
आर० के० पुरम, नई दिल्ली-66
दूरभाष नo- 011-29583490

Subject: Detailed Project Report (DPR) of Kotha Barrage Major Project (Part of Ken-Betwa Link Project Phase-II) – regd.

Ref: CWC U.O. 4/9/2012/NP-II/1358 Dated : 31 August 2017

The observation on Kotha Brarrage DPR was issued in the absence of input details required for design analysis of barrage. Now, vide the above mentioned letter project authority has clarified that current DPR of the Kotha Barrage Major Project is the part of the combined DPRs of Ken-Betwa Link Project Phase-II. The design chapter of Ken-Betwa Link Project Phase-II was prepared by CWC.

In view of above, there are no comments on current DPR of Kotha Barrage Major Project and the project may be considered technically cleared from this directorate.

This issues with the approval of CE Designs (NW&S).

(अनिल जैन)
निदेशक
बी.पी.एल. स. - 3489

Director, National Projects (NP) Dte., CWC, Sewa Bhawan, R.K. Puram, New Delhi
No. 05/49/2017/BCD(NW&S)/ 631 Dated: 5/9/2017

6/9/17

6/9/2017

सत्यमेव जयते

State Environment Impact Assessment Authority, M.P.

(Ministry of Environment, Forest and Climate Change, Government of India)

Environmental Planning & Coordination Organization

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No.: 2350 /SEIAA/
Date : 21.8.2020

To,
Engineer-in chief
Department of water Resources,
Tulsi Nagar Bhopal (MP) -462003

Sub:-Case No.7224/2020: Prior Environment Clearance for proposed Kotha Barrage Major Irrigation Project at Village - Kotha, Tehsil - Kurwai, District- Vidisha (MP) Gross Command Area- 39000ha; Cultureable command area (CCA): 35000 ha Catchment Area- 8711 sq.m.Height of Barrage- 15.6 M by Project Administrator, Office of Project Administrator, Kotha Barrage Project Implementation Unit, Ganjbasoda, Dist. Vidisha, MP,through Engineer-in chief Department of water Resources,Tulsi Nagar Bhopal (MP) -462003 Email – piukothabarrage@gmail.com, Phone - 07594 – 222942 Environmental Consultant Voyants Solutions Pvt. Ltd., Gurgaon

Ref: Your application dtd. 13.05.20 received in SEIAA office on 12.06.2020

With reference to the above, the proposal has been appraised as per prescribed procedure & provisions under the EIA notification issued by the Ministry of Environment & Forests vide S.O. 1533 (E), dated 14th September 2006 and its amendments, on the basis of the mandatory documents enclosed with the application viz., Form I, pre-feasibility report, ToR, EIA Report, ppt. and additional clarifications furnished in response to observations by the State Expert Appraisal Committee (SEAC) and State Environment Impact Assessment Authority (SEIAA) constituted by the competent Authority.

i. The Kotha Barrage Major Irrigation project is located on river Betwa in upper middle Betwa sub-basin in district Vidisha, Madhya Pradesh. The river sub basin is a part of Yamuna basin. The proposed Barrage site shall be across Betwa River near village Kotha in Kurwai Tehsil of Vidisha district.

ii. The proposed project is green field project and shall be conceived with a view to harness Betwa River for providing irrigation facility to 5500 ha during Kharif and 20000 ha during Rabi with 127.50 % annual irrigation intensity.

iii. Proposed barrage shall be across Betwa River near village Kotha in Kurwai Tehsil of Vidisha district, M.P., and is about 8 km from Kurwai and 5 km from Mandi Bamora on Ganj Basoda – Bina road.

iv. As per EIA Notification of September 2006 and subsequent amendments, Irrigation Projects, listed at item 1(c) of Schedule, having culturable command area (CCA) greater than or equal to 10,000 ha and less than 50,000 ha are considered as category B1 project; and are therefore be appraised at State level.

v. No National Park, Sanctuary, Defense Establishments, Archeological Monuments, Notified Eco-sensitive areas or protected area under Wildlife (Protection) Act exists within the project area or within 10 km distance from it.

vi. TOR was issued by MoEF & CC vide their letter No. J-12011/05/2016-IA-I (R), dated 9th December, 2016, prior to amendment of 14/08/2018 in EIA Notification of September 2006. Earlier CCA of > 10,000 ha was Category A.

vii. Betwa River originates in the Raisen district of Madhya Pradesh near Barkhera village south-west of Bhopal at an elevation of about 576 masl. The river drains gross, intercepted and net catchment of 8771 sq. km, 6867.95 sq.km and 1843.05 sq.km respectively, at the project site.

viii. The project shall encompass the following components.
- 576 m long barrage having 32 bays, 15m clear span each, separated by 3m thick piers.
- The crest level of each bay 384.5masl and pond level at 396.00masl
- 32 fixed wheel vertical lift gates (15000 mm x 11500 mm).
- 11.50 km long and 1.60m diameter right rising main (26m lift).
- 8.50 km long and 1.60m diameter left rising main (31m lift).
- Distribution network upto 1.00 ha chak.

ix. Presently the command area is being cultivated in Rabi and Kharif crop seasons. Crop intensity during Kharif and Rabi being 37.8 % and 62.2 % respectively. The Annual Crop intensity has been assessed as 127.5%of the CCA with Rabi 100% (20000 ha) and Kharif 27.5% (5500 ha).

x. The project has been conceived with a view to utilize 103.50 MCM and harness it for providing irrigation facility to 5500 ha during Kharif and 20000 ha during Rabi with 127.50 % annual irrigation intensity. Crop water requirement has been assessed as 102.36 MCM.

xi. Public Hearing was held on 10.07.2019, in village Kakarua at Annapurna warehouse, Tehsil Kurwai, District Vidisha under the chairmanship of Additional District Magistrate, Vidhisha District. The main issues were about adequate compensation and employment to the PAF as per their skill which was readdressed by the project proponent.

xii. The total land requirement is 1359 ha which is comprised of 678 ha revenue land and 681 ha private land respectively. Owing to acquisition of land 27 villages shall be partially affected. There shall be 638 project-affected families (Titleholders) whose land shall be acquired of which none shall be displaced. The land acquisition shall be carried out as per RFCTLARRA 2013. INR 14158 lakhs provided under R&R Plan. No diversion of forest land is required for project.

xiii. In irrigation schemes, air & noise pollution occurs mainly during project construction phase. The major sources of air pollution during construction phase are: Pollution due to fuel combustion in various equipment. Emission from various construction

plants. Fugitive emissions from material handling and transportation. During operation phase, no major impacts are envisaged on air quality. **For control of air & noise pollution PP has proposed the following:-**

- Dust mask will also be provided to the workers.
- Proper regular maintenance of machineries will be done.
- Speed of the vehicles will be kept within the prescribed limits.
- Trucks/ dumpers will not be over loaded.
- Copious sprinkling of water at the work site and haul roads shall be carried out and hooded trucks shall be used.
- Wet drilling shall be adopted.
- Periodical monitoring of ambient air quality
- The DG set should be fitted in acoustic enclosures.
- DG sets should not be located on downstream of prominent and first prominent wind direction. . The emission norms prescribed by the CPCB should be adhered.
- The norms prescribed by the CPCB in respect of fixing the minimum stack height for generator, should be strictly complied with

xiv. The flows downstream of the dam shall be reduced to the volume (103.50 MCM) stored and diverted for consumptive use. Minimum flow of 20% of inflow shall be ensured during June to October. For the non-monsoon months, average monthly flows have been worked out and 15% of the average monthly flows in different non-monsoon months have been reserved for environmental and ecological purposes

xv. Generation of debris (8.35 lakh cum) from excavation of which 7.68 lakh cum muck shall be consumed and balance 0.67 lakh cum to be disposed in embankment adjacent to masonry/concrete structure, key walls etc.

xvi. Solid waste generated from temporary and permanent colonies in construction as well as operation phase requires special management to disposed of as warranted under the new Solid Wastes Management Rules, 2016. **Following mitigation measures shall be adopted for waste management:**

- Solid waste generated from temporary and permanent colonies in construction as well as operation phase requires special management to disposed of as warranted under the new Solid Wastes Management Rules, 2016.
- Solid waste generated in the project complex/ project colony/ labour colony, shall be managed and handled in accordance with the duties set forth under clause 4 (1) through 4(3) and clause 20 of SWM Rules, 2016, in respect of landfill.
- The waste oil and oil contaminated wastes are to be sold off to approved waste oil recyclers

xvii. The sewage waste shall be disposed after treatment through STP. The effluent to be discharged should conform to the Standard norms.

xviii. Deposition of sediment in reservoir and reduction in its capacity, thus affecting the water available for the designated use. There shall be recharge of ground water from reservoir (4.17MCM). For maintaining the water availability PP has proposed as follows:-

- The Catchment Area Treatment (CAT) plans with objective to addresses issues such as prevention of gully erosion, enhancing the forest cover for increasing soil holding capacity; and arresting total sediment flow in the reservoir and flowing waters.

- 1560 ha have been proposed to be treated under the CAT plan. This area includes 1145 ha area of catchment which shall be treated by biological / engineering measures and 415 ha area under private land treatment within the free draining catchment.
- Conjunctive use of ground water in command by developing tube wells is recommended. A provision of INR 1364 lakhs made under Catchment Area Treatment

xix. Irrigation in command area leads Land degradation in command area. Impairment of water Quality due to use of fertilizers/insecticides. There shall be recharge of ground water (5.54 MCM) from field application. To overcome the problems PP has proposed following measures along with provision of INR 12442 lakhs made under CAD&WM Plan:-

- Micro-irrigation through sprinkler.
- Construction of field channels and field drains.
- Participatory irrigation management through stake holders or farmers organization (WUA).
- Limited use of pesticide and fertilizers.
- Conjunctive use of ground water in command

xx. **Fisheries Conservation & Management Plan**

a. Fish community will be affected due to habitat alteration in downstream as well as upstream section.

b. The conservation of fishes under such conditions is one of important task because they typically use different habitats along the river stretch for spawning, feeding, shelter and growth.

c. It is proposed that the reservoir of the proposed dam be stocked with fingerlings.

d. Fisheries department is responsible for fisheries development and conservation in the state, therefore, stocking of fingerlings and management of reservoir fisheries in the proposed reservoir will be executed by the Department of Fisheries, Government of Madhya Pradesh and funds for the same shall be provided by the project proponent as follows:-

S.No.	Particular	Quantity	Rate	Amount (Rs lakh)	Funding Agency
1.	Jungle clearance in reservoir	1 Job	L.S.	5.00	P.P.
2.	Fish Landing Centre	1 Job	L.S.	10.00	Fisheries Dept.
3.	Construction of Peripheral Rearing Area	5.5	20 lakh/ha	110.00	P.P.
4..	Fish Seed Stocking	6,80,000	1.0 lakh/ ha	6.80	Fisheries Dept.
5.	Boats	3	25000/No	28.25	Fisheries Dept.
6.	Nylon Nets	453	500/No	2.27	Fisheries Dept.
7.	Motor boat	1	25 lakh/No	25.00	Fisheries Dept.
8.	Training to fishermen	453	1250/No	5.66	p.p.
			Total	**192.98**	
				Say Rs 193.00 lakh	

e. The Indian Major Carps Catla, (*Catla catla*) Rohu, (*Labeo rohita*) and Mirgal, (*Cirrhinus mirgala*) are the choice of species as they are reproduced easily in hatcheries

xxi. There is power requirement in the pipe canal system of Project is 5.07 MW (Left 2.72 MW + Right 2.35 MW).

xxii. Disaster resulting from dam break/ failure has been considered and dam break analysis by using BOSS DAMBRK model has been conducted. Evolution of disaster management plan dwells on various aspects such as provision of evacuation paths, setting up of alarms and warning systems, establishing communicating system besides delineating an Emergency Response Organization with an Effective Response System.

xxiii. Green belt is proposed to be developed within the project area around reservoir periphery, along the network of approach roads, residential areas and other working areas restored. Indigenous tree species are proposed to be planted. The area for green belt development around reservoir rim shall be about 22 ha for which a provision of Rs. 55.20 Lakh @Rs 1.84 lakh/ha has been earmarked. Total cost of project INR 750.75 crores with B.C. Ratio 2.08:1

xxiv. For safeguarding the overall environment of the project area and infra structure development, education, public health and sanitation and drinking water facilities, the Project Proponent shall undertake CER initiative (Rs 751 lakhs) in project affected areas. The total budget allocated for implementing the various activity and programme envisaged under CER in affected area around the project I given in table below:-

Description	Quantity	Unit	Rate (INRLakh)	Amount (INR Lakh)
Health Care				
Supply of hospital equipment to CHC	1	Job	L.S.	25.00
Infrastructure Development				
Construction of bridges on Keotan River to facilitate affected villages.	02	No.	250.00	500.00
Strengthening of bridges /roads.	03	No.	20.00	60.00
Approach roads to barrage to facilitate Betwa Crossing	1.5	km	40	60.00
Skill Development and Training				
Development of model farm for training of operation of pressurized irrigation system along with necessary arrangements.	1	No.	80.00	80.00
Operation and maintenance cost system for five years	-	-	LS	25.50
				750.70
				751.00

Benefit of the **project:** Additional irrigation potential shall be created in 20000 ha area,Better living Standards for famers of command area, Employment opportunities/to locals in project work and fisheries, Access to improved infrastructure facilities,Recreation and tourism potential may boost Improvement in environment through implementation of CAT, Command Area Development. Compensatory Afforestation, Green belt Development and different other plans. Better opportunities for cattle rearing. Increase in groundwater level.

Based on the information submitted at Para i to xxiv above and others, the State Level Environment Impact Assessment Authority (SEIAA) considered the case in its 630th meeting held on 10.08.2020 and decided to accept the recommendations of 444th SEAC meeting held on dtd. 03.07.20.

Hence, Prior Environmental Clearance is accorded under the provisions of EIA notification dtd. 14th September 2006 & its amendments for the proposed Kotha Barrage Major Irrigation Project at Village - Kotha, Tehsil - Kurwai, District- Vidisha (MP) Gross Command Area- 39000ha; Cultureable command area (CCA): 35000 ha Catchment Area-8711 sq.m.Height of Barrage- 15.6 M by Project Administrator, Office of Project Administrator, Kotha Barrage Project Implementation Unit, Ganjbasoda, Dist. Vidisha, MP,through Engineer-in chief Department of water Resources,Tulsi Nagar Bhopal (MP) - 462003, subject to the compliance of the Standard Conditions and the following additional Specific Conditions as recommended by SEIAA & SEAC in its meetings.

A. <u>Specific Conditions as recommended by SEIAA</u>

1. The project proponent shall obtain Consent to Establish / Operate under the provisions of Air (Prevention & Control of Pollution) Act, 1981 and the Water (Prevention & Control of Pollution) Act, 1974 from the concerned State pollution Control Board/Committee.
2. NOC shall be obtained from National Commission of Seismic Design Parameters (NCSDS) of CWC.
3. The inputs given by the participants during Public hearing should be properly redressed. All the promises and assurances made during the public hearing shall be fulfilled completely by the water resources department GoMP. The implementation of R & R Plan to be closely monitored to ensure that all project affected families (PAFs) get adequate & timely compensation.
4. Resettlement & Rehabilitation plan be implemented in consultation with the water resources department as approved by the State Govt
5. Besides the agricultural land, the rehabilitation of public buildings, infrastructures, monument etc. falling in the submergence area should also be included in the rehabilitation plan.
6. A monitoring Committee for R & R shall be constituted which must include representatives of project affected persons including form SC/ST community and at least a woman beneficiary.
7. A grievances redress mechanism is to be devised by WRD GoMP and put in place so that aggrieved PAFs and other stakeholders may approach the Authority easily for resolution of any dispute/conflict.
8. The implementation of Local Area Development Plan (LADP) to be closely monitored.

9. This being a seasonal stream/ river, a minimum environmental flow of 30 % in monsoon season should be released for downstream users.

10. Proposed Bio-diversity Conservation & Management Plan in EMP report should be implemented with State Forest Department. The allocated budget for this purpose shall be fully utilized and not to be diverted for any other purpose.

11. The catchment Area Treatment (CAT) Plan as proposed in EMP report shall be strictly implemented in consultation with Madhya Pradesh State Forest Department. Major works shall be completed before impounding of reservoir. The financial allocation for CAT Plan implementation shall be fully utilized and not to be diverted for any other purpose. Catchment Area Treatment Plan as has been proposed should be completed in five years.

12. To enhance the natural environmental quality & aesthetics of project site, greenbelt, as proposed in the EMP Report shall be undertaken in 20 ha of area. Allocated grant for this purpose shall be fully utilised and not to be diverted for any other purpose.

13. Fishery conservation & management plan as proposed shall be implemented in consultation with the Fisheries Department, Government of Madhya Pradesh.. The stocking density of the reservoir shall be around 300 fingerlings per ha. Allocated grant for this purpose shall be fully utilised and not to be diverted for any other purpose.

14. Occurrence of stagnant pools/slow moving water channels during construction and operation of the project may provide breeding source for vector mosquitoes and other parasites. The river should be properly channelized so that no small pools and puddles are allowed to be formed. Even after taking precaution, due to unforeseen situations, breeding of mosquito and resultant malaria or mosquito borne diseases can increase. If such a situation arises, it will be the responsibility of project authorities to take all steps i.e. residual insecticidal spray in all the project area and surrounding 3 km. Area keeping the flight range of mosquitoes in consideration. Also medical assistance to be provided to the affected people at the cost of the developer and appropriate health benefits may be initiated with the help of State Health Department.

15. If the water of reservoir is used for drinking water supply, it should be done after conventional treatment.

16. Regular monitoring of water quality (Surface and Ground) including heavy metals shall be undertaken in the project area and around the project area to ascertain the change, if any, in the water quality due to leaching of contaminants, if any, from the increased use of chemical fertilizers and pesticides.

17. As the reservoir will be acting as balancing reservoir and there would be fluctuation of water level during peaking period, efforts be made to reduce impact on aquatic life including impacts during spawning period both at the upstream and downstream of the project.

18. The project proponent shall comply with the provisions contained in this Ministry's OM vide F.No. 22-65/2017-IA.III dated 1St May 2018, as applicable, regarding Corporate Environment Responsibility for which budgetary allocation of Rs. 7.51 Crore has been made. PP should ensure the implementation of CER activities to the extent of Rs. 7.51crore as committed during presentation to the extent on regular basis in consultation with District Collector.

19. PP should ensure to submit half yearly compliance report and CER activity report with photographs of plantation in MP-SEIAA. If PP is failed to upload or submit two consecutive half yearly compliance reports of EC conditions to concerned authority (SEIAA and Regional Office, MoEF&CC, GoI, Bhopal) than prior environmental clearance issued to PP will automatically be treated as cancelled/ revoked as per OM No. 930/SEIAA/2019 dated 30.05.2019 issued by MPSEIAA.

B. Specific Conditions as recommended by SEAC

I. Statutory compliance:

i. The project proponent shall obtain forest clearance under the provisions of Forest (Conservation) Act, 1986, in case of the diversion of forest land for non-forest purpose involved in the project
ii. The project proponent shall obtain clearance from the National Board for Wildlife, if applicable.
iii. The project proponent shall prepare a Site-Specific Conservation Plan & Wildlife Management Plan and approved by the Chief Wildlife Warden. The recommendations of the approved Site-Specific Conservation Plan / Wildlife Management Plan shall be implemented in consultation with the State Forest Department. The implementation report shall be furnished along with the six-monthly compliance report. (incase of the presence of schedule-I species in the study area)
iv. The project proponent shall obtain Consent to Establish / Operate under the provisions of Air (Prevention & Control of Pollution) Act, 1981 and the Water (Prevention & Control of Pollution) Act, 1974 from the concerned State pollution Control Board/ Committee
v. NOC shall be obtained from National Commission of Seismic Design Parameters (NCSDS) of CWC.
vi. Necessary approval of CEA shall be obtained for those projects having the project cost more than Rs. 1,000 crore.

II. Air quality monitoring and preservation

i. Regular monitoring of various environmental parameters viz., Water Quality, Ambient Air Quality and Noise levels as per the CPCB guidelines at designated locations shall be carried out on monthly basis and a detailed database of the same shall be prepared and recorded. This shall be used as a baseline data for post construction EIA / Monitoring purposes.
ii. Appropriate Air Pollution Control (APC) system shall be provided for all the dust generating points including fugitive dust from all vulnerable sources, so as to comply prescribed standards.
iii. Necessary control measures such as water sprinkling arrangements, etc. be taken up to arrest fugitive dust at all the construction sites.

III. Water quality monitoring and preservation

i. Conjunctive use of surface water to be planned in the project to check water logging as well as to increase crops productivity. The field drains shall be connected with natural drainage system.
ii. Remodeling of existing natural drains (link drains) and connecting them with irrigated land through constructed field drains, collector drains, etc. are to be ensured on priority basis.
iii. Before impounding of the water, Cofferdams for both at the upstream and downstream are to be decommissioned as per EIA/EMP report so that once the project is commissioned; cofferdam should not create any adverse impact on water environment

including the rock mass and muck used for the Cofferdam.

iv. As the reservoir will be acting as balancing reservoir and there would be fluctuation of water level during peaking period, efforts be made to reduce impact on aquatic life including impacts during spawning period both at the upstream and downstream of the project

v. Water depth sensors shall be installed at suitable locations to monitor e-flow. Hourly data to be collected and converted to discharge data. The Gauge and Discharge data in the form of Excel Sheet be submitted to the Regional Office, MoEF & CC and to the CWC on weekly basis

vi. Mixed irrigation shall be practiced and necessary awareness be given to all the farmers and trained in the use of such systems. Proper crops selection shall be carried out for making irrigation facility more effective.

vii. On Farm Development (OFD) works like landscaping, land leveling, drainage facilities, field irrigation channels and farm roads, etc. should be taken up in phased manner prior to the start of irrigation in the entire command area. The Command Area Development Plan should be strictly implemented as proposed in the EIA/EMP report.

IV. Noise monitoring and prevention

i. All the equipment likely to generate high noise shall be appropriately enclosed or inbuilt noise enclosures be provided so as to meet the ambient noise standards as notified under the Noise Pollution (Regulation and Control) Rules, 2000, as amended in 2010 under the Environment Protection Act (EPA), 1986.

ii. The ambient noise levels should conform to the standards prescribed under E(P)A Rules, 1986 viz. 75 dB(A) during day time and 70 dB(A) during night time .

V. Catchment Area Treatment Plan

Catchment Area Treatment (CAT) Plan as proposed in the EIA/EMP report shall be implemented in consultation with the State Forest Department and shall be implemented in synchronization with the construction of the project.

VI. Waste management

i. Muck disposal (8.35 lakh cum) be carried out only in the approved and earmarked sites. The dumping sites shall be located sufficiently away from the HFL of the river. Efforts be made to reuse the muck for construction and other filling purposes and balanced be disposed of at the designated disposal sites. Once the muck disposal sites are inactive, proper treatment measures like both engineering and biological measures be carried out so that sites are stabilized quickly.

ii. Solid waste management should be planned in details. Land filling of plastic waste shall be avoided and instead be used for various purposes as envisaged in the EIA/EMP reports. Efforts be made to avoid one time use of plastics.

VII. Green Belt, EMP Cost, Fisheries and Wildlife Management

i. Based on the recommendation of Cumulative Impact Assessment and Carrying capacity study of river basin or as per the ToR conditions or minimum 15% of the average flow of four consecutive leanest months, whichever value is higher, shall be released as environmental flow.

ii. Detailed information on species composition particular to fish species from previous study/literature be inventorised and proper management plan shall be prepared for in-situ conservation in the streams, tributaries of river and the main river itself for which adequate budget provision be made and followed strictly.

iii. Wildlife Conservation Plan prepared for both core and buffer zones shall be implemented in consultation with the local State Forest Department.
iv. To enrich the habitat of the project site, plantation shall be raised as envisaged in the EIA/EMP report. Plantation to be developed along the periphery of the reservoir in multi-layers with local indigenous species in consultation with the local State Forest Department.
v. Compensatory afforestation programme shall be implemented as per the plan approved.
vi. Fish ladder/pass as envisaged in the EIA/EMP report shall be provided for migration of fishes. Regular monitoring of this facility be carried out to ensure its effectiveness.

VIII. Public hearing and Human health issues

i. Resettlement & Rehabilitation plan be implemented in consultation with the State Govt. as approved by the State Govt.
ii. Budget provisions made for the community and social development plan including community welfare schemes shall be implemented in toto.
iii. Preventive measures viz. fuming and spraying of mosquito control shall be done in and around the labour colonies, affected villages, stagnated pools, etc. Provisions be made to not to create any stagnated pools to avoid creation of breeding grounds of the vector borne diseases
iv. Provision shall be made for the housing of construction labour within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, crèche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.
v. Labour force to be engaged for construction works shall be examined thoroughly and adequately treated before issuing them work permit. Medical facilities shall be provided at the construction sites.
vi. Early Warning Telemetric system shall be installed in the upper catchment area of the project for advance intimation of flood forecast.
vii. Emergency preparedness plan be made for any eventuality of the dam failure and shall be implemented as per the Dam Break Analysis.

IX. Corporate Environment Responsibility

i. A budgetary provision of Rs. 16,412.5 Lakh is made for Environmental Management Plan as capital cost and Rs 193.50 lakh as recurring cost.
   - Out of which Rs. 37 Lakhs as capital and 6.0 lakhs as recurring cost provided for Green Belt Development Plan in EMP.
   - No muck disposal shall be done outside of the project site; Rs. 28.0 Lakh is made for Muck Management Plan in the EMP.
   - Provision of Rs 1364.0 Lakh is made for Catchment Area Treatment Plan in EMP. Rs 193.0 Lakh is made for Fisheries Management Plan in EMP.
   - Provision of Rs 12,442.0 Lakh is made for Command Area Development Plan in EMP.

ii. Under CER Rs 751.0 Lakh is envisaged for proposed various activities.
iii. The project proponent shall comply with the provisions contained in this Ministry's OM vide F.No. 22-65/2017-IA.III dated 1st May 2018, as applicable, regarding Corporate Environment Responsibility.
iv. Skill mapping be undertaken for the youths of the affected project area and based on the skill mapping, necessary trainings to the youths be provided for their long time livelihood generation

v. The company shall have a well laid down environmental policy duly approve by the Board of Directors. The environmental policy should prescribe for standard operating procedures to have proper checks and balances and to bring into focus any infringements/deviation/violation of the environmental / forest / wildlife norms / conditions. The company shall have defined system of reporting infringements / deviation / violation of the environmental / forest / wildlife norms / conditions and / or shareholders / stake holders. The copy of the board resolution in this regard shall be submitted to the MoEF&CC as a part of six-monthly report.

vi. A separate Environmental Cell both at the project and company head quarter level, with qualified personnel shall be set up under the control of senior Executive, who will directly to the head of the organization.

vii. Action plan for implementing EMP and environmental conditions along with responsibility matrix of the company shall be prepared and shall be duly approved by competent authority. The year wise funds earmarked for environmental protection measures shall be kept in separate account and not to be diverted for any other purpose. Year-wise progress of implementation of action plan shall be reported to the Ministry/Regional Office along with the Six Monthly Compliance Report.

viii. Post EIA and SIA be prepared for the project through a third party and evaluation report be submitted to the Ministry after five years of commissioning of the project.

ix. Multi Disciplinary Committee (MDC) be constituted with experts from Ecology, Forestry, Wildlife, Sociology, Soil Conservation, Fisheries, NGO, etc. to oversee implementation of various environmental safeguards proposed in EIA/EMP report during construction of the project. The monitoring report of the Committee shall be uploaded in the website of the Company.

x. Formation of Water User Association/Co-operative be made by involvement of the whole community be ensured for discipline use of available water for irrigation purposes.

X. Miscellaneous

i. The project proponent shall make public, the environmental clearance granted for their project along with the environmental conditions and safeguards at their cost by prominently advertising it at least in two local newspapers of the District or State, of which one shall be in the vernacular language within seven days and in addition this shall also be displayed in the project proponent's website permanently.

ii. The copies of the environmental clearance shall be submitted by the project proponents to the Heads of local bodies, Panchayats and Municipal Bodies in addition to the relevant offices of the Government who in turn has to display the same for 30 days from the date of receipt.

iii. The project proponent shall upload the status of compliance of the stipulated environment clearance conditions, including results of monitored data on their website and update the same on half-yearly basis.

iv. The project proponent shall submit the environmental statement for each financial year in Form-V to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently and put on the website of the company

v. The project proponent shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities, commencing the land development work and start of production operation by the project.

vi. The project authorities must strictly adhere to the stipulations made by the State Pollution Control Board and the State Government.

vii. The project proponent shall abide by all the commitments and recommendations made

in the EIA/EMP report, commitment made during Public Hearing and also that during their presentation to the Expert Appraisal Committee.

viii. No further expansion or modifications in the plant shall be carried out without prior approval of the Ministry of Environment, Forests and Climate Change (MoEF&CC).

ix. Concealing factual data or submission of false/fabricated data may result in revocation of this environmental clearance and attract action under the provisions of Environment (Protection) Act, 1986.

x. The Ministry may revoke or suspend the clearance, if implementation of any of the above conditions is not satisfactory.

xi. The Ministry reserves the right to stipulate additional conditions if found necessary. The Company in a time bound manner shall implement these conditions

xii. The Regional Office of this Ministry shall monitor compliance of the stipulated conditions. The project authorities should extend full cooperation to the officer (s) of the Regional Office by furnishing the requisite data / information/monitoring reports.

xiii. The above conditions shall be enforced, inter-alia under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, the Air (Prevention & Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986, Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and the Public Liability Insurance Act, 1991 along with their amendments and Rules and any other orders passed by the Hon'ble Supreme Court of India / High Courts and any other Court of Law relating to the subject matter.

Standard Conditions:

1. The Regional Office of MoEF, GoI, Bhopal & MPPCB shall monitor compliance of the stipulated conditions. A complete set of documents including Environment Impact Assessment Report, Environmental Management Plan and Monitoring Plan should be given to Regional Office, MoEF, GoI, Bhopal & MPPCB. The project proponent shall provide full cooperation during their inspection and all required documents/data to the officials.
2. The responsibility of implementation of environmental safeguards and RR plan rests fully with the Water Resources Department GoMP and Government of Madhya Pradesh. The WRD Government of Madhya Pradesh should also monitor implementation of EMP at regular intervals preferably at the level of Principal Secretary.
3. Necessary livelihood plan for oustees is to be prepared, if found necessary, in consultation with State Government Departments concerned. The Water Resources Department Government of Madhya Pradesh should submit compliance on this components & also while submitting six monthly compliance report to MoEF, GoI, Regional Office, Bhopal.
4. The monitored data for criteria pollutant levels, namely; SPM, RSPM, SO2, NOx (ambient levels) or critical sectoral parameters, indicated for the project shall be monitored and displayed at a convenient location near the dam site in the public domain.
5. The equipment likely to generated high noise levels during construction period or otherwise shall have to meet the ambient noise level standards as notified under the Noise Pollution (Regulation and Control) Rules, 2000 as amended from time to time under the Environment Protection Act (EPA), 1986. Workers shall be provided with ear plugs / muffs.

6. The Project Proponent has to submit half yearly compliance report of the stipulated terms and conditions in the Prior Environmental Clearance, including the results of monitored data in hard and soft copy to the Regulatory Authority, respective Zonal Office of CPCB and the SPCB and Regional Office of MoEF, GoI at Bhopal on 1st June and 1st December of each calendar year.
7. Adequate financial provision should be made in the total budget of the project for implementation of the above suggestion safeguard measures. The funds earmarked for environmental protection measures shall be kept in separate account and shall be fully utilized for the said purpose and not to be diverted for other purpose. Year wise expenditure shall be reported to the MoEF, GoI, Regional Office located at Bhopal, CPCB & MPCB. In case of revision of the project cost due to price level change the cost of EMP shall also be updated proportionately and revised upwardly.
8. Water User Associated (WUA) Co-operative should have to be formed for efficient water use. Involvement of the community for disciplined and wise use of available waters should be ensured through training programme / effective interactive sessions.
9. On-farm development (OFD) works are to be completed by the project proponent simultaneously and before the commencement of irrigation. WUA's (Water Users Associations) should be made functional to undertake the OFD works. Special & critical monitoring of progress to be undertaken by the Water Resources Department GoMP to ensure that OFD works are completed along with main canal networks.
10. The MP SEIAA or any other competent authority reserves the right to alter/modify or add additional, safeguard measures subsequently, if found necessary and to take action, including revoking of the clearance under provisions of the environment (Protection) Act 1986 to ensure effective implementation of the suggested safeguard measures in a time bound and satisfactory manner.
11. The Prior Environmental Clearance letter is valid for a period of 10 years from the date of issue of this letter for commissioning of the project.
12. A copy of the Prior Environmental Clearance issued by MP SEIAA shall be submitted by the Project Proponent to the Heads of the Local Bodies, Panchayat / Zila Parishad / Municipal Bodies as applicable, local NGO, if any, in addition to the associated Government Department from whom any suggestion / representations were received while processing the proposal and those responsible for controlling the proposed project, who in turn has to display the same for 30 days from the date of receipt. The clearance letter shall also be put on website by the project proponent.
13. State Pollution Control board / committee shall display a copy of the clearance letter at the regional office, district industries centre and collector's/tehsildar's office for 30 days.
14. The Project Proponent shall advertise at least in two local newspapers widely circulated in the region around the project, one of which shall be in the vernacular language of the locality concerned, within 7 days of the issue of the clearance letter informing that the project has been accorded environmental clearance and a copy of the clearance letter is available with the State Pollution Control Board and also at web site of the State Level Environment Impact Assessment Authority (SEIAA) website at www.mpseiaa.nic.in and copy the same shall be forwarded to the Regional Office, MoEF&CC, GoI, Bhopal.

15. After 5 years of the commissioning of the project a study shall be undertaken regarding impact of the project on the environment and downstream ecology. The study shall be undertaken by an independent agency to be decided in consultation with the Ministry / authority.
16. A multi disciplinary committee (MDC) for monitoring the implementation of environmental safe guards during construction shall be constituted by the project proponent (PP) in consultation with the state environment ministry as early as possible. A panel may be proposed by the PP and submitted to ministry. The Project Proponent shall organize six monthly meetings of the committee and submit the monitoring report to the ministry.
17. The environmental statement for each financial year ending 31st March in Form-V as is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be put on the website of the company along with the status of compliance of EC conditions and shall also be sent to the Regional Office of MoEF.
18. Any other clearance required from any other organization / department should be obtained before commencement of works and commissioning of the project, as applicable.
19. Any appeal against this prior environmental clearance shall lie with the Green Tribunal, if necessary, within a period of 30 days from the date of issue, as prescribed under Section 10 of the National Green Tribunal Act 2010.

2351

(Tanvi Sundriyal)
Member Secretary

Endt No. / SEIAA/ 2020 Dated 21.8.2020

Copy to:-

(1). Principal Secretary, Urban Development & Environment Deptt. 3rd Floor, Mantralaya Vallabh Bhawan, Bhopal.

(2). Secretary, SEAC, Research and Development Wing Madhya Pradesh Pollution Control Board, Paryavaran Parisar, E-5, Arera Colony Bhopal-462016.

(3). Member Secretary, Madhya Pradesh Pollution Control Board, Paryavaran Parisar, E-5, Arera Colony, Bhopal-462016.

(4). The Collector, Distt- Vidisha (M.P.).

(5). The Principal Chief Conservator of forest, Ground floor Satpuda Bhawan, Bhopal (M.P)

(6). Director, I.A. Division, Monitoring Cell, MoEF, GoI, Ministry of Environment & Forest Indira Paryavaran Bhawan, Jor Bagh Road, New Delhi – 110 003

(7). Director (S), Regional office of the MOEF, (Western Region), Kendriya Paryavaran Bhawan, Link Road No. 3, Ravi Shankar Nagar, Bhopal-462016.

(8). Guard file.

(Dr. Sanjeev Sachdev)
Officer-in-Charge

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन नदी विकास एवं गंगा संरक्षण विभाग
केंद्रीय जल आयोग
लागत मूल्यांकन) सिंचाई-)-2 निदेशालय

Government of India
Ministry of Jal Shakti
Dept. of water Resources, RD & GR
Central Water Commission
Cost Appraisal(Irrigation)-2 Directorate

Sub: - Comprehensive Project Report of Ken-Betwa Link project- Examination of Cost Estimate of "Kotha Project" (Part of Ken Betwa Link Project Phase-II) – regarding.

Ref- 1. CWC Lr. No. 4/11/2019/NP-II/Vol-I/3040-51 dated:16.08.2019
2. MPWRD Lr. No. TS/CWC/KOTHA/2020/216 dated 05.10.2020
3. CWC Lr. No. 10A/34/2017/CA(I)-2/107 dated 20.10.2019
4. MPWRD Lr. No. 22/TS/CWC/KOTHA/2020/256 dated 16.11.2020
5. MPWRD Lr. No 2/CWC/Kotha/2020-21 Camp at Delhi dated 27.07.2021
6. This Office Letter No T-49030/2/2021-CA-I DTE dated 02.08.2021
7. MPWRD letter No Q/1/2021/Camp at Delhi dated 21.10.2021

The Cost Estimate of Comprehensive Project of Ken-Betwa Link Project for an amount of Rs.35111.24 Cr. at PL 2017-18 was received vide letter under reference (1) for examination of Cost aspects. In this Report, the Cost Estimate of "Kotha Barrage Major Project" (Part of Ken-Betwa link Project Phase-II) amounting Rs.708.73 Cr. has also been submitted. Vide letter under reference 6 the finalised cost of Rs 68849.71 lakhs (Rs 688.50 crores) at Price level 2017-18 has been conveyed.

2. A meeting chaired by Member, WP&P has been held on 11.10.2021 in respect of Ken-Betwa National Project. The estimate of Bina complex had been discussed in the meeting. Certain points were raised by Project Officials ion the meeting. To discuss and for sorting out the issues, it has been decided to depute a team of Project officials. A team of Project officials comprising of Shri Anil Pipre, SE, along with Shri Avinash Chaturvedi (AEE), Shri Ranjeet Shaw(AEE) of MPWRD has visited this Office from 21.10.2021 to 27.10.2021. The discussions were held regarding the cost aspects of Bina and kotha Projects. Further they have submitted a revised cost Estimate amounting Rs 786.55 crores for Bina Project vide Letter Q/ 1/2021/Camp at Delhi dated 21.10.2021 (Reference 7).

3. In view of the decisions taken in the meeting and further considerations the various items in the Cost Estimate have been revisited in reference to the above mentioned letter. The cost of Kotha Barrage Project has been finalised for Rs 70947.25 lakhs (Rs 709.47 crores) at Price level 2017-18. The Unit wise finalised cost of the project is as under-

Sl No	Item	Cost (in lakhs)
1	Unit I	34486.24
2	Unit II	32178.61

3	Unit III	4282.40
	Total Cost	70947.25

4. The Project Cost is provisional subjected to the correctness of the quantities as per the detailed survey carried out and rates indicated in the cost estimates at Madhya Pradesh Unified Schedule of Rates 2017-18. The Project Authorities have also submitted a certificate regarding the correctness of quantities as per Design and Drawings proposed for preparation of Cost Estimate. The Abstract of Cost of the Project at SoR 2017-18 is enclosed.

This issues with the approval of the Chief Engineer, (PAO), CWC, New Delhi.

Signed by Ajay Shivlal Banode
Date: 29-10-2021 16:36:58
Reason: Approved

(Ajay Shivlal Banode)
Director

Director, National Projects Directorate, CWC, New Delhi

NAME OF PROJECT : - KOTHA BARRAGE MAJOR PROJECT (PART OF KEN BETWA LINK PHASE - II)
GENERAL ABSTRACT

PL 2017 / Amount in Lakhs

Sr. No.	Project Sub Head	UNIT - I (Head Works like Dam, Barrage etc.)			UNIT - II (Canal Works)			Unit-III (Power)			Grand Total		
		Expenditure incurred upto June 2020	Balance Cost	Total Cost (3 + 4)	Expenditure incurred upto June 2020	Balance Cost	Total Cost (6 + 7)	Expenditure incurred upto June	Balance Cost	Total Cost (9 + 10)	Expenditure incurred upto June 2020	Balance Cost	Total Cost (12 + 13)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	I - Works												
1	A - Preliminary	23.18	6.39	29.57	0.00	43.98	43.98	0.00	0.00	0.00	23.18	50.38	73.56
2	B - Land	0.00	13178.64	13178.64	0.00	196.60	196.60	0.00	0.00	0.00	0.00	13375.24	13375.24
3	C - Works	0.00	15453.13	15453.13	5968.49	1290.37	7258.86	0.00	0.00	0.00	5968.49	16743.51	22712.00
4	D - Regulator & Measuring Devices	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	E - Falls	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	F - C. D. Works	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	G - Bridges	0.00	0.00	0.00	0.00	1070.70	1070.70	0.00	0.00	0.00	0.00	1070.70	1070.70
8	H - Escape	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	I- Navigation Works	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	J - Power plant & Civil works	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	K - Building	14.32	8.23	22.55	0.00	16.91	16.91	0.00	0.00	0.00	14.32	25.14	39.46
12	L - Earth Work												
	a) Earthworks	0.00	0.00	0.00	684.51	0.00	684.51	0.00	0.00	0.00	684.51	0.00	684.51
	c) Lining	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	d) Service road	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	M - Plantation	0.00	18.15	18.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.15	18.15
14	N-Tanks & Reservoir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	O - Miscellaneous	34.50	15.50	50.00	0.00	0.00	0.00	0.00	0.00	0.00	34.50	15.50	50.00
16	P - Maintenance	0.00	179.24	179.24	0.00	321.59	321.59	0.00	0.00	0.00	0.00	500.83	500.83
17	Q - Special Tools & Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	R - Communication	11.37	1180.08	1191.45	0.00	420.00	420.00	0.00	0.00	0.00	11.37	1600.08	1611.45
19	S- Power Plant & Electric Syst	0.00	0.00	0.00	0.00	149.40	149.40	0.00	4240.00	4240.00	0.00	4389.40	4389.40
20	T- Water Supply Works	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

21	**U - Distributary & Minors**	0.00	0.00	0.00	0.00	16480.40	16480.40	0.00	0.00	0.00	0.00	16480.40	16480.40
22	**V - Water Course**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	**W - Drainage.**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	**X - Environment & Ecology**	0.00	12.00	12.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.00	12.00
25	**Y - Losses on Stock**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total of I - Works	**83.37**	**30051.37**	**30134.74**	**6653.00**	**19989.96**	**26642.96**	**0.00**	**4240.00**	**4240.00**	**6736.37**	**54281.33**	**61017.70**
	GST@ 12% (Excluding cost of B - Land and Solar power)	10	2025	2035	798.36	2357.28	3155.64	0.00	0.00	0.00	808.36	4382.00	5190.37
	G.Total.	**93.37**	**32076.10**	**32169.47**	**7451.36**	**22347.23**	**29798.59**	**0.00**	**4240.00**	**4240.00**	**7544.73**	**58663.33**	**66208.06**
II	**Establishment @ 8.0 % (Excluding cost of B - Land and S - Solar Power)**	2.50	1353.99	1356.49	199.59	1904.17	2103.76	0.00	0.00	0.00	202.09	3258.15	3460.24
III	**T & P - Nil (No Spl. T & P)**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IV	**Suspense**	0.00	0	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00
V	**Receipt & Recoveries**	0.00	0	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00
A	**TOTAL: DIRECT CHARGES**	**95.87**	**33430.08**	**33525.96**	**7650.95**	**24251.40**	**31902.35**	**0.00**	**4240.00**	**4240.00**	**7746.82**	**61921.49**	**69668.31**
	INDIRECT CHARGES												
(a)	**Capitalised value of abatement of land revenue @ 5% of B Land**	0.00	658.93	658.93	0.00	9.83	9.83	0.00	0.00	0.00	0.00	668.76	668.76
(b)	**Audit & Accounts charges @ 1% of I Works**	0.83	300.51	301.35	66.53	199.90	266.43	0.00	42.40	42.40	67.36	542.81	610.18
B	**TOTAL: INDIRECT CHARGES**	**0.83**	**959.45**	**960.28**	**66.53**	**209.73**	**276.26**	**0.00**	**42.40**	**42.40**	**67.36**	**1211.58**	**1278.94**
	Total of Direct & Indirect Charges (A + B)	**96.71**	**34389.53**	**34486.24**	**7717.48**	**24461.13**	**32178.61**	**0.00**	**4282.40**	**4282.40**	**7814.19**	**63133.06**	**70947.25**
	Grand Total (A + B + C + D)												**70947.25**

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास और गंगा संरक्षण विभाग
केन्द्रीय जल आयोग
सिंचाई आयोजन (दक्षिण) निदेशालय

सत्यमेव जयते

Government of India
Ministry of Jal Shakti
Deptt. of Water Resources, RD&GR
Central Water Commission
Irrigation Planning (South) Directorate

विषय: DPR of Kotha Barrage project - reg.

संदर्भ: (i) File No.T-26030/2/2020-IP(S) DTEI/75441/2021 dated 05.11.2021.
(ii) Email from Project Authorities dated 12.11.2021.
(iii) Email from Project Authorities dated 15.11.2021.
(iv) Email from NP Dte. dated 18.11.2021
(v) Noting dated 29.11.2021

May please refer to the email received under reference (iv) above vide which NP Dte. of CWC has forwarded the copy of minutes of the meeting held on 11.11.2021 under the chairmanship of Member, WP&P,CWC to review the status of appraisal of Ken-Betwa Project.. Further, vide email under reference (ii) above the Project Authorities has submitted the revised BC ratio computation for examination. In view of the above, the BC ratio computation of the project has been examined and the observations thereon are as under:

Observations:

1. The project authorities have now provided the certificate in respect of benefits of fisheries, duly authenticated by Assistant Director, State Fisheries Department, Govt. of M.P. and now the production rate (in kg/ha) and rate per kg of fish has been considered @ Rs. 600 kg/ha and @ Rs. 504.68/ kg (by arriving at from that of year 2021 after taking into account 3% depreciation each year) respectively. Based on this, the benefits of fisheries have been considered in the BC Ratio computation.
2. Based on the meeting held on 11.11.2021 under the chairmanship of Member, WP&P, CWC, it was decided to consider the crop rates for Kotha Barrage project for the year 2017 by arriving at from that of year 2018 after taking into account inflation. Accordingly, the rates and cost of cultivation (viz. seeds, manure, labour etc.) of crops in pre-project and post project scenario has been revised and the same has been used in the BC Ratio computation.
3. The cost of land development has not been considered by the project authorities in the BC Ratio computation. During the meeting held on 24.11.2021, WRD, Govt. of MP has requested to exclude the cost of land development for Kotha Barrage in BC Ratio calculation. WRD, Govt. of MP vide letter dated 23.11.2021 addressed to Chairman, CWC has intimated that *"Govt. of MP has undertaken about 40 nos. of pressurized irrigation projects using sprinkler system. In all these projects no land levelling and command area development cost is required because they serve upto 1 ha. Out of which 3 nos. of projects namely Garoth, Mohanpura, BanSujara irrigation projects are functioning well and irrigating 1.20 lakh ha by sprinkler system. In all these projects neither land leveling and Command Area Development cost has been considered nor any expenditure made on that. The water is delivered upto 1 ha with*

20 mtr head, therefore the cost of command area development is already included in the project."

Further vide letter dated 24.11.2021, Director, CA (I)-2 Dte, CWC has confirmed that the rates for survey, planning, design and construction of underground pressurized pipe distribution network for micro irrigation system to facilitate pressurized irrigation have been taken upto 1.0 ha chak area in case of Kotha Barrage project (as per clause 6.41.2 of MPWRD Unified Schedule of Rates 2017).

In view of above and considering the fact that, in case of Kotha Barrage project, micro-irrigation through pressurized pipe distribution network has been adopted and the cost of providing underground pressurized pipe distribution network for micro irrigation system to facilitate pressurized irrigation have been taken upto 1.0 ha chak area the land development charges have been taken as 'NIL' in the B.C. ratio computation, with the approval of Chairman, CWC, vide ref. (v) above.

4. Based on above and veracity of the documents submitted by the project authorities, the BC ratio computation has been checked and found to be 1.63.

This issues with approval of CE (IMO), CWC, New Delhi.

Signed by Vineet Gupta
Date: 30-11-2021 13:30:41
Reason: Approved

(विनीत गुप्ता)
निदेशक

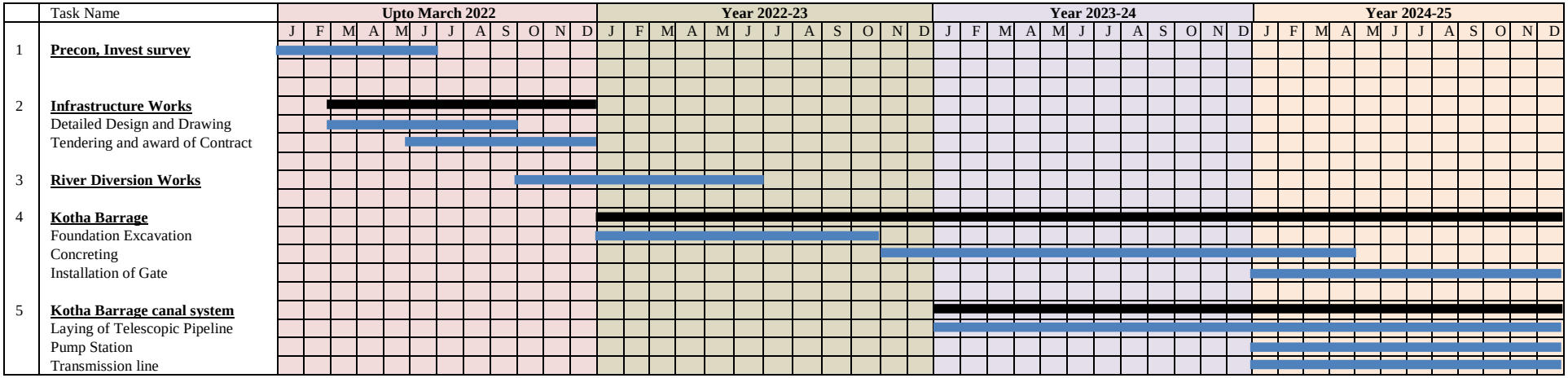
To.

i. Director, NP Dte., CWC, Sewa Bhawan, R.K. Puram, New Delhi.
ii. Director, PA (C) Dte., CWC, Sewa Bhawan, R.K. Puram, New Delhi.

Copy for kind information to:
(i) CE, PAO, CWC, Sewa Bhawan, R.K Puram, New Delhi.
(ii) CE, PPO, CWC, Sewa Bhawan, R.K Puram, New Delhi.

Kotha Project

Construction Schedule



KOTHA BARRAGE MAJOR PROJECT-DISTRICT-VIDISHA.

TABLE-PROPOSED CROPPING PATTERN AND PRODUCTIVITY AFTER IRRIGATION

S.No.	Crop	Area	Yield in (Qtl./Ha)	Total Yield (Qtl.)	Price per Qtl (In Rs.)	Gross income (Rs In Lac)	Brake up of Expenditure						Total Expenditure (in lac)	Net Income In Lakhs
							Seed		Fertilizers, Chemicals etc.		Human,Animal Machinery & Misc.			
							Rate/Ha (Rs.)	Amt. (in lac)	Rate/Ha (Rs.)	Amt. (in lac)	Rate/Ha (Rs.)	Amt. (in lac)		
TABLE-PROPOSED CROPPING PATTERN AND PRODUCTIVITY AFTER IRRIGATION														
Kharif														
1	Soyabeen	5500.00	25	137500	2500	3438	3500	192.5	5000	275.00	9000	495.00	962.50	2475.50
	Total	5500		137500		3438		192.5		275		495	962.5	2475.50
Rabi														
1	Wheat(HYV)	12000	50	600000	1650	9900	2500	300	6000	720	8000	960	1980	7920
2	Wheat (Ord)	4000	30	120000	1650	1980	2500	100	6000	240	8000	320	660	1320
3	Gram	4000	25	100000	6000	6000	4500	180	4000	160	6000	240	580	5420
	Total	**20000**		**820000**		**17880**		**580**		**1120**		**1520**	**3220**	**14660**
	Grand Total	**25500**		**957500**		**21318**		**772.5**		**1395**		**2015**		**17135.50**

(B.C.Jain)
Sub Divisional Officer
Water Resources Survey Sub Division
Kurwai

किसान कल्याण तथा कृषि विकास
विभाग विदिशा (म.प्र.)

(K.D.Ojha)
Executive Engineer
Sanjay Sagar Project Bah River Division
Ganj Basoda

संयुक्त संचालक
किसान कल्याण तथा कृषि विकास
भोपाल संभाग, भोपाल

KOTHA BARRAGE PROJECT

TABLE - PROPOSED CROP PATTERN AND PRODUCTIVITY BEFORE IRRIGATION

(All rates in Rs., Amount in Rs. Lakh and Area in Ha.)

Sr. No.	Crop	Area	Yield (Qtl/ Ha)	Total yield (Qtl)	Price per Qtl. (in Rs.)	Gross Income (in Lac)	Breakup of Expenditure							Net Income (in Lac)
							Seed		Fertilizers, Chemicals etc.		Human, Animal & Machinery & Misc		Total Expenditure	
							Rate/ Ha (Rs.)	Amt. (in lac)	Rate/ Ha (Rs.)	Amt. (in lac)	Rate/ Ha (Rs.)	Amt. (in lac)		
Kharif														
1	Soyabean	5328.00	12	63936	2500	1598.40	3500	186.48	5000	266.40	2000	106.56	559.44	1038.96
	Total	**5328**		**63936**		**1598.40**		**186.48**		**266.4**		**106.56**	**559.44**	**1038.96**
Rabi														
1	Wheat (HYV)	5345.00	25	133625	1650	2204.81	2500	133.63	6000	320.70	5250	280.61	734.94	1469.87
2	Masoor	100.00	12	1200	3500	42.00	2500	2.50	6000	6.00	2880	2.88	11.38	30.62
3	Gram	3662.00	12	43944	4000	1757.76	4500	164.79	4000	146.48	5460	199.95	511.22	1246.54
	Total	**9107**		**178769**		**4004.57**		**300.92**		**473.18**		**483.44**	**1257.54**	**2747.03**
	Grand Total	**14435**		**242705**		**5602.97**		**487.4**		**739.58**		**590.00**	**1816.98**	**3785.99**

(B.C.Jain)
Sub Divisional Officer
Water Resources Survey Sub Division
Kurwai

(K.D.Ojha)
Executive Engineer
Sanjay Sagar Project Bah River Division
Ganj Basoda

संयुक्त संचालक
किसान कल्याण तथा कृषि विकास
भोपाल संभाग, भोपाल

714

Annexure-1.3.11

मध्यप्रदेश शासन
जल संसाधन विभाग,
-:: मंत्रालय ::-
वल्लभ भवन भोपाल

E-mail (under.secretary@yahoo.in; under.secretary2013@gmail.com)

पत्र क्रं.-22(ए)/344/2018/एमपीएस/31 /1740 भोपाल दिनांक-4/10/2018

प्रति,

प्रमुख अभियंता,
जल संसाधन विभाग,
भोपाल ।

विषय :- विदिशा जिले की कोठा बैराज परियोजना की प्रशासकीय स्वीकृति ।

000

राज्य शासन एतद् द्वारा विदिशा जिले की कोठा बैराज परियोजना की सैच्य क्षेत्र 20,000 हेक्टर के लिए रूपये 515.18 करोड़ (पाँच सौ पंद्रह करोड़ अठारह लाख) की प्रशासकीय स्वीकृति प्रदान करता है ।

2. परियोजना पर व्यय मांग संख्या 23/4700 (मुख्य सिंचाई पर पूँजीगत परिव्यय) के अंतर्गत विकलनीय होगा ।

3. यह आदेश मंत्रि-परिषद की बैठक दिनांक 29.09.2018 में प्राप्त अनुमोदन के क्रम में जारी किया जा रहा है ।

04/10/18
(विनोद सिंह टेकाम)
उप सचिव
म.प्र.शासन, जल संसाधन विभाग

पृ. क्रं.- 22(ए)/344/2018/एमपीएस/31 /1741 भोपाल दिनांक- 4/10/2018
प्रतिलिपि :-

1. अपर मुख्य सचिव/नर्मदा-घाटी विकास प्राधिकरण/योजना आर्थिक एवं सांख्यिकी/आदिम जाति कल्याण/कृषि विभाग, मंत्रालय भोपाल ।
2. प्रमुख सचिव, म.प्र.शासन, वित्त विभाग, मंत्रालय भोपाल ।
3. मुख्य अभियंता, (बोधी) जल संसाधन विभाग, भोपाल ।
4. मुख्य अभियता, चंबल-बेतवा कछार, जल संसाधन विभाग, भोपाल ।
5. अधीक्षण यंत्री, जल संसाधन मण्डल भोपाल ।
6. कार्यपालन यंत्री, संजय सागर परियोजना बाह्य नदी सभाग, गजवासौदा ।
7. निज सचिव, मा. मंत्रीजी/राज्य मंत्रीजी, जल संसाधन विभाग, भोपाल ।
8. वेब मैनेजर स्वारा भवन, जल संसाधन विभाग, भोपाल की ओर विभागीय वेब-साईड पर प्रकाशित करने हेतु प्रेषित ।

04/10/18
उप सचिव
म.प्र.शासन, जल संसाधन विभाग

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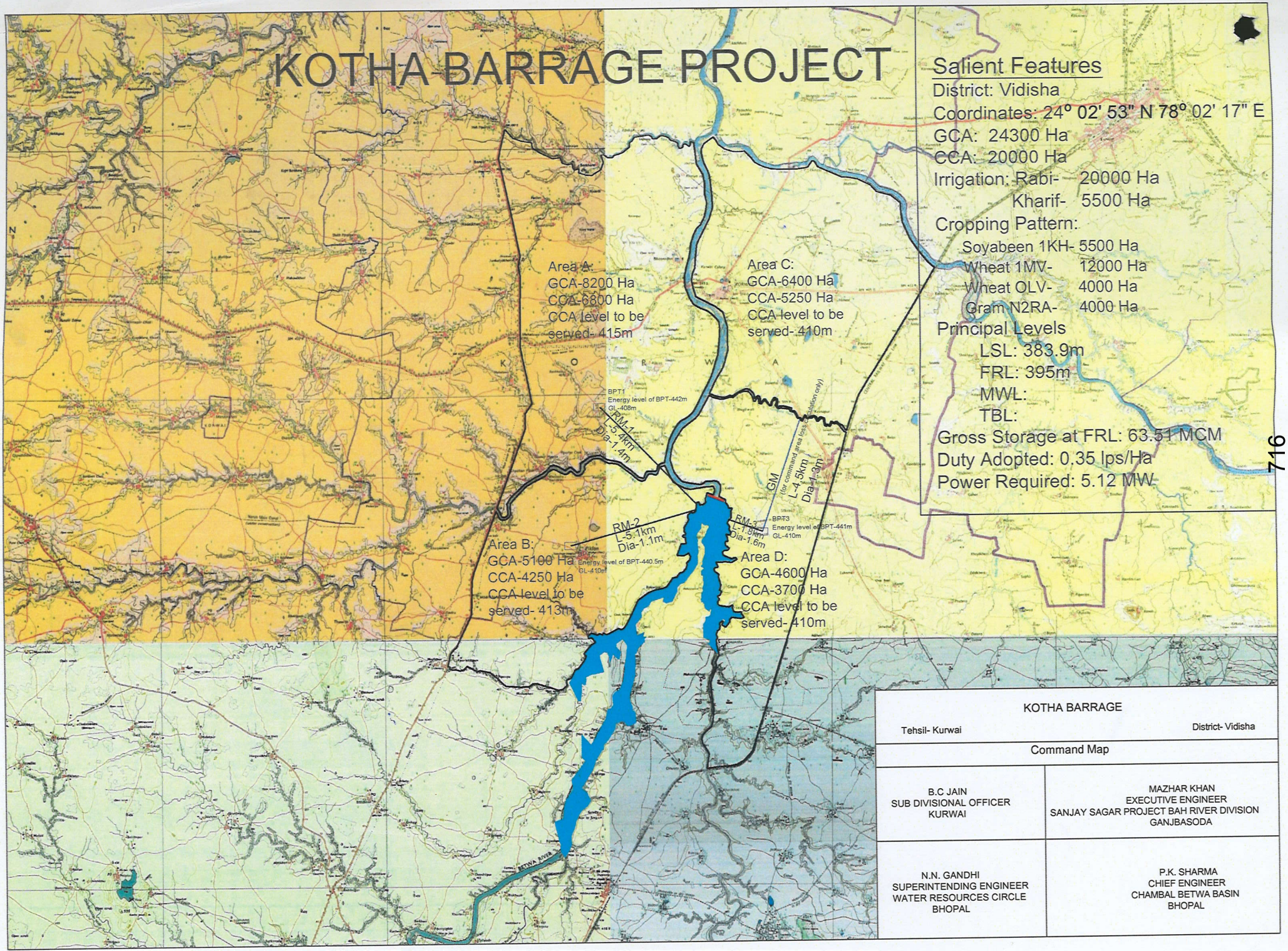
जलं रक्षति रक्षितः

KOTHA BARRAGE PROJECT



Salient Features

District: Vidisha
Coordinates: 24° 02' 53" N 78° 02' 17" E
GCA: 24300 Ha
CCA: 20000 Ha
Irrigation: Rabi- 20000 Ha
Kharif- 5500 Ha
Cropping Pattern:
Soyabeen 1KH- 5500 Ha
Wheat 1MV- 12000 Ha
Wheat OLV- 4000 Ha
Gram N2RA- 4000 Ha
Principal Levels
LSL: 383.9m
FRL: 395m
MWL:
TBL:
Gross Storage at FRL: 63.51 MCM
Duty Adopted: 0.35 lps/Ha
Power Required: 5.12 MW

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KOTHA BARRAGE

Tehsil- Kurwai | District- Vidisha

Command Map

B.C JAIN SUB DIVISIONAL OFFICER KURWAI	MAZHAR KHAN EXECUTIVE ENGINEER SANJAY SAGAR PROJECT BAH RIVER DIVISION GANJBASODA
N.N. GANDHI SUPERINTENDING ENGINEER WATER RESOURCES CIRCLE BHOPAL	P.K. SHARMA CHIEF ENGINEER CHAMBAL BETWA BASIN BHOPAL

S. No.	Particulars	Madia	Semra Ghat Feeder	Dehra	Chakarpur
I	**Location**				
1.	State	MADHYA PRADESH			
2.	District	SAGAR			
3.	River	Bina	Dhasan	Dehra Nalla	Bina
4.	Accessibility	42 km from sagar on sagar Bhopal Road	36 km from sagar on sagarRahatgarh Road	36 km from sagar on sagarRahatgarh Road	50 km from sagar on sagar Vidisha Road
5.	Latitude	$23^0$45'11"	$23^0$46'17"	$23^0$48'11"	$23^0$50'27"
6.	Longitude	$78^0$23'24"	$78^0$32'43"	$78^0$26'37"	$78^0$23'16"
II	**Hydrology**				
1.	Catchment area sqkm.	1109.84	314.00	62.90	187.80
2.	Maximum annual rainfall (mm)	1640.7 mm	1245.7 mm	-	1840.30 mm
3.	Minimum annual rainfall (mm)	767.20 mm	814.4 mm	-	590.20 mm
4.	Average annual rainfall (mm)	1170.60 mm	1223.50 mm	1201.68	1201.68 mm
5.	Designed flood (PMF) cumec.	6647.00	2310	932	8241
6.	Gross yield (MCM)	294.04	89.30	17.10	51.00
7.	Available run off at site (MCM)				
8.	75% dependable annual	294.04	89.30	17.10	51.00
9.	Reserve for U/S (MCM)	24.00	Nil	Nil	Nil
10.	Reserve for D/S (MCM)	6.00	Nil	Nil	Nil
III	**Reservoir Data**				
1.	Maximum water level, m	500.65	499.8	492	453.00
2.	Full reservoir level, m	500.55	499.7	491.60	451.50
3.	Submerged area, ha.	6435.60	575.00	754.60	1349.50
I	Private land, ha.	5624.17	525.00	335.96	910
II	Other lands, ha.	680.45	50.00	40	68.01
III	Forest land, m	130.98	nil	378.64	462.52
IV	Other Land				
i	Power House	15.00		1.00	

	ha				
ii	Canal ha				105
iii	Road Diversion ha			26.30	
iv	Pipe canal ha				
v	Feeder Channel Semra Ghat Feeder to Dehra ha		39		
4.	Dead storage level, m	487.62	495	465.35	435.75
5.	River bed level m	481	490.48	459.00	427
6.	Top of bund level m	504.55	501.80	494.00	456
7.	Height of dam m	23.55	11.32	35.00	25.00
8.	Gross storage (MCM)	270.10	6.46	72.36	74.31
9.	Live storage (MCM)	267.67	6.00	72.35	73.84
10.	Dead storage (MCM)	2.429	0.46	0.01	0.47
11.	Length of main dam m	2070	1440	3509	751.68
12.	Saddles, Nos.	1 (6.71m high)	Nil	2 (5m high)	2 (8m &3m high)
13.	Total length of saddles, m	1500m	Nil	(30m & 2148m)	(131.884m & 516.65m)
14.	MDD Level, m	492.50	-	484	439.5
15.	Feeder channel Semra Ghat Feeder to Dehra km.		8.0 Km with average depth of cutting 10 m		

V	**Irrigation**				
1.	Design irrigation	96,000 Ha. (Kharif Nil Ha , Rabi 90,000 Ha.& Basin Lift 6000 Ha)			
2.	CCA, Ha.	96,000 Ha			
VI	Drinking purposes (MCM)	19.20			
VII	Industrial Use (MCM)	25.00			
VIII	Total Village affected (84 no.)	59	8	6	11
IX	Total Benefited Village	296 no.			
	Khurai Tehsil Malthone Tehsil Bina Tehsil	167 no. 107 no. 22 no.			
X	**Hydropower**				
1.	Hydro Power component	Yes			
2.	Hydro power generation				

भारत सरकार
केन्द्रिय जल आयोग
जल विज्ञान (मध्य) निदेशालय

कमरा न० 504(द०),सेवा भवन
रा० कृ० पुरम, नई दिल्ली –66.

विषय :–**Bina Complex Irrigation Multi Purpose Project-reg.**

सन्दर्भ÷पत्राक **CWC UO NO MP/71/2008/PAC/314-20 dated 09.05.2013**

उपर्युक्त सन्दर्भित पत्र का कृपया अवलोकन करें जिंसमे इस निंदेशालय से उपरोक्त परियोजना सम्ब'धीं रिपोर्ट कीं टिप्पणीं भेजने का अनुरोध किंया है। इस सम्ब'ध मे वाँछित टिप्पणीं पुनः प्रेषित कीं जा रहीं है।

सँल्गनक÷उपरोक्तानुसार ।

(clear)

(एम० रघुराम)
निदेशक

निदेशक, परियोजना मूल्या'कन (मध्य) निंदेशालय के०ज०आ०।
फाइल संख्या 1/37/2011–ज०वि०(म)/705 दिना'क 18/11/2013

Bina Complex Irrigation and Multipurpose project

Project Background

Bina Complex Irrigation and Multipurpose project envisages construction of four dams: Madia and Chakarpur on Bina River, Dhasan on Dhasan River and Dehra on Dehra nallah to provide irrigation for 77,000 Ha . Additionally two power houses with installed capacity of 22 MW and 10 MW are proposed below Madia and Dehra dams respectively.

Water Availability Studies

No Gauge & Discharge site is available on Bina as well as Dehra nallah. However, Basoda (7525 sqkm) and Garrauli (6400 sq km) Gauge & Discharge sites on Rivers Betwa and Dashan Rivers respectively are the nearest sites to the proposed project.

The rainfall data of 6 stations viz. Bhopal, Vidisha, Raisen, Goharganj, Basoda and Berasia and 7 stations viz. Gairatganj, Begumganj, Silwani, Sagar, Rahatgarh, JC Nagar and Khurai has been used to compute the average areal rainfall of Basoda G&D site and four proposed dams respectively. The rainfall data has been checked for consistency using double mass curve technique and found to be consistent with the nearby stations data. The areal average rainfall of G & D stations and four dam catchment areas for the years 1978-79 to 2009-10 computed using Thiessen polygon method are given below:

S.No.	Project/Site	Areal Average Rainfall (mm)
1	Basoda G&D Site	1134.30 mm
2	Madia dam	1165.90 mm
3	Chakarpur Dam	1195.12 mm
4	Dehra Dam	1195.12 mm
5	Dhasan Dam	1208.00 mm

The above table shows the areal average rainfall of Basoda G & D site and all four proposed dams which are in the range of 1134 mm to 1208 mm. The normal rainfall in Dashan basin reduces from upper to lower reaches and it is observed that the rainfall of Garrauli G & D site (1080 mm) is comparatively lower than Dashan and remaining other three dams also. Based on the rainfall pattern and proximity to the proposed dams, Basoda G & D site data has been further used in computation of Yield series of the projects.

The catchment areas of all the proposed projects have been delineated using SRTM 52_08 data with Arc GIS software and cross checked with the relevant Topographic Maps. The catchment area maps are attached as Annex – I & II. The physiographic parameters of all the four projects' catchment areas are tabulated below:

S.No.	Project Name	Area (sqkm)	Longest Flow Path (km)	Lc (Km)
1	Madia	1109.84	70.28	35.95
2	Chakarpur *	187.80	24.84	5.02
3	Dehra	62.90	24.21	13.07
4	Dhasan	424.00	50.58	22.98

*Intermediate Catchment Area between Chakarpur, d/s of Madia and Dehra dams

In the first step, the observed flows of Basoda G & D site have to be naturalized duly taking upstream withdrawals into account. 130 Minor and 1 Medium Projects are in operation on River Betwa upstream of Basoda G & D site. MP state government provided the planned utilizations of all these projects vide their letter no. 3715/TS/2013 dated 1st August, 2013. Based on the data, the upstream planned irrigation withdrawals have been computed by redistributing 90% and 10% of total withdrawals into monsoon and non-monsoon months respectively to reflect the actual withdrawals. Further the monthly virgin / natural flows at Basoda site have been computed by adding 90% of above computed monthly irrigation withdrawals and 20% of monthly industrial / domestic withdrawals to the observed flows at Basoda.

The annual runoff coefficients at Basoda G & D site are in the range of 0.2 to 0.76 with an average value of 0.35, which is consistent with the area. The virgin flows of Basoda site have been used to compute the yield series at the proposed dams' locations in the following two methods:

- Rainfall-Runoff relationship
- In Catchment area proportion

Rainfall – Runoff Relationship:

The month wise Rainfall-Runoff relationships for monsoon season at Basoda site have been developed and the same are tabulated below:

No.	Month	Equation	R value
1	June	$Y = 0.099X_1 - 3.043$	0.8
2	July	$Y = 0.5377X_1 - 98.842$	0.86
3	August	$Y= 0.478X_1 - 7.26$	0.73
4	September	$Y= 0.568X_1 - 5.7$	0.95
5	October	$Y= 0.227X_1 + 0.163X_2 - 10.3$	0.8

*X_1- Rainfall (mm) of current Month, X_2 – Rainfall (mm) of previous month and Y -Runoff (mm)

The monsoon yield at the four dam sites has been computed using the above Rainfall-Runoff relationships and concerned catchment area's monthly areal rainfall depths. The non monsoon yield was computed using the ratio of non- monsoon to monsoon rainfall depth of the concerned year and this non monsoon yield has been further distributed to the individual months using average ratios of non-monsoon monthly rainfall to total non-monsoon rainfall.

Catchment area and Rainfall Proportion Method:

The individual four dams' yields have been computed using the catchment area and average areal rainfall ratio of Basoda site and the concerned dam catchment. The following equation shows the method:

$$Q_{June_Madia} = Q_{June_Basoda} \frac{(A_{Madia})}{(A_{Basoda})} * \frac{(R_{Madia})}{(R_{Basoda})}$$

Both methods have given almost same yields at all the four dam locations. However, Rainfall-Runoff relationship method yielded few negative values in monsoon months, which cannot be correct. To remove such discrepancies, the yield series developed with the Catchment Area and Rainfall Proportion method have been adopted. The yield series at the four dam sites are enclosed as Annexure – III to VI and the same may be used for planning purpose. The yield series presented in Annex –IV gives the yield from the intermediate catchment area between Chakarpur, downstream side of Dehra and Madia Dams.

It is suggested that necessary hydro meteorological network may be established in the project area for collection of site specific discharge and rainfall data and the same may be used to update the hydrological studies after collecting sufficient data.

Water Yield Series at Mudia Project

Year	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	ANNUAL Runoff (MCM)
1978-79	23.75	212.20	412.07	75.99	13.75	4.01	7.39	5.67	4.86	2.72	1.83	1.37	765.62
1979-80	10.38	23.17	67.52	5.63	1.43	13.85	12.67	1.90	1.33	1.10	0.38	0.24	139.60
1980-81	27.79	35.21	140.88	66.09	12.76	3.33	2.83	4.05	2.45	2.43	2.19	2.70	302.73
1981-82	11.83	33.68	119.27	16.06	7.15	3.76	3.74	5.61	6.15	3.12	2.23	0.89	213.49
1982-83	6.74	34.76	209.33	77.80	41.81	18.35	18.68	7.64	2.92	2.35	1.46	0.79	422.62
1983-84	4.66	52.79	179.96	265.12	80.56	31.69	7.97	10.54	5.33	3.60	2.01	1.28	645.50
1984-85	5.10	14.72	361.48	47.20	12.89	3.13	3.74	3.50	2.14	1.98	0.92	0.69	457.49
1985-86	4.82	48.53	302.62	205.15	170.30	28.74	6.68	5.88	6.45	5.59	1.97	0.91	787.66
1986-87	19.50	573.45	224.73	40.42	12.66	3.23	4.03	4.33	3.27	2.45	1.49	0.71	890.27
1987-88	4.94	28.47	230.39	69.80	14.79	5.17	3.35	2.72	3.23	2.11	0.91	0.69	366.57
1988-89	9.64	86.99	144.51	22.72	10.70	3.50	3.81	3.49	2.50	1.48	1.12	0.69	291.15
1989-90	6.13	33.51	201.99	50.93	7.55	1.90	2.81	2.03	1.03	0.71	0.70	0.69	309.98
1990-91	47.07	115.89	181.31	259.23	32.04	6.47	2.98	2.12	2.09	1.93	1.41	0.77	653.30
1991-92	12.43	43.57	318.32	35.97	5.97	2.41	2.90	4.19	2.51	1.64	0.95	0.79	431.63
1992-93	4.47	43.97	168.78	54.02	5.43	1.39	1.81	0.97	0.70	0.70	0.70	0.70	283.64
1993 -94	7.57	47.69	114.16	235.99	47.43	5.54	4.06	3.66	2.57	2.32	2.28	1.23	474.50
1994-95	42.80	180.75	357.74	129.53	13.80	3.08	3.79	3.55	4.33	5.44	2.35	1.07	748.22
1995-96	4.49	47.92	83.23	85.86	7.86	2.96	3.63	3.56	1.73	1.55	0.85	0.72	244.35
1996- 97	4.50	136.34	282.93	139.60	28.44	11.31	4.68	3.79	3.84	1.77	1.15	0.99	619.32
1997-98	4.68	146.83	172.36	100.01	18.77	17.81	64.21	6.88	4.17	4.07	2.47	1.15	543.41
1998-99	14.53	129.38	148.90	142.53	80.97	22.45	4.17	3.61	48.45	16.51	1.40	0.80	613.68
1999-00	7.57	134.87	186.77	414.88	166.18	17.88	3.99	3.73	4.51	3.02	1.87	0.89	946.17
2000-01	7.29	255.93	75.97	17.77	4.91	2.07	4.33	2.17	0.72	0.72	0.72	0.72	373.31
2001-02	15.77	92.44	163.44	22.60	9.90	1.99	2.45	4.47	1.13	1.25	1.31	0.72	317.46
2002-03	7.48	14.70	163.79	91.53	4.46	1.21	2.12	0.72	0.72	0.72	0.72	0.72	288.91
2003-04	17.54	84.97	104.57	140.41	26.68	3.12	3.46	3.39	4.62	3.12	0.93	0.78	393.60
2004-05	8.33	61.00	305.61	26.92	9.90	2.88	4.13	6.05	3.51	1.65	0.87	0.73	431.59
2005-06	6.56	304.26	165.86	50.83	7.96	2.44	4.17	4.58	3.40	2.04	1.01	1.06	554.17
2006-07	5.03	67.89	473.99	400.69	19.67	2.04	4.60	5.03	3.30	2.50	0.90	0.73	986.37
2007-08	5.71	54.39	47.53	42.51	4.40	0.74	0.74	0.74	0.74	0.74	0.74	0.74	159.72
2008-09	17.64	44.15	150.43	41.28	5.00	0.75	0.75	0.75	0.75	0.75	0.75	0.75	263.78
2009-10	5.00	83.09	52.21	99.85	31.36	27.82	9.03	2.32	2.17	1.19	0.85	0.77	315.67
Average	**11.93**	**102.11**	**197.27**	**108.59**	**28.67**	**8.03**	**6.55**	**3.86**	**4.30**	**2.60**	**1.30**	**0.89**	**476.109**

Water Yield Series from the intermediate Catchment Area between

Year	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	ANNUAL Runoff
1978-79	4.12	36.81	71.47	13.18	2.39	0.70	1.28	0.98	0.84	0.47	0.32	0.24	132.80
1979-80	1.80	4.02	11.71	0.98	0.25	2.40	2.20	0.33	0.23	0.19	0.07	0.04	24.21
1980-81	4.82	6.11	24.44	11.46	2.21	0.58	0.49	0.70	0.43	0.42	0.38	0.47	52.51
1981-82	2.05	5.84	20.69	2.78	1.24	0.65	0.65	0.97	1.07	0.54	0.39	0.15	37.03
1982-83	1.17	6.03	36.31	13.49	7.25	3.18	3.24	1.32	0.51	0.41	0.25	0.14	73.30
1983-84	0.81	9.16	31.21	45.99	13.97	5.50	1.38	1.83	0.92	0.62	0.35	0.22	111.96
1984-85	0.88	2.55	62.70	8.19	2.24	0.54	0.65	0.61	0.37	0.34	0.16	0.12	79.35
1985-86	0.84	8.42	52.49	35.58	29.54	4.99	1.16	1.02	1.12	0.97	0.34	0.16	136.62
1986-87	3.38	99.47	38.98	7.01	2.20	0.56	0.70	0.75	0.57	0.43	0.26	0.12	154.42
1987-88	0.86	4.94	39.96	12.11	2.57	0.90	0.58	0.47	0.56	0.37	0.16	0.12	63.58
1988-89	1.67	15.09	25.07	3.94	1.86	0.61	0.66	0.61	0.43	0.26	0.19	0.12	50.50
1989-90	1.06	5.81	35.04	8.83	1.31	0.33	0.49	0.35	0.18	0.12	0.12	0.12	53.77
1990-91	8.17	20.10	31.45	44.96	5.56	1.12	0.52	0.37	0.36	0.33	0.25	0.13	113.32
1991-92	2.16	7.56	55.21	6.24	1.03	0.42	0.50	0.73	0.44	0.28	0.17	0.14	74.87
1992-93	0.78	7.63	29.28	9.37	0.94	0.24	0.31	0.17	0.12	0.12	0.12	0.12	49.20
1993-94	1.31	8.27	19.80	40.93	8.23	0.96	0.70	0.63	0.45	0.40	0.40	0.21	82.30
1994-95	7.42	31.35	62.05	22.47	2.39	0.53	0.66	0.62	0.75	0.94	0.41	0.19	129.78
1995-96	0.78	8.31	14.44	14.89	1.36	0.51	0.63	0.62	0.30	0.27	0.15	0.12	42.38
1996-97	0.78	23.65	49.07	24.21	4.93	1.96	0.81	0.66	0.67	0.31	0.20	0.17	107.42
1997-98	0.81	25.47	29.90	17.35	3.26	3.09	11.14	1.19	0.72	0.71	0.43	0.20	94.26
1998-99	2.52	22.44	25.83	24.72	14.05	3.89	0.72	0.63	8.40	2.86	0.24	0.14	106.45
1999-00	1.31	23.39	32.40	71.96	28.82	3.10	0.69	0.65	0.78	0.52	0.32	0.16	164.12
2000-01	1.26	44.39	13.18	3.08	0.85	0.36	0.75	0.38	0.12	0.12	0.12	0.12	64.75
2001-02	2.73	16.03	28.35	3.92	1.72	0.35	0.42	0.77	0.20	0.22	0.23	0.12	55.07
2002-03	1.30	2.55	28.41	15.88	0.77	0.21	0.37	0.13	0.13	0.13	0.13	0.12	50.11
2003-04	3.04	14.74	18.14	24.36	4.63	0.54	0.60	0.59	0.80	0.54	0.16	0.14	68.27
2004-05	1.44	10.58	53.01	4.67	1.72	0.50	0.72	1.05	0.61	0.29	0.15	0.13	74.86
2005-06	1.14	52.78	28.77	8.82	1.38	0.42	0.72	0.79	0.59	0.35	0.18	0.18	96.12
2006-07	0.87	11.78	82.22	69.50	3.41	0.35	0.80	0.87	0.57	0.43	0.16	0.13	171.09
2007-08	0.99	9.44	8.24	7.37	0.76	0.13	0.13	0.13	0.13	0.13	0.13	0.13	27.70
2008-09	3.06	7.66	26.09	7.16	0.87	0.13	0.13	0.13	0.13	0.13	0.13	0.13	45.75
2009-10	0.87	14.41	9.06	17.32	5.44	4.83	1.57	0.40	0.38	0.21	0.15	0.13	54.75
Average	**2.07**	**17.71**	**34.22**	**18.84**	**4.97**	**1.39**	**1.14**	**0.67**	**0.75**	**0.45**	**0.22**	**0.15**	**82.58**

CENTRAL WATER COMMISSION

Water Yield Series at Dehra Project (MCM)

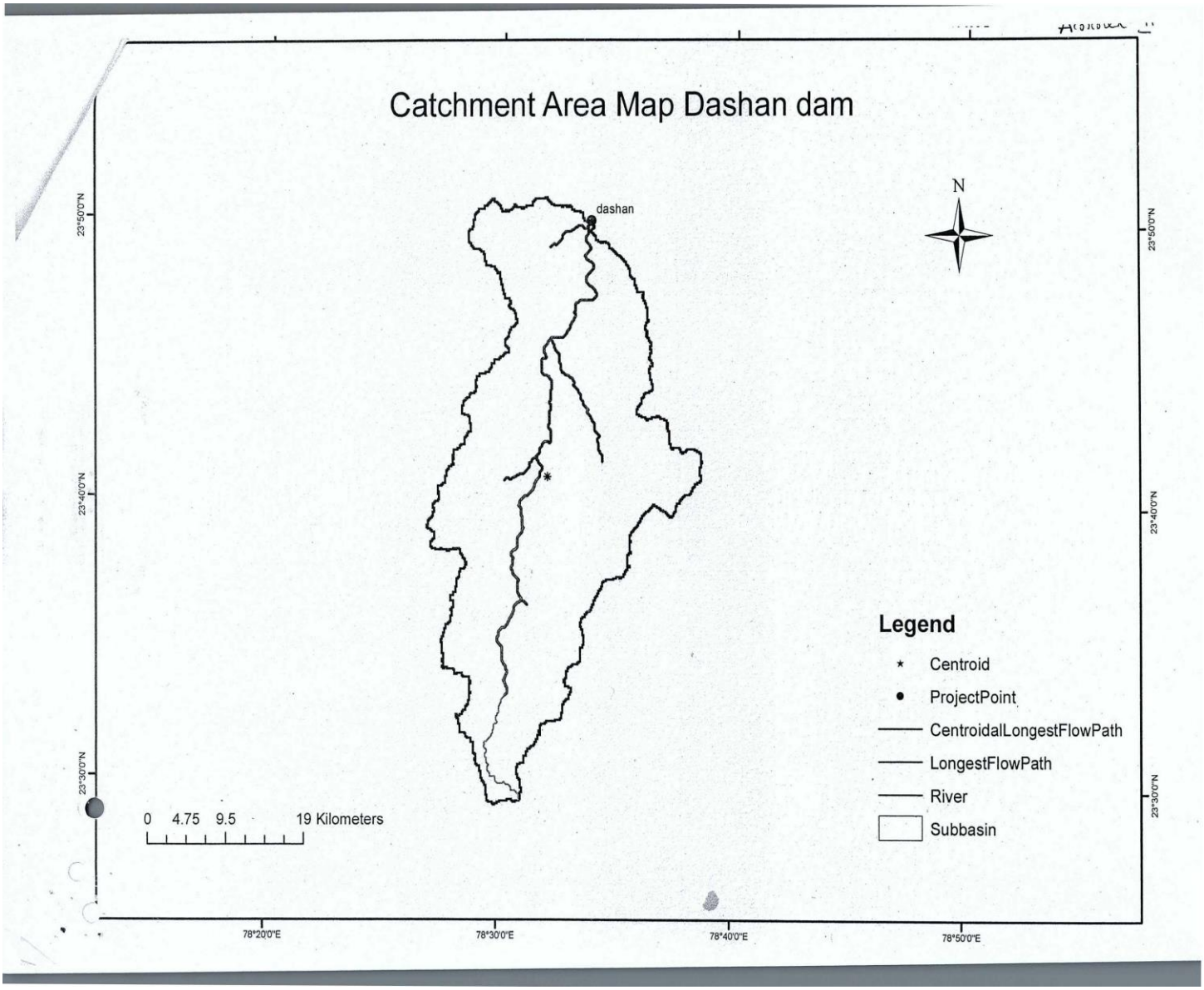
Year	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	ANNUAL Runoff (MCM)
1978-79	1.38	12.33	23.94	4.41	0.80	0.23	0.43	0.33	0.28	0.16	0.11	0.08	44.48
1979-80	0.60	1.35	3.92	0.33	0.08	0.80	0.74	0.11	0.08	0.06	0.02	0.01	8.11
1980-81	1.61	2.05	8.18	3.84	0.74	0.19	0.16	0.24	0.14	0.14	0.13	0.16	17.59
1981-82	0.69	1.96	6.93	0.93	0.42	0.22	0.22	0.33	0.36	0.18	0.13	0.05	12.40
1982-83	0.39	2.02	12.16	4.52	2.43	1.07	1.09	0.44	0.17	0.14	0.08	0.05	24.55
1983-84	0.27	3.07	10.45	15.40	4.68	1.84	0.46	0.61	0.31	0.21	0.12	0.07	37.50
1984-85	0.30	0.86	21.00	2.74	0.75	0.18	0.22	0.20	0.12	0.11	0.05	0.04	26.58
1985-86	0.28	2.82	17.58	11.92	9.89	1.67	0.39	0.34	0.37	0.32	0.11	0.05	45.76
1986-87	1.13	33.31	13.06	2.35	0.74	0.19	0.23	0.25	0.19	0.14	0.09	0.04	51.72
1987-88	0.29	1.65	13.38	4.05	0.86	0.30	0.19	0.16	0.19	0.12	0.05	0.04	21.30
1988-89	0.56	5.05	8.40	1.32	0.62	0.20	0.22	0.20	0.15	0.09	0.06	0.04	16.91
1989-90	0.36	1.95	11.73	2.96	0.44	0.11	0.16	0.12	0.06	0.04	0.04	0.04	18.01
1990-91	2.73	6.73	10.53	15.06	1.86	0.38	0.17	0.12	0.12	0.11	0.08	0.04	37.95
1991-92	0.72	2.53	18.49	2.09	0.35	0.14	0.17	0.24	0.15	0.10	0.06	0.05	25.08
1992-93	0.26	2.55	9.81	3.14	0.32	0.08	0.10	0.06	0.04	0.04	0.04	0.04	16.48
1993-94	0.44	2.77	6.63	13.71	2.76	0.32	0.24	0.21	0.15	0.13	0.13	0.07	27.57
1994-95	2.49	10.50	20.78	7.52	0.80	0.18	0.22	0.21	0.25	0.32	0.14	0.06	43.47
1995-96	0.26	2.78	4.84	4.99	0.46	0.17	0.21	0.21	0.10	0.09	0.05	0.04	14.20
1996-97	0.26	7.92	16.44	8.11	1.65	0.66	0.27	0.22	0.22	0.10	0.07	0.06	35.98
1997-98	0.27	8.53	10.01	5.81	1.09	1.03	3.73	0.40	0.24	0.24	0.14	0.07	31.57
1998-99	0.84	7.52	8.65	8.28	4.70	1.30	0.24	0.21	2.81	0.96	0.08	0.05	35.65
1999-00	0.44	7.84	10.85	24.10	9.65	1.04	0.23	0.22	0.26	0.18	0.11	0.05	54.97
2000-01	0.42	14.87	4.41	1.03	0.29	0.12	0.25	0.13	0.04	0.04	0.04	0.04	21.69
2001-02	0.92	5.37	9.50	1.31	0.58	0.12	0.14	0.26	0.07	0.07	0.08	0.04	18.44
2002-03	0.43	0.85	9.52	5.32	0.26	0.07	0.12	0.04	0.04	0.04	0.04	0.04	16.78
2003-04	1.02	4.94	6.08	8.16	1.55	0.18	0.20	0.20	0.27	0.18	0.05	0.05	22.87
2004-05	0.48	3.54	17.75	1.56	0.58	0.17	0.24	0.35	0.20	0.10	0.05	0.04	25.07
2005-06	0.38	17.68	9.64	2.95	0.46	0.14	0.24	0.27	0.20	0.12	0.06	0.06	32.19
2006-07	0.29	3.94	27.54	23.28	1.14	0.12	0.27	0.29	0.19	0.15	0.05	0.04	57.30
2007-08	0.33	3.16	2.76	2.47	0.26	0.04	0.04	0.04	0.04	0.04	0.04	0.04	9.28
2008-09	1.03	2.56	8.74	2.40	0.29	0.04	0.04	0.04	0.04	0.04	0.04	0.04	15.32
2009-10	0.29	4.83	3.03	5.80	1.82	1.62	0.52	0.13	0.13	0.07	0.05	0.04	18.34
Average	**0.69**	**5.93**	**11.46**	**6.31**	**1.67**	**0.47**	**0.38**	**0.22**	**0.25**	**0.15**	**0.08**	**0.05**	**27.66**

केन्द्रीय जल आयोग
CENTRAL WATER COMMISSION

Water Yield Series at Dashan Project (MCM)

Year	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	ANNUAL Runoff
1978-79	9.40	84.00	163.11	30.08	5.44	1.59	2.92	2.24	1.92	1.08	0.72	0.54	303.06
1979-80	4.11	9.17	26.73	2.23	0.56	5.48	5.01	0.75	0.53	0.43	0.15	0.09	55.26
1980-81	11.00	13.94	55.77	26.16	5.05	1.32	1.12	1.60	0.97	0.96	0.87	1.07	119.83
1981-82	4.68	13.33	47.21	6.36	2.83	1.49	1.48	2.22	2.44	1.23	0.88	0.35	84.51
1982-83	2.67	13.76	82.86	30.79	16.55	7.26	7.40	3.02	1.16	0.93	0.58	0.31	167.29
1983-84	1.85	20.90	71.23	104.94	31.89	12.54	3.15	4.17	2.11	1.42	0.79	0.51	255.51
1984-85	2.02	5.83	143.08	18.68	5.10	1.24	1.48	1.39	0.85	0.78	0.37	0.27	181.09
1985-86	1.91	19.21	119.79	81.20	67.41	11.38	2.65	2.33	2.55	2.21	0.78	0.36	311.78
1986-87	7.72	226.99	88.95	16.00	5.01	1.28	1.60	1.72	1.30	0.97	0.59	0.28	352.40
1987-88	1.96	11.27	91.20	27.63	5.85	2.05	1.33	1.08	1.28	0.84	0.36	0.27	145.10
1988-89	3.82	34.43	57.20	8.99	4.24	1.39	1.51	1.38	0.99	0.59	0.44	0.27	115.25
1989-90	2.43	13.26	79.95	20.16	2.99	0.75	1.11	0.80	0.41	0.28	0.28	0.27	122.70
1990-91	18.63	45.87	71.77	102.61	12.68	2.56	1.18	0.84	0.83	0.76	0.56	0.30	258.60
1991-92	4.92	17.25	126.00	14.24	2.36	0.95	1.15	1.66	0.99	0.65	0.38	0.31	170.85
1992-93	1.77	17.40	66.81	21.38	2.15	0.55	0.71	0.38	0.28	0.28	0.28	0.28	112.27
1993-94	3.00	18.88	45.19	93.41	18.78	2.19	1.61	1.45	1.02	0.92	0.90	0.48	187.82
1994-95	16.94	71.55	141.60	51.27	5.46	1.22	1.50	1.40	1.71	2.15	0.93	0.42	296.17
1995-96	1.78	18.97	32.95	33.99	3.11	1.17	1.44	1.41	0.68	0.61	0.34	0.28	96.72
1996-97	1.78	53.97	111.99	55.26	11.26	4.48	1.85	1.50	1.52	0.70	0.45	0.39	245.15
1997-98	1.85	58.12	68.22	39.59	7.43	7.05	25.42	2.72	1.65	1.61	0.98	0.46	215.10
1998-99	5.75	51.21	58.94	56.42	32.05	8.89	1.65	1.43	19.18	6.54	0.55	0.31	242.91
1999-00	3.00	53.38	73.93	164.22	65.78	7.08	1.58	1.48	1.79	1.20	0.74	0.35	374.53
2000-01	2.88	101.31	30.07	7.03	1.94	0.82	1.72	0.86	0.28	0.28	0.28	0.28	147.77
2001-02	6.24	36.59	64.70	8.95	3.92	0.79	0.97	1.77	0.45	0.50	0.52	0.28	125.66
2002-03	2.96	5.82	64.83	36.23	1.76	0.48	0.84	0.29	0.29	0.29	0.29	0.28	114.36
2003-04	6.94	33.64	41.39	55.58	10.56	1.24	1.37	1.34	1.83	1.23	0.37	0.31	155.80
2004-05	3.30	24.15	120.97	10.66	3.92	1.14	1.64	2.39	1.39	0.65	0.34	0.29	170.84
2005-06	2.60	120.44	65.65	20.12	3.15	0.96	1.65	1.81	1.35	0.81	0.40	0.42	219.36
2006-07	1.99	26.87	187.62	158.61	7.78	0.81	1.82	1.99	1.31	0.99	0.36	0.29	390.44
2007-08	2.26	21.53	18.81	16.83	1.74	0.29	0.29	0.29	0.29	0.29	0.29	0.29	63.22
2008-09	6.98	17.47	59.55	16.34	1.98	0.30	0.30	0.30	0.30	0.30	0.30	0.30	104.41
2009-10	1.98	32.89	20.67	39.52	12.41	11.01	3.57	0.92	0.86	0.47	0.34	0.30	124.95
Average	**4.72**	**40.42**	**78.09**	**42.98**	**11.35**	**3.18**	**2.59**	**1.53**	**1.70**	**1.03**	**0.51**	**0.35**	**188.46**

केन्द्रीय जल आयोग
CENTRAL WATER COMMISSION


Catchment Area Map Dashan dam
dashan
N
Legend
Centroid
ProjectPoint
CentroidalLongestFlowPath
LongestFlowPath
River
Subbasin
0 4.75 9.5 19 Kilometers
23°50'0"N
23°40'0"N
23°30'0"N
78°20'0"E
78°30'0"E
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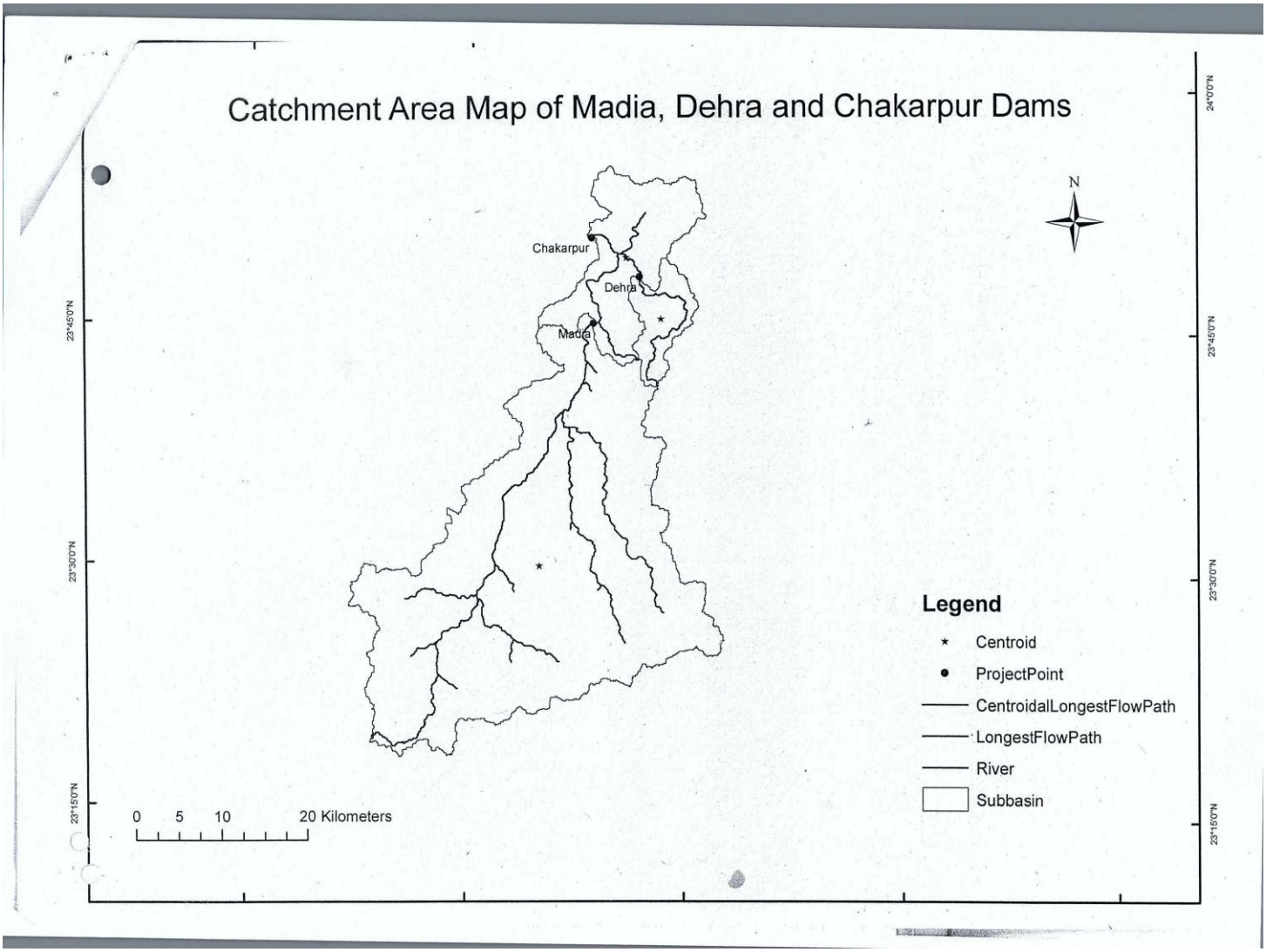
Catchment Area Map of Madia, Dehra and Chakarpur Dams
Chakarpur
Dehra
Madia
N
Legend
Centroid
ProjectPoint
CentroidalLongestFlowPath
LongestFlowPath
River
Subbasin
0 5 10 20 Kilometers
24°0'0"N
23°45'0"N
23°30'0"N
23°15'0"N

भारत सरकार
Government of India
केंद्रीय जल आयोग
Central Water Commission
जल विज्ञान (मध्य) निदेशालय
Hydrology(C) Directorate
दूरभाष-011-26106432
Telephone-011-24106432

विषय : Bina Complex Irrigation Multi Purpose Project-reg.

सन्दर्भ: पत्राक CWC UO No. MP/71/2008/PAC/314-20 dated 09.05.2013

कृपया उपरोक्त विषयक सन्दर्भित पत्र का अवलोकन करें जिसमे इस निदेशालय से उपरोक्त परियोजना पर टिप्पणी हेतु अनुरोध किया गया था। इस निदेशालय की ओर से उक्त परियोजना के Design Flood तथा Sedimentation Studies से संबंधित आवश्यक टिप्पणी आपके सूचनार्थ एवं अग्रेतर कारवाई हेतु प्रेषित की जा रही है। ज्ञात हो कि इस निदेशालय के पत्रांक के.ज.आ./1/37/2011–ज०वि०(म.)/705 दिना'क 18/11/2013 द्वारा उक्त परियोजना के जल उपलब्धता अध्ययन (Water Availability Studies) से संबंधित टिप्पणी आपको पूर्व में प्रेषित कीं जा चूकी हैं।

यह मुख्य अभियंता, जल विज्ञानीय अध्ययन संगठन, केन्द्रीय जल आयोग, नई दिल्ली के अनुमोदन से निर्गत किया जाता है।

संलग्नक: यथोक्त।

07/3/14
(एस.पी.सिंह)
उप निदेशक

निदेशक, परियोजना मूल्या'कन (मध्य) निदेशालय, के०ज०आ०

संख्या: के.ज.आ./1/37/2011–ज०वि०(म.)/ 156-57 दिना'क: 07/03/2014

Pincode No :- 470002

प्रतिलिपि:
मुख्य अभियंता, धसान केन बेसिन, जल संसाधन विभाग, सागर, मध्य प्रदेश को उनके पत्रांक मेमो संख्या: 417/ टी. एस./2013-14 दिनांक 28.01.2014 के संदर्भ में सूचनार्थ प्रेषित।

Bina Complex Irrigation and Multipurpose project

Project Background

Bina Complex Irrigation and Multipurpose Project envisages construction of four dams: Madia and Chakarpur on Bina River, Dehra on Dehra Nallah and Dhasan on Dhasan River to provide irrigation for 77,000 Ha. Water availability studies of the Bina Complex Project was approved vide this office letter no.1/37/2011-Hyd9c)/705 dated 18.11.2013 The project authorities furnished revised design flood and sedimentation studies which are vetted and following observations are made:

Design Flood Studies

As the storage capacity of all the four reservoirs is more than 60 MCM, as per IS: 11223:1985, the design flood will be Probable Maximum Flood (PMF). The design flood has been calculated using hydro-meteorological approach and cross checked with the flood frequency method also.

The catchment areas of all the four proposed projects have been delineated using SRTM 52_08 data with Arc GIS software and checked with the relevant Topographic Maps. The catchment area maps are attached as Annex – I & II.

In the absence of concurrent short interval rainfall-runoff data, the unit hydrographs of all the four projects have been worked out based on Flood Estimation Report of Sub Zone -1(C). The relevant physiographic parameters and the Unit Hydrograph ordinates are given in Table-1 & 2 respectively.

IMD carried out the Design Storm Studies for all the four projects considering two storms viz. 7th July, 1952 (Centre at Biaora) and 28-29 July, 1965 (Centre at Raisen). The Probable Maximum Precipitation (PMP) value recommended by IMD for Dehra dam based on 7th July, 1952 storm has been adopted for PMF computations. However, for remaining three projects the storm occurred on 3-4 July, 2005 with centre at Sagar has been found to be more critical as it yielded higher 1 Day rainfall depth compared to 28-29 July, 1965 storm. Accordingly, the PMP depths have been computed by transposing the Sagar storm and considering the Moisture Adjustment Factor (MAF) as 1.20. Looking at the base periods of unit hydrographs, 1 Day duration PMP and 2 Day duration PMP have been considered for Dehra and other projects respectively. The relevant Standard Project Storm (SPS) and PMP values are tabulated below:

Project Name	1 Day		2 Day	
	SPS (cm)	PMP (cm)	SPS (cm)	PMP (cm)
Dehra	43.2	58.7	-	-
Madia	44.4	53.3	54.9	65.9
Chakarpur	43.4	52.1	53.4	64.1
Dhasan	45.3	54.4	56.4	67.7

Clock hour correction of 1.15 applied to convert one day PMP value to 24 hour PMP in respect of Dehra project and no clock hour correction applied in case of other projects as 2 Day PMP values have been used in the computations. The cumulative PMP depth have been converted into hourly rainfall increments using temporal distribution factors recommended in IMD report and such rainfall increments have been arranged in the form of two bells of 12 hrs each per day. Critical sequencing of rainfall bells has been carried out as per norms. As per FER, loss rate of 0.23 cm/hr and base flow contributions of 0.018 cumec / sqkm are adopted in the calculations. The PMF for Dehra, Madia and Dhasan have been computed by convoluting the effective rainfall increments with the respective basin response functions.

In case of Chakarpur project, an attempt has been made to compute the PMF using the distributed model with the help of already developed unit hydrographs of Madia and Dehra projects. Almost 82% of Chakarpur catchment area lies in Madia project and just remaining 18% is free catchment area and falls in Dehra project. Dividing the catchment area into such uneven sub catchments is not preferred in distributed model approach. In view of this, the PMF has been computed by considering the total catchment area as a single catchment only. Accordingly, PMF calculations have been performed.

The flood hydrographs of all the four projects are enclosed as Tables 4(i) to 4(iv). The PMF of individual projects are tabulated below:

S.No.	Project Name	PMF Peak (cumec)
1	Dehra	932
2	Madia	6647
3	Chakarpur	8241
4	Dhasan	3182

Further, 10000 year return period flood at Basoda G&D site was computed as 29000 cumec using the flood frequency approach with the annual flood peaks of the site. Basoda site flood has been transferred to all the four proposed projects using Dicken's formula and the same are tabulated below:

S.No.	Project Name	10000 Year flood (cumec)
1	Dehra	804
2	Madia	6920
3	Chakarpur	8065
4	Dhasan	3363

The 10000 year return period flood computed at the four proposed projects are generally agreeing with the PMF values computed using the hydro meteorological approach.

In view of the above, it is recommended to use the flood hydrographs computed by hydro-meteorological approach and enclosed at Tables:4(i) - (iv) for planning and design purpose. It is suggested to establish necessary hydro-meteorological network for collection of short term concurrent observed discharge and rainfall data for flood events so as to revise the design flood calculations after collecting sufficient data.

Sedimentation Studies

Sediment observation sites are not available at the proposed projects and an effort has been made to compute the sediment rate using the sediment data of Gaurali site on Dhasan, Banda site on Ken and Shahjina on Betwa. However, due to restricted data period of just 5 years (i.e.2006-07 to 2011-12), a representative sediment rate could not be computed. Based on the sediment resurveys carried out in the nearby projects such as Dhukwan project (0.423 ham/100 sqkm/year), Matatila project (4.69 ham/100 sqkm/year) and sediment rate computed using long term data of Banda site (3.3 ham/100 sqkm/year), a sediment rate of 5 ham/100 sqkm/year has been adopted in the present study.

Based on the adopted sediment rate, the trapped sediment volume in Dehra, Madia and Dhasan reservoirs in 50 years and 100 years periods was computed taking the trap efficiencies into account. The trapped sediment volume in Chakarpur reservoir has been computed as sum of sediment from free catchment area (i.e.187.8 sqkm) and sediment releases from Dehra and Madia Projects. The relevant results are tabulated below:

Name of Reservoir	Catchment Area (Sq.Km)	Capacity Inflow Ratio (C/I)	Trap Efficiency (in %)	Trapped Sediment Volume (MCM)	
				50 Year	100 Year
Dhasan	424	0.46	96	10.18	20.35
Madia	1109.84	0.66	96	26.64	53.27
Dehra	62.9	2.62	98	1.54	3.08
Chakarpur	187.8	0.9	98	5.73	11.45

As per IS:5477 (Part 2):1994, all the reservoirs have been classified as Type I and further New Zero elevation and revised Elevation- Area - Capacity curves after 100 and 50 years of life have been computed by Empirical Area Reduction method. The project wise New Zero Elevation after 100 years of life is tabulated below:

S.No.	Project Name	NZE after 100 Years of life (m)
1	Dehra	465.35
2	Madia	487.62
3	Chakarpur	435.75
4	Dhasan	491.06

The revised elevation- area- capacity curves after 50 years and 100 years are presented in Table 5(i) - (iv). The same may be adopted for planning and design purpose. It is suggested to establish necessary sediment observation sites at the proposed projects to revise the sediment studies after collection of sufficient length of data.

Table:1 Physiographic and UH Parameters for Bina Comlex Irrigation & Multipurpose Project

Details	Sub Basin Name			
	Madia	Dhasan	Chakarpur	Dehra
Physiographic parameters				
Catchment Area (Km^2)	1109.84	424	1360.54	62.9
Longest Flow Path L (km)	60.23	50.58	77.5	13
Centroidal Flow Path, Lc (Km)	-	-	-	-
Equivalent Stream Slope, S (m/Km)	0.73	1.48	1.26	3.72
UH Parameters				
Tp (hour)	12.5	8.5	11.5	3.5
Q_p (cumec/sq. km)	0.17	0.23	0.18	0.72
W50(hour)	12.89	9.05	12.18	2.86
W75(hour)	5.90	4.38	5.62	1.66
WR50(hour)	4.2	3.01	3.98	1.02
WR75(hour)	2.15	1.63	2.06	0.65
TB (hour)	48.0	33.0	44.0	14
Tm (hour)	13.0	9.0	12.0	4.0
Qp (cumec)	188.67	97.5	244.9	45.24

Table: 2 - Ordinates of Unit Hydrographs of Four Projects (Cumec)

Hours	Dehra	Madia	Chakarpur	Dhasan
0	0	0	0	0
1	2.5	4	5.5	6
2	8.5	9	13.5	12
3	23	15	25	20
4	**45.2**	23	40	28
5	34.5	33	57	38
6	21	45	77	49
7	14	59	97.9	66
8	9.5	78	122	94.3
9	6.5	96	150	**97.5**
10	4.5	116	188	95
11	3	145	234	84
12	1.75	185	**244.9**	72
13	0.75	**188.7**	240	63
14	0	185	220	56
15		173	197	50
16		156	176	45.5
17		138	158	41.5
18		124	144	37.5
19		114	133	34
20		105	123	30.5
21		98	114	27.5
22		91.5	105	24.5
23		84.5	97	21.5
24		78.5	90	18.5
25		72.5	83	16
26		67.5	77	13.5
27		62.5	71	11
28		58.5	65	9
29		54.5	60	7
30		50.5	55	5
31		46.5	50	3
32		43	45	1.5
33		39.5	40	0
34		36	36	
35		33	31	
36		30	27	
37		27	23	
38		24	19	
39		21	15.5	
40		18	12	
41		15.5	9	
42		12.5	6	
43		10	3	
44		7.5	0	
45		5		
46		3		
47		1.19		
48		0		

Table: 3 – Effective Rainfall Bells (mm)

Hours	Dehra	Madia	Chakarpur	Dhasan
1.	5.94	4.60	4.44	4.74
2.	5.97	4.61	4.45	4.75
3.	7.61	4.62	4.47	6.16
4.	7.61	5.99	5.80	6.16
5.	10.09	5.99	5.80	6.16
6.	10.09	8.06	7.83	8.28
7.	10.09	8.06	7.83	8.28
8.	26.60	21.88	21.34	22.38
9.	26.60	21.88	21.34	22.38
10.	26.60	21.88	21.34	22.38
11.	7.61	8.06	7.83	8.28
12.	5.96	5.99	5.80	4.77
13.	18.89	15.43	15.03	15.80
14.	18.98	15.46	15.06	15.83
15.	23.18	15.50	15.10	19.46
16.	23.18	19.02	18.54	19.46
17.	29.55	19.02	18.54	19.46
18.	29.55	24.35	23.75	24.90
19.	29.55	24.35	23.75	24.90
20.	72.02	59.88	58.49	61.17
21.	72.02	59.89	58.49	61.17
22.	72.01	59.88	58.48	61.16
23.	23.18	24.35	23.75	24.90
24.	18.93	19.02	18.54	15.87
25.		1.89	1.69	2.12
26.		1.90	1.70	2.13
27.		1.91	1.71	3.02
28.		2.74	2.50	3.02
29.		2.74	2.50	3.02
30.		4.00	3.70	4.35
31.		4.00	3.70	4.35
32.		12.40	11.70	13.22
33.		12.40	11.70	13.22
34.		12.40	11.70	13.22
35.		4.00	3.70	4.35
36.		2.74	2.50	2.14
37.		0.00	0.00	0.00
38.		0.00	0.00	0.00
39.		0.00	0.00	0.00
40.		0.00	0.00	0.00
41.		0.00	0.00	0.00
42.		0.15	0.03	0.29
43.		0.15	0.03	0.29
44.		3.42	3.14	3.73
45.		3.42	3.14	3.73
46.		3.42	3.14	3.73
47.		0.15	0.03	0.29
48.		0.00	0.00	0.00

Table-4(i): Probable Maximum Flood (PMF) Hydrograph of Dehra Project (in cumec)

Hours	Ordinates
0	2
1	3
2	8
3	22
4	50
5	75
6	98
7	117
8	142
9	171
10	218
11	294
12	339
13	334
14	280
15	254
16	282
17	316
18	353
19	389
20	441
21	507
22	624
23	818
24	**932**
25	907
26	723
27	535
28	361
29	238
30	158
31	103
32	64
33	35
34	17
35	7
36	3
37	2
38	2
39	2
40	2
41	2

Table-4(ii): Probable Maximum Flood (PMF) Hydrograph of Madia Project (in cumec)

Hour	Ordinate	Hour	Ordinates	Hours	Ordinates
1	20	44	4068	87	33
2	22	45	3914	88	31
3	26	46	3737	89	28
4	33	47	3517	90	25
5	44	48	3281	91	23
6	60	49	3032	92	22
7	84	50	2791	93	20
8	116	51	2566	94	20
9	166	52	2362	95	20
10	233	53	2177	96	20
11	322	54	2011	97	20
12	436	55	1859	98	20
13	579	56	1727	99	20
14	741	57	1599	100	20
15	922	58	1469		
16	1123	59	1330		
17	1337	60	1190		
18	1569	61	1052		
19	1819	62	920		
20	2108	63	799		
21	2399	64	688		
22	2676	65	588		
23	2918	66	498		
24	3170	67	418		
25	3463	68	351		
26	3782	69	297		
27	4134	70	257		
28	4528	71	227		
29	4935	72	202		
30	5346	73	180		
31	5752	74	160		
32	6186	75	140		
33	6502	76	122		
34	**6647**	77	105		
35	6546	78	89		
36	6290	79	76		
37	5907	80	64		
38	5507	81	56		
39	5139	82	50		
40	4833	83	46		
41	4585	84	42		
42	4384	85	39		
43	4212	86	36		

Table-4(iii): Probable Maximum Flood (PMF) Hydrograph of ChakarpurProject (in cumec)

Hour	Ordinate	Hour	Ordinates	Hours	Ordinates
1	25	44	4631	87	31
2	27	45	4397	88	28
3	33	46	4119	89	28
4	45	47	3813	90	28
5	63	48	3494	91	28
6	90	49	3188	92	26
7	129	50	2904	93	25
8	181	51	2647	94	25
9	255	52	2412	95	25
10	359	53	2206	96	25
11	501	54	2022	97	25
12	684	55	1857	98	25
13	891	56	1691	99	25
14	1121	57	1523	100	25
15	1366	58	1357		
16	1628	59	1192		
17	1912	60	1032		
18	2225	61	886		
19	2579	62	755		
20	2922	63	640		
21	3242	64	536		
22	3525	65	469		
23	3834	66	413		
24	4206	67	371		
25	4634	68	316		
26	5110	69	272		
27	5611	70	229		
28	6121	71	197		
29	6634	72	170		
30	7150	73	148		
31	7677	74	128		
32	8071	75	110		
33	**8241**	76	93		
34	8101	77	83		
35	7747	78	76		
36	7245	79	70		
37	6730	80	62		
38	6260	81	54		
39	5865	82	48		
40	5539	83	44		
41	5267	84	40		
42	5036	85	37		
43	4836	86	34		

Table-4(iv): Probable Maximum Flood (PMF) Hydrograph of Dhasan Project (in cumec)

Hour	Ordinate	Hour	Ordinates
1	9	44	1163
2	12	45	1017
3	18	46	882
4	28	47	764
5	43	48	662
6	64	49	575
7	92	50	501
8	131	51	439
9	196	52	391
10	274	53	348
11	369	54	312
12	464	55	273
13	560	56	238
14	665	57	205
15	782	58	177
16	929	59	153
17	1067	60	131
18	1182	61	113
19	1249	62	96
20	1307	63	81
21	1413	64	67
22	1558	65	55
23	1755	66	46
24	1962	67	40
25	2178	68	35
26	2395	69	31
27	2620	70	28
28	2883	71	25
29	3086	72	22
30	**3182**	73	20
31	3096	74	17
32	2897	75	15
33	2633	76	13
34	2382	77	11
35	2171	78	10
36	2001	79	9
37	1865	80	9
38	1754	81	9
39	1660	82	9
40	1589	83	9
41	1514	84	9
42	1425	85	9
43	1303	86	

Table:5(i) Revised Elevation - Area - Capacity curve of Dehra Reservoir

Elevation	Original Area (Ha)	Original Capacity (MCM)	After 50 years		After 100 years	
			Revised Area (Ha)	Revised Capacity (MCM)	Revised Area (Ha)	Revised Capacity (MCM)
1	2	3	4	5	6	7
491.6	747.4	72.4	747.40	70.86	747.40	69.31
491	714.9	67.9	708.63	66.38	702.31	64.85
490	662.3	61	653.93	59.55	645.51	58.09
489	603.1	54.7	593.78	53.34	584.40	51.97
488	547.2	48.9	537.43	47.63	527.59	46.36
487	498.1	43.7	488.17	42.53	478.18	41.36
486	457.4	38.9	447.52	37.83	437.58	36.76
485	418.4	34.6	408.71	33.63	398.96	32.66
484	382	30.6	372.61	29.73	363.16	28.85
483	346.4	26.9	337.39	26.12	328.33	25.33
482	329.8	23.5	321.24	22.80	312.62	22.11
481	303.4	20.4	295.33	19.79	287.21	19.18
480	278.1	17.5	270.56	16.97	262.97	16.43
479	256.4	14.8	249.41	14.34	242.38	13.88
478	234.9	12.3	228.48	11.91	222.01	11.51
477	209.1	10.1	203.25	9.77	197.37	9.44
476	187.9	8.1	182.63	7.82	177.32	7.55
475	169.8	6.3	165.10	6.07	160.37	5.85
474	149.1	4.7	144.96	4.52	140.80	4.34
473	128.4	3.4	124.81	3.26	121.19	3.11
472	97.6	2.2	94.53	2.09	91.44	1.98
471	74	1.4	71.43	1.32	68.84	1.24
470	49.8	0.8	47.70	0.74	45.58	0.68
469	27.7	0.4	26.03	0.36	24.35	0.32
468	14.1	0.2	12.82	0.17	11.54	0.15
467	5.8	0.1	4.88	0.09	3.95	0.07
466	2.4	0.0123	1.78	0.01	1.15	0.00
465	0.1	0.0023	0.00	0.00	0.00	0.00
464	0.1	0.0013	0.00	0.00	0.00	0.00

Table 5(ii): Revised Elevation - Area - Capacity Curve of Madia

Elevation	Original Area (Ha)	Original Capacity (MCM)	After 50 years		After
			Revised Area (Ha)	Revised Capacity (MCM)	Revised Area (Ha)
1	2	3	4	5	6
501.1	7120	313.11	7120.00	286.45	7120.00
501	6998.6	305.51	6898.97	278.90	6795.08
500	5747.5	241.78	5532.67	216.74	5308.66
499	4627.6	189.9	4382.27	167.16	4126.46
498	3750	148.01	3496.06	127.77	3231.28
497	3026	114.13	2774.97	96.41	2513.22
496	2511	86.45	2270.01	71.19	2018.73
495	2028	63.75	1801.76	50.83	1565.87
494	1539.7	45.91	1331.37	35.16	1114.14
493	1201.9	32.2	1013.52	23.43	817.09
492	886.2	21.76	718.96	14.77	544.58
491	624.7	14.21	479.13	8.79	327.35
490	438.5	8.89	314.57	4.81	185.35
489	280.4	5.3	177.59	2.36	70.40
488	184.4	2.98	101.77	0.96	15.61
487	103.9	1.53	40.10	0.25	0.00
486	52.1	0.75	5.43	0.02	0.00
485	30.3	0.34	0.00	0.00	0.00
484	15.2	0.11	0.00	0.00	0.00
483	3.4	0.02	0.00	0.00	0.00
482	0.4	0	0.00	0.00	0.00
481	0	0	0.00	0.00	0.00

Table 5(iii): Revised Elevation - Area - Capacity Curve of Chakarpur Reservoir

Elevation	Original Area (Ha)	Original Capacity (MCM)	After 50 years		After 100 years	
			Revised Area (Ha)	Revised Capacity (MCM)	Revised Area (Ha)	Revised Capacity (MCM)
1	2	3	4	5	6	7
451.5	1349.58	74.31	1349.58	68.57	1349.58	62.86
451	1280.1	67.57	1248.36	61.91	1216.03	56.28
450	1141.54	55.46	1098.29	50.18	1054.24	44.92
449	1004.38	44.73	956.88	39.90	908.51	35.11
448	823.19	35.59	774.43	31.24	724.77	26.94
447	694.04	28	645.74	24.14	596.55	20.33
446	572.21	21.67	525.50	18.28	477.94	14.96
445	474.5	16.44	430.16	13.51	385.00	10.65
444	377.39	12.18	335.96	9.68	293.77	7.25
443	284.87	8.87	246.72	6.76	207.88	4.75
442	214.37	6.37	179.75	4.63	144.50	2.98
441	154.53	4.53	123.58	3.11	92.06	1.80
440	114.31	3.18	87.09	2.06	59.36	1.04
439	87.07	2.18	63.55	1.31	39.60	0.55
438	60.51	1.44	40.61	0.79	20.35	0.25
437	47.54	0.9	31.12	0.43	14.40	0.08
436	27.14	0.53	14.00	0.21	0.63	0.01
435	18.31	0.3	8.21	0.09	0.00	0.00
434	11.55	0.15	4.19	0.03	0.00	0.00
433	5.88	0.06	0.91	0.00	0.00	0.00
432	1.84	0.02	0.00	0.00	0.00	0.00
431	0.89	0.01	0.00	0.00	0.00	0.00
430	0.43	0	0.00	0.00	0.00	0.00
429	0	0	0.00	0.00	0.00	0.00

No. J-12011/31/2014-IA-I
Government of India
Ministry of Environment, Forest & Climate Change
(IA-I Division)

Indira Paryavaran Bhawan
3rd Floor, Vayu Wing
Jor Bagh Road
New Delhi-110 003

Dated: 22nd February, 2017

To

The Engineer -in- Chief
Office of the Engineer -in- Chief
Water Resources Department
Government of Madhya Pradesh
Bhopal - 462 003
Madhya Pradesh.

