

**EXECUTIVE SUMMARY OF  
DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT**  
ಕರಡು ಪರಿಸರ ಆಫಾತ ಅಂದಾಜೀಕರಣ ವರದಿಯ ಕಾರ್ಯಕಾರಿ ಸಾರಾಂಶ

**UPPER BHADRA LIFT IRRIGATION PROJECT  
ಭದ್ರಾ ಮೇಲ್ದಂಡೆ ಏತ ನೀರಾವರಿ ಯೋಜನೆ**

CHIKMAGALUR DISTRICT, KARNATAKA

ಚಿಕ್ಕಮಗಳೂರು ಜಿಲ್ಲೆ, ಕರ್ನಾಟಕ



**KARNATAKA NEERAVARI NIGAM LTD**

ಕರ್ನಾಟಕ ನೀರಾವರಿ ನಿಗಮ ನಿಯಮಿತ

UPPER BHADRA PROJECT ZONE, CHITRADURGA KARNATAKA

ಭದ್ರಾ ಮೇಲ್ದಂಡೆ ಯೋಜನಾ ವಲಯ, ಚಿತ್ರದುರ್ಗ ಜಿಲ್ಲೆ, ಕರ್ನಾಟಕ

CONSULTANTS

ವರದಿ ಸಿದ್ಧಪಡಿಸಿದವರು



**ENVIRONMENTAL HEALTH & SAFETY CONSULTANTS PVT LTD**

ಮೆ. ಎನ್ವಿರಾನ್‌ಮೆಂಟಲ್ ಹೆಲ್ತ್ ಅಂಡ್ ಸೇಫ್ಟಿ ಕನ್ಸಲ್ಟೆಂಟ್ ಪ್ರೈ.ಲಿ.

# 13/2, 1<sup>ST</sup> MAIN ROAD, NEAR FIRE STATION, INDUSTRIAL TOWN,  
RAJAJINAGAR, BANGALORE-560 010,

ನಂ. 13/2, ಮೊದಲನೇ ಮುಖ್ಯ ರಸ್ತೆ, ಅಗ್ನಿ ಶಾಮಕ ತಾಣೆಯ ಹತ್ತಿರ,

ಕೈಗಾರಿಕಾ ನಗರ, ರಾಜಾಜಿನಗರ, ಬೆಂಗಳೂರು - 10

**JULY 2016**

**EXECUTIVE SUMMARY OF  
DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT**

FOR

**UPPER BHADRA LIFT IRRIGATION SCHEME**  
Near Muttinakoppa Village, N.R.Pura Taluk,  
Chikmagalur District, Karnataka.

PROJECT BY



**THE CHIEF ENGINEER**  
KARNATAKA NEERAVARI NIGAM LTD  
UPPER BHADRA PROJECT ZONE,  
CHITRADURGA, KARNATAKA

CONSULTANTS



**ENVIRONMENTAL HEALTH & SAFETY CONSULTANTS PVT LTD**  
# 13/2, 1<sup>ST</sup> MAIN ROAD, NEAR FIRE STATION, INDUSTRIAL TOWN,  
RAJAJINAGAR, BANGALORE-560 010,  
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## 1. Introduction

Upper Bhadra Project-Stage-1 was accorded environmental clearance vide letter dated 05.01.2010. The Project involves lifting of water from Tunga and Bhadra reservoirs and convey water to the drought-prone areas of Chikamagalur and Chitradurga districts utilizing 21.5 TMC of water (Lifting of 10 TMC of water from Tunga river and 21.5 TMC from Bhadra reservoir) to irrigate 1,07,265 Ha through flow irrigation system. The project also involved filling up of 37 MI tanks to cater the needs of drinking water supply in the said districts.

The Stage-1 project neither involves submergence nor construction of new dams/weirs. Bhadra Wildlife Sanctuary located within 10 km from the Upper Bhadra main canal, the project was considered as 'A' category, completed Environmental Public Consultation in Chikamagalur and Chitradurga Districts and accorded Environmental Clearance on 05.01.2010. Further, as per the Environmental clearance conditions, six monthly compliance report are being regularly submitted to Regional Office of MoEF, Bangalore and KSPCB regularly.

Considering, the availability of more water for the project and the dire need by farmers of Davangere and Tumkur Districts, the scope of the project is increased to cover these districts. The proposed project (stage-2) utilizes the same infrastructure (of Stage – 1) for the project to irrigate additional 1,18,250 Ha of drought prone area and filling up of additional 330 MI tanks in command area, thus improving water table and provide a major source of drinking water.

Further, in order to achieve water conservation, the entire command (existing 1,07,265 Ha + proposed 1,18,250 Ha) area is proposed to be brought under drip irrigation system. MoEF has issued ToRs for expansion of upper Bhadra project vide letter No-J-12011/7/2009-1A-1 (Vol-II) dated 26-05-2015. Copy of the same is enclosed as Annexure-2. Overall, Upper Bhadra Lift Irrigation Scheme envisages lifting upto 17.40 TMC of water in first stage from Tunga river to existing Bhadra reservoir and lifting 29.90 TMC of water in second stage from Bhadra reservoir to Tunnel near Ajjamapura, in Tungabhadra sub-basin of Krishna basin. After tunnel, it is planned to irrigate an extent of 2,25,515 ha by micro irrigation in districts of Chikamagalur, Chitradurga, Tumkur and Davangere.

As stated above, the proposed expansion will utilize existing infrastructure of the Upper Bhadra Project stage-1 including the main canals and existing Bhadra dam and only involves construction of branch canals and distributory network in Davangere and Tumkur districts. Additional land required for the construction of branch canals will be compensated as per the Land Acquisition Act, in force. The Government of Karnataka has accorded revision administrative approval to the modified scope of the project. The primary objective of the project is providing sustainable irrigation facility in Khariff season and the objective of the project is to recharge the ground water table and providing drinking water by filling 367 tanks in drought-prone taluks of the above said district.

The present Executive Summary EIA report includes the data on various field studies undertaken by the accredited experts during the study period from March 2016 to May 2016. In line with the ToRs, anticipated impacts(identified, predicted & evaluated) on different components of the environment was delineated and specific Environmental Management Plan (EMP) including Environmental Monitoring Program along with the budgetary provisions to be undertaken by KNNL stating

responsibilities of various parallel departments for effective implementation of the same is proposed.

## 2. Project Description

### 2.1 Present Proposal

Upper Bhadra expansion project envisages lifting of 17.40 TMC of water in first stage from Tunga river to Existing Bhadra reservoir and lifting 29.90 TMC of water in second stage from Bhadra reservoir and to Tunnel near Ajjampura, in Tungabhadra sub-basin of Krishna basin. After Tunnel, it is planned to irrigate an extent of 2,25,515 Ha by micro-irrigation in districts of Chikmagalur, Chitradurga, Tumkur and Davangere. For the purpose of execution of the projects, entire UBP is divided into 2 stages, Stage-I and II and the details are given below.

Table 1. Details of execution of UBP

Stage - I (Environmental Clearance obtained)	
Package - 1	Lifting of 15 TMC of water from Tunga River to Bhadra Reservoir
Package - 2	Lifting of 21.5 TMC of water from Bhadra reservoir to tunnel near Ajjampura, Tarikere Taluka
Package - 3	Conveying water from Ajjampura to Chitradurga branch canal
Stage – II (Environmental Clearance sought)	
Package-1	Lifting of 17.4 TMC of water from Tunga River to Bhadra Reservoir
Package-2	Lifting Of 29.9 TMC Of Water From Bhadra Reservoir to Tunnel near Ajjampura, Tarikere Taluk
Package-3	Conveying water from Ajjampura to Chitradurga Branch Canal
4	Conveying water to Tarekere flow and lift canal
5	Conveying water from Ajjampura to Tumkur branch canal
6	Conveying water from Chitradurga Branch Canal to Jagalur branch canal
7	Conveying water to Molakalmuru, Chalkere and Holalkere tanks from Chitradurga Branch Canal
8	Augmentation of Vani Vilas Sagar reservoir through conveying water from Tumkur Branch Canal

The primary objective of the project is providing sustainable irrigation facility in Khariff season and the objective of the project is to recharge the ground water table and provide drinking water by filling 367 tanks in drought-prone taluks of the above said districts.



