KRISHNA BHAGYA JALA NIGAM LIMITED

(A Government of Karnataka Undertaking)
Office of the Chief Engineer, KBJNL Dam Zone,
ALMATTI - 586 201. B. Bagewadi Taluk, Bijapur District.
Phone : 08426-281038 (O), 281046 (Estt), 281600 (Fax), E-mail : cedam_almatti@yahoo.co.in

NO.KBJNL/CEA/AE-4/2016-17/2353 Dated:28.07.2016

To,

The Director and Member Secretary,
River Valley and Hydroelectric Projects,
Vayu wing, 3rd Floor,
Indira Paryavaran Bhavan,
Ali Ganj, Lodhi Road,
New Delhi-110003.

Sir,

Sub: Upper Krishna project Stage-I and II in Karnataka by M/s Krishna Bhagya Jala Nigam Ltd (KBJNL) - Submission of Final EIA report for issue of Environmental Clearance - reg.,

Ref: Terms of Reference issued on 10.05.2016

======

Upper Krishna irrigation project across Krishna river provides irrigation facility to desert areas of Bijapur district and drought prone areas of Bagalakot, Gulbarga, Yadagir and Raichur districts in northern Karnataka. Govt. of India has accorded special provision to these areas under article 371J of the constitution to combat the regional imbalances. The project involves construction of 2 major dams near Alamatti and Narayanapur to facilitate the irrigation. The Upper Krishna project was executed in 2 stages. Stage-I of the project is irrigating 4,24,903 Ha and Stage-II is irrigating 1,97,120 Ha. Both Stage-I & II was accorded Environmental Clearance from MoEF vide letter Nos. J-12011/41/86-IA dated 05.04.1989, J-12011/31/96-IA.I dated 18.07.2000 and J-12011/30/96-IA.I dated 04.10.2000 respectively.

Now, due to the dire demand of farmers and to eradicate regional imbalances, KBJNL is intending to expand the command area of Upper Krishna project by providing irrigation facilities for the additional command area which was left out physical area of Stage-I and II of Upper Krishna project. This proposal involves lifting of water from Krishna river directly at 4 places without constructing any structures across the river and intending to provide irrigation facilities for the drought prone areas. The water required to irrigate the additional command area is achieved by reducing the irrigation intensity of Upper Krishna Project from 115% to 100%. The details of the additional command area proposed are as follows;

Sl.No	Name of lifting point	Area propose to be irrigated (Ha)	Water requirement in M.Cum
1	Thimmapur LIS	20100	124.87
2	Ramthal(Marol) LIS	38000	165.37
3	Budihaal-Peerapur LIS	20243	107.03
4	Nandawadagi LIS	36100	106.18

The project was considered in the 91st EAC held on 09.02.2016 and issued ToRs for preparation of EIA report by considering one season baseline data collection and directed to conduct Environmental Public Consultation (EPC) in Bagalkot, Vijayapura and Raichur Districts. As per the ToRs, Draft EIA/EMP report was prepared and submitted to KSPCB for conducting EPC. Accordingly, EPC was conducted on 25.07.2016 at Nandawadagi Village, Hunagund Taluk, Bagalkot District, 26.07.2016 at Salwadagi Village, Muddebihal Taluk, Vijayapura District and on 27.07.2016 at Tondihal Village, Lingasugur Taluk, Raichur District respectively.

On the above aspect the 'Final EIA Report, Executive Summary of Final EIA report along with the compliance to the EPC proceedings and ToRs' is herewith submitted for kind consideration and it is kindly requested to issue the Environmental Clearance for the above said projects at the earliest.

Yours faithfully,

Encl:1. Final EIA Report.
2. Executive Summary of Final EIA Report.
3. Soft copy of the above in CD.

Chief Engineer,
KBJNL, Dam Zone,
Almatti.

FINAL ENVIRONMENT IMPACT ASSESSMENT REPORT

FOR

UPPER KRISHNA PROJECT IN VIJAYAPURA DISTRICT IN KARNATAKA

PROJECT BY

KRISHNA BHAGYA JALA NIGAM LTD
KARNATAKA

CONSULTANTS

ENVIRONMENTAL HEALTH & SAFETY CONSULTANTS PVT LTD
 # 13/2, 1ST MAIN ROAD, NEAR FIRE STATION, INDUSTRIAL TOWN,
RAJAJINAGAR,BANGALORE-560 010,
QCI NO. 43 AS PER REV. 43 JUL 11, 2016

DOCUMENT NO. EHSC/KBJNL/UKP

VOLUME - I

[1]Cover page - www.kbjnl.com

REVISION RECORD

Rev. No	Date	Purpose
EHSC/01	09.06.2016	Issued as Draft EIA Report for Comments and Suggestions
EHSC/02	10.06.2016	Issued as Draft EIA Report for submission to KSPCB for conducting Environmental Public Hearing
EHSC/03	28.07.2016	Issued as Draft Final EIA Report to Clients and Experts for comments and suggestions
EHSC/04	29.07.2016	Issued as Final EIA Report for submission to MoEF

DECLARATION BY EXPERTS CONTRIBUTING TO THE EIA STUDIES

I, hereby certify that, I was a part of the EIA Team in the following capacity that developed this EIA.

EIA Coordinator Name	Madhu Kumar C.
Signature & Date	30/05/16
Period of Involvement	February 2016 to December 2016
Contact Information	080-23012100 / madhu@ehsc.in

A. Functional Area Experts

Sl.No	Functional Area	Name of the Expert	Signature & Date
1	Soil Conservation (SC)	Shri. K. S Prabhakar	
2	Ecology and Biodiversity (EB - Aquatic Studies)	Shri. M.F Rahman	
3	Ecology and Biodiversity (EB)	Santhosh Kumar T M	04.06.16
4	Socio-Economics (SE)	Dr. H V Shivappa	
5	Risk Assessment & Hazard Management (RH)	Shri. Rakesh Gupta	
6	Air Pollution Prevention, Monitoring & Control (AP)	Shri. Vishal N Wadkar	02/06/2016
7	Meteorology, Air Quality Modeling & Prediction (AQ)	Mrs. Praveena Kumari H N	Praveena
8	Hydrology, Ground Water & Water Conservation (HG)	Shri. Venkata Naresh Kumar	E. V. Naresh Kumar
9	Geology (GEO)	Shri. Venkata Naresh Kumar	E. V. Naresh Kumar
10	Water Pollution Prevention, Control & Prediction of Impacts (WP)	Shri. Vishal N Wadkar	02/06/2016
11	Noise (NV)	Prof. M N Sreehari	
12	Land Use (LU)	Dr. B. C Nagaraja	
13	Solid Waste and Hazardous Waste Management (SHW)	Shri. Vishal N Wadkar	02/06/2016

B. Team Member

Sl.No	Name	Signature & Date
1.	Mr. Santhosh Kumar T.M	04.06.16

C. Supporting Staff

Sl.No	Name	Signature & Date
1.	Ms. Shrinidhi R.	
2.	Ms. Vijayalakshmi R. Naik	
3.	Mr. Naresh G.	

D. Environmental Monitoring Services

Sl.No	Name	Signature & Date
1.	Environmental Health and Safety Research and Development Centre, #13/2, Ist Main Road, Near Fire Station, Industrial Town, Rajajinagar, Bangalore-10.	7/06/2016

I, Shivanand M Dambal, hereby, confirm that the above mentioned experts prepared the EIA project entitled Upper Krishna Project in Vijayapura District, Karnataka' by M/s Krishna Bhagya Jala Nigam Ltd. I also confirm that the consultant organization shall be fully accountable for any misleading information mentioned in this statement.

Signature	
Name	Shivanand M. Dambal
Designation	Chairman & Managing Director
Name of the EIA Consultant Organization	Environmental Health and Safety Consultant Pvt Ltd, Bangalore
NABET Certificate No. & Issue Date	NABET/EIA/RA080/55 dated 03 Dec 2015

National Accreditation Board for Education and Training

NABET

NABET/EIA/RA080/55 **Dec 03, 2015**

Environmental Health & Safety Consultants Pvt. Ltd.
13/2, IST Main Road, Near Fire Station,
Industrial Town, Rajajinagar,
Bangalore - 560 010
(Kind Attention: **Mr. Madhu Kumar C.**)

Dear Sir,

Sub: Re-Accreditation

This has reference to your application to QCI-NABET for re-accreditation (RA) as EIA Consultant Organization and the assessment carried for same in your organization from **Aug. 20-22, 2015.**

We are pleased to inform you that based on the document and office assessment during RA, the Accreditation Committee has approved renewal of accreditation of your organization for a period of three years from **Aug. 22, 2015 to Aug. 21, 2018** subject to coverage of balance Functional areas and specific response to NCs/Obs./Alerts issued, as applicable (Refer Annexure III) with the following details:

1. Annexure I - Scope of accreditation
2. Annexure II - List of experts with approved sectors/ functional areas
3. Annexure III - Non-Conformances/ Observations/ Alerts (NCs/ Obs./ Alerts)
4. Annexure IV - Observations on Quality Management System (QMS)
5. Annexure V - Terms and conditions of accreditation
6. Annexure VI - Result of assessment
7. Annexure VII - Guidelines for addressing Major Non-Conformances/ Observations/ Alerts
8. Annexure VIII - Format to be followed for mentioning the names of the experts involve in EIA reports prepared by **Environmental Health & Safety Consultants Pvt. Ltd.**

Result of RA for successful candidates are already posted on QCI-NABET Website. Details including those not approved and NCs/Obs/alerts, as applicable, are given in Annexure III. You are requested to take necessary actions to close the NCs/ Obs. as per guidelines and timeframe mentioned in Annexure VII of this letter. You are also advised to review eligibility of organization as per Version 3 of the Scheme (posted on NABET website) which has become effective from Sep 1, 2015 and meet its requirements by Dec. 31, 2015 positively.

Please make all payments to NABET as applicable, within one month from the date of invoice sent to you. Continuation of this accreditation of your organization is subject to the clearance of all dues by your organization, satisfactory compliance to Annexure III and V.
With best regards,

Yours sincerely,

(Abhay Sharma)
Assistant Director

6th Floor, ITPI Building, 4-A, Ring Road, I.P Estate, New Delhi - 110 002, India
Tel. : +91-11-2332 3416 / 17 / 18 / 19 / 20 Fax : +91-11-2332 3415
e-mail : nabet@qcin.org Website : www.qcin.org

QCI — Scheme for Accreditation of EIA Consultant Organizations — NABET

Scope of Accreditation **Annexure I**

NAME OF THE CONSULTANT ORGANIZATION: **Environmental Health & Safety Consultants Pvt. Ltd.**
13/2, IST Main Road, Near Fire Station,
Industrial Town, Rajajinagar,
Bangalore -560 010

Sl. No.	Sector number		Name of Sector	Category A/B
	As per MoEF Notification	As per NABET Scheme		
1.	1 (c)	3	River Valley, Hydel, Drainage and Irrigation projects	A
2.	3 (a)	8	Secondary ferrous	B
3.	5 (g)	22	Distilleries	A
4.	5 (j)	25	Sugar Industry	B
5.	7 (f)	34	Highways, railways, transport terminals, mass rapid transport systems	B
6.	8 (a)	38	Building and large construction projects including shopping malls, multiplexes, commercial complexes, housing estates, hospitals, institutions	B
7.	8 (b)	39	Townships and Area development projects	B
Total = 07 Sectors *Individual EIA Coordinators approved for different sectors are mentioned in Annexure II*				

The ACO has overall obtained more than 60 % marks and therefore qualifies for Cat. A.

for
(Abhay Sharma)
Assistant Director

ABBREVIATIONS

AIS & LUS	All India Soil and Land Use Survey
APHA	American Public Health Association
BIS	Bureau of Indian Standards
BOD	Biological Oxygen Demand
BPL	Below Poverty Line
BPLIS	Budihaal-Peerapur Lift Irrigation Scheme
BSI	Botanical Survey of India
CA	Compensatory Afforestation
CAD	Command Area Development Plan
CADA	Command Area Development Authority
CAT	Catchment Area Treatment
CGWB	Central Ground Water Board
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
CWC	Central Water Commission
DAP	Diammonium phosphate
dB(A)	Decibels - A scale rating
DC	Deputy Commissioner
DDP	Dry land Development Programme
DG	Diesel Generator
DPAP	Drought Prone Area Programme
DWL	Depth to Water Level
E-FLOW	Environmental/ecological flow
EIA	Environment Impact Assessment
EMP	Environmental Management Plan
EPA	Environment Protection Agency
EPH	Environmental Public Hearing
ERDAS	Earth Resources Data Analysis System
GBDP	Green Belt Development Plan
GDP	Gross Domestic Product
GEM	Ground Water Estimation Committee methodology
GESCOM	Gulbarga Electricity Supply Company
GIS	Geographical Information System
GOI	Govt. of India
GOK	Government of Karnataka
GWDT	Godavari Water Dispute Tribunal
Ha	Hectare
IMD	Indian Meteorological Dept.,
IRS	Indian Remote Sensing satellites
IUCN	International Union for Conservation of Natural Resources
IWDP	Integrated Watershed Development Programme
K	Kelvin
KBJNL	Krishna Bhagya Jala Nigam Ltd
KFD	Karnataka Forest Dept.,
KPTCL	Karnataka Power Transmission Corporation Ltd
KSPCB	Karnataka State Pollution Control Board
KSRSAC	Karnataka State Remote Sensing Application Centre
KWDT	Krishna Water Dispute Tribunal
LA	Land Acquisition
LISS	Linear Imaging Self-Scanning
M.CUM	Million Cubic Meter

MOEF	Ministry of Environment, Forests and Climate Change
NAAQ	National Ambient Air Quality Standards
NBSS&LU	National Bureau of Soil Survey and Land Use
NDMA	National Disaster Management Authority
NGO	Non Governmental Organisation
NIDM	National Institute for Disaster Management
NLIS	Nandawadagi Lift Irrigation Scheme
NTFP	Non Timber Forest Produce
NWDPRA	National Watershed Development Project for Rainfed Areas
OFD	On-farm Development Works
PAF	Project Affected Family
PAP	Project Affected Person
PDO	Panchayath Development Officer
PHC	Public Health Centre
PM	Particulate Matter
PPE	Personal Protective Equipment
PWD	Public Works Dept.
R&R	Rehabilitation and Resettlement
RET	Rare, Endangered and Threatened
RF	Reserve Forests
RFCTLARR	Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement
RL	Ridge Level
RLIS	Ramthal (Marol) Lift Irrigation Scheme
SC	Scheduled Caste
SHG	Self Help Group
SOI	Survey of India
SPM	Suspended Particulate Matter
ST	Scheduled Tribe
TLIS	Thimmapur Lift Irrigation Scheme
TMC	Thousand Million Cubic Feet
TOR	Terms of Reference
TSP	Total Suspended Particulate
WL(P)A	Wildlife (Protection) Act
WRD	Water Resource Dept.,
WUA	Water Users Association
ZSI	Zoological Survey of India

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Chapter 1. Introduction

1.1 Project Proponent

"Krishna Bhagya Jala Nigam Ltd (KBJNL) was incorporated on19th August 1994 under the Companies Act, 1956 as a Company, wholly owned by the Government of Karnataka for implementation of the Upper Krishna Project (UKP) in the State of Karnataka.

The Company is responsible for planning, investigation, estimation, execution, operation and maintenance of all irrigation projects coming under the UKP. The Company is also responsible to obtain Government of India's clearance and execute the UKP. The Company is also entrusted with the responsibility of Rehabilitation and Resettlement of the people affected by the Project. The Company is authorised to sell water and recover revenues from individuals, groups of farmers including those in the Command Area Development Authority, towns, city municipalities and industries.

Large parts of Karnataka are located in the drought-prone rain shadow of the Western Ghats characterised by low and unreliable rainfall. UKP and other irrigation projects are being executed in the drought-prone northeastern part of Karnataka about 456 Kms from Bangalore in the districts of Gulbarga, Yadgir, Raichur, Bagalkot and Bijapur. It occupies a triangular area lying between the Krishna and Bhima rivers. The population in this area subsists mainly on agriculture. The area, though being subjected to vagaries of the monsoons, has highly fertile land. Making available water for irrigation, the economic picture of the area would be transformed contributing greatly to the development of the region in particular and Karnataka State in genera"[2].

M/s Environmental Health & Safety Consultants Private Limited, Bangalore is entrusted by KBJNL to carry out the Environmental Impact Assessment & Environmental Management Plan studies for Modernization of Upper Krishna Project in Karnataka. KBJNL is the employer and executing agency for the project. The proposed project falls under 1(c) of EIA Notification, 2006 and its amendments and hence, the additional Terms of reference (ToR) for the project was accorded by Ministry of Environment, Forests and Climate Change (MoEF) vide letter no. No. J-12011/3/1996-IA-Idated 10.05.2015 (Annexure-1).

This EIA report presents baseline data collected for one season viz, March 2016 to May-2016 for physical, biological and socio-economic components of environment, identification, prediction and evaluation of impacts based on the project activities and to prepare Environmental Management Plan (EMP) for mitigation of adverse impacts due to the proposed project.

1.2 Brief Description of the Project and its Importance to the Region

Upper Krishna irrigation project across Krishna river provides irrigation facility to desert areas of Bijapur district and drought prone areas of Bagalkot, Gulbarga, Yadagir and Raichur districts in northern Karnataka. Govt. of India has accorded special provision to these areas under article 371J of the constitution to combat the regional imbalances. The project involves construction of two major dams near Almatti and Narayanapur to facilitate the irrigation. The Upper Krishna project was executed in two stages. Stage-I of the project is irrigating 4,24,903 Ha and Stage-II is irrigating 1,97,120 Ha. Both Stage-I & II was accorded Environmental Clearance from MoEF vide letter Nos. J-12011/41/86-IA dated 05.04.1989, J-12011/31/96-IA.I dated 18.07.2000 and J-12011/30/96-IA.I dated 04.10.2000 respectively (Annexure-2).

Now, due to the dire demand of farmers and to eradicate regional imbalances, KBJNL is intending to expand the command area of Upper Krishna project **by providing irrigation facilities for the adjacent areas within the gross command area which was left out**

[2] www.kbjnl.com

physical area of Stage-I and II of Upper Krishna project. This proposal involves lifting of water from Krishna river directly at four places without constructing any structures across the river and intending to provide irrigation facilities for the drought prone areas. The water required to irrigate the additional command area is achieved by reducing the irrigation intensity of Upper Krishna Project from 115% to 100%. The details of the additional command area proposed are as follows;

Table 1.1 List of modernization works taken up by KBJNL

Sl.No	Name of lifting point	Area propose to be irrigated (Ha)	Water requirement in M.Cum
1	Thimmapur	20100	124.87
2	Ramthal(Marol)	38000	165.37
3	Budihaal-Peerapur	20243	107.03
4	Nandawadagi	36100	106.18
5	NRBC 9(A) Distributory	15200	97.91

The additional lifting of water neither involves submergence nor Rehabilitation & Resettlement. Further, there are no ecologically sensitive area, national parks, wildlife sanctuaries, Reserve Forests in the command area and no forest land is required to implement the scheme. KBJNL approved to reduce the irrigation intensity of UKP from 115% to 100% vide 100th Board of Directors meeting held on 30.09.2015. UKP Stage-I and II has already obtained EC and hence amendment to Environmental Clearance was sought from MoEF, New Delhi for the already approved EC.

1.3 Need for the Study

"Every anthropogenic activity has some impact on the environment. More often, it is harmful to the environment than benign. However, mankind as it is developed today cannot live without taking up these activities for his food, security and other needs. Consequently, there is a need to harmonize developmental activities with the environmental concerns. Environmental impact assessment (EIA) is one of the tools available with the planners to achieve the above-mentioned goal.

It is desirable to ensure that the development options under consideration are sustainable. In doing so, environmental consequences must be characterized early in the project cycle and accounted for in the project design.

The objective of EIA is to foresee the potential environmental problems that would arise out of a proposed development and address them in the project's planning and design stage. The EIA process should then allow for the communication of this information to:

- The project proponent;
- The regulatory agencies; and,
- All stakeholders and interest groups.

EIA integrates the environmental concerns in the developmental activities right at the time of initiating for preparing the feasibility report. In doing so, it can enable the integration of environmental concerns and mitigation measures in project development. EIA can often prevent future liabilities or expensive alterations in project design.

- The project proponent;
- The regulatory agencies; and,
- All stakeholders and interest groups.

EIA integrates the environmental concerns in the developmental activities right at the time of initiating for preparing the feasibility report. In doing so, it can enable the

integration of environmental concerns and mitigation measures in project development. EIA can often prevent future liabilities or alterations in project design"[3].

1.4 Scope of the EIA

The present study includes detailed inventory of existing status of environment in the Study area for various identified environmental components viz. air, noise, water, land, biological and socio-economic aspects. Under the scope of EIA, it is envisaged to study:

- To assess the present status of air, noise, water, land, biological and socio-economic components of the environment.
- To identify, predict and evaluate significant impacts due to project activities on various environmental components during the Construction and Operational stages of the project.
- To delineate proposed pollution control measures and accordingly formulating Environmental Management Plan (EMP).
- To delineate post-project environmental monitoring programme to be implemented by KBJNL.

1.5 Components of EIA

The proposed project requires comprehensive EIA. Following components are included in the EIA report.

- Project Description
- Baseline Environmental Scenario
- Anticipated Environmental Impacts and Mitigation Measures
- Additional Studies - Public Consultation, Risk Assessment, Social Impact Assessment for Land Acquisition
- Project Benefits
- Environmental Monitoring Program
- Environmental Management Plan
- Disclosure of Consultants
- Summary & Conclusion

1.6 Approach and Methodology

The EIA report has been prepared and presented as per requirements of the EIA, 2006 of MoEF under the Environment (Protection) Act, 1986. The following methodologies were followed for the preparation of EIA.

This EIA report presents baseline data collected for one season viz, March 2016 to May-2016 for physical, biological and socio-economic components of environment, identification, prediction and evaluation of impacts based on the project activities and to prepare Environmental Management Plan (EMP) for mitigation of adverse impacts due to the proposed project.

[3]http://envfor.nic.in/divisions/iass/eia/Chapter1.htm

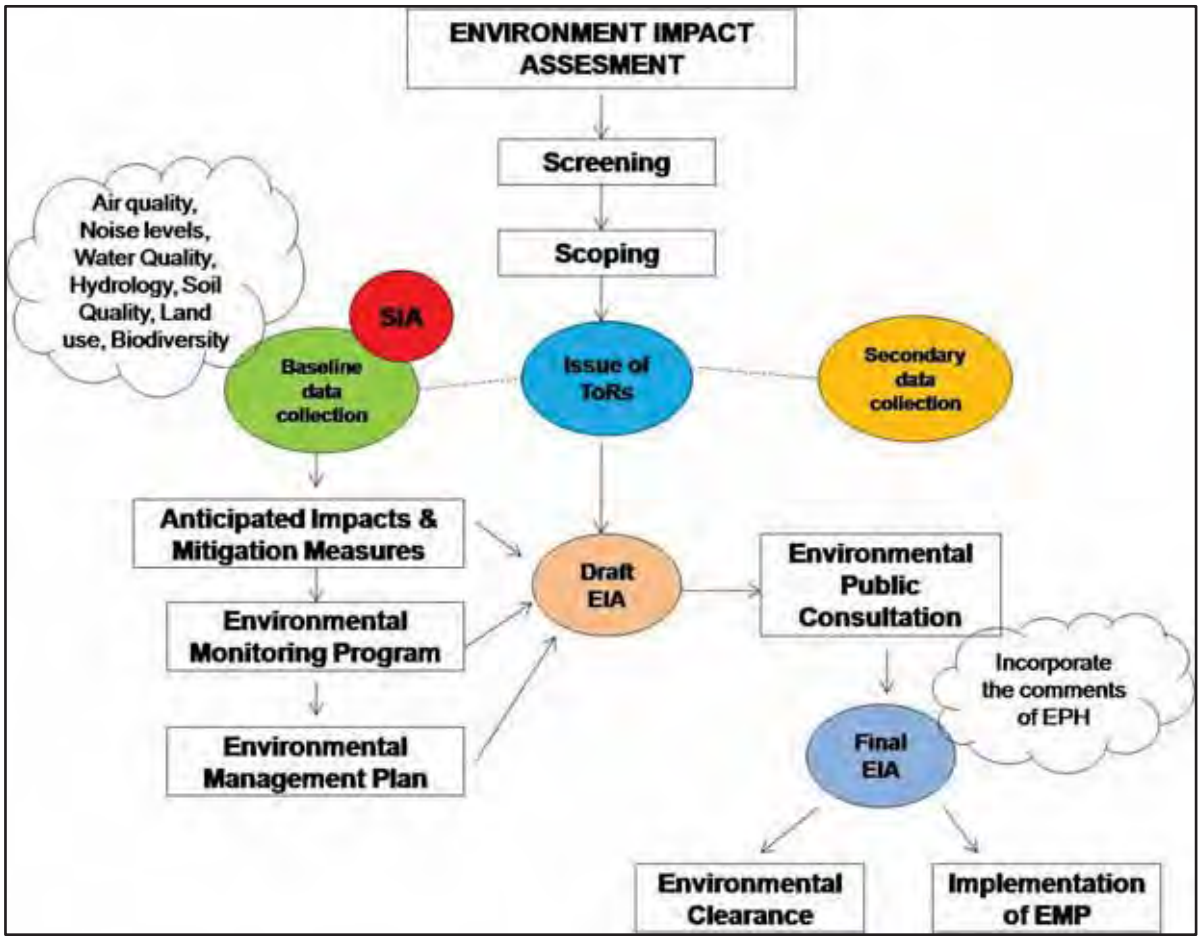


Fig 1.1 Methodology adopted for preparation of EIA report

Chapter 2. Project Description

2.1 Brief History of Upper Krishna Project in Karnataka

The River Krishna is the second biggest river in the peninsular India and takes birth in the Mahadev range of Western Ghats. It rises in the Western Ghats at an altitude of 1,336.49 m above sea level near Mahabaleshwar in Maharashtra and flows across the peninsula from West to East for a length of about 1,392 Km before it drains into the Bay of Bengal. It enters the State of Karnataka at its 304 Km and passes through the State for 480 Km and finally falls into Bay of Bengal near Bapatla in Andhra Pradesh . It is an interstate river flowing in three States viz., Maharashtra, Karnataka, Telangana and Andhra Pradesh. The river basin is 2.57 lakh Sq. Km, and the States of Maharashtra, Karnataka and Andhra Pradesh contributes 68,800 Sq. Km (26.8%), 1, 12,600 Sq. Km (43.8%) and 75,600 Sq. Km (29.4%) respectively.

The Upper Krishna Project was originally conceived by the erstwhile State of Hyderabad along with the Lower Krishna Project (now known as Nagarjunasagar project). This project could not be initially implemented because the submersion was mostly in Bijapur Dist., which was then not a part of State of Mysore (Karnataka). After the reorganisation of states the scope of the project was modified so as to include two storage reservoirs.

In 1973, the Krishna Water Dispute Tribunal (KWDT) adjudicated on the sharing of Krishna river waters between the three riparian states of Maharashtra, Karnataka, and Andhra Pradesh. KWDT - I in its final order dated 24.12.1973 has allocated the 75% dependable flows of 2060 TMC of Krishna waters amongst three riparian states and the share of Karnataka State aggregated to 734 TMC of water. The further report of the Tribunal dated 27.05.1976 also contained modification of the final order based on references made by different States under Section 5(3) of the Act.

The Central government construed the aforesaid final order to be the decision of the Tribunal and accordingly published the same in the Extraordinary Gazette dated 31.05.1976 and on such publication, the said final order has statutorily became final and binding on the parties to the dispute. To implement the award, the Government of Karnataka formulated a Master Plan comprising of various projects. One of these projects was the Upper Krishna Project under which it was proposed to utilise 173 TMC of water. In order to derive maximum benefits as early as possible, the project was envisaged to be executed in different Stages and Phases to utilise 119 TMC of water in Stage 1 and 54 TMC in Stage II. The command area map of UKP Stage-I and II is enclosed as Annexure-3.

2.2 Components of Upper Krishna Project in Karnataka

Upper Krishna project involves construction of two major dams viz., Narayanpur Dam and Almatti Dam. Narayanapur dam acts has a balancing reservoir for the later. The salient features of the above is given below;

Table 2.1 Salient features of UKP

Particulars	**Stage-I**	**Stage-II**	**Present status**
Water Utilization (TMC)	119	54	173
Gross Command area (Ha)	5,49,000	2,68,074	8,17,074
Irrigable Command area (Ha)	4,24,903	1,97,120	6,22,023
Districts benefitting	Bijapur, Raichur, Kalaburgi, Yadgir and Bagalkot		
1. Narayanpur Reservoir			
Location	$16^0 13^I 17.11^{II}$ N, $76^0 20^I 46.61^{II}$ E		

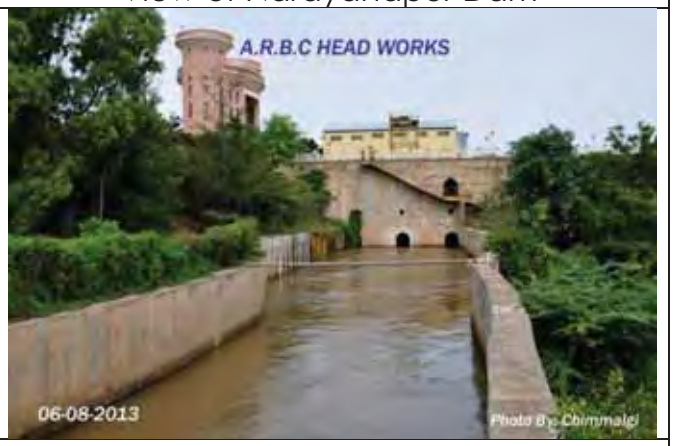
Particulars	**Stage-I**	**Stage-II**	**Present status**
Catchment area (Sq.Km)	47,850	--	47,850
Net yield at dam site (75% dependability) TMC	284	--	284
Gross storage capacity (TMC)	37.965	--	37.965
Dead storage (TMC)	7.165		7.165
Full Reservoir Level (m)	492.252	--	492.252
Max. Water Level (m)	492.252	--	492.252
Top level of dam in earthen & in masonry section (m)	496.752	--	496.752
Max. Area of water spread (Sq.km)	132	--	132
Total length of dam including dykes (m)	10637.52		
Max. Height of the dam above the lowest foundation level (m)	29.72	--	29.72
Top width of the dam (m)	7.5	--	7.5
Design flood intensity	37,945 Cum./sec (13,40,000 cusecs)	--	37,945 Cum./sec (13,40,000 cusecs)
No.& size of spillway crest gates	30 Nos. (15 m x 12 m)	--	30 Nos. (15 m x 12 m)
Total area of submergence (ha)	13206	--	13206
Villages submerged	41	--	41
2. Almatti Dam			
Location	$16^0 19' 55.24''$ N, $75^0 53' 14.73''$ E		
Net yield at dam site (75% dependability) TMC	270	--	270
Catchment area (Sq.Km)	35925	--	35925
Gross storage capacity (TMC)	42.19	80.89	123.08
Dead storage (TMC)	--	17.65	17.65
Full Reservoir Level (m)	512.256	519.6	519.6
Max. Water Level (m)	519.8	519.8	519.8
Top level of dam in earthen & in masonry section (m)	523.80 m	528.756	528.756
Max. Area of water spread (Sq.km)	181	306.87	487.87
Total length (m)	1564.83	--	1564.83
Max. Height of the dam above the lowest foundation level (m)	49.29	--	49.29
Top width of the dam (m)	7.5	--	7.5
Design flood intensity	31007 Cum./sec (10,95,000 cusecs)	--	31007 Cum./sec (10,95,000 cusecs)
No.& size of spillway crest	26 Nos. (15 m x 3.24	26 Nos. (15 m x	26 Nos. (15 m x

Particulars	**Stage-I**	**Stage-II**	**Present status**
gates	m)	10.584 m)	10.584 m)
Total area of submergence (ha)	24230	24557	48787
Villages submerged	136	--	136
Power generation	--	297 MW	--
B.C Ratio	1.25	1.65	--
Cost of the project	1214.97 Cr (86-87 Price level)	2358.27 Cr (98-99 Price level)	--
3. Canal Systems			
Narayanapur Left Bank Canal	Length - 448 Km	--	Length - 448 Km
	GCA – 5,27,000 Ha		GCA – 5,27,000 Ha
	CCA – 4,08,800 Ha		CCA – 4,08,800 Ha
Almatti Left Bank Canal	Length - 77.65 Km	Length - 25.35 Km	Length - 103 Km
	GCA – 22,000 Ha	GCA – 7,334 Ha	GCA – 29,334 Ha
	CCA - 16,200 Ha	CCA - 4,035 Ha	CCA - 20,235 Ha
Narayanapur Right Bank Canal	--	Length - 95 Km	Length - 95 Km
		GCA – 1,05,000 Ha	GCA – 1,05,000 Ha
		CCA - 84,000 Ha	CCA - 84,000 Ha
Almatti Right Bank Canal	--	Length - 121 Km	Length - 121 Km
		GCA – 23,000 Ha	GCA – 23,000 Ha
		CCA - 16,100 Ha	CCA - 16,100 Ha
Mulawad LIS	--	Length - 128.5 Km	Length - 128.5 Km
		GCA – 44,070 Ha	GCA – 44,070 Ha
		CCA - 30,850 Ha	CCA - 30,850 Ha
Indi LIS	--	Length - 96.5 Km	Length - 96.5 Km
		GCA – 59,860 Ha	GCA – 59,860 Ha
		CCA - 41,900 Ha	CCA - 41,900 Ha
Rampur LIS	--	Length - 32 Km	Length - 32 Km
		GCA – 28,910 Ha	GCA – 28,910 Ha
		CCA - 20,235 Ha	CCA - 20,235 Ha
Total	GCA – 5,49,000 Ha	GCA – 2,68,074 Ha	GCA – 8,17,074 Ha
	CCA – 4,25,000 Ha	CCA – 1,97,120 Ha	CCA – 6,22,023 Ha

View of Almatti Dam

View of Narayanapur Dam

View of NLBC - Canal



View of Almatti Right Bank Canal Head works

2.3 Need for Modernization of Upper Krishna Project

Due to the dire demand of farmers and to eradicate regional imbalances, the modernization of UKP is undertaken by KBJNL to provide irrigation facilities for the higher lands within the gross command area of UKP. The need for taking up modernization works is as follows;

- The command area of UKP is a part of undeveloped Hyderabad Karnataka region. Govt. of India has accorded special status to these areas under article 371 (J) of the constitution. Hence, providing irrigation is utmost important to these regions.
- Separate allocations of water for the modernization works are not required as the command lies within the planned GCA of UKP Stage-I and II.
- KBJNL has initiated water conservation measures by adopting Govt. of India program on 'National Water Mission (NWM)' as a part of National Action Plan for Climate Change. The main objective of NWM is conservation of water and minimizing wastage and ensuring its more equitable distribution both across and within states through 'Integrated Water Resource Development and Management (IWRM)'.
- The modernization works are in line with the programs of water conservation schemes launched by Govt. of Karnataka and Govt. of India.

- To eradicate regional imbalances in the command area and to fulfill the persistent demands of the formers and public representatives. Increased demands of adjoining formers of the command areas in the event of savings of water in the allocation.
- Technological advancement in lift irrigation schemes helps in providing irrigating facility to higher lands to eradicate regional imbalances.
- Micro-irrigation technology helps in conservation of water and hence equitable distribution/benefit sharing.
- Adoptation of farmers to new irrigation technologies thrive KBJNL for providing irrigation for drought prone areas.

Table 2.2 Details of projects undertaken in modernization works

Sl.No	Name of lifting point	Command area (Ha)	Water req. in M.Cum	Water req.in TMC
1	Thimmapur	20100	124.87	4.41
2	Ramthal(Marol)	38000	165.37	5.84
3	Budihaal-Peerapur	20243	107.03	3.78
4	Nandawadagi	36100	106.18	3.75
5	NRBC 9(A) Distributory	15200	97.91	3.46

Comprehensive map of UKP Stage-I and II showing the proposed locations is given below.