Subject: Bina Complex Multipurpose Project (32 MW) District Sagar in Madhya Pradesh M/s Water Resources Department, Govt. of Madhya Pradesh - for Environmental Clearance (EC)- regarding.

Sir,

This is with reference to your letter no 3211871/8/P-III/W/Bina pro./2016 dated 26.11.2016 on the above mentioned subject.

2. The above referred proposal was appraised by the Expert Appraisal Committee (EAC) for River Valley and Hydro Electric Power Projects (RV&HEP) in its meeting held on 30th December, 2016. The comments and observations of EAC of this project may be seen in the Minutes of the Meeting which are available on the web-site of this Ministry.

3. The project envisages construction of 4 dams on Bina & Dhassan Rivers (both are tributaries to Betwa river) to provide irrigation facility in 84,200 ha of land in Sagar District of Madhya Pradesh. Water flow from Bina River will be stored in an earthen dam (known as Madia dam) near Madia in Rahatgarh Tehsil of Sagar District of Madhya Pradesh. An underground powerhouse is also proposed on the left bank of the river downstream of the Madia dam for generation of 22 MW (2x11 MW) of hydropower & Dehra dam for generation of 10 MW (2x5 MW) of hydropower. The gross command (GCA) area is 1,02,500 ha and irrigable command area is 90,747 ha. The total land requirement for this project is 12,671.18 ha. Out of which, 1,024.44 ha is forest land; 10,652.59 ha is private land and other type/waste land is 994.15 ha. Total submergence area is 10,391.88 ha. About 69 villages consisting of about 2957 families are likely to be affected due to this project. The total cost of the project is about Rs. 3249.627 Crores and it is proposed to be completed in 36 months.

Bina Complex

भारत सरकार
केन्द्रीय जल आयोग
जलविज्ञान (मध्य) निदेशालय

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2. The location of structure on Dhasan has been shifted upstream of the previously proposed location. The catchment areas (delineated using SRTM 52_08 data with Arc GIS software) of earlier proposed Dhasan dam at Bhainsa and the present proposed weir at Semraghat are tabulated below:

S.No.	Project site	Catchment area (sqkm)
1.	Bhainsa (previously proposed)	424
2.	Semraghat (now proposed)	324

3. Discharge data of Basoda G&D site (1978-79 to 2009-10), due to its proximity to the project site, has been used in water availability computations as done earlier. The observed runoff at Basoda G&D site were earlier naturalized taking into account the upstream utilization in the catchment, and the same has been used in the present study. Weighted mean rainfall at Basoda G&D site has been computed using rainfall data at 6 raingauge stations, viz. Bhopal, Vidisha, Raisen, Goharganj, Basoda and Berasia, by Thiessen polygon method. Three Raingauge stations, viz. Begumganj, Rahatgarh and Jaisinagar fall within or near the project catchment; and the rainfall data of the same has been used to calculate mean rainfall at project site using Thiessen polygon method. The average annual rainfall in the catchment of Basoda G&D site and proposed Semraghat weir have been calculated as 1134.30 mm and 1211.66 mm respectively.
4. The yield at proposed project's location has been calculated using the catchment area and average areal rainfall ratio of Basoda G&D site and the project catchment. The following equation describes the method:

$$Q_{June_Semraghat} = Q_{June_Basoda} \frac{(A_{Semraghat})}{(A_{Basoda})} * \frac{(R_{Semraghat})}{(R_{Basoda})}$$

Using this method, the total yield series at Semraghat site for the period 1978-79 to 2009-10 month-wise has been derived and enclosed as Annexure-I, which may be used for planning and design purposes.

5. In the DPR, there is no mention of any utilization from projects located upstream of proposed Semraghat weir, this yield series may be treated as virgin flow series and the project authorities are advised to duly take into account the present and proposed upstream utilisations to derive 'net' yield series at the project site.
6. Further, it is suggested that necessary hydro meteorological network may be established in the project area for collection of site specific discharge and rainfall data which may be used to update the hydrological studies after collecting sufficient data.

Design Flood Study

1. According to the earlier submitted DPR, all four dam sites, viz. Dhasan, Madia, Chakarpur and Dehra qualified for Probable Maximum Flood (PMF) as Inflow Design Flood. There will be no change in the Inflow Design Flood in respect of dams at Chakarpur and Dehra, as there is no change in their location or capacity according to the modified DPR. Though the capacity of Madia dam has been reduced from 310.44 MCM to 276.83 MCM, yet with the reduced capacity, the dam still qualifies for Probable Maximum Flood (PMF) as the Inflow Design Flood for the safety of the structure as per IS:11223 (1985). Hence, the Design Flood value and Flood Hydrograph as approved vide this office letter cited above may be adopted without any change for planning and design purpose. Therefore, the Design Flood values and Flood Hydrograph as approved vide this office letter cited above may be adopted without any change for planning and design purpose in respect of these 3 structures.
2. As per modified DPR, the Dhasan Diversion Dam site has been shifted some distance upstream of the previous location on the river Dhasan at Semraghat where a Barrage has now been proposed to be constructed in place of a dam. As per IS:6966 (Part 1)-1989, a return period flood of 100-year frequency may be adopted as the Inflow Design Flood for the barrage at Semraghat, along with Standard Project Flood (SPF) as check flood for deciding the free board. The analysis for the same is provided below.
3. Hydro-meteorological approach has been used in the current study for assessing the Inflow Design Flood for the barrage at Semraghat. In the absence of concurrent and short interval rainfall runoff data, unit hydrograph has been derived synthetically using the 'Flood Estimation Report (FER) for Betwa Sub-Zone 1(c)'. The catchment area for the proposed project site has been delineated using SRTM 52_08 data with Arc GIS software and is obtained as 324 Sq.Km.
4. 24-hour 100-year return period point rainfall has been taken as 350 mm, from the Isopluvial Maps published by IMD for computing the Design Flood for the barrage at Semraghat. For converting point rainfall into areal rainfall, a multiplication factor known as Area Reduction Factor (ARF) is applied to the point rainfall. ARF is obtained from the FER 1(c) as 0.90. Thus, the 24-hour 100-year return period areal rainfall is obtained as 350*0.90= 315 mm.
5. IMD carried out the Design Storm Studies for all the four projects as propsed in the earlier DPR, considering two storms viz. 7th July, 1952 (Centre at Biaora) and 28-29 July, 1965 (Centre at Raisen). However, the storm occurred on 3-4 July, 2005 with centre at Sagar has been found to be more critical as it yielded higher 1 Day rainfall depth compared to 28-29 July, 1965 storm. Accordingly, the SPS depth has been computed by transposing the Sagar storm to the centroid of the Semraghat catchment.
6. A loss rate of 0.23 cm/hr (modal loss rate), as recommended in the FER for sub-zone 1(c), has been adopted for calculating the effective rainfall i.e. excess rainfall in the

basin, for computing 100-year return period flood (Design Flood). A lower loss rate of 0.10 cm/hr has been considered for computing SPF (Check Flood). The base flow has been taken from FER for sub-zone 1(c) as 0.018 $m^3/s/Sq.Km$.

7. The cumulative rainfall (100-Year and SPS) depths have been converted into hourly rainfall increments using temporal distribution factors recommended in IMD report and such rainfall increments have been arranged in the form of two bells of 12 hrs each per day. Critical sequencing of rainfall bells has been carried out as per norms.
8. The ordinates of Flood Hydrograph are obtained after convoluting the critically sequenced rainfall bells with the ordinates of the Unit Hydrograph. The peak value of flood hydrograph thus obtained are as under:-

S.No.	Flood Type	Peak Value (m^3/s)
1	100-Year Return Period (Design Flood)	1454
2	Standard Project Flood (Check Flood)	2310

9. In view of the above, it is recommended to use the flood hydrograph computed by hydro-meteorological approach and enclosed at Annexure-VI for planning and design purpose for the barrage at Semraghat. It is suggested to establish necessary hydro-meteorological network for collection of short term concurrent observed discharge and rainfall data for flood events so as to revise the design flood calculations after collecting sufficient data. Details of the flood study are enclosed at Annexure II to IX.

Sedimentation Studies

1. The sedimentation study carried out earlier for Dehra & Chakarpur dam will remain unchanged. Though, there is a change in the capacity of the proposed structure at Semraghat, there is a change in type of structure too, from dam to weir; which suggests, there is no need to perform sedimentation studies at this site.
2. With reference to the ambiguities / discrepancies in the submitted proposal regarding the updated proposed capacity and FRL of the Madia dam, Project authorities, vide letter cited under reference (iii), informed this office that the FRL and capacity of the Madia dam have been fixed as 500.55 m & 276.83 MCM respectively.
3. Based on the earlier observations issued by this office, a sediment load rate of 5 ha-m/ 100 sqkm/ year has been adopted. The Trap efficiency has been taken as 96% based on Brune's curve. As per IS:5477 (Part 2):1994, the project reservoir has been classified as Type-I and further New Zero elevation and revised Elevation- Area - Capacity curves after 100 and 50 years of life have been computed by Empirical Area Reduction method. The New Zero Elevation, thus obtained, after 100 years of life is 488.12m. The revised Elevation-Area-Capacity relationships of the reservoir, after 50

and 100 years of operation, are enclosed as Annexure-X. The same may be adopted for planning and design purpose. It is suggested to establish necessary sediment observation sites at the proposed projects to revise the sediment studies after collection of sufficient length of data.

This issues with the approval of Chief Engineer, HSO.

4/9/17

Director

(S. K. Sinha)

Director, Project Appraisal (Central), CWC, New Delhi

CWC U.O No. 1/37/2011-Hyd(C)/ 428 Date: 04.09.2017

Annexure-I

Gross Yield Series at Semraghat weir

S .NO	Year	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	Monsoon (MCM)	Non Monsoon (MCM)	ANNUAL Runoff (MCM)
1	1978-79	7.22	64.46	125.18	23.09	4.18	1.22	2.24	1.72	1.48	0.83	0.56	0.42	224.12	8.46	232.58
2	1979-80	3.15	7.04	20.51	1.71	0.43	4.21	3.85	0.58	0.40	0.33	0.12	0.07	32.85	9.56	42.41
3	1980-81	8.44	10.70	42.80	20.08	3.88	1.01	0.86	1.23	0.74	0.74	0.67	0.82	85.89	6.07	91.96
4	1981-82	3.59	10.23	36.23	4.88	2.17	1.14	1.14	1.71	1.87	0.95	0.68	0.27	57.11	7.75	64.85
5	1982-83	2.05	10.56	63.59	23.63	12.70	5.57	5.68	2.32	0.89	0.71	0.44	0.24	112.53	15.85	128.38
6	1983-84	1.42	16.04	54.67	80.54	24.47	9.63	2.42	3.20	1.62	1.09	0.61	0.39	177.13	18.96	196.09
7	1984-85	1.55	4.47	109.81	14.34	3.92	0.95	1.14	1.06	0.65	0.60	0.28	0.21	134.08	4.89	138.98
8	1985-86	1.47	14.74	91.93	62.32	51.73	8.73	2.03	1.79	1.96	1.70	0.60	0.28	222.19	17.08	239.27
9	1986-87	5.92	174.20	68.27	12.28	3.85	0.98	1.23	1.32	0.99	0.74	0.45	0.21	264.51	5.93	270.44
10	1987-88	1.50	8.65	69.99	21.20	4.49	1.57	1.02	0.83	0.98	0.64	0.28	0.21	105.83	5.52	111.35
11	1988-89	2.93	26.43	43.90	6.90	3.25	1.06	1.16	1.06	0.76	0.45	0.34	0.21	83.41	5.04	88.44
12	1989-90	1.86	10.18	61.36	15.47	2.29	0.58	0.85	0.62	0.31	0.22	0.21	0.21	91.17	3.00	94.16
13	1990-91	14.30	35.20	55.08	78.75	9.73	1.96	0.90	0.64	0.63	0.59	0.43	0.23	193.06	5.40	198.46
14	1991-92	3.77	13.24	96.70	10.93	1.81	0.73	0.88	1.27	0.76	0.50	0.29	0.24	126.45	4.67	131.12
15	1992-93	1.36	13.36	51.27	16.41	1.65	0.42	0.55	0.29	0.21	0.21	0.21	0.21	84.04	2.12	86.16
16	1993-94	2.30	14.49	34.68	71.69	14.41	1.68	1.23	1.11	0.78	0.70	0.69	0.37	137.57	6.58	144.14
17	1994-95	13.00	54.91	108.67	39.35	4.19	0.94	1.15	1.08	1.31	1.65	0.71	0.33	220.12	7.17	227.29
18	1995-96	1.36	14.56	25.28	26.08	2.39	0.90	1.10	1.08	0.53	0.47	0.26	0.22	69.67	4.55	74.23
19	1996-97	1.37	41.42	85.95	42.41	8.64	3.44	1.42	1.15	1.17	0.54	0.35	0.30	179.78	8.36	188.13
20	1997-98	1.42	44.60	52.36	30.38	5.70	5.41	19.51	2.09	1.27	1.24	0.75	0.35	134.47	30.61	165.08
21	1998-99	4.41	39.30	45.23	43.30	24.60	6.82	1.27	1.10	14.72	5.02	0.42	0.24	156.84	29.58	186.42
22	1999-00	2.30	40.97	56.74	126.03	50.48	5.43	1.21	1.13	1.37	0.92	0.57	0.27	276.52	10.91	287.43
23	2000-01	2.21	77.75	23.08	5.40	1.49	0.63	1.32	0.66	0.22	0.22	0.22	0.22	109.92	3.48	113.40
24	2001-02	4.79	28.08	49.65	6.86	3.01	0.60	0.74	1.36	0.34	0.38	0.40	0.22	92.39	4.05	96.44
25	2002-03	2.27	4.47	49.76	27.80	1.35	0.37	0.64	0.22	0.22	0.22	0.22	0.22	85.65	2.11	87.76
26	2003-04	5.33	25.81	31.77	42.65	8.10	0.95	1.05	1.03	1.40	0.95	0.28	0.24	113.67	5.90	119.57
27	2004-05	2.53	18.53	92.84	8.18	3.01	0.88	1.26	1.84	1.07	0.50	0.26	0.22	125.08	6.02	131.11
28	2005-06	1.99	92.43	50.38	15.44	2.42	0.74	1.27	1.39	1.03	0.62	0.31	0.32	162.66	5.68	168.34
29	2006-07	1.53	20.62	143.99	121.72	5.97	0.62	1.40	1.53	1.00	0.76	0.27	0.22	293.84	5.80	299.64
30	2007-08	1.73	16.52	14.44	12.91	1.34	0.22	0.22	0.22	0.22	0.22	0.22	0.22	46.95	1.57	48.52
31	2008-09	5.36	13.41	45.70	12.54	1.52	0.23	0.23	0.23	0.23	0.23	0.23	0.23	78.53	1.60	80.13
32	2009-10	1.52	25.24	15.86	30.33	9.53	8.45	2.74	0.71	0.66	0.36	0.26	0.23	82.48	13.41	95.89
	Average	**3.62**	**31.02**	**59.93**	**32.99**	**8.71**	**2.44**	**1.99**	**1.17**	**1.31**	**0.79**	**0.39**	**0.27**	**136.27**	**8.37**	**144.63**

Annexure-II

Semraghat Barrage Site

Equivalent stream slope (Semraghat)						
S.No.	Reduced Distance (Km)	Reduced Level (m)	Length of each segment Li (km)	Height above Datum Di (m)	Di-I + Di	Li*(Di-1 + Di)
1	0.0	497	0	0	0	0
2	5.5	502	5.5	5	5	27.50
3	10.5	506	5	9	14	70.00
4	15.5	511	5	14	23	115.00
5	20.5	521	5	24	38	190.00
6	25.5	526	5	29	53	265.00
7	30.5	549	5	52	81	405.00
8	35.5	575	5	78	130	650.00
9	38.0	585	2.5	88	166	415.00
10	39.5	599	1.5	102	190	285.00
11	40.5	668	1	171	273	273.00
			40.5		∑Li*(Di-1 + Di)	2695.50

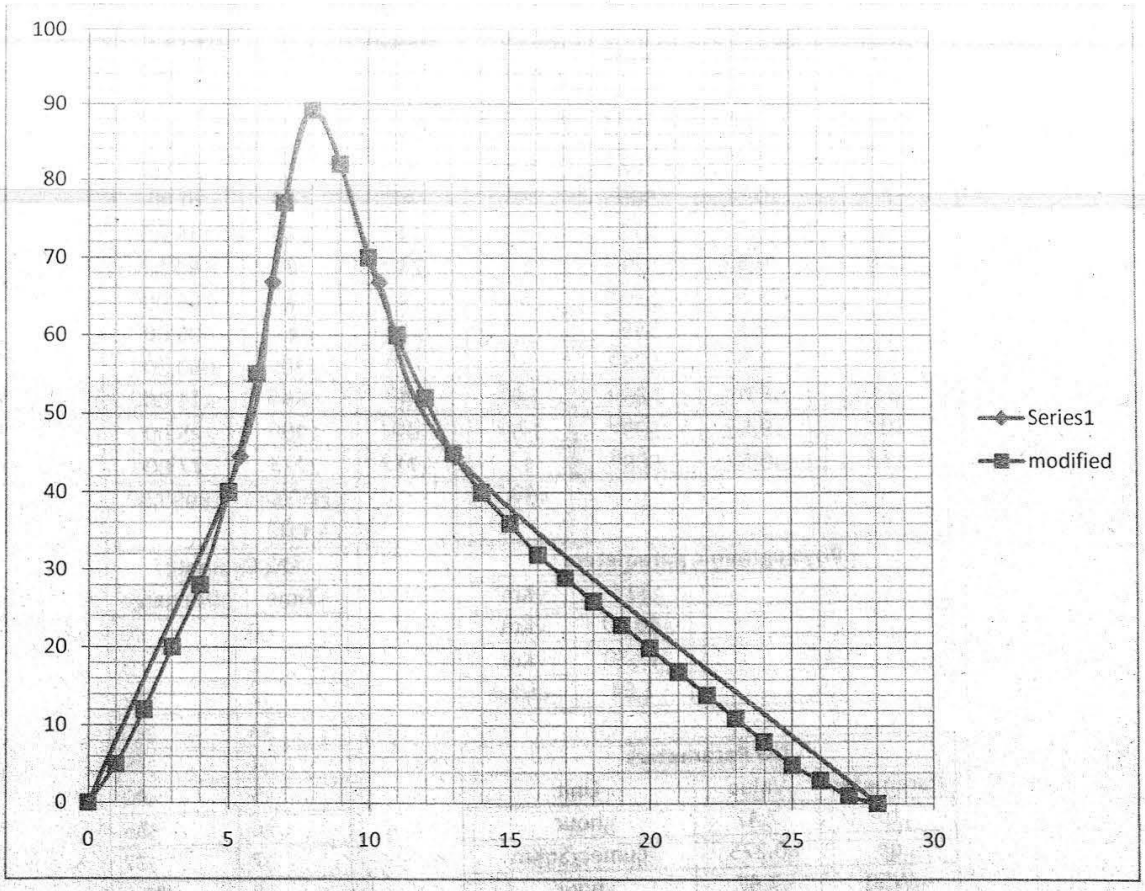
Physiographic parameters		
A	314	Km^2
L	40.50	Km
Lc	17.20	Km
S	1.64	m/Km

UG Parameters		
Parameter	Value	Unit
tp	7.42	hour
qp	0.275	cumec/SqKm
W50	7.67	hour
W75	3.81	hour
WR50	2.58	hour
WR75	1.43	hour
TB	28.5	hour
Tm	8	hour
Qp	89.12	m3/sec

UG Ordinates	
Time	Discharge
0	0
1	5
2	12
3	20
4	28
5	40
6	55
7	77
8	**89.1**
9	82
10	70
11	60
12	52
13	45
14	40
15	36
16	32
17	29
18	26
19	23
20	20
21	17
22	14
23	11
24	8
25	5
26	3
27	1
28	0

Annexure-III

UG For Semraghat Barrage Site



Annexure-IV

Computation of Rainfall Excess (100-year Return Period) Semraghat

24 Hr 100-year Point Rainfall	35	cm
24 Hr Areal Rainfall	31.50	cm

1st Day	Total 1st day rainfall	31.50	cm
	First bell (12 hour)	22.68	cm
	Second bell (12 hour)	8.82	cm

			First Day						
Time in hr	Time distribution coeff	% storm distribution	I st Bell				2nd Bell		
			Cum. Rain fall (cm)	Incremental Rainfall (cm)	Loss Rate (cm)	Rainfall Excess (cm)	Cum. Rain fall (cm)	Incremental Rainfall (cm)	Rainfall Excess (cm)
1	16	22	5.04	5.04	0.23	**4.81**	1.96	1.96	**1.73**
2	27	38	8.51	3.47	0.23	**3.24**	3.31	1.35	**1.12**
3	35	49	11.02	2.51	0.23	**2.28**	4.29	0.98	**0.75**
4	40	56	12.60	1.58	0.23	**1.35**	4.90	0.61	**0.38**
5	45	63	14.18	1.58	0.23	**1.35**	5.51	0.61	**0.38**
6	50	69	15.75	1.57	0.23	**1.34**	6.12	0.61	**0.38**
7	54	75	17.01	1.26	0.23	**1.03**	6.62	0.50	**0.27**
8	58	81	18.27	1.26	0.23	**1.03**	7.11	0.49	**0.26**
9	62	86	19.53	1.26	0.23	**1.03**	7.59	0.48	**0.25**
10	65	91	20.58	1.05	0.23	**0.82**	8.00	0.41	**0.18**
11	69	95	21.63	1.05	0.23	**0.82**	8.41	0.41	**0.18**
12	72	100	22.68	1.05	0.23	**0.82**	8.82	0.41	**0.18**

Annexure-V

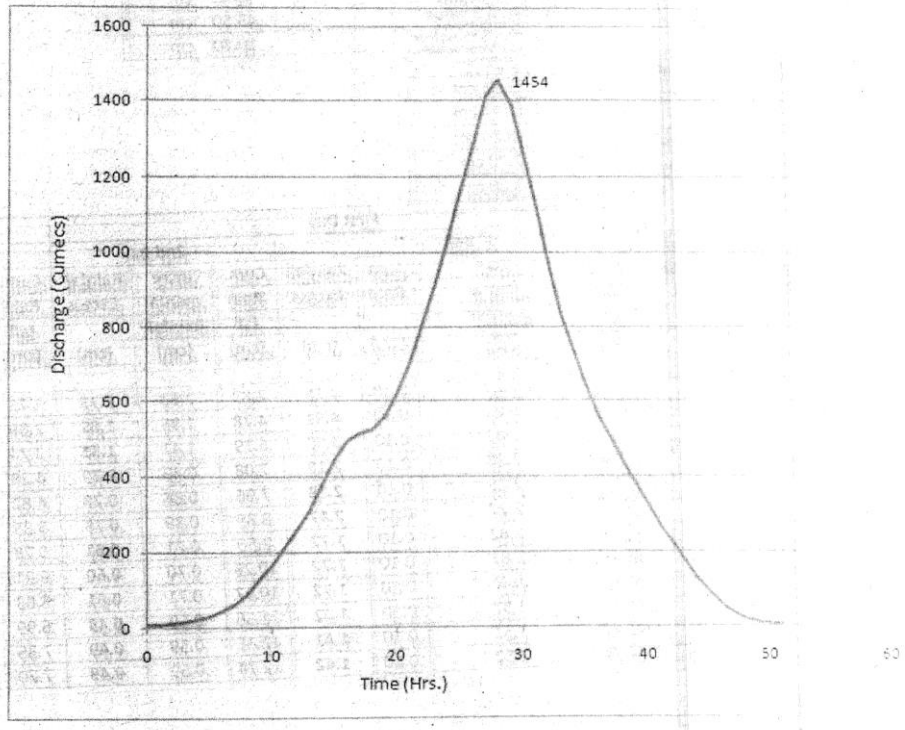
Critical Sequencing of Rainfall Excess Semraghat Unit : cm

Time (hrs)	UG ORD (cumecs)	Critical Sequencing 1st Bell	IInd Bell	IIIrd Bell	IVth Bell	Reverse Order 1st Bell	IInd Bell	IIIrd Bell	IVth Bell
0	0.0					0.18	0.82		
1	5.0					0.18	0.82		
2	12.0					0.26	1.03		
3	20.0					0.26	1.03		
4	28.0					0.26	1.03		
5	40.0	0.82	0.18			0.38	1.35		
6	55.0	1.35	0.38			0.38	1.35		
7	77.0	2.29	0.75			1.12	3.24		
8	**89.1**	**4.81**	**1.73**			1.73	4.81		
9	82.0	3.24	1.12			0.75	2.29		
10	70.0	1.35	0.38			0.38	1.35		
11	60.0	1.35	0.38			0.18	0.82		
12	52.0	1.03	0.26						
13	45.0	1.03	0.26						
14	40.0	1.03	0.26						
15	36.0	0.82	0.18						
16	32.0	0.82	0.18						
17	29.0								
18	26.0								
19	23.0								
20	20.0								
21	17.0								
22	14.0								
23	11.0								
24	8.0								
25	5.0								
26	3.0								
27	1.0								
28	0.0								

Annexure-VI

Design Flood Hydrograph (100-Year RP) for Semraghat

Time (hr)	Discharge (cumec)	Time (hr)	Discharge (cumec)
0	6	26	1288
1	7	27	1413
2	9	28	**1454**
3	13	29	1388
4	19	30	1261
5	28	31	1113
6	40	32	965
7	59	33	836
8	85	34	731
9	121	35	641
10	163	36	564
11	207	37	497
12	253	38	435
13	307	39	376
14	373	40	319
15	444	41	266
16	492	42	215
17	511	43	168
18	525	44	124
19	556	45	86
20	614	46	55
21	700	47	31
22	804	48	16
23	912	49	10
24	1027	50	7
25	1152	51	6



Annexure-VII

Computation of Rainfall Excess (SPS) Semraghat

2- day SPS value	56.2 cm
Ist day SPS value	45.50 cm
IInd day SPS value	10.70 cm

1st Day	Total 1st day rainfall	45.50 cm
	First bell (12 hour)	32.76 cm
	Second bell (12 hour)	12.74 cm
2nd Day	Total 2nd day rainfall	10.70 cm
	First bell (12 hour)	7.70 cm
	Second bell (12 hour)	3.00 cm

			First Day							Second Day					
Time	Time	% storm	I st Bell				2nd Bell			1st Bell			2nd Bell		
in hr	distri	distribu	Cum.	Incre	Loss	Rainfall	Cum.	Incre	Rainfall	Cum.	Incre	Rainfall	Cum.	Incre	Rainfall
	bution	tion	Rain	mental	Rate	Excess	Rain	mental	Excess	Rain	mental	Excess	Rain	mental	Excess
	coeff		fall	Rainfall			fall	Rainfall		fall	Rainfall		fall	Rainfall	
			(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
1	16	22	7.28	7.28	0.10	**7.18**	2.83	2.83	**2.73**	1.71	1.71	**1.61**	0.67	0.67	**0.57**
2	27	38	12.29	5.01	0.10	**4.91**	4.78	1.95	**1.85**	2.89	1.18	**1.08**	1.12	0.46	**0.36**
3	35	49	15.92	3.63	0.10	**3.53**	6.19	1.41	**1.31**	3.74	0.86	**0.76**	1.46	0.33	**0.23**
4	40	56	18.20	2.28	0.10	**2.18**	7.08	0.89	**0.79**	4.28	0.54	**0.44**	1.66	0.21	**0.11**
5	45	63	20.48	2.28	0.10	**2.18**	7.96	0.88	**0.78**	4.82	0.53	**0.43**	1.87	0.21	**0.11**
6	50	69	22.75	2.27	0.10	**2.17**	8.85	0.89	**0.79**	5.35	0.53	**0.43**	2.08	0.21	**0.11**
7	54	75	24.57	1.82	0.10	**1.72**	9.56	0.71	**0.61**	5.78	0.43	**0.33**	2.25	0.17	**0.07**
8	58	81	26.39	1.82	0.10	**1.72**	10.26	0.70	**0.60**	6.21	0.43	**0.33**	2.41	0.17	**0.07**
9	62	86	28.21	1.82	0.10	**1.72**	10.97	0.71	**0.61**	6.63	0.43	**0.33**	2.58	0.17	**0.07**
10	65	91	29.73	1.52	0.10	**1.42**	11.56	0.59	**0.49**	6.99	0.36	**0.26**	2.72	0.14	**0.04**
11	69	95	31.24	1.51	0.10	**1.41**	12.15	0.59	**0.49**	7.35	0.36	**0.26**	2.86	0.14	**0.04**
12	72	100	32.76	1.52	0.10	**1.42**	12.74	0.59	**0.49**	7.70	0.36	**0.26**	3.00	0.14	**0.04**

Annexure-VIII

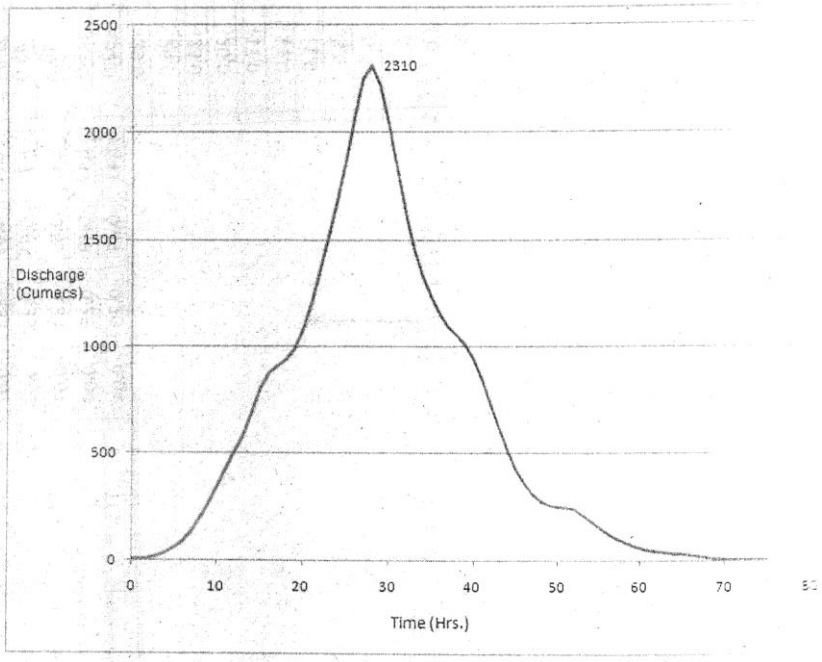
Critical Sequencing of Rainfall Excess Semraghat Unit : cm

Time (hrs)	UG ORD (cumecs)	Critical Sequencing 1st Bell	IInd Bell	IIIrd Bell	IVth Bell	Reverse Order 1st Bell	IInd Bell	IIIrd Bell	IVth Bell
0	0.0					1.41	0.49	0.26	0.04
1	5.0					1.42	0.49	0.26	0.04
2	12.0					1.72	0.61	0.33	0.07
3	20.0					1.72	0.61	0.33	0.07
4	28.0					1.72	0.61	0.33	0.07
5	40.0	1.42	0.49	0.26	0.04	2.18	0.78	0.44	0.11
6	55.0	2.18	0.78	0.44	0.11	2.18	0.78	0.44	0.11
7	77.0	3.54	1.32	0.76	0.23	4.91	1.85	1.08	0.36
8	**89.1**	**7.18**	**2.73**	**1.61**	**0.57**	**7.18**	**2.73**	**1.61**	**0.57**
9	82.0	4.91	1.85	1.08	0.36	3.54	1.32	0.76	0.23
10	70.0	2.18	0.78	0.44	0.11	2.18	0.78	0.44	0.11
11	60.0	2.18	0.78	0.44	0.11	1.42	0.49	0.26	0.04
12	52.0	1.72	0.61	0.33	0.07				
13	45.0	1.72	0.61	0.33	0.07				
14	40.0	1.72	0.61	0.33	0.07				
15	36.0	1.42	0.49	0.26	0.04				
16	32.0	1.41	0.49	0.26	0.04				
17	29.0								
18	26.0								
19	23.0								
20	20.0								
21	17.0								
22	14.0								
23	11.0								
24	8.0								
25	5.0								
26	3.0								
27	1.0								
28	0.0								

Annexure-IX

Check Flood Hydrograph (SPF) for Semraghat

Time (hr)	Discharge (cumec)	Time (hr)	Discharge (cumec)	Time (hr)	Discharge (cumec)
0	6	26	2067	52	240
1	8	27	2248	53	216
2	14	28	**2310**	54	187
3	25	29	2216	55	158
4	40	30	2037	56	131
5	62	31	1829	57	107
6	93	32	1627	58	88
7	137	33	1462	59	73
8	196	34	1336	60	62
9	268	35	1237	61	54
10	344	36	1159	62	47
11	421	37	1100	63	42
12	499	38	1053	64	36
13	589	39	1009	65	31
14	693	40	942	66	26
15	804	41	843	67	22
16	880	42	730	68	17
17	915	43	616	69	13
18	940	44	512	70	10
19	991	45	425	71	8
20	1079	46	358	72	7
21	1208	47	308	73	6
22	1361	48	276	74	6
23	1520	49	260	75	6
24	1688	50	254		
25	1870	51	251		



Annexure-X

Revised Elevation - Area - Capacity Table for Madia dam						
Elevation	Original Area (Ha)	Original Capacity (MCM)	After 50 years		After 100 years	
			Revised Area (Ha)	Revised Capacity (MCM)	Revised Area (Ha)	Revised Capacity (MCM)
1	2	3	4	5	4	5
500.55	6435.61	276.83	6435.61	250.22	6435.61	221.68
500	5747.50	241.78	5563.78	215.67	5355.71	187.70
499	4627.60	189.90	4386.22	165.92	4112.85	140.36
498	3750.00	148.01	3490.21	126.53	3196.00	103.81
497	3026.00	114.13	2764.40	95.26	2468.14	75.49
496	2511.00	86.45	2257.15	70.16	1969.65	53.31
495	2028.00	63.75	1788.00	49.93	1516.19	35.87
494	1539.70	45.91	1317.59	34.40	1066.04	22.96
493	1201.90	32.20	1000.31	22.81	772.00	13.77
492	886.20	21.76	706.72	14.27	503.46	7.39
491	624.70	14.21	468.12	8.40	290.79	3.42
490	438.50	8.89	304.95	4.53	153.70	1.20
489	280.40	5.30	169.44	2.16	43.77	0.21
488	184.40	2.98	95.10	0.85	0.00	0.00
487	103.90	1.53	34.87	0.19	0.00	0.00
486	52.10	0.75	1.56	0.01	0.00	0.00
485	30.30	0.34	0.00	0.00	0.00	0.00
484	15.20	0.11	0.00	0.00	0.00	0.00
483	3.40	0.02	0.00	0.00	0.00	0.00
482	0.40	0.00	0.00	0.00	0.00	0.00
481	0.00	0.00	0.00	0.00	0.00	0.00

File No.T-26030/2/2020-IP(S) DTE 900

I/78269/2021

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन नदी विकास एवं गंगा संरक्षण विभाग
केंद्रीय जल आयोग
सिंचाई आयोजन (दक्षिण) निदेशालय

सत्यमेव जयते

Government of India
Ministry of Jal Shakti
Dept. of Water Resources, RD&GR
Central Water Commission
Irrigation Planning (South) Directorate

विषय: DPR of Bina Complex Irrigation & Multipurpose project - reg.

संदर्भ: (i) Email from project authorities dated 26.10.2021.

(ii) Email from project authorities dated 10.11.2021.
(iii) Email from project authorities dated 09.11.2021.
(iv) Email from project authorities dated 11.11.2021.
(v) Email from Project Authorities dated 12.11.2021.
(vi) Email from Project Authorities dated 15.11.2021.
(vii) Email from NP Dte. dated 18.11.2021.
(viii) Email from NP Dte. of CWC dated 22.11.2021.
(ix)Noting dated 29.11.2021
(x)Email from Project Authorities dated 01.12.2021.

May please refer to reference (i) above dated 26.10.2021 vide which point-wise reply to the observation of this Directorate letter dated 16.06.2021 has been received directly from the project authorities. Further, vide email under reference (viii) dated 22.11.2021, NP Dte. of CWC has forwarded the letter from Cost Appraisal (I) Dte. of CWC. The same has been examined and the observations on the same are as under:-

Irrigation Planning

i. The project authorities have now submitted the crop water requirement for additional 6000 ha in soft copy. On examination, it has been found that the crop water requirement worked out by the project authorities as 24.97 MCM and the same has been found to be in order. Earlier, this office has finalized the CWR for 90000 ha of command as 374.94 MCM. Thus for 96,000 ha of the command the total crop water requirement worked out as 399.91 MCM. *No further comments to offer.*

ii. The integrated working table sheet for Madia dam, Chakarpur dam, Dehra dam & Semraghat weir for the period 1978-79 to 2009-10 (32 years) has been provided by the project authorities in soft copy. PA (C) Dte. of CWC vide there letter dated 13.7.2018 has forwarded the yield series for Madia, Chakarpur, Dehra and Semraghat weir and the same has been used in the preparation of working table. The working table has been examined and following observations are made.

a. The project authorities have now clarified that there is no u/s use of water in case of Madia, Chakarpur and Dehra dam also. Further, the MDDL values used for Madia, Chakarpur, Dehra and Semraghat in the working table is not matching with the Comprehensive Report of Ken- Betwa Link project prepared by NWDA. Therefore, the MDDL values for working table have been considered same as submitted by the project authorities to assess the success rate of the project.

b. The project authorities have now submitted the documents for ground water availability of 140.18 MCM in the command of the project duly authenticated by the Superintending Geohydrologist, Ground Water Survey Circle, Bhopal.

c. The project authorities have considered the releases from Madia to Chakarpur & from Dehra to Chakarpur for hydro power generation of 21 MW & 4 MW respectively. The same has been certified from the project authorities.

Based on above, the working table has been examined and the success rate for meeting the irrigation demands for Madia dam, Chakarpur dam, Dehra dam and Semraghat weir comes out as 100 % (out of 32 years, success in 32 years), 81.25 % (out of 32 years, success in 26 years), 100 % (out of 32 years, success in 32 years) and 81.25 % (out of 32 years, success in 26 years) respectively.

BC Ratio

The Cost Appraisal (I) Dte. of CWC vide their letter dated 22.11.2021 has revised the cost of the project as Rs. 335362.14 lakhs (at Price level 2017-18). The project authorities have submitted the BC Ratio computation vide email dated 10.11.2021 as 1.57. The same has been examined and following observations are made.

i. The cost of land development has not been considered by the project authorities in the BC Ratio computation. During the meeting held on 24.11.2021, WRD, Govt. of MP has requested to exclude the cost of land development for Kotha Barrage in BC Ratio calculation. WRD, Govt. of MP vide letter dated 23.11.2021 addressed to Chairman, CWC has intimated that *"Govt. of MP has undertaken about 40 nos. of pressurized irrigation projects using sprinkler system. In all these projects no land levelling and command area development cost is required because they serve upto 1 ha. Out of which 3 nos. of projects namely Garoth, Mohanpura, BanSujara irrigation projects are functioning well and irrigating 1.20 lakh ha by sprinkler system. In all these projects neither land leveling and Command Area Development cost has been considered nor any expenditure made on that. The water is delivered upto 1 ha with 20 mtr head, therefore the cost of command area development is already included in the project."*
Further vide letter dated 24.11.2021, Director, CA (I)-2 Dte, CWC has confirmed that the rates for survey, planning, design and construction of underground pressurized pipe distribution network for micro irrigation system to facilitate pressurized irrigation have been taken upto 1.0 ha chak area in case of Bina Complex project (as per clause 6.41.2 of MPWRD Unified Schedule of Rates 2017).

In view of above and considering the fact that, in case of Bina Complex project, micro-irrigation through pressurized pipe distribution network has been adopted and the cost of providing underground pressurized pipe distribution network for micro irrigation system to facilitate pressurized irrigation have been taken upto 1.0 ha chak area the land development charges have been taken as 'NIL' in the B.C. ratio computation, with the approval of Chairman, CWC, vide ref. (ix) above.

ii. The benefits of drinking and Industrial water are considered @ Rs. 5.6 lakh/ MCM and 80 lakh/ MCM amounting to Rs. 107.52 lakhs and Rs.2000 lakhs respectively. The rates for drinking water are considered as per the letter of WRD, MP dated 14.01.2000 and the rates for industrial water are considered as per the letter of WRD, MP dated 30.11.2010 respectively. However, it has been found that the rates of industrial water have been considered for 2021 price level. Accordingly, the same has now been revised as per the letter of WRD, MP dated 30.11.2010 (for the period upto 2018) and the same has been considered @Rs. 56 lakh/MCM in the BC Ratio computation.

iii. The project authorities have now provide the certificate in respect of benefits of fisheries duly authenticated by Assistant Director, State Fisheries Department, MP and now the production rate (in kg/ha) and rate per kg of fish has been considered @ Rs. 600 kg/ha and @ Rs. 504.68/ kg (as per 2017 rates with 3 % depreciation each year) respectively. However, on examination of the documents, the benefits of fisheries have been applicable to Kotha Barrage project only. In this regard, the project authorities vide their letter dated 15.11.2021 have clarified that the yield and rates of fisheries for Kotha Barrage is applicable to Bina Complex Project also. Taking these figures at face value, the benefits of fisheries have been considered in the BC Ratio computation.

iv. The benefits from hydro power generation of 25 MW has been considered @ Rs. 6000 lakhs. and the rate has been considered as Rs. 0.05 lakh/Mwhr. Further, the quantum of power requirement for lift have been assessed as Rs. 3281 per ha by the project authorities. As per the Retail Supply Tariff Order FY 2017-18 of Madhya Pradesh Electricity Regulatory Commission, the energy charges are Rs.5 per unit. However considering the overhead charges @ 10%, the energy charges have been re-worked out as Rs. 4.50 per unit.

v. The project authorities have submitted the certificate of computation of cost towards tube-wells as Rs. 849.44 lakhs and the same has been used in the BC Ratio computation.

vi. The project authorities have submitted the yield, rates and cost of cultivation (viz. seeds, manure, labour etc.) of crops in pre and post project scenario approved by the Deputy Director, State Agriculture Department, MP dated 01.12.2021 for the purpose of estimating the agricultural benefits. The same has been used in the BC ratio computation. Further, based on the meeting held on 02.11.2021 under the chairmanship of Member, WP&P, CWC, it was decided to consider the rates for crops as in 2017-18 PL for benefits calculation. Accordingly, the rates and cost of cultivation (viz. seeds, manure, labour etc.) of crops in pre-project and post project scenario has been revised.

Subject to above, the BC Ratio computation has been checked and worked out as 1.502.

This issues with approval of CE (IMO), CWC, New Delhi.

I/78269/2021

for 6/12/24
विनीत गुप्ता
(निदेशक)

To.

i. Director, NP Dte., CWC, Sewa Bhawan, R.K. Puram, New Delhi.
(ii) Director, PA (C) Dte., CWC, Sewa Bhawan, R.K. Puram, New Delhi.

Copy for kind information to:
(i) CE, PAO, CWC, Sewa Bhawan, R.K Puram, New Delhi.
(ii) CE, PPO, CWC, Sewa Bhawan, R.K Puram, New Delhi.

180080/2021/DD-IP(S)

GOVERNMENT OF MADHYA PRADESH
WATER RESOURCES DEPARTMENT
BINA COMPLEX IRRIGATION MULTIPURPOSE PROJECT PROJECT

BC Ratio Calculation

S. No.	Item	Before Irrigation	After Irrigation	Remark
1	2	3	4	5
A.	Gross Receipt			
1.0	Gross value of farm produce	20701.38	82400.00	
2.0	Dung receipts (at 30% of the fodder expenditure)	931.56	2472.00	
3.0	Total Gross Receipts (A) = (1+2)	21632.94	84872.00	
B.	EXPENSES			
1.0	Expenditure on Seeds	2618.80	3808.15	
2.0	Expenditure on Fertilizers,Chemicals etc.	4952.50	8160.00	
3.0	Expenditure on hired labour (human, animal & machinery) & Misc	6860.00	10000.00	
4.0	Fodder expenses (as percentage of gross value of produce)			
	a) 15% Gross value of farm produce before irrigation	3105.21		
	b) 10% Gross value of farm produce after irrigation		8240.00	
5.0	Depreciation on implements at 2.7% of the gross value of farm produce	558.94	2224.80	
6.0	Share and Cash Rent			
	a) 5% Gross value of farm produce before irrigation	1035.07		
	b) 3% Gross value of farm produce after irrigation		2472.00	
7.0	(x) Land Revenue at 2% of gross value of farm produce	414.03	1648.00	
8.0	Total Expenses (B) = (Sum 1 to 7)	19544.54	36552.95	
C.	NET VALUE OF PRODUCE			
1.0	Total Gross receipts (Total A.3)	21632.94	84872.00	
2.0	Total Expenses (Total B.8)	19544.54	36552.95	
3.0	Net value of produce (C) = (1-2)	2088.40	48319.05	
D.	ANNUAL AGRICULTURAL BENEFITS			
1.0	Net value after irrigation (C.3)		48319.05	
2.0	Minus Net value before irrigation(C.3)		2088.40	
3.0	Net Annual Benefits (D) = (1-2)		46230.65	
E.	(i) from Fish production		13395.97	
	(ii) from Power production		5400.00	
	(iii) from Water Supply		0.00	
	a) Domestic		107.52	
	b) Industrial		1400.00	
F.	Total Net Annual Benefits (D.3+E)		66534.15	
G.	Project Costs			
	(i) Estimated cost of the Project		335362.14	
	(ii) Land Development Cost @Rs 20,000 per Ha OF CCA		0.00	
	(iii) cost of tubewell		849.44	
	Annual Costs Total (G)		336211.58	
	ANNUAL COSTS			
1	Interest on capital @ 10% (Estimated total cost of the project excluding cost of land development)		33621.16	
2	Depreciation of the project @ 1% of the cost of project for 100 years life of the project and @ 2% for 50 years life of the project		3362.12	
3	Annual operation and maintenance charges @ 1175 Rs Per Ha		1128.00	
4	Maintenance of the head works @ 1% of its cost		760.97	
5	Depreciation of the pumping system @ 8.33% of the estimated cost of the pumping system assuming life of the system as 12 years (Applicable to lift irrigation)		980.93	
6	Depreciation of the rising mains @ 3.33% of the estimated cost of the rising mains assuming life of the system as years (Applicable to lift irrigation)		1213.68	
7	Annual cost of tubewell after assuming 12 year service life of pump		70.76	
8	Power Charges for lift water Rs 3281.0 @ per Ha.		3149.76	
9	Total Annual Costs (G) = Sum (1 to 7)		44287.37	
	Average Benefit Cost Ratio = Annual Benefits (F) / Annual Costs (G)		1.502	

* Note - Being pressurised irrigation project , there is no need to develop cost

Appendix – F(1)

EXISTING CROP PATTERN AND PRODUCTIVITY PRE-PROJECT / PRE-ERM

NAME OF PROJECT: BINA COMPLEX IRRIGATION & MULTIPURPOSE PROJECT DISTRICT SAGAR (M.P.)

(All rates in Rs. Amount in Rs. Lakh and Area in Ha.)

Sr. No.	Crop	Area	Yield (Qtl/ Ha)	Total yield (Qtl)	Price per Qtl. (Rs.)	Gross Income (in Rs. Lakh)	Breakup of Expenditure							Net Income (in Lakhs)
							Seed		Fertilizers, Chemicals, Manure etc.		Hired labour (Human, Animal & Machinery &Misc)		Total Expenditure	
							Rate/ Ha (Rs.)	Amt.	Rate/ Ha (Rs.)	Amt.	Rate/ Ha (Rs.)	Amt.		
Kharif														
1	Soyabeen	3500	10	35000	2775	971.25	4500	157.50	8500	297.50	8000	280.00	735.00	236.25
2														
3														
4														
	Total	**3500**	**10**	35000	2800	**971.25**								
Rabi														
1	Wheat(Hyd.)	35000	15	525000	1625	8531.25	3000	1050.00	6500	2275.00	10000	3500.00	6625	1706.25
2	Gram	28000	10	280000	4000	11200	5040	1411.20	8500	2380.00	11000	3080.00	6871.20	4328.80
3														
4														
	Total	**63000**	**25**	805000		**19731.25**								
Other Crops														
1														
2														
3														
4														
	Total													
	GRAND TOTAL													

Dy. Director
Farmer Welfare & Agri. Dev. Deptt.
Distt.– SAGAR (M. P.)

DIRECTOR
STATE AGRICULTURE DEPARTMENT

Appendix – F(2)

PROPOSED CROP PATTERN AND PRODUCTIVITY POST-PROJECT / POST - ERM

NAME OF PROJECT:Bina Complex Irrigation and Multipurpose Project District Sagar (M.P)

(All rates in Rs. Amount in Rs. Lakh and Area in Ha.)

Sr. No.	Crop	Area	Yield (Qtl/ Ha)	Total yield (Qtl)	Price per Qtl. (Rs.)	Gross Income (in Rs. Lakh)	Breakup of Expenditure							Net Income (in Lakhs)
							Seed		Fertilizers, Chemicals, Manure etc.		Hired labour (Human, Animal & Machinery &Misc)		Total Expenditure	
							Rate/ Ha (Rs.)	Amt(lakh).	Rate/ Ha (Rs.)	Amt.(lakh)	Rate/ Ha (Rs.)	Amt.(lakh)		
Kharif														
1														
2														
3														
4														
	Total													
Rabi														
1	Wheat(Hyd.)	56000	45	2520000	2000	50400	3200	1792.00	8500	4760.00	10000	560000	12152	38798.00
2	Gram	40000	20	800000	4000	32000	5040	2016.00	8500	3400	11000	4400	9816	22184.00
3														
4														
	Total													
Other Crops														
1														
2														
3														
4														
	Total													
	GRAND TOTAL													

Dy. Director
Farmer Welfare & Agri. Dev. Deptt,
Distt.– SAGAR (M. P.)

DIRECTOR
STATE AGRICULTURE DEPARTMENT

OFFICE OF THE CHIEF ENGINEER BODHI , NARMADA BHAWAN , BHOPAL (M.P)

MEMO NO -...../WORK/2017-18 BHOPAL DATE .../06/2017

To,

The Chief Engineer,
Project appraisal Organization,
Central Water Commission
Sewa Bhavan, R.K. Puram,
New Delhi – 110066

Subject: Clearance Bina Complex Irrigation and Multipurpose Project.

The above project has been examined in the Central Design Organization with reference to the Check list as per the latest guidelines for preparation of DPR of Ministry of Water Resources, RD & GR (2010) and it is found that:

i) All necessary surveys and investigations for planning of the project and establishing its techno-economic feasibility have been carried out as per the aforementioned guidelines.

(ii) 10%/5000 ha. of the command area of the project (whichever is minimum) has been investigated in full details in three patches representing terrain conditions in the command for estimation of the conveyance system upto the last farm gates.

(iii) Survey of 100% for Main Canal and 10% of the remaining Canal structures (Branch canals, Distributaries, Minors etc.) was carried out for preparation of the DPR in the year 2010 In the instant proposal the canal system has been adopted as pressurized pipe canal system, execution of which shall be carried out on EPC basis. Therefore, the survey for canal system separately is not necessary.

(iv) Detailed Hydrological, geological, construction material investigations, have been carried out for all major structures i.e. dams, weirs, main canal, branch canal up-to distributaries carrying a discharge of 10 cumecs.

(v) Soil survey of the command has been carried out in detail as per IS 5510-1969.

(vi) Necessary designs for the various components of the project has been done in accordance with the guidelines and relevant Indian Standards for Planning & Design/Safety aspects including design flood estimation etc., of the project which are enclosed. List of Codes is enclosed.

(vii) Necessary studies for utilization of ground water have been done with special regard to problem of water logging and suitable provisions have been made for conjunctive use of ground water & drainage arrangements.

(viii) The cropping pattern has been adopted in consultation with the State Agriculture Department and is based on soil surveys of the command keeping in view the national policy in respect of encouraging crops for producing oil seeds and pulses. Availability of water as per Inter-State agreements, awards and consent of co-basin States are also considered.

(ix) The cost estimates and economic evaluations are carried out as per guidelines issued by the Central Water Commission. No existing command of existing ground water, water bodies or minor irrigation.schemes has been taken as beneficial command of the proposed project.

(2) The project has also been examined by the State level Project appraisal / Technical Advisory Committee comprising representative of Irrigation, Agriculture, Fisheries, Forests, Soil Conservation, Ground Water, Revenue and Finance Deptt and State level Environmental Committee etc. and techno-economic feasibility of the project has been established.

(3) The project is recommended for acceptance by Central Water Commission and Ministry of Water Resources, River Development & Ganga Rejuvenation.

(Sudhir Khare)
Cheif Engineer
Dhasan Ken Basin
Water Resources Sagar (M.P.)

25/6/17
(Bharat Gosavi)
Chief Engineer, Central Design Organization, Water Resources Department, Govt. Madhya Pradesh

28/06/17
(राजीव कुमार सुकलीकर)
प्रमुख अभियंता
जल संसाधन विभाग, भोपाल

Counter signed by

28/6/17

Principal Secretary, Water Resources Department,
Govt. of Madhya Pradesh

भारत सरकार
केन्द्रीय विद्युत प्राधिकरण
तापीय सिविल अभिकल्प प्रभाग
9वाँ तल, उत्तरी स्कन्ध , सेवा भवन, राम कृष्ण पुरम
नई दिल्ली-110066

Sub: Bina Complex Irrigation & Multipurpose project, Sagar in MP: Examination of DPR - Reg.

Ref: CEA letter No.2/MP/67/CEA/10-PAC/1646-51 dated 21/07/2017

Kind reference is invited to CEA's office letter no. under reference on the examination of DPR for Bina Complex Irrigation & Multipurpose Project, Sagar in M.P. vide which volume of 1 set of DPR (Project Report & Drawing volume) submitted by Chief Engineer, Dhasan Ken Basin WR Development Sagar, MP was sent to this Division for examination and comments.

The same has been examined and observations are as follows.

1. No details of power component(Unit III) has been enclosed in the DPR.
2. Detailed report on power generation modified from 32 MW (22 MW+10 MW) to 25 MW(21 MW+ 4 MW) is not enclosed.

In view of the above, it is informed that the DPR bereft of the chapter on Hydro Power is not relevant to TCD Division of CEA.

31/7/17

(टी सुकुमार सिंह)
निदेशक

निदेशक (पी0ए0सी0), के0 ज0आ0, आर के पुरम, नई दिलली
न0 4/21/Bina Complex /2011/टीसीडी/ 387 - 389 दिनांक: 31 जुलाई, 2017

Copy for information:

1. Director, PAC(CEA)
2. Director HPA-I, CEA

File No.T-85013(11)/1/2019-ISM-2 DTE

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन नदी विकास एवं गंगा संरक्षण विभाग
केंद्रीय जल आयोग
अंतरराज्यीय मामले निदेशालय-2

सत्यमेव जयते

Government of India
Ministry of Jal Shakti
Dept. of Water Resources, RD&GR
Central Water Commission
ISM-2 Directorate

Sub: Examination of Comprehensive Project Report of Ken-Betwa Link Project - Reg.

May kindly refer to Memorandum of Agreement (MoA) amongst the states of Madhya Pradesh, Uttar Pradesh and the Union Government on the implementation of Ken-Betwa link project (KBLP) signed on 22nd March, 2021.

Earlier, this office vide letter dated 20.04.2020 (copy attached) considered Comprehensive Project Report of KBLP acceptable from inter-state angle subject to signing of MoU among the States of Madhya Pradesh, Uttar Pradesh and Union Govt. for implementation of Ken-Betwa Link Project.

Since, MoA on Comprehensive Project Report of Ken-Betwa Link Project has been signed on 22.03. 2021 between Madhya Pradesh, Uttar Pradesh and Union Govt. for implementation of Ken-Betwa Link Project, the project proposal may be considered acceptable from inter-state aspects.

This issues with the approval of Chief Engineer (IMO), CWC.

Encl.: As Above.

(Rajesh Kumar)
Director (ISM-2)

Chief Engineer, PAO, CWC, Sewa Bhawan(S), R.K. Puram, New Delhi
File No. 2/ 1/ ISM-2/ 2017/ 152 Date: 02 .07.2021

Signature Not Verified

Digitally signed by RAJESH KUMAR
Date: 2021.07.02 16:26:14 IST

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No.J-12011/31/2014 -IA-I
Ministry of Environment, Forests & Climate Change
Government of India
(IA-I Division)

Indira Paryavan Bhavan
3rd Floor, Vayu Wing
Jor Bagh Road
New Delhi – 110 003

11 FEB 2015

Date: ~~20th~~ 21st January, 2015

To

The Engineer-in-Chief
Office of the Engineer-in-Chief
Water Resources Department
Government of Madhya Pradesh
Bhopal – 462 003
Madhya Pradesh

C.E.(I.S.) | S.E. (N)
C.E.-(N.H.) | C.F.O.
C.E. (P) | E.E. (V)
S.E. (Major) | E.E. (E)
S.E. (W) | Sr. P.A. | S.A. (E-in-C)
11.2.15

Subject: Bina Complex Multipurpose Project (32 MW) District: Sagar in Madhya Pradesh M/s Water Resources Department, Govt. of Madhya Pradesh – for TOR - regarding

Sir,

This is with reference to your letter no. 3441111/2001 dated 5.9.2014 and 14.10.2014, on the above mentioned subject.

2. The said proposal was appraised by the Environment Appraisal Committee (EAC) for River Valley and Hydro Electric Power Projects (RV&HEP) in its meeting held on 16-17th October, 2014. The comments and observations of EAC of this project may be seen in the Minutes of the meetings which are available on the web-site of this Ministry.

3. It is noted that the project envisages construction of 4 dams on Bina & Dhassan Rivers (both are tributaries to Betwa river) to provide irrigation facility in 84,200 ha of land in Sagar District of Madhya Pradesh. Water flow from Bina river would be stored in an earthen dam (known as Madia dam) near Madia in Rahatgarh tehsil of Sagar District. The structure will be known as Madia dam. An underground powerhouse is also proposed on the left bank of the river downstream of the Madia dam for generation of 22 MW of hydropower of 2 x 11 MW capacity each. Water flow from Dassan river would be stored in an concrete dam (Dehra dam) at Dehra Nallah. Dhassan diversion dam at Dhassan river and feeder canal to divert its water to Dehra dam to generate 10 MW (2 x 5 MW) of hydropower. Tail water from Madia powerhouse will flow in Bina river and 22 Km downstream of Madia dam and will be arrested at Dam constructed near Chakarpur. The gross command (GCA) area is 102500 ha. The total land requirement for project is 11,706.09 ha out of which 717.849 ha is forest land; 10,981.046 ha is private land and other type/waste land is 10 ha. Total submergence area is 11,665.09 ha. About 69 villages consisting of about 12277 families are likely to be affected due to this project. The total cost of the project is about Rs. 1514.577 Crores.

4. Based on the recommendations of the EAC, the Ministry of Environment & Forests hereby accords clearance for pre-construction activities at the proposed site as per the provisions of the Environmental Impact Assessment Notification, 2006 and subsequent

amendment in 2009 along with the following Terms of Reference (TOR) for preparation of EIA/EMP report as Annexure-I. The EIA/EMP report should contain the information in accordance with provisions & stipulations as given in the Annexure. While preparing the EIA/EMP report prevailing norms shall be strictly followed specially with respect to environmental flows, and muck disposal sites and management plans, muck disposal sites & management and other relevant aspects.

5. The Consultant engaged for preparation of EIA/EMP report has to be registered with Quality Council of India (QCI)/NABET under the scheme of Accreditation & Registration of MoEF. This is a pre-requisite.

6. Consultants shall include a "Certificate" in EIA/EMP report regarding portion of EIA/EMP prepared by them and data provided by other organization(s)/ laboratories including status of approval of such laboratories.

7. The draft EIA/EMP report prepared as per the above Terms of References should be submitted to the State Pollution Control Board/Committee concerned for conducting Public Hearing / Consultation as per the provisions stipulated in EIA Notification of 2006. The draft EIA/EMP report is to be submitted to SPCB etc sufficiently before the expiry of the ToR validity so that necessary amendments in EIA/EMP can be undertaken based on public hearing and the same is submitted to MoEF &CC before expiry of validity. Public Hearing to be conducted in both the Districts namely Sagar and Vidisha.

8. All issues discussed in the Public Hearing/Consultations should be addressed and incorporated in the EIA/EMP Report. Final EIA/EMP report should be submitted to the Ministry for Environmental Clearance only after incorporating these issues before the expiry of validity of ToR.

9. The TOR will remain valid for a period of 3 years from the date of issue of this letter for submission of EIA/EMP report along with public consultation. The ToR will stand lapsed on completion of 3 years time in case final EIA/EMP is not submitted and the validity is not renewed.

10. In case of any change in the Scope of the Project such as capacity enhancement, shifting of dam site/powerhouse and change in submergence etc., fresh scoping clearance has to be obtained by the project proponent.

11. (a) Information pertaining to Corporate Environmental Responsibility and Environmental Policy shall be provided in the EIA/EMP Report as per this Ministry's OM No.J-11013/25/2014-IA-I dated 11.8.2014.

(b) As far as wildlife clearance is concerned, conditions as stipulated in this Ministry's OM No.J-11013/41/2006-IA-II(I) (Part) dated 20.8.2014 is also to be complied with, in case it is applicable.

12. The EIA/EMP Report must contain an Index showing details of compliance of all ToR conditions. The Index will comprise of page no. etc., vide which compliance of a specific ToR is available. It may be noted that without this index, EIA/EMP report will not be accepted.

13. In case the validity is to be extended, necessary application is to be submitted at least 3 months before expiry of validity of TOR.

14. Forest Clearance application shall be submitted immediately and not later than 6 months from the date of issue of the TOR

15. This has approval of the Competent Authority.

Yours faithfully,

(B. B. Barman)
Director

Copy to:

1. Secretary,Min.of Water Resources, Shram Shakti, Bhawan, Rafi Marg,New Delhi 1.
2. The Adviser (I &CAD), Planning Commission, Yojna Bhawan, New Delhi - 110001.
3. The Principal Secretary (WRD), Government of Madhya Pradesh, Secretariat, Bhopal-462 016
4. The Secretary, Department of Environment, Government of Madhya Pradesh, Secretariat, Bhopal -462 016
5. The Engineer-in-Chief , Water Resources Department of Environment, Narmada Bhavan, Tulsi Nagar, Bhopal -462 003
6. The Chief Engineer, Project Appraisal Directorate, Central Water Commission, Sewa Bhawan, R.K. Puram, New Delhi-110066.
7. CCF, Regional Office (WR), Ministry of Environment & Forests, Kendriya Paryavaran Bhavan, Link Road No-3, Ravi Shankar Nagar, Bhopal – 462 016
8. Member Secretary, Madhya Pradesh State Pollution Control Board, Paryavaran Parisar, E-5, Arera Colony, Bhopal – 462 016.
9. EI- Division, Ministry of Environment & Forests, New Delhi-110003.
10. Guard file,
11. PS to JS (BS)/ Director (BB)/ PVS Rao (Sci. B).
12. NIC Cell – uploading in MOEF's website.
13. Guard File.

(B. B. Barman)
Director

Annexure-1

TERMS OF REFERENCE FOR CONDUCTING ENVIRONMENT IMPACT ASSESSMENT STUDY AND INFORMATION TO BE INCLUDED IN EIA/EMP REPORT IN RESPECT OF BINA COMPLEX MULTIPURPOSE PROJECT IN SAGAR DISTRICT OF MADHYA PRADESH.

(1) Scope of EIA Study:

The EIA Report should identify the relevant environmental concerns and focus on potential impacts that may change due to the construction of proposed project. Based on the baseline data collected for three (3) seasons (Pre- monsoon/Summer, Monsoon and Winter), the status of the existing environment in the area and capacity to bear the impact on this should be analysed. Based on this analysis, the mitigation measures for minimizing the impact shall be suggested in the EIA/EMP study.

(2) Details of the Project and Site

- General introduction about the proposed project.
- Details of Project and site giving L-Sections of all U/S and D/S Projects with all relevant maps and figures. Connect such information as to establish the total length of interference of Natural River and the committed unrestricted release from the site of Dam/Barrage into the main river.
- A map of boundary of the project site giving details of protected areas in the vicinity of project location.
- Location details on a map of the project area with contours indicating main project features. The project layout shall be superimposed on a contour map of ground elevation showing main project features (*viz.* location of dam, Head works, main canal, branch canals, quarrying etc.) shall be depicted in a scaled map.
- Layout details and map of the project along with contours with project components clearly marked with proper scale maps of at least 1:50,000 scale and printed at least on A3 scale for clarity.
- Existence of National Park, Sanctuary, Biosphere Reserve etc. in the study area, if any, should be detailed and presented on a map with distinct distances from the project components.
- Drainage pattern and map of the river catchment up to the proposed project site.
- Delineation of critically degraded areas in the directly draining catchment on the basis of Silt Yield Index as per the methodology of Soil and Land use Survey of India.
- Soil characteristics and map of the project area.
- Geological and Seismo-tectonic details and maps of the area surrounding the proposed project site showing location of dam site and canal sites.
- Remote Sensing studies, interpretation of satellite imagery, topographic sheets along with ground verification shall be used to develop the land use/land cover pattern of the study using overlaying mapping techniques viz. Geographic Information System (GIS), False Color Composite (FCC) generated from satellite data of project area.
- Land details including forests, private and other land.
- Demarcation of snow fed/rain fed areas for a realistic estimate of the water availability.

(3) Description of Environment and Baseline Data

To know the present status of environment in the area, baseline data with respect to environmental components air, water, noise, soil, land and biology & biodiversity (flora & fauna), wildlife, socioeconomic status etc. should be collected within 10 km radius of the main components of the project/site i.e. dam site and power house site. The air quality and noise are to be monitored at such locations which are environmentally & ecologically more sensitive in the study area. The baseline studies should be collected for 3 seasons (Pre Monsoon, Monsoon and Post Monsoon seasons). Flora-Fauna in the catchment and command area should be documented. The study area should comprise of the following:

- Catchment area up to the dam/barrage site.
- Submergence Area.
- Project area or the direct impact area should comprise of area within 10 km radius of the main project components like dam, canals etc.
- Downstream up-to 10 km from the tip of the reservoir.
- Monsoon data collected for the period 2014 can be utilized

(4) Details of the Methodology

The methodology followed for collection of base line data along with details of number of samples and their locations in the map should be included. Study area should be demarcated properly on the appropriate scale map. Sampling sites should be depicted on map for each parameter with proper legends. For Forest Classification, Champion and Seth (1968) methodology should be followed.

(5) Methodology for Collection of Biodiversity Data

- The number of sampling locations should be adequate to get a reasonable idea of the diversity and other attributes of flora and fauna. The guiding principles should be the size of the study area (larger area should have larger number of sampling locations) and inherent diversity at the location, as known from secondary sources (e.g. eastern Himalayan and low altitude sites should have a larger number of sampling locations owing to higher diversity).
- The entire area should be divided in grids of 5kmX5km preferably on a GIS domain. There after 25% of the grids should be randomly selected for sampling of which half should be in the directly affected area (grids including project components such as reservoir, dam, powerhouse, tunnel, canal etc.) and the remaining in the rest of the area (areas of influence in 10 km radius form project components). At such chosen location, the size and number of sampling units (e.g. quadrates in case of flora/transects in case of fauna) must be decided by species area curves and the details of the same (graphs and cumulative number of species in a tabulated form) should be provided in the EIA report. Some of the grids on the edges may not be completely overlapping with the study area boundaries. However these should be counted and considered for selecting 25% of the grids. The number of grids to be surveyed may come out as a decimal number (i.e. it has an integral and a fractional part) which should be rounded to the next whole number,
- The conventional sampling is likely to miss the presence of rare, endangered and threatened (r.e.t.) species since they often occur in low densities and in case of faunal species are usually secretive in behaviour. Reaching the conclusion about the absence

of such species in the study area based on such methodology is misleading. It is very important to document the status of such species owing to their high conservation value. Hence likely presence of such species should be ascertained from secondary sources by a proper literature survey for the said area including referring to field guides which are now available for many taxonomic groups in India. Even literature from studies/surveys in the larger landscapes which include the study area for the concerned project must be referred to, since most species from adjoining catchments is likely to be present in the catchments in question. In fact such literature form the entire state can be referred to. Once a listing of possible r.e.t. species form the said area is developed, species specific methodologies should be adopted to ascertain their presence in the study area which would be far more conclusive as compared to the conventional sampling. If the need be, modern methods like camera trapping can be resorted to, particularly for areas in the eastern Himalayas and for secretive/nocturnal species. A detailed listing of the literature referred to, for developing lists of r.e.t. species should be provided in the EIA reports.

- The R.E.T. species referred to in this point should include species listed in Schedule I and II of Wildlife (Protection) Act, 1972 and those listed in the red data books (BSI, ZSI and IUCN).

(6) Components of the EIA Study

Various aspects to be studied and provided in the EIA/EMP report are as follows:

A. Physical and Chemical Environment

Geological & Geophysical Aspects and Seismo- Tectonics:

- Physical geography, Topography, Regional Geological aspects and structure of the Catchment.
- Tectonics, seismicity and history of past earthquakes in the area. A site specific study of the earthquake parameters will be done. The results of the site specific earthquake design shall be sent for approval of the NCSDP (National Committee of Seismic Design Parameters, Central water Commission, New Delhi for large dams.
- Landslide zone or area prone to landslide existing in the study area should be examined.
- Presence of important economic mineral deposit, if any.
- Justification for location & execution of the project in relation to structural components (dam / barrage height).
- Impact of project on geological environment.

Meteorology, Air and Noise:

- Meteorology (viz. Temperature, Relative humidity, wind speed/direction etc.) to be collected from nearest IMD station.
- Ambient Air Quality with parameters viz. Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM) i.e. suspended particulate materials < 10 microns, Sulphur dioxide (SO_2) and Oxides of Nitrogen (NO_X) in the study area at 6 Locations.
- Existing Noise Levels and traffic density in the study area at 6 Locations.

Soil Characteristics:

- Soil classification, physical parameters (viz., texture, Porosity, Bulk Density and water holding capacity) and chemical parameters (viz. pH, electrical conductivity,

magnesium, calcium, total alkalinity, chlorides, sodium, potassium, organic carbon, available potassium, available phosphorus, SAR, nitrogen and salinity, etc.) at @ one sample/2500 ha of command area – (32-35 Stations)

Remote Sensing and GIS Studies:

- Generation of thematic maps viz, slope map, drainage map, soil map, land use and land cover map, etc. Based on these, thematic maps, an erosion intensity map should be prepared.
- New configuration map to be given in the EIA Report.

Water Quality

- History of the ground water table fluctuation in the study area.
- Water Quality for both surface water and ground water for [i] Physical parameters (pH, Temperature, Electrical Conductivity, TSS); [ii] Chemical parameters (Alkalinity, Hardness, BOD, COD, NO3, PO4, Cl, So4, Na, K, Ca, Mg, Silica, Oil & grease, phenolic compounds, residual sodium carbonate); [iii] Bacteriological parameter (MPN, Total coliform); and [iv] Heavy Metals (Pb, As, Hg, Cd, Cr-6, Total Cr, Cu, Zn, Fe) at minimum 32-35 Locations, however, the sampling numbers should be increased depending on the command area.
- Delineation of sub and micro watersheds, their locations and extent based on the Soil and Land Use Survey of India (SLUSOI), Department of Agriculture, Government of India. Erosion levels in each micro-watershed and prioritization of micro-watershed through Silt Yield Index (SYI) method of SLUSOI.

B. Water Environment & Hydrology

- Hydro-Meteorology of the project viz. precipitation (snowfall, rainfall), temperature, relative humidity, etc. Hydro-meteorological studies in the catchment area should be established along-with real time telemetry and data acquisition system for inflows monitoring.
- Run off, discharge, water availability for the project, sedimentation rate, etc.
- Basin Characteristics.
- Catastrophic events like cloud bursts and flash floods, if any, should be documented.
- For estimation of Sedimentation Rate, direct sampling of river flow is to be done during the EIA study. The study should be conducted for minimum one year. Actual silt flow rate to be expressed in ha-m km^{-2} year-1.
- Set-up a G&D monitoring station and a few rain gauge stations in the catchment area for collecting data during the investigation.
- Flow series, 10 daily with 90%, 75% and 50% dependable years discharges.
- A table of 10 daily water discharge in 75% dependable year showing the intercepted discharge at the barrage, diversion for irrigation, environmental and other flow releases downstream of the barrage shall be included in the EIA report.
- Norms for release of Environmental flows, i.e. 30% in monsoon season, 20% in lean season and 25% in non-monsoon & non-lean season to be followed corresponding to 90% dependable year.
- A site specific study on minimum environment flow should be carried out. Assessment of environmental release in lean period.
- Impacts of backwater effects of the reservoir in flood season.

C. Biological Environment

Flora

- Characterization of forest types (as per Champion and Seth method) in the study area and extent of each forest type as per the Forest Working Plan.
- General vegetation profile and floral diversity covering all groups of flora including Bryophytes, Pteridophytes, Lichens and Orchids. A species wise list may be provided.
- Assessment of plant species with respect to dominance, density, frequency, abundance, diversity index, similarity index, importance value index [IVI], Shannon Weiner Index etc. of the species to be provided. Methodology used for calculating various diversity indices along with details of locations of quadrats, size of quadrats etc. to be reported within the study area in different ecosystems.
- Existence of National Park, Sanctuary, Biosphere Reserve etc in the study area, if any, should be detailed.
- Economically important species like medicinal plants, timber, fuel wood etc.
- Details of endemic species found in the project area.
- Flora under RET categories should be documented using International Union for the Conservation of Nature and Natural Resources (IUCN) criteria and Botanical Survey of India's Red Data list along with economic significance. Species diversity curve for RET species should be given.
- Terrestrial ecology to be monitored in 12 locations

Fauna

- Fauna study and inventorisation should be carried out for all groups of animals including reptiles and nocturnal animals in the study area. Their present status along with Schedule of the species.
- Information (authenticated) on Avi-fauna and wild life in the study area.
- Status of avifauna their resident/migratory/ passage migrants etc.
- Documentation of butterflies, if any, found in the area.
- Details of endemic species found in the project area.
- RET species- voucher specimens should be collected along with GPS readings to facilitate rehabilitation. RET faunal species to be classified as per IUCN Red Data list and as per different schedule of Indian Wildlife (Protection) Act, 1972.
- Existence of barriers and corridors, if any, for wild animals.
- Compensatory afforestation to compensate the green belt area that will be removed, if any, as part of the proposed project development and loss of biodiversity.
- For categorization of sub-catchments into various erosion classes and for the consequent CAT plan, the entire catchment (Indian Portion) is to be considered and not only the directly the draining catchment.
- Terrestrial ecology to be monitored in 12 locations
- Biodiversity study including nocturnal fauna may be conducted through specialized institute (i.e. Biodiversity Institute, Jabalpur)

D. <u>Aquatic Ecology</u>

- Documentation of aquatic fauna like macro-invertebrates, zooplankton, phytoplanktons, benthos etc.
- Fish and fisheries, their migration and breeding grounds. Fishery survey should be at 12 locations (@A3 site/dam)
- Fish diversity, composition and maximum length & weight of the measured populations to be studied for estimation of environmental flow.

- Conservation status of aquatic fauna.
- Aquatic ecology to be monitored in 12 locations

E. Irrigation and Cropping Pattern

- Cropping pattern and Horticultural practices in the study area.
- Collection of primary data on agricultural activity, crop and their productivity and irrigation facilities component.
- Component of pressurized/drip irrigation and micro irrigation.
- Details of Conjunctive use of water for irrigation.

F. Socio-Economic

- Collection of Baseline data on human settlements, health status of the community and existing infrastructure facilities for social welfare including sources of livelihood, job opportunities and safety and security of workers and surrounding population.
- Collection of information with respect to social awareness about the developmental activity in the area and social welfare measures existing and proposed by project proponent.
- Collection of information on sensitive habitat of historical, cultural and religious and ecological importance.
- The Socio-economic survey/profile within 10 Km of the study area for Demographic profile; Economic Structure; Development Profile; Agricultural Practices; Infrastructure, education facilities; health and sanitation facilities; available communication network etc.
- Documentation of Demographic, Ethnographic, Economic structure and development profile of the area
- Information on Agricultural practices, Cultural and aesthetic sites, Infrastructure facilities etc
- Information on the dependence of the local people on minor forest produce and their cattle grazing rights in the forest land.
- List of all the Project Affected Families with their names, education, land holdings, other properties, occupation, source of income, land and other properties to be acquired, etc.
- In addition to Socio-economic aspects of the study area, a separate chapter on socio-cultural aspects based upon study on Ethnography of the area should be provided. Social Impact Assessment study to be conducted.
- Realistic assessment of requirement of labour during the construction phase of the project should be done and local labour should be preferred. Mixing with local tribal community to be minimized.

7. Impact Prediction and Mitigation Measures

The adverse impact due to the proposed project should be assessed and effective mitigation steps to abate these impacts should be described.

Air Environment

- Changes in ambient and ground level concentrations due to total emissions from point, line and area sources
- Effect on soils, material, vegetation and human health
- Impact of emissions from DG sets used for power during the construction, if any, on air environment.

- Pollution due to fuel combustions in equipments & vehicles
- Fugitive emissions from various sources.
- Impact on micro climate.

Water Environment

- Changes in surface & ground water quality.
- Steps to develop pisci-culture and recreational facilities.
- Changes in hydraulic regime and down stream flow.
- Water pollution due to disposal of sewage.
- Water pollution from labour colony/camps and washing equipment.

Land Environment

- Adverse impact on land stability, catchment of soil erosion, reservoir sedimentation and spring flow (if any) [a] due to considerable road construction/widening activity [b] interference of reservoir with the inflowing streams [c] blasting for excavation of canals and some other structures
- Changes in land use/land cover and drainage pattern.
- Immigration of labour population.
- Quarrying operation and muck disposal.
- Changes in land quality including effects of waste disposal
- River bank and their stability
- Impact due to submergence.
- Impacts of mining material for the project.

Biological Environment

- Impact on forests, flora, fauna including wildlife, migratory avi-fauna, rare and endangered species, medicinal plants etc.
- Pressure on existing natural resources
- Deforestation and disturbance to wildlife, habitat fragmentation and wild animal's migratory corridors
- Compensatory afforestation–Identification of suitable native tree species for compensatory afforestation & green belt.
- Impact on fish migration and habitat degradation due to decreased flow of water
- Impact on breeding and nesting grounds of animals and fish

Socio-economic Aspects

- Impact on local community including demographic profile.
- Impact on socio-economic status.
- Impact on economic status.
- Impact on human health due to water / vector borne disease.
- Impact on increases traffic.
- Impact on Holy Places and Tourism.
- Impacts of blasting activity during project construction which generally destabilize the land mass and lead to landslides, damage to properties and drying up of natural springs and cause noise pollution, will be studied. Proper record shall be maintained of the base line information in the post project period.
- Positive as well as negative impacts likely to be accrued due to the project are to be listed.

(8) <u>Environment Impact Analysis</u>

Environmental Impact Analysis due to the project on the above mentioned components should be carried out for construction and operation phases using qualitative or quantitative methods.

(9) Environment Management Plan (EMP)

Environmental Management Plan aimed at minimizing the negative impacts of the project should be given in detail. The mitigation measures are to be presented for all the likely adverse impacts on the environment. The following suggestive mitigating plans should be included:

- **Catchment Area Treatment (CAT) Plan** should be prepared micro-watershed wise. Identification of area for treatment based upon Remote Sensing & GIS methodology and Silt Yield Index (SYI) method of SLUSOI coupled with ground survey. Areas/watersheds falling under 'very severe' and `severe' erosion categories are required to be treated. Both biological and engineering measures should be proposed in consultation with State Forest Department. Year-wise schedule of work and monetary allocation should be provided. CAT plan is to be completed prior to reservoir impoundment. Mitigations measures to check shifting cultivation in the catchment area with provision for alternative and better agricultural practices should be included.
- **Command Area Development (CAD) Plan** giving details of implementation schedule with a sample CAD plan to be provided along with EIA/EMP report.
- **Compensatory Afforestation** in lieu of the forest land required for the project needs to be proposed. Choice of plants should be made in consultation with State Forest Department including native and RET species, if any.
- **Biodiversity and Wild Life Conservation & Management Plan** for conservation and preservation of endemic, rare and endangered species of flora and fauna to be prepared in consultation with State Forest Department.
- **Resettlement and Rehabilitation (R&R) Plan** need to be prepared with due consultation with Project Affected Families (PAFs). The provision of the R&R plan should be according to the norms of Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation & Resettlements Act, 2013.
- **Livelihood plan for Project Affected Families losing land to be prepared**
- **Plan for Green Belt Development** along the periphery of reservoir, colonies, approach road, canals etc. to be prepared in consultation with the State Forest Department. Local plant species suitable for greenbelt development should be selected.
- **Reservoir Rim Treatment Plan** for stabilization of land slide/land slip zones if any, around the reservoir periphery to be prepared. Suitable engineering and biological measures for treatment of the identified slip zones to be provided with physical and financial schedule.
- **Plan for Land Restoration and Landscaping** of project sites.
- **Fisheries Conservation & Management Plan**-Fish fauna inhabiting the affected stretch of river, a specific fisheries management plan should be prepared for river and reservoir. A detailed plan for sustenance of fisheries. Assessment of providing a fish ladders
- **Muck Disposal Plan-** suitable sites for dumping of excavated material should be identified in consultation with the State Pollution Control Board and Forest Department. All Muck disposal sites should be minimum 30 m away from the HFL of river. Plan for rehabilitation of muck disposal sites should also be given. The L- section/ cross section of muck disposal sites and approach roads to be given. Financial out lay for this may be given separately.

- **Plan for Restoration of quarry sites** and landscaping of colony areas, working areas, roads, etc.
- Study of Design Earthquake Parameters: A site specific study of earthquake parameters should be done. The results of the site specific earth quake design parameters should be approval by National Committee of Seismic Design Parameters, Central Water Commission (NCSDP), New Delhi.
- **Dam Break Analysis and Disaster Management Plan**: The outputs of Dam Break Model should be illustrated with appropriate graphs and maps clearly bringing out the impact of Dam break scenario. Provision for early warning systems should be provided.
- **Water and Air Quality & Noise Management Plans** to be implemented during construction and post-construction periods.
- Mitigating measures for **impacts due to Blasting** on the structures in the vicinity.
- **Ground Water Management Plan.**
- **Public Health Delivery Plan** including the provisions for drinking water facility for the local community.
- **Labour Management Plan** for their Health and Safety.
- **Sanitation and Solid Waste Management Plan** for domestic waste from colonies and labour camps etc.
- **Local Area Development Plan** to be formulated in consultation with the Revenue Officials and Village Panchayats. Local skill development schemes should be given. Details of various activities to be undertaken along with its financial out lay should be provided.
- Environmental safeguards during construction activities including Road Construction.
- **Energy Conservation Measures.**
- **Environmental Monitoring Programme** with physical & financial details covering all the aspects of EMP. A summary of cost estimate for all the plans, cost for implementing all Environmental Management Plans including the cost for implementing environmental monitoring programme should be given. Provision for an Environmental Management Cell should be made.

*****

In the EMP, please include a sample CAD plan for a distributary outlet command. Such a plan is to show the alignment of irrigation and drainage channels. The components of the OFD works to be undertaken may be clearly mentioned along with a time schedule for their completion vis-à-vis the progress of irrigation development.

Endt no 3441111 /CWC/2015 date 18.2.15

Copy forwarded to chief Engineer Dhanaskon Sagar for immediate necessary achon

18/2
कार्यपालन यंत्री
कार्यालय प्रमुख अभियन्ता
जल संसाधन विभाग, भोपाल (म.प्र.)

4. The Public Hearings were conducted in 3 Districts namely Raisen, Vidhisa and Sagar in Madhya Pradesh on 18.5.2016, 20.5.2016 and 27.5.2016, respectively.

5. The Expert Appraisal Committee (EAC), after due consideration of the relevant documents submitted by the project proponent and clarifications furnished in response to its observations, have recommended for grant of Environmental Clearance for this project. Accordingly, the Ministry of Environment, Forest and Climate Change hereby accords necessary Environmental Clearance for the above project as per the provisions of Environmental Impact Assessment Notification, 2006 and its amendment in 2009, subject to compliance of the following conditions:

Part A: Specific Conditions

i. The proposed Catchment Area Treatment (CAT) plan for 5 years with biological and engineering measures shall be implemented in consultation with Madhya Pradesh Forest Department. The CAT proposed is 1853 Sq. km. Allocated amount of Rs. 30.5 crores for this purpose be fully utilized and not to be diverted for any other purpose.

ii. The R&R benefits for the land losing will have to comply with "The Right to fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013" which has come in force on 1.1.2014. Adequate publicity of the compensation package should be circulated in the affected villages. All R&R issues shall be completed before commissioning of the project.

iii. The project-displaced people should be rehabilitated with human angle. Rehabilitation plan should include –

(a) Land for Land, to the extent feasible, should be provided.
(b) One-time financial assistance needs to be increased substantially.
(c) The people who are poor, their land should be considered very compassionately.
(d) R & R plan should have all possible provisions to provide livelihood option/cash compensation.

iv. A monitoring Committee for R&R shall be constituted which shall include representatives of project affected persons including representative from SC/ST category and a woman beneficiary.

v. All commitment made during the public hearing should be fulfilled completely by the project proponent and record maintained.

vi. The Command Area Development (CAD) plan as proposed in EIA/EMP report (November, 2016) shall be strictly implemented.

vii. The Water User Association's (WUAs)/ Co-operative shall be formed and involvement of the whole community for disciplined use of available water shall be ensured.

viii. Conjunctive use of surface water shall be planned to check water logging as well as to increase productivity.

ix. Consolidation and compaction of the generated muck should be carried out at the muck dumping sites. As proposed in the muck disposal plan, out of 7.33 lakh m^3 generated. Out of which, 1.81 lakh m^3 is to be utilized for construction purpose and remaining 5.52 lakh m^3 to be dumped in 11.75 ha of area at 4 designated disposal sites. The muck disposal sites should be reclaimed/ restored with vegetative cover once capacity is utilized and it should be strictly adhered to.

x. To enhance the environment of project site, greenbelt, as proposed in the EIA/EMP report (November, 2016) shall be developed. The proposed greenbelt development in and around the reservoir, boundaries of the project colony, approach roads and various project components in 1068.12 ha with 14 different local plant species shall be undertaken in consultation with State Forest Department, Government of Madhya Pradesh. The allocated grant of Rs. 72 lakhs for this purpose should be fully utilized and the same shell not to be diverted for other purpose.

xi. Water quality monitoring shall be done on bimonthly basis in the 5 km stretch at the upstream and downstream of Bina & Dhassan Rivers during construction phase for drinking water quality standards at suitable locations and a copy of the test reports to be submitted to the Regional Office, MoEF & CC, Bhopal six monthly. Further, aquatic ecology studies to assess the health of the aquatic biota to be conducted on a yearly basis during the period of construction.

xii. The equipment likely to generate high noise levels during the construction period or otherwise shall meet the Ambient Noise level standards as notified under the Noise Pollution (Regulation and Control) Rules, 2000, as amended in 2010 under the Environment Protection Act (EPA), 1986. Ambient Noise level monitoring shall be conducted on a monthly basis during the period of construction at suitable locations and copy of the test reports to be submitted to Regional Office, MoEF & CC, Bhopal six monthly.

xiii. The On Farm Development (OFD) works shall be completed and WUAs (Water User Associations) shall be made functional before commencement of irrigation.

xiv. The fishery development and management plan, as proposed in the EIA/EMP report (November, 2016) shall be developed in consultation with the State Fishery Department. Under the fisheries management plan, stocking of fish seed should be ensured from the river originally. Fish breeding ground should be identified and impact analysis shall be studied regularly. The allocated grant Rs. 3.34 crores for this purpose shall be fully utilized and shall not to be diverted for any other purposes.

xv. Six monthly compliance reports shall be submitted to the Regional Office of the Ministry located at Bhopal without fail until completion of the project along with the monitoring data. It should also to be uploaded in the own website of the project as a part of information to the General Public.

xvi. Periodical soil health shall be verified in command area during operation phase to ensure maintenance of soil fertility.

xvii. Occurrence of stagnant pools/slow moving water channels during construction and operation of the project providing breeding source for vector mosquitoes and other parasites. The river should be properly channelized so that no small pools and puddles are allowed to be formed. Even after taking precaution, due to unforeseen situations, breeding of mosquito and resultant malaria or mosquito borne diseases can increase. If such a situation arises, it will be the responsibility of project proponent to take all steps i.e. residual insecticidal spray in all the project area and its surrounding 3 km area keeping the flight range of mosquitoes in consideration.

xviii. Water quality monitoring including Dissolved Oxygen, Fluoride, Iron and Nitrate level shall be carried out at the upstream and downstream of water drawl point of Bina & Dhassan River at sufficient stretch during construction phase on monthly basis. The monitoring

results shall be submitted to the Regional Office, Bhopal six monthly along with the point-wise compliance to EC conditions.

xix. Bio-assay test should be carried out to ascertain the survival of aquatic life in the stream of Bina & Dhassan River on monthly basis.

xx. Any other clearance from other organization/department, if required, should be obtained as and when necessary.

xxi. Solid waste generated especially plastic waste should not be disposed of as landfill material. It should be treated with scientific approach and recycled.

xxii. Benefits of tank-bed irrigation should be assessed properly and accounted for at the project formulation stage.

xxiii. The post project yield of the crops should be assessed realistically.

Part B: General Conditions

i. Adequate arrangements for providing free fuel like LPG/kerosene shall be made at the project cost for the labourforce engaged during the construction work so that indiscriminate felling of trees is prevented that is located adjacent to the proposed project site

ii. Medical facilities as well as recreational facilities shall also be provided to the labourers at the construction sites. First aid facility at the project site shall also be provided with proper sigange.

iii. The labourers to be engaged for construction works shall be thoroughly examined by health personnel and adequately treated before issuing them work permit to avoid contraction of any disease to the local people.

iv. Water sprinkling arrangements shall be made to control the fugitive dust and fugitive dust, ambient air quality ect. be monitored during the period of construction according to the CPCB guidelines to meet the NAAQ standards.

v. Potable drinking water and proper sanitary facilities shall be provided for the labour force. Any solid water generated at the colony of the labour force shall be collected and suitably disposed of.

vi. Restoration of construction area including muck dumping sites of excavated materials shall be ensured by leveling, filling up of borrow pits, landscaping, etc. The area should be properly treated with suitable plant species preferable local indigenous species for better survival of plants and also to enrich the local habitat.

vii. Environmental parameters shall be monitored and "six monthly monitoring reports" shall be submitted to the Regional office of the Ministry located at Bhopal as per guidelines.

6. The Project Proponent shall provide full cooperation and all required documents / data to the Officer (s) of the Regional Office of the Ministry located at Bhopal who would be monitoring the implementation of environmental safeguards.

7. The responsibility of implementation of environmental safeguards and carrying out environmental monitoring rests fully with the Water Resources Department, Government of Madhya Pradesh.

8. Besides the above stated conditions, the Project Proponent shall also implement all environmental safeguards, as proposed in the EIA/EMP report and other reports from time to time. The Regional Office, MoEF&CC, Bhopal shall monitor implementation of EMP at regular intervals.

9. The Environmental Management Plan (EMP) shall be strictly adhered to. The total cost of implementation of mitigation measures as per EMP is Rs 1735.05 crores and cost of monitoring during construction/operation phase is Rs. 93.40 crores. In case of revision of the project cost or due to price level change, the cost of EMP shall also be updated proportionately.

10. In case of change in the scope of the project, the same shall be intimated to the Ministry and fresh approval, if required, shall be taken from the Ministry accordingly.

11. The Ministry reserves the right to add additional safeguard measures subsequently, if found necessary and to take action including revoking of the clearance under the provisions of the Environment (Protection) Act, 1986, to ensure effective implementation of the suggested safeguard measures in a time-bound and satisfactory manner.

12. The project proponent should advertise at least in two local newspapers widely circulated in the region around the project, one of which shall be in vernacular language of the locality concerned informing that the project has been accorded environmental clearance and copies of clearance letters are available with the State Pollution Control Board / Committee and may also be seen at the Website of the Ministry of Environment, Forest & Climate Change at http://www.moef.nic.in.

13. A copy of the clearance letter shall be marked to concerned Panchayat/ Zilla Parishad/Municipal Corporation, Urban local body and local NGO, if any, from whom any suggestion/representations were received while processing the proposal. The clearance letter shall also be put in the website by the project proponent. Compliance to the condition shell be ensured by the project and intimated to the state accordingly.

14. State Pollution Control Board / Committee shall display a copy of the clearance letter at the Regional Office, District Industries Centre and Collector's / Tehsildar's Office for 30 days.

15. This clearance letter is valid for a period of 10 years from the date of issue of this letter for commencement of construction work of the project.

16. After 5 years of the commissioning of the Project, a study shall be undertaken regarding impact of the project on the environment and downstream ecology. The study shall be undertaken by an independent agency, decided in consultation with the Ministry.

17. The project proponent shall also submit six monthly reports on the status of compliance of stipulated EC conditions including the results of monthly monitored data (both in hard copies as well as by email) to the Regional Office of MoEF&CC, Bhopal

18. Any appeal against this environmental clearance shall lie solely with the National Green Tribunal, if preferred, within a period of 30 days from the date of issue, as prescribed under Section-10 of the National Green Tribunal Act, 2010.

Yours faithfully,

(Dr. S. Kerketta)
Director

Copy to:

1. The Secretary, Ministry of Water Resources, RD & GR, Shram Shakti, Bhawan, Rafi Marg, New Delhi 110 001.
2. The Principal Secretary (Water Resources Department), Government of Madhya Pradesh, Secretariat, Bhopal -462 016.
3. The Secretary, Department of Environment, Government of Madhya Pradesh, Secretariat, Bhopal -462 016.
4. The Chief Engineer, Project Appraisal Directorate, Central Water Commission, Sewa Bhawan, R.K. Puram, New Delhi-110 066.
5. The Additional PCCF (Central), Regional Office (WR), Ministry of Environment, Forest & Climate Change, Kendriya Paryavaran Bhavan, Link Raoad No-3, Ravi Shanker Nager, Bhopal -462 016..
6. The Member Secretary, Madhya Pradesh State Pollution Control Board, Paryavaran Parisar, E-5, Arera Colony, Bhopal -462 016.
7. EI-Division, Ministry of Environment, Forest & Climate Change, New Delhi-110 003.
8. NIC Cell - uploading in MoEFCC's website.
9. PPS to JS (GB)/ Director (SKK)/ DD (SP).
10. Guard file.

(Dr. S. Kerketta)
Director

F.No.8-13/2015-FC
Government of India
Ministry of Environment, Forests and Climate Change
(FC Division)

Indira Paryavaran Bhawan,
Aliganj, Jor Bag Road,
New Delhi - 110003.

Dated: 27th July, 2016.

To,

The Principal Secretary (Forests),
Government of Madhya Pradesh,
Bhopal

Sub: Diversion of 1024.44 ha of forest land in favour of Water Resource Department No. - II, Sagar for construction of Bina Joint Irrigation and Multipurpose Scheme in Sagar district in the State of Madhya Pradesh – regarding.

Sir,

I am directed to refer to the State Government's letter No. F-3/77/2014/10-11/12/879 dated 27.03.2005 on the subject mentioned above seeking prior approval of the Central Government under Section-2 of the Forest (Conservation) Act, 1980 and to say that the proposal has been examined by the Forest Advisory Committee constituted by the Central Government under Section-3 of the aforesaid Act.

After careful examination of the proposal of the State Government and on the basis of the recommendations of the Forest Advisory Committee, **in-principle** approval of the Central Government is hereby granted for diversion of 1024.44 ha, of forest land in favour of Water Resource Department No. - II, Sagar for construction of Bina Joint Irrigation and Multipurpose Scheme in Sagar district in the State of Madhya Pradesh subject to the following conditions:

(i.) Legal status of the diverted forest land shall remain unchanged;
(ii.) Compensatory afforestation over the revenue land equal in extent to the forest land being diverted shall be raised and maintained by the State Forest Department at the cost of the User Agency;
(iii.) The revenue land identified for raising compensatory afforestation shall be transferred and mutated in favour of the State Forest Department before issue of the Stage-II clearance;
(iv.) The land identified for the purpose of CA shall be clearly depicted on a Survey of India topo sheet of 1:50,000 scale;
(v.) Revenue land to be transferred and mutated in favour of the State Forest Department for raising Compensatory Afforestation shall be notified as reserved Forest under Section-4 or Protected Forest under Section-29 of the Indian Forest Act, 1927 or under the relevant Section(s) of the local Forest Act. The Nodal officer must report compliance within a period of 6 month from the date of grant of final approval and send a copy of the notification declaring the revenue land under Section 4 or Section 29 of the Indian Forest Act, 1927, or under the relevant section of the local Forest Act as the case may be, to this Ministry for information and record.

(vi.) The State Government shall realize cost of implementation of Catchment Area Treatment (CAT) Plan and transfer the same to Ad-hoc CAMPA.

(vii.) The User Agency shall transfer the cost of raising and maintaining the compensatory afforestation at the current wage rate in consultation with State Forest Department in the account of Ad-hoc Campa of the concerned State through online portal. The scheme may include appropriate provision for anticipated cost increase for works scheduled for subsequent years.

(viii.) The User Agency shall transfer the funds for the Net Present Value (NPV) of the forest land being diverted under this proposal from the User Agency as per the orders of the Hon'ble Supreme Court of India dated 28.03.2008, 24.04.2008 and 09.05.2008 in Writ Petition (Civil) No. 202/1995 and the guidelines issued by this Ministry vide its letter No. 5-3/2007-FC dated 05.02.2009 through online portal of Ad-hoc CAMPA account of the State Concerned.

(ix.) At the time of payment of the Net Present Value (NPV) at the then prevailing rate, the User Agency shall furnish an undertaking to pay the additional amount of NPV, if so determined, as per the final decision of the Hon'ble Supreme Court of India;

(x.) Any fund received from the user agency under the project, except the funds realized for regeneration/ demarcation of safety zone, shall be transferred to Ad-hoc CAMPA through online portal of Ad-hoc CAMPA account of the State Concerned;

(xi.) A Catchment area treatment plan as approved by State Government be implemented by/or under the supervision of State Forest Department at the project cost;

(xii.) The User Agency shall obtain the Environment Clearance as per the provisions of the Environmental (Protection) Act, 1986, if required;

(xiii.) No labour camp shall be established on the forest land;

(xiv.) The User Agency shall provide fuels preferably alternate fuels to the labourers and the staff working at the site so as to avoid any damage and pressure on the nearby forest areas;

(xv.) The boundary of the diverted forest land, safety zone, as applicable, shall be demarcated on ground at the project cost, by erecting four feet high reinforced cement concrete pillars, each inscribed with its serial number, forward and back bearing ,distance from pillar to pillar and GPS co-ordinates;

(xvi.) The layout plan of the proposal shall not be changed without the prior approval of the Central Government;

(xvii.) The forest land shall not be used for any purpose other than that specified in the proposal;

(xviii.) The forest land proposed to be diverted shall under no circumstances be transferred to any other agency, department or person without prior approval of the Central Government;

(xix.) The water shall be provided from the reservoir to the Forest Department for raising and maintenance of plantations and nurseries around the site whenever required, free of charge. The quantity and time of supply of water shall be as decided by the Forest Department.

(xx.) No damage to the flora and fauna of the adjoining area shall be caused;

(xxi.) Felling of trees on the forest land being diverted shall be reduced to the bare minimum and the trees shall be felled under strict supervision of the State Forest Department;

(xxii.) The User Agency shall undertake afforestation along the periphery of the reservoir and canals (as applicable).

(xxiii.) The User Agency shall carry out muck/silt disposal at pre-designated sites in such a manner so as to avoid its rolling down.

(xxiv.) The dumping area for muck/silt disposal shall be stabilized and reclaimed by planting suitable species by the User Agency at the cost of project under the supervision of State Forest Department. Retaining walls and terracing shall be carried out to hold the dumping

material in place. Stabilization and reclamation of such dumping sites shall be completed before handing over the same to the State Forest Department in a time bound manner as per Plan.

(xxv.) The State Government and the User Agency shall ensure that the trees available between full reservoir level (FRL) and FRL-4 meters are not felled;

(xxvi.) A plan for conservation of wildlife will be made by the User Agency in consultation with the CCF (Wildlife) to be implemented at the User Agency's cost.

(xxvii.) The State Government shall complete settlement of rights, in terms of the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, if any, on the forest land to be diverted and submit the documentary evidence as prescribed by this Ministry in its letter No. 11-9/1998-FC (Pt.) dated 03.08.2009 read with 05.07.2013, in support thereof;

(xxviii.) The User Agency shall submit the annual self-compliance report in respect of the above conditions to the State Government and to the concerned Regional Office of the Ministry regularly:

(xxix.) Any other condition that the concerned Regional Office of this Ministry may stipulate, from time to time, in the interest of conservation, protection and development of forests & wildlife; and

(xxx.) The User Agency and the State Government shall ensure compliance to provisions of the all Acts, Rules, Regulations, Guidelines and relevant Hon'ble Court Order (s), if any, pertaining to this project for the time being in force, as applicable to the project.

After receipt of compliance report on fulfilment of the conditions mentioned above, the proposal shall be considered for final approval under Section-2 of the Forest (Conservation) Act, 1980. Transfer of forest land shall not be affected till final approval is granted by the Central Government in this regard.

Yours faithfully,

(Nisheeth Saxena)
Sr. Assistant Inspector General of Forests (FC)

Copy to:

1. The Principal Chief Conservation of Forests, Government of Madhya Pradesh, Bhopal.
2. The Addl. PCCF (Central), Regional Office (Western Zone), Bhopal.
3. The Nodal Officer, O/o the PCCF, Government of Madhya Pradesh, Bhopal.
4. User Agency.
5. Monitoring Cell, FC Division, MoEF&CC, New Delhi
6. Guard File.

(Nisheeth Saxena)
Sr. Assistant Inspector General of Forests (FC)

F. No. 8-13/2015-FC
Government of India
Ministry of Environment, Forests and Climate Change
(Forest Conservation Division)
****

Indira ParyavaranBhawan
Aliganj, Jorbagh Road
New Delhi – 110 003
Dated: 11th July, 2018

To,

The Principal Secretary (Forests),
Department of Forest & Environment,
Government of Madhya Pradesh,
Bhopal.

Sub: Diversion of 1024.44 ha forest land in favour of Water Resource Department No. – II, Sagar for construction of Bina Joint Irrigation and Multipurpose Scheme in Sagar district in the State of Madhya Pradesh. – regarding.

Sir,

I am directed to refer to the State Government of Madhya Pradesh letter no. F-3/77/2014/10-11/12/879 dated 27.03.2005 on the above-mentioned subject, seeking prior approval of the Central Government under Section-2 of the Forest (Conservation) Act, 1980. After careful examination of the proposal and recommendations made thereof by the Forest Advisory Committee constituted under Section-3 of the said Act, '***in-principle***' approval was granted vide this Ministry's letter of even number dated 26.07.2016 subject to fulfillment of certain conditions prescribed therein. The State Government has furnished compliance report in respect of the conditions stipulated in the 'in-principle' approval and requested the Central Government to grant final approval to the proposal.

2. In this connection, I am directed to say that on the basis of the compliance report furnished by the State Government of Madhya Pradesh vide their letter no. F-3/77/2014/10-11/12/3108 dated 18.10.2017 and letter No. F-3/77/2014/10-11/12/1751 dated 26.06.2018 final approval (Stage - 2) of the Central Government is hereby granted under Section -2 of the Forest (Conservation) Act, 1980 for diversion of 1024.44 ha forest land in favour of Water Resource Department No. – II, Sagar for construction of Bina Joint Irrigation and Multipurpose Scheme in Sagar district in the State of Madhya Pradesh subject to following conditions:

(i) Legal status of the diverted forest land shall remain unchanged;
(ii) Compensatory afforestation over the non-forest land i.e. 1190.56 ha forest land being diverted shall be raised and maintained by the State Forest Department from the **funds deposited in Ad-hoc CAMPA Account** by the User Agency;
(iii) The non-forest land to be transferred and mutated in favour of the State Forest Department for raising Compensatory Afforestation shall be notified as Reserved Forest under Section-4 or Protected Forest under Section-29 of the Indian Forest Act, 1927 or under the relevant Section (s) of the local Forest Act. The Nodal Officer must report compliance within a period of six (6) months form the date of grant of Stage-II approval under the Forest (Conservation) Act, 1980 for diversion of the said forest land and send a copy of the notification declaring the non-forest land under Section – 4 or Section – 29 of the Indian

11.7.18

Forest Act, 1927, or under the relevant section of the local forest Act as the case may be, to this Ministry for information and record;

(iv) The User Agency shall pay the additional amount of NPV, if so determined, as per the final decision of the Hon'ble Supreme Court of India;

(v) The project area shall be demarcated on ground at the project cost using 4 feet high RCC pillars with each pillar inscribed with serial No. forward and backward bearing distance between 2 adjacent pillars and GPS co-ordinates.

(vi) The User Agency shall obtain the Environment Clearance as per the provisions of the Environmental (Protection) Act, 1986, if required;

(vii) No additional forest land will be sought for construction of any canal in future;

(viii) To prevent illegal occupation/encroachment of forest land by the families to be displaced form the project site, the User Agency shall ensure that each family being displaced from the project site actually acquires and settles on non-forest land. Apart from taking other measures to achieve the said objective, as a measure to discourage the project affected families from encroaching into the forest land, payment of annuity for a period of at-least five years at the rate of the minimum wage payable to the unskilled person for 200 person-days per annum to each adult member of the project affected families, on receipt of a certificate signed by a forest officer not below the rank of a Range Officer having jurisdiction over the area where such person has settled after displacement from the project site, should be incorporated in the R & R plan. Payment of the said annuity should be an additionally and not in replacement of any of the benefits to be accrued to the project affected persons, as per the present R&R Plan;

(ix) User agency shall track location of each displaced family and ensure that none of them encroach/occupy forest land. In support of compliance to this condition at least for five years from the date of taking possession of the forest land, the user agency shall submit an annual certificate to the Principal Chief Conservator of Forests, Madhya Pradesh that none of the persons displaced from the project land has encroached/ settled on the forest land during the year;

(x) The State Government shall ensure the Catchment Area Treatment (CAT) Plan of the project shall be implemented under the supervision of State Forest Department from the funds of Rs. 4,23,44,703/- deposited in Ad-hoc CAMPA Account by the user agency;

(xi) The Felling of trees on the forest land being diverted shall be reduced to the bare minimum and the trees should be felled under strict supervision of the State Forest Department;

(xii) The User agency shall take up afforestation activities all along the Reservoir / Dam / Canal in consultation with the Forest Department;

(xiii) The Government of Madhya Pradesh and the user agency shall ensure that the trees available between Full reservoir level (FRL) and FRL—4 meters are not felled;

(xiv) The User Agency shall provide free water from the project for all forestry related activities;

(xv) The layout plan of the proposal shall not be changed without the prior approval of the Central Government;

(xvi) No labour camps shall be established on the forest land;

(xvii) The Forest land shall not be used for any purpose other than that specified in the proposal and under no circumstances be transferred to any other agency, department or person.

(xviii) The User agency shall provide alternate fuels to the labourers and the staff working at the site so as to avoid any damage and pressure on the nearby forest areas;

(xix) User agency shall ensure that because of this project, no damage is caused to the flora and fauna available in the area;

(xx) The State Government shall ensure that the user agency may be carried out muck disposal at pre-designated sites in such a manner so as to avoid its rolling down;

11.7.11

(xxi) The State Government shall ensure the implementation of conditions stipulated by the Standing Committee of the NBWL at the cost of user agency;

(xxii) The State Government shall ensure in – consultation with State Agriculture Department to utilize such area (except those located in forest land) during dry months for cultivation of appropriate crops by the project affected families (without the use of fertilizers) simultaneously during implementation of the project;

(xxiii) The State Government shall ensure that the dumping area for muck disposal shall be stabilized and reclaimed by planting suitable species by the user agency at the cost of project under the supervision of State Forest Department;

(xxiv) The State Government shall maintain the character of the project as an irrigation project and to ensure continued benefit to the farmers in the command area, no more diversion of water from the project for industrial projects will be permitted in future;

(xxv) Any other condition that the concerned Regional Office of this Ministry may stipulate, from time to time, in the interest of conservation, protection and development of forests & wildlife;

(xxvi) The User Agency shall submit the annual self-compliance report in respect of the above conditions and also to the conditions stipulated in Stage -I clearance to the State Government, concerned Regional and this Ministry by the end of March of every year regularly;

(xxvii) The User Agency and the State Government shall ensure compliance to provisions of the all Act, Rules, Regulations, Guidelines, NGT Order (s) and relevant Hon'ble Court Order (s), if any, pertaining to this project for the time being in force, as applicable to the project;

(xxviii) State Government shall ensure that the land which has been transferred and mutated in favour of forest department for raising of compensatory afforestation shall be free from encroachment.

Yours faithfully,

11.7.16

(Sandeep Sharma)
Assistant Inspector General of Forests (FC)

Copy to:-

1. The Principal Chief Conservator of Forests, Government of Madhya Pradesh,Bhopal.
2. The Addl. PCCF (Central), Regional Office (WZ), Bhopal.
3. The Nodal Officer, the Forest (Conservation) Act, 1980, Government of Madhya Pradesh, Bhopal.
4. User Agency.
5. Forest Conservation Monitoring Cell, FC Division, MoEF, New Delhi.
6. Guard File.

11.7.16

(Sandeep Sharma)
Assistant Inspector General of Forests (FC)

RESETTLEMENT AND REHABILITATION PLAN

4.1 INTRODUCTION

Bina complex, irrigation and Multipurpose project consists of four storage dams viz. Madia and Chakarpur on Bina River, and Dhasan and Dehra dams on Dhasan river and Dehra Nallah, a water conductor/ feeder from Semra ghat dam to Dehra and pressur pipe headworks at Chakarpur. Further two power plants are proposed one near the Madia dam and another below Dehra.

The dam near Chakarpur village is provided to serve as headwork for irrigation canals. The command area is surrounded by Bina river in east that joins Betwa River and narain river in west. The details of land to be acquired for the project is given in Table: 4.1.The total households being affected and the status of settlement in submergence area is given in Table-4.2.

Table: 4.1: The details of land to be acquired for the project

S. No	Type of Land	Total Land (ha)
1	Private Land	10652.59
2	Government Land	994.15
3	Forest Land	1024.44
	Total	**12671.18**

Source: WRD, MP

Table-4.2: Village wise list of the total household affected and the status of settlement in submergence area

S. No	Village Name	Number of Project Affected Homestead	Status of Settlement in Submergence area
	Madia (A)		
	Sagar District		
1	Gawari	80	Fully
2	ParsariKhurd	84	Fully
3	Mardevra	76	Partially
4	ParsariKalan	92	Partially
5	Nadanwara	68	Partially
	Raisen District		
6	Kakarua	73	Fully
7	KhiriyaParsara	22	Fully
8	Chandamau	149	Fully
9	Jhiriya	93	Partially
10	Khajuriya	83	Partially

11	Barri Kalan	56	Partially
12	Sothiya	28	Partially
13	Khejra	23	Partially
14	Belai	43	Partially
	Total	970	
	Dehra (B)		
	Sagar District		
1	Mankapur	83	Fully
2	Chauki	209	Fully
3	Rasullpur	16	Partially
	Total	308	
	Chakarpur (C)		
	Sagar District		
1	Muriya	41	Fully
2	Semra	53	Partially
3	Sikarpur	32	Partially
	Total	126	
	Total(A+B+C)	1404	

4.2 RESETTLEMENT AND REHABILITATION PLAN

For the purpose of this project, the R&R plan has been devised using the norms and guidelines of the "Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013". The Consultant based on past experiences in similar projects, in the area have suggested/specified/ augmented/ enhanced the R&R provisions. The objective of the R&R Plan is to enable project planners to take appropriate measures to devise suitable compensation as a part of resettlement and rehabilitation package for the PAFs. The village wise details list of status of submergence, total no. of households being affected, private land to be acquired along with their current market rates are enclosed as Annexure-V

4.2.1 MEASURES FOR COMPENSATION OF LOSS OF PRIVATE PROPERTIES

4.2.1.1 Compensation for Land

Of the total land coming under submergence area, private irrigated land accounts for 8425.64 ha. About 2290 families are likely to lose land in submergence area of the project. Whereas the private land to be acquired for the canal network is about 220 ha. On the other hand, compensation for acquisition of private land would be paid to the respective land owners/

land titleholders as per the provisions of "Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013".

4.2.2 COMPENSATION FOR HOMESTEADS

It is envisaged that this proposed project is also likely to evict a number of families from their homesteads as well. As per the assessment, in all there are 1404 homestead structures are likely to get affected as a result of land acquisition.

4.2.3 COMPENSATION OF OTHER PROPERTIES

Other properties such as trees, wells, ponds, temples, cremation grounds, public utility buildings and spaces, electric and telephone poles and cables, etc., would be assessed, evaluated and compensation rates would be fixed as per the prevalent guidelines/norms. The compensation amount shall be disbursed to the concerned department, agency, individuals, etc.

4.3 MEASURES FOR RESETTLEMENT

There are 2290 families that are likely to be evicted from their homesteads as a result of the process of land acquisition due to construction of dam and subsequent submergence area. These families would be eligible to receive resettlement benefits, in addition to compensation of homestead plot and structure. The provisions "Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013" have been taken into consideration. Further, it is suggested that these families be resettled/ relocated at one place as a group, in one or more of the existing nearby villages. The provisions for Resettlement that would be extended to the families losing homesteads are given in Table-4.3.