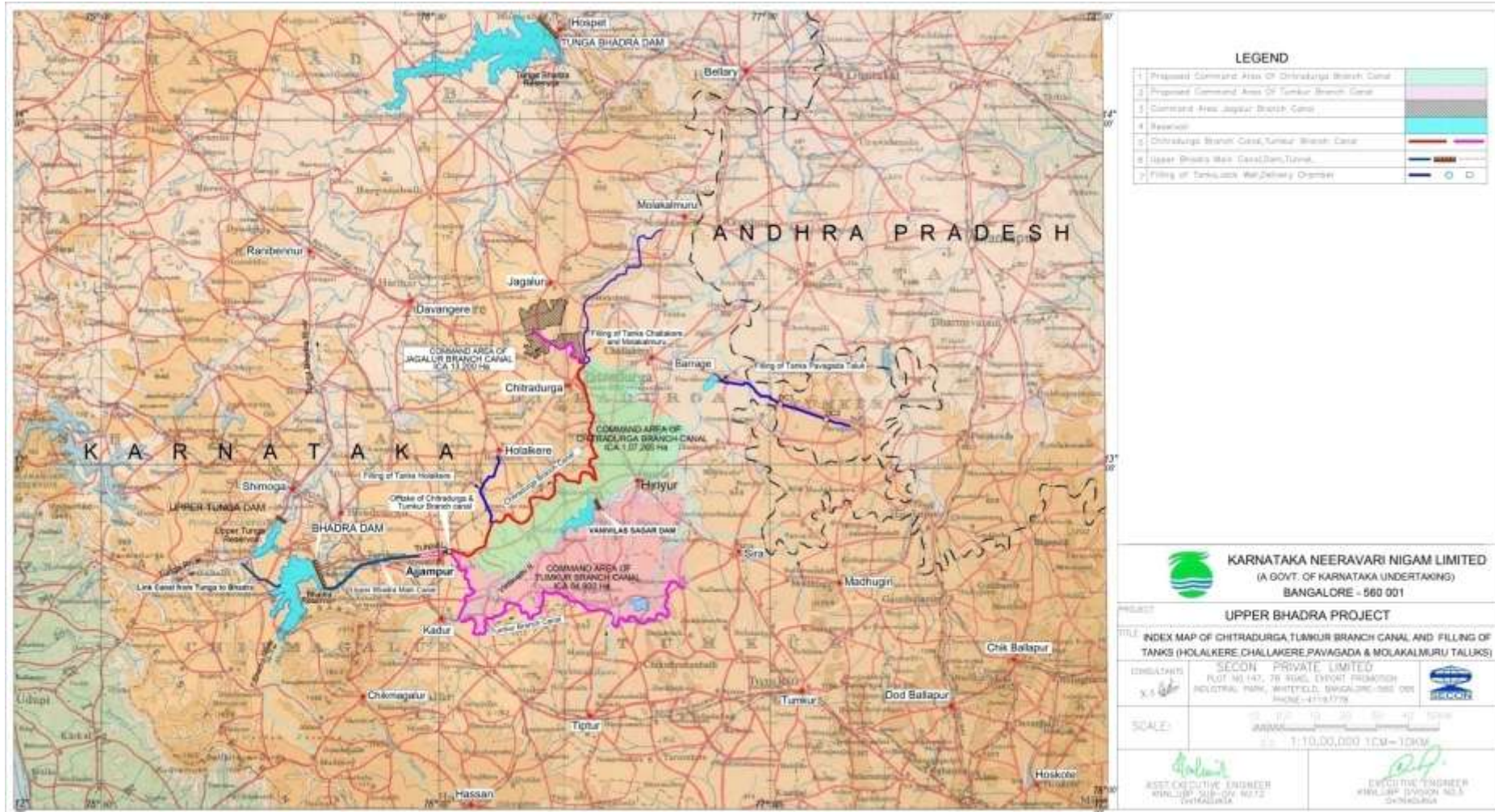


Fig - 1 Location map of the project

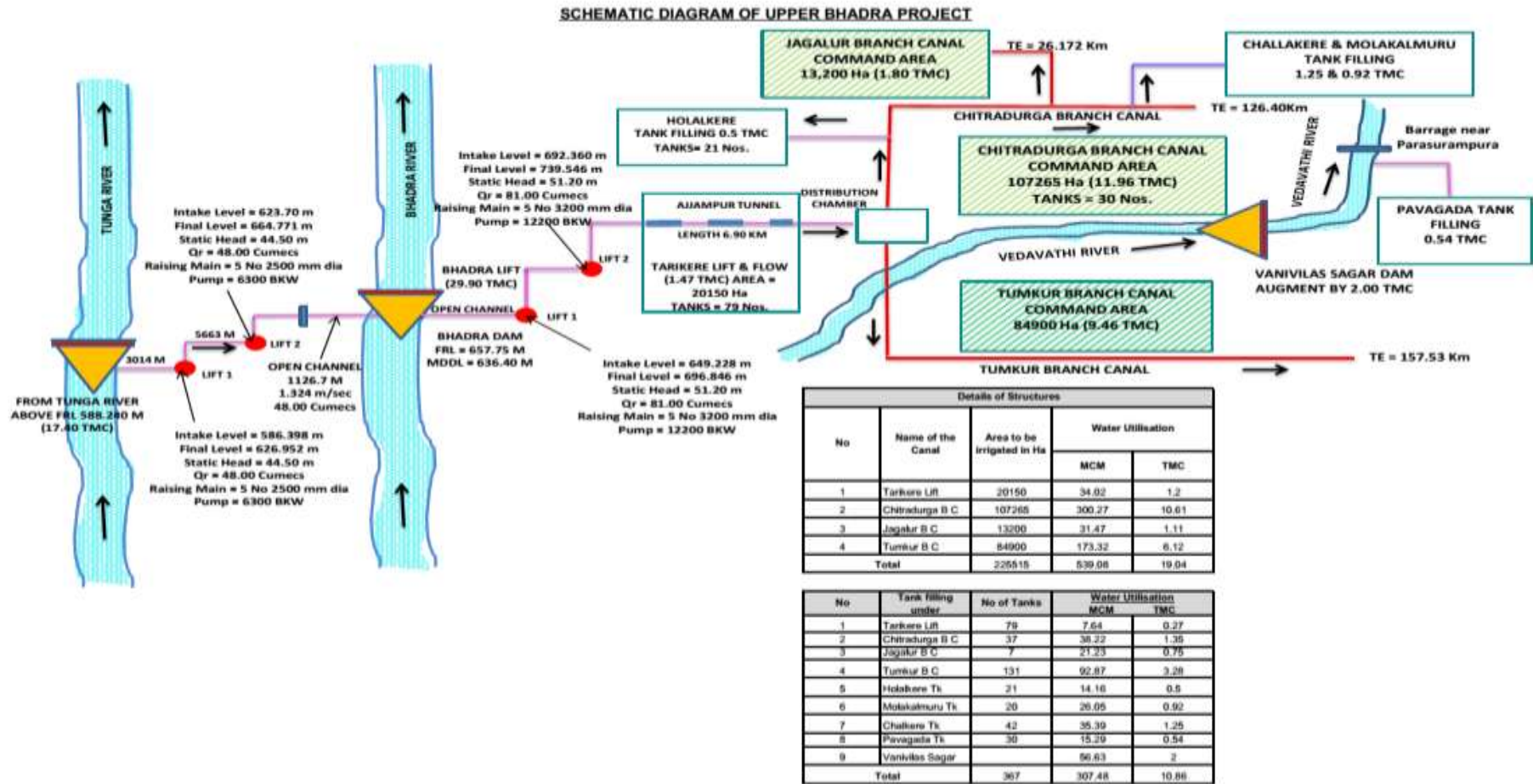


Fig - 2 Schematic diagram of UBLIS

Table 2. Salient Features of the project

1	Name of the Scheme	Upper Bhadra LIS
2	Name of the river	Tunga and Bhadra
3	Geographical Location of Lift point	Latitude –13018'0'' N and Longitude - 750 28'0'' E
4	Location of the Lift point	Near Muttinakoppa Village, NR Pura Taluk, Chickmagalur District in Karnataka
5	Type of the project	Irrigation
6	Estimated cost of the project	Rs. 12340.00 Cr
7	Command Area	2,25,515 Ha
8	Benefitting areas	4 districts, 787 villages
9	Allocated water	29.9 TMC
10	Cropping pattern	Kharif (June - October)
11	Irrigation efficiency	81%
12	Submergence area	Nil
13	Rehabilitation and Resettlement	Nil
14	Total Land required	2114 Ha
15	Total forest land required	351.98 ha (318.62 ha Stage-I Forest Clearance obtained and for remaining 33.36 ha application for FC will be submitted after detailed survey)
16	Power Requirement	242 MW, Source – wind mills
17	B C Ratio	1.263

Table 3. Salient features of the branch canals

Sl.No	Name of the branch canal	Drawl point / off take	Command area (ICA) in ha	Water utilization for irrigation (TMC)	No. of tanks filling	Water utilization for tank filling (TMC)	Total Utilization (TMC)
1	Chitradurga Branch Canal	Exit of Tunnel	107265	10.61	37	1.35	11.96
2	Tumkur Branch Canal	Exit of Tunnel	84900	6.12	131	3.28	9.40
3	Jagalur Branch Canal	125.167 Km of CBC	13200	1.11	07	0.75	1.86
4	Tarikere flow and lift canal	DC near Ajjampura Tunnel	20150	1.20	79	0.27	1.47
5	Allocation of water for Pavagada Taluk for drinking water	From tail-end of CBC	-	-	30	0.54	0.54
6	Allocation of water to VV Sagar to meet the shortfall	86.00 Km of TBC by distributory of length of 10 Km	-	-		2	2

Sl.No	Name of the branch canal	Drawl point / off take	Command area (ICA) in ha	Water utilization for irrigation (TMC)	No. of tanks filling	Water utilization for tank filling (TMC)	Total Utilization (TMC)
7	Tank filling in Chalkere Taluk	125.832 Km of CBC	-	-	42	1.25	1.25
8	Tank filling in Molakalmuru Taluk		-	-	20	0.92	0.92
9	Tank filling in Holalkere Taluk	25.710 Km from CBC	-	-	21	0.5	0.5
<b>Total</b>			<b>225515</b>	<b>19.04</b>	<b>367</b>	<b>10.86</b>	<b>29.90</b>

## 2.2 Need for the project

- Proposed command area districts are severely prone to erratic droughts due to south-west monsoons.
- Farmers of Tarikere and Kadur taluk are constantly demanding for irrigation facilities. Similarly, Jagalur, Parts of Sira, Chiknayakanhalli are devoid of irrigation facilities. Hence, it was decided to extend the irrigation facilities to these areas to migrate the regional imbalances.
- Similarly the ground water is alarmingly over exploited in Pavagada, Molakalmuru and also in Holalkere taluks of Chitradurga districts. Health problems in these regions are common due to higher concentrations of salt present in the ground water.
- Therefore, farmers and elected representatives pressurised Government to augment the existing MI tanks in these regions. Accordingly, it was decided to fill the existing MI tanks of the region to recharge the ground water.

## 2.3 Water allocation

The total requirement of water for irrigation in the command area is 539.07 MCM (19.04 TMC). Filling up of 367 number of tanks to their 50% of live capacity are proposed. The requirement of water for this purpose is 307.48 MCM (10.86 TMC) including augmentation of 2.00 TMC for Vani Vilas Sagar Reservoir.

## 2.4 Project components

River Tunga is being gauged by CWC at about 12 Km downstream of the existing Upper Tunga project. At this gauging site the catchment area is 2831 Sq.Kms. This discharge data reduced to Upper Tunga project site (Catchment area: 2240.36 Sq.km). Similarly, the catchment area of river Bhadra at the Bhadra reservoir site is 1968 Sq.Km. The inflow data of both the rivers are available from 1972-73 – 2012-13 and allocated 29.9 TMC of water for Upper Bhadra project. Following tables reveal the hydrology details.

