Government of Nepal
Ministry of Irrigation
Department of Irrigation
Irrigation and Water Resources Management Project
(IWRMP)

Mahakali Irrigation System – Stage II

Asset Management Plan of Main Canal
Draft Final Report

Prepared by

Desh Bhakta Mallik
WME-MIS

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1. Project Background

1.1 General Background

Mahakali Irrigation System is a large-scale Agency Managed Irrigation System of Terai. Command area of this system was developed in two stages. About 2 years ago, irrigation management of Mahakali Irrigation System, Stage - II (MIS-II) was transferred to WUA Regional Committee, under Irrigation Management Transfer (IMT) component (Component-B) of Irrigation and Water Resources Management Project (IWRMP) of Department of Irrigation (DoI). The WUA has to operate and maintain the transferred system below main canal as per the legal transfer agreement guidelines. The responsibility of operation and maintenance of main canal remains with DoI, Mahakali Pathraiya Mohana Irrigation Management Division (MPMIMD).

The overall objective of Component-B is to improve service performance and service delivery of MIS-I. This component is designed to address the problem in large public irrigation schemes (AMIS or agency –managed irrigation systems) of below –capacity performance, poor O&M, negligible cost recovery (below 5 percent on average) and inadequate maintenance funds.

The Component-B is to provide improved arrangements and instruments for operation and maintenance (O&M) to AMIS for empowering WUAs to operate, maintain and manage parts of the irrigation systems for their sustainability. Asset Management Plan is such an instrument expected to help in improving the physical performance and service delivery.

The Component-B aims to achieve :

(i) improved physical performance of the MIS-II;
(ii) reliable bulk water service delivery from main canal to off-taking branch and minor canals by DoI, MPMIMD, and
(iii) efficient and equitable service delivery from branch and minor canals to tertiary canals, and from tertiary canals to field outlets by WUA.

Therefore, Asset Management Plan should focus on improving physical performance of the irrigation system so that reliable bulk water service delivery from main canal can be provided to branch and minor canals as per Canal Operation Plan.

1.2 Asset Management Plan

Generally, Asset Management Plan (AMP) has its origin in finance and business sector and is now applied to the irrigation drainage sector. Traditionally, the investment made in irrigation and drainage infrastructure by the government was focused primarily on the cost planning and construction the infrastructure with little attention to the consumption of assets during their economic life. However, the management of infrastructure comprises several other types of events including maintenance, rehabilitation (replacement), modernization or implementation of the new technology, retirement and disposal of assets. All these events have specific costs, which form part of the overall cost of providing a sustainable service.

> **The AMP can be defined as a process for planning investment in infrastructure in a sustainable manner, to provide users with a reliable and affordable service.**

Asset Management Plan is one of the pivotal activities for the component B to assess the values of the infrastructures for management transfer and also the required basic requirements for the

management of the systems as a whole. AMP for Mahakali Irrigation System Stage – II was already prepared by Creative Consultancy (P) Limited in fiscal year 2067/68 BS. This AMP has been prepared as per demand of Office of Project Director (OPD) of IWRMP. OPD would like submit this document to Department of Irrigation so that enough operation and maintenance budget can be released to maintain the main canal and ensure bulk water delivery to branch and minor canals.

1.3 Objective of AMP

Objective of this Asset Management Plan is to determine annual budget allocation requirement by the Government of Nepal for proper operation and maintenance of main canal of MIS-II, to ensure reliable bulk water service delivery from main canal to branch and minor canals.

1.4 Methodology

List of structures of main canal of MIS-II (from Balama Syphon to Kalikich), Belauri Main Branch Canal and Shivanagar Main Branch Canal, was prepared before fieldwork. Inventory of irrigation structures was done by Site Engineer Naresh Suwal in June 2016 and later by Site Engineer Binod Pariyar in June 2017. Assessment of physical status of structures were carried out with reference to given five ranks criteria for assessment of physical status, during field work.

Later, cost estimate of maintenance work for irrigation structures was done in consultation with SWME Vijay Shankar Mishra. The cost estimate was also broken down in five fiscal years. Finally, this report was prepared including annual budget allocation requirement for operation and maintenance of irrigation structures of main canal and main branch canals of MIS-II, including new construction of chowkidar sheds.

1.5 Limitations

The AMP does not include valuation of the assets. Also, it does not suggest how WUA is going to collect and mobilize fund to contribute to the maintenance requirement of main canal.

1.6 Organization of Report

The report includes general project background, irrigation system description, water users Organization, inventory of assets – irrigation structures and associated buildings, operation and maintenance cost, conclusion and recommendations. The report consists of four annexes as, Inventory of Main Canal and Main Branch Canals Irrigation Structures, Operation cost of Main Canal, Deferred maintenance cost of main canal irrigation structures, and Deferred maintenance cost of main canal associated buildings.