Table-4.3: Provisions for Resettlement Plan for families losing homestead

S.No.	Description	Unit	Assumed Provision	Cost (Rs. lakh)
	Housing Benefits and compensation			
1	a) If a house is lost in rural areas, a constructed house shall be provided as per the Indira AwasYojana specifications. b) If a house is lost in urban areas, a constructed house shall be provided, which will be not less than 50 sqmts in plinth area c) In case family in urban areas does not opts to take the house offered,		Resettlement benefits shall be extended to 2290 PAFs who are likely to be evicted from their homesteads. Thus, a provision of 73.925 ha (1404 PAFs x 250sqm x 10⁻⁴) is required for providing housing	

	one-time financial assistance of not less than Rs. 150,000/- for house construction d) If any affected family in rural areas so prefers, the equivalent cost of the house may be offered in lieu of the constructed house		plots to the displaced families. In addition, about 25% of the plot size would be required for providing civic amenities and about 25% of the plot size for providing infrastructure facilities (amounting to 36.96 ha) are also required to be provided in the resettlement site. Thus, the total land required for the resettlement site: (73.925 + 36.96) 110.89 ha	
2.	House Building Assistance @ Rs. 1,50,000/ha	Per family	2290 PAFs x Rs. 150,000/PAF	3435.00
3.	**Cattle Shed**			
	One-time financial assistance of a minimum of Rs. 25,000/- or as the appropriate Government may, by notification specify, for construction of cattle shed	Per family	2290 PAFs x Rs. 25,000/PAF	572.50
4.	**Transportation Grant**			
	One time financial assistance of Rs. 50,000/-for each displaced family for shifting of the family, building materials, belongings and cattle.	Per family	2290 PAFs x Rs. 50,000/PAF	1145.00
5.	**Subsistence Allowance**			
	a) Each affected family, losing land, will be given a monthly subsistence allowance equivalent to Rs. 3000/ month for a period of one year from the date of award. Scheduled Castes and the Scheduled Tribes displaced from Scheduled Areas shall receive an amount equivalent to Rs. 50,000/-,	Per family	2290PAFsxRs. 3000 per month x12 months for each PAF	824.40

	in addition to subsistence allowance			
6.	**One time Resettlement Allowance**			
	Each affected family shall be given a onetime "Resettlement Allowance" of Rs. 50,000/	Per family	2290 PAFs x Rs. 50,000/PAF	1145.00
7.	**Stamp Duty and Registration**			
	a) The stamp duty and the other fees payable for registration of the land of the house allotted to the affected families shall be borne by the requiring body b) The land for house allotted to the affected families shall be free from all encumbrance c) The land and the house allotted may be in the joint names of wife and husband of the affected family.		To be decided by the District Administration	
	TOTAL			7121.90

NAME OF PROJECT : - BINA COMPLEX IRRIGATION AND MULTIPURPOSE PROJECT (PART OF KEN BETWA LINK PHASE - II)

GENERAL ABSTRACT

PL 2017 / Amount in Lakhs

Sr. No.	Project Sub Head	UNIT - I (Head Works like Dam, Barrage etc.)			UNIT - II (Canal Works)			Unit-III (Power)			Grand Total		
		Expenditure incurred upto Sept 2020	Balance Cost	Total Cost (3 + 4)	Expenditure incurred upto Sept 2020	Balance Cost	Total Cost (6 + 7)	Expenditure incurred upto Sept 2020	Balance Cost	Total Cost (9 + 10)	Expenditure incurred upto Sept 2020	Balance Cost	Total Cost (12 + 13)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	I - Works												
1	A - Preliminary	104.61	23.76	128.37	0.00	208.15	208.15	0.00	0.00	0.00	104.61	231.91	336.52
2	B - Land	84846.84	15899.74	100746.58	0.00	2300.42	2300.42	0.00	0.00	0.00	84846.84	18200.17	103047.01
3	C - Works	645.85	32794.66	33440.51	0.00	44785.49	44785.49	0.00	0.00	0.00	645.85	77580.15	78226.00
4	D - Regulator & Measuring Devices	0.00	0.00	0.00	0.00	0.20	0.20	0.00	0.00	0.00	0.00	0.20	0.20
5	E - Falls	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	F - C. D. Works	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	G - Bridges	0.00	0.00	0.00	0.00	2233.24	2233.24	0.00	0.00	0.00	0.00	2233.24	2233.24
8	H - Escape	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	I- Navigation Works	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	J - Power plant & Civil works	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	K - Building	52.28	703.44	755.72	0.00	199.02	199.02	0.00	0.00	0.00	52.28	902.46	954.74
12	L - Earth Work												
	a) Earthworks	0.00	0.00	0.00	0.00	842.17	842.17	0.00	0.00	0.00	0.00	842.17	842.17
	c) Lining	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	d) Service road	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	M - Plantation	0.00	124.82	124.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	124.82	124.82
14	N-Tanks & Reservoir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	O - Miscellaneous	88.08	68.92	157.00	0.00	0.00	0.00	0.00	0.00	0.00	88.08	68.92	157.00
16	P - Maintenance	0.00	319.00	319.00	0.00	371.13	371.13	0.00	0.00	0.00	0.00	690.13	690.13
17	Q - Special Tools & Plants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	R - Communication	9.33	8328.17	8337.50	0.00	250.00	250.00	0.00	0.00	0.00	9.33	8578.17	8587.50
19	S- Power Plant & Electric System	0.00	0.00	0.00	0.00	870.39	870.39	0.00	14534.46	14534.46	0.00	15404.85	15404.85
20	T- Water Supply Works	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	U - Distributary & Minors	0.00	0.00	0.00	0.00	74160.00	74160.00	0.00	0.00	0.00	0.00	74160.00	74160.00
22	V - Water Course	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	W - Drainage.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	X - Environment & Ecology	194.00	20723.37	20917.37	0.00	0.00	0.00	0.00	0.00	0.00	194.00	20723.37	20917.37
25	Y - Losses on Stock	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total of I - Works	**85940.99**	**78985.88**	**164926.87**	**0.00**	**126220.22**	**126220.22**	**0.00**	**14534.46**	**14534.46**	**85940.99**	**219740.56**	**305681.55**
	GST@ 12% (Excluding cost of B - Land and S power and GST portion of R communication)	131	6622	6754	0.00	14765.93	14765.93	0.00	1744.13	1744.13	131.30	23132.40	23263.70
	G.Total.	**86072.29**	**85608.22**	**171680.51**	**0.00**	**140986.15**	**140986.15**	**0.00**	**16278.59**	**16278.59**	**86072.29**	**242872.96**	**328945.25**
II	Establishment @ 2 % (Excluding cost of B - Land and S - Solar Power)	513.00	770.61	1283.61	199.59	2261.40	2460.99	0.00	0.00	0.00	712.59	3032.00	3744.59
III	T & P - Nil (No Spl. T & P)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IV	Suspense	0.00	0	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00
V	Receipt & Recoveries	0.00	0	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00
A	TOTAL: DIRECT CHARGES	**86585.29**	**86378.82**	**172964.11**	**199.59**	**143247.55**	**143447.14**	**0.00**	**16278.59**	**16278.59**	**86784.88**	**245904.96**	**332689.84**
	INDIRECT CHARGES												
(a)	Capitalised value of abatement of land revenue @2% of B Land	1696.94	317.99	2014.93	0.00	46.01	46.01	0.00	0.00	0.00	1696.94	364.00	2060.94
(b)	Audit & Accounts charges @ 0.2% of I Works	171.88	157.97	329.85	0.00	252.44	252.44	0.00	29.07	29.07	171.88	46145.52	611.36
B	TOTAL: INDIRECT CHARGES	**1868.82**	**475.97**	**2344.79**	**0.00**	**298.45**	**298.45**	**0.00**	**29.07**	**29.07**	**1868.82**	**46509.52**	**2672.30**
	Total of Direct & Indirect Charges (A + B + C)	**88454.11**	**86854.79**	**175308.90**	**199.59**	**143546.00**	**143745.59**	**0.00**	**16307.66**	**16307.66**	**88653.70**	**292414.48**	**335362.14**
	Grand Total (A + B + C + D)												**335362.14**

Proforma for Computation of Internal Rate of Return

CCA= 96000 Ha

1	Life of project after completion	=	100	Years			
2	Construction Period	=	7 Years	0 Months			
3	Total Cost of the project	=	335362.14	Lakhs			
4	Anuual Benefits	=	67130.64	Lakhs			
5	Annual O&M charges @ Rs. 1175/- per ha of 96000 ha	=	1128.00	Lakhs		1128	
6	Maintenance of Head Works @ 1% of cost of head works	=	760.97	Lakhs			
7	Depreciation of the project @ 1% of cost of project for 100 years	=	3362.49	Lakhs			
8	Depreciation of the pumping system	=	980.93	Lakhs			
9	Depreciation of the rising mains	=	1213.68	Lakhs			
10	Power charges for lifting water through pumping system @ Rs.5/ unit	=	3149.76	Lakhs			
11	Annual cost of tubewell after assuming 12 year service life of pump		70.76				
12	Total Annual Operation and Maintanance	=	10666.58	Lakhs	Rs. Per Ha	11111.025	
13	Cost of the pumping system	=	980.93	Lakhs			
14	Costof the Rising Main	=	1213.68	Lakhs			
15	SOR	=	PL 2017				

S.N.	Year	Project Cost (Expenditure on project during the year)Rs. In lakh	CCA Developed		O & M Cost@ Rs 11111.0246 per ha.(Rs. In lakh)	Total Cost col.3 + col 6(Rs. In lakh)	Benefits Rs. In Lakh	Net cash col.8-col 7(with-or+sign) (Rs. In lakh)	Discount factor		% age worth cash flow at discount with + or - sign	
			% age	Area in ha.					A%	B%		
									12.5883%	10.00%	Col. 10 x Col.9	Col. 11 x Col. 9
1	2	3	4	5	6	7	8	9	10	11	12	13
0	2021	98324.19	0%	0	0	98324.19	0	-98324.19	1.000	1.000	-98324.19	-98324.2
1	2022	30000	0%	0	0	30000	0	-30000	0.888	0.909	-26642.98401	-27272.7
2	2023	55200	0%	0	0	55200.00	0	-55200	0.789	0.826	-43537.38063	-45619.8
3	2024	60000	0%	0	0	60000	0	-60000	0.700	0.751	-42027.74406	-45078.9
4	2025	40000	0%	0	0	40000	0	-40000	0.622	0.683	-24883.2114	-27320.5
5	2026	40000	50%	48000	5333.291798	45333.292	33565.32	-11767.972	0.552	0.621	-6501.441608	-7306.98
6	2027	11837.95	100%	96000	10666.5836	22504.534	67130.64	44626.1064	0.491	0.564	21895.6909	25190.3
7	2028		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.436	0.513	24603.86533	28975
8	2029		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.387	0.467	21850.67969	26340.9
9	2030		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.344	0.424	19405.57699	23946.3
10	2031		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.305	0.386	17234.08258	21769.3
11	2032		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.271	0.350	15305.57956	19790.3
12	2033		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.241	0.319	13592.87705	17991.2
13	2034		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.214	0.290	12071.82687	16355.6
14	2035		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.190	0.263	10720.98301	14868.8
15	2036		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.169	0.239	9521.299295	13517
16	2037		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.150	0.218	8455.860831	12288.2
17	2038		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.133	0.198	7509.645498	11171.1
18	2039		100%	96000	11647.5108	11647.511	67130.64	55483.1292	0.118	0.180	6553.448904	9979.13
19	2040		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.105	0.164	5923.01258	9232.32
20	2041		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.093	0.149	5260.224316	8393.02
21	2042		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.083	0.135	4671.602412	7630.02
22	2043		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.073	0.123	4148.847613	6936.38
23	2044		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.065	0.112	3684.589354	6305.8
24	2045		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.058	0.102	3272.281842	5732.55
25	2046		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.051	0.092	2906.11176	5211.41
26	2047		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.046	0.084	2580.916306	4737.64
27	2048		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.041	0.076	2292.110396	4306.95
28	2049		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.036	0.069	2035.622021	3915.41
29	2050		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.032	0.063	1807.834832	3559.46
30	2051		100%	96000	11647.5108	11647.511	67130.64	55483.1292	0.028	0.057	1577.644804	3179.66
31	2052		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.025	0.052	1425.876689	2941.7
32	2053		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.022	0.047	1266.320327	2674.28
33	2054		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.020	0.043	1124.618408	2431.16
34	2055		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.018	0.039	998.7730088	2210.15
35	2056		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.016	0.036	887.0097769	2009.22
36	2057		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.014	0.032	787.7529103	1826.57
37	2058		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.012	0.029	699.6029398	1660.51
38	2059		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.011	0.027	621.3169981	1509.56
39	2060		100%	96000	11880.26786	11880.268	67130.64	55250.3721	0.010	0.024	539.9306449	1342.83
40	2061		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.009	0.022	490.045555	1247.57
41	2062		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.008	0.020	435.2091963	1134.15
42	2063		100%	96000	11647.5108	11647.511	67130.64	55483.1292	0.007	0.018	379.7943899	1013.14
43	2064		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.006	0.017	343.2584861	937.317
44	2065		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.005	0.015	304.8476786	852.107
45	2066		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.005	0.014	270.7350609	774.642

S.N.	Year	Project Cost (Expenditure on project during the year)Rs. In lakh	CCA Developed		O & M Cost@ Rs 11111.0246 per ha.(Rs. In lakh)	Total Cost col.3 + col 6(Rs. In lakh)	Benefits Rs. In Lakh	Net cash col.8-col 7(with-or+sign) (Rs. In lakh)	Discount factor		% age worth cash flow at discount with + or - sign	
									A%	B%		
			% age	Area in ha.					12.5883%	10.00%	Col. 10 x Col.9	Col. 11 x Col. 9
1	2	3	4	5	6	7	8	9	10	11	12	13
46	2067		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.004	0.012	240.4396633	704.22
47	2068		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.004	0.011	213.5343369	640.2
48	2069		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.003	0.010	189.6397308	582
49	2070		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.003	0.009	168.4189439	529.091
50	2071		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.003	0.009	149.5727743	480.992
51	2072		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.002	0.008	132.8355012	437.265
52	2073		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.002	0.007	117.9711378	397.514
53	2074		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.002	0.006	104.7701046	361.376
54	2075		100%	96000	11647.5108	11647.511	67130.64	55483.1292	0.002	0.006	91.4298188	322.817
55	2076		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.001	0.005	82.63434643	298.658
56	2077		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.001	0.005	73.38751903	271.507
57	2078		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.001	0.004	65.17541654	246.825
58	2079		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.001	0.004	57.8822527	224.386
59	2080		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.001	0.004	51.40519778	203.988
60	2081		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.001	0.003	45.65292876	185.443
61	2082		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.001	0.003	40.5443417	168.585
62	2083		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.001	0.003	36.00740826	153.259
63	2084		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.001	0.002	31.97816009	139.326
64	2085		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.001	0.002	28.39978694	126.66
65	2086		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.002	25.22183565	115.146
66	2087		100%	96000	11647.5108	11647.511	67130.64	55483.1292	0.000	0.002	22.01036137	102.859
67	2088		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.002	19.89298295	95.1617
68	2089		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.002	17.66694755	86.5106
69	2090		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.001	15.69000671	78.646
70	2091		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.001	13.9342866	71.4964
71	2092		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.001	12.3750325	64.9967
72	2093		100%	96000	11880.26786	11880.268	67130.64	55250.3721	0.000	0.001	10.75402621	57.8178
73	2094		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.001	9.760443847	53.7163
74	2095		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.001	8.668244979	48.833
75	2096		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.001	7.698263747	44.3936
76	2097		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.001	6.836823932	40.3578
77	2098		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.001	6.071779691	36.689
78	2099		100%	96000	11647.5108	11647.511	67130.64	55483.1292	0.000	0.001	5.298665292	32.7742
79	2100		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.001	4.788938106	30.3214
80	2101		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.000	4.253053381	27.565
81	2102		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.000	3.777134441	25.059
82	2103		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.000	3.354471084	22.781
83	2104		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.000	2.979103983	20.71
84	2105		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.000	2.645740659	18.8272
85	2106		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.000	2.34968087	17.1157
86	2107		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.000	2.086750328	15.5597
87	2108		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.000	1.853241855	14.1452
88	2109		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.000	1.645863104	12.8593
89	2110		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.000	1.461690145	11.6902
90	2111		100%	96000	11647.5108	11647.511	67130.64	55483.1292	0.000	0.000	1.275574417	10.4429
91	2112		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.000	1.152865221	9.66135
92	2113		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.000	1.023858989	8.78304
93	2114		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.000	0.909288622	7.98459
94	2115		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.000	0.807538741	7.25871
95	2116		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.000	0.717174726	6.59883
96	2117		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.000	0.636922492	5.99894
97	2118		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.000	0.565650525	5.45358
98	2119		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.000	0.50235393	4.9578
99	2120		100%	96000	10666.5836	10666.584	67130.64	56464.0564	0.000	0.000	0.446140258	4.50709
									Total algebraic =		316.85280	92657.3

I.R.R= Discount Rate(A) + $\frac{\text{(Total of Col 12)}}{\text{Arithmetic sum of Col 12 \& 13}}$ x (Diffrence of rate of Col.11 - Col. 10

+ Say 'C'

I.R.R = (A+C) %

I.R.R= 12.6%

मध्यप्रदेश शासन
जल संसाधन विभाग,
-:: मंत्रालय ::-
वल्लभ भवन भोपाल

पत्र क्रं.22(ए)/117/2017/एमपीएस/31 /1013 भोपाल दिनांक-01/6 /2017

प्रति,

प्रमुख अभियंता,
जल संसाधन विभाग,
भोपाल म.प्र.

विषय :- बीना संयुक्त सिंचाई एवं बहुउद्देशीय परियोजना की पुनरीक्षित प्रशासकीय स्वीकृति ।

-:000:-

मंत्रि-परिषद की बैठक दिनांक 23 मई-2017, में बीना संयुक्त सिंचाई एवं बहुउद्देशीय परियोजना के लिए रू.3735.90 करोड़ (सैंतीस अरब पैंतीस करोड़ नब्बे लाख) की पुनरीक्षित प्रशासकीय स्वीकृति प्रदान किए जाने का निर्णय लिए जाने के परिप्रेक्ष्य में राज्य शासन एतद द्वारा बीना संयुक्त सिंचाई एवं बहुउद्देशीय परियोजना से 90,000 हेक्टर रबी सिंचाई हेतु रू.3735.90 करोड़ (सैंतीस अरब पैंतीस करोड़ नब्बे लाख) की पुनरीक्षित प्रशासकीय स्वीकृति प्रदान करता है ।

2 परियोजना पर व्यय मांग संख्या 23 लेखा-शीर्ष-4700 (सैच्य पूंजीगत परिव्यय) के अंतर्गत विकलनीय होगा ।

मध्यप्रदेश के राज्यपाल के नाम से
तथा आदेशानुसार
(प्रमोद कुमार खरे) 1/6/17
अवर सचिव
म.प्र.शासन, जल संसाधन विभाग

पृ. क्रं.22(ए)/117/2017/एमपीएस/31 /1014 भोपाल दिनांक-01/6 /2017

प्रतिलिपि :-

1. अपर मुख्य सचिव, म.प्र.शासन, वित्त विभाग, मंत्रालय भोपाल ।
2. प्रमुख सचिव, योजना आर्थिक एवं सांख्यिकी/आदिम जाति कल्याण/ कृषि विभाग, मंत्रालय भोपाल ।
3. मुख्य अभियंता, (बोधी) एवं सदस्य सचिव, साधिकार समिति म.प्र.शासन, जल संसाधन विभाग, भोपाल ।
4. मुख्य अभियंता, धसान-केन कछार, जल संसाधन विभाग, सागर ।
5. निज सचिव, मा. मंत्रीजी/मा. राज्य मंत्री जी म.प्र.शासन, जल संसाधन विभाग, भोपाल ।
6. उप सचिव (बजट) म.प्र.शासन, जल संसाधन विभाग, भोपाल ।
7. वेब मैनेजर, पाईकू, जल संसाधन विभाग की ओर विभागीय वेबसाईड पर प्रकाशित करने हेतु ।

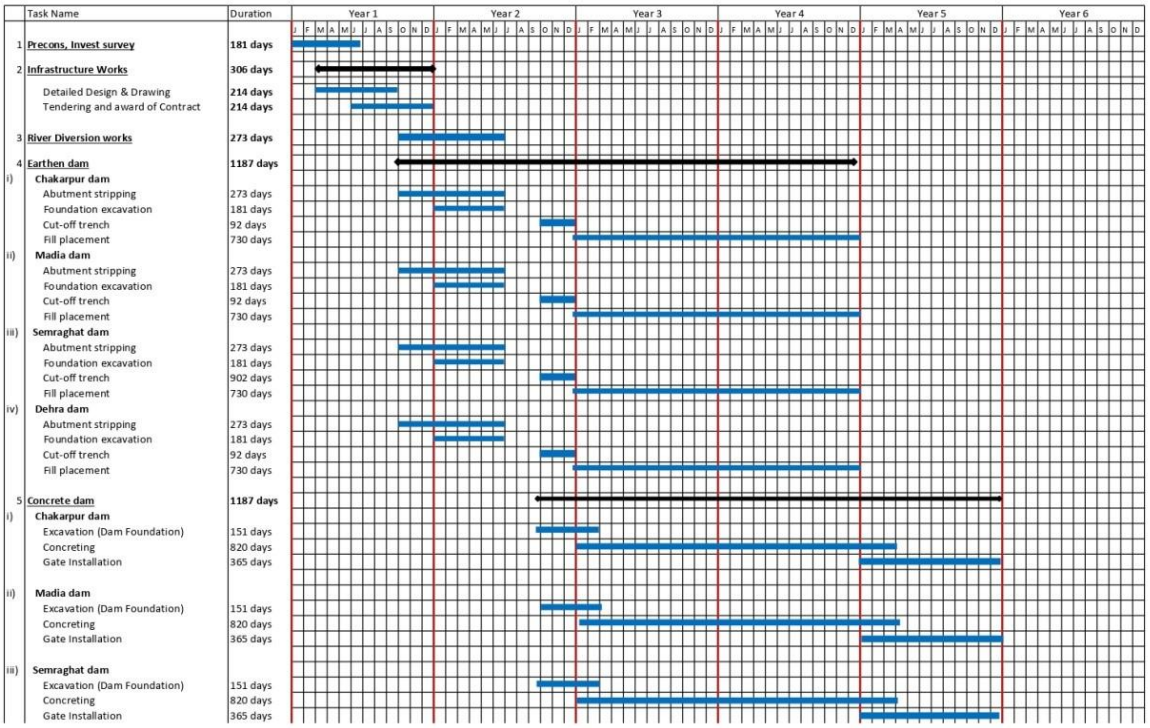
1.6.17
अवर सचिव
म.प्र.शासन, जल संसाधन विभाग

E:\एमपीएस शाखा\MPS-2017\MPS LETTER-2017.docx राऊत//

जल ही जीवन है।

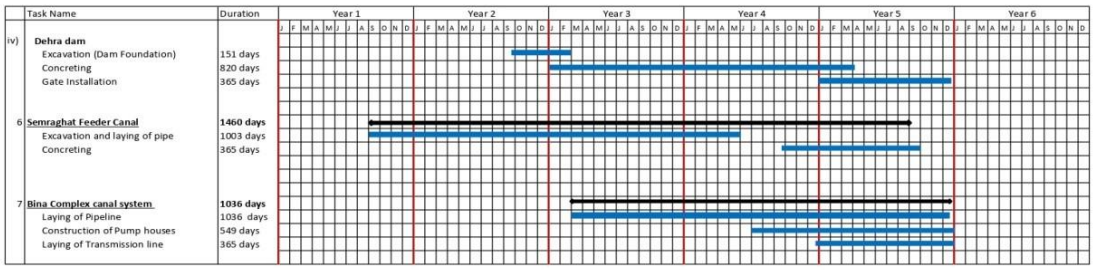
Bina Complex project

Construction Schedule



	Task Name	Duration
1	**Precons, Invest survey**	**181 days**
2	**Infrastructure Works**	**306 days**
	Detailed Design & Drawing	**214 days**
	Tendering and award of Contract	**214 days**
3	**River Diversion works**	**273 days**
4	**Earthen dam**	**1187 days**
i)	**Chakarpur dam**	
	Abutment stripping	273 days
	Foundation excavation	181 days
	Cut-off trench	92 days
	Fill placement	730 days
ii)	**Madia dam**	
	Abutment stripping	273 days
	Foundation excavation	181 days
	Cut-off trench	92 days
	Fill placement	730 days
iii)	**Semraghat dam**	
	Abutment stripping	273 days
	Foundation excavation	181 days
	Cut-off trench	902 days
	Fill placement	730 days
iv)	**Dehra dam**	
	Abutment stripping	273 days
	Foundation excavation	181 days
	Cut-off trench	92 days
	Fill placement	730 days
5	**Concrete dam**	**1187 days**
i)	**Chakarpur dam**	
	Excavation (Dam Foundation)	151 days
	Concreting	820 days
	Gate Installation	365 days
ii)	**Madia dam**	
	Excavation (Dam Foundation)	151 days
	Concreting	820 days
	Gate Installation	365 days
iii)	**Semraghat dam**	
	Excavation (Dam Foundation)	151 days
	Concreting	820 days
	Gate Installation	365 days

545



	Task Name	Duration
iv)	**Dehra dam**	
	Excavation (Dam Foundation)	151 days
	Concreting	820 days
	Gate Installation	365 days
6	**Semraghat Feeder Canal**	**1460 days**
	Excavation and laying of pipe	1003 days
	Concreting	365 days
7	**Bina Complex canal system**	**1036 days**
	Laying of Pipeline	1036 days
	Construction of Pump houses	549 days
	Laying of Transmission line	365 days

546

अनुलग्नक–1

केन–बेतवा लिंक परियोजना फेज–।। के अंतर्गत परियोजनाओं पर अद्यतन व्यय

(राशि करोड़ में)

स.क्र.	परियोजना का नाम	भारत सरकार द्वारा स्वीकृत राशि	30 नवंबर 2021 तक अद्यतन व्यय			भौतिक प्रगति			रूपांकित सिंचाई (हे.)
			भू–अर्जन एवं वन	कार्य	कुल व्यय	शीर्ष कार्य (%)	नहर कार्य (%)	कुल कार्य (%)	
1	कोठा बैराज	709.46	73.00	78.06	151.06	10	25	20	20,000
2	बीना परियोजना	3353.62	853.11	183.14	1036.25	40	5	10	96,000
3	लोअर उर्र	2657.03	414.92	1249.6	1664.52	70	25	50	90,000
	योग	**6720.11**	**1341.03**	**1510.8**	**2851.83**				**206000**

16.12.21

(एम. एस. डाबर)
प्रमुख अभियंता
जल संसाधन विभाग

16/12

PHYSICAL AND FINANCIAL PROGRAMME FOR COMPLETION OF BINA COMPLEX PROJECT

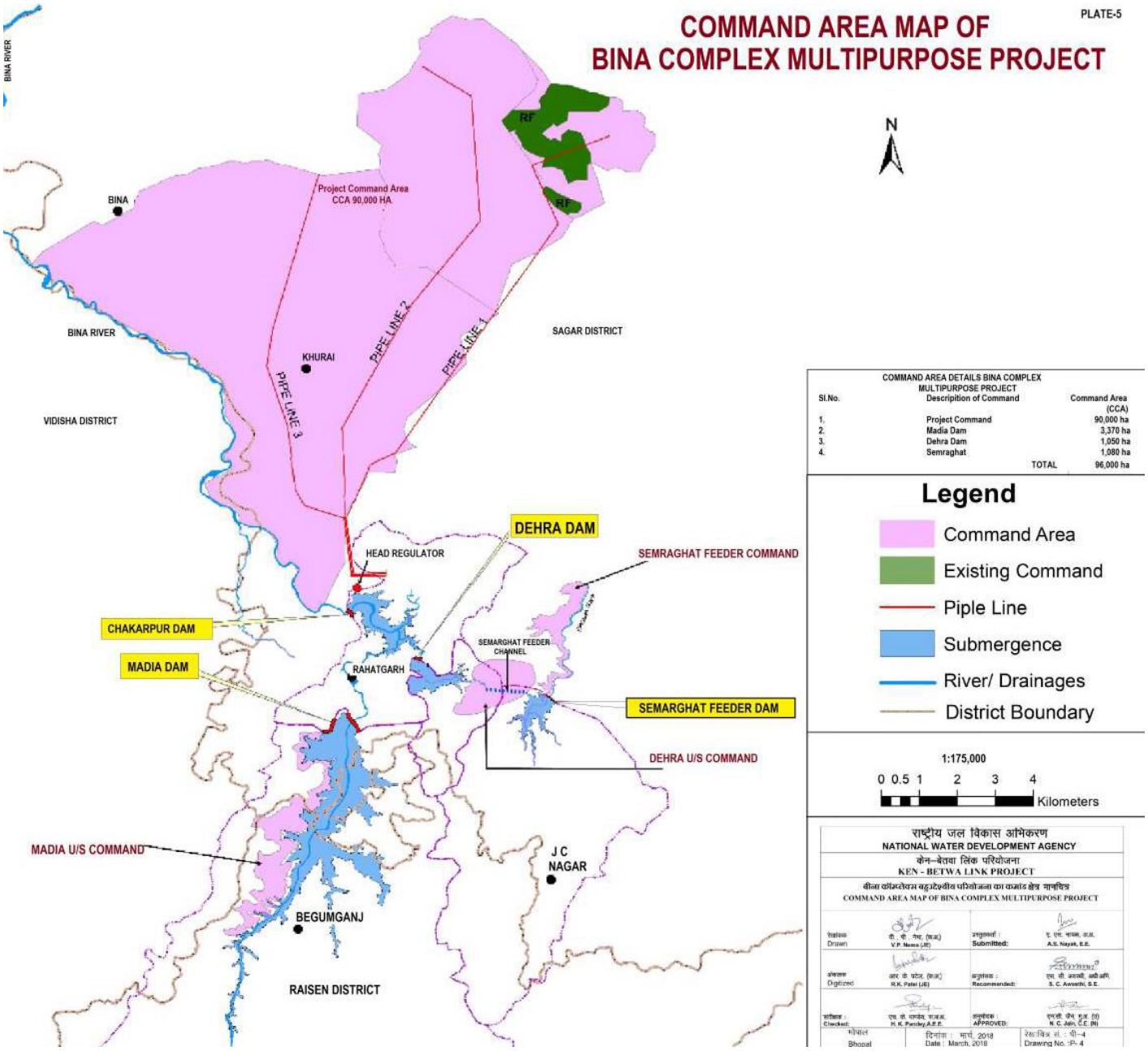
S.No.	Year	Yearly Phasing of Project Cost (Rs. In Crore)	Physical Progress	
			Dam	Canal
1	2	3	4	5
1	2021-22	1275.00	40%	5%
2	2022-23	500.00	30%	20%
3	2023-24	500.00	20%	20%
4	2024-25	350.00	7.5%	25%
5	2025-26	350.00	2.5%	15%
6	2026-27	300.00		10%
7	2027-28	78.62		5%
	Total	**3353.62**	**100%**	**100%**

Additional Project Director
Betwa Project Management Unit
Water Resources Department,Bhopal

Project Director
Betwa Project Management Unit
Water Resources Department,Bhopal

(Shirish Mishra)
Project Director,
Betwa Project Management Unit
Water Resources Deptt., Bhopal

2.1 Location Map of the project



Hydraulic design for size of tunnel

Velocity in tunnel=(R^2/3xS^1/2)/n

R= wetted perimeter

S=bed slope of tunnel

n=reigoocitycofficient

Discharge required=159.9 Cumec

Cross sectional Area of tunnel

h= Rectangular height in M

h= crown radius in M

Base width=2h in M

A1= Area for rectangular portion with height h & base width 2h=2h^2 M^2

A2=Area of D portion = (3.14 h^2)/2 where h is the radius of crown same as rectangular height in M.

Total area (A1+A2)=3.57 h^2

Velocity in tunnel=(R^2/3xS^1/2)/n

R= wetted perimeter

S= bed slope of tunnel

n= rugeocity coefficient

Base width= 8.5M

Tunnel height =8.5m

Radius of Crown h=4.0m

Area of cross section of tunnel= 3.57x4.0^2=57.12M^2

R=A/P

P= (8.5+4.0+4.0+3.14x4.0) =29.06m

A=57.12M^2

R=1.96M

S=1/800 = bed slope of tunnel

n= .017

V=(R^2/3xS^1/2)/n

V=3.26m/sec

As per IS code 4880- part-3 “Code of practice for design of tunnel conveying water” the permissible velocity of water is 8m/sec. So our velocity 3.26m/sec is in very safe side.

ANNEXURE-4.2

File No.T-11308/4/2020-BCD(NWS) DTE

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन नदी विकास एवं गंगा संरक्षण विभाग
केंद्रीय जल आयोग
बैराजएंवनहरअभिकल्प (उ.प.एवं द.) निदेशालय

सत्यमेव जयते

Government of India
Ministry of Jal Shakti
Dept. of Water Resources, RD&GR
Central Water Commission
BCD (NW&S) Directorate

To,

The Chief Engineer,
NWDA, Lucknow-226010

Subject: Feasibility of 32 km long alternate alignment of Ken-Betwa Link Project.

Ref: The MoU dated 20.11.2020 signed between CWC and NWDA.

Sir,

Reference is invited to the MOU under reference on the subject cited above. In this regard, it is to mention that, based on the limited available data provided by the NWDA, presentation/ discussions held and visit to the project site conducted by CWC team, the proposal for 32 km long alternate alignment of Ken-Betwa Link Project has been examined to study its feasibility and is observed as below:

1) **Head limitation and corresponding uneconomical diameter:** The available gravity head is 8.85 m in the 32.0 km stretch of the new alternate. For 0.5 m driving head at exit, six pipes of 3.2 m diameter each with maximum thickness of up to 20 mm shall be required for carrying discharge of 42.07 cumec.

NWDA has estimated cost of 3m dia with 14 mm thickness as Rs 9702 Crore, which is 22% higher than the cost of Rs 7932 Crore for the original alignment of open channel. The cost of the 3.2 m diameter each with maximum up to 20 mm thickness pipe will be even more and if the cost the land acquisition for this new alternate is considered, then the cost will further go up, hence much costlier as compared to the originally approved canal.

2) **Inherent Silt and O&M Challenges:** The representative silt data of the site is not available. However, due to inherent silt concentration in the sub- basin, it is apprehended that technically there may be issues with effective silt transport through the proposed alternative 32km long pipes, therefore, posing maintenance problem. Further, it may also lead to frequent air entrainment, impairing the delivery efficiency. On the contrary, the already approved open channel provides hassle free flow conditions, therefore, is a better option as compared to the new alternate alignment.

In view of the economic un-viability, silt related management issues and O&M challenges, the proposal for the 32 km long alternate alignment of Ken-Betwa Link Project may not be feasible. As such, CWC is of considered opinion that the original proposal for 74 km long (open channel) is better and safe proposition to proceed with, dropping the new alternate for the aforesaid reasons.

This issues with approval of Member D&R, CWC.

Yours faithfully,

Asstt. Director

षष्ठ तल(दक्षिण), सेवा भवन
राम कृष्ण पुरम, नई दिल्ली -110066
दूरभाष: 011-29583270,
ई मेल: bcdnwsdte@nic.in
•जल संरक्षण-सुरक्षित भविष्य•

6th Floor(South), SewaBhawan,
R.K. Puram, New Delhi-110066
Tel: 011-29583270,
E-mail: bcdnwsdte@nic.in
ΣConserve Water- Save LifeΣ

KEN-BETWA LINK PROJECT (PHASE-I) **Annexure- 4.3**

Design of Modified Ken-Betwa Link as per latest CWR provided by MP and UP and MOA 2021

Peak demand of KBLP at Head in Jan **313.98** MCM **(Considering 25 days running of canal in a month)**

As per DPR April 2010

Sl. No.	RD of outlet in m.		Name of Outlet/ Channels	Culturable command area in ha.			Water reqirement for irrigation in Jan month MCM			Water tranfer in Parrichha for Lalitpur	Domestic water supply	Total water reqirement in Jan Month (MCM)	Peak Discharge(Jan month) in Cumecs	Design Discharge of branch 110 % (Jan month) in Cumecs	Design Discharge of Modified Ken Betwa Link Canal125 % (Jan month) in Cumecs	Canal Size			Bed Slope	Velocity in m per second	Bed Width in m	FSD in m	Design Discharge in cumecs
	Rom	To		MP	UP	Total	MP	UP	Total							Bed Width in m	FSD in m	Design Discharge in cumecs					
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**21**	**22**	**23**	**24**	**25**
1	0	18	**Peak Discharge at Head**							0	0				159.9	13.2	5.1	165.05	1:9000	1.36			
2	18	44	**PS-1**	43678		43678	53.934		53.934		1	54.93	25.43	27.98	**131.92**	13.2	4.6	134.46	1:9000	1.28	**13.2**	**3.44**	**76.23**
3	44	71	**PS-2**	22730		22730	28.0673		28.0673		2	30.07	13.92	15.31	**116.61**	13.2	4.3	117.77	1:9000	1.23	**13.2**	**3.44**	**76.23**
4	71	87	**PS-3**	29322	**42214**	71536	36.2072	53.8972	90.1044		5	95.10	44.03	48.43	**68.18**	13.2	3.3	70.71	1:9000	1.07	**13.2**	**3.44**	**76.23**
5	87	102	**PS-4**	15823		15823	19.5384		19.5384		1	20.54	9.51	10.46	**57.72**	13.2	3	59.07	1:9000	1.01	**13.2**	**3.44**	**76.23**
6	102	171	**PS-5**	20860		20860	25.7582		25.7582			25.76	11.93	13.12	**44.60**	10	3	45.39	1:10000	0.98	**13.1**	**3.44**	**72.04**
7	171	207	**PS-6**	25112	**5568**	30680	31.0086	6.10353	37.1121			37.11	17.18	18.90	**25.70**	10	3	42.70	1:11300	0.98	**13**	**3.44**	68.42
8	207	216	**PS-7**	25000	**7270**	32270	30.8703	7.96923	38.8395			38.84	17.98	19.78	**5.92**	10	3	42.70	1:11300	0.89	**13**	**3.44**	68.42
9	216	218										0.00	0.00	0.00	**5.92**	10	3	41.43	1:12000	0.89	**10.75**	**3.44**	**59.32**
	Tail end									4.63	7	11.63											
			Total	182525	55052	237577	225.38	67.97	293.35	4.63	16.00	313.98	139.98	153.98									

Average **68.50 Cumecs**

Annexure-6.1

Annexure 1 to letter dated 25/06/2021

Cropping pattern proposed for the Ken Betwa Link Project for Madhya Prasesh

CCA	451364	Ha					
		% of CCA					
	S. No.	**Name of the crop**	**HLC Command**	**Ken LBC MP Command**	**SALEHA Damoh**	**KBL Enroute Command**	**Bariyarpur**	**Saleha Panna**
Kharif	1	Paddy	7	7	7	7	7	7
	2	Jowar / Maize/Bajra	6	6	6	6	6	6
	3	Pulses	10	10	10	10	10	10
	4	Oil seeds	15	15	15	15	15	15
	5	Vegetables	6	6	6	6	6	6
		Total	**44**	**44**	**44**	**44**	**44**	**44**
Rabi	1	Wheat(HYV)- 1MV	60	60	60	60	0	60
	2	Wheat(HYV) - 3 MV	0	0	0	0	60	0
	3	Gram	23	23	23	23	23	23
	4	Peas/Fodder1RA	5	5	5	5	5	5
	5	Oil seeds	7	7	7	7	7	7
	6	Vegetables	5	5	5	5	5	5
		Total	**100**	**100**	**100**	**100**	**100**	**100**

Note -

1. Crop water requirement for rabi reduced to 90% in crop water computation in light of 90% rabi irrigation intensity. Hence irrigation intensity accounts to 134%
2. Rainfall data is as per MPWRD database
3. Effective rainfall computaion for kharif crops is as per TC-25
4. Percolation losses are adopted as 3mm/day for paddy (ponded crops)
5. Efficiency adopted for crop water requirement computation is as TC 59 of MPWRD which depends on type of crop and method of irrigation

Annexure-6.2

Annexure 2 to letter dated 25/06/2021

KEN BETWA LINK PROJECT

ABSTRACT OF CROP WATER REQUIREMENT OF MP

(All figures are in mcum)

Particulars		Months										TOTAL
CCA-KBL		JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	
	Kharif	7.612	55.621	18.865	65.037	0.000	0.000	0.000	0.000	0.000	0.000	147.135
138847	Rabi	0.000	0.000	0.000	0.000	16.182	152.021	151.959	171.450	63.035	0.000	554.647
Ha												
Micro	**Sub Total**	**7.612**	**55.621**	**18.865**	**65.037**	**16.182**	**152.021**	**151.959**	**171.450**	**63.035**	**0.000**	**701.782**
CCA-HLC												
	Kharif	2.395	17.498	5.934	20.459	0.000	0.000	0.000	0.000	0.000	0.000	46.286
43678	Rabi	0.000	0.000	0.000	0.000	5.091	47.822	47.803	53.934	19.829	0.000	174.48
Ha												
Micro	**Sub Total**	**2.395**	**17.498**	**5.934**	**20.459**	**5.091**	**47.822**	**47.803**	**53.934**	**19.829**	**0.000**	**220.765**
CCA-KEN_Command												
	Kharif	7.667	56.022	19.001	65.506	0.000	0.000	0.000	0.000	0.000	0.000	148.196
139848	Rabi	0.000	0.000	0.000	0.000	16.299	153.117	153.055	172.686	63.489	0.000	558.646
Ha												
Micro	**Sub Total**	**7.667**	**56.022**	**19.001**	**65.506**	**16.299**	**153.117**	**153.055**	**172.686**	**63.489**	**0.000**	**706.842**
CCA-Bariyarpur_LMC_Command												
	Kharif	2.540	18.601	6.312	21.761	0.000	0.000	0.000	0.000	0.000	0.000	49.214
38890	Rabi	0.000	0.000	0.000	0.000	5.382	17.402	51.951	54.014	46.052	0.000	174.801
Ha												
Flow	**Sub Total**	**2.540**	**18.601**	**6.312**	**21.761**	**5.382**	**17.402**	**51.951**	**54.014**	**46.052**	**0.000**	**224.015**
CCA-SALEHA Panna												
	Kharif	16.598	62.945	1.492	23.695	0.000	0.000	0.000	0.000	0.000	0.000	104.730
70000	Rabi	0.000	0.000	0.000	0.000	7.666	67.664	57.561	67.664	26.348	0.000	226.903
Ha												
Micro	**Sub Total**	**16.598**	**62.945**	**1.492**	**23.695**	**7.666**	**67.664**	**57.561**	**67.664**	**26.348**	**0.000**	**331.634**
CCA-SALEHA Damoh												
	Kharif	4.806	6.535	1.862	6.936	0.000	0.000	0.000	0.000	0.000	0.000	20.138
20101	Rabi	0.000	0.000	0.000	0.000	2.250	22.529	24.343	25.777	9.615	0.000	84.515
Ha												
	Sub Total	**4.806**	**6.535**	**1.862**	**6.936**	**2.250**	**22.529**	**24.343**	**25.777**	**9.615**	**0.000**	**104.653**
Total CCA - Ken Betwa	Kharif	41.617	217.222	53.466	203.395	0.000	0.000	0.000	0.000	0.000	0.000	**515.70**
451364	Rabi	0.000	0.000	0.000	0.000	52.870	460.555	486.673	545.524	228.369	0.000	**1773.99**
Ha												
Hybrid	**Total**	**41.617**	**217.222**	**53.466**	**203.395**	**52.870**	**460.555**	**486.673**	**545.524**	**228.369**	**0.000**	**2289.7**

Flow	8.6	%
Micro	91.4	%

Annexure-6.3

Ken-Betwa Link Project

Month wise Water Requirement (M.C.M.) of U.P.

Month	**Ken Canal (Banda District)** Irrigation			**Enroute Command** (Jhansi District) Irrigation		Mahoba Command Irrigation	**Govind Sagar** Dam (Lalitpur) Command Irrigation	Drinking Water Requirement (MCM)			**Total Water Requirement (MCM)**
	Paddy 84990 Ha. Lined Canal	Wheat 88012 Ha. Lined Canal	Jayad 19477 Ha. Lined Canal	**Peddy** 2606 Ha. Pressurised Piped/ Micro Irrigation	Wheat 14882 Ha. Pressurised-Piped/ Micro Irrigation	Wheat 37564 Ha. Pressurised-Piped/ Micro Irrigation	Wheat 3533 Ha. Lined Canal	**Jhansi City** (Population-6.54 Lakh)	**Lalitpur City** (Population-1.33 Lakh)	**Mahoba City** (Population-0.95 Lakh)	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**(=2+3+4+5+6+7+8+9+10+11)
Jan		116.24	33.39		19.17	48.80	4.63		7.00		229.22
Feb		113.36	36.77		18.93	50.49	4.44		7.00		230.98
March		82.40			14.52	37.12	3.42	5.00	7.00	7.00	156.46
April								5.00	7.00	8.00	20.00
May								4.66	3.98	5.13	13.77
June	13.49			0.69							14.18
July	127.58			5.81							133.39
Aug	207.14			6.71							213.85
Sep	240.81			6.69							247.50
Oct	152.35			4.77							157.13
Nov		50.02	4.66		8.49	20.66	1.86				85.69
Dec		111.79	15.78		18.98	46.91	4.60				198.05
Total-	**741.37**	**473.81**	**90.59**	**24.67**	**80.09**	**203.97**	**18.95**	**14.66**	**31.98**	**20.13**	**1700.22**

08.11.2021

(शील चन्द्र उपाध्याय)
अधीक्षण अभियन्ता
सिंचाई निर्माण मण्डल झाँसी

CROP WATER REQUIREMENT (U.P.)

Ken Canal (Banda District) Water Requirement for Irrigation-

CROP- Peddy (Kharif) -

ET0 Station- **Banda**
CCA (Ha)- 84,990
Canal Type- Lined Canal System
Irrigation System- Pressurised Piped Micro Irrigation-
Soil Type- Clayey-Loam
Soil Moisture Adjustment- Nil (Assumed)
Percolation Loss- 4.00 mm/day (Assumed)
Conveyance Efficiency- 75% (Assumed)
Field Pipe Efficiency- 84% (Assumed)

ET0 Station-	Jhansi	Lalitpur	Banda	Mahoba
Lalitude (Deg.)	23.4500-N	24.6912-N	25.4763-N	25.2921-N
Longitude (Deg.)	78.5800-E	78.4138-E	80.3395-E	79.8724-E
Altitude (m)	251 m	350 m	120 m	210 m
Population (2011)	6.50 Lakh	1.33 Lakh	1.54 Lakh	0.95 Lakh
Annual Rainfall (mm)	871	953	951	618
Avg Temp. (°C)	25.8	25.2	26	28
Avg Sun Shine Hour	9.8	9.6	9.7	9.4
Relative Humidity (%)	53%	53%	56%	43%

SL. No.	Month	Period	No. of Days	Crop Stage	ET0 (mm/day)	ET0 (mm/ Period)	Crop Coefficient (Kc)	Consumptive Use (Kc*ET0) (mm)	Percolation Loss @ 4 mm/day (mm)	Effective Rainfall (mm)	Net Irrigation Reqirement (mm)	F.I.R = NIR/0.84 (mm)	G.I.R = FIR/0.75 (mm)	Proposed Area of Irrigation (Ha)	Water Requirement (MCM)	Monthly Water Requirement (MCM)
1	2	3	4	5	6	7 (=Col 4*6)	8	9 (=Col 7*8)	10	11	12 (=9+10-11)	13 (=Col 12/0.84)	14 (=Col 13/0.75)	15	16 (=0.00001*Col 15)	17
1	June	11 --30	20	Nursary				50.00		40.00	10.00	11.90	15.87	84,990	13.49	13.49
2	July	1--10	10	Nursary & Transplantation	4.71	47.10	1.10	51.81		48.40	3.41	4.06	5.41	84,990	4.60	
		11 --31	21	Initial stage	4.71	98.91	1.10	108.80	84.00	101.64	91.16	108.53	144.70	84,990	122.98	127.58
3	Aug	1--31	31	Mid Season	4.21	130.51	1.30	169.66	124.00	140.12	153.54	182.79	243.72	84,990	207.14	207.14
4	Sep	1--30	30	Development	4.50	135.00	1.10	148.50	120.00	90.00	178.50	212.50	283.33	84,990	240.81	240.81
5	Oct	1--15	15	Late Stage	4.22	63.30	0.95	60.14	60.00	7.20	112.94	134.45	179.26	84,990	152.35	152.35
Total													**872.30**			**741.37**

Ken Canal (Banda District) Water Requirement for Irrigation-

CROP -Wheat (Rabi)-

ET0 Station- **Banda**
CCA (Ha)- 88,012
Canal Type- Lined Canal System
Irrigation System- Pressurised Piped Micro Irrigation-
Soil Type- Clayey-Loam
Soil Moisture Adjustment- Nil (Assumed)
Percolation Loss- 0.00 mm/day (Assumed)
Conveyance Efficiency- 75% (Assumed)
Field Pipe Efficiency- 84% (Assumed)

ET0 Station-	Jhansi	Lalitpur	Banda	Mahoba
Lalitude (Deg.)	23.4500-N	24.6912-N	25.4763-N	25.2921-N
Longitude (Deg.)	78.5800-E	78.4138-E	80.3395-E	79.8724-E
Altitude (m)	251 m	350 m	120 m	210 m
Population (2011)	6.50 Lakh	1.33 Lakh	1.54 Lakh	0.95 Lakh
Annual Rainfall (mm)	871	953	951	618
Avg Temp. (°C)	25.8	25.2	26	28
Avg Sun Shine Hour	9.8	9.6	9.7	9.4
Relative Humidity (%)	53%	53%	56%	43%

SL No.	Month	Period	No. of Days	Crop Stage	ET0 (mm/day)	ET0 (mm/Period)	Crop Coefficient (Kc)	Consumptive Use (Kc*ET0) (mm)	Percolation Loss @ 0 mm/day (mm)	Effective Rainfall (mm)	Net Irrigation Reqirement (mm)	F.I.R = NIR/0.84 (mm)	G.I.R = FIR/0.75 (mm)	Proposed Area of Irrigation (Ha)	Water Requirement (MCM)	Monthly Water Requirement (MCM)
1	2	3	4	5	6	7 (=Col 4*6)	8	9 (=Col 7*8)	10	11	12 (=9+10-11)	13 (=Col 12/0.84)	14 (=Col 13/0.75)	15	16 (=0.00001*Col 15)	17

812

1	November	1--15	15	Pre sowing	3.10	46.50	0.33	15.35	0.00	0.00	15.35	18.27	24.36	88,012	21.44	
		16 --30	15	Initial stage	3.10	46.50	0.44	20.46	0.00	0.00	20.46	24.36	32.48	88,012	28.58	50.02
2	December	1 --31	31	Mid Season	2.39	74.09	1.08	80.02	0.00	0.00	80.02	95.26	127.01	88,012	111.79	111.79
3	January	1--31	31	Development	2.44	75.64	1.10	83.20	0.00	0.00	83.20	99.05	132.07	88,012	116.24	116.24
4	February	1 --28	28	Development	3.22	90.16	0.90	81.14	0.00	0.00	81.14	96.60	128.80	88,012	113.36	113.36
5	March	1 --15	15	Late Stage	4.52	67.80	0.87	58.99	0.00	0.00	58.99	70.22	93.63	88,012	82.40	82.40
	Total												**538.34**			**473.81**

Ken Canal (Banda District) Water Requirement for Irrigation-

CROP -Vegetable (Zaid)-

ET0 Station- **Banda**

CCA (Ha)- 19,477 Ha

Canal Type- Lined Canal System

Irrigation System- Pressurised Piped Micro Irrigation-

Soil Type- Clayey-Loam

Soil Moisture Adjustment- Nil (Assumed)

Percolation Loss- 0.00 mm/day (Assumed)

Conveyance Efficiency- 75% (Assumed)

Field Pipe Efficiency- 84% (Assumed)

ET0 Station-	Jhansi	Lalitpur	Banda	Mahoba
Lalitude (Deg.)	23.4500-N	24.6912-N	25.4763-N	25.2921-N
Longitude (Deg.)	78.5800-E	78.4138-E	80.3395-E	79.8724-E
Altitude (m)	251 m	350 m	120 m	210 m
Population (2011)	6.50 Lakh	1.33 Lakh	1.54 Lakh	0.95 Lakh
Annual Rainfall (mm)	871	953	951	618
Avg Temp. (°C)	25.8	25.2	26	28
Avg Sun Shine Hour	9.8	9.6	9.7	9.4
Relative Humidity (%)	53%	53%	56%	43%

SL. No.	Month	Period	No. of Days	Crop Stage	ET0 (mm/day)	ET0 (mm/ Period)	Crop Coefficient (Kc)	Consumptive Use (Kc*ET0) (mm)	Percolation Loss @ 0 mm/day (mm)	Effective Rainfall (mm)	Net Irrigation Reqirement (mm)	F.I.R = NIR/0.84 (mm)	G.I.R = FIR/0.75 (mm)	Proposed Area of Irrigation (Ha)	Water Requirement (MCM)	Monthly Water Requirement (MCM)
1	2	3	4	5	6	7 (=Col 4*6)	8	9 (=Col 7*8)	10	11	12 (=9+10-11)	13 (=Col 12/0.84)	14 (=Col 13/0.75)	15	16 (=0.00001*Col 15)	17
1	November	1--15	15	Pre sowing	3.10	62	0.00	0.000	0.00	0.000	0.00	0.00	0.00	19,477	0.00	
		16 --30	15	Initial stage	3.10	52.00	0.29	15.080	0.00	0.000	15.08	17.95	23.94	19,477	4.66	4.66
2	December	1--15	15	Mid Season	2.39	51.00	0.37	18.870	0.00	0.000	18.87	22.46	29.95	19,477	5.83	
		16 --31	16	Mid Season	2.39	48.00	0.67	32.160	0.00	0.000	32.16	38.29	51.05	19,477	9.94	15.78
3	January	1--15	15	Development	2.44	51.00	1.00	51.000	0.00	0.000	51.00	60.71	80.95	19,477	15.77	
		16 --31	16	Development	2.44	57.00	1.00	57.000	0.00	0.000	57.00	67.86	90.48	19,477	17.62	33.39
4	February	1--15	15	Development	3.22	55.00	1.00	55.000	0.00	0.000	55.00	65.48	87.30	19,477	17.00	
		16 --28	13	Late Stage	3.22	68.00	0.94	63.920	0.00	0.000	63.92	76.10	101.46	19,477	19.76	36.77
	Total												**465.13**			**90.59**

Enroute Command (Jhansi District) Water Requirement for Irrigation-

CROP- Peddy (Kharif)-

ET0 Station- **Jhansi**

CCA (Ha)- 2,606

Canal Type- Lined Canal System

Irrigation System- Pressurised Piped Micro Irrigation-

Soil Type- Clayey-Loam

Soil Moisture Adjustment- Nil (Assumed)

Percolation Loss- 4.00 mm/day (Assumed)

Conveyance Efficiency- 75% (Assumed)

Field Pipe Efficiency- 84% (Assumed)

ET0 Station-	Jhansi	Lalitpur	Banda	Mahoba
Lalitude (Deg.)	23.4500-N	24.6912-N	25.4763-N	25.2921-N
Longitude (Deg.)	78.5800-E	78.4138-E	80.3395-E	79.8724-E
Altitude (m)	251 m	350 m	120 m	210 m
Population (2011)	6.50 Lakh	1.33 Lakh	1.54 Lakh	0.95 Lakh
Annual Rainfall (mm)	871	953	951	618
Avg Temp. (°C)	25.8	25.2	26	28
Avg Sun Shine Hour	9.8	9.6	9.7	9.4
Relative Humidity (%)	53%	53%	56%	43%

6.1.21

(शील चन्द्र उपाध्याय)

Annexure-6.3 Contd.

SL. No.	Month	Period	No. of Days	Crop Stage	ET0 (mm/day)	ET0 (mm/ Period)	Crop Coefficient (Kc)	Consumptive Use (Kc*ET0) (mm)	Percolation Loss @ 4 mm/day (mm)	Effective Rainfall (mm)	Net Irrigation Reqirement (mm)	F.I.R = NIR/0.84 (mm)	G.I.R = FIR/0.75 (mm)	Proposed Area of Irrigation (Ha)	Water Requirement (MCM)	Mon. Water Requirement (MCM)
1	2	3	4	5	6	7 (=Col 4*6)	8	9 (=Col 7*8)	10	11	12 (=9+10-11)	13 (=Col 12/0.84)	14 (=Col 13/0.75)	15	16 (=0.00001*Col 15)	17
1	June	11 --30	20	Nursary				50.00		33.40	16.60	19.76	26.35	2,606	0.69	0.69
2	July	1--10	10	Transplantation	4.59	45.90	1.10	50.49	40.00	45.20	45.29	53.92	71.89	2,606	1.87	
		11 --31	21	Initial stage	4.59	96.39	1.10	106.03	84.00	94.92	95.11	113.23	150.97	2,606	3.93	5.81
3	Aug	1--31	31	Mid Season	4.05	125.55	1.30	163.22	124.00	124.93	162.29	193.20	257.60	2,606	6.71	6.71
4	Sep	1--30	30	Development	4.45	133.50	1.10	146.85	120.00	105.00	161.85	192.68	256.90	2,606	6.69	6.69
5	Oct	1--15	15	Late Stage	4.22	63.30	0.95	60.14	60.00	4.80	115.34	137.30	183.07	2,606	4.77	4.77
Total													**946.78**			**24.67**

Enroute Command (Jhansi District) Water Requirement for Irrigation-

CROP -Wheat (Rabi)-

ET0 Station- **Jhansi**

CCA (Ha)- 14,882

Canal Type- Lined Canal System

Irrigation System- Pressurised Piped Micro Irrigation-

Soil Type- Clayey-Loam

Soil Moisture Adjustment- Nil (Assumed)

Percolation Loss- 0.00 mm/day (Assumed)

Conveyance Efficiency- 75% (Assumed)

Field Pipe Efficiency- 84% (Assumed)

ET0 Station-	Jhansi	Lalitpur	Banda	Mahoba
Lalitude (Deg.)	23.4500-N	24.6912-N	25.4763-N	25.2921-N
Longitude (Deg.)	78.5800-E	78.4138-E	80.3395-E	79.8724-E
Altitude (m)	251 m	350 m	120 m	210 m
Population (2011)	6.50 Lakh	1.33 Lakh	1.54 Lakh	0.95 Lakh
Annual Rainfall (mm)	871	953	951	618
Avg Temp. (°C)	25.8	25.2	26	28
Avg Sun Shine Hour	9.8	9.6	9.7	9.4
Relative Humidity (%)	53%	53%	56%	43%

SL. No.	Month	Period	No. of Days	Crop Stage	ET0 (mm/day)	ET0 (mm/Period)	Crop Coefficient (Kc)	Consumptive Use (Kc*ET0) (mm)	Percolation Loss (mm)	Effective Rainfall (mm)	Net Irrigation Reqirement (mm)	F.I.R = NIR/0.84 (mm)	G.I.R = FIR/0.75 (mm)	Proposed Area of Irrigation (Ha)	Water Requirement (MCM)	Monthly Water Requirement (MCM)
1	2	3	4	5	6	7 (=Col 4*6)	8	9 (=Col 7*8)	10	11	12 (=9+10-11)	13 (=Col 12/0.84)	14 (=Col 13/0.75)	15	16 (=0.00001*Col 15)	17
1	November	1--15	15	Pre sowing	3.11	46.65	0.33	15.39	0.00	0.00	15.39	18.33	24.44	14,882	3.64	
		16 --30	15	Initial stage	3.11	46.65	0.44	20.53	0.00	0.00	20.53	24.44	32.58	14,882	4.85	8.49
2	December	1 --31	31	Mid Season	2.40	74.40	1.08	80.35	0.00	0.00	80.35	95.66	127.54	14,882	18.98	18.98
3	January	1--31	31	Development	2.38	73.78	1.10	81.16	0.00	0.00	81.16	96.62	128.82	14,882	19.17	19.17
4	February	1 --28	28	Development	3.18	89.04	0.90	80.14	0.00	0.00	80.14	95.40	127.20	14,882	18.93	18.93
5	March	1 --15	15	Late Stage	4.71	70.65	0.87	61.47	0.00	0.00	61.47	73.17	97.56	14,882	14.52	14.52
Total													**538.15**			**80.09**

Enroute Command (Mahoba District) Water Requirement for Irrigation-

CROP -Wheat (Rabi)-

ET0 Station- **Mahoba**

CCA (Ha)- 37,564

Canal Type- Lined Canal System

Irrigation System- Pressurised Piped Micro Irrigation-

Soil Type- Clayey-Loam

Soil Moisture Adjustment- Nil (Assumed)

Percolation Loss- 0.00 mm/day (Assumed)

Conveyance Efficiency- 75% (Assumed)

Field Pipe Efficiency- 84% (Assumed)

ET0 Station-	Jhansi	Lalitpur	Banda	Mahoba
Lalitude (Deg.)	23.4500-N	24.6912-N	25.4763-N	25.2921-N
Longitude (Deg.)	78.5800-E	78.4138-E	80.3395-E	79.8724-E
Altitude (m)	251 m	350 m	120 m	210 m
Population (2011)	6.50 Lakh	1.33 Lakh	1.54 Lakh	0.95 Lakh
Annual Rainfall (mm)	871	953	951	618
Avg Temp. (°C)	25.8	25.2	26	28
Avg Sun Shine Hour	9.8	9.6	9.7	9.4
Relative Humidity (%)	53%	53%	56%	43%

(शील चन्द्र उपाध्याय)

Annexure-6.3 Contd.

SL. No.	Month	Period	No. of Days	Crop Stage	ET0 (mm/day)	ET0 (mm/Period)	Crop Coefficient (Kc)	Consumptive Use (Kc*ET0) (mm)	Percolation Loss @ 2mm/day (mm)	Effective Rainfall (mm)	Net Irrigation Reqirement (mm)	F.I.R = NIR/0.84 (mm)	G.I.R = FIR/0.75 (mm)	Proposed Area of Irrigation (Ha)	Water Requirement (MCM)	Mon. Water Requirement (MCM)
1	2	3	4	5	6	7 (=Col 4*6)	8	9 (=Col 7*8)	10	11	12 (=9+10-11)	13 (=Col 12/0.84)	14 (=Col 13/0.75)	15	16 (=0.00001*Col 15)	17
1	November	1--15	15	Pre sowing	3.00	45.00	0.33	14.85	0.00	0.00	14.85	17.68	23.57	37,564	8.85	
		16 --30	15	Initial stage	3.00	45.00	0.44	19.80	0.00	0.00	19.80	23.57	31.43	37,564	11.81	20.66
2	December	1 --31	31	Mid Season	2.35	72.85	1.08	78.68	0.00	0.00	78.68	93.66	124.89	37,564	46.91	46.91
3	January	1--31	31	Development	2.40	74.40	1.10	81.84	0.00	0.00	81.84	97.43	129.90	37,564	48.80	48.80
4	February	1 --28	28	Development	3.36	94.08	0.90	84.67	0.00	0.00	84.67	100.80	134.40	37,564	50.49	50.49
5	March	1 --15	15	Late Stage	4.77	71.55	0.87	62.25	0.00	0.00	62.25	74.11	98.81	37,564	37.12	37.12
Total													**543.00**			**203.97**

Govind Sagar Dam (Lalitpur District) Water Requirement for Irrigation-

CROP -Wheat (Rabi)-

ET0 Station- **Lalitpur**

CCA (Ha)- 3,533

Canal Type- Lined Canal System

Irrigation System- Furrow Irrigation-

Soil Type- Clayey-Loam

Soil Moisture Adjustment- Nil (Assumed)

Percolation Loss- 0.00 mm/day (Assumed)

Conveyance Efficiency- 75% (Assumed)

Field Pipe Efficiency- 76% (Assumed)

ET0 Station-	Jhansi	Lalitpur	Banda	Mahoba
Lalitude (Deg.)	23.4500-N	24.6912-N	25.4763-N	25.2921-N
Longitude (Deg.)	78.5800-E	78.4138-E	80.3395-E	79.8724-E
Altitude (m)	251 m	350 m	120 m	210 m
Population (2011)	6.50 Lakh	1.33 Lakh	1.54 Lakh	0.95 Lakh
Annual Rainfall (mm)	871	953	951	618
Avg Temp. (°C)	25.8	25.2	26	28
Avg Sun Shine Hour	9.8	9.6	9.7	9.4
Relative Humidity (%)	53%	53%	56%	43%

SL. No.	Month	Period	No. of Days	Crop Stage	ET0 (mm/day)	ET0 (mm/ Period)	Crop Coefficient (Kc)	Consumptive Use (Kc*ET0) (mm)	Percolation Loss @ 0 mm/day (mm)	Effective Rainfall (mm)	Net Irrigation Reqirement (mm)	F.I.R = NIR/0.76 (mm)	G.I.R = FIR/0.75 (mm)	Proposed Area of Irrigation (Ha)	Water Requirement (MCM)	Monthly Water Requirement (MCM)
1	2	3	4	5	6	7	8	9 (=Col 7*8)	10	11	12 (=9+10-11)	12 (=Col 11/0.84)	13 (=Col 12/0.75)	14	15 (=0.00001*Col 14)	16
1	November	1--15	15	Pre sowing	3.03	45.45	0.31	14.09	0.00	0.00	14.09	16.77	22.36	3,533	0.79	
		16 --30	15	Initial stage	3.03	45.45	0.42	19.09	0.00	0.00	19.09	22.73	30.30	3,533	1.07	1.86
2	December	1 --31	31	Mid Season	2.45	75.95	1.08	82.03	0.00	0.00	82.03	97.65	130.20	3,533	4.60	4.60
3	January	1--31	31	Development	2.42	75.02	1.10	82.52	0.00	0.00	82.52	98.24	130.99	3,533	4.63	4.63
4	February	1 --28	28	Development	3.25	91.00	0.87	79.17	0.00	0.00	79.17	94.25	125.67	3,533	4.44	4.44
5	March	1 --15	15	Late Stage	4.68	70.20	0.87	61.07	0.00	0.00	61.07	72.71	96.94	3,533	3.42	3.42
Total													**536.46**			**18.95**

Water Requirement for Irrigation (MCM)	1,633.45
Water Requirement for Drinking (MCM)	66.77
Total Water Requirement (MCM)	**1,700.22**
Total Command Area -Irrigation (Ha)	**251,064**
Population Benefitted_Drinking Water (Lakh)	8.78

6/1/21

(शील चन्द्र उपाध्याय)
अधीक्षण अभियन्ता
सिंचाई निर्माण मण्डल झाँसी

KEN - BETWA LINK PROJECT

ESTIMATION OF CROP WATER REQUIREMENT
HLC - 43678 Ha
Kharif crop water requirement

Name of Crop	Particulars	JUN		JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
OIL SEEDS (SOYABEAN-2KH)	ETo			87	70	75	74	83	86	84	74
	Crop factor (Kc)			0.44	0.63	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)			38.28	44.10	68.25	74.00	83.00	86.00	55.44	0
6551.7	Plant Use (Pre-Sowing)			75	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	0	0	-55.44	0
	Gross Water Requirement			113.28	44.10	68.25	74.00	83.00	86.00	0.00	0
	Rainfall			100.00	141.00	202.60	96.00	93.00	31.00	9.00	0.00
	Effective Rainfall			69.98	44.10	68.25	61.00	60.97	22.06	0.00	0.00
	Net Irrigation Requirement at Field (NIR)			43.30	0.00	0.00	13.00	22.03	63.94	0	0
	Requirement at Canal Head With Efficiency 61 % (G I R) in mm			70.98	0.00	0.00	21.31	36.11	104.81	0	0
	Water Requirement at Canal Head for crop in sowing area MCM)			4.65	0.00	0.00	1.40	2.37	6.87	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**4.651**		**1.396**		**9.233**		**0.000**	

Annexure-6.4 Contd.

Name of Crop	Particulars	JUN		JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
CEREALS (MAIZE-2 KH)	ETo	123	106	87	70	75	74	83	86	84	74
	Crop factor (Kc)	0	0	0.49	0.59	0.91	1.10	1.10	1.01	0.71	0
Sowing Area	Consumptive Use (Etc)	0	0	43	41	68	81	91	87	60	0
2620.68	Plant Use (Pre-Sowing)	0	0	75	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	0	-60	0
	Gross Water Requirement	0	0.0	117.63	41.3	68.25	81.4	91.3	86.86	0	0
	Rainfall	5	205.6	100.0	141.0	202.6	96.0	93.0	31.0	9	0
	Effective Rainfall	0.00	0.00	70.73	41.30	68.25	62.44	62.21	22.10	0.00	0.00
	Net Irrigation Requirement at Field (NIR)	0	0	46.90	0.00	0.00	18.96	29.09	64.76	0	0
	Requirement at Canal Head With Efficiency 61 % (G I R) in mm	0	0	76.88	0.00	0.00	31.08	47.70	106.17	0	0
	Water Requirement at Canal Head for crop in sowing area MCM)	0	0	2.01	0.00	0.00	0.81	1.25	2.78	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**0**		**2.015**		**0.814**		**4.032**		**0.000**	

Annexure-6.4 Contd.

Name of Crop	Particulars	JUNE		JULY		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
PADDY (RICE-1HYVTP)	ETo	123	106	87	70	75	74	83	86	84	74
	Crop factor (Kc)	0	0	1.07	1.10	1.10	1.15	1.15	1.06	0.99	0
Sowing Area	Consumptive Use (Etc)	0	0	93.09	77	82.5	85.1	95.45	91.16	83.16	0
3057.46	Nursery	28	16	0	0	0	0	0	0	0	0
	Land Preparation	0	150	0	0	0	0	0	0	0	0
	Transplantation	0	0	125	0	0	0	0	0	0	0
	Percolation	0	0	45	45	45	45	45	45	0	0
	Soil Moisture Adjust.(SMADJ)	0	0	0	0	0	0	0	0	-83.16	0
	Gross Water Requirement	28.00	166.00	263.09	122.00	127.50	130.10	140.45	136.16	0	0
	Rainfall	5.00	205.60	100.00	141.00	202.60	96.00	93.00	31.00	9.00	0.00
	Effective Rainfall	0.00	130.56	85.00	103.45	127.50	82.20	80.10	31.00	0.00	0.00
	Net Irrigation Requirement at Field (NIR)	28.00	35.44	178.09	18.55	0.00	47.90	60.35	105.16	0.0	0.0
	Requirement at Canal Head With Efficiency 81 % (G I R) in mm	34.57	43.75	219.86	22.90	0.00	59.14	74.51	129.83	0	0
	Water Requirement at Canal Head for crop in sowing area MCM)	1.06	1.34	6.72	0.70	0.00	1.81	2.28	3.97	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**2.395**		**7.422**		**1.808**		**6.247**		**0.000**	

Annexure-6.4 Contd.

Name of Crop	Particulars			JUL		AUG		SEPT		OCT	
				I	II	I	II	I	II	I	II
PULSES-2KH	ETo	123	106	87	70	75	74	83	86	84	74
	Crop factor (Kc)			0.50	0.75	1.10	1.10	0.65	0.00	0.00	0
Sowing Area	Consumptive Use (Etc)			44	53	83	81	54	0	0	0
4367.8	Plant Use (Pre-Sowing)			75	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	-54	0	0	0
	Gross Water Requirement			118.5	52.5	82.5	81.4	0	0	0	0
	Rainfall			100	141	202.6	96	93	31	9	0
	Effective Rainfall			70.88	52.50	82.50	62.44	0.00	0.00	0.00	0.00
	Net Irrigation Requirement at Field (NIR)			47.62	0.00	0.00	18.96	0.00	0.00	0.00	0.00
	Requirement at Canal Head With Efficiency 61 % (G I R) in mm			78.062	0	0	31.08	0	0	0	0
	Water Requirement at Canal Head for crop in sowing area MCM)			3.4096	0	0	1.357	0	0	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**3.41**		**1.36**		**0.00**		**0.00**	

Annexure-6.4 Contd.

Name of Crop	Particulars	JUN		JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
VEGETABLES-1KH	ETo	123	106	87	70	75	74	83	86	84	74
	Crop factor (Kc)		0.39	0.46	0.69	1.00	1.00	1.00	0.92	0.00	0
Sowing Area	Consumptive Use (Etc)		41	40	48	75	74	83	79	0	0
2620.68	Plant Use (Pre-Sowing)		75	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	-79	0	0
	Gross Water Requirement		116.34	40.02	48.3	75	74	83	0	0	0
	Rainfall		205.6	100	141	202.6	96	93	31	9	0
	Effective Rainfall		116.34	40.02	48.30	75.00	61.00	60.97	0.00	0.00	0.00
	Net Irrigation Requirement at Field (NIR)		0.00	0.00	0.00	0.00	13.00	22.03	0.00	0.00	0.00
	Requirement at Canal Head With Efficiency 61 % (G I R) in mm		0.00	0.00	0.00	0.00	21.31	36.11	0.00	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area MCM)		0	0	0	0	0.56	0.95	0	0	0
	Total fornightly water req. for kharif irrigated area (Mcum)	**1.06**	**1.34**	**16.80**	**0.70**	**0.00**	**5.93**	**6.84**	**13.62**	**0.00**	**0.00**
	Monthly water requirement for kharif irrigated area	**2.39**		**17.50**		**5.93**		**20.46**		**0.00**	

Annexure-6.4 Contd.

Rabi crop water requirement

HLC - 43678 Ha.

Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB		MAR	
		I	II	I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (HYY)	ETo	84	74	62	52	51	48	51	57	55	68	77	97
	Crop factor (Kc)	0.00	0.00	0.31	0.42	0.80	1.08	1.10	1.10	1.07	0.87	0.50	0.00
Sowing Area	Consumptive Use (Etc)	0.00	0.00	19.22	21.84	40.80	51.84	56.10	62.70	58.85	59.16	39.00	0.00
26206.8	Plant Use (Pre-Sowing)	0	0	60	0	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	0.00	0.00	-59.16	-39.00	0
	Gross Water Requirement	0.00	0.00	79.22	21.84	40.80	51.84	56.10	62.70	58.85	0.00	0.00	0
	Rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)	0.00	0.00	79.22	21.84	40.80	51.84	56.10	62.70	58.85	0.00	0.00	0.00
	Requirement at Canal Head With Efficiency 76 % (G I R) in mm	0.00	0.00	104.24	28.74	53.68	68.21	73.82	82.50	77.43	0.00	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area (MCM)	0.00	0.00	27.32	7.53	14.07	17.88	19.34	21.62	20.29	0.00	0.00	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**0.000**		**34.848**		**31.945**		**40.965**		**20.293**		**0.000**	

Annexure-6.4 Contd.

	VEGETABLE-RA										
Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
VEGETABLE-RA	ETo			62	52	51	48	51	57	55	68
	Crop factor (Kc)			0	0.29	0.37	0.67	1.00	1.00	1.00	0.94
Sowing Area	Consumptive Use (Etc)			0	15.08	18.87	32.16	51.00	57.00	55.00	63.92
2183.9	Plant Use (Pre-Sowing)			0	60	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	0	0	-18.33	-63.92
	Gross Water Requirement			0	75.08	18.87	32.16	51.00	57.00	36.67	0
	Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)			0.00	75.08	18.87	32.16	51.00	57.00	36.67	0.00
	Requirement at Canal Head With Efficiency 76 % (G I R) in mm			0.00	98.79	24.83	42.32	67.11	75.00	48.25	0.00
	Water Requirement at Canal Head for crop in sowing area(MCM)			0.00	2.16	0.54	0.92	1.47	1.64	1.05	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**2.157**		**1.466**		**3.103**		**1.054**	

Annexure-6.4 Contd.

Name of Crop	Particulars	MUSTARD (Oilseed-2RA)									
		OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
MUSTARD (Oilseed-2RA)	ETo	84	74	62	52	51	48	51	57	55	68
	Crop factor (Kc)	0	0.31	0.48	0.50	1.09	1.10	1.10	1.09	0.93	0.52
Sowing Area	Consumptive Use (Etc)	0	22.94	29.76	26.00	55.59	52.80	56.10	62.13	51.15	35.36
3057.46	Plant Use (Pre-Sowing)	0	60	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	0	-34.1	-35.4
	Gross Water Requirement	0	82.94	29.8	26.0	55.6	52.8	56.1	62.1	17.1	0
	Rainfall (mm)	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)	0.00	82.94	29.76	26.00	55.59	52.80	56.10	62.13	17.05	0.00
	Requirement at Canal Head With Efficiency 76 % (G I R) in mm	0.00	109.13	39.16	34.21	73.14	69.47	73.82	81.75	22.43	0.00
	Water Requirement at Canal Head for crop in sowing area by (MCM)	0.00	3.34	1.20	1.05	2.24	2.12	2.26	2.50	0.69	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**3.337**		**2.243**		**4.361**		**4.756**		**0.686**	

Annexure-6.4 Contd.

		PEAS									
Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
PEAS	ETo	84	74	62	52	51	48	51	57	55	68
	Crop factor (Kc)	0	0.28	0.47	0.83	1.07	1.1	1.1	1.02	0.71	0
Sowing Area	Consumptive Use (Etc)	0	20.72	29.14	43.16	54.57	52.8	56.1	58.14	39.05	0
2183.9	Plant Use (Pre-Sowing)	0	60	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	-58.14	-39.05	0
	Gross Water Requirement	0	80.72	29.14	43.16	54.57	52.8	56.1	0	0	0
	Rainfall (mm)	9	0	0	0	0	0	0	0	0	0
	Effective Rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)	0.0	80.7	29.1	43.2	54.6	52.8	56.1	0.0	0.0	0.0
	Requirement at Canal Head With Efficiency 76 % (G I R) in mm	0.00	106.21	38.34	56.79	71.80	69.47	73.82	0.00	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area(MCM)	0.00	2.32	0.84	1.24	1.57	1.52	1.61	0.00	0.00	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**2.320**		**2.078**		**3.085**		**1.612**		**0.000**	

Annexure-6.4 Contd.

Name of Crop	Particulars	GRAM - N2RA									
		OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
GRAM - N2RA	ETo			62	52	51	48	51	57	55	68
	Crop factor (Kc)			0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)			14.26	15.08	42.33	50.40	53.55	54.72	37.40	29.00
10045.94	Plant Use (Pre-Sowing)			60.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Soil Moisture Adjust. (SMADJ)			0.00	0.00	0.00	0.00	0.00	-36.48	-37.40	-29.00
	Gross Water Requirement			74.26	15.08	42.33	50.40	53.55	18.24	0.00	0.00
	Rainfall (mm)			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Effective Rainfall (mm)			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Net Irrigation Requirement at Field (NIR) mm			74.26	15.08	42.33	50.40	53.55	18.24	0.00	0.00
	Requirement at Canal Head With Efficiency 76 % (G I R) in mm			97.71	19.84	55.70	66.32	70.46	24.00	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area			9.82	1.99	5.60	6.66	7.08	2.41	0.00	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**11.809**		**12.257**		**9.489**		**0.000**	
	Total fornightly water req. for entire irrigated area (Mcum)	**0.000**	**5.656**	**39.168**	**13.968**	**24.011**	**29.103**	**31.758**	**28.169**	**22.033**	**0.000**
	Requirement for 90% Rabi Intensity	**0.000**	**5.091**	**35.251**	**12.571**	**21.610**	**26.193**	**28.582**	**25.352**	**19.829**	**0.000**

KEN - BETWA LINK PROJECT

ESTIMATION OF CROP WATER REQUIREMENT
Saleha (Damoh) - 20101 Ha.
Kharif crop water requirement

Name of Crop	Particulars	JUN		JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
OIL SEEDS (SOYABEAN-2KH)	ETo	96	79	76	67	62	62	75	79	81	77
	Crop factor (Kc)			0.44	0.63	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)			33.44	42.21	56.42	62.00	75.00	79.00	53.46	0
3015.15	Plant Use (Pre-Sowing)			75	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	0	0	-53.46	0
	Gross Water Requirement			108.44	42.21	56.42	62.00	75.00	79.00	0.00	0
	Rainfall			102.90	226.80	197.00	88.20	143.40	13.80	0.00	0.00
	Effective Rainfall			70.92	42.21	56.42	53.40	75.00	9.67	0.00	0.00
	Net Irrigation Requirement at Field (NIR)			37.52	0.00	0.00	8.60	0.00	69.33	0	0
	Requirement at Canal Head With Efficiency 61 % (G I R)in mm			57.72	0.00	0.00	13.23	0.00	106.66	0	0
	Water Requirement at Canal Head for crop in sowing area MCM)			1.74	0.00	0.00	0.40	0.00	3.22	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**1.740**		**0.399**		**3.216**		**0.000**	

Annexure-6.5 Contd.

Name of Crop	Particulars	JUN		JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
CEREALS (MAIZE-2 KH)	ETo	96	79	76	67	62	62	75	79	81	77
	Crop factor (Kc)	0	0	0.49	0.59	0.91	1.10	1.10	1.01	0.71	0
Sowing Area	Consumptive Use (Etc)	0	0	37	40	56	68	83	80	58	0
1206.06	Plant Use (Pre-Sowing)	0	0	75	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	0	-58	0
	Gross Water Requirement	0	0.0	112.24	39.53	56.42	68.2	82.5	79.79	0	0
	Rainfall	0	13.5	102.90	226.80	197.00	88.20	143.40	13.80	0.00	0.00
	Effective Rainfall	0.00	0.00	71.60	39.53	56.42	55.16	80.03	9.68	0.00	0.00
	Net Irrigation Requirement at Field (NIR)	0	0	40.64	0.00	0.00	13.04	2.47	70.11	0	0
	Requirement at Canal Head With Efficiency 61 % (G I R)in mm	0	0	62.52	0.00	0.00	20.06	3.80	107.86	0	0
	Water Requirement at Canal Head for crop in sowing area MCM)	0	0	0.75	0.00	0.00	0.24	0.05	1.30	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**0**		**0.754**		**0.242**		**1.347**		**0.000**	

Annexure-6.5 Contd.

Name of Crop	Particulars	JUNE		JULY		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
PADDY (RICE-1HYVTP)	ETo	96	79	76	67	62	62	75	79	81	77
	Crop factor (Kc)	0	0	1.07	1.10	1.10	1.15	1.15	1.06	0.99	0
Sowing Area	Consumptive Use (Etc)	0	0	81.32	73.7	68.2	71.3	86.25	83.74	80.19	0
1407.07	Nursery	28	16	0	0	0	0	0	0	0	0
	Land Preparation	0	150	0	0	0	0	0	0	0	0
	Transplantation	0	0	125	0	0	0	0	0	0	0
	Percolation	0	0	45	45	45	45	45	45	0	0
	Soil Moisture Adjust.(SMADJ)	0	0	0	0	0	0	0	0	-80.19	0
	Gross Water Requirement	28.00	166.00	251.32	118.70	113.20	116.30	131.25	128.74	0	0
	Rainfall	0.0	13.5	102.9	226.8	197.0	88.2	143.4	13.8	0.0	0.0
	Effective Rainfall	0.00	13.50	86.31	118.70	113.20	76.74	104.53	13.80	0.00	0.00
	Net Irrigation Requirement at Field (NIR)	28.00	152.50	165.02	0.00	0.00	39.56	26.72	114.94	0.0	0.0
	Requirement at Canal Head With Efficiency 81 % (G I R)in mm	33.33	181.55	196.45	0.00	0.00	47.10	31.81	136.83	0	0
	Water Requirement at Canal Head for crop in sowing area MCM)	0.47	2.55	2.76	0.00	0.00	0.66	0.45	1.93	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**3.024**		**2.764**		**0.663**		**2.373**		**0.000**	

Annexure-6.5 Contd.

Name of Crop	Particulars			JUL		AUG		SEPT		OCT	
				I	II	I	II	I	II	I	II
PULSES-2KH	ETo	96	79	76	67	62	62	75	79	81	77
	Crop factor (Kc)			0.50	0.75	1.10	1.10	0.65	0.00	0.00	0
Sowing Area	Consumptive Use (Etc)			38	50	68	68	49	0	0	0
2010.1	Plant Use (Pre-Sowing)			75	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	-49	0	0	0
	Gross Water Requirement			113	50.25	68.2	68.2	0	0	0	0
	Rainfall			102.9	226.8	197	88.2	143.4	13.8	0	0
	Effective Rainfall			71.74	50.25	68.2	55.22	0	0	0	0
	Net Irrigation Requirement at Field (NIR)			41.26	0	0	12.98	0	0	0	0
	Requirement at Canal Head With Efficiency 61 % (G I R) in mm			63.48	0.00	0.00	19.97	0.00	0.00	0	0
	Water Requirement at Canal Head for crop in sowing area MCM)			1.28	0.00	0.00	0.40	0.00	0.00	0.00	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**1.28**		**0.40**		**0.00**		**0.00**	

Annexure-6.5 Contd.

Name of Crop	Particulars	JUN		JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
VEGETABLES-1KH	ETo	96	79	76	67	62	62	75	79	81	77
	Crop factor (Kc)		0.39	0.46	0.69	1.00	1.00	1.00	0.92	0.00	0
Sowing Area	Consumptive Use (Etc)		31	35	46	62	62	75	73	0	0
1206.06	Plant Use (Pre-Sowing)		75	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	-73	0	0
	Gross Water Requirement		105.81	34.96	46.23	62	62	75	0	0	0
	Rainfall		13.5	102.9	226.8	197	88.2	143.4	13.8	0	0
	Effective Rainfall		9.77	34.96	46.23	62	53.51	75	0	0	0
	Net Irrigation Requirement at Field (NIR)		96.04	0	0	0	8.49	0	0	0	0
	Requirement at Canal Head With Efficiency 61 % (G I R)in mm		147.75	0.00	0.00	0.00	13.06	0.00	0.00	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area MCM)		1.78	0.00	0.00	0.00	0.16	0.00	0	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**1.78**		**0.00**		**0.16**		**0.00**		**0.00**	
	Total fornightly water req. for kharif irrigated area (Mcum)	**0.47**	**4.34**	**6.53**	**0.00**	**0.00**	**1.86**	**0.49**	**6.44**	**0.00**	**0.00**
	Monthly water requirement for kharif irrigated area	**4.81**		**6.53**		**1.86**		**6.94**		**0.00**	

Rabi crop water requirement

Saleha Damoh - 20101 Ha.

Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB		MAR	
		I	II	I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (HYY)	ETo	81	77	71	63	58	57	56	62	61	73	81	100
	Crop factor (Kc)	0.00	0.00	0.31	0.42	0.80	1.08	1.10	1.10	1.07	0.87	0.50	0
Sowing Area	Consumptive Use (Etc)	0.00	0.00	22.01	26.46	46.40	61.56	61.60	68.20	65.27	63.51	41.00	0
12060.6	Plant Use (Pre-Sowing)	0	0	60	0	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	0.00	0.00	-64	-41.00	0
	Gross Water Requirement	0.00	0.00	82.01	26.46	46.40	61.56	61.60	68.20	65.27	0	0.00	0
	Rainfall (mm)	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)	0.00	0.00	82.01	26.46	46.40	61.56	61.60	68.20	65.27	0.00	0.00	0.00
	Requirement at Canal Head With Efficiency 80 % (G I R) in mm	0.00	0.00	102.51	33.08	58.00	76.95	77.00	85.25	81.59	0.00	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area (MCM)	0.00	0.00	12.36	3.99	7.00	9.28	9.29	10.28	9.84	0.00	0.00	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**0.000**		**16.353**		**16.276**		**19.568**		**9.840**		**0.000**	

Annexure-6.5 Contd.

Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
VEGETABLE-RA	ETo			71	63	58	57	56	62	61	73
	Crop factor (Kc)			0	0.29	0.37	0.67	1.00	1.00	1.00	0.94
Sowing Area	Consumptive Use (Etc)			0	18.27	21.46	38.19	56.00	62.00	61.00	68.62
1005.05	Plant Use (Pre-Sowing)			0	60	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	0	0	-20.33	-68.62
	Gross Water Requirement			0	78.27	21.46	38.19	56.00	62.00	40.67	0
	Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)			0.00	78.27	21.46	38.19	56.00	62.00	40.67	0.00
	Requirement at Canal Head With Efficiency 80 % (G I R)in mm			0.00	97.84	26.83	47.74	70.00	77.50	50.83	0.00
	Water Requirement at Canal Head for crop in sowing area			0.00	0.98	0.27	0.48	0.70	0.78	0.51	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**0.983**		**0.749**		**1.482**		**0.511**	

Annexure-6.5 Contd.

Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
MUSTARD (Oilseed-2RA)	ETo	81	77	71	63	58	57	56	62	61	73
	Crop factor (Kc)	0	0.31	0.48	0.50	1.09	1.10	1.10	1.09	0.93	0.52
Sowing Area	Consumptive Use (Etc)	0	23.87	34.08	31.50	63.22	62.70	61.60	67.58	56.73	37.96
1407.07	Plant Use (Pre-Sowing)	0	60	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	0	-37.8	-38.0
	Gross Water Requirement	0	83.87	34.1	31.5	63.2	62.7	61.6	67.6	18.9	0
	Rainfall (mm)	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)	0.00	83.87	34.08	31.50	63.22	62.70	61.60	67.58	18.91	0.00
	Requirement at Canal Head With Efficiency 80 % (G I R) in mm	0.00	104.84	42.60	39.38	79.03	78.38	77.00	84.48	23.64	0.00
	Water Requirement at Canal Head for crop in sowing area (MCM)	0.00	1.48	0.60	0.55	1.11	1.10	1.08	1.19	0.33	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**1.48**		**1.15**		**2.21**		**2.27**		**0.33**	

Annexure-6.5 Contd.

Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
PEAS	ETo	81	77	71	63	58	57	56	62	61	73
	Crop factor (Kc)	0	0.28	0.47	0.83	1.07	1.1	1.1	1.02	0.71	0
Sowing Area	Consumptive Use (Etc)	0	21.56	33.37	52.29	62.06	62.7	61.6	63.24	43.31	0
1005.05	Plant Use (Pre-Sowing)	0	60	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	-63.24	-43.31	0
	Gross Water Requirement	0	81.56	33.37	52.29	62.06	62.7	61.6	0	0	0
	Rainfall (mm)	9	0	0	0	0	0	0	0	0	0
	Effective Rainfall (mm)	0	0	0	0	0	0	0	0	0	0
	Net Irrigation Requirement at Field (NIR)	0	81.56	33.37	52.29	62.06	62.7	61.6	0	0	0
	Requirement at Canal Head With Efficiency 80 % (G I R)in mm	0	101.95	41.71	65.36	77.58	78.38	77.00	0	0	0
	Water Requirement at Canal Head for crop in sowing area (MCM)	0.00	1.02	0.42	0.66	0.78	0.79	0.77	0.00	0.00	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**1.025**		**1.076**		**1.567**		**0.774**		**0.000**	

Annexure-6.5 Contd.

Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
GRAM - N2RA	ETo	81	77	71	63	58	57	56	62	61	73
	Crop factor (Kc)			0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)			16.33	18.27	48.14	59.85	58.80	59.52	41.48	31.00
4623.23	Plant Use (Pre-Sowing)			60	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	0	-39.68	-41.48	-31.00
	Gross Water Requirement			76.33	18.27	48.14	59.85	58.80	19.84	0.00	0.00
	Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR) mm			76.33	18.27	48.14	59.85	58.80	19.84	0.00	0.00
	Requirement at Canal Head With Efficiency 80 % (G I R)in mm			95.41	22.84	60.18	74.81	73.50	24.80	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area(MCM)			4.41	1.06	2.78	3.46	3.40	1.15	0.00	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**5.467**		**6.241**		**4.545**		**0.000**	
	Total fornightly water req. for entire irrigated area (Mcum)	**0.000**	**2.500**	**17.793**	**7.239**	**11.938**	**15.110**	**15.246**	**13.396**	**10.683**	**0.000**
	Requirement for 90% rabi irrigation intensity	**0.000**	**2.250**	**16.014**	**6.515**	**10.745**	**13.599**	**13.721**	**12.056**	**9.615**	**0.000**

Annexure-6.5

KEN - BETWA LINK PROJECT

ESTIMATION OF CROP WATER REQUIREMENT
Saleha Panna - 70000 Ha.
Kharif crop water requirement

Name of Crop	Particulars	JUN		JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
OIL SEEDS (SOYABEAN-2KH)	ETo	129	107	89	78	73	73	70	73	70	71
	Crop factor (Kc)			0.44	0.63	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)			39.16	49.14	66.43	73.00	70.00	73.00	46.20	0
10500	Plant Use (Pre-Sowing)			75	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	0	0	-46.20	0
	Gross Water Requirement			114.16	49.14	66.43	73.00	70.00	73.00	0.00	0
	Rainfall			15.00	55.80	152.10	178.30	381.40	0.00	0.00	0.00
	Effective Rainfall			10.95	35.31	66.43	73.00	70.00	0.00	0.00	0.00
	Net Irrigation Requirement at Field (NIR)			103.21	13.83	0.00	0.00	0.00	73.00	0	0
	Requirement at Canal Head With Efficiency 61 % (G I R)in mm			158.78	21.28	0.00	0.00	0.00	112.31	0	0
	Water Requirement at Canal Head for crop in sowing area (MCM)			16.67	2.23	0.00	0.00	0.00	11.79	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**18.906**		**0.000**		**11.792**		**0.000**	

Annexure-6.5 Contd.

Name of Crop	Particulars	JUN		JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
CEREALS (MAIZE-2 KH)	ETo	129	107	89	78	73	73	70	73	70	71
	Crop factor (Kc)	0	0	0.49	0.59	0.91	1.10	1.10	1.01	0.71	0
Sowing Area	Consumptive Use (Etc)	0	0	44	46	66	80	77	74	50	0
4200	Plant Use (Pre-Sowing)	0	0	75	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	0	-50	0
	Gross Water Requirement	0	0.0	118.61	46.02	66.43	80.3	77	73.73	0	0
	Rainfall	0	21.4	15.0	55.8	152.1	178.3	381.4	0.0	0	0
	Effective Rainfall	0	0	10.99	33.98	66.43	80.30	77.00	0.00	0	0
	Net Irrigation Requirement at Field (NIR)	0	0	107.62	12.04	0.00	0.00	0.00	73.73	0	0
	Requirement at Canal Head With Efficiency 61 % (G I R)in mm	0	0	165.57	18.52	0.00	0.00	0.00	113.43	0	0
	Water Requirement at Canal Head for crop in sowing area (MCM)	0	0	6.95	0.78	0.00	0.00	0.00	4.76	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area (MCM)	**0**	**0**	**6.95**	**0.78**	**0.00**	**0.00**	**0.00**	**4.76**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**0**		**7.732**		**0.000**		**4.764**		**0.000**	

Annexure-6.5 Contd.

Name of Crop	Particulars	JUNE		JULY		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
PADDY (RICE-1HYVTP)	ETo	129	107	89	78	73	73	70	73	70	71
	Crop factor (Kc)	0	0	1.07	1.10	1.10	1.15	1.15	1.06	0.99	0
Sowing Area	Consumptive Use (Etc)	0	0	95.23	85.8	80.3	83.95	80.5	77.38	69.3	0
4900	Nursery	28	16	0	0	0	0	0	0	0	0
	Land Preparation	0	150	0	0	0	0	0	0	0	0
	Transplantation	0	0	125	0	0	0	0	0	0	0
	Percolation	0	0	45	45	45	45	45	45	0	0
	Soil Moisture Adjust.(SMADJ)	0	0	0	0	0	0	0	0	-69.3	0
	Gross Water Requirement	28.00	166.00	265.23	130.80	125.30	128.95	125.50	122.38	0	0
	Rainfall	0.00	21.40	15.00	55.80	152.10	178.30	381.40	0.00	0.00	0.00
	Effective Rainfall	0.00	21.40	15.00	54.06	108.44	120.24	125.50	0.00	0.00	0.00
	Net Irrigation Requirement at Field (NIR)	28.00	144.60	250.23	76.74	16.86	8.71	0.00	122.38	0.0	0.0
	Requirement at Canal Head With Efficiency 81 % (G I R)in mm	33.33	172.14	297.89	91.36	20.07	10.38	0.00	145.69	0	0
	Water Requirement at Canal Head for crop in sowing area (MCM)	1.63	8.44	14.60	4.48	0.98	0.51	0.00	7.14	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**10.068**		**19.073**		**1.492**		**7.139**		**0.000**	

		I	II	I	II	I	II	
		73	73	70	73	70	71	
		5	1.10	1.10	0.65	0.00	0.00	0
		59	80	80	46	0	0	0
		0	0	0	0	0	0	0
	0	0	0	0	-46	0	0	0
	119.50	58.50	80.30	80.30	0.00	0.00	0.00	0.00
	15.00	55.80	152.10	178.30	381.40	0.00	0.00	0.00
	11.00	36.54	80.30	80.30	0.00	0.00	0.00	0.00
	108.5	21.96	0	0	0	0	0	0
n	166.92	33.78	0.00	0.00	0.00	0.00	0	0
at Canal owing area M)	11.685	2.365	0	0	0	0	0	0

monthly Water
ment at Canal Head for

839

Annexure-6.5 Contd.

Name of Crop	Particulars	JUN		JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
VEGETABLES-1KH	ETo	129	107	89	78	73	73	70	73	70	71
	Crop factor (Kc)		0.39	0.46	0.69	1.00	1.00	1.00	0.92	0.00	0
Sowing Area	Consumptive Use (Etc)		42	41	54	73	73	70	67	0	0
4200	Plant Use (Pre-Sowing)		75	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	-67	0	0
	Gross Water Requirement		116.73	40.94	53.82	73.00	73.00	70.00	0.00	0.00	0.00
	Rainfall		21.40	15.00	55.80	152.10	178.30	381.40	0.00	0.00	0.00
	Effective Rainfall		15.68	9.41	36.07	73.00	73.00	70.00	0.00	0.00	0.00
	Net Irrigation Requirement at Field (NIR)		101.05	31.53	17.75	0.00	0.00	0.00	0.00	0.00	0.00
	Requirement at Canal Head With Efficiency 61 % (G I R)in mm		155.46	48.51	27.31	0.00	0.00	0.00	0.00	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area (MCM)		6.53	2.04	1.15	0.00	0.00	0.00	0.00	0.00	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**6.53**		**3.18**		**0.00**		**0.00**		**0.00**	
	Total fornightly water req. for kharif irrigated area (Mcum)	**1.63**	**14.96**	**51.94**	**11.00**	**0.98**	**0.51**	**0.00**	**23.70**	**0.00**	**0.00**
	Monthly water requirement for kharif irrigated area	**16.60**		**62.95**		**1.49**		**23.70**		**0.00**	

Annexure-6.5 Contd.

Rabi crop water requirement

Saleha Panna - 70000 Ha.

Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB		MAR	
		I	II	I	II	I	II	I	II	I	II	I	II
WHEAT-1MV HYY	ETo	70	71	51	44	39	39	42	47	48	58	72	88
	Crop factor (Kc)	0.00	0.00	0.31	0.42	0.80	1.08	1.10	1.10	1.07	0.87	0.50	0
Sowing Area	Consumptive Use (Etc)	0.00	0.00	15.81	18.48	31.20	42.12	46.20	51.70	51.36	50.46	36.00	0
42000	Plant Use (Pre-Sowing)	0	0	60	0	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	0.00	0.00	-50	-36.00	0
	Gross Water Requirement	0.00	0.00	75.81	18.48	31.20	42.12	46.20	51.70	51.36	0	0.00	0
	Rainfall (mm)	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)	0.00	0.00	75.81	18.48	31.20	42.12	46.20	51.70	51.36	0.00	0.00	0.00
	Requirement at Canal Head With Efficiency 80 % (G I R)in mm	0.00	0.00	94.76	23.10	39.00	52.65	57.75	64.63	64.20	0.00	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area (MCM)	0.00	0.00	39.80	9.70	16.38	22.11	24.26	27.14	26.96	0.00	0.00	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**0.000**		**49.502**		**38.493**		**51.398**		**26.964**		**0.000**	

Annexure-6.5 Contd.

Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
VEGETABLE-RA	ETo			51	44	39	39	42	47	48	58
	Crop factor (Kc)			0	0.29	0.37	0.67	1.00	1.00	1.00	0.94
Sowing Area	Consumptive Use (Etc)			0	12.76	14.43	26.13	42.00	47.00	48.00	54.52
3500	Plant Use (Pre-Sowing)			0	60	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	0	0	-16.00	-54.52
	Gross Water Requirement			0	72.76	14.43	26.13	42.00	47.00	32.00	0
	Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)			0.00	72.76	14.43	26.13	42.00	47.00	32.00	0.00
	Requirement at Canal Head With Efficiency 80 % (G I R)in mm			0.00	90.95	18.04	32.66	52.50	58.75	40.00	0.00
	Water Requirement at Canal Head for crop in sowing area (MCM)			0.00	3.18	0.63	1.14	1.84	2.06	1.40	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**3.183**		**1.775**		**3.894**		**1.400**	

Annexure-6.5 Contd.

Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
MUSTARD (Oilseed-2RA)	ETo	70	71	51	44	39	39	42	47	48	58
	Crop factor (Kc)	0	0.31	0.48	0.50	1.09	1.10	1.10	1.09	0.93	0.52
Sowing Area	Consumptive Use (Etc)	0	22.01	24.48	22.00	42.51	42.90	46.20	51.23	44.64	30.16
4900	Plant Use (Pre-Sowing)	0	60	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	0	-29.8	-30.2
	Gross Water Requirement	0	82.01	24.5	22.0	42.5	42.9	46.2	51.2	14.9	0
	Rainfall (mm)	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)	0.00	82.01	24.48	22.00	42.51	42.90	46.20	51.23	14.88	0.00
	Requirement at Canal Head With Efficiency 80 % (G I R)in mm	0.00	102.51	30.60	27.50	53.14	53.63	57.75	64.04	18.60	0.00
	Water Requirement at Canal Head for crop in sowing area (MCM)	0.00	5.02	1.50	1.35	2.60	2.63	2.83	3.14	0.91	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**5.023**		**2.847**		**5.231**		**5.968**		**0.911**	

Annexure-6.5 Contd.

Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
PEAS	ETo	70	71	51	44	39	39	42	47	48	58
	Crop factor (Kc)	0	0.28	0.47	0.83	1.07	1.10	1.10	1.02	0.71	0
Sowing Area	Consumptive Use (Etc)	0	19.88	23.97	36.52	41.73	42.9	46.2	47.94	34.08	0
3500	Plant Use (Pre-Sowing)	0	60	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	-47.94	-34.08	0.0
	Gross Water Requirement	0	79.88	23.97	36.52	41.73	42.90	46.20	0.00	0.00	0
	Rainfall (mm)	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)	0.00	79.88	23.97	36.52	41.73	42.90	46.20	0.00	0.00	0.00
	Requirement at Canal Head With Efficiency 80 % (G I R)in mm	0.00	99.85	29.96	45.65	52.16	53.63	57.75	0.00	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area (MCM)	0.00	3.49	1.05	1.60	1.83	1.88	2.02	0.00	0.00	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**3.495**		**2.646**		**3.703**		**2.021**		**0.000**	

Annexure-6.5 Contd.

Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
GRAM - N2RA	ETo	70	71	51	44	39	39	42	47	48	58
	Crop factor (Kc)			0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)			11.73	12.76	32.37	40.95	44.10	45.12	32.64	24.00
16100	Plant Use (Pre-Sowing)			60	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	0	-30.08	-32.64	-24.00
	Gross Water Requirement			71.73	12.76	32.37	40.95	44.10	15.04	0.00	0.00
	Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR) mm			71.73	12.76	32.37	40.95	44.10	15.04	0.00	0.00
	Requirement at Canal Head With Efficiency 80 % (G I R)in mm			89.66	15.95	40.46	51.19	55.13	18.80	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area (MCM)			14.44	2.57	6.51	8.24	8.88	3.03	0.00	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**17.004**		**14.756**		**11.902**		**0.000**	
	Total fornightly water req. for irrigated area (Mcum)	**0.000**	**8.518**	**56.784**	**18.398**	**27.955**	**36.002**	**39.819**	**35.363**	**29.275**	**0.000**
	Requirement for 90% rabi irrigation intensity	**0.000**	**7.666**	**51.106**	**16.559**	**25.160**	**32.402**	**35.837**	**31.827**	**26.348**	**0.000**

Annexure-6.6

KEN - BETWA LINK PROJECT

ESTIMATION OF CROP WATER REQUIREMENT
KBL - 138847
Kharif crop water requirement

Name of Crop	Particulars	JUN		JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
OIL SEEDS (SOYABEAN-2KH)	ETo			87	70	75	74	83	86	84	74
	Crop factor (Kc)			0.44	0.63	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)			38.28	44.10	68.25	74.00	83.00	86.00	55.44	0
20827.05	Plant Use (Pre-Sowing)			75	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	0	0	-55.44	0
	Gross Water Requirement			113.28	44.10	68.25	74.00	83.00	86.00	0.00	0
	Rainfall			100.00	141.00	202.60	96.00	93.00	31.00	9.00	0.00
	Effective Rainfall			69.98	44.10	68.25	61.00	60.97	22.06	0.00	0.00
	Net Irrigation Requirement at Field (NIR)			43.30	0.00	0.00	13.00	22.03	63.94	0	0
	Requirement at Canal Head With Efficiency 61 % (G I R)in mm			70.98	0.00	0.00	21.31	36.11	104.81	0	0
	Water Requirement at Canal Head for crop in sowing area(MCM)			14.78	0.00	0.00	4.44	7.52	21.83	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**14.782**		**4.438**		**29.351**		**0.000**	

Annexure-6.6 Contd.

Name of Crop	Particulars	JUN		JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
CEREALS (MAIZE-2 KH)	ETo	123	106	87	70	75	74	83	86	84	74
	Crop factor (Kc)	0	0	0.49	0.59	0.91	1.10	1.10	1.01	0.71	0
Sowing Area	Consumptive Use (Etc)	0	0	43	41	68	81	91	87	60	0
8330.82	Plant Use (Pre-Sowing)	0	0	75	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	0	-60	0
	Gross Water Requirement	0	0.0	117.63	41.3	68.25	81.4	91.3	86.86	0	0
	Rainfall	5	205.6	100.0	141.0	202.6	96.0	93.0	31.0	9	0
	Effective Rainfall	0.00	0.00	70.73	41.30	68.25	62.44	62.21	22.10	0.00	0.00
	Net Irrigation Requirement at Field (NIR)	0	0	46.90	0.00	0.00	18.96	29.09	64.76	0	0
	Requirement at Canal Head With Efficiency 61 % (G I R)in mm	0	0	76.88	0.00	0.00	31.08	47.70	106.17	0	0
	Water Requirement at Canal Head for crop in sowing area (MCM)	0	0	6.40	0.00	0.00	2.59	3.97	8.84	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**0**		**6.405**		**2.589**		**12.818**		**0.000**	

Annexure-6.6 Contd.

Name of Crop	Particulars	JUNE		JULY		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
PADDY (RICE-1HYVTP)	ETo	123	106	87	70	75	74	83	86	84	74
	Crop factor (Kc)	0	0	1.07	1.10	1.10	1.15	1.15	1.06	0.99	0
Sowing Area	Consumptive Use (Etc)	0	0	93.09	77	82.5	85.1	95.45	91.16	83.16	0
9719.29	Nursery	28	16	0	0	0	0	0	0	0	0
	Land Preparation	0	150	0	0	0	0	0	0	0	0
	Transplantation	0	0	125	0	0	0	0	0	0	0
	Percolation	0	0	45	45	45	45	45	45	0	0
	Soil Moisture Adjust.(SMADJ)	0	0	0	0	0	0	0	0	-83.16	0
	Gross Water Requirement	28.00	166.00	263.09	122.00	127.50	130.10	140.45	136.16	0	0
	Rainfall	5.0	205.6	100.0	141.0	202.6	96.0	93.0	31.0	9.0	0.0
	Effective Rainfall	0.00	130.56	85.00	103.45	127.50	82.20	80.10	31.00	0.00	0.00
	Net Irrigation Requirement at Field (NIR)	28.00	35.44	178.09	18.55	0.00	47.90	60.35	105.16	0.0	0.0
	Requirement at Canal Head With Efficiency 81 % (G I R)in mm	34.57	43.75	219.86	22.90	0.00	59.14	74.51	129.83	0	0
	Water Requirement at Canal Head for crop in sowing area (MCM)	3.36	4.25	21.37	2.23	0.00	5.75	7.24	12.62	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**7.612**		**23.595**		**5.748**		**19.860**		**0.000**	

Annexure-6.6 Contd.

Name of Crop	Particulars			JUL		AUG		SEPT		OCT	
				I	II	I	II	I	II	I	II
PULSES-2KH	ETo			87	70	75	74	83	86	84	74
	Crop factor (Kc)			0.50	0.75	1.10	1.10	0.65	0.00	0.00	0
Sowing Area	Consumptive Use (Etc)			44	53	83	81	54	0	0	0
13884.7	Plant Use (Pre-Sowing)			75	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	-54	0	0	0
	Gross Water Requirement			118.5	52.5	82.5	81.4	0	0	0	0
	Rainfall			100	141	202.6	96	93	31	9	0
	Effective Rainfall			70.88	52.50	82.50	62.44	0.00	0.00	0.00	0.00
	Net Irrigation Requirement at Field (NIR)			47.62	0.00	0.00	18.96	0.00	0.00	0.00	0.00
	Requirement at Canal Head With Efficiency 61 % (G I R)in mm			78.06	0.00	0.00	31.08	0.00	0	0	0
	Water Requirement at Canal Head for crop in sowing area (MCM)			10.84	0.00	0.00	4.31	0.00	0	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**10.84**		**4.31**		**0.00**		**0.00**	

Annexure-6.6 Contd.

Name of Crop	Particulars	JUN		JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
VEGETABLES-1KH	ETo		106	87	70	75	74	83	86	84	74
	Crop factor (Kc)		0.39	0.46	0.69	1.00	1.00	1.00	0.92	0.00	0
Sowing Area	Consumptive Use (Etc)		41	40	48	75	74	83	79	0	0
8330.82	Plant Use (Pre-Sowing)		75	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	-79	0	0
	Gross Water Requirement		116.34	40.02	48.3	75	74	83	0	0	0
	Rainfall		205.6	100	141	202.6	96	93	31	9	0
	Effective Rainfall		116.34	40.02	48.30	75.00	61.00	60.97	0.00	0.00	0.00
	Net Irrigation Requirement at Field (NIR)		0.00	0.00	0.00	0.00	13.00	22.03	0.00	0.00	0.00
	Requirement at Canal Head With Efficiency 61 % (G I R)in mm		0.00	0.00	0.00	0.00	21.31	36.11	0.00	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area(MCM)		0	0	0	0	1.78	3.01	0	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**0.00**		**0.00**		**1.78**		**3.01**		**0.00**	
	Total fornightly water req. for kharif irrigated area (Mcum)	**3.36**	**4.25**	**53.40**	**2.23**	**0.00**	**18.86**	**21.75**	**43.29**	**0.00**	**0.00**
	Monthly water requirement for kharif irrigated area	**7.61**		**55.62**		**18.86**		**65.04**		**0.00**	

Annexure-6.6 Contd.

Rabi crop water requirement

KBL - 138847 Ha.

Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB		MAR	
		I	II	I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (HYY)	ETo	84	74	62	52	51	48	51	57	55	68	77	97
	Crop factor (Kc)	0.00	0.00	0.31	0.42	0.80	1.08	1.10	1.10	1.07	0.87	0.50	0
Sowing Area	Consumptive Use (Etc)	0.00	0.00	19.22	21.84	40.80	51.84	56.10	62.70	58.85	59.16	39.00	0
83308.2	Plant Use (Pre-Sowing)	0	0	60	0	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	0.00	0.00	-59	-39.00	0
	Gross Water Requirement	0.00	0.00	79.22	21.84	40.80	51.84	56.10	62.70	58.85	0	0.00	0
	Rainfall (mm)	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)	0.00	0.00	79.22	21.84	40.80	51.84	56.10	62.70	58.85	0.00	0.00	0.00
	Requirement at Canal Head With Efficiency 76% (G I R)in mm	0.00	0.00	104.24	28.74	53.68	68.21	73.82	82.50	77.43	0.00	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area	0.00	0.00	86.84	23.94	44.72	56.82	61.49	68.73	64.51	0.00	0.00	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**0.000**		**110.778**		**101.548**		**130.224**		**64.509**		**0.000**	

Annexure-6.6 Contd.

			VEGETABLE-RA							
Name of Crop	Particulars	OCT	NOV		DEC		JAN		FEB	
		I II	I	II	I	II	I	II	I	II
VEGETABLE-RA	ETo		62	52	51	48	51	57	55	68
	Crop factor (Kc)		0	0.29	0.37	0.67	1.00	1.00	1.00	0.94
Sowing Area	Consumptive Use (Etc)		0	15.08	18.87	32.16	51.00	57.00	55.00	63.92
6942.35	Plant Use (Pre-Sowing)		0	60	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	-18.33	-63.92
	Gross Water Requirement		0	75.08	18.87	32.16	51.00	57.00	36.67	0
	Rainfall (mm)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)		0.00	75.08	18.87	32.16	51.00	57.00	36.67	0.00
	Requirement at Canal Head With Efficiency 76% (G I R)in mm		0.00	98.79	24.83	42.32	67.11	75.00	48.25	0.00
	Water Requirement at Canal Head for crop in sowing area		0.00	6.86	1.72	2.94	4.66	5.21	3.35	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)		**6.858**		**4.661**		**9.865**		**3.349**	

Annexure-6.6 Contd.

				MUSTARD (Oilseed-2RA)							
Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
MUSTARD (Oilseed-2RA)	ETo	84	74	62	52	51	48	51	57	55	68
	Crop factor (Kc)	0	0.31	0.48	0.5	1.09	1.1	1.1	1.09	0.93	0.52
Sowing Area	Consumptive Use (Etc)	0	22.94	29.76	26	55.59	52.8	56.1	62.13	51.15	35.36
9719.29	Plant Use (Pre-Sowing)	0	60	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	0	-34.1	-35.36
	Gross Water Requirement	0	82.94	29.76	26	55.59	52.8	56.1	62.13	17.05	0
	Rainfall (mm)	9	0	0	0	0	0	0	0	0	0
	Effective Rainfall (mm)	0	0	0	0	0	0	0	0	0	0
	Net Irrigation Requirement at Field (NIR)	0	82.94	29.76	26	55.59	52.8	56.1	62.13	17.05	0
	Requirement at Canal Head With Efficiency 76% (G I R)in mm	0.00	109.13	39.16	34.21	73.14	69.47	73.82	81.75	22.43	0.00
	Water Requirement at Canal Head for crop in sowing area	0.00	10.61	3.81	3.33	7.11	6.75	7.17	7.95	2.18	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**10.607**		**7.131**		**13.861**		**15.120**		**2.180**	

Annexure-6.6 Contd.

Name of Crop	Particulars			PEAS							
		OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
PEAS	ETo	84	74	62	52	51	48	51	57	55	68
	Crop factor (Kc)	0	0.28	0.47	0.83	1.07	1.10	1.10	1.02	0.71	0
Sowing Area	Consumptive Use (Etc)	0	20.72	29.14	43.16	54.57	52.8	56.1	58.14	39.05	0
6942.35	Plant Use (Pre-Sowing)	0	60	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	-58.14	-39.05	0.0
	Gross Water Requirement	0	80.72	29.14	43.16	54.57	52.80	56.10	0.00	0.00	0
	Rainfall (mm)	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)	0.00	80.72	29.14	43.16	54.57	52.80	56.10	0.00	0.00	0.00
	Requirement at Canal Head With Efficiency 76% (G I R)in mm	0.00	106.21	38.34	56.79	71.80	69.47	73.82	0.00	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area	0.00	7.37	2.66	3.94	4.98	4.82	5.12	0.00	0.00	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**7.374**		**6.604**		**9.808**		**5.125**		**0.000**	

Annexure-6.6 Contd.

Name of Crop	Particulars			GRAM - N2RA							
		OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
GRAM - N2RA	ETo			62	52	51	48	51	57	55	68
	Crop factor (Kc)			0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)			14.26	15.08	42.33	50.40	53.55	54.72	37.40	29.00
31934.81	Plant Use (Pre-Sowing)			60	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	0	-36.48	-37.40	-29.00
	Gross Water Requirement			74.26	15.08	42.33	50.40	53.55	18.24	0.00	0.00
	Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR) mm			74.26	15.08	42.33	50.40	53.55	18.24	0.00	0.00
	Requirement at Canal Head With Efficiency 76% (G I R)in mm			97.71	19.84	55.70	66.32	70.46	24.00	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area			31.20	6.34	17.79	21.18	22.50	7.66	0.00	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**37.540**		**38.965**		**30.166**		**0.000**	
	Total fornightly water req. for entire irrigated area (Mcum)	**0.000**	**17.980**	**124.509**	**44.403**	**76.328**	**92.516**	**100.954**	**89.546**	**70.039**	**0.000**
	Requirement for 90% Rabi irrigation intensity	**0.000**	**16.182**	**112.058**	**39.962**	**68.695**	**83.264**	**90.858**	**80.591**	**63.035**	**0.000**

KEN - BETWA LINK PROJECT

ESTIMATION OF CROP WATER REQUIREMENT
Ken LBC - 139848 Ha.
Kharif crop water requirement

Name of Crop	Particulars	JUN		JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
OIL SEEDS (SOYABEAN-2KH)	ETo			87	70	75	74	83	86	84	74
	Crop factor (Kc)			0.44	0.63	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)			38.28	44.10	68.25	74.00	83.00	86.00	55.44	0
20977.2	Plant Use (Pre-Sowing)			75	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	0	0	-55.44	0
	Gross Water Requirement			113.28	44.10	68.25	74.00	83.00	86.00	0.00	0
	Rainfall			100.00	141.00	202.60	96.00	93.00	31.00	9.00	0.00
	Effective Rainfall			69.98	44.10	68.25	61.00	60.97	22.06	0.00	0.00
	Net Irrigation Requirement at Field (NIR)			43.30	0.00	0.00	13.00	22.03	63.94	0	0
	Requirement at Canal Head With Efficiency 61 % (G I R)in mm			70.98	0.00	0.00	21.31	36.11	104.81	0	0
	Water Requirement at Canal Head for crop in sowing area (MCM)			14.89	0.00	0.00	4.47	7.58	21.99	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**14.889**		**4.470**		**29.562**		**0.000**	

Annexure-6.7 Contd.

Name of Crop	Particulars	JUN		JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
CEREALS (MAIZE-2 KH)	ETo	123	106	87	70	75	74	83	86	84	74
	Crop factor (Kc)	0	0	0.49	0.59	0.91	1.10	1.10	1.01	0.71	0
Sowing Area	Consumptive Use (Etc)	0	0	43	41	68	81	91	87	60	0
8390.88	Plant Use (Pre-Sowing)	0	0	75	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	0	-60	0
	Gross Water Requirement	0	0.0	117.63	41.3	68.25	81.4	91.3	86.86	0	0
	Rainfall	5	205.6	100.0	141.0	202.6	96.0	93.0	31.0	9	0
	Effective Rainfall	0	0	70.73	41.30	68.25	62.44	62.21	22.10	0	0
	Net Irrigation Requirement at Field (NIR)	0	0	46.90	0.00	0.00	18.96	29.09	64.76	0	0
	Requirement at Canal Head With Efficiency 61 % (G I R)in mm	0	0	76.88	0.00	0.00	31.08	47.70	106.17	0	0
	Water Requirement at Canal Head for crop in sowing area (MCM)	0	0	6.45	0.00	0.00	2.61	4.00	8.91	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**0**		**6.451**		**2.608**		**12.911**		**0.000**	

Annexure-6.7 Contd.

Name of Crop	Particulars	JUNE		JULY		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
PADDY (RICE-1HYVTP)	ETo	123	106	87	70	75	74	83	86	84	74
	Crop factor (Kc)	0	0	1.07	1.10	1.10	1.15	1.15	1.06	0.99	0
Sowing Area	Consumptive Use (Etc)	0	0	93.09	77	82.5	85.1	95.45	91.16	83.16	0
9789.36	Nursery	28	16	0	0	0	0	0	0	0	0
	Land Preparation	0	150	0	0	0	0	0	0	0	0
	Transplantation	0	0	125	0	0	0	0	0	0	0
	Percolation	0	0	45	45	45	45	45	45	0	0
	Soil Moisture Adjust.(SMADJ)	0	0	0	0	0	0	0	0	-83.16	0
	Gross Water Requirement	28.00	166.00	263.09	122.00	127.50	130.10	140.45	136.16	0	0
	Rainfall	5.0	205.6	100.0	141.0	202.6	96.0	93.0	31.0	9.0	0.0
	Effective Rainfall	0.0	130.56	85.00	103.45	127.50	82.20	80.10	31.00	0.0	0.0
	Net Irrigation Requirement at Field (NIR)	28.00	35.44	178.09	18.55	0.00	47.90	60.35	105.16	0.0	0.0
	Requirement at Canal Head With Efficiency 81 % (G I R)in mm	34.57	43.75	219.86	22.90	0.00	59.14	74.51	129.83	0	0
	Water Requirement at Canal Head for crop in sowing area (MCM)	3.38	4.28	21.52	2.24	0.00	5.79	7.29	12.71	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**7.667**		**23.765**		**5.789**		**20.003**		**0.000**	

Annexure-6.7 Contd.

Name of Crop	Particulars			JUL		AUG		SEPT		OCT	
				I	II	I	II	I	II	I	II
PULSES-2KH	ETo			87	70	75	74	83	86	84	74
	Crop factor (Kc)			0.50	0.75	1.10	1.10	0.65	0.00	0.00	0
Sowing Area	Consumptive Use (Etc)			44	53	83	81	54	0	0	0
13984.8	Plant Use (Pre-Sowing)			75	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	-54	0	0	0
	Gross Water Requirement			118.5	52.5	82.5	81.4	0	0	0	0
	Rainfall			100.00	141.00	202.60	96.00	93.00	31.00	9.00	0.00
	Effective Rainfall			70.88	52.50	82.50	62.44	0.00	0.00	0.00	0.00
	Net Irrigation Requirement at Field (NIR)			47.62	0.00	0.00	18.96	0.00	0.00	0.00	0.00
	Requirement at Canal Head With Efficiency 61 % (G I R)in mm			78.06	0.00	0.00	31.08	0.00	0.00	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area (MCM)			10.92	0.00	0.00	4.35	0.00	0.00	0.00	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**10.92**		**4.35**		**0.00**		**0.00**	

Annexure-6.7 Contd.

Name of Crop	Particulars	JUN		JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
VEGETABLES-1KH	ETo		106	87	70	75	74	83	86	84	74
	Crop factor (Kc)		0.39	0.46	0.69	1.00	1.00	1.00	0.92	0.00	0
Sowing Area	Consumptive Use (Etc)		41	40	48	75	74	83	79	0	0
8390.88	Plant Use (Pre-Sowing)		75	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	-79	0	0
	Gross Water Requirement		116.34	40.02	48.3	75	74	83	0	0	0
	Rainfall		205.6	100	141	202.6	96	93	31	9	0
	Effective Rainfall		116.34	40.02	48.30	75.00	61.00	60.97	0.00	0.00	0.00
	Net Irrigation Requirement at Field (NIR)		0	0	0	0	13	22.03	0	0	0
	Requirement at Canal Head With Efficiency 61 % (G I R)in mm		0.00	0.00	0.00	0.00	21.31	36.11	0.00	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area (MCM)		0	0	0	0	1.788	3.03	0	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**0.00**		**0.00**		**1.79**		**3.03**		**0.00**	
	Total fornightly water req. for kharif irrigated area (Mcum)	**3.38**	**4.28**	**53.78**	**2.24**	**0.00**	**19.00**	**21.90**	**43.60**	**0.00**	**0.00**
	Monthly water requirement for kharif irrigated area	**7.67**		**56.02**		**19.00**		**65.51**		**0.00**	

Annexure-6.7 Contd.

Rabi crop water requirement

Ken LBC - 139848 Ha.

Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB		MAR	
		I	II	I	II	I	II	I	II	I	II	I	II
WHEAT-1MV HYY	ETo	84	74	62	52	51	48	51	57	55	68	77	97
	Crop factor (Kc)	0.00	0.00	0.31	0.42	0.80	1.08	1.10	1.10	1.07	0.87	0.50	0
Sowing Area	Consumptive Use (Etc)	0.00	0.00	19.22	21.84	40.80	51.84	56.10	62.70	58.85	59.16	39.00	0
83908.8	Plant Use (Pre-Sowing)	0	0	60	0	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	0.00	0.00	-59	-39.00	0
	Gross Water Requirement	0.00	0.00	79.22	21.84	40.80	51.84	56.10	62.70	58.85	0	0.00	0
	Rainfall (mm)	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)	0.00	0.00	79.22	21.84	40.80	51.84	56.10	62.70	58.85	0.00	0.00	0.00
	Requirement at Canal Head With Efficiency 76% (G I R)in mm	0.00	0.00	104.24	28.74	53.68	68.21	73.82	82.50	77.43	0.00	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area (MCM)	0.00	0.00	87.46	24.11	45.05	57.23	61.94	69.22	64.97	0.00	0.00	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**0.000**		**111.577**		**102.280**		**131.163**		**64.974**		**0.000**	

				VEGETABLE-RA							
Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
VEGETABLE-RA	ETo			62	52	51	48	51	57	55	68
	Crop factor (Kc)			0	0.29	0.37	0.67	1.00	1.00	1.00	0.94
Sowing Area	Consumptive Use (Etc)			0	15.08	18.87	32.16	51.00	57.00	55.00	63.92
6992.4	Plant Use (Pre-Sowing)			0	60	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	0	0	-18.33	-63.92
	Gross Water Requirement			0	75.08	18.87	32.16	51.00	57.00	36.67	0
	Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)			0.00	75.08	18.87	32.16	51.00	57.00	36.67	0.00
	Requirement at Canal Head With Efficiency 76% (G I R)in mm			0.00	98.79	24.83	42.32	67.11	75.00	48.25	0.00
	Water Requirement at Canal Head for crop in sowing area (MCM)			0.00	6.91	1.74	2.96	4.69	5.24	3.37	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**6.908**		**4.695**		**9.937**		**3.374**	

				MUSTARD (Oilseed-2RA)							
Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
MUSTARD (Oilseed-2RA)	ETo	84	74	62	52	51	48	51	57	55	68
	Crop factor (Kc)	0	0.31	0.48	0.50	1.09	1.10	1.10	1.09	0.93	0.52
Sowing Area	Consumptive Use (Etc)	0	22.94	29.76	26.00	55.59	52.80	56.10	62.13	51.15	35.36
9789.36	Plant Use (Pre-Sowing)	0	60	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	0	-34.1	-35.4
	Gross Water Requirement	0	82.94	29.8	26.0	55.6	52.8	56.1	62.1	17.1	0
	Rainfall (mm)	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)	0.00	82.94	29.76	26.00	55.59	52.80	56.10	62.13	17.05	0.00
	Requirement at Canal Head With Efficiency 76% (G I R)in mm	0.00	109.13	39.16	34.21	73.14	69.47	73.82	81.75	22.43	0.00
	Water Requirement at Canal Head for crop in sowing area (MCM)	0.00	10.68	3.83	3.35	7.16	6.80	7.23	8.00	2.20	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**10.683**		**7.182**		**13.961**		**15.229**		**2.196**	

Annexure-6.7 Contd.

