EXECUTIVE SUMMARY OF

FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT

FOR

SINGATALUR LIFT IRRIGATION SCHEME

AT

NEAR HAMMIGE VILLAGE, MUNDARAGI TQ, GADAG DISTRICT, KARNATAKA.

BY

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1. Introduction

Singtalur Lift Irrigation Scheme is proposed by KNNL to irrigate77,198 ha dry lands in 146 villages of Mundaragi and Gadag Taluks of Gadag District, Koppal Taluk in Koppal District (Left side of Tungabhadra river) and Hoovina Hadagali Taluk in Bellary District (Right side of Tungabhadra River). MoEF issued the TORs for the project vide its Letter dated 21-04-2014 based on which FINAL Environmental Impact Assessment (EIA) Report was prepared along with in line as per generic structure in the EIA Notification, 2006 by MoEF, Govt.of India. The said FINAL EIA report includes the data on various field studies undertaken by the accredited experts including baseline environmental data collection from the study area during the study period August 2014 to April 2015, in line with the TORs, anticipated impacts (identified, predicted & evaluated) on different components of the environment, delineating specific Environmental Management Plan (EMP) including Environmental Monitoring Programme along with the budgetary provisions to be undertaken by KNNL stating responsibilities of various parallel departments for effective implementation of the same.

2. Project Description

The villages coming under this scheme are poverty offended drought area. Agriculture is the economic activity of the Gadag, Koppal & Bellary districts. Low annual rainfall of the order of 650 mm coupled with large variance in annual rainfall and uncertainty in various years caused the agriculture a risky venture. Hence, to uplift the socio-economic conditions of the farmers of the region with assured water, the proposed scheme has been envisaged with diversion of 18.55 TMC of water by constructing a Barrage across Tungabhadra near Hammige village of Mundaragi Taluk, Gadag District, lifting of water to higher lands and providing irrigation facility (canal & micro irrigation based). Thus providing irrigation and stabilizing the agricultural production and improving per capita income and standard of living of the people in the region.

The project envisages displacement of the 4 villages due to construction of barrage and submergence of 1620 ha, for which requisite R&R issues has been considered. The total land requirement for the project is 4304.5 ha, spread across Gadag, Bellary and Koppal districts of Karnataka which includes 4.9 ha of forest land.

The common crops that are grown in the region are Sugarcane, Sunflower, Jowar, Pulses, Groundnut, Thil, etc. The irrigation intensity of the project is kept at 100% for Kharif and 17% for Rabi season. The command area map of the project and the salient features of the project are given below:

Table-1 Salient Features of the project

a)	Name of the Scheme	Singatalur Lift Irrigation Scheme (SLIS)
b)	Name of the river	Tungabhadra
c)	Geographical Location of the barrage	Latitude – 15° 2'19.41"N, Longitude – 75°50'11.08"E Elevation – 512.5 m AMSL (Top of the Barrage)
d)	Location of the barrage	Hammige Village, Mundargi Taluk, Gadag District, Karnataka
e)	Type of the project	Irrigation
f)	Estimated cost of the project	Rs. 1894.50 Crores (2010-11 Prices) Rs. 5768.03 Crores (2012-13 prices)
g)	Culturable Command Area	77,198 Ha
h)	Cropping pattern	Kharif (100%) – 68922 Ha Rabi (17%) – 8276 Ha
i)	Submergence area	1620 Ha (1249 ha of agricultural land, 276 ha river portion and 95 ha -Waste Land). No forest land.

j)	Number of affected villages	04 Villages Completely Submerged- Gumgola, Mundaragi Taluk, Gadag Dist
		Partially Submerged- Bidarahalli, Vittalapura, Mundaragi Taluk, and Gadag Dist. Allipura, Huvinahadagali Taluk, Ballari Dist
k)	Total forest land required for the scheme	4.9 Ha of Reserve Forest for construction of rising main for first lift on left side of the barrage and canal works.
l)	Power Requirement	7.07 MW for Right Bank from Gulbarga Electricity Supply Company Limited (GESCOM) and 59 MW for Left Bank from Hubli Electricity Supply Company Limited (HESCOM).

2.1 Need for the project

Gadag, Koppal and Bellary districts falls under semi arid tract and categorized as drought prone and the normal annual rainfall ranges between 570 mm to 650 mm (CGWB, 2009). The average rainfall days in these districts are ranging between 40-50 days per years and hence agriculture is becoming risky venture to farmers. This district is severely prone to erratic droughts due to lack of south-west monsoons. Drought can have serious health, social, economic and political impacts with far-reaching consequences and sequential droughts not only affects the farmers but also lower production and lesser GDP. Hence, Singatalur Lift Irrigation Scheme is utmost important to the region.

Due to exploitation of ground water for irrigation, the water quality is deteriorated to the greater extent in Gadag, Koppal and Bellary districts. As per the ground water studies conducted by CGWB, the nitrate content in command area taluks is varied between 106 to 450 mg/l (desirable 45 mg/l). Similarly, fluoride is ranging between 0.2 - 3.2 mg/l which is very high and as per Indian standards it should be in the range between 1.0-1.5 mg/l. Therefore, exploitation of ground water should be avoided by providing irrigation to the region and thereby augment the underground aquifers to dissolve the salts.

2.2 Water availability

The catchment area of Tungabhadra River at Hammige site is 19,850 Sq. km. The river is not being gauged at the proposed Singatalur site. But the river Tungabhadra and the river Varada are being gauged by the CWC authorities independently near upstream of confluence point at Haralahalli site and Marol gauging site respectively. The catchment area of Tungabhadra River at Haralahalli site is 14582 Sq.Km and that of Varada River at Marol site 4901 Sq.Kms.

The gauged flow details for 32 years for the period from 1969 – 70 to 2010 – 11 are collected and analyzed duly considering upstream utilization and based on the water requirement under this scheme. Considering these details, 75% dependable yield at Tungabhadra dam site is 357.506 TMC. From the regime tables it is evident that the water requirement for this project @ 75% dependability can be fairly met with during all the months of the water year for the utilization of 18.55 TMC. 75 % dependable flow is considered for the project, which is feasible environmental flow for all aquatic animals. Further, report on simulation study on utilization of 18.55 TMC at SLIS barrage conducted by Prof. Rama Prasad, Former Professor, Dept., of Civil Engineering, IISc also confirmed the availability of 18.55 TMC of water at SLIS barrage.

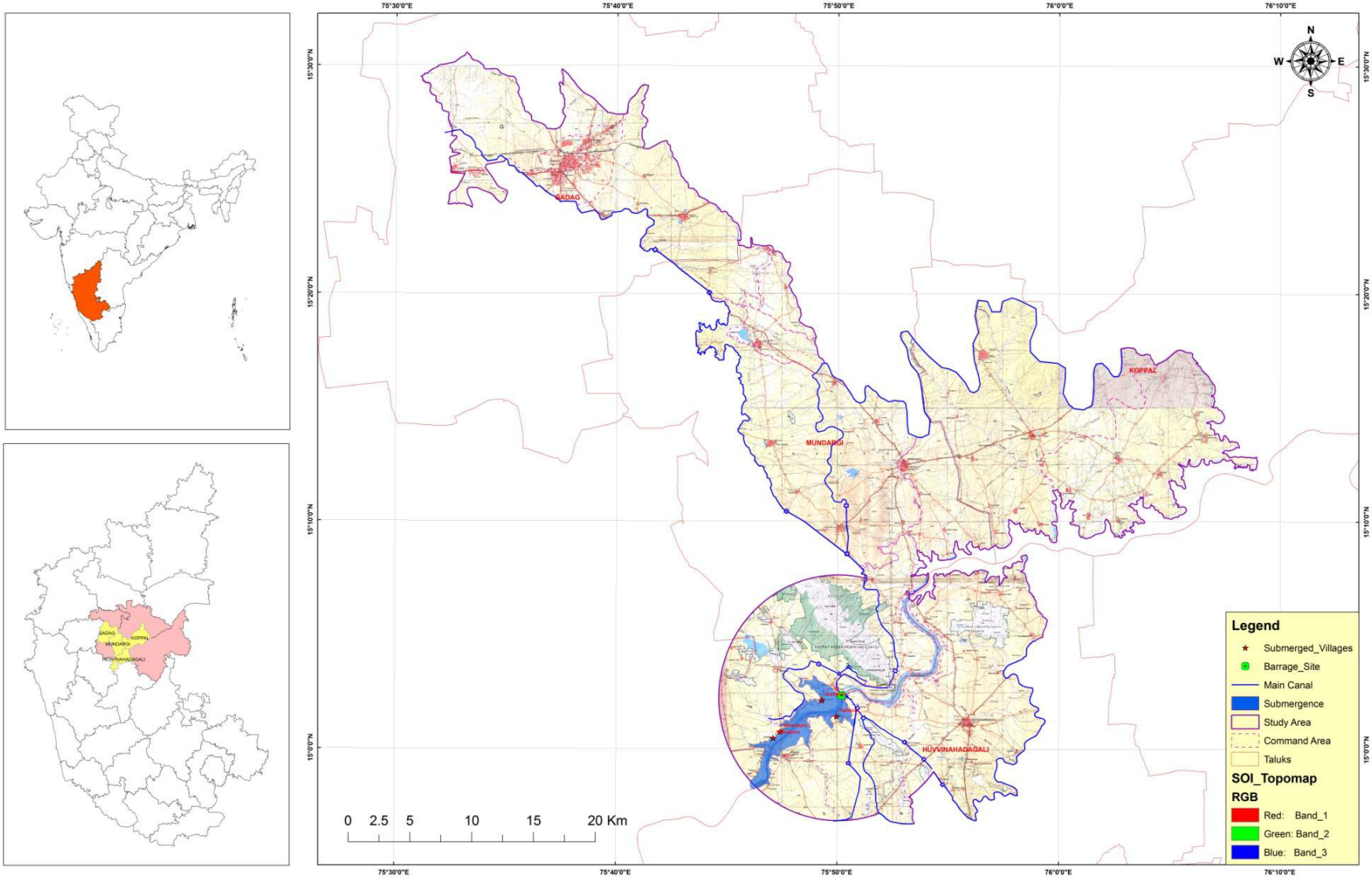

Fig - 1 Location map of the project

2.3 Command area of the project

The command area covering the districts of Gadag, Koppal and Bellary receives very low rainfall and even this is ill distributed. The region is subjected to frequent drought and famine, affecting the life and economic status of the population, which subsist mainly on agriculture. List of benefitting villages, command area of the project on toposheet and schematic diagram of the project is given below;

Table -2 Command area details

Sl.No	District	Taluk	Command Area in Ha	Villages Benefited
1	Gadag	Mundargi and Gadag	43121	71
2	Koppal	Koppal	17122	30
3	Bellary	Huvinahadagalli	16955	45
Total			**77198**	**146**

2.4 Irrigation Planning and structural components of the project

An intake canal on right and left side of the barrage is constructed across the Tungabhadra river. With the help of Jack-well cum pump house, the water is lifted and distributed to main canals and further by constructing distributory network, the water will be flow to the agricultural fields of the farmers. The structural components of the project is given below;

2.5 Provision for micro-irrigation

It was proposed to provide Micro Irrigation (Low pressure Drip system) under the left out areas. This type of Micro irrigation system is being implemented in Shiggaon LIS under KNNL and the first stage is already commissioned. The scheme is running successfully and farmers are pleased with the implementation of the scheme.