2. Irrigation System Description

2.1 General Background

Mahakali Irrigation System (MIS) is located in Kanchanpur District, in Far-Western Development Region of Nepal. It gets its water supply from the River Mahakali through the Sarada Barrage, which was constructed in 1928 by the British Indian Government. This irrigation system was initially constructed in nineties by the Government of Nepal. By 1975, main canal and some major secondary were completed but not more than 3400 ha could be irrigated. In 1976, the Mahakali Irrigation Project (MIP) was identified by International Development Association. The Development Credit Agreement for the Mahakali Irrigation Project (Stage I) was signed on September 29, 1980, with an effective date of December 30, 1980. The project had a five-year implementation period, with a completion date of June 30,

1985. The project (Stage I) was completed in 1988. Financing agreement for Stage II of Mahakali Irrigation Project between Government of Nepal and International Development Association was signed on and made effective on 18 November 1988. The project (Stage II) was completed in June1997.

Total command area of the MIS is 11600 ha. The command area is separated into two parts by the Shuklaphanta Wildlife Reserve Forest (Figure 1). The upper part of command area is named as MIS Stage-I and the lower part of the command area (downstream of the Shuklaphanta Wildlife Reserve Forest) is named as MIS Stage-II.

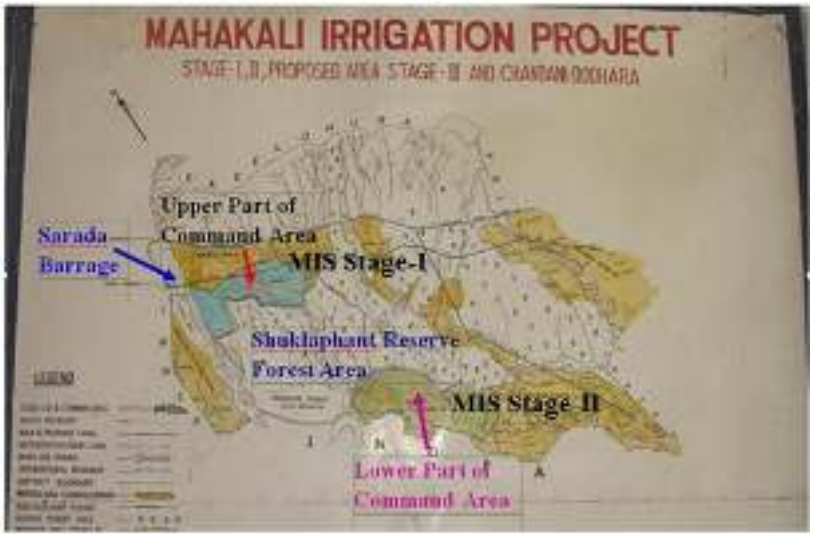

Figure 1 : Location Map of Mahakali Irrigation System

The main canal takes-off from the eastern bank of the barrage. It runs eastward through Mahendranagar upto Ghorsuwa Escape and from there it goes southward through Daiji and Shuklaphanta Wildlife Reserve Forest upto Kalikich (Beldandi). The main canal bifurcates into two main branch canals at Kalikich, namely - the Shivnagar main branch canal and Belauri main branch canal (M3 Canal). Total length of main canal upto Kalikich is about 36 Km and its design discharge is 28.35 m3/s (1000 cusecs).

The Department of Irrigation supplies bulk water delivery from main canal to branch and minor canals. There are 11 branch and minor canals in MIS Stage-I to convey irrigation water to tertiary canals for distribution among farmers' fields. These are Gudda minor, Bhujela distributary, Basantpur minor, Majhgaon minor, Mahendranagar distributary, Bhagatpur minor, Ultakham distributary, Chunariya minor, Suda minor, Sisaiya minor and Daiji minor. In addition, there are 25 sub-minor and tertiary canals, which off-take direct from the main canal.

In MIS Stage-II area, bulk water supply is delivered to branch and minors through Shivnagar and Belauri main branch canals. The Shivnagar main branch canal is about 21 Km long. It runs westward upto Jhilmila, then to south-eastward upto Sadakghat and finally northward upto Shivnagar. Its design capacity is 3.49 m3/s and the command area is 3400 ha. The Shivnagar main branch canal delivers water to eight branch and minor canals, which convey it to tertiary canals of block 5 and 6 for distribution among farmers' fields. These are Kamari branch, Khairighat branch, Imiliya minor, Baibaha branch, Jhilmila minor, Bhuda minor, Bhuda-Gauri minor and Gaurigaun minor. In addition, there are 54 tertiary canals, which off-take direct from the main canal and the Shivnagar main branch canal.

The Belauri main branch canal (M3 Canal) is about 16 Km. It runs south-eastwards upto Singhpur. Its design capacity is 3.53 m3/s and the command area is 3100 ha. The Belauri main branch canal delivers water to twelve branch and minor canals, which convey it to tertiary canals of block 7 and 8 for distribution among farmers' fields. These are Beldandi branch, Beldandi minor, Dhakka minor, Salghari branch, Salghari minor, Pachoi branch, Khajuwa minor, Kunda minor, Singhpur minor, Syali-A minor, Syali-Y minor and Belauri branch. In addition, there are 9 tertiary canals, which take-off direct from the Belauri main branch canal.