Fig 2.1 Comprehensive Map of Upper Krishna Project

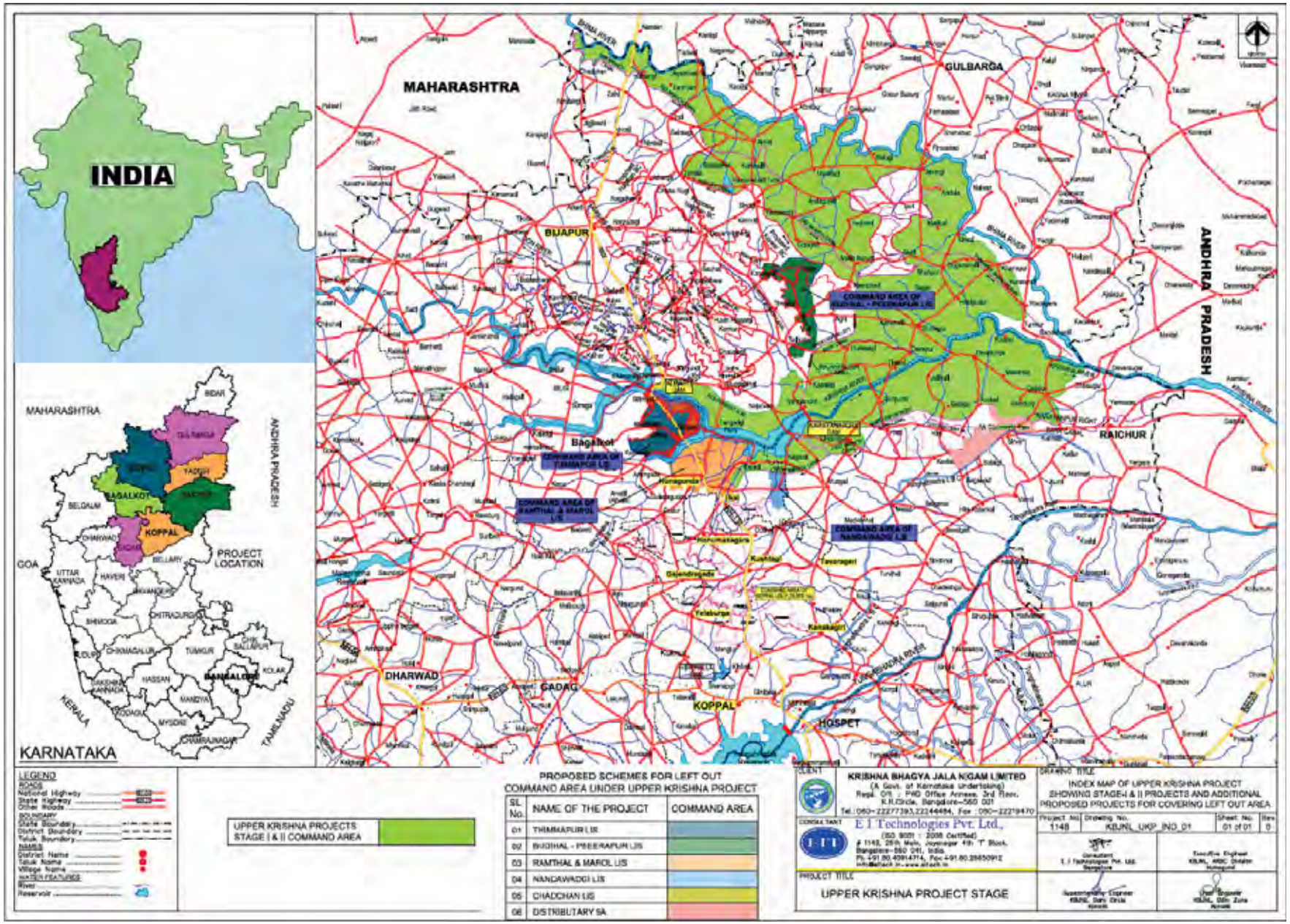
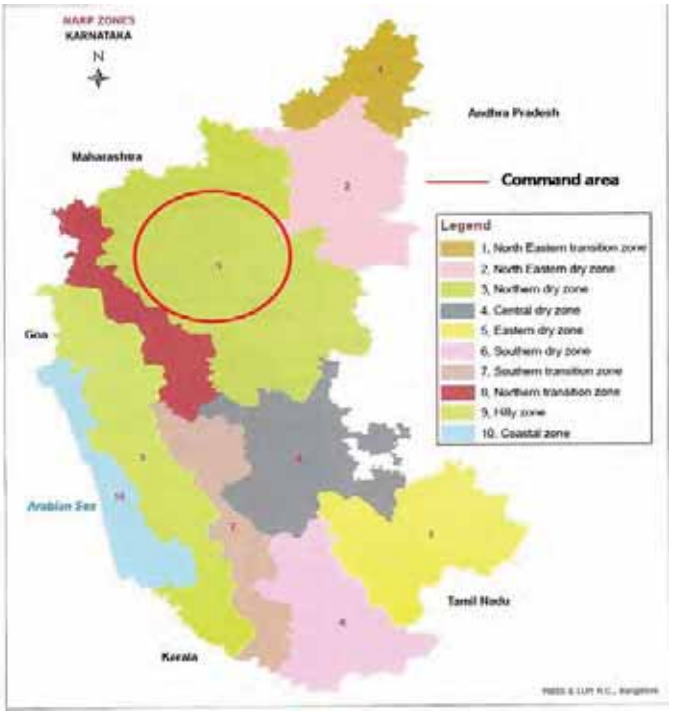


Fig 2.2 Comprehensive Map of Upper Krishna Project showing proposed modernization works

Fig 2.3 Google View of Almatti and Narayanpur Dams showing proposed lift locations

2.3.1 Agro – climatic zones

The command area of UKP is falling under Northern Dry Zone[4]. This region receives an annual rainfall between 603 mm - 836 mm. The dominant soils in this region are deep black soils and shallow loamy soils. The areas proposed for irrigation is subjected to repeated droughts and hence irrigation is very much required for the area.



2.3.2 Hydrology of Krishna River and Interstate aspects

Krishna is an Inter-State river and rises in the Western Ghats at an altitude of 1338m (4385 ft) near Mahabaleshwar in Maharashtra State. It flows across the whole width of the peninsula, from west to east, for a length of about 1392 km through Maharashtra, Karnataka and Andhra Pradesh. The catchment area of Krishna basin is 2.59 lakh sq. km.

2.3.2.1 Award of Krishna Water Dispute Tribunal

In 1973, the Krishna Water Dispute Tribunal (KWDT) adjudicated on the sharing of Krishna river waters between the three riparian states of Maharashtra, Karnataka, and Andhra Pradesh. KWDT - I in its final order dated 24.12.1973 has allocated the 75% dependable flows of 2060 TMC of Krishna waters amongst three riparian states and the share of Karnataka State aggregated to 734 TMC of water. The further report of the Tribunal dated 27.05.1976 also contained modification of the final order based on references made by different States under Section 5(3) of the Act.

The Central government construed the aforesaid final order to be the decision of the Tribunal and accordingly published the same in the Extraordinary Gazette dated 31.05.1976 and on such publication, the said final order has statutorily became final and binding on the parties to the dispute. To implement the award, the Government of Karnataka formulated a Master Plan comprising of various projects. One of these projects was the Upper Krishna Project under which it was proposed to utilise 173 TMC of water. In order to derive maximum benefits as early as possible, the project was envisaged to be executed in different Stages and Phases to utilise 119 TMC of water in Stage 1 and 54 TMC in Stage II. The awards of the KWDT I is enclosed as Annexure-4.

4 *Soil Erosion in Karnataka* (2014), National Bureau of Soil Survey and Land Use Planning, Technical Bulletin No. 162, Page 11-15.

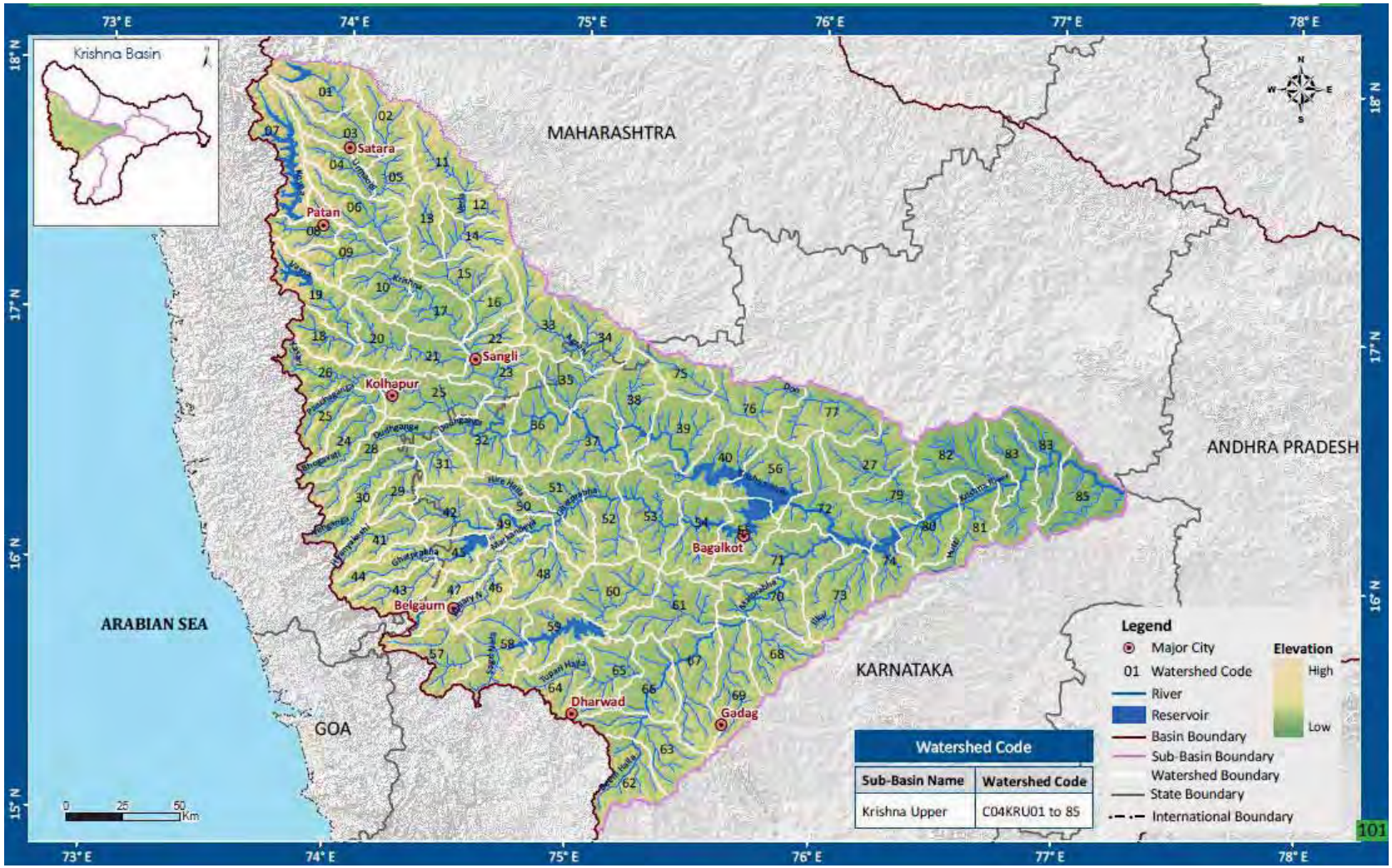


Fig 2.4 Map of Upper Krishna Basin showing Almatti and Narayanpur dams[5]

[5]Krishna Basin (2014), Central Water Commission and National Remote Sensing Centre Publication, Ministry of Water Resource, Govt. of India

2.3.3 Erratic droughts in command area

Proposed command area Taluks are severely prone to erratic droughts due to lack of monsoons. The drought details from 2001 to 2015 is given below;

Table 2.3 Drought details project command area Taluks[6]

Taluk	Year 20'														
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Bagalkot															
Hunagund															
Muddebihal															
Sindagi															
Lingasugur															
Devdurga															
Manvi															

Drought causes agriculture a risky venture and Sindagi, Lingasugur and Muddebihal taluks are considered to be the most backward taluks and whereas Hunagund taluks is more backward taluk[7]. Due to which people are constantly translocating to coffee estates, towns and cities including Maharastra and Goa. The people of the region have no other employment opportunities except agriculture and there is potential land bank to grow suitable crops in the region. Hence providing irrigation and stabilizing the agricultural production, provides a much needed relief to the people. It improves the per capita income and standard of living of the people. Further it utilizes the water and land resources and substantially improves GDP contribution from agriculture.

2.4 Proposed Modernization works

2.4.1 Thimmapur LIS

The Scheme envisages lifting of water from existing Almatti Right Bank Canal (ARBC) with single stage lifting arrangements with two delivery points located at RL 540.0 m and RL 560.0 m. 9.584 Cumecs of water to be drawn from ARBC main canal at Km 5.386 to irrigate 15500 Ha of land lying between RL 520.0 m to RL 540.0 m, design discharge being 7.392 Cumecs and also to irrigate 4600 Ha of land lying between RL 540.0 m to RL 560.0 m, design discharge being 2.192 Cumecs. The total utilisation of water to Irrigate 20100 ha of land in Hungund and Bagalkot taluks of Bagalkot district is 4.41 TMC.

Intake canal length is 1560 m from the ARBC main canal at Km 5.386 to the sump and pump house and located near Thimmapur village, Bagalkot Taluk. The length of the Raising main at Ist stage is 0.76 KM & IInd Stage is 1.94 Km so as to carry the water from Pump house to Delivery chamber DC-1 and DC-2 near Thimmapur village, Bagalkot Taluk of Bagalkot district.

The command area map of the project and salient features of the project is given below;

[6] Karnataka State Disaster Monitoring Centre, Govt. of Karnataka

[7] Report of the High Power Committee on Redressal of Regional Imbalances (2002), Govt. of Karnataka, Chapter 33, Page 869

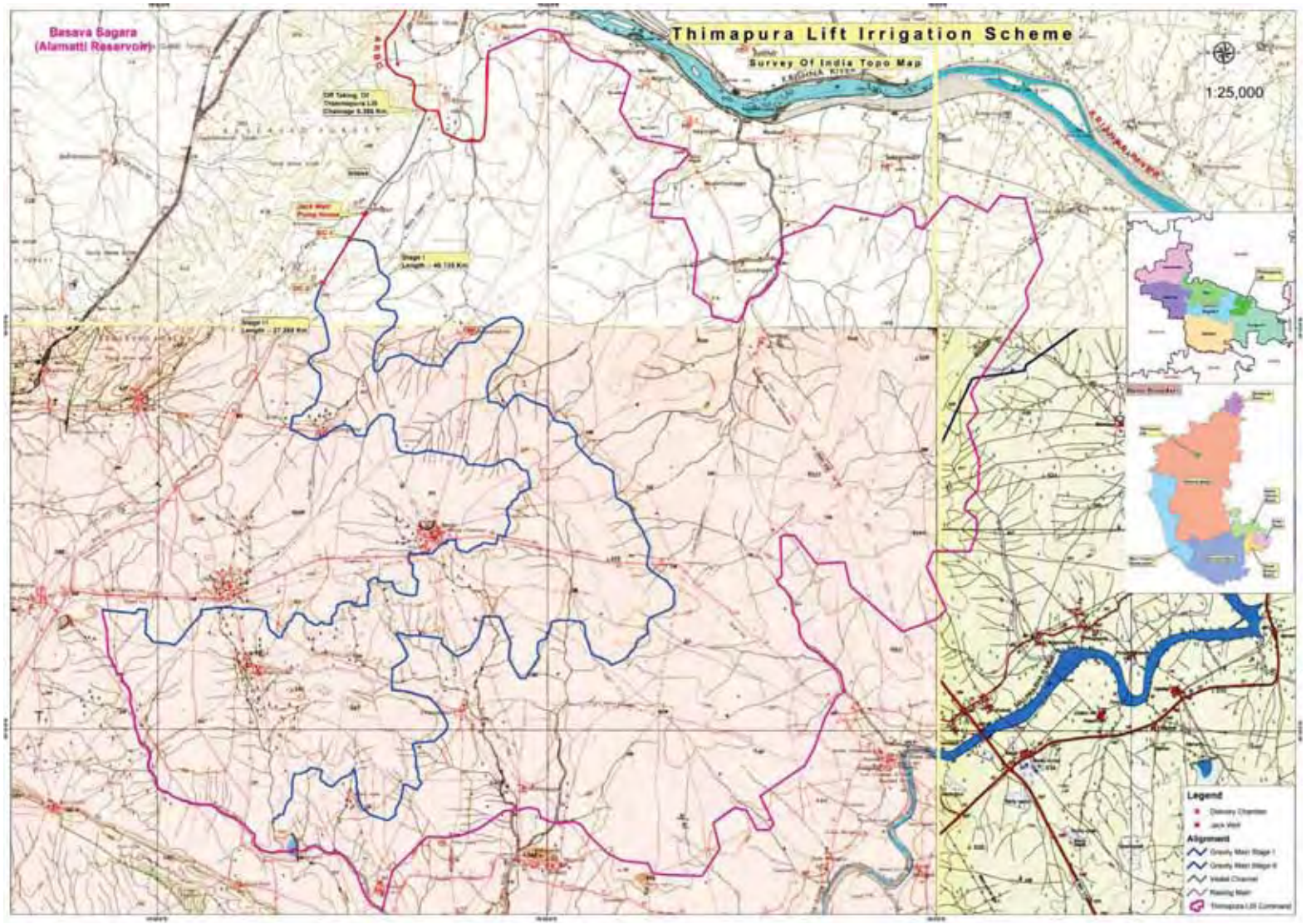


Fig 2.5 Command area map of Thimmapur LIS

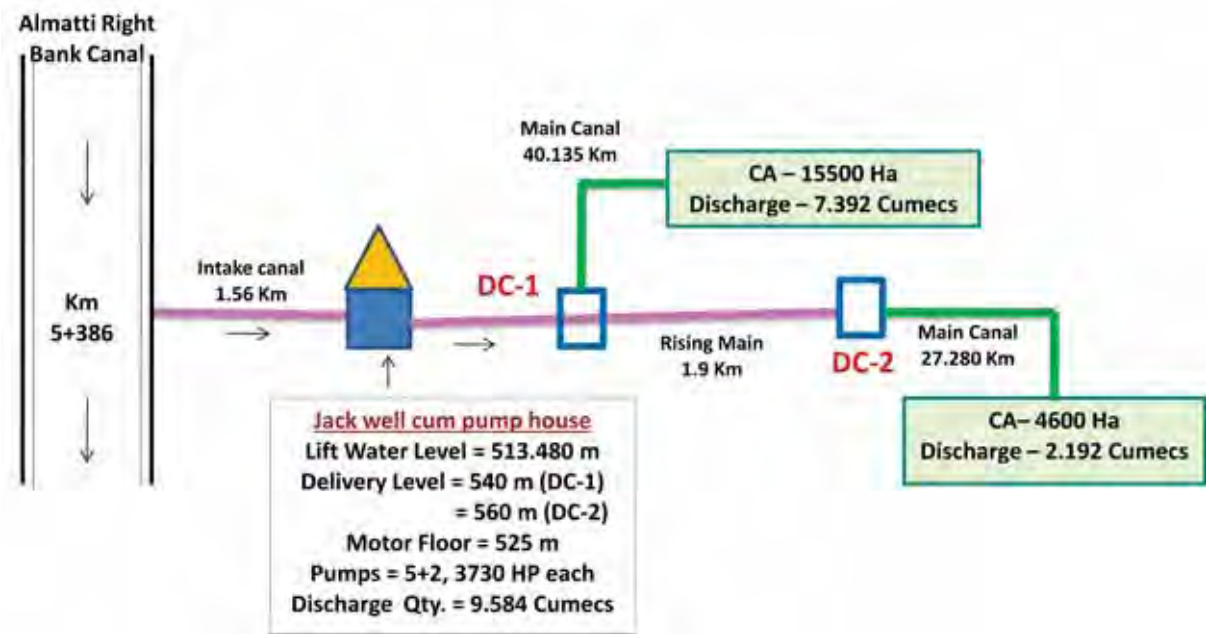


Fig 2.6 Schematic diagram of Thimmapur LIS

Table 2.4 Salient Features of the project

1.	Name of the Scheme	Thimmapur LIS
2.	Name of the river	Krishna and off take from Almatti Right Bank Canal
3.	Geographical Location of Lift point	Latitude – 16^{0}17'10.29"N, Longitude –75^{0}53'05.91"E
4.	Location of the Lift point	Near Thimmapur Village, Bagalkot Taluk & District, Karnataka
5.	Type of the project	Irrigation
6.	Estimated cost of the project	Rs. 133.3 Crores
7.	Command Area	20100 Ha (gravity flow open canal irrigation)
8.	No. of villages benefitting	36
9.	Allocated water	124.84 M.Cum (4.41 TMC)
10.	Cropping pattern	Kharif, Rabi and Biseasonal
11.	Irrigation intensity	115%
12.	Submergence area	Nil
13.	Rehabilitation and Resettlement	Nil
14.	Total Land required	764.90 Ha
15.	Total forest land required	Nil
16.	Power Requirement	7.45 MW, Source – Gulbarga Electricity Supply Company Limited (GESCOM).
17.	B C Ratio	1.3

In the First stage, the water is lifted from the Ist stage Main canal from RL 513.480 m to 540.0 m near Bilkerur village for irrigating an area of 15500 Ha. In the second stage the water is lifted from RL 513.480 m from the common Jack well to RL 560.0 m for irrigating an area of 4600 ha with the irrigation intensity of 115% and the water utilization is 4.41 TMC. The total area of Irrigation under the scheme is 20100 Ha. in the Hunugund & Bagalkot Taluka of Bagalkot District. The drawings of the project is enclosed in Annexure-5.

2.4.1.1 Cropping Pattern

Table 2.5 Details of cropping pattern with Irrigation intensity

Season	Crop Detail	Percent	Crop period (days)	Area in Ha
Khariff	Maize (Hybrd)	15	120	1608
	Jowar (Hybrd)	15	90	3417
	Ground Nut	25	90	2412
	Sun Flower	5	60	4422
	Pulses	5	75	1206
	Sub Total	65		13065
Rabi	Local Jowar	10	135	804
	Safflower	5	150	1005
	Gram	5	135	1005
	Sunflower	5	120	2211
	Wheat	10	150	1005
	Ground nut	5	90	1005
	Sub total	35		7035
Two-Seasonal	Cotton	5	165	1005
	Vegetable/Red gram	5	135	1005
	Chillies	5	150	1005
	Subtotal	15		3015
	Total	115		23115

2.4.1.2 Command area

Table 2.6 List of benefitting villages under Thimmapur LIS

Sl.No	District	Taluk	Benefitting Villages
1	Bagalkot	Bagalkot	Thimmapur
2			Achanur
3			Bilkerur
4			Bodanayakanadhinni
5			Manahalli
6			Hosur
7			Nagasampige
8			Nagaral
9			Nainegali
10			Bevor
11			Devalapur
12			Domnal
13			Hiremagerei
14			Hallur
15			Bairamatti
16			Benakatti
17			Bagavathi
18			Choudapur
19			Bommanagi
20			Mankani
21			Sangapur
22	Bagalkot	Hunugund	Chitiginakoppa

Sl.No	District	Taluk	Benefitting Villages
23			MudivinaKoppa
24			Chikkamageri
25			Ingalagi
26			Handargal
27			Sutagundar
28			Turudagi
29			Valakadinni
30			Voragodudinni
31			Sangam
32			Kengalkadapatti
33			Hoovanur
34			Ambikopa
35			Suralikal
36			Kadivaal-Kallapur

View of ARBC at Km 5+360

Command area

2.4.2 Ramthal (Marol) LIS

The Ramthal Lift Irrigation Scheme (RLIS) is proposed in Scheme "A" of the Krishna Basin Projects. It propose to provide benefits of irrigation to about 26,200 ha of draught prone areas of Hunagund Taluk (Bagalkot District) on the right bank of river Malaprabha.

In the original scheme, there was a proposal to construct a barrage across river Malaprabha near Ramthal village and lift water from barrage in two stages. But the scheme has been modified proposing to lift water directly from Narayanapur reservoir near Marol village.

It is proposed to combine the command area of ARBC beyond river Malaprabha in the Ramthal L.I.S. Therefore, the total utilization for the project is 5.84 TMC. The project comprises of the following;

The Ist stage Ramthal (Marol) LIS comprises of lifting water from the fore shore of Narayanpur reservoir,. i.e., from RL 485.50 m to RL 522.0 m near Havergi Village of Hungund Taluka Bagalkot District to provide Irrigation facilities through conventional method for an area of 14000 Ha. The intensity of irrigation adopted is 115%. The water utilized for the Ist stage area of irrigation is 3.07 TMC.

In the second stage the water is lifted from the Ist stage West Main canal from RL 520.11 m to RL 547.0 m near Ramavadagi village to provide irrigation facilities for an area of 12571 ha. But due to adoption of Drip irrigation the area under the second stage has been increased from 12571 Ha to 24000 Ha, with the irrigation intensity of 115% and the water utilization is 2.77 TMC. The total area of Irrigation under the scheme is now increased from 26200 Ha to 38000 ha with the same allocation of 5.84 TMC of water. The total area of Irrigation under the scheme is 38000. Under Conventional method of irrigation it is propose to provide irrigation to 14000 Ha and under Micro Irrigation for 24000 ha is irrigated in the Hunugunda Taluka of Bagalkot District.

The command area map of the project is given below and project drawings are enclosed in Annexure-6.

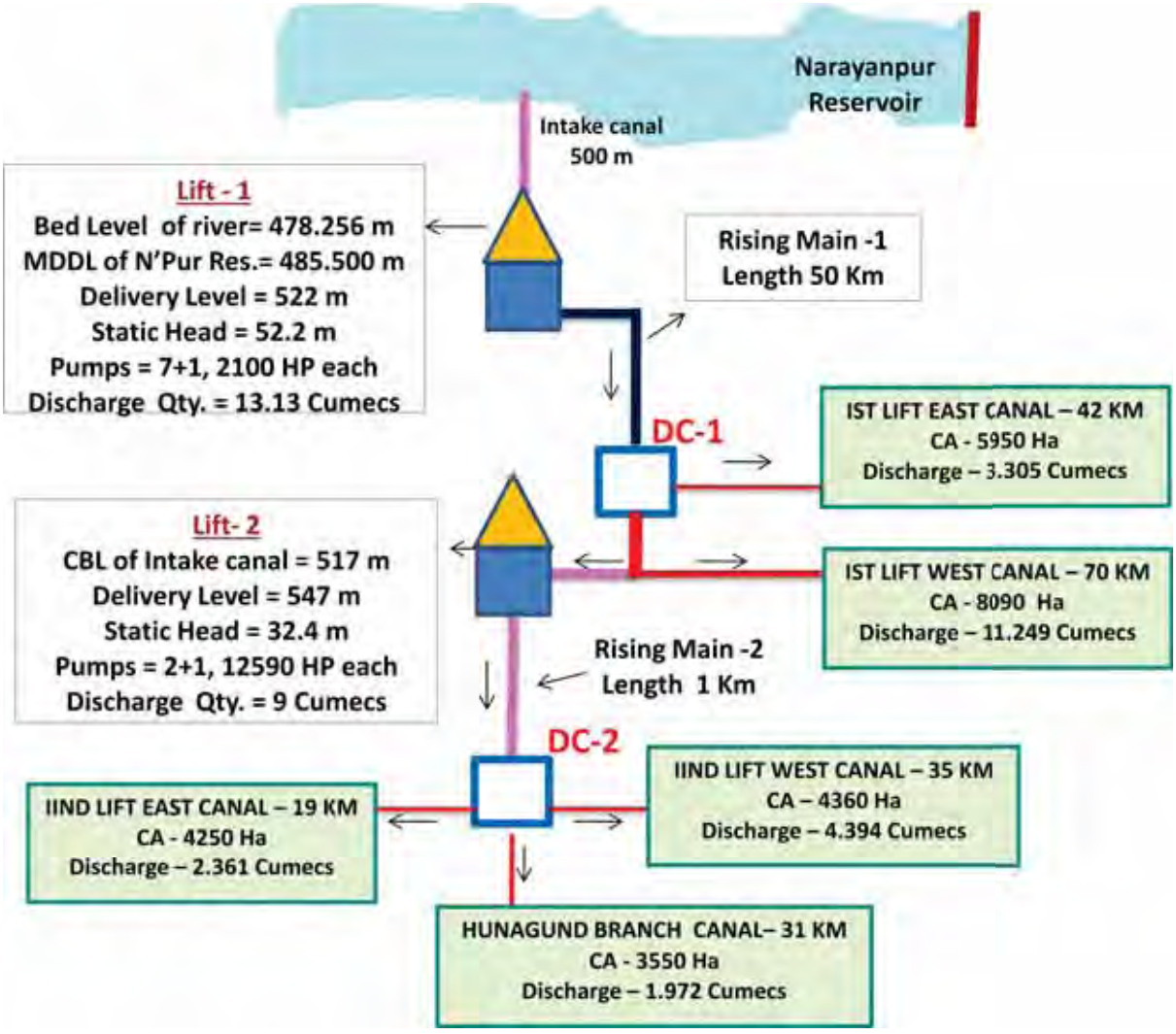


Fig 2.7 Schematic diagram of Ramthal (Marol) LIS

Fig 2.8 Command area map of Ramthal (Marol) LIS

Table 2.7 Salient Features of the project

1.	Name of the Scheme	Ramthal (Marol) LIS
2.	Name of the river	Krishna
3.	Geographical Location of Lift point	Latitude – 16^{0}10'42.03"N, Longitude –76^{0}09'08.26"E
4.	Location of the Lift point	Near Havegeri Village, Hunagund Taluk Bagalkot District, Karnataka (Backwater of Narayanpur dam)
5.	Type of the project	Irrigation
6.	Estimated cost of the project	Rs. 1004 Crores
7.	Command Area	38000 Ha (14000 Ha - gravity flow open canal irrigation + 24000 Ha drip irrigation)
8.	No. of villages benefitting	83
9.	Allocated water	165.272 M.Cum (5.84 TMC)
10.	Cropping pattern	Kharif, Rabi and Biseasonal
11.	Irrigation intensity	115%
12.	Submergence area	Nil
13.	Rehabilitation and Resettlement	Nil
14.	Total Land required	1064.11 Ha
15.	Total forest land required	Nil
16.	Power Requirement	16.5 MW, Source – Gulbarga Electricity Supply Company Limited (GESCOM).
17.	B C Ratio	1.18

2.4.2.1 Cropping Pattern

Table 2.8 The details of cropping pattern with Irrigation intensity

Season	Crop Detail	Existing cropping %	Existing Area in Ha	Proposed Cropping %
Khariff	Maize (Hybrd.)	8	3040	15
	Jowar	17	6460	15
	Ground Nut	12	4560	25
	Sun Flower	22	8360	5
	Pulses	6	2280	5
	Sub Total	**65**	**24700**	**65**
Rabi	Local Jowar	4	1520	10
	Safflower	5	1900	5
	Gram	5	1900	5
	Sunflower	11	4180	5
	Wheat	5	1900	5
	Ground nut	5	1900	5
	Sub total	**35**	**13300**	**35**
Two-Seasonal	Cotton	5	1900	5
	Vegetable/Red gram	5	1900	5
	Chillies	5	1900	5
	Subtotal	**15**	**5700**	**15**
	Total	**115**	**38000**	**115**

2.4.2.2 Command area

Table 2.9 Details of benefitting villages

Sl.No	District	Taluk	Villages benefitting under conventional irrigation	Villages benefitting under Drip Irrigation
1	Bagalakot	Hunagund	Haavaragi	Belagal
2			Kongawada	Thimmapura
3			Koujaganuru	Hungund
4			Anapakatti	Bevinmatti
5			Indavaara	Hirebadwadagi
6			Odeyara Gonala	Banihatti
7			Kamaladinni	Rakkasagi
8			Chinta Kamaladinni	Chittawadagi
9			Gattiganuru	Honnarahalli
10			Konnuru	Nagura
11			Palthi	Yadalli
12			Manmathanaala	Amingada
13			Pochapura	Sulibhavi
14			Dasabaala	Chickkarayankeri
15			Kesarapenti	Hirerayankeri
16			Paachapura	Ramavadagi
17			Amaravadagi	Iddalagi
18			Marola	Bisnalkoppa
19			Koppa	Dannura
20			Dannuru	Bisnal
21			Hullalli	Hadagali
22			Adihala	Medinapura
23			Yammetti	Kirasura
24			Eddalagi	Gangura
25			Medinapura	Chittaragi
26			Hadagali	Huluginala
27			Kirasuru	Kallugonala
28			Gangura	Madapura
29			Madapura	
30			Budhihaala	
31			Ramawadagi	
32			Kadivala	
33			Revadihaala	
34			Bekamaladinni	
35			Hagedala	
36			Hanagunda	
37			Belagal	
38			Thimmapura	
39			Binjawadagi	
40			Turamari	

Sl.No	District	Taluk	Villages benefitting under conventional irrigation	Villages benefitting under Drip Irrigation
41			Islampura	
42			Jalakamaladinni	
43			Lolaasara	
44			Hemaawaadagi	
45			Bisanaalakoppa	
46			Chittaragi	
47			Karadi	
48			Needasanura	
49			Benakanadoni	
50			Chinnapura S K	
51			Kamadatta	
52			Hiremaagi	
53			Bevinaala	
54			Hulaginala	
55			Enam Budihaala	

2.4.2.3 Automation in drip irrigation command area

The automation of the system proposed in the east side project is due to following objectives.

- To control the operation of valves in each block and sub-block according to predefined irrigation schedule.
- To flush the screen filter by opening the drain valve of screen filter.
- To monitor the system schedules.
- To identify malfunctioning and generate alarms.
- To control the operation of pumps for each zone.
- To control the flushing of filters at the main filter station.
- To control the operation of control valve.

In one zone there are several blocks and each block has several sub-blocks. Typically, one sub-block is considered as one farmer's field. Every Sub-block has one automatic On/off valve. At the entrance of the block there is an entrance valve. Entrance valve is a pressure reducing valve. There is one pressure transmitter at the entrance.

On/off operation of the valve is controlled through the DC latch solenoid pilot valve. DC latching solenoid pilot valve (SPVDC) operates on 12 VDC, latching pulse output. This SPVDC is connected to a Remote Terminal Unit (RTU). One RTU can control 1 to 8 SPVDC as per the requirement. If required, it can also have digital and analog inputs.

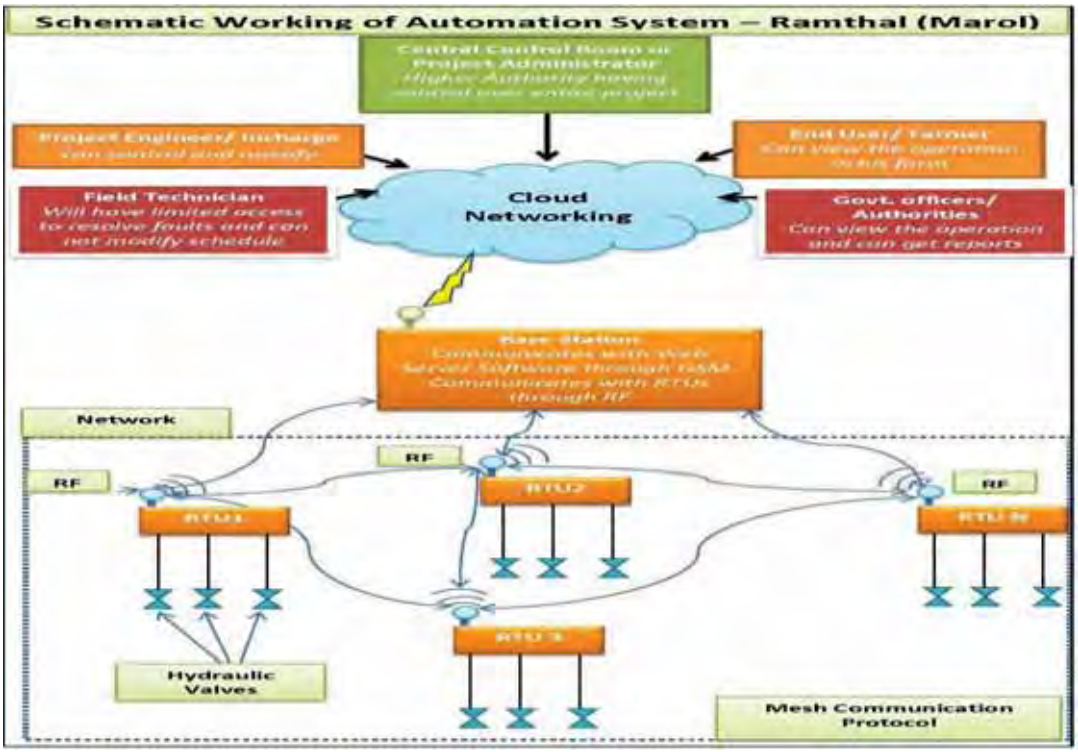
RTU is drawing power to operate SPVDC through a solar charging system. The solar panel charges the battery within RTU.

Depending upon valve placement and distance between the valves, there can be several RTUs within one block. These RTUs get its command from a Base Station RTU (BSRTU). The communication between RTU and BSRTU is done using radio frequency of bandwidth between 865 to 867 MHz.

One Base Station (BSRTU) can control approximately 150 to 200 no. of RTUs depending on distance between the base station and RTUs and topography the area. Area covered under one base station is called as Network.

There can be several Base Stations in one zone. Base Station gets its schedule of operation through a Web Server Based Software. The communication between the Base Station and Web Server is through cellular network using GSM.

User or Project Manager can prepare a schedule of operations for different sub-blocks or group of sub-blocks. It also monitors the current operation and also monitor any preset alarming conditions. If there is an alarm, either software can take preset action through Rules or it allows user to take actions.



The components of the Automation System are as follows.

- **The web based client subscription software** is used to develop the irrigation schedules and it is directly interacting with the base station RTU to transmit the irrigation schedules and get the sensor feedback from the RTU.
- **Base station remote terminal unit (BSRTU)** is equipped with GSM data card facility to initialize the communication to the server. This BSRTU can communicate approximately 150 to 250 field RTU's within the Radio Frequency (RF) network depending upon the terrain and topological constraints.

- **Remote Terminal Unit (RTU)** which is the wireless device that can be operated on 865 to 867 MHZ band having 1 to 8 output stations and these RTU's will get communicated to one another in radio frequency and it is mainly used to operate the solenoid coils in ON/OFF latching condition.
- **Water meters** are the devices that measure the flow of water entering in every block.
- **Pressure transmitter** is the device that measures the pressure of the water entering the block and generates the pulse signals and these signals get transmitted to the Remote Terminal Unit.
- **Flow Transmitter** measures the flow and send analog signals to the base station through RTU.
- **Hydraulic Valves** operate on water pressure of the pipeline. It requires min. pressure of around 0.5 kg/cm2 to operate. It is On/Off type of valve. It gets the signal to open or close through solenoid pilot valve (SPV).
- **Solenoid Pilot Valve (SPVDC)** is DC latching type valve which transmits the hydraulic pressure for the opening or closing of the hydraulic valve. It requires 12 VDC supply. It gets electrical actuation command from the RTU.
- **Pressure Reducing hydraulic valve** is a basic hydraulic valve with a pressure reducing pilot installed with it. It ensures constant downstream pressure irrespective of the pressure fluctuations on the upstream side. It is installed at the entrance of each block.
- **Rain Sensor** is a counter type digital sensor. It has a tipping bucket type of switch which measures preset volume of water (0.2mm per pulse). It sends the pulses to the RTU which is then sent to the base station. Base station can ask server to take appropriate action (e.g.pause valve in operations) when it senses rain.