Table - 3 Command area and crop proposed for micro irrigation

Season	Crop	Percentage	Area (Ha)	Utilization (M.Cum)
Kharif	Vegetable	40	6328	27.482
	Floriculture	30	4746	20.611
	Soya bean	30	4745	17.687
	Total	**100**	**15819**	**65.780**

2.6 Land Requirement

Altogether, 4304.5 Ha of land is required for the project. Out of which 1620 Ha is under submergence which also included 4 villages. The details of submergence is given under SIA. Further, 4.9 Ha of forest land is required for the rising main of first lift on left side and for canal works. The proposal for diversion of forest land was submitted to Karnataka Forest Dept., which is under progress. The details of land required for various activities is given below;

Table -4 Land requirement for SLIS

Sl.No	Description	Quantity (Ha)
1	**Barrage and Allied Works**	
A	For Seating of Barrage	15
B	For Colony	76
C	For intake canal on both side	60
D	Submergence	1620
2	**Canal**	
A	Right Bank canal including distributory network	403.5
B	Left Bank canal including distributory network	2060
3	Resettlement and Rehabilitation	70
Total Land Required		**4304.5**

Table -5 Structural Components of the project

Structural Components of the project		
A)	**Barrage Details**	
a)	Length of the spill way	387.5 m
b)	Maximum height of the spill way above deepest foundation	10 m
c)	Gross storage capacity	88.34 M.Cum (3.12 TMC)
d)	Crest level	501.0 m
e)	Full reservoir level	RL 509 m
f)	Maximum water level	RL 509.50 m
g)	Top of bund level	RL512.50 m
h)	Dead storage level	RL 502.420 m
i)	Dead storage capacity	14.70 M.cum (0.52 TMC)
j)	Area under submergence	1620 ha
k)	No. of villages affected / submerged	04 (Bidarahalli, Gumgola, Vittalapura in Mundaragi Taluk, Gadag Dist and Allipura in Huvinahadagali Taluk, Bellary Dist)
l)	Construction work started in	August, 1998
m)	Current stage of construction of barrage & right bank works	Completed
n)	No. of gates installed	26 (12.5 m x 8.00 m size)
B	**Right Side canal Details**	
a	**Intake Canal**	
a)	Length of the intake canal	1.05 km
b)	Construction work started	August, 1998
c)	Current stage of construction	Completed
d)	No. of Cross Drainage works	01
b	**Canal System**	
a)	Ayyanahalli Branch Canal	Length – 5.7 km, Irrigating area – 2024 ha, Construction work started in April, 2006 and completed in 2012.
b)	Rajawala Branch Canal	Length – 4 km, Irrigating area – 1215 ha, Construction work started in April, 2006 and completed in 2012.
c)	Magala Branch Canal	Length – 5 km, Irrigating area – 1619 ha, Construction work started in April, 2010 and completed in 2012.

d)	Hadagali Branch Canal	Length – 25.43 km, Irrigating area – 9632 ha, Construction work started in May, 2010 and currently 67% completed (20 km).
	Lift Works	
a)	Right side first lift including electromechanical works	Construction work started in September, 2005 and completed in 2012.
b)	Right side second lift including electromechanical works	Construction work started in May, 2010 and completed in 2012.
C	**Left Side canal Details**	
a	**Intake Canal**	
a)	Length of the intake canal	6.71km
b)	Construction work started	August, 1998
c)	Current stage of construction	80%
d)	No. of Cross Drainage works	13 Nos. Out of which 5 Nos. completed and 6 nos. (70 % completed)
b	**Canal System**	
a)	Mundawada Branch Canal	Length – 19.28 km, Irrigating area – 1911 ha, Construction work started in October 2011 and currently 20% woks completed (4 km).
b)	Hammige Branch Canal	Length – 2.72 km and 2.66 km, Irrigating area – 373 ha, Construction work started in October 2011 & currently 80% woks completed (4 km).
c)	Mundaragi Branch Canal	Length – 72.16 km, Irrigating area – 26515 ha, Construction work started in October 2011 & currently 20% woks completed (15 km).
d)	Left Bank main canal first reach	Length – 14.5 km, Irrigating area – 1699 ha, Construction work started in October 2012 & currently 15% woks completed (2 km).
e)	Left Bank main canal second reach	Length – 28.94 km, Irrigating area – 8115 ha, Construction work started in June, 2011 & currently 60% woks completed (17 km).
f)	Left Bank main canal third reach	Length – 26.18 km, Irrigating area – 15819 ha, Construction work started in February, 2012 & currently the woks are ongoing.
c	**Lift Works**	
a)	Left side first lift including electromechanical works	Construction work started in April, 2010 and 80% works are completed.
b)	Left side second lift including electromechanical works	Construction work started in April, 2010 and 40% works are completed.
c)	Left side third lift including electromechanical works	Construction work started in April, 2010 and 40% works are completed.

2.7 Existing cropping pattern details

Sl.No	Name of Crop	Area in Acres	Yield/ Acre in Qtls	Total yield	Rate in Rs/Qtl	Amount in Lakhs	Material Expenses seeds & manure & others				Hire charges for labour& bullocks and others	Amount Rs. in Lakhs
							Seeds		Manure			
							Rate/ acre	Amount in lakh	Rate/ acre	Amount in lakh		
A	**KHARIFF**											
1	Jawar	24956	6.00	149736	1000	1497.36	200	49.912	1200	299.47	1000	249.56
2	Maize	20800	8.00	166400	800	1331.20	250	52.000	1000	208.00	1000	208.00
3	Pulses(G.Gram)	8400	2.00	16800	6200	1041.60	125	10.500	1000	84.00	1000	84.00
4	Ground nut	16600	2.50	41500	2900	1203.50	1000	166.000	1100	182.60	1000	166.00
5	Sunflower	6000	3.50	21000	2200	462.00	400	24.000	750	45.00	1000	60.00
6	Bengalgram	3500	2.50	8750	2058	180.08	350	12.250	500	17.50	1000	35.00
		70756				**5535.66**		**314.662**		**836.57**		**802.56**
B	**RABI**											
1	Jawar	4200	3.00	12600	1000	126.00	200	8.400	1300	54.60	1000	42.00
2	Maize	3000	5.00	15000	800	120.00	250	7.500	1000	30.00	1000	30.00
		7200				**246**		**15.9**		**84.6**		**72.00**
TOTAL FOR SLIS		**77956**				**5781.66**		**330.562**		**921.172**		**874.56**

It is seen that pulses and oilseeds dominate in the command area and cropped area and crops are mostly in Khariff. The Rabi crops are meager and is dependent on soil moisture remained.

Under rainfed conditions crop yields are small and varying from year to year. The crop yields are poor, in the light of recent trends in agricultural production can be increased in the area which is having an assured supply of water for agriculture and having used the new high yielding varieties of seeds and corresponding other inputs.

2.8 Proposed cropping pattern details

The proposed crops for irrigated agriculture in the area are taken from the recommendations of the State Agricultural Department. The recommended crops are Hy. Jowar, Maize, Pulses and Ground Nut for Khariff season and Hy.Jowar, Maize and Pulses for Rabi season.

Sl.No	Name of Crop	Area in Acres	Yield/ Acre in Qtls	Total yield	Rate in Rs/Qtl	Amount in Lakhs	Material Expenses seeds & manure & others				Hire charges for labour& bullocks and others	Amount Rs. in Lakhs
							Seeds		Manure			
							Rate/ acre	Amt in lakh	Rate/ acre	Amount in lakh		
A	**KHARIFF**											
1	Hy, Jawar	51071	22.00	1123562	1000	11235.62	200	102.142	1800	919.28	1000	510.71
2	Maize	42560	25.00	1064000	800	8512.00	250	106.400	1200	510.72	1000	425.60
3	Pulses(G.Gram)	42560	8.00	340480	6200	21109.76	125	53.200	1200	510.72	1000	425.60
6	Ground nut	34047	15.00	510705	2800	14299.74	1000	340.470	1400	476.66	1000	340.47
		170238				**55157.12**		**602.212**		**2417.38**		**1702.38**
B	**RABI**											
1	Hy, Jawar	6013	22.00	132286	1000	1322.86	200	12.026	1800	108.23	1000	60.13
2	Maize	8416	25.00	210400	800	1683.20	250	21.040	1200	100.99	1000	84.16
3	Pulses(G.Gram)	6013	8.00	48104	6200	2982.45	125	7.516	1000	60.13	1000	60.13
		20442				**5988.508**		**40.5823**		**269.356**		**204.42**
Total for SLIS		**190680**				**61145.628**		**642.794**		**2686.732**		**1906.80**

3. Description of baseline environment

Collecting the baseline environmental status of the project area helps to ascertain the magnitude of impacts that are likely to be caused due to the proposed project on different environmental components. It also helps to identify critical environmental attributes required to be monitored during and after the proposed development. To assess the baseline environmental status, submergence area, command area, 10 Km radius from the main project components and downstream up to 10 Km from the tip of the barrage were considered and the data was collected for during the period Monsoon Season (August 2014 to October 2014), Winter season (November 2014 to Jan 2015) and Summer Season (February 2015 to April 2015). In addition to the baseline environmental monitoring, field inspection in the study area, collection of secondary information for all the environmental components and discussions with the officials and local public were conducted by the experts to establish realistic information on the area w.r.t the project.

3.1 Physical Environment

3.1.1 Geography and Topography

The command area of the project covers in three district viz., Gadag, Bellary & Koppal. The terrain is almost flat and ranging from 402 - 714 m. It is evident from the below figure that the slope towards and on either side of the Tungabhadra river is low compared to Gadag and Mundaragi portions of the command area.

3.1.2 Climate & Meteorology

The climate of the study area can be described as semi arid subtropical. The rainfall is mostly confined to the period from April to November. The command area receives rainfall both from South –West Monsoon as well as retreating monsoons. The heavy rainfall is received during the months of May to October. The winter season is from November to January which is cold and dry. The summer is hot and dry from February to April.

The Project area experiences the Highest mean temperature in the month, recorded in April, was 37.7°C.and then December is generally the coldest month, with mean temperature of 14.7 °C.

The Relative humidity ranges from high of 87 to 90% in monsoon to low of 18 to 33% in summer. During post-monsoon season, morning humidity remains between 79-88% and during the evening it remains between 39 to 67%.

The climate of the district is hot and dry. Post monsoon is during October and November. The normal average rainfall is 650 mm and number of rainy days are 35.

Wind rose shows that the prevailing wind direction during the study period is North East. Stable condition is seen in most of the study period, which indicates that less turbulence in the air, hence less mixing of air pollutants anticipated. During the study period, most of the time 0.5 m/s to 2.1 m/s wind speed is observed with Stability class of "F".

3.1.3 Ambient air quality

Ambient air quality was monitored at 06 stations for PM_{10}, $PM_{2.5}$, SO_2 and NO_2 parameters in the study area viz., during the Monsoon Season (August 2014 to October 2014), Winter Season (November 2014 to January 2015) & Summer Season (February 2015 to April 2015) AAQM was carried out on 24hrly basis on weekly twice mode continuously for one single month in each season viz., August, 2014, December 2014 & March 2015. The Results reveal that, ambient air quality in the study area in well within the NAAQ standards and found to be good and satisfactory.