Table 4. Existing hydrology of Tunga and Bhadra rivers

A. Tunga River	
75% Dependable gross annual yield	104.50 TMC
Upstream utilization (Upper Tunga Project)	11.50 TMC
Net 75% dependable yield	93 TMC
B. Bhadra River	

75% Dependable gross annual yield	72.36 TMC
Upstream utilization	Nil
Existing utilization at Bhadra reservoir	
a) Bhadra Project	-61.70 TMC
b) Ubrani-Ambruthapura LIS	-1.5 TMC
Net 75% dependable yield	9.16 TMC

Table 5. Water allocation for UBP

Direct allocation by Master Plan Committee under Scheme -A	10 TMC
From the savings after the modernization of Tunga anecut (6.25 TMC) Bhadra anecut (0.5 TMC), and Vijanagara Channels (6.25 TMC)	13 TMC
Sub-Total	23 TMC
Deducting allocation for Ubrani-Ambruthapura LIS	-1.50 TMC
Total	21.50 TMC
Additional allocation of water by the implementation of Indirasagar-Pollavaram project	2.40 TMC
Additional allocation of water from the surplus flow in Krishna basin	6.00 TMC
Grand Total	29.90 TMC

## 2.5 Diversion of water from Tunga river to Bhadra Reservoir (Package – I)

It is proposed to lift 17.40 TMC of water from Tunga to Bhadra reservoir. In preparing the working tables, both Package – I and Package – II pumping are assumed to take place from 16<sup>th</sup> June to 15<sup>th</sup> October. For Package-I pumping from Tunga, the calculation have been carried out from pumping capacity 48 as well as 60 cumecs (excluding/including the standby pump). When four pumps together are used then the lifting capacity is 1465 Mcft in 10 days and 1611 Mcft in 11 days. When all five pumps are used, the lifting capacities are respectively 1831 and 2014 Mcft. Priority is given to satisfy the requirements of Upper Tunga and Tunga Anicut Project, and Packing-I pumping is done if inflow exceeds these. The upper limit for pumping is the balance flow in Tunga or pumping capacity of 4 pumps as the case may be. Pumping is reduced/stopped when Bhadra Reservoir is surplus.

## 2.6 Lifting of water from Bhadra Reservoir (Package-II)

It is proposed to lift 29.9 TMC of water from Bhadra reservoir and priority is given in each 10 daily periods to irrigation and domestic uses at Bhadra Reservoir, and Packages-II pumping is done only if water is available after the above requirement and that to the water in the reservoirs above the MDDL of UBP.

## 2.7 Environmental Flow

The total divertible water available at Tunga river is 93 TMC. Out of which, 17.40 TMC is proposed to be divert to Bhadra reservoir leaving sufficient downstream flow of 75.6 TMC. Similarly, the dead storage of Bhadra reservoir is 8.51 TMC. The proposed project is planning to utilize the water only during June-October. Therefore, sufficient e-flow is available at both Tunga river as well as in Bhadra reservoir.

## 2.8 Command area

The command area of UBP is spread across 10 taluks in 4 districts in south Karnataka viz., Chikamagalur, Chitradurga, Tumkur and Davangere. Totally 781 villages are benefitting under the scheme apart from filling 367 ML tanks. Command area details are given below:

Table 6. Command area details of UBP

Sl. No	Name of district	Name of the Taluk	Stage-I (ha)		Stage-II (Expansion) - ha					
			Chitradurga branch canal	No. of Benefitting Villages	Tarikere flow and lift	Chitradurga branch	Tumkur branch canal	Jagalur branch canal	Total Area in Ha	No. of Benefitting villages
1	Chikkamagalur	Tarikere	411	4	20150	411	1628		22189	110
		Kadur	1864	13		1864	20502		22366	89
<b>Sub Total</b>			<b>2275</b>	<b>17</b>	<b>20150</b>	<b>2275</b>	<b>22130</b>		<b>44555</b>	<b>199</b>
2	Chitradurga	Hosadurga	31035	91		31035	13573		44608	214
		Holalakere	371			371			371	
		Hiriyur	37052	48		37052	29982		67034	136
		Chitradurga	23266	13		23266		5700	28966	52
		Challakere	13266	22		13266			13266	40
<b>Sub Total</b>			<b>104990</b>	<b>174</b>		<b>104990</b>	<b>43555</b>	<b>5700</b>	<b>154245</b>	<b>442</b>
3	Tumkur	C.N Halli					4657		4657	71
		Sira					14558		14558	39
<b>Sub Total</b>							<b>19215</b>		<b>19215</b>	<b>110</b>
4	Davangere	Jagalur					7500		7500	36
<b>Sub Total</b>							<b>7500</b>		<b>7500</b>	<b>36</b>
<b>Total</b>			<b>107265</b>	<b>191</b>	<b>20150</b>	<b>107265</b>	<b>84900</b>	<b>13200</b>	<b>225515</b>	<b>787</b>

## 2.9 Irrigation Planning

As described above, considering the mega scale of the project, for the purpose of implementation, the entire project is divided into 2 stages. The details of each is given below;

### 2.9.1 Link Canal from Tunga River to Bhadra Reservoir

The lifting point of Tunga water is located at Muthinakoppa village near Mandagadde of Narasimharajapura Taluk, Chikamagalur district. Total length of Link Canal from Tunga to Bhadra works out to 11.26 Km. The salient features of the canal is given below;

1	Name of the River	Tunga	
2	Geographical Location of Lift point	Latitude -13018'0'' N and Longitude - 750 28'0'' E	
3	Location of the Lift point	Near Muttinakoppa Village, NR Pura Taluk, Chickmagalur District in Karnataka	
4	Qty. of water to be lifted	17.40 TMC	
5	Water lifting period	June - October	
6	Distance from the Tunga reservoir	17 Km	
7	FRL of Tunga reservoir	588.24 m	
8	Total forest land required	96.95 ha (Stage-I Forest clearance obtained)	
9	Total land required for the canal	42 ha	
10	Lift Details	Lift-I	Lift-II
11	Length of the intake canal	3014 m	5663 m
12	RL from which water to be lifted	586.398 m	623.70 m
13	RL of Delivery point	626.952 m	664.771 m
14	Static head	44.50 m	44.50 m
15	Length of the rising main	290 m	290 m
16	Discharge required	48 Cumecs	48 Cumecs
17	No. of Pumps	4+1	4+1
18	Power requirement	63 MW	
19	Length of the main canal	11.26 Km	
20	Bed width of the canal	7.1 m	
21	FSD	3.583 m	
22	Free Board	1 - 2.76 m	

### 2.9.2 Canal from Bhadra reservoir to Ajjampura tunnel

Bhadra river is one of the east flowing rivers in the southern peninsular India. It starts from Western Ghats in Chikmagalur districts. The yield in the river is in the order of 75 TMC to 100 TMC and the flow is mainly during south west monsoon period of June to October. A dam has been constructed across Bhadra river near Lakkavalli village in Tarikere taluk of Chikmagalur district to cater to the needs of irrigation. The capacity of the reservoir at full level is 71.535 TMC. Salient features of the Bhadra dam is as follows;

1	Name of the dam	Bhadra
2	Geographical Location of dam	Latitude -13042'0'' N and Longitude - 750 38'0'' E
3	Location	Near Lakkavalli Village, Tarikere Taluk, Chickmagalur District in Karnataka
4	Catchment area	1968 Sq.km

5	Gross storage	71.5 TMC
6	Dead Storage	8.5 TMC
7	Live Storage	63 TMC
8	Submergence	11250.88 ha
9	Utilization	61.7 TMC
10	Gross command area	162818 ha
11	Irrigable command area	105570 ha
12	Length of the dam	1708 m
	Height of the dam	59.13 m
13	MWL	657.75 m
14	FRL	657.75 m
15	MDDL	636.40 m
16	Crest gates	4, 7.62 x 18.28 m size
17	River sluice	2, 1.82 x 4 m size
18	Length of the left bank canal	77 Km
19	Length of the right bank canal	387.9 Km
20	Hydropower generation	40.4 MW
21	Year of completion	1965

Two stage pumping from Bhadra Reservoir is proposed. The intake canal is situated near the dam and through the lift, the water will be pumped to DC-I and with the help of another lift at DC-2, the water will be routed to tunnel near Ajjampura, The salient features of the canal is as follows;

1	Name of the dam	Bhadra	
2	Geographical Location of Lift point	Latitude -13041'44.9" N and Longitude - 750 38'22.46" E	
3	Qty. of water to be lifted	29.90 TMC	
4	Water lifting period	June - October	
5	Length of intake canal (m)	48	
6	Length of the Aqueduct	1003 m	
7	Total forest land required	110.10 ha (Stage-I Forest clearance obtained)	
8	Total land required for the canal	530 ha	
9	Lift Details	Lift-I	Lift-II
10	RL from which water to be lifted	649.228 m	692.360 m
11	RL of Delivery point	696.846 m	739.546 m
12	Static head	51.20 m	51.20 m
13	Length of the rising main	242.79 m	161.51 m
14	Discharge required	81 Cumecs	81 Cumecs
15	No. of Pumps	4+1	4+1
16	Power requirement	122 MW	
17	Length of the main canal	40.535 Km	
18	Bed width of the canal	7.6 to 9.6 m	
19	FSD	4.85 m	
20	Free Board	0.75 m	

## 2.10 Ajjampura Tunnel

A tunnel of length 6.9 Km is proposed near Ajjampura, Tarikere Taluk to convey water to Chitradurga Branch Canal, Tumkur Branch Canal and Tarikere Flow and Lift Canal. The salient features of the tunnel is as follows;

1	Total length of the tunnel	6.9 Km
2	Diameter of the tunnel	7.25 m



3	Discharge in tunnel	79.37 Cumecs
4	Bed Slope of the tunnel	1:2100
5	Approach Length and RL	0.330 Km, 733.575 m
6	Exit Length and RL	2.770 Km, 730.35 m

## 2.11 Branch Canals

- **Tarikere flow and Lift Canal:** It is proposed to irrigate 3650 Ha and 16500 Ha around Tarikere by Gravity as well as lifting water from the main canal before the tunnel. The utilization is 1.20 TMC of water.
- **Chitradurga Branch Canal:** It runs for a length of 139.636 Km feeding the land by gravity in Kadur and Tarikere taluks of Chikamagalur district, Hosadurga, Hiriya, Chitradurga, Holalakere and Challakere tauks of Chitradurga district. The total area proposed under Chitradurga Branch Canal is 107265 Ha utilizing in all 10.61 TMC of water.
- **Jagalur Branch Canal:** It takes off from Chitradurga Branch Canal for a length of 26.172 Km feeding the lands by gravity in Chitradurga taluk of Chitradurga district and Jagalur taluk in Davangere district. The total irrigated area proposed under Jagalur Branch Canal is 13200 Ha utilizing 1.11 TMC.
- **Tumkur Branch Canal:** It runs for a length of 157.534 Km feeding lands by gravity in Chikkanayakanahalli and Sira taluk of Tumkur district, Tarikere, Kadur taluks in Chikamagalur district, Hosadurga, Hiriya in Chitradurga district. The area proposed for irrigation under Tumkur Branch Canal is 84900 Ha utilizing 6.12 TMC of water.