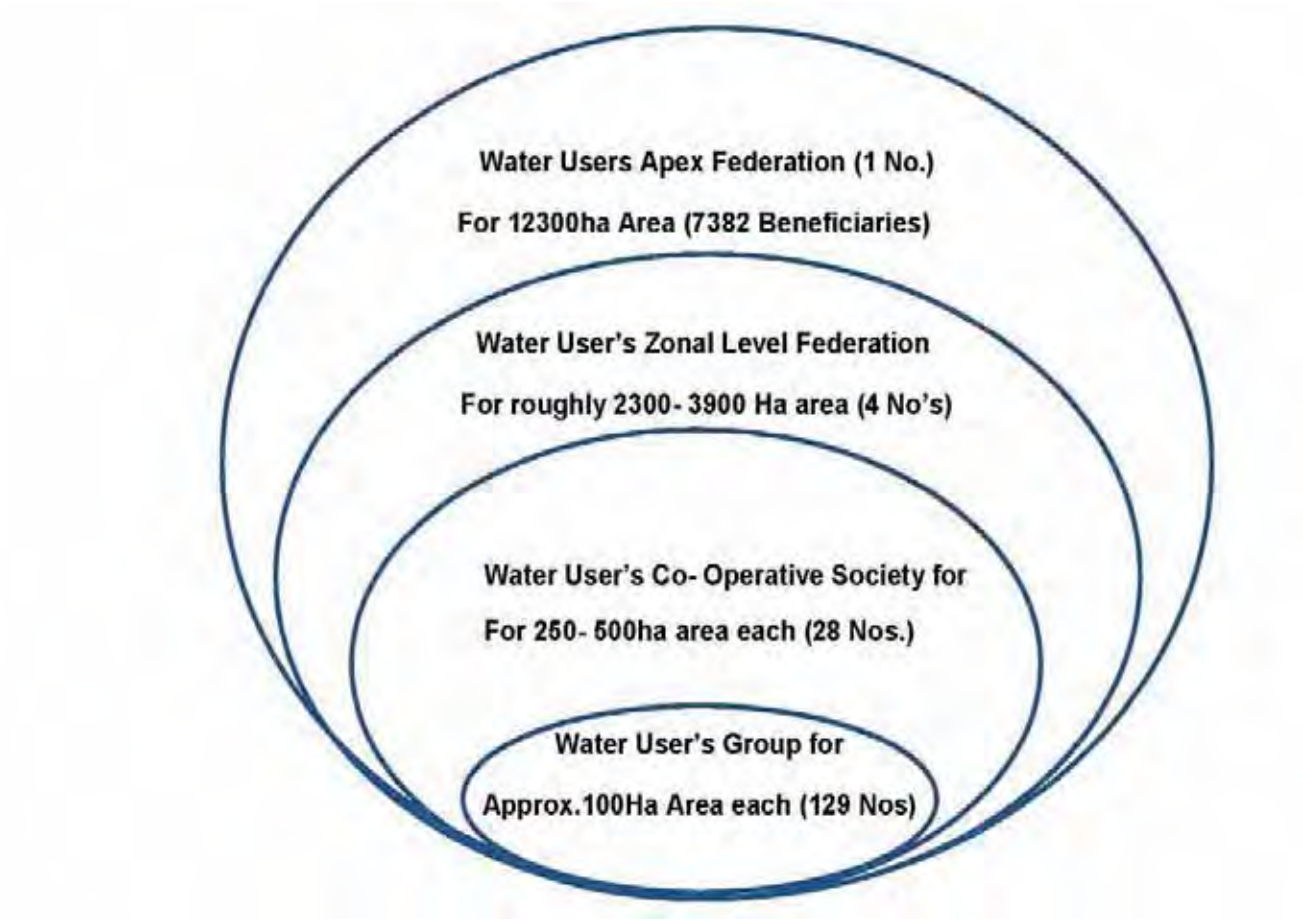
1) WUC'S and Capacity Building

This components activity is of formation of WUC'S and Develop farmer's interest to work in WUC'S by the way of trainings, field visits demo van campaigning's, group meetings etc.

In includes WUC'S training Schedule - By conducting village level meeting regarding project concept, benchmark survey, training on Drip Irrigation, Irrigation Scheduling, Crop Geometry, Land Preparation, Fertigation scheduling, Agri. Business and Post-harvest, Automation and Formation of WUCS, Operation of WUCS

Field training on Demo Plots and Visit to successful fields of Drip Irrigation System and Automation System.

Proposed Structure for Formation of Water User Co-Operative Societies is as below.



The WUC'S and Capacity Building includes following activities.

- Formation of blockwise WUC'S.
- Constitution of guidelines, rules and regulation for WUC'S.
- Defining roles and responsibilities of WUC'S.
- Preparation of crop books of relevant crops in kannada.
- Preparation of training material, demo van.
- Identification of training places.
- Identification of training faculties.
- Preparation of training calendar.
- Onsite and offsite training regarding agronomy, drip irrigation, maintenance of drip irrigation system etc.

2) Post-Harvest Linkages

After implementation of Drip Irrigation Project, the produce of the farmers needs buy-back facility for better income / market for produce. The Post-Harvest Linkages Building includes following activities.

- Conduction of training programme on post-harvest handling of the produce, processing etc.
- Propose visit of farmers to the processing facilities.

- Provide the linkages for the buy back or selling of the produce from the benefitted command area farmers through the agri-consortium to enable higher economic returns for the farmers.
- Provision of information on post-production activities and the information about the agencies organizing collection, grading, storage, transportation, processing and marketing of the produce.
- Provision of the information of the agencies like financial institutions and market information centers.
- The project was show cased in 'Invest Karnataka'- a gloabal investors meet for investing in Karnataka.
- The Project also supports 'agriculture corridor' proposed by Govt. of Karnataka.

	
Backwater of Narayanpur Reservoir showing location water drawal location	Command area

2.4.3 Budihaal-Peerapur LIS

Budihaal-Peerapur LIS envisages lifting of water from the fore shore of Narayanpur reservoir,. i.e., from RL 486.0 m to RL 850.0 m near Nagabenal Village of Muddebhihaal Taluka Bijapur District., with an allocation of 3.78 TMC of water & to provide Irrigation for 20243 ha of periniaaly drought prone areas of Muddebhihaal and Sindagi Taluks.

There is about 56,465.0 Ha of command area is left out between Narayanpur Left Bank Canal and proposed Bijapur Branch Canal from Mulwad LIS. The area being near to Narayanpur Reservoir and drought affected does not receive water from any of the schemes planned under Upper Krishna Project. In view of this there is a representation from the local formers and MLAs of the area to plan a separate scheme to cover this area by proposing a project to lift water from Narayanpur Dam.

It is proposed to locate lift head works on right flank of Narayanpur reservoir near Nagabenal village of Muddebihal taluk, Bijapur district. Intake level at the proposed Head work is 480.0 m. From lift head works the alignment of raising main runs in North direction passes east of Nagabenal village. The alignment further crosses taluk/district boundary of Muddebihal/Bijapur and Surpur/Yadgir and runs in the same direction and passes east of Yanniwadageri village and further crosses Hirehalla. Further the alignment follows almost taluk/district boundary of Muddebihal/Bijapur and Surpur/Yadgir for certain length and then runs in North-East direction to enter Surpur taluk. The alignment crosses Bopargi village in South-east side and further crosses Don river.

After crossing Don river the raising main enters the command area and runs in the same direction and further crosses taluk boundary of Surpur to enter in to Muddebihal taluk. Raising main is terminated at EL 552.0 m near Salwadgi village. The delivery chamber is located North-west of Salavadgi village. Total length of raising main works out to 29.80 Km. The delivery level at DC-1 is 551.0 m and static head works out to 71.0 m. Peak discharge for the 1st stage lift works out to 9.312 cumecs. Two distributaries have been proposed at DC-1 covering an ICA of 2758.00 Ha and the discharge required for this area is 1.269 cumecs.

The balance discharge of 8.043 cumecs is further carried by Gravity pipe for a length of 3.30 Km which runs in north direction. At the end of gravity main DC-2 is proposed. Two distributaries have been proposed at DC-2 covering an ICA of 1,631.00 Ha and the discharge required for this area is 0.579 cumecs.

From the end of DC-2 2nd stage pumping head work is proposed to lift Balance discharge of 7.293 cumecs water to EL 585.0 m. The alignment of II stage raising main runs in north direction and terminates at North of Shelagi village in Muddebihal taluka. Total length of the raising main works out to 5.90 Km and static head works out to 48.0 m.

From the end of DC-3, the balance area of 15,854.0 Ha is proposed to be covered by Budihal-Peerapur Main Canal which runs for a length of 27.60 Km. Total 27 distributary blocks have been proposed under 2nd Lift. Salient features of the project and command area map of the project is given below. Project drawings are enclosed as Annexure-7.

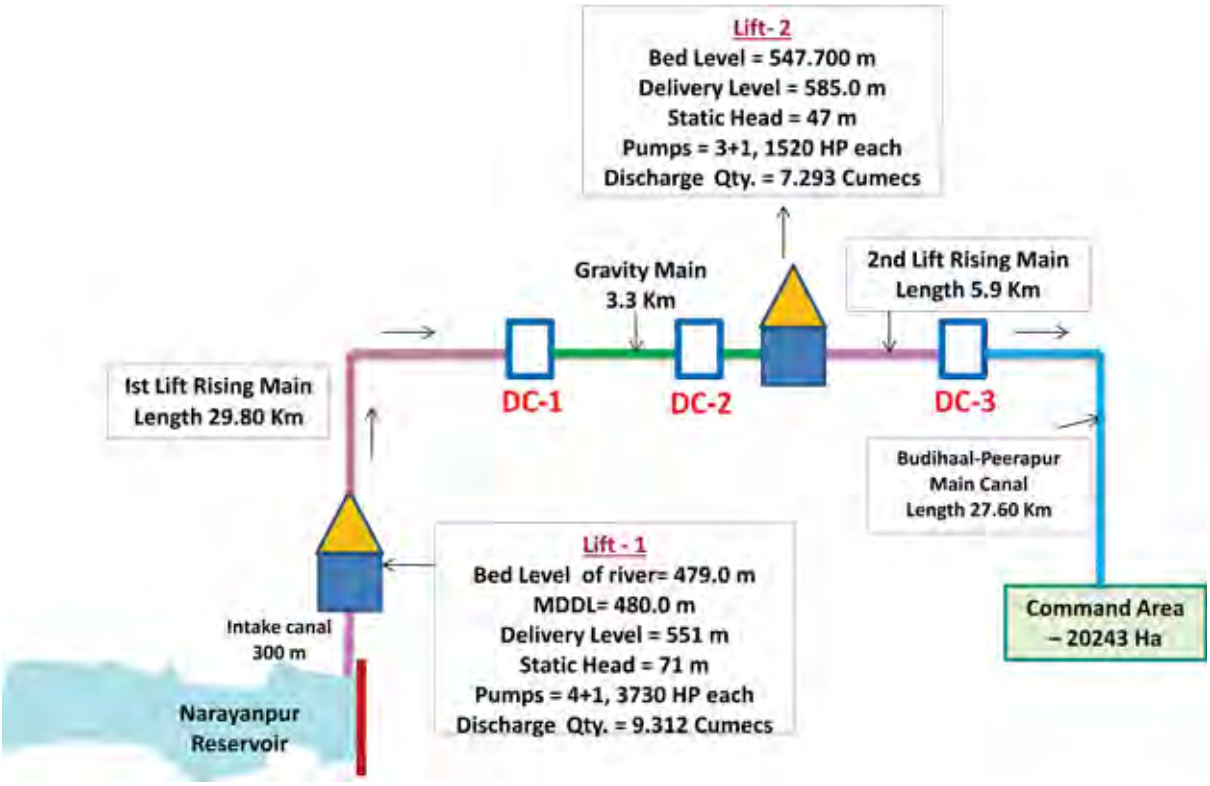


Fig 2.9 Schematic diagram of Budihaal-Peerapur LIS

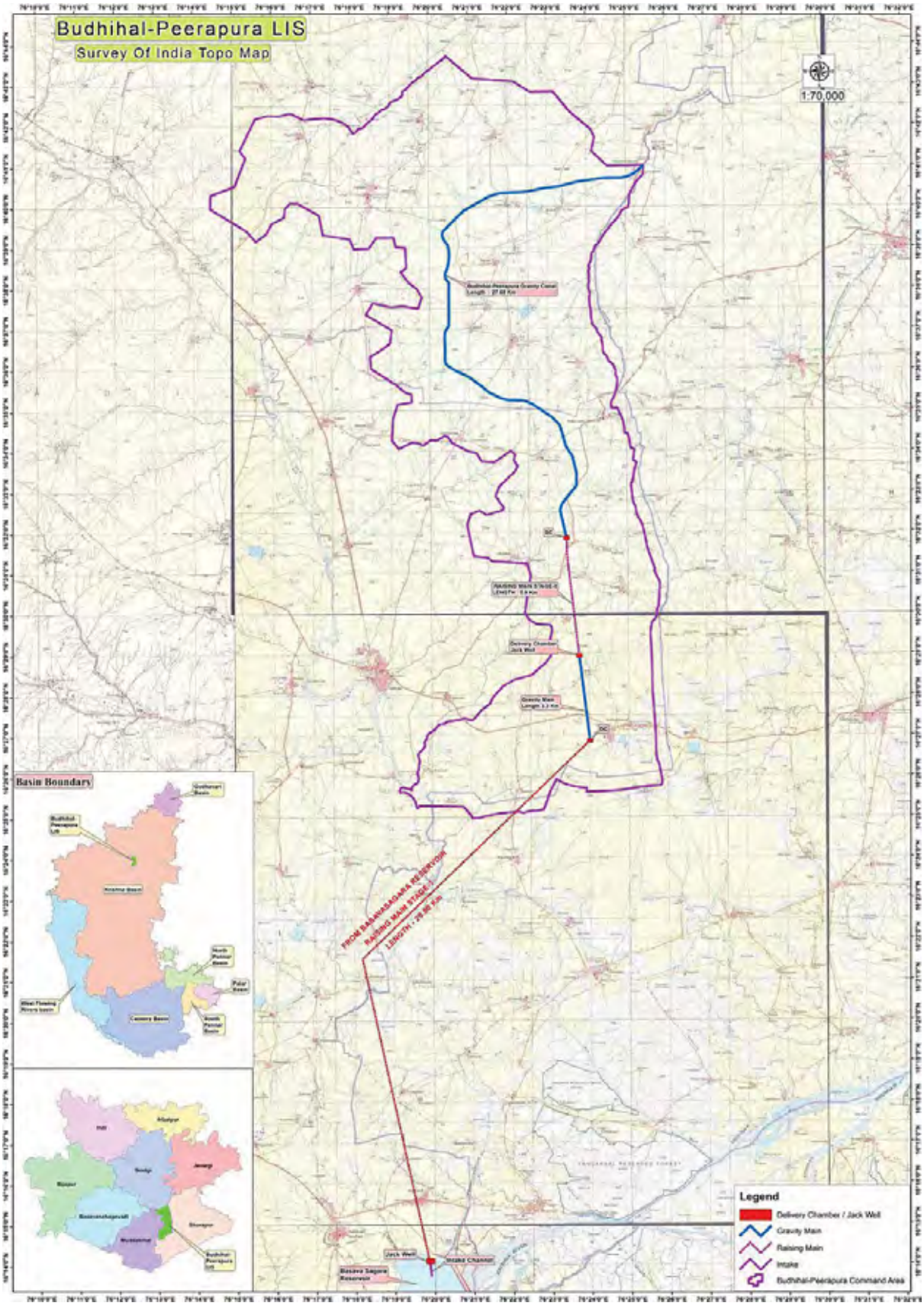


Fig 2.10 Command area map of Budihaal-Peerapur LIS

Table 2.10 Salient Features of the project

1.	Name of the Scheme	Budihaal-Peerapur LIS
2.	Name of the river	Krishna
3.	Geographical Location of Lift point	Latitude – 16^{0}10'42.03"N, Longitude –76^{0}09'08.26"E
4.	Location of the Lift point	Near Nagabenal Village, Muddebihal Taluk Bijapur District, Karnataka (Foreshore of Narayanpur dam)
5.	Type of the project	Irrigation
6.	Estimated cost of the project	Rs. 840 Crores
7.	Command Area	20243 Ha (gravity flow open canal irrigation)
8.	No. of villages benefitting	42
9.	Allocated water	107.03 M.Cum (3.78 TMC)
10.	Cropping pattern	Kharif, Rabi and Biseasonal
11.	Irrigation intensity	115%
12.	Submergence area	Nil
13.	Rehabilitation and Resettlement	Nil
14.	Total Land required	558.20 Ha
15.	Total forest land required	Nil
16.	Power Requirement	12 MW, Source – Gulbarga Electricity Supply Company Limited (GESCOM).
17.	B C Ratio	1.2

2.4.3.1 Cropping Pattern

Table 2.11 The details of cropping pattern with Irrigation intensity

Season	Crop	Percent	Area (Ha)
Kharif	Maize (Hy Br)	15	3036.45
	Jowar	15	3036.45
	Ground Nut	20	4048.6
	Sun Flower	5	1012.15
	Pulses	5	1012.15
	Sub Total	**60**	**12145.8**
Rabi	Local Jowar	10	2024.3
	Safflower	2.5	506.075
	Gram	5	1012.15
	Sun Flower	2.5	506.075
	Wheat	5	1012.15
	Ground Nut	2.5	506.075
	Sub Total	**27.5**	**5566.82**
Two Seasonal	Cotton	5	1012.15
	Vegetables / Red Gram	5	1012.15
	Chillies	2.5	506.075
	Sub Total	**12.5**	**2530.37**
	Total	**100**	**20243.00**

2.4.3.2 Command area

Table 2.12 Details of benefitting villages

Sl.No	District	Taluk	Benefitting Villages
1	`Bijapur	Muddebihal	Maskanal
2			Maileswar
3			Bilebhavi
4			Salvadgi
5			Bandepennahalli
6			Gundaknal
7			Navadgi
8			Lakkundi
9			Belur
10			Shellagi
11			Kodanganur
12			Koraganur
13			Bhantanur
14			Gatakhandaki
15			Peerapur
16			Godisomanal
17			Kyogonal
18			Hosahalli
19			Huyinahalli
20			Tumbagi
21			Fattepur
22			Bolavad
23			Guttihal
24			Bommanahalli
25			Talikata
26			Nagpur
27	`Bijapur	Sindagi	Niralogi
28			Aski
29			Bannihatti
30			Jalapur
31			Binjalabhavi
32			Bekinal
33			Yanakihal
34			Turukanagari
35			Budihal
36			Algar
37			Kerutagi
38			Ramapur
39			Hunashihal
40			Kalakeri
41			Kudaraguda
42			Kodarapur


Command area

2.4.4 Nandawadagi LIS

Hunagund and Lingsugur of Bijapur and Raichur districts are economically backward areas comprising of about 72% of local population with agriculture as their main source of occupation. The annual rainfall in these regions is very much lower in comparison to the state average and hence these farmers are growing only dry crops being water scarce area. This has reduced the area to drought prone with irrigation area less than 20% of the total area. There is always a risk of possible crop failures or reduced yields due to uncertain and scanty rains.

The topographical features of the area coming under Lingasugur and parts of Hunagund taluks do not facilitate supply of water through gravity canal system from the Narayanapur storage dam as the areas are lying above the Maximum Full Supply level of Narayanapur Dam. Hence proposing a Lift Irrigation Scheme to cater the required water to these affected areas is more feasible considering the flat topographical terrain.

Nandawadagi LIS comprises of lifting water from the fore shore of Narayanpur reservoir,. i.e., from RL 486.0 m to RL 550.0 m near Tondihal Village of Lingasugur Taluka Raichur dist., with an allocation of 3.75 TMC of water & to provide Micro Irrigation for 36100 Ha of Lingasugur and Hunugunda Taluka with an allocated water under UKP Stage-I and II. Intake canal of 400.0 m is proposed from fore shore to the sump and pump house located near Tondihal village, Lingasugur Taluk. Raising main of 14 KM is proposed to carry the water from Pump house to Delivery chamber near Nandawadagi village to provide drip irrigation facilities. The schematic diagram, salient features and command area map of the project is given below and project drawings are enclosed as Annexure-8.

Table 2.13 Salient Features of the project

1.	Name of the Scheme	Nandawadagi LIS
2.	Name of the river	Krishna
3.	Geographical Location of Lift point	Latitude – $16^0$08'33.57"N, Longitude –$76^0$16'25.11"E
4.	Location of the Lift point	Near Tondihal Village (Mallapura), Lingasugur Taluk Raichur District, Karnataka (Foreshore of Narayanpur dam)
5.	Type of the project	Irrigation (Drip)
6.	Estimated cost of the project	Rs. 1530 Crores
7.	Command Area	36100 Ha (drip irrigation)
8.	No. of villages benefitting	86

9.	Allocated water	106.12 M.Cum (3.75 TMC)
10.	Cropping pattern	Kharif, Rabi and Biseasonal
11.	Irrigation intensity	115%
12.	Submergence area	Nil
13.	Rehabilitation and Resettlement	Nil
14.	Total Land required	195 Ha
15.	Total forest land required	Nil
16.	Power Requirement	12 MW, Source – Gulbarga Electricity Supply Company Limited (GESCOM).
17.	B C Ratio	1.62

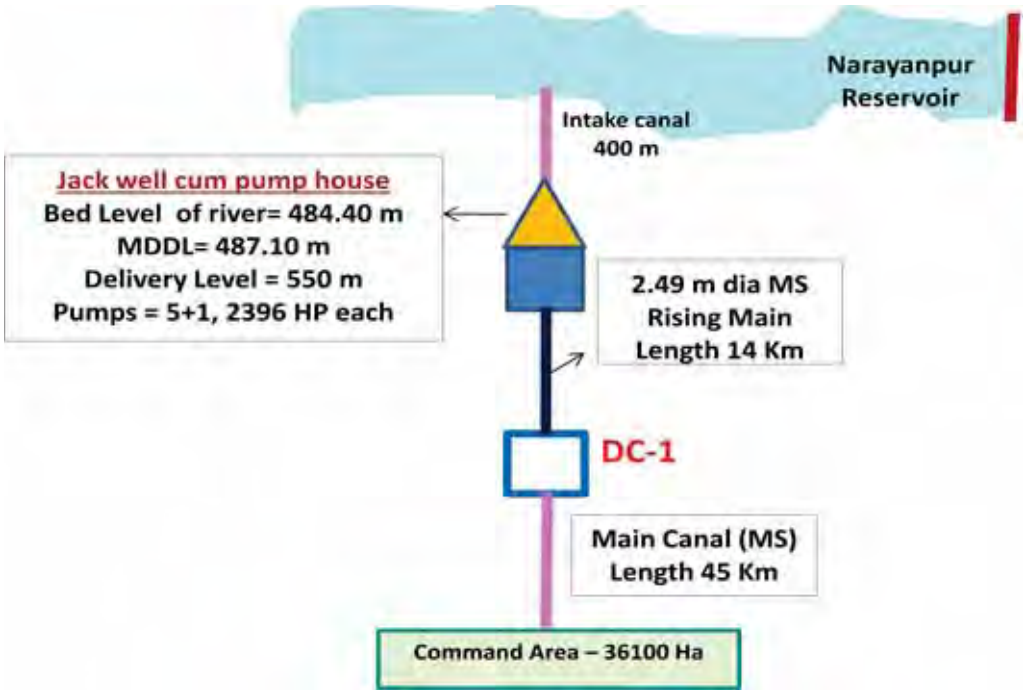


Fig 2.11 Schematic diagram of Nandawadagi LIS

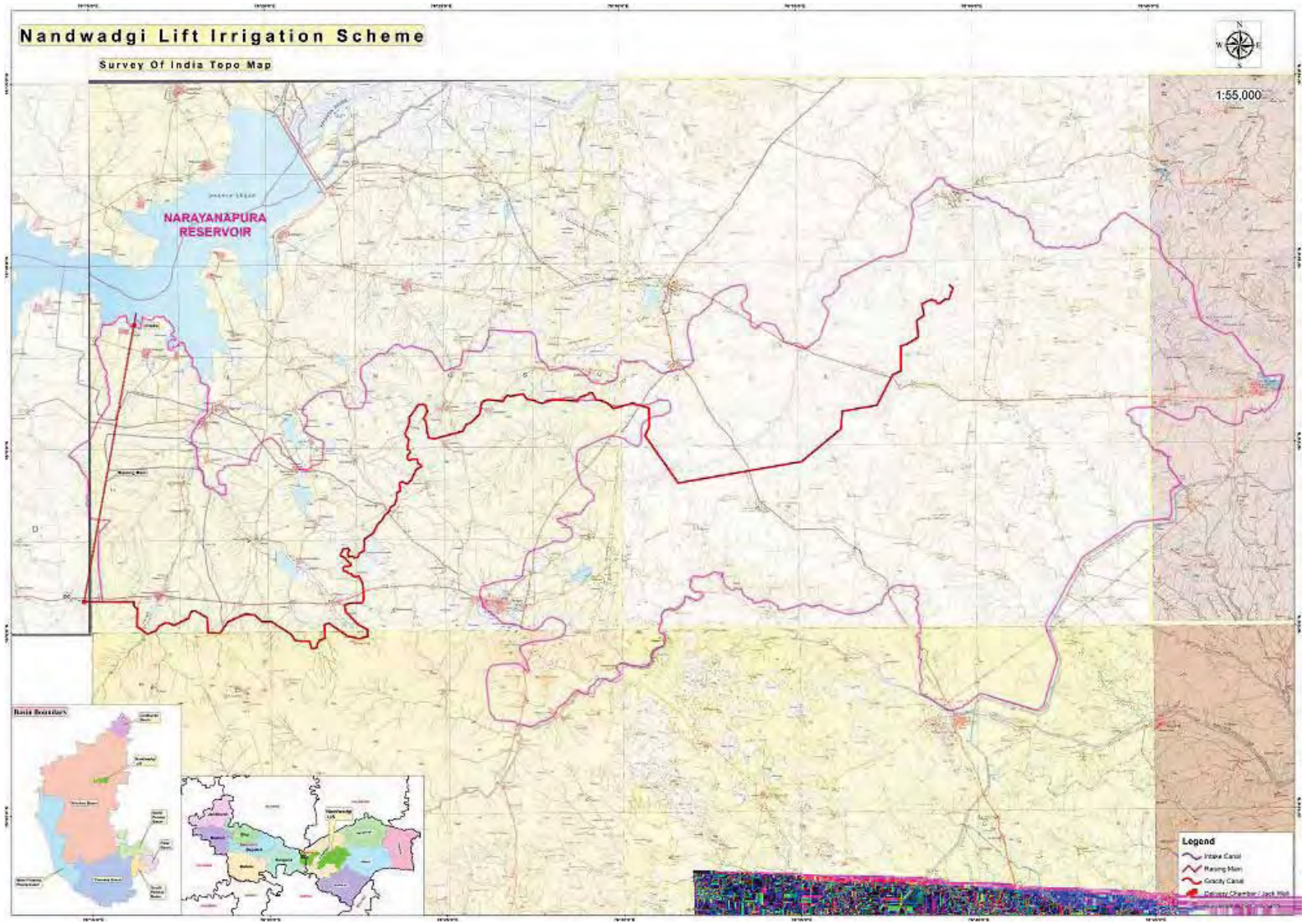


Fig 2.12 Command area map of Nandawadagi LIS

2.4.4.1 Cropping Pattern

Table 2.14 The details of cropping pattern with Irrigation intensity

Season	Crop	Percent	Area (Ha)
Kharif	Maize (Hy Br)	8	2511
	Jowar	17	5336
	Ground Nut	12	3766
	Sun Flower	22	6905
	Pulses	6	1883
	Sub Total	**65**	**20401**
Rabi	Local Jowar	4	1256
	Safflower	5	1570
	Gram	5	1570
	Sun Flower	11	3453
	Wheat	5	1570
	Ground Nut	5	1570
	Sub Total	**35**	**10989**
Two Seasonal	Cotton	5	1570
	Vegetables / Red Gram	5	1570
	Sub Total	**15**	**4710**
	Total	**115**	**36100**

2.4.4.2 Command area

Table 2.15 Details of benefitting villages

Sl.No	District	Taluk	Benefitting Villages	Sl.No	Benefitting Villages
1	Bagalkot	Hunagund	Chamalapur	44	Jhulgud
2			Gonal s. k.	45	Jokkarmadugu
3			Harnapur	46	Kachapur
4			Kamblihal	47	Kallelingsugur
5			Kodihal	48	Katgal
6			Nandawadgi	49	Khairwatgi
7			Yattinahatti (karadi)	50	Kilarhatti
8	Lingasugur	Raichur	Advibhavi	51	Komnur
9			Amdihal	52	Kota h
10			Amravati	53	Lakkihal b.
11			Anahosur	54	Lakkihal k.
12			Aankanhal	55	Lingsugur
13			Ankasdoddi	56	Lingsugur rural
14			Anwari	57	Maidnapur
15			Ashihal	58	Marbikallur
16			Bainderkarlkunta	59	Masalikarlkunta
17			Bandisunkapur	60	Maski
18			Basapur	61	Mattur
19			Bayapur	62	Mavinbhavi
20			Bellihal	63	Mudbal
21			Bhupur	64	Mudgal
22			Bommanhal	65	Marladinni

Sl.No	District	Taluk	Benefitting Villages	Sl.No	Benefitting Villages
23			Bliddini	66	Nagalapur
24			Buddini	67	Nagarhal
25			Chikkesrur	68	Nilvagal
26			Chiknagnur	69	Niralkera
27			Chiknahatti	70	Palgaldinni
28			Chitranal	71	Picklihal
29			Dabbermadu	72	Ramankatti
30			Erapur	73	Rampur
31			Gejjalgatta	74	Sajjalgud
32			Gonwar	75	Sanbal
33			Gudihal	76	Santikallur
34			Gundsagar	77	Sultanpur
35			Hadadarhal	78	Surjapur
36			Halkawatgi	79	Taribhavi
37			Hatti	80	Halkwatgi
38			Hirehesrur	81	Tondihal
39			Hirenagnur	82	Tumbalgaddi
40			Hosur	83	Upparnandihal
41			Huligud	84	Uskihal
42			Hunkunti	85	Wyasnandihal
43			Huvvinbhavi	86	Yardihal B

2.4.4.3 Automation for entire command area

- Automation at Jack well

At Jack well level there are pumping stations feeding to MDC's. A level transmitter will continuously monitor the available water level at the source to ensure enough water level for operation of the system. One pump out of each pumping station will be variable frequency drive pump. This VFD will cater the fluctuations in demand. It will regulate to deliver lower or higher flow rates according to system demand. Pressure transmitter is used on each rising main to monitor the pressures and to detect the pressure fluctuations. Flow meter on each rising main will monitor the flow of the system.

All these operations will be controlled by PLC at each pumping station. These PLCs will communicate with SCADA station through GSM/GPRS communication.

- Automation at MDCs

At MDCs, water level in the MDC will be monitored using level transmitter and will be communicated to respective PLCs at Jack well station to control the operation of the pumps.

- Automation at Block Levels

At Block Levels VFD will control the fluctuations in demand. There will be a pressure transmitter at each block. Pressure transmitter will monitor the pressure fluctuations and control the pumps in case there is pressure fluctuations due to changes in demand. Flow will be monitored using automatic flow meter for each block. There will be a control valve at the outlet of pumping station of each block to control the flow rate.

All the operations are controlled through PLC allocated for each block. These PLCs will communicate with SCADA station for control and monitoring.

- Outlets of each block

Although outlets are not directly controlled through automation. It is designed to maintain constant pre-set downstream pressure using pressure reducing valve (PRV). PRV will maintain constant pre-set downstream pressure. In case, demand is low at the downstream, valve will throttle to maintain required pressure with varying demand situations. In addition to this flow control is also provided at each outlet for maintain the desired flow of 5.5 LPS at each Outlet.

Proposed Intake canal location

Proposed Jackwell cum pump house location

Proposed Delivery Chamber location

Command area

2.4.5 9(A) Distributary

The District, Raichur through which, the river Krishna borderly flows is in a rain shadow area where in the rainfall is very meagre and unevenly distributed. Although the land is fertile this area has been subjected to frequent recurring famine and scarcity conditions. The population in this area subsists mainly on Agriculture which is not gainful and profitable, on account of failure of rains. Therefore the living conditions are very hard in this district, in spite of river Krishna. If the water is made available for irrigation it will ameliorate the poverty stricken and acute drought conditions prevailing in this area and the additional food production will help to improve the socio-economic conditions of the riots in these drought prone districts.

The alignment of distributory 9 (A) takes off at Km 54+12 of NRBC. From Km.54+330 to 54+986 m there is a fall of 32 mtr in the canal bed level of NRBC. alignment for which a chute is already constructed, the above head of 32 m is considered for irrigating the lands of Devdurga and Manvi taluks benefiting about 44 villages.

The alignment of distributory 9(A) almost runs in hilly terrains as such the alignment crosses the numerous valleys major and minor nalas for which suitable cross drainage work are proposed. The alignment runs in the most hilly terrains of Somanamaradi village almost running parallel to the existing, NRBC alignment 55+000 to 60+000 Km. The alignment is taken in the required contour on the side long ground of the existing hillocks and connected to the nearest hill lock thereby avoiding detouring of canal on the existing hillocks as such the alignment runs in cutting and banking reaches involving major cross drainage works such as aquducts etc.,

The total length of the main distributory is 29.15 Km with the discharge quantity of 8.51 Cumecs. Further, the main canal is divided into Arekara branch distributory is 22.98 Km length to irrigate 5522 Ha of command area and whereas another distributory namely Wadawatti distributory is 35 Km long and irrigating 8228 ha of command area. Schematic diagram of the project is given below;

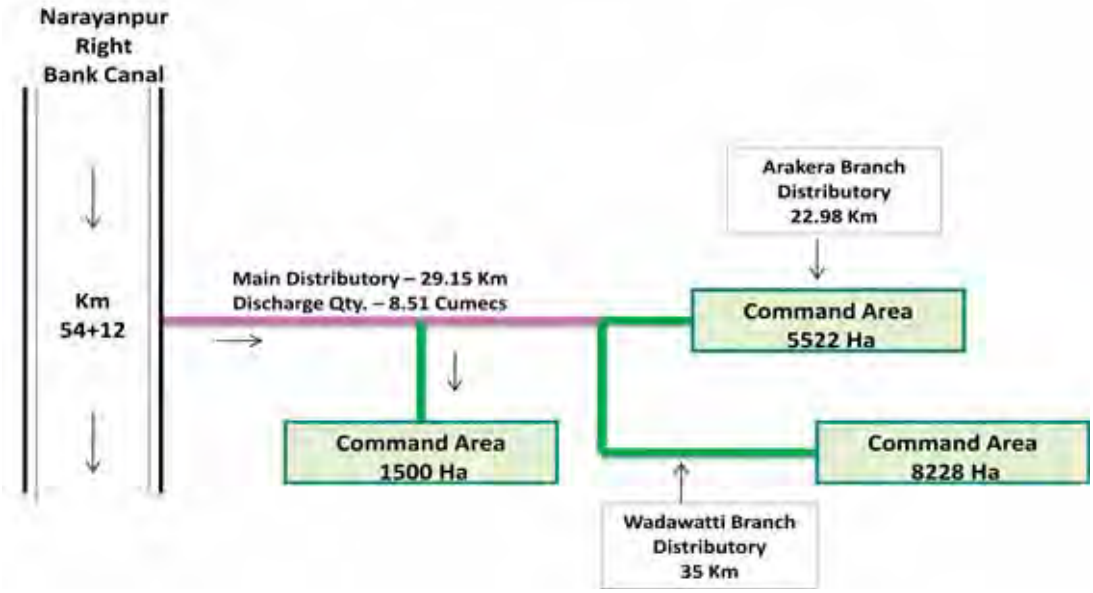


Fig 2.13 Schematic diagram of 9(A) distributory

Table 2.16 Salient Features of the project

1.	Name of the Scheme	9(A) distributor
2.	Name of the river	Krishna
3.	Geographical Location of Lift point	Latitude – 16^{0}17'44.89"N, Longitude –76^{0}44'34.51"E
4.	Location of the Lift point	Offtake from NRBC at Km 54+12
5.	Type of the project	Irrigation (gravity flow)
6.	Estimated cost of the project	Rs. 203 Crores
7.	Command Area	15250 Ha (gravity flow open canal irrigation)
8.	No. of villages benefitting	44
9.	Allocated water	97.91 M.Cum (3.46 TMC)
10.	Cropping pattern	Kharif, Rabi and Biseasonal
11.	Irrigation intensity	115%
12.	Submergence area	Nil
13.	Rehabilitation and Resettlement	Nil
14.	Total Land required	150 Ha
15.	Total forest land required	6.6 ha (Forest Clearace obtained)
16.	Power Requirement	Nil
17.	B C Ratio	1.5

2.4.5.1 Cropping Pattern

Table 2.17 The details of cropping pattern with Irrigation intensity

Season	Crop	Percent	Area (Ha)
Kharif	Bajra	8	1216
	Jowar	12	1824
	Ground Nut	12	1824
	Cotton	20	3040
	Pulses	6	912
	Chilly	7	1064
	Sub Total	**65**	**9880**
Rabi	Local Jowar	4	608
	Safflower	5	760
	Gram	5	760
	Sun Flower	11	1672
	Wheat	5	760
	Ground Nut	5	760
	Sub Total	**35**	**5320**
	Total	**100**	**15200**

2.4.5.2 Command area

Table 2.18 Details of benefitting villages

Sl.No	District	Taluk	Benefitting Villages	Sl.No	Benefitting Villages
1	Raichur	Devdurga & Manvi	Matanoor	23	Sirwara
2			Rodalbanda	24	Boomangudda
3			Yalagatti	25	Mylapura
4			Vandali	26	Kothaldoddi
5			Mallapur	27	Kalapura
6			Palkana maradi	28	Bannigudi
7			Madarkal	29	Mallata
8			Chincharki	30	Murukigudda
9			Buddinni	31	Huda
10			Heera	32	Mapalparti
11			Navalkal	33	Kanumadoddi
12			Narbandi	34	Vadnati
13			Kurkundi	35	Hunacheta
14			Bandagudda	36	Badakanadoddi
15			Arekara	37	Anavara
16			Sosinaitanda	38	Sadakalagudda
17			Kyadigiri	39	Alkodi
18			Hulupeenamardi	40	Bavantikal
19			Mardi	41	Devargudda
20			Nagol	42	Madapkal
21			Jadaldinni	43	Chadajalnuda
22			Marata	44	Yaramaras

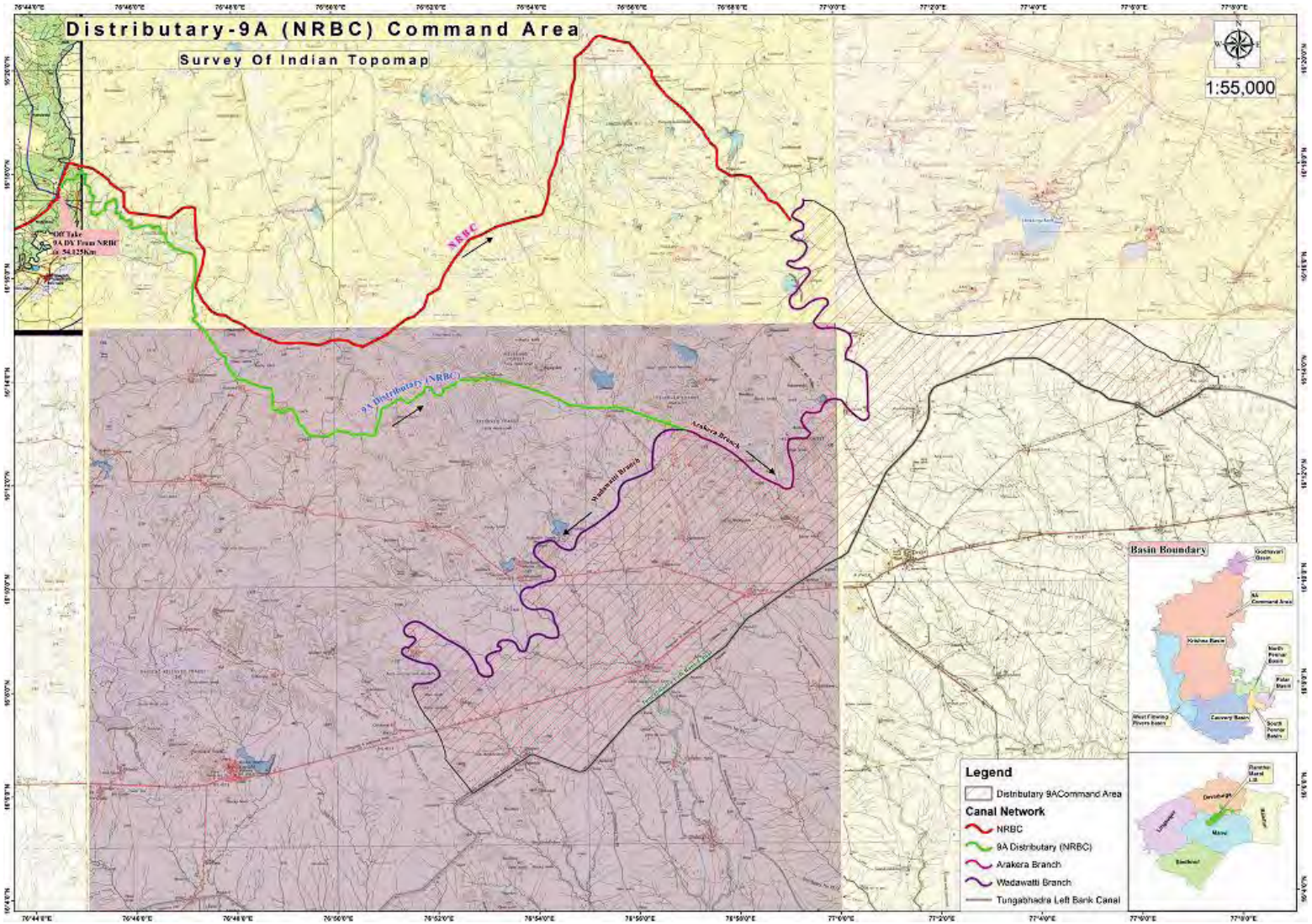


Fig 2.14 Command area map of 9(A)distributory

2.5 Water availability

The irrigation intensity of UKP Stage-I is 108% and 115 % for Narayanpur and Almatti respectively. Similarly, under Stage-II, the irrigation intensity of both Almatti and Narayanpur dams utilization is 115%.