3.1.4 Ambient Noise levels

Ambient Noise Level Monitoring was conducted at 06 locations in the study area for Leq day dB(A) & Leq night dB(A) parameters. Leq Day dB (A) were in the range between 40.1 dB (A)

and 45.7 dB (A) and Leq Night dB (A) were in the range between 30.79 dB (A) and 35.66 dB (A) and to conclude, levels were observed to be well within the CPCB standards.

3.1.5 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.

3.1.6 Geology and Minerals

All the three district of the Study area is endowed with Dolerite dykes, Pegmatite, Quartz, granite, Limestone, Mica, gneiss amphibolites and phyllites. The Mineral deposits such as Granite Blocks quartz, iron ore, Redoxides, sand and Clay particles mineral ores were also found.

3.1.7 Soil characteristics

The major part of all three district has red sandy soil followed by the medium black soil and deep black soil. All these soils are generally suitable for irrigation.

From the overall results of the physico-chemical analysis of the soil samples, it was observed that, the soil pH values range between 6.5 to 10.11 in the October 2014 and pH Values ranges from 6.6 to 9.1 in December 2014 and in March 2015, the pH value varied from 9.5 to 7.7. The most of the values belong to soil reaction index II, which shows that the soils of the study area are under the neutral range.

The electrical conductivity of the soil samples were observed in the range between 91-1257 µmhos/cm in October 2014, 100.1- 2301 µmhos/cm in December 2014 and 21-1040 µmhos/cm during March, 2015 indicating Salinity of the soils are in Low to medium and high range. Based on the rating chart of soil tests, all the soil samples belong to Normal i.e., Salt Index I, where-as Organic Carbon content of soil samples were observed to range from 0.06 to 1.02 percent in October, 2014, in December 2014, the Organic carbon ranges from 0.12 to 0.9 percent and in March, 2015, the organic carbon ranges from 1.08 to 0.12 percent .As per the nutrient index, the Organic Carbon, Available Nitrogen (N) is at low level and Available Potassium(K) is at Low level and Available phosphorous (P) is at High level in soil samples for all the seasons. Overall, results of the soil quality analysis revealed that, it holds good for cultivation. The nutrient index values for soil samples collected in different seasons are given below; -

Table-6 Characteristics of Nutrient Index for all the three Season

Sl No	Parameter	Nutrient index	Remarks
October - 2014			
1	pH	2.37	High
2	EC	1.31	Low
3	Organic carbon	1.37	Low
4	Available Nitrogen	1.37	Low
5	Available phosphorus	3.00	High
6	Available potassium	2.38	Medium
December - 2014			
1	pH	2.31	Medium
2	EC	1.29	Low
3	Organic carbon	1.23	Low
4	Available Nitrogen	1.46	Low
5	Available phosphorus	3.00	High
6	Available potassium	2.38	Medium
March - 2015			
1	pH	2.60	High
2	EC	1.03	Low
3	Organic carbon	1.43	Low
4	Available Nitrogen	1.23	Low

Sl No	Parameter	Nutrient index	Remarks
5	Available phosphorus	2.00	Medium
6	Available potassium	2.45	Medium

3.1.8 Hydrology

The study area forms part of Krishna Basin and Tungabhadra Sub Basin. Tungabhadra enters the Bellary district at Kuruvatti village in Hadagalli taluk and forms the boundary for nearly 300 km and drains from south western part, then flows north east to east west and drains out of the district. Chikka Hagari and Hagari / Vedavathi are the tributaries of Tungabhadra runs south to north from the southern tip of the district. These are seasonal rivers flows during monsoon season. Dense drainage is noticed in the eastern and western part and sparse drainage is noted in the central part of Bellary district. The main river draining part of the catchment is Tungabhadra River and Tungabhadra Reservoir in the south eastern and eastern part. The area is drained with numerous medium and small streamlets. Prominent among them are Javali Halla, Saralahalla, Ichahalla, Karodihalla, Kesarahalla, Turahalla, Hirehalla, Hunisehalla, Hasarugonnehalla, Kumbarahall, Urumundinahalla, Hirehalla, Kappatahalla.

3.1.9 Surface Water

The baseline status of water quality in the study area of all the three districts was established. Water samples were collected from 15 locations (5 No. of surface water & 10 No. of ground water) in the study area during Monsoon Season (August 2014 to October 2014), Winter Season (November 2014 to January 2015) & Summer Season (February 2015 to April 2015).

The results were compared to IS 10500:2012 standards. In Monsoon season all the parameters were well within the standards except pH and Iron ranges from 0.7 to 1.69mg/l and also presence of Fecal coli observed, due to improper sanitation. In Winter Season, all parameters were within the standards except TDS exceeding 360 mg/l & Total Hardness exceeding 340 mg/l. In Summer Season, all the parameters were within the standards except Total Hardness of 800 mg/l observed at Basapura station and also presence of oil & grease

3.1.10 Ground Water

In Monsoon season, the physico-chemical parameters at all the locations were observed well within the standards except Total Hardness (840 mg/l at Ragunathahalli station), Calcium (220 mg/l at Ragunathahalli and Lakkundi station) & Magnesium (194 mg/l at Ragunathahalli station), Alkalinity (620 mg/l at Thipapura station). Total Coliform and Fecal Coliform were absent at all the location.

In Winter Season, the physical parameters for Tungabhadra river were well within the standards except TDS is (2170 mg/l),Total Hardness ((860-948mg/l) and Calcium (209.6-217 mg/l) is exceeding the standards. Fecal Coli form was absent at all the locations.

In Summer Season, the physico-Chemical parameters at all the locations were well within the standards except Total Hardness ranges (860-1100 mg/l) and Calcium (310-310.4 mg/l), Alkalinity of (640 mg/l) & TDS of (2066 mg/l) . Total Coliform and Fecal Coliform were absent at all the locations.

3.2 Biological Environment

3.2.1 Flora

The Command area of all the three Districts consist of Dry land Agriculture plots and with the Kappat Reserve forest range of hills which run in the North-South direction for a length of nearly 60 km starting from Gadag' and ending at Singatalur. From the studies it is evident that most common useful trees are found such as *Anogeissus latifolia, Tamarindus indica, Phoenix sylvestris, Cassia fistula, Randia dumetorum ,Albizzia lebbek, Pterocarpus marsupium. The Major Trees found in Agricultural and Horticultral garden are Musa sapientum; Citrus indica; Anacardium occidentale; Artocarpus integrifolia; Tamarindus indica; Eugenia jamboolina; Mangifera indica; Citrus bergamia; Psidium pomiferum; Anona reticulate; Anona squmosa; Coccus nucifera and Areca catechu, Bambusa arundinacea, Saccharam officinarium, Alove*

vulgaris, Caryota urens, and Helicicteres isora. The common hedge plants are Adhatoda vasica, Opuntia dillenia, Jatropa curcas, Moringa pterygosperma, Erythrina indica, Acacia concinna and Pithecolobium dulce

The chief exotic trees and plants which have been introduced into the area are the rain tree (*Pithecolobium saman*), dividivi tree *(Caesalpinia coriaria),* Mahogany *(Swietenia mahogany)* suru *(Casuarina equisetifolia),* American bustard cedar *(Guazuma tomentosa),* akas-mallige *(Millingtonia hortensis),* nilgiri *(Eucalyptus oblique)*, silver oak (*Grewilia robasta*) and chikku (*Achorus sapota*).

The ornamental shrubs and plants which thrive well are *Acalyphas, Achemenes, Aralias arums, bignonias, caladiums, coleus, crotons, dahlias, dracaenas, gardenias, gladiolus, hoyas, irish, ivy, Jasminum and Plumbago.* The chief varieties of flowers are the *Amaranthus antirrhinum, aster, balsam, calliopsis, candy tuft, cockscomb, convolvulus, dianthus or pink geranium, mignonette, portulaca, rose sweet pea, sunflower, and verbena etc.,* The chief vegetables are beet root, cabbage, capsicum *(menasinakayi*), carrots *(gajjari),* cauliflower, celery, cucumber *(savtekayi),* French Beans *(tingalvari),* knolkhol, lettuce, mustard *(sasavi),* onion *(ullagadde),* peas, radish *(mulangi),* spinach, tomato, turnip, fenugreek *(mente)* and potato.

A total of 286 plant species were recorded in both core and buffer area of the proposed project site. Of which 127 belong to tree species, 34 belongs to shrub species and 125 species belongs to herbs respectively. A total of 10961 trees area coming within the project submergence area comprising of 61 species. The dominant tree species recorded in the project submergence area are *Cocus nucifera*, *Eucalyptus torticornis*, *Acacia auriculiformis*, *Tectona grandis*, *Areca catechu* followed by *Azhadirictha indica*.

Out of the 286 plant species recorded in quantitative study, 8 species belong to rare, endangered and threatened species (RET) category. Among these were two climbers, one herb and remaining species belong to trees.

Table- 7 List of plant species as under IUCN/Red Data Book category

Sl. no	Species	Family	Category	Conservation Status
1	*Gloriosa superba*	Liliaceae	Climber	Endangered
2	*Aegle marmelos*	Rutaceae	Tree	Rare
3	*Celastrus paniculata*	Celastraceae	Climber	Threatened
4	*Chloroxylong swietenia*	Rutaceae	Tree	Vulnerable
5	***Santalum album***	Santalaceae	Tree	Endangered
6	*Ficus religiosa*	Moraceae	Tree	Keystone species
7	*Pterocaprus indicus*	Fabaceae	Tree	Vulnerable
8	*Dolichondron crispae*	Bignoniaceae	Herb	Vulnerable

Source: IUCN/Red data books: Karnataka Forest Department and Botanical Survey of India.

3.2.2 Fauna

Wild Dog, Sambar, Deer, Muntjac *(Munticus muntjak)* and the Mouse Deer *(Moschiola memina)* are found in forest areas. Blackbuck and Indian Antelope *(Antilope cervicapra)* are found in Cultivated Plains and also Monkeys Such as Langur and Bonnet Monkey are seen. The Most Common mammals Such as bats, Fox *(Pteropus gigantus)* Rats, Mice and Bandicoots as well as the Indian Porcupine and Giant Malabar Squirrel, Small Indian Civet Cat *(Viverricula malaccensis),* and the Mongoose *(Herpestes adwardsii)* are commonly occur in these Forest area.

3.2.3 Avi Fauna

The Kappat reserve forests contain many bird species of remarkably brilliant plumage, such as Malabar Trogon (*Harpactes fasciatus malabaricus*) and the Fairy Bluebird (*Irena puella puella*),Great Indian Hornbill (*Dichoceros bicornis*) and also the different families of Pigeons are found.

3.2.4 Amphibians

The snakes such as Cobra, Krait and viper are the poisonous snakes reported from the Kappat Reserve forests. The non-poisonous snakes are *Typhlops beddomei* and T. porrectus are found in decaying earth, feeding on soft insects and worms. There are about nine species, belonging to family Colubride, which were also recorded in the region. *Ptyas mucosus* (rat snake) is quite common. *Natrix stolata* and *Natric beddomei* are found near moist places and ponds. Both *binocellate* and *accellate* varieties of cobra are found here. The common krait, black with narrow white double cross-bars and complete *caudals*, is found in the Kappat Hills.