Table 7. Salient features of the branch canal

Particulars	Tarikere flow and lift canal	Chitradurga Branch Canal	Tumkur Branch Canal	Jagalur Branch Canal
Length (Km)	72	139.636	157.534	26.172
Peak discharge (Cumecs)	2.20	44.15	28.75	4.48
Required discharge	2.20	53.493	37.213	5.862
Design discharge	2.32	55.25	37.477	6.015
Bed width (m)	1.70	6.0	6.0	2.60
FSD (m)	1.10	4.80	3.70	1.65
Free Board (m)	0.45	1.0	1.0	0.60
Side Slope	1:1	1:1	1:1	1:1
Bed gradient (m)	1:3000	1:10000	1:8000	1:4000
Velocity (m/sec)	0.753	1.063	1.044	0.858
ICA (ha)	3650 by flow 16500 by gravity	107265	84900	13200
Total no. of block divided in CA	02	11	06	03
Type of canal	Contour	Contour	Contour	Contour
No. of benefitting villages	98	244	375	70
Forest land required	--	111.57	36.36	--
Status of Forest Clearance	NA	Stage-I obtained	Will be applied after detailed survey	NA
Power requirement	--	5.47	4.29	0.67

## 2.12 Land Requirement

The proposed project requires 2114 Ha and 351.98 Ha forest land is required for the project. Out of which, Stage-I Forest Clearance has been obtained for 318.62 Ha and for remaining 33.26 Ha, application for stage-I Forest Clearance will be submitted upon detailed survey, The required land will be acquired as per the Right to Fair Compensation and Transparency in Land Acquisition Act, 2013.

## 2.13 Adoption Of Low Pressure System (LPS) Drip Irrigation

To achieve the sustainable utilization of water, LPS drip irrigation is adopted for the entire command area of 225515 Ha. The system is proposed to be run on Low Pressure System (LPS). Electric power required to run the pumps on LPS system in a part of the command area where pressure of 1 bar (10.2 m head) is not available and where pressure of more than 1 bar is available, the modules will run on gravity system of drip not requiring electrical power. The LPS drip design eliminates the need of constructing distributaries, laterals, minors and field channels thereby reducing the cost of land acquisition and the project can be completed within shorter span of time.

## 2.14 Cropping Pattern

The present agricultural practices including the crops grown are tuned to the rainfall regime. The crops grown are Khariff crops only which are as under. The estimated percentage area of these crops and their corresponding yields are given below;

Table 8. Existing cropping pattern in the command area

Sl. No.	Crops	% area
1	Groundnut	23.6
2	Maize	15.62
3	Ragi	9.39
4	Sunflower	2.09
5	Jowar	2.09
6	Pulses	37.21
7	Vegetables & Misc Crops	10.00
Total		100

In view of introducing Drip Irrigation system in the entire command area of 2,25,515 Ha, the following cropping pattern (for Khariff Season) is proposed.

Table 9. Proposed cropping pattern

Sl. No.	Crops	% area
1	Groundnut	45
2	Sunflower	20
3	Pulses	10
4	Maize	10
5	Jowar	15
Total		100

### 3. Description of baseline environment

In order to assess the baseline environmental status, command area, 10 Km radius from the main project components were considered and the data was collected for Monsoon Season (Jul 2015 to Sept 2015), Post Monsoon season (Oct 2015 to Dec 2015) and Summer Season (Jan 2016 to Mar 2016). In addition to the baseline environmental monitoring, field inspection in the study area, collection of primary & secondary information for all the environmental components and discussions with the officials and local public were conducted by the experts.

#### 3.1 Physical Environment

##### 3.1.1 Topography

The area is flat and continuous sloping without undulations towards the Bhadra and Vani Vilas reservoirs respectively. The topography of the project area is partly plain and partly sloping. The elevation in the study area ranges from RL 631.00 m to RL 690.00 m.

##### 3.1.2 Ambient air quality

The results of ambient air quality reveal that, the minimum and maximum level of Particulate Matter <2.5 $\mu$  recorded within the study area were in the range of 14 to 27  $\mu\text{g}/\text{m}^3$ . The minimum and maximum level of Particulate Matter <10 $\mu$  recorded within the study area were in the range of 44 to 71  $\mu\text{g}/\text{m}^3$ . The minimum and maximum level of SO<sub>2</sub> recorded within the study area was in the range of 3.19  $\mu\text{g}/\text{m}^3$  to 16.32  $\mu\text{g}/\text{m}^3$ . The minimum and maximum level of NO<sub>x</sub> recorded within the study area was in the range of 7.25  $\mu\text{g}/\text{m}^3$  to 22.35  $\mu\text{g}/\text{m}^3$ . The air quality index in the study area is found to be satisfactory for PM<sub>10</sub> and PM<sub>2.5</sub> and good for gases (SO<sub>2</sub> and NO<sub>2</sub>).

##### 3.1.3 Ambient Noise levels

The results of ambient noise levels were compared with Residential standards and results reveal that, the noise levels in the study area ranging from 40.99 - 43.93 d(B)A for day time and 34.06-37.16 d(B)A for night time during monsoon season. The noise levels during Post-Monsoon season is ranging between 50.68-54.86 d(B)A for day time and 41.57 - 43.79 d(B)A for night time and 48.70-50.51dB(A) for day and 37.67-41.14 d(B)A for night time during Pre-Monsoon season respectively. Overall, the noise levels in all the seasons were observed to be well within the CPCB standards.

##### 3.1.4 Seismicity

The proposed project area is located in the Zone-II of Seismic Zoning Map of India. Hence, the area is very less prone to Earthquakes.

##### 3.1.5 Geology and Minerals

The dominant geologic units are Dharwar schists, granitic gneiss, younger granite, basic intrusions and ferruginous Quartzites. Crystalline schists constitute parts of Chitradurga, Chikkanayakanahalli schist belt. The litho units are quartzite, conglomerate, Manganiferous clay, schist, banded iron ore formations and associated Metavolconics. Major part of the area is underlain by the schistose rocks. Granitic gneiss constitutes the low lying hillocks. It is banded and made of light to dark grey sands. Basic dykes are found intruding into schists and granitic gneiss having varying dimensions. The hillocks in the eastern part are composed of Dharwar schists, Phyllites and Ferruginous Quartzites with barytes on the top. The conglomerate beds forms the base of these schists. The strike of the schistose rock is north -west to south-east dipping 55° to 75° east. Ferruginous are noticed occupying the top of the ridges

of schistose formations as noticed to the north west of Bheemasamudram and Sireger villages.

### 3.1.6 Soil characteristics

The soil types found in the command area are black, Red, red and black colored. The black cotton soil is rich in bases (alkaline condition) and has a very high water holding capacity. The soils in the Upper Bhadra project area are mostly red and mixed soils, while the black soil constitutes only 30 percent and are 45-90cms and above, heavy in texture, with 45 to 55 per cent clay and contain free calcium carbonate throughout the profile. Below the gypsum layer occurs 'murrum' which is practically impermeable to water, so that the internal drainage of the soil is lateral rather than vertical within the profile.

### 3.1.7 Hydrology

- Tumakuru Branch Canal

Depth of existing bore wells in the study area vary from 30 to 120 m bgl. It is reported that the potential fractured zones exist from 20 to 90 m bgl. yielding 1.5 to 4.5 litres per second (lps). The potential fractured zones are recharged from the saturated weathered zone through vertical leakage as well as from horizontal flow from adjacent areas.

- Jagalur Branch Canal

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### 3.1.8 Surface Water

The baseline status of water quality in the study area was established. Water samples were collected from 7 locations (1 No. surface water & 6 No. ground water) in the study area during the study period. In Monsoon season, The physico-chemical parameters for Vedavati river at Vanivilas sagar are well within the standards. Total dissolved solids are reporting 452 mg/l. Dissolved oxygen was observed to be in the range of 5.1 mg/l. Total Coliform and E. Coli were present in all the locations due to improper sanitation facilities.

In post monsoon season, The physico-chemical parameters for Vedavati river at Vanivilas sagar are well within the standards. Total dissolved solids was 412 mg/l. Iron was found 0.11 mg/l. Dissolved oxygen was found to be higher than monsoon and it was 7.4 mg/l.

In pre monsoon season, The physico-chemical parameters for Vedavati river at Vanivilas sagar are well within the standards. Total dissolved solids was 410 mg/l. Heavy metals were not detected. Dissolved oxygen was observed to be 6.2 mg/l.

### 3.1.9 Ground Water

In monsoon season, Total Hardness in ground water was ranging from 152 - 1100 mg/l and whereas the Nitrate levels were in the range of 3.92 – 33.59 mg/l. Fluoride levels are ranging between 0.21 – 1.1 mg/l and E.coli and faecal coli forms were absent in all locations. Heavy metals absent in all the locations. Overall, the ground water quality was found to be good and confirming to IS standards.

In post monsoon season, The ground water quality analysis results reveal that, the Total Hardness was found in the range of 100 mg/l at Anival to 550 mg/l at Kunabevu

village. Fluoride levels are ranging between 0.67 mg/l at Hunasikatte to 1.17 mg/l at Chippanakere and E.coli and faecal coli forms were absent in all locations. Heavy metals absent in all the locations. Overall, the ground water quality was found to be good and confirming to IS standards.

In pre monsoon season, the ground water quality analysis results reveal that, the Total Hardness was 232 mg/l at Lakkenahalli to 708 mg/l at Challakere. Calcium was found least of 35.2 at Lakkenahalli and was found highest of 168 mg/l at Challakere, Magnesium at Bidarakere was 17.49 mg/L and 69.98 mg/l at Challakere. Nitrate was within permissible limit (0.22- 10.98 mg/l). E.coli and faecal coli forms were absent in all locations. Heavy metals absent in all the locations. Overall, the ground water quality was found to be good and confirming to IS standards.