The command area of MIS-II is divided into 4 blocks A –E, and that of MIS-II is divided into 4 blocks 5 – 8. Block-wise list of branch and minor canals MIS-I and MIS-II is given in Table 1 below:

Table 1 – Block wise group of branch and minor canals

MIS Stage	Block	Branch and minor canals
I	A	Gudda minor and Bhujela distributary
	B	Basantpur minor, Majhgaon minor and Mahendranagar distributary
	C	Bhagatpur minor and Ultakham distributary
	D	Chunariya minor, Suda minor and Sisaiya minor
	E	Daiji minor
II	5	Jhilmila minor, Bhuda minor, Bhuda-Gauri minor and Gaurigaun minor
	6	Kamari branch, Khairighat branch, Imiliya minor, Baibaha branch
	7	Beldandi branch, Beldandi minor, Dhakka minor, Salghari branch, Salghari minor, Pachoi branch and Khajuwa minor
	8	Kunda minor, Singhpur minor, Syali-A minor, Syali-Y minor and Belauri branch

2.2 Infrastructures :

2.2.1 Main Canal - Irrigation Structures

(A) Length of Main Canal from Balama Syphon to Kalikch (MIS Stage-II) – 15.704 Km
(B) Inventory of Structures (MIS-II)

Table 2 Inventory of Irrigation Structures in main canal (Refer Annex 1)

S. No.	Irrigation Structure	Quantity
1	Main Branch Head Regulator	2 no.
2	Drop	6 no.
3	Syphon	2 no.
4	Escape	1 no.
5	Bridge	1 no.
6	Pipe culvert	1 no.

2.2.2 Shivanagar Main Branch Canal - Irrigation Structures

A. Length of Shivanagar Main Branch - 21.127 Km
B. Inventory of Structures (MIS-II)

Table 3 Inventory of Irrigation Structures in Shivanagar main branch (Refer Annex 1)

S. No.	Irrigation Structure	Quantity
1	Branch/Minor Head Regulator	8 no.
2	Tertiary off-take /Head Regulator	54 no.
3	Cross Regulator	3 no.
4	Side Escape	4 no.
5	Cross-drainage	1 no.
6	Drop	2 no.
7	VRB	32 no.
8	Box culvert	1 no.
9	Path slab	9 no.
10	Chute Spillway	1 no.
11	Tail Escape	1 no.

2.2.3 Belauri Main Branch Canal - Irrigation Structures

A. Length of Belauri Main Branch – 16.243 Km
B. Inventory of Structures

Table 4 Inventory of Irrigation Structures in Belauri main branch (Refer Annex 1)

S. No.	Irrigation Structure	Quantity
1	Branch/Minor Head Regulator	12 no.
2	Tertiary off-take /Head Regulator	9 no.
3	Cross Regulator	4 no.
4	Escape	3 no.
5	Cross-drainage	3 no.
6	Drop	1 no.
7	Syphon	1 no.
8	Check structure	1 no.
9	VRB	17 no.
10	Bridge with railing	1 no.
11	Path slab	1 no.

2.3 Infrastructures : Main Canal - Buildings

One chowkidar quarter exists along main canal in MIS Stage – II area and it is in use. With assumption that chowkidar quarter or shed is necessary for proper duty of chowkidars, for better bulk water service delivery from main canal to branch and minor canals, five new chowkidar sheds (two along Shivanagar main branch and three along Belauri main branch) have been proposed, as given below in Table 5.

Table 5 : Existing and proposed Chowkidar quarters and sheds

S. No.	Structure	Chainage (m)
1	Chowkidar Quarter at Shivanagar HR, Kalikich (Existing)	0+000
2	Chowkidar shed at Baibaha HR on Shivanagar Main Branch (New)	3+247
3	Chowkidar shed at Bhuda-Gauri HR on Shivanagar Main Branch (New)	16+300
4	Chowkidar shed at Beldandi HR on Belauri Main Branch (New)	0+842
5	Chowkidar shed at Panchoi HR on Belauri Main Branch (New)	8+404
6	Chowkidar shed at Kunda HR on Belauri Main Branch (New)	12+105

3. Water Users' Organization

Mahakali Irrigation System is operational under joint management of Department of Irrigation and Mahakali Irrigation Water Users' Association. Irrigation management function of canal network except main canal and, Belauri and Shivanagar main branch canals has been transferred to Mahakali Irrigation WUA Regional Committees of Stage-I and Stage-II. The main canal and, Belauri and Shivanagar main branch canals are jointly managed by Mahakali Patharaiya Mohana Irrigation Management Division and Mahakali Irrigation WUA Central Committee. The present Central Committee of WUA is as given below:

Mahakali Irrigation Water Users Association Central Committee

1. Chakra Mahata	Chairman
2. Khageshwor Pandey	Ex-Chairman, Ex-Officio Member
3. Bhanu Bhakta Bhatta	Vice-Chairman
4. Dipendra Prakash Saud	General Secreatary
5. Jayraj Bhatta	Secretary
6. Karunakar Joshi	Treasurer
7. Ramesh Chandra Joshi	Member
8. Raj Bahadur Chaudhary	Member
9. Parvati Malla	Member
10. Bhagrathi Shahi	Member
11. Ratna BK	Member
12. Arjun Bahadur Rawal	Ex-officio Member (Chairman of Stage I Regional Committee)
13. Bhim Bahadur Thapa	Ex-officio Member(Chairman of Stage II Regional Committee)