KBJNL decided to reduce the irrigation intensity from 115% to 100% so as to provide irrigation facilities for modernization works. The total water conservation achieved due to modernization works is as follows;

Table 2.19 Crop water requirement for UKP Stage-I

Name of the Reservoir	Area in Ha	Water utilization (TMC)			Savings in Water (TMC)
		For 108%	For 115%	For 100%	
Almatti	16,200	--	3.579	3.029	0.550
Narayanpur	4,08,800	90.317	--	76.432	13.885
Total	4,25,000	90.317	3.579	79.461	14.435

Table 2.20 Crop water requirement for UKP Stage-II

Name of the Reservoir	Area in Ha	Water utilization (TMC)		Savings in Water (TMC)
		For 115%	For 100%	
Almatti	50,985	11.264	9.532	1.732
Narayanpur	1,46,135	32.286	27.322	4.964
Total	1,97,120	43.550	36.854	6.696

Therefore, a total water savings of 20.97 TMC will be achieved by reducing the irrigation intensity. Govt. vide order dated WRD 312 KBAN 2015, Bangalore dated 21.05.2016 (Annexure-9) allocated the savings of water for the following projects.

Table 2.21 Water allocation for modernization works

Sl.No	Name of the project	Water requirement in TMC	Water allocation
1	Thimmapur LIS	4.41	The savings in water due to adotoption of 100% irrigation intensity has been reallocated
2	Ramthal(Marol) LIS	5.84	
3	Budihaal-Peerapur LIS	3.78	
4	Nandawadagi LIS	3.75	
5	9(A) distributory	3.46	

2.6 Environmental flow

There is no additional water drawl from the existing water allocation. The modernization works will be undertaken by reducing the irrigation intensity. However, the water yield calculations of Krishna river at Almatti and Narayanpur reservoir between 1983-2008 shows that there is sufficient downstream flow towards mainatainence of ecosystem services and any deviations is binding agreement between the riparian states.

Table 2.22 Water yield calculations for the period from 1983-84 to 2008-09

Sl.No	Year	Inflow at Almatti Reservoir (TMC)	Water Utilization* @ Almatti Reservoir (TMC)	Inflow to N'pur Reservoir (TMC)	Water Utilization* @ N'Pur Reservoir (TMC)	Downstream flow (TMC)
1.	1983-84	611.22	49.0	540.15	143.3	396.85
2.	1984-85	362.12	46.9	325.93	143.0	182.93
3.	1985-86	301.66	44.0	265.59	142.2	123.39
4.	1986-87	273.65	41.6	238.61	133.0	105.61
5.	1987-88	109.70	43.1	33.41	13.9	19.51
6.	1988-89	583.93	46.4	521.94	143.4	378.54
7.	1989-90	297.69	45.6	237.61	143.2	94.41
8.	1990-91	569.85	46.2	513.31	143.1	370.21
9.	1991-92	767.43	49.3	702.30	143.8	558.5
10.	1992-93	404.57	45.6	341.15	142.7	198.45
11.	1993-94	682.88	51.8	593.94	143.5	450.44
12.	1994-95	1036.16	51.1	961.62	143.4	818.22
13.	1995-96	243.23	45.7	179.34	142.2	37.14
14.	1996-97	411.87	50.5	324.14	142.9	181.24
15.	1997-98	723.09	50.8	934.94	143.3	791.64
16.	1998-99	457.24	52.0	355.05	143.2	211.85
17.	1999-00	585.90	52.2	495.13	143.0	352.13
18.	2000-01	209.64	41.3	144.98	141.4	3.58
19.	2001-02	212.22	39.2	144.86	141.3	3.56
20.	2002-03	204.87	37.9	144.62	141.0	3.62
21.	2003-04	149.34	31.4	117.50	113.9	3.6
22.	2004-05	515.96	54.6	408.38	142.2	266.18
23.	2005-06	1180.10	57.7	1036.83	145.3	891.53
24.	2006-07	55.93	41.1	0.00	7.5	0.00
25.	2007-08	342.19	43.9	295.33	102.0	193.33
26.	2008-09	753.16	44.3	702.80	142.8	560
Average		463.29	46.27	406.13	129.63	276.5

Note - * includes Irrigation, Evaporation and Domestic and Industrial Purpose

2.7 Natural Catastrophes in command area

2.7.1 Floods

Karnataka is facing moderate to severe floods. Floods are associated with cloud bursts, cyclones or depressions in Bay of Bengal and Arabian sea. In Karnataka, parts of Krishna basin and Godavari basin experiencing floods even during drought conditions in others parts of the state due to heavy discharges from Maharashtra[8]. In the year September, 2009, a catastrophic event had occurred in the project area due to cloud bursts resulting in flash floods. The project location falls in 'low damage risk zone' and hence the risk of flood chances are very less and do not affect the structural components of the project. Disaster Management Plan for Almatti and Naryanpur reservoirs was prepared by CWC and in case of emergency the same shall be utilized.

[8]Karnataka State Profile, National Institute of Disaster Management, Govt. of India (http://nidm.gov.in/pdf/dp/Karnataka.pdf)

2.7.3 Earthquake

In Karnataka, 22.13% of the total geographical area is under moderate earthquake damage risk zone & remaining area of the state is under low damage risk zone[15].The state of Karnataka has reported more than 500 earthquake tremors in the last three decades with most of them having low magnitude.

The Karnataka state is categorized as moderate to low seismic risk zone. The following Districts are falling in Zone III (Moderate Damage Risk Zone (MSK VII) viz., Bidar, Gulbarga, Vijayapura, Bagalkot, Belgaum, Dharwad, Uttar kannada, Shimoga, Udupi, Dakshina Kannada, Kodagu. All other Districts are falling under Zone II(Low Damage Risk zone MSK VI). Parts of Vijayapura and Bagalkot districts area under moderate risk zone. However, disaster management plan prepared by CWC for Almatti and Narayanpur reservoirs will be implemented.

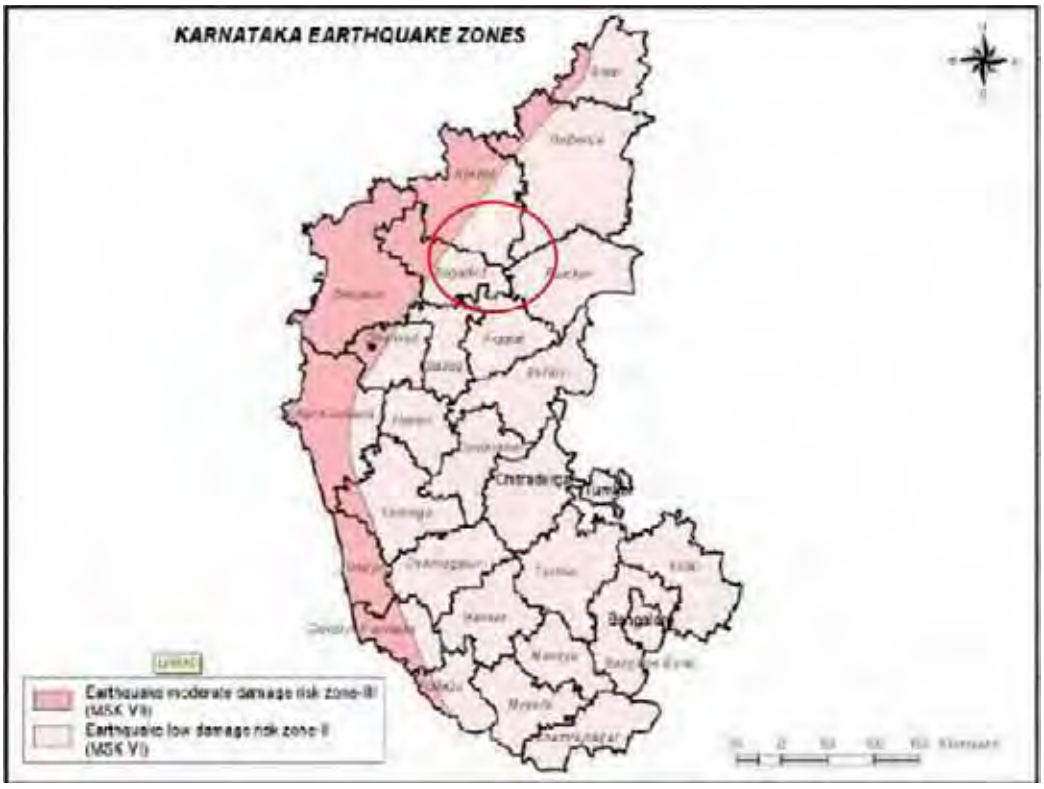


Fig 2.15 Earthquake map of Karnataka showing project location

2.7.4 Landslides

Hilly regions of Western Ghats in Karnataka are prone to landslides during rainy season. The project district is part of the northern Karnataka and hence not prone to landslides.

Chapter 3. Baseline Environment Scenario

Collecting the baseline environmental status of the project area helps to predict 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 project.

3.1 Study area

In order to assess the baseline environmental status, command area, 10 Km radius from the main project components were considered and the data was collected for one Season (March 2016 to May 2016). In addition to the baseline environmental monitoring, field inspection in the study area, collection of primary & secondary information for all the environmental components and discussions with the officials and local public were conducted by the experts. The baseline environmental status presented below comprises of;

- Physical Environment
- Land use assessment of study area
- Biological (Terrestrial) Environment
- Aquatic Environment
- Socio – economic Environment

3.2 Physical Environment

3.2.1 Topography

The area is flat and continuous sloping without undulations towards the Krishna river. The topography of the entire command area is partly plain and partly sloping. The topography in the study area and their corresponding percentages are as given below. The slope maps of the study area are given below (Fig 3.1 to Fig 3.5).

Table 3.1 Topography of the study area

SL.No	Slope	Area Ha	%
A. Budihaal-Peerapur LIS			
1	0-1%	3453	18
2	1-3%	15439	76
3	3-5%	1038	5
4	5-10%	313	1
	Total	**20243**	**100.000**
B. Ramthal (Marol) LIS			
1	0-1%	11767	30
2	1-3%	26108	68
3	3-5%	29	0.076
4	5-10%	96	0.067
	Total	**38000**	**100**
C. Thimmapur LIS			
1	0-1%	20011	99.5
2	1-3%	1.0	0.005
3	3-5%	88	0.43
4	5-10%	0	0
	Total	**20100**	**100**
D. Nandawadagi LIS			
1	0-1%	12297	22.5

SL.No	Slope	Area Ha	%
2	1-3%	31347	58.5
3	3-5%	6446	12
4	5-10%	3910	7
	Total	**54000**	**100**
E. 9 (A) distributory			
1	0-1%	1887	13.35
2	1-3%	11793	75.88
3	3-5%	446	3.16
4	5-10%	1074	7.5
	Total	**15200**	**100**

3.2.2 Climate & Meteorology

Air borne pollutants is dispersed by atmospheric motion. Knowledge of these motions, which range in scale from turbulent diffusion to long-range transport by weather systems, is essential to simulate such dispersion and quality of impacts of air pollution on the environment. The purpose of EIA is to determine whether average concentrations are likely to encounter at fixed locations (Know as the receptor), due to the given sources (locations and rates of emission known) under idealized atmospheric conditions.

Secondary information with respect to meteorological data (Temperature, Relative Humidity, Rainfall, Wind speed and Wind direction etc.) were collected from Vijayapura and Bagalkot meteorological observatory.

3.2.2.1 Meteorology data collected at site

Meteorological data for the study period was collected by establishing meteorological station and already established meteorological stations by Water Resource Dept., Govt. of Karnataka. The data are presented below.

Table 3.2 Meteorological data collected during the study period

Meteorological data		Solar Rad (wat/m2)	Temperature (^{0}C)	Rainfall (mm)	Wind Gust (km/h)	Wind Speed (km/h)	Dew Point (^{0}C)	Mixing height (m)
March, 2016	Max	1145	42.9	0.7	19	7	26.12	2147
	Min	0	18.5	0	0	0	-1.9	0.8
	Avg	259.4	28.4	0.00	5.68	0.53	13.7	1045
April, 2016	Max	1159	43.1	0.05	26	11	25.8	2198
	Min	0	20.8	0	0	0	-2.9	1
	Avg	309.7	31.4	0.000	4.78	0.45	13.9	783
May, 2016	Max	1108	43.7	0.3	26	6	24.6	2461
	Min	0	20.8	0	0	0	-0.75	8.9
	Avg	307.5	30.4	0.00	5.34	1.14	18.7	1166.41

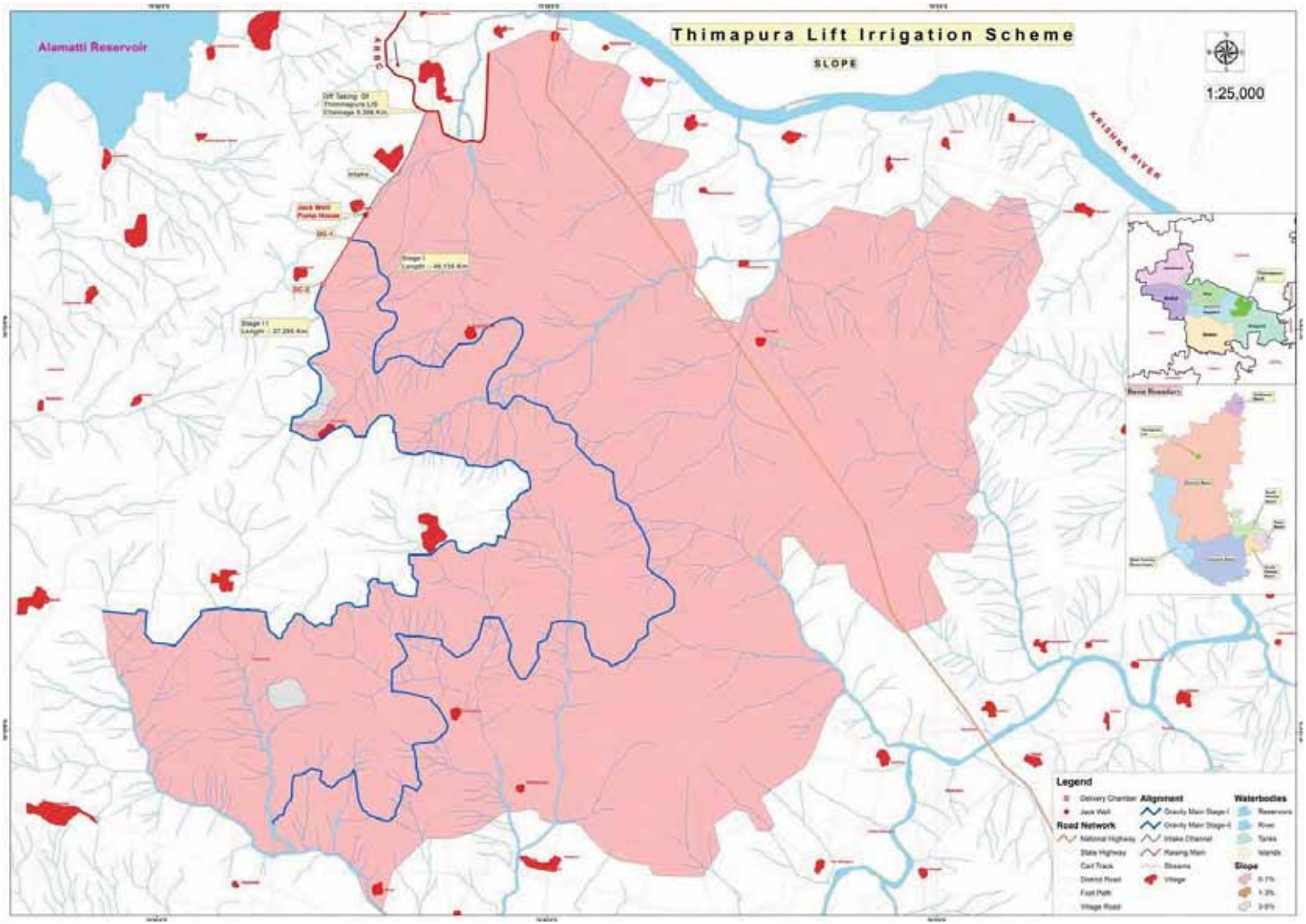


Fig 3.1 Slope map of Thimmapur LIS

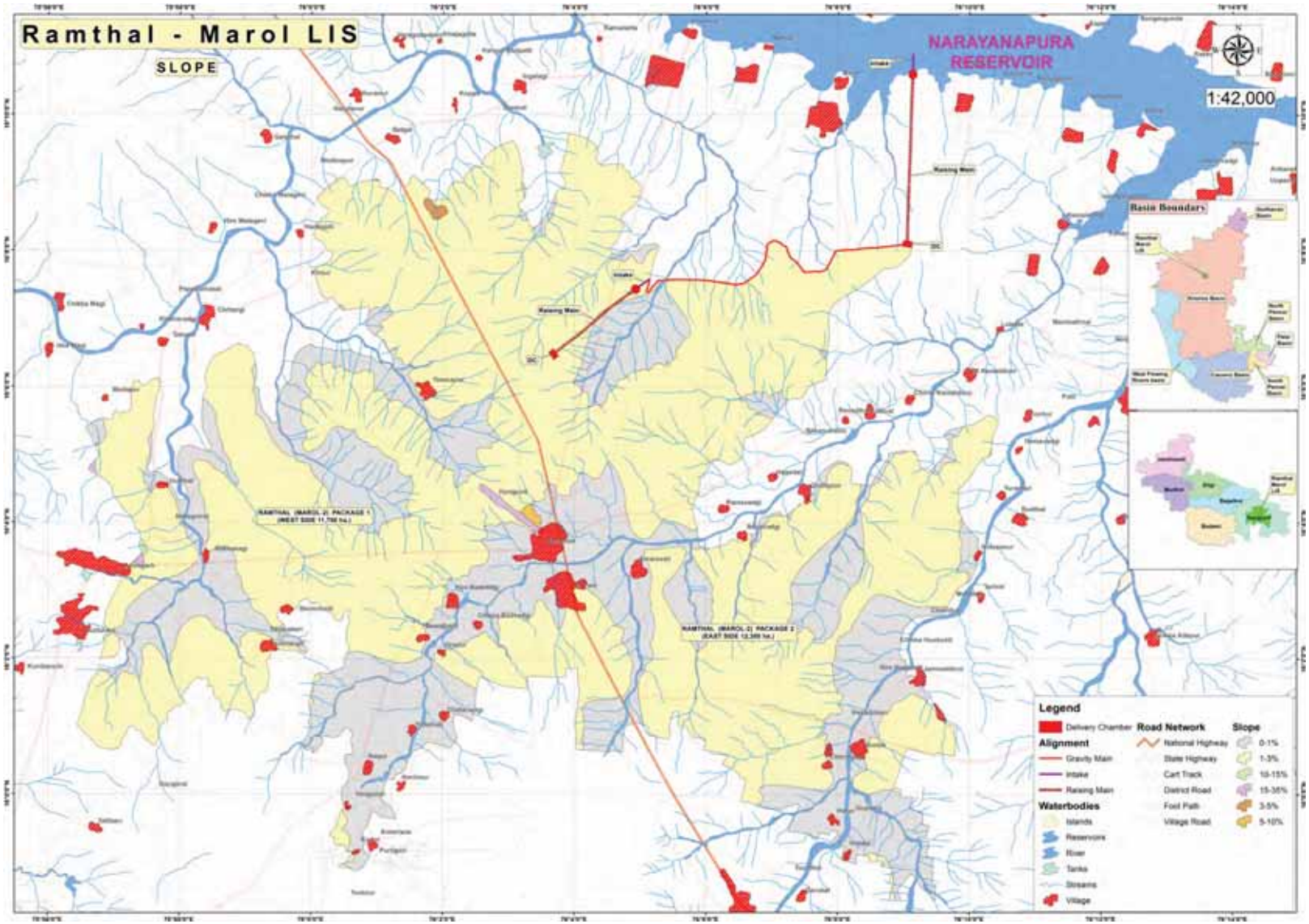


Fig 3.2 Slope map of Ramthal LIS

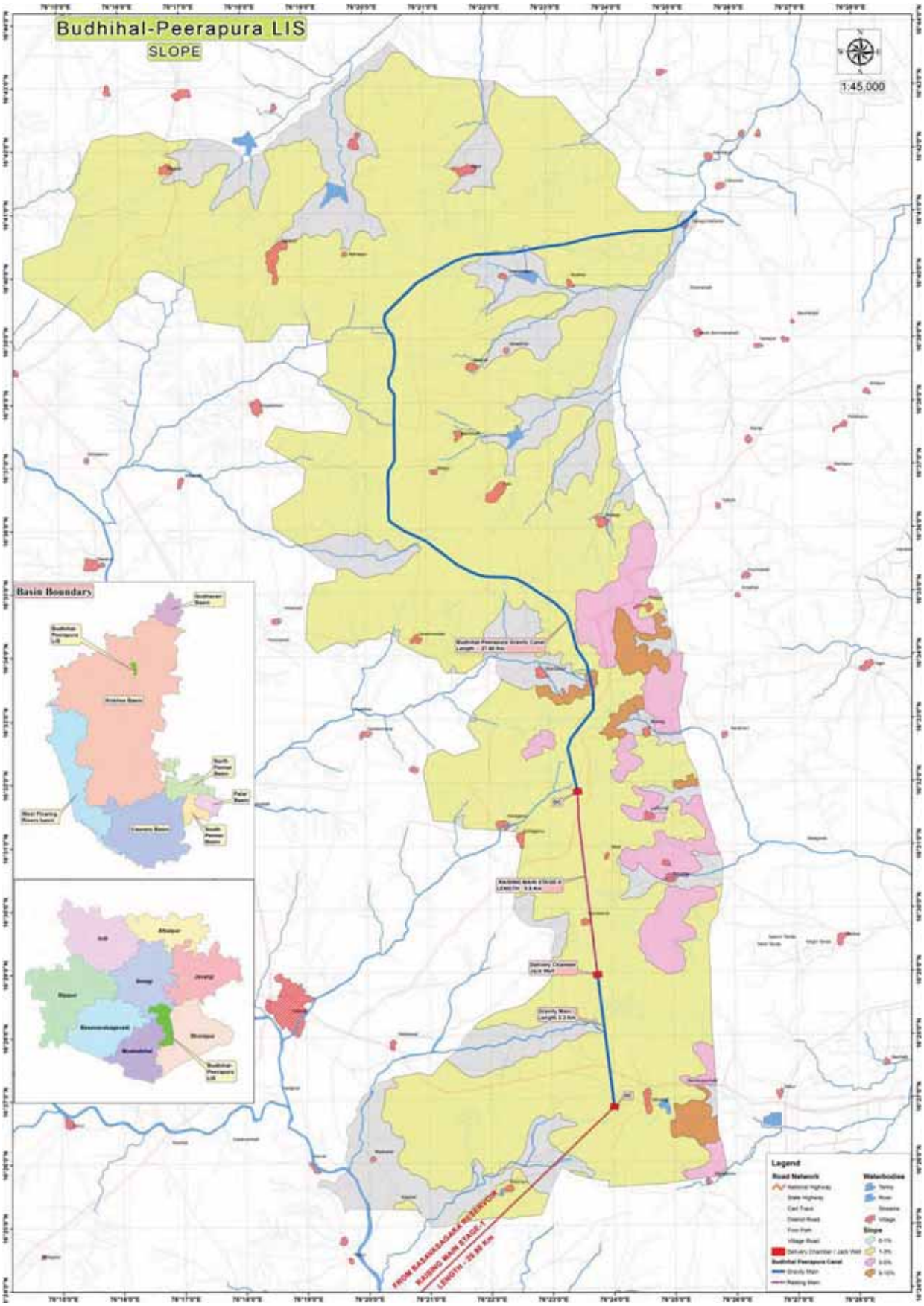


Fig 3.3 Slope map of Budhihaal- Peerapur LIS

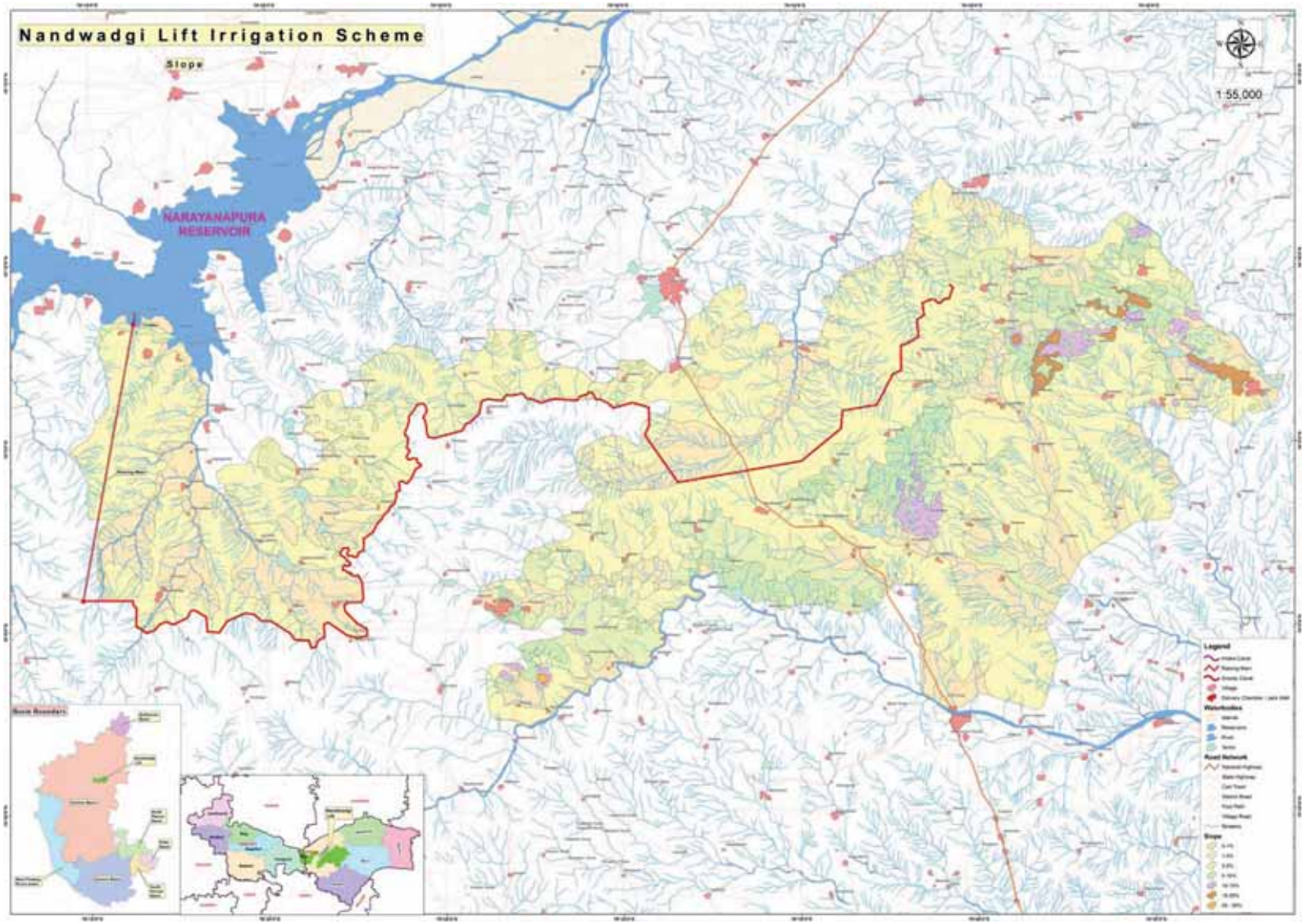


Fig 3.4 Slope map of Nandwadgi LIS

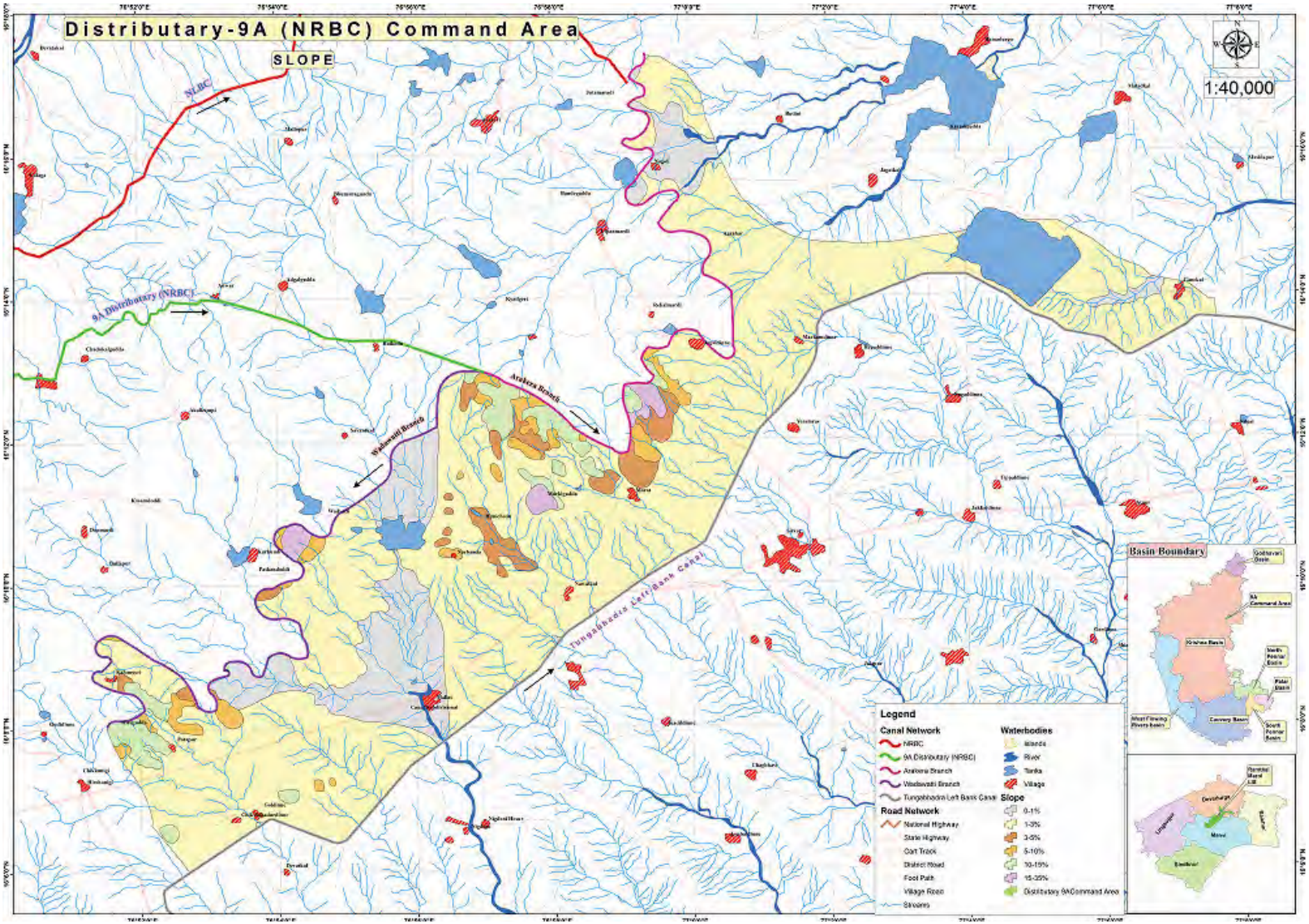


Fig 3.5 Slope map of 9(A) Distributory

Table 3.3 Meteorological data collected at Vijayapura IMD station for the period Jan-2013 to Dec 2013[9]

Month	Temperature (°C)		Mean Dew Point Temperature in (°C)		Mean RH %		Rainfall (mm)		Mean Station level pressure in hPa		Mean of Av. Wind speed for 24 hrs.(kmph)
	Mean Max	Mean Min.	0830hrs.	1730hrs.	0830hrs.	1730hrs.	Total	Heaviest	0830hrs.	1730hrs.	
Jan	31.6	15.0	11.9	9.8	54	29	4.2	4.2	947.1	943.6	4.1
Feb	32.9	17.7	12.9	9.9	52	27	8.6	5.4	946.1	942.1	5.7
Mar	36.2	20.1	11.7	9.7	38	22	1.4	1.4	944.9	940.7	6.3
Apr	38.7	23.1	14.7	10.4	43	21	31.6	31.6	942.5	938.0	6.8
May	39.3	23.9	19.0	13.7	58	28	50.3	19.8	940.5	936.0	12.8
Jun	31.8	21.7	21.2	19.9	77	60	89.6	34.2	937.8	935.1	xx
Jul	28.5	21.3	21.0	20.7	83	76	206.6	110.0	937.8	935.5	15.0
Aug	30.4	20.6	20.6	19.8	80	63	72.0	25.4	940.1	936.9	12.9
Sep	30.7	20.9	21.2	20.6	83	66	194.8	35.4	940.8	937.4	8.8
Oct	30.7	20.5	20.6	19.3	78	61	112.5	50.5	943.0	939.6	6.9
Nov	29.2	15.8	16.6	14.8	68	48	0.0	0.0	946.3	942.7	3.9
Dec	29.0	11.6	12.5	10.4	61	36	0.0	0.0	946.6	943.3	4.1

[9]Indian Meteorological Dept., Vijayapura, Karnataka

Table 3.4 Meteorological data collected at Bagalkot IMD station for the period Jan-2012 to Dec 2012[10]

Month	Temperature (°C)		Mean Dew Point Temperature in (°C)		Mean RH %		Rainfall (mm)		Mean Station level pressure in hPa		Mean of Av. Wind speed for 24 hrs (kmph)
	Mean Max	Mean Min.	0830hrs	1730hrs	0830hrs.	1730hrs.	Total	Heaviest	0830hrs	1730hrs	
Jan	27.4	15.8	17.1	21.3	75	70	15.2	15.2	956.6	953.5	3.1
Feb	29.8	20.0	17.9	20.9	67	58	0.0	0.0	955.7	951.5	2.8
Mar	34.6	20.7	20.7	20.8	72	46	0.0	0.0	954.6	950.1	2.9
Apr	36.8	22.9	23.1	21.6	71	44	6.8	4.6	953.3	948.7	4.5
May	37.8	25.9	22.8	22.9	68	45	44.0	19.4	950.2	945.0	5.9
Jun	30.9	23.6	22.5	22.9	77	64	46.2	13.0	949.4	946.8	8.1
Jul	28.3	19.6	22.9	23.2	83	77	41.6	10.6	948.5	946.0	7.0
Aug	29.0	20.0	21.8	24.1	81	76	77.4	39.6	948.4	946.1	6.2
Sep	28.4	20.7	22.1	22.7	81	72	95.6	25.6	949.6	947.5	2.9
Oct	28.4	20.0	22.4	27.7	81	93	64.2	32.6	952.0	947.4	3.1
Nov	29.0	19.6	21.6	23.2	85	xx	66.8	28.8	952.0	948.5	4.0
Dec	28.6	17.1	19.1	22.6	79	xx	0.0	0.0	953.0	948.6	3.2

[10] Indian Meteorological Dept., Bagalkot, Karnataka

Table 3.5 Rainfall data collected at Hunagund taluk observatories during the study period

Sl.No	Name of the observatory	March-2016	April-2016	May-2016
1	Hunagund	Nil	0.80	42.60
2	Gudur	Nil	Nil	53.40
3	Ilakal	Nil	Nil	69.20
4	Kandagal	Nil	Nil	88.00
5	Kavadi	Nil	Nil	33.80
6	K.Sangam	Nil	90.40	4.20
7	Sulibhavi	Nil	7.80	72.60
8	Amingad	Nil	23.00	58.20

Table 3.6 Rainfall data collected at Narayanpur observatory during 2015

Date	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	1.6	0.0	0.2	0.0	0.0	6.8	0.0	0.0	0.0	0.0	0.0	0.0
2	0.2	0.0	1.6	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	9.8	0.0	0.0	0.0	2.8	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	5.2	0.0	0.0	8.6	50.2	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.2	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.6	2.2	0.0	0.0	62.2	0.6	0.0	0.0
8	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.0	18.6	0.0	0.0	0.0
10	0.0	0.0	11.8	0.0	0.0	0.6	0.0	0.0	15.8	0.0	0.0	0.0
11	0.0	0.0	0.0	7.2	0.0	0.0	0.0	0.0	18.8	0.0	0.0	0.0
12	0.0	0.0	0.0	13.8	0.0	0.0	0.0	0.0	1.2	1.4	0.0	0.0
13	0.0	0.0	0.0	6.8	0.0	0.0	0.0	24.2	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	7.2	0.0	5.8	0.0	0.0	0.0
16	0.0	0.0	0.0	4.2	2.0	6.2	0.0	0.0	1.8	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	9.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.6	1.2	0.0	0.2	0.0	0.4	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	3.8	0.0	0.0	0.0	0.0	1.6	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	1.6	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.2	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	2.2	4.8	30.2	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0
29	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0		0.0	0.0	0.8	0.0	0.0	1.6	0.6	0.0	0.0	0.0

Date	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
31	0.0		0.0		0.0		0.0	0.0		0.0		0.0
Total	**1.8**	**0.0**	**14.0**	**32.0**	**15.2**	**44.0**	**12.4**	**33.0**	**197.0**	**55.0**	**2.6**	**0.0**

Table 3.7 Rainfall data collected at Narayanpur observatory upto May, 2016

Date	Jan	Feb	Mar	Apr	May	June
1	0.0	0.0	0.0	0.0	0.0	3.6
2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	3.8
4	0.0	0.0	0.0	0.0	0.0	10.4
5	0.0	0.0	0.0	0.0	0.0	0.6
6	0.0	0.0	0.0	7.2	0.0	4.8
7	0.0	0.0	0.0	0.0	1.2	
8	0.0	0.0	0.0	0.0	0.0	
9	0.0	0.0	0.0	0.0	0.0	
10	0.0	0.0	0.0	0.0	0.0	
11	0.0	0.0	0.0	0.0	4.4	
12	0.0	0.0	0.0	0.0	0.0	
13	0.0	0.0	0.0	0.0	0.0	
14	0.0	0.0	0.0	0.0	3.8	
15	0.0	0.0	0.0	0.0	10.4	
16	0.0	0.0	0.0	0.0	0.0	
17	0.0	0.0	0.0	0.0	0.0	
18	0.0	0.0	0.0	0.0	0.0	
19	0.8	0.0	0.0	0.0	1.4	
20	0.0	0.0	0.0	0.0	19.6	
21	0.0	0.0	0.0	0.0	0.0	
22	0.0	0.0	0.0	0.0	0.0	
23	0.0	0.0	0.0	0.0	0.0	
24	0.0	0.0	0.0	0.0	0.0	
25	0.0	0.0	0.0	0.0	0.0	
26	0.0	0.0	0.0	0.0	0.0	
27	0.0	0.0	0.0	0.0	0.0	
28	0.0	0.0	0.0	0.0	0.0	
29	0.0	0.0	0.0	0.0	0.0	
30	0.0		0.0	0.0	0.0	
31	0.0		0.0		0.0	
Total	0.8	0.0	0.0	7.2	40.8	

3.2.2.2 Temperature

During the study period, maximum temperature of 43.7^{0}C was observed in the month of May, while minimum of 18.5^{0}C was recorded in the month of March.