				Peas							
Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
Peas	ETo	84	74	62	52	51	48	51	57	55	68
	Crop factor (Kc)	0	0.28	0.47	0.83	1.07	1.10	1.10	1.02	0.71	0
Sowing Area	Consumptive Use (Etc)	0	20.72	29.14	43.16	54.57	52.8	56.1	58.14	39.05	0
6992.4	Plant Use (Pre-Sowing)	0	60	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	-58.14	-39.05	0.0
	Gross Water Requirement	0	80.72	29.14	43.16	54.57	52.80	56.10	0.00	0.00	0
	Rainfall (mm)	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)	0.00	80.72	29.14	43.16	54.57	52.80	56.10	0.00	0.00	0.00
	Requirement at Canal Head With Efficiency 76% (G I R)in mm	0.00	106.21	38.34	56.79	71.80	69.47	73.82	0.00	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area (MCM)	0.00	7.43	2.68	3.97	5.02	4.86	5.16	0.00	0.00	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**7.427**		**6.652**		**9.879**		**5.161**		**0.000**	

Annexure-6.7 Contd.

		GRAM - N2RA									
Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
GRAM - N2RA	ETo			62	52	51	48	51	57	55	68
	Crop factor (Kc)			0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)			14.26	15.08	42.33	50.40	53.55	54.72	37.40	29.00
32165.04	Plant Use (Pre-Sowing)			60	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	0	-36.48	-37.40	-29.00
	Gross Water Requirement			74.26	15.08	42.33	50.40	53.55	18.24	0.00	0.00
	Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR) mm			74.26	15.08	42.33	50.40	53.55	18.24	0.00	0.00
	Requirement at Canal Head With Efficiency 76 % (G I R)in mm			97.71	19.84	55.70	66.32	70.46	24.00	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area (MCM)			31.43	6.38	17.92	21.33	22.66	7.72	0.00	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**37.811**		**39.246**		**30.383**		**0.000**	
	Total fornightly water req. for rabi irrigated area (Mcum)	**0.0**	**18.1**	**125.4**	**44.7**	**76.9**	**93.2**	**101.7**	**90.2**	**70.5**	**0.0**
	Requirement for 90% rabi irrigation intensity	**0.000**	**16.299**	**112.866**	**40.250**	**69.190**	**83.865**	**91.513**	**81.172**	**63.489**	**0.000**

Annexure-6.8

KEN - BETWA LINK PROJECT

ESTIMATION OF CROP WATER REQUIREMENT
Bariyarpur - 38890 Ha.
Kharif crop water requirement

Name of Crop	Particulars	JUN		JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
OIL SEEDS (SOYABEAN-2KH)	ETo			87	70	75	74	83	86	84	74
	Crop factor (Kc)			0.44	0.63	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)			38.28	44.10	68.25	74.00	83.00	86.00	55.44	0
5833.5	Plant Use (Pre-Sowing)			75	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	0	0	-55.44	0
	Gross Water Requirement			113.28	44.10	68.25	74.00	83.00	86.00	0.00	0
	Rainfall			100.00	141.00	202.60	96.00	93.00	31.00	9.00	0.00
	Effective Rainfall			69.98	44.10	68.25	61.00	60.97	22.06	0.00	0.00
	Net Irrigation Requirement at Field (NIR)			43.30	0.00	0.00	13.00	22.03	63.94	0	0
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm			84.89	0.00	0.00	25.49	43.20	125.36	0	0
	Water Requirement at Canal Head for crop in sowing area by gravity flow(MCM)			4.95	0.00	0.00	1.49	2.52	7.31	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**4.952**		**1.487**		**9.833**		**0.000**	

Annexure-6.8 Contd.

Name of Crop	Particulars	JUN		JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
CEREALS (MAIZE-2 KH)	ETo	123	106	87	70	75	74	83	86	84	74
	Crop factor (Kc)	0	0	0.49	0.59	0.91	1.10	1.10	1.01	0.71	0
Sowing Area	Consumptive Use (Etc)	0	0	43	41	68	81	91	87	60	0
2333.4	Plant Use (Pre-Sowing)	0	0	75	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	0	-60	0
	Gross Water Requirement	0	0.0	117.63	41.3	68.25	81.4	91.3	86.86	0	0
	Rainfall	5.00	205.60	100.00	141.00	202.60	96.00	93.00	31.00	9.00	0.00
	Effective Rainfall	0.00	0.00	70.73	41.30	68.25	62.44	62.21	22.10	0.00	0.00
	Net Irrigation Requirement at Field (NIR)	0.00	0.00	46.90	0.00	0.00	18.96	29.09	64.76	0.00	0.00
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm	0	0	91.96	0.00	0.00	37.17	57.05	126.99	0	0
	Water Requirement at Canal Head for crop in sowing area by gravity flow(MCM)	0	0	2.15	0.00	0.00	0.87	1.33	2.96	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**0**		**2.15**		**0.87**		**4.29**		**0.000**	

Annexure-6.8 Contd.

Name of Crop	Particulars	JUNE		JULY		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
PADDY (RICE-1HYVTP)	ETo	123	106	87	70	75	74	83	86	84	74
	Crop factor (Kc)	0	0	1.07	1.10	1.10	1.15	1.15	1.06	0.99	0
Sowing Area	Consumptive Use (Etc)	0	0	93.09	77	82.5	85.1	95.45	91.16	83.16	0
2722.3	Nursery	28	16	0	0	0	0	0	0	0	0
	Land Preparation	0	150	0	0	0	0	0	0	0	0
	Transplantation	0	0	125	0	0	0	0	0	0	0
	Percolation	0	0	45	45	45	45	45	45	0	0
	Soil Moisture Adjust.(SMADJ)	0	0	0	0	0	0	0	0	-83.16	0
	Gross Water Requirement	28.00	166.00	263.09	122.00	127.50	130.10	140.45	136.16	0.00	0.00
	Rainfall	5.00	205.60	100.00	141.00	202.60	96.00	93.00	31.00	9.00	0.00
	Effective Rainfall	0.00	130.56	85.00	103.45	127.50	82.20	80.10	31.00	0.00	0.00
	Net Irrigation Requirement at Field (NIR)	28.00	35.44	178.09	18.55	0.00	47.90	60.35	105.16	0.00	0.00
	Requirement at Canal Head With Efficiency 68 % (G I R)in mm	41.18	52.12	261.90	27.28	0.00	70.44	88.75	154.65	0	0
	Water Requirement at Canal Head for crop in sowing area by gravity flow(MCM)	1.12	1.42	7.13	0.74	0.00	1.92	2.42	4.21	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**2.540**		**7.872**		**1.918**		**6.626**		**0.000**	

Annexure-6.8 Contd.

Name of Crop	Particulars			JUL		AUG		SEPT		OCT	
				I	II	I	II	I	II	I	II
PULSES-2KH	ETo			87	70	75	74	83	86	84	74
	Crop factor (Kc)			0.50	0.75	1.10	1.10	0.65	0.00	0.00	0
Sowing Area	Consumptive Use (Etc)			44	53	83	81	54	0	0	0
3889	Plant Use (Pre-Sowing)			75	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	-54	0	0	0
	Gross Water Requirement			118.50	52.50	82.50	81.40	0.00	0.00	0.00	0.00
	Rainfall			100.00	141.00	202.60	96.00	93.00	31.00	9.00	0.00
	Effective Rainfall			70.88	52.50	82.50	62.44	0.00	0.00	0.00	0.00
	Net Irrigation Requirement at Field (NIR)			47.62	0.00	0.00	18.96	0.00	0.00	0.00	0.00
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm			93.37	0.00	0.00	37.17	0.00	0.00	0	0
	Water Requirement at Canal Head for crop in sowing area by gravity flow(MCM)			3.63	0	0	1.446	0	0	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**3.63**		**1.45**		**0.00**		**0.00**	

Annexure-6.8 Contd.

Name of Crop	Particulars	JUN		JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II	I	II
VEGETABLES-1KH	ETo		106	87	70	75	74	83	86	84	74
	Crop factor (Kc)		0.39	0.46	0.69	1.00	1.00	1.00	0.92	0.00	0
Sowing Area	Consumptive Use (Etc)		41	40	48	75	74	83	79	0	0
2333.4	Plant Use (Pre-Sowing)		75	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	-79	0	0
	Gross Water Requirement		116.34	40.02	48.30	75.00	74.00	83.00	0.00	0.00	0.00
	Rainfall		205.60	100.00	141.00	202.60	96.00	93.00	31.00	9.00	0.00
	Effective Rainfall		116.34	40.02	48.30	75.00	61.00	60.97	0.00	0.00	0.00
	Net Irrigation Requirement at Field (NIR)		0.00	0.00	0.00	0.00	13.00	22.03	0.00	0.00	0.00
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm		0.00	0.00	0.00	0.00	25.49	43.20	0.00	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area by gravity flow(MCM)		0	0	0	0	0.595	1.008	0	0	0
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**0.00**		**0.00**		**0.59**		**1.01**		**0.00**	
	Total fornightly water req. for kharif irrigated area (Mcum)	**1.12**	**1.42**	**17.86**	**0.74**	**0.00**	**6.31**	**7.27**	**14.49**	**0.00**	**0.00**
	Monthly water requirement for kharif irrigated area	**2.54**		**18.60**		**6.31**		**21.76**		**0.00**	

Annexure-6.8 Contd.

Rabi crop water requirement

Bariyarpur - 38890 Ha.

Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB		MAR	
		I	II	I	II	I	II	I	II	I	II	I	II
WHEAT-3MV (High yield)	ETo			62	52	51	48	51	57	55	68	77	97
	Crop factor (Kc)			0.00	0.00	0.31	0.44	0.92	1.10	1.10	1.10	0.92	0.53
Sowing Area	Consumptive Use (Etc)			0.00	0.00	15.81	21.12	46.92	62.70	60.50	74.80	71.00	51.00
23334	Plant Use (Pre-Sowing)			0	0	60	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	0	0	0	0.00	-71.00	-51
	Gross Water Requirement			0.00	0.00	75.81	21.12	46.92	62.70	60.50	74.80	0.00	0
	Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)			0.00	0.00	75.81	21.12	46.92	62.70	60.50	74.80	0.00	0.00
	Requirement at Canal Head With Efficiency 64 % (G I R)			0.00	0.00	118.45	33.00	73.31	97.97	94.53	116.88	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area (MCM)			0.00	0.00	27.64	7.70	17.11	22.86	22.06	27.27	0.00	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**0.000**		**35.340**		**39.967**		**49.330**		**0.000**	

Annexure-6.8 Contd.

Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
VEGETABLE-RA	ETo			62	52	51	48	51	57	55	68
	Crop factor (Kc)			0	0.29	0.37	0.67	1.00	1.00	1.00	0.94
Sowing Area	Consumptive Use (Etc)			0	15.08	18.87	32.16	51.00	57.00	55.00	63.92
1944.5	Plant Use (Pre-Sowing)			0	60	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	0	0	-18.33	-63.92
	Gross Water Requirement			0	75.08	18.87	32.16	51.00	57.00	36.67	0
	Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)			0.00	75.08	18.87	32.16	51.00	57.00	36.67	0.00
	Requirement at Canal Head With Efficiency 64 % (G I R)			0.00	117.31	29.48	50.25	79.69	89.06	57.29	0.00
	Water Requirement at Canal Head for crop in sowing area (MCM)			0.00	2.28	0.57	0.98	1.55	1.73	1.11	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**2.281**		**1.550**		**3.281**		**1.114**	

Annexure-6.8 Contd.

Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
MUSTARD (Oilseed-2RA)	ETo	84	74	62	52	51	48	51	57	55	68
	Crop factor (Kc)	0	0.31	0.48	0.50	1.09	1.10	1.10	1.09	0.93	0.52
Sowing Area	Consumptive Use (Etc)	0	22.94	29.76	26.00	55.59	52.80	56.10	62.13	51.15	35.36
2722.3	Plant Use (Pre-Sowing)	0	60	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	0	-34.1	-35.4
	Gross Water Requirement	0	82.94	29.8	26.0	55.6	52.8	56.1	62.1	17.1	0
	Rainfall (mm)	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)	0.00	82.94	29.76	26.00	55.59	52.80	56.10	62.13	17.05	0.00
	Requirement at Canal Head With Efficiency 64 % (G I R)	0.00	129.59	46.50	40.63	86.86	82.50	87.66	97.08	26.64	0.00
	Water Requirement at Canal Head for crop in sowing area (MCM)	0.00	3.53	1.27	1.11	2.36	2.25	2.39	2.64	0.73	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**3.528**		**2.372**		**4.610**		**5.029**		**0.725**	

Annexure-6.8 Contd.

Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
Peas	ETo	84	74	62	52	51	48	51	57	55	68
	Crop factor (Kc)	0	0.28	0.47	0.83	1.07	1.10	1.10	1.02	0.71	0
Sowing Area	Consumptive Use (Etc)	0	20.72	29.14	43.16	54.57	52.8	56.1	58.14	39.05	0
1944.5	Plant Use (Pre-Sowing)	0	60	0	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	-58.14	-39.05	0.0
	Gross Water Requirement	0	80.72	29.14	43.16	54.57	52.80	56.10	0.00	0.00	0
	Rainfall (mm)	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR)	0.00	80.72	29.14	43.16	54.57	52.80	56.10	0.00	0.00	0.00
	Requirement at Canal Head With Efficiency 64 % (G I R)	0.00	126.13	45.53	67.44	85.27	82.50	87.66	0.00	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area (MCM)	0.00	2.45	0.89	1.31	1.66	1.60	1.70	0.00	0.00	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)	**2.453**		**2.197**		**3.262**		**1.704**		**0.000**	

Annexure-6.8 Contd.

Name of Crop	Particulars	OCT		NOV		DEC		JAN		FEB	
		I	II	I	II	I	II	I	II	I	II
GRAM - N2RA	ETo			62	52	51	48	51	57	55	68
	Crop factor (Kc)			0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)			14.26	15.08	42.33	50.40	53.55	54.72	37.40	29.00
8944.7	Plant Use (Pre-Sowing)			60	0	0	0	0	0	0	0
	Soil Moisture Adjust. (SMADJ)			0	0	0	0	0	-36.48	-37.40	-29.00
	Gross Water Requirement			74.26	15.08	42.33	50.40	53.55	18.24	0.00	0.00
	Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Effective Rainfall (mm)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Net Irrigation Requirement at Field (NIR) mm			74.26	15.08	42.33	50.40	53.55	18.24	0.00	0.00
	Requirement at Canal Head With Efficiency 64 % (G I R)			116.03	23.56	66.14	78.75	83.67	28.50	0.00	0.00
	Water Requirement at Canal Head for crop in sowing area (MCM)			10.38	2.11	5.92	7.04	7.48	2.55	0.00	0.00
	Total monthly Water Requirement at Canal Head for crop in sowing area (MCM)			**12.486**		**12.960**		**10.033**		**0.000**	
	Total fornightly water req. for irrigated area (Mcum)	**0.0**	**5.98**	**12.5**	**6.8**	**38.2**	**19.6**	**30.2**	**29.8**	**23.9**	**27.3**
	Requirement for 90% rabi intensity	**0.000**	**5.382**	**11.277**	**6.125**	**34.337**	**17.614**	**27.208**	**26.805**	**21.507**	**24.544**

				Month wisewater demand of MP and UP for operation study of Daudhan Dam														
SL. No.	Month	Saleha LIS Demand (direct from reservoir)	High level command direct from reservoir	Ken-Betwa Link (Upper Level Tunnel)														From PH-I/River Sluice Through Bariyarpur PUW for Ken canal of UP
			High Level command from RD 18.00	Enroute Command including tank filling(including Transmission losses of Main Canal)	Domestic Water Supply	Total enroute of Link canal(4+5+6)	Ken Left Bank Canal (KMPP) from lower level tunnel (PH-II)	From PH-I/River Sluice Through Bariyarpur PUW	Total od MP(3+7+8+9)	Enroute of Link Canal UP	Devolopment of new command in mahoba including transmission losses	Irrigation demand of Lalitpur by Transfer	Domestic Water Supply in enroute for jhansi and mahoba	Domestic Water Supply for Lalitpur By Transfer	Total enroute of Link canal(11+12+13+14+15)	Total Water Transfer to Parichha in lieu of Lalitpur irrigation and	Total releases from Ken Betwa link(7+16)	
			MP	MP	MP	(MP Portion)	MP	MP			UP	UP	UP		(UP Portion)	UP	(MP+UP)	UP
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	CCA (ha)	**90101**	**43678**	**138847**		**182525**	**139848**	**38890**	**451364**	**17488**	**37564**	**3533**			**58585**		**241110**	**192479**
1	June	21.40	2.39	7.61	0.00	**10.01**	7.67	2.54	**41.62**	**0.69**	**0.00**	**0.00**	0		**0.69**	0.00	**10.69**	13.49
2	July	69.48	17.50	55.62	6.00	**79.12**	56.02	18.60	**223.22**	**5.81**	**0.00**	**0.00**	0		**5.81**	0.00	**84.93**	127.58
3	August	3.35	5.93	18.86	6.00	**30.80**	19.00	6.31	**59.47**	**6.71**	**0.00**	**0.00**	0		**6.71**	0.00	**37.51**	207.14
4	September	30.63	20.46	65.04	6.00	**91.50**	65.51	21.76	**209.39**	**6.69**	**0.00**	**0.00**	0		**6.69**	0.00	**98.19**	240.81
5	October	9.92	5.09	16.18	6.00	**27.27**	16.30	5.38	**58.87**	**4.77**	**0.00**	**0.00**	0		**4.77**	0.00	**32.04**	152.35
6	November	90.19	47.82	152.02	9.00	**208.84**	153.12	17.40	**469.56**	**8.49**	**20.66**	**1.86**	0		**31.01**	1.86	**239.85**	54.68
7	December	81.90	47.80	151.96	9.00	**208.76**	153.05	51.95	**495.67**	**18.98**	**46.91**	**4.60**	0		**70.49**	4.60	**279.26**	127.56
8	**January**	**93.44**	**53.93**	171.45	9.00	**234.38**	172.69	54.01	**554.52**	**19.17**	**48.80**	**4.63**	0	7	**79.60**	11.63	**313.98**	**149.63**
9	February	35.96	19.83	63.03	9.00	**91.86**	63.49	46.05	**237.37**	**18.93**	**50.49**	**4.44**	0	7	**80.86**	11.44	**172.72**	150.12
10	March	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	**0.00**	**14.52**	**37.12**	**3.42**	12	7	**74.06**	10.42	**74.06**	82.40
11	April	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	**0.00**	**0.00**	**0.00**	**0.00**	13	7	**20.00**	7.00	**20.00**	0.00
12	May	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	**0.00**	**0.00**	**0.00**	**0.00**	9.79	3.98	**13.77**	3.98	**13.77**	0.00
	Total	**436.29**	**220.76**	**701.78**	**60.00**	**982.55**	**706.84**	**224.02**	**2349.69**	**104.76**	**203.97**	**18.95**	**34.79**	**31.98**	**394.45**	**50.93**	**1377.00**	**1305.77**

SL. No.	Month	From PH-I/River Sluice Through Bariyarpur PUW			Total Environmental Flow (as per EAC of MOEF &CC)	Total of Madhya Pradesh				Total of Uttar Pradesh				Total Utilisation from Daudhan reservoir
		MP	Supplied by Uttar Pradesh	Total		Irrigation	Domestic	Transfer	Total	Irrigation	Domestic	Transfer	Total	
20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
	CCA (ha)	38890	192479	231369		451364			451364	247531		3533	251064	
1	June	2.54	13.49	16.03	17.63	41.62	0	0	41.62	14.18	0	0.00	14.18	73.42
2	July	18.60	127.58	146.18	123.6	217.22	6	0	223.22	133.39	0	0.00	133.39	480.21
3	August	6.31	207.14	213.45	257.49	53.47	6	0	59.47	213.85	0	0.00	213.85	530.81
4	September	21.76	240.81	262.57	36.17	203.39	6	0	209.39	247.50	0	0.00	247.50	493.06
5	October	5.38	152.35	157.74	4.81	52.87	6	0	58.87	157.13	0	0.00	157.13	220.81
6	November	17.40	54.68	72.08	7.7	460.56	9	0	469.56	83.83	0	1.86	85.69	562.94
7	December	51.95	127.56	179.51	7.7	486.67	9	0	495.67	193.45	0	4.60	198.05	701.43
8	January	54.01	149.63	203.64	7.7	545.52	9	0	554.52	217.60	0	11.63	229.22	791.45
9	February	46.05	150.12	196.18	7.7	228.37	9	0	237.37	219.54	0	11.44	230.98	476.05
10	March	0.00	82.40	82.40	7.7	0.00	0	0	0.00	134.04	12	10.42	156.46	164.16
11	April	0.00	0.00	0.00	7.7	0.00	0	0	0.00	0.00	13	7.00	20.00	27.70
12	May	0.00	0.00	0.00	7.7	0.00	0	0	0.00	0.00	9.79	3.98	13.77	21.47
	Total	224.02	1305.77	1529.78	493.6	2289.69	60.00	0.00	2349.69	1614.50	34.79	50.93	1700.22	4543.51

Annexure-6.10

Virgin flow at Daudhan (Estimated from Madla virgin flow & area and rainfall ratios)													
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1981.00	51.61	48.26	25.87	2.58	74.24	71.36	683.07	1781.38	447.06	278.47	97.05	44.45	3605.42
1982.00	103.01	113.84	49.06	14.07	59.56	9.09	566.76	5587.46	2067.73	135.65	71.16	52.39	8829.76
1983.00	138.69	135.64	64.35	4.47	19.69	11.23	1398.58	2401.91	3704.62	793.37	134.92	60.04	8867.52
1984.00	**91.47**	**138.41**	**141.01**	**23.67**	**27.66**	**15.54**	**162.26**	**4158.97**	**1373.99**	**243.83**	**143.44**	**69.52**	**6589.76**
1985.00	93.35	85.41	28.94	3.35	20.44	63.87	1056.79	5393.57	594.93	507.18	179.81	71.97	8099.61
1986.00	166.81	139.13	84.79	11.93	60.00	191.89	1103.86	2395.38	283.09	145.66	147.41	63.20	4793.15
1987.00	65.53	102.33	42.99	3.37	26.64	5.30	989.51	2625.27	4303.56	564.93	152.12	80.24	8961.81
1988.00	107.31	152.90	34.33	5.17	50.60	351.99	1894.78	3952.55	558.47	171.28	127.73	58.24	7465.35
1989.00	68.39	88.74	29.59	3.00	22.65	42.66	611.66	1916.61	754.49	131.10	114.98	46.26	3830.13
1990.00	57.03	49.49	24.51	2.92	39.42	1895.16	3893.76	4013.74	4646.74	606.31	153.02	52.53	15434.65
1991.00	126.53	175.79	35.05	6.79	34.44	12.90	1282.21	5861.92	1072.89	157.27	147.55	50.21	8963.56
1992.00	68.30	107.38	28.58	3.10	5.82	2.83	766.55	4841.34	5025.84	284.89	103.22	79.11	11316.96
1993.00	176.87	101.96	33.46	2.82	14.02	4.74	532.21	2184.52	4442.09	635.23	177.33	126.05	8431.31
1994.00	117.44	133.55	49.14	9.37	28.24	566.97	5820.88	8655.53	1427.07	262.85	142.64	61.29	17274.97
1995.00	95.17	64.16	30.94	3.78	38.98	1.58	1288.35	3535.20	1152.55	240.59	90.34	44.99	6586.63
1996.00	58.83	51.12	26.13	3.46	40.88	2.13	619.40	4601.66	2019.77	314.72	181.72	68.13	7987.94
1997.00	137.95	114.32	30.33	3.38	5.92	2.01	2130.08	3758.13	2879.26	379.91	362.56	738.76	10542.61
1998.00	228.14	180.72	99.42	3.96	76.88	12.58	951.84	3613.38	1086.95	342.51	148.50	43.80	6788.70
1999.00	171.29	58.83	27.52	3.20	37.78	3.82	1030.55	5619.70	9720.58	1405.32	160.08	65.65	18304.32
2000.00	185.85	121.74	35.55	8.35	49.28	170.77	1797.08	1435.94	1344.71	36.64	24.48	46.67	5257.05
2001.00	74.29	65.09	34.07	4.62	9.23	564.01	5685.36	2528.91	579.05	249.91	190.80	63.58	10048.90
2002.00	114.02	87.17	37.90	5.47	19.31	2.60	65.76	3039.85	2212.56	222.89	181.92	78.49	6067.95
2003.00	105.27	131.31	39.65	9.26	29.68	48.07	1461.61	3507.71	8543.33	1304.04	228.91	86.34	15495.16
2004.00	153.87	129.34	59.20	7.94	9.79	845.57	546.77	4170.81	1198.63	384.25	132.65	73.58	7712.38

Annexure-6.11

Proposed upstream utilization in the Madhya Pradesh (as per commitment of 2265 MCM)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Total**
1981.00	51.61	48.26	25.87	2.58	74.24	39.06	373.85	974.97	244.68	152.41	97.05	44.45	2129.04
1982.00	103.01	113.84	49.06	14.07	59.56	1.93	120.55	1188.46	439.81	28.85	71.16	52.39	2242.69
1983.00	138.69	135.64	64.35	4.47	19.69	2.23	277.51	476.59	735.07	157.42	134.92	60.04	2206.62
1984.00	**91.47**	**138.41**	**141.01**	**23.67**	**27.66**	**4.75**	**49.64**	**1272.27**	**420.31**	**74.59**	**143.44**	**69.52**	2456.74
1985.00	93.35	85.41	28.94	3.35	20.44	13.01	215.28	1098.75	121.20	103.32	179.81	71.97	2034.83
1986.00	166.81	139.13	84.79	11.93	60.00	84.51	486.17	1055.00	124.68	64.15	147.41	63.20	2487.78
1987.00	65.53	102.33	42.99	3.37	26.64	1.05	196.23	520.61	853.42	112.03	152.12	80.24	2156.56
1988.00	107.31	152.90	34.33	5.17	50.60	94.87	510.72	1065.37	150.53	46.17	127.73	58.24	2403.94
1989.00	68.39	88.74	29.59	3.00	22.65	23.84	341.77	1070.94	421.58	73.25	114.98	46.26	2304.99
1990.00	57.03	49.49	24.51	2.92	39.42	211.71	434.97	448.37	519.08	67.73	153.02	52.53	2060.78
1991.00	126.53	175.79	35.05	6.79	34.44	2.85	283.60	1296.52	237.30	34.78	147.55	50.21	2431.42
1992.00	68.30	107.38	28.58	3.10	5.82	0.45	123.15	777.76	807.40	45.77	103.22	79.11	2150.04
1993.00	176.87	101.96	33.46	2.82	14.02	0.99	110.89	455.15	925.51	132.35	177.33	126.05	2257.40
1994.00	117.44	133.55	49.14	9.37	28.24	61.97	636.26	946.10	155.99	28.73	142.64	61.29	2370.71
1995.00	95.17	64.16	30.94	3.78	38.98	0.50	404.07	1108.75	361.48	75.46	90.34	44.99	2318.60
1996.00	58.83	51.12	26.13	3.46	40.88	0.49	141.31	1049.85	460.80	71.80	181.72	68.13	2154.52
1997.00	137.95	114.32	30.33	3.38	5.92	0.13	134.00	236.41	181.12	23.90	362.56	738.76	1968.78
1998.00	228.14	180.72	99.42	3.96	76.88	3.72	281.26	1067.71	321.18	101.21	148.50	43.80	2556.50
1999.00	171.29	58.83	27.52	3.20	37.78	0.35	95.03	518.20	896.34	129.59	160.08	65.65	2163.86
2000.00	185.85	121.74	35.55	8.35	49.28	71.64	753.95	602.43	564.16	15.37	24.48	46.67	2479.47
2001.00	74.29	65.09	34.07	4.62	9.23	102.60	1034.28	460.06	105.34	45.46	190.80	63.58	2189.41
2002.00	114.02	87.17	37.90	5.47	19.31	0.79	20.05	926.94	674.68	67.97	181.92	78.49	2214.72
2003.00	105.27	131.31	39.65	9.26	29.68	5.14	156.40	375.35	914.19	139.54	228.91	86.34	2221.02
2004.00	153.87	129.34	59.20	7.94	9.79	243.73	157.60	1202.20	345.49	110.76	132.65	73.58	2626.13

Net flow at Daudhan after considering 2266 MCM for upstream use													
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1981.00	0.00	0.00	0.00	0.00	0.00	32.31	309.22	806.42	202.38	126.06	0.00	0.00	1476.38
1982.00	0.00	0.00	0.00	0.00	0.00	7.15	446.21	4399.00	1627.92	106.79	0.00	0.00	6587.07
1983.00	0.00	0.00	0.00	0.00	0.00	9.00	1121.07	1925.33	2969.55	635.95	0.00	0.00	6660.90
1984.00	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**10.78**	**112.62**	**2886.70**	**953.67**	**169.24**	**0.00**	**0.00**	4133.02
1985.00	0.00	0.00	0.00	0.00	0.00	50.86	841.51	4294.82	473.73	403.86	0.00	0.00	6064.78
1986.00	0.00	0.00	0.00	0.00	0.00	107.38	617.69	1340.39	158.41	81.51	0.00	0.00	2305.37
1987.00	0.00	0.00	0.00	0.00	0.00	4.25	793.29	2104.67	3450.14	452.90	0.00	0.00	6805.25
1988.00	0.00	0.00	0.00	0.00	0.00	257.11	1384.06	2887.18	407.94	125.11	0.00	0.00	5061.41
1989.00	0.00	0.00	0.00	0.00	0.00	18.82	269.89	845.68	332.91	57.85	0.00	0.00	1525.14
1990.00	0.00	0.00	0.00	0.00	0.00	1683.46	3458.80	3565.37	4127.66	538.58	0.00	0.00	13373.87
1991.00	0.00	0.00	0.00	0.00	0.00	10.05	998.62	4565.40	835.59	122.48	0.00	0.00	6532.14
1992.00	0.00	0.00	0.00	0.00	0.00	2.38	643.40	4063.58	4218.44	239.12	0.00	0.00	9166.92
1993.00	0.00	0.00	0.00	0.00	0.00	3.76	421.32	1729.37	3516.58	502.88	0.00	0.00	6173.91
1994.00	0.00	0.00	0.00	0.00	0.00	505.00	5184.63	7709.43	1271.08	234.12	0.00	0.00	14904.26
1995.00	0.00	0.00	0.00	0.00	0.00	1.09	884.28	2426.45	791.08	165.14	0.00	0.00	4268.03
1996.00	0.00	0.00	0.00	0.00	0.00	1.64	478.08	3551.81	1558.97	242.92	0.00	0.00	5833.42
1997.00	0.00	0.00	0.00	0.00	0.00	1.89	1996.08	3521.71	2698.14	356.01	0.00	0.00	8573.83
1998.00	0.00	0.00	0.00	0.00	0.00	8.86	670.59	2545.67	765.77	241.30	0.00	0.00	4232.19
1999.00	0.00	0.00	0.00	0.00	0.00	3.46	935.53	5101.50	8824.24	1275.74	0.00	0.00	16140.47
2000.00	0.00	0.00	0.00	0.00	0.00	99.12	1043.13	833.50	780.55	21.27	0.00	0.00	2777.57
2001.00	0.00	0.00	0.00	0.00	0.00	461.40	4651.08	2068.85	473.71	204.44	0.00	0.00	7859.49
2002.00	0.00	0.00	0.00	0.00	0.00	1.81	45.71	2112.90	1537.88	154.93	0.00	0.00	3853.23
2003.00	0.00	0.00	0.00	0.00	0.00	42.93	1305.21	3132.36	7629.15	1164.50	0.00	0.00	13274.14
2004.00	0.00	0.00	0.00	0.00	0.00	601.84	389.17	2968.61	853.13	273.50	0.00	0.00	5086.25

Working Table **Annexure-6.13**

Monthly operation simulation of Daudhan Dam

Dead Storage 62.38 MCM Live 2644.48 MCM

S.No	Year - Month	Initial Storage	Gross Flow	Proposed Upstream Utilisation on prorate basis	Inflow	Total yield available	Total demand U.P.	Total demand M.P.	Total	Drinking U.P.	DrinkingM.P.	Total	Environment release	Monthly Draw off: Irrigation Demand	Drinking	Environment release	Total	Evaporation Losses	Balance at end of month (5-11-12)	Spill	Reservoir Level at the end of month	Balance at end of month internal	Success (S) or Failure (F): Month	June	July	Year
		Mcum			Mcum	Mcum	Mcum	Mcum		Mcum	Mcum		Mcum	Mcum	Mcum		Mcum	Mcum	Mcum	Mcum	M	Mcum				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	1981-06	300.00	71.36	39.06	32.31	332.31	14.18	41.62	55.80	0.00	0.00	0.00	17.63	55.80	0.00	17.63	73.43	7.87	251.01	0.00	247.41	251.01	S	S		
2	1981-07	251.01	683.07	373.85	309.22	560.23	133.39	217.22	350.61	0.00	6.00	6.00	123.60	350.61	6.00	123.60	480.21	3.96	76.06	0.00	240.81	76.06	S		S	
3	1981-08	76.06	1781.38	974.97	806.42	882.48	299.33	53.47	352.80	0.00	6.00	6.00	257.49	267.32	6.00	257.49	530.81	3.81	347.86	0.00	250.27	347.86	S			
4	1981-09	347.86	447.06	244.68	202.38	550.24	346.43	203.39	549.82	0.00	6.00	6.00	36.17	441.82	6.00	36.17	483.99	3.87	62.38	0.00	240.00	62.38	F			
5	1981-10	62.38	278.47	152.41	126.06	188.44	157.13	52.87	210.00	0.00	6.00	6.00	4.81	112.47	6.00	4.81	123.28	2.78	62.38	0.00	240.00	62.38	F			
6	1981-11	62.38	97.05	97.05	0.00	62.38	67.47	460.56	528.03	0.00	9.00	9.00	7.70	0.00	0.00	0.00	0.00	1.98	60.40	0.00	239.88	60.40	F			
7	1981-12	60.40	44.45	44.45	0.00	60.40	156.00	486.67	642.67	0.00	9.00	9.00	7.70	0.00	0.00	0.00	0.00	1.66	58.74	0.00	239.78	58.74	F			
8	1982-01	58.74	103.01	103.01	0.00	58.74	174.94	545.52	720.46	7.00	9.00	16.00	7.70	0.00	0.00	0.00	0.00	1.81	56.93	0.00	239.68	56.93	F			
9	1982-02	56.93	113.84	113.84	0.00	56.93	176.26	228.37	404.63	7.00	9.00	16.00	7.70	0.00	0.00	0.00	0.00	2.14	54.79	0.00	239.55	54.79	F			
10	1982-03	54.79	49.06	49.06	0.00	54.79	108.33	0.00	108.33	19.00	0.00	19.00	7.70	0.00	0.00	0.00	0.00	3.28	51.51	0.00	239.35	51.51	F			
11	1982-04	51.51	14.07	14.07	0.00	51.51	0.00	0.00	0.00	20.00	0.00	20.00	7.70	0.00	0.00	0.00	0.00	4.32	47.19	0.00	239.10	47.19	S			
12	1982-05	47.19	59.56	59.56	0.00	47.19	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	5.29	41.90	0.00	238.78	41.90	S			F
13	1982-06	41.90	9.09	1.93	7.15	49.05	14.18	41.62	55.80	0.00	0.00	0.00	17.63	0.00	0.00	0.00	0.00	4.55	44.50	0.00	238.94	44.50	F	F		
14	1982-07	44.50	566.76	120.55	446.21	490.71	133.39	217.22	350.61	0.00	6.00	6.00	123.60	295.80	6.00	123.60	425.40	2.93	62.38	0.00	240.00	62.38	F		F	
15	1982-08	62.38	5587.46	1188.46	4399.00	4461.38	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	257.49	616.29	6.64	2644.48	1193.97	288.00	2644.48	S			
16	1982-09	2644.48	2067.73	439.81	1627.92	4272.39	346.43	203.39	549.82	0.00	6.00	6.00	36.17	549.83	6.00	36.17	592.00	10.97	2644.48	1024.95	288.00	2644.48	S			
17	1982-10	2644.48	135.65	28.85	106.79	2751.27	157.13	52.87	210.00	0.00	6.00	6.00	4.81	210.00	6.00	4.81	220.81	10.32	2520.15	0.00	286.52	2520.15	S			
18	1982-11	2520.15	71.16	71.16	0.00	2520.15	67.47	460.56	528.03	0.00	9.00	9.00	7.70	524.53	9.00	7.70	541.23	6.62	1972.29	0.00	279.45	1972.29	S			
19	1982-12	1972.29	52.39	52.39	0.00	1972.29	156.00	486.67	642.67	0.00	9.00	9.00	7.70	641.96	9.00	7.70	658.66	4.85	1308.79	0.00	269.61	1308.79	S			
20	1983-01	1308.79	138.69	138.69	0.00	1308.79	174.94	545.52	720.46	7.00	9.00	16.00	7.70	719.37	9.00	7.70	736.07	4.35	568.36	0.00	255.69	568.36	S			
21	1983-02	568.36	135.64	135.64	0.00	568.36	176.26	228.37	404.63	7.00	9.00	16.00	7.70	403.60	9.00	7.70	420.30	3.71	144.35	0.00	243.75	144.35	S			
22	1983-03	144.35	64.35	64.35	0.00	144.35	108.33	0.00	108.33	19.00	0.00	19.00	7.70	70.25	0.00	7.70	77.95	4.02	62.38	0.00	240.00	62.38	F			
23	1983-04	62.38	4.47	4.47	0.00	62.38	0.00	0.00	0.00	20.00	0.00	20.00	7.70	0.00	0.00	0.00	0.00	4.58	57.80	0.00	239.73	57.80	S			
24	1983-05	57.80	19.69	19.69	0.00	57.80	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	5.60	52.20	0.00	239.39	52.20	S			F
25	1983-06	52.20	11.23	2.23	9.00	61.20	14.18	41.62	55.80	0.00	0.00	0.00	17.63	0.00	0.00	0.00	0.00	4.83	56.37	0.00	239.64	56.37	F	F		
26	1983-07	56.37	1398.58	277.51	1121.07	1177.45	133.39	217.22	350.61	0.00	6.00	6.00	123.60	350.61	6.00	123.60	480.21	4.79	692.45	0.00	258.36	692.45	S		S	
27	1983-08	692.45	2401.91	476.59	1925.33	2617.77	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	257.49	616.29	7.21	1994.28	0.00	279.76	1994.28	S			
28	1983-09	1994.28	3704.62	735.07	2969.55	4963.83	346.43	203.39	549.82	0.00	6.00	6.00	36.17	549.83	6.00	36.17	592.00	9.90	2644.48	1717.46	288.00	2644.48	S			
29	1983-10	2644.48	793.37	157.42	635.95	3280.43	157.13	52.87	210.00	0.00	6.00	6.00	4.81	210.00	6.00	4.81	220.81	10.66	2644.48	404.48	288.00	2644.48	S			
30	1983-11	2644.48	134.92	134.92	0.00	2644.48	67.47	460.56	528.03	0.00	9.00	9.00	7.70	524.53	9.00	7.70	541.23	6.95	2096.29	0.00	281.16	2096.29	S			
31	1983-12	2096.29	60.04	60.04	0.00	2096.29	156.00	486.67	642.67	0.00	9.00	9.00	7.70	641.96	9.00	7.70	658.66	5.03	1432.61	0.00	271.57	1432.61	S			
32	1984-01	1432.61	91.47	91.47	0.00	1432.61	174.94	545.52	720.46	7.00	9.00	16.00	7.70	719.37	9.00	7.70	736.07	4.61	691.93	0.00	258.35	691.93	S			
33	1984-02	691.93	138.41	138.41	0.00	691.93	176.26	228.37	404.63	7.00	9.00	16.00	7.70	403.60	9.00	7.70	420.30	4.10	267.52	0.00	247.90	267.52	S			
34	1984-03	267.52	141.01	141.01	0.00	267.52	108.33	0.00	108.33	19.00	0.00	19.00	7.70	108.61	0.00	7.70	116.31	4.98	146.24	0.00	243.83	146.24	S			
35	1984-04	146.24	23.67	23.67	0.00	146.24	0.00	0.00	0.00	20.00	0.00	20.00	7.70	0.00	0.00	0.00	0.00	6.18	140.06	0.00	243.57	140.06	S			
36	1984-05	140.06	27.66	27.66	0.00	140.06	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	7.61	132.45	0.00	243.25	132.45	S			F
37	1984-06	132.45	15.54	4.75	10.78	143.23	14.18	41.62	55.80	0.00	0.00	0.00	17.63	55.79	0.00	17.63	73.42	5.79	64.02	0.00	240.10	64.02	S	S		
38	1984-07	64.02	162.26	49.64	112.62	176.64	133.39	217.22	350.61	0.00	6.00	6.00	123.60	105.18	6.00	0.00	111.18	3.08	62.38	0.00	240.00	62.38	F		F	
39	1984-08	62.38	4158.97	1272.27	2886.70	2949.08	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	257.49	616.29	6.02	2326.78	0.00	284.16	2326.78	S			
40	1984-09	2326.78	1373.99	420.31	953.67	3280.45	346.43	203.39	549.82	0.00	6.00	6.00	36.17	549.83	6.00	36.17	592.00	10.32	2644.48	33.66	288.00	2644.48	S			
41	1984-10	2644.48	243.83	74.59	169.24	2813.72	157.13	52.87	210.00	0.00	6.00	6.00	4.81	210.00	6.00	4.81	220.81	10.41	2582.50	0.00	287.28	2582.50	S			
42	1984-11	2582.50	143.44	143.44	0.00	2582.50	67.47	460.56	528.03	0.00	9.00	9.00	7.70	524.53	9.00	7.70	541.23	6.72	2034.55	0.00	280.33	2034.55	S			
43	1984-12	2034.55	69.52	69.52	0.00	2034.55	156.00	486.67	642.67	0.00	9.00	9.00	7.70	641.96	9.00	7.70	658.66	4.95	1370.94	0.00	270.61	1370.94	S			
44	1985-01	1370.94	93.35	93.35	0.00	1370.94	174.94	545.52	720.46	7.00	9.00	16.00	7.70	719.37	9.00	7.70	736.07	4.50	630.37	0.00	257.04	630.37	S			
45	1985-02	630.37	85.41	85.41	0.00	630.37	176.26	228.37	404.63	7.00	9.00	16.00	7.70	403.60	9.00	7.70	420.30	3.90	206.16	0.00	245.92	206.16	S			
46	1985-03	206.16	28.94	28.94	0.00	206.16	108.33	0.00	108.33	19.00	0.00	19.00	7.70	108.61	0.00	7.70	116.31	4.39	85.47	0.00	241.26	85.47	S			
47	1985-04	85.47	3.35	3.35	0.00	85.47	0.00	0.00	0.00	20.00	0.00	20.00	7.70	10.51	0.00	7.70	18.21	4.88	62.38	0.00	240.00	62.38	F			
48	1985-05	62.38	20.44	20.44	0.00	62.38	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	5.73	56.65	0.00	239.66	56.65	S			F
49	1985-06	56.65	63.87	13.01	50.86	107.51	14.18	41.62	55.80	0.00	0.00	0.00	17.63	22.54	0.00	17.63	40.17	4.96	62.38	0.00	240.00	62.38	F	F		
50	1985-07	62.38	1056.79	215.28	841.51	903.89	133.39	217.22	350.61	0.00	6.00	6.00	123.60	350.61	6.00	123.60	480.21	4.34	419.34	0.00	252.13	419.34	S		S	

Working Table **Annexure-6.13**

Monthly operation simulation of Daudhan Dam

Dead Storage 62.38 MCM Live 2644.48 MCM

S.No	Year - Month	Initial Storage	Gross Flow	Proposed Upstream Utilisation on prorate basis	Inflow	Total yield available	Total demand U.P.	Total demand M.P.	Total	Drinking U.P.	DrinkingM.P.	Total	Environment release	Monthly Draw off: Irrigation Demand	Drinking	Environment release	Total	Evaporation Losses	Balance at end of month (5-11-12)	Spill	Reservoir Level at the end of month	Balance at end of month internal	Success (S) or Failure (F)			
		Mcum			Mcum	Mcum	Mcum	Mcum		Mcum	Mcum		Mcum	Mcum	Mcum		Mcum	Mcum	Mcum	Mcum	M	Mcum	Month	June	July	Year
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
51	1985-08	419.34	5393.57	1098.75	4294.82	4714.15	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	257.49	616.29	7.79	2644.48	1445.60	288.00	2644.48	S			
52	1985-09	2644.48	594.93	121.20	473.73	3118.21	346.43	203.39	549.82	0.00	6.00	6.00	36.17	549.83	6.00	36.17	592.00	10.61	2515.61	0.00	286.46	2515.61	S			
53	1985-10	2515.61	507.18	103.32	403.86	2919.47	157.13	52.87	210.00	0.00	6.00	6.00	4.81	210.00	6.00	4.81	220.81	10.31	2644.48	43.87	288.00	2644.48	S			
54	1985-11	2644.48	179.81	179.81	0.00	2644.48	67.47	460.56	528.03	0.00	9.00	9.00	7.70	524.53	9.00	7.70	541.23	6.95	2096.29	0.00	281.16	2096.29	S			
55	1985-12	2096.29	71.97	71.97	0.00	2096.29	156.00	486.67	642.67	0.00	9.00	9.00	7.70	641.96	9.00	7.70	658.66	5.03	1432.61	0.00	271.57	1432.61	S			
56	1986-01	1432.61	166.81	166.81	0.00	1432.61	174.94	545.52	720.46	7.00	9.00	16.00	7.70	719.37	9.00	7.70	736.07	4.61	691.93	0.00	258.35	691.93	S			
57	1986-02	691.93	139.13	139.13	0.00	691.93	176.26	228.37	404.63	7.00	9.00	16.00	7.70	403.60	9.00	7.70	420.30	4.10	267.52	0.00	247.90	267.52	S			
58	1986-03	267.52	84.79	84.79	0.00	267.52	108.33	0.00	108.33	19.00	0.00	19.00	7.70	108.61	0.00	7.70	116.31	4.98	146.24	0.00	243.83	146.24	S			
59	1986-04	146.24	11.93	11.93	0.00	146.24	0.00	0.00	0.00	20.00	0.00	20.00	7.70	0.00	0.00	0.00	0.00	6.18	140.06	0.00	243.57	140.06	S			
60	1986-05	140.06	60.00	60.00	0.00	140.06	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	7.61	132.45	0.00	243.25	132.45	S			F
61	1986-06	132.45	191.89	84.51	107.38	239.82	14.18	41.62	55.80	0.00	0.00	0.00	17.63	55.79	0.00	17.63	73.42	6.72	159.68	0.00	244.32	159.68	S	S		
62	1986-07	159.68	1103.86	486.17	617.69	777.37	133.39	217.22	350.61	0.00	6.00	6.00	123.60	350.61	6.00	123.60	480.21	4.55	292.61	0.00	248.66	292.61	S		S	
63	1986-08	292.61	2395.38	1055.00	1340.39	1632.99	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	257.49	616.29	5.55	1011.16	0.00	264.54	1011.16	S			
64	1986-09	1011.16	283.09	124.68	158.41	1169.56	346.43	203.39	549.82	0.00	6.00	6.00	36.17	549.83	6.00	36.17	592.00	6.38	571.19	0.00	255.75	571.19	S			
65	1986-10	571.19	145.66	64.15	81.51	652.70	157.13	52.87	210.00	0.00	6.00	6.00	4.81	210.00	6.00	4.81	220.81	5.36	426.53	0.00	252.32	426.53	S			
66	1986-11	426.53	147.41	147.41	0.00	426.53	67.47	460.56	528.03	0.00	9.00	9.00	7.70	344.62	9.00	7.70	361.32	2.83	62.38	0.00	240.00	62.38	F			
67	1986-12	62.38	63.20	63.20	0.00	62.38	156.00	486.67	642.67	0.00	9.00	9.00	7.70	0.00	0.00	0.00	0.00	1.67	60.71	0.00	239.90	60.71	F			
68	1987-01	60.71	65.53	65.53	0.00	60.71	174.94	545.52	720.46	7.00	9.00	16.00	7.70	0.00	0.00	0.00	0.00	1.82	58.89	0.00	239.79	58.89	F			
69	1987-02	58.89	102.33	102.33	0.00	58.89	176.26	228.37	404.63	7.00	9.00	16.00	7.70	0.00	0.00	0.00	0.00	2.16	56.73	0.00	239.66	56.73	F			
70	1987-03	56.73	42.99	42.99	0.00	56.73	108.33	0.00	108.33	19.00	0.00	19.00	7.70	0.00	0.00	0.00	0.00	3.31	53.42	0.00	239.47	53.42	F			
71	1987-04	53.42	3.37	3.37	0.00	53.42	0.00	0.00	0.00	20.00	0.00	20.00	7.70	0.00	0.00	0.00	0.00	4.37	49.05	0.00	239.21	49.05	S			
72	1987-05	49.05	26.64	26.64	0.00	49.05	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	5.35	43.70	0.00	238.89	43.70	S			F
73	1987-06	43.70	5.30	1.05	4.25	47.95	14.18	41.62	55.80	0.00	0.00	0.00	17.63	0.00	0.00	0.00	0.00	4.56	43.39	0.00	238.87	43.39	F	F		
74	1987-07	43.39	989.51	196.23	793.29	836.68	133.39	217.22	350.61	0.00	6.00	6.00	123.60	350.61	6.00	123.60	480.21	4.00	352.47	0.00	250.39	352.47	S		S	
75	1987-08	352.47	2625.27	520.61	2104.67	2457.13	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	257.49	616.29	6.49	1834.36	0.00	277.51	1834.36	S			
76	1987-09	1834.36	4303.56	853.42	3450.14	5284.50	346.43	203.39	549.82	0.00	6.00	6.00	36.17	549.83	6.00	36.17	592.00	9.79	2644.48	2038.24	288.00	2644.48	S			
77	1987-10	2644.48	564.93	112.03	452.90	3097.38	157.13	52.87	210.00	0.00	6.00	6.00	4.81	210.00	6.00	4.81	220.81	10.66	2644.48	221.44	288.00	2644.48	S			
78	1987-11	2644.48	152.12	152.12	0.00	2644.48	67.47	460.56	528.03	0.00	9.00	9.00	7.70	524.53	9.00	7.70	541.23	6.95	2096.29	0.00	281.16	2096.29	S			
79	1987-12	2096.29	80.24	80.24	0.00	2096.29	156.00	486.67	642.67	0.00	9.00	9.00	7.70	641.96	9.00	7.70	658.66	5.03	1432.61	0.00	271.57	1432.61	S			
80	1988-01	1432.61	107.31	107.31	0.00	1432.61	174.94	545.52	720.46	7.00	9.00	16.00	7.70	719.37	9.00	7.70	736.07	4.61	691.93	0.00	258.35	691.93	S			
81	1988-02	691.93	152.90	152.90	0.00	691.93	176.26	228.37	404.63	7.00	9.00	16.00	7.70	403.60	9.00	7.70	420.30	4.10	267.52	0.00	247.90	267.52	S			
82	1988-03	267.52	34.33	34.33	0.00	267.52	108.33	0.00	108.33	19.00	0.00	19.00	7.70	108.61	0.00	7.70	116.31	4.98	146.24	0.00	243.83	146.24	S			
83	1988-04	146.24	5.17	5.17	0.00	146.24	0.00	0.00	0.00	20.00	0.00	20.00	7.70	0.00	0.00	0.00	0.00	6.18	140.06	0.00	243.57	140.06	S			
84	1988-05	140.06	50.60	50.60	0.00	140.06	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	7.61	132.45	0.00	243.25	132.45	S			F
85	1988-06	132.45	351.99	94.87	257.11	389.56	14.18	41.62	55.80	0.00	0.00	0.00	17.63	55.79	0.00	17.63	73.42	7.35	308.79	0.00	249.14	308.79	S	S		
86	1988-07	308.79	1894.78	510.72	1384.06	1692.85	133.39	217.22	350.61	0.00	6.00	6.00	123.60	350.61	6.00	123.60	480.21	6.42	1206.21	0.00	267.95	1206.21	S		S	
87	1988-08	1206.21	3952.55	1065.37	2887.18	4093.40	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	257.49	616.29	8.80	2644.48	823.83	288.00	2644.48	S			
88	1988-09	2644.48	558.47	150.53	407.94	3052.42	346.43	203.39	549.82	0.00	6.00	6.00	36.17	549.83	6.00	36.17	592.00	10.51	2449.91	0.00	285.66	2449.91	S			
89	1988-10	2449.91	171.28	46.17	125.11	2575.03	157.13	52.87	210.00	0.00	6.00	6.00	4.81	210.00	6.00	4.81	220.81	9.61	2344.61	0.00	284.38	2344.61	S			
90	1988-11	2344.61	127.73	127.73	0.00	2344.61	67.47	460.56	528.03	0.00	9.00	9.00	7.70	524.53	9.00	7.70	541.23	6.36	1797.02	0.00	276.99	1797.02	S			
91	1988-12	1797.02	58.24	58.24	0.00	1797.02	156.00	486.67	642.67	0.00	9.00	9.00	7.70	641.96	9.00	7.70	658.66	4.63	1133.73	0.00	266.69	1133.73	S			
92	1989-01	1133.73	68.39	68.39	0.00	1133.73	174.94	545.52	720.46	7.00	9.00	16.00	7.70	719.37	9.00	7.70	736.07	3.98	393.68	0.00	251.46	393.68	S			
93	1989-02	393.68	88.74	88.74	0.00	393.68	176.26	228.37	404.63	7.00	9.00	16.00	7.70	311.52	9.00	7.70	328.22	3.08	62.38	0.00	240.00	62.38	F			
94	1989-03	62.38	29.59	29.59	0.00	62.38	108.33	0.00	108.33	19.00	0.00	19.00	7.70	0.00	0.00	0.00	0.00	3.41	58.97	0.00	239.80	58.97	F			
95	1989-04	58.97	3.00	3.00	0.00	58.97	0.00	0.00	0.00	20.00	0.00	20.00	7.70	0.00	0.00	0.00	0.00	4.50	54.47	0.00	239.53	54.47	S			
96	1989-05	54.47	22.65	22.65	0.00	54.47	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	5.50	48.97	0.00	239.20	48.97	S			F
97	1989-06	52.20	42.66	23.84	18.82	71.02	14.18	41.62	55.80	0.00	0.00	0.00	17.63	3.96	0.00	17.63	21.59	4.96	66.34	0.00	238.94	44.47	F	F		
98	1989-07	44.47	611.66	341.77	269.89	314.36	133.39	217.22	350.61	0.00	6.00	6.00	123.60	119.28	6.00	123.60	248.88	2.93	62.21	0.00	240.01	62.55	F		F	
99	1989-08	62.55	1916.61	1070.94	845.68	908.23	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	257.49	616.29	3.56	288.04	0.00	248.53	288.38	S			
100	1989-09	288.38	754.49	421.58	332.91	621.29	346.43	203.39	549.82	0.00	6.00	6.00	36.17	513.04	6.00	36.17	555.21	3.70	62.38	0.00	240.00	62.38	F			

Working Table **Annexure-6.13**

Monthly operation simulation of Daudhan Dam

Dead Storage 62.38 MCM Live 2644.48 MCM

S.No	Year - Month	Initial Storage	Gross Flow	Proposed Upstream Utilisation on prorate basis	Inflow	Total yield available	Total demand U.P.	Total demand M.P.	Total	Drinking U.P.	DrinkingM.P.	Total	Environment release	Monthly Draw off: Irrigation Demand	Drinking	Environment release	Total	Evaporation Losses	Balance at end of month (5-11-12)	Spill	Reservoir Level at the end of month	Balance at end of month internal	Success (S) or Failure (F): Month	June	July	Year
		Mcum			Mcum	Mcum	Mcum	Mcum		Mcum	Mcum		Mcum	Mcum	Mcum		Mcum	Mcum	Mcum	Mcum	M	Mcum				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
101	1989-10	62.38	131.10	73.25	57.85	120.23	157.13	52.87	210.00	0.00	6.00	6.00	4.81	44.26	6.00	4.81	55.07	2.78	62.38	0.00	240.00	62.38	F			
102	1989-11	62.38	114.98	114.98	0.00	62.38	67.47	460.56	528.03	0.00	9.00	9.00	7.70	0.00	0.00	0.00	0.00	1.98	60.40	0.00	239.88	60.40	F			
103	1989-12	60.40	46.26	46.26	0.00	60.40	156.00	486.67	642.67	0.00	9.00	9.00	7.70	0.00	0.00	0.00	0.00	1.66	58.74	0.00	239.78	58.74	F			
104	1990-01	58.74	57.03	57.03	0.00	58.74	174.94	545.52	720.46	7.00	9.00	16.00	7.70	0.00	0.00	0.00	0.00	1.81	56.93	0.00	239.68	56.93	F			
105	1990-02	56.93	49.49	49.49	0.00	56.93	176.26	228.37	404.63	7.00	9.00	16.00	7.70	0.00	0.00	0.00	0.00	2.14	54.79	0.00	239.55	54.79	F			
106	1990-03	54.79	24.51	24.51	0.00	54.79	108.33	0.00	108.33	19.00	0.00	19.00	7.70	0.00	0.00	0.00	0.00	3.28	51.51	0.00	239.35	51.51	F			
107	1990-04	51.51	2.92	2.92	0.00	51.51	0.00	0.00	0.00	20.00	0.00	20.00	7.70	0.00	0.00	0.00	0.00	4.32	47.19	0.00	239.10	47.19	S			
108	1990-05	47.19	39.42	39.42	0.00	47.19	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	5.29	41.90	0.00	238.78	41.90	S			F
109	1990-06	62.38	1895.16	211.71	1683.46	1745.84	14.18	41.62	55.80	0.00	0.00	0.00	17.63	55.80	0.00	17.63	73.43	**9.87	**1662.54	0.00	275.02	**1662.54	S	S		
110	1990-07	1662.54	3893.76	434.97	3458.80	5121.34	133.39	217.22	350.61	0.00	6.00	6.00	123.60	350.61	6.00	123.60	480.21	10.35	2644.48	1986.30	288.00	2644.48	S		S	
111	1990-08	2644.48	4013.74	448.37	3565.37	6209.85	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	257.49	616.29	10.54	2644.48	2938.54	288.00	2644.48	S			
112	1990-09	2644.48	4646.74	519.08	4127.66	6772.14	346.43	203.39	549.82	0.00	6.00	6.00	36.17	549.83	6.00	36.17	592.00	10.97	2644.48	3524.70	288.00	2644.48	S			
113	1990-10	2644.48	606.31	67.73	538.58	3183.06	157.13	52.87	210.00	0.00	6.00	6.00	4.81	210.00	6.00	4.81	220.81	10.66	2644.48	307.12	288.00	2644.48	S			
114	1990-11	2644.48	153.02	153.02	0.00	2644.48	67.47	460.56	528.03	0.00	9.00	9.00	7.70	524.53	9.00	7.70	541.23	6.95	2096.29	0.00	281.16	2096.29	S			
115	1990-12	2096.29	52.53	52.53	0.00	2096.29	156.00	486.67	642.67	0.00	9.00	9.00	7.70	641.96	9.00	7.70	658.66	5.03	1432.61	0.00	271.57	1432.61	S			
116	1991-01	1432.61	126.53	126.53	0.00	1432.61	174.94	545.52	720.46	7.00	9.00	16.00	7.70	719.37	9.00	7.70	736.07	4.61	691.93	0.00	258.35	691.93	S			
117	1991-02	691.93	175.79	175.79	0.00	691.93	176.26	228.37	404.63	7.00	9.00	16.00	7.70	403.60	9.00	7.70	420.30	4.10	267.52	0.00	247.90	267.52	S			
118	1991-03	267.52	35.05	35.05	0.00	267.52	108.33	0.00	108.33	19.00	0.00	19.00	7.70	108.61	0.00	7.70	116.31	4.98	146.24	0.00	243.83	146.24	S			
119	1991-04	146.24	6.79	6.79	0.00	146.24	0.00	0.00	0.00	20.00	0.00	20.00	7.70	0.00	0.00	0.00	0.00	6.18	140.06	0.00	243.57	140.06	S			
120	1991-05	140.06	34.44	34.44	0.00	140.06	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	7.61	132.45	0.00	243.25	132.45	S			S
121	1991-06	132.45	12.90	2.85	10.05	142.49	14.18	41.62	55.80	0.00	0.00	0.00	17.63	55.79	0.00	17.63	73.42	5.78	63.29	0.00	240.05	63.29	S	S		
122	1991-07	63.29	1282.21	283.60	998.62	1061.91	133.39	217.22	350.61	0.00	6.00	6.00	123.60	350.61	6.00	123.60	480.21	4.63	577.07	0.00	255.89	577.07	S		S	
123	1991-08	577.07	5861.92	1296.52	4565.40	5142.46	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	257.49	616.29	8.04	2644.48	1873.66	288.00	2644.48	S			
124	1991-09	2644.48	1072.89	237.30	835.59	3480.07	346.43	203.39	549.82	0.00	6.00	6.00	36.17	549.83	6.00	36.17	592.00	10.97	2644.48	232.63	288.00	2644.48	S			
125	1991-10	2644.48	157.27	34.78	122.48	2766.96	157.13	52.87	210.00	0.00	6.00	6.00	4.81	210.00	6.00	4.81	220.81	10.34	2535.82	0.00	286.71	2535.82	S			
126	1991-11	2535.82	147.55	147.55	0.00	2535.82	67.47	460.56	528.03	0.00	9.00	9.00	7.70	524.53	9.00	7.70	541.23	6.65	1987.93	0.00	279.67	1987.93	S			
127	1991-12	1987.93	50.21	50.21	0.00	1987.93	156.00	486.67	642.67	0.00	9.00	9.00	7.70	641.96	9.00	7.70	658.66	4.87	1324.41	0.00	269.86	1324.41	S			
128	1992-01	1324.41	68.30	68.30	0.00	1324.41	174.94	545.52	720.46	7.00	9.00	16.00	7.70	719.37	9.00	7.70	736.07	4.39	583.94	0.00	256.05	583.94	S			
129	1992-02	583.94	107.38	107.38	0.00	583.94	176.26	228.37	404.63	7.00	9.00	16.00	7.70	403.60	9.00	7.70	420.30	3.77	159.87	0.00	244.33	159.87	S			
130	1992-03	159.87	28.58	28.58	0.00	159.87	108.33	0.00	108.33	19.00	0.00	19.00	7.70	85.70	0.00	7.70	93.40	4.09	62.38	0.00	240.00	62.38	F			
131	1992-04	62.38	3.10	3.10	0.00	62.38	0.00	0.00	0.00	20.00	0.00	20.00	7.70	0.00	0.00	0.00	0.00	4.58	57.80	0.00	239.73	57.80	S			
132	1992-05	57.80	5.82	5.82	0.00	57.80	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	5.60	52.20	0.00	239.39	52.20	S			F
133	1992-06	52.20	2.83	0.45	2.38	54.58	14.18	41.62	55.80	0.00	0.00	0.00	17.63	0.00	0.00	0.00	0.00	4.75	49.83	0.00	239.25	49.83	F	F		
134	1992-07	49.83	766.55	123.15	643.40	693.23	133.39	217.22	350.61	0.00	6.00	6.00	123.60	350.61	6.00	123.60	480.21	3.66	209.36	0.00	246.03	209.36	S		S	
135	1992-08	209.36	4841.34	777.76	4063.58	4272.94	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	257.49	616.29	7.26	2644.48	1004.91	288.00	2644.48	S			
136	1992-09	2644.48	5025.84	807.40	4218.44	6862.92	346.43	203.39	549.82	0.00	6.00	6.00	36.17	549.83	6.00	36.17	592.00	10.97	2644.48	3615.47	288.00	2644.48	S			
137	1992-10	2644.48	284.89	45.77	239.12	2883.60	157.13	52.87	210.00	0.00	6.00	6.00	4.81	210.00	6.00	4.81	220.81	10.66	2644.48	7.65	288.00	2644.48	S			
138	1992-11	2644.48	103.22	103.22	0.00	2644.48	67.47	460.56	528.03	0.00	9.00	9.00	7.70	524.53	9.00	7.70	541.23	6.95	2096.29	0.00	281.16	2096.29	S			
139	1992-12	2096.29	79.11	79.11	0.00	2096.29	156.00	486.67	642.67	0.00	9.00	9.00	7.70	641.96	9.00	7.70	658.66	5.03	1432.61	0.00	271.57	1432.61	S			
140	1993-01	1432.61	176.87	176.87	0.00	1432.61	174.94	545.52	720.46	7.00	9.00	16.00	7.70	719.37	9.00	7.70	736.07	4.61	691.93	0.00	258.35	691.93	S			
141	1993-02	691.93	101.96	101.96	0.00	691.93	176.26	228.37	404.63	7.00	9.00	16.00	7.70	403.60	9.00	7.70	420.30	4.10	267.52	0.00	247.90	267.52	S			
142	1993-03	267.52	33.46	33.46	0.00	267.52	108.33	0.00	108.33	19.00	0.00	19.00	7.70	108.61	0.00	7.70	116.31	4.98	146.24	0.00	243.83	146.24	S			
143	1993-04	146.24	2.82	2.82	0.00	146.24	0.00	0.00	0.00	20.00	0.00	20.00	7.70	0.00	0.00	0.00	0.00	6.18	140.06	0.00	243.57	140.06	S			
144	1993-05	140.06	14.02	14.02	0.00	140.06	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	7.61	132.45	0.00	243.25	132.45	S			F
145	1993-06	132.45	4.74	0.99	3.76	136.20	14.18	41.62	55.80	0.00	0.00	0.00	17.63	55.79	0.00	17.63	73.42	5.71	57.07	0.00	239.68	57.07	S	S		
146	1993-07	57.07	532.21	110.89	421.32	478.39	133.39	217.22	350.61	0.00	6.00	6.00	123.60	283.39	6.00	123.60	412.99	3.02	62.38	0.00	240.00	62.38	F		F	
147	1993-08	62.38	2184.52	455.15	1729.37	1791.75	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	257.49	616.29	4.87	1170.60	0.00	267.33	1170.60	S			
148	1993-09	1170.60	4442.09	925.51	3516.58	4687.18	346.43	203.39	549.82	0.00	6.00	6.00	36.17	549.83	6.00	36.17	592.00	9.13	2644.48	1441.57	288.00	2644.48	S			
149	1993-10	2644.48	635.23	132.35	502.88	3147.36	157.13	52.87	210.00	0.00	6.00	6.00	4.81	210.00	6.00	4.81	220.81	10.66	2644.48	271.41	288.00	2644.48	S			
150	1993-11	2644.48	177.33	177.33	0.00	2644.48	67.47	460.56	528.03	0.00	9.00	9.00	7.70	524.53	9.00	7.70	541.23	6.95	2096.29	0.00	281.16	2096.29	S			

Working Table **Annexure-6.13**

Monthly operation simulation of Daudhan Dam

Dead Storage 62.38 MCM Live 2644.48 MCM

S.No	Year - Month	Initial Storage	Gross Flow	Proposed Upstream Utilisation on prorate basis	Inflow	Total yield available	Total demand U.P.	Total demand M.P.	Total	Drinking U.P.	DrinkingM.P.	Total	Environment release	Monthly Draw off: Irrigation Demand	Drinking	Environment release	Total	Evaporation Losses	Balance at end of month (5-11-12)	Spill	Reservoir Level at the end of month	Balance at end of month internal	Success (S) or Failure (F): Month	June	July	Year
		Mcum			Mcum	Mcum	Mcum	Mcum		Mcum	Mcum		Mcum	Mcum	Mcum		Mcum	Mcum	Mcum	Mcum	M	Mcum				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
151	1993-12	2096.29	126.05	126.05	0.00	2096.29	156.00	486.67	642.67	0.00	9.00	9.00	7.70	641.96	9.00	7.70	658.66	5.03	1432.61	0.00	271.57	1432.61	S			
152	1994-01	1432.61	117.44	117.44	0.00	1432.61	174.94	545.52	720.46	7.00	9.00	16.00	7.70	719.37	9.00	7.70	736.07	4.61	691.93	0.00	258.35	691.93	S			
153	1994-02	691.93	133.55	133.55	0.00	691.93	176.26	228.37	404.63	7.00	9.00	16.00	7.70	403.60	9.00	7.70	420.30	4.10	267.52	0.00	247.90	267.52	S			
154	1994-03	267.52	49.14	49.14	0.00	267.52	108.33	0.00	108.33	19.00	0.00	19.00	7.70	108.61	0.00	7.70	116.31	4.98	146.24	0.00	243.83	146.24	S			
155	1994-04	146.24	9.37	9.37	0.00	146.24	0.00	0.00	0.00	20.00	0.00	20.00	7.70	0.00	0.00	0.00	0.00	6.18	140.06	0.00	243.57	140.06	S			
156	1994-05	140.06	28.24	28.24	0.00	140.06	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	7.61	132.45	0.00	243.25	132.45	S			F
157	1994-06	132.45	566.97	61.97	505.00	637.45	14.18	41.62	55.80	0.00	0.00	0.00	17.63	55.79	0.00	17.63	73.42	8.28	555.74	0.00	255.39	555.74	S	S		
158	1994-07	555.74	5820.88	636.26	5184.63	5740.37	133.39	217.22	350.61	0.00	6.00	6.00	123.60	350.61	6.00	123.60	480.21	8.93	2644.48	2606.75	288.00	2644.48	S		S	
159	1994-08	2644.48	8655.53	946.10	7709.43	10353.91	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	257.49	616.29	10.54	2644.48	7082.60	288.00	2644.48	S			
160	1994-09	2644.48	1427.07	155.99	1271.08	3915.56	346.43	203.39	549.82	0.00	6.00	6.00	36.17	549.83	6.00	36.17	592.00	10.97	2644.48	668.12	288.00	2644.48	S			
161	1994-10	2644.48	262.85	28.73	234.12	2878.60	157.13	52.87	210.00	0.00	6.00	6.00	4.81	210.00	6.00	4.81	220.81	10.66	2644.48	2.65	288.00	2644.48	S			
162	1994-11	2644.48	142.64	142.64	0.00	2644.48	67.47	460.56	528.03	0.00	9.00	9.00	7.70	524.53	9.00	7.70	541.23	6.95	2096.29	0.00	281.16	2096.29	S			
163	1994-12	2096.29	61.29	61.29	0.00	2096.29	156.00	486.67	642.67	0.00	9.00	9.00	7.70	641.96	9.00	7.70	658.66	5.03	1432.61	0.00	271.57	1432.61	S			
164	1995-01	1432.61	95.17	95.17	0.00	1432.61	174.94	545.52	720.46	7.00	9.00	16.00	7.70	719.37	9.00	7.70	736.07	4.61	691.93	0.00	258.35	691.93	S			
165	1995-02	691.93	64.16	64.16	0.00	691.93	176.26	228.37	404.63	7.00	9.00	16.00	7.70	403.60	9.00	7.70	420.30	4.10	267.52	0.00	247.90	267.52	S			
166	1995-03	267.52	30.94	30.94	0.00	267.52	108.33	0.00	108.33	19.00	0.00	19.00	7.70	108.61	0.00	7.70	116.31	4.98	146.24	0.00	243.83	146.24	S			
167	1995-04	146.24	3.78	3.78	0.00	146.24	0.00	0.00	0.00	20.00	0.00	20.00	7.70	0.00	0.00	0.00	0.00	6.18	140.06	0.00	243.57	140.06	S			
168	1995-05	140.06	38.98	38.98	0.00	140.06	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	7.61	132.45	0.00	243.25	132.45	S			S
169	1995-06	132.45	1.58	0.50	1.09	133.53	14.18	41.62	55.80	0.00	0.00	0.00	17.63	47.75	0.00	17.63	65.38	5.77	62.38	0.00	240.00	62.38	F	F		
170	1995-07	62.38	1288.35	404.07	884.28	946.66	133.39	217.22	350.61	0.00	6.00	6.00	123.60	350.61	6.00	123.60	480.21	4.45	462.00	0.00	253.21	462.00	S		S	
171	1995-08	462.00	3535.20	1108.75	2426.45	2888.45	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	257.49	616.29	7.17	2265.00	0.00	283.40	2265.00	S			
172	1995-09	2265.00	1152.55	361.48	791.08	3056.08	346.43	203.39	549.82	0.00	6.00	6.00	36.17	549.83	6.00	36.17	592.00	9.78	2454.30	0.00	285.71	2454.30	S			
173	1995-10	2454.30	240.59	75.46	165.14	2619.44	157.13	52.87	210.00	0.00	6.00	6.00	4.81	210.00	6.00	4.81	220.81	9.68	2388.95	0.00	284.92	2388.95	S			
174	1995-11	2388.95	90.34	90.34	0.00	2388.95	67.47	460.56	528.03	0.00	9.00	9.00	7.70	524.53	9.00	7.70	541.23	6.42	1841.30	0.00	277.61	1841.30	S			
175	1995-12	1841.30	44.99	44.99	0.00	1841.30	156.00	486.67	642.67	0.00	9.00	9.00	7.70	641.96	9.00	7.70	658.66	4.67	1177.97	0.00	267.46	1177.97	S			
176	1996-01	1177.97	58.83	58.83	0.00	1177.97	174.94	545.52	720.46	7.00	9.00	16.00	7.70	719.37	9.00	7.70	736.07	4.08	437.82	0.00	252.61	437.82	S			
177	1996-02	437.82	51.12	51.12	0.00	437.82	176.26	228.37	404.63	7.00	9.00	16.00	7.70	355.57	9.00	7.70	372.27	3.17	62.38	0.00	240.00	62.38	F			
178	1996-03	62.38	26.13	26.13	0.00	62.38	108.33	0.00	108.33	19.00	0.00	19.00	7.70	0.00	0.00	0.00	0.00	3.41	58.97	0.00	239.80	58.97	F			
179	1996-04	58.97	3.46	3.46	0.00	58.97	0.00	0.00	0.00	20.00	0.00	20.00	7.70	0.00	0.00	0.00	0.00	4.50	54.47	0.00	239.53	54.47	S			
180	1996-05	54.47	40.88	40.88	0.00	54.47	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	5.50	48.97	0.00	239.20	48.97	S			F
181	1996-06	48.97	2.13	0.49	1.64	50.61	14.18	41.62	55.80	0.00	0.00	0.00	17.63	0.00	0.00	0.00	0.00	4.66	45.95	0.00	239.02	45.95	F	F		
182	1996-07	45.95	619.40	141.31	478.08	524.04	133.39	217.22	350.61	0.00	6.00	6.00	123.60	329.12	6.00	123.60	458.72	2.94	62.38	0.00	240.00	62.38	F		F	
183	1996-08	62.38	4601.66	1049.85	3551.81	3614.19	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	257.49	616.29	6.64	2644.48	346.78	288.00	2644.48	S			
184	1996-09	2644.48	2019.77	460.80	1558.97	4203.45	346.43	203.39	549.82	0.00	6.00	6.00	36.17	549.83	6.00	36.17	592.00	10.97	2644.48	956.00	288.00	2644.48	S			
185	1996-10	2644.48	314.72	71.80	242.92	2887.40	157.13	52.87	210.00	0.00	6.00	6.00	4.81	210.00	6.00	4.81	220.81	10.66	2644.48	11.45	288.00	2644.48	S			
186	1996-11	2644.48	181.72	181.72	0.00	2644.48	67.47	460.56	528.03	0.00	9.00	9.00	7.70	524.53	9.00	7.70	541.23	6.95	2096.29	0.00	281.16	2096.29	S			
187	1996-12	2096.29	68.13	68.13	0.00	2096.29	156.00	486.67	642.67	0.00	9.00	9.00	7.70	641.96	9.00	7.70	658.66	5.03	1432.61	0.00	271.57	1432.61	S			
188	1997-01	1432.61	137.95	137.95	0.00	1432.61	174.94	545.52	720.46	7.00	9.00	16.00	7.70	719.37	9.00	7.70	736.07	4.61	691.93	0.00	258.35	691.93	S			
189	1997-02	691.93	114.32	114.32	0.00	691.93	176.26	228.37	404.63	7.00	9.00	16.00	7.70	403.60	9.00	7.70	420.30	4.10	267.52	0.00	247.90	267.52	S			
190	1997-03	267.52	30.33	30.33	0.00	267.52	108.33	0.00	108.33	19.00	0.00	19.00	7.70	108.61	0.00	7.70	116.31	4.98	146.24	0.00	243.83	146.24	S			
191	1997-04	146.24	3.38	3.38	0.00	146.24	0.00	0.00	0.00	20.00	0.00	20.00	7.70	0.00	0.00	0.00	0.00	6.18	140.06	0.00	243.57	140.06	S			
192	1997-05	140.06	5.92	5.92	0.00	140.06	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	7.61	132.45	0.00	243.25	132.45	S			F
193	1997-06	132.45	2.01274302	0.126615	1.89	134.33	14.18	41.62	55.80	0.00	0.00	0.00	17.63	48.55	0.00	17.63	66.18	5.77	62.38	0.00	240.00	62.38	F	F		
194	1997-07	62.38	2130.07679	133.9962	1996.08	2058.46	133.39	217.22	350.61	0.00	6.00	6.00	123.60	350.61	6.00	123.60	480.21	5.94	1572.31	0.00	273.69	1572.31	S		S	
195	1997-08	1572.31	3758.12573	236.4114	3521.71	5094.02	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	257.49	616.29	9.23	2644.48	1824.03	288.00	2644.48	S			
196	1997-09	2644.48	2879.26225	181.125	2698.14	5342.62	346.43	203.39	549.82	0.00	6.00	6.00	36.17	549.83	6.00	36.17	592.00	10.97	2644.48	2095.17	288.00	2644.48	S			
197	1997-10	2644.48	379.910011	23.89889	356.01	3000.49	157.13	52.87	210.00	0.00	6.00	6.00	4.81	210.00	6.00	4.81	220.81	10.66	2644.48	124.55	288.00	2644.48	S			
198	1997-11	2644.48	362.559632	362.5596	0.00	2644.48	67.47	460.56	528.03	0.00	9.00	9.00	7.70	524.53	9.00	7.70	541.23	6.95	2096.29	0.00	281.16	2096.29	S			
199	1997-12	2096.29	738.757695	738.7577	0.00	2096.29	156.00	486.67	642.67	0.00	9.00	9.00	7.70	641.96	9.00	7.70	658.66	5.03	1432.61	0.00	271.57	1432.61	S			
200	1998-01	1432.61	228.144285	228.1443	0.00	1432.61	174.94	545.52	720.46	7.00	9.00	16.00	7.70	719.37	9.00	7.70	736.07	4.61	691.93	0.00	258.35	691.93	S			

Working Table **Annexure-6.13**

Monthly operation simulation of Daudhan Dam

Dead Storage 62.38 MCM Live 2644.48 MCM

S.No	Year - Month	Initial Storage	Gross Flow	Proposed Upstream Utilisation on prorate basis	Inflow	Total yield available	Total demand U.P.	Total demand M.P.	Total	Drinking U.P.	DrinkingM.P.	Total	Environment release	Monthly Draw off: Irrigation Demand	Drinking	Environment release	Total	Evaporation Losses	Balance at end of month (5-11-12)	Spill	Reservoir Level at the end of month	Balance at end of month internal	Success (S) or Failure (F)			
		Mcum			Mcum	Mcum	Mcum	Mcum		Mcum	Mcum		Mcum	Mcum	Mcum		Mcum	Mcum	Mcum	Mcum	M	Mcum	Month	June	July	Year
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
201	1998-02	691.93	180.722103	180.7221	0.00	691.93	176.26	228.37	404.63	7.00	9.00	16.00	7.70	403.60	9.00	7.70	420.30	4.10	267.52	0.00	247.90	267.52	S			
202	1998-03	267.52	99.418922	99.41892	0.00	267.52	108.33	0.00	108.33	19.00	0.00	19.00	7.70	108.61	0.00	7.70	116.31	4.98	146.24	0.00	243.83	146.24	S			
203	1998-04	146.24	3.96341244	3.963412	0.00	146.24	0.00	0.00	0.00	20.00	0.00	20.00	7.70	0.00	0.00	0.00	0.00	6.18	140.06	0.00	243.57	140.06	S			
204	1998-05	140.06	76.8759445	76.87594	0.00	140.06	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	7.61	132.45	0.00	243.25	132.45	S			F
205	1998-06	132.45	12.58	3.72	8.86	141.31	14.18	41.62	55.80	0.00	0.00	0.00	17.63	55.79	0.00	17.63	73.42	5.77	62.12	0.00	239.98	62.12	S	S		
206	1998-07	62.12	951.84	281.26	670.59	732.70	133.39	217.22	350.61	0.00	6.00	6.00	123.60	350.61	6.00	123.60	480.21	3.85	248.64	0.00	247.34	248.64	S		S	
207	1998-08	248.64	3613.38	1067.71	2545.67	2794.32	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	257.49	616.29	6.51	2171.52	0.00	282.16	2171.52	S			
208	1998-09	2171.52	1086.95	321.18	765.77	2937.29	346.43	203.39	549.82	0.00	6.00	6.00	36.17	549.83	6.00	36.17	592.00	9.47	2335.82	0.00	284.27	2335.82	S			
209	1998-10	2335.82	342.51	101.21	241.30	2577.13	157.13	52.87	210.00	0.00	6.00	6.00	4.81	210.00	6.00	4.81	220.81	9.44	2346.88	0.00	284.41	2346.88	S			
210	1998-11	2346.88	148.50	148.50	0.00	2346.88	67.47	460.56	528.03	0.00	9.00	9.00	7.70	524.53	9.00	7.70	541.23	6.36	1799.29	0.00	277.02	1799.29	S			
211	1998-12	1799.29	43.80	43.80	0.00	1799.29	156.00	486.67	642.67	0.00	9.00	9.00	7.70	641.96	9.00	7.70	658.66	4.63	1136.00	0.00	266.73	1136.00	S			
212	1999-01	1136.00	171.29	171.29	0.00	1136.00	174.94	545.52	720.46	7.00	9.00	16.00	7.70	719.37	9.00	7.70	736.07	3.99	395.94	0.00	251.52	395.94	S			
213	1999-02	395.94	58.83	58.83	0.00	395.94	176.26	228.37	404.63	7.00	9.00	16.00	7.70	313.77	9.00	7.70	330.47	3.09	62.38	0.00	240.00	62.38	F			
214	1999-03	62.38	27.52	27.52	0.00	62.38	108.33	0.00	108.33	19.00	0.00	19.00	7.70	0.00	0.00	0.00	0.00	3.41	58.97	0.00	239.80	58.97	F			
215	1999-04	58.97	3.20	3.20	0.00	58.97	0.00	0.00	0.00	20.00	0.00	20.00	7.70	0.00	0.00	0.00	0.00	4.50	54.47	0.00	239.53	54.47	S			
216	1999-05	54.47	37.78	37.78	0.00	54.47	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	5.50	48.97	0.00	239.20	48.97	S			F
217	1999-06	48.97	3.82	0.35	3.46	52.43	14.18	41.62	55.80	0.00	0.00	0.00	17.63	0.00	0.00	0.00	0.00	4.68	47.75	0.00	239.13	47.75	F	F		
218	1999-07	47.75	1030.55	95.03	935.53	983.28	133.39	217.22	350.61	0.00	6.00	6.00	123.60	350.61	6.00	123.60	480.21	4.39	498.68	0.00	254.07	498.68	S		S	
219	1999-08	498.68	5619.70	518.20	5101.50	5600.18	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	257.49	616.29	7.94	2644.48	2331.48	288.00	2644.48	S			
220	1999-09	2644.48	9720.58	896.34	8824.24	11468.72	346.43	203.39	549.82	0.00	6.00	6.00	36.17	549.83	6.00	36.17	592.00	10.97	2644.48	8221.27	288.00	2644.48	S			
221	1999-10	2644.48	1405.32	129.59	1275.74	3920.21	157.13	52.87	210.00	0.00	6.00	6.00	4.81	210.00	6.00	4.81	220.81	10.66	2644.48	1044.27	288.00	2644.48	S			
222	1999-11	2644.48	160.08	160.08	0.00	2644.48	67.47	460.56	528.03	0.00	9.00	9.00	7.70	524.53	9.00	7.70	541.23	6.95	2096.29	0.00	281.16	2096.29	S			
223	1999-12	2096.29	65.65	65.65	0.00	2096.29	156.00	486.67	642.67	0.00	9.00	9.00	7.70	641.96	9.00	7.70	658.66	5.03	1432.61	0.00	271.57	1432.61	S			
224	2000-01	1432.61	185.85	185.85	0.00	1432.61	174.94	545.52	720.46	7.00	9.00	16.00	7.70	719.37	9.00	7.70	736.07	4.61	691.93	0.00	258.35	691.93	S			
225	2000-02	691.93	121.74	121.74	0.00	691.93	176.26	228.37	404.63	7.00	9.00	16.00	7.70	403.60	9.00	7.70	420.30	4.10	267.52	0.00	247.90	267.52	S			
226	2000-03	267.52	35.55	35.55	0.00	267.52	108.33	0.00	108.33	19.00	0.00	19.00	7.70	108.61	0.00	7.70	116.31	4.98	146.24	0.00	243.83	146.24	S			
227	2000-04	146.24	8.35	8.35	0.00	146.24	0.00	0.00	0.00	20.00	0.00	20.00	7.70	0.00	0.00	0.00	0.00	6.18	140.06	0.00	243.57	140.06	S			
228	2000-05	140.06	49.28	49.28	0.00	140.06	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	7.61	132.45	0.00	243.25	132.45	S			F
229	2000-06	132.45	170.77	71.64	99.12	231.57	14.18	41.62	55.80	0.00	0.00	0.00	17.63	55.79	0.00	17.63	73.42	6.69	151.46	0.00	244.04	151.46	S	S		
230	2000-07	151.46	1797.08	753.95	1043.13	1194.59	133.39	217.22	350.61	0.00	6.00	6.00	123.60	350.61	6.00	123.60	480.21	5.43	708.95	0.00	258.71	708.95	S		S	
231	2000-08	708.95	1435.94	602.43	833.50	1542.45	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	257.49	616.29	6.22	919.94	0.00	262.85	919.94	S			
232	2000-09	919.94	1344.71	564.16	780.55	1700.49	346.43	203.39	549.82	0.00	6.00	6.00	36.17	549.83	6.00	36.17	592.00	6.95	1101.55	0.00	266.13	1101.55	S			
233	2000-10	1101.55	36.64	15.37	21.27	1122.81	157.13	52.87	210.00	0.00	6.00	6.00	4.81	210.00	6.00	4.81	220.81	6.71	895.30	0.00	262.40	895.30	S			
234	2000-11	895.30	24.48	24.48	0.00	895.30	67.47	460.56	528.03	0.00	9.00	9.00	7.70	524.53	9.00	7.70	541.23	4.00	350.07	0.00	250.33	350.07	S			
235	2000-12	350.07	46.67	46.67	0.00	350.07	156.00	486.67	642.67	0.00	9.00	9.00	7.70	268.72	9.00	7.70	285.42	2.27	62.38	0.00	240.00	62.38	F			
236	2001-01	62.38	74.29	74.29	0.00	62.38	174.94	545.52	720.46	7.00	9.00	16.00	7.70	0.00	0.00	0.00	0.00	1.84	60.54	0.00	239.89	60.54	F			
237	2001-02	60.54	65.09	65.09	0.00	60.54	176.26	228.37	404.63	7.00	9.00	16.00	7.70	0.00	0.00	0.00	0.00	2.18	58.36	0.00	239.76	58.36	F			
238	2001-03	58.36	34.07	34.07	0.00	58.36	108.33	0.00	108.33	19.00	0.00	19.00	7.70	0.00	0.00	0.00	0.00	3.34	55.02	0.00	239.56	55.02	F			
239	2001-04	55.02	4.62	4.62	0.00	55.02	0.00	0.00	0.00	20.00	0.00	20.00	7.70	0.00	0.00	0.00	0.00	4.41	50.61	0.00	239.30	50.61	S			
240	2001-05	50.61	9.23	9.23	0.00	50.61	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	5.39	45.22	0.00	238.98	45.22	S			F
241	2001-06	45.22	564.01	102.60	461.40	506.62	14.18	41.62	55.80	0.00	0.00	0.00	17.63	55.79	0.00	17.63	73.42	6.95	426.25	0.00	252.31	426.25	S	S		
242	2001-07	426.25	5685.36	1034.28	4651.08	5077.33	133.39	217.22	350.61	0.00	6.00	6.00	123.60	350.61	6.00	123.60	480.21	8.70	2644.48	1943.94	288.00	2644.48	S		S	
243	2001-08	2644.48	2528.91	460.06	2068.85	4713.33	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	257.49	616.29	10.54	2644.48	1442.03	288.00	2644.48	S			
244	2001-09	2644.48	579.05	105.34	473.71	3118.19	346.43	203.39	549.82	0.00	6.00	6.00	36.17	549.83	6.00	36.17	592.00	10.61	2515.58	0.00	286.46	2515.58	S			
245	2001-10	2515.58	249.91	45.46	204.44	2720.02	157.13	52.87	210.00	0.00	6.00	6.00	4.81	210.00	6.00	4.81	220.81	9.92	2489.30	0.00	286.14	2489.30	S			
246	2001-11	2489.30	190.80	190.80	0.00	2489.30	67.47	460.56	528.03	0.00	9.00	9.00	7.70	524.53	9.00	7.70	541.23	6.58	1941.49	0.00	279.02	1941.49	S			
247	2001-12	1941.49	63.58	63.58	0.00	1941.49	156.00	486.67	642.67	0.00	9.00	9.00	7.70	641.96	9.00	7.70	658.66	4.80	1278.03	0.00	269.12	1278.03	S			
248	2002-01	1278.03	114.02	114.02	0.00	1278.03	174.94	545.52	720.46	7.00	9.00	16.00	7.70	719.37	9.00	7.70	736.07	4.29	537.67	0.00	254.97	537.67	S			
249	2002-02	537.67	87.17	87.17	0.00	537.67	176.26	228.37	404.63	7.00	9.00	16.00	7.70	403.60	9.00	7.70	420.30	3.54	113.82	0.00	242.46	113.82	S			
250	2002-03	113.82	37.90	37.90	0.00	113.82	108.33	0.00	108.33	19.00	0.00	19.00	7.70	39.92	0.00	7.70	47.62	3.82	62.38	0.00	240.00	62.38	F			

Working Table **Annexure-6.13**

Monthly operation simulation of Daudhan Dam

Dead Storage 62.38 MCM Live 2644.48 MCM

S.No	Year - Month	Initial Storage	Gross Flow	Proposed Upstream Utilisation on prorate basis	Inflow	Total yield available	Total demand U.P.	Total demand M.P.	Total	Drinking U.P.	DrinkingM.P.	Total	Environment release	Monthly Draw off: Irrigation Demand	Drinking	Environment release	Total	Evaporation Losses	Balance at end of month (5-11-12)	Spill	Reservoir Level at the end of month	Balance at end of month internal	Success (S) or Failure (F)			
		Mcum			Mcum	Mcum	Mcum	Mcum		Mcum	Mcum		Mcum	Mcum	Mcum		Mcum	Mcum	Mcum	Mcum	M	Mcum	Month	June	July	Year
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
251	2002-04	62.38	5.47	5.47	0.00	62.38	0.00	0.00	0.00	20.00	0.00	20.00	7.70	0.00	0.00	0.00	0.00	4.58	57.80	0.00	239.73	57.80	S			
252	2002-05	57.80	19.31	19.31	0.00	57.80	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	5.60	52.20	0.00	239.39	52.20	S			F
253	2002-06	52.20	2.60	0.79	1.81	54.01	14.18	41.62	55.80	0.00	0.00	0.00	17.63	0.00	0.00	0.00	0.00	4.74	49.27	0.00	239.22	49.27	F	F		
254	2002-07	49.27	65.76	20.05	45.71	94.97	133.39	217.22	350.61	0.00	6.00	6.00	123.60	23.63	6.00	0.00	29.63	2.96	62.38	0.00	240.00	62.38	F		F	
255	2002-08	62.38	3039.85	926.94	2112.90	2175.28	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	0.00	358.80	1.80	0.00	0.00	230.90	1814.69	S			
256	2002-09	1814.69	2212.56	674.68	1537.88	3352.57	346.43	203.39	549.82	0.00	6.00	6.00	36.17	549.83	6.00	36.17	592.00	4.74	0.00	0.00	230.90	2644.48	S			
257	2002-10	2644.48	222.89	67.97	154.93	2799.41	157.13	52.87	210.00	0.00	6.00	6.00	4.81	210.00	6.00	4.81	220.81	5.76	0.00	0.00	230.90	2572.84	S			
258	2002-11	2572.84	181.92	181.92	0.00	2572.84	67.47	460.56	528.03	0.00	9.00	9.00	7.70	524.53	9.00	7.70	541.23	3.93	0.00	0.00	230.90	2027.68	S			
259	2002-12	2027.68	78.49	78.49	0.00	2027.68	156.00	486.67	642.67	0.00	9.00	9.00	7.70	641.96	9.00	7.70	658.66	2.86	0.00	0.00	230.90	1366.16	S			
260	2003-01	1366.16	105.27	105.27	0.00	1366.16	174.94	545.52	720.46	7.00	9.00	16.00	7.70	719.37	9.00	7.70	736.07	2.86	0.00	0.00	230.90	627.23	S			
261	2003-02	627.23	131.31	131.31	0.00	627.23	176.26	228.37	404.63	7.00	9.00	16.00	7.70	403.60	9.00	7.70	420.30	2.65	0.00	0.00	230.90	204.27	S			
262	2003-03	204.27	39.65	39.65	0.00	204.27	108.33	0.00	108.33	19.00	0.00	19.00	7.70	108.61	0.00	7.70	116.31	3.02	0.00	0.00	230.90	84.95	S			
263	2003-04	84.95	9.26	9.26	0.00	84.95	0.00	0.00	0.00	20.00	0.00	20.00	7.70	11.58	0.00	7.70	19.28	3.29	0.00	0.00	230.90	62.38	F			
264	2003-05	62.38	29.68	29.68	0.00	62.38	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	3.82	0.00	0.00	230.90	58.56	S			F
265	2003-06	58.56	48.07	5.14	42.93	101.49	14.18	41.62	55.80	0.00	0.00	0.00	17.63	18.22	0.00	17.63	35.85	3.26	0.00	0.00	230.90	62.38	F	F		
266	2003-07	62.38	1461.61	156.40	1305.21	1367.59	133.39	217.22	350.61	0.00	6.00	6.00	123.60	350.61	6.00	123.60	480.21	2.01	0.00	0.00	230.90	885.37	S		S	
267	2003-08	885.37	3507.71	375.35	3132.36	4017.73	299.33	53.47	352.80	0.00	6.00	6.00	257.49	352.80	6.00	257.49	616.29	3.61	0.00	0.00	230.90	2644.48	S			
268	2003-09	2644.48	8543.33	914.19	7629.15	10273.62	346.43	203.39	549.82	0.00	6.00	6.00	36.17	549.83	6.00	36.17	592.00	5.93	0.00	0.00	230.90	2644.48	S			
269	2003-10	2644.48	1304.04	139.54	1164.50	3808.98	157.13	52.87	210.00	0.00	6.00	6.00	4.81	210.00	6.00	4.81	220.81	5.76	0.00	0.00	230.90	2644.48	S			
270	2003-11	2644.48	228.91	228.91	0.00	2644.48	67.47	460.56	528.03	0.00	9.00	9.00	7.70	524.53	9.00	7.70	541.23	4.12	0.00	0.00	230.90	2099.12	S			
271	2003-12	2099.12	86.34	86.34	0.00	2099.12	156.00	486.67	642.67	0.00	9.00	9.00	7.70	641.96	9.00	7.70	658.66	2.91	0.00	0.00	230.90	1437.56	S			
272	2004-01	1437.56	153.87	153.87	0.00	1437.56	174.94	545.52	720.46	7.00	9.00	16.00	7.70	719.37	9.00	7.70	736.07	2.91	0.00	0.00	230.90	698.58	S			
273	2004-02	698.58	129.34	129.34	0.00	698.58	176.26	228.37	404.63	7.00	9.00	16.00	7.70	403.60	9.00	7.70	420.30	2.74	0.00	0.00	230.90	275.53	S			
274	2004-03	275.53	59.20	59.20	0.00	275.53	108.33	0.00	108.33	19.00	0.00	19.00	7.70	108.61	0.00	7.70	116.31	3.23	0.00	0.00	230.90	156.00	S			
275	2004-04	156.00	7.94	7.94	0.00	156.00	0.00	0.00	0.00	20.00	0.00	20.00	7.70	0.00	0.00	0.00	0.00	3.89	0.00	0.00	230.90	152.11	S			
276	2004-05	152.11	9.79	9.79	0.00	152.11	0.00	0.00	0.00	13.77	0.00	13.77	7.70	0.00	0.00	0.00	0.00	4.88	0.00	0.00	230.90	147.23	S			F

Total Months	**276**
Total Year	**23**
No of Failure Months (Supply<Demand)	**52**
No of Failure Year (If any month fails)	**20**
No of complete success Year	**3**
No of Failure Year (If only fails in June)	**12**
No of Failure Year (If only fails in July)	**6**
No of success Year considering suppliment June and July requirement of Kharif crop By Ground water or switch off water supply to kharif crop in Aug as a late Paddy(5+8+6)	**19**
Monthly Reliablity of Daudhan Dam Project	**86%**
Annual Reliablity of Daudhan dam Project including June and July Failure	**13%**
Annual Reliablity of Daudhan dam Project excluding June and July Failure	**83%**

Annexure-6.14

LOWER ORR MAJOR IRRIGATION PROJECT PROJECT

CCA 90000 Ha DISTRICT : Shivpuri & Datia

MONTHLY WATER REQUIREMENT OF CROPS

S No.	Name of Crops	% of area	Area Proposed in ha.	Pariculars	MONTHS																		Total
					Oct.		Nov.		Dec		Jan.		Fab.		March		April		May		June		
					I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	
1	2	3	4	5	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
4	WHEAT 1MV	43.45	39105	GIR (mm)			72.0	16.00	27.00	34.00	35.00	36.00	46.00	0.00	0.00	0.00							266
				W.R.(mcm)			28.16	6.26	10.56	13.30	13.69	14.08	17.99	0.00	0.00	0.00							104.02
5	WHEAT 0LV	35.55	31995	GIR (mm)	81.0	18.0	36.0	44.0	38.0	34.0	34.0	0.0	0.0	0.0	0.0								285
				W.R.(mcm)	25.92	5.76	11.52	14.08	12.16	10.88	10.88	0.00	0.00	0.00	0.00	0.00							91.19
6	GRAM N1 (PEAS)	11.11	10000	GIR (mm)	0.0	76.0	10.0	28.0	35.0	33.0	33.0	5.0	0.0	0.0	0.0	0.0							220
				W.R.(mcm)	0.00	7.60	1.00	2.80	3.50	3.30	3.30	0.50	0.00	0.00	0.00	0.00							22.00
7	GRAM N2	7.89	7100	GIR (mm)		0.00	104.0	14.0	38.0	43.0	45.0	7.0	0.0	0.0	0.0	0.0							251
				W.R.(mcm)		0.00	7.38	0.99	2.70	3.05	3.20	0.50	0.00	0.00	0.00	0.00							17.82
8	VEG. RA	2.00	1800	GIR (mm)			0.00	81.0	12.00	20.00	32.00	33.00	28.00	0.00	0.00	0.00							206
				W.R.(mcm)			0.00	1.46	0.22	0.36	0.58	0.59	0.50	0.00	0.00	0.00							3.71
	Total	**100**	**90000**	W.R.(mcm)	25.92	13.36	48.06	25.59	29.13	30.89	31.64	15.67	18.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	238.73
					39.28		73.64		60.02		47.30		18.49										
Total crop water requirement = **238.73** **MCUM**																							

Duty = 0.26 lit/sec/Ha

Adopt = 0.35 lit/sec/Ha CWR= 285.77 MCM

Shivpuri

ESTIMATION OF CROP WATER REQUIREMENT

CROP	:	WHEAT 1MV	GROWING TIME	:	135 DAYS
SOWING TIME	:	NOV (21)	% OF C.C.A.	:	43.45

S.No.	PARTICULARS	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		TOTAL	REMARKS
1	Eto	65	57.8	43	36.1	30.2	28.4	30	33.5	38	46.9	64	74.3		
2	CROP FACTOR Kc			0.11	0.42	0.8	1.09	1.1	1.1	1.07	0.87	0.5			
3	CONSUMPTIVE USE (Etc)	0	0	5	15	24	31	33	37	41	41	32		259	ETo X Kc
4	PLANT USE (PRE- SOWING)			60										60	
5	SOIL MOISTURE ADJUST										-41	-32		-73	
6	GROSS WATER	0	0	65	15	24	31	33	37	41	0	0	0	246	
7	RAIN FALL	28.3		8.5		6.1		16.4		8.5		4.5		72.3	
8	EFFECTIVE RAIN FALL	0	0	3.67	1.27	0.84	2.27	2.94	6.19	1.85	3.05	1.07	1.39	24.54	
9	NET IRRIGATION REQUIRED AT FIELD (NIR)	0	0	61.33	13.73	23.16	28.73	30.06	30.8	39.15	0	0	0	227	
10	REQUIREMENT AT CANAL HEAD WITH EFF. 85% (GIR)	0	0	72	16	27	34	35	36	46	0	0	0	266	S No.9/Eff. For lined
11	WATER REQUIIRMENT AT CANAL HEAD FOR 100 HA. OF NET C.C.A. IN (Ha.m)with 85%GIR	0.00	0.00	3.13	0.70	1.17	1.48	1.52	1.56	2.00	0.00	0.00	0.00	11.56	GIRx100x% OF ICA / 100x1000

Shivpuri

ESTIMATION OF CROP WATER REQUIREMENT

CROP	:	WHEAT OLV	GROWING TIME	:	135 DAYS
SOWING TIME	:	OCT(19)	% OF C.C.A.	:	35.55

S.No.	PARTICULARS	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		TOTAL	REMARKS
1	Eto	65	57.8	43	36.1	30.2	28.4	30	33.5	38	46.9	64	74.3		
2	CROP FACTOR Kc	0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5					
3	CONSUMPTIVE USE (Etc)	20	24	34	39	33	31	32	29	19	0	0	0	261	ETo X Kc
4	PLANT USE (PRE- SOWING)	60												60	
5	SOIL MOISTURE ADJUST								-29	-19	0	0		-48	
6	GROSS WATER	80	24	34	39	33	31	32	0	0	0	0	0	273	
7	RAIN FALL	28.3		8.5		6.1		16.4		8.5		4.5		72.3	
8	EFFECTIVE RAIN FALL	10.82	8.82	3.67	1.27	0.84	2.27	2.94	6.19	1.85	3.05	1.07	1.39	44.18	
9	NET IRRIGATION REQUIRED AT FIELD (NIR)	69.18	15.2	30.33	37.73	32.16	28.73	29.06	0	0	0	0	0	242.37	
10	REQUIREMENT AT CANAL HEAD WITH EFF. 85 % (GIR)	81	18	36	44	38	34	34	0	0	0	0	0	285	S No.9/Eff. For lined
11	WATER REQUIIRMENT AT CANAL HEAD FOR 100 HA. OF NET C.C.A. IN (Ha.m)with 85%GIR	2.88	0.64	1.28	1.56	1.35	1.21	1.21	0.00	0.00	0.00	0.00	0.00	10.13	GIRx100x% OF ICA 100x1000

Shivpuri

ESTIMATION OF CROP WATER REQUIREMENT

CROP	:	GRAM N2	GROWING TIME	:	120 DAYS
SOWING TIME	:	NOV (21)	% OF C.C.A.	:	11.11

S.No.	PARTICULARS	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		TOTAL	REMARKS
1	Eto	65	57.8	43	36.1	30.2	28.4	30	33.5	38	46.9	64	74.3		
2	CROP FACTOR Kc		0.23	0.28	0.69	1.02	1.05	1.04	0.89	0.63	0.41				
3	CONSUMPTIVE USE (Etc)	0	13	12	25	31	30	31	30	24	19	0	0	215	ETo X Kc
4	PLANT USE (PRE- SOWING)		60											60	
5	SOIL MOISTURE ADJUST								-20	-24	-19	0		-62.8	
6	GROSS WATER	0	73	12	25	31	30	31	10	0	0	0	0	212.2	
7	RAIN FALL	28.3		8.5		6.1		16.4		8.5		4.5		72.3	
8	EFFECTIVE RAIN FALL	10.82	8.82	3.67	1.27	0.84	2.27	2.94	6.19	1.85	3.05	1.07	1.39	44.18	
9	NET IRRIGATION REQUIRED AT FIELD (NIR)	0	64.2	8.33	23.73	30.16	27.73	28.06	4.01	0	0	0	0	186.2	
10	REQUIREMENT AT CANAL HEAD WITH EFF. 85 % (GIR)	0	76	10	28	35	33	33	5	0	0	0	0	220	S No.9/Eff. For lined
11	WATER REQUIIRMENT AT CANAL HEAD FOR 100 HA. OF NET C.C.A. IN (Ha.m)with 85%GIR	0.00	0.84	0.11	0.31	0.39	0.37	0.37	0.06	0.00	0.00	0.00	0.00	2.44	GIRx100x% OF ICA / 100x1000

Shivpuri

ESTIMATION OF CROP WATER REQUIREMENT

CROP	:	GRAM N2	GROWING TIME	:	120 DAYS
SOWING TIME	:	NOV (21)	% OF C.C.A.	:	7.89

S.No.	PARTICULARS	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		TOTAL	REMARKS
1	Eto	65	57.8	43	36.1	30.2	28.4	30	33.5	38	46.9	64	74.3		
2	CROP FACTOR Kc			0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42				
3	CONSUMPTIVE USE (Etc)	0	0	10	10	25	30	32	32	26	20	0	0	185	ETo X Kc
4	PLANT USE (PRE- SOWING)			60										60	
5	SOIL MOISTURE ADJUST								-21	-26	-20	0		-67.12	
6	GROSS WATER	0	0	70	10	25	30	32	11	0	0	0	0	177.88	
7	RAIN FALL	28.3		8.5		6.1		16.4		8.5		4.5		72.3	
8	EFFECTIVE RAIN FALL	10.82	8.82	3.67	1.27	0.84	2.27	2.94	6.19	1.85	3.05	1.07	1.39	44.18	
9	NET IRRIGATION REQUIRED AT FIELD (NIR)			66.33	8.73	24.16	27.73	29.06	4.69					160.7	
10	REQUIREMENT AT CANAL HEAD WITH EFF. 85 % (GIR)	0	0	104	14	38	43	45	7					251	S No.9/Eff. For lined
11	WATER REQUIIRMENT AT CANAL HEAD FOR 100 HA. OF NET C.C.A. IN (Ha.m)with 85%GIR	0.00	0.00	0.82	0.11	0.30	0.34	0.36	0.06	0.00	0.00	0.00	0.00	1.98	GIRx100x% OF ICA 100x1000

Shivpuri

ESTIMATION OF CROP WATER REQUIREMENT

CROP	:	VEGETABLES (RA)	GROWING TIME	:	105 DAYS
SOWING TIME	:	Nov (22)	% OF C.C.A.	:	2.00

S.No.	PARTICULARS	OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		TOTAL	REMARKS
1	Eto	65	57.8	43	36.1	30.2	28.4	30	33.5	38	46.9	64	74.3		
2	CROP FACTOR Kc				0.29	0.37	0.67	1	1	1	0.94				
3	CONSUMPTIVE USE (Etc)	0	0	0	10	11	19	30	34	38	44	0	0	186	ETo X Kc
4	PLANT USE (PRE- SOWING)				60									60	
5	SOIL MOISTURE ADJUST									-13	-44	0		-56.54	
6	GROSS WATER	0	0	0	70	11	19	30	34	25	0	0	0	189.46	
7	RAIN FALL	28.3		8.5		6.1		16.4		8.5		4.5		72.3	
8	EFFECTIVE RAIN FALL	10.82	8.82	3.67	1.27	0.84	2.27	2.94	6.19	1.85	3.05	1.07	1.39	44.18	
9	NET IRRIGATION REQUIRED AT FIELD (NIR)				68.73	10.16	16.73	27.06	27.8	23.61	0			174.1	
10	REQUIREMENT AT CANAL HEAD WITH EFF. 85 % (GIR)				81	12	20	32	33	28	0	0	0	206	S No.9/Eff. For lined
11	WATER REQUIIRMENT AT CANAL HEAD FOR 100 HA. OF NET C.C.A. IN (Ha.m)with 85%GIR	0.00	0.00	0.00	0.16	0.02	0.04	0.06	0.07	0.06	0.00	0.00	0.00	0.41	GIRx100x% OF ICA 100x1000

Shivpuri

ESTIMATION OF CROP WATER REQUIREMENT

CROP	:	RICE 1HYVTP	GROWING TIME	:	105 DAYS
SOWING TIME	:	July (14)	% OF C.C.A.	:	100.00

S.No.	PARTICULARS	MAY		JUNE		JULY		AUG		SEPT		OCT		TOTAL	REMARKS
1	Eto	119	127	123	106	87	70	75	74	83	86	84	74		
2	CROP FACTOR Kc					1.07	1.1	1.1	1.15	1.15	1.06	0.99			
3	CONSUMPTIVE USE (Etc)	0	0	0	0	93	77	83	85	95	91	83	0	607	ETo X Kc
4	NURSERY			28	16									44	
5	PLANT USE (PRE- SOWING)				150									150	
6	TRANSPLANTATION					125									
7	PERCOLATION					45	45	45	45	45	45				
8	SOIL MOISTURE ADJUST											-70		-70	
9	GROSS WATER	0	0	28	166	263	122	128	130	140	136	13	0	1126	
10	RAIN FALL	0	0	0	0	0	0	0	0	0	0	0	0	0	
11	EFFECTIVE RAIN FALL	0	0	0	0	0	0	0	0	0	0	0	0	0	
12	NET IRRIGATION REQUIRED AT FIELD (NIR)	0	0	28	166	263	122	128	130	140	136	13	0	1126	
13	REQUIREMENT AT CANAL HEAD WITH EFF. 51 % (GIR)	0	0	55	325	516	239	251	255	275	267	25	0	2208	S No.9/Eff. For lined
14	WATER REQUIIRMENT AT CANAL HEAD FOR 100 HA. OF NET C.C.A. IN (Ha.m)with 51%GIR	0.00	0.00	5.50	32.50	51.60	23.90	25.10	25.50	27.50	26.70	2.50	0.00	220.80	GIRx100x% OF ICA / 100x1000

Shivpuri

ESTIMATION OF CROP WATER REQUIREMENT

CROP	:	MAIZE 1KH	GROWING TIME	:	105 DAYS
SOWING TIME	:	June (12)	% OF C.C.A.	:	100.00

S.No.	PARTICULARS	MAY		JUNE		JULY		AUG		SEPT		OCT		TOTAL	REMARKS
1	Eto	119	127	123	106	87	70	75	74	83	86	84	74		
2	CROP FACTOR Kc				0.49	0.59	0.91	1.1	1.1	1.01	0.71				
3	CONSUMPTIVE USE (Etc)	0	0	0	52	51	64	83	81	84	61	0	0	476	ETo X Kc
4	PLANT USE (PRE- SOWING)				75									75	
5	SOIL MOISTURE ADJUST										-50			-50	
6	GROSS WATER	0	0	0	127	51	64	83	81	84	11	0	0	501	
7	RAIN FALL	0	0	0	0	0	0	0	0	0	0	0	0	0	
8	EFFECTIVE RAIN FALL	0	0	0	0	0	0	0	0	0	0	0	0	0	
9	NET IRRIGATION REQUIRED AT FIELD (NIR)	0	0	0	127	51	64	83	81	84	0	0	0	490	
10	REQUIREMENT AT CANAL HEAD WITH EFF. 51 % (GIR)	0	0	0	249	100	125	163	159	165	0	0	0	961	S No.9/Eff. For lined
11	WATER REQUIIRMENT AT CANAL HEAD FOR 100 HA. OF NET C.C.A. IN (Ha.m)with 51%GIR	0.00	0.00	0.00	24.90	10.00	12.50	16.30	15.90	16.50	0.00	0.00	0.00	96.10	GIRx100x% OF ICA 100x1000

Shivpuri

ESTIMATION OF CROP WATER REQUIREMENT

CROP	:	SOYABEEN 1KH	GROWING TIME	:	105 DAYS
SOWING TIME	:	June (12)	% OF C.C.A.	:	100.00

S.No.	PARTICULARS	MAY		JUNE		JULY		AUG		SEPT		OCT		TOTAL	REMARKS
1	Eto	119	127	123	106	87	70	75	74	83	86	84	74		
2	CROP FACTOR Kc				0.44	0.63	0.91	1	1	1	0.66				
3	CONSUMPTIVE USE (Etc)	0	0	0	47	55	64	75	74	83	57	0	0	455	ETo X Kc
4	PLANT USE (PRE- SOWING)				75									75	
5	SOIL MOISTURE ADJUST										-46			-46	
6	GROSS WATER	0	0	0	122	55	64	75	74	83	11	0	0	484	
7	RAIN FALL	0	0	0	0	0	0	0	0	0	0	0	0	0	
8	EFFECTIVE RAIN FALL	0	0	0	0	0	0	0	0	0	0	0	0	0	
9	NET IRRIGATION REQUIRED AT FIELD (NIR)	0	0	0	122	55	64	75	74	83	0	0	0	473	
10	REQUIREMENT AT CANAL HEAD WITH EFF. 51 % (GIR)	0	0	0	239	108	125	147	145	163	0	0	0	927	S No.9/Eff. For lined
11	WATER REQUIIRMENT AT CANAL HEAD FOR 100 HA. OF NET C.C.A. IN (Ha.m)with 51%GIR	0.00	0.00	0.00	23.90	10.80	12.50	14.70	14.50	16.30	0.00	0.00	0.00	92.70	GIRx100x% OF ICA 100x1000

Annexure-6.15

KOTHA BARRAGE

MONTHLY ABSTRACT OF DEMAND TABLE

(All figures are in Mcum)

S.No.	Year	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Total
1	1989-90	0.322	0.00	2.27	3.49	20.78	12.60	14.81	6.04	60.323
2	1990-91	0.77	1.45	0.87	5.42	21.66	15.44	12.65	6.32	64.591
3	1991-92	7.53	0.39	8.60	5.42	21.66	18.50	18.72	7.70	88.518
4	1992-93	4.99	0.00	5.78	4.82	17.01	18.50	16.16	5.66	72.933
5	1993-94	6.33	0.02	0.00	3.08	21.66	11.56	16.17	6.32	65.148
6	1994-95	2.56	0.25	7.32	5.42	21.66	18.50	18.72	7.70	82.133
7	1995-96	5.25	1.90	5.11	4.28	21.66	10.25	16.48	6.23	71.151
8	1996-97	4.02	0.00	4.89	2.06	16.51	9.86	13.23	6.32	56.886
9	1997-98	1.73	0.00	6.53	4.86	20.58	10.15	18.72	7.70	70.268
10	1998-99	0.69	3.13	5.00	3.04	16.04	13.04	18.72	7.70	67.370
11	1999-00	2.44	0.91	0.00	3.01	21.66	18.50	18.72	7.70	72.934
12	2000-01	0.00	1.33	8.08	5.42	21.66	18.50	18.72	7.70	81.423
13	2001-02	0.99	0.48	5.11	3.47	21.66	13.85	12.43	5.85	63.841
14	2002-03	7.53	4.49	6.23	5.42	21.66	18.50	18.72	6.08	88.629
15	2003-04	2.48	0.00	0.14	3.11	20.90	11.60	16.16	6.42	60.816
16	2004-05	6.00	0.00	7.88	1.80	17.95	18.50	14.84	5.57	72.551
17	2005-06	0.00	1.59	4.13	4.59	20.81	16.03	14.52	6.32	67.988
18	2006-07	6.11	0.25	5.11	4.29	21.66	12.62	16.41	6.13	72.595
19	2007-08	2.43	1.83	2.94	3.49	21.66	11.05	14.81	7.70	65.917
20	2008-09	0.00	4.14	2.55	5.01	20.61	18.50	12.25	6.42	69.469

KOTHA BARRAGE
ESTIMATION OF CROP WATER REQUIREMENT BY MODIFIED PENMAN METHOD
DEMAND TABLE
Year - 1989-90

Name of Crop	Particulars	JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II
SOYABEAN-2KH	ETo	94	76	65	64	70	79	78	74
	Crop factor (Kc)	0.4	0.6	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)	41	48	59	64	70	79	51	0
0	Plant Use (Pre-Sowing)	75	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	-51	0
	Gross Water Requirement	116	48	59.2	64	70	79	0	0
Sowing Area	Rainfall	180	135	133	151	96	83	37	24
5500	Effective Rainfall	111	47.9	59.15	64	59.17	54.71	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)	5	0	0	0	10.8	24.3	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 51 % (G I R)in mm for gravity flow	9.8	0	0	0	21.2	47.6	0	0
5500	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow	5.9	0	0	0	12.7	28.6	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)	0	0	0	0	0	0	0	0
	Water Requirement at Canal Head for crop in sowing area of 5500 Ha.by Pipe (MCM)	0.3	0	0	0	0.7	1.57	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**0.32**	**0**	**0.0**	**0.00**	**0.70**	**1.57**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**0.32**		**0.00**		**2.27**		**0.00**	

Anneuxre-6.15 Contd.

Name of Crop	Particulars		OCT		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II	I	II
WHEAT-OLV (Ordinary)	ETo		78	74	52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		24.2	31.08	41.6	48.6	45.1	44	44.9	40.9	25.5	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-40.9	-26	0
	Gross Water Requirement		84.2	31.08	42	49	45	44	45	0	0	0
Sowing Area	Rainfall (mm)		37	24	0	29	18	22	14	15	18	0
4000	Effective Rainfall (mm)		26.32	14.68	0	18.62	11.45	13.98	8.866	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		57.9	16.4	41.6	29.98	33.7	30	36.1	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		90.4	25.63	65	46.84	52.6	46.9	56.4	0	0	0
4000	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		68.1	19.3	48.9	35.27	39.6	35.3	42.4	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		2.72	0.772	1.96	1.411	1.58	1.41	1.7	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**2.723**	**0.772**	**1.958**	**1.411**	**1.584**	**1.413**	**1.698**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.49**		**3.37**		**3.00**		**1.70**		**0.00**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB		MAR	
			I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (High yield)	ETo		52	45	41	40	42	47	51	60	76	91
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		16	19	33	43	46	52	55	52	38	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-52	-38	0
	Gross Water Requirement		76	19	33	43	46	52	55	0	0	0
Sowing Area	Rainfall (mm)		0	29	18	22	14	15	18	0	0	0
12000	Effective Rainfall (mm)		0	0	11.05	13.95	8.895	9.696	11.8	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		76.1	18.9	21.7	29.2	37.3	42	42.8	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		119	29.53	34	45.7	58.3	65.6	66.9	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		89.6	22.24	25.6	34.4	43.9	49.4	50.3	0	0	0
12000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 12000 Ha.by Pipe (MCM)		10.7	2.668	3.07	4.13	5.27	5.93	6.04	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**10.7**	**2.668**	**3.07**	**4.13**	**5.27**	**5.93**	**6.04**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**13.415**		**7.200**		**11.197**		**6.040**		**0.000**	

Anneuxre-6.15 Contd.