3.4.5 Forest land required for the project

The alignment rising main of first lift on left side of Singatalur LIS passes through the Kappatgudda RF through Survey No 161 of Hammige village and Survey No 134 of Singatalur Village to an extent of 1.42 ha and the Mundawad and Hammige branch canal alignment passes through the forest land through Survey No 331, 6, 9, 157, 104, 105, 106, 107 of Hammige and Jalwadagi village to an extent of 3.48 Ha.

The PCCF, Head of Forest Force, Karnataka Forests Dept., recommended the 1.42 proposal for issue of forest clearance in view of public interest. Required amount paid to KFD for raising compensatory afforestation and mutations were also transferred in the name of KFD for CA land. Whereas, the other proposal is under progress for issue of forest clearance and the KFD informed to identify suitable land for compensatory afforestation.

The vegetation in the forest land to be diverted consists of shrub forest and there is no tree growth. The density of vegetation is less than 0.1 and belongs to eco-class IV, open forest. No rare / endangered / unique species of flora and fauna found in the proposed area. It does not form any part of national park / wildlife sanctuary / tiger reserve or elephant corridor.

3.3 Aquatic Ecology

The plankton of the water body studied, inherently, is poor and is subjected to constant changes (poor - rich - poor). As values indicate, zooplankton dominated over phytoplankton by numbers and percentage whereas, by species, phytoplankton faired considerably in good position.

The phytoplankton, in order of abundance, consists mainly of Chlorophyceae (2 - 225 nos./l - 0.47 - 52.85%), Bacillariophyceae (2 - 28 Nos./l - 0.47 - 6.64%) and Myxophyceae (2-28 nos. /l - 0.54%). The zooplankton consists mainly of Copepoda (2- 383 u/l - 0.47 - 40.22%), Rotifera (2 - 202 u/l - 0.54 - 18.54%), Cladocera (2 - 93 -u/l - 0.47 - 11.14%), Ostracoda (2 - 32 u/l - 0.47 - 3.65%) and Protozoa (6 - 11 u/l - 1.01 - 3.13%) and the Miscellaneous group (2 u/l - 0.47 - 1.04%).

The zooplankton constituents are represented by Protozoa (*Arcella mitrata*) , Rotifers. (*Brachionus calcyflorus, Keratella tropica, Lecane aspacia, Filinia longiseta*), Cladocera (*Sida crystallina, Daphnia magna, Moina brachiata, Bosmina longisrostris*), Ostracoda (*Cypris subglobosa*) & Copepoda (*Cyclops & nauplius*) and the Miscellaneous group was represented by Insect remains and vegetative parts.

Freshwater fish species constitutes the important part of the inland aquatic fauna. Majority of these, in their early formative stages are planktivores, also feed on benthos/littoral faunistic elements, whereas minnows/weed fish forms the food of predatory catfish and Murrells. Most of the Crustaceans also act as the food of certain fish species. Amphibians being aquatic dwellers, which acts as pest-controlling agents in good many paddy fields and in biotopes, also provide, as food, as tadpoles to the predatory fish species, Murrells in particular. Fish species, 58 nos. recorded when studies were carried-out in the river Tungabhadra covering good part of the river - both in the up and the downstream stretches, serves as *food* to the consumers and as a source of monetary gains to the fishermen who are engaged in the profession since years.

Reports indicate, as observed too, that the fish catch composition of the river, as also part of the reservoir, at the landing centers is mainly comprised of the exotic *Tilapia species, Oreochromis nilotica, mossambica* and the highly predaceous catfish *Clarias gariepinus*, followed by varied species listed. Indian major and the other exotic carp had a meager representation in the total fish catch; as also, to a lesser degree, by fish species such as *C.reba, L.pangusia, S.nukta,O. bimaculatus, M.cavasius, R.pavimentata, Q.marulius, C.striatus, N.notopterus and N.Khavalohor*. As has been stressed earlier on the accidental/inadvertent entry of C.gariep1nus, Q.nilotica ani O.mossambica and their marked dominance in the over-all fish catch composition is a DANGER SIGNAL which was expected to create enough problems to the fishery workers, the fishermen and the fish germplasm of the biotope in the days to come.

All though the only long-distance migratory fish *Anguilla bengalensis and A.nebulosa* recorded earlier and whose contribution towards the fishery was in a miniscule proportion from the reservoir/river studied during 1958-1965, presently, as reported, the said species have not been recorded in the biotope. *Tor khudree and T.neili*, the short-distance famous gamefish of India, recorded earlier is reported to occur in the fish catch, but quite rarely. Similar is the case with the herbivorous carp of Karnataka, *Puntius pulchellus and Thynnichthys sandkhol* (Microcystis controlling fish).

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 sections reveal the impacts due to the project on the physical, biological and social environment. Impacts have been assessed based on the information collected from the screening and feasibility study reports, field surveys and additional secondary data collected as part of the study. The majority of the impacts are confined only during the construction stage

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, which include;

- Grading,
- Excavation of footings, and
- laying of canal.

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.

To determine the potential worst-case daily construction impacts, exhaust and dust emission rates have been evaluated for each source of emissions. Maximum short-term impacts are calculated based on the equipment mix expected during the construction schedule and predicted by using ISCST model.

Table-8 Result obtained from the model data for AAQM locations without mitigation measures

Location code	Name of the Location	Baseline concentration (ug/m^3)	Predicted concentration (ug/m^3)	Total concentration (ug/m^3)	AQI	Remarks
A1	Huvinahadagali	60.1	1.870	61.97	61.97	Satisfactory
A2	Hammige	60.3	4.135	64.435	64.435	Satisfactory
A3	Gadag	57.8	0.057	57.857	57.857	Satisfactory
A4	Dambal	59.3	0.057	59.357	59.357	Satisfactory
A5	Mundargi	59.3	0.510	59.81	59.81	Satisfactory
A6	Alavandi	60.1	0.057	60.157	60.157	Satisfactory

Table-9 Maximum concentration of PM in monitoring locations with mitigation measures

Location code	Name of the Location	Baseline concentration (ug/m^3)	Predicted concentration (ug/m^3)	Total concentration (ug/m^3)	AQI	Remarks
A1	Huvinahadagali	60.1	1.30	61.4	61.4	Satisfactory
A2	Hammige	60.3	2.813	63.113	63.11	Satisfactory
A3	Gadag	57.8	0.020	57.82	57.82	Satisfactory
A4	Dambal	59.3	0.020	59.32	59.32	Satisfactory
A5	Mundargi	59.3	0.350	59.65	59.65	Satisfactory
A6	Alavandi	60.1	0.020	60.12	60.12	Satisfactory

It is evident from the above table that ambient air quality observed during the excavation period/ construction phase of the project with respect to PM_{10} is found be satisfactory and well within the CPCB standards (100 ug/m^3) hence there will be no impact on human health, vegetation, microclimate, soil, etc.

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

- Unpaved roads and disturbed areas in the project construction site are watered as frequently as necessary to prevent fugitive dust plumes. The frequency of watering are reduced or eliminated during periods of precipitation.
- Construction equipment vehicle tires inspected and washed as necessary to be cleaned free of dirt prior to entering paved roadways.
- Vehicles used to transport solid bulk material on public roadways and having the potential to cause visible emissions provided with a cover, or the materials sufficiently wetted and loaded onto the trucks in a manner to provide at least one foot of freeboard.
- Any construction vehicle not meeting the emission norms standards not being allowed within the construction site and emission certificate made mandatory for the same and this is strictly enforced on the transport contractors to abide by the same.
- Water sprinkling done in all the dust generating activities like site clearing, leveling, excavation, material handling etc to suppress the dust.
- Vehicles delivering loose and fine materials like sand and fine aggregates covered by tarpaulin sheets to reduce spills on roads and to reduce fugitive emissions.

4.2 Ambient Noise Level

During construction phase, various sources of noise pollution arise due to operation of machineries like compactors, concrete plant, cranes, blasting, 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).

Road way construction noise model was used to calculate the noise levels for different construction equipments at various distances. The results reveal that, the construction should not be undertaken within 500 m from the sensitive receptors like villages, temples, schools,

hospitals, etc. If necessary, suitable noise control barriers will be erected around the construction activities to mitigate the unwanted noise. Construction activities shall be restricted only to day time and there should not be any construction during evening and night hours to avoid the psychological effects on surrounding population and biota.

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.

Construction of barrage was completed and the question of deterioration of river water quality does not arise. There will be impact on ground water in specific locations due to construction activities due to pumping of water from bore wells for watering which is short term in nature.

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/flies, 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.

R & R activities such as site clearing for housing and infrastructure including roads, and the presence of larger numbers of humans in formerly unoccupied areas can also cause moderate increase of water pollution levels to the nearby water bodies. Road construction can change drainage patterns and lead to greater soil erosion. 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 and domestic solid waste will be disposed to nearby municipal landfills. Thus, no impacts are anticipated as a result of disposal of effluents from the labor colony. And frequent monitoring of surface and ground water will be done and care shall be taken not to deteriorate the quality of the river.
- Frequent check of septic tank and soak pits will be done to repair and replacement of leaking and malfunctioning. And it will be designed in such a way that no adverse change in groundwater quality as a result of the discharge.
- Machines oil spills from the machinery maintenance will be collected in leak proof barrels and then disposed off to KSPCB authorized dealers.
- BOD and COD limits of the water will be checked regularly as part of Environmental Monitoring Programme to monitor on eutrophication.
- Restrictions on the time, method and rate of application of fertilizers and pesticides will be imposed to avoid surface run-off and leaching into the ground water.
- Farmers will be advised to use nutrient management plans to reduce excess application of nutrients.
- To minimize pesticide impacts, farmers shall be advised to practice Integrated Pest Management (IPM) techniques (which can include biological pest control) to maintain control over pests, reduce reliance on chemical pesticides, and protect water quality.
- Impoundment of water shall be avoided in the fields.
- The deposition of sediments and other breakdowns resulting from the construction activities will be checked and maintained regularly to avoid decomposition of sediments to avoid eutrophication.
- Since the project is run-of-the-river scheme, flow of river will not be disturbed.
- Changes in cropping pattern
- Conjunctive use of Surface and ground water
- Resort to drip / sprinkler irrigation storing in small sumps
- Dilution of quality of water in conjunctive use
- Proper planning of available water and select crop pattern
- Rainwater run-off Recharge to ground water through various conservation structures
- Discourage application of traditional farming and irrigation methods
- Unscientific development of ground water results in depletion of bore well yields and lowering of water table.

4.4. Land Environment

Temporary loss of soil may be envisaged during the construction phase, if construction site, temporary offices, workers camps, stockyards, borrow areas etc are located on fertile areas and if haul roads and traffic during construction etc are routed through agricultural lands.

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.