### 3.1.10 Land use assessment

The results indicate that the buffer zone is dominated by crop lands followed by scrub forest, plantations and water bodies. It also includes built-up and barren rocky land. The ground truth survey revealed that the crops cultivated in the region are Ragi, Hybrid Maize, Bajra, Hybrid Jowar, Cotton, Pulses, Ground Nut and Sunflower.

Table 10. Land use / land cover classification in the study area

Sl. No	LULC	Area	
		Sq Km	%
1	Acacia Plantation	10.26	0.081
2	Agricultural Plantation	527.85	4.155
3	Arecanut Plantation	4.45	0.035
4	Bamboo plantation	4.25	0.033
5	Barren rocky/Stony waste	148.22	1.167
6	Built-up	145.76	1.147
7	Coconut Plantation	69.58	0.548
8	Coffee plantation	0.27	0.002
9	Coffee/Cardamom Plantation	19.31	0.152
10	Crop-Land	8423.93	66.303
11	Dry Deciduous Forest	393.54	3.097
12	Eucalyptus Plantation	248.46	1.956
13	Evergreen Forest	0.23	0.002
14	Forest Blank	99.53	0.783
15	Grass land	46.56	0.366
16	Land with/without scrub	417.4	3.285
17	Mining/Quarrying/Industrial waste	21.11	0.166
18	Mixed Forest Plantation	149.96	1.180
19	Moist Deciduous Forest	387.58	3.051
20	Other Forest Plantation	9.64	0.076
21	River Island	1.14	0.009
22	Rubber Plantation	3.74	0.029
23	Scrub-Forest	901.64	7.097
24	Semi Evergreen Forest	22.55	0.177
25	Teak Plantation	21.96	0.173
26	Wastelands	0.17	0.001
27	Water body	532.03	4.188
28	Waterlogged	94.02	0.740
	Total	12705.14	100.000

## 3.2 Biological Environment

### 3.2.1 Flora

A total of 68 grids of 5x5 km were prepared using GIS software. A total of 186 quadrates were laid down to sample trees, shrubs and herbs in both core and buffer refer area respectively.

A total of 231 plant species were recorded in both core and buffer area of the proposed project site. Of which 94 belong to tree species, 31 belongs to shrub species and 106 species belongs to herbs respectively.

Out of the 231 plant species recorded in quantitative study, 3 species one belong to various categories of IUCN. Among these one is climbers and four are trees. We have also grouped *Ficus* species as Keystone species, that means this tree is sacred to local community, where people worshipping and protecting and promoting in the rural areas.

### 3.2.2 Fauna

The field sighting and published records for the region indicated that 14 mammals were reported for the region. Of which only jackel is belongs to rare category. There are about 37 birds recorded for the region, which are more common found in outside the project area. There are 11 species of butterflies were observed in core and buffer area of the project. A total of ten reptiles and two amphibians were also observed in the project area. Majority of the fauna recorded or reported for the region were also observed outside the project area in semi-arid region of Karnataka.

### 3.2.3 Protected Areas

Under stage-1, Mandagadde Bird Sanctuary, Bhadra wild life sanctuary and Jogimatti wild life sanctuary are found within the 10 Km radius of command area. Where as, in stage-II, there are no protected areas or eco-sensitive areas within the 10 Km radius of main project components and command area.

### 3.2.4 Forest land

About 318.62 ha of forest land is required for stage-1 and 33.69 ha of forest land is required for stage-II.

## 3.3 Aquatic Ecology

The Upper – Bhadra Lift Irrigation scheme slated to be commissioned by drawing water from the Tunga reservoir, Shivamogga district to the Bhadra reservoir, Chikmagalur district and , further through the canals system originating from the Bhadra reservoir, proposed to fill – in 232 tanks located in Tarikere taluk (Chikmagalur district), Hosadurga taluk, Holalkere taluk, Challakere taluk and Molakalmuru taluk (Chitradurga district and Pavagada taluk) and also to facilitate provision of the medium to cater to the needs of the agricultural lands situated in Jagalur taluk (Davangere District).

Detailed Physico – chemical features of the surface water samples and also the biological components such as Plankton, Littoral fauna, aquatic vegetation and fish and fisheries aspects to certain tanks, rivers, studied have been incorporated in the report. Physico – chemical and biological features, although has a very 'poor' representation, but accounted to bear 'optimum' sustainable levels to cater to the needs of the fish species present.

The occurrence of immigrant African catfish, *Clarias gariepinus* and river Nile (Egypt) Tilapia – *Oreochromis nilotica* and the related Brazilian (South America) species *Oreochromis mossambica* in Vanivilas sagar reservoir and most other biotopes in the districts, as observed and obtained reports also, does not auger well for the development and proliferation of fish species indigenous as also the Gangetic carp – Catla, Rohu and Mrigal suggested stocking in good many tanks, canals, rivers and reservoirs. Serious steps need to be taken to completely eliminate the exotic fish species from the water bodies present in the taluks mentioned and from elsewhere too. Fish seed stocking strategies in the tanks, canals and reservoirs have been detailed to make use of the facility and opportunity being advanced by this beneficial project to record considerable fish production in order to help scores of fishermen engaged in the profession to eke-out their livelihood.

#### **4. Anticipated Environmental Impacts & Mitigation Measures**

Due to the activities of the project, there will be potential impacts on the environment of varying magnitude. Most of the impacts are likely to occur during the construction phase of the project. The following section reveals the prediction of impacts due to the project on the physical, biological and social environment. Impacts have been assessed based on the information collected from the primary and secondary data.

##### **4.1 Ambient Air Quality**

The construction of the project is expected to last approximately in 60 months. The initial site clearing will be followed by site preparation activities

Fugitive dust emissions from the project will result from:

- Dust entrained during site preparation and grading/excavation at the site;
- Dust entrained during onsite travel on paved and unpaved surfaces;
- Dust entrained during aggregate and soil loading and unloading operations; and
- Wind erosion of areas disturbed during construction activities.
- During muck disposal
- Combustion emissions during construction will result from:
  - Exhaust from the Diesel construction equipment used for site preparation, grading, excavation, trenching and construction of onsite structures;
  - Exhaust from pickup trucks and Diesel trucks used to transport workers and materials around the construction site;
  - Exhaust from Diesel trucks used to deliver concrete, fuel, and construction supplies to the construction site; and
  - Exhaust from automobiles used by workers to commute to the construction site.

Combustion emissions during construction will result from:

- Exhaust from the Diesel construction equipment used for site preparation, grading, excavation, trenching and construction of onsite structures;

- Exhaust from pickup trucks and Diesel trucks used to transport workers and materials around the construction site;
- Exhaust from Diesel trucks used to deliver concrete, fuel, and construction supplies to the construction site; and
- Exhaust from automobiles used by workers to commute to the construction site.

The following mitigation measures will be followed to control potential emissions of fugitive dust during construction of the project:

- Low Sulphur Diesel will be used for the construction equipments/ vehicles which has low ash content.
- Unpaved roads in the project construction site are watered frequently as necessary to prevent fugitive dust. All vehicles carrying construction materials are covered with tarpaulin to avoid spillage of construction materials.
- All the trucks carrying construction materials to the site shall be inspected regularly and shall have valid Pollution Under Control (PUC) certificate.
- Labors camps shall be provided with LPG facilities.
- Usage of PPEs like nose masks will be provided.
- During excavation, water sprinkling will be undertaken to reduce the emissions to the highest level.

## 4.2 Ambient Noise Level

During construction phase, various sources of noise pollution arise due to operation of machineries like concrete plant, cranes, batch plants, material lifting operations, communication noise, including DG sets etc., Other source of noise pollution includes movement of vehicles for unloading of construction materials, fabrication, handling of equipments. Construction activities are expected to produce noise levels in the range of 80 – 95 dB (A).

- PPEs such as, ear plugs and ear muffs will be provided to the workers.
- Periodic maintenance and servicing of construction equipments/ vehicles.
- Acoustic enclosures will be provided for DG sets
- Construction activities shall be restricted only during day time and there shall not be any construction during evening and night hours to avoid the psychological effects on surrounding population and biota.
- Wherever blasting is required, control blasting will be operated to reduce the noise levels.
- Local roads using for carrying out constructions materials will be upgraded.

## 4.3 Water Environment

The quality of water resources both surface and ground water may also deteriorate if solid waste management practices are not adopted in the labour camps of the project during peak construction phase.



Improper treatment of sewage from labor camps leads to infiltration into the subsurface soil and finally affects the ground water of the region. This will create unaesthetic conditions in the site, attracts mosquitoes/fly, thereby chances of deteriorating the health of the workers in unhygienic conditions. Improper disposal of construction debris, used oil, diesel for DG sets, etc will result in ground water contamination and in turn affecting drainage of the area.

The mitigation measures include;

- The sewage generated from the labour camps shall be treated in the Septic Tank and Soak Pits designed and constructed as per IS 2470 Part-I & Part-II.
- There will be no open discharge of sewage from labour camps and the labour camps will be provided with sufficient bathrooms and toilets. Periodical health check-ups for labors will be done.
- Construction debris will be reused at site, used oil generated from the DG sets will be stored separately and handed over to authorized recyclers.
- During construction of CD structures, the streams and the point of contact of canal will be provided with sand bags.

#### **4.4. Land Environment**

Temporary loss of soil may be envisaged during the construction phase during construction of temporary offices, workers camps, stockyards, borrow areas etc.

Compaction of soil may occur, particularly on haul roads during site clearance due to movement of heavy machinery and vehicles and during setting up of construction camps and stockyards.

Mitigation measures:

- Labour camps will be constructed in the vacant/ barren lands so that impact on agricultural lands are nullified.
- Maintenance and period repair of machineries will not be taken up in the project site vicinity. Maintenance of DG sets will be done at the vendors place and will not be taken up near project site.

#### **4.5 Biological Environment**

- During construction, due to the fugitive dust, photosynthetic activity would be reduced and leads to wilting of plants.
- Use of river water for domestic needs by labors will bear riverine water pollution and affects aquatic biota.
- Use of fire wood for labor camps results in cutting of trees.
- Construction equipment / vehicles washing leads to oil spillages into river and leads to reduction in dissolved oxygen levels.
- Improper disposal of construction materials and domestic wastes leads to eutrophication.