3.2.2.3 Solar radiation

Solar radiation is the radiant energy emitted by the sun, particularly electromagnetic energy. About half of the radiation is in the visible short-wave part of the electromagnetic spectrum. The other half is mostly in the near-infrared part, with some in

the ultraviolet part of the spectrum. Maximum Solar radiation 1159 wat/m^2 was observed during the April, 2016.

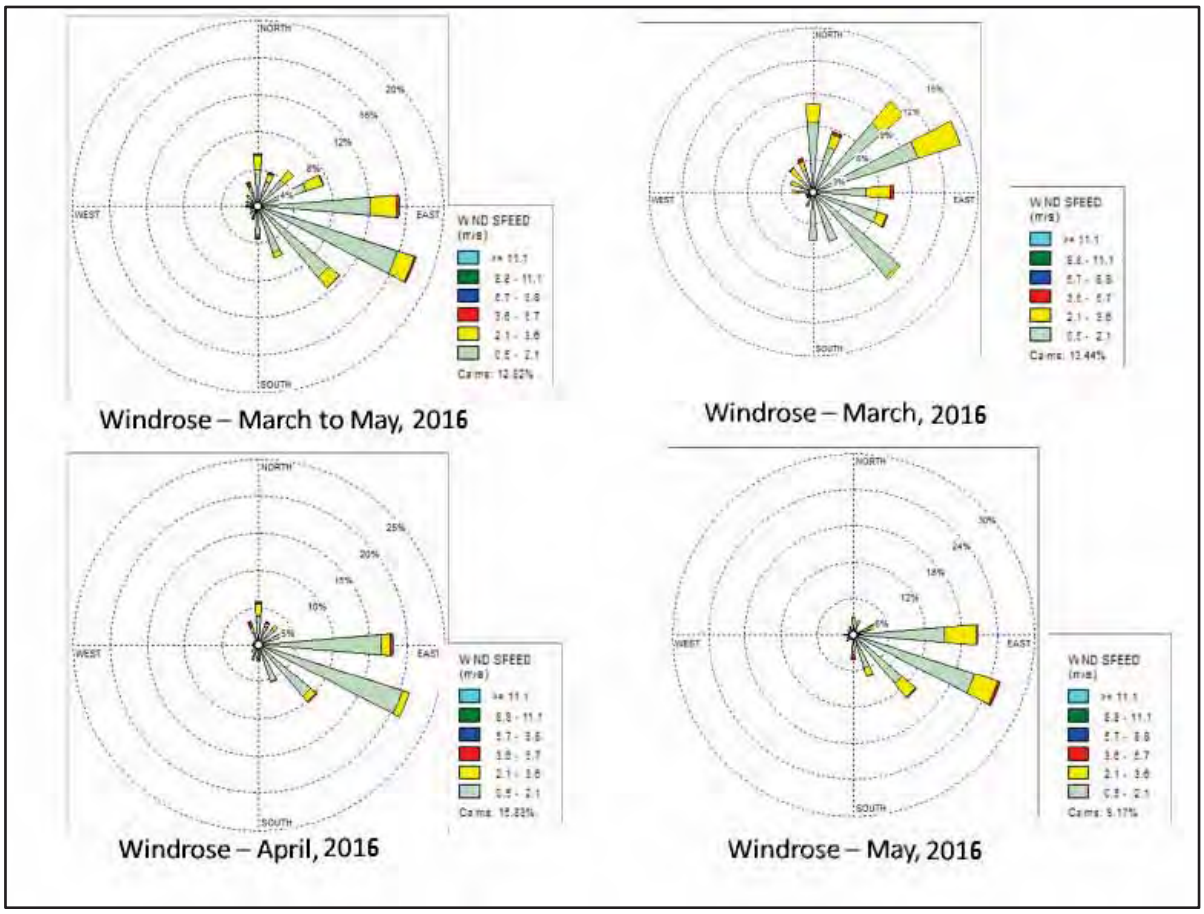


Fig 3.6 Wind rose diagram for the study period

3.2.3 Ambient Air Quality

According to preliminary investigations, the ambient air quality in the study area is found to be good, in the absence of industrial growth in the command area. However, as part of the baseline data collection and in order to understand the **status of ambient air quality during the study area, 14 ambient air quality monitoring stations were established and continuously monitored** during the study period. The criteria followed for selection of ambient air quality monitoring (AAQM) locations and parameters monitored are given below;

- The stations were selected at a place where interferences are not present.
- Height of the inlet was maintained at 3 ± 0.5 m above the ground.
- The sampler was kept more than 20 m away from trees.
- There was unrestricted airflow in three of four quadrants.
- The sampling stations selected were away from major pollution sources[11].

Table 3.8 Details of AAQM parameters with analysis methodology[12]

Pollutants			Frequency of Monitoring	NAAQM Standards, 2009	Unit	Method of analysis
Dust	PM_{10}	Particulate Matter	One month per season for 24 Hrs at all stations	100	µg/m³	Gravimetric method
	$PM_{2.5}$	Particulate Matter		60	µg/m³	Gravimetric method
Gases	SO_2	Sulfur dioxide		80	µg/m³	Improved West and
	NO_2	Nitrogen Di Oxide		80	µg/m³	Jacob & Hochheisser Modified Method

Table 3.9 Details of Ambient Air Quality Monitoring Stations w.r.t Thimmapur LIS

Monitoring Station Code	Name of the location	Geographical Coordinates
A1	Bodanayakdinni	16°14'28.98"N , 75°54'21.23"E
A2	Amblikoppa	16° 9'21.55"N, 75°54'39.48"E

The results of ambient air quality reveal that, PM10 was in the range between 55 – 58.38 µg/m3 and whereas PM2.5 was in the range between 19.5-32 µg/m3. SO2 and NO2 are in the range between 1.5-1.58 µg/m3 and 5.0-5.24 µg/m3 respectively. The air quality index in the study area is found to be satisfactory for PM10 and PM2.5 and good for gases (SO2 and NO2).

[11]Methods for Measurement of Air Pollution (2005), Part 14 Guidelines for Planning the Sampling of Atmosphere, IS 5182 (Part 14): 2000.
[12]National Ambient Air Quality Standards - 2009, CPCB, New Delhi.

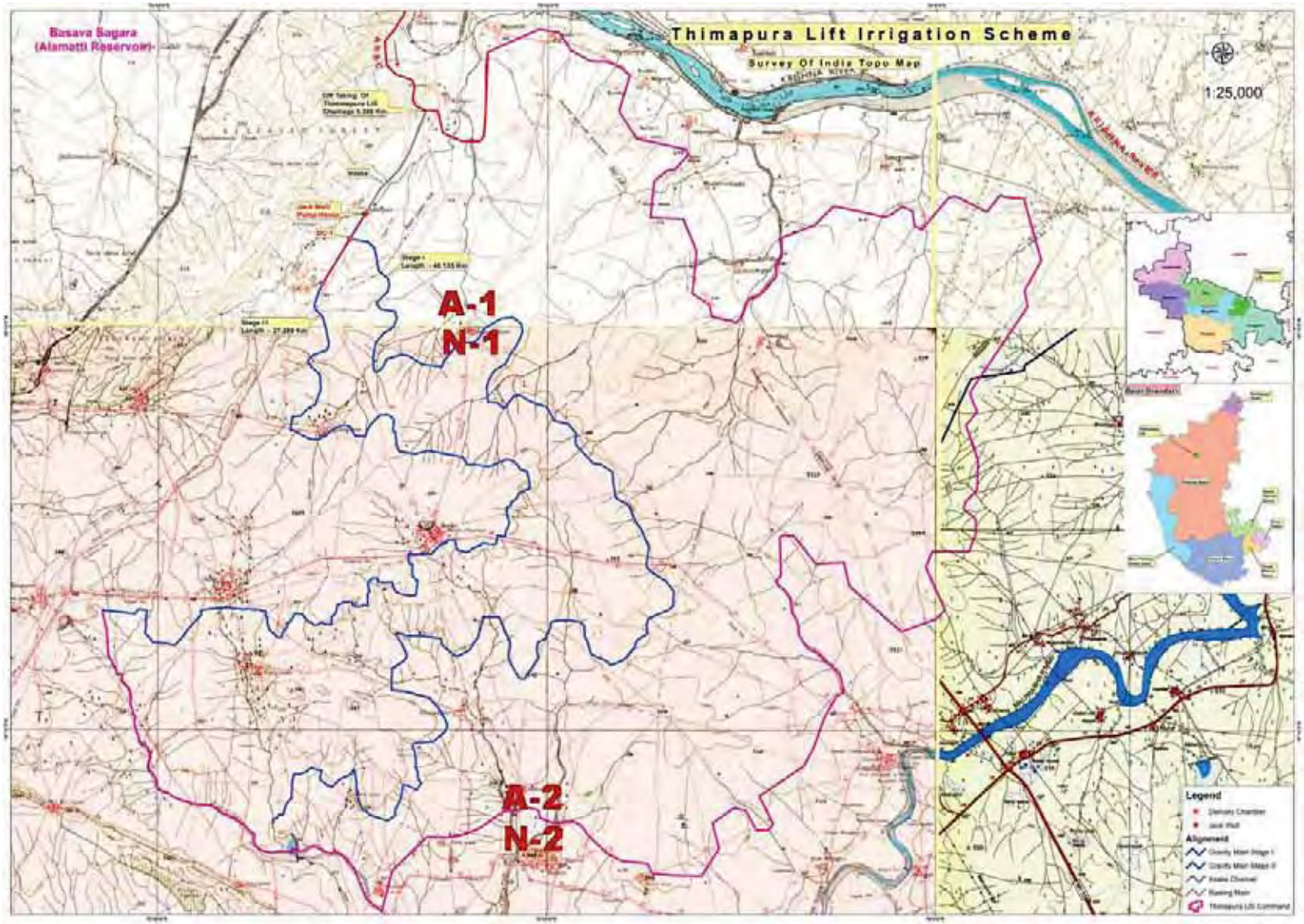


Fig 3.7 Location of AAQM stations on study area m

Table 3.10 Results of Particulate Matter (PM_{10})

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE (PM_{10})			
						98	85	50	35
A1	74.00	41.00	58.38	12.97	57.03	73.58	70.75	62.50	53.85
A2	93.00	41.00	55.00	16.38	53.31	87.96	56.85	53.00	49.15

Table 3.11 Results of Particulate Matter ($PM_{2.5}$)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE ($PM_{2.5}$)			
						98	85	50	35
A1	32.00	18.00	32.00	4.44	21.29	30.60	22.00	20.50	19.45
A2	28.00	10.00	19.50	5.86	18.63	27.44	23.95	20.50	17.80

Table 3.12 Results of Sulphur di-oxide (SO_2)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	1.78	1.35	1.51	0.14	1.50	1.75	1.60	1.49	1.45
A2	1.71	1.50	1.58	0.07	1.58	1.70	1.63	1.56	1.54

Table 3.13 Results of Nitrogen di-oxide (NO_2)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	5.72	4.28	5.27	0.50	5.24	5.71	5.67	5.47	5.18
A2	5.44	4.69	5.00	0.24	5.00	5.41	5.19	4.98	4.89

Table 3.14 Results of Lead (Pb)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	0.03	0.003	0.01	0.01	0.01	0.02	0.01	0.01	0.01
A2	0.02	0.005	0.01	0.005	0.01	0.02	0.02	0.01	0.01

Table 3.15 Results of Nickel (Ni)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	10.23	2.49	5.81	2.61	5.27	9.90	7.88	5.46	5.05
A2	9.09	2.83	5.93	2.42	5.47	9.04	8.69	5.61	4.85

Table 3.16 Results of Carbon Monoxide (CO)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	0.81	0.66	0.75	0.04	0.75	0.80	0.77	0.76	0.76
A2	0.89	0.54	0.79	0.13	0.78	0.89	0.88	0.85	0.83

Table 3.17 Results of Ozone (O_3)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	49.50	37.80	44.96	3.83	44.81	49.33	48.23	46.10	44.49
A2	51.70	26.50	41.09	7.50	40.41	50.75	44.84	42.95	41.92

Table 3.18 Results of Arsenic (As)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	2.22	0.00	0.55	0.75	0.00	2.05	0.96	0.36	0.11
A2	1.92	0.00	0.73	0.78	0.00	1.86	1.48	0.49	0.22

Table 3.19 Results of Ammonia (NH_3)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	3.86	3.14	3.44	0.24	3.43	3.83	3.61	3.38	3.32
A2	3.81	3.24	3.57	0.16	3.57	3.79	3.64	3.59	3.57

Table 3.20 Results of Benzene (C_6H_6)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 3.21 Results of Benzo (a) pyrene (BaP)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 3.22 Ambient Air Quality Index for dust

Monitoring locations	PM 10	AQI	Remarks	PM2.5	AQI	Remarks
A1	58.38	73.58	SATISFACTORY	32.00	51.00	SATISFACTORY
A2	55.00	87.96	SATISFACTORY	19.50	45.73	GOOD

Table 3.23 Ambient Air Quality Index for gases[13]

Monitoring locations	SO2	AQI	Remarks	NO2	AQI	Remarks
A1	1.51	2.19	GOOD	5.27	7.14	GOOD
A2	1.58	2.04	GOOD	5.00	6.48	GOOD

Table 3.24 Ambient Air Quality Index for other parameters

Monitoring locations	Pb	AQI	Remarks	NH3	AQI	Remarks
A1	0.01	2.32	GOOD	3.44	0.96	GOOD
A2	0.01	2.12	GOOD	3.57	0.94	GOOD
Monitoring locations	CO	AQI	Remarks	Ozone	AQI	Remarks
A1	0.75	40.22	GOOD	44.81	49.33	GOOD
A2	0.79	44.43	GOOD	40.41	50.75	GOOD

Table 3.25 Details of Ambient Air Quality Monitoring Stations w.r.t Ramthal LIS

Monitoring Station Code	**Name of the location**	**Geographical Coordinates**
A1	Thimmapur	16° 6'45.38"N, 76° 2'42.24"E
A2	Rakkasagi	16° 3'35.09"N, 75°59'2.77"E
A3	Amaravathi	16° 3'21.83"N, 76° 4'54.39"E
A4	Thumba	16° 0'14.73"N, 76° 8'58.53"E

[13]National Air Quality Index, Control of Urban Pollution Sources Series, (2015), CUPC/82/2014-15,CPCB, New Delhi.

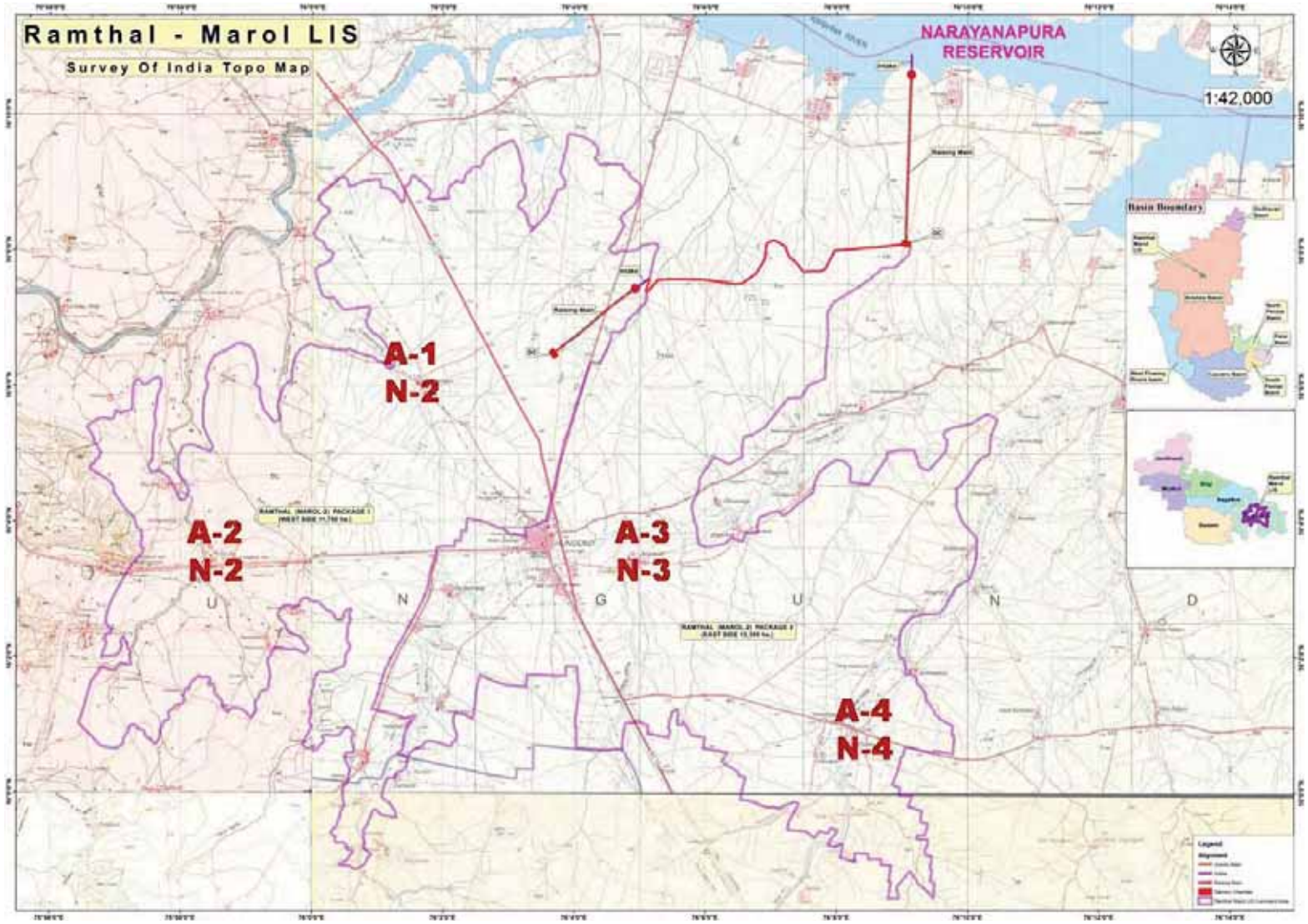


Fig 3.8 Location of AAQM stations on study area of Ramthal (Marol) LIS

The results of ambient air quality reveal that, PM_{10} was in the range between 47.75 – 61.13 μg/m³ and whereas $PM_{2.5}$ was in the range between 19.50 – 22.38 μg/m³. SO_2 and NO_2 are in the range between 1.41 – 1.66 μg/m³ and 4.54 – 5.10 μg/m³ respectively. The air quality index in the study area is found to be satisfactory for PM_{10} and $PM_{2.5}$ and good for gases (SO_2 and NO_2).

Table 3.26 Results of Particulate Matter (PM_{10})

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE (PM_{10})			
						98	85	50	35
A1	62.00	45.00	54.38	5.26	54.14	61.44	57.90	55.50	54.45
A2	54.00	41.00	47.75	5.80	47.44	54.00	53.95	48.00	43.35
A3	79.00	47.00	61.13	11.32	60.21	77.88	70.80	60.50	55
A4	68.00	42.00	54.50	9.43	53.78	67.44	63.85	54.00	49.35

Table 3.27 Results of Particulate Matter ($PM_{2.5}$)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE ($PM_{2.5}$)			
						98	85	50	35
A1	25.00	17.00	21.50	2.56	21.36	24.86	23.90	22.00	21.45
A2	24.00	14.00	19.50	3.89	19.15	24.00	23.95	19.00	18.45
A3	26.00	18.00	22.13	2.95	21.95	26.00	25.90	21.50	20.45
A4	27.00	18.00	22.38	3.38	22.16	27.00	26.85	21.50	21.00

Table 3.28 Results of Sulphur di-oxide (SO_2)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	1.68	1.19	1.47	0.18	1.46	1.67	1.60	1.53	1.45
A2	1.63	1.24	1.41	0.14	1.40	1.63	1.60	1.38	1.34
A3	1.83	1.16	1.55	0.20	1.54	1.81	1.70	1.57	1.5325
A4	1.87	1.19	1.66	0.21	1.64	1.87	1.84	1.67	1.65

Table 3.29 Results of Nitrogen di-oxide (NO_2)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	4.81	4.28	4.54	0.19	4.53	4.80	4.73	4.50	4.46
A2	5.31	4.58	5.10	0.24	5.09	5.31	5.31	5.14	5.11
A3	1.83	4.38	4.63	0.15	4.62	4.82	4.78	4.65	4.566
A4	4.96	4.01	4.74	0.30	4.73	4.95	4.91	4.84	4.79

Table 3.30 Results of Lead (Pb)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	0.014	0.006	0.010	0.003	0.009	0.014	0.012	0.009	0.008
A2	0.104	0.005	0.029	0.037	0.016	0.099	0.067	0.012	0.010
A3	0.026	0.003	0.012	0.007	0.010	0.024	0.015	0.011	0.008
A4	0.073	0.005	0.026	0.029	0.016	0.073	0.068	0.012	0.010

Table 3.31 Results of Nickel (Ni)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	10.10	2.92	5.17	2.22	4.84	9.51	5.88	4.68	4.38
A2	16.10	2.89	5.78	4.36	4.89	14.79	6.68	4.45	3.72
A3	9.97	1.94	4.59	2.65	4.02	9.48	6.42	3.94	3.28
A4	13.04	2.45	5.59	3.40	4.87	12.20	6.98	4.89	4.20

Table 3.32 Results of Carbon Monoxide (CO)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	0.84	0.67	0.73	0.06	0.73	0.84	0.82	0.72	0.70
A2	0.85	0.65	0.71	0.08	0.71	0.85	0.82	0.68	0.66
A3	0.86	0.58	0.71	0.11	0.70	0.85	0.82	0.70	0.65
A4	0.87	0.62	0.79	0.08	0.79	0.87	0.85	0.82	0.81

Table 3.33 Results of Ozone (O_3)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	48.90	37.80	43.74	4.02	43.57	48.54	46.30	45.45	42.78
A2	45.30	29.90	35.61	5.66	35.24	44.92	42.34	33.50	32.85
A3	48.90	30.80	39.68	7.01	39.12	48.70	47.30	40.70	36.45
A4	51.40	32.60	42.08	5.55	41.75	50.69	46.16	42.00	41.17

Table 3.34 Results of Arsenic (As)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	2.17	0.00	0.39	0.76	0.00	1.97	0.71	0.00	0.00
A2	2.17	0.00	0.42	0.76	0.00	1.97	0.71	0.00	0.00
A3	1.21	0.00	0.21	0.44	0.00	1.11	0.46	0.00	0.00
A4	0.73	0.00	0.22	0.31	0.00	0.70	0.50	0.00	0.00

Table 3.35 Results of Ammonia (NH_3)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	3.67	3.42	3.53	0.09	3.53	3.67	3.64	3.52	3.50
A2	3.97	3.66	3.77	0.10	3.77	3.95	3.82	3.75	3.71
A3	3.96	3.57	3.79	0.13	3.79	3.95	3.95	3.82	3.80
A4	4.36	0.82	3.61	1.16	3.28	4.33	4.17	4.03	3.94

Table 3.36 Results of Benzene (C_6H_6)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 3.37 Results of Benzo (a) pyrene (BaP)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 3.38 Ambient Air Quality Index for dust

Monitoring locations	PM 10	AQI	Remarks	PM2.5	AQI	Remarks
A1	54.38	61.44	SATISFACTORY	21.50	41.43	GOOD
A2	47.75	54.00	SATISFACTORY	19.50	40.00	GOOD
A3	61.13	77.88	SATISFACTORY	22.13	43.33	GOOD
A4	54.50	67.44	SATISFACTORY	22.38	45.00	GOOD

Table 3.39 Ambient Air Quality Index for gases

Monitoring locations	SO2	AQI	Remarks	NO2	AQI	Remarks
A1	1.47	2.09	GOOD	4.54	5.99	GOOD
A2	1.41	2.03	GOOD	5.10	6.63	GOOD
A3	1.55	2.26	GOOD	4.63	6.02	GOOD
A4	1.66	2.33	GOOD	4.74	6.19	GOOD

Table 3.40 Ambient Air Quality Index for other parameters

Monitoring locations	Pb	AQI	Remarks	NH3	AQI	Remarks
A1	0.010	1.37	GOOD	3.53	0.92	GOOD
A2	0.029	9.92	GOOD	3.77	0.98	GOOD
A3	0.012	2.45	GOOD	3.79	0.98	GOOD
A4	0.026	7.26	GOOD	3.61	1.08	GOOD
Monitoring locations	CO	AQI	Remarks	Ozone	AQI	Remarks
A1	0.73	41.86	GOOD	43.74	48.54	GOOD
A2	0.71	42.36	GOOD	35.61	44.92	GOOD
A3	0.71	42.72	GOOD	39.68	48.70	GOOD
A4	0.79	43.36	GOOD	42.08	50.67	GOOD

Table 3.41 Details of AAQM Stations w.r.t Budhihal - Peerapur LIS

Monitoring Station Code	**Name of the location**	**Geographical Coordinates**
A1	Rampur	16°40'23.32"N, 76°20'6.50"E
A2	Neeralagi	16°36'27.84"N, 76°23'33.84"E

The results of ambient air quality reveal that, PM_{10} was in the range between 57.56 – 58.88 μg/m³ and whereas $PM_{2.5}$ was in the range between 20.33 – 22.75 μg/m³. SO_2 and NO_2 are in the range between 1.5 – 1.61 μg/m³ and 4.65 – 4.73 μg/m³ respectively. The air quality index in the study area is found to be satisfactory for PM_{10} and $PM_{2.5}$ and good for gases (SO_2 and NO_2).

Table 3.42 Results of Particulate Matter (PM_{10})

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE (PM_{10})			
						98	85	50	35
A1	89.00	38.00	58.88	16.64	56.88	86.62	71.65	58.00	52.60
A2	73.00	46.00	57.56	8.46	57.01	71.72	64.40	58.00	55.20

Table 3.43 Results of Particulate Matter ($PM_{2.5}$)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE (PM2.5)			
						98	85	50	35
A1	31.00	15.00	22.75	6.34	21.95	30.72	28.95	23.00	18.80
A2	27.00	12.00	20.33	5.17	19.71	26.84	25.60	19.00	18.00

Table 3.44 Results of Sulphur di-oxide (SO_2)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	1.69	1.35	1.50	0.13	1.49	1.69	1.66	1.46	1.43
A2	1.83	1.17	1.61	0.20	1.60	1.82	1.78	1.61	1.59

Table 3.45 Results of Nitrogen di-oxide (NO_2)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	4.79	4.45	4.65	0.12	4.65	4.79	4.76	4.67	4.64
A2	4.96	4.46	4.73	0.16	4.73	4.95	4.87	4.75	4.69

Table 3.46 Results of Lead (Pb)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	0.027	0.003	0.015	0.008	0.013	0.027	0.025	0.016	0.012
A2	0.05	0.01	0.02	0.01	0.01	0.05	0.02	0.01	0.009

Table 3.47 Results of Nickel (Ni)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	9.90	1.20	5.68	3.04	4.71	9.60	7.75	6.59	4.55
A2	9.49	1.76	6.02	2.42	5.42	9.26	7.86	6.56	6.28

Table 3.48 Results of Carbon Monoxide (CO)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	0.027	0.003	0.015	0.008	0.013	0.027	0.025	0.016	0.012
A2	0.77	0.67	0.72	0.03	0.72	0.77	0.75	0.72	0.70

Table 3.49 Results of Ozone (O_3)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	42.70	29.70	38.63	4.00	38.42	42.53	41.45	39.60	38.62
A2	47.70	30.90	35.43	4.98	35.16	45.91	36.36	34.70	33.40

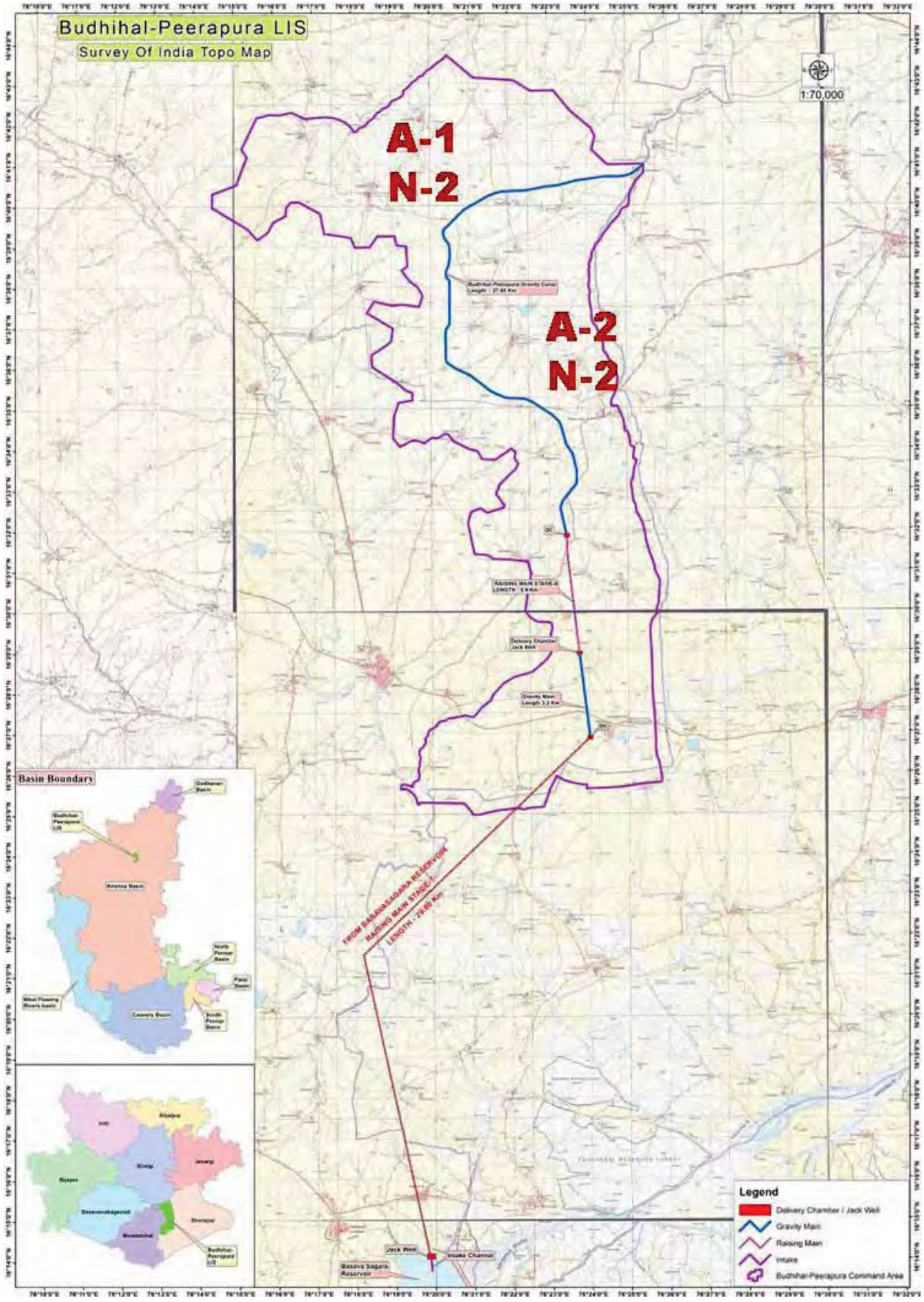


Fig 3.9 Location of AAQM stations on study area of Budhihal - Peerapur LIS

Table 3.50 Results of Arsenic (As)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	1.20	0.00	0.46	0.52	0.00	1.17	0.99	0.25	0.00
A2	4.58	0.00	0.95	1.62	0.00	4.28	2.31	0.24	0.00

Table 3.51 Results of Ammonia (NH_3)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	3.63	3.41	3.51	0.06	3.51	3.62	3.54	3.51	3.49
A2	3.95	3.30	3.51	0.22	3.51	3.91	3.68	3.39	3.35

Table 3.52 Results of Benzene (C_6H_6)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 3.53 Results of Benzo (a) pyrene (BaP)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 3.54 Ambient Air Quality Index for dust

Monitoring locations	PM 10	AQI	Remarks	PM2.5	AQI	Remarks
A1	58.88	86.62	SATISFACTORY	22.75	51.20	SATISFACTORY
A2	57.56	71.72	SATISFACTORY	20.33	44.73	GOOD

Table 3.55 Ambient Air Quality Index for gases

Monitoring locations	SO2	AQI	Remarks	NO2	AQI	Remarks
A1	1.50	2.11	GOOD	4.65	5.98	GOOD
A2	1.61	2.28	GOOD	4.73	6.18	GOOD

Table 3.56 Ambient Air Quality Index for other parameters

Monitoring locations	Pb	AQI	Remarks	NH3	AQI	Remarks
A1	0.015	2.6	GOOD	3.51	0.9	GOOD
A2	0.02	4.59	GOOD	3.51	0.98	GOOD
Monitoring locations	CO	AQI	Remarks	Ozone	AQI	Remarks
A1	0.015	40.8	GOOD	38.63	42.53	GOOD
A2	0.72	38.34	GOOD	35.43	45.90	GOOD

Table 3.57 Details of Ambient Air Quality Monitoring Stations w.r.t Nandwadgi LIS

Monitoring Station Code	**Name of the location**	**Geographical Coordinates**
A1	Veerapur	16° 9'46.10"N, 76°41'3.12"E
A2	Sanbal	16° 0'55.10"N, 76°40'53.47"E
A3	Mattur	16° 2'22.33"N, 76°30'29.76"E
A4	Nandavadgi	16° 1'44.10"N, 76°15'33.95"E

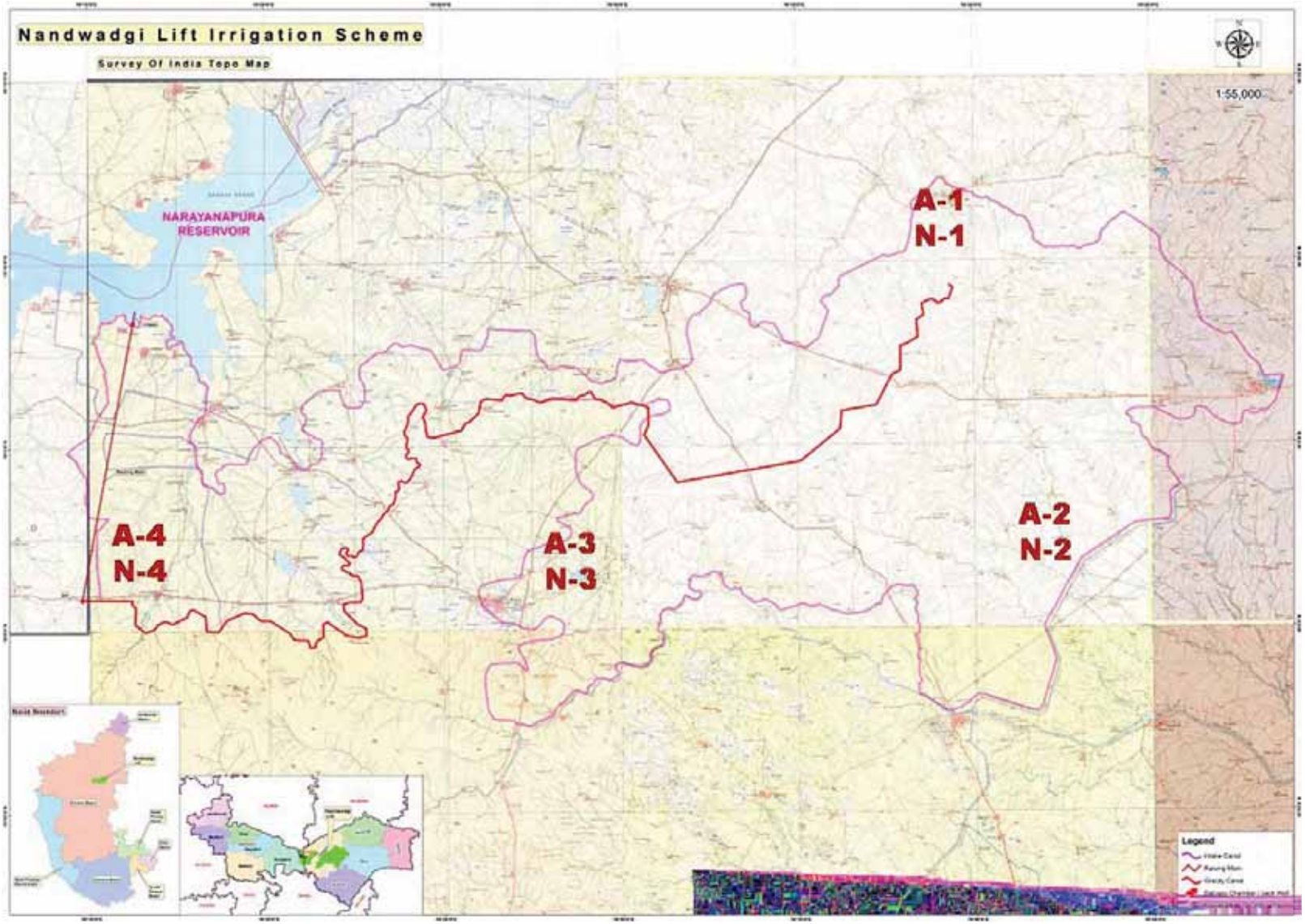


Fig 3.10 Location of AAQM stations on study area of Nandwadgi LIS

The results of ambient air quality reveal that, PM_{10} was in the range between 56.63 – 62.25 μg/m³ and whereas $PM_{2.5}$ was in the range between 19.88 – 23.25 μg/m³. SO_2 and NO_2 are in the range between 1.48 – 1.69 μg/m³ and 4.97 – 5.26 μg/m³ respectively. The air quality index in the study area is found to be satisfactory for PM_{10} and $PM_{2.5}$ and good for gases (SO_2 and NO_2).