In this project contamination of soil may take place, from the following activities at the construction zones, construction of labour camps, and the auxiliary facilities required for the construction. Details of the activities from which the contamination can occur are presented below;

- Maintenance of the machinery and operation of the diesel generator sets on site
- Oil spills from the operation of the mechanical works, diesel pumps, diesel storage and during transportation and transfer, parking places and diesel generator sets.
- Operation of the residential facilities for the labour and officers

4.5 Biological Environment

The direct impacts of the proposed project shall be limited to the area of submergence and barrage sites only. The submergence area doesn't contain reserve forest, but it diverts 4.9 ha RF for constructions of lifts and canals. Hence it doesn't have much impact on natural forests and wildlife of the area. The proposed project may affect 10961 trees coming in submergence area of the proposed project. However, tree cutting is not envisaged so as to avoid soil erosion in the submergence area. But the proposed reservoirs are going to bring about a major change in the quality of habitat. They provide water in all seasons and increase fodder production especially during the summer on the reservoir bed as the water levels drop so that the herbivores can thrive. Further the reservoirs can promote reservoir fisheries leading to an improvement in the aquatic flora and fauna. No islands are going to be created on account of submergence. No rare / endangered / threatened flora or fauna is affected due to the project.

Table -10 Village wise No. of species & individuals recorded in submergence area

Sl. No.	Village	No. of species		No. of individuals	
		Agro-ecosystem	Village settlements	Agro-ecosystem	Village settlements
1	Gumgol	32	19	3630	211
2	Bidarahalli	30	21	3314	602
3	Allipura	7	8	353	78
4	Vithalapura	4	6	399	124
Total		**73**	**54**	**7696**	**1015**

Table-11 Overall trees may be affected in submergence along the right and left side of the river

Sl. No	Location of submergence	No. of Species	No. of Individuals
1	Left bank	50	8127
2	Right bank	39	2834
Overall		**63**	**10961**

A total 4.9 Ha is going to be acquired for the proposed project area. Among which only 1.42 Ha area is coming under Kappathgudda RF under proposed canal network.

There will not be any type of 'negative' impact of the said Project during both the 'construction and operation' phases on the fish *food* organisms - plankton, benthic/littoral fauna as also the fish species and their breeding grounds. There are number of minor tributaries/streams draining their waters during monsoon which will facilitate breeding and recruitment success of the fish species present.

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 and 1 represents the least and 10 represents the maximum impact. Further, the impacts are quantified 'with' and 'without' EMP. The Evaluation Impacts is shown in the table given below.

Overall results of evaluation of impacts on various environmental parameters indicates that, during construction phase without mitigation measures the impacts will be 362 and if suggested mitigation measures will be implemented, the impacts will be reduced to 134 i.e 63% of the impacts will be reduced on environment. Similarly, during operation phase without implementation of EMP, the impacts will be 42.5 and if suggested EMP is implemented with spirit,, the impacts will be increased to 138.5 (70%) positively.

Table-12 Evaluation Impacts

Sl.No	Environmental Attributes	Project Activities	Nature of Impacts										
			Magnitude	Reversible	Irreversible	Long Term	Short Term	Direct	Indirect	Positive	Negative	Without EMP	With EMP
A. Construction Phase													
1.Impacts on Land Environment													
1	Land	Construction of, Pump House, Rising mains, Delivery chambers, Canals, Distributory Net works.	L	✓			✓	✓			✓	8	2
		Excavation for canals	M	✓			✓	✓			✓	7	3
		Heavy earth moving vehicles	H	✓			✓	✓			✓	8	2.5
2	Change in Topography	Construction of Pump House, Rising mains, Delivery chambers, Canals, Distributory Net works.	M	-	✓	✓	-	✓			✓	8	3
		Excavation of canals	M	✓	✓	✓		✓			✓	7	4
3	Change in Geology	Controlled Blasting	H		✓	✓		✓			✓	8	3
4	Loss of Productive Soil	Construction site, temporary offices, workers camps, stockyards, borrow areas	L	✓			✓		✓		✓	5	2
		Construction of Haul roads and traffic detours	L		✓		✓	✓			✓	5	2
5	Compaction of Soil	Site Clearance	L		✓	✓		✓			✓	5	2
		Movement of heavy machinery and vehicles	M		✓		✓	✓			✓	8	3
6	Contamination of Soil	Machinery and operation of the Diesel Generator Sets	L		✓		✓		✓		✓	5	2
		Construction labor camps	L	✓			✓		✓		✓	4	1
8	Soil erosion and change in	Construction of Pump House, Rising mains,	H	✓			✓		✓		✓	7	3

Sl.No	Environmental Attributes	Project Activities	Nature of Impacts										
			Magnitude	Reversible	Irreversible	Long Term	Short Term	Direct	Indirect	Positive	Negative	Without EMP	With EMP
	land forms	Delivery chambers, Canals, Distributory Net works.											
		Site clearance	H		✓	✓		✓			✓	8	4
9	Submergence of Villages	Rehabilitation to R&R centre	H		✓	✓		✓			✓	9	4
2. Impacts on Water Environment													
1	Eutrophication	Sewage from labor camp	L	✓			✓	✓			✓	6	2
		Muck disposal	M	✓			✓	✓			✓	7	2
	Siltation and sedimentation	Washing off from crusher	L	✓			✓	✓			✓	5	2
		Muck disposal	M	✓			✓	✓			✓	7	2
2	Change in River Water Quality	Construction of Pump House, Rising mains, Delivery chambers, Canals, Distributory Net works.	M	✓			✓		✓		✓	6	2
		Diversion of river water	H		✓	✓		✓		✓		8	3
		Decomposition of sediments and deposition of organic matter	M	✓			✓	✓			✓	6	2
		Washing of equipments	M	✓			✓	✓			✓	6	2
		Muck disposal	M	✓			✓	✓			✓	6	2
3	Change in surface and ground water quality	Sewage from labor camp	L	✓			✓		✓		✓	5	2
4	Change in Hydraulic Regime	Creation of Impoundments in the Construction yard	L	✓			✓	✓			✓	5	1.5
		Construction of Pump House, Rising mains, Delivery chambers, Canals, Distributory Net works.	M		✓	✓			✓		✓	7	3

Sl.No	Environmental Attributes	Project Activities	Nature of Impacts										
			Magnitude	Reversible	Irreversible	Long Term	Short Term	Direct	Indirect	Positive	Negative	Without EMP	With EMP
3. Impacts on Air Environment													
1	Increase in dust concentration	Construction activity, operation of crusher, structural and erection works	M	✓			✓	✓			✓	7	2
		Excavation	H	✓			✓	✓			✓	8	3
2	Fugitive Emissions from various sources	Vehicular movement	H	✓			✓	✓			✓	7.5	3
		Loading and dislodging Use of sand, fine aggregates	M	✓			✓	✓			✓	7	2
		Batching plant	M	✓			✓	✓			✓	6	2
3	Increase in SO_2, PM, NO_x	Vehicular movement	M	✓			✓	✓			✓	8	3
		Operation of DG sets	M	✓			✓	✓			✓	6	2
		Fuel Combustion in equipments and Vehicles	M	✓			✓	✓			✓	6	2
		Burning of fuels from construction workers	M	✓			✓	✓			✓	6	2
4	Impact on Human Health	Emission of Dust particles	M	✓			✓	✓			✓	6	2
4. Impact on Noise Environment													
1	Increase Noise Level	During Construction from movement of heavy earth moving vehicles.	M	✓			✓	✓			✓	6	2
		Operation of D.G sets	L	✓			✓	✓			✓	6	2
		Movement of vehicles carrying raw materials	M	✓			✓	✓			✓	6	2
5. Impact on Biological Environment													
1	Pressure on existing natural resources	Immigration of labor population & technical staff	L		✓	✓		✓			✓	4	1
2.	Reduced Photosynthetic activity, Wilting of plants, loss	Transportation of construction materials	M		✓		✓		✓		✓	5	2
		Site Clearance	M		✓	✓		✓			✓	7	3.5

Sl.No	Environmental Attributes	Project Activities	Nature of Impacts										
			Magnitude	Reversible	Irreversible	Long Term	Short Term	Direct	Indirect	Positive	Negative	Without EMP	With EMP
	of floral diversity												
3.	Impact on Local Flora & Fauna	Construction activities	L		✓		✓		✓		✓	5	1.5
		Immigration of labour population	L	✓			✓		✓		✓	4	1
		Vehicular movement	M	✓			✓		✓		✓	7	3
4.	Impacts on Fishes and Aquatic Ecosystem	Construction of Barrage	L		✓		✓		✓		✓	5	1.5
		Increase in turbidity of water due to Washing of machineries	M	✓			✓	✓			✓	7	3
		Sewage from labor camp	L	✓			✓	✓			✓	6	2.5
5	Diversion of Forest	Construction of lift works, canals, etc	M		✓	✓		✓			✓	8	3
6	Flora of submergence area	Submergence of trees, agro ecosystem	H		✓	✓		✓			✓	9	3
6. Impact on Socio-economic Environment													
1	Submergence of villages	Affecting livelihood	H		✓	✓		✓			✓	9	5
2	Increase in job opportunity	For Construction activities	H	✓			✓	✓		✓		9	3
3	Pressure on existing infrastructure facility	Immigration of labor and technical staff	M	✓			✓	✓			✓	7.5	4
4	Impact on Human Health	Due to water/air borne diseases, traffic movement	H	✓			✓		✓		✓	8	2
											Total	**362**	**134**
B. Operation Phase													
1	Change in climate and meteorology	Improvement in Agro-Bio diversity	H		✓	✓		✓		✓		1.5	9
		Replenishment of	H		✓	✓			✓	✓		2.5	8

Sl.No	Environmental Attributes	Project Activities	Nature of Impacts										
			Magnitude	Reversible	Irreversible	Long Term	Short Term	Direct	Indirect	Positive	Negative	Without EMP	With EMP
		underground water table											
2	Impacts on Land Environment	Due to good yield of crops	H		✓	✓		✓		✓		3.5	8.5
		Soil Salinity, Soil Erosion, Soil Properties, etc	M	✓			✓		✓		✓	2	7
		Application of natural fertilizers	H	✓		✓		✓		✓		3	8
3	Impacts on Water Environment	Changes in surface and ground water quality due to soil erosion	L	✓			✓		✓		✓	1	6
		Application of fertilizers and pesticides	M		✓	✓			✓	✓		2	6
		Impounding of water	L		✓		✓		✓		✓	1	3
4	Impacts on Air Environment	Spraying of pesticides	M		✓	✓		✓			✓	3	7
		Operation of Pump House	L		✓	✓			✓		✓	2.5	4
	Impacts on Noise Environment	Vehicular Movement	L	✓		✓			✓		✓	2.5	8
6	Impacts on Biological Environment	Increase of Agro-biodiversity	H		✓	✓		✓		✓		3	8
		Change in cropping pattern	H		✓	✓		✓		✓		3.5	9
		Improvement in Aquatic Life	M		✓	✓		✓		✓		1.5	7
		Retaining Trees in submergence area	H		✓	✓		✓		✓		1.5	7
7	Impacts on Socio economic Environment	Employment opportunity	H		✓	✓		✓		✓		2.5	8
		Yield of the crops	H		✓	✓		✓		✓		3	9
		Economic status of the region	H		✓	✓		✓		✓		1.5	9
		Quality of life	H		✓	✓		✓		✓		1.5	7
											Total	**42.5**	**138.5**

5. Analysis of Alternatives

Four alternative sites for the location of barrage across Tungabhadra River were examined initially right from Bidarahalli to finally selected site near Paravathi Temple. Four locations are;

- Location 1 - Bidarahalli
- Location 2 - Hammige Site
- Location 3 - Singatalur Site near Veerabhadra Temple.
- Location 4 - Singatalur Site near Parvathi Temple.