Name of Crop	Particulars		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II
GRAM - N2RA	ETo		52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)		12	13	34	42	44	45	35	25
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	-30	-35	-25
	Gross Water Requirement		72	13	34	42	44	15	0	0
Sowing Area	Rainfall (mm)		0	29	18	22	14	15	18	0
4000	Effective Rainfall (mm)		0	0	11.09	13.9	8.846	9.515	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR) mm		72	13	23	28	35	6	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		112	20	36	44	55	9	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		85	15	27	33	41	6	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.39	0.61	1.08	1.32	1.66	0.26	0.00	0.00
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.39**	**0.61**	**1.08**	**1.32**	**1.66**	**0.26**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**4.000**		**2.402**		**1.919**		**0.000**	
	Total fornightly water req. for entire irrigated area of 25500 Ha (Mcum)	0.32 0.00 0.00 0.00 0.70 1.57 2.72 0.77	**16.09**	**4.69**	**5.73**	**6.86**	**8.62**	**6.19**	**6.04**	**0.00**
	Total Monthly water req. for entire irrigated area of 25500 Ha (Mcum)	**0.32** **0.00** **2.27** **3.49**	**20.783**		**12.597**		**14.813**		**6.040**	

KOTHA BARRAGE

ESTIMATION OF CROP WATER REQUIREMENT BY MODIFIED PENMAN METHOD

DEMAND TABLE
Year - 1990-91

Name of Crop	Particulars	JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II
SOYABEAN-2KH	ETo	94	76	65	64	70	79	78	74
	Crop factor (Kc)	0.4	0.6	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)	41	48	59	64	70	79	51	0
0	Plant Use (Pre-Sowing)	75	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	-51	0
	Gross Water Requirement	116	48	59.2	64	70	79	0	0
Sowing Area	Rainfall	159	116	218	63	90	297	12	0
5500	Effective Rainfall	104	47.9	59.15	41.54	56.48	79	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)	12	0	0	22.5	13.5	0	0	0
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm for gravity flow	23	0	0	44	26.5	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow	14	0	0	26.4	15.9	0	0	0
5500	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 5500 Ha.by Pipe (MCM)	0.8	0	0	1.45	0.87	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**0.77**	**0.00**	**0.00**	**1.45**	**0.875**	**0.000**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**0.77**		**1.45**		**0.87**		**0.00**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB		MAR	
			I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (High yield)	ETo		52	45	41	40	42	47	51	60	76	91
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		16	19	33	43	46.2	52	55	52	38	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-52	-38	0
	Gross Water Requirement		76	19	33	43	46	52	55	0	0	0
Sowing Area	Rainfall (mm)		0	0	21	0	25	19	15	0	0	0
12000	Effective Rainfall (mm)		0	0	12.9	0	16.02	12.33	9.79	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		76.1	18.9	19.9	43.2	30.2	39.4	44.8	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		119	29.53	31.1	67.5	47.2	61.5	70	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		89.6	22.24	23.4	50.8	35.5	46.3	52.7	0	0	0
12000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 12000 Ha.by Pipe (MCM)		10.7	2.668	2.81	6.1	4.26	5.56	6.32	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**10.7**	**2.668**	**2.81**	**6.1**	**4.26**	**5.56**	**6.32**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**13.415**		**8.908**		**9.819**		**6.322**		**0.000**	

Anneuxre-6.15 Contd.

Name of Crop	Particulars		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II
GRAM - N2RA	ETo		52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.23	0.29	0.83	1.05	1.05	1.0	0.68	0.42
Sowing Area	Consumptive Use (Etc)		12	13	34	42	44.1	45	35	25
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	-30	-35	-25
	Gross Water Requirement		72	13	34	42	44	15	0	0
Sowing Area	Rainfall (mm)		0	0	21	0	25	19	15	0
4000	Effective Rainfall (mm)		0	0	12.95	0	15.92	12.1	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR) mm		72	13	21	42	28	3	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		112	20	33	66	44	5	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		85	15	25	49	33	3	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.39	0.61	0.99	1.98	1.33	0.14	0.00	0.00
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.39**	**0.61**	**0.99**	**1.98**	**1.33**	**0.14**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**4.000**		**2.968**		**1.465**		**0.000**	
	Total fornightly water req. for entire irrigated area of 25500 Ha (Mcum)	0.77 0.00 0.00 1.45 0.87 0.00 3.96 1.46	**16.09**	**5.57**	**5.29**	**10.15**	**6.95**	**5.70**	**6.32**	**0.00**
	Total Monthly water req. for entire irrigated area of 25500 Ha (Mcum)	**0.77** **1.45** **0.87** **5.42**	**21.660**		**15.439**		**12.648**		**6.322**	

KOTHA BARRAGE

ESTIMATION OF CROP WATER REQUIREMENT BY MODIFIED PENMAN METHOD

DEMAND TABLE
Year - 1991-92

Name of Crop	Particulars	JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II
SOYABEAN-2KH	ETo	94	76	65	64	70	79	78	74
	Crop factor (Kc)	0.4	0.6	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)	41	48	59	64	70	79	51	0
0	Plant Use (Pre-Sowing)	75	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	-51	0
	Gross Water Requirement	116	48	59.2	64	70	79	0	0
Sowing Area	Rainfall	9	213	91	228	0	23	0	0
5500	Effective Rainfall	0	47.9	53.17	64	0	16.17	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)	116	0	5.98	0	70	62.8	0	0
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm for gravity flow	228	0	11.7	0	137	123	0	0
	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow	137	0	7.04	0	82.4	73.9	0	0
Total sowing area =	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)	0	0	0	0	0	0	0	0
5500	Water Requirement at Canal Head for crop in sowing area of 5500 Ha.by Pipe (MCM)	7.5	0	0.39	0	4.53	4.07	0	0
Ha	**Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)**	**7.53**	**0.00**	**0.39**	**0.00**	**4.529**	**4.066**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**7.53**		**0.39**		**8.60**		**0.00**	

Name of Crop	Particulars		OCT		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II	I	II
WHEAT-OLV (Ordinary)	ETo		78	74	52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		24.2	31.08	41.6	48.6	45.1	44	44.9	40.9	25.5	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-40.9	-26	0
	Gross Water Requirement		84.2	31.08	42	49	45	44	45	0	0	0
Sowing Area	Rainfall (mm)		0	0	0	0	0	0	0	0	0	0
4000	Effective Rainfall (mm)		0	0	0	0	0	0	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		84.2	31.08	41.6	48.6	45.1	44	44.9	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		132	48.56	65	75.94	70.5	68.8	70.2	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		99	36.56	48.9	57.18	53.1	51.8	52.9	0	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.96	1.463	1.96	2.287	2.12	2.07	2.11	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.961**	**1.463**	**1.958**	**2.287**	**2.122**	**2.071**	**2.115**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**5.42**		**4.24**		**4.19**		**2.11**		**0.00**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB		MAR	
			I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (High yield)	ETo		52	45	41	40	42	47	51	60	76	91
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		16	19	33	43	46	52	55	52	38	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-52	-38	0
	Gross Water Requirement		76	19	33	43	46	52	55	0	0	0
Sowing Area	Rainfall (mm)		0	0	0	0	0	0	0	0	0	0
12000	Effective Rainfall (mm)		0	0	0	0	0	0	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		76.1	18.9	32.8	43.2	46.2	51.7	54.6	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		119	29.53	51.3	67.5	72.2	80.8	85.3	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		89.6	22.24	38.6	50.8	54.4	60.8	64.2	0	0	0
12000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 12000 Ha.by Pipe (MCM)		10.7	2.668	4.63	6.1	6.52	7.3	7.7	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**10.7**	**2.668**	**4.63**	**6.1**	**6.52**	**7.3**	**7.7**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**13.415**		**10.729**		**13.821**		**7.704**		**0.000**	

KOTHA BARRAGE

ESTIMATION OF CROP WATER REQUIREMENT BY MODIFIED PENMAN METHOD

DEMAND TABLE
Year - 1992-93

Name of Crop	Particulars	JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II
SOYABEAN-2KH	ETo	94	76	65	64	70	79	78	74
	Crop factor (Kc)	0.4	0.6	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)	41	48	59	64	70	79	51	0
0	Plant Use (Pre-Sowing)	75	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	-51	0
	Gross Water Requirement	116	48	59.2	64	70	79	0	0
Sowing Area	Rainfall	54	132	292	351	97	0	1	21
5500	Effective Rainfall	39.3	47.9	59.15	64	59.62	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)	77	0	0	0	10.4	79	0	0
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm for gravity flow	151	0	0	0	20.4	155	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow	91	0	0	0	12.2	92.9	0	0
5500	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 5500 Ha.by Pipe (MCM)	5	0	0	0	0.67	5.11	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**4.99**	**0.00**	**0.00**	**0.00**	**0.672**	**5.112**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**4.99**		**0.00**		**5.78**		**0.00**	

Anneuxre-6.15 Contd.

Name of Crop	Particulars		OCT		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II	I	II
WHEAT-OLV (Ordinary)	ETo		78	74	52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		24.2	31.08	41.6	48.6	45.1	44	44.9	40.9	25.5	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-40.9	-26	0
	Gross Water Requirement		84.2	31.08	42	49	45	44	45	0	0	0
Sowing Area	Rainfall (mm)		1	21	26	15	0	0	0	21	22	0
4000	Effective Rainfall (mm)		0	12.84	16.41	9.604	0	0	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		84.2	18.24	25.2	39	45.1	44	44.9	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		132	28.5	39.4	60.93	70.5	68.8	70.2	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		99	21.46	29.6	45.88	53.1	51.8	52.9	0	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.96	0.858	1.19	1.835	2.12	2.07	2.11	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.961**	**0.858**	**1.185**	**1.835**	**2.122**	**2.071**	**2.115**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**4.82**		**3.02**		**4.19**		**2.11**		**0.00**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB		MAR	
			I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (High yield)	ETo		52	45	41	40	42	47	51	60	76	91
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		16	19	33	43	46	52	55	52	38	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-52	-38	0
	Gross Water Requirement		76	19	33	43	46	52	55	0	0	0
Sowing Area	Rainfall (mm)		26	15	0	0	0	21	22	0	0	0
12000	Effective Rainfall (mm)		18.22	0	0	0	0	13.65	14.4	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		57.9	18.9	32.8	43.2	46.2	38	40.1	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		90.5	29.53	51.3	67.5	72.2	59.5	62.7	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		68.1	22.24	38.6	50.8	54.4	44.8	47.2	0	0	0
12000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 12000 Ha.by Pipe (MCM)		8.17	2.668	4.63	6.1	6.52	5.37	5.66	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**8.17**	**2.668**	**4.63**	**6.1**	**6.52**	**5.37**	**5.66**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**10.842**		**10.729**		**11.894**		**5.665**		**0.000**	

Anneuxre-6.15 Contd.

Name of Crop	Particulars		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II
GRAM - N2RA	ETo		52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)		12	13	34	42	44	45	35	25
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	-30	-35	-25
	Gross Water Requirement		72	13	34	42	44	15	0	0
Sowing Area	Rainfall (mm)		26	15	0	0	0	21	22	0
4000	Effective Rainfall (mm)		18.03	0	0	0	0	13.39	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR) mm		54	13	34	42	44	2	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		84	20	53	66	69	3	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		63	15	40	49	52	2	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		2.54	0.61	1.60	1.98	2.08	0.08	0.00	0.00
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**2.54**	**0.61**	**1.60**	**1.98**	**2.08**	**0.08**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.152**		**3.578**		**2.153**		**0.000**	
	Total fornightly water req. for entire irrigated area of 25500 Ha (Mcum)	4.99 0.00 0.00 0.00 0.67 5.11 3.96 0.86	**11.90**	**5.12**	**8.35**	**10.15**	**10.71**	**5.45**	**5.66**	**0.00**
	Total Monthly water req. for entire irrigated area of 25500 Ha (Mcum)	**4.99** **0.00** **5.78** **4.82**	**17.015**		**18.500**		**16.162**		**5.665**	

KOTHA BARRAGE

ESTIMATION OF CROP WATER REQUIREMENT BY MODIFIED PENMAN METHOD

DEMAND TABLE
Year - 1993-94

Name of Crop	Particulars	JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II
SOYABEAN-2KH	ETo	94	76	65	64	70	79	78	74
	Crop factor (Kc)	0.4	0.6	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)	41	48	59	64	70	79	51	0
0	Plant Use (Pre-Sowing)	75	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	-51	0
	Gross Water Requirement	116	48	59.2	64	70	79	0	0
Sowing Area	Rainfall	79	15	120	126	183	204	43	32
5500	Effective Rainfall	56.9	9.59	58.8	64	70	79	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)	60	38	0.35	0	0	0	0	0
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm for gravity flow	117	75	0.68	0	0	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow	70	45	0.41	0	0	0	0	0
5500	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 5500 Ha.by Pipe (MCM)	3.9	2.5	0.02	0	0	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**3.85**	**2.48**	**0.02**	**0.00**	**0.000**	**0.000**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**6.33**		**0.02**		**0.00**		**0.00**	

Anneuxre-6.15 Contd.

Name of Crop	Particulars		OCT		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II	I	II
WHEAT-OLV (Ordinary)	ETo		78	74	52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		24.2	31.08	41.6	48.6	45.1	44	44.9	40.9	25.5	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-40.9	-26	0
	Gross Water Requirement		84.2	31.08	42	49	45	44	45	0	0	0
Sowing Area	Rainfall (mm)		43	32	0	0	18	29	17	0	15	0
4000	Effective Rainfall (mm)		30.31	19.53	0	0	11.45	18.38	10.8	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		53.9	11.55	41.6	48.6	33.7	25.6	34.1	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		84.2	18.04	65	75.94	52.6	40	53.3	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		63.4	13.59	48.9	57.18	39.6	30.1	40.2	0	0	0
9500	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		2.53	0.543	1.96	2.287	1.58	1.21	1.61	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**2.535**	**0.543**	**1.958**	**2.287**	**1.584**	**1.205**	**1.607**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.08**		**4.24**		**2.79**		**1.61**		**0.00**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB		MAR	
			I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (High yield)	ETo		52	45	41	40	42	47	51	60	76	91
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		16	18.9	33	43	46	52	55	52	38	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-52	-38	0
	Gross Water Requirement		76	19	33	43	46	52	55	0	0	0
Sowing Area	Rainfall (mm)		0	0	18	29	17	0	15	0	0	0
12000	Effective Rainfall (mm)		0	0	11.05	18.34	10.84	0	9.79	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		76.1	18.9	21.7	24.9	35.4	51.7	44.8	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		119	29.53	34	38.8	55.3	80.8	70	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		89.6	22.24	25.6	29.2	41.6	60.8	52.7	0	0	0
12000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 12000 Ha.by Pipe (MCM)		10.7	2.668	3.07	3.51	4.99	7.3	6.32	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**10.7**	**2.668**	**3.07**	**3.51**	**4.99**	**7.3**	**6.32**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**13.415**		**6.579**		**12.291**		**6.322**		**0.000**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II
GRAM - N2RA	ETo		52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)		12	13	34	42	44	45	35	25
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	-30	-35	-25
	Gross Water Requirement		72	13	34	42	44	15	0	0
Sowing Area	Rainfall (mm)		0	0	18	29	17	0	15	0
4000	Effective Rainfall (mm)		0	0	11.09	18.28	10.77	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR) mm		72	13	23	24	33	15	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		112	20	36	37	52	24	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		85	15	27	28	39	18	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.39	0.61	1.08	1.12	1.57	0.71	0.00	0.00
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.39**	**0.61**	**1.08**	**1.12**	**1.57**	**0.71**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**4.000**		**2.196**		**2.276**		**0.000**	
	Total fornightly water req. for entire irrigated area of 25500 Ha (Mcum)	3.85 2.48 0.02 0.00 0.00 0.00 2.53 0.54	**16.09**	**5.57**	**5.73**	**5.83**	**8.17**	**8.01**	**6.32**	**0.00**
	Total Monthly water req. for entire irrigated area of 25500 Ha (Mcum)	**6.33** **0.02** **0.00** **3.08**	**21.660**		**11.564**		**16.174**		**6.322**	

KOTHA BARRAGE

ESTIMATION OF CROP WATER REQUIREMENT BY MODIFIED PENMAN METHOD

DEMAND TABLE
Year - 1994-95

Name of Crop	Particulars	JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II
SOYABEAN-2KH	ETo	94	76	65	64	70	79	78	74
	Crop factor (Kc)	0.4	0.6	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)	41	48	59	64	70	79	51	0
0	Plant Use (Pre-Sowing)	75	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	-51	0
	Gross Water Requirement	116	48	59.2	64	70	79	0	0
Sowing Area	Rainfall	110	391	303	108	53	0	0	0
5500	Effective Rainfall	76.8	47.9	59.15	60.11	35.94	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)	40	0	0	3.89	34.1	79	0	0
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm for gravity flow	78	0	0	7.63	66.8	155	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow	47	0	0	4.58	40.1	92.9	0	0
5500	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 5500 Ha.by Pipe (MCM)	2.6	0	0	0.25	2.2	5.11	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**2.56**	**0.00**	**0.00**	**0.25**	**2.204**	**5.112**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**2.56**		**0.25**		**7.32**		**0.00**	

Anneuxre-6.15 Contd.

Name of Crop	Particulars		OCT		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II	I	II
WHEAT-OLV (Ordinary)	ETo		78	74	52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		24.2	31.08	41.6	48.6	45.1	44	44.9	40.9	25.5	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-40.9	-26	0
	Gross Water Requirement		84.2	31.08	42	49	45	44	45	0	0	0
Sowing Area	Rainfall (mm)		0	0	0	0	0	0	0	0	0	0
4000	Effective Rainfall (mm)		0	0	0	0	0	0	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		84.2	31.08	41.6	48.6	45.1	44	44.9	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		132	48.56	65	75.94	70.5	68.8	70.2	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		99	36.56	48.9	57.18	53.1	51.8	52.9	0	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.96	1.463	1.96	2.287	2.12	2.07	2.11	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.961**	**1.463**	**1.958**	**2.287**	**2.122**	**2.071**	**2.115**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**5.42**		**4.24**		**4.19**		**2.11**		**0.00**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB		MAR	
			I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (High yield)	ETo		52	45	41	40	42	47	51	60	76	91
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		16	18.9	33	43	46	52	55	52	38	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-52	-38	0
	Gross Water Requirement		76	19	33	43	46	52	55	0	0	0
Sowing Area	Rainfall (mm)		0	0	0	0	0	0	0	0	72	0
12000	Effective Rainfall (mm)		0	0	0	0	0	0	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		76.1	18.9	32.8	43.2	46.2	51.7	54.6	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		119	29.53	51.3	67.5	72.2	80.8	85.3	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		89.6	22.24	38.6	50.8	54.4	60.8	64.2	0	0	0
12000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 12000 Ha.by Pipe (MCM)		10.7	2.668	4.63	6.1	6.52	7.3	7.7	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**10.7**	**2.668**	**4.63**	**6.1**	**6.52**	**7.3**	**7.7**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**13.415**		**10.729**		**13.821**		**7.704**		**0.000**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II
GRAM - N2RA	ETo		52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)		12	13	34	42	44	45	35	25
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	-30	-35	-25
	Gross Water Requirement		72	13	34	42	44	15	0	0
Sowing Area	Rainfall (mm)		0	0	0	0	0	0	0	0
4000	Effective Rainfall (mm)		0	0	0	0	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR) mm		72	13	34	42	44	15	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		112	20	53	66	69	24	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		85	15	40	49	52	18	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.39	0.61	1.60	1.98	2.08	0.71	0.00	0.00
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.39**	**0.61**	**1.60**	**1.98**	**2.08**	**0.71**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**4.000**		**3.578**		**2.783**		**0.000**	
	Total fornightly water req. for entire irrigated area of 25500 Ha (Mcum)	2.56 0.00 0.00 0.25 2.20 5.11 3.96 1.46	**16.09**	**5.57**	**8.35**	**10.15**	**10.71**	**8.01**	**7.70**	**0.00**
	Total Monthly water req. for entire irrigated area of 25500 Ha (Mcum)	**2.56** **0.25** **7.32** **5.42**	**21.660**		**18.500**		**18.719**		**7.704**	

KOTHA BARRAGE

ESTIMATION OF CROP WATER REQUIREMENT BY MODIFIED PENMAN METHOD

DEMAND TABLE
Year - 1995-96

Name of Crop	Particulars	JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II
SOYABEAN-2KH	ETo	94	76	65	64	70	79	78	74
	Crop factor (Kc)	0.4	0.6	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)	41	48	59	64	70	79	51	0
0	Plant Use (Pre-Sowing)	75	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	-51	0
	Gross Water Requirement	116	48	59.2	64	70	79	0	0
Sowing Area	Rainfall	48.4	394	45	260	131	1	0	40
5500	Effective Rainfall	35.3	47.9	29.75	64	70	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)	81	0	29.4	0	0	79	0	0
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm for gravity flow	159	0	57.7	0	0	155	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow	95	0	34.6	0	0	92.9	0	0
5500	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 5500 Ha.by Pipe (MCM)	5.2	0	1.9	0	0	5.11	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**5.25**	**0.00**	**1.90**	**0.00**	**0.000**	**5.112**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**5.25**		**1.90**		**5.11**		**0.00**	

Anneuxre-6.15 Contd.

Name of Crop	Particulars		OCT		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II	I	II
WHEAT-OLV (Ordinary)	ETo		78	74	52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		24.2	31.08	41.6	48.6	45.1	44	44.9	40.9	25.5	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-40.9	-26	0
	Gross Water Requirement		84.2	31.08	42	49	45	44	45	0	0	0
Sowing Area	Rainfall (mm)		0	40	0	0	26	30	15	0	16	0
4000	Effective Rainfall (mm)		0.0	24.39	0	0	16.6	19	9.51	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)			6.69	41.6	48.6	28.5	25	35.4	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		132	10.45	65	75.94	44.6	39.1	55.4	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		99	7.871	48.9	57.18	33.5	29.4	41.7	0	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.96	0.315	1.96	2.287	1.34	1.18	1.67	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.961**	**0.315**	**1.958**	**2.287**	**1.342**	**1.176**	**1.667**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**4.28**		**4.24**		**2.52**		**1.67**		**0.00**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB		MAR	
			I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (High yield)	ETo		52	45	41	40	42	47	51	60	76	91
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		16	19	33	43	46	52	55	52	38	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-52	-38	0
	Gross Water Requirement		76	19	33	43	46	52	55	0	0	0
Sowing Area	Rainfall (mm)		0	0	26	30	15	0	16	0	6	0
12000	Effective Rainfall (mm)		0	0	16.0	18.96	9.543	0	10.5	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		76.1	18.9	16.8	24.2	36.7	51.7	44.1	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		119	29.53	26.3	37.9	57.3	80.8	68.9	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		89.6	22.24	19.8	28.5	43.1	60.8	51.9	0	0	0
12000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 12000 Ha.by Pipe (MCM)		10.7	2.668	2.37	3.42	5.18	7.3	6.23	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**10.7**	**2.668**	**2.37**	**3.42**	**5.18**	**7.3**	**6.23**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**13.415**		**5.796**		**12.474**		**6.228**		**0.000**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II
GRAM - N2RA	ETo		52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)		12	13	34	42	44	45	35	25
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	-30	-35	-25
	Gross Water Requirement		72	13	34	42	44	15	0	0
Sowing Area	Rainfall (mm)		0	0	26	30	15	0	16	0
4000	Effective Rainfall (mm)		0	0	16.04	18.9	9.489	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR) mm		72	13	18	23	35	15	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		112	20	28	36	54	24	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		85	15	21	27	41	18	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.39	0.61	0.85	1.09	1.63	0.71	0.00	0.00
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.39**	**0.61**	**0.85**	**1.09**	**1.63**	**0.71**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**4.000**		**1.934**		**2.337**		**0.000**	
	Total fornightly water req. for entire irrigated area of 25500 Ha (Mcum)	5.25 0.00 1.90 0.00 0.00 5.11 3.96 0.31	**16.09**	**5.57**	**4.56**	**5.69**	**8.47**	**8.01**	**6.23**	**0.00**
	Total Monthly water req. for entire irrigated area of 25500 Ha (Mcum)	**5.25** **1.90** **5.11** **4.28**	**21.660**		**10.248**		**16.478**		**6.228**	

KOTHA BARRAGE

ESTIMATION OF CROP WATER REQUIREMENT BY MODIFIED PENMAN METHOD

DEMAND TABLE
Year -1996-97

Name of Crop	Particulars	JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II
SOYABEAN-2KH	ETo	94	76	65	64	70	79	78	74
	Crop factor (Kc)	0.4	0.6	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)	41	48	59	64	70	79	51	0
0	Plant Use (Pre-Sowing)	75	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	-51	0
	Gross Water Requirement	116	48	59.2	64	70	79	0	0
Sowing Area	Rainfall	75	204	129.8	508	84	28	66	46
5500	Effective Rainfall	54.2	47.9	59.15	64	53.79	19.7	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)	62	0	0	0	16.2	59.3	0	0
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm for gravity flow	122	0	0	0	31.8	116	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow	73	0	0	0	19.1	69.8	0	0
5500	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 5500 Ha.by Pipe (MCM)	4	0	0	0	1.05	3.84	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**4.02**	**0.00**	**0.00**	**0.00**	**1.049**	**3.837**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**4.02**		**0.00**		**4.89**		**0.00**	

Name of Crop	Particulars		OCT		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II	I	II
WHEAT-OLV (Ordinary)	ETo		78	74	52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		24.2	31.08	41.6	48.6	45.1	44	44.9	40.9	25.5	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-40.9	-26	0
	Gross Water Requirement		84.2	31.08	42	49	45	44	45	0	0	0
Sowing Area	Rainfall (mm)		66	46	32	0	52	13	22	18	15	0
4000	Effective Rainfall (mm)		45.35	26.11	20.11	0	31.75	8.201	14.02	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		38.8	4.967	21.5	48.6	13.3	35.8	30.9	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		60.7	7.761	33.6	75.94	20.9	55.9	48.3	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		45.7	5.844	25.3	57.18	15.7	42.1	36.4	0	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		1.83	0.234	1.01	2.287	0.63	1.68	1.45	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**1.827**	**0.234**	**1.011**	**2.287**	**0.628**	**1.685**	**1.455**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**2.06**		**3.30**		**2.31**		**1.45**		**0.00**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB		MAR	
			I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (High yield)	ETo		52	45	41	40	42	47	51	60	76	91
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		16	19	33	43	46	52	55	52	38	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-52	-38	0
	Gross Water Requirement		76	19	33	43	46	52	55	0	0	0
Sowing Area	Rainfall (mm)		32	0	52	13	22	18	15	0	0	0
12000	Effective Rainfall (mm)		22.41	0	27.62	8.184	14.08	11.67	9.79	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		53.7	18.9	5.2	35	32.1	40	44.8	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		83.9	29.53	8.09	54.7	50.2	62.5	70	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		63.2	22.24	6.09	41.2	37.8	47.1	52.7	0	0	0
12000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 12000 Ha.by Pipe (MCM)		7.58	2.668	0.73	4.94	4.54	5.65	6.32	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**7.58**	**2.668**	**0.73**	**4.94**	**4.54**	**5.65**	**6.32**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**10.250**		**5.675**		**10.186**		**6.322**		**0.000**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II
GRAM - N2RA	ETo		52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)		12	13	34	42	44	45	35	25
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	-30	-35	-25
	Gross Water Requirement		72	13	34	42	44	15	0	0
Sowing Area	Rainfall (mm)		32	0	52	13	22	18	15	0
4000	Effective Rainfall (mm)		22.15	0	28.03	8.159	13.99	11.45	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR) mm		50	13	6	34	30	4	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		78	20	9	53	47	6	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		59	15	7	40	35	4	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		2.34	0.61	0.28	1.59	1.42	0.17	0.00	0.00
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**2.34**	**0.61**	**0.28**	**1.59**	**1.42**	**0.17**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**2.958**		**1.875**		**1.586**		**0.000**	
	Total fornightly water req. for entire irrigated area of 25500 Ha (Mcum)	4.02 0.00 0.00 0.00 1.05 3.84 1.83 0.23	**10.94**	**5.57**	**1.64**	**8.22**	**7.41**	**5.82**	**6.32**	**0.00**
	Total Monthly water req. for entire irrigated area of 25500 Ha (Mcum)	**4.02** **0.00** **4.89** **2.06**	**16.507**		**9.862**		**13.227**		**6.322**	

KOTHA BARRAGE

ESTIMATION OF CROP WATER REQUIREMENT BY MODIFIED PENMAN METHOD

DEMAND TABLE
Year - 1997-98

Name of Crop	Particulars	JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II
SOYABEAN-2KH	ETo	94	76	65	64	70	79	78	74
	Crop factor (Kc)	0.4	0.6	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)	41	48	59	64	70	79	51	0
0	Plant Use (Pre-Sowing)	75	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	-51	0
	Gross Water Requirement	116	48	59.2	64	70	79	0	0
Sowing Area	Rainfall	132	217	143	149.6	73.4	12	17	0
5500	Effective Rainfall	89.6	47.9	59.15	64	48.1	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)	27	0	0	0	21.9	79	0	0
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm for gravity flow	53	0	0	0	42.9	155	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow	32	0	0	0	25.8	92.9	0	0
5500	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 5500 Ha.by Pipe (MCM)	1.7	0	0	0	1.42	5.11	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**1.73**	**0.00**	**0.00**	**0.00**	**1.417**	**5.112**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**1.73**		**0.00**		**6.53**		**0.00**	

Name of Crop	Particulars		OCT		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II	I	II
WHEAT-OLV (Ordinary)	ETo		78	74	52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		24.2	31.08	41.6	48.6	45.1	44	44.9	40.9	25.5	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-40.9	-26	0
	Gross Water Requirement		84.2	31.08	42	49	45	44	45	0	0	0
Sowing Area	Rainfall (mm)		17	0	0	36	105	0	0	0	0	0
4000	Effective Rainfall (mm)		12	0	0	22.98	45.1	0	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		72.2	31.08	41.6	25.62	0	44	44.9	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		113	48.56	65	40.03	0	68.8	70.2	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		84.9	36.56	48.9	30.14	0	51.8	52.9	0	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.4	1.463	1.96	1.206	0	2.07	2.11	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.396**	**1.463**	**1.958**	**1.206**	**0.000**	**2.071**	**2.115**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**4.86**		**3.16**		**2.07**		**2.11**		**0.00**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB		MAR	
			I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (High yield)	ETo		52	45	41	40	42	47	51	60	76	91
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		16	18.9	33	43	46	52	55	52	38	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-52	-38	0
	Gross Water Requirement		76	19	33	43	46	52	55	0	0	0
Sowing Area	Rainfall (mm)		0	36	105	0	0	0	0	0	7	42
12000	Effective Rainfall (mm)		0	0	32.8	0	0	0	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		76.1	18.9	0	43.2	46.2	51.7	54.6	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		119	29.53	0	67.5	72.2	80.8	85.3	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		89.6	22.24	0	50.8	54.4	60.8	64.2	0	0	0
12000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 12000 Ha.by Pipe (MCM)		10.7	2.668	0	6.1	6.52	7.3	7.7	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**10.7**	**2.668**	**0**	**6.1**	**6.52**	**7.3**	**7.7**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**13.415**		**6.099**		**13.821**		**7.704**		**0.000**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II
GRAM - N2RA	ETo		52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)		12	13	34	42	44	45	35	25
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	-30	-35	-25
	Gross Water Requirement		72	13	34	42	44	15	0	0
Sowing Area	Rainfall (mm)		0	36	105	0	0	0	0	0
4000	Effective Rainfall (mm)		0	0	34.03	0	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR) mm		72	13	0	42	44	15	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		112	20	0	66	69	24	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		85	15	0	49	52	18	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.39	0.61	0.00	1.98	2.08	0.71	0.00	0.00
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.39**	**0.61**	**0.00**	**1.98**	**2.08**	**0.71**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**4.000**		**1.976**		**2.783**		**0.000**	
	Total fornightly water req. for entire irrigated area of 25500 Ha (Mcum)	1.73 0.00 0.00 0.00 1.42 5.11 3.40 1.46	**16.09**	**4.49**	**0.00**	**10.15**	**10.71**	**8.01**	**7.70**	**0.00**
	Total Monthly water req. for entire irrigated area of 25500 Ha (Mcum)	**1.73** **0.00** **6.53** **4.86**	**20.578**		**10.146**		**18.719**		**7.704**	

KOTHA BARRAGE

ESTIMATION OF CROP WATER REQUIREMENT BY MODIFIED PENMAN METHOD

DEMAND TABLE
Year - 1998-99

Name of Crop	Particulars	JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II
SOYABEAN-2KH	ETo	94	76	65	64	70	79	78	74
	Crop factor (Kc)	0.4	0.6	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)	41	48	59	64	70	79	51	0
0	Plant Use (Pre-Sowing)	75	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	-51	0
	Gross Water Requirement	116	48	59.2	64	70	79	0	0
Sowing Area	Rainfall	182	69	199	23	79	29	74.6	0
5500	Effective Rainfall	112	41.5	59.15	15.56	51.33	20.4	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)	4.3	6.3	0	48.4	18.7	58.6	0	0
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm for gravity flow	8.5	12	0	95	36.6	115	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow	5.1	7.5	0	57	22	68.9	0	0
5500	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 5500 Ha.by Pipe (MCM)	0.3	0.4	0	3.13	1.21	3.79	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**0.28**	**0.41**	**0.00**	**3.13**	**1.208**	**3.791**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**0.69**		**3.13**		**5.00**		**0.00**	

Name of Crop	Particulars		OCT		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II	I	II
WHEAT-OLV (Ordinary)	ETo		78	74	52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		24.2	31.08	41.6	48.6	45.1	44	44.9	40.9	25.5	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-40.9	-26	0
	Gross Water Requirement		84.2	31.08	42	49	45	44	45	0	0	0
Sowing Area	Rainfall (mm)		74.6	0	28	37	16	21	0	0	0	0
4000	Effective Rainfall (mm)		50.56	0	17.64	23.6	10.16	13.34	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		33.6	31.08	24	25	34.9	30.7	44.9	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		52.5	48.56	37.4	39.06	54.6	47.9	70.2	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		39.6	36.56	28.2	29.41	41.1	36.1	52.9	0	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		1.58	1.463	1.13	1.176	1.64	1.44	2.11	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**1.582**	**1.463**	**1.127**	**1.176**	**1.644**	**1.443**	**2.115**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.04**		**2.30**		**3.09**		**2.11**		**0.00**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB		MAR	
			I	**II**	**I**	**II**	**I**	**II**	**I**	**II**	**I**	**II**
WHEAT-1MV (High yield)	ETo		52	45	41	40	42	47	51	60	76	91
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		16	19	33	43	46	52	55	52	38	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-52	-38	0
	Gross Water Requirement		76	19	33	43	46	52	55	0	0	0
Sowing Area	Rainfall (mm)		28	37	16	21	0	0	0	0	0	0
12000	Effective Rainfall (mm)		19.62	0	9.817	13.31	0	0	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		56.5	18.9	23	29.9	46.2	51.7	54.6	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		88.3	29.53	35.9	46.7	72.2	80.8	85.3	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		66.5	22.24	27	35.2	54.4	60.8	64.2	0	0	0
12000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 12000 Ha.by Pipe (MCM)		7.98	2.668	3.24	4.22	6.52	7.3	7.7	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**7.98**	**2.668**	**3.24**	**4.22**	**6.52**	**7.3**	**7.7**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**10.645**		**7.464**		**13.821**		**7.704**		**0.000**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II
GRAM - N2RA	ETo		52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)		12	13	34	42	44	45	35	25
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	-30	-35	-25
	Gross Water Requirement		72	13	34	42	44	15	0	0
Sowing Area	Rainfall (mm)		28	37	16	21	0	0	0	0
4000	Effective Rainfall (mm)		19.4	0	9.851	13.26	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR) mm		53	13	24	29	44	15	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		82	20	38	45	69	24	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		62	15	28	34	52	18	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		2.47	0.61	1.14	1.35	2.08	0.71	0.00	0.00
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**2.47**	**0.61**	**1.14**	**1.35**	**2.08**	**0.71**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.087**		**2.490**		**2.783**		**0.000**	
	Total fornightly water req. for entire irrigated area of 25500 Ha (Mcum)	0.28 0.41 0.00 3.13 1.21 3.79 1.58 1.46	**11.58**	**4.46**	**6.03**	**7.01**	**10.71**	**8.01**	**7.70**	**0.00**
	Total Monthly water req. for entire irrigated area of 25500 Ha (Mcum)	**0.69 3.13 5.00 3.04**	**16.036**		**13.041**		**18.719**		**7.704**	

KOTHA BARRAGE

ESTIMATION OF CROP WATER REQUIREMENT BY MODIFIED PENMAN METHOD

DEMAND TABLE
Year -1999-2000

Name of Crop	Particulars	JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II
SOYABEAN-2KH	ETo	94	76	65	64	70	79	78	74
	Crop factor (Kc)	0.4	0.6	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)	41	48	59	64	70	79	51	0
0	Plant Use (Pre-Sowing)	75	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	-51	0
	Gross Water Requirement	116	48	59.2	64	70	79	0	0
Sowing Area	Rainfall	113	244	131	78	127	256	76	0
5500	Effective Rainfall	78.7	47.9	59.15	49.98	70	79	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)	38	0	0	14	0	0	0	0
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm for gravity flow	74	0	0	27.5	0	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow	44	0	0	16.5	0	0	0	0
5500	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 5500 Ha.by Pipe (MCM)	2.4	0	0	0.91	0	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**2.44**	**0.00**	**0.00**	**0.91**	**0.000**	**0.000**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**2.44**		**0.91**		**0.00**		**0.00**	

Name of Crop	Particulars		OCT		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II	I	II
WHEAT-OLV (Ordinary)	ETo		78	74	52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		24.2	31.08	41.6	48.6	45.1	44	44.9	40.9	25.5	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-40.9	-26	0
	Gross Water Requirement		84.2	31.08	42	49	45	44	45	0	0	0
Sowing Area	Rainfall (mm)		76	0	0	0	0	0	0	0	0	0
4000	Effective Rainfall (mm)		51.38	0	0	0	0	0	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		32.8	31.08	41.6	48.6	45.1	44	44.9	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		51.3	48.56	65	75.94	70.5	68.8	70.2	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		38.6	36.56	48.9	57.18	53.1	51.8	52.9	0	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		1.54	1.463	1.96	2.287	2.12	2.07	2.11	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**1.544**	**1.463**	**1.958**	**2.287**	**2.122**	**2.071**	**2.115**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.01**		**4.24**		**4.19**		**2.11**		**0.00**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB		MAR	
			I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (High yield)	ETo		52	45	41	40	42	47	51	60	76	91
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		16	19	33	43	46	52	55	52	38	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-52	-38	0
	Gross Water Requirement		76	19	33	43	46	52	55	0	0	0
Sowing Area	Rainfall (mm)		0	0	0	0	0	0	0	0	0	0
12000	Effective Rainfall (mm)		0	0	0	0	0	0	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		76.1	18.9	32.8	43.2	46.2	51.7	54.6	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		119	29.53	51.3	67.5	72.2	80.8	85.3	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		89.6	22.24	38.6	50.8	54.4	60.8	64.2	0	0	0
12000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 12000 Ha.by Pipe (MCM)		10.7	2.668	4.63	6.1	6.52	7.3	7.7	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**10.7**	**2.668**	**4.63**	**6.1**	**6.52**	**7.3**	**7.7**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**13.415**		**10.729**		**13.821**		**7.704**		**0.000**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II
GRAM - N2RA	ETo		52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)		12	13	34	42	44	45	35	25
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	-30	-35	-25
	Gross Water Requirement		72	13	34	42	44	15	0	0
Sowing Area	Rainfall (mm)		0	0	0	0	0	0	0	0
4000	Effective Rainfall (mm)		0	0	0	0	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR) mm		72	13	34	42	44	15	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		112	20	53	66	69	24	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		85	15	40	49	52	18	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.39	0.61	1.60	1.98	2.08	0.71	0.00	0.00
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.39**	**0.61**	**1.60**	**1.98**	**2.08**	**0.71**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**4.000**		**3.578**		**2.783**		**0.000**	
	Total fornightly water req. for entire irrigated area of 25500 Ha (Mcum)	2.44 0.00 0.00 0.91 0.00 0.00 1.54 1.46	**16.09**	**5.57**	**8.35**	**10.15**	**10.71**	**8.01**	**7.70**	**0.00**
	Total Monthly water req. for entire irrigated area of 25500 Ha (Mcum)	**2.44** **0.91** **0.00** **3.01**	**21.660**		**18.500**		**18.719**		**7.704**	

Name of Crop	Particulars	JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II
SOYABEAN-2KH	ETo	94	76	65	64	70	79	78	74
	Crop factor (Kc)	0.4	0.6	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)	41	48	59	64	70	79	51	0
0	Plant Use (Pre-Sowing)	75	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	-51	0
	Gross Water Requirement	116	48	59.2	64	70	79	0	0
Sowing Area	Rainfall	230	602	59	218	35	2	0	0
5500	Effective Rainfall	116	47.9	38.57	64	24.06	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)	0	0	20.6	0	45.9	79	0	0
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm for gravity flow	0	0	40.3	0	90.1	155	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow	0	0	24.2	0	54.1	92.9	0	0
5500	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 5500 Ha.by Pipe (MCM)	0	0	1.33	0	2.97	5.11	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**0.00**	**0.00**	**1.33**	**0.00**	**2.973**	**5.112**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**0.00**		**1.33**		**8.08**		**0.00**	

Name of Crop	Particulars		OCT		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II	I	II
WHEAT-OLV (Ordinary)	ETo		78	74	52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		24.2	31.08	41.6	48.6	45.1	44	44.9	40.9	25.5	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-40.9	-26	0
	Gross Water Requirement		84.2	31.08	42	49	45	44	45	0	0	0
Sowing Area	Rainfall (mm)		0	0	0	0	0	0	0	0	0	0
4000	Effective Rainfall (mm)		0	0	0	0	0	0	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		84.2	31.08	41.6	48.6	45.1	44	44.9	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		132	48.56	65	75.94	70.5	68.8	70.2	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		99	36.56	48.9	57.18	53.1	51.8	52.9	0	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.96	1.463	1.96	2.287	2.12	2.07	2.11	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.961**	**1.463**	**1.958**	**2.287**	**2.122**	**2.071**	**2.115**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**5.42**		**4.24**		**4.19**		**2.11**		**0.00**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB		MAR	
			I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (High yield)	ETo		52	45	41	40	42	47	51	60	76	91
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		16	19	33	43	46	52	55	52	38	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-52	-38	0
	Gross Water Requirement		76	19	33	43	46	52	55	0	0	0
Sowing Area	Rainfall (mm)		0	0	0	0	0	0	0	0	0	0
12000	Effective Rainfall (mm)		0	0	0	0	0	0	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		76.1	18.9	32.8	43.2	46.2	51.7	54.6	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		119	29.53	51.3	67.5	72.2	80.8	85.3	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		89.6	22.24	38.6	50.8	54.4	60.8	64.2	0	0	0
12000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 12000 Ha.by Pipe (MCM)		10.7	2.668	4.63	6.1	6.52	7.3	7.7	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**10.7**	**2.668**	**4.63**	**6.1**	**6.52**	**7.3**	**7.7**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**13.415**		**10.729**		**13.821**		**7.704**		**0.000**	

Name of Crop	Particulars								NOV		DEC		JAN		FEB	
									I	II	I	II	I	II	I	II
GRAM - N2RA	ETo								52	45	41	40	42	47	51	60
	Crop factor (Kc)								0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)								12	13	34	42	44	45	35	25
0	Plant Use (Pre-Sowing)								60	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)								0	0	0	0	0	-30	-35	-25
	Gross Water Requirement								72	13	34	42	44	15	0	0
Sowing Area	Rainfall (mm)								0	0	0	0	0	0	0	0
4000	Effective Rainfall (mm)								0	0	0	0	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR) mm								72	13	34	42	44	15	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow								112	20	53	66	69	24	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow								85	15	40	49	52	18	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)								0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)								3.39	0.61	1.60	1.98	2.08	0.71	0.00	0.00
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)								**3.39**	**0.61**	**1.60**	**1.98**	**2.08**	**0.71**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)								**4.000**		**3.578**		**2.783**		**0.000**	
	Total fornightly water req. for entire irrigated area of 25500 Ha (Mcum)	0.00	0.00	1.33	0.00	2.97	5.11	3.96	1.46	**16.09**	**5.57**	**8.35**	**10.15**	**10.71**	**8.01**	**7.70**	**0.00**
	Total Monthly water req. for entire irrigated area of 25500 Ha (Mcum)	**0.00**		**1.33**		**8.08**		**5.42**		**21.660**		**18.500**		**18.719**		**7.704**	

ESTIMATION OF CROP WATER REQUIREMENT BY MODIFIED PENMAN METHOD

DEMAND TABLE
Year - 2001-02

Name of Crop	Particulars	JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II
SOYABEAN-2KH	ETo	94	76	65	64	70	79	78	74
	Crop factor (Kc)	0.4	0.6	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)	41	48	59	64	70	79	51	0
0	Plant Use (Pre-Sowing)	75	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	-51	0
	Gross Water Requirement	116	48	59.2	64	70	79	0	0
Sowing Area	Rainfall	191	54.9	256.2	96.4	164	0	60	0
5500	Effective Rainfall	115	34.3	59.15	56.54	70	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)	1.6	14	0	7.46	0	79	0	0
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm for gravity flow	3.2	27	0	14.6	0	155	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow	1.9	16	0	8.77	0	92.9	0	0
5500	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)	0	0	0	0	0	0	0	
Ha	Water Requirement at Canal Head for crop in sowing area of 5500 Ha.by Pipe (MCM)	0.1	0.9	0	0.48	0	5.11	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**0.11**	**0.88**	**0.00**	**0.48**	**0.000**	**5.112**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**0.99**		**0.48**		**5.11**		**0.00**	

Name of Crop	Particulars		OCT		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II	I	II
WHEAT-OLV (Ordinary)	ETo		78	74	52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		24.2	31.08	41.6	48.6	45.1	44	44.9	40.9	25.5	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-40.9	-26	0
	Gross Water Requirement		84.2	31.08	42	49	45	44	45	0	0	0
Sowing Area	Rainfall (mm)		60	0	0	0	32	0	29	16	20	14
4000	Effective Rainfall (mm)		41.58	0	0	0	20.3	0	18.43	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		42.6	31.08	41.6	48.6	24.8	44	26.5	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		66.6	48.56	65	75.94	38.8	68.8	41.4	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		50.1	36.56	48.9	57.18	29.2	51.8	31.2	0	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		2	1.463	1.96	2.287	1.17	2.07	1.25	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**2.005**	**1.463**	**1.958**	**2.287**	**1.167**	**2.071**	**1.247**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.47**		**4.24**		**3.24**		**1.25**		**0.00**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB		MAR	
			I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (High yield)	ETo		52	45	41	40	42	47	51	60	76	91
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		16	19	33	43	46	52	55	52	38	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-52	-38	0
	Gross Water Requirement		76	19	33	43	46	52	55	0	0	0
Sowing Area	Rainfall (mm)		0	0	32	0	29	16	20	14	0	0
12000	Effective Rainfall (mm)		0	0	19.63	0	18.5	10.36	13.1	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		76.1	18.9	13.2	43.2	27.7	41.3	41.5	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		119	29.53	20.6	67.5	43.3	64.6	64.8	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		89.6	22.24	15.5	50.8	32.6	48.6	48.8	0	0	0
12000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 12000 Ha.by Pipe (MCM)		10.7	2.668	1.86	6.1	3.91	5.84	5.85	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**10.7**	**2.668**	**1.86**	**6.1**	**3.91**	**5.84**	**5.85**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**13.415**		**7.959**		**9.748**		**5.853**		**0.000**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II
GRAM - N2RA	ETo		52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)		12	13	34	42	44	45	35	25
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	-30	-35	-25
	Gross Water Requirement		72	13	34	42	44	15.04	0	0
Sowing Area	Rainfall (mm)		0	0	32	0	29	16	20	14
4000	Effective Rainfall (mm)		0	0	19.69	0	18.39	10.16	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR) mm		72	13	14	42	26	4.88	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		112	20	22	66	40	7.62	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		85	15	17	49	30	5.74	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.39	0.61	0.67	1.98	1.21	0.23	0.00	0.00
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.39**	**0.61**	**0.67**	**1.98**	**1.21**	**0.23**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**4.000**		**2.651**		**1.440**		**0.000**	
	Total fornightly water req. for entire irrigated area of 25500 Ha (Mcum)	0.11 0.88 0.00 0.48 0.00 5.11 2.00 1.46	**16.09**	**5.57**	**3.70**	**10.15**	**6.37**	**6.07**	**5.85**	**0.00**
	Total Monthly water req. for entire irrigated area of 25500 Ha (Mcum)	**0.99** **0.48** **5.11** **3.47**	**21.660**		**13.847**		**12.435**		**5.853**	

KOTHA BARRAGE

ESTIMATION OF CROP WATER REQUIREMENT BY MODIFIED PENMAN METHOD

DEMAND TABLE
Year - 2002-03

Name of Crop	Particulars	JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II
SOYABEAN-2KH	ETo	94	76	65	64	70	79	78	74
	Crop factor (Kc)	0.4	0.6	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)	41	48	59	64	70	79	51	0
0	Plant Use (Pre-Sowing)	75	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	-51	0
	Gross Water Requirement	116	48	59.2	64	70	79	0	0
Sowing Area	Rainfall	11.4	84.8	94	0	81.6	0	0	4.2
5500	Effective Rainfall	0	47.9	53.78	0	52.72	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)	116	0	5.37	64	17.3	79	0	0
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm for gravity flow	228	0	10.5	125	33.9	155	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow	137	0	6.31	75.3	20.3	92.9	0	0
5500	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 5500 Ha.by Pipe (MCM)	7.5	0	0.35	4.14	1.12	5.11	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**7.53**	**0.00**	**0.35**	**4.14**	**1.118**	**5.112**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**7.53**		**4.49**		**6.23**		**0.00**	

Name of Crop	Particulars		OCT		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II	I	II
WHEAT-OLV (Ordinary)	ETo		78	74	52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		24.2	31.08	41.6	48.6	45.1	44	44.9	40.9	25.5	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-40.9	-26	0
	Gross Water Requirement		84.2	31.08	42	49	45	44	45	0	0	0
Sowing Area	Rainfall (mm)		0	4.2	6	0	0	0	0	0	17.6	16
4000	Effective Rainfall (mm)		0	0	0	0	0	0	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		84.2	31.08	41.6	48.6	45.1	44	44.9	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		132	48.56	65	75.94	70.5	68.8	70.2	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		99	36.56	48.9	57.18	53.1	51.8	52.9	0	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.96	1.463	1.96	2.287	2.12	2.07	2.11	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.961**	**1.463**	**1.958**	**2.287**	**2.122**	**2.071**	**2.115**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**5.42**		**4.24**		**4.19**		**2.11**		**0.00**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB		MAR	
			I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (High yield)	ETo		52	45	41	40	42	47	51	60	76	91
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		16	19	33	43	46	52	55	52	38	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-52	-38	0
	Gross Water Requirement		76	19	33	43	46	52	55	0	0	0
Sowing Area	Rainfall (mm)		6	0	0	0	0	0	17.6	16	0	0
12000	Effective Rainfall (mm)		0	0	0	0	0	0	11.5	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		76.1	18.9	32.8	43.2	46.2	51.7	43.1	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		119	29.53	51.3	67.5	72.2	80.8	67.3	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		89.6	22.24	38.6	50.8	54.4	60.8	50.6	0	0	0
12000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 12000 Ha.by Pipe (MCM)		10.7	2.668	4.63	6.1	6.52	7.3	6.08	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**10.7**	**2.668**	**4.63**	**6.1**	**6.52**	**7.3**	**6.08**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**13.415**		**10.729**		**13.821**		**6.078**		**0.000**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II
GRAM - N2RA	ETo		52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)		12	13	34	42	44	45	35	25
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	-30	-35	-25
	Gross Water Requirement		72	13	34	42	44	15	0	0
Sowing Area	Rainfall (mm)		6	0	0	0	0	0	17.6	16
4000	Effective Rainfall (mm)		0	0	0	0	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR) mm		72	13	34	42	44	15	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		112	20	53	66	69	24	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		85	15	40	49	52	18	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.39	0.61	1.60	1.98	2.08	0.71	0.00	0.00
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.39**	**0.61**	**1.60**	**1.98**	**2.08**	**0.71**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**4.000**		**3.578**		**2.783**		**0.000**	
	Total fornightly water req. for entire irrigated area of 25500 Ha (Mcum)	7.53 0.00 0.35 4.14 1.12 5.11 3.96 1.46	**16.09**	**5.57**	**8.35**	**10.15**	**10.71**	**8.01**	**6.08**	**0.00**
	Total Monthly water req. for entire irrigated area of 25500 Ha (Mcum)	**7.53** **4.49** **6.23** **5.42**	**21.660**		**18.500**		**18.719**		**6.078**	

KOTHA BARRAGE

ESTIMATION OF CROP WATER REQUIREMENT BY MODIFIED PENMAN METHOD

DEMAND TABLE
Year - 2003-04

Name of Crop	Particulars	JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II
SOYABEAN-2KH	ETo	94	76	65	64	70	79	78	74
	Crop factor (Kc)	0.4	0.6	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)	41	48	59	64	70	79	51	0
0	Plant Use (Pre-Sowing)	75	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	-51	0
	Gross Water Requirement	116	48	59.2	64	70	79	0	0
Sowing Area	Rainfall	112	137	135.4	268.4	269.4	133	34	41
5500	Effective Rainfall	78	47.9	59.15	64	70	76.78	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)	38	0	0	0	0	2.22	0	0
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm for gravity flow	75	0	0	0	0	4.36	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow	45	0	0	0	0	2.61	0	0
5500	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 5500 Ha.by Pipe (MCM)	2.5	0	0	0	0	0.14	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**2.48**	**0.00**	**0.00**	**0.00**	**0.000**	**0.144**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**2.48**		**0.00**		**0.14**		**0.00**	

Name of Crop	Particulars		OCT		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II	I	II
WHEAT-OLV (Ordinary)	ETo		78	74	52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		24.2	31.08	41.6	48.6	45.1	44	44.9	40.9	25.5	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-40.9	-26	0
	Gross Water Requirement		84.2	31.08	42	49	45	44	45	0	0	0
Sowing Area	Rainfall (mm)		34	41	0	25	29	18	0	21	14	0
4000	Effective Rainfall (mm)		24.16	25	0	16.13	18.44	11.41	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		60	6.08	41.6	32.47	26.7	32.6	44.9	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		93.8	9.5	65	50.73	41.7	50.9	70.2	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		70.6	7.153	48.9	38.2	31.4	38.3	52.9	0	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		2.82	0.286	1.96	1.528	1.25	1.53	2.11	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**2.825**	**0.286**	**1.958**	**1.528**	**1.254**	**1.533**	**2.115**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.11**		**3.49**		**2.79**		**2.11**		**0.00**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB		MAR	
			I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (High yield)	ETo		52	45	41	40	42	47	51	60	76	91
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		16	19	33	43	46	52	55	52	38	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-52	-38	0
	Gross Water Requirement		76	19	33	43	46	52	55	0	0	0
Sowing Area	Rainfall (mm)		0	25	29	18	0	21	14	0	0	0
12000	Effective Rainfall (mm)		0	0	17.8	11.39	0	13.65	9.13	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		76.1	18.9	15	31.8	46.2	38	45.4	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		119	29.53	23.4	49.7	72.2	59.5	71	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		89.6	22.24	17.6	37.4	54.4	44.8	53.5	0	0	0
12000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 12000 Ha.by Pipe (MCM)		10.7	2.668	2.12	4.49	6.52	5.37	6.42	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**10.7**	**2.668**	**2.12**	**4.49**	**6.52**	**5.37**	**6.42**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**13.415**		**6.608**		**11.894**		**6.416**		**0.000**	

Anneuxre-6.15 Contd.

Name of Crop	Particulars		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II
GRAM - N2RA	ETo		52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)		12	13	34	42	44	45	35	25
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	-30	-35	-25
	Gross Water Requirement		72	13	34	42	44	15	0	0
Sowing Area	Rainfall (mm)		0	25	29	18	0	21	14	0
4000	Effective Rainfall (mm)		0	0	17.87	11.35	0	13.39	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR) mm		72	13	16	31	44	2	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		112	20	25	48	69	3	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		85	15	19	36	52	2	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.39	0.61	0.76	1.44	2.08	0.08	0.00	0.00
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.39**	**0.61**	**0.76**	**1.44**	**2.08**	**0.08**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**4.000**		**2.203**		**2.153**		**0.000**	
	Total fornightly water req. for entire irrigated area of 25500 Ha (Mcum)	2.48 0.00 0.00 0.00 0.00 0.14 2.82 0.29	**16.09**	**4.81**	**4.13**	**7.47**	**10.71**	**5.45**	**6.42**	**0.00**
	Total Monthly water req. for entire irrigated area of 25500 Ha (Mcum)	**2.48** **0.00** **0.14** **3.11**	**20.901**		**11.599**		**16.162**		**6.416**	

KOTHA BARRAGE

ESTIMATION OF CROP WATER REQUIREMENT BY MODIFIED PENMAN METHOD

DEMAND TABLE
Year - 2004-05

Name of Crop	Particulars	JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II
SOYABEAN-2KH	ETo	94	76	65	64	70	79	78	74
	Crop factor (Kc)	0.4	0.6	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)	41	48	59	64	70	79	51	0
0	Plant Use (Pre-Sowing)	75	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	-51	0
	Gross Water Requirement	116	48	59.2	64	70	79	0	0
Sowing Area	Rainfall	31.8	117	310.6	177.4	13	26	123	0
5500	Effective Rainfall	23.6	47.9	59.15	64	8.907	18.29	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)	93	0	0	0	61.1	60.7	0	0
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm for gravity flow	182	0	0	0	120	119	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow	109	0	0	0	71.9	71.4	0	0
5500	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 5500 Ha.by Pipe (MCM)	6	0	0	0	3.95	3.93	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**6.00**	**0.00**	**0.00**	**0.00**	**3.953**	**3.929**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**6.00**		**0.00**		**7.88**		**0.00**	

Name of Crop	Particulars		OCT		NOV		DEC		JAN		FEB	
				II	I	II	I	II	I	II	I	II
WHEAT-OLV (Ordinary)	ETo		78	74	52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		24.2	31.08	41.6	48.6	45.1	44	44.9	40.9	25.5	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-40.9	-26	0
	Gross Water Requirement		84.2	31.08	42	49	45	44	45	0	0	0
Sowing Area	Rainfall (mm)		123	0	23	0	0	0	0	32	23	0
4000	Effective Rainfall (mm)		77	0	14.52	0	0	0	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		7.18	31.08	27.1	48.6	45.1	44	44.9	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		11.2	48.56	42.3	75.94	70.5	68.8	70.2	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		8.44	36.56	31.9	57.18	53.1	51.8	52.9	0	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		0.34	1.463	1.27	2.287	2.12	2.07	2.11	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**0.338**	**1.463**	**1.274**	**2.287**	**2.122**	**2.071**	**2.115**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**1.80**		**3.56**		**4.19**		**2.11**		**0.00**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB		MAR	
			I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (High yield)	ETo		52	45	41	40	42	47	51	60	76	91
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		16	18.9	33	43	46	52	55	52	38	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-52	-38	0
	Gross Water Requirement		76	19	33	43	46	52	55	0	0	0
Sowing Area	Rainfall (mm)		23	0	0	0	0	32	23	0	16	0
12000	Effective Rainfall (mm)		16.11	0	0	0	0	20.69	15.1	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		60	18.9	32.8	43.2	46.2	31	39.5	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		93.8	29.53	51.3	67.5	72.2	48.5	61.7	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		70.6	22.24	38.6	50.8	54.4	36.5	46.4	0	0	0
12000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 12000 Ha.by Pipe (MCM)		8.47	2.668	4.63	6.1	6.52	4.38	5.57	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**8.47**	**2.668**	**4.63**	**6.1**	**6.52**	**4.38**	**5.57**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**11.140**		**10.729**		**10.900**		**5.571**		**0.000**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II
GRAM - N2RA	ETo		52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)		12	13	34	42	44	45	35	25
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	-30	-35	-25
	Gross Water Requirement		72	13	34	42	44	15	0	0
Sowing Area	Rainfall (mm)		23	0	0	0	0	32	23	0
4000	Effective Rainfall (mm)		15.95	0	0	0	0	20.3	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR) mm		56	13	34	42	44	-5	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		88	20	53	66	69	-8	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		66	15	40	49	52	-6	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		2.64	0.61	1.60	1.98	2.08	-0.25	0.00	0.00
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**2.64**	**0.61**	**1.60**	**1.98**	**2.08**	**-0.25**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.250**		**3.578**		**1.828**		**0.000**	
	Total fornightly water req. for entire irrigated area of 25500 Ha (Mcum)	6.00 0.00 0.00 0.00 3.95 3.93 0.34 1.46	**12.38**	**5.57**	**8.35**	**10.15**	**10.71**	**4.13**	**5.57**	**0.00**
	Total Monthly water req. for entire irrigated area of 25500 Ha (Mcum)	**6.00** **0.00** **7.88** **1.80**	**17.951**		**18.500**		**14.843**		**5.571**	

KOTHA BARRAGE

ESTIMATION OF CROP WATER REQUIREMENT BY MODIFIED PENMAN METHOD

DEMAND TABLE
Year - 2005-06

Name of Crop	Particulars	JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II
SOYABEAN-2KH	ETo	94	76	65	64	70	79	78	74
	Crop factor (Kc)	0.4	0.6	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)	41	48	59	64	70	79	51	0
0	Plant Use (Pre-Sowing)	75	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	-51	0
	Gross Water Requirement	116	48	59.2	64	70	79	0	0
Sowing Area	Rainfall	477	101	137.8	59.6	29.8	100.6	0	29
5500	Effective Rainfall	116	47.9	59.15	39.46	20.51	64.67	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)	0	0	0	24.5	49.5	14.3	0	0
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm for gravity flow	0	0	0	48.1	97	28.1	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow	0	0	0	28.9	58.2	16.9	0	0
5500	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 5500 Ha.by Pipe (MCM)	0	0	0	1.59	3.2	0.93	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**0.00**	**0.00**	**0.00**	**1.59**	**3.202**	**0.927**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**0.00**		**1.59**		**4.13**		**0.00**	

Name of Crop	Particulars		OCT		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II	I	II
WHEAT-OLV (Ordinary)	ETo		78	74	52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		24.2	31.08	41.6	48.6	45.1	44	44.9	40.9	25.5	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-40.9	-26	0
	Gross Water Requirement		84.2	31.08	42	49	45	44	45	0	0	0
Sowing Area	Rainfall (mm)		0	29	0	28	17	0	28	0	15	0
4000	Effective Rainfall (mm)		0	17.72	0	18	10.8	0	17.81	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		84.2	13.36	41.6	30.6	34.3	44	27.1	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		132	20.88	65	47.81	53.6	68.8	42.4	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		99	15.72	48.9	36	40.3	51.8	31.9	0	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.96	0.629	1.96	1.44	1.61	2.07	1.28	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.961**	**0.629**	**1.958**	**1.440**	**1.614**	**2.071**	**1.276**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**4.59**		**3.40**		**3.68**		**1.28**		**0.00**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB		MAR	
			I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (High yield)	ETo		52	45	41	40	42	47	51	60	76	91
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		16	19	33	43	46	52	55	52	38	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-52	-38	0
	Gross Water Requirement		76	19	33	43	46	52	55	0	0	0
Sowing Area	Rainfall (mm)		0	28	17	0	28	0	15	0	0	0
12000	Effective Rainfall (mm)		0	0	10.43	0	17.88	0	9.79	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		76.1	18.9	22.4	43.2	28.3	51.7	44.8	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		119	29.53	34.9	67.5	44.3	80.8	70	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		89.6	22.24	26.3	50.8	33.3	60.8	52.7	0	0	0
12000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 12000 Ha.by Pipe (MCM)		10.7	2.668	3.16	6.1	4	7.3	6.32	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**10.7**	**2.668**	**3.16**	**6.1**	**4**	**7.3**	**6.32**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**13.415**		**9.256**		**11.297**		**6.322**		**0.000**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II
GRAM - N2RA	ETo		52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)		12	13	34	42	44	45	35	25
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	-30	-35	-25
	Gross Water Requirement		72	13	34	42	44	15	0	0
Sowing Area	Rainfall (mm)		0	28	17	0	28	0	15	0
4000	Effective Rainfall (mm)		0	0	10.47	0	17.77	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR) mm		72	13	24	42	26	15	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		112	20	37	66	41	24	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		85	15	28	49	31	18	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.39	0.61	1.11	1.98	1.24	0.71	0.00	0.00
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.39**	**0.61**	**1.11**	**1.98**	**1.24**	**0.71**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**4.000**		**3.085**		**1.947**		**0.000**	
	Total fornightly water req. for entire irrigated area of 25500 Ha (Mcum)	0.00 0.00 0.00 1.59 3.20 0.93 3.96 0.63	**16.09**	**4.72**	**5.88**	**10.15**	**6.51**	**8.01**	**6.32**	**0.00**
	Total Monthly water req. for entire irrigated area of 25500 Ha (Mcum)	**0.00** **1.59** **4.13** **4.59**	**20.813**		**16.026**		**14.520**		**6.322**	

KOTHA BARRAGE

ESTIMATION OF CROP WATER REQUIREMENT BY MODIFIED PENMAN METHOD

DEMAND TABLE
Year - 2006-07

Name of Crop	Particulars	JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II
SOYABEAN-2KH	ETo	94	76	65	64	70	79	78	74
	Crop factor (Kc)	0.4	0.6	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)	41	48	59	64	70	79	51	0
0	Plant Use (Pre-Sowing)	75	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	-51	0
	Gross Water Requirement	116	48	59.2	64	70	79	0	0
Sowing Area	Rainfall	29.6	403	245	108	181	10	0	39.4
5500	Effective Rainfall	21.9	47.9	59.15	60.11	70	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)	94	0	0	3.89	0	79	0	0
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm for gravity flow	185	0	0	7.63	0	155	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow	111	0	0	4.58	0	92.9	0	0
5500	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 5500 Ha.by Pipe (MCM)	6.1	0	0	0.25	0	5.11	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**6.11**	**0.00**	**0.00**	**0.25**	**0.000**	**5.112**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**6.11**		**0.25**		**5.11**		**0.00**	

Name of Crop	Particulars						OCT		NOV		DEC		JAN		FEB	
							I	II	I	II	I	II	I	II	I	II
WHEAT-OLV (Ordinary)	ETo						78	74	52	45	41	40	42	47	51	60
	Crop factor (Kc)						0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)						24.2	31.08	41.6	48.6	45.1	44	44.9	40.9	25.5	0
0	Plant Use (Pre-Sowing)						60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)						0	0	0	0	0	0	0	-40.9	-26	0
	Gross Water Requirement						84.2	31.08	42	49	45	44	45	0	0	0
Sowing Area	Rainfall (mm)						0	39.4	0	0	24	16	0	19	17	0
4000	Effective Rainfall (mm)						0	24.02	0	0	15.32	10.13	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)						84.2	7.056	41.6	48.6	29.8	33.9	44.9	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow						132	11.03	65	75.94	46.5	52.9	70.2	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow						99	8.301	48.9	57.18	35	39.8	52.9	0	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)						0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)						3.96	0.332	1.96	2.287	1.4	1.59	2.11	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)						**3.961**	**0.332**	**1.958**	**2.287**	**1.401**	**1.594**	**2.115**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)						**4.29**		**4.24**		**3.00**		**2.11**		**0.00**	

Anneuxre-6.15 Contd.

Name of Crop	Particulars		NOV		DEC		JAN		FEB		MAR	
			I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (High yield)	ETo		52	45	41	40	42	47	51	60	76	91
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		16	19	33	43	46	52	55	52	38	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-52	-38	0
	Gross Water Requirement		76	19	33	43	46	52	55	0	0	0
Sowing Area	Rainfall (mm)		0	0	24	16	0	19	17	0	0	0
12000	Effective Rainfall (mm)		0	0	14.76	10.11	0	12.33	11.1	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		76.1	18.9	18	33.1	46.2	39.4	43.5	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		119	29.53	28.2	51.7	72.2	61.5	67.9	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		89.6	22.24	21.2	38.9	54.4	46.3	51.1	0	0	0
12000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 12000 Ha.by Pipe (MCM)		10.7	2.668	2.55	4.67	6.52	5.56	6.13	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**10.7**	**2.668**	**2.55**	**4.67**	**6.52**	**5.56**	**6.13**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**13.415**		**7.219**		**12.080**		**6.134**		**0.000**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II
GRAM - N2RA	ETo		52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)		12	13	34	42	44	45	35	25
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	-30	-35	-25
	Gross Water Requirement		72	13	34	42	44	15	0	0
Sowing Area	Rainfall (mm)		0	0	24	16	0	19	17	0
4000	Effective Rainfall (mm)		0	0	14.81	10.07	0	12.1	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR) mm		72	13	19	32	44	3	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		112	20	30	50	69	5	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		85	15	23	38	52	3	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.39	0.61	0.90	1.50	2.08	0.14	0.00	0.00
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.39**	**0.61**	**0.90**	**1.50**	**2.08**	**0.14**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**4.000**		**2.407**		**2.214**		**0.000**	
	Total fortnightly water req. for entire irrigated area of 25500 Ha (Mcum)	6.11 0.00 0.00 0.25 0.00 5.11 3.96 0.33	**16.09**	**5.57**	**4.85**	**7.77**	**10.71**	**5.70**	**6.13**	**0.00**
	Total Monthly water req. for entire irrigated area of 25500 Ha (Mcum)	**6.11** **0.25** **5.11** **4.29**	**21.660**		**12.621**		**16.409**		**6.134**	

KOTHA BARRAGE

ESTIMATION OF CROP WATER REQUIREMENT BY MODIFIED PENMAN METHOD

DEMAND TABLE
Year - 2007-08

Name of Crop	Particulars	JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II
SOYABEAN-2KH	ETo	94	76	65	64	70	79	78	74
	Crop factor (Kc)	0.4	0.6	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)	41	48	59	64	70	79	51	0
0	Plant Use (Pre-Sowing)	75	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	-51	0
	Gross Water Requirement	116	48	59.2	64	70	79	0	0
Sowing Area	Rainfall	113	85.3	129.8	53.5	145	48.4	39	22
5500	Effective Rainfall	78.8	47.9	59.15	35.67	70	33.63	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)	38	0	0	28.3	0	45.4	0	0
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm for gravity flow	74	0	0	55.6	0	89	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow	44	0	0	33.3	0	53.4	0	0
5500	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 5500 Ha.by Pipe (MCM)	2.4	0	0	1.83	0	2.94	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**2.43**	**0.00**	**0.00**	**1.83**	**0.000**	**2.936**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**2.43**		**1.83**		**2.94**		**0.00**	

Name of Crop	Particulars		OCT		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II	I	II
WHEAT-OLV (Ordinary)	ETo		78	74	52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		24.2	31.08	41.6	48.6	45.1	44	44.9	40.9	25.5	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-40.9	-26	0
	Gross Water Requirement		84.2	31.08	42	49	45	44	45	0	0	0
Sowing Area	Rainfall (mm)		39	22	0	0	37	14	26	0	0	0
4000	Effective Rainfall (mm)		27.67	13.45	0	0	23.4	8.844	16.58	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		56.5	17.63	41.6	48.6	21.7	35.2	28.4	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		88.3	27.55	65	75.94	33.9	54.9	44.3	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		66.5	20.74	48.9	57.18	25.5	41.4	33.4	0	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		2.66	0.83	1.96	2.287	1.02	1.65	1.33	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**2.659**	**0.830**	**1.958**	**2.287**	**1.021**	**1.654**	**1.335**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.49**		**4.24**		**2.68**		**1.33**		**0.00**	

Anneuxre-6.15 Contd.

Name of Crop	Particulars		NOV		DEC		JAN		FEB		MAR	
			I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (High yield)	ETo		52	45	41	40	42	47	51	60	76	91
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		16	19	33	43	46	52	55	52	38	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-52	-38	0
	Gross Water Requirement		76	19	33	43	46	52	55	0	0	0
Sowing Area	Rainfall (mm)		0	0	37	14	26	0	0	0	0	0
12000	Effective Rainfall (mm)		0	0	22.66	8.825	16.64	0	0	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		76.1	18.9	10.1	34.4	29.6	51.7	54.6	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		119	29.53	15.8	53.7	46.2	80.8	85.3	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		89.6	22.24	11.9	40.4	34.8	60.8	64.2	0	0	0
12000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 12000 Ha.by Pipe (MCM)		10.7	2.668	1.43	4.85	4.17	7.3	7.7	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**10.7**	**2.668**	**1.43**	**4.85**	**4.17**	**7.3**	**7.7**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**13.415**		**6.284**		**11.472**		**7.704**		**0.000**	

Anneuxre-6.15 Contd.

Name of Crop	Particulars		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II
GRAM - N2RA	ETo		52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42
Sowing Area	Consumptive Use (Etc)		12	13	34	42	44	45	35	25
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	-30	-35	-25
	Gross Water Requirement		72	13	34	42	44	15	0	0
Sowing Area	Rainfall (mm)		0	0	37	14	26	0	0	0
4000	Effective Rainfall (mm)		0	0	22.74	8.797	16.54	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR) mm		72	13	11	33	28	15	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		112	20	18	52	43	24	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		85	15	13	39	32	18	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.39	0.61	0.53	1.56	1.30	0.71	0.00	0.00
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.39**	**0.61**	**0.53**	**1.56**	**1.30**	**0.71**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**4.000**		**2.094**		**2.005**		**0.000**	
	Total fornightly water req. for entire irrigated area of 25500 Ha (Mcum)	2.43 0.00 0.00 1.83 0.00 2.94 2.66 0.83	**16.09**	**5.57**	**2.98**	**8.07**	**6.81**	**8.01**	**7.70**	**0.00**
	Total Monthly water req. for entire irrigated area of 25500 Ha (Mcum)	**2.43** **1.83** **2.94** **3.49**	**21.660**		**11.054**		**14.812**		**7.704**	

KOTHA BARRAGE

ESTIMATION OF CROP WATER REQUIREMENT BY MODIFIED PENMAN METHOD

DEMAND TABLE
Year - 2008-09

Name of Crop	Particulars	JUL		AUG		SEPT		OCT	
		I	II	I	II	I	II	I	II
SOYABEAN-2KH	ETo	94	76	65	64	70	79	78	74
	Crop factor (Kc)	0.4	0.6	0.91	1.0	1.0	1.0	0.66	0
Sowing Area	Consumptive Use (Etc)	41	48	59	64	70	79	51	0
0	Plant Use (Pre-Sowing)	75	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	-51	0
	Gross Water Requirement	116	48	59.2	64	70	79	0	0
Sowing Area	Rainfall	311	114	234.3	0	77.7	90.7	12.5	0
5500	Effective Rainfall	116	47.9	59.15	0	50.57	59.07	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)	0	0	0	64	19.4	19.9	0	0
	Requirement at Canal Head With Efficiency 51 % (G I R)in mm for gravity flow	0	0	0	125	38.1	39.1	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow	0	0	0	75.3	22.9	23.4	0	0
5500	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 5500 Ha.by Pipe (MCM)	0	0	0	4.14	1.26	1.29	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**0.00**	**0.00**	**0.00**	**4.14**	**1.257**	**1.289**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 5500 Ha.(MCM)	**0.00**		**4.14**		**2.55**		**0.00**	

Name of Crop	Particulars		OCT		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II	I	II
WHEAT-OLV (Ordinary)	ETo		78	74	52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		24.2	31.08	41.6	48.6	45.1	44	44.9	40.9	25.5	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-40.9	-26	0
	Gross Water Requirement		84.2	31.08	42	49	45	44	45	0	0	0
Sowing Area	Rainfall (mm)		12.5	0	0	35	0	0	25.2	22	14	0
4000	Effective Rainfall (mm)		8.81	0	0	22.36	0	0	16.08	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		75.4	31.08	41.6	26.24	45.1	44	28.9	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		118	48.56	65	41	70.5	68.8	45.1	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		88.7	36.56	48.9	30.87	53.1	51.8	34	0	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.55	1.463	1.96	1.235	2.12	2.07	1.36	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.547**	**1.463**	**1.958**	**1.235**	**2.122**	**2.071**	**1.358**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**5.01**		**3.19**		**4.19**		**1.36**		**0.00**	

Name of Crop	Particulars		NOV		DEC		JAN		FEB		MAR	
			I	II	I	II	I	II	I	II	I	II
WHEAT-1MV (High yield)	ETo		52	45	41	40	42	47	51	60	76	91
	Crop factor (Kc)		0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	0
Sowing Area	Consumptive Use (Etc)		16	18.9	33	43	46	52	55	52	38	0
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	0	0	-52	-38	0
	Gross Water Requirement		76	19	33	43	46	52	55	0	0	0
Sowing Area	Rainfall (mm)		0	35	0	0	25.2	22	14	0	0	0
12000	Effective Rainfall (mm)		0	0	0	0	16.14	14.31	9.13	0	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR)		76.1	18.9	32.8	43.2	30.1	37.4	45.4	0	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		119	29.53	51.3	67.5	47	58.4	71	0	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		89.6	22.24	38.6	50.8	35.4	44	53.5	0	0	0
12000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0	0	0	0	0	0	0	0	0	0
Ha	Water Requirement at Canal Head for crop in sowing area of 12000 Ha.by Pipe (MCM)		10.7	2.668	4.63	6.1	4.24	5.28	6.42	0	0	0
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**10.7**	**2.668**	**4.63**	**6.1**	**4.24**	**5.28**	**6.42**	**0**	**0**	**0**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 12000 Ha.(MCM)		**13.415**		**10.729**		**9.522**		**6.416**		**0.000**	

Anneuxre-6.15 Contd.

Name of Crop	Particulars		NOV		DEC		JAN		FEB	
			I	II	I	II	I	II	I	II
GRAM - N2RA	ETo		52	45	41	40	42	47	51	60
	Crop factor (Kc)		0.23	0.29	0.83	1.05	1.05	1.0	0.68	0.42
Sowing Area	Consumptive Use (Etc)		12	13	34	42	44	45	35	25
0	Plant Use (Pre-Sowing)		60	0	0	0	0	0	0	0
Ha by gravity flow	Soil Moisture Adjust. (SMADJ)		0	0	0	0	0	-30	-35	-25
	Gross Water Requirement		72	13	34	42	44	15	0	0
Sowing Area	Rainfall (mm)		0	35	0	0	25.2	22	14	0
4000	Effective Rainfall (mm)		0	0	0	0	16.04	14.03	0	0
Ha by Pipe	Net Irrigation Requirement at Field (NIR) mm		72	13	34	42	28	1	0	0
	Requirement at Canal Head With Efficiency 64 % (G I R)in mm for gravity flow		112	20	53	66	44	2	0	0
Total sowing area =	Requirement at Canal Head With Efficiency 85 % (G I R)in mm for Pipe flow		85	15	40	49	33	1	0	0
4000	Water Requirement at Canal Head for crop in sowing area of 0 Ha.by gravity flow(MCM)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ha	Water Requirement at Canal Head for crop in sowing area of 4000 Ha.by Pipe (MCM)		3.39	0.61	1.60	1.98	1.32	0.05	0.00	0.00
	Total Fortnightly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**3.39**	**0.61**	**1.60**	**1.98**	**1.32**	**0.05**	**0.00**	**0.00**
	Total monthly Water Requirement at Canal Head for crop in sowing area of 4000 Ha.(MCM)		**4.000**		**3.578**		**1.368**		**0.000**	
	Total fornightly water req. for entire irrigated area of 25500 Ha (Mcum)	0.00 0.00 0.00 4.14 1.26 1.29 3.55 1.46	**16.09**	**4.52**	**8.35**	**10.15**	**6.92**	**5.33**	**6.42**	**0.00**
	Total Monthly water req. for entire irrigated area of 25500 Ha (Mcum)	**0.00** **4.14** **2.55** **5.01**	**20.608**		**18.500**		**12.248**		**6.416**	

Annexure-6.16

Bina Complex Irrigation and Multipurpose Project
ESTIMATION OF CROP WATER REQUIREMENT

			(Considering wholly Lined system)									
				RABI CROPS								
	CROP -		WHEAT 1 MV									
	SOWING TIME -		NOV (I st Fortnight)									
	DURATION -		135 Days									
	SOWING AREA -		50000	Ha				Efficiency	84	%		
	YEAR -		(ETO Valve of Sagar Station are Considered)									
21								(All figures are in mm)				

S.No.	Particulars	NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		Total CWR in MCM
		I st Fortnight	II nd Fortnight	I st Fortnight	II nd Fortnight	I st Fortnight	II nd Fortnight	I st Fortnight	II nd Fortnight	I st Fortnight	II nd Fortnight	
		21	22	23	24	1	2	3	4	5	6	
1	ETo	**72**	**62**	**58**	**57**	**56**	**62**	**62**	**72**	**82**	**99**	245.51
2	Crop factor (Kc)	0.31	0.42	0.8	1.08	1.1	1.1	1.07	0.87	0.5	-	
3	Consumptive Use (Etc)	22	26	46	62	62	68	66	63	41	-	
4	Plant Use (Pre-Sowing)	60	0	0	0	0	0	0	0	0	0	
5	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	0	-63	-41		
6	Gross Water Requirement	82	26	46	62	62	68	66	0	0	0	
7	Rainfall	8.51	9.12	4.93	3.05	7.1	7.07	8.05	3.78	7.27	0	
8	Effective Rainfall	0	0	0	0.0	0.0	0.0	0	0	0	0	
9	Net Irrigation Requirement at Field (NIR)	82	26	46	62	62	68	66	0	0	0	
10	Requirement at Canal Head With Efficiency 84% (G I R) By Flow	98.00	31.00	55.24	73.29	73.33	81.19	78.98	0.00	0.00	0.00	
11	Water Requirement at Canal Head for crop in sowing area of 50000 Ha. (MCM)	49.00	15.50	27.62	36.64	36.67	40.60	39.49	0.00	0.00	0.00	
12	Total Water Requirement at Canal Head for crop in sowing area of 50000 Ha. (MCM)	64.50		64.26		77.26		39.49		0.00		

	crop water required 95226 Ha CCA											
		AREA	WATER REQUIREMENT									
	WHEAT	55,226 Ha	245.51	MCM								
	GRAM N2	40,000 Ha	152.71	MCM								
	total	95226 Ha	398.22	MCM								

Bina Complex Irrigation and Multipurpose Project
ESTIMATION OF CROP WATER REQUIREMENT

(Considering wholly Lined system)

RABI CROPS

	CROP -		GRAM N2 RA									
	SOWING TIME -		NOV (I st Fortnight)									
	DURATION -		120 Days									
	SOWING AREA -		40000	Ha.				Efficiency	84	%		
	YEAR -		(ETO Valve of Sagar Station are Considered)									
								(All figures are in mm)				
S.No.	Particulars	NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		Total CWR in MCM
		Ist Fortnight	IInd Fortnight	Ist Fortnight	IInd Fortnight	Ist Fortnight	IInd Fortnight	Ist Fortnight	IInd Fortnight	Ist Fortnight	IInd Fortnight	
		21	22	23	24	1	2	3	4	5	6	
1	ETo	**72**	**62**	**58**	**57**	**56**	**62**	**62**	**72**	**82**	**99**	
2	Crop factor (Kc)	0.23	0.29	0.83	1.05	1.05	0.96	0.68	0.42	0	0	
3	Consumptive Use (Etc)	17	18	48	60	59	60	42	30	0	0	
4	Plant Use (Pre-Sowing)	60	0	0	0	0	0	0	0	0	0	
5	Soil Moisture Adjust. (SMADJ)	0	0	0	0	0	0	-42	-30	0	0	
6	Gross Water Requirement	77	18	48	60	59	60	0	0	0	0	
7	Rainfall	**8.51**	**9.12**	**4.93**	**3.05**	**7.1**	**7.07**	**8.05**	**3.75**	**0**	**0**	
8	Effective Rainfall	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
9	Net Irrigation Requirement at Field (NIR)	77	18	48	60	59	60	0	0	0	0	152.79
10	Requirement at Canal Head With Efficiency 84% (G I R) By Flow	91.14	21.40	57.31	71.25	70.00	70.86	0.00	0.00	0.00	0.00	
11	Water Requirement at Canal Head for crop in sowing area of 40000 Ha. (MCM)	36.46	8.56	22.92	28.50	28.00	28.34	0.00	0.00	0.00	0.00	
12	Total Water Requirement at Canal Head for crop in sowing area of 40000 Ha. (MCM)	45.02		51.42		56.34		0.00		0.00		

									Total water required for Rabi Irrigation		398.22	mcm
									Water required from 90% Rabi		358.40	mcm
									Deducting 20% for consumptive use		304.64	mcm
											Water Use	
									Total Storage		**419.86**	**mcm**
									Irrigation	**96000 Ha**	**324.95**	**mcm**
									Drinking Water		**57.00**	**mcm**
									Industried		**31.40**	**mcm**
									Environmental		**6.51**	**mcm**
											419.86	**mcm**

Lower Orr -Working Table
Working Table
Monthly operation simulation of Lower Orr project

Dead Storage 43.63 MCM MDDL 360.50 m Gross 371.80 MCM 380m

S.No	Year - Month	Initial Storage	Inflow	Total yield available	Monthly Demand				Monthly Draw off			Evaporation Losses	Spill	Reservoir Level at the end of month	Balance at end of month internal	Success (S) or Failure (F)	
					Irrigation Demand	Ground Conjunctive Use (20%)	Net Irrigation Demand	Drinking	Irrigation Demand	Drinking	Total						
		Mcum	Mcum	Mcum	Mcum	Mcum	8=5+7-6	Mcum	Mcum	Mcum	Mcum	Mcum	Mcum	M	Mcum	Month	Year
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
1	1979-06	43.63	0.00	43.63	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.96	0.00	360.22	41.17	S	
2	1979-07	41.17	0.00	41.17	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.31	0.00	360.01	39.36	S	
3	1979-08	39.36	32.31	71.67	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.42	0.00	363.19	69.75	S	
4	1979-09	69.75	7.42	77.17	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.85	0.00	363.65	74.82	S	
5	1979-10	74.82	0.00	74.82	38.17	7.63	30.54	0.50	30.54	0.50	31.04	1.55	0.00	360.34	42.24	S	
6	1979-11	42.24	0.17	42.41	66.25	13.25	53.00	0.50	0.00	0.50	0.50	0.97	0.00	360.19	40.94	F	
7	1979-12	40.94	0.06	40.99	77.52	15.50	62.02	0.50	0.00	0.50	0.50	0.83	0.00	360.04	39.66	F	
8	1980-01	39.66	0.00	39.66	92.68	18.54	74.14	0.50	0.00	0.50	0.50	0.89	0.00	359.87	38.27	F	
9	1980-02	38.27	0.00	38.27	98.74	19.75	78.99	0.50	0.00	0.50	0.50	0.99	0.00	359.68	36.78	F	
10	1980-03	36.78	0.00	36.78	16.17	3.23	12.94	0.50	0.00	0.50	0.50	1.37	0.00	359.44	34.91	F	
11	1980-04	34.91	0.00	34.91	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.59	0.00	359.18	32.82	S	
12	1980-05	32.82	0.00	32.82	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.82	0.00	358.86	30.50	S	F
13	1980-06	30.50	24.97	55.48	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.92	0.00	361.54	53.06	S	
14	1980-07	53.06	8.99	62.04	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.54	0.00	362.25	60.00	S	
15	1980-08	60.00	219.90	279.90	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.43	0.00	376.18	276.97	S	
16	1980-09	276.97	25.64	302.61	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.91	0.00	377.10	298.20	S	
17	1980-10	298.20	6.87	305.07	38.17	7.63	30.54	0.50	30.54	0.50	31.04	3.63	0.00	375.89	270.40	S	
18	1980-11	270.40	3.52	273.93	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.33	0.00	373.33	218.10	S	
19	1980-12	218.10	3.03	221.13	77.52	15.50	62.02	0.50	62.02	0.50	62.52	1.70	0.00	369.71	156.91	S	
20	1981-01	156.91	1.24	158.15	92.68	18.54	74.14	0.50	74.14	0.50	74.64	1.47	0.00	364.28	82.04	S	
21	1981-02	82.04	2.10	84.13	98.74	19.75	78.99	0.50	38.75	0.50	39.25	1.25	0.00	360.50	43.63	F	
22	1981-03	43.63	0.61	44.24	16.17	3.23	12.94	0.50	0.00	0.50	0.50	1.50	0.00	360.34	42.24	F	
23	1981-04	42.24	0.00	42.24	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.75	0.00	360.08	39.99	S	

24	1981-05	39.99	0.00	39.99	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.02	0.00	359.77	37.47	S	F
25	1981-06	37.47	0.00	37.47	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.82	0.00	359.47	35.15	S	
26	1981-07	35.15	75.40	110.54	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.66	0.00	366.40	108.38	S	
27	1981-08	108.38	217.46	325.84	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.85	0.00	378.10	322.49	S	
28	1981-09	322.49	64.18	386.67	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.40	9.97	380.00	371.80	S	
29	1981-10	371.80	5.63	377.43	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.19	0.00	378.88	342.20	S	
30	1981-11	342.20	4.42	346.62	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.79	0.00	376.76	290.33	S	
31	1981-12	290.33	3.82	294.15	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.11	0.00	373.93	229.53	S	
32	1982-01	229.53	1.64	231.17	92.68	18.54	74.14	0.50	74.14	0.50	74.64	1.89	0.00	369.57	154.64	S	
33	1982-02	154.64	2.68	157.31	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.65	0.00	363.77	76.17	S	
34	1982-03	76.17	0.87	77.04	16.17	3.23	12.94	0.50	12.94	0.50	13.44	1.86	0.00	362.42	61.75	S	
35	1982-04	61.75	0.00	61.75	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.09	0.00	362.17	59.16	S	
36	1982-05	59.16	0.00	59.16	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.43	0.00	361.87	56.23	S	S
37	1982-06	56.23	0.00	56.23	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.21	0.00	361.58	53.52	S	
38	1982-07	53.52	78.01	131.53	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.90	0.00	367.89	129.13	S	
39	1982-08	129.13	512.18	641.31	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.12	265.89	380.00	371.80	S	
40	1982-09	371.80	49.38	421.18	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.60	44.28	380.00	371.80	S	
41	1982-10	371.80	3.62	375.41	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.18	0.00	378.80	340.20	S	
42	1982-11	340.20	7.93	348.13	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.79	0.00	376.83	291.84	S	
43	1982-12	291.84	6.93	298.78	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.13	0.00	374.17	234.13	S	
44	1983-01	234.13	3.23	237.36	92.68	18.54	74.14	0.50	74.14	0.50	74.64	1.92	0.00	369.96	160.80	S	
45	1983-02	160.80	4.94	165.74	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.70	0.00	364.50	84.54	S	
46	1983-03	84.54	1.92	86.46	16.17	3.23	12.94	0.50	12.94	0.50	13.44	1.96	0.00	363.31	71.07	S	
47	1983-04	71.07	0.11	71.18	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.23	0.00	363.07	68.45	S	
48	1983-05	68.45	0.00	68.45	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.59	0.00	362.77	65.36	S	S
49	1983-06	65.36	0.00	65.36	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.37	0.00	362.49	62.49	S	
50	1983-07	62.49	138.62	201.11	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.17	0.00	372.24	198.44	S	
51	1983-08	198.44	272.76	471.20	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.32	95.58	380.00	371.80	S	
52	1983-09	371.80	387.78	759.58	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.60	382.68	380.00	371.80	S	
53	1983-10	371.80	41.32	413.12	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.30	5.98	380.00	371.80	S	
54	1983-11	371.80	10.40	382.20	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.98	0.00	378.23	325.72	S	
55	1983-12	325.72	9.12	334.85	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.34	0.00	375.87	269.99	S	
56	1984-01	269.99	4.35	274.34	92.68	18.54	74.14	0.50	74.14	0.50	74.64	2.14	0.00	372.19	197.55	S	
57	1984-02	197.55	6.53	204.09	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.94	0.00	367.44	122.65	S	
58	1984-03	122.65	2.65	125.31	16.17	3.23	12.94	0.50	12.94	0.50	13.44	2.42	0.00	366.48	109.45	S	
59	1984-04	109.45	0.32	109.77	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.76	0.00	366.27	106.51	S	

60	1984-05	106.51	0.00	106.51	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.22	0.00	365.99	102.79	S	S
61	1984-06	102.79	0.00	102.79	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.94	0.00	365.71	99.35	S	
62	1984-07	99.35	0.00	99.35	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.98	0.00	365.52	96.87	S	
63	1984-08	96.87	292.00	388.87	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.96	13.61	380.00	371.80	S	
64	1984-09	371.80	52.69	424.49	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.60	47.59	380.00	371.80	S	
65	1984-10	371.80	2.25	374.05	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.17	0.00	378.75	338.85	S	
66	1984-11	338.85	4.20	343.04	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.77	0.00	376.61	286.77	S	
67	1984-12	286.77	3.63	290.40	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.09	0.00	373.74	225.80	S	
68	1985-01	225.80	1.55	227.34	92.68	18.54	74.14	0.50	74.14	0.50	74.64	1.87	0.00	369.32	150.83	S	
69	1985-02	150.83	2.53	153.36	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.63	0.00	363.41	72.24	S	
70	1985-03	72.24	0.81	73.04	16.17	3.23	12.94	0.50	12.94	0.50	13.44	1.81	0.00	362.03	57.80	S	
71	1985-04	57.80	0.00	57.80	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.03	0.00	361.77	55.27	S	
72	1985-05	55.27	0.00	55.27	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.36	0.00	361.47	52.41	S	S
73	1985-06	52.41	0.00	52.41	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.14	0.00	361.19	49.77	S	
74	1985-07	49.77	36.52	86.29	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.65	0.00	364.46	84.14	S	
75	1985-08	84.14	393.79	477.93	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.90	102.73	380.00	371.80	S	
76	1985-09	371.80	244.82	616.62	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.60	239.72	380.00	371.80	S	
77	1985-10	371.80	138.32	510.12	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.30	102.98	380.00	371.80	S	
78	1985-11	371.80	10.07	381.87	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.98	0.00	378.22	325.39	S	
79	1985-12	325.39	8.82	334.21	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.34	0.00	375.84	269.35	S	
80	1986-01	269.35	4.19	273.54	92.68	18.54	74.14	0.50	74.14	0.50	74.64	2.13	0.00	372.14	196.77	S	
81	1986-02	196.77	6.32	203.09	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.94	0.00	367.37	121.65	S	
82	1986-03	121.65	2.55	124.21	16.17	3.23	12.94	0.50	12.94	0.50	13.44	2.40	0.00	366.40	108.37	S	
83	1986-04	108.37	0.29	108.66	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.75	0.00	366.18	105.41	S	
84	1986-05	105.41	0.00	105.41	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.20	0.00	365.90	101.71	S	S
85	1986-06	101.71	0.00	101.71	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.92	0.00	365.63	98.29	S	
86	1986-07	98.29	190.45	288.74	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.80	0.00	376.55	285.44	S	
87	1986-08	285.44	69.46	354.90	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.66	0.00	379.21	350.74	S	
88	1986-09	350.74	0.00	350.74	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.40	0.00	379.02	345.84	S	
89	1986-10	345.84	0.00	345.84	38.17	7.63	30.54	0.50	30.54	0.50	31.04	3.96	0.00	377.62	310.85	S	
90	1986-11	310.85	3.10	313.95	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.61	0.00	375.31	257.84	S	
91	1986-12	257.84	2.66	260.49	77.52	15.50	62.02	0.50	62.02	0.50	62.52	1.92	0.00	372.10	196.06	S	
92	1987-01	196.06	1.05	197.11	92.68	18.54	74.14	0.50	74.14	0.50	74.64	1.70	0.00	367.30	120.76	S	
93	1987-02	120.76	1.83	122.59	98.74	19.75	78.99	0.50	77.05	0.50	77.55	1.41	0.00	360.50	43.63	F	
94	1987-03	43.63	0.48	44.11	16.17	3.23	12.94	0.50	0.00	0.50	0.50	1.50	0.00	360.32	42.11	F	
95	1987-04	42.11	0.00	42.11	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.75	0.00	360.07	39.86	S	

96	1987-05	39.86	0.00	39.86	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.01	0.00	359.75	37.35	S	F
97	1987-06	37.35	0.00	37.35	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.82	0.00	359.46	35.03	S	
98	1987-07	35.03	197.86	232.89	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.14	0.00	373.97	230.25	S	
99	1987-08	230.25	304.26	534.50	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.48	158.72	380.00	371.80	S	
100	1987-09	371.80	319.39	691.18	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.60	314.29	380.00	371.80	S	
101	1987-10	371.80	49.11	420.91	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.30	13.78	380.00	371.80	S	
102	1987-11	371.80	10.78	382.58	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.98	0.00	378.24	326.10	S	
103	1987-12	326.10	9.46	335.56	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.34	0.00	375.90	270.70	S	
104	1988-01	270.70	4.52	275.22	92.68	18.54	74.14	0.50	74.14	0.50	74.64	2.14	0.00	372.24	198.43	S	
105	1988-02	198.43	6.78	205.21	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.95	0.00	367.51	123.77	S	
106	1988-03	123.77	2.77	126.53	16.17	3.23	12.94	0.50	12.94	0.50	13.44	2.43	0.00	366.57	110.67	S	
107	1988-04	110.67	0.35	111.02	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.78	0.00	366.36	107.74	S	
108	1988-05	107.74	0.00	107.74	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.25	0.00	366.08	103.99	S	S
109	1988-06	103.99	24.67	128.66	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.15	0.00	367.60	125.01	S	
110	1988-07	125.01	57.46	182.47	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.43	0.00	371.12	179.54	S	
111	1988-08	179.54	109.86	289.40	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.94	0.00	376.57	285.96	S	
112	1988-09	285.96	78.17	364.13	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.19	0.00	379.53	359.44	S	
113	1988-10	359.44	8.15	367.59	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.10	0.00	378.50	332.46	S	
114	1988-11	332.46	3.42	335.88	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.74	0.00	376.29	279.64	S	
115	1988-12	279.64	2.94	282.58	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.05	0.00	373.32	218.01	S	
116	1989-01	218.01	1.20	219.21	92.68	18.54	74.14	0.50	74.14	0.50	74.64	1.83	0.00	368.80	142.73	S	
117	1989-02	142.73	2.03	144.77	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.57	0.00	362.61	63.70	S	
118	1989-03	63.70	0.58	64.28	16.17	3.23	12.94	0.50	12.94	0.50	13.44	1.70	0.00	361.12	49.14	S	
119	1989-04	49.14	0.00	49.14	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.88	0.00	360.86	46.76	S	
120	1989-05	46.76	0.00	46.76	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.18	0.00	360.55	44.08	S	S
121	1989-06	44.08	1.30	45.39	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.99	0.00	360.42	42.90	S	
122	1989-07	42.90	0.00	42.90	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.34	0.00	360.20	41.06	S	
123	1989-08	41.06	207.69	248.74	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.18	0.00	374.75	246.06	S	
124	1989-09	246.06	102.02	348.08	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.94	0.00	378.94	343.64	S	
125	1989-10	343.64	6.68	350.32	38.17	7.63	30.54	0.50	30.54	0.50	31.04	3.97	0.00	377.81	315.31	S	
126	1989-11	315.31	3.73	319.04	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.64	0.00	375.54	262.90	S	
127	1989-12	262.90	3.22	266.12	77.52	15.50	62.02	0.50	62.02	0.50	62.52	1.95	0.00	372.42	201.65	S	
128	1990-01	201.65	1.33	202.98	92.68	18.54	74.14	0.50	74.14	0.50	74.64	1.73	0.00	367.71	126.61	S	
129	1990-02	126.61	2.23	128.84	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.45	0.00	360.99	47.90	S	
130	1990-03	47.90	0.67	48.57	16.17	3.23	12.94	0.50	2.89	0.50	3.39	1.55	0.00	360.50	43.63	F	
131	1990-04	43.63	0.00	43.63	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.78	0.00	360.24	41.35	S	

132	1990-05	41.35	0.00	41.35	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.05	0.00	359.94	38.80	S	F
133	1990-06	38.80	17.87	56.67	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.04	0.00	361.65	54.13	S	
134	1990-07	54.13	141.09	195.22	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.09	0.00	371.90	192.63	S	
135	1990-08	192.63	167.84	360.47	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.24	0.00	379.43	356.73	S	
136	1990-09	356.73	226.03	582.77	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.54	205.93	380.00	371.80	S	
137	1990-10	371.80	22.30	394.10	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.25	0.00	379.51	358.82	S	
138	1990-11	358.82	7.14	365.96	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.89	0.00	377.57	309.57	S	
139	1990-12	309.57	6.23	315.80	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.25	0.00	375.00	251.03	S	
140	1991-01	251.03	2.87	253.90	92.68	18.54	74.14	0.50	74.14	0.50	74.64	2.03	0.00	370.98	177.23	S	
141	1991-02	177.23	4.43	181.66	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.80	0.00	365.80	100.37	S	
142	1991-03	100.37	1.68	102.05	16.17	3.23	12.94	0.50	12.94	0.50	13.44	2.14	0.00	364.66	86.47	S	
143	1991-04	86.47	0.05	86.52	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.43	0.00	364.42	83.59	S	
144	1991-05	83.59	0.00	83.59	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.85	0.00	364.13	80.24	S	S
145	1991-06	80.24	0.00	80.24	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.61	0.00	363.86	77.13	S	
146	1991-07	77.13	194.07	271.21	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.63	0.00	375.78	268.08	S	
147	1991-08	268.08	294.87	562.95	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.68	186.97	380.00	371.80	S	
148	1991-09	371.80	0.00	371.80	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.58	0.00	379.81	366.72	S	
149	1991-10	366.72	0.00	366.72	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.13	0.00	378.46	331.55	S	
150	1991-11	331.55	5.98	337.54	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.74	0.00	376.37	281.30	S	
151	1991-12	281.30	5.21	286.50	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.06	0.00	373.53	221.93	S	
152	1992-01	221.93	2.35	224.28	92.68	18.54	74.14	0.50	74.14	0.50	74.64	1.85	0.00	369.13	147.78	S	
153	1992-02	147.78	3.68	151.47	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.61	0.00	363.24	70.36	S	
154	1992-03	70.36	1.34	71.70	16.17	3.23	12.94	0.50	12.94	0.50	13.44	1.79	0.00	361.90	56.47	S	
155	1992-04	56.47	0.00	56.47	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.01	0.00	361.63	53.96	S	
156	1992-05	53.96	0.00	53.96	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.33	0.00	361.33	51.13	S	S
157	1992-06	51.13	0.00	51.13	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.12	0.00	361.06	48.51	S	
158	1992-07	48.51	51.08	99.59	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.70	0.00	365.56	97.39	S	
159	1992-08	97.39	198.77	296.16	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.68	0.00	376.88	292.98	S	
160	1992-09	292.98	129.25	422.23	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.28	45.65	380.00	371.80	S	
161	1992-10	371.80	28.05	399.85	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.27	0.00	379.73	364.54	S	
162	1992-11	364.54	4.98	369.52	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.92	0.00	377.72	313.10	S	
163	1992-12	313.10	4.32	317.41	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.26	0.00	375.07	252.64	S	
164	1993-01	252.64	1.90	254.53	92.68	18.54	74.14	0.50	74.14	0.50	74.64	2.04	0.00	371.02	177.85	S	
165	1993-02	177.85	3.03	180.88	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.79	0.00	365.73	99.60	S	
166	1993-03	99.60	1.04	100.64	16.17	3.23	12.94	0.50	12.94	0.50	13.44	2.13	0.00	364.54	85.07	S	
167	1993-04	85.07	0.00	85.07	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.42	0.00	364.29	82.15	S	

168	1993-05	82.15	0.00	82.15	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.83	0.00	364.01	78.82	S	S
169	1993-06	78.82	0.00	78.82	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.59	0.00	363.73	75.73	S	
170	1993-07	75.73	0.00	75.73	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.74	0.00	363.53	73.49	S	
171	1993-08	73.49	174.29	247.78	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.36	0.00	374.70	244.92	S	
172	1993-09	244.92	533.06	777.98	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.05	401.63	380.00	371.80	S	
173	1993-10	371.80	45.32	417.12	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.30	9.98	380.00	371.80	S	
174	1993-11	371.80	9.25	381.05	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.97	0.00	378.18	324.58	S	
175	1993-12	324.58	8.10	332.68	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.33	0.00	375.77	267.83	S	
176	1994-01	267.83	3.82	271.65	92.68	18.54	74.14	0.50	74.14	0.50	74.64	2.12	0.00	372.03	194.89	S	
177	1994-02	194.89	5.79	200.68	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.92	0.00	367.20	119.27	S	
178	1994-03	119.27	2.31	121.57	16.17	3.23	12.94	0.50	12.94	0.50	13.44	2.38	0.00	366.21	105.76	S	
179	1994-04	105.76	0.22	105.98	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.71	0.00	365.99	102.77	S	
180	1994-05	102.77	0.00	102.77	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.15	0.00	365.70	99.12	S	S
181	1994-06	99.12	19.79	118.91	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.05	0.00	366.92	115.36	S	
182	1994-07	115.36	317.59	432.95	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.23	57.42	380.00	371.80	S	
183	1994-08	371.80	181.90	553.70	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.06	177.34	380.00	371.80	S	
184	1994-09	371.80	27.72	399.52	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.60	22.62	380.00	371.80	S	
185	1994-10	371.80	0.02	371.81	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.17	0.00	378.66	336.61	S	
186	1994-11	336.61	6.79	343.40	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.77	0.00	376.62	287.13	S	
187	1994-12	287.13	5.92	293.05	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.10	0.00	373.88	228.43	S	
188	1995-01	228.43	2.71	231.14	92.68	18.54	74.14	0.50	74.14	0.50	74.64	1.89	0.00	369.57	154.61	S	
189	1995-02	154.61	4.20	158.81	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.66	0.00	363.91	77.66	S	
190	1995-03	77.66	1.58	79.24	16.17	3.23	12.94	0.50	12.94	0.50	13.44	1.89	0.00	362.63	63.91	S	
191	1995-04	63.91	0.02	63.93	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.12	0.00	362.38	61.31	S	
192	1995-05	61.31	0.00	61.31	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.47	0.00	362.09	58.34	S	S
193	1995-06	58.34	0.00	58.34	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.25	0.00	361.80	55.59	S	
194	1995-07	55.59	170.91	226.50	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.25	0.00	373.63	223.75	S	
195	1995-08	223.75	329.79	553.54	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.44	177.80	380.00	371.80	S	
196	1995-09	371.80	197.74	569.54	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.60	192.64	380.00	371.80	S	
197	1995-10	371.80	15.26	387.06	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.22	0.00	379.25	351.80	S	
198	1995-11	351.80	8.82	360.62	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.86	0.00	377.35	304.26	S	
199	1995-12	304.26	7.71	311.97	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.22	0.00	374.81	247.23	S	
200	1996-01	247.23	3.63	250.86	92.68	18.54	74.14	0.50	74.14	0.50	74.64	2.01	0.00	370.79	174.21	S	
201	1996-02	174.21	5.51	179.72	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.78	0.00	365.64	98.44	S	
202	1996-03	98.44	2.18	100.62	16.17	3.23	12.94	0.50	12.94	0.50	13.44	2.12	0.00	364.54	85.07	S	
203	1996-04	85.07	0.19	85.26	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.42	0.00	364.31	82.34	S	

204	1996-05	82.34	0.00	82.34	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.83	0.00	364.03	79.01	S	S
205	1996-06	79.01	0.00	79.01	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.59	0.00	363.75	75.92	S	
206	1996-07	75.92	163.63	239.54	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.45	0.00	374.29	236.59	S	
207	1996-08	236.59	448.53	685.13	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.52	309.31	380.00	371.80	S	
208	1996-09	371.80	56.74	428.53	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.60	51.64	380.00	371.80	S	
209	1996-10	371.80	11.40	383.20	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.21	0.00	379.10	347.95	S	
210	1996-11	347.95	8.40	356.35	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.84	0.00	377.17	300.01	S	
211	1996-12	300.01	7.35	307.35	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.19	0.00	374.59	242.65	S	
212	1997-01	242.65	3.44	246.09	92.68	18.54	74.14	0.50	74.14	0.50	74.64	1.98	0.00	370.50	169.46	S	
213	1997-02	169.46	5.24	174.70	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.75	0.00	365.24	93.46	S	
214	1997-03	93.46	2.06	95.52	16.17	3.23	12.94	0.50	12.94	0.50	13.44	2.07	0.00	364.11	80.01	S	
215	1997-04	80.01	0.15	80.16	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.36	0.00	363.87	77.30	S	
216	1997-05	77.30	0.00	77.30	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.75	0.00	363.58	74.05	S	S
217	1997-06	74.05	3.21	77.27	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.54	0.00	363.59	74.23	S	
218	1997-07	74.23	67.03	141.25	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.05	0.00	368.53	138.70	S	
219	1997-08	138.70	239.85	378.55	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.15	3.11	380.00	371.80	S	
220	1997-09	371.80	209.91	581.71	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.60	204.81	380.00	371.80	S	
221	1997-10	371.80	43.92	415.72	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.30	8.59	380.00	371.80	S	
222	1997-11	371.80	6.99	378.79	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.97	0.00	378.09	322.32	S	
223	1997-12	322.32	6.10	328.42	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.31	0.00	375.57	263.60	S	
224	1998-01	263.60	2.81	266.40	92.68	18.54	74.14	0.50	74.14	0.50	74.64	2.10	0.00	371.72	189.66	S	
225	1998-02	189.66	4.33	193.99	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.88	0.00	366.72	112.62	S	
226	1998-03	112.62	1.64	114.26	16.17	3.23	12.94	0.50	12.94	0.50	13.44	2.29	0.00	365.65	98.53	S	
227	1998-04	98.53	0.04	98.57	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.59	0.00	365.40	95.48	S	
228	1998-05	95.48	0.00	95.48	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.02	0.00	365.12	91.96	S	S
229	1998-06	91.96	0.00	91.96	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.76	0.00	364.85	88.70	S	
230	1998-07	88.70	1.10	89.80	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.87	0.00	364.74	87.43	S	
231	1998-08	87.43	153.50	240.94	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.38	0.00	374.36	238.06	S	
232	1998-09	238.06	137.36	375.41	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.99	0.00	379.97	370.92	S	
233	1998-10	370.92	18.87	389.79	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.23	0.00	379.35	354.52	S	
234	1998-11	354.52	3.80	358.32	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.86	0.00	377.25	301.96	S	
235	1998-12	301.96	3.27	305.23	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.18	0.00	374.48	240.54	S	
236	1999-01	240.54	1.37	241.90	92.68	18.54	74.14	0.50	74.14	0.50	74.64	1.96	0.00	370.24	165.30	S	
237	1999-02	165.30	2.28	167.57	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.71	0.00	364.65	86.37	S	
238	1999-03	86.37	0.69	87.06	16.17	3.23	12.94	0.50	12.94	0.50	13.44	1.98	0.00	363.36	71.64	S	
239	1999-04	71.64	0.00	71.64	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.23	0.00	363.11	68.91	S	

240	1999-05	68.91	0.00	68.91	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.60	0.00	362.82	65.81	S	S
241	1999-06	65.81	0.00	65.81	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.37	0.00	362.54	62.94	S	
242	1999-07	62.94	128.59	191.53	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.13	0.00	371.68	188.90	S	
243	1999-08	188.90	101.74	290.64	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.98	0.00	376.62	287.16	S	
244	1999-09	287.16	423.76	710.92	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.25	334.37	380.00	371.80	S	
245	1999-10	371.80	40.05	411.85	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.30	4.72	380.00	371.80	S	
246	1999-11	371.80	8.57	380.37	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.97	0.00	378.16	323.90	S	
247	1999-12	323.90	7.50	331.40	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.32	0.00	375.71	266.56	S	
248	2000-01	266.56	3.52	270.08	92.68	18.54	74.14	0.50	74.14	0.50	74.64	2.11	0.00	371.94	193.33	S	
249	2000-02	193.33	5.35	198.68	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.91	0.00	367.06	117.28	S	
250	2000-03	117.28	2.11	119.39	16.17	3.23	12.94	0.50	12.94	0.50	13.44	2.35	0.00	366.05	103.60	S	
251	2000-04	103.60	0.17	103.77	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.67	0.00	365.81	100.60	S	
252	2000-05	100.60	0.00	100.60	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.12	0.00	365.52	96.98	S	S
253	2000-06	96.98	0.00	96.98	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.84	0.00	365.26	93.64	S	
254	2000-07	93.64	302.14	395.77	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.10	20.38	380.00	371.80	S	
255	2000-08	371.80	129.19	500.98	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.06	124.63	380.00	371.80	S	
256	2000-09	371.80	55.77	427.57	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.60	50.67	380.00	371.80	S	
257	2000-10	371.80	2.53	374.33	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.18	0.00	378.76	339.11	S	
258	2000-11	339.11	6.01	345.12	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.78	0.00	376.70	288.84	S	
259	2000-12	288.84	5.23	294.07	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.11	0.00	373.93	229.45	S	
260	2001-01	229.45	2.36	231.81	92.68	18.54	74.14	0.50	74.14	0.50	74.64	1.89	0.00	369.61	155.27	S	
261	2001-02	155.27	3.70	158.97	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.66	0.00	363.92	77.82	S	
262	2001-03	77.82	1.35	79.17	16.17	3.23	12.94	0.50	12.94	0.50	13.44	1.89	0.00	362.62	63.84	S	
263	2001-04	63.84	0.00	63.84	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.12	0.00	362.37	61.22	S	
264	2001-05	61.22	0.00	61.22	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.47	0.00	362.08	58.25	S	S
265	2001-06	58.25	19.38	77.63	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.41	0.00	363.64	74.72	S	
266	2001-07	74.72	163.52	238.24	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.43	0.00	374.22	235.31	S	
267	2001-08	235.31	194.38	429.69	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.51	53.88	380.00	371.80	S	
268	2001-09	371.80	44.28	416.08	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.60	39.18	380.00	371.80	S	
269	2001-10	371.80	7.65	379.45	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.19	0.00	378.96	344.22	S	
270	2001-11	344.22	5.31	349.54	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.81	0.00	376.89	293.23	S	
271	2001-12	293.23	4.61	297.84	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.13	0.00	374.12	233.19	S	
272	2002-01	233.19	2.05	235.24	92.68	18.54	74.14	0.50	74.14	0.50	74.64	1.91	0.00	369.83	158.69	S	
273	2002-02	158.69	3.25	161.94	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.68	0.00	364.18	80.77	S	
274	2002-03	80.77	1.14	81.90	16.17	3.23	12.94	0.50	12.94	0.50	13.44	1.92	0.00	362.89	66.55	S	
275	2002-04	66.55	0.00	66.55	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.16	0.00	362.63	63.89	S	

276	2002-05	63.89	0.00	63.89	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.52	0.00	362.33	60.87	S	S
277	2002-06	60.87	17.30	78.17	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.44	0.00	363.68	75.23	S	
278	2002-07	75.23	0.00	75.23	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.74	0.00	363.48	72.99	S	
279	2002-08	72.99	246.70	319.68	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.65	0.00	377.86	316.53	S	
280	2002-09	316.53	76.67	393.20	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.38	16.53	380.00	371.80	S	
281	2002-10	371.80	4.38	376.18	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.18	0.00	378.83	340.96	S	
282	2002-11	340.96	4.07	345.03	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.79	0.00	376.69	288.74	S	
283	2002-12	288.74	3.52	292.26	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.10	0.00	373.83	227.64	S	
284	2003-01	227.64	1.49	229.13	92.68	18.54	74.14	0.50	74.14	0.50	74.64	1.88	0.00	369.44	152.60	S	
285	2003-02	152.60	2.45	155.05	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.64	0.00	363.57	73.92	S	
286	2003-03	73.92	0.77	74.69	16.17	3.23	12.94	0.50	12.94	0.50	13.44	1.83	0.00	362.19	59.42	S	
287	2003-04	59.42	0.00	59.42	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.05	0.00	361.94	56.87	S	
288	2003-05	56.87	0.00	56.87	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.39	0.00	361.63	53.98	S	S
289	2003-06	53.98	4.98	58.96	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.22	0.00	361.87	56.24	S	
290	2003-07	56.24	66.94	123.18	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.88	0.00	367.31	120.80	S	
291	2003-08	120.80	221.39	342.19	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.97	0.00	378.74	338.72	S	
292	2003-09	338.72	340.75	679.47	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.46	302.71	380.00	371.80	S	
293	2003-10	371.80	28.08	399.88	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.27	0.00	379.73	364.57	S	
294	2003-11	364.57	8.23	372.80	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.93	0.00	377.85	316.37	S	
295	2003-12	316.37	7.20	323.57	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.28	0.00	375.35	258.77	S	
296	2004-01	258.77	3.37	262.14	92.68	18.54	74.14	0.50	74.14	0.50	74.64	2.07	0.00	371.47	185.42	S	
297	2004-02	185.42	5.13	190.55	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.86	0.00	366.47	109.20	S	
298	2004-03	109.20	2.01	111.21	16.17	3.23	12.94	0.50	12.94	0.50	13.44	2.25	0.00	365.41	95.52	S	
299	2004-04	95.52	0.14	95.66	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.55	0.00	365.17	92.61	S	
300	2004-05	92.61	0.00	92.61	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.97	0.00	364.89	89.14	S	S
301	2004-06	89.14	13.75	102.89	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.83	0.00	365.73	99.56	S	
302	2004-07	99.56	31.92	131.48	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.14	0.00	367.87	128.84	S	
303	2004-08	128.84	337.83	466.67	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.12	91.25	380.00	371.80	S	
304	2004-09	371.80	40.73	412.53	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.60	35.63	380.00	371.80	S	
305	2004-10	371.80	11.81	383.60	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.21	0.00	379.12	348.36	S	
306	2004-11	348.36	5.40	353.76	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.83	0.00	377.07	297.43	S	
307	2004-12	297.43	4.69	302.12	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.16	0.00	374.33	237.44	S	
308	2005-01	237.44	2.09	239.53	92.68	18.54	74.14	0.50	74.14	0.50	74.64	1.94	0.00	370.10	162.94	S	
309	2005-02	162.94	3.31	166.25	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.70	0.00	364.54	85.06	S	
310	2005-03	85.06	1.16	86.22	16.17	3.23	12.94	0.50	12.94	0.50	13.44	1.96	0.00	363.28	70.82	S	
311	2005-04	70.82	0.00	70.82	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.22	0.00	363.04	68.10	S	

312	2005-05	68.10	0.00	68.10	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.59	0.00	362.74	65.01	S	S
313	2005-06	65.01	9.28	74.30	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.44	0.00	363.33	71.36	S	
314	2005-07	71.36	280.45	351.81	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.90	0.00	379.12	348.41	S	
315	2005-08	348.41	31.64	380.05	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.97	3.78	380.00	371.80	S	
316	2005-09	371.80	112.92	484.72	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.60	107.82	380.00	371.80	S	
317	2005-10	371.80	7.65	379.45	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.19	0.00	378.96	344.23	S	
318	2005-11	344.23	5.47	349.70	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.81	0.00	376.89	293.39	S	
319	2005-12	293.39	4.76	298.14	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.13	0.00	374.13	233.50	S	
320	2006-01	233.50	2.12	235.62	92.68	18.54	74.14	0.50	74.14	0.50	74.64	1.92	0.00	369.85	159.05	S	
321	2006-02	159.05	3.35	162.41	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.68	0.00	364.22	81.24	S	
322	2006-03	81.24	1.19	82.42	16.17	3.23	12.94	0.50	12.94	0.50	13.44	1.92	0.00	362.94	67.07	S	
323	2006-04	67.07	0.00	67.07	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.17	0.00	362.68	64.40	S	
324	2006-05	64.40	0.00	64.40	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.52	0.00	362.38	61.38	S	S
325	2006-06	61.38	0.00	61.38	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.30	0.00	362.11	58.58	S	
326	2006-07	58.58	179.75	238.32	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.34	0.00	374.23	235.48	S	
327	2006-08	235.48	226.22	461.71	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.51	85.90	380.00	371.80	S	
328	2006-09	371.80	101.77	473.57	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.60	96.67	380.00	371.80	S	
329	2006-10	371.80	7.12	378.92	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.19	0.00	378.94	343.69	S	
330	2006-11	343.69	6.38	350.08	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.81	0.00	376.91	293.77	S	
331	2006-12	293.77	5.56	299.33	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.14	0.00	374.19	234.67	S	
332	2007-01	234.67	2.53	237.20	92.68	18.54	74.14	0.50	74.14	0.50	74.64	1.93	0.00	369.95	160.63	S	
333	2007-02	160.63	3.94	164.57	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.69	0.00	364.40	83.39	S	
334	2007-03	83.39	1.46	84.84	16.17	3.23	12.94	0.50	12.94	0.50	13.44	1.95	0.00	363.16	69.46	S	
335	2007-04	69.46	0.00	69.46	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.20	0.00	362.91	66.76	S	
336	2007-05	66.76	0.00	66.76	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.56	0.00	362.61	63.70	S	S
337	2007-06	63.70	7.87	71.57	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.40	0.00	363.09	68.67	S	
338	2007-07	68.67	29.62	98.28	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.82	0.00	365.44	95.96	S	
339	2007-08	95.96	106.06	202.02	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.22	0.00	372.28	199.30	S	
340	2007-09	199.30	134.97	334.28	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.60	0.00	378.40	330.18	S	
341	2007-10	330.18	9.63	339.81	38.17	7.63	30.54	0.50	30.54	0.50	31.04	3.88	0.00	377.38	304.89	S	
342	2007-11	304.89	3.55	308.44	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.58	0.00	375.06	252.36	S	
343	2007-12	252.36	3.05	255.40	77.52	15.50	62.02	0.50	62.02	0.50	62.52	1.89	0.00	371.80	191.00	S	
344	2008-01	191.00	1.25	192.25	92.68	18.54	74.14	0.50	74.14	0.50	74.64	1.67	0.00	366.96	115.93	S	
345	2008-02	115.93	2.11	118.05	98.74	19.75	78.99	0.50	72.53	0.50	73.03	1.39	0.00	360.50	43.63	F	
346	2008-03	43.63	0.61	44.24	16.17	3.23	12.94	0.50	0.00	0.50	0.50	1.50	0.00	360.34	42.24	F	
347	2008-04	42.24	0.00	42.24	0.00	0.00	0.00	0.50	0.00	0.50	0.50	1.75	0.00	360.08	39.99	S	

348	2008-05	39.99	0.00	39.99	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.02	0.00	359.77	37.47	S	F
349	2008-06	37.47	112.36	149.83	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.68	0.00	369.06	146.65	S	
350	2008-07	146.65	58.39	205.04	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.59	0.00	372.43	201.95	S	
351	2008-08	201.95	157.21	359.16	0.00	0.00	0.00	0.50	0.00	0.50	0.50	3.28	0.00	379.38	355.38	S	
352	2008-09	355.38	58.21	413.60	0.00	0.00	0.00	0.50	0.00	0.50	0.50	4.53	36.77	380.00	371.80	S	
353	2008-10	371.80	11.22	383.02	38.17	7.63	30.54	0.50	30.54	0.50	31.04	4.21	0.00	379.10	347.77	S	
354	2008-11	347.77	4.91	352.68	66.25	13.25	53.00	0.50	53.00	0.50	53.50	2.82	0.00	377.02	296.36	S	
355	2008-12	296.36	4.26	300.63	77.52	15.50	62.02	0.50	62.02	0.50	62.52	2.15	0.00	374.26	235.96	S	
356	2009-01	235.96	1.87	237.83	92.68	18.54	74.14	0.50	74.14	0.50	74.64	1.93	0.00	369.99	161.25	S	
357	2009-02	161.25	2.99	164.25	98.74	19.75	78.99	0.50	78.99	0.50	79.49	1.69	0.00	364.37	83.07	S	
358	2009-03	83.07	1.02	84.09	16.17	3.23	12.94	0.50	12.94	0.50	13.44	1.94	0.00	363.09	68.71	S	
359	2009-04	68.71	0.00	68.71	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.19	0.00	362.84	66.02	S	
360	2009-05	66.02	0.00	66.02	0.00	0.00	0.00	0.50	0.00	0.50	0.50	2.55	0.00	362.54	62.97	S	S

No of Failure Year (If any month fails) 5

Annual Reliablity of Lower Orr Project 83.33 %

Annexure-6.18

KOTHA BARRAGE MAJOR PROJECT
WORKING TABLE
YEAR 1990-91

2

L.S.L. 384.5 CAPACITY 0.605 Mcum
FRL 395 CAPACITY 63.51 Mcum

(All figures are in Mcum)

S.N.	Month	Initial Capacity (MCM)	Inflow (MCM)	Total	Irrigation Demand (MCM)	Irrigation Supply (MCM)	Evaporation Losses (MCM)	Env. Releases (MCM)	Spill (MCM)	Irrig Supply + Evap Losses + Env.Releases (MCM)	Final Capacity (MCM)	Shortage (MCM)	Shortage in %	Level at final capacity (MCM)	Remark	Success/ Failure
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
				(3+4)						(7+8+9)	(5-12-11)	(6-7)	(13/6 x100)			
1	June	0.507	90.168	90.675	0	0.000	3.316	0.208	23.64	3.524	63.510	0.000	0	395.000	FRL	Success
2	July	63.510	405.216	468.726	0.000	0.000	2.310	0.208	402.70	2.518	63.510	0.000	0	395.000	FRL	Success
3	August	63.510	1196.210	1259.720	0.000	0.000	1.753	0.208	1194.25	1.961	63.510	0.000	0	395.000	FRL	Success
4	Sept.	63.510	652.417	715.927	1.790	1.790	2.025	0.208	648.39	4.024	63.510	0.000	0	395.000	FRL	Success
5	Oct.	63.510	61.085	124.595	8.816	8.816	2.066	0.208	50.00	11.090	63.510	0.000	0	395.000	FRL	Success
6	Nov.	63.510	23.770	87.280	25.347	25.347	1.318	0.208	0.000	26.873	60.407	0.000	0	392.767		Success
7	Dec.	60.407	19.032	79.439	19.374	19.374	0.698	0.208	0.000	20.280	59.158	0.000	0	390.487		Success
8	Jan	59.158	6.402	65.560	21.455	21.455	0.568	0.208	0.000	22.231	43.330	0.000	0	387.784		Success
9	Feb.	43.330	8.913	52.243	22.071	22.071	0.430	0.208	0.000	22.710	29.533	0.000	0	384.919		Success
10	March	29.533	2.825	32.358	10.78125	10.781	1.002	0.208	0.000	11.992	20.366	0.000	0	383.520		Success
11	April	20.366	0.029	20.395	0	0.000	1.278	0.208	0.000	1.486	18.909	0.000	0	383.520		Success
12	May	18.909	0.000	18.909	0	0.000	1.524	0.208	0.000	1.732	17.177	0.000	0	383.520		Success
		Total	2466.067		109.634	109.634	18.288	2.500	2258.026			0	0			

(Mazhar Khan)
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Chief Engineer
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Bhopal

Annexure-6.18 Contd.