Table 3.58 Results of Particulate Matter (PM_{10})

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE (PM_{10})			
						98	85	50	35
A1	76.00	43.00	62.25	12.21	61.11	75.72	73.90	63.50	60.35
A2	77.00	41.00	59.75	11.47	58.75	75.88	68.95	58.50	53.90
A3	71.00	34.00	56.63	13.07	55.16	70.86	69.90	57.00	51.25
A4	67.00	44.00	58.50	7.50	58.04	66.44	63.00	61.00	58.90

Table 3.59 Results of Particulate Matter ($PM_{2.5}$)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE (PM2.5)			
						98	85	50	35
A1	29.00	15.00	23.25	4.30	22.86	28.72	26.90	24.00	22.35
A2	29.00	11.00	19.88	5.30	19.22	28.16	23.00	19.00	18.00
A3	26.00	10.00	21.38	5.07	20.65	25.86	25.00	22.00	21.45
A4	29.00	15.00	22.13	5.14	21.59	28.86	27.85	22.50	19.80

Table 3.60 Results of Sulphur di-oxide (SO_2)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	1.89	1.51	1.69	0.12	1.68	1.88	1.80	1.70	1.65
A2	1.83	1.34	1.55	0.20	1.54	1.83	1.82	1.49	1.44
A3	1.67	1.34	1.48	0.12	1.47	1.66	1.61	1.46	1.41
A4	1.75	1.29	1.54	0.18	1.53	1.75	1.73	1.57	1.45

Table 3.61 Results of Nitrogen di-oxide (NO_2)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	5.85	4.55	5.26	0.36	5.25	5.79	5.44	5.30	5.21
A2	5.42	4.35	4.97	0.31	4.96	5.39	5.18	4.96	4.96
A3	5.87	4.78	5.14	0.36	5.12	5.81	5.45	5.04	4.96
A4	5.34	4.43	5.03	0.27	5.02	5.32	5.18	5.07	5.03

Table 3.62 Results of Lead (Pb)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	0.063	0.008	0.018	0.018	0.014	0.057	0.018	0.012	0.011
A2	0.02	0.006	0.01	0.005	0.01	0.02	0.02	0.01	0.009
A3	0.06	0.004	0.02	0.02	0.01	0.05	0.02	0.010	0.007
A4	0.022	0.007	0.010	0.005	0.010	0.020	0.010	0.009	0.008

Table 3.63 Results of Nickel (Ni)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	13.95	3.14	7.73	4.04	6.89	13.94	13.55	6.61	5.81
A2	8.04	2.02	4.96	2.17	4.49	7.95	7.30	5.00	4.09
A3	39.01	1.50	8.25	12.51	4.77	34.42	6.16	4.20	3.78
A4	8.58	2.88	5.44	2.05	5.08	8.35	6.91	5.64	4.33

Table 3.64 Results of Carbon Monoxide (CO)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	0.84	0.73	0.80	0.04	0.79	0.84	0.83	0.81	0.79
A2	0.82	0.69	0.77	0.04	0.77	0.82	0.81	0.78	0.76
A3	0.86	0.58	0.71	0.10	0.70	0.85	0.82	0.68	0.64
A4	0.80	0.61	0.73	0.06	0.73	0.80	0.79	0.75	0.73

Table 3.65 Results of Ozone (O_3)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	42.60	30.50	36.88	3.81	36.70	42.36	40.75	36.80	36.15
A2	43.60	29.80	39.36	4.81	39.08	43.60	43.56	40.55	38.97
A3	48.20	29.30	40.06	6.60	39.54	47.74	44.80	42.00	40.90
A4	49.80	25.80	39.40	8.17	38.61	49.65	48.52	38.15	37.06

Table 3.66 Results of Arsenic (As)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	1.26	0.00	0.37	0.42	0.00	1.15	0.50	0.36	0.11
A2	0.74	0.00	0.19	0.29	0.00	0.71	0.49	0.00	0.00
A3	1.22	0.00	0.21	0.44	0.00	1.12	0.47	0.00	0.00
A4	2.16	0.00	0.36	0.74	0.00	1.89	0.26	0.12	0.00

Table 3.67 Results of Ammonia (NH_3)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	3.87	3.43	3.70	0.13	3.70	3.86	3.81	3.72	3.70
A2	4.31	3.63	4.07	0.20	4.07	4.29	4.19	4.10	4.08
A3	4.12	3.49	3.90	0.19	3.89	4.11	4.04	3.94	3.89
A4	3.90	3.35	3.67	0.19	3.67	3.89	3.82	3.71	3.61

Table 3.68 Results of Benzene (C_6H_6)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 3.69 Results of Benzo (a) pyrene (BaP)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 3.70 Ambient Air Quality Index for dust

Monitoring locations	PM 10	AQI	Remarks	PM2.5	AQI	Remarks
A1	62.25	75.72	SATISFACTORY	23.25	47.87	GOOD
A2	59.75	75.88	SATISFACTORY	19.88	46.93	GOOD
A3	56.63	70.86	SATISFACTORY	21.38	43.1	GOOD
A4	58.50	66.44	SATISFACTORY	22.13	48.10	GOOD

Table 3.71 Ambient Air Quality Index for gases

Monitoring locations	SO2	AQI	Remarks	NO2	AQI	Remarks
A1	1.69	2.35	GOOD	5.26	7.24	GOOD
A2	1.55	2.29	GOOD	4.97	6.73	GOOD
A3	1.48	2.07	GOOD	5.14	7.27	GOOD
A4	1.54	2.18	GOOD	5.03	6.65	GOOD

Table 3.72 Ambient Air Quality Index for Other parameters

Monitoring locations	Pb	AQI	Remarks	CO	AQI	Remarks
A1	0.018	1.94	GOOD	0.80	40.93	GOOD
A2	0.01	5.05	GOOD	0.77	42.72	GOOD
A3	0.02	2.03	GOOD	0.71	39.93	GOOD
A4	0.010	5.67	GOOD	0.73	41.93	GOOD
Monitoring locations	NH_3	AQI	Remarks	O_3	AQI	Remarks
A1	3.70	1.07	GOOD	36.88	43.6	GOOD
A2	4.07	1.03	GOOD	39.36	47.74	GOOD
A3	3.90	0.97	GOOD	40.06	49.65	GOOD
A4	3.67	0.96	GOOD	39.40	42.36	GOOD

Table 3.73 Details of Ambient Air Quality Monitoring Stations w.r.t 9A Distributory

Monitoring Station Code	**Name of the location**	**Geographical Coordinates**
A1	Irkal	15°37'48.40"N, 76°48'7.54"E
A2	Anandagal	16° 4'26.86"N, 76°42'16.87"E

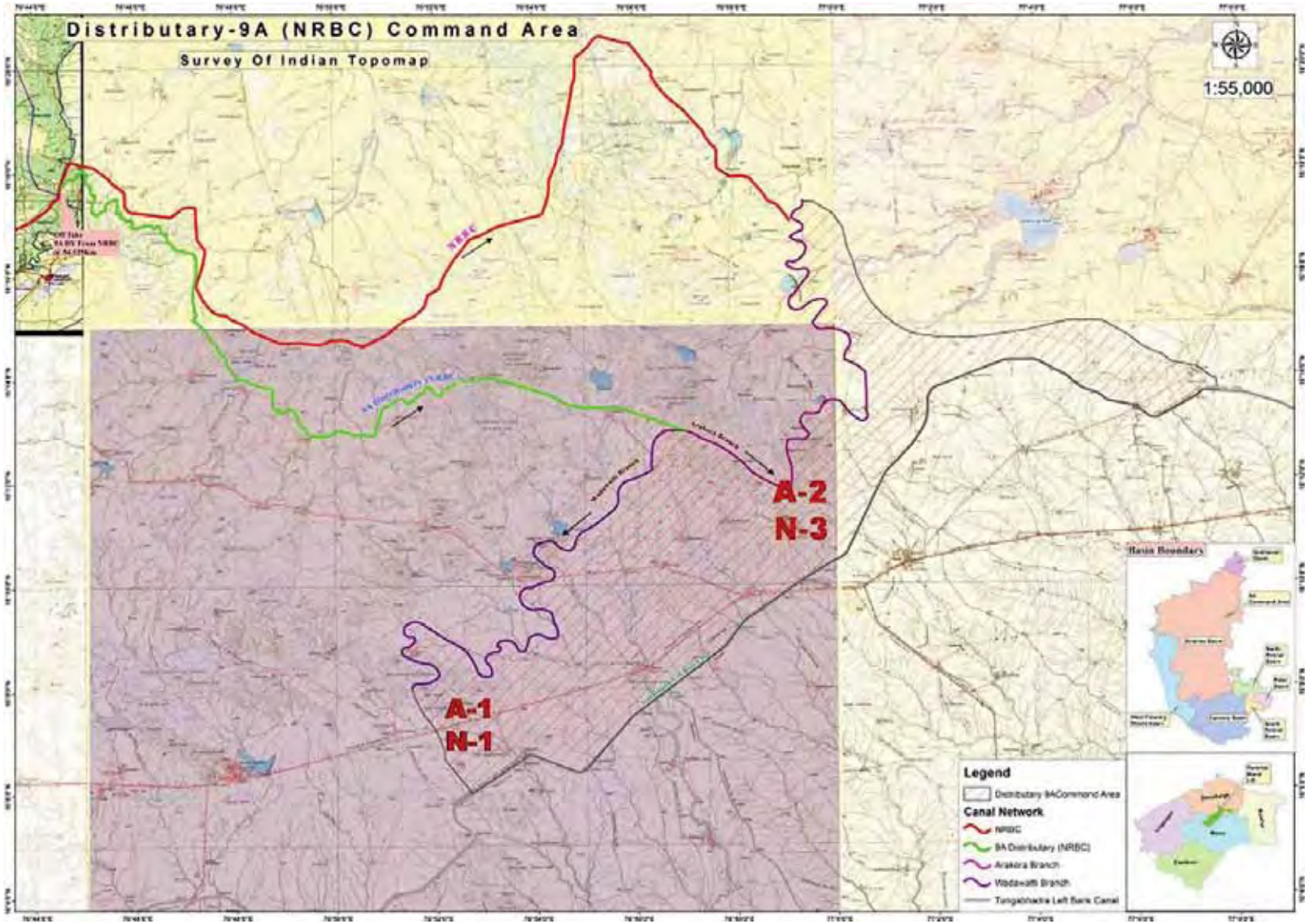


Fig 3.11 Location of AAQM stations on study area of 9(A) Distributory

The results of ambient air quality reveal that, PM_{10} was in the range between 57.25 – 57.88 μg/m³ and whereas $PM_{2.5}$ was in the range between 22.38 – 22.88 μg/m³. SO_2 and NO_2 are in the range between 1.65 – 1.56 μg/m³ and 4.74 – 4.99 μg/m³ respectively. The air quality index in the study area is found to be satisfactory for PM_{10} and $PM_{2.5}$ and good for gases (SO_2 and NO_2).

Table 3.74 Results of Particulate Matter (PM_{10})

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE (PM_{10})			
						98	85	50	35
A1	65.00	39.00	57.25	8.58	56.60	64.86	63.95	59.50	56.90
A2	78.00	47.00	57.88	10.19	57.15	76.32	65.65	56.00	53.45

Table 3.75 Results of Particulate Matter ($PM_{2.5}$)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE ($PM_{2.5}$)			
						98	85	50	35
A1	28.00	14.00	22.38	5.53	21.71	28.00	27.95	23.00	21.45
A2	26.00	19.00	22.88	2.23	22.78	25.86	24.95	23.00	22.45

Table 3.76 Results of Sulphur di-oxide (SO_2)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	1.83	1.50	1.65	0.12	1.65	1.82	1.78	1.61	1.59
A2	1.77	1.38	1.56	0.13	1.56	1.76	1.67	1.56	1.50

Table 3.77 Results of Nitrogen di-oxide (NO_2)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	5.19	4.35	4.74	0.27	4.73	5.15	4.91	4.80	4.66
A2	5.49	4.39	4.99	0.35	4.98	5.46	5.28	5.01	4.91

Table 3.78 Results of Lead (Pb)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	0.030	0.009	0.015	0.007	0.014	0.029	0.021	0.012	0.012
A2	0.021	0.000	0.013	0.007	0.000	0.020	0.020	0.013	0.009

Table 3.79 Results of Nickel (Ni)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	11.46	0.00	6.94	3.69	0.00	11.24	9.88	7.21	6.36
A2	10.30	0.00	6.19	3.17	0.00	10.16	9.19	6.72	5.63

Table 3.80 Results of Carbon Monoxide (CO)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	0.75	0.68	0.71	0.03	0.71	0.75	0.75	0.70	0.69
A2	0.76	0.61	0.69	0.05	0.69	0.76	0.74	0.69	0.66

Table 3.81 Results of Ozone (O_3)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	40.90	32.60	36.56	3.31	36.43	40.89	40.69	36.20	35.04
A2	39.60	26.40	33.23	4.86	32.91	39.50	38.83	31.90	30.43

Table 3.82 Results of Arsenic (As)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	0.72	0.00	0.15	0.25	0.00	0.65	0.24	0.00	0.00
A2	1.44	0.00	0.27	0.50	0.00	1.31	0.48	0.00	0.00

Table 3.83 Results of Ammonia (NH_3)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	3.83	0.37	3.25	1.17	2.74	3.82	3.75	3.65	3.58
A2	3.66	3.24	3.55	0.13	3.55	3.66	3.65	3.59	3.55

Table 3.84 Results of Benzene (C_6H_6)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 3.85 Results of Benzo (a) pyrene (BaP)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 3.86 Ambient Air Quality Index for dust

Monitoring locations	PM 10	AQI	Remarks	PM2.5	AQI	Remarks
A1	57.25	64.86	SATISFACTORY	22.38	46.66	GOOD
A2	57.88	76.32	SATISFACTORY	22.88	43.10	GOOD

Table 3.87 Ambient Air Quality Index for gases

Monitoring locations	SO2	AQI	Remarks	NO2	AQI	Remarks
A1	1.65	2.28	GOOD	4.74	6.44	GOOD
A2	1.56	2.20	GOOD	4.99	6.83	GOOD

Table 3.88 Ambient Air Quality Index for Other parameters

Monitoring locations	Pb	AQI	Remarks	CO	AQI	Remarks
A1	0.015	2.87	GOOD	0.71	37.50	GOOD
A2	0.013	1.99	GOOD	0.69	37.86	GOOD
Monitoring locations	NH_3	AQI	Remarks	O_3	AQI	Remarks
A1	3.25	0.95	GOOD	36.56	40.88	GOOD
A2	3.55	0.91	GOOD	33.23	39.50	GOOD