4. Asset Inventory of the infrastructures

The inventory of the irrigation structures of the main canal and associated chowkidar quarters was carried out by Er. Naresh Suwal in June 2016 and later by Site Engineer Binod Pariyar in the month of in June 2017 based on the five criteria for assessing the physical conditions of the structures, suggested by the World Bank missions, as given in Table 6 below:

Table 6 : Criteria for assessing the physical conditions of the structures

Rating	Condition
5	Practically new and fully serviceable
4	Generally good with no damage only routine maintenance required, performs assigned function satisfactorily
3	Generally good but with some deterioration or damage, Need attention. Still performing assigned functions satisfactorily
2	Significantly damaged or deteriorated, Suffering from deferred maintenance, Serviceability is impaired, Needs urgent rehabilitation
1	Very poor and dilapidated condition, Non-functional, Requires partial restoration or complete replacement to restore serviceability

4.1 Physical Status of Main Canal – Irrigation Structures

Inventory of main canal irrigation structures, from Balama Syphon to Kalikich, to tail end of Shivanagar and Belauri Main Branch Canals (included) is given in Annex 1.

4.2 Physical Status of Main Canal – Buildings

Inventory of main canal - buldings is given in Table 7 below.

Table 7 : Physical Status of Existing and proposed Chowkidar quarters and sheds

S. No.	Structure	Chainage (m)	Condition	Damage / Maintenance need
1	Chowkidar Quarter at Shivanagar HR , Kalikich (Existing)	0+000	4	
2	Chowkidar shed at Baibaha HR on Shivanagar Main Branch (New)	3+247		New proposed
3	Chowkidar shed at Bhuda-Gauri HR on Shivanagar Main Branch (New)	16+300		New proposed
4	Chowkidar shed at Beldandi HR on Belauri Main Branch (New)	0+842		New proposed
5	Chowkidar shed at Panchoi HR on Belauri Main Branch (New)	8+404		New proposed
6	Chowkidar shed at Kunda HR on Belauri Main Branch (New)	12+105		New proposed

5. Operation and Maintenance Cost

Details of operation cost is given in Annex 2. Maintenance cost is estimated for regular maintenance, deferred maintenance and emergency maintenance. Details of differed maintenance for irrigation structures and buildings are given in Annex 3 and Annex 4 respectively. Cost of emergency maintenance has been assumed to be 10% of deferred maintenance cost.

Operation and maintenance cost for 5 years period (assumed) of main canal of MIS-II with Annual Break down is given in Table 8 below.

Table 8 : Operation and Maintenance Cost for 5 Years (With Annual Break down)

S. No.	Description	Estimated Cost (NRs.)	Year 1 (NRs.)	Year 2 (NRs.)	Year 3 (NRs.)	Year 4 (NRs.)	Year 5 (NRs.)
1	**Operation Cost***	**23100000**	**4980000**	**4380000**	**4380000**	**4980000**	**4380000**
2	**Maintenance Cost**						
2.1	**Regular Maintenance**						
2.1.1	Greasing and painting of gates (40 no.) other than Tertiary Canals @ 3000 per year	600000	120000	120000	120000	120000	120000
2.1.2	Greasing and painting of gates (63 no.) other than Tertiary Canals @ 1000 per year	315000	63000	63000	63000	63000	63000
	Sub-Total	**915000**	**183000**	**183000**	**183000**	**183000**	**183000**
2.2	**Deferred Maintenance**						
2.2.1	Irrigation Structures**	**42500000**					**42500000**
2.2.2	Buildings***	**1000000**	200000	200000	200000	200000	200000
	Sub-Total	**43500000**	**200000**	**200000**	**200000**	**200000**	**42700000**
2.3	**Emergency maintenance 10% of Deferred maintenance**	**4350000**	**870000**	**870000**	**870000**	**870000**	**870000**
	Total Maintenance Cost	**48765000**	**1253000**	**1253000**	**1253000**	**1253000**	**43753000**
	Total O&M Cost	**71865000**	**6233000**	**5633000**	**5633000**	**6233000**	**48133000**

Note :

* Refer to Annex 2

** Refer to Annex 3

*** Refer to Annex 4

5.1 Operation and Maintenance Cost Borne by Government

As per Irrigation Policy 2070, Schedule 1 - Table of contribution to be borne by the Users, Table 1 – for repair and maintenance of AMIS/FMIS, cost to be borne by WUA is 10% of the total repair and maintenance cost. Therefore, 90% of total cost of maintenance should be borne by Government. Accordingly, the Government should allocate annual budget for coming five years including the current fiscal year as follows (Table 9):

Table 9 : Government budget allocation requirement for O&M

Description	Estimated Cost (NRs.)	Year 1 (NRs.)	Year 2 (NRs.)	Year 3 (NRs.)	Year 4 (NRs.)	Year 5 (NRs.)
Total Maintenance Cost	**48765000**	**1253000**	**1253000**	**1253000**	**1253000**	**43753000**
Government budget allocation requirement for maintenance (90%) of Total maintenance cost	43888500	1127700	1127700	1127700	1127700	39377700
Government budget allocation requirement for operation (100%)	23100000	4980000	4380000	4380000	4980000	4380000
Total Government budget allocation for O&M	**66988500**	**6107700**	**5507700**	**5507700**	**6107700**	**43757700**