KOTHA BARRAGE MAJOR PROJECT
WORKING TABLE
YEAR 1992-93

4

L.S.L. 384.5
FRL 395

CAPACITY 0.605 Mcum
CAPACITY 63.51 Mcum

(All figures are in Mcum)

S.N.	Month	Initial Capacity (MCM)	inflow (MCM)	Total	Irrigation Demand (MCM)	Irrigation Supply (MCM)	Evaporation Losses (MCM)	Env. Releases (MCM)	Spill (MCM)	Irrig Supply + Evap Losses + Env.Releases (MCM)	Final Capacity (MCM)	Shortage (MCM)	Shortage in %	Level at final capacity (MCM)	Remark	Success/ Failure
1	2	3	4	5	6	7	8	10	11	11	12	14	15	16	17	
				(3+4)						(7+8+9)	(5-12-11)	(6-7)	(14/6 x100)			
1	June	0.000	0.000	0.000	0	0.000	0.000	0.208	0	0.208	0.000	0.000	0	383.520		Success
2	July	0.000	362.629	362.629	0.000	0.000	2.510	0.208	296.6007	2.518	63.510	0.000	0	395.000	FRL	Success
3	August	63.510	1216.231	1279.741	0.000	0.000	1.753	0.208	1214.27	1.961	63.510	0.000	0	395.000	FRL	Success
4	Sept.	63.510	358.088	421.598	1.79	1.790	2.025	0.208	354.0645	4.023	63.510	0.000	0	395.000	FRL	Success
5	Oct.	63.510	26.408	89.918	8.816	8.816	2.066	0.208	15.31837	11.090	63.510	0.000	0	395.000	FRL	Success
6	Nov.	63.510	20.365	83.875	25.347	25.347	1.318	0.208	0	26.873	57.002	0.000	0	393.277		Success
7	Dec.	57.002	15.635	72.637	19.374	19.374	0.758	0.208	0	20.341	52.296	0.000	0	390.726		Success
8	Jan	52.296	6.105	58.401	21.455	21.455	0.584	0.208	0	22.248	36.153	0.000	0	387.220		Success
9	Feb.	36.153	7.015	43.168	22.071	22.071	0.363	0.208	0	22.642	20.526	0.000	0	383.520		Success
10	March	20.526	2.760	23.286	10.781	10.781	0.857	0.208	0	11.847	11.440	0.000	0	383.520		Success
11	April	11.440	0.080	11.520	0	0.000	1.093	0.208	0	1.301	10.218	0.000	0	383.520		Success
12	May	10.218	0.019	10.237	0	0.000	1.040	0.208	0	1.248	8.989	0.000	0	383.520		Success
		Total	2015.335		109.634	109.634	14.167	2.500	1820.083			0	0			

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KOTHA BARRAGE MAJOR PROJECT
WORKING TABLE
YEAR 1993-94

5

L.S.L. 384.5
FRL 395

CAPACITY 0.605 Mcum
CAPACITY 63.51 Mcum

(All figures are in Mcum)

S.N.	Month	Initial Capacity (MCM)	Inflow (MCM)	Total	Irrigation Demand (MCM)	Irrigation Supply (MCM)	Evaporation Losses (MCM)	Env. Releases (MCM)	Spill (MCM)	Irrig Supply + Evap Losses + Env.Releases (MCM)	Final Capacity (MCM)	Shortage (MCM)	Shortage in %	Level at final capacity (MCM)	Remark	Success/ Failure
1	2	3	4	5	6	7	8	10	11	11	12	14	15	16	17	
				(3+4)						(7+8+9)	(5-12-11)	(6-7)	(14/6 x100)			
1	June	8.99	4.879	13.87	0.00	0.00	1.25	0.21	0.00	1.46	12.41	0.00	0.00	383.52		Success
2	July	12.41	344.132	356.54	0.00	0.00	2.31	0.21	290.51	2.52	63.51	0.00	0.00	395.00	FRL	Success
3	August	63.51	1053.10	1116.61	0.00	0.00	1.75	0.21	1051.14	1.96	63.51	0.00	0.00	395.00	FRL	Success
4	Sept.	63.51	1811.23	1874.74	1.79	1.79	2.03	0.21	1807.21	4.02	63.51	0.00	0.00	395.00	FRL	Success
5	Oct.	63.51	163.94	227.45	8.82	8.82	2.07	0.21	152.85	11.09	63.51	0.00	0.00	395.00	FRL	Success
6	Nov.	63.51	30.64	94.15	25.35	25.35	1.32	0.21	3.77	26.87	63.51	0.00	0.00	392.77		Success
7	Dec.	63.51	25.09	88.60	19.37	19.37	0.70	0.21	0.00	20.28	68.32	0.00	0.00	391.08		Success
8	Jan	68.32	9.62	77.94	21.45	21.45	0.61	0.21	0.00	22.27	55.67	0.00	0.00	387.87		Success
9	Feb.	55.67	13.51	69.18	22.07	22.07	0.44	0.21	0.00	22.72	46.46	0.00	0.00	385.10		Success
10	March	46.46	4.41	50.87	10.78	10.78	0.32	0.21	0.00	11.31	39.56	0.00	0.00	384.13		Success
11	April	39.56	0.43	39.99	0.00	0.00	0.17	0.21	0.00	0.38	39.61	0.00	0.00	383.52		Success
12	May	39.61	0.13	39.74	0.00	0.00	0.00	0.21	0.00	0.21	39.83	0.00	0.00	383.52		Success
		Total	3460.996		109.634	109.634	12.970	2.500	3240.422			0	0			

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6

KOTHA BARRAGE MAJOR PROJECT
WORKING TABLE
YEAR 1994-95

L.S.L 384.5
FRL 395

CAPACITY 0.605 Mcum
CAPACITY 63.51 Mcum

(All figures are in Mcum)

S.N.	Month	Initial Capacity (MCM)	Inflow (MCM)	Total	Irrigation Demand (MCM)	Irrigation Supply (MCM)	Evaporation Losses (MCM)	Env. Releases (MCM)	Spill (MCM)	Irrig Supply + Evap Losses + Env.Releases (MCM)	Final Capacity (MCM)	Shortage (MCM)	Shortage in %	Level at final capacity (MCM)	Remark	Success/ Failure
1	2	3	4	5	6	7	8	10	11	11	12	14	15	16	17	
				(3+4)						(7+8+9)	(5-12-11)	(6-7)	(14/6 x100)			
1	June	39.527	175.426	214.953	0.000	0.000	3.316	0.208	147.919	3.524	63.510	0.000	0	395.00	FRL	Success
2	July	63.510	741.085	804.595	0.000	0.000	2.310	0.208	738.5667	2.518	63.510	0.000	0	395.00	FRL	Success
3	August	63.510	1776.831	1840.341	0.000	0.000	1.753	0.208	1774.87	1.961	63.510	0.000	0	395.00	FRL	Success
4	Sept.	63.510	413.890	477.400	1.790	1.790	2.025	0.208	409.8665	4.024	63.510	0.000	0	395.00	FRL	Success
5	Oct.	63.510	18.881	82.391	8.816	8.816	2.066	0.208	7.79137	11.090	63.510	0.000	0	395.00	FRL	Success
6	Nov.	63.510	28.862	92.372	25.347	25.347	1.318	0.208	1.988595	26.873	63.510	0.000	0	395.00	FRL	Success
7	Dec.	63.510	23.641	87.151	19.374	19.374	0.698	0.208	0	20.280	66.871	0.000	0	392.77		Success
8	Jan	66.871	8.490	75.361	21.455	21.455	0.535	0.208	0	22.198	53.163	0.000	0	390.01		Success
9	Feb.	53.163	11.909	65.072	22.071	22.071	0.000	0.208	0	22.279	42.793	0.000	0	383.52		Success
10	March	42.793	3.727	46.520	10.781	10.781	0.000	0.208	0	10.990	35.530	0.000	0	383.52		Success
11	April	35.530	0.256	35.786	0.000	0.000	0.000	0.208	0	0.208	35.578	0.000	0	383.52		Success
12	May	35.578	0.043	35.621	0.000	0.000	0.000	0.208	0	0.209	35.413	0.000	0	383.52		Success
		Total	3203.041		109.634	109.634	14.020	2.500	2987.787				0			

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7

KOTHA BARRAGE MAJOR PROJECT
WORKING TABLE
YEAR 1995-96

L.S.L 384.5 CAPACITY 0.605 Mcum
FRL 395 CAPACITY 63.51 Mcum

(All figures are in Mcum)

S.N.	Month	Initial Capacity (MCM)	Inflow (MCM)	Total	Irrigation Demand (MCM)	Irrigation Supply (MCM)	Evaporation Losses (MCM)	Env. Releases (MCM)	Spill (MCM)	Irrig Supply + Evap Losses + Env.Releases (MCM)	Final Capacity (MCM)	Shortage (MCM)	Shortage in %	Level at final capacity (MCM)	Remark	Success/ Failure
1	2	3	4	5	6	7	8	10	11	11	12	14	15	16	17	
				(3+4)						(7+8+9)	(5-12-11)	(6-7)	(14/6 x100)			
1	June	35.413	0.000	35.413	0.00	0.000	0.000	0.208	0	0.208	35.204	0.000	0	383.520		Success
2	July	35.204	555.779	590.983	0.00	0.000	2.310	0.208	524.9552	2.518	63.510	0.000	0	395.000	FRL	Success
3	August	63.510	835.915	899.425	0.00	0.000	1.753	0.208	833.9537	1.961	63.510	0.000	0	395.000	FRL	Success
4	Sept.	63.510	527.869	591.379	1.79	1.790	2.025	0.208	523.8455	4.024	63.510	0.000	0	395.000	FRL	Success
5	Oct.	63.510	64.861	128.371	8.82	8.816	2.066	0.208	53.77137	11.090	63.510	0.000	0	395.000	FRL	Success
6	Nov.	63.510	20.434	83.944	25.35	25.347	1.318	0.208	0	26.873	57.071	0.000	0	392.767		Success
7	Dec.	57.071	15.696	72.767	19.37	19.374	0.698	0.208	0	20.280	52.486	0.000	0	391.263		Success
8	Jan	52.486	6.504	58.990	21.45	21.455	0.628	0.208	0	22.291	36.699	0.000	0	388.115		Success
9	Feb.	36.699	7.585	44.284	22.07	22.071	0.469	0.208	0	22.749	21.536	0.000	0	385.609		Success
10	March	21.536	3.023	24.559	10.78	10.781	0.352	0.208	0	11.342	13.217	0.000	0	385.036		Success
11	April	13.217	0.151	13.368	0.00	0.000	0.405	0.208	0	0.614	12.754	0.000	0	384.005		Success
12	May	12.754	0.090	12.844	0.00	0.000	0.149	0.208	0	0.357	12.487	0.000	0	383.520		Success
		Total	2037.907		109.634	109.634	12.173	2.500	1841.219			0	0			

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8

KOTHA BARRAGE MAJOR PROJECT
WORKING TABLE
YEAR 1996-97

L.S.L. 384.5
FRL 395

CAPACITY 0.605 Mcum
CAPACITY 63.51 Mcum

(All figures are in Mcum)

S.N.	Month	Initial Capacity (MCM)	Inflow (MCM)	Total	Irrigation Demand (MCM)	Irrigation Supply (MCM)	Evaporation Losses (MCM)	Env. Releases (MCM)	Spill (MCM)	Irrig Supply + Evap Losses + Env.Releases (MCM)	Final Capacity (MCM)	Shortage (MCM)	Shortage in %	Level at final capacity (MCM)	Remark	Success/ Failure
1	2	3	4	5	6	7	8	10	11	11	12	14	15	16	17	
				(3+4)						(7+8+9)	(5-12-11)	(6-7)	(14/6 x100)			
1	June	12.487	0.000	12.487	0.000	0.000	0.000	0.208	0	0.208	12.279	0.000	0	383.520		Success
2	July	12.279	1142.008	1154.287	0.000	0.000	2.310	0.208	1088.259	2.518	63.510	0.000	0	395.000	FRL	Success
3	August	63.510	1855.448	1918.958	0.000	0.000	1.753	0.208	1853.487	1.961	63.510	0.000	0	395.000	FRL	Success
4	Sept.	63.510	565.827	629.337	1.790	1.790	2.025	0.208	561.8035	4.024	63.510	0.000	0	395.000	FRL	Success
5	Oct.	63.510	108.000	171.510	8.816	8.816	2.066	0.208	96.91037	11.090	63.510	0.000	0	395.000	FRL	Success
6	Nov.	63.510	33.803	97.313	25.347	25.347	1.318	0.208	0	26.873	63.510	0.000	0	393.329		Success
7	Dec.	63.510	28.081	91.591	19.374	19.374	0.766	0.208	0	20.349	63.510	0.000	0	392.011		Success
8	Jan	63.510	10.582	74.092	21.455	21.455	0.698	0.208	0	22.361	51.731	0.000	0	388.822		Success
9	Feb.	51.731	15.232	66.963	22.071	22.071	0.649	0.208	0	22.928	44.035	0.000	0	388.299		Success
10	March	44.035	4.076	48.111	10.781	10.781	0.737	0.208	0	11.727	36.384	0.000	0	387.948		Success
11	April	36.384	0.332	36.716	0.000	0.000	0.863	0.208	0	1.071	35.645	0.000	0	387.469		Success
12	May	35.645	0.080	35.725	0	0.000	0.898	0.208	0	1.107	34.618	0.000	0	386.971		Success
		Total	3763.469		109.634	109.634	14.083	2.500	3525.323			0	0	0		

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Chief Engineer
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9

KOTHA BARRAGE MAJOR PROJECT
WORKING TABLE
YEAR 1997-98

L.S.L. 384.5 CAPACITY 0.605 Mcum
FRL 395 CAPACITY 63.51 Mcum

(All figures are in Mcum)

S.N.	Month	Initial Capacity (MCM)	Inflow (MCM)	Total	Irrigation Demand (MCM)	Irrigation Supply (MCM)	Evaporation Losses (MCM)	Env. Releases (MCM)	Spill (MCM)	Irrig Supply + Evap Losses + Env. Releases (MCM)	Final Capacity (MCM)	Shortage (MCM)	Shortage in %	Level at final capacity (MCM)	Remark	Success/ Failure
1	2	3	4	5	6	7	8	10	11	11	12	14	15	16	17	
				(3+4)						(7+8+9)	(5-12-11)	(6-7)	(14/6 x100)			
1	June	34.618	0.339	34.957	0.000	0.000	0.752	0.208	0	0.961	33.996	0.000	0	386.464		Success
2	July	33.996	737.300	771.296	0.000	0.000	2.310	0.208	705.2679	2.519	63.510	0.000	0	395.000	FRL	Success
3	August	63.510	984.027	1047.537	0.000	0.000	1.753	0.208	982.0656	1.961	63.510	0.000	0	395.000	FRL	Success
4	Sept.	63.510	411.274	474.784	1.790	1.790	2.025	0.208	407.2505	4.023	63.510	0.000	0	395.000	FRL	Success
5	Oct.	63.510	112.793	176.303	8.816	8.816	2.066	0.208	101.7034	11.090	63.510	0.000	0	395.000	FRL	Success
6	Nov.	63.510	22.294	85.804	25.347	25.347	1.318	0.208	0	26.873	58.931	0.000	0	392.897		Success
7	Dec.	58.931	17.344	76.275	19.374	19.374	0.708	0.208	0	20.291	55.984	0.000	0	391.424		Success
8	Jan	55.984	6.326	62.310	21.455	21.455	0.643	0.208	0	22.306	40.004	0.000	0	387.845		Success
9	Feb.	40.004	8.299	48.303	22.071	22.071	0.438	0.208	0	22.717	25.586	0.000	0	383.520		Success
10	March	25.586	2.906	28.492	10.781	10.781	1.002	0.208	0	11.992	16.500	0.000	0	383.520		Success
11	April	16.500	0.093	16.593	0.000	0.000	1.278	0.208	0	1.486	15.107	0.000	0	383.520		Success
12	May	15.107	0.000	15.107	0	0.000	1.524	0.208	0	1.732	13.375	0.000	0	383.520		Success
		Total	2302.995		109.634	109.634	15.817	2.500	2104.821			0	0			

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10

KOTHA BARRAGE MAJOR PROJECT
WORKING TABLE
YEAR 1998-99

L.S.L. 384.5
FRL 395

CAPACITY 0.605 Mcum
CAPACITY 63.51 Mcum

(All figures are in Mcum)

S.N.	Month	Initial Capacity (MCM)	Inflow (MCM)	Total	Irrigation Demand (MCM)	Irrigation Supply (MCM)	Evaporation Losses (MCM)	Env. Releases (MCM)	Spill (MCM)	Irrig Supply + Evap Losses + Env.Releases (MCM)	Final Capacity (MCM)	Shortage (MCM)	Shortage in %	Level at final capacity (MCM)	Remark	Success/ Failure
1	2	3	4	5	6	7	8	10	11	11	12	14	15	16	17	
				(3+4)						(7+8+9)	(5-12-11)	(6-7)	(14/6 x100)			
1	June	13.375	28.313	41.688	0.000	0.000	1.488	0.208	0	1.697	39.991	0.000	0	389.729		Success
2	July	39.991	601.901	641.892	0.000	0.000	2.310	0.208	575.8634	2.519	63.510	0.000	0	395.000	FRL	Success
3	August	63.510	616.431	679.941	0.000	0.000	1.753	0.208	614.4696	1.961	63.510	0.000	0	395.000	FRL	Success
4	Sept.	63.510	853.057	916.567	1.790	1.790	2.025	0.208	849.0335	4.023	63.510	0.000	0	395.000	FRL	Success
5	Oct.	63.510	79.057	142.567	8.816	8.816	2.066	0.208	67.96737	11.090	63.510	0.000	0	395.000	FRL	Success
6	Nov.	63.510	21.609	85.119	25.347	25.347	1.318	0.208	0	26.873	58.246	0.000	0	393.377		Success
7	Dec.	58.246	16.987	75.233	19.374	19.374	0.773	0.208	0	20.356	54.877	0.000	0	391.640		Success
8	Jan	54.877	6.120	60.997	21.455	21.455	0.663	0.208	0	22.326	38.670	0.000	0	388.219		Success
9	Feb.	38.670	7.499	46.169	22.071	22.071	0.481	0.208	0	22.760	23.409	0.000	0	385.121		Success
10	March	23.409	2.770	26.179	10.781	10.781	0.323	0.208	0	11.312	14.867	0.000	0	384.226		Success
11	April	14.867	0.057	14.924	0.000	0.000	0.187	0.208	0	0.395	14.529	0.000	0	383.520		Success
12	May	14.529	0.000	14.529	0.000	0.000	0.000	0.208	0	0.208	14.320	0.000	0	383.520		Success
		Total	2233.801		109.634	109.634	13.383	2.500	2020.762			0.00	0.00			

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KOTHA BARRAGE MAJOR PROJECT
WORKING TABLE
YEAR 1999-2000

11

L.S.L. 384.5
FRL 395

CAPACITY 0.605 Mcum
CAPACITY 63.51 Mcum

(All figures are in Mcum)

S.N.	Month	Initial Capacity (MCM)	Inflow (MCM)	Total	Irrigation Demand (MCM)	Irrigation Supply (MCM)	Evaporation Losses (MCM)	Env. Releases (MCM)	Spill (MCM)	Irrig Supply + Evap Losses + Env.Releases (MCM)	Final Capacity (MCM)	Shortage (MCM)	Shortage in %	Level at final capacity (MCM)	Remark	Success/ Failure
1	2	3	4	5	6	7	8	10	11	11	12	14	15	16	17	
				(3+4)						(7+8+9)	(5-12-11)	(6-7)	(14/6 x100)			
1	June	14.320	13.034	27.354	0	0.000	0.573	0.208	0	0.781	26.573	0.000	0	385.479		Success
2	July	26.573	722.350	748.923	0	0.000	2.310	0.208	682.8948	2.519	63.510	0.000	0	395.000	FRL	Success
3	August	63.510	848.714	912.224	0	0.000	1.753	0.208	846.7526	1.961	63.510	0.000	0	395.000	FRL	Success
4	Sept.	63.510	2553.803	2617.313	1.79	1.790	2.025	0.208	2549.78	4.023	63.510	0.000	0	395.000	FRL	Success
5	Oct.	63.510	362.025	425.535	8.816	8.816	2.066	0.208	350.9354	11.090	63.510	0.000	0	395.000	FRL	Success
6	Nov.	63.510	42.326	105.836	25.347	25.347	1.318	0.208	15.4526	26.873	63.510	0.000	0	392.757		Success
7	Dec.	63.510	35.874	99.384	19.374	19.374	0.698	0.208	15.5939	20.280	63.510	0.000	0	390.007		Success
8	Jan	63.510	13.864	77.374	21.455	21.455	0.535	0.208	0	22.198	55.176	0.000	0	383.520		Success
9	Feb.	55.176	21.706	76.882	22.071	22.071	0.753	0.208	0	23.032	53.850	0.000	100	383.520		Success
10	March	53.850	4.276	58.126	10.781	10.781	1.002	0.208	0	11.992	46.135	0.000	0	383.520		Success
11	April	46.135	0.384	46.519	0	0.000	0.875	0.208	0	1.083	45.435	0.000	0	383.520		Success
12	May	45.435	0.104	45.539	0	0.000	0.000	0.208	0	0.208	45.331	0.000	0	383.520		Success
		Total	4618.356		109.634	109.634	13.907	2.500	4347.213				10.56			

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KOTHA BARRAGE MAJOR PROJECT
WORKING TABLE
YEAR 2000-01

12

L.S.L 384.5 CAPACITY 0.605 Mcum
FRL 395 CAPACITY 63.51 Mcum

(All figures are in Mcum)

S.N.	Month	Initial Capacity (MCM)	Inflow (MCM)	Total	Irrigation Demand (MCM)	Irrigation Supply (MCM)	Evaporation Losses (MCM)	Env. Releases (MCM)	Spill (MCM)	Irrig Supply + Evap Losses + Env.Releases (MCM)	Final Capacity (MCM)	Shortage (MCM)	Shortage in %	Level at final capacity (MCM)	Remark	Success/ Failure
1	2	3	4	5	6	7	8	10	11	11	12	14	15	16	17	
				(3+4)						(7+8+9)	(5-12-11)	(6-7)	(14/6 x100)			
1	June	45.331	6.115	51.446	0.000	0.000	1.003	0.208	0	1.211	63.510	0.000	0	386.884		Success
2	July	63.510	1276.932	1340.442	0.000	0.000	2.310	0.208	1274.414	2.518	63.510	0.000	0	395.000	FRL	Success
3	August	63.510	366.449	429.959	0.000	0.000	1.753	0.208	364.4877	1.961	63.510	0.000	0	395.000	FRL	Success
4	Sept.	63.510	42.236	105.746	1.790	1.790	2.025	0.208	0	4.024	63.510	0.000	0	395.000	FRL	Success
5	Oct.	63.510	1.951	65.461	8.816	8.816	2.066	0.208	0	11.090	54.371	0.000	0	394.460		Success
6	Nov.	54.371	13.902	68.273	25.347	25.347	1.167	0.208	0	26.722	41.551	0.000	0	392.001		Success
7	Dec.	41.551	12.105	53.656	19.374	19.374	0.634	0.208	0	20.217	33.440	0.000	0	388.844		Success
8	Jan	33.440	6.559	39.999	21.455	21.455	0.442	0.208	0	22.105	17.893	0.000		383.520		Success
9	Feb.	17.893	7.663	25.556	22.071	22.071	0.666	0.208	0	22.945	2.611	0.000		383.520		Success
10	March	2.611	2.777	5.388	10.781	3.889	0.685	0.208	0	4.783	0.605	6.892		383.520		Fail
11	April	0.605	0.185	0.790	0.000	0.000	0.000	0.208	0	0.208	0.582	0.000		383.520		Success
12	May	0.582	0.009	0.591	0.000	0.000	0.000	0.208	0	0.208	0.382	0.000		383.520		Success
		Total	1736.883		109.634	102.742	12.751	2.500	1551.805			0				

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KOTHA BARRAGE MAJOR PROJECT
WORKING TABLE
YEAR 2001-02

13

Annexure-6.18 Contd.

L.S.L. 384.5
FRL 395

CAPACITY 0.605 Mcum
CAPACITY 63.51 Mcum

(All figures are in Mcum)

S.N.	Month	Initial Capacity (MCM)	Inflow (MCM)	Total	Irrigation Demand (MCM)	Irrigation Supply (MCM)	Evaporation losses (MCM)	Env. Releases (MCM)	Spill (MCM)	Irrig.Supply + Evap Losses + Env.Releases (MCM)	Final Capacity (MCM)	Shortage (MCM)	Shortage in %	Level at final capacity (MCM)	Remark	Success/ Failure
1	2	3	4	5	6	7	8	10	11	11	12	14	15	16	17	
				(3+4)						(7+8+9)	(5-12-11)	(6-7)	(14/6 x100)			
1	June	0.382	75.578	75.960	0.000	0.000	2.611	0.208	0	2.819	73.141	0.000	0	394.061		Success
2	July	73.141	435.751	508.892	0.000	0.000	2.310	0.208	442.8638	2.518	63.510	0.000	0	395.000	FRL	Success
3	August	63.510	774.597	838.107	0.000	0.000	1.753	0.208	772.6957	1.961	63.510	0.000	0	395.000	FRL	Success
4	Sept.	63.510	84.469	147.979	1.790	1.790	2.025	0.208	80.44545	4.024	63.510	0.000	0	395.000	FRL	Success
5	Oct.	63.510	46.316	109.826	8.816	8.816	2.066	0.208	35.22605	11.090	63.510	0.000	0	395.000	FRL	Success
6	Nov.	63.510	15.757	79.267	25.347	25.347	1.318	0.208	0	26.873	52.394	0.000	0	392.767		Success
7	Dec.	52.394	11.555	63.949	19.374	19.374	0.698	0.208	0	20.280	43.668	0.000	0	390.737		Success
8	Jan	43.668	5.982	49.650	21.455	21.455	0.585	0.208	0	22.248	27.402	0.000	0	388.221		Success
9	Feb.	27.402	6.840	34.242	22.071	22.071	0.481	0.208	0	22.760	11.482	0.000	0	386.015		Success
10	March	11.482	2.416	13.898	10.781	10.781	0.378	0.208	0	11.367	2.530	0.000	0	385.434		Success
11	April	2.530	0.080	2.610	0.000	0.000	0.436	0.208	0	0.644	1.966	0.000	0	384.684		Success
12	May	1.966	0.000	1.966	0.000	0.000	0.875	0.208	0	0.583	1.383	0.000	0	383.520		Success
		Total	1459.341		109.634	109.634	15.036	2.500	1269.504				0			

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16

KOTHA BARRAGE MAJOR PROJECT
WORKING TABLE
YEAR 2004-05

L.S.L 384.5 CAPACITY 0.605 Mcum
FRL 395 CAPACITY 63.51 Mcum

(All figures are in Mcum)

S.N.	Month	Initial Capacity (MCM)	Inflow (MCM)	Total	Irrigation Demand (MCM)	Irrigation Supply (MCM)	Evaporation Losses (MCM)	Env. Releases (MCM)	Spill (MCM)	Irrig.Supply + Evap Losses + Env.Releases (MCM)	Final Capacity (MCM)	Shortage (MCM)	Shortage in %	Level at final capacity (MCM)	Remark	Success/ Failure
1	2	3	4	5	6	7	8	10	11	11	12	14	15	16	17	
				(3+4)						(7+8+9)	(5-12-11)	(6-7)	(14/6 x100)			
1	June	14.232	29.602	43.834	0.000	0.000	1.911	0.208	0	2.119	41.715	0.000	0	388.395		Success
2	July	41.715	203.535	245.250	0.000	0.000	2.310	0.208	179.2215	2.519	63.510	0.000	0	395.000	FRL	Success
3	August	63.510	1368.669	1432.179	0.000	0.000	1.753	0.208	1366.708	1.961	63.510	0.000	0	395.000	FRL	Success
4	Sept.	63.510	141.163	204.673	1.790	1.790	2.025	0.208	137.1395	4.023	63.510	0.000	0	395.000	FRL	Success
5	Oct.	63.510	54.380	117.890	8.816	8.816	2.066	0.208	43.29037	11.090	63.510	0.000	0	395.000	FRL	Success
6	Nov.	63.510	17.607	81.117	25.347	25.347	1.318	0.208	0	26.873	54.244	0.000	0	393.181		Success
7	Dec.	54.244	13.194	67.438	19.374	19.374	0.744	0.208	0	20.326	47.111	0.000	0	390.581		Success
8	Jan	47.111	6.301	53.412	21.455	21.455	0.574	0.208	0	22.238	31.175	0.000	0	387.334		Success
9	Feb.	31.175	7.296	38.471	22.071	22.071	0.376	0.208	0	22.656	15.815	0.000	0	384.238		Success
10	March	15.815	2.890	18.705	10.781	10.781	0.149	0.208	0	11.139	7.566	0.000	0	383.520		Success
11	April	7.566	0.075	7.641	0.000	0.000	1.093	0.208	0	1.301	6.340	0.000	0	383.520		Success
12	May	6.340	0.000	6.340	0.000	0.000	1.303	0.208	0	1.511	4.829	0.000	0	383.520		Success
		Total	1844.712		109.634	109.634	15.623	2.500	1655.546			0	0			

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17

KOTHA BARRAGE MAJOR PROJECT
WORKING TABLE
YEAR 2005-06

Annexure-6.18 Contd.

L.S.L 384.5
FRL 395
CAPACITY 0.605 Mcum
CAPACITY 63.51 Mcum

(All figures are in Mcum)

S.N.	Month	Initial Capacity (MCM)	Inflow (MCM)	Total	Irrigation Demand (MCM)	Irrigation Supply (MCM)	Evaporation Losses (MCM)	Env. Releases (MCM)	Spill (MCM)	Irrig Supply + Evap Losses + Env.Releases (MCM)	Final Capacity (MCM)	Shortage (MCM)	Shortage in %	Level at final capacity (MCM)	Remark	Success/ Failure
1	2	3	4	5	6	7	8	10	11	11	12	14	15	16	17	
				(3+4)						(7+8+9)	(5-12-11)	(6-7)	(14/6 x100)			
1	June	4.829	0.841	5.670	0.000	0.000	0.358	0.208	0	0.566	5.104	0.000	0	383.520		Success
2	July	5.104	1255.989	1261.093	0.000	0.000	2.310	0.208	1195.064	2.519	63.510	0.000	0	395.000	FRL	Success
3	August	63.510	345.692	409.202	0.000	0.000	1.753	0.208	343.7306	1.961	63.510	0.000	0	395.000	FRL	Success
4	Sept.	63.510	550.200	613.710	1.790	1.790	2.025	0.208	546.1765	4.023	63.510	0.000	0	395.000	FRL	Success
5	Oct.	63.510	33.198	96.708	8.816	8.816	2.066	0.208	22.10837	11.090	63.510	0.000	0	395.000	FRL	Success
6	Nov.	63.510	21.199	84.709	25.347	25.347	1.318	0.208	0	26.873	57.836	0.000	0	392.869		Success
7	Dec.	57.836	16.374	74.210	19.374	19.374	0.706	0.208	0	20.289	53.921	0.000	0	390.527		Success
8	Jan	53.921	6.706	60.627	21.455	21.455	0.571	0.208	0	22.234	38.393	0.000	0.00	387.338		Success
9	Feb.	38.393	7.874	46.267	22.071	22.071	0.376	0.208	0	22.655	23.612	0.000	0	383.520		Success
10	March	23.612	3.156	26.768	10.781	10.781	1.132	0.208	0	12.122	14.647	0.000	0	383.520		Success
11	April	14.647	0.157	14.804	0.000	0.000	1.278	0.208	0	1.486	13.318	0.000	0	383.520		Success
12	May	13.318	0.000	13.318	0.000	0.000	1.524	0.208	0	1.732	11.585	0.000	0	383.520		Success
		Total	2241.386		109.634	109.634	15.416	2.500	2009.150				0.00			

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18

KOTHA BARRAGE MAJOR PROJECT
WORKING TABLE
YEAR 2006-07

L.S.L. 384.5
FRL 395

CAPACITY 0.605 Mcum
CAPACITY 63.51 Mcum

(All figures are in Mcum)

S.N.	Month	Initial Capacity (MCM)	Inflow (MCM)	Total	Irrigation Demand (MCM)	Irrigation Supply (MCM)	Evaporation Losses (MCM)	Env. Releases (MCM)	Spill (MCM)	Irrig Supply + Evap Losses + Env.Releases (MCM)	Final Capacity (MCM)	Shortage (MCM)	Shortage in %	Level at final capacity (MCM)	Remark	Success/ Failure
1	2	3	4	5	6	7	8	10	11	11	12	14	15	16	17	
				(3+4)						(7+8+9)	(5-12-11)	(6-7)	(14/6 x100)			
1	June	11.585	0.000	11.585	0.000	0.000	1.252	0.208	0	1.460	10.125	0.000	0	383.520		Success
2	July	10.125	549.029	559.154	0.000	0.000	2.310	0.208	493.1254	2.519	63.510	0.000	0	395.000	FRL	Success
3	August	63.510	2107.908	2171.418	0.000	0.000	1.753	0.208	2105.947	1.961	63.510	0.000	0	395.000	FRL	Success
4	Sept.	63.510	1249.902	1313.412	1.790	1.790	2.025	0.208	1245.879	4.023	63.510	0.000	0	395.000	FRL	Success
5	Oct.	63.510	90.283	153.793	8.816	8.816	2.066	0.208	79.19337	11.090	63.510	0.000	0	395.000	FRL	Success
6	Nov.	63.510	36.584	100.094	25.347	25.347	1.318	0.208	9.710595	26.873	63.510	0.000	0	392.767		Success
7	Dec.	63.510	30.790	94.300	19.374	19.374	1.101	0.208	0	20.683	73.617	0.000	0	390.929		Success
8	Jan	73.617	11.350	84.967	21.455	21.455	1.210	0.208	0	22.873	62.093	0.000	0	387.510		Success
9	Feb.	62.093	18.006	80.099	22.071	22.071	1.508	0.208	0	23.787	56.312	0.000	0	384.274		Success
10	March	56.312	4.489	60.801	10.781	10.781	1.787	0.208	0	12.777	48.025	0.000	0	383.520		Success
11	April	48.025	0.302	48.327	0.000	0.000	2.279	0.208	0	2.487	45.839	0.000	0	383.520		Success
12	May	45.839	0.065	45.904	0.000	0.000	0.000	0.208	0	0.208	45.696	0.000	0	383.520		Success
		Total	4098.708		109.634	109.634	18.609	2.500	3858.036				0			

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KOTHA BARRAGE MAJOR PROJECT
WORKING TABLE
YEAR 2007-08

L.S.L 384.5
FRL 395

CAPACITY 0.605 Mcum
CAPACITY 63.51 Mcum

(All figures are in Mcum)

S.N.	Month	Initial Capacity (MCM)	Inflow (MCM)	Total	Irrigation Demand (MCM)	Irrigation Supply (MCM)	Evaporation Losses (MCM)	Env. Releases (MCM)	Spill (MCM)	Irrig Supply + Evap Losses + Env.Releases (MCM)	Final Capacity (MCM)	Shortage (MCM)	Shortage in %	Level at final capacity (MCM)	Remark	Success/ Failure
1	2	3	4	5	6	7	8	10	11	11	12	14	15	16	17	
				(3+4)						(7+8+9)	(5-12-11)	(6-7)	(14/6 x100)			
1	June	45.696	5.817	51.513	0.000	0.000	0.671	0.208	0	0.879	50.634	0.000	0	388.068		Success
2	July	50.634	346.384	397.018	0.000	0.000	2.310	0.208	330.9893	2.519	63.510	0.000	0	395.000	FRL	Success
3	August	63.510	349.392	412.902	0.000	0.000	1.753	0.208	347.4806	1.961	63.510	0.000	0	395.000	FRL	Success
4	Sept.	63.510	519.563	583.073	1.790	1.790	2.025	0.208	515.5395	4.023	63.510	0.000	0	395.000	FRL	Success
5	Oct.	63.510	28.321	91.831	8.816	8.816	2.066	0.208	17.23137	11.090	63.510	0.000	0	395.000	FRL	Success
6	Nov.	63.510	13.857	77.367	25.347	25.347	1.318	0.208	0	26.873	50.494	0.000	0	392.767		Success
7	Dec.	50.494	10.467	60.961	19.374	19.374	0.698	0.208	0	20.280	40.680	0.000	0	391.153		Success
8	Jan	40.680	5.724	46.404	21.455	21.455	0.618	0.208	0	22.281	24.124	0.000	0.00	388.304		Success
9	Feb.	24.124	6.471	30.595	22.071	22.071	0.491	0.208	0	22.770	7.825	0.000	0	385.306		Success
10	March	7.825	1.888	9.713	10.781	8.565	0.334	0.208	0	9.108	0.605	2.216	0	384.544		Fail
11	April	0.605	0.010	0.615	0.000	0.000	0.275	0.208	0	0.484	0.131	0.000	0	383.520		Success
12	May	0.131	0.000	0.131	0.000	0.000	0.000	0.208	0	0.208	-0.077	0.000	0	383.520		Success
		Total	1287.894		109.634	107.418	12.558	2.500	1108.731							

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KOTHA BARRAGE MAJOR PROJECT
WORKING TABLE
YEAR 2008-09

L.S.L. 384.5
FRL 395

CAPACITY 0.605 Mcum
CAPACITY 63.51 Mcum

(All figures are in Mcum)

S.N.	Month	Initial Capacity (MCM)	Inflow (MCM)	Total	Irrigation Demand (MCM)	Irrigation Supply (MCM)	Evaporation Losses (MCM)	Env. Releases (MCM)	Spill (MCM)	Irrig Supply + Evap Losses + Env.Releases (MCM)	Final Capacity (MCM)	Shortage (MCM)	Shortage in %	Level at final capacity (MCM)	Remark	Success/ Failure
1	2	3	4	5	6	7	8	10	11	11	12	14	15	16	17	
				(3+4)						(7+8+9)	(5-12-11)	(6-7)	(14/6 x100)			
1	June	0.077	107.860	107.783	0.000	0.000	3.316	0.208	40.74887	3.524	63.510	0.000	0	395.000	FRL	Success
2	July	63.510	80.889	144.399	0.000	0.000	2.310	0.208	78.3707	2.518	63.510	0.000	0	395.000	FRL	Success
3	August	63.510	443.179	506.689	0.000	0.000	1.753	0.208	441.2177	1.961	63.510	0.000	0	395.000	FRL	Success
4	Sept.	63.510	335.021	398.531	1.790	1.790	2.025	0.208	330.9975	4.024	63.510	0.000	0	395.000	FRL	Success
5	Oct.	63.510	26.413	89.923	8.816	8.816	2.066	0.208	15.32337	11.090	63.510	0.000	0	395.000	FRL	Success
6	Nov.	63.510	12.381	75.891	25.347	25.347	1.318	0.208	0	26.873	49.018	0.000	0	392.899		Success
7	Dec.	49.018	9.396	58.914	19.374	19.374	0.708	0.208	0	20.291	38.623	0.000	0	390.171		Success
8	Jan	38.623	5.432	44.055	21.455	21.455	0.788	0.208	0	22.451	21.604	0.000	0	387.335		Success
9	Feb.	21.604	5.606	27.210	22.071	22.071	0.666	0.208	0	22.945	4.265	0.000	0	383.520		Success
10	March	4.265	1.129	5.394	10.781	3.894	0.686	0.208	0	4.789	0.605	6.887	0	383.520		Fail
11	April	0.605	0.026	0.631	0.000	0.000	0.000	0.208	0	0.208	0.423	0.000	0	383.520		Success
12	May	0.423	0.000	0.423	0.000	0.000	0.000	0.208	0	0.208	0.214	0.000	0	383.520		Success
		Total	1027.832		109.634	102.747	15.636	2.500	842.099				0.00			

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MONTHLY WATER BALANCE OF CHAKARPUR DAM																	Annexure-6.19 Contd.
Year	Month	Intial Reservoir			Inflow from self catchment	Release from Madia dam	Release from Dehra dam	Total Volume	Demand for Environ. Require.	Demand for Drinking use	Irrigation release from chakarpur dam Rabi	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1978-79	June	0.470	435.75	0.25	4.120	0.000	0.000	4.590	0.000	0.500	0.000	0.500	175.00	0.044	4.046	0.000	4.046
	July	4.046	440.64	1.40	36.807	0.000	0.000	40.853	0.000	0.500	0.000	0.500	143.00	0.200	40.153	0.000	40.153
	Aug	40.153	448.50	9.14	71.475	355.274	4.819	471.721	0.000	0.500	0.000	0.500	124.00	1.133	470.088	395.778	74.310
	Sept	74.310	451.50	13.50	13.182	63.542	9.611	160.644	0.000	0.500	0.000	0.500	154.00	2.080	158.064	83.754	74.310
	Oct	74.310	451.50	13.50	2.386	5.000	24.000	105.696	0.000	0.500	49.092	49.592	159.00	2.147	53.956	0.000	53.956
	Nov	53.956	449.86	11.22	0.696	54.000	30.000	138.652	0.930	0.500	56.354	57.784	134.00	1.504	79.364	5.054	74.310
	Dec	74.310	451.50	13.50	1.281	92.000	4.000	171.591	0.930	0.500	105.109	106.539	115.00	1.553	63.499	0.000	63.499
	Jan	63.499	450.66	12.34	0.984	50.000	0.000	114.483	0.930	0.500	71.974	73.404	118.00	1.456	39.623	0.000	39.623
	Feb	39.623	448.44	9.03	0.843	33.000	0.000	73.466	0.930	0.500	47.422	48.852	134.00	1.210	23.404	0.000	23.404
	Mar	23.404	446.27	6.06	0.472	0.000	0.000	23.876	0.930	0.500	0.000	1.430	181.00	1.096	21.350	0.000	21.350
	Apr	21.350	445.94	5.66	0.318	0.000	0.000	21.668	0.930	0.500	0.000	1.430	217.00	1.229	19.009	0.000	19.009
	May	19.009	445.49	5.22	0.238	0.000	0.000	19.247	0.930	0.500	0.000	1.430	247.00	1.291	16.526	0.000	16.526
1979-80	June	16.526	445.02	4.76	1.801	0.000	0.000	18.327	0.000	0.500	0.000	0.500	175.00	0.833	16.994	0.000	16.994
	July	16.994	445.11	4.85	4.018	0.000	0.000	21.013	0.000	0.500	0.000	0.500	143.00	0.693	19.819	0.000	19.819
	Aug	19.819	445.65	5.38	11.712	0.000	0.000	31.532	0.000	0.500	0.000	0.500	124.00	0.667	30.365	0.000	30.365
	Sept	30.365	447.31	7.34	0.977	0.000	0.000	31.342	0.000	0.500	0.000	0.500	154.00	1.131	29.711	0.000	29.711
	Oct	29.711	447.23	7.23	0.247	5.000	15.000	49.958	0.000	0.500	39.092	39.592	159.00	1.150	9.216	0.000	9.216
	Nov	9.216	443.10	2.95	2.402	45.000	15.000	71.619	0.930	0.500	50.000	51.430	134.00	0.395	19.794	0.000	19.794
	Dec	19.794	445.64	5.37	2.197	18.000	2.000	41.991	0.930	0.500	30.000	31.430	115.00	0.618	9.943	0.000	9.943
	Jan	9.943	443.32	3.15	0.329	1.000	0.000	11.273	0.930	0.500	4.000	5.430	118.00	0.372	5.471	0.000	5.471
	Feb	5.471	441.51	1.85	0.231	1.000	0.000	6.702	0.930	0.500	0.000	1.430	134.00	0.248	5.024	0.000	5.024
	Mar	5.024	441.27	1.71	0.190	1.000	0.000	6.214	0.930	0.500	0.000	1.430	181.00	0.309	4.476	0.000	4.476
	Apr	4.476	440.96	1.53	0.067	1.000	0.000	5.542	0.930	0.500	0.000	1.430	217.00	0.332	3.780	0.000	3.780
	May	3.780	440.44	1.32	0.042	0.000	0.000	3.822	0.930	0.500	0.000	1.430	247.00	0.327	2.065	0.000	2.065
1980-81	June	2.065	438.85	0.83	4.820	0.000	0.000	6.886	0.000	0.500	0.000	0.500	175.00	0.145	6.241	0.000	6.241
	July	6.241	441.93	2.10	6.108	0.000	0.000	12.349	0.000	0.500	0.000	0.500	143.00	0.301	11.548	0.000	11.548
	Aug	11.548	443.81	3.60	24.437	0.000	0.000	35.985	0.000	0.500	0.000	0.500	124.00	0.446	35.039	0.000	35.039
	Sept	35.039	447.93	8.14	11.464	0.000	0.000	46.503	0.000	0.500	0.000	0.500	154.00	1.253	44.750	0.000	44.750
	Oct	44.750	449.00	10.05	2.214	5.000	24.000	75.964	0.000	0.500	49.092	49.592	159.00	1.597	24.774	0.000	24.774
	Nov	24.774	446.49	6.32	0.578	54.000	30.000	109.352	0.930	0.500	56.354	57.784	134.00	0.847	50.721	0.000	50.721
	Dec	50.721	449.56	10.81	0.491	92.000	2.000	145.212	0.930	0.500	105.109	106.539	115.00	1.243	37.430	0.000	37.430
	Jan	37.430	448.20	8.60	0.703	40.000	0.000	78.133	0.930	0.500	71.974	73.404	118.00	1.014	3.714	0.000	3.714
	Feb	3.714	440.40	1.30	0.425	24.000	0.000	28.139	0.930	0.500	20.000	21.430	134.00	0.174	6.535	0.000	6.535
	Mar	6.535	442.07	2.19	0.421	1.000	0.000	7.956	0.930	0.500	0.000	1.430	181.00	0.396	6.130	0.000	6.130
	Apr	6.130	441.87	2.07	0.380	1.000	0.000	7.510	0.930	0.500	0.000	1.430	217.00	0.448	5.632	0.000	5.632
	May	5.632	441.60	1.90	0.469	1.000	0.000	7.100	0.930	0.500	0.000	1.430	247.00	0.470	5.200	0.000	5.200

MONTHLY WATER BALANCE OF CHAKARPUR DAM																	Annexure-6.19 Contd.
Year	Month	Intial Reservoir			Inflow from self catchment	Release from Madia dam	Release from Dehra dam	Total Volume	Demand for Environ. Require.	Demand for Drinking use	Irrigation release from chakarpur dam Rabi	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1981-82	June	5.200	441.36	1.76	2.052	0.000	0.000	7.252	0.000	0.500	0.000	0.500	175.00	0.309	6.444	0.000	6.444
	July	6.444	442.03	2.16	5.842	0.000	0.000	12.286	0.000	0.500	0.000	0.500	143.00	0.310	11.476	0.000	11.476
	Aug	11.476	443.79	3.58	20.688	0.000	0.000	32.165	0.000	0.500	0.000	0.500	124.00	0.444	31.221	0.000	31.221
	Sept	31.221	447.42	7.49	2.785	0.000	0.000	34.006	0.000	0.500	0.000	0.500	154.00	1.153	32.353	0.000	32.353
	Oct	32.353	447.57	7.68	1.240	5.000	24.000	62.593	0.000	0.500	49.092	49.592	159.00	1.221	11.779	0.000	11.779
	Nov	11.779	443.88	3.66	0.652	54.000	20.000	86.431	0.930	0.500	40.000	41.430	134.00	0.491	44.510	0.000	44.510
	Dec	44.510	448.98	10.00	0.648	37.000	4.000	86.159	0.930	0.500	60.000	61.430	115.00	1.150	23.579	0.000	23.579
	Jan	23.579	446.30	6.09	0.974	0.000	0.500	25.052	0.930	0.500	16.000	17.430	118.00	0.719	6.904	0.000	6.904
	Feb	6.904	442.21	2.29	1.067	0.000	0.500	8.471	0.930	0.500	0.000	1.430	134.00	0.307	6.734	0.000	6.734
	Mar	6.734	442.15	2.25	0.541	0.000	0.500	7.775	0.930	0.500	0.000	1.430	181.00	0.407	5.938	0.000	5.938
	Apr	5.938	441.77	2.00	0.387	0.000	0.500	6.825	0.930	0.500	0.000	1.430	217.00	0.435	4.960	0.000	4.960
	May	4.960	441.23	1.69	0.155	0.000	0.600	5.715	0.930	0.500	0.000	1.430	247.00	0.416	3.869	0.000	3.869
1982-83	June	3.869	440.51	1.35	1.169	0.000	0.000	5.038	0.000	0.500	0.000	0.500	175.00	0.236	4.302	0.000	4.302
	July	4.302	440.83	1.48	6.030	0.000	0.000	10.331	0.000	0.500	0.000	0.500	143.00	0.211	9.620	0.000	9.620
	Aug	9.620	443.23	3.06	36.309	0.000	0.000	45.929	0.000	0.500	0.000	0.500	124.00	0.379	45.050	0.000	45.050
	Sept	45.050	449.03	10.08	13.494	30.997	0.000	89.542	0.000	0.500	0.000	0.500	154.00	1.553	87.489	13.179	74.310
	Oct	74.310	451.50	13.50	7.251	27.193	24.000	132.754	0.000	0.500	49.092	49.592	159.00	2.147	81.015	6.705	74.310
	Nov	74.310	451.50	13.50	3.182	20.000	30.000	127.492	0.930	0.500	56.354	57.784	134.00	1.810	67.899	0.000	67.899
	Dec	67.899	451.02	12.84	3.241	92.000	4.000	167.140	0.930	0.500	105.109	106.539	115.00	1.476	59.124	0.000	59.124
	Jan	59.124	450.30	11.83	1.324	50.000	0.000	110.449	0.930	0.500	71.974	73.404	118.00	1.396	35.648	0.000	35.648
	Feb	35.648	448.01	8.24	0.506	33.000	0.000	69.154	0.930	0.500	47.422	48.852	134.00	1.105	19.198	0.000	19.198
	Mar	19.198	445.53	5.26	0.407	25.000	0.000	44.605	0.930	0.500	0.000	1.430	181.00	0.952	42.223	0.000	42.223
	Apr	42.223	448.73	9.55	0.254	9.000	0.000	51.477	0.930	0.500	0.000	1.430	217.00	2.072	47.975	0.000	47.975
	May	47.975	449.30	10.46	0.137	0.000	0.000	48.112	0.930	0.500	0.000	1.430	247.00	2.583	44.099	0.000	44.099
1983-84	June	44.099	448.93	9.92	0.809	0.000	0.000	44.908	0.000	0.500	0.000	0.500	175.00	1.736	42.672	0.000	42.672
	July	42.672	448.77	9.64	9.157	0.000	0.000	51.830	0.000	0.500	0.000	0.500	143.00	1.378	49.952	0.000	49.952
	Aug	49.952	449.49	10.71	31.214	0.000	0.000	81.166	0.000	0.500	0.000	0.500	124.00	1.328	79.338	5.028	74.310
	Sept	74.310	451.50	13.50	45.986	234.072	5.465	359.833	0.000	0.500	0.000	0.500	154.00	2.080	357.253	282.943	74.310
	Oct	74.310	451.50	13.50	13.973	65.943	24.000	178.226	0.000	0.500	49.092	49.592	159.00	2.147	126.486	52.176	74.310
	Nov	74.310	451.50	13.50	5.497	54.000	30.000	163.807	0.930	0.500	56.354	57.784	134.00	1.810	104.214	29.904	74.310
	Dec	74.310	451.50	13.50	1.382	92.000	4.000	171.692	0.930	0.500	105.109	106.539	115.00	1.553	63.600	0.000	63.600
	Jan	63.600	450.67	12.35	1.827	50.000	0.000	115.427	0.930	0.500	71.974	73.404	118.00	1.457	40.566	0.000	40.566
	Feb	40.566	448.54	9.22	0.924	33.000	0.000	74.490	0.930	0.500	47.422	48.852	134.00	1.235	24.403	0.000	24.403
	Mar	24.403	446.43	6.25	0.624	0.000	0.000	25.027	0.930	0.500	0.000	1.430	181.00	1.131	22.466	0.000	22.466
	Apr	22.466	446.13	5.88	0.348	0.000	0.000	22.815	0.930	0.500	0.000	1.430	217.00	1.275	20.110	0.000	20.110
	May	20.110	445.70	5.43	0.223	0.000	0.000	20.332	0.930	0.500	0.000	1.430	247.00	1.341	17.561	0.000	17.561

MONTHLY WATER BALANCE OF CHAKARPUR DAM — **Annexure-6.19 Contd.**

Year	Month	Intial Reservoir			Inflow from self catchment	Release from Madia dam	Release from Dehra dam	Total Volume	Demand for Environ. Require.	Demand for Drinking use	Irrigation release from chakarpur dam Rabi	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1984-85	June	17.561	445.21	4.95	0.885	0.000	0.000	18.446	0.000	0.500	0.000	0.500	175.00	0.867	17.079	0.000	17.079
	July	17.079	445.12	4.86	2.553	0.000	0.000	19.632	0.000	0.500	0.000	0.500	143.00	0.696	18.436	0.000	18.436
	Aug	18.436	445.38	5.12	62.699	136.654	2.008	219.797	0.000	0.500	0.000	0.500	124.00	0.635	218.662	144.352	74.310
	Sept	74.310	451.50	13.50	8.188	34.751	7.939	125.188	0.000	0.500	0.000	0.500	154.00	2.080	122.608	48.298	74.310
	Oct	74.310	451.50	13.50	2.236	5.000	24.000	105.546	0.000	0.500	49.092	49.592	159.00	2.147	53.807	0.000	53.807
	Nov	53.807	449.85	11.20	0.543	54.000	30.000	138.350	0.930	0.500	56.354	57.784	134.00	1.501	79.065	4.755	74.310
	Dec	74.310	451.50	13.50	0.649	92.000	4.000	170.959	0.930	0.500	105.109	106.539	115.00	1.553	62.866	0.000	62.866
	Jan	62.866	450.61	12.26	0.607	50.000	0.000	113.473	0.930	0.500	71.974	73.404	118.00	1.447	38.622	0.000	38.622
	Feb	38.622	448.33	8.83	0.371	33.000	0.000	71.993	0.930	0.500	47.422	48.852	134.00	1.184	21.958	0.000	21.958
	Mar	21.958	446.05	5.78	0.343	0.000	0.000	22.301	0.930	0.500	0.000	1.430	181.00	1.046	19.825	0.000	19.825
	Apr	19.825	445.65	5.38	0.160	0.000	0.000	19.986	0.930	0.500	0.000	1.430	217.00	1.167	17.389	0.000	17.389
	May	17.389	445.18	4.92	0.120	0.000	0.000	17.508	0.930	0.500	0.000	1.430	247.00	1.216	14.863	0.000	14.863
1985-86	June	14.863	444.63	4.39	0.837	0.000	0.000	15.699	0.000	0.500	0.000	0.500	175.00	0.767	14.432	0.000	14.432
	July	14.432	444.53	4.29	8.418	0.000	0.000	22.850	0.000	0.500	0.000	0.500	143.00	0.613	21.737	0.000	21.737
	Aug	21.737	446.01	5.74	52.491	82.047	0.000	156.275	0.000	0.500	0.000	0.500	124.00	0.711	155.064	80.754	74.310
	Sept	74.310	451.50	13.50	35.584	192.697	11.980	314.570	0.000	0.500	0.000	0.500	154.00	2.080	311.991	237.681	74.310
	Oct	74.310	451.50	13.50	29.540	157.530	24.000	285.380	0.000	0.500	49.092	49.592	159.00	2.147	233.640	159.330	74.310
	Nov	74.310	451.50	13.50	4.985	54.000	30.000	163.295	0.930	0.500	56.354	57.784	134.00	1.810	103.702	29.392	74.310
	Dec	74.310	451.50	13.50	1.159	92.000	4.000	171.469	0.930	0.500	105.109	106.539	115.00	1.553	63.377	0.000	63.377
	Jan	63.377	450.65	12.32	1.020	50.000	0.000	114.397	0.930	0.500	71.974	73.404	118.00	1.454	39.538	0.000	39.538
	Feb	39.538	448.43	9.01	1.118	33.000	0.000	73.657	0.930	0.500	47.422	48.852	134.00	1.208	23.597	0.000	23.597
	Mar	23.597	446.30	6.09	0.970	0.000	0.000	24.567	0.930	0.500	0.000	1.430	181.00	1.103	22.034	0.000	22.034
	Apr	22.034	446.06	5.79	0.342	0.000	0.000	22.376	0.930	0.500	0.000	1.430	217.00	1.257	19.689	0.000	19.689
	May	19.689	445.62	5.35	0.158	0.000	0.000	19.848	0.930	0.500	0.000	1.430	247.00	1.322	17.096	0.000	17.096
1986-87	June	17.096	445.13	4.87	3.382	0.000	0.000	20.478	0.000	0.500	0.000	0.500	175.00	0.852	19.126	0.000	19.126
	July	19.126	445.51	5.25	99.467	355.877	0.000	474.470	0.000	0.500	0.000	0.500	143.00	0.750	473.220	398.910	74.310
	Aug	74.310	451.50	13.50	38.980	214.204	31.244	358.738	0.000	0.500	0.000	0.500	124.00	1.675	356.564	282.254	74.310
	Sept	74.310	451.50	13.50	7.010	27.963	7.544	116.828	0.000	0.500	0.000	0.500	154.00	2.080	114.248	39.938	74.310
	Oct	74.310	451.50	13.50	2.196	5.000	24.000	105.506	0.000	0.500	49.092	49.592	159.00	2.147	53.766	0.000	53.766
	Nov	53.766	449.84	11.20	0.560	54.000	30.000	138.326	0.930	0.500	56.354	57.784	134.00	1.501	79.042	4.732	74.310
	Dec	74.310	451.50	13.50	0.699	92.000	4.000	171.009	0.930	0.500	105.109	106.539	115.00	1.553	62.917	0.000	62.917
	Jan	62.917	450.62	12.27	0.752	50.000	0.000	113.669	0.930	0.500	71.974	73.404	118.00	1.448	38.817	0.000	38.817
	Feb	38.817	448.35	8.87	0.568	33.000	0.000	72.385	0.930	0.500	47.422	48.852	134.00	1.189	22.345	0.000	22.345
	Mar	22.345	446.11	5.85	0.425	0.000	0.000	22.770	0.930	0.500	0.000	1.430	181.00	1.059	20.281	0.000	20.281
	Apr	20.281	445.73	5.46	0.258	0.000	0.000	20.539	0.930	0.500	0.000	1.430	217.00	1.185	17.923	0.000	17.923
	May	17.923	445.28	5.02	0.123	0.000	0.000	18.046	0.930	0.500	0.000	1.430	247.00	1.240	15.375	0.000	15.375

MONTHLY WATER BALANCE OF CHAKARPUR DAM																	Annexure-6.19 Contd.
Year	Month	Intial Reservoir			Inflow from self catchment	Release from Madia dam	Release from Dehra dam	Total Volume	Demand for Environ. Require.	Demand for Drinking use	Irrigation release from chakarpur dam Rabi	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1987-88	June	15.375	444.75	4.50	0.857	0.000	0.000	16.233	0.000	0.500	0.000	0.500	175.00	0.788	14.945	0.000	14.945
	July	14.945	444.65	4.40	4.938	0.000	0.000	19.883	0.000	0.500	0.000	0.500	143.00	0.630	18.753	0.000	18.753
	Aug	18.753	445.44	5.18	39.963	0.000	0.000	58.716	0.000	0.500	0.000	0.500	124.00	0.642	57.574	0.000	57.574
	Sept	57.574	450.17	11.66	12.107	50.368	0.000	120.049	0.000	0.500	0.000	0.500	154.00	1.795	117.754	43.444	74.310
	Oct	74.310	451.50	13.50	2.565	5.000	24.000	105.875	0.000	0.500	49.092	49.592	159.00	2.147	54.136	0.000	54.136
	Nov	54.136	449.88	11.25	0.896	20.000	30.000	105.032	0.930	0.500	56.354	57.784	134.00	1.507	45.741	0.000	45.741
	Dec	45.741	449.09	10.17	0.582	92.000	4.000	142.323	0.930	0.500	105.109	106.539	115.00	1.170	34.614	0.000	34.614
	Jan	34.614	447.87	8.07	0.471	50.000	0.000	85.085	0.930	0.500	71.974	73.404	118.00	0.952	10.729	0.000	10.729
	Feb	10.729	443.56	3.37	0.560	39.000	0.000	50.289	0.930	0.500	47.422	48.852	134.00	0.451	0.986	0.000	0.986
	Mar	0.986	437.16	0.50	0.366	24.000	0.000	25.352	0.930	0.500	0.000	1.430	181.00	0.090	23.833	0.000	23.833
	Apr	23.833	446.34	6.14	0.157	10.000	0.000	33.990	0.930	0.500	0.000	1.430	217.00	1.332	31.228	0.000	31.228
	May	31.228	447.43	7.49	0.120	0.000	0.000	31.348	0.930	0.500	0.000	1.430	247.00	1.850	28.068	0.000	28.068
1988-89	June	28.068	447.01	6.95	1.672	0.000	0.000	29.740	0.000	0.500	0.000	0.500	175.00	1.217	28.023	0.000	28.023
	July	28.023	447.00	6.94	15.089	0.000	0.000	43.112	0.000	0.500	0.000	0.500	143.00	0.993	41.619	0.000	41.619
	Aug	41.619	448.66	9.43	25.066	0.000	0.000	66.685	0.000	0.500	0.000	0.500	124.00	1.169	65.016	0.000	65.016
	Sept	65.016	450.79	12.51	3.941	0.000	0.000	68.957	0.000	0.500	0.000	0.500	154.00	1.926	66.530	0.000	66.530
	Oct	66.530	450.91	12.68	1.856	5.000	24.000	97.387	0.000	0.500	49.092	49.592	159.00	2.016	45.778	0.000	45.778
	Nov	45.778	449.10	10.18	0.608	51.000	30.000	127.385	0.930	0.500	56.354	57.784	134.00	1.364	68.238	0.000	68.238
	Dec	68.238	451.05	12.87	0.661	86.000	4.000	158.899	0.930	0.500	105.109	106.539	115.00	1.480	50.879	0.000	50.879
	Jan	50.879	449.57	10.83	0.605	48.000	0.000	99.484	0.930	0.500	71.974	73.404	118.00	1.278	24.802	0.000	24.802
	Feb	24.802	446.49	6.32	0.433	32.000	2.000	59.236	0.930	0.500	47.422	48.852	134.00	0.848	9.536	0.000	9.536
	Mar	9.536	443.20	3.03	0.257	1.000	0.000	10.793	0.930	0.500	0.000	1.430	181.00	0.549	8.814	0.000	8.814
	Apr	8.814	442.98	2.83	0.193	0.000	0.000	9.007	0.930	0.500	0.000	1.430	217.00	0.615	6.962	0.000	6.962
	May	6.962	442.24	2.31	0.120	0.000	0.000	7.082	0.930	0.500	0.000	1.430	247.00	0.571	5.081	0.000	5.081
1989-90	June	5.081	441.30	1.72	1.064	0.000	0.000	6.146	0.000	0.500	0.000	0.500	175.00	0.302	5.344	0.000	5.344
	July	5.344	441.44	1.81	5.812	0.000	0.000	11.156	0.000	0.500	0.000	0.500	143.00	0.259	10.397	0.000	10.397
	Aug	10.397	443.46	3.28	35.036	0.000	0.000	45.433	0.000	0.500	0.000	0.500	124.00	0.406	44.527	0.000	44.527
	Sept	44.527	448.98	10.00	8.833	0.000	0.000	53.360	0.000	0.500	0.000	0.500	154.00	1.541	51.320	0.000	51.320
	Oct	51.320	449.61	10.89	1.309	3.000	18.000	73.629	0.000	0.500	49.092	49.592	159.00	1.731	22.306	0.000	22.306
	Nov	22.306	446.10	5.84	0.330	44.000	12.000	78.635	0.930	0.500	56.354	57.784	134.00	0.783	20.068	0.000	20.068
	Dec	20.068	445.69	5.42	0.488	96.000	6.000	122.557	0.930	0.500	105.109	106.539	115.00	0.624	15.394	0.000	15.394
	Jan	15.394	444.75	4.51	0.353	54.000	8.000	77.746	0.930	0.500	71.974	73.404	118.00	0.532	3.810	0.000	3.810
	Feb	3.810	440.47	1.33	0.178	34.000	11.600	49.589	0.930	0.500	47.422	48.852	134.00	0.178	0.559	0.000	0.559
	Mar	0.559	436.08	0.29	0.123	2.000	0.000	2.682	0.930	0.500	0.000	1.430	181.00	0.052	1.200	0.000	1.200
	Apr	1.200	437.55	0.55	0.121	1.000	0.000	2.320	0.930	0.500	0.000	1.430	217.00	0.119	0.771	0.000	0.771
	May	0.771	436.65	0.40	0.120	1.500	0.000	2.391	0.930	0.500	0.000	1.430	247.00	0.100	0.861	0.000	0.861

MONTHLY WATER BALANCE OF CHAKARPUR DAM																	Annexure-6.19 Contd.
Year	Month	Intial Reservoir			Inflow from self catchment	Release from Madia dam	Release from Dehra dam	Total Volume	Demand for Environ. Require.	Demand for Drinking use	Irrigation release from chakarpur dam Rabi	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1990-91	June	0.861	436.90	0.45	8.165	0.000	0.000	9.027	0.000	0.500	0.000	0.500	175.00	0.079	8.447	0.000	8.447
	July	8.447	442.83	2.73	20.101	0.000	0.000	28.549	0.000	0.500	0.000	0.500	143.00	0.390	27.658	0.000	27.658
	Aug	27.658	446.95	6.87	31.449	54.902	0.000	114.009	0.000	0.500	0.000	0.500	124.00	0.852	112.657	38.347	74.310
	Sept	74.310	451.50	13.50	44.965	246.778	7.693	373.745	0.000	0.500	0.000	0.500	154.00	2.080	371.165	296.855	74.310
	Oct	74.310	451.50	13.50	5.557	19.264	24.000	123.131	0.000	0.500	49.092	49.592	159.00	2.147	71.391	0.000	71.391
	Nov	71.391	451.28	13.20	1.122	30.000	30.000	132.513	0.930	0.500	56.354	57.784	134.00	1.769	72.960	0.000	72.960
	Dec	72.960	451.40	13.36	0.517	92.000	4.000	169.477	0.930	0.500	105.109	106.539	115.00	1.537	61.401	0.000	61.401
	Jan	61.401	450.49	12.10	0.367	50.000	0.000	111.768	0.930	0.500	71.974	73.404	118.00	1.427	36.937	0.000	36.937
	Feb	36.937	448.15	8.50	0.363	33.000	0.000	70.299	0.930	0.500	47.422	48.852	134.00	1.139	20.309	0.000	20.309
	Mar	20.309	445.74	5.47	0.335	24.000	0.000	44.644	0.930	0.500	0.000	1.430	181.00	0.990	42.224	0.000	42.224
	Apr	42.224	448.73	9.55	0.245	0.000	0.000	42.469	0.930	0.500	0.000	1.430	217.00	2.072	38.968	0.000	38.968
	May	38.968	448.37	8.90	0.133	0.000	0.000	39.101	0.930	0.500	0.000	1.430	247.00	2.199	35.472	0.000	35.472
1991-92	June	35.472	447.98	8.21	2.155	0.000	0.000	37.627	0.000	0.500	0.000	0.500	175.00	1.437	35.690	0.000	35.690
	July	35.690	448.01	8.25	7.557	0.000	0.000	43.248	0.000	0.500	0.000	0.500	143.00	1.180	41.568	0.000	41.568
	Aug	41.568	448.65	9.42	55.214	101.989	0.000	198.770	0.000	0.500	0.000	0.500	124.00	1.168	197.102	122.792	74.310
	Sept	74.310	451.50	13.50	6.239	23.517	4.217	108.283	0.000	0.500	0.000	0.500	154.00	2.080	105.704	31.394	74.310
	Oct	74.310	451.50	13.50	1.035	0.000	24.000	99.345	0.000	0.500	49.092	49.592	159.00	2.147	47.605	0.000	47.605
	Nov	47.605	449.27	10.41	0.417	54.000	30.000	132.023	0.930	0.500	56.354	57.784	134.00	1.395	72.844	0.000	72.844
	Dec	72.844	451.39	13.35	0.503	92.000	4.000	169.347	0.930	0.500	105.109	106.539	115.00	1.535	61.272	0.000	61.272
	Jan	61.272	450.48	12.08	0.726	50.000	0.000	111.998	0.930	0.500	71.974	73.404	118.00	1.425	37.169	0.000	37.169
	Feb	37.169	448.17	8.54	0.435	39.000	0.000	76.604	0.930	0.500	47.422	48.852	134.00	1.145	26.607	0.000	26.607
	Mar	26.607	446.78	6.67	0.284	5.000	0.000	31.891	0.930	0.500	0.000	1.430	181.00	1.208	29.253	0.000	29.253
	Apr	29.253	447.17	7.15	0.165	0.000	0.000	29.419	0.930	0.500	0.000	1.430	217.00	1.552	26.437	0.000	26.437
	May	26.437	446.75	6.64	0.137	0.000	0.000	26.574	0.930	0.500	0.000	1.430	247.00	1.640	23.504	0.000	23.504
1992-93	June	23.504	446.29	6.08	0.776	0.000	0.000	24.279	0.000	0.500	0.000	0.500	175.00	1.063	22.716	0.000	22.716
	July	22.716	446.17	5.92	7.627	0.000	0.000	30.343	0.000	0.500	0.000	0.500	143.00	0.847	28.996	0.000	28.996
	Aug	28.996	447.13	7.11	29.276	0.000	0.000	58.272	0.000	0.500	0.000	0.500	124.00	0.882	56.890	0.000	56.890
	Sept	56.890	450.12	11.58	9.369	0.000	4.920	71.180	0.000	0.500	0.000	0.500	154.00	1.783	68.896	0.000	68.896
	Oct	68.896	451.10	12.94	0.941	5.000	13.000	87.838	0.000	0.500	49.092	49.592	159.00	2.057	36.188	0.000	36.188
	Nov	36.188	448.07	8.35	0.241	51.000	15.000	102.429	0.930	0.500	56.354	57.784	134.00	1.119	43.527	0.000	43.527
	Dec	43.527	448.87	9.81	0.313	100.000	15.000	158.840	0.930	0.500	105.109	106.539	115.00	1.128	51.173	0.000	51.173
	Jan	51.173	449.60	10.87	0.168	44.000	13.000	108.341	0.930	0.500	71.974	73.404	118.00	1.282	33.655	0.000	33.655
	Feb	33.655	447.75	7.90	0.622	12.000	4.500	50.777	0.930	0.500	47.422	48.852	134.00	1.059	0.866	0.000	0.866
	Mar	0.866	436.91	0.46	0.122	3.000	2.000	5.988	0.930	0.500	0.000	1.430	181.00	0.083	4.475	0.000	4.475
	Apr	4.475	440.96	1.53	0.122	0.000	0.000	4.597	0.930	0.500	0.000	1.430	217.00	0.332	2.835	0.000	2.835
	May	2.835	439.66	1.05	0.121	0.000	0.000	2.956	0.930	0.500	0.000	1.430	247.00	0.259	1.267	0.000	1.267

MONTHLY WATER BALANCE OF CHAKARPUR DAM — **Annexure-6.19 Contd.**

Year	Month	Intial Reservoir			Inflow from self catchment	Release from Madia dam	Release from Dehra dam	Total Volume	Demand for Environ. Require.	Demand for Drinking use	Irrigation release from chakarpur dam Rabi	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1993-94	June	1.267	437.68	0.56	1.313	0.000	0.000	2.581	0.000	0.500	0.000	0.500	175.00	0.099	1.982	0.000	1.982
	July	1.982	438.73	0.80	8.273	0.000	0.000	10.255	0.000	0.500	0.000	0.500	143.00	0.114	9.640	0.000	9.640
	Aug	9.640	443.23	3.06	19.801	0.000	0.000	29.442	0.000	0.500	0.000	0.500	124.00	0.380	28.562	0.000	28.562
	Sept	28.562	447.07	7.04	40.934	111.834	0.000	181.330	0.000	0.500	0.000	0.500	154.00	1.084	179.746	105.436	74.310
	Oct	74.310	451.50	13.50	8.227	34.657	23.000	140.195	0.000	0.500	49.092	49.592	159.00	2.147	88.455	14.145	74.310
	Nov	74.310	451.50	13.50	0.960	54.000	30.000	159.270	0.930	0.500	56.354	57.784	134.00	1.810	99.677	25.367	74.310
	Dec	74.310	451.50	13.50	0.705	92.000	4.000	171.015	0.930	0.500	105.109	106.539	115.00	1.553	62.922	0.000	62.922
	Jan	62.922	450.62	12.27	0.634	50.000	7.000	120.557	0.930	0.500	71.974	73.404	118.00	1.448	45.705	0.000	45.705
	Feb	45.705	449.09	10.17	0.447	33.000	2.000	81.151	0.930	0.500	47.422	48.852	134.00	1.363	30.937	0.000	30.937
	Mar	30.937	447.39	7.44	0.402	0.000	1.000	32.339	0.930	0.500	0.000	1.430	181.00	1.347	29.562	0.000	29.562
	Apr	29.562	447.21	7.21	0.396	0.000	0.000	29.958	0.930	0.500	0.000	1.430	217.00	1.564	26.964	0.000	26.964
	May	26.964	446.84	6.74	0.212	0.000	0.000	27.177	0.930	0.500	0.000	1.430	247.00	1.665	24.082	0.000	24.082
1994-95	June	24.082	446.38	6.19	7.424	0.000	0.000	31.506	0.000	0.500	0.000	0.500	175.00	1.083	29.923	0.000	29.923
	July	29.923	447.25	7.27	31.352	0.000	0.000	61.276	0.000	0.500	0.000	0.500	143.00	1.039	59.736	0.000	59.736
	Aug	59.736	450.35	11.90	62.051	308.636	1.061	431.484	0.000	0.500	0.000	0.500	124.00	1.476	429.508	355.198	74.310
	Sept	74.310	451.50	13.50	22.467	117.073	12.721	226.571	0.000	0.500	0.000	0.500	154.00	2.080	223.992	149.682	74.310
	Oct	74.310	451.50	13.50	2.394	5.000	24.000	105.704	0.000	0.500	49.092	49.592	159.00	2.147	53.965	0.000	53.965
	Nov	53.965	449.86	11.22	0.535	54.000	30.000	138.499	0.930	0.500	56.354	57.784	134.00	1.504	79.212	4.902	74.310
	Dec	74.310	451.50	13.50	0.657	92.000	4.000	170.967	0.930	0.500	105.109	106.539	115.00	1.553	62.874	0.000	62.874
	Jan	62.874	450.61	12.26	0.615	50.000	0.000	113.489	0.930	0.500	71.974	73.404	118.00	1.447	38.638	0.000	38.638
	Feb	38.638	448.33	8.84	0.751	33.000	0.000	72.389	0.930	0.500	47.422	48.852	134.00	1.184	22.353	0.000	22.353
	Mar	22.353	446.11	5.85	0.943	0.000	0.000	23.297	0.930	0.500	0.000	1.430	181.00	1.059	20.807	0.000	20.807
	Apr	20.807	445.83	5.56	0.407	0.000	0.000	21.214	0.930	0.500	0.000	1.430	217.00	1.207	18.577	0.000	18.577
	May	18.577	445.41	5.14	0.186	0.000	0.000	18.763	0.930	0.500	0.000	1.430	247.00	1.271	16.062	0.000	16.062
1995-96	June	16.062	444.91	4.66	0.779	0.000	0.000	16.841	0.000	0.500	0.000	0.500	175.00	0.815	15.526	0.000	15.526
	July	15.526	444.79	4.54	8.311	0.000	0.000	23.837	0.000	0.500	0.000	0.500	143.00	0.649	22.688	0.000	22.688
	Aug	22.688	446.16	5.92	14.437	0.000	0.000	37.125	0.000	0.500	0.000	0.500	124.00	0.734	35.891	0.000	35.891
	Sept	35.891	448.03	8.29	14.894	0.000	0.000	50.785	0.000	0.500	0.000	0.500	154.00	1.277	49.008	0.000	49.008
	Oct	49.008	449.40	10.59	1.363	5.000	24.000	79.370	0.000	0.500	49.092	49.592	159.00	1.684	28.094	0.000	28.094
	Nov	28.094	447.01	6.96	0.514	52.000	30.000	110.608	0.930	0.500	56.354	57.784	134.00	0.932	51.892	0.000	51.892
	Dec	51.892	449.67	10.96	0.629	89.000	4.000	145.521	0.930	0.500	105.109	106.539	115.00	1.260	37.722	0.000	37.722
	Jan	37.722	448.23	8.65	0.617	48.000	0.000	86.338	0.930	0.500	71.974	73.404	118.00	1.021	11.913	0.000	11.913
	Feb	11.913	443.92	3.70	0.300	0.600	0.000	12.813	0.930	0.500	6.000	7.430	134.00	0.496	4.887	0.000	4.887
	Mar	4.887	441.19	1.66	0.269	0.600	0.000	5.757	0.930	0.500	0.000	1.430	181.00	0.301	4.026	0.000	4.026
	Apr	4.026	440.63	1.40	0.147	0.600	0.000	4.773	0.930	0.500	0.000	1.430	217.00	0.303	3.040	0.000	3.040
	May	3.040	439.86	1.11	0.124	0.600	0.000	3.764	0.930	0.500	0.000	1.430	247.00	0.273	2.061	0.000	2.061

MONTHLY WATER BALANCE OF CHAKARPUR DAM																	Annexure-6.19 Contd.
Year	Month	Intial Reservoir			Inflow from self catchment	Release from Madia dam	Release from Dehra dam	Total Volume	Demand for Environ. Require.	Demand for Drinking use	Irrigation release from chakarpur dam Rabi	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1996-97	June	2.061	438.84	0.83	0.991	0.200	0.000	3.252	0.000	0.500	0.000	0.500	175.00	0.145	2.607	0.000	2.607
	July	2.607	439.43	0.99	23.649	0.000	0.000	26.256	0.000	0.500	0.000	0.500	143.00	0.141	25.615	0.000	25.615
	Aug	25.615	446.62	6.48	49.075	136.849	0.000	211.539	0.000	0.500	0.000	0.500	124.00	0.804	210.236	135.926	74.310
	Sept	74.310	451.50	13.50	24.214	127.148	6.132	231.804	0.000	0.500	0.000	0.500	154.00	2.080	229.224	154.914	74.310
	Oct	74.310	451.50	13.50	4.932	15.662	24.000	118.905	0.000	0.500	49.092	49.592	159.00	2.147	67.165	0.000	67.165
	Nov	67.165	450.97	12.75	1.962	54.000	30.000	153.127	0.930	0.500	56.354	57.784	134.00	1.709	93.634	19.324	74.310
	Dec	74.310	451.50	13.50	0.812	92.000	4.000	171.122	0.930	0.500	105.109	106.539	115.00	1.553	63.029	0.000	63.029
	Jan	63.029	450.63	12.28	0.657	50.000	0.000	113.686	0.930	0.500	71.974	73.404	118.00	1.449	38.833	0.000	38.833
	Feb	38.833	448.35	8.87	0.665	33.000	0.000	72.498	0.930	0.500	47.422	48.852	134.00	1.189	22.457	0.000	22.457
	Mar	22.457	446.12	5.87	0.306	0.000	0.000	22.763	0.930	0.500	0.000	1.430	181.00	1.063	20.270	0.000	20.270
	Apr	20.270	445.73	5.46	0.199	0.000	0.000	20.469	0.930	0.500	0.000	1.430	217.00	1.185	17.854	0.000	17.854
	May	17.854	445.27	5.01	0.171	0.000	0.000	18.025	0.930	0.500	0.000	1.430	247.00	1.237	15.358	0.000	15.358
1997-98	June	15.358	444.75	4.50	0.811	0.000	0.000	16.169	0.000	0.500	0.000	0.500	175.00	0.787	14.882	0.000	14.882
	July	14.882	444.63	4.39	25.469	0.000	0.000	40.351	0.000	0.500	0.000	0.500	143.00	0.628	39.223	0.000	39.223
	Aug	39.223	448.40	8.95	29.896	58.359	0.000	127.478	0.000	0.500	0.000	0.500	124.00	1.110	125.868	51.558	74.310
	Sept	74.310	451.50	13.50	17.347	87.555	5.307	184.519	0.000	0.500	0.000	0.500	154.00	2.080	181.940	107.630	74.310
	Oct	74.310	451.50	13.50	3.257	6.000	24.000	107.567	0.000	0.500	49.092	49.592	159.00	2.147	55.827	0.000	55.827
	Nov	55.827	450.03	11.46	3.089	54.000	30.000	142.916	0.930	0.500	56.354	57.784	134.00	1.535	83.597	9.287	74.310
	Dec	74.310	451.50	13.50	11.138	92.000	4.000	181.448	0.930	0.500	105.109	106.539	115.00	1.553	73.355	0.000	73.355
	Jan	73.355	451.43	13.41	1.193	50.000	0.000	124.548	0.930	0.500	71.974	73.404	118.00	1.582	49.562	0.000	49.562
	Feb	49.562	449.45	10.66	0.723	33.000	0.000	83.285	0.930	0.500	47.422	48.852	134.00	1.429	33.005	0.000	33.005
	Mar	33.005	447.66	7.79	0.707	0.000	0.000	33.711	0.930	0.500	0.000	1.430	181.00	1.410	30.871	0.000	30.871
	Apr	30.871	447.38	7.43	0.428	0.000	0.000	31.299	0.930	0.500	0.000	1.430	217.00	1.612	28.257	0.000	28.257
	May	28.257	447.03	6.98	0.200	0.000	0.000	28.457	0.930	0.500	0.000	1.430	247.00	1.725	25.302	0.000	25.302
1998-99	June	25.302	446.57	6.42	2.520	0.000	0.000	27.823	0.000	0.500	0.000	0.500	175.00	1.124	26.199	0.000	26.199
	July	26.199	446.72	6.59	22.442	0.000	0.000	48.641	0.000	0.500	0.000	0.500	143.00	0.943	47.198	0.000	47.198
	Aug	47.198	449.23	10.36	25.827	81.222	0.000	154.246	0.000	0.500	0.000	0.500	124.00	1.285	152.462	78.152	74.310
	Sept	74.310	451.50	13.50	24.722	130.076	9.206	238.314	0.000	0.500	0.000	0.500	154.00	2.080	235.734	161.424	74.310
	Oct	74.310	451.50	13.50	14.045	68.199	24.000	180.554	0.000	0.500	49.092	49.592	159.00	2.147	128.814	54.504	74.310
	Nov	74.310	451.50	13.50	3.894	54.000	30.000	162.204	0.930	0.500	56.354	57.784	134.00	1.810	102.610	28.300	74.310
	Dec	74.310	451.50	13.50	0.723	92.000	4.000	171.033	0.930	0.500	105.109	106.539	115.00	1.553	62.940	0.000	62.940
	Jan	62.940	450.62	12.27	0.625	50.000	0.000	113.566	0.930	0.500	71.974	73.404	118.00	1.448	38.713	0.000	38.713
	Feb	38.713	448.34	8.85	8.403	33.000	0.000	80.117	0.930	0.500	47.422	48.852	134.00	1.186	30.079	0.000	30.079
	Mar	30.079	447.27	7.29	2.864	0.000	0.000	32.944	0.930	0.500	0.000	1.430	181.00	1.320	30.193	0.000	30.193
	Apr	30.193	447.29	7.31	0.242	0.000	0.000	30.435	0.930	0.500	0.000	1.430	217.00	1.587	27.418	0.000	27.418
	May	27.418	446.91	6.83	0.138	0.000	0.000	27.556	0.930	0.500	0.000	1.430	247.00	1.687	24.440	0.000	24.440

MONTHLY WATER BALANCE OF CHAKARPUR DAM — **Annexure-6.19 Contd.**

Year	Month	Intial Reservoir			Inflow from self catchment	Release from Madia dam	Release from Dehra dam	Total Volume	Demand for Environ. Require.	Demand for Drinking use	Irrigation release from chakarpur dam Rabi	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1999-00	June	24.440	446.44	6.26	1.313	0.000	0.000	25.753	0.000	0.500	0.000	0.500	175.00	1.095	24.158	0.000	24.158
	July	24.158	446.39	6.20	23.393	0.000	0.000	47.551	0.000	0.500	0.000	0.500	143.00	0.887	46.164	0.000	46.164
	Aug	46.164	449.13	10.23	32.396	117.611	0.840	197.011	0.000	0.500	0.000	0.500	124.00	1.268	195.243	120.933	74.310
	Sept	74.310	451.50	13.50	71.963	402.431	29.299	578.003	0.000	0.500	0.000	0.500	154.00	2.080	575.423	501.113	74.310
	Oct	74.310	451.50	13.50	28.824	153.403	24.000	280.538	0.000	0.500	49.092	49.592	159.00	2.147	228.798	154.488	74.310
	Nov	74.310	451.50	13.50	3.102	54.000	30.000	161.412	0.930	0.500	56.354	57.784	134.00	1.810	101.819	27.509	74.310
	Dec	74.310	451.50	13.50	0.692	92.000	4.000	171.002	0.930	0.500	105.109	106.539	115.00	1.553	62.910	0.000	62.910
	Jan	62.910	450.62	12.27	0.647	50.000	0.000	113.557	0.930	0.500	71.974	73.404	118.00	1.448	38.705	0.000	38.705
	Feb	38.705	448.34	8.85	0.783	33.000	0.000	72.488	0.930	0.500	47.422	48.852	134.00	1.186	22.451	0.000	22.451
	Mar	22.451	446.12	5.87	0.525	0.000	0.000	22.975	0.930	0.500	0.000	1.430	181.00	1.063	20.482	0.000	20.482
	Apr	20.482	445.77	5.50	0.324	0.000	0.000	20.806	0.930	0.500	0.000	1.430	217.00	1.194	18.183	0.000	18.183
	May	18.183	445.33	5.07	0.155	0.000	0.000	18.338	0.930	0.500	0.000	1.430	247.00	1.252	15.655	0.000	15.655
2000-01	June	15.655	444.82	4.57	1.264	0.000	0.000	16.919	0.000	0.500	0.000	0.500	175.00	0.799	15.620	0.000	15.620
	July	15.620	444.81	4.56	44.392	11.628	0.000	71.641	0.000	0.500	0.000	0.500	143.00	0.652	70.489	0.000	70.489
	Aug	70.489	451.22	13.11	13.177	65.445	8.124	157.234	0.000	0.500	0.000	0.500	124.00	1.625	155.109	80.799	74.310
	Sept	74.310	451.50	13.50	3.082	5.316	2.228	84.936	0.000	0.500	0.000	0.500	154.00	2.080	82.356	8.046	74.310
	Oct	74.310	451.50	13.50	0.852	5.000	24.000	104.162	0.000	0.500	49.092	49.592	159.00	2.147	52.422	0.000	52.422
	Nov	52.422	449.72	11.03	0.359	54.000	30.000	136.781	0.930	0.500	56.354	57.784	134.00	1.478	77.520	3.210	74.310
	Dec	74.310	451.50	13.50	0.752	92.000	4.000	171.062	0.930	0.500	105.109	106.539	115.00	1.553	62.969	0.000	62.969
	Jan	62.969	450.62	12.27	0.377	50.000	0.000	113.346	0.930	0.500	71.974	73.404	118.00	1.448	38.494	0.000	38.494
	Feb	38.494	448.32	8.81	0.125	33.000	0.000	71.618	0.930	0.500	47.422	48.852	134.00	1.180	21.586	0.000	21.586
	Mar	21.586	445.98	5.71	0.125	0.000	0.000	21.711	0.930	0.500	0.000	1.430	181.00	1.033	19.248	0.000	19.248
	Apr	19.248	445.54	5.27	0.125	0.000	0.000	19.373	0.930	0.500	0.000	1.430	217.00	1.144	16.799	0.000	16.799
	May	16.799	445.07	4.81	0.124	0.000	0.000	16.923	0.930	0.500	0.000	1.430	247.00	1.189	14.305	0.000	14.305
2001-02	June	14.305	444.50	4.26	2.735	0.000	0.000	17.040	0.000	0.500	0.000	0.500	175.00	0.745	15.794	0.000	15.794
	July	15.794	444.85	4.60	16.034	0.000	0.000	31.829	0.000	0.500	0.000	0.500	143.00	0.657	30.671	0.000	30.671
	Aug	30.671	447.35	7.39	28.350	0.000	0.000	59.021	0.000	0.500	0.000	0.500	124.00	0.917	57.604	0.000	57.604
	Sept	57.604	450.18	11.66	3.920	0.000	0.000	61.524	0.000	0.500	0.000	0.500	154.00	1.796	59.228	0.000	59.228
	Oct	59.228	450.31	11.85	1.717	5.000	24.000	89.945	0.000	0.500	49.092	49.592	159.00	1.884	38.469	0.000	38.469
	Nov	38.469	448.31	8.80	0.345	54.000	30.000	122.814	0.930	0.500	56.354	57.784	134.00	1.180	63.851	0.000	63.851
	Dec	63.851	450.69	12.38	0.425	92.000	4.000	160.276	0.930	0.500	105.109	106.539	115.00	1.423	52.313	0.000	52.313
	Jan	52.313	449.71	11.01	0.775	50.000	7.000	110.088	0.930	0.500	71.974	73.404	118.00	1.300	35.384	0.000	35.384
	Feb	35.384	447.97	8.20	0.196	33.000	0.000	68.580	0.930	0.500	47.422	48.852	134.00	1.098	18.630	0.000	18.630
	Mar	18.630	445.42	5.15	0.217	5.000	0.000	23.847	0.930	0.500	0.000	1.430	181.00	0.933	21.484	0.000	21.484
	Apr	21.484	445.96	5.69	0.227	1.000	0.000	22.712	0.930	0.500	0.000	1.430	217.00	1.234	20.047	0.000	20.047
	May	20.047	445.69	5.42	0.125	0.000	0.000	20.172	0.930	0.500	0.000	1.430	247.00	1.338	17.404	0.000	17.404

MONTHLY WATER BALANCE OF CHAKARPUR DAM																	Annexure-6.19 Contd.
Year	Month	Intial Reservoir			Inflow from self catchment	Release from Madia dam	Release from Dehra dam	Total Volume	Demand for Environ. Require.	Demand for Drinking use	Irrigation release from chakarpur dam Rabi	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
2002-03	June	17.404	445.18	4.93	1.298	0.000	0.000	18.702	0.000	0.500	0.000	0.500	175.00	0.862	17.340	0.000	17.340
	July	17.340	445.17	4.91	2.550	0.000	0.000	19.889	0.000	0.500	0.000	0.500	143.00	0.703	18.687	0.000	18.687
	Aug	18.687	445.43	5.16	28.410	0.000	0.000	47.097	0.000	0.500	0.000	0.500	124.00	0.640	45.957	0.000	45.957
	Sept	45.957	449.11	10.20	15.876	0.000	1.694	63.527	0.000	0.500	0.000	0.500	154.00	1.571	61.456	0.000	61.456
	Oct	61.456	450.50	12.10	0.773	3.000	24.000	89.229	0.000	0.500	49.092	49.592	159.00	1.924	37.712	0.000	37.712
	Nov	37.712	448.23	8.65	0.210	54.000	30.000	121.922	0.930	0.500	56.354	57.784	134.00	1.159	62.979	0.000	62.979
	Dec	62.979	450.62	12.28	0.368	92.000	4.000	159.347	0.930	0.500	105.109	106.539	115.00	1.412	51.396	0.000	51.396
	Jan	51.396	449.62	10.90	0.126	48.000	2.000	101.522	0.930	0.500	71.974	73.404	118.00	1.286	26.832	0.000	26.832
	Feb	26.832	446.82	6.72	0.126	24.000	1.000	51.957	0.930	0.500	47.422	48.852	134.00	0.900	2.206	0.000	2.206
	Mar	2.206	439.03	0.88	0.126	0.000	1.000	3.331	0.930	0.500	0.000	1.430	181.00	0.159	1.742	0.000	1.742
	Apr	1.742	438.41	0.71	0.126	0.000	1.500	3.368	0.930	0.500	0.000	1.430	217.00	0.155	1.783	0.000	1.783
	May	1.783	438.46	0.73	0.125	0.000	0.500	2.408	0.930	0.500	0.000	1.430	247.00	0.180	0.798	0.000	0.798
2003-04	June	0.798	436.72	0.42	3.043	0.000	0.000	3.841	0.000	0.500	0.000	0.500	175.00	0.073	3.268	0.000	3.268
	July	3.268	440.06	1.17	14.739	0.000	0.000	18.007	0.000	0.500	0.000	0.500	143.00	0.167	17.339	0.000	17.339
	Aug	17.339	445.17	4.91	18.138	0.000	0.000	35.478	0.000	0.500	0.000	0.500	124.00	0.609	34.369	0.000	34.369
	Sept	34.369	447.84	8.02	24.355	51.029	0.000	109.753	0.000	0.500	0.000	0.500	154.00	1.236	108.017	33.707	74.310
	Oct	74.310	451.50	13.50	4.627	13.902	24.000	116.840	0.000	0.500	49.092	49.592	159.00	2.147	65.100	0.000	65.100
	Nov	65.100	450.80	12.52	0.541	54.000	30.000	149.641	0.930	0.500	56.354	57.784	134.00	1.677	90.180	15.870	74.310
	Dec	74.310	451.50	13.50	0.599	92.000	4.000	170.909	0.930	0.500	105.109	106.539	115.00	1.553	62.817	0.000	62.817
	Jan	62.817	450.61	12.26	0.588	50.000	0.000	113.405	0.930	0.500	71.974	73.404	118.00	1.446	38.555	0.000	38.555
	Feb	38.555	448.32	8.82	0.801	33.000	0.000	72.356	0.930	0.500	47.422	48.852	134.00	1.182	22.323	0.000	22.323
	Mar	22.323	446.10	5.85	0.541	0.000	0.000	22.864	0.930	0.500	0.000	1.430	181.00	1.058	20.375	0.000	20.375
	Apr	20.375	445.75	5.48	0.162	0.000	0.000	20.537	0.930	0.500	0.000	1.430	217.00	1.189	17.918	0.000	17.918
	May	17.918	445.28	5.02	0.136	0.000	0.000	18.054	0.930	0.500	0.000	1.430	247.00	1.240	15.384	0.000	15.384
2004-05	June	15.384	444.75	4.50	1.445	0.000	0.000	16.828	0.000	0.500	0.000	0.500	175.00	0.788	15.540	0.000	15.540
	July	15.540	444.79	4.54	10.581	0.000	0.000	26.121	0.000	0.500	0.000	0.500	143.00	0.649	24.972	0.000	24.972
	Aug	24.972	446.52	6.36	53.009	105.937	0.000	183.918	0.000	0.500	0.000	0.500	124.00	0.788	182.630	108.320	74.310
	Sept	74.310	451.50	13.50	4.670	14.468	0.687	94.135	0.000	0.500	0.000	0.500	154.00	2.080	91.555	17.245	74.310
	Oct	74.310	451.50	13.50	1.717	5.000	24.000	105.027	0.000	0.500	49.092	49.592	159.00	2.147	53.287	0.000	53.287
	Nov	53.287	449.80	11.14	0.500	54.000	30.000	137.788	0.930	0.500	56.354	57.784	134.00	1.492	78.511	4.201	74.310
	Dec	74.310	451.50	13.50	0.717	92.000	4.000	171.027	0.930	0.500	105.109	106.539	115.00	1.553	62.935	0.000	62.935
	Jan	62.935	450.62	12.27	1.049	50.000	0.000	113.983	0.930	0.500	71.974	73.404	118.00	1.448	39.131	0.000	39.131
	Feb	39.131	448.39	8.93	0.609	33.000	0.000	72.740	0.930	0.500	47.422	48.852	134.00	1.197	22.692	0.000	22.692
	Mar	22.692	446.16	5.92	0.287	0.000	0.000	22.979	0.930	0.500	0.000	1.430	181.00	1.071	20.477	0.000	20.477
	Apr	20.477	445.77	5.50	0.151	0.000	0.000	20.628	0.930	0.500	0.000	1.430	217.00	1.193	18.005	0.000	18.005
	May	18.005	445.30	5.04	0.126	0.000	0.000	18.131	0.930	0.500	0.000	1.430	247.00	1.244	15.456	0.000	15.456

MONTHLY WATER BALANCE OF CHAKARPUR DAM																	Annexure-6.19 Contd.
Year	Month	Intial Reservoir			Inflow from self catchment	Release from Madia dam	Release from Dehra dam	Total Volume	Demand for Environ. Require.	Demand for Drinking use	Irrigation release from chakarpur dam Rabi	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
2005-06	June	15.456	444.77	4.52	1.138	0.000	0.000	16.595	0.000	0.500	0.000	0.500	175.00	0.791	15.303	0.000	15.303
	July	15.303	444.73	4.49	52.776	42.450	0.000	110.530	0.000	0.500	0.000	0.500	143.00	0.641	109.388	35.078	74.310
	Aug	74.310	451.50	13.50	28.769	155.335	1.695	260.108	0.000	0.500	0.000	0.500	124.00	1.675	257.934	183.624	74.310
	Sept	74.310	451.50	13.50	8.817	38.381	8.149	129.657	0.000	0.500	0.000	0.500	154.00	2.080	127.077	52.767	74.310
	Oct	74.310	451.50	13.50	1.381	5.000	24.000	104.691	0.000	0.500	49.092	49.592	159.00	2.147	52.951	0.000	52.951
	Nov	52.951	449.77	11.09	0.423	54.000	30.000	137.373	0.930	0.500	56.354	57.784	134.00	1.487	78.103	3.793	74.310
	Dec	74.310	451.50	13.50	0.723	92.000	4.000	171.033	0.930	0.500	105.109	106.539	115.00	1.553	62.940	0.000	62.940
	Jan	62.940	450.62	12.27	0.795	50.000	0.000	113.735	0.930	0.500	71.974	73.404	118.00	1.448	38.883	0.000	38.883
	Feb	38.883	448.36	8.88	0.590	33.000	0.000	72.473	0.930	0.500	47.422	48.852	134.00	1.191	22.431	0.000	22.431
	Mar	22.431	446.12	5.87	0.353	0.000	0.000	22.784	0.930	0.500	0.000	1.430	181.00	1.062	20.292	0.000	20.292
	Apr	20.292	445.74	5.46	0.175	0.000	0.000	20.467	0.930	0.500	0.000	1.430	217.00	1.186	17.851	0.000	17.851
	May	17.851	445.27	5.01	0.185	0.000	0.000	18.036	0.930	0.500	0.000	1.430	247.00	1.237	15.369	0.000	15.369
2006-07	June	15.369	444.75	4.50	0.873	0.000	0.000	16.241	0.000	0.500	0.000	0.500	175.00	0.788	14.954	0.000	14.954
	July	14.954	444.65	4.41	11.776	0.000	0.000	26.730	0.000	0.500	0.000	0.500	143.00	0.630	25.600	0.000	25.600
	Aug	25.600	446.62	6.48	82.217	271.243	5.773	384.832	0.000	0.500	0.000	0.500	124.00	0.803	383.529	309.219	74.310
	Sept	74.310	451.50	13.50	69.502	388.238	28.474	560.524	0.000	0.500	0.000	0.500	154.00	2.080	557.944	483.634	74.310
	Oct	74.310	451.50	13.50	3.411	6.893	24.000	108.614	0.000	0.500	49.092	49.592	159.00	2.147	56.874	0.000	56.874
	Nov	56.874	450.12	11.58	0.354	54.000	30.000	141.228	0.930	0.500	56.354	57.784	134.00	1.551	81.893	7.583	74.310
	Dec	74.310	451.50	13.50	0.797	92.000	4.000	171.107	0.930	0.500	105.109	106.539	115.00	1.553	63.015	0.000	63.015
	Jan	63.015	450.62	12.28	0.872	50.000	0.000	113.887	0.930	0.500	71.974	73.404	118.00	1.449	39.034	0.000	39.034
	Feb	39.034	448.38	8.91	0.572	33.000	0.000	72.606	0.930	0.500	47.422	48.852	134.00	1.195	22.560	0.000	22.560
	Mar	22.560	446.14	5.89	0.434	0.000	0.000	22.994	0.930	0.500	0.000	1.430	181.00	1.067	20.497	0.000	20.497
	Apr	20.497	445.78	5.50	0.156	0.000	0.000	20.653	0.930	0.500	0.000	1.430	217.00	1.194	18.029	0.000	18.029
	May	18.029	445.30	5.04	0.127	0.000	0.000	18.155	0.930	0.500	0.000	1.430	247.00	1.245	15.480	0.000	15.480
2007-08	June	15.480	444.77	4.53	0.990	0.000	0.000	16.470	0.000	0.500	0.000	0.500	175.00	0.792	15.178	0.000	15.178
	July	15.178	444.70	4.46	9.435	0.000	0.000	24.613	0.000	0.500	0.000	0.500	143.00	0.637	23.475	0.000	23.475
	Aug	23.475	446.29	6.07	8.244	0.000	0.000	31.720	0.000	0.500	0.000	0.500	124.00	0.753	30.467	0.000	30.467
	Sept	30.467	447.33	7.36	7.373	0.000	0.000	37.840	0.000	0.500	0.000	0.500	154.00	1.133	36.207	0.000	36.207
	Oct	36.207	448.07	8.35	0.763	5.000	20.000	61.970	0.000	0.500	49.092	49.592	159.00	1.328	11.049	0.000	11.049
	Nov	11.049	443.66	3.46	0.128	54.000	18.000	83.178	0.930	0.500	56.354	57.784	134.00	0.463	24.931	0.000	24.931
	Dec	24.931	446.52	6.35	0.128	25.000	2.000	52.059	0.930	0.500	48.000	49.430	115.00	0.730	1.899	0.000	1.899
	Jan	1.899	438.62	0.77	0.128	20.000	2.000	24.027	0.930	0.500	20.000	21.430	118.00	0.091	2.506	0.000	2.506
	Feb	2.506	439.33	0.96	0.128	10.000	0.000	12.635	0.930	0.500	6.500	7.930	134.00	0.129	4.576	0.000	4.576
	Mar	4.576	441.03	1.56	0.128	1.000	0.000	5.705	0.930	0.500	0.000	1.430	181.00	0.282	3.992	0.000	3.992
	Apr	3.992	440.60	1.39	0.128	1.000	0.000	5.121	0.930	0.500	0.000	1.430	217.00	0.301	3.390	0.000	3.390
	May	3.390	440.16	1.21	0.128	1.000	0.000	4.518	0.930	0.500	0.000	1.430	247.00	0.298	2.790	0.000	2.790

MONTHLY WATER BALANCE OF CHAKARPUR DAM													Annexure-6.19 Contd.				
Year	Month	Intial Reservoir			Inflow from self catchment	Release from Madia dam	Release from Dehra dam	Total Volume	Demand for Environ. Require.	Demand for Drinking use	Irrigation release from chakarpur dam Rabi	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
2008-09	June	2.790	439.61	1.04	3.060	0.000	0.000	5.380	0.000	0.500	0.000	0.500	175.00	0.181	4.699	0.000	4.699
	July	4.699	441.09	1.60	7.657	0.000	0.000	12.356	0.000	0.500	0.000	0.500	143.00	0.229	11.627	0.000	11.627
	Aug	11.627	443.83	3.62	26.093	0.000	0.000	37.720	0.000	0.500	0.000	0.500	124.00	0.449	36.771	0.000	36.771
	Sept	36.771	448.13	8.47	7.161	0.000	0.000	43.932	0.000	0.500	0.000	0.500	154.00	1.304	42.128	0.000	42.128
	Oct	42.128	448.72	9.53	0.867	5.000	20.000	67.996	0.000	0.500	49.092	49.592	159.00	1.515	16.888	0.000	16.888
	Nov	16.888	445.09	4.83	0.131	50.000	30.000	97.019	0.930	0.500	56.354	57.784	134.00	0.647	38.588	0.000	38.588
	Dec	38.588	448.33	8.83	0.131	90.000	2.000	130.719	0.930	0.500	105.109	106.539	115.00	1.015	23.165	0.000	23.165
	Jan	23.165	446.24	6.01	0.131	45.000	0.000	68.296	0.930	0.500	61.000	62.430	118.00	0.709	5.156	0.000	5.156
	Feb	5.156	441.34	1.75	0.131	2.000	0.000	7.287	0.930	0.500	0.000	1.430	134.00	0.234	5.623	0.000	5.623
	Mar	5.623	441.59	1.90	0.131	1.000	0.000	6.754	0.930	0.500	0.000	1.430	181.00	0.344	4.980	0.000	4.980
	Apr	4.980	441.24	1.69	0.131	1.000	0.000	6.110	0.930	0.500	0.000	1.430	217.00	0.367	4.313	0.000	4.313
	May	4.313	440.84	1.48	0.130	1.000	0.000	5.443	0.930	0.500	0.000	1.430	247.00	0.366	3.648	0.000	3.648
2009-10	June	3.648	440.35	1.28	0.868	0.000	0.000	4.516	0.000	0.500	0.000	0.500	175.00	0.224	3.791	0.000	3.791
	July	3.791	440.45	1.33	14.412	0.000	0.000	18.204	0.000	0.500	0.000	0.500	143.00	0.190	17.514	0.000	17.514
	Aug	17.514	445.21	4.95	9.056	0.000	0.000	26.571	0.000	0.500	0.000	0.500	124.00	0.613	25.457	0.000	25.457
	Sept	25.457	446.60	6.45	17.319	0.000	0.000	42.776	0.000	0.500	0.000	0.500	154.00	0.993	41.283	0.000	41.283
	Oct	41.283	448.62	9.36	5.440	5.000	22.000	73.722	0.000	0.500	49.092	49.592	159.00	1.488	22.642	0.000	22.642
	Nov	22.642	446.15	5.91	4.825	54.000	30.000	111.467	0.930	0.500	56.354	57.784	134.00	0.792	52.891	0.000	52.891
	Dec	52.891	449.76	11.09	1.566	92.000	4.000	150.458	0.930	0.500	105.109	106.539	115.00	1.275	42.643	0.000	42.643
	Jan	42.643	448.77	9.63	0.403	50.000	0.000	93.046	0.930	0.500	71.974	73.404	118.00	1.136	18.505	0.000	18.505
	Feb	18.505	445.39	5.13	0.377	33.000	0.000	51.882	0.930	0.500	47.422	48.852	134.00	0.688	2.343	0.000	2.343
	Mar	2.343	439.16	0.92	0.207	6.000	0.000	8.550	0.930	0.500	0.000	1.430	181.00	0.166	6.954	0.000	6.954
	Apr	6.954	442.23	2.31	0.148	0.000	0.000	7.102	0.930	0.500	0.000	1.430	217.00	0.501	5.171	0.000	5.171
	May	5.171	441.35	1.75	0.133	0.000	0.000	5.304	0.930	0.500	0.000	1.430	247.00	0.433	3.441	0.000	3.441
		Success rate			81.25 %												

MONTHLY WATER BALANCE OF MADIA DAM													Annexure-6.19 Contd.						
Year	Month	Intial Reservoir			Inflow from self catch-ment	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Irrigation release to chakar-pur dam	Release to Chakarpur Dam Based on total volume ,total demand & dead storage	Total Demand	Evaporation Loss		Balance Volume	Spill	Net Storage	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume				
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1978-79	June	2.429	487.62	1.54	23.752	23.752	2.083	0.458	0.000	0.00	0.000	2.542	175.00	0.269	20.941	0.000	20.941	20.941
	July	20.941	491.89	8.58	212.202	233.143	2.083	0.458	0.000	0.00	0.000	2.542	143.00	1.227	229.374	0.000	229.374	229.374
	Aug	229.374	499.76	54.80	412.066	641.441	2.083	0.458	0.000	0.00	355.274	2.542	124.00	6.795	632.104	355.274	276.830	276.830
	Sep	276.830	500.55	64.36	75.994	352.824	2.083	0.458	0.000	0.00	63.542	2.542	154.00	9.911	340.372	63.542	276.830	276.830
	Oct	276.830	500.55	64.36	13.753	290.583	2.083	0.458	1.838	5.00	5.000	9.380	159.00	10.233	270.970	0.000	270.970	270.970
	Nov	270.970	500.46	63.21	4.012	274.983	2.083	0.458	2.110	54.00	54.000	58.652	134.00	8.470	207.862	0.000	207.862	207.862
	Dec	207.862	499.35	50.15	7.387	215.249	2.083	0.458	3.936	92.00	92.000	98.478	115.00	5.768	111.003	0.000	111.003	111.003
	Jan	111.003	496.89	29.68	5.672	116.675	2.083	0.458	2.693	50.00	50.000	55.234	118.00	3.502	57.939	0.000	57.939	57.939
	Feb	57.939	494.67	18.69	4.859	62.798	2.083	0.458	1.772	33.00	33.000	37.313	134.00	2.504	22.980	0.000	22.980	22.980
	Mar	22.980	492.12	9.23	2.723	25.704	2.083	0.458	0.000	0.00	0.000	2.542	181.00	1.671	21.491	0.000	21.491	21.491
	Apr	21.491	491.96	8.77	1.831	23.322	2.083	0.458	0.000	0.00	0.000	2.542	217.00	1.903	18.878	0.000	18.878	18.878
	May	18.878	491.62	7.86	1.372	20.250	2.083	0.458	0.000	0.00	0.000	2.542	247.00	1.942	15.766	0.000	15.766	15.766
1979-80	June	15.766	491.21	6.79	10.383	26.148	2.083	0.458	0.000	0.00	0.000	2.542	175.00	1.188	22.419	0.000	22.419	22.419
	July	22.419	492.06	9.06	23.167	45.586	2.083	0.458	0.000	0.00	0.000	2.542	143.00	1.296	41.749	0.000	41.749	41.749
	Aug	41.749	493.70	14.37	67.524	109.272	2.083	0.458	0.000	0.00	0.000	2.542	124.00	1.782	104.948	0.000	104.948	104.948
	Sep	104.948	496.67	28.55	5.632	110.580	2.083	0.458	0.000	0.00	0.000	2.542	154.00	4.397	103.642	0.000	103.642	103.642
	Oct	103.642	496.62	28.31	1.426	105.067	2.083	0.458	1.838	5.00	5.000	9.380	159.00	4.501	91.186	0.000	91.186	91.186
	Nov	91.186	496.17	25.99	13.851	105.037	2.083	0.458	2.110	45.00	45.000	49.652	134.00	3.483	51.903	0.000	51.903	51.903
	Dec	51.903	494.34	17.04	12.668	64.571	2.083	0.458	3.936	18.00	18.000	24.478	115.00	1.959	38.134	0.000	38.134	38.134
	Jan	38.134	493.43	13.48	1.899	37.603	2.083	0.458	2.693	1.00	1.000	6.234	118.00	1.591	29.778	0.000	29.778	29.778
	Feb	29.778	492.77	11.29	1.330	28.680	2.083	0.458	1.772	1.00	1.000	5.313	134.00	1.512	21.854	0.000	21.854	21.854
	Mar	21.854	492.01	8.89	1.098	20.523	2.083	0.458	0.000	1.00	1.000	3.542	181.00	1.609	15.372	0.000	15.372	15.372
	Apr	15.372	491.15	6.65	0.384	13.327	2.083	0.458	0.000	1.00	1.000	3.542	217.00	1.443	8.342	0.000	8.342	8.342
	May	8.342	489.85	4.14	0.240	6.153	2.083	0.458	0.000	0.00	0.000	2.542	247.00	1.024	2.588	0.000	2.588	2.588
1980-81	June	2.588	487.73	1.63	27.791	30.379	2.083	0.458	0.000	0.00	0.000	2.542	175.00	0.285	27.552	0.000	27.552	27.552
	July	27.552	492.55	10.61	35.214	62.766	2.083	0.458	0.000	0.00	0.000	2.542	143.00	1.518	58.707	0.000	58.707	58.707
	Aug	58.707	494.72	18.90	140.883	199.590	2.083	0.458	0.000	0.00	0.000	2.542	124.00	2.344	194.705	0.000	194.705	194.705
	Sep	194.705	499.09	47.31	66.094	260.799	2.083	0.458	0.000	0.00	0.000	2.542	154.00	7.286	250.972	0.000	250.972	250.972
	Oct	250.972	500.14	59.28	12.762	263.733	2.083	0.458	1.838	5.00	5.000	9.380	159.00	9.425	244.928	0.000	244.928	244.928
	Nov	244.928	500.05	58.09	3.332	248.260	2.083	0.458	2.110	54.00	54.000	58.652	134.00	7.784	181.824	0.000	181.824	181.824
	Dec	181.824	498.81	44.58	2.830	184.654	2.083	0.458	3.936	92.00	92.000	98.478	115.00	5.127	81.049	0.000	81.049	81.049
	Jan	81.049	495.76	23.96	4.053	85.102	2.083	0.458	2.693	40.00	40.000	45.234	118.00	2.827	37.040	0.000	37.040	37.040
	Feb	37.040	493.35	13.21	2.452	39.492	2.083	0.458	1.772	24.00	24.000	28.313	134.00	1.770	9.408	0.000	9.408	9.408
	Mar	9.408	490.10	4.57	2.428	11.837	2.083	0.458	0.000	1.00	1.000	3.542	181.00	0.827	7.468	0.000	7.468	7.468
	Apr	7.468	489.60	3.76	2.193	9.662	2.083	0.458	0.000	1.00	1.000	3.542	217.00	0.816	5.304	0.000	5.304	5.304
	May	5.304	489.00	2.81	2.701	8.005	2.083	0.458	0.000	1.00	1.000	3.542	247.00	0.693	3.771	0.000	3.771	3.771