The site number 1 and 2 though located away from the back water effect of Tungabhadra Dam (FRL 497.73) has to be left out in view of uneconomical cost of the raising main and feeder channel.

The third site near Veerabhadra temple has narrow width of river but it was insufficient to pass the design flood of 5,20,000 cusecs. As such, fourth site near Parvathi temple was finally selected for the location of the barrage and four villages viz., Bidarahalli, Gumgola, Allipura and Vithalapura are likely to be submerged due to the barrage. Technical Committee of Krishna Basin in its meeting held on 30.08.1990 at Bangalore accorded the approval for the location.

6. 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. To ensure the effective implementation of the EMP, it is essential that an effective monitoring programme be designed and carried out. Six monthly compliance reports to Regional Office, MoEF as per Environmental Clearance conditions will be submitted twice a year.

The proposed Environmental monitoring program will be carried out to ensure effective implementation of EMP.

Table – 13 Environmental Monitoring Plan

Environmental Parameters	Project Stage	Parameters to be Monitored	Frequency of Monitoring	Locations	Implementation & Supervision	Cost in Rs.
Water Quality	Construction	Physico-Chemical and Bacteriological analysis for Surface water and Groundwater (Pre-and Post Monsoon)	Monthly	8	Contractor or Sub-Consultants appointed by Contractor	28,000/-
	Operation		Six Monthly	10	KNNL or Sub-Consultants appointed by KNNL	35,000/-
Soil Quality	Construction	Physico-Chemical, and Irrigation Properties	Monthly	15	Contractor or Sub-Consultants appointed by Contractor	45,000/-
	Operation		Six Monthly	25	KNNL or Sub-Consultants appointed by KNNL	75,000/-
Air Quality	Construction	PM_{10}, $PM_{2.5}$, NO2 and SO_2	Monthly	6	Contractor or Sub-Consultants appointed by Contractor	24,000/-
	Operation	Not Required	Not Required	Not Required	Not Required	-
Noise Levels	Construction	Leq Day, Leq Night in dB(A)	Monthly	6	Contractor or Sub-Consultants appointed by Contractor	6,000/-
	Operation	Not Required	Not Required	Not Required	Not Required	-
Aquatic life	Operation	Fishes, Phyto and Zooplanktons	Yearly once	At barrage site and canals	CADA, KNNL	35,000/-

7. Social Impact Assessment

The land acquisition process for the project started during 2010. In order to relocate and rehabilitate the families in the affected villages of Singatalur Lift Irrigation Scheme, as per the provisions of National Rehabilitation and Reconstruction Programme, 2007, initially, only three villages viz Allipura, Gumgola, and Bidarahalli were considered as fully submerged. Later, Vithalapura Village, under the Bidarahalli Gram Panchayat, Mundargi Taluk, Gadag District was added in to the submerged villages list to provide Rehabilitation and Resettlement benefits.

The Expert Appraisal Committee while appraising the project instructed to conduct a separate Social impact assessment study and propose the mitigation measures for the displaced families as detailed in the additional ToR approved. Based on this instruction, this report was prepared, updating the primary data collected through the social surveys. The main sources of additional information includes community consultations, secondary data sources like census data 2011, Land Acquisition records, Records of the R&R wing, Discussion with PDOs & land acquisition officer, Village Panchayath, etc.

7.1 Demographic profile of the villages

Demographic profiles of the affected families as per primary survey in the villages show that there are 1241 families in these 4 villages consisting population of 4989 persons. The details is further verified with the 2011 Census data then there is an increase in population in three villages viz; Allipura & Bidarahalli have a population of 2315 and 2154 persons respectively while Vithalapura and Gumgola are very small villages have only 564 and 598 persons and the increase in the population due to the difference in the year of Surveys.

7.2 Impact of the project

The four villages viz Allipura, Gumgola, Bidarahalli and Vithalapura will be fully submerged requiring 100% displacement of the families. The possible impact of the project on affected population is given below in the tables ;

Table -14 Impact on people and assets

SL. No	Name of the villages	Total no of families	Total population	Total Number of Buildings	Vacant land
1	Allipura	375	1509	396	19
2	Gumgola	178	700	194	69
3	Bidarahalli	547	2200	574	202
4	Vithalapura	141	580	153	53
Total		**1241**	**4989**	**1317**	**343**

Table – 15 Details of the Project Affected Buildings in the Village

Village name	Total number of Private buildings in village	Total number of Public buildings in village	Total number of religious buildings in village	Total Number of Buildings
Allipura	375	7	14	396
Gumgola	178	4	12	194
Bidarahalli	547	8	19	574
Vittalapura	141	5	7	153
Total	**1241**	**24**	**52**	**1317**

Table -16 Submergence status of Religious places

Name of the village	No of Temples and Mosques	No under submergence threat	Big temples of archeological significance
Allipura	12 temples	6	Anjaneya (Hanuman) temple
Gumgola	15 temples 1 mosque	16	Goni Basaveshwara Temple
Biderahalli & Vithalapura	23 temples 1 mosque	7	Renukadevi temple and NarayanaThirthah
Total	**50 temples 2 mosques**	**29**	

7.3 Stakeholder consultations

- Families located in the boundary mark wanted to shift to other locations and get rehabilitated, considering safety conditions.
- Those who have land and agriculture operations in the village were unhappy about losing their land and assets
- Most of the lands located along the river bank are irrigated through lift irrigation, for which IP sets have been installed and financed from various financial institutions and the farmers are worried about the nature of compensation packages for these pipe lines and IP sets.
- They hope that the rehabilitation sites are better dwelling area as the special planning of the area is done
- Many people prefer to have residential buildings constructed by the Government in the allotted sites but an equal number prefer to construct own house but need further govt supports for construction.
- They wanted to have all infrastructure supports available in the area ,as they enjoyed before

7.4 Positive and negative impacts likely to be occurred due to the project

7.4.1 Negative impacts

- People of 4 villages living there since ages will be totally uprooted and displaced from their historic land and dwelling place, forever. Their ancestors have lived and died there and they have lots of emotional and cultural values attached to this land which will leave lasting impacts in their life.
- Families will lose all their immovable properties and cultural symbols in the villages.
- The demographic, socio cultural, economic impacts will be severe unless they are appropriately resettled and rehabilitated.
- On public consultations held, people complained about the compensation paid which is very low rate and with the money given for house construction they cannot rebuild a house, in the current rates in prevalence.
- When there is time gap in the payment of compensation and shifting to the R&R sites, people will waste away money on other purposes leaving only little or nothing to build houses .This happened already as people were reported to spent money for buying bikes, paying debts, for food and other minor luxuries , leaving nothing in hand for making further living when shifted to R&R sites .

7.4.2 Positive Impacts

- Resettlement and rehabilitation packages offered to displaced communities are comparatively much better and comprehensive to cover the negative impacts to some extent, though not all.
- The R&R policy and plan of the project based on the National Resettlement and rehabilitation policies framed in 2007 will ensure rehabilitation sites, basic facilities such as access roads, electricity, water supply and other important institutions enjoyed by the communities. Financial supports for constructing houses, animal sheds, small

shops, shifting allowance, livelihood supports, etc are ensured to certain extent under this R&R plans.

- The State Govt. provides additional supports to joint families with more adult male members and unmarried women to rehabilitate them.
- The R&R wing of the Department undertakes the construction works related to develop the R&R sites setting up all facilities, ready for occupation.

7.5 Rehabilitation & Reconstruction Budget

A budget of the total costs estimated and approved in the master plan for the resettlement and rehabilitation of the Project displaced families from 4 villages under submergence due to the project is shown in the following Table. The total costs for R&R expenses are Rs 10991.3 lakhs (109.91 crores).

Table – 17 R&R costs- Budget

Sl. No	Rehabilitation Particulars	R & R- Revised Estimated cost (in Lakhs)				
		Allipura	Gumgola	Bidarahalli	Vithalapura	Total
1	a) Compensation paid for Acquisition of Built up & Vacant land	1200	800	2600	750	5350
	b) Land acquisition Cost for Rehabilitation centre	121.8	79.22	191.39		392.41
	Cost for the development of Rehabilitation Centre	786.92	1210.04	1352.7		3349.65
2	Transportation Cost for Shifting of Families	37.5	17.8	54.7	14.1	124.1
3	Compensation Paid for Construction of Cattle Shed	56.25	26.7	82.5	21.15	186.15
4	Cost for the Construction of Commercial shops.	5.25	2.5	5	1.75	14.5
5	Cost allotted for Livelihood (Non-Agrarian)	168.75	80.1	246.15	63.45	558.45
6	Cost Allotted for compensating Daily wage laborers, Non-Agrarian coolies	63	30.38	92.25	25.88	211.5
7	Cost allotted for Construction of households for houseless BPL people.	17.78	15.24	20.32	12.7	66.04
8	Cost allotted for construction of households for families allotted with land	93.75	44.5	136.75	35.25	310.25
9	Cost allotted for the construction of Houses for affected family with two male adults and/or unmarried girls above age of 35	40	26	53.25	19	138.25
10	Cost allotted for the ex gratia for the people who lost their land .	-	-	-		290
11	Total sum of Rs	2591	2332.47	4834.56	943.28	**10991.3**

8. Project Benefits

The Singtalur Lift Irrigation Scheme provides economically viable and socially acceptable irrigation practices for the command area. The project benefits are given below;

8.1 Improvements in the Physical Infrastructure

- The project boosts total farm output and hence, with unchanged prices, raises farm income.
- Project improves yields through reduced crop loss due to erratic, unreliable or insufficient rainwater supply.
- It allows for the possibility of multiple-cropping and so an increase in annual output.
- It allows a greater area of land to be used for crops in areas where rain fed production is impossible or marginal.

8.2 Improvements in the Social Infrastructure

- By making employment and incomes more reliable (as well as higher), the project aims to protect farmers from loss of assets and also prevents peasants from getting into debt-traps.
- Increased health benefits—improved sanitation due to better access to water.
- Increased benefits from water use for rural domestic and livestock purposes.

8.3 Employment Potential

- Raising Main, wells and pumps etc. This is likely to be an important sector of employment for the poor, especially the landless rural poor or rural households.
- It reduces migration to urban areas, and so reduces the pool of job-seekers and relieves the downward pressure on urban areas.

9. Environmental Management Plan

Although agriculture is usually associated with its positive impacts on human life, irrigation practices may be associated with adverse 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).

9.1 Catchment Area Treatment Plan

Catchment area treatment plan includes the management of the following;

9.1.1 Soil erosion

Soil conservation practices shall be on the basis of the following inventories,

- Extent of the soil and nutrient losses and sediment transports in various environments.
- Land use/Land Cover details, provides basis for implementation of different soil conservation measures on soil losses and sediment yields.
- A better understanding of the soil erosion processes the dynamic and relative importance of the single processes and their interactions.