5.2 Operation and Maintenance Cost Contribution by WUA

The WUA has to contribute in maintenance cost only. WUA contribution requirement for maintenance is given in Table 10 below:

Table 10 : WUA contribution requirement for Maintenance

Description	Estimated Cost (NRs.)	Year 1 (NRs.)	Year 2 (NRs.)	Year 3 (NRs.)	Year 4 (NRs.)	Year 5 (NRs.)
Total Maintenance Cost	**48765000**	**1253000**	**1253000**	**1253000**	**1253000**	**43753000**
WUA contribution requirement for maintenance (10%) of Total Maintenance cost	**4876500**	**125300**	**125300**	**125300**	**125300**	**4375300**

6. Conclusion and Recommendations

For the success of Irrigation Management Transfer program, reliable bulk water delivery from main canal to branch and minor canals is necessary. For reliable bulk water delivery from main canal and main branch canals, the irrigation structures should be in good condition and operational requirements of main canal should be properly provided. As Department of Irrigation is responsible for operation and maintenance of main canal and main branch canals as per Irrigation Management Transfer Agreement between DOI and WUA, the Government should allocate annual budget for operation and maintenance as given in Table 9. The DOI should ensure the allocation of proposed annual budget for operation and maintenance by the Government of Nepal.

ANNEX 1

Mahakali Irrigation System, Stage-II

1.1 Inventory of Assets of Main Canal - Irrigation Structures

S. No.	Structure	Chainage	Condition	Damage/Maintenance need
1	Syphon	20+054	4	
2	Hathi Khada	22+012	4	
3	Pipe Culvert	22+081	4	
4	Check Drop	24+509	4	
5	Syphon	24+654	4	
6	Bridge /Drop	25+698	4	
7	Check Drop	27+393	4	
8	Check Drop	28+583	4	
9	Check Drop	31+683	4	
10	Bridge /Road	32+183	4	
11	Check Drop	35+483	4	
12	Escape Structure	35+568	4	
13	Head Regulators of Belauri and Shivanagar main branch canals	35+758	4	

1.2 Inventory of Assets of Shivanagar Main Branch - Irrigation Structures

S. No.	Structure	Chainage	Condition	Damage/Maintenance need
1	H/R SHIVANAGAR MAIN BRANCH			
2	VRB	0+307	4	
3	H/R (KAMARI BRANCH)	0+579	4	
4	C/R with VRB	0+594	4	
5	H/R (KHAIRIGHAT BRANCH)	1+010	4	
6	C/R with VRB	1+020	4	
7	Chute Spillway	1+380	4	
8	VRB	2+090	4	
9	VRB	2+514	4	
10	IMILIYA MINOR	2+564	4	
11	VRB	2+750	4	
12	Side Escape	3+165	4	
13	H/R (BAIBAHA BRANCH)	3+247	4	
14	C/R with VRB	3+256	4	
15	VRB	3+750	4	
16	H/R (JHILMILA BRANCH)	4+219	4	
17	SHR 1/1 (L)	4+230		
18	VRB	4+239	4	
19	SHR 2/1 (L)	4+360		
20	VRB	4+527	4	

21	SHR 2/2 (L)	4+840		
22	SHR 3/1 (L)	4+977		
23	VRB	5+050	4	
24	SHR 3/2 (L)	5+350		
25	VRB	5+500	4	
26	VRB	6+037	4	
27	SHR 3/4 (L)	6+485		
28	SHR 3/5 (L)	6+485		
29	Path Slab	6+500	4	
30	SHR 3/5 A (L)	6+665		
31	VRB	6+670	4	
32	Unknown SHR (R)	6+770		
33	VRB	7+342	4	
34	VRB	7+800	4	
35	Unknown SHR (R)	7+850		
36	VRB	8+200	4	
37	VRB	8+500	4	
38	VRB	9+700	4	
39	Side Escape	9+720	4	
40	SHR 4/1 Parallel (R)	10+000		
41	SHR 4/1 (L)	10+550		
42	SHR 4/2 (L)	10+550		
43	VRB	10+760	4	
44	VRB	10+800	4	
45	SHR 4/3 (L)	11+110		
46	VRB	11+271	4	
47	SHR 4/4 (L)	11+495		
48	SHR 4/5 (L)	11+730		
49	Side Escape	11+800	4	
50	SHR 4/6 (L)	11+830		
51	Path Slab	12+000	4	
52	VRB	12+350	4	
53	SHR 4/7 (L)	12+350		
54	SHR 5/1 (L)	12+930		
55	VRB	13+050	4	
56	SHR 5/2 (L)	13+050		
57	SHR 5/3 (L)	13+450		
58	SHR 5/4 (L)	13+530		
59	SHR 5/5 (L)	13+900		
60	VRB	14+250		
61	Drop Structure	14+500	4	
62	SHR 5/6 (R)	14+500		