MONTHLY WATER BALANCE OF MADIA DAM														Annexure-6.19 Contd.					
Year	Month	Intial Reservoir			Inflow from self catch-ment	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Irrigation release to chakar-pur dam	Release to Chakarpur Dam Based on total volume ,total demand & dead storage	Total Demand	Evaporation Loss		Balance Volume	Spill	Net Storage	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume				
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1981-82	June	3.771	488.34	2.17	11.830	15.600	2.083	0.458	0.000	0.00	0.000	2.542	175.00	0.380	12.679	0.000	12.679	12.679
	July	12.679	490.71	5.71	33.681	46.360	2.083	0.458	0.000	0.00	0.000	2.542	143.00	0.817	43.001	0.000	43.001	43.001
	Aug	43.001	493.79	14.68	119.273	162.274	2.083	0.458	0.000	0.00	0.000	2.542	124.00	1.820	157.912	0.000	157.912	157.912
	Sep	157.912	498.24	39.57	16.056	173.969	2.083	0.458	0.000	0.00	0.000	2.542	154.00	6.094	165.332	0.000	165.332	165.332
	Oct	165.332	498.41	41.13	7.148	172.481	2.083	0.458	1.838	5.00	5.000	9.380	159.00	6.540	156.561	0.000	156.561	156.561
	Nov	156.561	498.20	39.29	3.759	160.320	2.083	0.458	2.110	54.00	54.000	58.652	134.00	5.265	96.403	0.000	96.403	96.403
	Dec	96.403	496.36	26.96	3.738	100.141	2.083	0.458	3.936	37.00	37.000	43.478	115.00	3.101	53.563	0.000	53.563	53.563
	Jan	53.563	494.43	17.49	5.614	56.748	2.083	0.458	2.693	33.00	0.000	38.234	118.00	2.064	16.449	0.000	16.449	16.449
	Feb	16.449	491.30	7.02	6.154	20.175	2.083	0.458	1.772	0.00	0.000	4.313	134.00	0.941	14.920	0.000	14.920	14.920
	Mar	14.920	491.09	6.49	3.117	15.608	2.083	0.458	0.000	0.00	0.000	2.542	181.00	1.175	11.891	0.000	11.891	11.891
	Apr	11.891	490.56	5.44	2.231	11.694	2.083	0.458	0.000	0.00	0.000	2.542	217.00	1.179	7.973	0.000	7.973	7.973
	May	7.973	489.74	3.98	0.893	6.436	2.083	0.458	0.000	0.00	0.000	2.542	247.00	0.983	2.911	0.000	2.911	2.911
1982-83	June	2.911	487.95	1.81	6.739	7.222	2.083	0.458	0.000	0.00	0.000	2.542	175.00	0.316	4.364	0.000	4.364	4.364
	July	4.364	488.60	2.42	34.762	39.126	2.083	0.458	0.000	0.00	0.000	2.542	143.00	0.346	36.238	0.000	36.238	36.238
	Aug	36.238	493.29	13.01	209.327	245.566	2.083	0.458	0.000	0.00	0.000	2.542	124.00	1.614	241.410	0.000	241.410	241.410
	Sep	241.410	499.99	57.40	77.798	319.208	2.083	0.458	0.000	0.00	30.997	2.542	154.00	8.839	307.827	30.997	276.830	276.830
	Oct	276.830	500.55	64.36	41.806	318.636	2.083	0.458	1.838	5.00	27.193	9.380	159.00	10.233	299.023	22.193	276.830	276.830
	Nov	276.830	500.55	64.36	18.345	295.175	2.083	0.458	2.110	20.00	20.000	24.652	134.00	8.624	261.900	0.000	261.900	261.900
	Dec	261.900	500.32	61.42	18.685	280.585	2.083	0.458	3.936	92.00	92.000	98.478	115.00	7.064	175.043	0.000	175.043	175.043
	Jan	175.043	498.65	43.16	7.636	182.679	2.083	0.458	2.693	50.00	50.000	55.234	118.00	5.093	122.351	0.000	122.351	122.351
	Feb	122.351	497.24	32.02	2.920	125.271	2.083	0.458	1.772	33.00	33.000	37.313	134.00	4.290	83.667	0.000	83.667	83.667
	Mar	83.667	495.88	24.52	2.346	86.013	2.083	0.458	0.000	25.00	25.000	27.542	181.00	4.438	54.033	0.000	54.033	54.033
	Apr	54.033	494.46	17.62	1.463	55.496	2.083	0.458	0.000	9.00	9.000	11.542	217.00	3.824	40.131	0.000	40.131	40.131
	May	40.131	493.58	13.97	0.792	40.923	2.083	0.458	0.000	0.00	0.000	2.542	247.00	3.451	34.930	0.000	34.930	34.930
1983-84	June	34.930	493.20	12.69	4.663	39.593	2.083	0.458	0.000	0.00	0.000	2.542	175.00	2.221	34.830	0.000	34.830	34.830
	July	34.830	493.19	12.67	52.794	87.624	2.083	0.458	0.000	0.00	0.000	2.542	143.00	1.811	83.271	0.000	83.271	83.271
	Aug	83.271	495.86	24.43	179.958	263.229	2.083	0.458	0.000	0.00	0.000	2.542	124.00	3.030	257.658	0.000	257.658	257.658
	Sep	257.658	500.25	60.59	265.117	522.775	2.083	0.458	0.000	0.00	234.072	2.542	154.00	9.331	510.902	234.072	276.830	276.830
	Oct	276.830	500.55	64.36	80.555	357.385	2.083	0.458	1.838	5.00	65.943	9.380	159.00	10.233	337.773	60.943	276.830	276.830
	Nov	276.830	500.55	64.36	31.692	308.522	2.083	0.458	2.110	54.00	54.000	58.652	134.00	8.624	241.247	0.000	241.247	241.247
	Dec	241.247	499.99	57.36	7.970	249.217	2.083	0.458	3.936	92.00	92.000	98.478	115.00	6.596	144.143	0.000	144.143	144.143
	Jan	144.143	497.89	36.67	10.536	154.678	2.083	0.458	2.693	50.00	50.000	55.234	118.00	4.327	95.117	0.000	95.117	95.117
	Feb	95.117	496.31	26.72	5.325	100.442	2.083	0.458	1.772	33.00	33.000	37.313	134.00	3.581	59.548	0.000	59.548	59.548
	Mar	59.548	494.76	19.13	3.597	63.145	2.083	0.458	0.000	0.00	0.000	2.542	181.00	3.463	57.141	0.000	57.141	57.141
	Apr	57.141	494.63	18.47	2.008	59.150	2.083	0.458	0.000	0.00	0.000	2.542	217.00	4.008	52.600	0.000	52.600	52.600
	May	52.600	494.37	17.23	1.284	53.884	2.083	0.458	0.000	0.00	0.000	2.542	247.00	4.255	47.087	0.000	47.087	47.087

MONTHLY WATER BALANCE OF MADIA DAM													Annexure-6.19 Contd.					
Year	Month	Intial Reservoir			Inflow from self catch-ment	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Irrigation release to chakar-pur dam	Release to Chakarpur Dam Based on total volume ,total demand & dead storage	Total Demand	Evaporation Loss		Balance Volume	Spill	Net Storage	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume				
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1984-85	June	47.087	494.07	15.72	5.100	52.187	2.083	0.458	0.000	0.00	0.000	2.542	175.00	2.751	46.895	0.000	46.895	46.895
	July	46.895	494.06	15.67	14.717	61.612	2.083	0.458	0.000	0.00	0.000	2.542	143.00	2.240	56.830	0.000	56.830	56.830
	Aug	56.830	494.61	18.39	361.475	418.305	2.083	0.458	0.000	0.00	136.654	2.542	124.00	2.280	413.484	136.654	276.830	276.830
	Sep	276.830	500.55	64.36	47.204	324.034	2.083	0.458	0.000	0.00	34.751	2.542	154.00	9.911	311.581	34.751	276.830	276.830
	Oct	276.830	500.55	64.36	12.893	289.723	2.083	0.458	1.838	5.00	5.000	7.542	159.00	10.233	271.948	0.000	271.948	271.948
	Nov	271.948	500.47	63.40	3.133	275.082	2.083	0.458	2.110	54.00	54.000	56.542	134.00	8.495	210.045	0.000	210.045	210.045
	Dec	210.045	499.39	50.62	3.741	213.786	2.083	0.458	3.936	92.00	92.000	94.542	115.00	5.822	113.423	0.000	113.423	113.423
	Jan	113.423	496.97	30.13	3.499	116.922	2.083	0.458	2.693	50.00	50.000	52.542	118.00	3.555	60.825	0.000	60.825	60.825
	Feb	60.825	494.84	19.48	2.140	62.965	2.083	0.458	1.772	33.00	33.000	35.542	134.00	2.610	24.813	0.000	24.813	24.813
	Mar	24.813	492.29	9.79	1.977	26.790	2.083	0.458	0.000	0.00	0.000	2.542	181.00	1.771	22.478	0.000	22.478	22.478
	Apr	22.478	492.07	9.08	0.923	23.401	2.083	0.458	0.000	0.00	0.000	2.542	217.00	1.970	18.889	0.000	18.889	18.889
	May	18.889	491.62	7.87	0.691	19.580	2.083	0.458	0.000	0.00	0.000	2.542	247.00	1.943	15.095	0.000	15.095	15.095
1985-86	June	15.095	491.12	6.55	4.824	19.919	2.083	0.458	0.000	0.00	0.000	2.542	175.00	1.147	16.231	0.000	16.231	16.231
	July	16.231	491.27	6.95	48.532	64.763	2.083	0.458	0.000	0.00	0.000	2.542	143.00	0.993	61.228	0.000	61.228	61.228
	Aug	61.228	494.86	19.59	302.620	363.848	2.083	0.458	0.000	0.00	82.047	2.542	124.00	2.429	358.877	82.047	276.830	276.830
	Sep	276.830	500.55	64.36	205.149	481.979	2.083	0.458	0.000	0.00	192.697	2.542	154.00	9.911	469.527	192.697	276.830	276.830
	Oct	276.830	500.55	64.36	170.304	447.134	2.083	0.458	1.838	5.00	157.530	7.542	159.00	10.233	429.360	152.530	276.830	276.830
	Nov	276.830	500.55	64.36	28.742	305.572	2.083	0.458	2.110	54.00	54.000	56.542	134.00	8.624	240.407	0.000	240.407	240.407
	Dec	240.407	499.97	57.18	6.684	247.091	2.083	0.458	3.936	92.00	92.000	94.542	115.00	6.576	145.974	0.000	145.974	145.974
	Jan	145.974	497.94	37.06	5.878	151.852	2.083	0.458	2.693	50.00	50.000	52.542	118.00	4.374	94.937	0.000	94.937	94.937
	Feb	94.937	496.31	26.69	6.448	101.384	2.083	0.458	1.772	33.00	33.000	35.542	134.00	3.576	62.266	0.000	62.266	62.266
	Mar	62.266	494.92	19.87	5.592	67.859	2.083	0.458	0.000	0.00	0.000	2.542	181.00	3.597	61.720	0.000	61.720	61.720
	Apr	61.720	494.89	19.72	1.969	63.689	2.083	0.458	0.000	0.00	0.000	2.542	217.00	4.280	56.867	0.000	56.867	56.867
	May	56.867	494.61	18.40	0.913	57.780	2.083	0.458	0.000	0.00	0.000	2.542	247.00	4.544	50.695	0.000	50.695	50.695
1986-87	June	50.695	494.27	16.71	19.500	70.195	2.083	0.458	0.000	0.00	0.000	2.542	175.00	2.924	64.729	0.000	64.729	64.729
	July	64.729	495.04	20.49	573.449	638.178	2.083	0.458	0.000	0.00	355.877	2.542	143.00	2.930	632.707	355.877	276.830	276.830
	Aug	276.830	500.55	64.36	224.726	501.556	2.083	0.458	0.000	0.00	214.204	2.542	124.00	7.980	491.034	214.204	276.830	276.830
	Sep	276.830	500.55	64.36	40.416	317.246	2.083	0.458	0.000	0.00	27.963	2.542	154.00	9.911	304.793	27.963	276.830	276.830
	Oct	276.830	500.55	64.36	12.658	289.488	2.083	0.458	1.838	5.00	5.000	7.542	159.00	10.233	271.714	0.000	271.714	271.714
	Nov	271.714	500.47	63.35	3.229	274.943	2.083	0.458	2.110	54.00	54.000	56.542	134.00	8.489	209.913	0.000	209.913	209.913
	Dec	209.913	499.39	50.60	4.033	213.945	2.083	0.458	3.936	92.00	92.000	94.542	115.00	5.819	113.585	0.000	113.585	113.585
	Jan	113.585	496.98	30.16	4.334	117.919	2.083	0.458	2.693	50.00	50.000	52.542	118.00	3.559	61.819	0.000	61.819	61.819
	Feb	61.819	494.89	19.75	3.275	65.094	2.083	0.458	1.772	33.00	33.000	35.542	134.00	2.647	26.905	0.000	26.905	26.905
	Mar	26.905	492.49	10.42	2.452	29.357	2.083	0.458	0.000	0.00	0.000	2.542	181.00	1.886	24.930	0.000	24.930	24.930
	Apr	24.930	492.30	9.82	1.487	26.417	2.083	0.458	0.000	0.00	0.000	2.542	217.00	2.131	21.744	0.000	21.744	21.744
	May	21.744	492.00	8.86	0.708	22.452	2.083	0.458	0.000	0.00	0.000	2.542	247.00	2.188	17.723	0.000	17.723	17.723

MONTHLY WATER BALANCE OF MADIA DAM														Annexure-6.19 Contd.					
Year	Month	Intial Reservoir			Inflow from self catch-ment	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Irrigation release to chakar-pur dam	Release to Chakarpur Dam Based on total volume ,total demand & dead storage	Total Demand	Evaporation Loss		Balance Volume	Spill	Net Storage	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume				
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1987-88	June	17.723	491.47	7.46	4.942	22.664	2.083	0.458	0.000	0.00	0.000	2.542	175.00	1.306	18.817	0.000	18.817	18.817
	July	18.817	491.61	7.84	28.471	47.287	2.083	0.458	0.000	0.00	0.000	2.542	143.00	1.121	43.624	0.000	43.624	43.624
	Aug	43.624	493.83	14.83	230.393	274.017	2.083	0.458	0.000	0.00	0.000	2.542	124.00	1.839	269.636	0.000	269.636	269.636
	Sep	269.636	500.44	62.94	69.797	339.433	2.083	0.458	0.000	0.00	50.368	2.542	154.00	9.693	327.198	50.368	276.830	276.830
	Oct	276.830	500.55	64.36	14.790	291.620	2.083	0.458	1.838	5.00	5.000	7.542	159.00	10.233	273.846	0.000	273.846	273.846
	Nov	273.846	500.50	63.77	5.167	279.013	2.083	0.458	2.110	20.00	20.000	22.542	134.00	8.545	247.926	0.000	247.926	247.926
	Dec	247.926	500.10	58.68	3.353	251.279	2.083	0.458	3.936	92.00	92.000	94.542	115.00	6.748	149.989	0.000	149.989	149.989
	Jan	149.989	498.05	37.91	2.716	152.705	2.083	0.458	2.693	50.00	50.000	52.542	118.00	4.474	95.690	0.000	95.690	95.690
	Feb	95.690	496.33	26.83	3.229	98.919	2.083	0.458	1.772	39.00	39.000	41.542	134.00	3.595	53.782	0.000	53.782	53.782
	Mar	53.782	494.44	17.55	2.112	55.894	2.083	0.458	0.000	24.00	24.000	26.542	181.00	3.177	26.175	0.000	26.175	26.175
	Apr	26.175	492.42	10.20	0.906	27.082	2.083	0.458	0.000	10.00	10.000	12.542	217.00	2.213	12.327	0.000	12.327	12.327
	May	12.327	490.65	5.59	0.691	13.018	2.083	0.458	0.000	0.00	0.000	2.542	247.00	1.380	9.096	0.000	9.096	9.096
1988-89	June	9.096	490.04	4.46	9.640	18.736	2.083	0.458	0.000	0.00	0.000	2.542	175.00	0.780	15.415	0.000	15.415	15.415
	July	15.415	491.16	6.66	86.991	102.406	2.083	0.458	0.000	0.00	0.000	2.542	143.00	0.953	98.911	0.000	98.911	98.911
	Aug	98.911	496.45	27.43	144.508	243.419	2.083	0.458	0.000	0.00	0.000	2.542	124.00	3.401	237.476	0.000	237.476	237.476
	Sep	237.476	499.92	56.55	22.721	260.197	2.083	0.458	0.000	0.00	0.000	2.542	154.00	8.708	248.947	0.000	248.947	248.947
	Oct	248.947	500.11	58.88	10.702	259.649	2.083	0.458	1.838	5.00	5.000	7.542	159.00	9.362	242.745	0.000	242.745	242.745
	Nov	242.745	500.02	57.66	3.503	246.248	2.083	0.458	2.110	51.00	51.000	53.542	134.00	7.727	184.979	0.000	184.979	184.979
	Dec	184.979	498.88	45.25	3.811	188.790	2.083	0.458	3.936	86.00	86.000	88.542	115.00	5.203	95.045	0.000	95.045	95.045
	Jan	95.045	496.31	26.71	3.488	98.533	2.083	0.458	2.693	48.00	48.000	50.542	118.00	3.152	44.840	0.000	44.840	44.840
	Feb	44.840	493.92	15.13	2.497	47.337	2.083	0.458	1.772	32.00	32.000	34.542	134.00	2.028	10.768	0.000	10.768	10.768
	Mar	10.768	490.35	5.04	1.480	12.248	2.083	0.458	0.000	1.00	1.000	3.542	181.00	0.913	7.793	0.000	7.793	7.793
	Apr	7.793	489.69	3.90	1.115	8.909	2.083	0.458	0.000	0.00	0.000	2.542	217.00	0.847	5.520	0.000	5.520	5.520
	May	5.520	489.06	2.90	0.691	6.211	2.083	0.458	0.000	0.00	0.000	2.542	247.00	0.717	2.953	0.000	2.953	2.953
1989-90	June	2.953	487.98	1.83	6.135	9.087	2.083	0.458	0.000	0.00	0.000	2.542	175.00	0.320	6.226	0.000	6.226	6.226
	July	6.226	489.26	3.21	33.508	39.733	2.083	0.458	0.000	0.00	0.000	2.542	143.00	0.459	36.732	0.000	36.732	36.732
	Aug	36.732	493.33	13.14	201.991	238.724	2.083	0.458	0.000	0.00	0.000	2.542	124.00	1.629	234.553	0.000	234.553	234.553
	Sep	234.553	499.86	55.92	50.925	285.479	2.083	0.458	0.000	0.00	0.000	2.542	154.00	8.611	274.326	0.000	274.326	274.326
	Oct	274.326	500.51	63.86	7.547	281.873	2.083	0.458	1.838	3.00	3.000	5.542	159.00	10.154	266.177	0.000	266.177	266.177
	Nov	266.177	500.38	62.26	1.900	268.077	2.083	0.458	2.110	44.00	44.000	46.542	134.00	8.343	213.192	0.000	213.192	213.192
	Dec	213.192	499.45	51.30	2.814	216.006	2.083	0.458	3.936	96.00	96.000	98.542	115.00	5.900	111.565	0.000	111.565	111.565
	Jan	111.565	496.91	29.78	2.033	113.597	2.083	0.458	2.693	54.00	54.000	56.542	118.00	3.514	53.541	0.000	53.541	53.541
	Feb	53.541	494.43	17.49	1.028	54.570	2.083	0.458	1.772	34.00	34.000	36.542	134.00	2.343	15.685	0.000	15.685	15.685
	Mar	15.685	491.20	6.76	0.709	16.394	2.083	0.458	0.000	2.00	2.000	4.542	181.00	1.223	10.629	0.000	10.629	10.629
	Apr	10.629	490.33	4.99	0.695	11.324	2.083	0.458	0.000	1.00	1.000	3.542	217.00	1.084	6.699	0.000	6.699	6.699
	May	6.699	489.39	3.42	0.691	7.391	2.083	0.458	0.000	1.50	1.500	4.042	247.00	0.845	2.504	0.000	2.504	2.504

MONTHLY WATER BALANCE OF MADIA DAM														Annexure-6.19 Contd.					
Year	Month	Intial Reservoir			Inflow from self catch-ment	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Irrigation release to chakar-pur dam	Release to Chakarpur Dam Based on total volume ,total demand & dead storage	Total Demand	Evaporation Loss		Balance Volume	Spill	Net Storage	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume				
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1990-91	June	2.504	487.67	1.58	47.075	49.579	2.083	0.458	0.000	0.00	0.000	2.542	175.00	0.276	46.760	0.000	46.760	46.760
	July	46.760	494.05	15.63	115.888	162.649	2.083	0.458	0.000	0.00	0.000	2.542	143.00	2.235	157.872	0.000	157.872	157.872
	Aug	157.872	498.24	39.57	181.308	339.180	2.083	0.458	0.000	0.00	54.902	2.542	124.00	4.906	331.732	54.902	276.830	276.830
	Sep	276.830	500.55	64.36	259.230	536.060	2.083	0.458	0.000	0.00	246.778	2.542	154.00	9.911	523.608	246.778	276.830	276.830
	Oct	276.830	500.55	64.36	32.038	308.868	2.083	0.458	1.838	5.00	19.264	7.542	159.00	10.233	291.094	14.264	276.830	276.830
	Nov	276.830	500.55	64.36	6.466	283.296	2.083	0.458	2.110	30.00	30.000	32.542	134.00	8.624	242.130	0.000	242.130	242.130
	Dec	242.130	500.01	57.54	2.978	245.109	2.083	0.458	3.936	92.00	92.000	94.542	115.00	6.618	143.950	0.000	143.950	143.950
	Jan	143.950	497.88	36.63	2.118	146.067	2.083	0.458	2.693	50.00	50.000	52.542	118.00	4.323	89.203	0.000	89.203	89.203
	Feb	89.203	496.10	25.62	2.090	91.293	2.083	0.458	1.772	33.00	33.000	35.542	134.00	3.433	52.318	0.000	52.318	52.318
	Mar	52.318	494.36	17.15	1.931	54.249	2.083	0.458	0.000	24.00	24.000	26.542	181.00	3.104	24.603	0.000	24.603	24.603
	Apr	24.603	492.27	9.72	1.415	26.018	2.083	0.458	0.000	0.00	0.000	2.542	217.00	2.110	21.367	0.000	21.367	21.367
	May	21.367	491.95	8.73	0.767	22.133	2.083	0.458	0.000	0.00	0.000	2.542	247.00	2.155	17.436	0.000	17.436	17.436
1991-92	June	17.436	491.43	7.36	12.427	29.863	2.083	0.458	0.000	0.00	0.000	2.542	175.00	1.289	26.032	0.000	26.032	26.032
	July	26.032	492.41	10.15	43.569	69.601	2.083	0.458	0.000	0.00	0.000	2.542	143.00	1.452	65.607	0.000	65.607	65.607
	Aug	65.607	495.08	20.68	318.317	383.924	2.083	0.458	0.000	0.00	101.989	2.542	124.00	2.564	378.819	101.989	276.830	276.830
	Sep	276.830	500.55	64.36	35.970	312.800	2.083	0.458	0.000	0.00	23.517	2.542	154.00	9.911	300.347	23.517	276.830	276.830
	Oct	276.830	500.55	64.36	5.966	282.796	2.083	0.458	1.838	0.00	0.000	2.542	159.00	10.233	270.022	0.000	270.022	270.022
	Nov	270.022	500.44	63.02	2.406	272.428	2.083	0.458	2.110	54.00	54.000	56.542	134.00	8.445	207.441	0.000	207.441	207.441
	Dec	207.441	499.34	50.06	2.901	210.342	2.083	0.458	3.936	92.00	92.000	94.542	115.00	5.757	110.043	0.000	110.043	110.043
	Jan	110.043	496.85	29.50	4.187	114.231	2.083	0.458	2.693	50.00	50.000	52.542	118.00	3.481	58.208	0.000	58.208	58.208
	Feb	58.208	494.69	18.76	2.510	60.718	2.083	0.458	1.772	39.00	39.000	41.542	134.00	2.514	16.662	0.000	16.662	16.662
	Mar	16.662	491.32	7.10	1.636	18.298	2.083	0.458	0.000	5.00	5.000	7.542	181.00	1.284	9.472	0.000	9.472	9.472
	Apr	9.472	490.11	4.59	0.954	10.426	2.083	0.458	0.000	0.00	0.000	2.542	217.00	0.996	6.888	0.000	6.888	6.888
	May	6.888	489.44	3.50	0.791	7.679	2.083	0.458	0.000	0.00	0.000	2.542	247.00	0.865	4.272	0.000	4.272	4.272
1992-93	June	4.272	488.56	2.38	4.471	8.743	2.083	0.458	0.000	0.00	0.000	2.542	175.00	0.416	5.785	0.000	5.785	5.785
	July	5.785	489.14	3.02	43.969	49.754	2.083	0.458	0.000	0.00	0.000	2.542	143.00	0.432	46.781	0.000	46.781	46.781
	Aug	46.781	494.05	15.64	168.784	215.565	2.083	0.458	0.000	0.00	0.000	2.542	124.00	1.939	211.084	0.000	211.084	211.084
	Sep	211.084	499.41	50.85	54.015	265.100	2.083	0.458	0.000	0.00	0.000	2.542	154.00	7.831	254.727	0.000	254.727	254.727
	Oct	254.727	500.20	60.02	5.426	260.153	2.083	0.458	1.838	5.00	5.000	7.542	159.00	9.543	243.069	0.000	243.069	243.069
	Nov	243.069	500.02	57.73	1.392	244.461	2.083	0.458	2.110	51.00	51.000	53.542	134.00	7.736	183.184	0.000	183.184	183.184
	Dec	183.184	498.84	44.87	1.806	184.990	2.083	0.458	3.936	100.00	100.000	102.542	115.00	5.160	77.288	0.000	77.288	77.288
	Jan	77.288	495.60	23.16	0.971	78.259	2.083	0.458	2.693	44.00	44.000	46.542	118.00	2.733	28.985	0.000	28.985	28.985
	Feb	28.985	492.69	11.05	0.703	29.688	2.083	0.458	1.772	12.00	12.000	14.542	134.00	1.480	13.666	0.000	13.666	13.666
	Mar	13.666	490.90	6.06	0.702	14.368	2.083	0.458	0.000	3.00	3.000	5.542	181.00	1.096	7.730	0.000	7.730	7.730
	Apr	7.730	489.68	3.87	0.702	8.432	2.083	0.458	0.000	0.00	0.000	2.542	217.00	0.841	5.050	0.000	5.050	5.050
	May	5.050	488.89	2.70	0.698	5.748	2.083	0.458	0.000	0.00	0.000	2.542	247.00	0.667	2.539	0.000	2.539	2.539

MONTHLY WATER BALANCE OF MADIA DAM														Annexure-6.19 Contd.					
Year	Month	Intial Reservoir			Inflow from self catch-ment	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Irrigation release to chakar-pur dam	Release to Chakarpur Dam Based on total volume ,total demand & dead storage	Total Demand	Evaporation Loss		Balance Volume	Spill	Net Storage	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume				
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1993-94	June	2.539	487.70	1.60	7.572	10.112	2.083	0.458	0.000	0.00	0.000	2.542	175.00	0.280	7.290	0.000	7.290	7.290
	July	7.290	489.55	3.68	47.693	54.983	2.083	0.458	0.000	0.00	0.000	2.542	143.00	0.526	51.916	0.000	51.916	51.916
	Aug	51.916	494.34	17.04	114.159	166.074	2.083	0.458	0.000	0.00	0.000	2.542	124.00	2.113	161.420	0.000	161.420	161.420
	Sep	161.420	498.32	40.31	235.994	397.413	2.083	0.458	0.000	0.00	111.834	2.542	154.00	6.208	388.664	111.834	276.830	276.830
	Oct	276.830	500.55	64.36	47.432	324.262	2.083	0.458	1.838	5.00	34.657	7.542	159.00	10.233	306.487	29.657	276.830	276.830
	Nov	276.830	500.55	64.36	5.536	282.366	2.083	0.458	2.110	54.00	54.000	56.542	134.00	8.624	217.201	0.000	217.201	217.201
	Dec	217.201	499.53	52.17	4.063	221.264	2.083	0.458	3.936	92.00	92.000	94.542	115.00	5.999	120.723	0.000	120.723	120.723
	Jan	120.723	497.19	31.67	3.657	124.380	2.083	0.458	2.693	50.00	50.000	52.542	118.00	3.737	68.101	0.000	68.101	68.101
	Feb	68.101	495.19	21.21	2.575	70.676	2.083	0.458	1.772	33.00	33.000	35.542	134.00	2.842	32.293	0.000	32.293	32.293
	Mar	32.293	493.01	12.04	2.317	34.609	2.083	0.458	0.000	0.00	0.000	2.542	181.00	2.180	29.888	0.000	29.888	29.888
	Apr	29.888	492.78	11.32	2.282	32.170	2.083	0.458	0.000	0.00	0.000	2.542	217.00	2.456	27.172	0.000	27.172	27.172
	May	27.172	492.52	10.50	1.225	28.397	2.083	0.458	0.000	0.00	0.000	2.542	247.00	2.593	23.262	0.000	23.262	23.262
1994-95	June	23.262	492.14	9.32	42.802	66.064	2.083	0.458	0.000	0.00	0.000	2.542	175.00	1.630	61.892	0.000	61.892	61.892
	July	61.892	494.90	19.77	180.752	242.645	2.083	0.458	0.000	0.00	0.000	2.542	143.00	2.827	237.276	0.000	237.276	237.276
	Aug	237.276	499.91	56.50	357.738	595.014	2.083	0.458	0.000	0.00	308.636	2.542	124.00	7.006	585.466	308.636	276.830	276.830
	Sep	276.830	500.55	64.36	129.526	406.356	2.083	0.458	0.000	0.00	117.073	2.542	154.00	9.911	393.903	117.073	276.830	276.830
	Oct	276.830	500.55	64.36	13.803	290.633	2.083	0.458	1.838	5.00	5.000	7.542	159.00	10.233	272.859	0.000	272.859	272.859
	Nov	272.859	500.49	63.58	3.083	275.942	2.083	0.458	2.110	54.00	54.000	56.542	134.00	8.519	210.881	0.000	210.881	210.881
	Dec	210.881	499.40	50.81	3.785	214.667	2.083	0.458	3.936	92.00	92.000	94.542	115.00	5.843	114.283	0.000	114.283	114.283
	Jan	114.283	497.00	30.29	3.548	117.830	2.083	0.458	2.693	50.00	50.000	52.542	118.00	3.575	61.714	0.000	61.714	61.714
	Feb	61.714	494.89	19.72	4.328	66.042	2.083	0.458	1.772	33.00	33.000	35.542	134.00	2.643	27.857	0.000	27.857	27.857
	Mar	27.857	492.58	10.71	5.439	33.296	2.083	0.458	0.000	0.00	0.000	2.542	181.00	1.938	28.816	0.000	28.816	28.816
	Apr	28.816	492.68	11.00	2.345	31.162	2.083	0.458	0.000	0.00	0.000	2.542	217.00	2.386	26.234	0.000	26.234	26.234
	May	26.234	492.43	10.21	1.071	27.305	2.083	0.458	0.000	0.00	0.000	2.542	247.00	2.523	22.240	0.000	22.240	22.240
1995-96	June	22.240	492.05	9.01	4.491	26.731	2.083	0.458	0.000	0.00	0.000	2.542	175.00	1.576	22.613	0.000	22.613	22.613
	July	22.613	492.08	9.12	47.916	70.529	2.083	0.458	0.000	0.00	0.000	2.542	143.00	1.304	66.683	0.000	66.683	66.683
	Aug	66.683	495.13	20.90	83.230	149.914	2.083	0.458	0.000	0.00	0.000	2.542	124.00	2.592	144.780	0.000	144.780	144.780
	Sep	144.780	497.90	36.81	85.864	230.644	2.083	0.458	0.000	0.00	0.000	2.542	154.00	5.669	222.434	0.000	222.434	222.434
	Oct	222.434	499.63	53.30	7.855	230.289	2.083	0.458	1.838	5.00	5.000	7.542	159.00	8.475	214.273	0.000	214.273	214.273
	Nov	214.273	499.47	51.54	2.963	217.236	2.083	0.458	2.110	52.00	52.000	54.542	134.00	6.906	155.788	0.000	155.788	155.788
	Dec	155.788	498.19	39.13	3.627	159.415	2.083	0.458	3.936	89.00	89.000	91.542	115.00	4.500	63.374	0.000	63.374	63.374
	Jan	63.374	494.98	20.18	3.556	66.929	2.083	0.458	2.693	48.00	48.000	50.542	118.00	2.381	14.007	0.000	14.007	14.007
	Feb	14.007	490.96	6.18	1.730	15.737	2.083	0.458	1.772	0.60	0.600	3.142	134.00	0.828	11.767	0.000	11.767	11.767
	Mar	11.767	490.54	5.39	1.553	13.320	2.083	0.458	0.000	0.60	0.600	3.142	181.00	0.976	9.202	0.000	9.202	9.202
	Apr	9.202	490.06	4.49	0.848	10.051	2.083	0.458	0.000	0.60	0.600	3.142	217.00	0.975	5.934	0.000	5.934	5.934
	May	5.934	489.18	3.08	0.715	6.649	2.083	0.458	0.000	0.60	0.600	3.142	247.00	0.762	2.746	0.000	2.746	2.746

MONTHLY WATER BALANCE OF MADIA DAM														Annexure-6.19 Contd.					
Year	Month	Intial Reservoir			Inflow from self catch-ment	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Irrigation release to chakar-pur dam	Release to Chakarpur Dam Based on total volume ,total demand & dead storage	Total Demand	Evaporation Loss		Balance Volume	Spill	Net Storage	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume				
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1996-97	June	2.746	487.84	1.71	4.502	7.248	2.083	0.458	0.000	0.20	0.200	2.742	175.00	0.300	4.206	0.000	4.206	4.206
	July	4.206	488.53	2.35	136.342	140.548	2.083	0.458	0.000	0.00	0.000	2.542	143.00	0.336	137.670	0.000	137.670	137.670
	Aug	137.670	497.69	35.29	282.927	420.597	2.083	0.458	0.000	0.00	136.849	2.542	124.00	4.376	413.679	136.849	276.830	276.830
	Sep	276.830	500.55	64.36	139.600	416.430	2.083	0.458	0.000	0.00	127.148	2.542	154.00	9.911	403.978	127.148	276.830	276.830
	Oct	276.830	500.55	64.36	28.437	305.267	2.083	0.458	1.838	5.00	15.662	7.542	159.00	10.233	287.492	10.662	276.830	276.830
	Nov	276.830	500.55	64.36	11.309	288.139	2.083	0.458	2.110	54.00	54.000	56.542	134.00	8.624	222.974	0.000	222.974	222.974
	Dec	222.974	499.64	53.42	4.679	227.653	2.083	0.458	3.936	92.00	92.000	94.542	115.00	6.143	126.969	0.000	126.969	126.969
	Jan	126.969	497.38	33.00	3.788	130.756	2.083	0.458	2.693	50.00	50.000	52.542	118.00	3.894	74.320	0.000	74.320	74.320
	Feb	74.320	495.47	22.53	3.836	78.156	2.083	0.458	1.772	33.00	33.000	35.542	134.00	3.019	39.596	0.000	39.596	39.596
	Mar	39.596	493.54	13.84	1.765	41.361	2.083	0.458	0.000	0.00	0.000	2.542	181.00	2.505	36.314	0.000	36.314	36.314
	Apr	36.314	493.30	13.03	1.145	37.459	2.083	0.458	0.000	0.00	0.000	2.542	217.00	2.828	32.090	0.000	32.090	32.090
	May	32.090	492.99	11.99	0.987	33.077	2.083	0.458	0.000	0.00	0.000	2.542	247.00	2.960	27.575	0.000	27.575	27.575
1997-98	June	27.575	492.56	10.62	4.676	32.251	2.083	0.458	0.000	0.00	0.000	2.542	175.00	1.859	27.851	0.000	27.851	27.851
	July	27.851	492.58	10.70	146.833	174.684	2.083	0.458	0.000	0.00	0.000	2.542	143.00	1.531	170.611	0.000	170.611	170.611
	Aug	170.611	498.54	42.23	172.357	342.968	2.083	0.458	0.000	0.00	58.359	2.542	124.00	5.237	335.189	58.359	276.830	276.830
	Sep	276.830	500.55	64.36	100.008	376.838	2.083	0.458	0.000	0.00	87.555	2.542	154.00	9.911	364.385	87.555	276.830	276.830
	Oct	276.830	500.55	64.36	18.775	295.605	2.083	0.458	1.838	5.00	6.000	7.542	159.00	10.233	277.830	1.000	276.830	276.830
	Nov	276.830	500.55	64.36	17.809	294.639	2.083	0.458	2.110	54.00	54.000	56.542	134.00	8.624	229.474	0.000	229.474	229.474
	Dec	229.474	499.76	54.82	64.210	293.684	2.083	0.458	3.936	92.00	92.000	94.542	115.00	6.304	192.838	0.000	192.838	192.838
	Jan	192.838	499.06	46.91	6.877	199.715	2.083	0.458	2.693	50.00	50.000	52.542	118.00	5.535	141.638	0.000	141.638	141.638
	Feb	141.638	497.81	36.14	4.169	145.808	2.083	0.458	1.772	33.00	33.000	35.542	134.00	4.843	105.423	0.000	105.423	105.423
	Mar	105.423	496.69	28.64	4.073	109.497	2.083	0.458	0.000	0.00	0.000	2.542	181.00	5.184	101.771	0.000	101.771	101.771
	Apr	101.771	496.55	27.96	2.469	104.240	2.083	0.458	0.000	0.00	0.000	2.542	217.00	6.067	95.631	0.000	95.631	95.631
	May	95.631	496.33	26.82	1.153	96.784	2.083	0.458	0.000	0.00	0.000	2.542	247.00	6.624	87.618	0.000	87.618	87.618
1998-99	June	87.618	496.04	25.33	14.531	102.149	2.083	0.458	0.000	0.00	0.000	2.542	175.00	4.432	95.175	0.000	95.175	95.175
	July	95.175	496.32	26.73	129.382	224.557	2.083	0.458	0.000	0.00	0.000	2.542	143.00	3.823	218.192	0.000	218.192	218.192
	Aug	218.192	499.55	52.38	148.896	367.089	2.083	0.458	0.000	0.00	81.222	2.542	124.00	6.496	358.052	81.222	276.830	276.830
	Sep	276.830	500.55	64.36	142.528	419.358	2.083	0.458	0.000	0.00	130.076	2.542	154.00	9.911	406.906	130.076	276.830	276.830
	Oct	276.830	500.55	64.36	80.973	357.803	2.083	0.458	1.838	5.00	68.199	7.542	159.00	10.233	340.029	63.199	276.830	276.830
	Nov	276.830	500.55	64.36	22.447	299.277	2.083	0.458	2.110	54.00	54.000	56.542	134.00	8.624	234.112	0.000	234.112	234.112
	Dec	234.112	499.85	55.82	4.166	238.278	2.083	0.458	3.936	92.00	92.000	94.542	115.00	6.419	137.317	0.000	137.317	137.317
	Jan	137.317	497.68	35.21	3.606	140.923	2.083	0.458	2.693	50.00	50.000	52.542	118.00	4.155	84.226	0.000	84.226	84.226
	Feb	84.226	495.90	24.64	48.447	132.673	2.083	0.458	1.772	33.00	33.000	35.542	134.00	3.301	93.830	0.000	93.830	93.830
	Mar	93.830	496.27	26.48	16.514	110.344	2.083	0.458	0.000	0.00	0.000	2.542	181.00	4.793	103.009	0.000	103.009	103.009
	Apr	103.009	496.60	28.19	1.396	104.405	2.083	0.458	0.000	0.00	0.000	2.542	217.00	6.117	95.746	0.000	95.746	95.746
	May	95.746	496.34	26.84	0.795	96.541	2.083	0.458	0.000	0.00	0.000	2.542	247.00	6.629	87.370	0.000	87.370	87.370

MONTHLY WATER BALANCE OF MADIA DAM														Annexure-6.19 Contd.					
Year	Month	Intial Reservoir			Inflow from self catch-ment	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Irrigation release to chakar-pur dam	Release to Chakarpur Dam Based on total volume ,total demand & dead storage	Total Demand	Evaporation Loss		Balance Volume	Spill	Net Storage	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume				
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1999-00	June	87.370	496.03	25.28	7.569	94.939	2.083	0.458	0.000	0.00	0.000	2.542	175.00	4.424	87.973	0.000	87.973	87.973
	July	87.973	496.06	25.39	134.867	222.840	2.083	0.458	0.000	0.00	0.000	2.542	143.00	3.631	216.667	0.000	216.667	216.667
	Aug	216.667	499.52	52.05	186.770	403.437	2.083	0.458	0.000	0.00	117.611	2.542	124.00	6.455	394.441	117.611	276.830	276.830
	Sep	276.830	500.55	64.36	414.883	691.713	2.083	0.458	0.000	0.00	402.431	2.542	154.00	9.911	679.261	402.431	276.830	276.830
	Oct	276.830	500.55	64.36	166.178	443.008	2.083	0.458	1.838	5.00	153.403	7.542	159.00	10.233	425.233	148.403	276.830	276.830
	Nov	276.830	500.55	64.36	17.885	294.715	2.083	0.458	2.110	54.00	54.000	56.542	134.00	8.624	229.549	0.000	229.549	229.549
	Dec	229.549	499.76	54.83	3.992	233.541	2.083	0.458	3.936	92.00	92.000	94.542	115.00	6.306	132.694	0.000	132.694	132.694
	Jan	132.694	497.55	34.23	3.732	136.425	2.083	0.458	2.693	50.00	50.000	52.542	118.00	4.039	79.845	0.000	79.845	79.845
	Feb	79.845	495.71	23.70	4.512	84.356	2.083	0.458	1.772	33.00	33.000	35.542	134.00	3.176	45.638	0.000	45.638	45.638
	Mar	45.638	493.98	15.33	3.025	48.663	2.083	0.458	0.000	0.00	0.000	2.542	181.00	2.775	43.347	0.000	43.347	43.347
	Apr	43.347	493.81	14.77	1.868	45.215	2.083	0.458	0.000	0.00	0.000	2.542	217.00	3.204	39.469	0.000	39.469	39.469
	May	39.469	493.53	13.81	0.894	40.363	2.083	0.458	0.000	0.00	0.000	2.542	247.00	3.411	34.410	0.000	34.410	34.410
2000-01	June	34.410	493.16	12.56	7.286	41.697	2.083	0.458	0.000	0.00	0.000	2.542	175.00	2.199	36.956	0.000	36.956	36.956
	July	36.956	493.35	13.19	255.930	292.886	2.083	0.458	0.000	0.00	11.628	2.542	143.00	1.886	288.458	11.628	276.830	276.830
	Aug	276.830	500.55	64.36	75.967	352.797	2.083	0.458	0.000	0.00	65.445	2.542	124.00	7.980	342.275	65.445	276.830	276.830
	Sep	276.830	500.55	64.36	17.768	294.598	2.083	0.458	0.000	0.00	5.316	2.542	154.00	9.911	282.146	5.316	276.830	276.830
	Oct	276.830	500.55	64.36	4.909	281.739	2.083	0.458	1.838	5.00	5.000	7.542	159.00	10.233	263.965	0.000	263.965	263.965
	Nov	263.965	500.35	61.83	2.069	266.034	2.083	0.458	2.110	54.00	54.000	56.542	134.00	8.285	201.207	0.000	201.207	201.207
	Dec	201.207	499.22	48.72	4.334	205.541	2.083	0.458	3.936	92.00	92.000	94.542	115.00	5.602	105.397	0.000	105.397	105.397
	Jan	105.397	496.68	28.64	2.173	107.569	2.083	0.458	2.693	50.00	50.000	52.542	118.00	3.379	51.649	0.000	51.649	51.649
	Feb	51.649	494.32	16.97	0.719	52.368	2.083	0.458	1.772	33.00	33.000	35.542	134.00	2.274	14.552	0.000	14.552	14.552
	Mar	14.552	491.05	6.37	0.719	15.271	2.083	0.458	0.000	0.00	0.000	2.542	181.00	1.152	11.578	0.000	11.578	11.578
	Apr	11.578	490.51	5.33	0.719	12.297	2.083	0.458	0.000	0.00	0.000	2.542	217.00	1.156	8.599	0.000	8.599	8.599
	May	8.599	489.92	4.26	0.715	9.314	2.083	0.458	0.000	0.00	0.000	2.542	247.00	1.051	5.721	0.000	5.721	5.721
2001-02	June	5.721	489.12	2.99	15.766	21.488	2.083	0.458	0.000	0.00	0.000	2.542	175.00	0.523	18.423	0.000	18.423	18.423
	July	18.423	491.56	7.71	92.441	110.864	2.083	0.458	0.000	0.00	0.000	2.542	143.00	1.102	107.220	0.000	107.220	107.220
	Aug	107.220	496.75	28.97	163.442	270.662	2.083	0.458	0.000	0.00	0.000	2.542	124.00	3.593	264.528	0.000	264.528	264.528
	Sep	264.528	500.36	61.94	22.599	287.126	2.083	0.458	0.000	0.00	0.000	2.542	154.00	9.539	275.046	0.000	275.046	275.046
	Oct	275.046	500.52	64.01	9.898	284.944	2.083	0.458	1.838	5.00	5.000	7.542	159.00	10.177	267.225	0.000	267.225	267.225
	Nov	267.225	500.40	62.47	1.990	269.215	2.083	0.458	2.110	54.00	54.000	56.542	134.00	8.371	204.303	0.000	204.303	204.303
	Dec	204.303	499.28	49.38	2.448	206.751	2.083	0.458	3.936	92.00	92.000	94.542	115.00	5.679	106.530	0.000	106.530	106.530
	Jan	106.530	496.73	28.85	4.468	110.998	2.083	0.458	2.693	50.00	50.000	52.542	118.00	3.404	55.052	0.000	55.052	55.052
	Feb	55.052	494.51	17.90	1.129	56.181	2.083	0.458	1.772	33.00	33.000	35.542	134.00	2.399	18.241	0.000	18.241	18.241
	Mar	18.241	491.53	7.64	1.251	19.492	2.083	0.458	0.000	5.00	5.000	7.542	181.00	1.383	10.567	0.000	10.567	10.567
	Apr	10.567	490.32	4.97	1.311	11.878	2.083	0.458	0.000	1.00	1.000	3.542	217.00	1.079	7.257	0.000	7.257	7.257
	May	7.257	489.55	3.67	0.719	7.976	2.083	0.458	0.000	0.00	0.000	2.542	247.00	0.905	4.529	0.000	4.529	4.529

MONTHLY WATER BALANCE OF MADIA DAM														Annexure-6.19 Contd.					
Year	Month	Intial Reservoir			Inflow from self catch-ment	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Irrigation release to chakar-pur dam	Release to Chakarpur Dam Based on total volume ,total demand & dead storage	Total Demand	Evaporation Loss		Balance Volume	Spill	Net Storage	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume				
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
2002-03	June	4.529	488.67	2.49	7.483	12.012	2.083	0.458	0.000	0.00	0.000	2.542	175.00	0.435	9.036	0.000	9.036	9.036
	July	9.036	490.03	4.44	14.699	23.735	2.083	0.458	0.000	0.00	0.000	2.542	143.00	0.634	20.559	0.000	20.559	20.559
	Aug	20.559	491.84	8.45	163.792	184.351	2.083	0.458	0.000	0.00	0.000	2.542	124.00	1.047	180.762	0.000	180.762	180.762
	Sep	180.762	498.78	44.36	91.528	272.290	2.083	0.458	0.000	0.00	0.000	2.542	154.00	6.832	262.917	0.000	262.917	262.917
	Oct	262.917	500.33	61.62	4.456	267.373	2.083	0.458	1.838	3.00	3.000	5.542	159.00	9.798	252.033	0.000	252.033	252.033
	Nov	252.033	500.16	59.49	1.210	253.243	2.083	0.458	2.110	54.00	54.000	56.542	134.00	7.971	188.730	0.000	188.730	188.730
	Dec	188.730	498.97	46.03	2.123	190.853	2.083	0.458	3.936	92.00	92.000	94.542	115.00	5.294	91.018	0.000	91.018	91.018
	Jan	91.018	496.17	25.96	0.724	91.742	2.083	0.458	2.693	48.00	48.000	50.542	118.00	3.063	38.137	0.000	38.137	38.137
	Feb	38.137	493.43	13.48	0.724	38.861	2.083	0.458	1.772	24.00	24.000	26.542	134.00	1.807	10.512	0.000	10.512	10.512
	Mar	10.512	490.30	4.95	0.724	11.236	2.083	0.458	0.000	0.00	0.000	2.542	181.00	0.896	7.798	0.000	7.798	7.798
	Apr	7.798	489.70	3.90	0.724	8.522	2.083	0.458	0.000	0.00	0.000	2.542	217.00	0.847	5.133	0.000	5.133	5.133
	May	5.133	488.93	2.73	0.720	5.853	2.083	0.458	0.000	0.00	0.000	2.542	247.00	0.676	2.636	0.000	2.636	2.636
2003-04	June	2.636	487.76	1.65	17.543	20.179	2.083	0.458	0.000	0.00	0.000	2.542	175.00	0.289	17.348	0.000	17.348	17.348
	July	17.348	491.42	7.33	84.973	102.321	2.083	0.458	0.000	0.00	0.000	2.542	143.00	1.049	98.731	0.000	98.731	98.731
	Aug	98.731	496.44	27.39	104.571	203.302	2.083	0.458	0.000	0.00	0.000	2.542	124.00	3.397	197.363	0.000	197.363	197.363
	Sep	197.363	499.14	47.89	140.412	337.776	2.083	0.458	0.000	0.00	51.029	2.542	154.00	7.375	327.859	51.029	276.830	276.830
	Oct	276.830	500.55	64.36	26.677	303.507	2.083	0.458	1.838	5.00	13.902	7.542	159.00	10.233	285.732	8.902	276.830	276.830
	Nov	276.830	500.55	64.36	3.121	279.951	2.083	0.458	2.110	54.00	54.000	56.542	134.00	8.624	214.786	0.000	214.786	214.786
	Dec	214.786	499.48	51.65	3.456	218.242	2.083	0.458	3.936	92.00	92.000	94.542	115.00	5.940	117.761	0.000	117.761	117.761
	Jan	117.761	497.11	31.04	3.393	121.153	2.083	0.458	2.693	50.00	50.000	52.542	118.00	3.662	64.950	0.000	64.950	64.950
	Feb	64.950	495.05	20.54	4.620	69.569	2.083	0.458	1.772	33.00	33.000	35.542	134.00	2.752	31.276	0.000	31.276	31.276
	Mar	31.276	492.91	11.74	3.119	34.395	2.083	0.458	0.000	0.00	0.000	2.542	181.00	2.125	29.728	0.000	29.728	29.728
	Apr	29.728	492.76	11.27	0.932	30.660	2.083	0.458	0.000	0.00	0.000	2.542	217.00	2.446	25.673	0.000	25.673	25.673
	May	25.673	492.37	10.05	0.784	26.456	2.083	0.458	0.000	0.00	0.000	2.542	247.00	2.481	21.434	0.000	21.434	21.434
2004-05	June	21.434	491.96	8.75	8.329	29.763	2.083	0.458	0.000	0.00	0.000	2.542	175.00	1.531	25.690	0.000	25.690	25.690
	July	25.690	492.38	10.05	61.002	86.692	2.083	0.458	0.000	0.00	0.000	2.542	143.00	1.437	82.713	0.000	82.713	82.713
	Aug	82.713	495.84	24.31	305.610	388.324	2.083	0.458	0.000	0.00	105.937	2.542	124.00	3.015	382.767	105.937	276.830	276.830
	Sep	276.830	500.55	64.36	26.921	303.751	2.083	0.458	0.000	0.00	14.468	2.542	154.00	9.911	291.298	14.468	276.830	276.830
	Oct	276.830	500.55	64.36	9.899	286.729	2.083	0.458	1.838	5.00	5.000	7.542	159.00	10.233	268.955	0.000	268.955	268.955
	Nov	268.955	500.43	62.81	2.883	271.838	2.083	0.458	2.110	54.00	54.000	56.542	134.00	8.417	206.880	0.000	206.880	206.880
	Dec	206.880	499.33	49.94	4.135	211.015	2.083	0.458	3.936	92.00	92.000	94.542	115.00	5.743	110.730	0.000	110.730	110.730
	Jan	110.730	496.88	29.63	6.046	116.776	2.083	0.458	2.693	50.00	50.000	52.542	118.00	3.496	60.738	0.000	60.738	60.738
	Feb	60.738	494.83	19.46	3.512	64.250	2.083	0.458	1.772	33.00	33.000	35.542	134.00	2.607	26.101	0.000	26.101	26.101
	Mar	26.101	492.42	10.17	1.654	27.755	2.083	0.458	0.000	0.00	0.000	2.542	181.00	1.842	23.372	0.000	23.372	23.372
	Apr	23.372	492.15	9.35	0.869	24.241	2.083	0.458	0.000	0.00	0.000	2.542	217.00	2.029	19.670	0.000	19.670	19.670
	May	19.670	491.72	8.14	0.727	20.397	2.083	0.458	0.000	0.00	0.000	2.542	247.00	2.010	15.845	0.000	15.845	15.845

MONTHLY WATER BALANCE OF MADIA DAM														Annexure-6.19 Contd.					
Year	Month	Intial Reservoir			Inflow from self catch-ment	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Irrigation release to chakar-pur dam	Release to Chakarpur Dam Based on total volume ,total demand & dead storage	Total Demand	Evaporation Loss		Balance Volume	Spill	Net Storage	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume				
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
2005-06	June	15.845	491.22	6.81	6.562	22.407	2.083	0.458	0.000	0.00	0.000	2.542	175.00	1.192	18.673	0.000	18.673	18.673
	July	18.673	491.59	7.79	304.264	322.936	2.083	0.458	0.000	0.00	42.450	2.542	143.00	1.114	319.280	42.450	276.830	276.830
	Aug	276.830	500.55	64.36	165.856	442.686	2.083	0.458	0.000	0.00	155.335	2.542	124.00	7.980	432.165	155.335	276.830	276.830
	Sep	276.830	500.55	64.36	50.833	327.663	2.083	0.458	0.000	0.00	38.381	2.542	154.00	9.911	315.211	38.381	276.830	276.830
	Oct	276.830	500.55	64.36	7.959	284.789	2.083	0.458	1.838	5.00	5.000	7.542	159.00	10.233	267.015	0.000	267.015	267.015
	Nov	267.015	500.40	62.43	2.436	269.451	2.083	0.458	2.110	54.00	54.000	56.542	134.00	8.366	204.544	0.000	204.544	204.544
	Dec	204.544	499.28	49.44	4.168	208.711	2.083	0.458	3.936	92.00	92.000	94.542	115.00	5.685	108.484	0.000	108.484	108.484
	Jan	108.484	496.80	29.21	4.583	113.067	2.083	0.458	2.693	50.00	50.000	52.542	118.00	3.447	57.079	0.000	57.079	57.079
	Feb	57.079	494.63	18.45	3.400	60.479	2.083	0.458	1.772	33.00	33.000	35.542	134.00	2.473	22.464	0.000	22.464	22.464
	Mar	22.464	492.07	9.07	2.036	24.500	2.083	0.458	0.000	0.00	0.000	2.542	181.00	1.643	20.315	0.000	20.315	20.315
	Apr	20.315	491.81	8.36	1.012	21.327	2.083	0.458	0.000	0.00	0.000	2.542	217.00	1.814	16.971	0.000	16.971	16.971
	May	16.971	491.37	7.20	1.065	18.036	2.083	0.458	0.000	0.00	0.000	2.542	247.00	1.779	13.715	0.000	13.715	13.715
2006-07	June	13.715	490.91	6.07	5.031	18.746	2.083	0.458	0.000	0.00	0.000	2.542	175.00	1.063	15.141	0.000	15.141	15.141
	July	15.141	491.12	6.57	67.891	83.032	2.083	0.458	0.000	0.00	0.000	2.542	143.00	0.939	79.551	0.000	79.551	79.551
	Aug	79.551	495.70	23.64	473.995	553.546	2.083	0.458	0.000	0.00	271.243	2.542	124.00	2.932	548.073	271.243	276.830	276.830
	Sep	276.830	500.55	64.36	400.690	677.520	2.083	0.458	0.000	0.00	388.238	2.542	154.00	9.911	665.068	388.238	276.830	276.830
	Oct	276.830	500.55	64.36	19.667	296.497	2.083	0.458	1.838	5.00	6.893	7.542	159.00	10.233	278.723	1.893	276.830	276.830
	Nov	276.830	500.55	64.36	2.039	278.869	2.083	0.458	2.110	54.00	54.000	56.542	134.00	8.624	213.704	0.000	213.704	213.704
	Dec	213.704	499.46	51.41	4.597	218.301	2.083	0.458	3.936	92.00	92.000	94.542	115.00	5.913	117.847	0.000	117.847	117.847
	Jan	117.847	497.11	31.05	5.029	122.876	2.083	0.458	2.693	50.00	50.000	52.542	118.00	3.664	66.670	0.000	66.670	66.670
	Feb	66.670	495.13	20.90	3.297	69.967	2.083	0.458	1.772	33.00	33.000	35.542	134.00	2.801	31.625	0.000	31.625	31.625
	Mar	31.625	492.94	11.85	2.501	34.125	2.083	0.458	0.000	0.00	0.000	2.542	181.00	2.144	29.440	0.000	29.440	29.440
	Apr	29.440	492.74	11.18	0.899	30.339	2.083	0.458	0.000	0.00	0.000	2.542	217.00	2.427	25.370	0.000	25.370	25.370
	May	25.370	492.35	9.95	0.731	26.101	2.083	0.458	0.000	0.00	0.000	2.542	247.00	2.459	21.101	0.000	21.101	21.101
2007-08	June	21.101	491.91	8.63	5.705	26.806	2.083	0.458	0.000	0.00	0.000	2.542	175.00	1.511	22.754	0.000	22.754	22.754
	July	22.754	492.10	9.16	54.395	77.149	2.083	0.458	0.000	0.00	0.000	2.542	143.00	1.310	73.297	0.000	73.297	73.297
	Aug	73.297	495.42	22.31	47.530	120.827	2.083	0.458	0.000	0.00	0.000	2.542	124.00	2.767	115.519	0.000	115.519	115.519
	Sep	115.519	497.04	30.56	42.509	158.028	2.083	0.458	0.000	0.00	0.000	2.542	154.00	4.706	150.780	0.000	150.780	150.780
	Oct	150.780	498.07	38.08	4.398	155.179	2.083	0.458	1.838	5.00	5.000	7.542	159.00	6.055	141.582	0.000	141.582	141.582
	Nov	141.582	497.81	36.13	0.740	142.323	2.083	0.458	2.110	54.00	54.000	56.542	134.00	4.841	80.940	0.000	80.940	80.940
	Dec	80.940	495.76	23.94	0.740	81.680	2.083	0.458	3.936	25.00	25.000	27.542	115.00	2.753	51.386	0.000	51.386	51.386
	Jan	51.386	494.31	16.90	0.740	52.126	2.083	0.458	2.693	20.00	20.000	22.542	118.00	1.994	27.591	0.000	27.591	27.591
	Feb	27.591	492.56	10.63	0.740	28.332	2.083	0.458	1.772	10.00	10.000	12.542	134.00	1.424	14.366	0.000	14.366	14.366
	Mar	14.366	491.02	6.30	0.740	15.107	2.083	0.458	0.000	1.00	1.000	3.542	181.00	1.140	10.424	0.000	10.424	10.424
	Apr	10.424	490.29	4.92	0.740	11.165	2.083	0.458	0.000	1.00	1.000	3.542	217.00	1.068	6.555	0.000	6.555	6.555
	May	6.555	489.35	3.36	0.736	7.292	2.083	0.458	0.000	1.00	1.000	3.542	247.00	0.829	2.921	0.000	2.921	2.921

MONTHLY WATER BALANCE OF MADIA DAM														Annexure-6.19 Contd.					
Year	Month	Intial Reservoir			Inflow from self catch-ment	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Irrigation release to chakar-pur dam	Release to Chakarpur Dam Based on total volume ,total demand & dead storage	Total Demand	Evaporation Loss		Balance Volume	Spill	Net Storage	Final Reservoir Storage
		Storage	Elevation	Area									Depth	Volume				
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
2008-09	June	2.921	487.96	1.81	17.644	20.564	2.083	0.458	0.000	0.00	0.000	2.542	175.00	0.317	17.706	0.000	17.706	17.706
	July	17.706	491.46	7.46	44.146	61.852	2.083	0.458	0.000	0.00	0.000	2.542	143.00	1.066	58.244	0.000	58.244	58.244
	Aug	58.244	494.69	18.77	150.430	208.673	2.083	0.458	0.000	0.00	0.000	2.542	124.00	2.328	203.804	0.000	203.804	203.804
	Sep	203.804	499.27	49.28	41.282	245.086	2.083	0.458	0.000	0.00	0.000	2.542	154.00	7.589	234.956	0.000	234.956	234.956
	Oct	234.956	499.87	56.00	5.001	239.957	2.083	0.458	1.838	5.00	5.000	7.542	159.00	8.904	223.511	0.000	223.511	223.511
	Nov	223.511	499.65	53.53	0.754	224.265	2.083	0.458	2.110	50.00	50.000	52.542	134.00	7.173	164.550	0.000	164.550	164.550
	Dec	164.550	498.39	40.97	0.754	165.304	2.083	0.458	3.936	90.00	90.000	92.542	115.00	4.711	68.051	0.000	68.051	68.051
	Jan	68.051	495.19	21.20	0.754	68.805	2.083	0.458	2.693	45.00	45.000	47.542	118.00	2.501	18.763	0.000	18.763	18.763
	Feb	18.763	491.60	7.82	0.754	19.517	2.083	0.458	1.772	2.00	2.000	4.542	134.00	1.048	13.927	0.000	13.927	13.927
	Mar	13.927	490.95	6.15	0.754	14.681	2.083	0.458	0.000	1.00	1.000	3.542	181.00	1.113	10.026	0.000	10.026	10.026
	Apr	10.026	490.21	4.78	0.754	10.780	2.083	0.458	0.000	1.00	1.000	3.542	217.00	1.038	6.201	0.000	6.201	6.201
	May	6.201	489.25	3.20	0.750	6.951	2.083	0.458	0.000	1.00	1.000	3.542	247.00	0.791	2.619	0.000	2.619	2.619
2009-10	June	2.619	487.75	1.64	5.004	7.622	2.083	0.458	0.000	0.00	0.000	2.542	175.00	0.288	4.793	0.000	4.793	4.793
	July	4.793	488.78	2.59	83.091	87.884	2.083	0.458	0.000	0.00	0.000	2.542	143.00	0.371	84.971	0.000	84.971	84.971
	Aug	84.971	495.93	24.80	52.212	137.183	2.083	0.458	0.000	0.00	0.000	2.542	124.00	3.075	131.567	0.000	131.567	131.567
	Sep	131.567	497.51	33.99	99.847	231.413	2.083	0.458	0.000	0.00	0.000	2.542	154.00	5.234	223.638	0.000	223.638	223.638
	Oct	223.638	499.65	53.56	31.360	254.998	2.083	0.458	1.838	5.00	5.000	7.542	159.00	8.516	238.940	0.000	238.940	238.940
	Nov	238.940	499.95	56.86	27.819	266.759	2.083	0.458	2.110	54.00	54.000	56.542	134.00	7.620	202.598	0.000	202.598	202.598
	Dec	202.598	499.24	49.02	9.030	211.628	2.083	0.458	3.936	92.00	92.000	94.542	115.00	5.637	111.450	0.000	111.450	111.450
	Jan	111.450	496.90	29.76	2.321	113.770	2.083	0.458	2.693	50.00	50.000	52.542	118.00	3.512	57.717	0.000	57.717	57.717
	Feb	57.717	494.66	18.63	2.172	59.888	2.083	0.458	1.772	33.00	33.000	35.542	134.00	2.496	21.851	0.000	21.851	21.851
	Mar	21.851	492.01	8.89	1.194	23.044	2.083	0.458	0.000	6.00	6.000	8.542	181.00	1.609	12.893	0.000	12.893	12.893
	Apr	12.893	490.75	5.79	0.854	13.747	2.083	0.458	0.000	0.00	0.000	2.542	217.00	1.256	9.950	0.000	9.950	9.950
	May	9.950	490.20	4.76	0.768	10.717	2.083	0.458	0.000	0.00	0.000	2.542	247.00	1.175	7.001	0.000	7.001	7.001
		Success rate			100.00	%												

MONTHLY WATER BALANCE OF DEHRA DAM												Annexure-6.19 Contd.						
Year	Month	Intial Reservoir			Inflow from self catchment	Release from Semraghat Weir	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Plan release	Irrigation release to chakarpur dam	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area										Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1978-79	June	0.010	465.35	0.01	1.380	0.000	1.380		0.642	0.000	0.000	0.000	0.642	175.00	0.002	0.737	0.000	0.737
	July	0.737	469.84	0.46	12.328	15.000	28.065		0.642	0.000	0.000	0.000	0.642	143.00	0.066	27.357	0.000	27.357
	Aug	27.357	483.12	3.51	23.939	27.000	78.296		0.642	0.000	0.000	4.819	0.642	124.00	0.435	77.219	4.819	72.400
	Sept	72.400	491.60	7.55	4.415	7.000	83.815		0.642	0.000	0.000	9.611	0.642	154.00	1.162	82.011	9.611	72.400
	Oct	72.400	491.60	7.55	0.799	3.350	76.549		0.642	0.845	24.000	24.000	25.487	159.00	1.200	49.862	0.000	49.862
	Nov	49.862	488.17	5.56	0.233	3.000	53.095		0.642	0.971	30.000	30.000	31.612	134.00	0.746	20.737	0.000	20.737
	Dec	20.737	481.11	3.06	0.429	0.000	21.166		0.642	1.810	4.000	4.000	6.452	115.00	0.352	14.362	0.000	14.362
	Jan	14.362	478.82	2.53	0.329	0.000	14.692		0.642	1.240	0.000	0.000	1.881	118.00	0.298	12.512	0.000	12.512
	Feb	12.512	478.08	2.37	0.282	0.000	12.795		0.642	0.817	0.000	0.000	1.458	134.00	0.317	11.019	0.000	11.019
	Mar	11.019	477.42	2.20	0.158	0.000	11.177		0.642	0.000	0.000	0.000	0.642	181.00	0.398	10.138	0.000	10.138
	Apr	10.138	477.02	2.10	0.106	0.000	10.244		0.642	0.000	0.000	0.000	0.642	217.00	0.455	9.148	0.000	9.148
	May	9.148	476.52	1.99	0.080	0.000	9.227		0.642	0.000	0.000	0.000	0.642	247.00	0.492	8.094	0.000	8.094
1979-80	June	8.094	476.00	1.88	0.603	0.222	8.920		0.642	0.000	0.000	0.000	0.642	175.00	0.329	7.949	0.000	7.949
	July	7.949	475.92	1.86	1.346	10.222	19.517		0.642	0.000	0.000	0.000	0.642	143.00	0.267	18.609	0.000	18.609
	Aug	18.609	480.38	2.88	3.923	20.222	42.754		0.642	0.000	0.000	0.000	0.642	124.00	0.357	41.756	0.000	41.756
	Sept	41.756	486.59	4.82	0.327	3.222	45.305		0.642	0.000	0.000	0.000	0.642	154.00	0.742	43.922	0.000	43.922
	Oct	43.922	487.04	5.00	0.083	0.722	44.727		0.642	0.845	15.000	15.000	16.487	159.00	0.795	27.444	0.000	27.444
	Nov	27.444	483.15	3.52	0.805	0.222	28.471		0.642	0.971	15.000	15.000	16.612	134.00	0.471	11.388	0.000	11.388
	Dec	11.388	477.59	2.24	0.736	0.222	12.346		0.642	1.810	2.000	2.000	4.452	115.00	0.258	7.636	0.000	7.636
	Jan	7.636	475.74	1.83	0.110	0.222	7.969		0.642	1.240	0.000	0.000	1.881	118.00	0.216	5.871	0.000	5.871
	Feb	5.871	474.73	1.64	0.077	0.222	6.171		0.642	0.817	0.000	0.000	1.458	134.00	0.220	4.492	0.000	4.492
	Mar	4.492	473.84	1.46	0.064	0.000	4.556		0.642	0.000	0.000	0.000	0.642	181.00	0.264	3.651	0.000	3.651
	Apr	3.651	473.19	1.32	0.022	0.000	3.673		0.642	0.000	0.000	0.000	0.642	217.00	0.287	2.744	0.000	2.744
	May	2.744	472.45	1.12	0.014	0.000	2.758		0.642	0.000	0.000	0.000	0.642	247.00	0.276	1.841	0.000	1.841
1980-81	June	1.841	471.55	0.87	1.615	0.000	3.455		0.642	0.000	0.000	0.000	0.642	175.00	0.152	2.661	0.000	2.661
	July	2.661	472.38	1.09	2.046	15.000	19.707		0.642	0.000	0.000	0.000	0.642	143.00	0.156	18.909	0.000	18.909
	Aug	18.909	480.49	2.90	8.185	27.000	54.094		0.642	0.000	0.000	0.000	0.642	124.00	0.360	53.092	0.000	53.092
	Sept	53.092	488.72	5.88	3.840	7.000	63.932		0.642	0.000	0.000	0.000	0.642	154.00	0.905	62.385	0.000	62.385
	Oct	62.385	490.20	6.73	0.741	3.350	66.476		0.642	0.845	24.000	24.000	25.487	159.00	1.070	39.919	0.000	39.919
	Nov	39.919	486.21	4.66	0.194	3.000	43.113		0.642	0.971	30.000	30.000	31.612	134.00	0.624	10.876	0.000	10.876
	Dec	10.876	477.35	2.18	0.164	0.000	11.041		0.642	1.810	2.000	2.000	4.452	115.00	0.251	6.338	0.000	6.338
	Jan	6.338	475.02	1.70	0.235	0.000	6.573		0.642	1.240	0.000	0.000	1.881	118.00	0.201	4.491	0.000	4.491
	Feb	4.491	473.84	1.46	0.142	0.000	4.634		0.642	0.817	0.000	0.000	1.458	134.00	0.195	2.980	0.000	2.980
	Mar	2.980	472.65	1.18	0.141	0.000	3.121		0.642	0.000	0.000	0.000	0.642	181.00	0.213	2.266	0.000	2.266
	Apr	2.266	472.06	0.99	0.127	0.000	2.394		0.642	0.000	0.000	0.000	0.642	217.00	0.215	1.537	0.000	1.537
	May	1.537	471.17	0.78	0.157	0.000	1.694		0.642	0.000	0.000	0.000	0.642	247.00	0.193	0.859	0.000	0.859

MONTHLY WATER BALANCE OF DEHRA DAM												Annexure-6.19 Contd.						
Year	Month	Intial Reservoir			Inflow from self catchment	Release from Semraghat Weir	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Plan release	Irrigation release to chakarpur dam	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area										Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1981-82	June	0.859	470.10	0.52	0.687	6.000	7.547		0.642	0.000	0.000	0.000	0.642	175.00	0.091	6.814	0.000	6.814
	July	6.814	475.29	1.75	1.957	12.000	20.770		0.642	0.000	0.000	0.000	0.642	143.00	0.250	19.878	0.000	19.878
	Aug	19.878	480.82	2.99	6.929	27.000	53.808		0.642	0.000	0.000	0.000	0.642	124.00	0.371	52.795	0.000	52.795
	Sept	52.795	488.67	5.85	0.933	4.000	57.728		0.642	0.000	0.000	0.000	0.642	154.00	0.901	56.186	0.000	56.186
	Oct	56.186	489.24	6.17	0.415	3.350	59.951		0.642	0.845	24.000	24.000	25.487	159.00	0.981	33.483	0.000	33.483
	Nov	33.483	484.72	4.08	0.218	3.000	36.701		0.642	0.971	20.000	20.000	21.612	134.00	0.547	14.542	0.000	14.542
	Dec	14.542	478.90	2.54	0.217	0.000	14.759		0.642	1.810	4.000	4.000	6.452	115.00	0.292	8.015	0.000	8.015
	Jan	8.015	475.95	1.87	0.326	0.000	8.341		0.642	1.240	0.500	0.500	2.381	118.00	0.221	5.739	0.000	5.739
	Feb	5.739	474.65	1.63	0.358	0.000	6.097		0.642	0.817	0.500	0.500	1.958	134.00	0.218	3.921	0.000	3.921
	Mar	3.921	473.40	1.37	0.181	0.000	4.102		0.642	0.000	0.500	0.500	1.142	181.00	0.247	2.713	0.000	2.713
	Apr	2.713	472.43	1.11	0.130	0.000	2.842		0.642	0.000	0.500	0.500	1.142	217.00	0.240	1.460	0.000	1.460
	May	1.460	471.08	0.76	0.052	0.000	1.512		0.642	0.000	0.600	0.600	1.242	247.00	0.187	0.083	0.000	0.083
1982-83	June	0.083	466.81	0.05	0.692	0.000	0.775		0.642	0.000	0.000	0.000	0.642	175.00	0.009	0.124	0.000	0.124
	July	0.124	467.24	0.08	2.019	15.000	17.144		0.642	0.000	0.000	0.000	0.642	143.00	0.011	16.491	0.000	16.491
	Aug	16.491	479.63	2.70	12.161	27.000	55.652		0.642	0.000	0.000	0.000	0.642	124.00	0.335	54.675	0.000	54.675
	Sept	54.675	489.00	6.03	4.520	7.000	66.195		0.642	0.000	0.000	0.000	0.642	154.00	0.928	64.625	0.000	64.625
	Oct	64.625	490.53	6.90	2.429	3.350	70.404		0.642	0.845	24.000	24.000	25.487	159.00	1.097	43.819	0.000	43.819
	Nov	43.819	487.02	4.99	1.066	3.000	47.885		0.642	0.971	30.000	30.000	31.612	134.00	0.669	15.604	0.000	15.604
	Dec	15.604	479.30	2.63	1.085	0.000	16.689		0.642	1.810	4.000	4.000	6.452	115.00	0.302	9.935	0.000	9.935
	Jan	9.935	476.92	2.07	0.444	0.000	10.379		0.642	1.240	0.000	0.000	1.881	118.00	0.245	8.253	0.000	8.253
	Feb	8.253	476.08	1.90	0.170	0.000	8.423		0.642	0.817	0.000	0.000	1.458	134.00	0.254	6.710	0.000	6.710
	Mar	6.710	475.23	1.74	0.136	0.000	6.847		0.642	0.000	0.000	0.000	0.642	181.00	0.315	5.890	0.000	5.890
	Apr	5.890	474.74	1.64	0.085	0.000	5.975		0.642	0.000	0.000	0.000	0.642	217.00	0.357	4.976	0.000	4.976
	May	4.976	474.17	1.53	0.046	0.000	5.022		0.642	0.000	0.000	0.000	0.642	247.00	0.377	4.004	0.000	4.004
1983-84	June	4.004	473.46	1.38	0.271	0.000	4.275		0.642	0.000	0.000	0.000	0.642	175.00	0.242	3.391	0.000	3.391
	July	3.391	472.99	1.28	3.067	15.000	21.458		0.642	0.000	0.000	0.000	0.642	143.00	0.183	20.633	0.000	20.633
	Aug	20.633	481.08	3.05	10.455	27.000	58.088		0.642	0.000	0.000	0.000	0.642	124.00	0.379	57.068	0.000	57.068
	Sept	57.068	489.38	6.25	15.402	7.000	79.470		0.642	0.000	0.000	5.465	0.642	154.00	0.963	77.865	5.465	72.400
	Oct	72.400	491.60	7.55	4.680	3.350	80.430		0.642	0.845	24.000	24.000	25.487	159.00	1.200	53.743	0.000	53.743
	Nov	53.743	488.83	5.94	1.841	3.000	58.584		0.642	0.971	30.000	30.000	31.612	134.00	0.796	26.176	0.000	26.176
	Dec	26.176	482.79	3.43	0.463	0.000	26.639		0.642	1.810	4.000	4.000	6.452	115.00	0.394	19.793	0.000	19.793
	Jan	19.793	480.79	2.98	0.612	0.000	20.405		0.642	1.240	0.000	0.000	1.881	118.00	0.352	18.172	0.000	18.172
	Feb	18.172	480.23	2.84	0.309	0.000	18.481		0.642	0.817	0.000	0.000	1.458	134.00	0.381	16.643	0.000	16.643
	Mar	16.643	479.68	2.71	0.209	0.000	16.852		0.642	0.000	0.000	0.000	0.642	181.00	0.491	15.719	0.000	15.719
	Apr	15.719	479.34	2.64	0.117	0.000	15.836		0.642	0.000	0.000	0.000	0.642	217.00	0.572	14.622	0.000	14.622
	May	14.622	478.93	2.55	0.075	0.000	14.696		0.642	0.000	0.000	0.000	0.642	247.00	0.630	13.425	0.000	13.425

MONTHLY WATER BALANCE OF DEHRA DAM												Annexure-6.19 Contd.						
Year	Month	Intial Reservoir			Inflow from self catchment	Release from Semraghat Weir	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Plan release	Irrigation release to chakarpur dam	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area										Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1984-85	June	13.425	478.45	2.45	0.296	6.000	19.721		0.642	0.000	0.000	0.000	0.642	175.00	0.428	18.652	0.000	18.652
	July	18.652	480.40	2.88	0.855	4.500	24.007		0.642	0.000	0.000	0.000	0.642	143.00	0.412	22.953	0.000	22.953
	Aug	22.953	481.82	3.25	21.000	31.500	75.453		0.642	0.000	0.000	2.008	0.642	124.00	0.403	74.408	2.008	72.400
	Sept	72.400	491.60	7.55	2.742	7.000	82.142		0.642	0.000	0.000	7.939	0.642	154.00	1.162	80.339	7.939	72.400
	Oct	72.400	491.60	7.55	0.749	3.350	76.499		0.642	0.845	24.000	24.000	25.487	159.00	1.200	49.812	0.000	49.812
	Nov	49.812	488.16	5.56	0.182	3.000	52.994		0.642	0.971	30.000	30.000	31.612	134.00	0.745	20.637	0.000	20.637
	Dec	20.637	481.08	3.05	0.217	0.000	20.854		0.642	1.810	4.000	4.000	6.452	115.00	0.351	14.051	0.000	14.051
	Jan	14.051	478.70	2.50	0.203	0.000	14.254		0.642	1.240	0.000	0.000	1.881	118.00	0.295	12.078	0.000	12.078
	Feb	12.078	477.90	2.32	0.124	0.000	12.203		0.642	0.817	0.000	0.000	1.458	134.00	0.311	10.433	0.000	10.433
	Mar	10.433	477.15	2.13	0.115	0.000	10.548		0.642	0.000	0.000	0.000	0.642	181.00	0.386	9.521	0.000	9.521
	Apr	9.521	476.71	2.03	0.054	0.000	9.574		0.642	0.000	0.000	0.000	0.642	217.00	0.440	8.492	0.000	8.492
	May	8.492	476.20	1.92	0.040	0.000	8.532		0.642	0.000	0.000	0.000	0.642	247.00	0.474	7.416	0.000	7.416
1985-86	June	7.416	475.62	1.81	0.280	0.000	7.696		0.642	0.000	0.000	0.000	0.642	175.00	0.317	6.738	0.000	6.738
	July	6.738	475.24	1.74	2.819	15.000	24.557		0.642	0.000	0.000	0.000	0.642	143.00	0.249	23.667	0.000	23.667
	Aug	23.667	482.05	3.31	17.581	27.000	68.247		0.642	0.000	0.000	0.000	0.642	124.00	0.410	67.196	0.000	67.196
	Sept	67.196	490.90	7.10	11.918	7.000	86.114		0.642	0.000	0.000	11.980	0.642	154.00	1.093	84.380	11.980	72.400
	Oct	72.400	491.60	7.55	9.894	3.350	85.644		0.642	0.845	24.000	24.000	25.487	159.00	1.200	58.957	0.000	58.957
	Nov	58.957	489.68	6.43	1.670	3.000	63.627		0.642	0.971	30.000	30.000	31.612	134.00	0.862	31.153	0.000	31.153
	Dec	31.153	484.14	3.87	0.388	0.000	31.541		0.642	1.810	4.000	4.000	6.452	115.00	0.445	24.644	0.000	24.644
	Jan	24.644	482.34	3.35	0.341	0.000	24.986		0.642	1.240	0.000	0.000	1.881	118.00	0.396	22.709	0.000	22.709
	Feb	22.709	481.74	3.23	0.375	0.000	23.083		0.642	0.817	0.000	0.000	1.458	134.00	0.433	21.192	0.000	21.192
	Mar	21.192	481.26	3.10	0.325	0.000	21.517		0.642	0.000	0.000	0.000	0.642	181.00	0.561	20.314	0.000	20.314
	Apr	20.314	480.97	3.03	0.114	0.000	20.428		0.642	0.000	0.000	0.000	0.642	217.00	0.657	19.130	0.000	19.130
	May	19.130	480.56	2.92	0.053	0.000	19.183		0.642	0.000	0.000	0.000	0.642	247.00	0.722	17.819	0.000	17.819
1986-87	June	17.819	480.11	2.81	1.133	0.000	18.952		0.642	0.000	0.000	0.000	0.642	175.00	0.492	17.819	0.000	17.819
	July	17.819	480.11	2.81	33.315	15.000	66.133		0.642	0.000	0.000	0.000	0.642	143.00	0.402	65.090	0.000	65.090
	Aug	65.090	490.59	6.93	13.056	27.000	105.146		0.642	0.000	0.000	31.244	0.642	124.00	0.860	103.644	31.244	72.400
	Sept	72.400	491.60	7.55	2.348	7.000	81.748		0.642	0.000	0.000	7.544	0.642	154.00	1.162	79.944	7.544	72.400
	Oct	72.400	491.60	7.55	0.735	3.350	76.485		0.642	0.845	24.000	24.000	25.487	159.00	1.200	49.798	0.000	49.798
	Nov	49.798	488.15	5.56	0.188	3.000	52.986		0.642	0.971	30.000	30.000	31.612	134.00	0.745	20.629	0.000	20.629
	Dec	20.629	481.07	3.05	0.234	0.000	20.863		0.642	1.810	4.000	4.000	6.452	115.00	0.351	14.060	0.000	14.060
	Jan	14.060	478.70	2.50	0.252	0.000	14.312		0.642	1.240	0.000	0.000	1.881	118.00	0.295	12.136	0.000	12.136
	Feb	12.136	477.93	2.33	0.190	0.000	12.326		0.642	0.817	0.000	0.000	1.458	134.00	0.312	10.555	0.000	10.555
	Mar	10.555	477.21	2.14	0.142	0.000	10.698		0.642	0.000	0.000	0.000	0.642	181.00	0.388	9.668	0.000	9.668
	Apr	9.668	476.78	2.05	0.086	0.000	9.754		0.642	0.000	0.000	0.000	0.642	217.00	0.444	8.669	0.000	8.669
	May	8.669	476.28	1.94	0.041	0.000	8.710		0.642	0.000	0.000	0.000	0.642	247.00	0.479	7.589	0.000	7.589

MONTHLY WATER BALANCE OF DEHRA DAM												Annexure-6.19 Contd.						
Year	Month	Intial Reservoir			Inflow from self catchment	Release from Semraghat Weir	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Plan release	Irrigation release to chakarpur dam	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area										Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1987-88	June	7.589	475.72	1.83	0.287	0.000	7.877		0.642	0.000	0.000	0.000	0.642	175.00	0.320	6.915	0.000	6.915
	July	6.915	475.34	1.76	1.654	9.000	17.569		0.642	0.000	0.000	0.000	0.642	143.00	0.252	16.676	0.000	16.676
	Aug	16.676	479.69	2.71	13.385	33.000	63.060		0.642	0.000	0.000	0.000	0.642	124.00	0.337	62.082	0.000	62.082
	Sept	62.082	490.16	6.71	4.055	7.000	73.137		0.642	0.000	0.000	0.000	0.642	154.00	1.033	71.463	0.000	71.463
	Oct	71.463	491.48	7.46	0.859	3.350	75.672		0.642	0.845	24.000	24.000	25.487	159.00	1.187	48.998	0.000	48.998
	Nov	48.998	488.02	5.48	0.300	3.000	52.298		0.642	0.971	30.000	30.000	31.612	134.00	0.735	19.952	0.000	19.952
	Dec	19.952	480.85	2.99	0.195	0.000	20.146		0.642	1.810	4.000	4.000	6.452	115.00	0.344	13.350	0.000	13.350
	Jan	13.350	478.42	2.44	0.158	0.000	13.508		0.642	1.240	0.000	0.000	1.881	118.00	0.288	11.339	0.000	11.339
	Feb	11.339	477.56	2.24	0.188	0.000	11.526		0.642	0.817	0.000	0.000	1.458	134.00	0.300	9.768	0.000	9.768
	Mar	9.768	476.83	2.06	0.123	0.000	9.891		0.642	0.000	0.000	0.000	0.642	181.00	0.372	8.877	0.000	8.877
	Apr	8.877	476.39	1.96	0.053	0.000	8.930		0.642	0.000	0.000	0.000	0.642	217.00	0.426	7.863	0.000	7.863
	May	7.863	475.87	1.86	0.040	0.000	7.903		0.642	0.000	0.000	0.000	0.642	247.00	0.458	6.803	0.000	6.803
1988-89	June	6.803	475.28	1.75	0.560	0.000	7.363		0.642	0.000	0.000	0.000	0.642	175.00	0.306	6.415	0.000	6.415
	July	6.415	475.06	1.71	5.054	15.000	26.469		0.642	0.000	0.000	0.000	0.642	143.00	0.244	25.583	0.000	25.583
	Aug	25.583	482.61	3.40	8.395	27.000	60.978		0.642	0.000	0.000	0.000	0.642	124.00	0.422	59.915	0.000	59.915
	Sept	59.915	489.83	6.52	1.320	7.000	68.235		0.642	0.000	0.000	0.000	0.642	154.00	1.004	66.589	0.000	66.589
	Oct	66.589	490.81	7.05	0.622	3.350	70.561		0.642	0.845	24.000	24.000	25.487	159.00	1.121	43.953	0.000	43.953
	Nov	43.953	487.05	5.00	0.203	3.000	47.156		0.642	0.971	30.000	30.000	31.612	134.00	0.671	14.873	0.000	14.873
	Dec	14.873	479.03	2.57	0.221	0.000	15.095		0.642	1.810	4.000	4.000	6.452	115.00	0.296	8.347	0.000	8.347
	Jan	8.347	476.12	1.91	0.203	0.000	8.550		0.642	1.240	0.000	0.000	1.881	118.00	0.225	6.444	0.000	6.444
	Feb	6.444	475.08	1.71	0.145	0.000	6.589		0.642	0.817	2.000	2.000	3.458	134.00	0.229	2.901	0.000	2.901
	Mar	2.901	472.58	1.16	0.086	0.000	2.987		0.642	0.000	0.000	0.000	0.642	181.00	0.209	2.136	0.000	2.136
	Apr	2.136	471.92	0.96	0.065	0.000	2.201		0.642	0.000	0.000	0.000	0.642	217.00	0.208	1.352	0.000	1.352
	May	1.352	470.92	0.72	0.040	0.000	1.392		0.642	0.000	0.000	0.000	0.642	247.00	0.178	0.572	0.000	0.572
1989-90	June	0.572	469.43	0.37	0.356	0.000	0.929		0.642	0.000	0.000	0.000	0.642	175.00	0.065	0.222	0.000	0.222
	July	0.222	468.11	0.16	1.947	12.000	14.168		0.642	0.000	0.000	0.000	0.642	143.00	0.022	13.504	0.000	13.504
	Aug	13.504	478.48	2.45	11.735	27.000	52.239		0.642	0.000	0.000	0.000	0.642	124.00	0.304	51.293	0.000	51.293
	Sept	51.293	488.41	5.70	2.959	10.000	64.252		0.642	0.000	0.000	0.000	0.642	154.00	0.878	62.732	0.000	62.732
	Oct	62.732	490.25	6.76	0.438	3.350	66.521		0.642	0.845	18.000	18.000	19.487	159.00	1.074	45.959	0.000	45.959
	Nov	45.959	487.43	5.19	0.110	3.000	49.070		0.642	0.971	12.000	12.000	13.612	134.00	0.696	34.761	0.000	34.761
	Dec	34.761	485.04	4.20	0.163	0.000	34.925		0.642	1.810	6.000	6.000	8.452	115.00	0.483	25.990	0.000	25.990
	Jan	25.990	482.73	3.42	0.118	0.000	26.108		0.642	1.240	8.000	8.000	9.881	118.00	0.404	15.824	0.000	15.824
	Feb	15.824	479.38	2.65	0.060	0.000	15.883		0.642	0.817	11.600	11.600	13.058	134.00	0.355	2.470	0.000	2.470
	Mar	2.470	472.23	1.05	0.041	0.000	2.512		0.642	0.000	0.000	0.000	0.642	181.00	0.189	1.681	0.000	1.681
	Apr	1.681	471.35	0.82	0.040	0.000	1.721		0.642	0.000	0.000	0.000	0.642	217.00	0.179	0.901	0.000	0.901
	May	0.901	470.17	0.54	0.040	0.000	0.941		0.642	0.000	0.000	0.000	0.642	247.00	0.133	0.166	0.000	0.166

MONTHLY WATER BALANCE OF DEHRA DAM												Annexure-6.19 Contd.						
Year	Month	Intial Reservoir			Inflow from self catchment	Release from Semraghat Weir	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Plan release	Irrigation release to chakarpur dam	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area										Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1990-91	June	0.166	467.66	0.11	2.735	0.000	2.901		0.642	0.000	0.000	0.000	0.642	175.00	0.020	2.240	0.000	2.240
	July	2.240	472.03	0.99	6.733	15.000	23.972		0.642	0.000	0.000	0.000	0.642	143.00	0.141	23.190	0.000	23.190
	Aug	23.190	481.90	3.27	10.533	27.000	60.723		0.642	0.000	0.000	0.000	0.642	124.00	0.406	59.675	0.000	59.675
	Sept	59.675	489.79	6.50	15.060	7.000	81.735		0.642	0.000	0.000	7.693	0.642	154.00	1.001	80.093	7.693	72.400
	Oct	72.400	491.60	7.55	1.861	3.350	77.611		0.642	0.845	24.000	24.000	25.487	159.00	1.200	50.924	0.000	50.924
	Nov	50.924	488.35	5.67	0.376	3.000	54.300		0.642	0.971	30.000	30.000	31.612	134.00	0.759	21.928	0.000	21.928
	Dec	21.928	481.49	3.16	0.173	0.000	22.101		0.642	1.810	4.000	4.000	6.452	115.00	0.364	15.286	0.000	15.286
	Jan	15.286	479.18	2.60	0.123	0.000	15.409		0.642	1.240	0.000	0.000	1.881	118.00	0.307	13.220	0.000	13.220
	Feb	13.220	478.37	2.43	0.121	0.000	13.342		0.642	0.817	0.000	0.000	1.458	134.00	0.325	11.558	0.000	11.558
	Mar	11.558	477.66	2.26	0.112	0.000	11.670		0.642	0.000	0.000	0.000	0.642	181.00	0.409	10.619	0.000	10.619
	Apr	10.619	477.24	2.15	0.082	0.000	10.701		0.642	0.000	0.000	0.000	0.642	217.00	0.467	9.593	0.000	9.593
	May	9.593	476.75	2.04	0.045	0.000	9.637		0.642	0.000	0.000	0.000	0.642	247.00	0.503	8.492	0.000	8.492
1991-92	June	8.492	476.20	1.92	0.722	0.000	9.214		0.642	0.000	0.000	0.000	0.642	175.00	0.336	8.236	0.000	8.236
	July	8.236	476.07	1.89	2.531	15.000	25.768		0.642	0.000	0.000	0.000	0.642	143.00	0.271	24.855	0.000	24.855
	Aug	24.855	482.40	3.36	18.493	27.000	70.348		0.642	0.000	0.000	0.000	0.642	124.00	0.417	69.289	0.000	69.289
	Sept	69.289	491.19	7.27	2.090	7.000	78.379		0.642	0.000	0.000	4.217	0.642	154.00	1.120	76.617	4.217	72.400
	Oct	72.400	491.60	7.55	0.347	3.350	76.097		0.642	0.845	24.000	24.000	25.487	159.00	1.200	49.410	0.000	49.410
	Nov	49.410	488.09	5.52	0.140	2.000	51.549		0.642	0.971	30.000	30.000	31.612	134.00	0.740	19.197	0.000	19.197
	Dec	19.197	480.59	2.93	0.169	0.000	19.366		0.642	1.810	4.000	4.000	6.452	115.00	0.337	12.577	0.000	12.577
	Jan	12.577	478.11	2.37	0.243	0.000	12.820		0.642	1.240	0.000	0.000	1.881	118.00	0.280	10.659	0.000	10.659
	Feb	10.659	477.25	2.16	0.146	0.000	10.805		0.642	0.817	0.000	0.000	1.458	134.00	0.289	9.058	0.000	9.058
	Mar	9.058	476.48	1.98	0.095	0.000	9.153		0.642	0.000	0.000	0.000	0.642	181.00	0.358	8.153	0.000	8.153
	Apr	8.153	476.03	1.88	0.055	0.000	8.208		0.642	0.000	0.000	0.000	0.642	217.00	0.409	7.157	0.000	7.157
	May	7.157	475.48	1.78	0.046	0.000	7.203		0.642	0.000	0.000	0.000	0.642	247.00	0.441	6.121	0.000	6.121
1992-93	June	6.121	474.89	1.67	0.260	0.000	6.381		0.642	0.000	0.000	0.000	0.642	175.00	0.293	5.446	0.000	5.446
	July	5.446	474.47	1.59	2.554	15.000	23.000		0.642	0.000	0.000	0.000	0.642	143.00	0.227	22.132	0.000	22.132
	Aug	22.132	481.56	3.18	9.806	35.000	66.937		0.642	0.000	0.000	0.000	0.642	124.00	0.395	65.901	0.000	65.901
	Sept	65.901	490.71	7.00	3.138	10.000	79.039		0.642	0.000	0.000	4.920	0.642	154.00	1.077	77.320	4.920	72.400
	Oct	72.400	491.60	7.55	0.315	3.350	76.065		0.642	0.845	13.000	13.000	14.487	159.00	1.200	60.378	0.000	60.378
	Nov	60.378	489.90	6.56	0.081	3.000	63.459		0.642	0.971	15.000	15.000	16.612	134.00	0.880	45.967	0.000	45.967
	Dec	45.967	487.44	5.20	0.105	0.000	46.072		0.642	1.810	15.000	15.000	17.452	115.00	0.597	28.023	0.000	28.023
	Jan	28.023	483.30	3.57	0.056	0.000	28.079		0.642	1.240	13.000	13.000	14.881	118.00	0.422	12.777	0.000	12.777
	Feb	12.777	478.19	2.39	0.041	0.000	12.817		0.642	0.817	4.500	4.500	5.958	134.00	0.320	6.539	0.000	6.539
	Mar	6.539	475.13	1.72	0.041	0.000	6.580		0.642	0.000	2.000	2.000	2.642	181.00	0.312	3.626	0.000	3.626
	Apr	3.626	473.17	1.32	0.041	0.000	3.667		0.642	0.000	0.000	0.000	0.642	217.00	0.286	2.739	0.000	2.739
	May	2.739	472.45	1.11	0.041	0.000	2.779		0.642	0.000	0.000	0.000	0.642	247.00	0.275	1.863	0.000	1.863

MONTHLY WATER BALANCE OF DEHRA DAM												Annexure-6.19 Contd.						
Year	Month	Intial Reservoir			Inflow from self catchment	Release from Semraghat Weir	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Plan release	Irrigation release to chakarpur dam	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area										Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1993-94	June	1.863	471.58	0.88	0.440	0.000	2.302		0.642	0.000	0.000	0.000	0.642	175.00	0.153	1.507	0.000	1.507
	July	1.507	471.13	0.77	2.771	15.000	19.278		0.642	0.000	0.000	0.000	0.642	143.00	0.110	18.526	0.000	18.526
	Aug	18.526	480.35	2.87	6.632	27.000	52.158		0.642	0.000	0.000	0.000	0.642	124.00	0.356	51.161	0.000	51.161
	Sept	51.161	488.39	5.69	13.710	7.000	71.871		0.642	0.000	0.000	0.000	0.642	154.00	0.876	70.353	0.000	70.353
	Oct	70.353	491.33	7.37	2.756	3.350	76.458		0.642	0.845	23.000	23.000	24.487	159.00	1.171	50.800	0.000	50.800
	Nov	50.800	488.33	5.66	0.322	3.000	54.122		0.642	0.971	30.000	30.000	31.612	134.00	0.758	21.752	0.000	21.752
	Dec	21.752	481.44	3.15	0.236	0.000	21.988		0.642	1.810	4.000	4.000	6.452	115.00	0.362	15.174	0.000	15.174
	Jan	15.174	479.14	2.59	0.212	0.000	15.386		0.642	1.240	7.000	7.000	8.881	118.00	0.306	6.199	0.000	6.199
	Feb	6.199	474.94	1.68	0.150	0.000	6.349		0.642	0.817	2.000	2.000	3.458	134.00	0.226	2.664	0.000	2.664
	Mar	2.664	472.39	1.10	0.135	0.000	2.799		0.642	0.000	1.000	1.000	1.642	181.00	0.198	0.959	0.000	0.959
	Apr	0.959	470.27	0.56	0.133	0.000	1.092		0.642	0.000	0.000	0.000	0.642	217.00	0.122	0.328	0.000	0.328
	May	0.328	468.64	0.23	0.071	0.500	0.899		0.642	0.000	0.000	0.000	0.642	247.00	0.056	0.201	0.000	0.201
1994-95	June	0.201	468.01	0.14	2.487	0.000	2.688		0.642	0.000	0.000	0.000	0.642	175.00	0.025	2.021	0.000	2.021
	July	2.021	471.78	0.92	10.501	15.000	27.522		0.642	0.000	0.000	0.000	0.642	143.00	0.132	26.748	0.000	26.748
	Aug	26.748	482.96	3.46	20.783	27.000	74.531		0.642	0.000	0.000	1.061	0.642	124.00	0.429	73.461	1.061	72.400
	Sept	72.400	491.60	7.55	7.525	7.000	86.925		0.642	0.000	0.000	12.721	0.642	154.00	1.162	85.121	12.721	72.400
	Oct	72.400	491.60	7.55	0.802	3.350	76.552		0.642	0.845	24.000	24.000	25.487	159.00	1.200	49.865	0.000	49.865
	Nov	49.865	488.17	5.57	0.179	3.000	53.044		0.642	0.971	30.000	30.000	31.612	134.00	0.746	20.686	0.000	20.686
	Dec	20.686	481.09	3.06	0.220	0.000	20.906		0.642	1.810	4.000	4.000	6.452	115.00	0.352	14.102	0.000	14.102
	Jan	14.102	478.72	2.50	0.206	0.000	14.309		0.642	1.240	0.000	0.000	1.881	118.00	0.295	12.132	0.000	12.132
	Feb	12.132	477.92	2.33	0.251	0.000	12.383		0.642	0.817	0.000	0.000	1.458	134.00	0.312	10.613	0.000	10.613
	Mar	10.613	477.23	2.15	0.316	0.000	10.929		0.642	0.000	0.000	0.000	0.642	181.00	0.389	9.898	0.000	9.898
	Apr	9.898	476.90	2.07	0.136	0.000	10.034		0.642	0.000	0.000	0.000	0.642	217.00	0.449	8.943	0.000	8.943
	May	8.943	476.42	1.97	0.062	0.000	9.005		0.642	0.000	0.000	0.000	0.642	247.00	0.486	7.878	0.000	7.878
1995-96	June	7.878	475.88	1.86	0.261	0.000	8.139		0.642	0.000	0.000	0.000	0.642	175.00	0.325	7.172	0.000	7.172
	July	7.172	475.48	1.79	2.784	15.000	24.956		0.642	0.000	0.000	0.000	0.642	143.00	0.255	24.059	0.000	24.059
	Aug	24.059	482.16	3.33	4.835	27.000	55.894		0.642	0.000	0.000	0.000	0.642	124.00	0.412	54.840	0.000	54.840
	Sept	54.840	489.02	6.04	4.988	7.000	66.828		0.642	0.000	0.000	0.000	0.642	154.00	0.931	65.256	0.000	65.256
	Oct	65.256	490.62	6.95	0.456	3.350	69.062		0.642	0.845	24.000	24.000	25.487	159.00	1.105	42.470	0.000	42.470
	Nov	42.470	486.74	4.88	0.172	3.000	45.642		0.642	0.971	30.000	30.000	31.612	134.00	0.653	13.377	0.000	13.377
	Dec	13.377	478.43	2.44	0.211	0.000	13.587		0.642	1.810	4.000	4.000	6.452	115.00	0.281	6.855	0.000	6.855
	Jan	6.855	475.31	1.75	0.207	0.000	7.061		0.642	1.240	0.000	0.000	1.881	118.00	0.207	4.973	0.000	4.973
	Feb	4.973	474.17	1.53	0.100	0.000	5.074		0.642	0.817	0.000	0.000	1.458	134.00	0.205	3.411	0.000	3.411
	Mar	3.411	473.01	1.29	0.090	0.000	3.501		0.642	0.000	0.000	0.000	0.642	181.00	0.233	2.627	0.000	2.627
	Apr	2.627	472.36	1.09	0.049	0.000	2.676		0.642	0.000	0.000	0.000	0.642	217.00	0.236	1.799	0.000	1.799
	May	1.799	471.50	0.86	0.042	0.000	1.840		0.642	0.000	0.000	0.000	0.642	247.00	0.212	0.987	0.000	0.987

MONTHLY WATER BALANCE OF DEHRA DAM												Annexure-6.19 Contd.						
Year	Month	Intial Reservoir			Inflow from self catchment	Release from Semraghat Weir	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Plan release	Irrigation release to chakarpur dam	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area										Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1996-97	June	0.987	470.31	0.57	0.262	0.000	1.248		0.642	0.000	0.000	0.000	0.642	175.00	0.100	0.506	0.000	0.506
	July	0.506	469.27	0.34	7.921	15.000	23.427		0.642	0.000	0.000	0.000	0.642	143.00	0.048	22.737	0.000	22.737
	Aug	22.737	481.75	3.23	16.437	27.000	66.174		0.642	0.000	0.000	0.000	0.642	124.00	0.401	65.132	0.000	65.132
	Sept	65.132	490.60	6.94	8.110	7.000	80.242		0.642	0.000	0.000	6.132	0.642	154.00	1.068	78.532	6.132	72.400
	Oct	72.400	491.60	7.55	1.652	3.350	77.402		0.642	0.845	24.000	24.000	25.487	159.00	1.200	50.715	0.000	50.715
	Nov	50.715	488.31	5.65	0.657	3.000	54.372		0.642	0.971	30.000	30.000	31.612	134.00	0.757	22.003	0.000	22.003
	Dec	22.003	481.52	3.17	0.272	0.000	22.275		0.642	1.810	4.000	4.000	6.452	115.00	0.365	15.459	0.000	15.459
	Jan	15.459	479.24	2.62	0.220	0.000	15.679		0.642	1.240	0.000	0.000	1.881	118.00	0.309	13.489	0.000	13.489
	Feb	13.489	478.48	2.45	0.223	0.000	13.711		0.642	0.817	0.000	0.000	1.458	134.00	0.328	11.925	0.000	11.925
	Mar	11.925	477.83	2.30	0.103	0.000	12.027		0.642	0.000	0.000	0.000	0.642	181.00	0.417	10.968	0.000	10.968
	Apr	10.968	477.39	2.19	0.067	0.000	11.035		0.642	0.000	0.000	0.000	0.642	217.00	0.476	9.917	0.000	9.917
	May	9.917	476.91	2.07	0.057	0.000	9.975		0.642	0.000	0.000	0.000	0.642	247.00	0.512	8.821	0.000	8.821
1997-98	June	8.821	476.36	1.96	0.272	0.000	9.093		0.642	0.000	0.000	0.000	0.642	175.00	0.342	8.109	0.000	8.109
	July	8.109	476.00	1.88	8.530	15.000	31.639		0.642	0.000	0.000	0.000	0.642	143.00	0.269	30.729	0.000	30.729
	Aug	30.729	484.03	3.83	10.013	27.000	67.742		0.642	0.000	0.000	0.000	0.642	124.00	0.475	66.625	0.000	66.625
	Sept	66.625	490.82	7.05	5.810	7.000	79.435		0.642	0.000	0.000	5.307	0.642	154.00	1.086	77.707	5.307	72.400
	Oct	72.400	491.60	7.55	1.091	3.350	76.841		0.642	0.845	24.000	24.000	25.487	159.00	1.200	50.154	0.000	50.154
	Nov	50.154	488.22	5.59	1.035	3.000	54.188		0.642	0.971	30.000	30.000	31.612	134.00	0.749	21.827	0.000	21.827
	Dec	21.827	481.46	3.16	3.730	0.000	25.557		0.642	1.810	4.000	4.000	6.452	115.00	0.363	18.742	0.000	18.742
	Jan	18.742	480.43	2.89	0.400	0.000	19.142		0.642	1.240	0.000	0.000	1.881	118.00	0.341	16.920	0.000	16.920
	Feb	16.920	479.79	2.73	0.242	0.000	17.162		0.642	0.817	0.000	0.000	1.458	134.00	0.366	15.337	0.000	15.337
	Mar	15.337	479.20	2.61	0.237	0.000	15.574		0.642	0.000	0.000	0.000	0.642	181.00	0.472	14.460	0.000	14.460
	Apr	14.460	478.86	2.53	0.143	0.000	14.604		0.642	0.000	0.000	0.000	0.642	217.00	0.550	13.412	0.000	13.412
	May	13.412	478.44	2.44	0.067	0.000	13.479		0.642	0.000	0.000	0.000	0.642	247.00	0.604	12.233	0.000	12.233
1998-99	June	12.233	477.97	2.34	0.844	0.000	13.078		0.642	0.000	0.000	0.000	0.642	175.00	0.410	12.026	0.000	12.026
	July	12.026	477.88	2.32	7.516	15.000	34.543		0.642	0.000	0.000	0.000	0.642	143.00	0.331	33.570	0.000	33.570
	Aug	33.570	484.74	4.09	8.650	27.000	69.220		0.642	0.000	0.000	0.000	0.642	124.00	0.507	68.071	0.000	68.071
	Sept	68.071	491.02	7.16	8.280	7.000	83.351		0.642	0.000	0.000	9.206	0.642	154.00	1.103	81.606	9.206	72.400
	Oct	72.400	491.60	7.55	4.704	3.350	80.454		0.642	0.845	24.000	24.000	25.487	159.00	1.200	53.767	0.000	53.767
	Nov	53.767	488.84	5.94	1.304	3.000	58.071		0.642	0.971	30.000	30.000	31.612	134.00	0.796	25.663	0.000	25.663
	Dec	25.663	482.64	3.40	0.242	0.000	25.905		0.642	1.810	4.000	4.000	6.452	115.00	0.391	19.062	0.000	19.062
	Jan	19.062	480.54	2.92	0.209	0.000	19.271		0.642	1.240	0.000	0.000	1.881	118.00	0.344	17.046	0.000	17.046
	Feb	17.046	479.83	2.74	2.815	0.000	19.860		0.642	0.817	0.000	0.000	1.458	134.00	0.368	18.034	0.000	18.034
	Mar	18.034	480.18	2.83	0.959	0.000	18.994		0.642	0.000	0.000	0.000	0.642	181.00	0.512	17.840	0.000	17.840
	Apr	17.840	480.12	2.81	0.081	0.000	17.921		0.642	0.000	0.000	0.000	0.642	217.00	0.610	16.670	0.000	16.670
	May	16.670	479.69	2.71	0.046	0.000	16.716		0.642	0.000	0.000	0.000	0.642	247.00	0.670	15.404	0.000	15.404

MONTHLY WATER BALANCE OF DEHRA DAM												Annexure-6.19 Contd.						
Year	Month	Intial Reservoir			Inflow from self catchment	Release from Semraghat Weir	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Plan release	Irrigation release to chakarpur dam	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area										Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1999-00	June	15.404	479.22	2.61	0.440	0.000	15.843		0.642	0.000	0.000	0.000	0.642	175.00	0.457	14.745	0.000	14.745
	July	14.745	478.98	2.56	7.835	15.000	37.580		0.642	0.000	0.000	0.000	0.642	143.00	0.366	36.572	0.000	36.572
	Aug	36.572	485.46	4.36	10.850	27.000	74.422		0.642	0.000	0.000	0.840	0.642	124.00	0.541	73.240	0.840	72.400
	Sept	72.400	491.60	7.55	24.103	7.000	103.503		0.642	0.000	0.000	29.299	0.642	154.00	1.162	101.699	29.299	72.400
	Oct	72.400	491.60	7.55	9.654	3.350	85.404		0.642	0.845	24.000	24.000	25.487	159.00	1.200	58.717	0.000	58.717
	Nov	58.717	489.64	6.41	1.039	3.000	62.756		0.642	0.971	30.000	30.000	31.612	134.00	0.859	30.285	0.000	30.285
	Dec	30.285	483.91	3.79	0.232	0.000	30.517		0.642	1.810	4.000	4.000	6.452	115.00	0.436	23.629	0.000	23.629
	Jan	23.629	482.04	3.30	0.217	0.000	23.846		0.642	1.240	0.000	0.000	1.881	118.00	0.390	21.575	0.000	21.575
	Feb	21.575	481.38	3.13	0.262	0.000	21.837		0.642	0.817	0.000	0.000	1.458	134.00	0.420	19.959	0.000	19.959
	Mar	19.959	480.85	3.00	0.176	0.000	20.135		0.642	0.000	0.000	0.000	0.642	181.00	0.542	18.951	0.000	18.951
	Apr	18.951	480.50	2.91	0.109	0.000	19.059		0.642	0.000	0.000	0.000	0.642	217.00	0.631	17.787	0.000	17.787
	May	17.787	480.10	2.81	0.052	0.000	17.839		0.642	0.000	0.000	0.000	0.642	247.00	0.693	16.504	0.000	16.504
2000-01	June	16.504	479.63	2.70	0.423	6.000	22.927		0.642	0.000	0.000	0.000	0.642	175.00	0.473	21.813	0.000	21.813
	July	21.813	481.46	3.15	14.868	27.000	63.681		0.642	0.000	0.000	0.000	0.642	143.00	0.451	62.588	0.000	62.588
	Aug	62.588	490.23	6.74	4.413	15.000	82.002		0.642	0.000	0.000	8.124	0.642	124.00	0.836	80.524	8.124	72.400
	Sept	72.400	491.60	7.55	1.032	3.000	76.432		0.642	0.000	0.000	2.228	0.642	154.00	1.162	74.628	2.228	72.400
	Oct	72.400	491.60	7.55	0.285	3.000	75.685		0.642	0.845	24.000	24.000	25.487	159.00	1.200	48.998	0.000	48.998
	Nov	48.998	488.02	5.48	0.120	2.400	51.518		0.642	0.971	30.000	30.000	31.612	134.00	0.735	19.172	0.000	19.172
	Dec	19.172	480.58	2.93	0.252	0.000	19.423		0.642	1.810	4.000	4.000	6.452	115.00	0.337	12.635	0.000	12.635
	Jan	12.635	478.13	2.38	0.126	0.000	12.761		0.642	1.240	0.000	0.000	1.881	118.00	0.281	10.599	0.000	10.599
	Feb	10.599	477.23	2.15	0.042	0.000	10.641		0.642	0.817	0.000	0.000	1.458	134.00	0.288	8.895	0.000	8.895
	Mar	8.895	476.40	1.96	0.042	0.000	8.937		0.642	0.000	0.000	0.000	0.642	181.00	0.355	7.940	0.000	7.940
	Apr	7.940	475.91	1.86	0.042	0.000	7.981		0.642	0.000	0.000	0.000	0.642	217.00	0.404	6.935	0.000	6.935
	May	6.935	475.35	1.76	0.042	0.000	6.977		0.642	0.000	0.000	0.000	0.642	247.00	0.435	5.900	0.000	5.900
2001-02	June	5.900	474.75	1.65	0.916	0.000	6.816		0.642	0.000	0.000	0.000	0.642	175.00	0.288	5.886	0.000	5.886
	July	5.886	474.74	1.64	5.370	18.000	29.257		0.642	0.000	0.000	0.000	0.642	143.00	0.235	28.380	0.000	28.380
	Aug	28.380	483.40	3.61	9.495	29.000	66.875		0.642	0.000	0.000	0.000	0.642	124.00	0.447	65.786	0.000	65.786
	Sept	65.786	490.69	6.99	1.313	7.000	74.099		0.642	0.000	0.000	0.000	0.642	154.00	1.076	72.381	0.000	72.381
	Oct	72.381	491.60	7.54	0.575	3.350	76.306		0.642	0.845	24.000	24.000	25.487	159.00	1.200	49.620	0.000	49.620
	Nov	49.620	488.12	5.54	0.116	3.000	52.735		0.642	0.971	30.000	30.000	31.612	134.00	0.743	20.380	0.000	20.380
	Dec	20.380	480.99	3.03	0.142	0.000	20.523		0.642	1.810	4.000	4.000	6.452	115.00	0.349	13.722	0.000	13.722
	Jan	13.722	478.57	2.47	0.260	0.000	13.982		0.642	1.240	7.000	7.000	8.881	118.00	0.292	4.809	0.000	4.809
	Feb	4.809	474.07	1.51	0.066	0.000	4.874		0.642	0.817	0.000	0.000	1.458	134.00	0.202	3.214	0.000	3.214
	Mar	3.214	472.85	1.24	0.073	0.000	3.287		0.642	0.000	0.000	0.000	0.642	181.00	0.224	2.422	0.000	2.422
	Apr	2.422	472.18	1.03	0.076	0.000	2.498		0.642	0.000	0.000	0.000	0.642	217.00	0.224	1.632	0.000	1.632
	May	1.632	471.29	0.81	0.042	0.000	1.674		0.642	0.000	0.000	0.000	0.642	247.00	0.200	0.832	0.000	0.832

MONTHLY WATER BALANCE OF DEHRA DAM												Annexure-6.19 Contd.						
Year	Month	Intial Reservoir			Inflow from self catchment	Release from Semraghat Weir	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Plan release	Irrigation release to chakarpur dam	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area										Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
2002-03	June	0.832	470.05	0.51	0.435	0.000	1.267		0.642	0.000	0.000	0.000	0.642	175.00	0.089	0.536	0.000	0.536
	July	0.536	469.34	0.35	0.854	6.000	7.390		0.642	0.000	0.000	0.000	0.642	143.00	0.050	6.698	0.000	6.698
	Aug	6.698	475.22	1.74	9.516	40.000	56.213		0.642	0.000	0.000	0.000	0.642	124.00	0.216	55.356	0.000	55.356
	Sept	55.356	489.10	6.09	5.317	15.000	75.674		0.642	0.000	0.000	1.694	0.642	154.00	0.938	74.094	1.694	72.400
	Oct	72.400	491.60	7.55	0.259	2.350	75.009		0.642	0.845	24.000	24.000	25.487	159.00	1.200	48.322	0.000	48.322
	Nov	48.322	487.89	5.42	0.070	1.000	49.392		0.642	0.971	30.000	30.000	31.612	134.00	0.726	17.054	0.000	17.054
	Dec	17.054	479.83	2.75	0.123	0.000	17.177		0.642	1.810	4.000	4.000	6.452	115.00	0.316	10.410	0.000	10.410
	Jan	10.410	477.14	2.13	0.042	0.000	10.452		0.642	1.240	0.000	2.000	1.881	118.00	0.251	8.320	0.000	8.320
	Feb	8.320	476.11	1.90	0.042	0.000	8.362		0.642	0.817	0.000	1.000	1.458	134.00	0.255	6.648	0.000	6.648
	Mar	6.648	475.19	1.73	0.042	0.000	6.690		0.642	0.000	0.000	1.000	0.642	181.00	0.314	5.735	0.000	5.735
	Apr	5.735	474.65	1.62	0.042	0.000	5.777		0.642	0.000	0.000	1.500	0.642	217.00	0.353	4.783	0.000	4.783
	May	4.783	474.05	1.50	0.042	0.300	5.125		0.642	0.000	0.000	0.500	0.642	247.00	0.371	4.112	0.000	4.112
2003-04	June	4.112	473.55	1.40	1.019	0.000	5.131		0.642	0.000	0.000	0.000	0.642	175.00	0.245	4.245	0.000	4.245
	July	4.245	473.65	1.42	4.937	15.000	24.182		0.642	0.000	0.000	0.000	0.642	143.00	0.203	23.337	0.000	23.337
	Aug	23.337	481.95	3.28	6.075	27.000	56.412		0.642	0.000	0.000	0.000	0.642	124.00	0.407	55.363	0.000	55.363
	Sept	55.363	489.11	6.09	8.157	7.000	70.521		0.642	0.000	0.000	0.000	0.642	154.00	0.938	68.941	0.000	68.941
	Oct	68.941	491.14	7.24	1.550	3.350	73.840		0.642	0.845	24.000	24.000	25.487	159.00	1.151	47.202	0.000	47.202
	Nov	47.202	487.67	5.31	0.181	3.000	50.383		0.642	0.971	30.000	30.000	31.612	134.00	0.712	18.059	0.000	18.059
	Dec	18.059	480.19	2.83	0.201	0.000	18.260		0.642	1.810	4.000	4.000	6.452	115.00	0.325	11.483	0.000	11.483
	Jan	11.483	477.63	2.25	0.197	0.000	11.680		0.642	1.240	0.000	0.000	1.881	118.00	0.266	9.533	0.000	9.533
	Feb	9.533	476.72	2.03	0.268	0.000	9.801		0.642	0.817	0.000	0.000	1.458	134.00	0.272	8.071	0.000	8.071
	Mar	8.071	475.98	1.88	0.181	0.000	8.252		0.642	0.000	0.000	0.000	0.642	181.00	0.340	7.271	0.000	7.271
	Apr	7.271	475.54	1.80	0.054	0.000	7.325		0.642	0.000	0.000	0.000	0.642	217.00	0.390	6.293	0.000	6.293
	May	6.293	475.00	1.70	0.046	0.000	6.339		0.642	0.000	0.000	0.000	0.642	247.00	0.419	5.278	0.000	5.278
2004-05	June	5.278	474.36	1.57	0.484	0.000	5.762		0.642	0.000	0.000	0.000	0.642	175.00	0.274	4.846	0.000	4.846
	July	4.846	474.09	1.51	3.544	15.000	23.390		0.642	0.000	0.000	0.000	0.642	143.00	0.216	22.533	0.000	22.533
	Aug	22.533	481.69	3.22	17.755	27.000	67.287		0.642	0.000	0.000	0.000	0.642	124.00	0.399	66.247	0.000	66.247
	Sept	66.247	490.76	7.02	1.564	7.000	74.811		0.642	0.000	0.000	0.687	0.642	154.00	1.082	73.087	0.687	72.400
	Oct	72.400	491.60	7.55	0.575	3.350	76.325		0.642	0.845	24.000	24.000	25.487	159.00	1.200	49.638	0.000	49.638
	Nov	49.638	488.13	5.54	0.167	3.000	52.806		0.642	0.971	30.000	30.000	31.612	134.00	0.743	20.451	0.000	20.451
	Dec	20.451	481.02	3.04	0.240	0.000	20.691		0.642	1.810	4.000	4.000	6.452	115.00	0.349	13.890	0.000	13.890
	Jan	13.890	478.64	2.49	0.351	0.000	14.241		0.642	1.240	0.000	0.000	1.881	118.00	0.293	12.066	0.000	12.066
	Feb	12.066	477.89	2.32	0.204	0.000	12.270		0.642	0.817	0.000	0.000	1.458	134.00	0.311	10.501	0.000	10.501
	Mar	10.501	477.18	2.14	0.096	0.000	10.597		0.642	0.000	0.000	0.000	0.642	181.00	0.387	9.568	0.000	9.568
	Apr	9.568	476.73	2.03	0.050	0.000	9.619		0.642	0.000	0.000	0.000	0.642	217.00	0.442	8.536	0.000	8.536
	May	8.536	476.22	1.93	0.042	0.000	8.578		0.642	0.000	0.000	0.000	0.642	247.00	0.476	7.461	0.000	7.461

MONTHLY WATER BALANCE OF DEHRA DAM												Annexure-6.19 Contd.						
Year	Month	Intial Reservoir			Inflow from self catchment	Release from Semraghat Weir	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Plan release	Irrigation release to chakarpur dam	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area										Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
2005-06	June	7.461	475.64	1.81	0.381	0.000	7.842		0.642	0.000	0.000	0.000	0.642	175.00	0.318	6.883	0.000	6.883
	July	6.883	475.32	1.76	17.676	15.000	39.559		0.642	0.000	0.000	0.000	0.642	143.00	0.251	38.666	0.000	38.666
	Aug	38.666	485.95	4.55	9.635	27.000	75.301		0.642	0.000	0.000	1.695	0.642	124.00	0.565	74.095	1.695	72.400
	Sept	72.400	491.60	7.55	2.953	7.000	82.353		0.642	0.000	0.000	8.149	0.642	154.00	1.162	80.549	8.149	72.400
	Oct	72.400	491.60	7.55	0.462	3.350	76.212		0.642	0.845	24.000	24.000	25.487	159.00	1.200	49.525	0.000	49.525
	Nov	49.525	488.11	5.53	0.142	3.000	52.667		0.642	0.971	30.000	30.000	31.612	134.00	0.741	20.313	0.000	20.313
	Dec	20.313	480.97	3.03	0.242	0.000	20.556		0.642	1.810	4.000	4.000	6.452	115.00	0.348	13.756	0.000	13.756
	Jan	13.756	478.58	2.47	0.266	0.000	14.022		0.642	1.240	0.000	0.000	1.881	118.00	0.292	11.849	0.000	11.849
	Feb	11.849	477.79	2.30	0.198	0.000	12.046		0.642	0.817	0.000	0.000	1.458	134.00	0.308	10.280	0.000	10.280
	Mar	10.280	477.08	2.11	0.118	0.000	10.398		0.642	0.000	0.000	0.000	0.642	181.00	0.382	9.374	0.000	9.374
	Apr	9.374	476.64	2.01	0.059	0.000	9.433		0.642	0.000	0.000	0.000	0.642	217.00	0.437	8.354	0.000	8.354
	May	8.354	476.13	1.91	0.062	0.000	8.416		0.642	0.000	0.000	0.000	0.642	247.00	0.471	7.304	0.000	7.304
2006-07	June	7.304	475.56	1.80	0.292	0.000	7.596		0.642	0.000	0.000	0.000	0.642	175.00	0.315	6.640	0.000	6.640
	July	6.640	475.19	1.73	3.944	15.000	25.584		0.642	0.000	0.000	0.000	0.642	143.00	0.248	24.694	0.000	24.694
	Aug	24.694	482.35	3.36	27.537	27.000	79.231		0.642	0.000	0.000	5.773	0.642	124.00	0.416	78.173	5.773	72.400
	Sept	72.400	491.60	7.55	23.278	7.000	102.678		0.642	0.000	0.000	28.474	0.642	154.00	1.162	100.874	28.474	72.400
	Oct	72.400	491.60	7.55	1.143	3.350	76.893		0.642	0.845	24.000	24.000	25.487	159.00	1.200	50.206	0.000	50.206
	Nov	50.206	488.23	5.60	0.118	3.000	53.324		0.642	0.971	30.000	30.000	31.612	134.00	0.750	20.962	0.000	20.962
	Dec	20.962	481.18	3.08	0.267	0.000	21.229		0.642	1.810	4.000	4.000	6.452	115.00	0.354	14.423	0.000	14.423
	Jan	14.423	478.85	2.53	0.292	0.000	14.715		0.642	1.240	0.000	0.000	1.881	118.00	0.299	12.535	0.000	12.535
	Feb	12.535	478.09	2.37	0.192	0.000	12.726		0.642	0.817	0.000	0.000	1.458	134.00	0.317	10.950	0.000	10.950
	Mar	10.950	477.39	2.19	0.145	0.000	11.096		0.642	0.000	0.000	0.000	0.642	181.00	0.397	10.058	0.000	10.058
	Apr	10.058	476.98	2.09	0.052	0.000	10.110		0.642	0.000	0.000	0.000	0.642	217.00	0.453	9.015	0.000	9.015
	May	9.015	476.46	1.98	0.042	0.000	9.058		0.642	0.000	0.000	0.000	0.642	247.00	0.488	7.928	0.000	7.928
2007-08	June	7.928	475.90	1.86	0.331	0.000	8.260		0.642	0.000	0.000	0.000	0.642	175.00	0.326	7.292	0.000	7.292
	July	7.292	475.55	1.80	3.160	15.000	25.452		0.642	0.000	0.000	0.000	0.642	143.00	0.257	24.553	0.000	24.553
	Aug	24.553	482.31	3.35	2.761	16.000	43.315		0.642	0.000	0.000	0.000	0.642	124.00	0.415	42.258	0.000	42.258
	Sept	42.258	486.70	4.86	2.470	7.000	51.727		0.642	0.000	0.000	0.000	0.642	154.00	0.748	50.337	0.000	50.337
	Oct	50.337	488.25	5.61	0.256	3.350	53.943		0.642	0.845	20.000	20.000	21.487	159.00	0.892	31.564	0.000	31.564
	Nov	31.564	484.24	3.91	0.043	2.000	33.607		0.642	0.971	18.000	18.000	19.612	134.00	0.524	13.471	0.000	13.471
	Dec	13.471	478.47	2.45	0.043	0.000	13.514		0.642	1.810	2.000	2.000	4.452	115.00	0.282	8.780	0.000	8.780
	Jan	8.780	476.34	1.95	0.043	0.000	8.823		0.642	1.240	2.000	2.000	3.881	118.00	0.230	4.712	0.000	4.712
	Feb	4.712	474.01	1.49	0.043	0.000	4.755		0.642	0.817	0.000	0.000	1.458	134.00	0.200	3.096	0.000	3.096
	Mar	3.096	472.75	1.21	0.043	0.000	3.139		0.642	0.000	0.000	0.000	0.642	181.00	0.218	2.280	0.000	2.280
	Apr	2.280	472.07	1.00	0.043	0.000	2.323		0.642	0.000	0.000	0.000	0.642	217.00	0.216	1.465	0.000	1.465
	May	1.465	471.08	0.76	0.043	0.000	1.507		0.642	0.000	0.000	0.000	0.642	247.00	0.187	0.678	0.000	0.678

MONTHLY WATER BALANCE OF DEHRA DAM													Annexure-6.19 Contd.					
Year	Month	Intial Reservoir			Inflow from self catchment	Release from Semraghat Weir	Total Volume	Demand for Industrial use	Demand for Drinking use	Demand for Irrigation Rabi	Plan release	Irrigation release to chakarpur dam	Total Demand	Evaporation Loss		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area										Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
2008-09	June	0.678	469.70	0.43	1.025	0.000	1.703		0.642	0.000	0.000	0.000	0.642	175.00	0.075	0.986	0.000	0.986
	July	0.986	470.31	0.57	2.565	15.000	18.551		0.642	0.000	0.000	0.000	0.642	143.00	0.082	17.827	0.000	17.827
	Aug	17.827	480.11	2.81	8.739	27.000	53.567		0.642	0.000	0.000	0.000	0.642	124.00	0.348	52.576	0.000	52.576
	Sept	52.576	488.63	5.83	2.398	7.000	61.975		0.642	0.000	0.000	0.000	0.642	154.00	0.897	60.436	0.000	60.436
	Oct	60.436	489.91	6.57	0.291	3.350	64.076		0.642	0.845	20.000	20.000	21.487	159.00	1.045	41.545	0.000	41.545
	Nov	41.545	486.55	4.80	0.044	3.000	44.588		0.642	0.971	30.000	30.000	31.612	134.00	0.643	12.333	0.000	12.333
	Dec	12.333	478.01	2.35	0.044	0.000	12.377		0.642	1.810	2.000	2.000	4.452	115.00	0.270	7.655	0.000	7.655
	Jan	7.655	475.75	1.83	0.044	0.000	7.699		0.642	1.240	0.000	0.000	1.881	118.00	0.216	5.601	0.000	5.601
	Feb	5.601	474.56	1.61	0.044	0.000	5.645		0.642	0.817	0.000	0.000	1.458	134.00	0.215	3.971	0.000	3.971
	Mar	3.971	473.44	1.37	0.044	0.000	4.015		0.642	0.000	0.000	0.000	0.642	181.00	0.249	3.124	0.000	3.124
	Apr	3.124	472.77	1.21	0.044	0.000	3.168		0.642	0.000	0.000	0.000	0.642	217.00	0.263	2.263	0.000	2.263
	May	2.263	472.05	0.99	0.044	0.000	2.307		0.642	0.000	0.000	0.000	0.642	247.00	0.245	1.420	0.000	1.420
2009-10	June	1.420	471.02	0.75	0.591	0.000	2.011		0.642	0.000	0.000	0.000	0.642	175.00	0.131	1.238	0.000	1.238
	July	1.238	470.73	0.67	4.827	15.000	21.066		0.642	0.000	0.000	0.000	0.642	143.00	0.096	20.327	0.000	20.327
	Aug	20.327	480.97	3.03	3.033	21.000	44.361		0.642	0.000	0.000	0.000	0.642	124.00	0.375	43.344	0.000	43.344
	Sept	43.344	486.93	4.95	5.801	13.000	62.144		0.642	0.000	0.000	0.000	0.642	154.00	0.762	60.740	0.000	60.740
	Oct	60.740	489.96	6.60	1.822	3.350	65.912		0.642	0.845	22.000	22.000	23.487	159.00	1.049	41.376	0.000	41.376
	Nov	41.376	486.52	4.78	1.616	3.000	45.992		0.642	0.971	30.000	30.000	31.612	134.00	0.641	13.739	0.000	13.739
	Dec	13.739	478.58	2.47	0.525	0.000	14.263		0.642	1.810	4.000	4.000	6.452	115.00	0.284	7.527	0.000	7.527
	Jan	7.527	475.68	1.82	0.135	0.000	7.662		0.642	1.240	0.000	0.000	1.881	118.00	0.215	5.566	0.000	5.566
	Feb	5.566	474.54	1.60	0.126	0.000	5.692		0.642	0.817	0.000	0.000	1.458	134.00	0.215	4.019	0.000	4.019
	Mar	4.019	473.48	1.38	0.069	0.000	4.088		0.642	0.000	0.000	0.000	0.642	181.00	0.250	3.196	0.000	3.196
	Apr	3.196	472.83	1.23	0.050	0.000	3.246		0.642	0.000	0.000	0.000	0.642	217.00	0.267	2.337	0.000	2.337
	May	2.337	472.11	1.01	0.045	0.000	2.381		0.642	0.000	0.000	0.000	0.642	247.00	0.250	1.490	0.000	1.490
			Success rate			100.00	%											

MONTHLY WATER BALANCE OF SEMRAGHAT

Annexure-6.19 Contd.