Mitigation measures:

- The forest area diverted for non forestry activity was already compensated by providing an alternative land equal to the land diverted as per Forest

(Conservation) Act, 1986 along with cost for raising compensatory afforestation at Varavu Kaval, Chitradurga District.

- The drip irrigation systems require lesser consumption of pesticides and fertilizers. However, necessary training will be imparted to water users associations by developing organic farming demonstration plots with the help of Agricultural scientists for enabling the farmers to switch over to Organic farming in the long run.

#### 4.6 Evaluation Impacts

Matrix method was used to identify interactions between various project activities and environmental parameters and components. Later, a weightage of 1-10 shall be given to the impacts based on the significance of the impacts. The impacts are quantified 'with' and 'without' EMP.

Table 11. Criteria for evaluation of impacts

Sl.No	Criteria	Score
1	Minor impact	1-2
2	Medium impact	3-4
3	Significant impact	5-8
4	Major impact	9-10

Table 12. Evaluation of Impacts

Sl.No	Environmental Attributes	Project Activities	Nature of Impacts										Without EMP	With EMP	
			Magnitude	Reversible	Irreversible	Long Term	Short Term	Direct	Indirect	Positive	Negative				
<b>A. Construction Phase</b>															
<b>1.Impacts on Land Environment</b>															
1	Land	Construction of DCs, pump house, main canal works and distributory network for drip irrigation	M	✓				✓	✓			✓	Orange	Light Green	
		Excavation for laying distributory network and pipes	L	✓				✓	✓			✓	Orange	Green	
		Vehicular movement	M	✓				✓	✓			✓	Orange	Light Green	
2	Change in Topography	Construction of DCs, pump house, main canal works and distributory network for drip irrigation	M	-	✓	✓		-	✓			✓	Orange	Light Green	
		Excavation for laying distributory network and pipes	M	✓				✓	✓			✓	Orange	Green	
3	Loss of Productive Soil	Construction site, temporary offices, workers camps, stockyards	M	✓				✓		✓		✓	Orange	Light Green	
		Construction of Haul roads	L	✓				✓	✓			✓	Light Green	Green	

Sl.No	Environmental Attributes	Project Activities	Nature of Impacts										
			Magnitude	Reversible	Irreversible	Long Term	Short Term	Direct	Indirect	Positive	Negative	Without EMP	With EMP
4	Compaction of Soil	Site Clearance	L	✓			✓	✓			✓		
		Movement of vehicles	L	✓			✓	✓			✓		
5	Contamination of Soil	Machinery and operation of the Diesel Generator Sets	M		✓		✓		✓		✓		
		Labor camps	H	✓			✓		✓		✓		
<b>2. Impacts on Water Environment</b>													
1	Eutrophication	Sewage from labor camp	H	✓			✓	✓			✓		
		Muck disposal	H	✓			✓	✓			✓		
2	Change in River Water Quality	Construction of DCs, pump house, main canal works and distributory network for drip irrigation	M	✓			✓		✓		✓		
		Decomposition of sediments and deposition of organic matter	M	✓			✓	✓			✓		
		Washing of equipments	L	✓			✓	✓			✓		
		Muck disposal	M	✓			✓	✓			✓		
3	Change in surface and ground water quality	Sewage from labor camp	H	✓			✓		✓		✓		
<b>3. Impacts on Air Environment</b>													
1	Increase in dust	Construction	M	✓			✓	✓			✓		

Sl.No	Environmental Attributes	Project Activities	Nature of Impacts											
			Magnitude	Reversible	Irreversible	Long Term	Short Term	Direct	Indirect	Positive	Negative	Without EMP	With EMP	
2	concentration Fugitive Emissions from various sources	equipments, operation of DG sets, Excavation	H	✓			✓	✓						
		Vehicular movement	H	✓			✓	✓						
		Loading and dislodging Use of sand, fine aggregates	M	✓			✓	✓						
		Batching plant	M	✓			✓	✓						
3	Increase in SO <sub>2</sub> , PM, NO <sub>x</sub>	Vehicular movement	M	✓			✓	✓						
		Operation of DG sets	M	✓			✓	✓						
		Fuel Combustion in equipments and Vehicles	M	✓			✓	✓						
		Burning of fuels from construction workers	M	✓			✓	✓						
4	Impact on Human Health	Emission of Dust particles	M	✓			✓	✓						
<b>4. Impact on Noise Environment</b>														
1	Increase Noise Level	Movement of vehicles	M	✓			✓	✓						
		Operation of D.G sets	L	✓			✓	✓						
		Movement of vehicles carrying raw materials	M	✓			✓	✓						
<b>5. Impact on Biological Environment</b>														
1	Pressure on existing natural resources	Immigration of labor population	L		✓	✓		✓						
2	Reduced Photosynthetic	Transportation of construction materials	M		✓		✓		✓					

Sl.No	Environmental Attributes	Project Activities	Nature of Impacts											
			Magnitude	Reversible	Irreversible	Long Term	Short Term	Direct	Indirect	Positive	Negative	Without EMP	With EMP	
	activity, Wilting of plants	Site Clearance	M		✓	✓			✓			✓		
3	Diversion of 33.36 ha forest land	Construction of TBC	M		✓	✓			✓			✓		
4.	Impacts on Fishes and Aquatic Ecosystem	Increase in turbidity of water due to Washing of machineries	M	✓				✓	✓			✓		
		Sewage from labor camp	H	✓				✓	✓			✓		
<b>6. Impact on Socio-economic Environment</b>														
1	Land acquisition	Affecting livelihood	H		✓	✓			✓			✓		
2	Impact on Human Health	Due to water/air borne diseases, traffic movement	H	✓				✓		✓		✓		
<b>B. Operation Phase</b>														
1	Impacts on Land Environment	Application of natural fertilizers and pesticides	H		✓	✓			✓		✓			
2	Impact on water environment	Application of fertilizers and pesticides	M		✓	✓				✓	✓			

## 5. Environmental Monitoring Program

The purpose of the monitoring programme is to ensure that the objectives of the project is achieved through the mitigation measures and result in desired benefits to environment and local population of the region.

Table 13. Environmental Monitoring Plan for construction phase (5 years)

Sl.No	Environmental Parameters	Parameters to be Monitored	Frequency of Monitoring	Locations	Responsibility	Estimated Cost in Rs.
1	Surface water quality	pH, Temperature, EC, TDS, Alkalinity, TH, DO, BOD, COD, NO <sub>3</sub> , PO <sub>4</sub> , Cl, SO <sub>4</sub> , Na, K, Ca, Mg, Silica, Oil & grease, MPN, Total coliform	Monthly once	Lift point at Tunga river, tail end of link canal from Tunga river @ Bhadra Reservoir, VV Sagar,	Contractors or agencies appointed by KNNL	9,000/-
2	Ground water quality	pH, Temperature, EC, TDS, Alkalinity, TH, NO <sub>3</sub> , PO <sub>4</sub> , Cl, SO <sub>4</sub> , Na, K, Ca, Mg, Silica, Oil & grease, MPN, Total coliform	Once in a month	Near Labor camps (Muttinakoppa, Rangenahalli, Ajjampura, Hosadurga, CN Halli - 5 Nos.)	Contractors or agencies appointed by KNNL	25,000/-
3	Soil Quality	pH, EC, Mg, Ca, Alkalinity, Cl, Na, K, Organic Carbon, K, PO <sub>4</sub> , SAR, N and Salinity	Once in a month	Near Labor camps (Muttinakoppa, Rangenahalli, Ajjampura, Hosadurga, CN Halli - 5 Nos.)	Contractors or agencies appointed by KNNL	17,500/-
4	Air Quality	PM <sub>10</sub> , PM <sub>2.5</sub> , NO <sub>2</sub> and SO <sub>2</sub>	As per NAAQ standards	Muttinakoppa, Rangapura, Ajjampura, Nanapura, Baggavalli, Chickballekere, Antaraghatte, Anival, Kelloodu, VV Pura, Hulikunte, Belaghatta, Yagati, Udugere, Ballalasangam, Belaguru, Arsinagundi, Elanadu, Pura,	Contractors or agencies appointed by KNNL	1,32,000/-

Sl.No	Environmental Parameters	Parameters to be Monitored	Frequency of Monitoring	Locations	Responsibility	Estimated Cost in Rs.
				Hunasekatte, Nibgur		
5	Noise Levels	Leq Day, Leq Night in dB(A)	Monthly once	-do-	Contractors or agencies appointed by KNNL	44,000/-
<b>Monthly Total</b>						<b>2,27,500/-</b>
<b>Until completion of project works (60 months)</b>						<b>1,36,50,000/-</b>
6	Aquatic life	Limnological and biological studies	Six monthly once until completion	Tunga river near Lift point and Bhadra reservoir	Contractors or agencies appointed by KNNL	1,50,000/-
7	Health check ups	Spirometry, Pulse Oxymetry, Blood Test, Lung Function Test, Eye test, Physical fitness tests	Six monthly once until completion	Labor camp (5 No.)	Contractors or Doctors / PHC appointed by KNNL	5,00,000/-
<b>Six monthly total</b>						<b>6,50,000/-</b>
<b>Until completion of project works (60 months)</b>						<b>32,50,000/-</b>

Table 14. Environmental Monitoring Plan for operation phase (3 years)

Sl.No	Environmental Parameters	Parameters to be Monitored	Frequency of Monitoring	Locations	Responsibility	Estimated Cost in Rs.
1	Surface water quality	pH, Temperature, EC, TDS Alkalinity, TH, DO, BOD, COD, NO <sub>3</sub> , PO <sub>4</sub> , Cl, SO <sub>4</sub> , Na, K, Ca, Mg, Silica, Oil & grease, MPN, Total coliform	Quarterly once for 3 years	Lift point at Tunga river, tail end of link canal from Tunga river @ Bhadra Reservoir, VV Sagar,	Agencies appointed by KNNL	9,000/-
2	Ground water	pH, Temperature, EC, TDS	Quarterly	10 locations	Agencies	30,000/-



Sl.No	Environmental Parameters	Parameters to be Monitored	Frequency of Monitoring	Locations	Responsibility	Estimated Cost in Rs.
	quality	Alkalinity, TH,NO <sub>3</sub> , PO <sub>4</sub> , Cl, SO <sub>4</sub> , Na, K, Ca, Mg, Silica, Oil & grease, MPN, Total coliform	once for 3 years		appointed by KNNL	
3	Soil Quality	pH, EC, Mg, Ca, Alkalinity, Cl, Na, K, Organic Carbon, K, PO <sub>4</sub> , SAR, N and Salinity	Quarterly once for 3 years	25 locations	Agencies appointed by KNNL	75,000/-
Total / Quarter						1,14,000/-
Total / 3 years						13,68,000/-
4	Aquatic life	Limnological and biological studies	Yearly once for 3 years	Tunga river near Lift point and Bhadra reservoir	Agencies appointed by KNNL	4,50,000/-
<b>Total</b>						<b>18,18,000/-</b>

Based on the above and as per the guidelines of MoEF under the supervision of The Chief Engineer, Karnataka Neeravari Nigam Ltd, Upper Bhadra Project Zone, Chitradurga, Karnataka State, six monthly compliance reports shall be submitted to Regional Office of MoEF, Bangalore.