63	SHR 5/7 (R)	14+500		
64	SHR 6/1 (L)	14+650		
65	VRB	14+700	4	
66	H/R (BHUDA BRANCH)	15+300	4	
67	Path Slab	15+310	4	
68	VRB	15+350	4	
69	SHR 7/1 (L)	15+600		
70	SHR 6/2 (L)	15+300		
71	Unknown SHR (R)	15+730		
72	SHR 7/2 (L)	15+850		
73	H/R (BHUDA GAURI BRANCH)	16+300	4	
74	SHR 7/3 (L)	16+300		
75	SHR 8/1 (L)	16+300		
76	Path Slab	16+310	4	
77	VRB	16+500	4	
78	Box Culvert	16+722	4	
79	C/D Structure	16+800	4	
80	SHR 8/2 (R)	16+950		
81	Side Escape	17+000	4	
82	VRB	17+200	4	
83	H/R (GAURI GAU BRANCH)	17+500	4	
84	SHR 8/3 (R)	17+500		
85	Unknown SHR (L)	17+500		
86	Drop Structure	17+510	4	
87	SHR 9/1 (R)	17+700		
88	SHR 9/2 (R)	18+000		
89	VRB	18+215	4	
90	SHR 9/3 (R)	18+215		
91	Path Slab	18+600	4	
92	SHR 9/4 (R)	18+600		
93	SHR 9/5 (R)	18+600		
94	Path Slab	18+800	4	
95	VRB	19+100	4	
96	SHR 10/1 (R)	19+100		
97	SHR 10/2 (R)	19+100		
98	SHR 10/3 (L)	19+275		
99	SHR 10/4 (R)	19+450		
100	VRB	20+100	4	
101	SHR 10/5 (R)	20+100		
102	VRB	20+200	4	
103	Path Slab	20+260	4	
104	SHR 10/5 A (L)	20+260		
105	SHR 10/6 (R)	20+260		

106	Path Slab	20+300	4	
107	SHR 11/1 (R)	20+300		
108	SHR 11/2 (R)	20+500		
109	SHR 11/3 (R)	20+500		
110	VRB	20+700	4	
111	SHR 11/4 (R)	20+700		
112	Path Slab	20+800	4	
113	SHR 11/5 (R)	21+010		
114	SHR 11/6 (R)	21+127		
115	SHR 11/7 (S)	21+127		
116	TAIL ESCAPE	21+127	3	

1.3 Inventory of Assets of Belauri Main Branch - Irrigation Structures

S. No.	Structure	Chainage	Condition	Damage/Maintenance need
1	H/R BELAURI MAIN BRANCH	0+005		
2	Gate	0+005	4	
3	H/R BELDANDI BRANCH (BDR)	0+842	4	
4	H/R BELDANDI Minor (BDM)	0+842	4	
5	C/R	0+858	4	
6	VRB	1+300	4	
7	VRB	2+010	4	
8	VRB	2+300	4	
9	VRB with Drop	2+600	4	
10	VRB	3+036	4	
11	Gate	3+250	4	
12	VRB	3+500	4	
13	C/D (Jhama Khola)	3+841	4	
14	Bridge with Railing	4+250	4	
15	VRB	4+580	4	
16	H/R SALGHARI BRANCH (SLR)	4+586	4	
17	H/R DHAKKA MINOR (DKR)	4+586		
18	H/R SALGHARI MINOR (SLM)	4+590	4	
19	C/R	4+591		
20	C/D	5+500	4	
21	VRB	5+630		
22	VRB	6+450		
23	VRB	6+900	4	
24	VRB	7+250		
25	VRB	7+780	4	
26	Escape	8+375	4	
27	H/R PACHOI BRANCH (PUR)	8+404		
28	C/R	8+424		

29	H/R KHAJUWA MINOR (KJR)	8+600	4	
30	Syphon (Pathariya)	9+177		
31	M3R 1/1 (R)	9+690	4	
32	M3R 1/2 (R)	9+700		
33	Check Structure	9+700	4	
34	VRB	10+280	4	
35	M3R 1/3 (R)	11+120		
36	VRB	12+100	4	
37	H/R KUNDA MINOR (KUR)	12+105	4	
38	Path Slab With Check Drop	12+120	4	
39	C/D	13+700	4	
40	Escape	13+770		
41	Path Slab	13+772		
42	H/R SINGHPUR MINOR (SPR)	14+150		
43	C/R with VRB	14+175	4	
44	M3R 5/1 (R)	14+300	4	
45	VRB	14+550		
46	M3R 6/1 (R)	14+910	4	
47	VRB	15+200		
48	VRB	15+480		
49	M3R 6/2 (R)	15+500	4	
50	M3R 6/3 (R)	15+950		
51	H/R SYALI A MINOR (SAR)	16+200	4	
52	Escape with VRB	16+220	4	
53	H/R SYALI Y MINOR (SAY)	16+237		
54	H/R BELAURI BRANCH (BLR)	16+243		