Year	Month	Intial Reservoir			Inflow from self catchment	Total Volume	Release to Dehera dam	Demand for Irrigation Rabi	Total Demand	Evaporation		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area						Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1978-79	June	0.470	495.00	0.26	7.220	7.690	0.000	0.000	0.000	175.00	0.045	7.645	1.605	6.040
	July	6.040	499.65	2.79	64.460	70.500	15.000	0.000	15.000	143.00	0.399	55.101	49.061	6.040
	Aug	6.040	499.65	2.79	125.180	131.220	27.000	0.000	27.000	124.00	0.346	103.874	97.834	6.040
	Sept	6.040	499.65	2.79	23.090	29.130	7.000	0.000	7.000	154.00	0.429	21.701	15.661	6.040
	Oct	6.040	499.65	2.79	4.180	10.220	3.350	0.589	3.939	159.00	0.443	5.838	0.000	5.838
	Nov	5.838	499.57	2.71	1.220	7.058	3.000	0.676	3.676	134.00	0.363	3.018	0.000	3.018
	Dec	3.018	498.25	1.58	2.240	5.258	0.000	1.261	1.261	115.00	0.181	3.816	0.000	3.816
	Jan	3.816	498.70	1.91	1.720	5.536	0.000	0.864	0.864	118.00	0.225	4.447	0.000	4.447
	Feb	4.447	499.04	2.16	1.480	5.927	0.000	0.569	0.569	134.00	0.290	5.068	0.000	5.068
	Mar	5.068	499.28	2.41	0.830	5.898	0.000	0.000	0.000	181.00	0.436	5.462	0.000	5.462
	Apr	5.462	499.43	2.56	0.560	6.022	0.000	0.000	0.000	217.00	0.556	5.466	0.000	5.466
	May	5.466	499.43	2.56	0.420	5.886	0.000	0.000	0.000	247.00	0.633	5.253	0.000	5.253
1979-80	June	5.253	499.35	2.48	3.150	8.403	0.000	0.000	0.000	175.00	0.434	7.969	1.929	6.040
	July	6.040	499.65	2.79	7.040	13.080	10.000	0.000	10.000	143.00	0.399	2.681	0.000	2.681
	Aug	2.681	498.05	1.44	20.510	23.191	20.000	0.000	20.000	124.00	0.178	3.013	0.000	3.013
	Sept	3.013	498.24	1.58	1.710	4.723	3.000	0.000	3.000	154.00	0.243	1.480	0.000	1.480
	Oct	1.480	497.01	0.86	0.430	1.910	0.500	0.589	1.089	159.00	0.137	0.684	0.000	0.684
	Nov	0.684	495.61	0.38	4.210	4.894	0.000	0.676	0.676	134.00	0.051	4.167	0.000	4.167
	Dec	4.167	498.91	2.05	3.850	8.017	0	1.261	1.261	115.00	0.236	6.520	0.480	6.040
	Jan	6.040	499.65	2.79	0.580	6.620	0	0.864	0.864	118.00	0.329	5.427	0.000	5.427
	Feb	5.427	499.42	2.55	0.400	5.827	0	0.569	0.569	134.00	0.341	4.917	0.000	4.917
	Mar	4.917	499.22	2.35	0.330	5.247	0	0.000	0.000	181.00	0.425	4.822	0.000	4.822
	Apr	4.822	499.19	2.31	0.120	4.942	0	0.000	0.000	217.00	0.501	4.440	0.000	4.440
	May	4.440	499.04	2.16	0.070	4.510	0	0.000	0.000	247.00	0.534	3.977	0.000	3.977
	June	3.977	498.80	1.97	8.440	12.417	0	0.000	0.000	175.00	0.345	12.071	6.031	6.040
	July	6.040	499.65	2.79	10.700	16.740	15	0.000	15.000	143.00	0.399	1.341	0.000	1.341
	Aug	1.341	496.80	0.78	42.800	44.141	27	0.000	27.000	124.00	0.097	17.045	11.005	6.040

Year	Month	Intial Reservoir			Inflow from self catchment	Total Volume	Release to Dehera dam	Demand for Irrigation Rabi	Total Demand	Evaporation		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area						Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1980-81	Sept	6.040	499.65	2.79	20.080	26.120	7	0.000	7.000	154.00	0.429	18.691	12.651	6.040
	Oct	6.040	499.65	2.79	3.880	9.920	3.35	0.589	3.939	159.00	0.443	5.538	0.000	5.538
	Nov	5.538	499.46	2.59	2.440	7.978	3	0.676	3.676	134.00	0.347	3.954	0.000	3.954
	Dec	3.954	498.78	1.96	1.990	5.944	0	1.261	1.261	115.00	0.226	4.457	0.000	4.457
	Jan	4.457	499.05	2.17	1.170	5.627	0	0.864	0.864	118.00	0.256	4.508	0.000	4.508
	Feb	4.508	499.07	2.19	1.310	5.818	0	0.569	0.569	134.00	0.293	4.955	0.000	4.955
	Mar	4.955	499.24	2.36	0.790	5.745	**0**	0.000	0.000	181.00	0.428	5.318	0.000	5.318
	Apr	5.318	499.38	2.50	0.390	5.708	**0**	0.000	0.000	217.00	0.544	5.164	0.000	5.164
	May	5.164	499.32	2.44	0.270	5.434	**0**	0.000	0.000	247.00	0.604	4.830	0.000	4.830

Year	Month	Intial Reservoir			Inflow from self catchment	Total Volume	Release to Dehera dam	Demand for Irrigation Rabi	Total Demand	Evaporation		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area						Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1981-82	June	4.830	499.19	2.31	3.590	8.420	6.000	0.000	6.000	175.00	0.405	2.015	0.000	2.015
	July	6.040	499.65	2.79	10.230	16.270	12.000	0.000	12.000	143.00	0.399	3.871	0.000	3.871
	Aug	6.040	499.65	2.79	36.230	42.270	27.000	0.000	27.000	124.00	0.346	14.924	8.884	6.040
	Sept	6.040	499.65	2.79	4.880	10.920	4.000	0.000	4.000	154.00	0.429	6.491	0.451	6.040
	Oct	6.040	499.65	2.79	2.170	8.210	3.350	0.589	3.939	159.00	0.443	3.828	0.000	3.828
	Nov	6.040	499.65	2.79	1.140	7.180	3.000	0.676	3.676	134.00	0.374	3.130	0.000	3.130
	Dec	6.040	499.65	2.79	1.140	7.180	0.000	1.261	1.261	115.00	0.321	5.598	0.000	5.598
	Jan	6.040	499.65	2.79	1.710	7.750	0.000	0.864	0.864	118.00	0.329	6.557	0.517	6.040
	Feb	6.040	499.65	2.79	1.870	7.910	0.000	0.569	0.569	134.00	0.374	6.967	0.927	6.040
	Mar	6.040	499.65	2.79	0.950	6.990	0.000	0.000	0.000	181.00	0.505	6.485	0.445	6.040
	Apr	6.040	499.65	2.79	0.680	6.720	0.000	0.000	0.000	217.00	0.605	6.115	0.075	6.040
	May	6.040	499.65	2.79	0.270	6.310	0.000	0.000	0.000	247.00	0.689	5.621	0.000	5.621
1982-83	June	6.040	499.65	2.79	2.050	8.090	0.000	0.000	0.000	175.00	0.488	7.602	1.562	6.040
	July	6.040	499.65	2.79	10.560	16.600	15.000	0.000	15.000	143.00	0.399	1.201	0.000	1.201
	Aug	6.040	499.65	2.79	63.590	69.630	27.000	0.000	27.000	124.00	0.346	42.284	36.244	6.040
	Sept	6.040	499.65	2.79	23.630	29.670	7.000	0.000	7.000	154.00	0.429	22.241	16.201	6.040
	Oct	6.040	499.65	2.79	12.700	18.740	3.350	0.589	3.939	159.00	0.443	14.358	8.318	6.040
	Nov	6.040	499.65	2.79	5.570	11.610	3.000	0.676	3.676	134.00	0.374	7.560	1.520	6.040
	Dec	6.040	499.65	2.79	5.680	11.720	0	1.261	1.261	115.00	0.321	10.138	4.098	6.040
	Jan	6.040	499.65	2.79	2.320	8.360	0	0.864	0.864	118.00	0.329	7.167	1.127	6.040
	Feb	6.040	499.65	2.79	0.890	6.930	0	0.569	0.569	134.00	0.374	5.987	0.000	5.987
	Mar	6.040	499.65	2.79	0.710	6.750	0	0.000	0.000	181.00	0.505	6.245	0.205	6.040
	Apr	6.040	499.65	2.79	0.440	6.480	0	0.000	0.000	217.00	0.605	5.875	0.000	5.875
	May	6.040	499.65	2.79	0.240	6.280	0	0.000	0.000	247.00	0.689	5.591	0.000	5.591
	June	6.040	499.65	2.79	1.420	7.460	0	0.000	0.000	175.00	0.488	6.972	0.932	6.040
	July	6.040	499.65	2.79	16.040	22.080	15	0.000	15.000	143.00	0.399	6.681	0.641	6.040
	Aug	6.040	499.65	2.79	54.670	60.710	27	0.000	27.000	124.00	0.346	33.364	27.324	6.040
	Sept	6.040	499.65	2.79	80.540	86.580	7	0.000	7.000	154.00	0.429	79.151	73.111	6.040

Year	Month	Intial Reservoir			Inflow from self catchment	Total Volume	Release to Dehera dam	Demand for Irrigation Rabi	Total Demand	Evaporation		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area						Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1983-84	Oct	6.040	499.65	2.79	24.470	30.510	3.35	0.589	3.939	159.00	0.443	26.128	20.088	6.040
	Nov	6.040	499.65	2.79	9.630	15.670	3	0.676	3.676	134.00	0.374	11.620	5.580	6.040
	Dec	6.040	499.65	2.79	2.420	8.460	0	1.261	1.261	115.00	0.321	6.878	0.838	6.040
	Jan	6.040	499.65	2.79	3.200	9.240	0	0.864	0.864	118.00	0.329	8.047	2.007	6.040
	Feb	6.040	499.65	2.79	1.620	7.660	0	0.569	0.569	134.00	0.374	6.717	0.677	6.040
	Mar	6.040	499.65	2.79	1.090	7.130	**0**	0.000	0.000	181.00	0.505	6.625	0.585	6.040
	Apr	6.040	499.65	2.79	0.610	6.650	**0**	0.000	0.000	217.00	0.605	6.045	0.005	6.040
	May	6.040	499.65	2.79	0.390	6.430	**0**	0.000	0.000	247.00	0.689	5.741	0.000	5.741
1984-85	June	5.741	499.54	2.67	1.550	7.291	6.000	0.000	6.000	175.00	0.467	0.824	0.000	0.824
	July	0.824	496.01	0.47	4.470	5.294	4.500	0.000	4.500	143.00	0.067	0.727	0.000	0.727
	Aug	0.727	495.73	0.41	109.810	110.537	31.500	0.000	31.500	124.00	0.051	78.987	72.947	6.040
	Sept	6.040	499.65	2.79	14.340	20.380	7.000	0.000	7.000	154.00	0.429	12.951	6.911	6.040
	Oct	6.040	499.65	2.79	3.920	9.960	3.350	0.589	3.939	159.00	0.443	5.578	0.000	5.578
	Nov	5.578	499.47	2.61	0.950	6.528	3.000	0.676	3.676	134.00	0.349	2.502	0.000	2.502
	Dec	2.502	497.92	1.36	1.140	3.642	0.000	1.261	1.261	115.00	0.156	2.225	0.000	2.225
	Jan	2.225	497.67	1.22	1.060	3.285	0.000	0.864	0.864	118.00	0.144	2.277	0.000	2.277
	Feb	2.277	497.72	1.25	0.650	2.927	0.000	0.569	0.569	134.00	0.167	2.190	0.000	2.190
	Mar	2.190	497.64	1.21	0.600	2.790	0.000	0.000	0.000	181.00	0.218	2.572	0.000	2.572
	Apr	2.572	497.98	1.39	0.280	2.852	0.000	0.000	0.000	217.00	0.302	2.550	0.000	2.550
	May	2.550	497.96	1.38	0.210	2.760	0.000	0.000	0.000	247.00	0.341	2.418	0.000	2.418
1985-86	June	2.418	497.85	1.32	1.470	3.888	0.000	0.000	0.000	175.00	0.231	3.658	0.000	3.658
	July	3.658	498.61	1.84	14.740	18.398	15.000	0.000	15.000	143.00	0.263	3.135	0.000	3.135
	Aug	3.135	498.31	1.63	91.930	95.065	27.000	0.000	27.000	124.00	0.202	67.863	61.823	6.040
	Sept	6.040	499.65	2.79	62.320	68.360	7.000	0.000	7.000	154.00	0.429	60.931	54.891	6.040
	Oct	6.040	499.65	2.79	51.730	57.770	3.350	0.589	3.939	159.00	0.443	53.388	47.348	6.040
	Nov	6.040	499.65	2.79	8.730	14.770	3.000	0.676	3.676	134.00	0.374	10.720	4.680	6.040
	Dec	6.040	499.65	2.79	2.030	8.070	0	1.261	1.261	115.00	0.321	6.488	0.448	6.040
	Jan	6.040	499.65	2.79	1.790	7.830	0	0.864	0.864	118.00	0.329	6.637	0.597	6.040

Year	Month	Intial Reservoir			Inflow from self catchment	Total Volume	Release to Dehera dam	Demand for Irrigation Rabi	Total Demand	Evaporation		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area						Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Feb	6.040	499.65	2.79	1.960	8.000	0	0.569	0.569	134.00	0.374	7.057	1.017	6.040
	Mar	6.040	499.65	2.79	1.700	7.740	0	0.000	0.000	181.00	0.505	7.235	1.195	6.040
	Apr	6.040	499.65	2.79	0.600	6.640	0	0.000	0.000	217.00	0.605	6.035	0.000	6.035
	May	6.035	499.65	2.79	0.280	6.315	0	0.000	0.000	247.00	0.688	5.627	0.000	5.627
1986-87	June	5.627	499.49	2.63	5.920	11.547	0	0.000	0.000	175.00	0.460	11.087	5.047	6.040
	July	6.040	499.65	2.79	174.200	180.240	15	0.000	15.000	143.00	0.399	164.841	158.801	6.040
	Aug	6.040	499.65	2.79	68.270	74.310	27	0.000	27.000	124.00	0.346	46.964	40.924	6.040
	Sept	6.040	499.65	2.79	12.280	18.320	7	0.000	7.000	154.00	0.429	10.891	4.851	6.040
	Oct	6.040	499.65	2.79	3.850	9.890	3.35	0.589	3.939	159.00	0.443	5.508	0.000	5.508
	Nov	5.508	499.45	2.58	0.980	6.488	3	0.676	3.676	134.00	0.346	2.466	0.000	2.466
	Dec	2.466	497.89	1.34	1.230	3.696	0	1.261	1.261	115.00	0.154	2.280	0.000	2.280
	Jan	2.280	497.72	1.25	1.320	3.600	0	0.864	0.864	118.00	0.148	2.589	0.000	2.589
	Feb	2.589	498.00	1.40	0.990	3.579	0	0.569	0.569	134.00	0.188	2.822	0.000	2.822
	Mar	2.822	498.13	1.50	0.740	3.562	**0**	0.000	0.000	181.00	0.271	3.291	0.000	3.291
	Apr	3.291	498.40	1.69	0.450	3.741	**0**	0.000	0.000	217.00	0.367	3.375	0.000	3.375
	May	3.375	498.45	1.72	0.210	3.585	**0**	0.000	0.000	247.00	0.426	3.159	0.000	3.159
1987-88	June	3.159	498.33	1.64	1.500	4.659	0.000	0.000	0.000	175.00	0.286	4.373	0.000	4.373
	July	4.373	499.02	2.13	8.650	13.023	9.000	0.000	9.000	143.00	0.305	3.717	0.000	3.717
	Aug	3.717	498.65	1.87	69.990	73.707	33.000	0.000	33.000	124.00	0.231	40.476	34.436	6.040
	Sept	6.040	499.65	2.79	21.200	27.240	7.000	0.000	7.000	154.00	0.429	19.811	13.771	6.040
	Oct	6.040	499.65	2.79	4.490	10.530	3.350	0.589	3.939	159.00	0.443	6.148	0.108	6.040
	Nov	6.040	499.65	2.79	1.570	7.610	3.000	0.676	3.676	134.00	0.374	3.560	0.000	3.560
	Dec	3.560	498.56	1.80	1.020	4.580	0.000	1.261	1.261	115.00	0.207	3.112	0.000	3.112
	Jan	3.112	498.30	1.62	0.830	3.942	0.000	0.864	0.864	118.00	0.191	2.887	0.000	2.887
	Feb	2.887	498.17	1.52	0.980	3.867	0.000	0.569	0.569	134.00	0.204	3.094	0.000	3.094
	Mar	3.094	498.29	1.61	0.640	3.734	0.000	0.000	0.000	181.00	0.291	3.443	0.000	3.443
	Apr	3.443	498.49	1.75	0.280	3.723	0.000	0.000	0.000	217.00	0.380	3.343	0.000	3.343
	May	3.343	498.43	1.71	0.210	3.553	0.000	0.000	0.000	247.00	0.423	3.130	0.000	3.130

Year	Month	Intial Reservoir			Inflow from self catchment	Total Volume	Release to Dehera dam	Demand for Irrigation Rabi	Total Demand	Evaporation		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area						Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1988-89	June	3.130	498.31	1.62	2.930	6.060	0.000	0.000	0.000	175.00	0.284	5.776	0.000	5.776
	July	5.776	499.55	2.68	26.430	32.206	15.000	0.000	15.000	143.00	0.384	16.822	10.782	6.040
	Aug	6.040	499.65	2.79	43.900	49.940	27.000	0.000	27.000	124.00	0.346	22.594	16.554	6.040
	Sept	6.040	499.65	2.79	6.900	12.940	7.000	0.000	7.000	154.00	0.429	5.511	0.000	5.511
	Oct	5.511	499.45	2.58	3.250	8.761	3.350	0.589	3.939	159.00	0.410	4.411	0.000	4.411
	Nov	4.411	499.03	2.15	1.060	5.471	3.000	0.676	3.676	134.00	0.288	1.507	0.000	1.507
	Dec	1.507	497.03	0.87	1.160	2.667	0	1.261	1.261	115.00	0.101	1.305	0.000	1.305
	Jan	1.305	496.75	0.76	1.060	2.365	0	0.864	0.864	118.00	0.089	1.412	0.000	1.412
	Feb	1.412	496.91	0.82	0.760	2.172	0	0.569	0.569	134.00	0.110	1.493	0.000	1.493
	Mar	1.493	497.02	0.87	0.450	1.943	0	0.000	0.000	181.00	0.157	1.786	0.000	1.786
	Apr	1.786	497.28	1.01	0.340	2.126	0	0.000	0.000	217.00	0.219	1.907	0.000	1.907
	May	1.907	497.39	1.07	0.210	2.117	0	0.000	0.000	247.00	0.264	1.853	0.000	1.853
1989-90	June	1.853	497.34	1.04	1.860	3.713	0.00	0.000	0.000	175.00	0.182	3.531	0.000	3.531
	July	3.531	498.54	1.79	10.180	13.711	12.00	0.000	12.000	143.00	0.256	1.455	0.000	1.455
	Aug	1.455	496.98	0.85	61.360	62.815	27.00	0.000	27.000	124.00	0.105	35.710	29.670	6.040
	Sept	6.040	499.65	2.79	15.470	21.510	10.00	0.000	10.000	154.00	0.429	11.081	5.041	6.040
	Oct	6.040	499.65	2.79	2.290	8.330	3.35	0.589	3.939	159.00	0.443	3.948	0.000	3.948
	Nov	3.948	498.78	1.96	0.580	4.528	3.00	0.676	3.676	134.00	0.263	0.589	0.000	0.589
	Dec	0.589	495.34	0.33	0.850	1.439	0.00	0.900	0.900	115.00	0.037	0.501	0.000	0.501
	Jan	0.501	495.09	0.27	0.620	1.121	0.00	0.600	0.600	118.00	0.032	0.489	0.000	0.489
	Feb	0.489	495.05	0.27	0.310	0.799	0.00	0.200	0.200	134.00	0.036	0.563	0.000	0.563
	Mar	0.563	495.27	0.31	0.220	0.783	0.00	0.000	0.000	181.00	0.056	0.727	0.000	0.727
	Apr	0.727	495.73	0.41	0.210	0.937	0.00	0.000	0.000	217.00	0.089	0.848	0.000	0.848
	May	0.848	496.04	0.48	0.210	1.058	0.00	0.000	0.000	247.00	0.119	0.940	0.000	0.940
	June	0.940	496.18	0.54	14.300	15.240	0.000	0.000	0.000	175.00	0.094	15.146	9.106	6.040
	July	6.040	499.65	2.79	35.200	41.240	15.000	0.000	15.000	143.00	0.399	25.841	19.801	6.040
	Aug	6.040	499.65	2.79	55.080	61.120	27.000	0.000	27.000	124.00	0.346	33.774	27.734	6.040
	Sept	6.040	499.65	2.79	78.750	84.790	7.000	0.000	7.000	154.00	0.429	77.361	71.321	6.040

Year	Month	Intial Reservoir			Inflow from self catchment	Total Volume	Release to Dehera dam	Demand for Irrigation Rabi	Total Demand	Evaporation		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area						Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1990-91	Oct	6.040	499.65	2.79	9.730	15.770	3.350	0.589	3.939	159.00	0.443	11.388	5.348	6.040
	Nov	6.040	499.65	2.79	1.960	8.000	3.000	0.676	3.676	134.00	0.374	3.950	0.000	3.950
	Dec	3.950	498.78	1.96	0.900	4.850	0.000	1.261	1.261	115.00	0.226	3.363	0.000	3.363
	Jan	3.363	498.44	1.72	0.640	4.003	0.000	0.864	0.864	118.00	0.203	2.937	0.000	2.937
	Feb	2.937	498.20	1.54	0.630	3.567	0.000	0.569	0.569	134.00	0.207	2.791	0.000	2.791
	Mar	2.791	498.12	1.48	0.590	3.381	0.000	0.000	0.000	181.00	0.269	3.112	0.000	3.112
	Apr	3.112	498.30	1.62	0.430	3.542	0.000	0.000	0.000	217.00	0.351	3.191	0.000	3.191
	May	3.191	498.35	1.65	0.230	3.421	0.000	0.000	0.000	247.00	0.407	3.014	0.000	3.014
1991-92	June	3.014	498.24	1.58	3.770	6.784	0.000	0.000	0.000	175.00	0.276	6.508	0.468	6.040
	July	6.040	499.65	2.79	13.240	19.280	15.000	0.000	15.000	143.00	0.399	3.881	0.000	3.881
	Aug	3.881	498.74	1.93	96.700	100.581	27.000	0.000	27.000	124.00	0.240	73.342	67.302	6.040
	Sept	6.040	499.65	2.79	10.930	16.970	7.000	0.000	7.000	154.00	0.429	9.541	3.501	6.040
	Oct	6.040	499.65	2.79	1.810	7.850	3.350	0.589	3.939	159.00	0.443	3.468	0.000	3.468
	Nov	3.468	498.50	1.76	0.730	4.198	2.000	0.676	2.676	134.00	0.236	1.285	0.000	1.285
	Dec	1.285	496.72	0.74	0.880	2.165	0.00	1.261	1.261	115.00	0.086	0.818	0.000	0.818
	Jan	0.818	495.99	0.46	1.270	2.088	0.00	0.864	0.864	118.00	0.055	1.170	0.000	1.170
	Feb	1.170	496.54	0.68	0.760	1.930	0.00	0.569	0.569	134.00	0.090	1.270	0.000	1.270
	Mar	1.270	496.69	0.74	0.500	1.770	0.00	0.000	0.000	181.00	0.133	1.637	0.000	1.637
	Apr	1.637	497.15	0.94	0.290	1.927	0.00	0.000	0.000	217.00	0.203	1.724	0.000	1.724
	May	1.724	497.23	0.98	0.240	1.964	0.00	0.000	0.000	247.00	0.242	1.722	0.000	1.722
1992-93	June	1.722	497.22	0.98	1.360	3.082	0.00	0.000	0.000	175.00	0.171	2.911	0.000	2.911
	July	2.911	498.18	1.53	13.360	16.271	15.00	0.000	15.000	143.00	0.219	1.051	0.000	1.051
	Aug	1.051	496.36	0.60	51.270	52.321	35.00	0.000	35.000	124.00	0.075	17.247	11.207	6.040
	Sept	6.040	499.65	2.79	16.410	22.450	10.00	0.000	10.000	154.00	0.429	12.021	5.981	6.040
	Oct	6.040	499.65	2.79	1.650	7.690	3.35	0.589	3.939	159.00	0.443	3.308	0.000	3.308
	Nov	3.308	498.41	1.70	2.220	5.528	3.00	0.676	3.676	134.00	0.227	1.624	0.000	1.624
	Dec	1.624	497.14	0.93	0.550	2.174	0.00	1.261	1.261	115.00	0.107	0.806	0.000	0.806
	Jan	0.806	495.96	0.46	0.290	1.096	0.00	0.500	0.500	118.00	0.054	0.542	0.000	0.542

Year	Month	Intial Reservoir			Inflow from self catchment	Total Volume	Release to Dehera dam	Demand for Irrigation Rabi	Total Demand	Evaporation		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area						Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Feb	0.542	495.21	0.30	0.210	0.752	0.00	0.200	0.200	134.00	0.040	0.512	0.000	0.512
	Mar	0.512	495.12	0.28	0.210	0.722	0.00	0.000	0.000	181.00	0.051	0.671	0.000	0.671
	Apr	0.671	495.58	0.38	0.210	0.881	0.00	0.000	0.000	217.00	0.081	0.800	0.000	0.800
	May	0.800	495.94	0.45	0.210	1.010	0.00	0.000	0.000	247.00	0.112	0.898	0.000	0.898

Year	Month	Intial Reservoir			Inflow from self catchment	Total Volume	Release to Dehera dam	Demand for Irrigation Rabi	Total Demand	Evaporation		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area						Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1993-94	June	0.898	496.12	0.51	2.300	3.198	0.000	0.000	0.000	175.00	0.089	3.109	0.000	3.109
	July	3.109	498.30	1.61	14.490	17.599	15.000	0.000	15.000	143.00	0.231	2.368	0.000	2.368
	Aug	2.368	497.80	1.29	34.680	37.048	27.000	0.000	27.000	124.00	0.160	9.888	3.848	6.040
	Sept	6.040	499.65	2.79	71.690	77.730	7.000	0.000	7.000	154.00	0.429	70.301	64.261	6.040
	Oct	6.040	499.65	2.79	14.410	20.450	3.350	0.589	3.939	159.00	0.443	16.068	10.028	6.040
	Nov	6.040	499.65	2.79	1.680	7.720	3.000	0.676	3.676	134.00	0.374	3.670	0.000	3.670
	Dec	3.670	498.62	1.85	1.230	4.900	0.000	1.261	1.261	115.00	0.212	3.427	0.000	3.427
	Jan	3.427	498.48	1.75	1.110	4.537	0.000	0.864	0.864	118.00	0.206	3.467	0.000	3.467
	Feb	3.467	498.50	1.76	0.780	4.247	0.000	0.569	0.569	134.00	0.236	3.442	0.000	3.442
	Mar	3.442	498.49	1.75	0.700	4.142	0.000	0.000	0.000	181.00	0.317	3.825	0.000	3.825
	Apr	3.825	498.71	1.91	0.690	4.515	0.000	0.000	0.000	217.00	0.414	4.100	0.000	4.100
	May	4.100	498.87	2.02	0.370	4.470	0.500	0.000	0.500	247.00	0.500	3.470	0.000	3.470
1994-95	June	3.470	498.51	1.76	13.000	16.470	0.000	0.000	0.000	175.00	0.309	16.162	10.122	6.040
	July	6.040	499.65	2.79	54.910	60.950	15.000	0.000	15.000	143.00	0.399	45.551	39.511	6.040
	Aug	6.040	499.65	2.79	108.670	114.710	27.000	0.000	27.000	124.00	0.346	87.364	81.324	6.040
	Sept	6.040	499.65	2.79	39.350	45.390	7.000	0.000	7.000	154.00	0.429	37.961	31.921	6.040
	Oct	6.040	499.65	2.79	4.190	10.230	3.350	0.589	3.939	159.00	0.443	5.848	0.000	5.848
	Nov	5.848	499.58	2.71	0.940	6.788	3.000	0.676	3.676	134.00	0.363	2.748	0.000	2.748
	Dec	2.748	498.09	1.47	1.150	3.898	0	1.261	1.261	115.00	0.169	2.468	0.000	2.468
	Jan	2.468	497.89	1.34	1.080	3.548	0	0.864	0.864	118.00	0.158	2.526	0.000	2.526
	Feb	2.526	497.94	1.37	1.310	3.836	0	0.569	0.569	134.00	0.184	3.083	0.000	3.083
	Mar	3.083	498.28	1.60	1.650	4.733	0	0.000	0.000	181.00	0.290	4.443	0.000	4.443
	Apr	4.443	499.04	2.16	0.710	5.153	0	0.000	0.000	217.00	0.469	4.684	0.000	4.684
	May	4.684	499.13	2.26	0.330	5.014	0	0.000	0.000	247.00	0.557	4.456	0.000	4.456
	June	4.456	499.05	2.17	1.360	5.816	0	0.000	0.000	175.00	0.379	5.437	0.000	5.437
	July	5.437	499.42	2.55	14.560	19.997	15	0.000	15.000	143.00	0.365	4.632	0.000	4.632
	Aug	4.632	499.11	2.24	25.280	29.912	27	0.000	27.000	124.00	0.277	2.635	0.000	2.635
	Sept	2.635	498.03	1.42	26.080	28.715	7	0.000	7.000	154.00	0.219	21.496	15.456	6.040

Year	Month	Intial Reservoir			Inflow from self catchment	Total Volume	Release to Dehera dam	Demand for Irrigation Rabi	Total Demand	Evaporation		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area						Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1995-96	Oct	6.040	499.65	2.79	2.390	8.430	3.35	0.589	3.939	159.00	0.443	4.048	0.000	4.048
	Nov	4.048	498.84	2.00	0.900	4.948	3	0.676	3.676	134.00	0.268	1.003	0.000	1.003
	Dec	1.003	496.28	0.57	1.100	2.103	0	1.261	1.261	115.00	0.066	0.776	0.000	0.776
	Jan	0.776	495.87	0.44	1.080	1.856	0	0.864	0.864	118.00	0.052	0.940	0.000	0.940
	Feb	0.940	496.19	0.54	0.530	1.470	0	0.569	0.569	134.00	0.072	0.829	0.000	0.829
	Mar	0.829	496.01	0.47	0.470	1.299	**0**	0.000	0.000	181.00	0.085	1.214	0.000	1.214
	Apr	1.214	496.61	0.70	0.260	1.474	**0**	0.000	0.000	217.00	0.152	1.322	0.000	1.322
	May	1.322	496.77	0.77	0.220	1.542	**0**	0.000	0.000	247.00	0.189	1.353	0.000	1.353

Year	Month	Intial Reservoir			Inflow from self catchment	Total Volume	Release to Dehera dam	Demand for Irrigation Rabi	Total Demand	Evaporation		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area						Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1996-97	June	1.353	496.82	0.79	1.370	2.723	0.000	0.000	0.000	175.00	0.137	2.585	0.000	2.585
	July	2.585	498.00	1.40	41.420	44.005	15.000	0.000	15.000	143.00	0.200	28.805	22.765	6.040
	Aug	6.040	499.65	2.79	85.950	91.990	27.000	0.000	27.000	124.00	0.346	64.644	58.604	6.040
	Sept	6.040	499.65	2.79	42.410	48.450	7.000	0.000	7.000	154.00	0.429	41.021	34.981	6.040
	Oct	6.040	499.65	2.79	8.640	14.680	3.350	0.589	3.939	159.00	0.443	10.298	4.258	6.040
	Nov	6.040	499.65	2.79	3.440	9.480	3.000	0.676	3.676	134.00	0.374	5.430	0.000	5.430
	Dec	5.430	499.42	2.55	1.420	6.850	0.000	1.261	1.261	115.00	0.293	5.296	0.000	5.296
	Jan	5.296	499.37	2.50	1.150	6.446	0.000	0.864	0.864	118.00	0.295	5.287	0.000	5.287
	Feb	5.287	499.36	2.49	1.170	6.457	0.000	0.569	0.569	134.00	0.334	5.554	0.000	5.554
	Mar	5.554	499.47	2.60	0.540	6.094	0.000	0.000	0.000	181.00	0.470	5.624	0.000	5.624
	Apr	5.624	499.49	2.63	0.350	5.974	0.000	0.000	0.000	217.00	0.570	5.404	0.000	5.404
	May	5.404	499.41	2.54	0.300	5.704	0.000	0.000	0.000	247.00	0.627	5.077	0.000	5.077
1997-98	June	5.077	499.28	2.41	1.420	6.497	0.000	0.000	0.000	175.00	0.422	6.075	0.035	6.040
	July	6.040	499.65	2.79	44.600	50.640	15.000	0.000	15.000	143.00	0.399	35.241	29.201	6.040
	Aug	6.040	499.65	2.79	52.360	58.400	27.000	0.000	27.000	124.00	0.346	31.054	25.014	6.040
	Sept	6.040	499.65	2.79	30.380	36.420	7.000	0.000	7.000	154.00	0.429	28.991	22.951	6.040
	Oct	6.040	499.65	2.79	5.700	11.740	3.350	0.589	3.939	159.00	0.443	7.358	1.318	6.040
	Nov	6.040	499.65	2.79	5.410	11.450	3.000	0.676	3.676	134.00	0.374	7.400	1.360	6.040
	Dec	6.040	499.65	2.79	19.510	25.550	0	1.261	1.261	115.00	0.321	23.968	17.928	6.040
	Jan	6.040	499.65	2.79	2.090	8.130	0	0.864	0.864	118.00	0.329	6.937	0.897	6.040
	Feb	6.040	499.65	2.79	1.270	7.310	0	0.569	0.569	134.00	0.374	6.367	0.327	6.040
	Mar	6.040	499.65	2.79	1.240	7.280	0	0.000	0.000	181.00	0.505	6.775	0.735	6.040
	Apr	6.040	499.65	2.79	0.750	6.790	0	0.000	0.000	217.00	0.605	6.185	0.145	6.040
	May	6.040	499.65	2.79	0.350	6.390	0	0.000	0.000	247.00	0.689	5.701	0.000	5.701
	June	5.701	499.52	2.66	4.410	10.111	0	0.000	0.000	175.00	0.465	9.647	3.607	6.040
	July	6.040	499.65	2.79	39.300	45.340	15	0.000	15.000	143.00	0.399	29.941	23.901	6.040
	Aug	6.040	499.65	2.79	45.230	51.270	27	0.000	27.000	124.00	0.346	23.924	17.884	6.040
	Sept	6.040	499.65	2.79	43.300	49.340	7	0.000	7.000	154.00	0.429	41.911	35.871	6.040

Year	Month	Intial Reservoir			Inflow from self catchment	Total Volume	Release to Dehera dam	Demand for Irrigation Rabi	Total Demand	Evaporation		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area						Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1998-99	Oct	6.040	499.65	2.79	24.600	30.640	3.35	0.589	3.939	159.00	0.443	26.258	20.218	6.040
	Nov	6.040	499.65	2.79	6.820	12.860	3	0.676	3.676	134.00	0.374	8.810	2.770	6.040
	Dec	6.040	499.65	2.79	1.270	7.310	0	1.261	1.261	115.00	0.321	5.728	0.000	5.728
	Jan	5.728	499.53	2.67	1.100	6.828	0	0.864	0.864	118.00	0.315	5.650	0.000	5.650
	Feb	5.650	499.50	2.64	14.720	20.370	0	0.569	0.569	134.00	0.353	19.448	13.408	6.040
	Mar	6.040	499.65	2.79	5.020	11.060	**0**	0.000	0.000	181.00	0.505	10.555	4.515	6.040
	Apr	6.040	499.65	2.79	0.420	6.460	**0**	0.000	0.000	217.00	0.605	5.855	0.000	5.855
	May	5.855	499.58	2.72	0.240	6.095	**0**	0.000	0.000	247.00	0.671	5.424	0.000	5.424

Year	Month	Intial Reservoir			Inflow from self catchment	Total Volume	Release to Dehera dam	Demand for Irrigation Rabi	Total Demand	Evaporation		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area						Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1999-00	June	5.424	499.42	2.55	2.300	7.724	0.000	0.000	0.000	175.00	0.446	7.279	1.239	6.040
	July	6.040	499.65	2.79	40.970	47.010	15.000	0.000	15.000	143.00	0.399	31.611	25.571	6.040
	Aug	6.040	499.65	2.79	56.740	62.780	27.000	0.000	27.000	124.00	0.346	35.434	29.394	6.040
	Sept	6.040	499.65	2.79	126.030	132.070	7.000	0.000	7.000	154.00	0.429	124.641	118.601	6.040
	Oct	6.040	499.65	2.79	50.480	56.520	3.350	0.589	3.939	159.00	0.443	52.138	46.098	6.040
	Nov	6.040	499.65	2.79	5.430	11.470	3.000	0.676	3.676	134.00	0.374	7.420	1.380	6.040
	Dec	6.040	499.65	2.79	1.210	7.250	0.000	1.261	1.261	115.00	0.321	5.668	0.000	5.668
	Jan	5.668	499.51	2.64	1.130	6.798	0.000	0.864	0.864	118.00	0.312	5.623	0.000	5.623
	Feb	5.623	499.49	2.62	1.370	6.993	0.000	0.569	0.569	134.00	0.352	6.072	0.032	6.040
	Mar	6.040	499.65	2.79	0.920	6.960	0.000	0.000	0.000	181.00	0.505	6.455	0.415	6.040
	Apr	6.040	499.65	2.79	0.570	6.610	0.000	0.000	0.000	217.00	0.605	6.005	0.000	6.005
	May	6.005	499.64	2.77	0.270	6.275	0.000	0.000	0.000	247.00	0.685	5.590	0.000	5.590
2000-01	June	5.590	499.48	2.61	2.210	7.800	6.000	0.000	6.000	175.00	0.457	1.343	0.000	1.343
	July	1.343	496.80	0.78	77.750	79.093	27.000	0.000	27.000	143.00	0.111	51.981	45.941	6.040
	Aug	6.040	499.65	2.79	23.080	29.120	15.000	0.000	15.000	124.00	0.346	13.774	7.734	6.040
	Sept	6.040	499.65	2.79	5.400	11.440	3.000	0.000	3.000	154.00	0.429	8.011	1.971	6.040
	Oct	6.040	499.65	2.79	1.490	7.530	3.000	0.589	3.589	159.00	0.443	3.498	0.000	3.498
	Nov	3.498	498.52	1.77	0.630	4.128	2.400	0.676	3.076	134.00	0.238	0.814	0.000	0.814
	Dec	0.814	495.98	0.46	1.320	2.134	0	1.261	1.261	115.00	0.053	0.819	0.000	0.819
	Jan	0.819	496.00	0.46	0.660	1.479	0	0.864	0.864	118.00	0.055	0.561	0.000	0.561
	Feb	0.561	495.26	0.31	0.220	0.781	0	0.200	0.200	134.00	0.041	0.539	0.000	0.539
	Mar	0.539	495.20	0.30	0.220	0.759	0	0.000	0.000	181.00	0.054	0.706	0.000	0.706
	Apr	0.706	495.67	0.40	0.220	0.926	0	0.000	0.000	217.00	0.086	0.840	0.000	0.840
	May	0.840	496.03	0.48	0.220	1.060	0	0.000	0.000	247.00	0.118	0.942	0.000	0.942
	June	0.942	496.19	0.54	4.790	5.732	0	0.000	0.000	175.00	0.094	5.638	0.000	5.638
	July	5.638	499.50	2.63	28.080	33.718	18	0.000	18.000	143.00	0.376	15.342	9.302	6.040
	Aug	6.040	499.65	2.79	49.650	55.690	29	0.000	29.000	124.00	0.346	26.344	20.304	6.040
	Sept	6.040	499.65	2.79	6.860	12.900	7	0.000	7.000	154.00	0.429	5.471	0.000	5.471

Year	Month	Intial Reservoir			Inflow from self catchment	Total Volume	Release to Dehera dam	Demand for Irrigation Rabi	Total Demand	Evaporation		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area						Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2001-02	Oct	5.471	499.43	2.56	3.010	8.481	3.35	0.589	3.939	159.00	0.408	4.134	0.000	4.134
	Nov	4.134	498.89	2.04	0.600	4.734	3	0.676	3.676	134.00	0.273	0.784	0.000	0.784
	Dec	0.784	495.90	0.44	0.740	1.524	0	1.000	1.000	115.00	0.051	0.474	0.000	0.474
	Jan	0.474	495.01	0.26	1.360	1.834	0	0.864	0.864	118.00	0.030	0.940	0.000	0.940
	Feb	0.940	496.18	0.54	0.340	1.280	0	0.569	0.569	134.00	0.072	0.639	0.000	0.639
	Mar	0.639	495.48	0.36	0.380	1.019	**0**	0.000	0.000	181.00	0.064	0.954	0.000	0.954
	Apr	0.954	496.21	0.54	0.400	1.354	**0**	0.000	0.000	217.00	0.118	1.236	0.000	1.236
	May	1.236	496.64	0.71	0.220	1.456	**0**	0.000	0.000	247.00	0.177	1.279	0.000	1.279

Year	Month	Intial Reservoir			Inflow from self catchment	Total Volume	Release to Dehera dam	Demand for Irrigation Rabi	Total Demand	Evaporation		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area						Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2002-03	June	1.279	496.71	0.74	2.270	3.549	0.000	0.000	0.000	175.00	0.130	3.420	0.000	3.420
	July	3.420	498.48	1.74	4.470	7.890	6.000	0.000	6.000	143.00	0.249	1.641	0.000	1.641
	Aug	1.641	497.15	0.94	49.760	51.401	40.000	0.000	40.000	124.00	0.116	11.284	5.244	6.040
	Sept	6.040	499.65	2.79	27.800	33.840	15.000	0.000	15.000	154.00	0.429	18.411	12.371	6.040
	Oct	6.040	499.65	2.79	1.350	7.390	2.350	0.589	2.939	159.00	0.443	4.008	0.000	4.008
	Nov	4.008	498.81	1.99	0.370	4.378	1.000	0.676	1.676	134.00	0.266	2.435	0.000	2.435
	Dec	2.435	497.86	1.33	0.640	3.075	0.000	1.261	1.261	115.00	0.152	1.662	0.000	1.662
	Jan	1.662	497.17	0.95	0.220	1.882	0.000	0.864	0.864	118.00	0.112	0.906	0.000	0.906
	Feb	0.906	496.13	0.52	0.220	1.126	0.000	0.569	0.569	134.00	0.069	0.488	0.000	0.488
	Mar	0.488	495.05	0.27	0.220	0.708	0.000	0.000	0.000	181.00	0.048	0.660	0.000	0.660
	Apr	0.660	495.54	0.37	0.220	0.880	0.000	0.000	0.000	217.00	0.080	0.800	0.000	0.800
	May	0.800	495.94	0.45	0.220	1.020	0.300	0.000	0.300	247.00	0.112	0.608	0.000	0.608
2003-04	June	0.608	495.39	0.34	5.330	5.938	0.000	0.000	0.000	175.00	0.059	5.879	0.000	5.879
	July	5.879	499.59	2.72	25.810	31.689	15.000	0.000	15.000	143.00	0.390	16.299	10.259	6.040
	Aug	6.040	499.65	2.79	31.770	37.810	27.000	0.000	27.000	124.00	0.346	10.464	4.424	6.040
	Sept	6.040	499.65	2.79	42.650	48.690	7.000	0.000	7.000	154.00	0.429	41.261	35.221	6.040
	Oct	6.040	499.65	2.79	8.100	14.140	3.350	0.589	3.939	159.00	0.443	9.758	3.718	6.040
	Nov	6.040	499.65	2.79	0.950	6.990	3.000	0.676	3.676	134.00	0.374	2.940	0.000	2.940
	Dec	2.940	498.20	1.55	1.050	3.990	0	1.261	1.261	115.00	0.178	2.551	0.000	2.551
	Jan	2.551	497.97	1.38	1.030	3.581	0	0.864	0.864	118.00	0.163	2.554	0.000	2.554
	Feb	2.554	497.97	1.38	1.400	3.954	0	0.569	0.569	134.00	0.185	3.200	0.000	3.200
	Mar	3.200	498.35	1.65	0.950	4.150	0	0.000	0.000	181.00	0.299	3.851	0.000	3.851
	Apr	3.851	498.72	1.92	0.280	4.131	0	0.000	0.000	217.00	0.417	3.714	0.000	3.714
	May	3.714	498.65	1.86	0.240	3.954	0	0.000	0.000	247.00	0.460	3.494	0.000	3.494
	June	3.494	498.52	1.77	2.530	6.024	0	0.000	0.000	175.00	0.310	5.713	0.000	5.713
	July	5.713	499.53	2.66	18.530	24.243	15	0.000	15.000	143.00	0.380	8.863	2.823	6.040
	Aug	6.040	499.65	2.79	92.840	98.880	27	0.000	27.000	124.00	0.346	71.534	65.494	6.040
	Sept	6.040	499.65	2.79	8.180	14.220	7	0.000	7.000	154.00	0.429	6.791	0.751	6.040

Year	Month	Intial Reservoir			Inflow from self catchment	Total Volume	Release to Dehera dam	Demand for Irrigation Rabi	Total Demand	Evaporation		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area						Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2004-05	Oct	6.040	499.65	2.79	3.010	9.050	3.35	0.589	3.939	159.00	0.443	4.668	0.000	4.668
	Nov	4.668	499.13	2.25	0.880	5.548	3	0.676	3.676	134.00	0.302	1.570	0.000	1.570
	Dec	1.570	497.09	0.90	1.260	2.830	0	1.261	1.261	115.00	0.104	1.464	0.000	1.464
	Jan	1.464	496.99	0.85	1.840	3.304	0	0.864	0.864	118.00	0.101	2.340	0.000	2.340
	Feb	2.340	497.78	1.28	1.070	3.410	0	0.569	0.569	134.00	0.171	2.670	0.000	2.670
	Mar	2.670	498.05	1.43	0.500	3.170	**0**	0.000	0.000	181.00	0.260	2.910	0.000	2.910
	Apr	2.910	498.18	1.53	0.260	3.170	**0**	0.000	0.000	217.00	0.333	2.838	0.000	2.838
	May	2.838	498.14	1.50	0.220	3.058	**0**	0.000	0.000	247.00	0.371	2.686	0.000	2.686

Year	Month	Intial Reservoir			Inflow from self catchment	Total Volume	Release to Dehera dam	Demand for Irrigation Rabi	Total Demand	Evaporation		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area						Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2005-06	June	2.686	498.06	1.44	1.990	4.676	0.000	0.000	0.000	175.00	0.252	4.424	0.000	4.424
	July	4.424	499.04	2.15	92.430	96.854	15.000	0.000	15.000	143.00	0.308	81.546	75.506	6.040
	Aug	6.040	499.65	2.79	50.380	56.420	27.000	0.000	27.000	124.00	0.346	29.074	23.034	6.040
	Sept	6.040	499.65	2.79	15.440	21.480	7.000	0.000	7.000	154.00	0.429	14.051	8.011	6.040
	Oct	6.040	499.65	2.79	2.420	8.460	3.350	0.589	3.939	159.00	0.443	4.078	0.000	4.078
	Nov	4.078	498.85	2.01	0.740	4.818	3.000	0.676	3.676	134.00	0.270	0.871	0.000	0.871
	Dec	0.871	496.08	0.50	1.270	2.141	0.000	1.261	1.261	115.00	0.057	0.823	0.000	0.823
	Jan	0.823	496.00	0.47	1.390	2.213	0.000	0.864	0.864	118.00	0.055	1.295	0.000	1.295
	Feb	1.295	496.73	0.75	1.030	2.325	0.000	0.569	0.569	134.00	0.101	1.655	0.000	1.655
	Mar	1.655	497.17	0.95	0.620	2.275	0.000	0.000	0.000	181.00	0.171	2.104	0.000	2.104
	Apr	2.104	497.57	1.16	0.310	2.414	0.000	0.000	0.000	217.00	0.253	2.161	0.000	2.161
	May	2.161	497.62	1.19	0.320	2.481	0.000	0.000	0.000	247.00	0.294	2.187	0.000	2.187
2006-07	June	2.187	497.64	1.20	1.530	3.717	0.000	0.000	0.000	175.00	0.211	3.506	0.000	3.506
	July	3.506	498.53	1.78	20.620	24.126	15.000	0.000	15.000	143.00	0.254	8.871	2.831	6.040
	Aug	6.040	499.65	2.79	143.990	150.030	27.000	0.000	27.000	124.00	0.346	122.684	116.644	6.040
	Sept	6.040	499.65	2.79	121.720	127.760	7.000	0.000	7.000	154.00	0.429	120.331	114.291	6.040
	Oct	6.040	499.65	2.79	5.970	12.010	3.350	0.589	3.939	159.00	0.443	7.628	1.588	6.040
	Nov	6.040	499.65	2.79	0.620	6.660	3.000	0.676	3.676	134.00	0.374	2.610	0.000	2.610
	Dec	2.610	498.01	1.41	1.400	4.010	0.00	1.261	1.261	115.00	0.162	2.587	0.000	2.587
	Jan	2.587	498.00	1.40	1.530	4.117	0.00	0.864	0.864	118.00	0.165	3.088	0.000	3.088
	Feb	3.088	498.29	1.61	1.000	4.088	0.00	0.569	0.569	134.00	0.215	3.304	0.000	3.304
	Mar	3.304	498.41	1.70	0.760	4.064	0.00	0.000	0.000	181.00	0.307	3.757	0.000	3.757
	Apr	3.757	498.67	1.88	0.270	4.027	0.00	0.000	0.000	217.00	0.408	3.619	0.000	3.619
	May	3.619	498.59	1.82	0.220	3.839	0.00	0.000	0.000	247.00	0.451	3.388	0.000	3.388
	June	3.388	498.46	1.73	1.730	5.118	0.00	0.000	0.000	175.00	0.303	4.815	0.000	4.815
	July	4.815	499.18	2.31	16.520	21.335	15.00	0.000	15.000	143.00	0.330	6.005	0.000	6.005
	Aug	6.005	499.64	2.77	14.440	20.445	16.00	0.000	16.000	124.00	0.344	4.101	0.000	4.101
	Sept	4.101	498.87	2.02	12.910	17.011	7.00	0.000	7.000	154.00	0.312	9.699	3.659	6.040

Year	Month	Intial Reservoir			Inflow from self catchment	Total Volume	Release to Dehera dam	Demand for Irrigation Rabi	Total Demand	Evaporation		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area						Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2007-08	Oct	6.040	499.65	2.79	1.340	7.380	3.35	0.589	3.939	159.00	0.443	2.998	0.000	2.998
	Nov	2.998	498.23	1.57	0.220	3.218	2.00	0.200	2.200	134.00	0.210	0.807	0.000	0.807
	Dec	0.807	495.96	0.46	0.220	1.027	0.0	0.000	0.000	115.00	0.052	0.975	0.000	0.975
	Jan	0.975	496.24	0.56	0.220	1.195	0.0	0.300	0.300	118.00	0.066	0.829	0.000	0.829
	Feb	0.829	496.01	0.47	0.220	1.049	0.0	0.100	0.100	134.00	0.063	0.886	0.000	0.886
	Mar	0.886	496.10	0.50	0.220	1.106	0.00	0.000	0.000	181.00	0.091	1.015	0.000	1.015
	Apr	1.015	496.30	0.58	0.220	1.235	0.00	0.000	0.000	217.00	0.126	1.109	0.000	1.109
	May	1.109	496.44	0.64	0.220	1.329	0.00	0.000	0.000	247.00	0.158	1.171	0.000	1.171
2008-09	June	1.171	496.54	0.68	5.360	6.531	0.000	0.000	0.000	175.00	0.118	6.413	0.373	6.040
	July	6.040	499.65	2.79	13.410	19.450	15.000	0.000	15.000	143.00	0.399	4.051	0.000	4.051
	Aug	4.051	498.84	2.00	45.700	49.751	27.000	0.000	27.000	124.00	0.248	22.503	16.463	6.040
	Sept	6.040	499.65	2.79	12.540	18.580	7.000	0.000	7.000	154.00	0.429	11.151	5.111	6.040
	Oct	6.040	499.65	2.79	1.520	7.560	3.350	0.000	3.350	159.00	0.443	3.767	0.000	3.767
	Nov	3.767	498.68	1.89	0.230	3.997	3.000	0.100	3.100	134.00	0.253	0.644	0.000	0.644
	Dec	0.644	495.50	0.36	0.230	0.874	0.000	0.000	0.000	115.00	0.041	0.833	0.000	0.833
	Jan	0.833	496.02	0.47	0.230	1.063	0.000	0.000	0.000	118.00	0.056	1.007	0.000	1.007
	Feb	1.007	496.29	0.58	0.230	1.237	0.000	0.569	0.569	134.00	0.077	0.591	0.000	0.591
	Mar	0.591	495.34	0.33	0.230	0.821	0.000	0.000	0.000	181.00	0.059	0.762	0.000	0.762
	Apr	0.762	495.83	0.43	0.230	0.992	0.000	0.000	0.000	217.00	0.093	0.898	0.000	0.898
	May	0.898	496.12	0.51	0.230	1.128	0.000	0.000	0.000	247.00	0.126	1.002	0.000	1.002
2009-10	June	1.002	496.28	0.57	1.520	2.522	0.000	0.000	0.000	175.00	0.100	2.422	0.000	2.422
	July	2.422	497.85	1.32	25.240	27.662	15.000	0.000	15.000	143.00	0.189	12.473	6.433	6.040
	Aug	6.040	499.65	2.79	15.860	21.900	21.000	0.000	21.000	124.00	0.346	0.554	0.000	0.554
	Sept	0.554	495.24	0.31	30.330	30.884	13.000	0.000	13.000	154.00	0.047	17.837	11.797	6.040
	Oct	6.040	499.65	2.79	9.530	15.570	3.350	0.589	3.939	159.00	0.443	11.188	5.148	6.040
	Nov	6.040	499.65	2.79	8.450	14.490	3.000	0.676	3.676	134.00	0.374	10.440	4.400	6.040
	Dec	6.040	499.65	2.79	2.740	8.780	0.00	1.261	1.261	115.00	0.321	7.198	1.158	6.040

Year	Month	Intial Reservoir			Inflow from self catchment	Total Volume	Release to Dehera dam	Demand for Irrigation Rabi	Total Demand	Evaporation		Balance Volume	Spill	Final Reservoir Storage
		Storage	Elevation	Area						Depth	Volume			
		MCM	M	MM^2	MCM	MCM	MCM	MCM	MCM	mm	MCM	MCM	MCM	MCM
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	Jan	6.040	499.65	2.79	0.710	6.750	0.00	0.864	0.864	118.00	0.329	5.557	0.000	5.557
	Feb	5.557	499.47	2.60	0.660	6.217	0.00	0.569	0.569	134.00	0.348	5.300	0.000	5.300
	Mar	5.300	499.37	2.50	0.360	5.660	0.00	0.000	0.000	181.00	0.452	5.208	0.000	5.208
	Apr	5.208	499.33	2.46	0.260	5.468	0.00	0.000	0.000	217.00	0.534	4.934	0.000	4.934
	May	4.934	499.23	2.35	0.230	5.164	0.00	0.000	0.000	247.00	0.582	4.582	0.000	4.582
	Success rate			81.25	%									

Annexure- 9.1

No. J-12011/20/2013-IA-I
Government of India
Ministry of Environment, Forest & Climate Change
(IA-I Division)

Indira ParyavaranBhawan
3rd Floor, Vayu Wing
JorBagh Road
New Delhi-110 003

Dated: 25.8. 2017

To

The Chief Engineer
M/s. National Water Development Agency
Ministry of Water Resources, RD & GR
18-20, Community Centre, Saket
New Delhi -110 066

Subject: Ken-Betwa Link Project Phase-I in Panna&Chhatarpur District of Madhya Pradesh M/s Water Resources Department, Government of Madhya Pradesh and M/s. National Water Development Agency - Environmental Clearance (EC)-regarding.

Sir,

This is with reference to your letter No. NWDA/SE-II/152/22/2015/Vol-I/10409 dated 20.7.2015, 7.10.2015, 14.10.2015, 9.2.2016, 2.6.2016, 17.11.2016, 8.12.2016, 26.12.2016 and 30.6.2017 on the above mentioned subject.

2. The above referred proposal was appraised by the Expert Appraisal Committee (EAC) for River Valley and Hydro Electric Power Projects (RV&HEP) in its meetings held on 24-25th August, 2015; 26-27th October, 2015; 8-9th February, 2016; 2-3rd June, 2016 and 30th December, 2016. The comments and observations of EAC of this project may be seen in the Minutes of these Meetings which are available on the web-site of this Ministry.

3. The project envisages construction of 77 m high & 2,031 m long composite dam across Ken river near village Daudhan in Chhatarpur District of Madhya Pradesh to provide irrigation facility to 6.35 lakh ha area, drinking water facility and generation of 78 MW hydropower. Two (2) powerhouses, viz., (i) 2 units of 30 MW capacity each, and (ii) 3 units of 6 MW capacity each are proposed to be constructed. Two (2) tunnels of 1.9 km long upper level and 1.1 km long lower level tunnel and 221 km long Ken-Betwa link Canal Phase-I on the left bank of the river are proposed to be constructed. Total submergence area is 9,000 ha, out of which 5,258 ha is forestland (includes 4,141 ha in Panna Tiger Reserve). A total of 10 villages consisting of 1,585 families are likely to be affected by this project. Panna Tiger Reserve falls within the 10 km radius of the project. The total cost of the project is about Rs.9,393 Crores and it is likely to be completed in 9 years.

4. The Public Hearingfor the project was conducted on 23.12.2014 at Government School Ground, Silone Village in Chhattarpur District and on 27.12.2014 at Forest Guest House, Hinnota Village in Panna District of Madhya Pradesh.

5. The Expert Appraisal Committee (EAC), after due consideration of the relevant documents submitted by the project proponent and clarifications furnished in response to its observations, have recommended for grant of Environmental Clearance for this project. Accordingly, the Ministry of Environment, Forest and Climate Change hereby accords necessary Environmental Clearance for the above project as per the provisions of Environmental Impact Assessment Notification, 2006 and its amendments thereof, subject to compliance of the following conditions:

Part A: Specific Conditions

i. The proposed Catchment Area Treatment (CAT) Plan as proposed in EIA/EMP (May, 2015) for 8 years with biological and engineering measures shall be implemented in consultation with Madhya Pradesh Forest Department. The CAT proposed is 2413.67 Sq. km. Allocated amount of Rs. 272.58crores for this purpose be fully utilized and not to be diverted for any other purpose.

Measures	I Year	II Year	III Year	IV Year	V Year	VI Year	VII Year	VIII Year	Total
Biological Measures									
Afforestation/ Reforestation (ha)	--	1249	1874	2498	2498	2498	1249	625	12490
Pasture Improvement (ha)	--	345	517	690	690	690	345	172	3448
Social forestry (ha)	--	225	338	450	450	450	225	113	2250
Engineering Measures									
Stone wall check dams (Nos)	32	61	61	61	20	20	20	15	292
Loose Boulder check dams (Nos)	46	88	88	88	29	29	29	21	419
Stone Contour Bunds (ha)	2395	4573	4573	4573	1524	1524	1524	1089	21776
Mini Percolation tanks (Nos)	1	2	2	1	--	--	--	--	6
Staggered Contour Trenches with plantation (ha)	994	1898	1898	1898	633	633	633	452	9036

i. The R&R benefits for the land losing will have to comply with "The Right to fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013" which has come in force on 1.1.2014. Adequate publicity of the compensation package should be circulated in the affected villages. All R&R issues shall be completed before commissioning of the project.

ii. A monitoring Committee for R&R shall be constituted which shall include representatives of project affected persons including representative from SC/ST category and a woman beneficiary.

iii. All commitment made during the public hearing should be fulfilled completely by the project proponent and record maintained.

iv. The Command Area Development (CAD) plan as proposed in EIA/EMP report (May, 2015) shall be strictly implemented.

v. The Water User Association's (WUAs)/ Co-operative shall be formed and involvement of the whole community for disciplined use of available water shall be ensured.

vi. Conjunctive use of surface water shall be planned to check water logging as well as to increase productivity.

vii. Consolidation and compaction of the generated muck should be carried out at the muck dumping sites. As proposed in the muck disposal plan, out of12.3 Mm^3generated. Out of which, 7.38 Mm^3lakh m^3 is to be utilized for construction purpose and remaining should be dumped in designated disposal sites. The muck disposal sites should be reclaimed/restored with vegetative cover once capacity is utilized and it should be strictly adhered to.

viii. The proposed compensatory afforestation programme in 10,856 ha shall be developed in consultation with State Forest Department. An amount of Rs.3061 Crores have been allocated for this purpose. A part of the Panna Tiger Reserve is coming under submergence, proposed Biodiversity Conservation and Management Plan in consultation with State Forest Department shall be implemented in toto. Allocated amount of Rs. 27.47 Croresfor this purpose should be fully used and not to divert for any other purpose.

ix. The equipment likely to generate high noise levels during the construction period or otherwise shall meet the Ambient Noise level standards as notified under the Noise Pollution (Regulation and Control) Rules, 2000, as amended in 2010 under the Environment Protection Act (EPA), 1986.

x. The On Farm Development (OFD) works shall be completed and WUAs (Water User Associations) shall be made functional before commencement of irrigation.

xi. The Fishery Development and Management Plan shall be developed in consultation with the State Fishery Department. Under the fisheries management plan, stocking of fish seed in Daudhan & Rangwan reservoirs, upstream/downstream of the river should be implemented strictly. The proposed Mahsheer hatchery taken-up strictly.The allocated grantRs.14.09 crores for this purpose shall be fully utilized and shall not be diverted for any other purposes.

xii. Six monthly compliance reports shall be submitted to the Regional Office of the Ministry located at Bhopal without fail until completion of the project along with the monitoring data. It should also to be uploaded in the own website of the project as a part of information to the General Public.

xiii. Periodical soil health shall be verified in command area during operation phase to ensure maintenance of soil fertility.

xiv. Occurrence of stagnant pools/slow moving water channels during construction and operation of the project providing breeding source for vector mosquitoes and other parasites. The river should be properly channelized so that no small pools and puddles are allowed to be formed. Even after taking precaution, due to unforeseen situations, breeding of mosquito and resultant malaria or mosquito borne diseases can increase. If such a situation arises, it will be the responsibility of project proponent to take all steps i.e. residual insecticidal spray in all the project area and its surrounding 3 km area keeping the flight range of mosquitoes in consideration.

xv. Any other clearance from other organization/department, if required, should be obtained as and when necessary.

xvi. Solid waste generated especially plastic waste should not be disposed of as landfill material. It should be treated with scientific approach and recycled.

xvii. As the submergence area is very large (about 9,000 ha), micro-climatic change conditions in the project area during construction/post-construction period to be brought-out/reported at regular intervals.

xviii. Impact due to habitat change having effect like corridor and loss of migratory path for wildlife including birds and impact on the breeding ground of species should be recorded during pre-construction/post - construction stages.

xix. Plans for greenbelt development and reservoir rim treatment plan have to be made in consultation with State Forest Department. Preference shall also be given to plant local indigenous species. If possible, transplantation of trees from the submergence area of the project be taken up and these may be re-planted in the affected area of the project as a part of LMP.

xx. The Panna Tiger Reserve is facing acute shortage of water and due to creation of reservoir; the water regime will improve to a great extent.The extent of creation of pasture land due to receding of submergence, increase of herbivorous population, growth in vulture population as well as increase in Tiger population be recorded in the project area.

xxi. While implementing the LMP for PTR, as and when the Land Management Plan, etc. are taken up in the affected areas of the Ken-Betwa Link Project Phase-I, status of implementation of the same shall be submitted to the Ministry and Regional Office, MoEF & CC, Bhopal for its monitoring on six monthly basis.

xxii. All conditions stipulated in the NBWL Clearance letter No. 6-109/2016-WL (39th Meeting) dated 21.9.2016 should be strictly adhered-to including the resultant reservoir area shall be retained as core area with minimum activities for management purpose under close consultation with Tiger Reserve Management.

xxiii. Six monthly compliance reports shall be submitted to Regional Office, MoEF& CC, Bhopal without fail until completion of the modernization works.

Part B: General Conditions

i. Adequate arrangements for providing free fuel like LPG/kerosene shall be made at theproject cost for the labourforce engaged during the construction work so that indiscriminatefelling of trees is preventedthat is located adjacent to the proposed project site

ii. Medical facilities as well as recreational facilities shall also be provided to the labourers at the construction sites. First aid facility at the project site shall also be provided with proper signage.

iii. The labourers to be engaged for construction works shall be thoroughly examined by health personnel and adequately treated before issuing them work permit to avoid contraction of any disease to the local people.

iv. Water sprinkling arrangements shall be made to control the fugitive dust and fugitive dust, ambient air quality ect.be monitored during the period of construction according to the CPCB guidelines to meet the NAAQ standards.

v. Potable drinking water and proper sanitary facilities shall be provided for the labour force. Any solid water generated at the colony of the labour force shall be collected and suitably disposed of.

vi. Restoration of construction area including muck dumping sites of excavated materials shall be ensured by leveling, filling up of borrow pits, landscaping, etc. The area should be properly treated with suitable plant species preferable local indigenous species for better survival of plants and also to enrich the local habitat.

vii. Environmental parameters shall be monitored and "six monthly monitoring reports" shall be submitted to the Regional office of the Ministry located at Bhopal as per guidelines.

6. The Project Proponent shall provide full cooperation and all required documents / data to the Officer (s) of the Regional Office of the Ministry located at Bhopal who would be monitoring the implementation of environmental safeguards.

7. The responsibility of implementation of environmental safeguards and carrying out environmental monitoring rests fully with the Water Resources Department, Government of Madhya Pradesh and M/s. NWDA.

8. Besides the above stated conditions, the Project Proponent shall also implement all environmental safeguards, as proposed in the EIA/EMP report and other reports from time to time. The Regional Office, MoEF & CC, Bhopal shall monitor implementation of EMP at regular intervals.

9. The Environmental Management Plan (EMP) shall be strictly adhered to. The total cost of implementation of mitigation measures as per EMP is Rs 5073 crores. In case of revision of the project cost or due to price level change, the cost of EMP shall also be updated proportionately.

10. In case of change in the scope of the project, the same shall be intimated to the Ministry and fresh approval, if required, shall be taken from the Ministry accordingly.

11. The Ministry reserves the right to add additional safeguard measures subsequently, if found necessary and to take action including revoking of the clearance under the provisions of the Environment (Protection) Act, 1986, to ensure effective implementation of the suggested safeguard measures in a time-bound and satisfactory manner.

12. The project proponent should advertise at least in two local newspapers widely circulated in the region around the project, one of which shall be in vernacular language of the locality concerned informing that the project has been accorded environmental clearance and copies of clearance letters are available with the State Pollution Control Board / Committee and may also be seen at the Website of the Ministry of Environment, Forest & Climate Change at http://www.moef.nic.in.

13. A copy of the clearance letter shall be marked to concerned Panchayat/ZillaParishad/Municipal Corporation, Urban local body and local NGO, if any, from whom any suggestion/representations were received while processing the proposal. The clearance letter shall also be put in the website by the project proponent. Compliance to the condition shell be ensured by the project and intimated to the state accordingly.

14. State Pollution Control Board / Committee shall display a copy of the clearance letter at the Regional Office, District Industries Centre and Collector's / Tehsildar's Office for 30 days.

15. This clearance letter is valid for a period of 10 years from the date of issue of this letter for commissioning of the project.

16. After 5 years of the commissioning of the Project, a study shall be undertaken regarding impact of the project on the environment and downstream ecology. The study shall be undertaken by an independent agency, decided in consultation with the Ministry.

17. The project proponent shall also submit six monthly reports on the status of compliance of stipulated EC conditions including the results of monthly monitored data (both in hard copies as well as by email) to the Regional Office of MoEF & CC, Bhopal.

18. Any appeal against this environmental clearance shall lie solely with the National Green Tribunal, if preferred, within a period of 30 days from the date of issue, as prescribed under Section-16 of the National Green Tribunal Act, 2010.

Yours faithfully,

(Dr. S. Kerketta)
Director

Copy to:

1. The Secretary, Ministry of Water Resources, RD & GR, Shram Shakti, Bhawan, Rafi Marg, New Delhi 110 001.
2. The Principal Secretary (Water Resources Department), Government of Madhya Pradesh, Secretariat, Bhopal -462 016.
3. The Secretary, Department of Environment, Government of Madhya Pradesh, Secretariat, Bhopal -462 016.
4. The Chief Engineer, Project Appraisal Directorate, Central Water Commission, SewaBhawan, R.K. Puram, New Delhi-110 066.
5. The Chief Engineer, National Water Development Agency, 18-20 Community Centre, Saket, New Delhi – 110017.
6. Shri. O. P. S. Kushwah, Superintending Engineer, National Water Development Agency, 205 – PalikaBhavan, RK Puram, New Delhi – 110066.
7. The Additional PCCF (Central), Regional Office (WR), Ministry of Environment, Forest & Climate Change, KendriyaParyavaranBhavan, Link Road No-3, Ravi ShankerNager, Bhopal -462 016..
8. The Member Secretary, Madhya Pradesh State Pollution Control Board, ParyavaranParisar, E-5, Arera Colony, Bhopal -462 016.
9. NIC Cell - uploading in MoEF&CC's website.
10. PPS to JS (GB)/Director (SKK)/ DD (NS).
11. Guard file.

(Dr. S. Kerketta)
Director

Annexure- 9.2

F. No. 8-49/2016-FC
Government of India
Ministry of Environment, Forest and Climate Change
(Forest Conservation Division)

Indira Paryavaran Bhawan
Aliganj, Jorbagh Road
New Delhi – 110003

Dated: 25th May, 2017

To,

The Pr. Secretary (Forests),
Govt. of Madhya Pradesh,
Bhopal.

Sub: **Diversion of 6017.00 ha. of forest land in favour of Rashtriya Jal Vikas Abhikaran for development of Ken-Betwa Link Project in Distt. Chattarpur, Panna and Tikamgarh, Madhya Pradesh.**

Sir,

I am directed to refer to the State Government of Madhya Pradesh's letter No. F-3/50/2015/10-11/2182 dated 07.10.2016 on the subject mentioned above seeking prior approval of the Central Government under Section-2 of the Forest (Conservation) Act, 1980 and to say that the proposal has been examined by the Forest Advisory Committee constituted by the Central Government under Section-3 of the aforesaid Act.

After careful examination of the proposal of the State Government and on the basis of the recommendations of the Forest Advisory Committee, ***Stage-I Clearance/ In-principle*** approval of the Central Government is hereby granted for diversion of 6017.00 ha. of forest land in favour of Rashtriya Jal Vikas Abhikaran for development of Ken-Betwa Link Project in Distt. Chattarpur, Panna and Tikamgarh, Madhya Pradesh subject to the following conditions:

1. Legal status of the diverted forest land shall remain unchanged;
2. The project proponent shall ensure that equal extent of revenue area to be added to Panna Tiger Reserve, either as a part of the core or corridor with other habitats or satellite core areas and consider the entire landscape as one conservation unit allowing for development and livelihood needs and Panna landscape has to be managed as a single landscape in the interest of long-term conservation because merely adding forest area of adjoining forest division to the core/buffer area of the tiger reserve will not be sufficient to compensate for the loss of forest area as these areas are as such available for use by the tiger and other wild animals of the PTR. Therefore it is necessary to compensate the loss of "forest land" through addition of revenue lands/non-forest lands by the project proponents and the government. The project proponents and the government should compensate the loss of forestland and tiger habitat by transferring to PTR equivalent revenue and private land. Inclusion of land to the west of Ken River would consolidate the Panna Tiger Reserve landscape. This land shall be declared as Reserve Forest/protected Forest and be brought under administrative control of Forest Department;
3. The user agency shall identify the CA sites over equal non -forest land which shall be provided by the user agency/ state government on the western side of PTR. The revised CA scheme approved by the competent authority with suitability certificate and shape file shall be submitted. The revised CA scheme should also include plantation of *Anogeissus pendula*.
4. The identified non-forest land for raising compensatory afforestation shall be transferred and mutated in favour of the State Forest Department before issue of the Stage-II clearance. Non-forest land to be transferred and mutated in favour of the State Forest Department for raising Compensatory Afforestation shall be notified as reserved Forest under Section-4 or Protected Forest under Section-29 of the Indian Forest Act, 1927 or under the relevant Section(s) of the local Forest Act. The Nodal officer must report compliance within a period of 6 month from the date of grant of final approval and send a

copy of the notification declaring the revenue land under Section 4 or Section 29 of the Indian Forest Act, 1927, or under the relevant section of the local Forest Act as the case may be, to this Ministry for information and record;

5. The entire exercise for relocation of revenue villages shall be carried out by the revenue department with the help of the project authorities and that the entire expense for relocation shall be borne by the project. Further, the revenue land so secured through relocation shall be declared Reserve Forest / PF and handed over to the forest department. A Committee consisting of the Field Director Panna National Park (Chairman), a representative of the Project proponent, a representative of the Regional office, Bhopal and a representative of NTCA shall approve such a list of villages to be relocated and forward it to MOEF&CC before the issue of final approval/ Stage II Clearance under Section 2 of Forest (Conservation) Act, 1980 is accorded by this Ministry. Until all the agreed to revenue villages are relocated no closure of dam gates and impounding of water shall be permitted;
6. The land identified for the purpose of CA shall be clearly depicted on a Survey of India topo sheet of 1:50,000 scale;
7. The Catchment area treatment plan as approved by State Government be implemented by/or under the supervision of State Forest Department at the project cost. State Government shall realize cost of implementation of Catchment Area Treatment (CAT) Plan and transfer the same to Ad-hoc CAMPA through on-line portal;
8. The User Agency shall transfer the cost of raising and maintaining the compensatory afforestation at the current wage rate in consultation with State Forest Department in the account of Ad-hoc CAMPA of the concerned State through online portal. The scheme may include appropriate provision for anticipated cost increase for works scheduled for subsequent years;
9. The User Agency shall transfer the funds for the Net Present Value (NPV) as applicable to National Park (PTR) for the forest land being diverted under this proposal as per the orders of the Hon'ble Supreme Court of India dated 28.03.2008, 24.04.2008 and 09.05.2008 in Writ Petition (Civil) No. 202/1995 and the guidelines issued by this Ministry vide its letter No. 5-3/2007-FC dated 05.02.2009 through online portal of Ad-hoc CAMPA account of the State Concerned;
10. The user agency shall submit the revised cost benefit analysis, after considering the ecological cost of diversion of Panna Tiger Reserve(PTR);
11. The State Govt. and the user agency shall ensure that the water flow downstream shall be regulated in line with the natural flow regime and, in the lean period, 100% of the existing flow regime should be maintained while in the non-lean period, the prescribed minimum by hydrology and aquatic biodiversity experts should be ensured. The minimum flow of water in the Ken River will be maintained till it joins the Yamuna to save wildlife including crocodiles and other aquatic animals. The user agency shall also construct a number of concrete dykes across smaller streams going off from the main reservoir which during FRL shall be over flown but which during lean season shall dam up small isolated water bodies for the benefit of the wildlife;
12. The State Govt. and the user agency shall ensure that the e-flow is maintained as given in the EIA and EMP of the project to save the wildlife including mugger and gharial, and to maintain the water regime downstream of the dam;
13. The State Govt. and the user agency shall ensure that the proposed Powerhouse, which have the capacity of 78 MW, shall not be constructed in the forest area to be diverted to avoid constant disturbance in the PTR;
14. The State Govt. and the user agency shall ensure that the canal should be realigned to minimize the use of forest land for construction of canal;
15. The State Govt. shall ensure that the appropriate provision should be made by the project proponent to strengthen and improve habitat management enforcement, and monitoring activities in the core as well as in buffer areas, as there is risk of increased human activities

due to this project. Further, support should be provided for buffer management and community activities, including eco-development and skill development programs, for local villagers. Alternative activities for local communities involved in extractive activities inside PTR should be implemented;

16. In the long-term interest of tiger conservation, the project proponent may implement landscape level conservation, which is administratively/legally effective for which Landscape Management Authority/Council/ Society should be brought under the purview of tiger reserve management;
17. The State Govt. shall ensure that no building material for the construction of dam/power house/canal or any other purpose should be permitted from the national park/forest area;
18. The task of consultancy for preparation of Action Plan for conservation of Vultures in affected area of PTR shall be given to BNHS and the program for Species Recovery Program for gharial in the landscape shall be done by the Wildlife Institute of India and the cost for these species recovery programs shall be borne by the project proponent;
19. The State Govt. shall constitute a dedicated team involving State Forest Department, National Tiger Conservation Authority, Wildlife Institute of India and the project proponent including NDWA should oversee this project during and post construction phases, and shall provide regular management inputs for ensuring the conditions proposed herewith;
20. As per the Supreme Court order, 5% of the project cost corresponding to the project area falling inside the Protected Areas would be paid by the user agency for the development of the concerned National Park/Wildlife Sanctuary and the fund so collected from the Project should be used exclusively for funding conservation and administrative activities for the Panna Tiger Conservation Landscape;
21. **The State Govt. shall carry out fresh enumeration for entire project area by increasing the sampling intensity;**
22. There will not be any tree felling done above tree line up to FRL minus 10 Mts. Tree felling below 10 meter from FRL shall not be carried out before ascertaining that these trees are actually getting submerged for considerably long period and eventually die. It is only after actually attaining FRL that the decision to fell trees above FRL minus 10 shall be taken by the forest department;
23. The State Govt. and the user agency shall comply the recommendations made by the National Tiger Conservation Authority (NTCA) as per provisions of Sections 38 0 (2), 38 (0)(1)(b) and 38 (0)(1)(g) of the Wildlife (Protection) Act, 1972 inclusive of recommendations of the NTCA Committee constituted in December, 2013, recommendation of the Committee constituted by the Standing Committee of the National Board for Wildlife (NBWL) vide its 37 th Meeting, and discussions held by the Expert Group which was suggested in the 38th Meeting of the SC of NBWL); vide their letter no. 7-2/2016-NTCA dated 22.08.2016 subject to the modifications/recommendations of CEC in light of the cognizance taken by CEC regarding NBWL recommendations and communication of CEC dated 10th April 2017 and subsequent discussion in CEC office and approval of the Supreme Court, if referred by the CEC. **The condition listed in letter no. 7-2/2016-NTCA dated 22.08.2016 is given below:**

    i. The following protected areas in the landscape shall be brought under Project Tiger;
       a) Nauradehi Wildlife Sanctuary, Madhya Pradesh
       b) Rani Durgawati Wildlife Sanctuary, Madhya Pradesh
       c) Ranipur Wildlife Sanctuary, Uttar Pradesh
       Commencement of works shall not be permitted till notification of at least core/critical tiger habitats is carried out by respective State Governments. States should expedite the process as benefits of the project shall accrue to both.

    ii. Critical areas in buffer of the Panna Tiger Reserve, which facilitate tiger dispersal to the west and south, shall be taken into the core/critical tiger habitat.

Necessary funding support to voluntarily rehabilitate people from these areas shall be borne by the user agency.

iii. Areas of South Panna and Chhatarpur Divisions which have historically seen tiger presence shall be notified as buffer of the Panna Tiger Reserve and shall be brought under unified control of the Field Director Panna to ensure suitable interventions in the long run.

iv. The aforesaid Landscape Management Plan (LMP) shall be prepared by the NTCA and WII with complete funding support by the user agency in three years. Phase I of the same shall focus on delineation of connecting/interlinking areas for tiger dispersal, at the micro level in consultation with stake holders and shall be completed within a year of commencement of LMP preparation work. No construction activity shall commence prior to delineation of these areas at the micro level. Strategies and management interventions for these delineated areas shall be proposed and implemented subsequently.

v. The LMP shall inter alia, also focus on a vulture recovery programme in consultation with domain experts as per a dynamic scenario based on effect of construction of the works and water levels on nesting behavior;

vi. The LMP shall be made part of the adjoining area plan/corridor plan of the Tiger Conservation Plan (TCP) of the Panna Tiger Reserve which shall categorically propose a tripartite Memorandum of Understanding between the State, Ministry controlling the User Agency (Ministry of Water Resources) and the NTCA ensuring reciprocal commitments by each party to safeguard the landscape. The contents of the MoU shall be worked by mutual consultation between the parties. However, the Panna Tiger Reserve Management need not wait for the LMP to be completed to furnish the TCP, as the LMP shall be incorporated as part subsequently by the NTCA as per Section 38 (0)(1)(a) of the Wildlife (Protection) Act, 1972.

vii. At Gherighat region in the Panna Tiger Reserve, an early warning system shall be installed by the user agency to predict water levels so as to maintain connectivity with the west of the tiger reserve. If required, structural interventions camouflaged to mimic nature shall be constructed at cost of the user agency to maintain tiger dispersal to the west;

viii. Along the canal alignment, structural interventions shall be carried out at wildlife cross over points, which are duly camouflaged and mimic nature, at cost to the user agency, so that dispersal is not hindered;

ix. At the end of ramification of the submergence water level, suitable water retention structures like dykes, shall be created by the user agency which can hold water during pinch periods for wildlife after the water has receded;

x. As the mitigation strategy envisaged involves operationalizing a landscape approach to tiger conservation, no new mining areas shall be proposed in the delineated corridor areas as well as those wherein tiger dispersal movement has been historically recorded. Further, extending of existing mining leases shall not be carried out until it is concretely justified that the project is in public interest and following due process of law;

xi. A Committee shall be set up to monitor the works during pre-construction, during construction and post construction phases as follows;

(i) AIG (NTCA), Regional Office, Nagpur with AIG (NTCA), Headquarters as link officer.

(ii) Representative of the Wildlife Institute of India, Dehradun, conversant with the landscape

(iii) Deputy Director, Panna Tiger Reserve with Field Director, Panna as link officer

(iv) Representative of the Global Tiger Forum

xii. Forest Clearance in the said case shall follow its due course and the matter shall be referred to the NTCA under Sections 38 (0)(1)(b) and 38 (0)(1)(g) of the Wildlife (Protection) Act, 1972 by the Forest Advisory Committee, when received, as per procedure.

23. (a) State Government of Madhya Pradesh and the user agency shall obtain prior approval before seeking Stage-II clearance from NTCA under Sections 38 of the Wildlife (Protection) Act, 1972;
24. State Government of Madhya Pradesh and the user agency shall implement the approved Rehabilitation and Resettlement (R & R) plan of the project affected families in a time bound and transparent manner;
25. To prevent illegal occupation/encroachment of the forest land by the families to be displaced from the project site, the user agency shall ensure that each family being displaced from the project site actually acquires and settles on non-forest land. Apart from taking other measures to achieve the said objective, as a measure to discourage the project affected families from encroachment on the forest land, payment of annuity for a period of at-least five years at the rate of the minimum wage payable to the unskilled person for 200 person-days per annum to each adult member of the project affected families, on receipt of a certificate signed by a forest officer not below the rank of a Range Officer having jurisdiction over the area where such person has settled after displacement from the project site, should be incorporated in the R & R plan. Payment of the said annuity should be an additionality and not in replacement of any of the benefits to be accrued to the project affected persons, as per the approved R&R Plan;
26. The State Govt. shall ensure that the User aagency shall track location of each displaced family and ensure that none of them encroach/ occupy forest land. In support of compliance to the said condition at least for five years from the date of taking possession of the forest land, the user agency shall submit an annual certificate to the Principal Chief Conservator of Forests, Madhya Pradesh that none of the persons displaced from the project land has encroached/ settled on the forest land during the year;
27. At the time of payment of the Net Present Value (NPV) at the then prevailing rate, the User Agency shall furnish an undertaking to pay the additional amount of NPV, if so determined, as per the final decision of the Hon'ble Supreme Court of India;
28. Any fund received from the user agency under the project, except the funds realized for regeneration/ demarcation of safety zone, shall be transferred to Ad-hoc CAMPA through online portal of Ad-hoc CAMPA account of the State Concerned;
29. The User Agency shall obtain the Environment Clearance as per the provisions of the Environmental (Protection) Act, 1986, if required;
30. No labour camp shall be established on the forest land;
31. The User Agency shall provide fuels preferably alternate fuels to the labourers and the staff working at the site so as to avoid any damage and pressure on the nearby forest areas;
32. The boundary of the diverted forest land shall be demarcated on ground at the project cost, by erecting four feet high reinforced cement concrete pillars, each inscribed with its serial number, forward and back bearing ,distance from pillar to pillar and GPS co-ordinates;
33. The layout plan of the proposal shall not be changed without the prior approval of the Central Government;
34. The forest land shall not be used for any purpose other than that specified in the proposal;
35. The forest land proposed to be diverted shall under no circumstances be transferred to any other agency, department or person without prior approval of the Central Government;
36. The water shall be provided from the reservoir to the Forest Department for raising and maintenance of plantations and nurseries around the site whenever required, free of charge. The quantity and time of supply of water shall be as decided by the Forest Department.
37. No damage to the flora and fauna of the adjoining area shall be caused;

38. Felling of trees on the forest land being diverted shall be reduced to the bare minimum and the trees shall be felled under strict supervision of the State Forest Department;
39. The User Agency shall undertake afforestation along the periphery of the reservoir and canals (as applicable).
40. The User Agency shall carry out muck disposal at pre-designated sites in such a manner so as to avoid its rolling down.
41. The dumping area for muck disposal shall be stabilized and reclaimed by planting suitable species by the User Agency at the cost of project under the supervision of State Forest Department. Retaining walls and terracing shall be carried out to hold the dumping material in place. Stabilization and reclamation of such dumping sites shall be completed before handing over the same to the State Forest Department in a time bound manner as per Plan.
42. The State Government and the User Agency shall ensure that the trees available between full reservoir level (FRL) and FRL-4 meters are not felled;
43. A plan for conservation of wildlife will be made by the User Agency in consultation with the CCF (Wildlife) to be implemented at the User Agency's cost.
44. The State Government shall complete settlement of rights, in terms of the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, if any, on the forest land to be diverted and submit the documentary evidence as prescribed by this Ministry in its letter No. 11-9/1998-FC (Pt.) dated 03.08.2009 read with 05.07.2013, in support thereof;
45. The User Agency shall submit the annual self-compliance report in respect of the above conditions to the State Government and to the concerned Regional Office of the Ministry regularly;
46. Any other condition that the concerned Regional Office of this Ministry may stipulate, from time to time, in the interest of conservation, protection and development of forests & wildlife; and
47. The User Agency and the State Government shall ensure compliance to provisions of the all Acts, Rules, Regulations, Guidelines and relevant Hon'ble Court Order (s), if any, pertaining to this project for the time being in force, as applicable to the project.

After receipt of compliance report on fulfilment of the conditions mentioned above, the proposal shall be considered for final approval under Section-2 of the Forest (Conservation) Act, 1980. Transfer of forest land shall not be affected till final approval is granted by the Central Government in this regard.

Yours faithfully,

(Nisheeth Saxena)
Sr. Assistant Inspector General of Forests (FC)

Copy to:-

1. The PCCF, Government of Madhya Pradesh, Bhopal.
2. The Member Secretary, National Tiger Conservation Authority (NTCA), 7th Floor, Paryavaran Bhawan, CGO Complex, Lodhi Road, New Delhi.
3. Addl. Director General of Forest (Wildlife), Ministry of Environment, Forest and Climate Change, IPB, New Delhi.
4. The Nodal Officer (FCA), O/o PCCF, Government of Madhya Pradesh, Bhopal.
5. The Addl. PCCF (Central), Regional Office, Bhopal.
6. User Agency.
7. Forest Conservation Monitoring Cell, MoEF&CC, New Delhi
8. Guard File.

(Nisheeth Saxena)
Sr. Assistant Inspector General of Forests (FC)

Annexure- 9.3

No. J-12011/31/2014-IA-I
Government of India
Ministry of Environment, Forest & Climate Change
(IA-I Division)

Indira Paryavaran Bhawan
3rd Floor, Vayu Wing
Jor Bagh Road
New Delhi-110 003

Dated: 22nd February, 2017

To

The Engineer -in- Chief
Office of the Engineer -in- Chief
Water Resources Department
Government of Madhya Pradesh
Bhopal - 462 003
Madhya Pradesh.

Subject: Bina Complex Multipurpose Project (32 MW) District Sagar in Madhya Pradesh M/s Water Resources Department, Govt. of Madhya Pradesh - for Environmental Clearance (EC)- regarding.

Sir,

This is with reference to your letter no 3211871/8/P-III/W/Bina pro./2016 dated 26.11.2016 on the above mentioned subject.

2. The above referred proposal was appraised by the Expert Appraisal Committee (EAC) for River Valley and Hydro Electric Power Projects (RV&HEP) in its meeting held on 30th December, 2016. The comments and observations of EAC of this project may be seen in the Minutes of the Meeting which are available on the web-site of this Ministry.

3. The project envisages construction of 4 dams on Bina & Dhassan Rivers (both are tributaries to Betwa river) to provide irrigation facility in 84,200 ha of land in Sagar District of Madhya Pradesh. Water flow from Bina River will be stored in an earthen dam (known as Madia dam) near Madia in Rahatgarh Tehsil of Sagar District of Madhya Pradesh. An underground powerhouse is also proposed on the left bank of the river downstream of the Madia dam for generation of 22 MW (2x11 MW) of hydropower & Dehra dam for generation of 10 MW (2x5 MW) of hydropower. The gross command (GCA) area is 1,02,500 ha and irrigable command area is 90,747 ha. The total land requirement for this project is 12,671.18 ha. Out of which, 1,024.44 ha is forest land; 10,652.59 ha is private land and other type/waste land is 994.15 ha. Total submergence area is 10,391.88 ha. About 69 villages consisting of about 2957 families are likely to be affected due to this project. The total cost of the project is about Rs. 3249.627 Crores and it is proposed to be completed in 36 months.

4. The Public Hearings were conducted in 3 Districts namely Raisen, Vidhisa and Sagar in Madhya Pradesh on 18.5.2016, 20.5.2016 and 27.5.2016, respectively.

5. The Expert Appraisal Committee (EAC), after due consideration of the relevant documents submitted by the project proponent and clarifications furnished in response to its observations, have recommended for grant of Environmental Clearance for this project. Accordingly, the Ministry of Environment, Forest and Climate Change hereby accords necessary Environmental Clearance for the above project as per the provisions of Environmental Impact Assessment Notification, 2006 and its amendment in 2009, subject to compliance of the following conditions:

Part A: Specific Conditions

i. The proposed Catchment Area Treatment (CAT) plan for 5 years with biological and engineering measures shall be implemented in consultation with Madhya Pradesh Forest Department. The CAT proposed is 1853 Sq. km. Allocated amount of Rs. 30.5 crores for this purpose be fully utilized and not to be diverted for any other purpose.

ii. The R&R benefits for the land losing will have to comply with "The Right to fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013" which has come in force on 1.1.2014. Adequate publicity of the compensation package should be circulated in the affected villages. All R&R issues shall be completed before commissioning of the project.

iii. The project-displaced people should be rehabilitated with human angle. Rehabilitation plan should include –

(a) Land for Land, to the extent feasible, should be provided.
(b) One-time financial assistance needs to be increased substantially.
(c) The people who are poor, their land should be considered very compassionately.
(d) R & R plan should have all possible provisions to provide livelihood option/cash compensation.

iv. A monitoring Committee for R&R shall be constituted which shall include representatives of project affected persons including representative from SC/ST category and a woman beneficiary.

v. All commitment made during the public hearing should be fulfilled completely by the project proponent and record maintained.

vi. The Command Area Development (CAD) plan as proposed in EIA/EMP report (November, 2016) shall be strictly implemented.

vii. The Water User Association's (WUAs)/ Co-operative shall be formed and involvement of the whole community for disciplined use of available water shall be ensured.

viii. Conjunctive use of surface water shall be planned to check water logging as well as to increase productivity.

ix. Consolidation and compaction of the generated muck should be carried out at the muck dumping sites. As proposed in the muck disposal plan, out of 7.33 lakh m^3 generated. Out of which, 1.81 lakh m^3 is to be utilized for construction purpose and remaining 5.52 lakh m^3 to be dumped in 11.75 ha of area at 4 designated disposal sites. The muck disposal sites should be reclaimed/ restored with vegetative cover once capacity is utilized and it should be strictly adhered to.

x. To enhance the environment of project site, greenbelt, as proposed in the EIA/EMP report (November, 2016) shall be developed. The proposed greenbelt development in and around the reservoir, boundaries of the project colony, approach roads and various project components in 1068.12 ha with 14 different local plant species shall be undertaken in consultation with State Forest Department, Government of Madhya Pradesh. The allocated grant of Rs. 72 lakhs for this purpose should be fully utilized and the same shell not to be diverted for other purpose.

xi. Water quality monitoring shall be done on bimonthly basis in the 5 km stretch at the upstream and downstream of Bina & Dhassan Rivers during construction phase for drinking water quality standards at suitable locations and a copy of the test reports to be submitted to the Regional Office, MoEF & CC, Bhopal six monthly. Further, aquatic ecology studies to assess the health of the aquatic biota to be conducted on a yearly basis during the period of construction.

xii. The equipment likely to generate high noise levels during the construction period or otherwise shall meet the Ambient Noise level standards as notified under the Noise Pollution (Regulation and Control) Rules, 2000, as amended in 2010 under the Environment Protection Act (EPA), 1986. Ambient Noise level monitoring shall be conducted on a monthly basis during the period of construction at suitable locations and copy of the test reports to be submitted to Regional Office, MoEF & CC, Bhopal six monthly.

xiii. The On Farm Development (OFD) works shall be completed and WUAs (Water User Associations) shall be made functional before commencement of irrigation.

xiv. The fishery development and management plan, as proposed in the EIA/EMP report (November, 2016) shall be developed in consultation with the State Fishery Department. Under the fisheries management plan, stocking of fish seed should be ensured from the river originally. Fish breeding ground should be identified and impact analysis shall be studied regularly. The allocated grant Rs. 3.34 crores for this purpose shall be fully utilized and shall not to be diverted for any other purposes.

xv. Six monthly compliance reports shall be submitted to the Regional Office of the Ministry located at Bhopal without fail until completion of the project along with the monitoring data. It should also to be uploaded in the own website of the project as a part of information to the General Public.

xvi. Periodical soil health shall be verified in command area during operation phase to ensure maintenance of soil fertility.

xvii. Occurrence of stagnant pools/slow moving water channels during construction and operation of the project providing breeding source for vector mosquitoes and other parasites. The river should be properly channelized so that no small pools and puddles are allowed to be formed. Even after taking precaution, due to unforeseen situations, breeding of mosquito and resultant malaria or mosquito borne diseases can increase. If such a situation arises, it will be the responsibility of project proponent to take all steps i.e. residual insecticidal spray in all the project area and its surrounding 3 km area keeping the flight range of mosquitoes in consideration.

xviii. Water quality monitoring including Dissolved Oxygen, Fluoride, Iron and Nitrate level shall be carried out at the upstream and downstream of water drawl point of Bina & Dhassan River at sufficient stretch during construction phase on monthly basis. The monitoring

results shall be submitted to the Regional Office, Bhopal six monthly along with the point-wise compliance to EC conditions.

xix. Bio-assay test should be carried out to ascertain the survival of aquatic life in the stream of Bina & Dhassan River on monthly basis.

xx. Any other clearance from other organization/department, if required, should be obtained as and when necessary.

xxi. Solid waste generated especially plastic waste should not be disposed of as landfill material. It should be treated with scientific approach and recycled.

xxii. Benefits of tank-bed irrigation should be assessed properly and accounted for at the project formulation stage.

xxiii. The post project yield of the crops should be assessed realistically.

Part B: General Conditions

i. Adequate arrangements for providing free fuel like LPG/kerosene shall be made at the project cost for the labourforce engaged during the construction work so that indiscriminate felling of trees is prevented that is located adjacent to the proposed project site

ii. Medical facilities as well as recreational facilities shall also be provided to the labourers at the construction sites. First aid facility at the project site shall also be provided with proper sigange.

iii. The labourers to be engaged for construction works shall be thoroughly examined by health personnel and adequately treated before issuing them work permit to avoid contraction of any disease to the local people.

iv. Water sprinkling arrangements shall be made to control the fugitive dust and fugitive dust, ambient air quality ect. be monitored during the period of construction according to the CPCB guidelines to meet the NAAQ standards.

v. Potable drinking water and proper sanitary facilities shall be provided for the labour force. Any solid water generated at the colony of the labour force shall be collected and suitably disposed of.

vi. Restoration of construction area including muck dumping sites of excavated materials shall be ensured by leveling, filling up of borrow pits, landscaping, etc. The area should be properly treated with suitable plant species preferable local indigenous species for better survival of plants and also to enrich the local habitat.

vii. Environmental parameters shall be monitored and "six monthly monitoring reports" shall be submitted to the Regional office of the Ministry located at Bhopal as per guidelines.

6. The Project Proponent shall provide full cooperation and all required documents / data to the Officer (s) of the Regional Office of the Ministry located at Bhopal who would be monitoring the implementation of environmental safeguards.

7. The responsibility of implementation of environmental safeguards and carrying out environmental monitoring rests fully with the Water Resources Department, Government of Madhya Pradesh.

8. Besides the above stated conditions, the Project Proponent shall also implement all environmental safeguards, as proposed in the EIA/EMP report and other reports from time to time. The Regional Office, MoEF&CC, Bhopal shall monitor implementation of EMP at regular intervals.

9. The Environmental Management Plan (EMP) shall be strictly adhered to. The total cost of implementation of mitigation measures as per EMP is Rs 1735.05 crores and cost of monitoring during construction/operation phase is Rs. 93.40 crores. In case of revision of the project cost or due to price level change, the cost of EMP shall also be updated proportionately.

10. In case of change in the scope of the project, the same shall be intimated to the Ministry and fresh approval, if required, shall be taken from the Ministry accordingly.

11. The Ministry reserves the right to add additional safeguard measures subsequently, if found necessary and to take action including revoking of the clearance under the provisions of the Environment (Protection) Act, 1986, to ensure effective implementation of the suggested safeguard measures in a time-bound and satisfactory manner.

12. The project proponent should advertise at least in two local newspapers widely circulated in the region around the project, one of which shall be in vernacular language of the locality concerned informing that the project has been accorded environmental clearance and copies of clearance letters are available with the State Pollution Control Board / Committee and may also be seen at the Website of the Ministry of Environment, Forest & Climate Change at http://www.moef.nic.in.

13. A copy of the clearance letter shall be marked to concerned Panchayat/ Zilla Parishad/Municipal Corporation, Urban local body and local NGO, if any, from whom any suggestion/representations were received while processing the proposal. The clearance letter shall also be put in the website by the project proponent. Compliance to the condition shell be ensured by the project and intimated to the state accordingly.

14. State Pollution Control Board / Committee shall display a copy of the clearance letter at the Regional Office, District Industries Centre and Collector's / Tehsildar's Office for 30 days.

15. This clearance letter is valid for a period of 10 years from the date of issue of this letter for commencement of construction work of the project.

16. After 5 years of the commissioning of the Project, a study shall be undertaken regarding impact of the project on the environment and downstream ecology. The study shall be undertaken by an independent agency, decided in consultation with the Ministry.

17. The project proponent shall also submit six monthly reports on the status of compliance of stipulated EC conditions including the results of monthly monitored data (both in hard copies as well as by email) to the Regional Office of MoEF&CC, Bhopal

18. Any appeal against this environmental clearance shall lie solely with the National Green Tribunal, if preferred, within a period of 30 days from the date of issue, as prescribed under Section-10 of the National Green Tribunal Act, 2010.

Yours faithfully,

(Dr. S. Kerketta)
Director

Copy to:

1. The Secretary, Ministry of Water Resources, RD & GR, Shram Shakti, Bhawan, Rafi Marg, New Delhi 110 001.
2. The Principal Secretary (Water Resources Department), Government of Madhya Pradesh, Secretariat, Bhopal -462 016.
3. The Secretary, Department of Environment, Government of Madhya Pradesh, Secretariat, Bhopal -462 016.
4. The Chief Engineer, Project Appraisal Directorate, Central Water Commission, Sewa Bhawan, R.K. Puram, New Delhi-110 066.
5. The Additional PCCF (Central), Regional Office (WR), Ministry of Environment, Forest & Climate Change, Kendriya Paryavaran Bhavan, Link Raoad No-3, Ravi Shanker Nager, Bhopal -462 016..
6. The Member Secretary, Madhya Pradesh State Pollution Control Board, Paryavaran Parisar, E-5, Arera Colony, Bhopal -462 016.
7. EI-Division, Ministry of Environment, Forest & Climate Change, New Delhi-110 003.
8. NIC Cell - uploading in MoEFCC's website.
9. PPS to JS (GB)/ Director (SKK)/ DD (SP).
10. Guard file.

(Dr. S. Kerketta)
Director

Annexure- 9.4

F.No.8-13/2015-FC
Government of India
Ministry of Environment, Forests and Climate Change
(FC Division)

Indira Paryavaran Bhawan,
Aliganj, Jor Bag Road,
New Delhi - 110003.

Dated: 27th July, 2016.

To,

The Principal Secretary (Forests),
Government of Madhya Pradesh,
Bhopal

Sub: Diversion of 1024.44 ha of forest land in favour of Water Resource Department No. - II, Sagar for construction of Bina Joint Irrigation and Multipurpose Scheme in Sagar district in the State of Madhya Pradesh – regarding.

Sir,

I am directed to refer to the State Government's letter No. F-3/77/2014/10-11/12/879 dated 27.03.2005 on the subject mentioned above seeking prior approval of the Central Government under Section-2 of the Forest (Conservation) Act, 1980 and to say that the proposal has been examined by the Forest Advisory Committee constituted by the Central Government under Section-3 of the aforesaid Act.

After careful examination of the proposal of the State Government and on the basis of the recommendations of the Forest Advisory Committee, **in-principle** approval of the Central Government is hereby granted for diversion of 1024.44 ha, of forest land in favour of Water Resource Department No. - II, Sagar for construction of Bina Joint Irrigation and Multipurpose Scheme in Sagar district in the State of Madhya Pradesh subject to the following conditions:

(i.) Legal status of the diverted forest land shall remain unchanged;
(ii.) Compensatory afforestation over the revenue land equal in extent to the forest land being diverted shall be raised and maintained by the State Forest Department at the cost of the User Agency;
(iii.) The revenue land identified for raising compensatory afforestation shall be transferred and mutated in favour of the State Forest Department before issue of the Stage-II clearance;
(iv.) The land identified for the purpose of CA shall be clearly depicted on a Survey of India topo sheet of 1:50,000 scale;
(v.) Revenue land to be transferred and mutated in favour of the State Forest Department for raising Compensatory Afforestation shall be notified as reserved Forest under Section-4 or Protected Forest under Section-29 of the Indian Forest Act, 1927 or under the relevant Section(s) of the local Forest Act. The Nodal officer must report compliance within a period of 6 month from the date of grant of final approval and send a copy of the notification declaring the revenue land under Section 4 or Section 29 of the Indian Forest Act, 1927, or under the relevant section of the local Forest Act as the case may be, to this Ministry for information and record.

(vi.) The State Government shall realize cost of implementation of Catchment Area Treatment (CAT) Plan and transfer the same to Ad-hoc CAMPA.

(vii.) The User Agency shall transfer the cost of raising and maintaining the compensatory afforestation at the current wage rate in consultation with State Forest Department in the account of Ad-hoc Campa of the concerned State through online portal. The scheme may include appropriate provision for anticipated cost increase for works scheduled for subsequent years.

(viii.) The User Agency shall transfer the funds for the Net Present Value (NPV) of the forest land being diverted under this proposal from the User Agency as per the orders of the Hon'ble Supreme Court of India dated 28.03.2008, 24.04.2008 and 09.05.2008 in Writ Petition (Civil) No. 202/1995 and the guidelines issued by this Ministry vide its letter No. 5-3/2007-FC dated 05.02.2009 through online portal of Ad-hoc CAMPA account of the State Concerned.

(ix.) At the time of payment of the Net Present Value (NPV) at the then prevailing rate, the User Agency shall furnish an undertaking to pay the additional amount of NPV, if so determined, as per the final decision of the Hon'ble Supreme Court of India;

(x.) Any fund received from the user agency under the project, except the funds realized for regeneration/ demarcation of safety zone, shall be transferred to Ad-hoc CAMPA through online portal of Ad-hoc CAMPA account of the State Concerned;

(xi.) A Catchment area treatment plan as approved by State Government be implemented by/or under the supervision of State Forest Department at the project cost;

(xii.) The User Agency shall obtain the Environment Clearance as per the provisions of the Environmental (Protection) Act, 1986, if required;

(xiii.) No labour camp shall be established on the forest land;

(xiv.) The User Agency shall provide fuels preferably alternate fuels to the labourers and the staff working at the site so as to avoid any damage and pressure on the nearby forest areas;

(xv.) The boundary of the diverted forest land, safety zone, as applicable, shall be demarcated on ground at the project cost, by erecting four feet high reinforced cement concrete pillars, each inscribed with its serial number, forward and back bearing ,distance from pillar to pillar and GPS co-ordinates;

(xvi.) The layout plan of the proposal shall not be changed without the prior approval of the Central Government;

(xvii.) The forest land shall not be used for any purpose other than that specified in the proposal;

(xviii.) The forest land proposed to be diverted shall under no circumstances be transferred to any other agency, department or person without prior approval of the Central Government;

(xix.) The water shall be provided from the reservoir to the Forest Department for raising and maintenance of plantations and nurseries around the site whenever required, free of charge. The quantity and time of supply of water shall be as decided by the Forest Department.

(xx.) No damage to the flora and fauna of the adjoining area shall be caused;

(xxi.) Felling of trees on the forest land being diverted shall be reduced to the bare minimum and the trees shall be felled under strict supervision of the State Forest Department;

(xxii.) The User Agency shall undertake afforestation along the periphery of the reservoir and canals (as applicable).

(xxiii.) The User Agency shall carry out muck/silt disposal at pre-designated sites in such a manner so as to avoid its rolling down.

(xxiv.) The dumping area for muck/silt disposal shall be stabilized and reclaimed by planting suitable species by the User Agency at the cost of project under the supervision of State Forest Department. Retaining walls and terracing shall be carried out to hold the dumping

material in place. Stabilization and reclamation of such dumping sites shall be completed before handing over the same to the State Forest Department in a time bound manner as per Plan.

(xxv.) The State Government and the User Agency shall ensure that the trees available between full reservoir level (FRL) and FRL-4 meters are not felled;

(xxvi.) A plan for conservation of wildlife will be made by the User Agency in consultation with the CCF (Wildlife) to be implemented at the User Agency's cost.

(xxvii.) The State Government shall complete settlement of rights, in terms of the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, if any, on the forest land to be diverted and submit the documentary evidence as prescribed by this Ministry in its letter No. 11-9/1998-FC (Pt.) dated 03.08.2009 read with 05.07.2013, in support thereof;

(xxviii.) The User Agency shall submit the annual self-compliance report in respect of the above conditions to the State Government and to the concerned Regional Office of the Ministry regularly:

(xxix.) Any other condition that the concerned Regional Office of this Ministry may stipulate, from time to time, in the interest of conservation, protection and development of forests & wildlife; and

(xxx.) The User Agency and the State Government shall ensure compliance to provisions of the all Acts, Rules, Regulations, Guidelines and relevant Hon'ble Court Order (s), if any, pertaining to this project for the time being in force, as applicable to the project.

After receipt of compliance report on fulfilment of the conditions mentioned above, the proposal shall be considered for final approval under Section-2 of the Forest (Conservation) Act, 1980. Transfer of forest land shall not be affected till final approval is granted by the Central Government in this regard.

Yours faithfully,

(Nisheeth Saxena)
Sr. Assistant Inspector General of Forests (FC)

Copy to:

1. The Principal Chief Conservation of Forests, Government of Madhya Pradesh, Bhopal.
2. The Addl. PCCF (Central), Regional Office (Western Zone), Bhopal.
3. The Nodal Officer, O/o the PCCF, Government of Madhya Pradesh, Bhopal.
4. User Agency.
5. Monitoring Cell, FC Division, MoEF&CC, New Delhi
6. Guard File.

(Nisheeth Saxena)
Sr. Assistant Inspector General of Forests (FC)

Annexure-9.5

As per Estimate of KBLP July 2022

S. No.	Component	Land acquisition (ha)				Cost (Rs. in crore)	Cost of R&R (Rs. in crore)	NPV (Rs. in crore)	CAT Rs. in crore)	CA Rs. in crore)
		Forest Land	Govt. land	Private land	Total					
1	Daudhan Dam, Ken-Betwa link canal, Ken LBCetc.									
a	Daudhan Dam	5765	1762	1473	**9,000**	331.13	236.57	3512.80	272.59	313.12
b	Proposed villages to be relocated to provide 6017 ha revenue land	0	3082	1256	**4,338**	291.15	962.88	0.00	0.00	0.00
c	Ken- Betwa Link	190.5	0	2492.32	**2,683**	613.87	0.00	0.00	0.00	0.00
d	Ken LBC	0	0	320	**320**	10.75	0.00	0.00	0.00	0.00
e	Hatta and Saleha LIS	25	0	170	**195**	11.13	0.00	0.00	0.00	0.00
	Total	**5980.5**	**4844**	**5711.32**	**16,536**	**1258.03**	**1199.45**	**3512.80**	**272.59**	**313.12**
2	Lower Orr Dam									
a	Dam	0	302.24	1425.41	**1727.65**	173.75	96.52	67.68	10.80	45.55
b	Canal	23.52	0	332.4	**355.92**	63.76	0.00	0.00	0.00	0.00
	Total	**23.52**	**302.24**	**1757.81**	**2083.57**	**237.51**	**96.52**	**67.68**	**10.80**	**45.55**
3	Bina Complex									
a	Dam	0	0	5732	**5732**	635.35	799.55	175.89	5.00	10.06
b	Canal	0	0	111	**111**	13.76	0.00	0.00	0.00	0.00
	Total	**0**	**0**	**5843**	**5843**	**649.11**	**799.55**	**175.89**	**5.00**	**10.06**

4	Kotha barrage									
a	Dam	0	0	681	**681**	131.79	0.00	10.00	0.00	0.13
b	Canal	0	0	8	**8**	1.97	0.00	0.00	0.00	0.00
	Total	**0**	**0**	**689**	**689**	**133.76**	**0.00**	**10.00**	**0.00**	**0.13**
	Grand Total	**6004.02**	**5146.24**	**14001.13**	**25151.39**	**2278.41**	**2095.52**	**3766.37**	**288.385**	**368.86**

Annexure-9.5 Contd.

S. No.	Component	Land acquisition (ha)	Cost (Rs. in crore)	Cost of R&R (Rs. in crore)	NPV (Rs. in crore)	CAT Rs. in crore)	CA Rs. in crore)	LMP
1	Daudhan Dam, Ken-Betwa link canal, Ken LBC etc.	16,536	1258.03	428.82	3,512.80	272.59	313.12	962.88
2	Lower Orr Dam	2,083.57	237.51	96.52	67.68	10.80	45.55	
3	Bina Complex	5,843	649.11	799.55	175.89	5.00	10.06	
4	Kotha barrage	689	133.76	0.00	10.00	0.00	0.13	
	Total	**25,152**	**2278.41**	**1324.89**	**3766.37**	**288.39**	**369**	**962.88**