The recommended soil and moisture conservation measures for Northern Dry zone are as follows:

- Contour bunds with waste weirs.
- Graded bunds/Graded border strips.
- Zing terraces with raised waste weirs.
- Diversion Drains/Water ways.
- Reducing wind erosion of soil by growing wind breaks (vegetation cover).
- Gully plugging.

9.1.2 Soil Conservation Measures

Sl.No.	Type of soil conservation	Practices recommended
1	Bench terracing on steep slopes (12-15%)	▪ Outward cross slope of 10% ▪ Longitudinal slope of 8% ▪ Length of terrace, 20-35 m ▪ Width of terrace, 3 to 5.5 m
2	Riser (earthen or stone)	▪ Steep batters of, 0.25:1
3	Earthen shoulder bund	▪ 0.5 m base, 0.3 m height,01 m top
4	Stone bunding or fencing when stone is easily available.	▪ 0.3 m base, 0.2 m height, 0.1 m top ▪ Followed by earthen bund of 0.1 m top
5	Land leveling	▪ Low (bottom) flat deep areas leveled. ▪ Bench terraces are also leveled by cut and fill.
6	Land slide control	▪ Vegetative means
7	Gools	▪ Water channels conveying water from natural springs as well as rainwater. ▪ Same design delivers 5-50 liters/min in winter and 100-500 liters/min during rainy season. ▪ Need improvement in regulation.
8	Khatta/khala	▪ Earthen ponds collecting discharge water of & seepage water.

9.1.3 Afforestation in Catchment Area

Even though the proposed project doesn't have direct impacts on the flora and fauna of the region but the project proponents are willing to avoid even secondary impacts of the project. Hence, as a part of EMP, Green Belt Development Plan (GBDP) is proposed. The trees chosen will be useful as perches to the water birds for laying their effects and help in their breeding. After growth, these trees provide fuel, fodder, timber and other ecosystem benefits to the society and Government. It helps in maintaining ecological balance of the nature.

9.2 Command Area Development Plan

9.2.1 Land Development Works

9.2.1.1 Construction of Canals

A total programme of 3 years has been contemplated for canal construction work. The overall work is divided into two parts, a) Conveyance system and b) Delivery net work. The conveyance system includes main canal, branch canals and distributaries down to service area turnouts which would generally cover one village. The Delivery Network consists of minor canals within the Service area to serve chaks (water delivery units). The chaks in turn will have sub-minor canals with turnouts to serve areas within which there will be unlined channels leading to individual fields.

9.2.1.2 Water courses and field canals

The construction of water courses and field channels is the liability of cultivators but they do not come forward to construct the water courses on permanent and scientific basis. Therefore, in order to expedite the construction of water courses and field channels, the Government will provide supporting infrastructure to farmers. Alternatively, the work will be taken up by Agricultural Department at cultivator's cost.

9.2.1.3 Field drainage

Though possibility of water logging is very less since the groundwater table is very low in these proposed command areas, still the rise in water table in the command area will be thoroughly assessed after introduction of irrigation. For this purpose, it is proposed to make consumptive use of surface and ground water to enhance the irrigation intensity and also to lower down the ground water level if problem is noticed.

9.2.1.4 Main Drains

There are few natural seasonal streams in the command area. The velocity of flows in these drains during monsoon varies from low to moderate. These streams would be used for draining out the excess water from fields to the outfalls in the post – irrigation period. Hence, it would be essential to strengthen the main drains with stabilization of banks to the possible extent and deepening and straightening, wherever required.

9.2.1.5 Field Drains

These drains would be constructed by the individual farmers with appropriate sizes so that the excess water from their fields is drained into intermediate drains. Field drains or ditches would be at least 30-cm deep with slide slopes ranging between 4:1 and 8:1 depending upon the terrain and runoff conditions. These would be constructed considering the low-spots, which collect water from adjoining higher areas. Ditches would be as straight as possible. The cross-sections of the field drains would be of trapezoidal shape.

9.2.1.6 Provision of Subsoil Drainage

Sub-soil drainage would remove the excess water from the sub-soil areas. This can be achieved by provision of adequate sub-soil drainage. Conjunctive use of groundwater would lower the water tables as far as possible by allowing natural sub-soil drainage, and accordingly water logging problems can be reduced. But since, the proposed command area portion is experiencing severe depletion of groundwater levels, conjunctive use of groundwater is least expected. As clayey content is more in the area, excess application of irrigation water may lead to water logging problems.

9.2.1.7 Farm Roads

At present, the road network to reach the various parts of the command area is sufficient. However after construction of pump house and canal network, some new farm roads will be constructed and old roads will be realigned for better accessibility to the site.

In addition to the above, land development works, marketing and warehousing facilities, credit facilities from bank, easy availability for agriculture inputs, consolidation of land holdings etc. will be developed / arranged for proper command area development.

9.2.1.8 On-Farm Development Works

As part of CAD Plan, On-Farm Development (OFD) works will be undertaken, after formation of Command Area Development Authority (CADA) and Water User's Associations (WUA).

9.2.1.9 Command Area Development Authority (CADA)

In pursuance of the polices of GoI, with an objective to ensure rapid and optimum utilization of Irrigation potential created under major and medium irrigation projects and to increase the agriculture production, CADA Programmes were started in Karnataka for all the irrigation projects. The main objective of the CADA is to reduce the gap between potential area created and actual area utilised. CADA is a multimember committee represented by KNNL officials, MLAs of Command Area, Farmers Leaders, line department officials, etc. to monitor the project during the operation. The functions of the CADA is as follows;

- Reclamation of water logged areas.
- Construction of field irrigation channels (FIC).
- Construction of field drains.
- On-farm development (OFD).
- Adoption of warabandi system for distribution of water.
- Adoption and enforcement of suitable cropping pattern.
- Conjunctive use of surface and ground water.
- Extension training and demonstration Programmes.
- All round development of areas pertaining to agriculture. Implementation of Participatory Irrigation Management.

9.2.1.10 Water Users' Association (WUA)

The modern irrigation management aims at high efficiency of water conveyance and appropriate methods of water application, through participatory irrigation management at each stage of irrigation development. In Karnataka, it is essential to promote and implement the theme of participatory irrigation management in all the Irrigation projects through formation of Water Users' Association. The construction of OFD works will be taken up after formation of WUAs under the supervision of CADA.

The efficient management of irrigation water for maximizing productivity requires, firstly the efficient on farm water management and secondly the optimization of the use of water and land, through appropriate methods of water application. The efficient on-farm water management is related to water delivery system and allied works in the command area, which distributes the water to each farm. The items of works pertaining to on farm water management are termed as "On Farm Development Works".

The On Farm Development works comprise of the following,

- Field channels for conveyance of water
- Control structures
- Crossings
- Surface Drainage system
- Farm roads
- Field channel protection works and
- Land forming (Smoothening / grading/leveling)

9.2.1.11 General Approach to Design and Execution of OFD Works

The general approach to design and execution of OFD works will be in accordance with the Govt. technical circulars, the Govt. Resolution and other directives issued by the Govt. from time to time for this purpose. The participatory irrigation management and efficient water delivery system to provide timely as well as adequate water supply to each farm, will be the main focus points in the design and implementation of OFD works. The basic issues of general approach are;

9.3 Green belt Development Plan

The proposed project by KNNL is fully committed for protection of Environment, flora and fauna. The common species such as *Santalum album* & *Pterocarpus indicus* will be translocated and planted in the catchment area. Even the forest department shall be requested to plant *Chloroxylon swietenia* in large numbers under compensatory afforestation. Thus these three RET plant species can be saved to the maximum extent possible. The KNNL and Forest Department will take adequate care for the conservation of RET plant species .

9.3.1 Compensatory Afforestation

A total of 4.9 Ha of Forests are proposed to be diverted for canal network. The KNNL in consultation with Forest department has identified 5 ha of revenue lands for compensatory afforestation. The KNNL project authority shall be responsible for timely payment of the assured amounts for compensatory afforestation. The budget for compensatory afforestation excluding the cost of the land shall be Rs.35.92 Lakhs.

9.3.2 Plan for conservation of Wild animals

The project proponents and operators shall follow the following strategies in conserving the RET wildlife:

- Provide absolute protection of the area from all factors causing degradation, depletion and destruction of wildlife and wildlife habitats by strict enforcement of the Wildlife (Protection) Act, 1972 and Forest (Conservation) Act, 1980.

- Eco-development works in and around Kappat hill to provide the essential benefits to the occupants of enclosures and villages respectively to ensure their support and willing participation in wildlife conservation.
- Encourage appropriate monitoring and research works to develop programmes and plans, and thereby tackle the identified problems.
- Facilitate education and awareness creation, facilities for the benefit of all sections of population and especially students. Create awareness on the need to conserve our natural bio-resources through various mass media and other means.
- Take fire prevention and control measures in and around Kappat hill through specific programmes.
- Take habitat restoration and improvement measures wherever necessary.
- Prevention of outbreak of contagious diseases among wild animals by taking prophylactic measures among domestic animals entering forests.
- Creation of Education and Interpretation Centers.
- Construction of crop protection structures like fences, trenches and walls, etc.
- Identification of restoration of corridors to facilitate free movement of animals between and around forests
- Settle adequate compensation to the persons for death or damage caused by wild animals.
- Restriction and regulation for pollution causing industries and activities in a radius of 25 Km around the protected areas as per the Environment Protection Act.
- Integrate the wildlife Protected Areas on a watershed or landscape basis with other sectors like Rural Development, Animal Husbandry, etc. for the sustained conservation and development of the area.
- Conserve the medicinal plants in the Kappat hill forest by creation and management of Medicinal Plants Conservation Area (MPCAs).

Table **-** 18 List of plants recommended for Grenelât Development

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

9.3.3 Avenue and Canal Bank Plantations

A total length of 215 km of the inspection path and service roads shall be planted with avenue trees. Native forest trees, especially the vulnerable *Chloroxylon swietenia* and *Pterocarpus marsupium* will be planted on both the sides of the road at a distance of 5 m. Along with the compensatory afforestation, avenue and canals bank plantations may be assigned to KFD. 6.17 Crores is earmarked for the same. Greenary activities will be also be

undertaken around lift works, jack well cum pump house, etc. The responsibility of implementing the green belt lies with CADA.

With the high density of the population in the rehabilitated colonies, the need for proper green belt is most essential, not only for aesthetic purposes but also for the fulfillment of ecological functions. A total of 10961 trees are going to be lost in the project submergence area, of which 1166 are recorded in and around submergence area and the remaining are in agro-ecosystem. The dominant species are *Cocus nucifera*, followed by *Eucalyptus torticornis*, *Acacia auriculiformis*, *Tectona grandis* and *Azhadirictha indica*. The eucalyptus and teak has been planted around house backyard, along the boundary of home garden, which have been supplied to the farmers under the social forestry programme.

9.3.4 Green Belt development at R&R Centers

The local community has maintained sufficient number of trees within the settlement area, who also wish to plant same kind of trees in the rehabilitated colony. As per the requirement of PAFs, seedlings will be supplied for planting inside their gardens. Also, green belt development will be undertaken in CA areas, on both sides of the roads, around temples, etc Local people prefer that trees such as *Ficus religiosa* and *Michielia champaka* should be planted near the temple premises. Rs. 3 Lakhs is earmarked for plantation in the 3 R &R centers (500 saplings / R&R centre x 3 x Rs. 200 per sapling). The responsibility of implementing the green belt lies with R&R division of KNNL.