ANNEX 2

Mahakali Irrigation System, Stage – II

Operation Cost of Main Canal

S. No.	Description	Estimated Cost (NRs.)	Year 1 (NRs.)	Year 2 (NRs.)	Year 3 (NRs.)	Year 4 (NRs.)	Year 5 (NRs.)
1	Chowkidar wage @ Rs 30,00,000 per year	15000000	3000000	3000000	3000000	3000000	3000000
2	Patrolling of main and main branch canals (for fuel) Rs 4,00,000 per year	2000000	400000	400000	400000	400000	400000
3	Patrolling of main canal (for vehicle maintenance) Rs 5,00,000 per year	2500000	2500000	500000	500000	500000	500000
4	Painting of sign boards and gauge paintings 2 times @ Rs. 3,00,000	1200000	600000			600000	
5	Notification of opening and closing of canal through media @ 30,000 per year	150000	30000	30000	30000	30000	30000
6	Communication among canal operation staff through mobile phone @ Rs. 2,00,000 per year	1000000	200000	200000	200000	200000	200000
7	Stationeries @ Rs. 1,50,000 per year	750000	150000	150000	150000	150000	150000
8	Logistics for canal operation staff @ Rs. 1,00,000 per year	500000	100000	100000	100000	100000	100000
	Total	**23100000**	**4980000**	**4380000**	**4380000**	**4980000**	**4380000**

ANNEX 3

Mahakali Irrigation System, Stage-II

Deferred Maintenance Cost Irrigation Structures

S. No.	Structure	Chainage (m)	Maintenance Cost (NRs.)					
A	**Canal Structures**		**Estimated Cost**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
A.1	**Main Canal (MIS Stage – II)**							
1	Syphon	20+054						
2	Hathi Khada	22+012						
3	Pipe Culvert	22+081						
4	Check Drop	24+509						
5	Syphon	24+654						
6	Bridge /Drop	25+698						
7	Check Drop	27+393						
8	Check Drop	28+583						
9	Check Drop	31+683						
10	Bridge /Road	32+183						
11	Check Drop	35+483						
12	Escape Structure	35+568						
13	Head Regulators of Belauri and Shivanagar main branch canals	35+758						
	Sub-Total (A.1)							
A.2	**Shivanagar Main Branch Canal**							
1	H/R SHIVANAGAR MAIN BRANCH							
2	VRB	0+307						

3	H/R (KAMARI BRANCH)	0+579						
4	C/R with VRB	0+594						
5	H/R (KHAIRIGHAT BRANCH)	1+010						
6	C/R with VRB	1+020						
7	Chute Spillway	1+380						
8	VRB	2+090						
9	VRB	2+514						
10	IMILIYA MINOR	2+564						
11	VRB	2+750						
12	Side Escape	3+165						
13	H/R (BAIBAHA BRANCH)	3+247						
14	C/R with VRB	3+256						
15	VRB	3+750						
16	H/R (JHILMILA BRANCH)	4+219						
17	SHR 1/1 (L)	4+230						
18	VRB	4+239						
19	SHR 2/1 (L)	4+360						
20	VRB	4+527						
21	SHR 2/2 (L)	4+840						
22	SHR 3/1 (L)	4+977						
23	VRB	5+050						
24	SHR 3/2 (L)	5+350						
25	VRB	5+500						
26	VRB	6+037						
27	SHR 3/4 (L)	6+485						
28	SHR 3/5 (L)	6+485						
29	Path Slab	6+500						
30	SHR 3/5 A (L)	6+665						

31	VRB	6+670						
32	Unknown SHR (R)	6+770						
33	VRB	7+342						
34	VRB	7+800						
35	Unknown SHR (R)	7+850						
36	VRB	8+200						
37	VRB	8+500						
38	VRB	9+700						
39	Side Escape	9+720						
40	SHR 4/1 Parallel (R)	10+000						
41	SHR 4/1 (L)	10+550						
42	SHR 4/2 (L)	10+550						
43	VRB	10+760						
44	VRB	10+800						
45	SHR 4/3 (L)	11+110						
46	VRB	11+271						
47	SHR 4/4 (L)	11+495						
48	SHR 4/5 (L)	11+730						
49	Side Escape	11+800						
50	SHR 4/6 (L)	11+830						
51	Path Slab	12+000						
52	VRB	12+350						
53	SHR 4/7 (L)	12+350						
54	SHR 5/1 (L)	12+930						
55	VRB	13+050						
56	SHR 5/2 (L)	13+050						
57	SHR 5/3 (L)	13+450						
58	SHR 5/4 (L)	13+530						

59	SHR 5/5 (L)	13+900						
60	VRB	14+250						
61	Drop Structure	14+500						
62	SHR 5/6 (R)	14+500						
63	SHR 5/7 (R)	14+500						
64	SHR 6/1 (L)	14+650						
65	VRB	14+700						
66	H/R (BHUDA BRANCH)	15+300						
67	Path Slab	15+310						
68	VRB	15+350						
69	SHR 7/1 (L)	15+600						
70	SHR 6/2 (L)	15+300						
71	Unknown SHR (R)	15+730						
72	SHR 7/2 (L)	15+850						
73	H/R (BHUDA GAURI BRANCH)	16+300						
74	SHR 7/3 (L)	16+300						
75	SHR 8/1 (L)	16+300						
76	Path Slab	16+310						
77	VRB	16+500						
78	Box Culvert	16+722						
79	C/D Structure	16+800						
80	SHR 8/2 (R)	16+950						
81	Side Escape	17+000						
82	VRB	17+200						
83	H/R (GAURI GAU BRANCH)	17+500						
84	SHR 8/3 (R)	17+500						
85	Unknown SHR (L)	17+500						
86	Drop Structure	17+510						