In order to verify the effectiveness of monitoring program, Regional Office, MoEF, Bangalore and Regional Office, KSPCB, Chitradurga will be the enforcing agency to monitor the project activities.

## 6. Social Impact Assessment

### 6.1 Project affected villages

One of the direct impacts of the project is Land acquisition and this project requires land from six villages as detailed in the Table below.

Table 15. Details of project impacted villages

District	Taluk	No. of villages
Chitradurga	Chalkere	4
	Chitradurga	11
	Hosadurga	17
Chikkamagaluru	Tarikere	36
	Kadur	40
Tumakuru	Sira	8
	Pavagada	3
	Chikkanayakanahalli	13
<b>3 districts</b>	<b>8 taluks</b>	<b>132 villages</b>

### 6.2 Impact of the project

- Upper Bhadra Lift Irrigation scheme is proposed to irrigate an area of 2,25,515 ha across 10 taluks in 4 districts in South Karnataka viz., Chikkamagaluru, Chitradurga, Tumakuru and Davanagere. This will help to increase the agricultural production during kharif season which in turn will raise their economic status and standard of living. This will have major impact on the area, especially since 80% of the population depends on agriculture for their subsistence.
- Direct employment opportunities for 600 members during construction phase and 200 members during operation phase of the project. Apart from this, 33 Lakhs people will be getting benefitted through various job opportunities.
- The only negative impact is that some people will lose their agricultural land for the project construction purposes and they will be sufficiently compensated as per prevailing RTFCRR rules, 2013. The project design will take due care to ensure that no residential or commercial properties affected and there is no need for any displacement of families.

So overall impact of the project is progressive for the development of the villages and the agricultural production will increase contributing to the economy of the region. Villagers generally welcome such irrigation projects and cooperate with the land acquisition process. The Department takes due care to consider the development needs of the people and due care will be taken to avoid all negative impacts.

## 7. Project Benefits

- Entire command area of the project is irrigating by drip irrigation system. Hence, there will be conjunctive use of surface water.
- Problem of weeding, usage of fertilizers and pesticides will be considerably reduced.
- Agricultural linkages will be considerably improved.
- The project improves total farm output and hence raises farm income.
- Project improves yields through reduced crop loss due to erratic, unreliable or insufficient rainfall.
- It allows a greater area of land to be used for crops in areas where rain fed production is impossible or marginal.
- Extensive agricultural production supplies raw materials to the nearby small scale industries thereby increasing the economy in the region.
- Altogether, population of 797 villages belonging to 8 taluks will be benefitted directly under the scheme.
- Direct employment opportunities for 600 members during construction phase and 200 members during operation phase of the project.
- Further, indirectly labour opportunities will be substantially improved since larger area will be brought under irrigation.
- It improves fodder crops and in turn dairy farming in the command area.
- Zero water logging and salinity problems. Weed and disease reduction due to adoption of micro irrigation.
- No submergence and hence no rehabilitation and resettlement.
- 367 MI tanks are proposed for filling. This would help in recharging the ground water and hence easy access to drinking water for rural areas.
- Dissolution of ground water salts and hence maximum health benefits to rural areas.

## 8. Environmental Management Plan

Although agriculture is usually associated with its positive impacts on human life, irrigation practices may be associated with impacts on environmental conditions, which may eventually curtail the sustainability of irrigation projects. For this reason, Environmental Impact Assessment (EIA) has been recognized as an integral part of the early planning studies of irrigation projects in order to identify any expected negative impacts and suggest the necessary mitigation plans to curb these impacts through formation of Environmental Management Plan (EMP).

Project Activity	Impacts	Mitigation measures	Advantage	Location	Responsibility & Monitoring Agency	Time frame
<b>A. Construction Phase</b>						
<b>1. Air Environment</b>						
Fuel combustion from construction equipments	Emission of pollutants (PM, SO <sub>2</sub> )	High speed Diesel with low sulphur content will be used for the construction equipments/ vehicles which has low ash content	Reduction in pollutants level	Construction of DCs, pump house, main canal works and distributory network for drip irrigation	Contractor & KNNL	Thorough out the construction period (60 months)
Vehicular movement and operation of batching plants	Dust pollution	Water sprinkling and vehicles should be covered with tarpaulin, speed limit restrictions	Reduction in fugitive emissions	Construction of DCs, pump house, main canal works and distributory network for drip irrigation	Contractor & KNNL	Water sprinkling - 3 times/day
Burning of fire wood	Emission of pollutants (C, SO <sub>2</sub> )	Labor camps supplied with LPG facility	Reduction in emission levels	Labor camp	Contractor & KNNL	Thorough out the construction period (60 months)

Project Activity	Impacts	Mitigation measures	Advantage	Location	Responsibility & Monitoring Agency	Time frame
Operation of DG sets, excavation	Health problems to labors	Usage of Nose masks	Healthy working environment	Construction of DCs, pump house, main canal works and distributory network for drip irrigation	Contractor & KNNL	Thorough out the construction period (60 months)
<b>2. Noise Environment</b>						
Operation of DG sets and usage of construction equipments	Increase is noise levels	PPEs such as, ear plugs and ear muffs will be provided to the workers, Acoustic enclosures for DG sets	Reduction in noise levels	Construction of DCs, pump house, main canal works and distributory network for drip irrigation	Contractor & KNNL	Thorough out the construction period (60 months)
Vehicular Movement	Increase is noise levels	Construction activities shall be restricted only to day time	Reduction in noise levels	Construction of DCs, pump house, main canal works and distributory network for drip irrigation	Contractor & KNNL	Thorough out the construction period (60 months)
<b>3. Water Environment</b>						
Sewage from labor camps	Surface and ground water pollution	Treatment through septic tank and soak pit	Reduction in pollution load	Labor camps	Contractor & KNNL	Thorough out the construction period (60 months)
Stagnation of water	Mosquito breeding grounds	Providing proper sanitary facilities	Healthy environment	Labor camps	Contractor & KNNL	Thorough out the construction period (60 months)

Project Activity	Impacts	Mitigation measures	Advantage	Location	Responsibility & Monitoring Agency	Time frame
Excavation and operation of DG sets	Muck generation, blockage of natural drains and contamination of ground water	Reuse of muck at site, disposal of used oil KSPCB authorized preprocessors	Reduction in surface and ground water contamination	Construction of DCs, pump house, main canal works and distributory network for drip irrigation	Contractor & KNNL	Thorough out the construction period (60months)
Construction of intake canal at Tunga river	Increase in turbidity levels in river	Provision of sand bags	Healthy aquatic ecosystem	intake canal	Contractor & KNNL	12 Months
<b>4. Soil Environment</b>						
Construction of labor camps, stock yards	Loss of fertile soil	Waste land will be used for erection of labor camps	Land resource optimization	Waste land	Contractor & KNNL	Thorough out the construction period (60 months)
Mainatenance of DG sets and construction machineries	Soil contamination	Maintenance at service centres	Reduction in soil contamination	Construction of DCs, pump house, main canal works and distributory network for drip irrigation	Contractor & KNNL	Thorough out the construction period (60 months)
<b>5. Solid and Hazardous waste Environment</b>						
Excavation	Change in hydraulic regime	Reuse of excavated earth	Natural drainage pattern maintained	Construction of DCs, pump house, main canal works and distributory network for drip	Contractor & KNNL	Thorough out the construction period (60 months)

Project Activity	Impacts	Mitigation measures	Advantage	Location	Responsibility & Monitoring Agency	Time frame
				irrigation		
Improper dumping of solid waste from labor camps	Water pollution	Labor camps at 1 km away from river, Disposal to Municipal Authorities	Reduction in siltation and eutrophication	Construction of DCs, pump house, main canal works and distributory network for drip irrigation	Contractor & KNNL	Thorough out the construction period (60 months)
<b>6. Biological Environment</b>						
Construction activities	Wilting of plants	Water sprinkling	Normal photosynthetic activity	Construction of DCs, pump house, main canal works and distributory network for drip irrigation	Contractor & KNNL	Thorough out the construction period (60 months)
Labor camps	Riverine water pollution	Labor camps at 1 km away from river, restrictions for not using the river water	Zero water pollution	Labor camps	Contractor & KNNL	Thorough out the construction period (60 months)
Use of fire wood	Cutting of trees	LPG for labor camps	Positive ecosystem services	Labor camps and its surrounding	Contractor & KNNL	Thorough out the construction period (60 months)
Washing of construction equipments	Reduced DO levels	Washing at authorized service stations	Aquatic system maintained	Tunga river	Contractor & KNNL	Thorough out the construction period (60 months)
Diversion of 33.36 ha of	Loss of forest area	Compensatory afforestation in an area equal to the forest	Loss of forest can be	The identification of CA land under	KNNL	As per KFD requirement

Project Activity	Impacts	Mitigation measures	Advantage	Location	Responsibility & Monitoring Agency	Time frame
forest land		land to be diverted	compensated as per the guidelines	progress		
<b>7. Socio-economic environment</b>						
Land acquisition	Affecting livelihood	Compensation as RFCLA&TRR Act 2013	Sustainability for livelihood opportunities	In the project impacted villages	KNNL	48 months
Vehicular movement	Health problems	Water sprinkling and movement of vehicles carrying raw materials only during night time.	Healthy environment	In the project impacted villages	Contractor & KNNL	Thorough out the construction period (60 months)
<b>B. Operation phase</b>						
Excess application of fertilizers and pesticides	Soil and water contamination	Awareness on organic farming practices	Reduction in pollution load	Command area	KNNL and Water user Associations	3 years



## 9.1 Command Area Development Plan

### 9.1.1 Water Users' Association (WUA)

Water user's association will be formed in the entire command area with area of about approximately 400 Ha or larger depending on District wise / village wise / Distributory. The objects of farmer's organization shall promote & secure distribution of water among its users, adequate maintenance of the irrigation system, efficient & economical utilization of water to optimize agriculture production.