9.3.5 Agro-forestry development plan

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.

9.3.6 Fisheries Conservation and Management plan

To improve the fisheries aspects, around 10 lakhs fingerlings (over 75 ma) comprised of Indian Major carp - *Catla catla* – 40.0%, *Labeo rohita* - 30.0% and *Cirrhinus mrigala* - *30.0% are* to be introduced annually in the river Tungabhadra above the Project site fisheries Division, Tungabhadra Board at T.B.Dam, on their part stock annually lakhs of fish seed of the Gangetic and exotic carp in the Tungabhadra reservoir for augmenting fish production. The Authorities related to the proposed Project could also contribute their service and also submit their indents well-in-advance - say - During January - February of each year to the Fisheries Development officer, T.B.Dam, Hospet taluk, Bellary district who, on their ,art, around August - September of every current year ensures apply of the required stocking material. The process envisages helps in increased fish production from the river in question, and the reservoir as well. The total cost towards the fish fingerlings will be around Rs. 10/- lakhs per annum. This good will on the part of the Project Authorities will positively help scores of fishermen engaged in the profession, generation after generation, to modestly elk out their livelihood. Post project monitoring is as follows;

- A 'Monitoring Technical Committee be constituted with representative from Fish and Fisheries disciplined to oversee the effective implementation of the suggestions made.
- Limnological and fisheries investigations for a period of 3 to 5 years be programmed to assess the impact of ecological changes, if any, in order to introduce corrective measures for the over-all sustainable developmental processes of the aquatic life prevail1ing based on the scientific know available.

9.4 Water, Air and Noise Management Plan

Project Activities	Environmental Impact	Mitigation Measures	Responsible Agency for Implementation	Cost for implementing EMP
1. Construction Phase				
a. Water Environment				
Construction of canals, field drains etc.	Impounding of water	• Water will be pumped and utilized for dust suppression activities in the nearby sites	Project Contractor KNNL	7.5 Lakhs (Rs.1.5 Lakhs / septic tank and soak pit x assuming 5 labor camps spread across the command area)
Construction of Labour camps	Deterioration surface and ground water quality	• The Sewage generated from labour camps will be treated in Septic Tank and Soak Pits that will be designed and constructed as per IS 2470 Part-I & Part-II guidelines. Project assures there will not be any direct discharge of sewage into the water. • Frequent check (say quarterly) of septic tank and soak pits will be done to repair and replacement of leaking and malfunctioning. And it will be designed in such a way that no adverse change in groundwater quality as a result of the discharge. • BOD and COD limits of the water shall be checked monthly to avoid eutrophication and also the decomposition of sediments to avoid eutrophication.	Project Contractor KNNL	
b. Air Environment				
Excavation, loading and unloading of sand, aggregates etc, movement of vehicles.	Fugitive dust emission, wilting of plants	• The transport vehicles using petrol or diesel will be properly maintained (emission checks on 6 monthly basis) to minimize pollutant emissions. • Any vehicle not meeting the vehicular pollution standards will not be allowed within the construction activity & vehicular speed will be regulated at 20 kmph. • Water shall be sprayed by high-pressure water hoses during dust generating construction activities e.g. excavation, crushing/demolishing, concrete mixing, material handling etc. to suppress dust; and	Project Contractor KNNL	10 Lakhs (Lumpsum)

Project Activities	Environmental Impact	Mitigation Measures	Responsible Agency for Implementation	Cost for implementing EMP
		• Vehicles delivering loose and fine materials like sand and fine aggregates shall be covered by tarpaulin to reduce spills on roads. • The height from which excavated materials are dropped will be controlled to a minimum practical height to limit fugitive dust generation from unloading. • All roads (internal and external) to be used by the project authorities should be made 'pucca' (Sprinkled with water) to mitigate the dust generation along the roads. • The workers will be provided with PPE such as nose masks and goggles to reduce impact on health. • A greenbelt will also be developed in and around the boundary of the project site for protecting ambient air quality status.		
Operation of D.G sets, burning of fuel for cooking from labour camps.	Emission of SO_2, NO_2, PM	• Exhausts of other equipment used for construction (e.g. generators), if any shall be positioned at a sufficient height to ensure dispersal of exhaust emissions and meet the standards set by CPCB. • Idle running of vehicles will be minimized during transport and handling activities. • Low sulphur content diesel (<0.5%) will be used to run the equipments. • Domestic fuel will be provided for the construction workers to prevent cutting of trees in the vicinity	Project Contractor KNNL	
c. Noise Environment				
Construction activity like excavation and vehicular traffic	Disturbance to construction workers, technical staff and locality.	• The noise pollution will be checked and maintained by installing sound barricades around crushing plants and by taking up half yearly maintenance of heavy earth moving vehicles. Selection of equipment with less noise generation will be used. • On site workers near the noise generating	Project Contractor KNNL	2 Lakhs (lumpsum)

Project Activities	Environmental Impact	Mitigation Measures	Responsible Agency for Implementation	Cost for implementing EMP
		equipment shall be provided with noise protection devices like earmuffs/earplugs.		
Operation of D.G. Sets	To the workers and technical staff.	• Acoustic enclosures for D.G sets will be provided. • Use of DG sets should be enclosed type and should conform to the EP rules prescribed for air and noise emission. • On site workers near the noise generating equipment shall be provided with noise protection devices like earmuffs/earplugs.	Project Contractor	
2. Operational Phase				
a. Water Environment				
Construction of barrage, canals, networks, diversion of water	Change in the hydraulic regime, down stream flow, water logging.	• The downstream users will not be affected due to the shortage of water. Proper checks and monitoring will be envisaged to maintain the welfare of ecology and downstream users.	CADA	The cost for EMP is included in CADA works
Application of pesticides, herbicides, fertilizers & watering etc.	Surface & ground water quality, aquatic flora and fauna.	• Care will be taken that the pesticides applied for the crops will not leach into the ground water that adversely affects the ground water. • Restrictions on the time, method and rate of application of fertilizers and pesticides will be imposed to avoid surface run-off and leaching into the ground water. • Farmers will be advised to use nutrient management plans to reduce excess application of nutrients. • To minimize pesticide impacts, farmers shall be advised to practice Integrated Pest Management (IPM) techniques (which can include biological pest control) to maintain control over pests, reduce reliance on chemical pesticides, and protect water quality. • It does not involve construction of any barrages, hence no much impact on the aquatic life.	CADA	

Project Activities	Environmental Impact	Mitigation Measures	Responsible Agency for Implementation	Cost for implementing EMP
Excess application of water	Soil Salinity, seepage, etc	• The mitigation measures are detailed separately in below sections	CADA	The cost for EMP is included in CADA works
b. Air Environment				
Vehicular movements. Application of pesticides and herbicides.	Emission of, SO_2, NO_2, SPM.	• The KPTCL will provide power required to run the pumps for Jack well. Hence there will not be any emission of SO2, NO2 etc, • The farmers will be advised to use pesticides & herbicides during the calm period when the wind speed is low, mornings and evenings are usually good times. • Before applying the pesticides, to check for the nozzles of the spray equipments. Spraying should be done continuously at a regular time and uniformly with low pressure.	CADA	The cost for EMP is included in CADA works
c. Noise Environment				
Operation of Pumps, Vehicular movement	To the farmers working in the site, nearby villagers.	• Acoustic enclosures will be provided for the pumps operating. • Regular check-up and maintenance of the operating equipments and machines will be done and maintained in a good condition. • Plantation of noise attenuating species to reduce noise pollution will be carried out. • The development of green belt will also help in controlling the noise arising from the pumps.	CADA	The cost for EMP is included in CADA works

9.5 Ground Water Management Plan

Due to irrigation facilities in the command area, the ground water table will be drastically improved and further exploitation of ground water will be minimized due to the availability of water in the long term.

9.6 Public Health Management Plan

9.6.1 Public Health Delivery System

The suggested measures are given in the following :

- Site selected for habitation of workers will not be done in the path of natural drainage.
- Adequate drainage system to dispose storm water from the labour camps will be provided by providing storm water drains/channels.
- Adequate vaccination and immunization facilities will be provided for workers at the construction.
- Labor camps will be located in at least 1.0 Km away from nearest water bodies and villages.

9.6.2 Development of Medical Facilities

In the proposed project site the population of about 500 in the peak construction period and 250-300 in the lean season is likely to congregate during the construction stage. It is proposed to have medical facilities at the construction sites. Hence, it is suggested to set up small dispensary near major construction site areas, so that it can serve the health aspects of labour population migrating in the area as well as the local population.

9.6.3 Proposed Health facilities at Construction Sites and Labour Camp

The First Aid post will be provided at the major construction site, so that workers are immediately attended to in case of an injury or accident. This first aid post will have at least the following facilities:

- First Aid Box with essential medicines including ORS packets
- First Aid appliances splints and dressing materials
- Stretcher, wheel chair etc.,
- Facilities such as Spirometry, Pulseoxymetry, Lung function test as per the guidelines of Dept of Factories and Boilers, GoK will be provided.

9.6.4 Health Extension Activities

The Doctor from the nearby dispensary will be made for regular visits to the construction sites and organize health promotional activities with the active participation of the local Village Panchayat, NGO's and available local health functionaries. In order to provide the better Health facilities, Rs. 5.00 Lakhs shall be allocated as part of the EMP.

The Health functionaries would undertake the following tasks as part of Health Promotion Activities:

- Collect water samples to ascertain the potability of water to monitor regular disinfection of drinking water sources.
- Maintain close surveillance on incidence of communicable diseases in the villages.
- Maintain close liaison with the community leaders and health functionaries of different departments, so that they can be mobilized in case of an emergency.

9.7 Solid Waste Management Plan

The population in the project site due to the congregation of construction labour is expected to be 400-500 persons. The average per capita solid waste generation is expected at the order of 0.45 Kg/Person/day & solid waste likely to be generated from labour camps will be 225 Kg/Day.

Adequate facilities for collection, conveyance and disposal of solid waste will be developed. For solid waste collection, adequate number of masonry storage vats each of $2m^3$ capacity will be constructed at suitable locations near labour camps. These vats will be emptied at regular intervals (say once in three days) and collected waste will then be transported to nearby municipal landfill sites as identified by the jurisdictional competent authorities. A sum of Rs. 35.69 Lakhs is allocated for better management of solid waste arising from the labor camps.

9.8 Cost for implementation of EMP

Table - 19 Estimated cost for implementation of EMP

Sl.No	Proposed EMP aspects	Cost in Lakhs	Responsible agency for implementation
1	Catchment Area Treatment Plan (Engineering and Biological measures)	1014.57	CADA
2	Command Area Development Plan	1300.00	CADA
3	Green belt development and biodiversity conservation measures	737.92	CADA, R&R Division, KFD
4	Fisheries conservation and management plan	10.00	Dept. Fisheries, GoK
5	Water, Noise and Air Quality Management Plan	19.50	KNNL
6	Public Health Management Plan	5.00	KNNL, Dept and Health and Family Welfare, GoK
7	Solid Waste Management Plan	35.69	KNNL
8	Rehabilitation and Resettlement Plan	10991.31	R&R Division
	Total	**14113.99**	