3.2.3.1 Summary of Ambient Air Quality Results

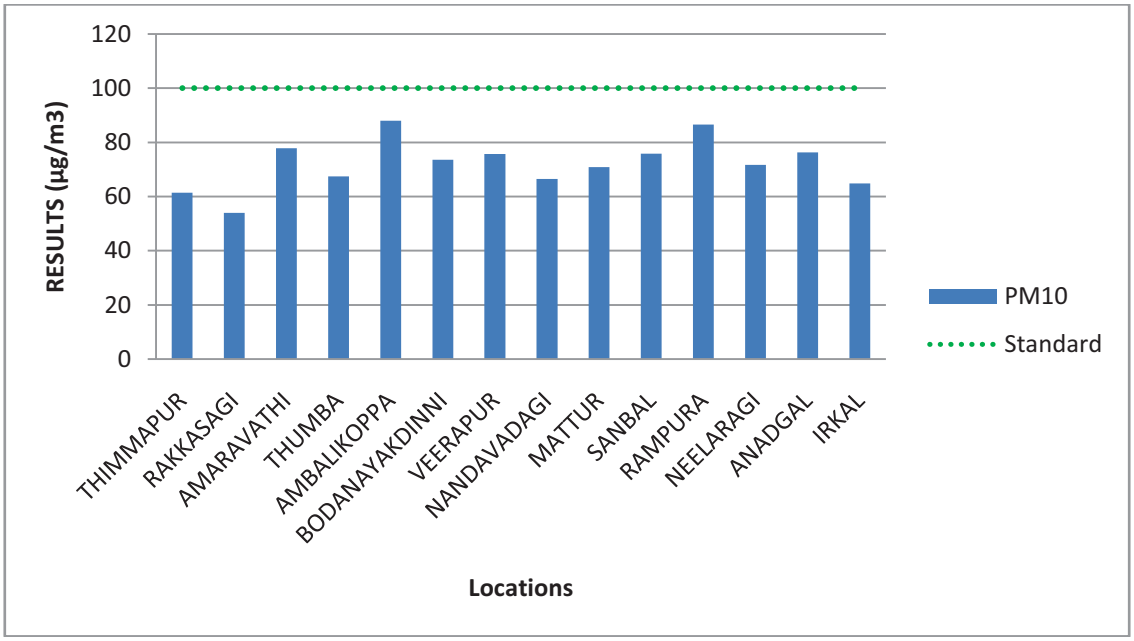


Fig 3.12 Graph showing PM10 values

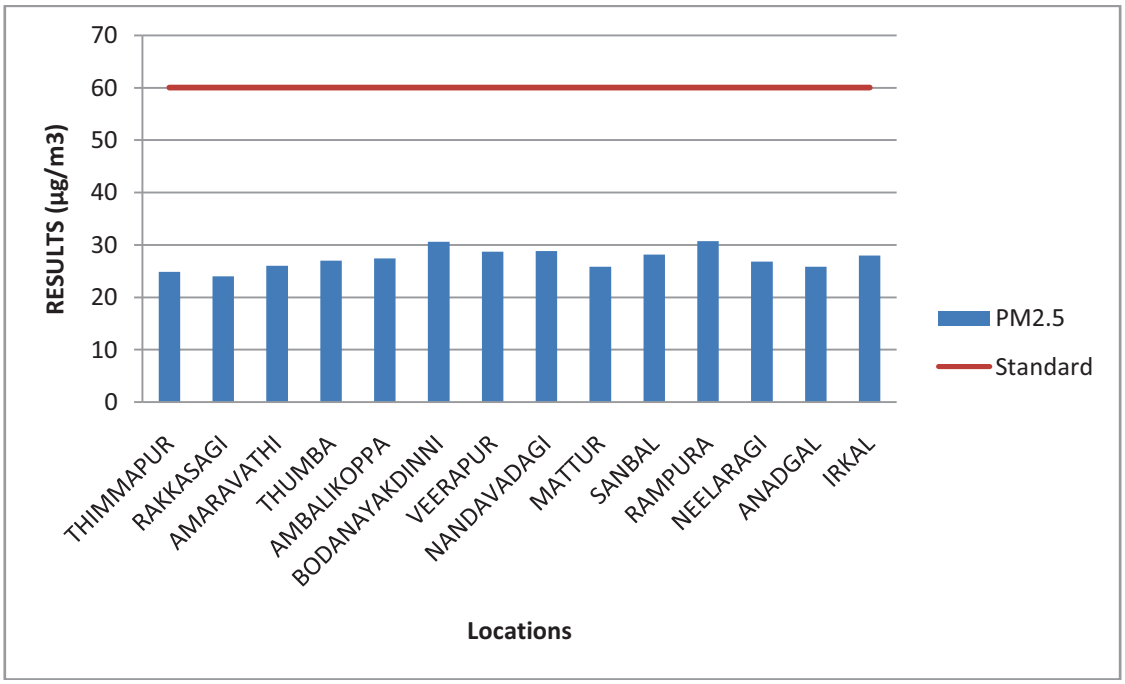


Fig 3.13 Graph showing PM2.5 values

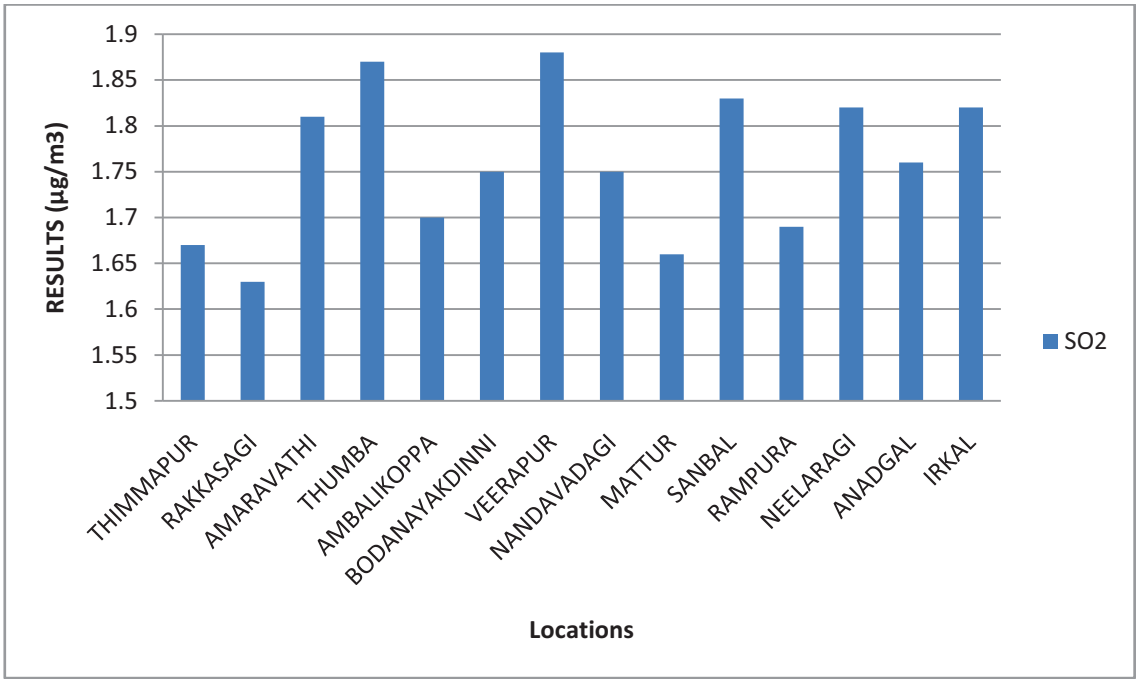


Fig 3.14 Graph showing SO2 values

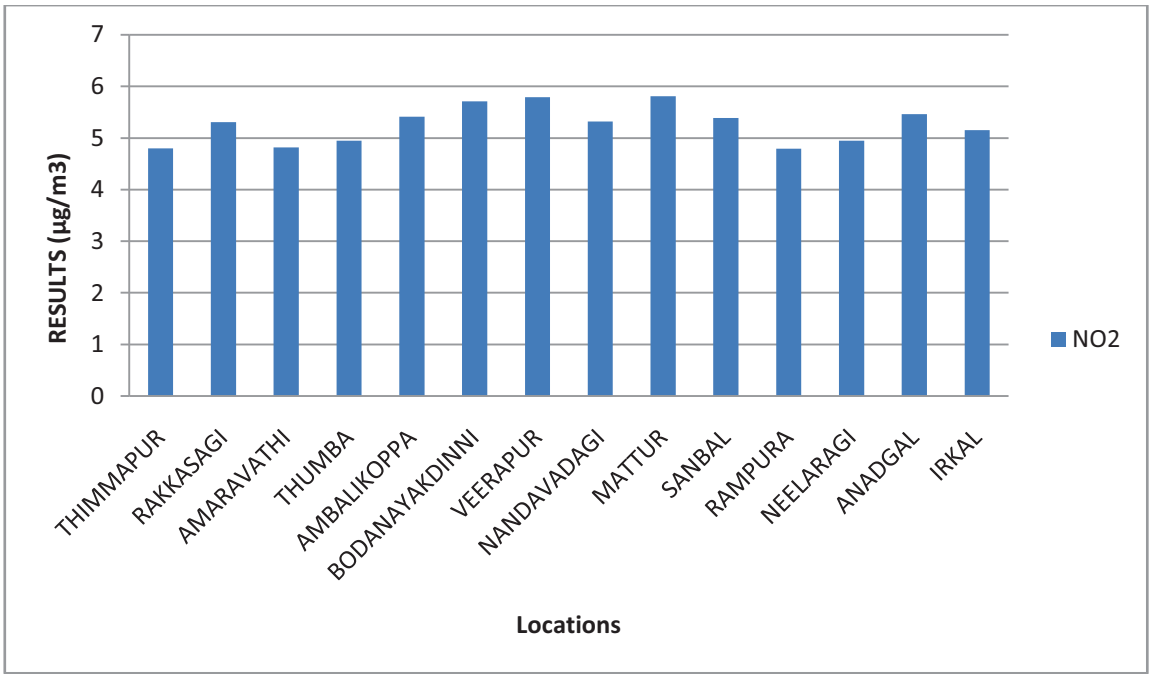


Fig 3.15 Graph showing NO2 values

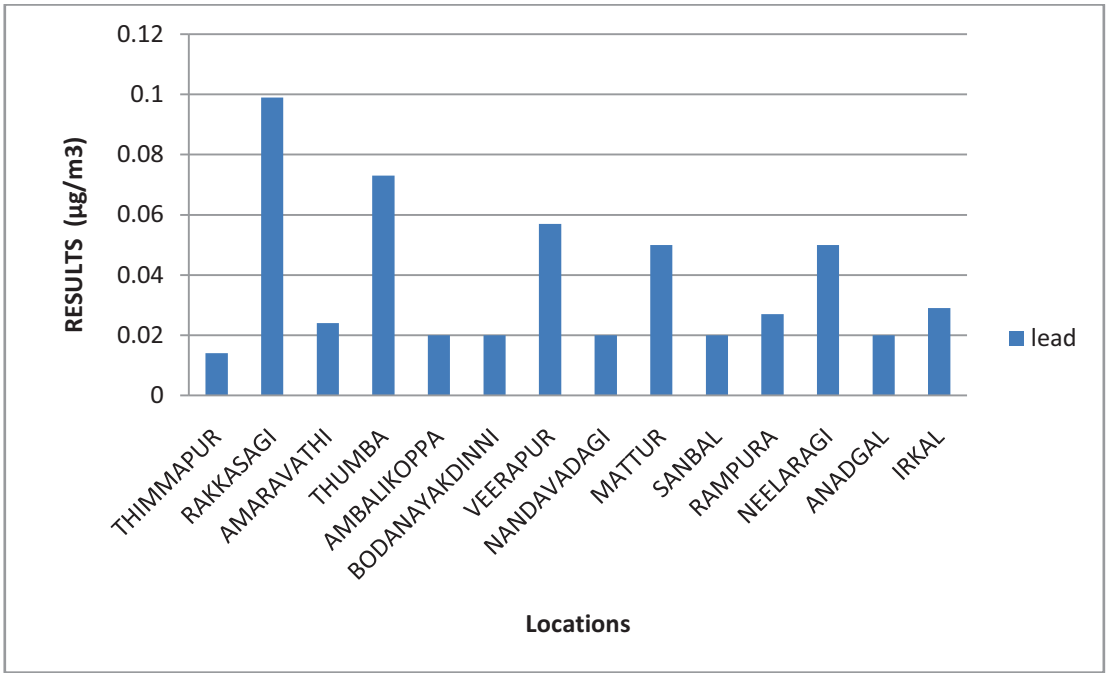


Fig 3.16 Graph showing Pb values

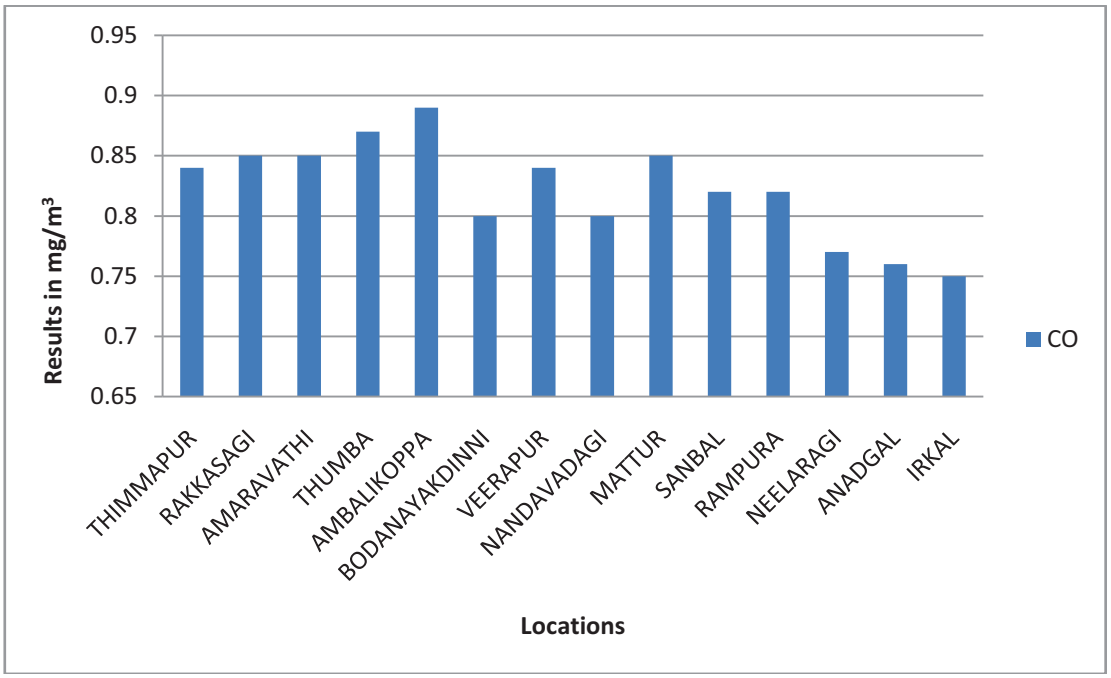


Fig 3.17 Graph showing CO values

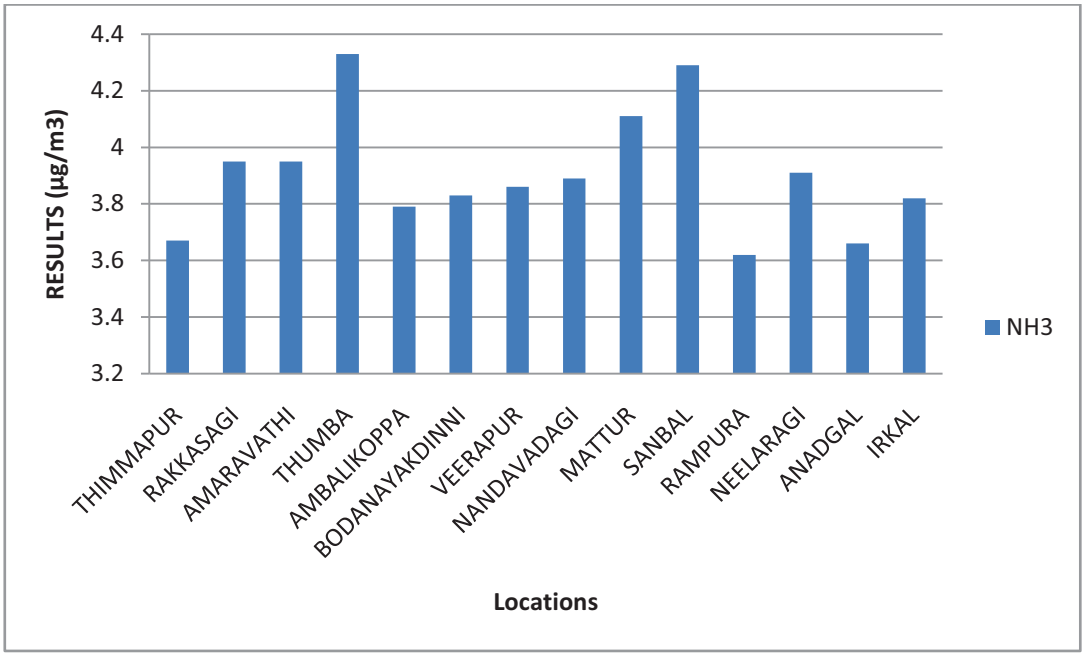


Fig 3.18 Graph showing NH3 values

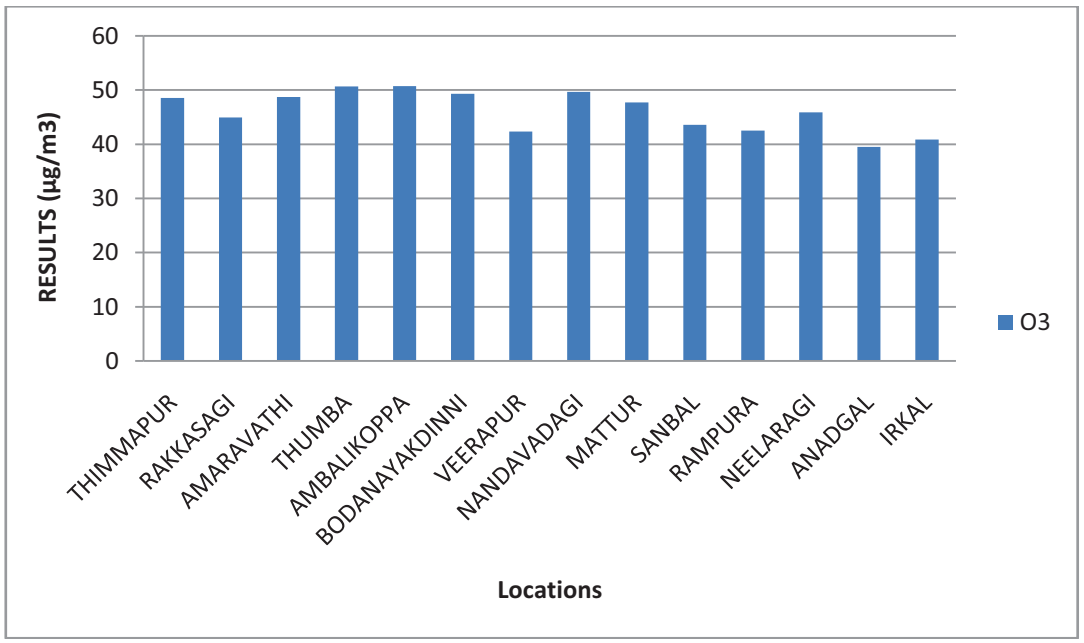


Fig 3.19 Graph showing O3 values

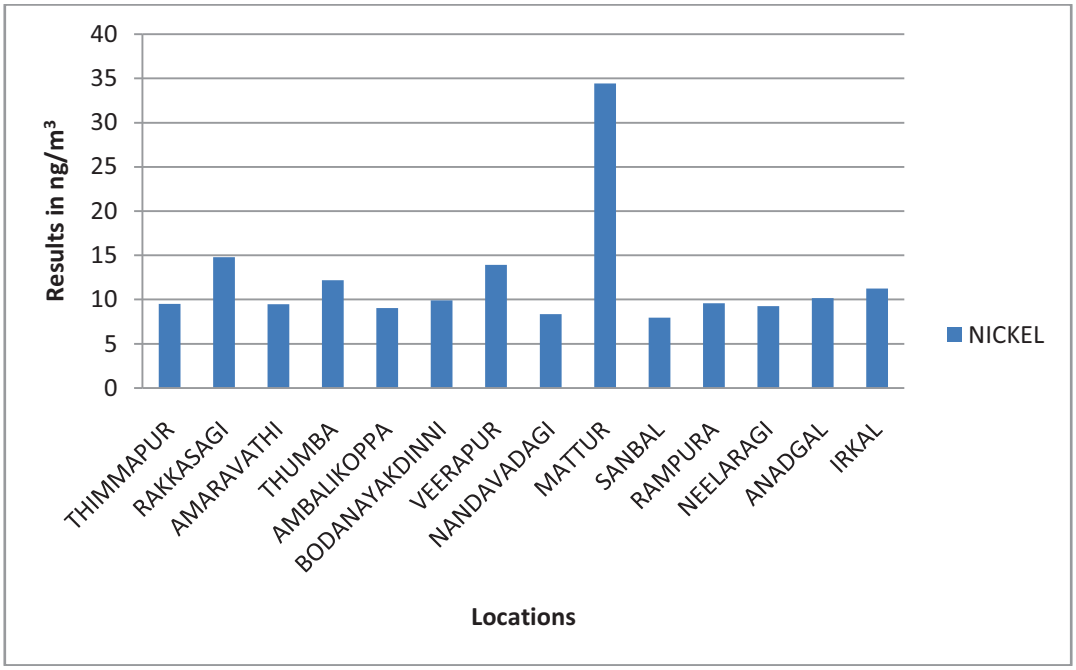


Fig 3.20 Graph showing Ni values

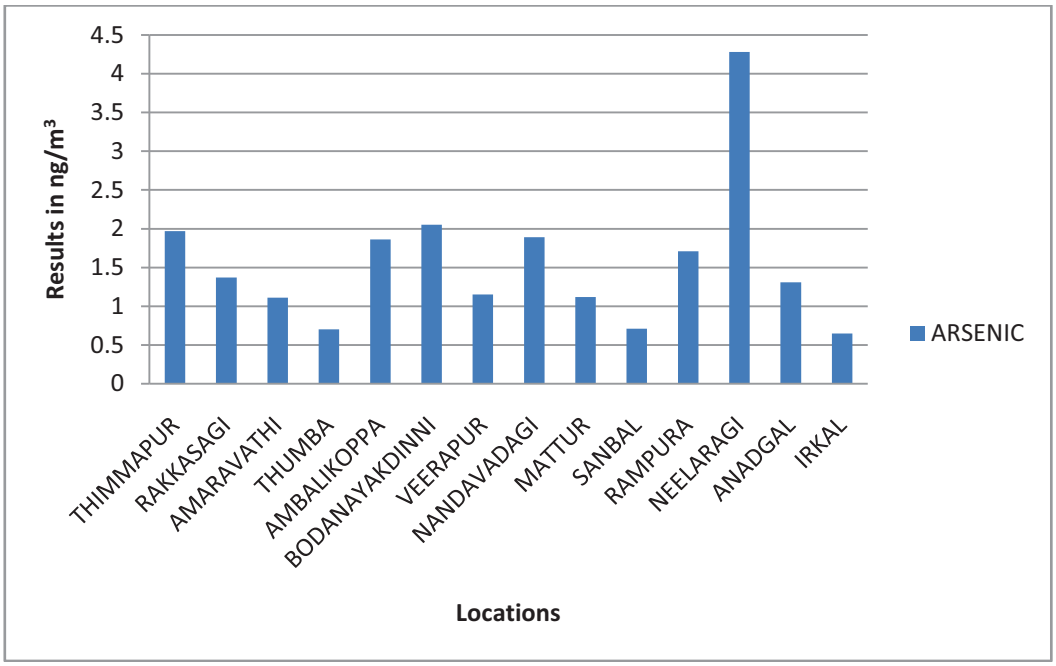


Fig 3.21 Graph showing As values

3.2.4 Ambient Noise Levels

The study area is not experiencing noise pollution due to least industrial growth and transportation (vehicles). As part of the baseline environment studies ambient noise levels were measured at 14 locations using pre-calibrated instrument for 24 Hrs for Leq (day) and Leq (night)[14]. The details of the monitoring locations are given below;

Table 3.89 Details of Noise Level Monitoring[15]

Parameters	Frequency	CPCB Standards dB(A) Leq		
Leq (Day) Leq (Night)	24 hrs	Category	Day	Night
		Industrial area	75	70
		Commercial area	65	55
		Residential area	55	45
		Silence zone	50	40

Table 3.90 Details of Noise Level Monitoring locations w.r.t Thimmapur LIS

Station Code	Name of the location	Geographical Coordinates
N1	Bodanayakdinni	16°14'28.98"N , 75°54'21.23"E
N2	Amblikoppa	16° 9'21.55"N, 75°54'39.48"E

The results of ambient noise levels were compared with Residential standards and results reveal that, the noise levels in the study area ranging from 45.2 – 46.7 d(B)A for day time and 34.9-36.7 d(B)A for night time during study period. Overall, the noise levels in all the seasons were observed to be well within the CPCB standards.

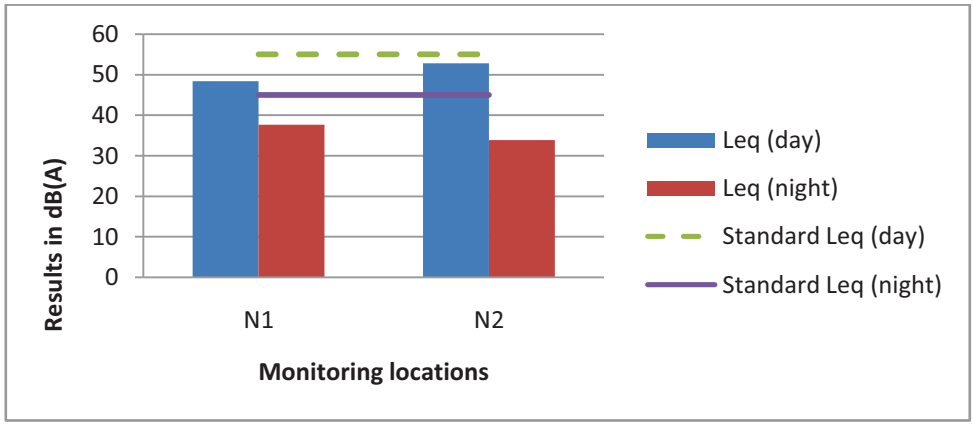


Fig 3.22 Summary of Noise level trends during the study period of Thimmapur LIS

Table 3.91 Details of Noise Level Monitoring locations w.r.t Ramthal LIS

Station Code	Name of the location	Geographical Coordinates
N1	Thimmapur	16° 6'45.38"N, 76° 2'42.24"E
N2	Rakkasagi	16° 3'35.09"N, 75°59'2.77"E
N3	Amaravathi	16° 3'21.83"N, 76° 4'54.39"E
N4	Thumba	16° 0'14.73"N, 76° 8'58.53"E

The results of ambient noise levels were compared with Residential standards and results reveal that, the noise levels in the study area ranging from 45.3 – 48.9 d(B)A for day time

[14]Protocol for Ambient Noise Level Monitoring (2015), CPCB, New Delhi
[15]Noise (Regulation and Control) Rules (2000), MoEF, Govt. of India

and 35.1 – 37.2 d(B)A for night time during study period. Overall, the noise levels in all the seasons were observed to be well within the CPCB standards.

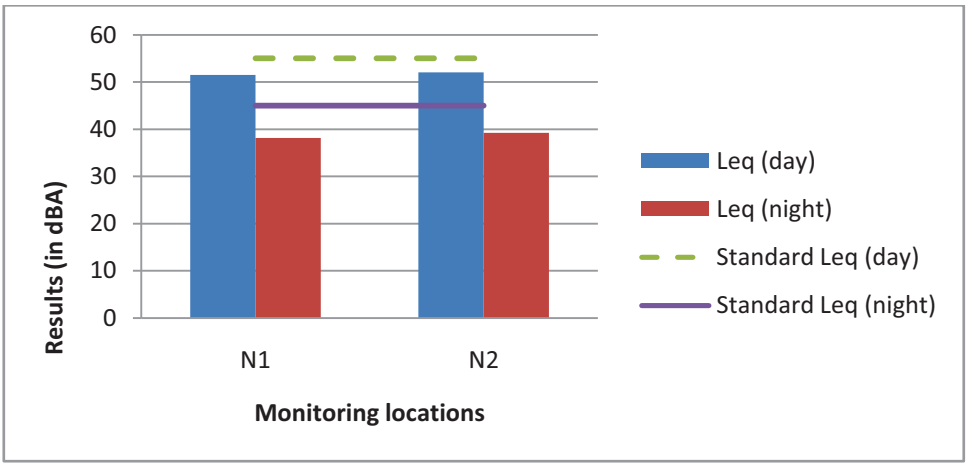


Fig 3.23 Summary of Noise level trends during the study period of Ramthal LIS

Table 3.92 Details of Noise Level Monitoring locations w.r.t Budhihal-Peerapur LIS

Station Code	Name of the location	Geographical Coordinates
N1	Rampur	16°40'23.32"N, 76°20'6.50"E
N2	Neeralagi	16°36'27.84"N, 76°23'33.84"E

The results of ambient noise levels were compared with Residential standards and results reveal that, the noise levels in the study area ranging from 48.3 – 53.43 d(B)A for day time and 35.4 - 38.32 d(B)A for night time during study period. Overall, the noise levels in all the seasons were observed to be well within the CPCB standards.

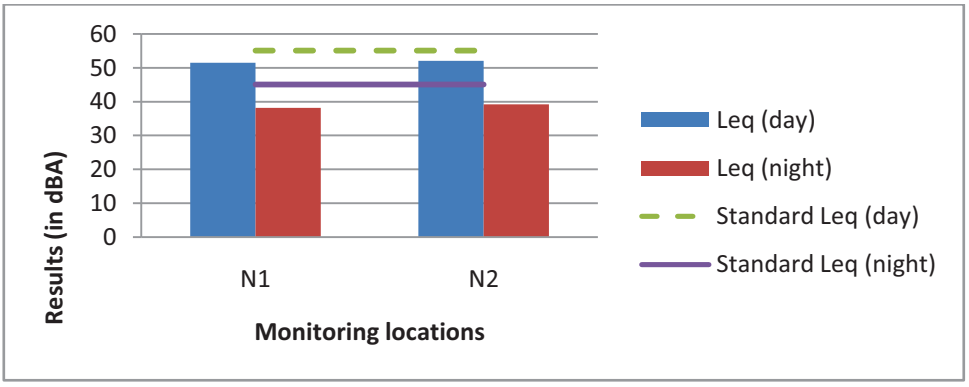


Fig 3.24 Summary of Noise level trends in Budhihal-Peerapur LIS

Table 3.93 Details of Noise Level Monitoring locations w.r.t Nandwadgi LIS

Station Code	Name of the location	Geographical Coordinates
N1	Veerapur	16° 9'46.10"N, 76°41'3.12"E
N2	Sanbal	16° 0'55.10"N, 76°40'53.47"E
N3	Mattur	16° 2'22.33"N, 76°30'29.76"E
N4	Nandavadgi	16° 1'44.10"N, 76°15'33.95"E

The results of ambient noise levels were compared with Residential standards and results reveal that, the noise levels in the study area ranging from 45.42 – 52.08 d(B)A for day time and 37.54 – 39.23 d(B)A for night time during study period. Overall, the noise levels in all the seasons were observed to be well within the CPCB standards.

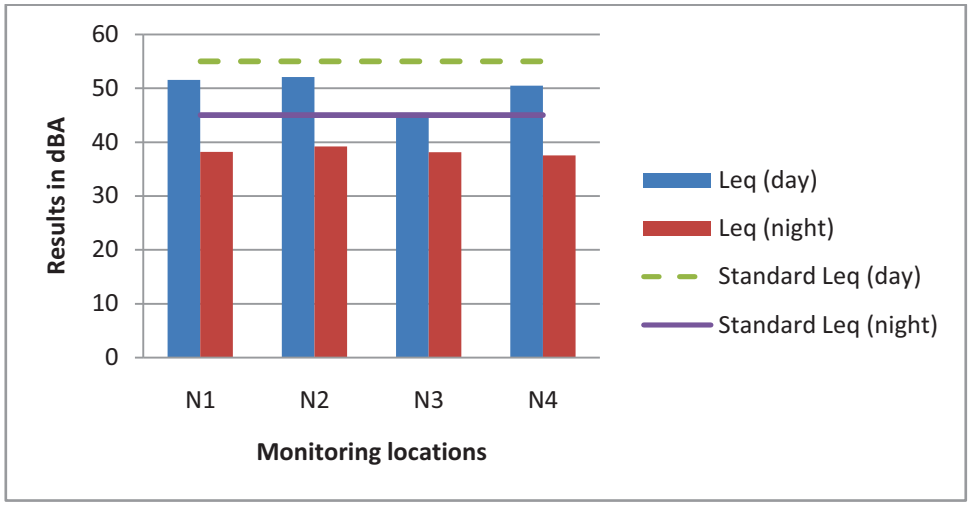


Fig 3.25 Summary of Noise level trends during the study period of Nandwadgi LIS

Table 3.94 Details of Noise Level Monitoring locations w.r.t 9A Distributory

Station Code	Name of the location	Geographical Coordinates
N1	Irkal	15°37'48.40"N, 76°48'7.54"E
N2	Anandagal	16° 4'26.86"N, 76°42'16.87"E

The results of ambient noise levels were compared with Residential standards and results reveal that, the noise levels in the study area ranging from 48.39 - 52.83 d(B)A for day time and 33.89 - 37.65 d(B)A for night time during study period. Overall, the noise levels in all the seasons were observed to be well within the CPCB standards.

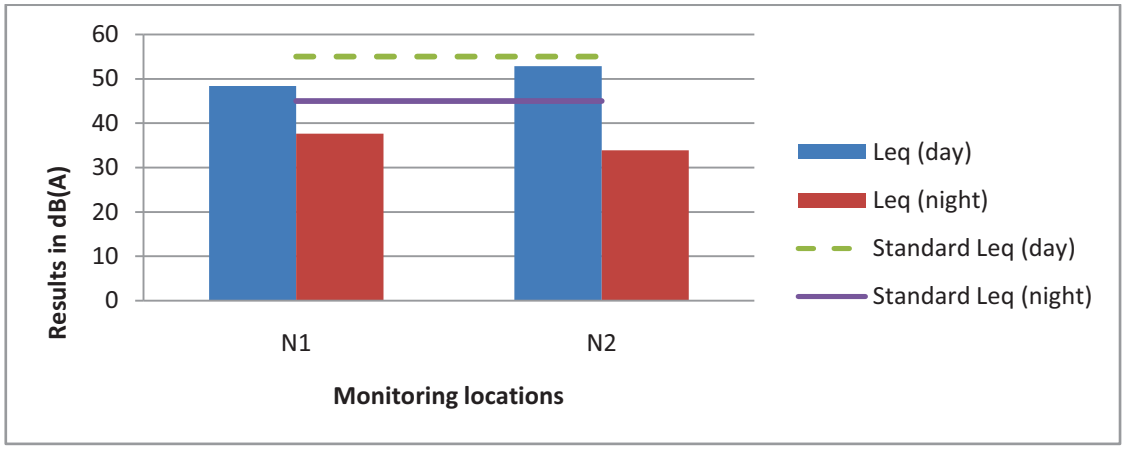


Fig 3.26 Summary of Noise level trends during the study period of 9A Distributory

3.2.5 Hydrology, Geology and Minerals

In any given environment the occurrence and movement of ground water and its quality & quantity is chiefly controlled and governed by many factors such as geographical set-up, climate and rainfall conditions, hydrological features, topography, soil characteristics, the nature and thickness of underlying rock formations and other related aspects that prevail in an area. Therefore the study envisages indentifying the existing both surface & ground water conditions comprising both quality and potential within the project site and its neighborhood, relating the projected lift irrigation scheme activity, identifying the likely impacts on surface and ground water resources and indicating mitigation measures. In order to accomplish the proposed objective of the study, the scope and methodology adopted is as follows:

- Collection of the relevant data contained in the EIA and EMP Reports, from the reports and maps of Central Ground Water Board (CGWB) Geological Survey of India (GSI), other Institutions and Departments.
- Identify Inter- related and Inter – dependent key factors that play vital role in the occurrence of ground water its quality and potential.
- Identify surface water resources in the project site and its catchment area.
- Assess the ground water resource potential in the catchment area of the project site.
- Bring out various events and processes that comprise the project activity.
- Identify the site specific environmental issues and mitigation measures and
- Compile a consolidated, comprehensive and meaningful report of the Project site and its catchment area.

3.2.5.1 Drainage

The Project site and the command area forms part of the Krishna River Basin. The lift point is at Almatti Dam and Narayanpur Reservoir. Devlapur Nala, Malaprabha River, Hire Halla, Don River, Sogali River & Bhima River are the other major tributaries of River Krishna in the study area. Most of these are seasonal rivers which drain in to River Krishna. Drainage pattern is observed to be dendritic to sub-dendritic with drainage density varying between 0.49 to 1.12 Kms. / Sq. Kms. Dense drainage is observed in the North and Southern portion of the command area while the central part of the command area is occupying sparse drainage. All the stream courses flow from higher reaches to lower levels following topography. Drainage Maps of the study area are given below;

3.2.5.2 Geology

The main rock types observed in the Project area is Basalt belonging to Deccan Traps of various flows belonging to Upper Cretaceous to Lower Eocene Age. Laterite is observed as patches to a limited extent. Granite gneiss, Grey and pink Granite, Basic volcanic, Granite, Granodiorite, Limestone, Ferruginous Sandstone & Quartzite, Amphibolite, Metabasalt and Migmatite are the major litho units observed over the study area.

3.2.5.3 Structure

No major faults or any structural disturbances are observed in the buffer zone and command area of the project excepting, minor Fractures/ Fissures and Lineaments along with the streams are formed and these act as conduits for the movement of surface and groundwater.

3.2.5.4 Geomorphology

Geomorphology of the study area environs is plateau slightly dissected and Plateau weathered with valleys. Occasionally, Mesa and Butte is observed scattered over the Budhihal- Perapura area of the command area wherein laterite formation is seen.

3.2.5.5 Mineral Resources

- **Vijayapura District**: Barytes is reported to occur near Mudhol in association with Chert bands of Kaladgi group.
- **Bagalkot District**: Both chemical and high grade Limestone suitable for cement manufacturing is available in Kaladgi super group of Bhima Basin.
- **Raichur District:** Gold, Copper, Iron, Feldspar, Granite, Sandstone, Quartz and limestone occur in Raichur District. The world famous Hutti Gold Mine is located in this District.

3.2.5.6 Hydrology

Raichur District forms part of Krishna Catchment in northern part, while southern part forms the lower Thungabhadra catchment area.The two important rivers in the district are the Krishna and Thungabhadra, which form the northern and southern boundary of the district respectively and are perennial in nature. River Bhima is an important tributary of River Krishna. The drainage pattern is dendritic in nature.The average annual rainfall of the district is 416mm. Climate varies from 17.7° C to 45.0° C

Bagalkot District is drained by the River Krishna and its tributaries Ghataprabha and Malaprabha. Krishna River enters the district at Terdal village in Jamkhandi Taluq and flows in south easterly direction and forms the northern boundary of the district separating it from Vijayapura District. Average rainfall of the district is 559.9mm. Climate varies from 10° C to 40.0° C.

Vijayapura District : The Krishna River forms the southern boundary with the Bagalkot District and Bhima River forms Northern boundary with the Maharashtra State. Southern part of the Vijayapura District forms a catchment area of the Krishna while northern part of the catchment area of Bhima. Bhima River is an important tributary of Krishna River. A Major dam has been constructed across the Krishna River near Almatti in the district. Don River is the tributary of the Krishna River and flows for about 160 Kms in a meandering course from west to east in the central part of the District. The water of this river is generally brackish. Drainage pattern is sub-dendritic to sub-parallel in nature and the drainage density varies from 0.49 to 1.02 Km/ Sq.Km. Average rainfall of the district is 578 mm. Climate varies from 20° C to 42.0° C.

3.2.5.7 Hydrogeology

The study area forms a part of three districts namely Vijayapura, Bagalkot and Raichur which is a part of Krishna River Catchment / Basin. Hire Halla, Kud Don Halla, Bhima, Malaprabha and Don River are the other major tributaries of River Krishna in the study area. Most of these are seasonal rivers which drain in to River Krishna. Drainage pattern is observed to be dendritic to sub-dendritic with drainage density varying between 0.49 to 1.12 Kms. / Sq. Kms.

Water table generally follows the topography of the study area and is at greater depths in the water divide area and topographic heights but occurs at shallow depth in the valleys and low lying terrain and therefore groundwater moves down and follows the gradient from the higher to lower elevations i.e. from recharge area to discharge areas. The general flow direction of groundwater in the study area is towards South and East.

3.2.5.8 Hydrogeological survey

Hydrogeological survey was carried out in the 10.0 Kms buffer zone of the Intake Point of Krishna River at Almatti Dam and Naryanpur reservoir and the total command area of the proposed project. 90 Wells were inventoried mostly borewells and few dug wells for deciphering the groundwater regime. Water samples have been collected from 58 wells representing the study area and subjected to chemical analysis conforming to IS 10500:2012 (second revision) standards to know the quality. The test results are enclosed as Annexure -10 . The aquifer performance test conducted by the CGWB authorities was referred to and concluded the field data observed randomly during the field survey.

Groundwater occurs under water table and semi-confined to confined conditions in weathered, fractured zones in basalts, limestones, Ferruginous Shales, ortho-quartzites, sandstones, granites and gneisses. The vesicular portion of different flows varies in thickness and has the primary porosity. The nature and the density of vesicles, their distribution and interconnection, depth of weathering and topography of the area are decisive factors for occurrence and movement of groundwater in these units. The weathered and fissured basalts occurring in topographic lows are the main water bearing formations in the study area.

The Deccan traps / basalts are the major litho-units in the study area i.e. command area and buffer zone of the proposed project area (Lift Point and Jack well). The basaltic flows are mostly horizontal to gently dipping. Deccan basalts mostly have low permeability depending upon the presence of primary and secondary porosity. The weathered basalt serves as an effective groundwater repository in this region. Occurrence of red bole at depth ranging between 30-50m constitutes the major aquifer in the study area.

Argillites / Ferruginous Quartzite and laterite are the sparsely occurring litho units in the study area while laterite is occurring over plateau tops. The litho units are depicted on Plate-3A to 3E. Groundwater is occurring in weathered and fractures zones in argillites. Groundwater occurs in the weathered zone in laterite.

3.2.5.9 Depth to Water Level

The depth to water level in the study area was measured wherever it was feasible and recorded as reported during the field study.

Timmapur LIS: The depth to water level varied between 4.0 to 40.0m. In general the water levels are between 12.0 to 35.0 m bgl. The annual water level fluctuation is varying between 5.0 to 15.0m in the study area. The rise in water level corresponds to the canal command areas where the recharge to groundwater takes place through applied irrigation and canal seepages in addition to rainfall. The depth to water level arrived corresponds to the well inventory and the table is annexed as Annexure-10.

Ramthal LIS: The depth to water level varied between 8.0 to 45.0m. In general the water levels are between 8.0 to 40.0 m bgl. The annual water level fluctuation is varying between 4.0 to 10.0m in the study area. The rise in water level corresponds to the canal command areas where the recharge to groundwater takes place through applied irrigation and canal seepages in addition to rainfall. The depth to water level arrived corresponds to the well inventory and the table is annexed as Annexure-10.

Budhihal Perapur LIS: The depth to water level varied between 12 to 50.0m. In general the water levels are between 10.0 to 48.0 m bgl. The annual water level fluctuation is varying between 3.0 to 8.0m in the study area. The rise in water level corresponds to the canal command areas where the recharge to groundwater takes place through applied irrigation and canal seepages in addition to rainfall. The depth to water level arrived corresponds to the well inventory and the table is annexed as Annexure-10.

Nandwadgi LIS: The depth to water level varied between 12 to 50.0m. In general the water levels are between 10.0 to 48.0 m bgl. The annual water level fluctuation is varying between 2.0 to 5.0m in the study area. The rise in water level corresponds to the canal command areas where the recharge to groundwater takes place through applied irrigation and canal seepages in addition to rainfall. The depth to water level arrived corresponds to the well inventory and the table is annexed as Annexure-10.

9(A) Command Area: The depth to water level varied between 8 to 20.0m. In general the water levels are between 7.0 to 18.0 m bgl. The annual water level fluctuation is varying between 2.0 to 5.0m in the study area. The rise in water level corresponds to the canal command areas where the recharge to groundwater takes place through applied irrigation and canal seepages in addition to rainfall. The depth to water level arrived corresponds to the well inventory and the table is annexed as Annexure-10.