87	SHR 9/1 (R)	17+700						
88	SHR 9/2 (R)	18+000						
89	VRB	18+215						
90	SHR 9/3 (R)	18+215						
91	Path Slab	18+600						
92	SHR 9/4 (R)	18+600						
93	SHR 9/5 (R)	18+600						
94	Path Slab	18+800						
95	VRB	19+100						
96	SHR 10/1 (R)	19+100						
97	SHR 10/2 (R)	19+100						
98	SHR 10/3 (L)	19+275						
99	SHR 10/4 (R)	19+450						
100	VRB	20+100						
101	SHR 10/5 (R)	20+100						
102	VRB	20+200						
103	Path Slab	20+260						
104	SHR 10/5 A (L)	20+260						
105	SHR 10/6 (R)	20+260						
106	Path Slab	20+300						
107	SHR 11/1 (R)	20+300						
108	SHR 11/2 (R)	20+500						
109	SHR 11/3 (R)	20+500						
110	VRB	20+700						
111	SHR 11/4 (R)	20+700						
112	Path Slab	20+800						
113	SHR 11/5 (R)	21+010						
114	SHR 11/6 (R)	21+127						

115	SHR 11/7 (S)	21+127						
116	TAIL ESCAPE	21+127						
	Sub-Total (A.2)							
A.3	**Belauri Main Branch Canal**							
1	H/R BELAURI MAIN BRANCH	0+005						
2	Gate	0+005						
3	H/R BELDANDI BRANCH (BDR)	0+842						
4	H/R BELDANDI Minor (BDM)	0+842						
5	C/R	0+858						
6	VRB	1+300						
7	VRB	2+010						
8	VRB	2+300						
9	VRB with Drop	2+600						
10	VRB	3+036						
11	Gate	3+250						
12	VRB	3+500						
13	C/D (Jhama Khola)	3+841						
14	Bridge with Railing	4+250						
15	VRB	4+580						
16	H/R SALGHARI BRANCH (SLR)	4+586						
17	H/R DHAKKA MINOR (DKR)	4+586						
18	H/R SALGHARI MINOR (SLM)	4+590						
19	C/R	4+591						
20	C/D	5+500						
21	VRB	5+630						
22	VRB	6+450						
23	VRB	6+900						

24	VRB	7+250						
25	VRB	7+780						
26	Escape	8+375						
27	H/R PACHOI BRANCH (PUR)	8+404						
28	C/R	8+424						
29	H/R KHAJUWA MINOR (KJR)	8+600						
30	Syphon (PathAriya)	9+177						
31	M3R 1/1 (R)	9+690						
32	M3R 1/2 (R)	9+700						
33	Check Structure	9+700						
34	VRB	10+280						
35	M3R 1/3 (R)	11+120						
36	VRB	12+100						
37	H/R KUNDA MINOR (KUR)	12+105						
38	Path Slab With Check Drop	12+120						
39	C/D	13+700						
40	Escape	13+770						
41	Path Slab	13+772						
42	H/R SINGHPUR MINOR (SPR)	14+150						
43	C/R with VRB	14+175						
44	M3R 5/1 (R)	14+300						
45	VRB	14+550						
46	M3R 6/1 (R)	14+910						
47	VRB	15+200						
48	VRB	15+480						
49	M3R 6/2 (R)	15+500						
50	M3R 6/3 (R)	15+950						
51	H/R SYALI A MINOR (SAR)	16+200						

52	Escape with VRB	16+220						
53	H/R SYALI Y MINOR (SAY)	16+237						
54	H/R BELAURI BRANCH (BLR)	16+243						
	Sub-Total (A.3)							
	Total (A)							
B	**Canals**							
1	Desilting and maintenance of service roads of 16 km (@ Rs. 15 Lakh per km) of main canal at the end of 5 years		24000000					24000000
1	Desilting and maintenance of service roads of 21 km (@ Rs. 5 Lakh per km) of main branch canal at the end of 5 years		10500000					10500000
1	Desilting and maintenance of service roads of 16 km (@ Rs. 5 Lakh per km) of main branch canal at the end of 5 years		8000000					8000000
	Total (B)		**42500000**					**42500000**
	Grand Total (A+B)		**42500000**					**42500000**

ANNEX 4

Mahakali Irrigation System, Stage-II

Deferred Maintenance Cost of Main Canal - Buildings

S. No.	Structure	Chainage (m)	Maintenance Cost (NRs.)					
			Estimated Cost	Year 1	Year 2	Year 3	Year 4	Year 5
1	Chowkidar Quarter at Shivanagar HR , Kalikich (Existing)	0+000						
2	Chowkidar shed at Baibaha HR on Shivanagar Main Branch (New)	3+247	200000	200000				
3	Chowkidar shed at Bhuda-Gauri HR on Shivanagar Main Branch (New)	16+300	200000	200000				
4	Chowkidar shed at Beldandi HR on Belauri Main Branch (New)	0+842	200000		200000			
5	Chowkidar shed at Panchoi HR on Belauri Main Branch (New)	8+404	200000		200000			
6	Chowkidar shed at Kunda HR on Belauri Main Branch (New)	12+105	200000		200000			
	Total		**1000000**	**400000**	**600000**			