Functions of water user's association.

- Preparation of plan for the maintenance of irrigation system in the area of its operation at the end of each crop season and carry out the maintenance works of both distributory system and minor & field drains in its area of operation with the funds of the association from time to time & provide funds for the maintenance of staff including such persons who are placed by the state Government with the Water User's Association for the purpose of regulation & maintenance of irrigation system.
- To regulate the use of water among the various pipe outlet under its area of operation.
- To promote economy in the use of water allocated.
- To maintain a register of land holders as published by the revenue department.
- To prepare & maintain a register of co-opted members.
- To prepare & maintain an inventory of the irrigation system within the area of operation.
- To monitor flow of water for irrigation.
- To resolve the disputes, if any between the members & water users in its area of operation.
- To raise resources.
- To maintain accounts.
- To cause annual audit of its accounts.
- To assist in the conduct of elections to the managing committee.
- To maintain other records as may be prescribed.
- To abide by the decisions of the distributory & project committee.
- To conduct general body meetings as may be prepared.
- To conduct regular water budgeting and also to conduct periodical social audit, as may be prescribed.
- To encourage modernization of agriculture in its area of operation.

## 9.2 Green belt development plan

The need for proper green belt is most essential, not only for aesthetic purposes but also for the fulfilment of ecological functions. We proposed to develop green belt using native species such as neem, Pongamia and Sampige. Several people feel that trees such as *Ficus religiosa* and *Michielia champaka* should be planted near the temple premises.

### 9.2.1 Canal bank plantation

All along the length of the inspection paths shall be planted with avenue trees. Native forest trees, especially the vulnerable *Santalum album*, *Aegle marmelos* and *Pterocarpus marsupium* will be planted on both the sides of the road at a distance of 5 m. Native forest trees, especially the vulnerable *Chloroxylon swietenia* and *Pterocarpus marsupium* will be planted on both the sides of the canals at a distance of 5 m. Along with the compensatory afforestation, avenue and canals bank plantations may be assigned to the State Forest Department.

Agro-forestry refers to the practice of Agriculture and Forestry in the same piece of land. The trees if planted on the bunds and on the boundary of the lands, protect the crops from the desiccating high winds and also provide additional income from the trees to the farmer apart from providing him fodder and fuel as well. Silvi-Pasture refers to the planting of the trees in a predominately grassland so as to provide fodder all the year round. This afforestation is aimed at not only addition of tree species, but also addition of highly nutritive and palatable grass species in the area, thereby providing much needed nutritious fodder to the livestock population.

### 9.2.2 Agro forestry activates in command area

Agro-forestry refers to the practice of Agriculture and Forestry in the same piece of land. The Karnataka Forest Department (KFD) has accorded high emphasis on farm forestry as a component in the afforestation programmes. The sector of Agro-forestry or Farm Forestry has a good potential as most of the agriculture lands are devoid of any trees, in the district. The trees if planted on the bunds and on the boundary of the lands, protect the crops from the desiccating high winds and also provide additional income from the trees to the farmer apart from providing him fodder and fuel as well.

Table 16. Green belt development Plan

Area proposed for Green belt	No. of saplings (250/km on either side of the canal)	Source for saplings	Time frame	Responsible agency for implementation
Chitradurga branch canal (116.80 Km)	29,200	Chitradurga division & KFD	After completion of site works	KNNL and KFD
Tumkur branch canal (146.84 Km)	36,700	Tumkur division & KFD		
Jagalur branch canal (26.17 Km)	6,543	Chitradurga & division KFD		
Tarikere lift and flow canal (120 Km)	30,000	Chikkamagaluru & division KFD		

Table 17. Species recommended for green belt development

Sl.No	Local Name	Botanical Name	Sl.No	Local Name	Botanical Name
1	Ala	<i>Ficus bengalensis</i>	17	Kaduggeru	<i>Semecarpus anacardium</i>
2	Basari	<i>Ficus infectoria</i>	18	Kadivala	<i>Stephegyne parviflora</i>
3	Beete	<i>Dalbergia latifolia</i>	19	Kadnugge	<i>Moringa pterygosperma</i>
4	Buruga	<i>Bombax ceiba</i>	20	Kakke	<i>Cassia fistula</i>
5	Dindiga	<i>Anogeissus latifolia</i>	21	Kanagalu	<i>Dillenia pentagyna</i>
6	Godda	<i>Lannea coromandlica</i>	22	Kaval	<i>Careya arborea</i>
7	Goni	<i>Ficus mysorensis</i>	23	Mathi	<i>Terminalia tomentsa</i>
8	Halasu	<i>Artocarpus heterophyllus</i>	24	Muthuga	<i>Butea monosperma</i>
9	Honne	<i>Pterocarpus marsupium</i>	25	Nandi	<i>Lagerstroemea lanceolata</i>
10	Hunlu	<i>Terminalia paniculata</i>	26	Nelli	<i>Embllica officinalis</i>
11	Ippe	<i>Madhuca indica</i>	27	Nerale	<i>Syzygium cumini</i>
12	Jagalaganti	<i>Diospyros montana</i>	28	Shivani	<i>Gmelina arborea</i>
13	Jambe	<i>Xylia xylocarpa</i>	29	Tadasalu	<i>Grewia tilaefolia</i>
14	Saguvani	<i>Tectona grandis</i>	30	Tare	<i>Terminalia bellerica</i>
15	Yethiga	<i>Adina cordifolia</i>	31	Hunase	<i>Tamarindus indica</i>
16	Mavu	<i>Mangifera indica</i>	32	Honge	<i>Pongamia pinnata</i>

### 9.3 Fisheries Development Plan

The occurrence of immigrant African catfish, *Clarias gariepinus* and river Nile (Egypt) Tilapia – *Oreochromis nilotica* and the related Brazilian (South America) species *Oreochromis mossambica* in Vanivilas sagar reservoir and most other biotopes in the districts, as observed and obtained reports also, does not auger well for the development and proliferation of fish species indigenous as also the Gangetic carp – Catla, Rohu and Mrigal suggested stocking in good many tanks, canals, rivers and reservoirs. Serious steps need to be taken to completely eliminate the exotic fish species from the water bodies present in the taluks mentioned and from elsewhere too. Fish seed stocking strategies in the tanks, canals and reservoirs have been detailed to make use of the facility and opportunity being advanced by this beneficial project to record considerable fish production in order to help scores of fishermen engaged in the profession to eke-out their livelihood.

## 9.4 Muck Disposal plan

Table 18. Muck disposal plan

Particulars	Qty of Excavation in Cum	Utilization (Cum)						Total Utilization Cum
		Service road & Inspection paths	Embankments	Land Leveling	Filling trenches	Construction material for CD works, Roads Etc	Restoration works for canal banks. Cum	
Chitradurga Branch Canal	1,37,38,884	38,60,631	20,60,832	54,95,553	1,30,519	15,04,405	6,86,944	1,37,38,884
Tumkur Branch Canal	9,47,060	84,118	3,13,059	2,36,824	1,71,000	94,706	47,353	9,47,060
Filling of MI tanks	1,22,78,620	26,83,586	8,41,792	9,11,448	60,00,001	12,27,862	6,13,931	1,22,78,620
Drinking water supply to Pavagada	18,97,409	69,222	2,84,611	5,56,428	8,02,538	89,740	94,870	18,97,409

## 9.4 Cost for implementing EMP

Table 19. Cost for implementing EMP

Item	Particulars	Estimated Cost in Rs.
<b>I. Construction Phase</b>		
<b>A. Air Pollution Control</b>		
Water sprinkling	400/- x 6 tractors x 3 trips per day x 60 months x 25 (excluding rainy season and holidays)	1,08,00,000.00
Personnel protective equipments	Lumpsum	2,50,000.00
Chimney to DG sets	Lumpsum	3,50,000.00
LPG as cooking fuel	4 cylinders per unit/month x 50 units (5 labor camps) x 550 x 60 months	66,00,000.00
<b>Sub-total A</b>		<b>1,80,00,000.00</b>
<b>B. Noise Pollution Control</b>		
Personnel protective equipments	Lumpsum	2,50,000.00
<b>Sub-total B</b>		<b>2,50,000.00</b>
<b>C. Water Pollution Control</b>		
Septic and soak pit	Lumpsum	15,00,000.00
Sand bags	Lumpsum	1,50,000.00
<b>Sub-total C</b>		<b>16,50,000.00</b>
<b>D. Solid &amp; Hazardous Waste Management</b>		
Solid waste collection bins with shed	Lumpsum	7,50,000.00
Hazardous waste collection area with shed	Lumpsum	7,50,000.00
<b>Sub-total D</b>		<b>15,00,000.00</b>
<b>E. Biological Environment</b>		
Plantation works	27400 saplings x 500 rs	1,37,00,000.00
Agro forestry development	1,02,443 saplings x 10 rs	10,24,430.00
Fisheries development	Lumpsum	10,00,000.00
Cost for rising CA and NPV for 33.36 ha of forest land	As per KFD	3,02,50,500.00
<b>Sub-total E</b>		<b>4,59,74,930.00</b>
<b>F. Socio-economic Environment</b>		
Land acquired cost	--	371,60,00,000.00
Awareness and Training	15 lakhs per year x 5 years	75,00,000.00
<b>Sub-total F</b>		<b>371,75,00,000.00</b>
<b>G. Environmental Monitoring during construction period</b>		
<b>Sub-total G</b>		<b>1,69,00,000.00</b>
<b>Total (A-G)</b>		<b>380,77,74,930.00</b>
<b>II. Operation Phase</b>		
Environmental Monitoring for 3 years		18,18,000.00
Green Belt maintainence for 3 years		25,00,000.00
Awareness and Training for 3 years		10,00,000.00
Soil conservation measures and implementation of CAT plan for 5 years		29,36,00,000.00
<b>Total</b>		<b>29,89,18,000.00</b>