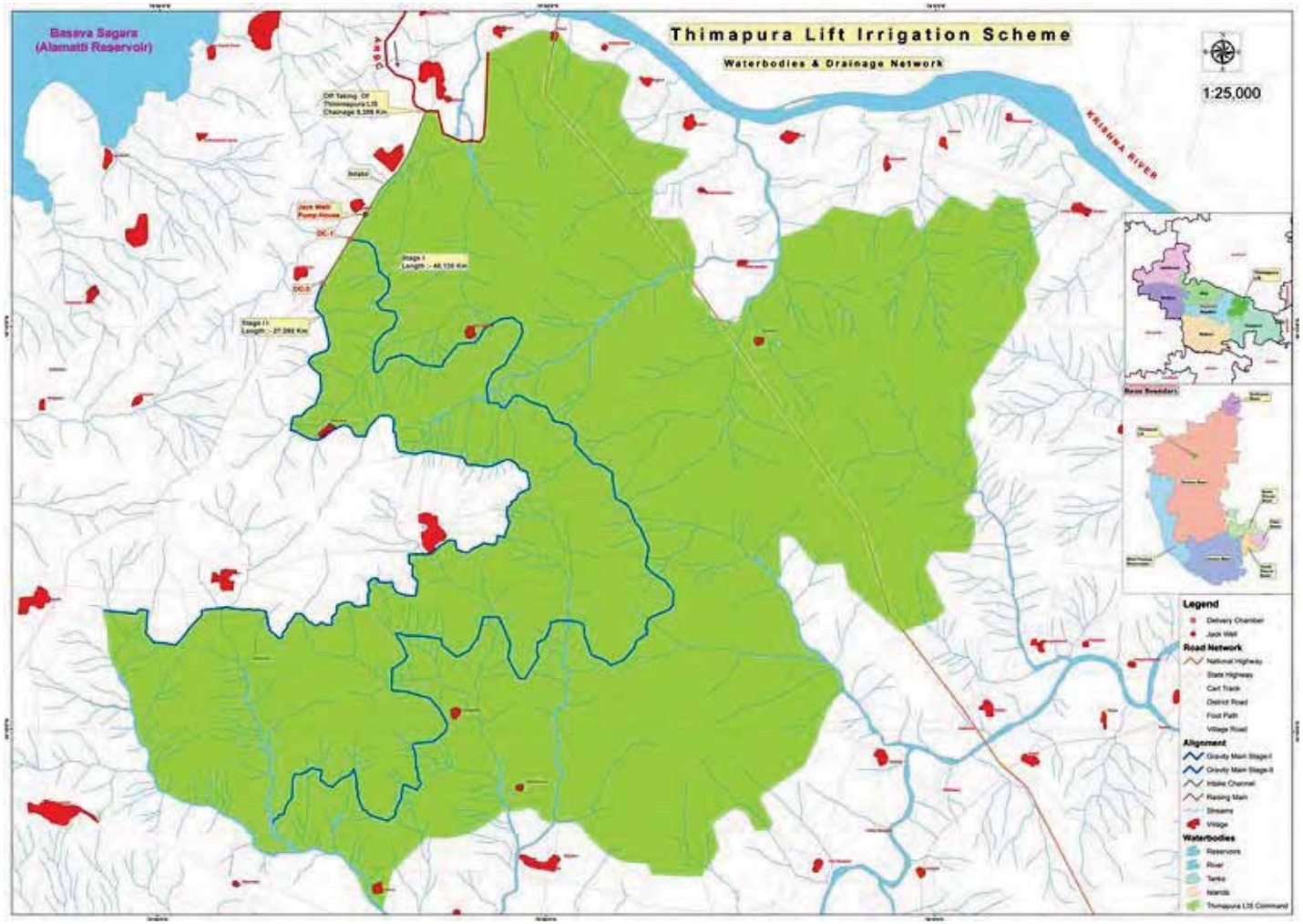


Fig 3.27 Drainage Map of the study area w.r.t Thimmapur LIS

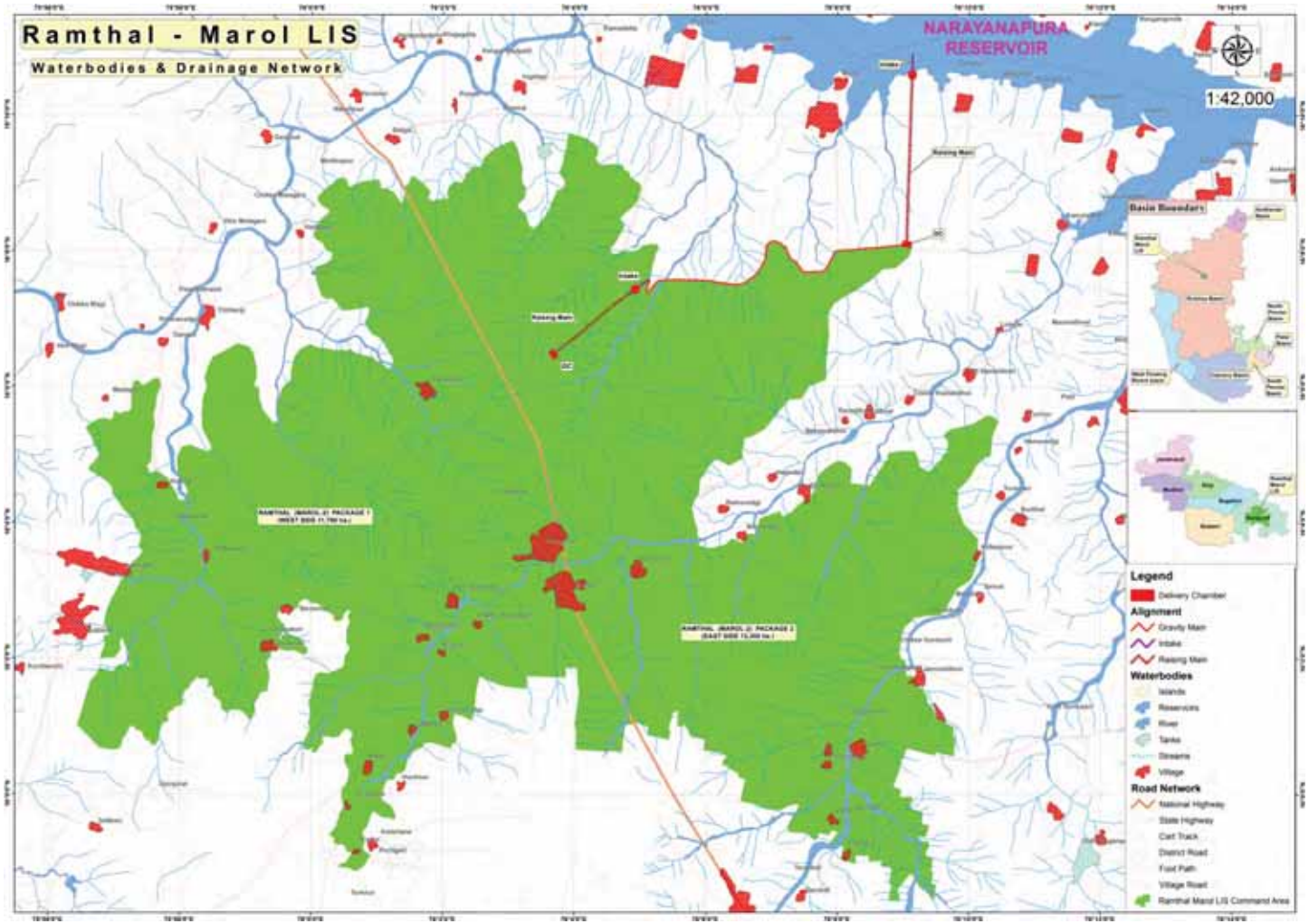


Fig 3.28 Drainage Map of the study area w.r.t Ramthal LIS

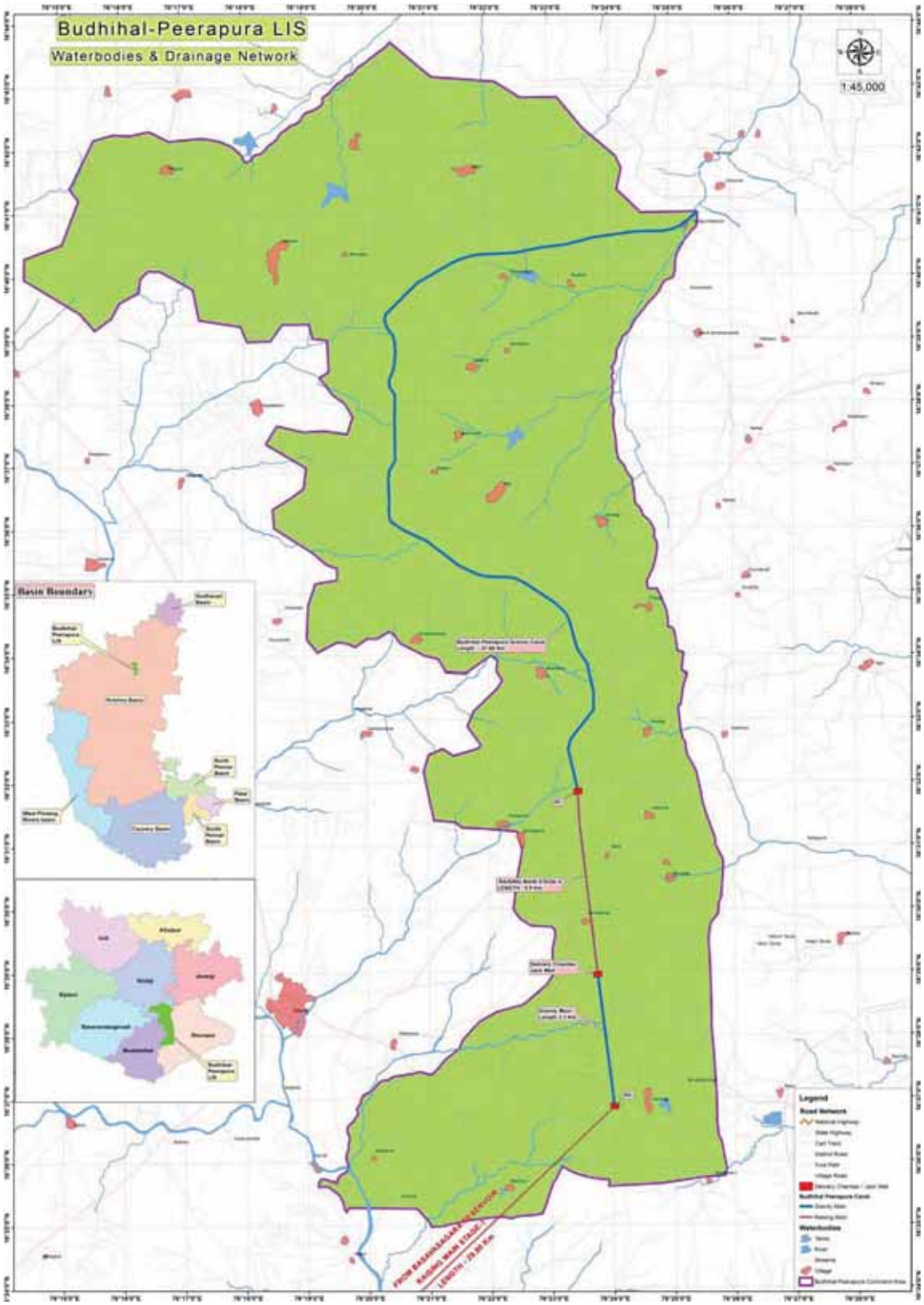


Fig 3.29 Drainage Map of the study area w.r.t Budhihal-Peerapur LIS

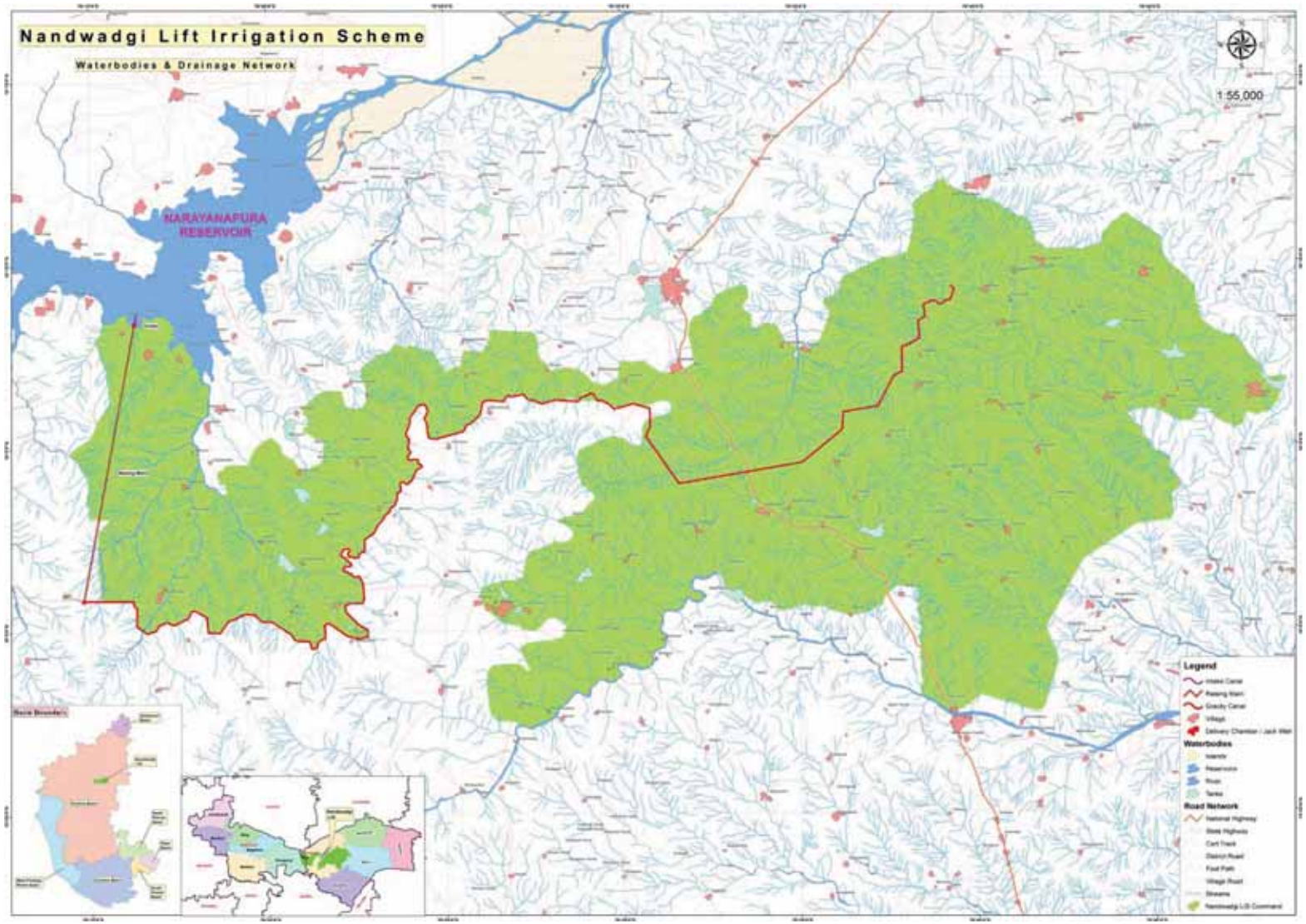


Fig 3.30 Drainage Map of the study area w.r.t Nandwadgi LIS

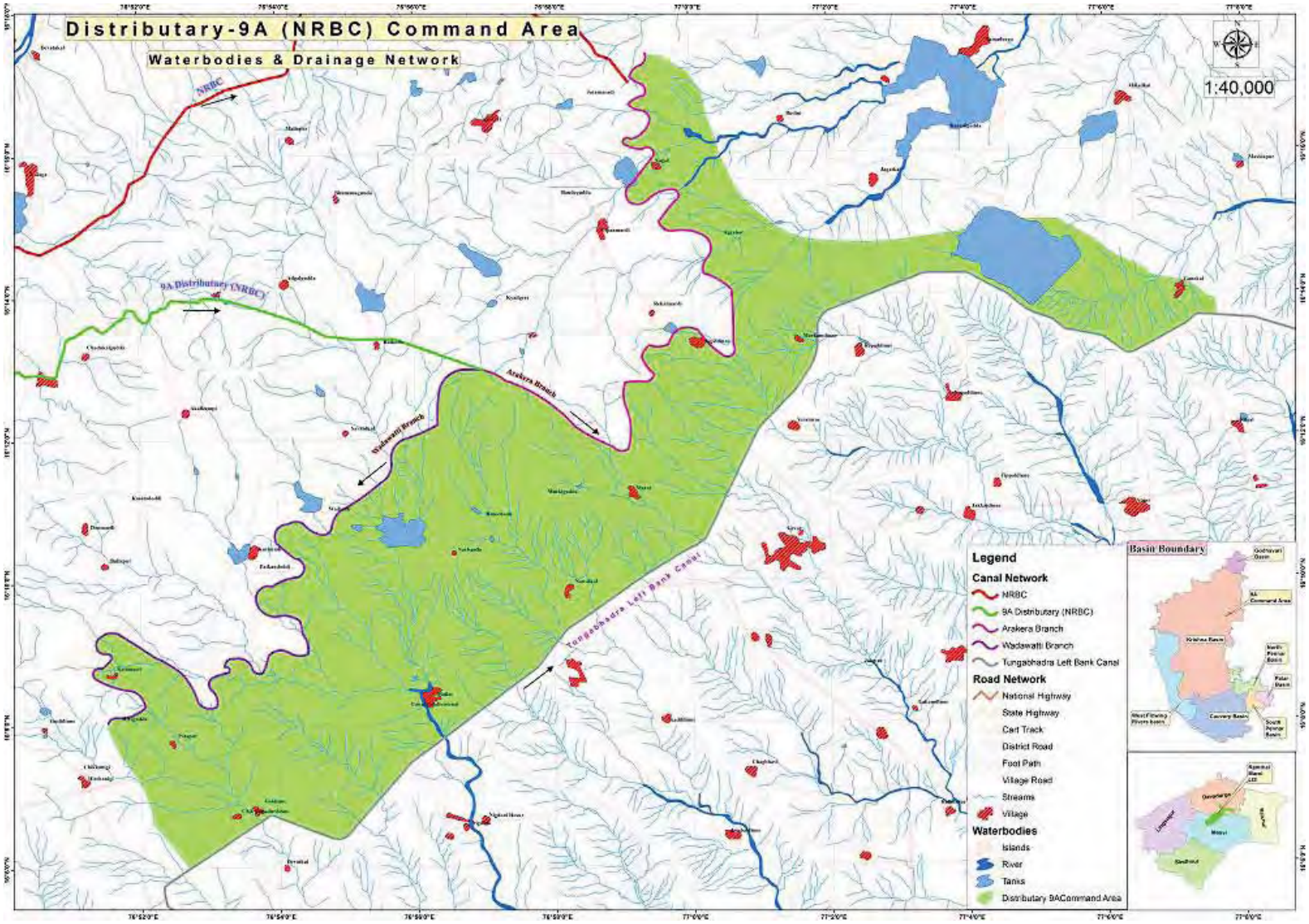


Fig 3.31 Drainage Map of the study area w.r.t 9(A) Distributory

3.2.5.10 Water Table Elevation

Vijayapura district: Long term water level data of NH Stations of the Central Ground Water Board have been observed that the water levels falls from 0.20 to 16.70 m. at all locations. The highest fall (16.70 m) in water levels has been observed at Tikota. 70% of wells show falling trend and 30 of wells show rising trend especially in canal command area in Indi, Basavana Bagewadi, Muddebial and Sindagi taluks.

Bagalkot district: The long term water level trend (1996-2005) reveals that out of the analysed 30 dugwells, 27% of the wells show rise in the range of 0.03 m to 4.43 m and the remaining 73% wells show fall in water level ranging from 0.08m to 1.39. The fall in the long term water level mainly observed in non-command area of the district indicates the effect of high groundwater development where rainfall is the sole source of recharge. Similarly, the rise in water level corresponds to the canal command areas of the district where, recharge to groundwater takes place through applied irrigation and canal seepages in addition to rainfall.

Raichur district: The medium to deep aquifers occurring in the district are mostly located in the semi-weathered to fractured hard rock and these aquifers are occurring between the depths of 30 -100 mbgl and are tapped through the bore wells. Ground water occurs under semi-confined condition in the semi-weathered zone, but occurs under confined conditions wherever fractures occur at depth, (generally below 40 m depth).

In the command area, the flow direction follows the general topography of the area. The general flow direction of groundwater in the study area is towards South and East.

3.2.5.11 Water Quality Analysis

57 representative samples have been collected from the study area and subjected to water quality analysis as recommended by BIS for drinking water standards. The result of the water quality is enclosed as Annexure-10. In total the water quality in the study area is moderately potable to non-potable.

- Timmapur LIS: No. of Sampling Locations-8

Conductivity: Conductivity in the study area ranges from 670 micro mhos/ cm to 1,865 micro mhos/ cm. Conductivity having more than 2,000 micro mhos/ cm may be considered as either brackish or saline. The villages having high conductivity are Devlapur and Chowadapur.

Chloride: Chloride in water samples in the study area range from 32.0 mg/ltr to 266.08 mg/ltr and this constituent is within the permissible limits.. The distribution of chloride is illustrated in figures annexed.

Constituents like Nitrate were in excess to the maximum permissible limits at Bodanayakanidinne while in other villages it is in the safe levels. The fluoride levels are well within the permissible limits. .Remedial measures may be initiated to safeguard the health of people in the villages. Already the Government and few social service organizations have installed mineral water plants in the villages to supply safe water.

- Ramthal LIS: No. of Sampling Locations-11

Conductivity: Conductivity in the study area ranges from 722 micro mhos/ cm to 4,760 micro mhos/ cm. Conductivity having more than 2,000 micro mhos/ cm may be considered as either brackish or saline. The villages having high conductivity are Rakkasagi, Bevinahatti, Hungund, Amaravathi, Binjawadgi and Nidasanuru.

Chloride: Chloride in water samples in the study area range from 104.46 mg/ltr to 645.5 mg/ltr and this constituent is within the permissible limits.. The distribution of chloride is illustrated in figures annexed.

Constituents like Nitrate were in excess to the maximum permissible limits at Amaravathi, Hungund and Millat while in other villages it is in the safe levels. The fluoride levels were excess to the maximum permissible limits at Rakkasagi, Honarhalli and Navalkal while in other villages it is in the safe levels. Remedial measures may be initiated to safeguard the health of people in the villages. Already the Government and few social service organizations have installed mineral water plants in the villages to supply safe water.

PH: The PH values of the water samples range from 8.24 to 8.98. The limits between 6.5 to 7.5 are considered as potable. The PH having more than 7.5 is NON POTABLE.

- Budhihal- Perapur LIS: No. of Sampling Locations-11

Conductivity: Conductivity in the study area ranges from 567 micro mhos/ cm to 10,070 micro mhos/ cm. Conductivity having more than 2,000 micro mhos/ cm may be considered as either brackish or saline. The villages having high conductivity are Karekal, Agartagi and Aski.

Chloride: Chloride in water samples in the study area range from 23.65 mg/ltr to 837.68 mg/ltr and 1892.17 mg/ltr at Agartagi this constituent is not within the permissible limit and all remains within the permissible limits. The distribution of chloride is illustrated in figures annexed.

Constituents like Nitrate were in excess to the maximum permissible limits at Agartagi, Kondaganuru, Aski and Budhihal while in other villages it is in the safe levels. The fluoride levels are well within the permissible limits. Also, Calcium, Magnesium, Sulphate, Chloride and High TDS showing above permissible limits at Agartagi village. Remedial measures may be initiated to safeguard the health of people in the villages.

- Nandwadgi LIS: No. of Sampling Locations-22

Conductivity: Conductivity in the study area ranges from 507 micro mhos/ cm to 8,860 micro mhos/ cm. Conductivity having more than 2,000 micro mhos/ cm may be considered as either brackish or saline. The villages having high conductivity are Santekallu, Sanbal, Kavital, Sarjapur, Mavinbavi, Nandawadgi and Kamlihal.

Chloride: Chloride in water samples in the study area range from 27.59 mg /ltr to 882.03 mg/ltr and this constituent is within the permissible limits. Highest concentration of 1399.44 mg/ltr Chloride is observed at Sarjapur. The distribution of chloride is illustrated in figures annexed.

Constituents like Nitrate, Sulphate, Calcium, Flouride and Magnesium were in excess to the maximum permissible limits at Sarjapur, Kavital, Kamlihal, Bommanhal, Sanbal and Nandwadgi while in other villages it is in the safe levels. Remedial measures may be initiated to safeguard the health of people in the villages. Already the Government and few social service organizations have installed mineral water plants in the villages to supply safe water.

- 9A Command Area LIS: No. of Sampling Locations-5

Conductivity: Conductivity in the study area ranges from 831 micro mhos/ cm to 5,950 micro mhos/ cm. Conductivity having more than 2,000 micro mhos/ cm may be considered as either brackish or saline. The villages having high conductivity are near Durga Temple, Millat and Millat Village.

Chloride: Chloride in water samples in the study area range from 31.53 mg/ltr to 191.18 mg/ltr and this constituent is within the permissible limits. The distribution of chloride is illustrated in figures annexed.

Ph values range between 8.44 to 8.86 indicating non –potable water.

Constituents like Magnesium, Sulphate, Nitrate, were in excess to the maximum permissible limits at Millat while in other villages it is in the safe levels. The fluoride levels

are well within the permissible limits. Remedial measures may be initiated to safeguard the health of people in the villages. Already the Government and few social service organizations have installed mineral water plants in the villages to supply safe water.

The details of location and geo-coordinates are enclosed as Annexure-10.

3.2.5.12 Ground Water Resources

The resource estimation and categorization is to be carried out as per the recommendations of Groundwater Estimation Methodology-97(GEM-97) considering watershed as a unit. Watershed and administrative boundaries do not match with the administrative boundaries. As a result different parts of taluq fall in different watersheds having different stages of groundwater development and categorization. Pro-rata approach to consolidate the watershed data into taluq wise data gives only details on groundwater resource, draft and additional irrigation potential. Pro-rata approach cannot be applied to taluq, as a unit, as far as stage of development and categorization is concerned. However, average stage of development is given to have an overall idea of the taluq. (Source: CGWG- Groundwater Information Booklet: Bijapur District, Karnataka, July'2008.)

Groundwater resources and recharge assessment has been arrived taking in to consideration of the monsoon and non-monsoon rainfall, command and non-command area, areas of recharge and discharge, water table fluctuations, specific yield of rock formations/litho units and normalized monsoon recharge.

As the present project does not involve pumping of groundwater the specific studies relating to aquifer parameters have not been carried out. However, already published relevant data was consulted and prepared this report.

The already published data of CGWB in the form of Groundwater information Booklets for the parts of three districts covering the subject area have been consulted and arrived at the conclusion. The Groundwater resources for the Bijapur, Bagalkot and Raichur Districts of Karnataka are categorized as safe as per the published data of CGWB. The extract is furnished below:

Table 3.95 Status of Ground Water Development

District	Taluk	Categorization (%)			
		Safe	Semi-Critical	Critical	Over Exploited
Vijayapura	Muddebihal	12	33	-	55
	Sindagi	33	-	8	59
Bagalkot	Bagalkot	5	-	-	95
	Hungund	10	38	-	52
Raichur	Lingasugur	80	01	-	19
	Devadurga	100	-	-	-
	Manvi	100	-	-	-

It is observed from the above table that Sindagi has 59% and Bagalkot ha 95% over exploited area and indicates that groundwater extraction is more than recharge. This area requires serious formulation of artificial recharge programmes and groundwater budgeting. Also planning with regard to change of cropping pattern is also required. The suitable recharge structures feasible are Farm Ponds, Nala Bunds, Check Dams besides desilting of tanks and thereby increase the surface storage capacity will augment the declining levels of groundwater.

3.2.6 Surface and Ground Water Quality

Any effect on physical, chemical and biological properties of water has direct impact on the quality of water[16].The baseline status of water quality in the command area has been established through the sampling and analysis of various water quality parameters. Water samples were collected at 19 locations in the command area of during the study period. The prime objective of the baseline water quality study was to establish the existing water quality in the study area to evaluate the anticipated impact of the proposed project on water quality and to suggest appropriate mitigation measures for implementation. This will also be useful for assessing the conformity to the standards of water quality during the construction and operation phase of the project. The details of sampling locations are given below;

Table 3.96 Details of Surface and Ground Water sampling locations

Sampling Station Code	Name of the sampling station	Geographical Coordinates
A. Thimmapur LIS		
SW1	Near Thimmapur Lift point	16°19'29.13"N, 75°53'18.65"E
SW2	Near Downstream	16°19'0.60"N, 75°54'51.92"E
GW1	Bodanayakdinni	16°14'30.21"N, 75°54'17.18"E
GW2	Ambalikoppa	16° 9'21.55"N, 75°54'39.48"E
B. Ramthal (Marol) LIS		
SW1	Near Lift Point	16° 8'31.03"N, 76°15'52.03"E
SW2	Near downstream	16° 9'46.19"N, 76°18'10.61"E
GW1	Belgal	16° 8'1.72"N, 76° 2'0.83"E
GW2	Hadagli	16° 7'51.10"N, 76° 0'47.61"E
GW3	Rakkasagi	16° 3'37.03"N, 75°59'4.35"E
GW4	Bevinamatti	16° 2'24.07"N, 76° 1'28.12"E
C. Budihaal-Peerapur LIS		
GW1	Rampur	16°40'23.02"N, 76°20'5.55"E
GW2	Navadgi	16°36'25.17"N, 76°23'35.49"E
GW3	Aski	16°36'40.56"N, 76°22'6.55"E
D. Nandawadagi LIS		
SW1	Lift point	16° 8'0.77"N, 76°18'29.98"E
SW2	Near Downstream	16°11'4.69"N, 76°20'24.95"E
GW1	Veerapur	16°14'46.33"N, 76°41'30.13"E
GW2	Sanbal	16° 3'44.62"N, 76°38'35.29"E
GW3	Mattur	16° 8'3.21"N, 76°30'38.37"E
GW4	Nandvadgi	16° 4'12.64"N, 76°23'8.20"E
GW5	Chitranhal	16° 9'43.58"N, 76°24'23.64"E
E. 9(A) Command area		
SW1	Near Huda	15°37'48.40"N, 76°48'7.54"E
GW1	Anandagal	16° 4'26.86"N, 76°42'16.87"E

[16]Furhan,I., Ali,M., Salam, A., Khan,B.A,. Ahmad,S,. Quamar M and Omer, Kashif (2004), *Seasonal variations of physico-chemical characteristics of river Soan water at Dhoak, Pathan Bridge (Chakwal), Pakisthan*, International J. of Agriculture and Biology, 6(1):89-92

Surface and ground water samples were collected (grab sampling) at each location as per CPCB guidelines[17]. Surface water samples were collected from the river by using a weighted bottle. Ground water samples from the production tube wells were collected after running the well for about 5 minutes. Adequate parameter specific preservatives were added to the samples and collected samples were brought to the laboratory by maintaining 4^{o}C in the ice boxes. Separate sterilized bottles were used for collection of water samples for microbial analysis.

3.2.6.1 Surface and Ground Water Quality Results

1. Thimmapur LIS

The physico-chemical parameters for Krishna river (lift point and downstream) are well within the standards. Total dissolved solids near lift point and downstream locations are reporting 466 mg/l and 471 mg/l respectively. Total Coliform and E. Coli were present in all the locations due to improper sanitation facilities.

Total Hardness in ground water was ranging from 180-760 mg/l and whereas the Nitrate levels are well within the standards. Fluoride levels are ranging between 0.7-0.9 mg/l and E.coli was absent in all locations. Heavy metals absent in all the locations. Overall, the ground water quality was found to be good and confirming to IS standards.

2. Ramthal (Marol) LIS

The physico-chemical parameters for Krishna river (lift point and downstream) are well within the standards. Total dissolved solids near lift point and downstream locations are reporting 810 mg/l and 811 mg/l respectively. Total Coliform and E. Coli were absent in all the locations.

Total Hardness in ground water was ranging from 136-820 mg/l and whereas the Nitrate levels are well within the standards. Fluoride levels are ranging between 0.07-1 mg/l. Heavy metals absent in all the locations. Overall, the ground water quality was found to be good and confirming to IS standards.

3. Budihaal-Peerapur LIS

Total Hardness in ground water was ranging from 340-976 mg/l and whereas the Nitrate levels are well within the standards. Fluoride levels are ranging between 0.7-0.9 mg/l and E.coli was absent in all locations. Heavy metals absent in all the locations. Overall, the ground water quality was found to be good and confirming to IS standards.

4. Nandawadagi LIS

The physico-chemical parameters for Krishna river (lift point and downstream) are well within the standards. Total dissolved solids near lift point and downstream locations are reporting 394 mg/l and 510.4 mg/l respectively. Total Coliform and E. Coli were absent in all the locations. Total Hardness in ground water was ranging from 136 - 930 mg/l. Fluoride levels are ranging between 0.28-1.31 mg/l. Heavy metals absent in all the locations. Overall, the ground water quality was found to be good and confirming to IS standards.

5. 9(A) Distributory

Total Hardness in ground water was ranging from 368-608 mg/l and whereas the Nitrate levels are well within the standards. Fluoride levels are ranging between 0.3-1.17 mg/l and E.coli was absent in all locations. Heavy metals absent in all the locations. Overall, the ground water quality was found to be good and confirming to IS standards.

The results of surface and ground water quality analysis are enclosed as Annexure-11.

[17]Guidelines for Water Quality Monitoring (2007), MINARS/27/2007-08, CPCB, New Delhi

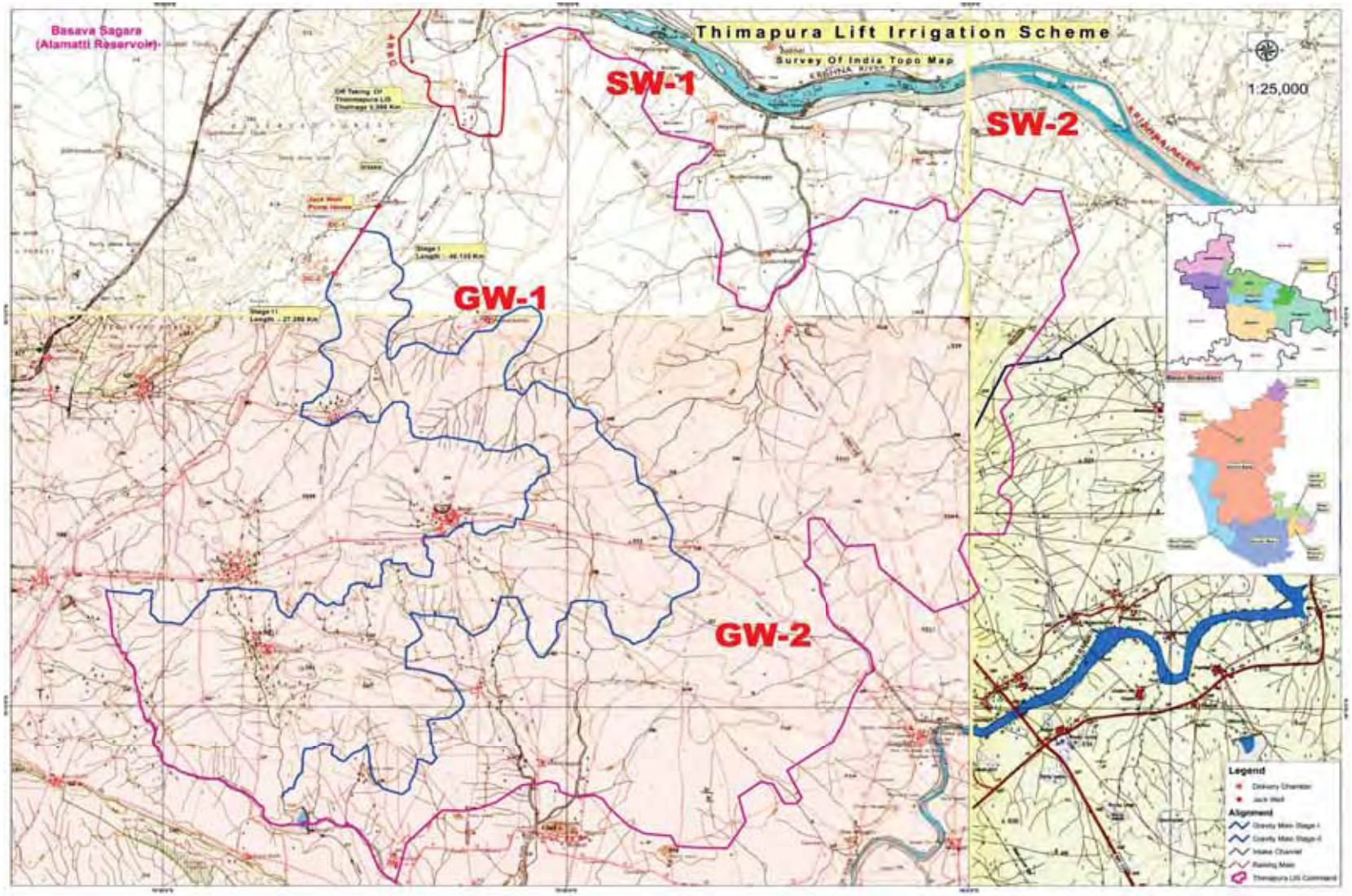


Fig 3.32 Surface and Ground Water Quality sampling locations of Thimmapur LIS

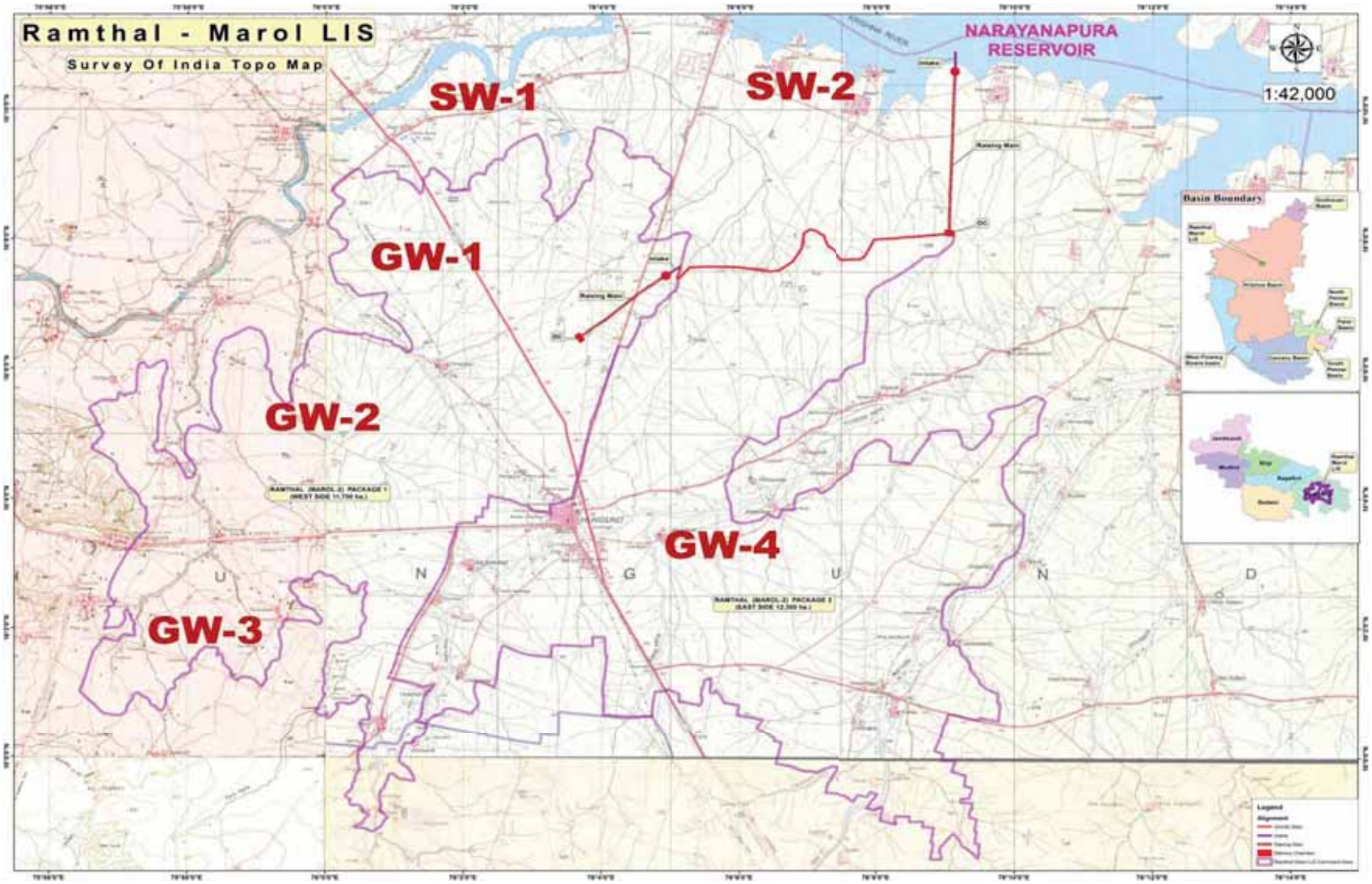


Fig 3.33 Surface and Ground Water Quality sampling locations of Ramthal LIS

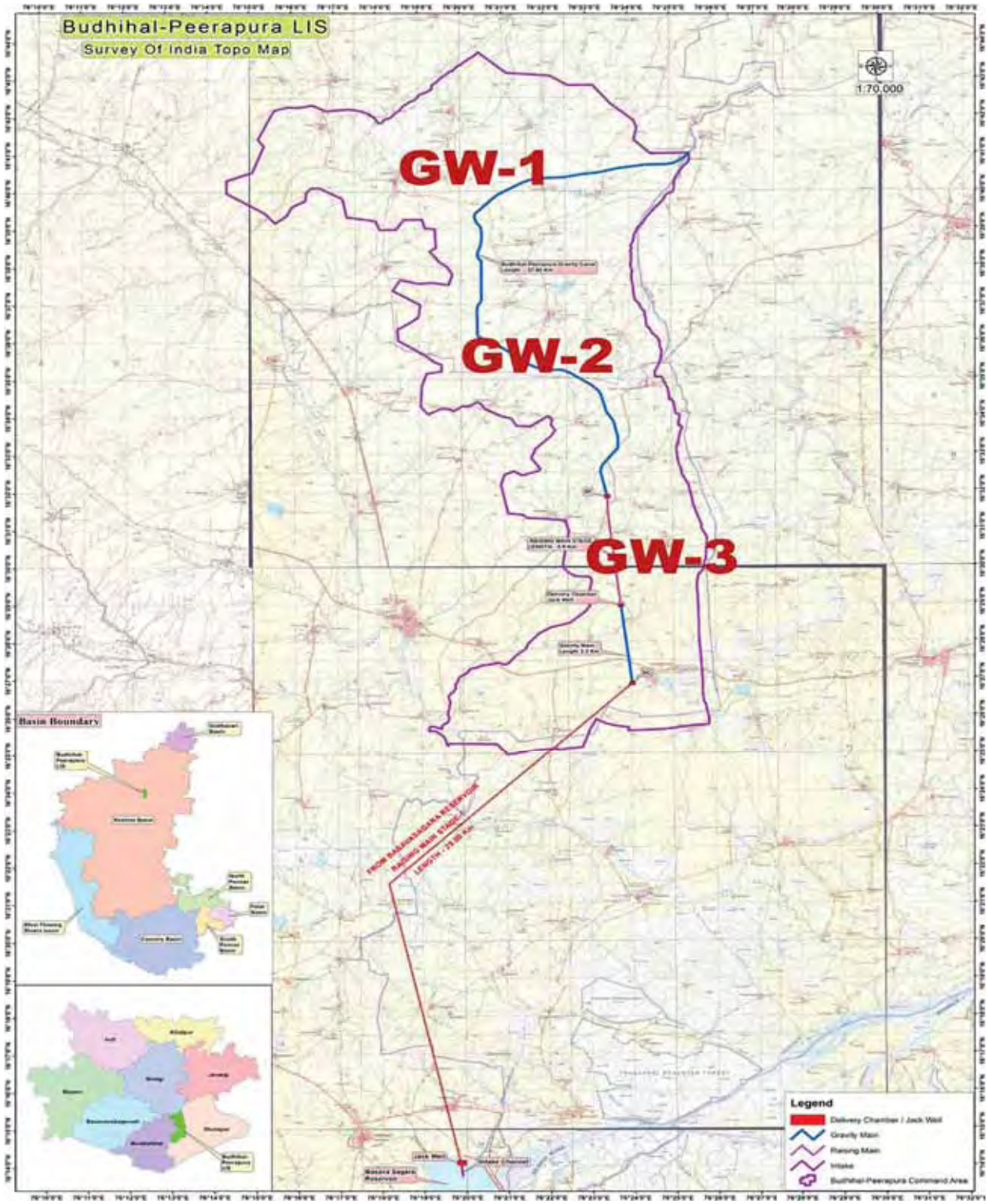


Fig 3.34 Surface and Ground Water Quality sampling locations of Thimmapur LIS

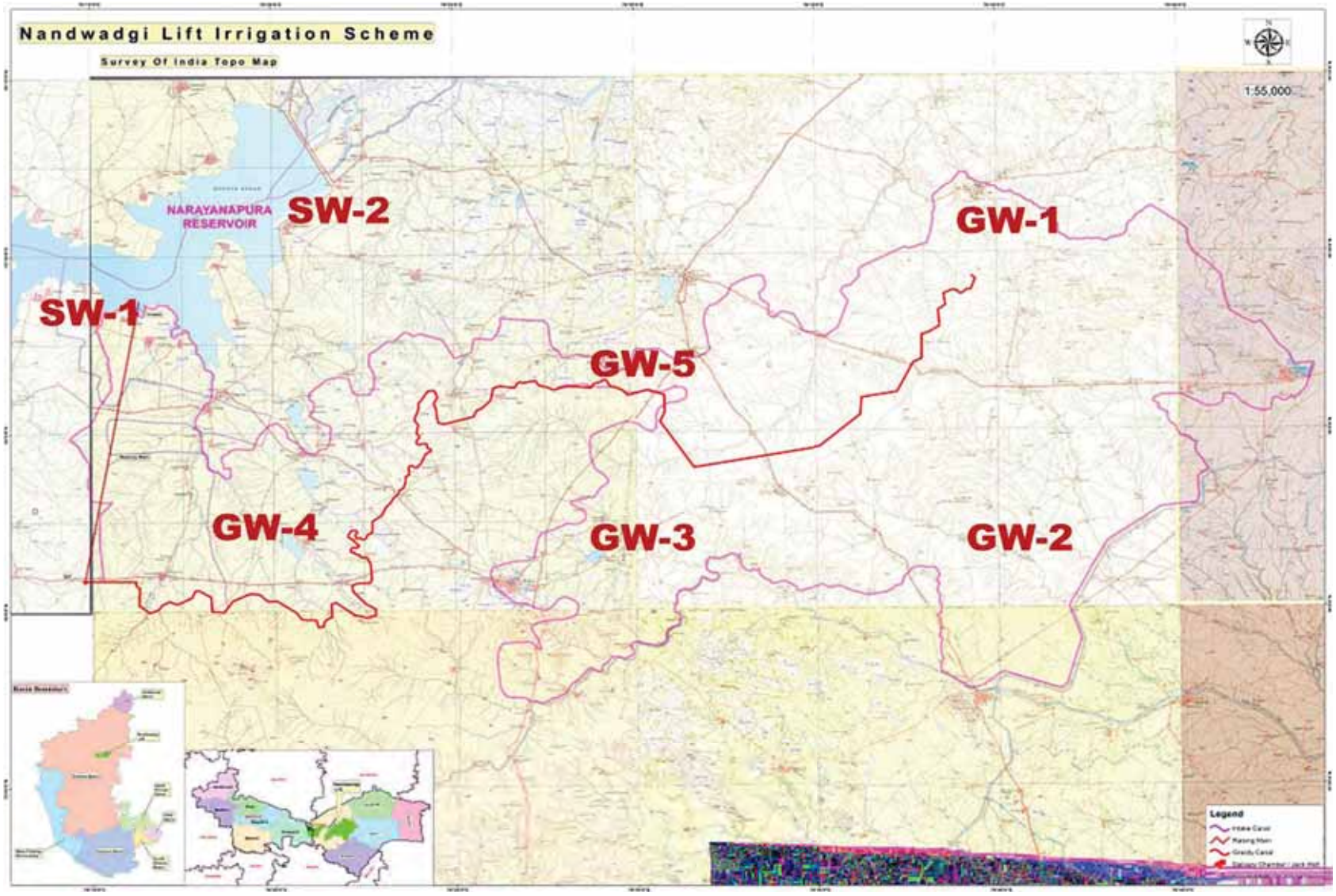


Fig 3.35 Surface and Ground Water Quality sampling locations of Nandwadgi LIS

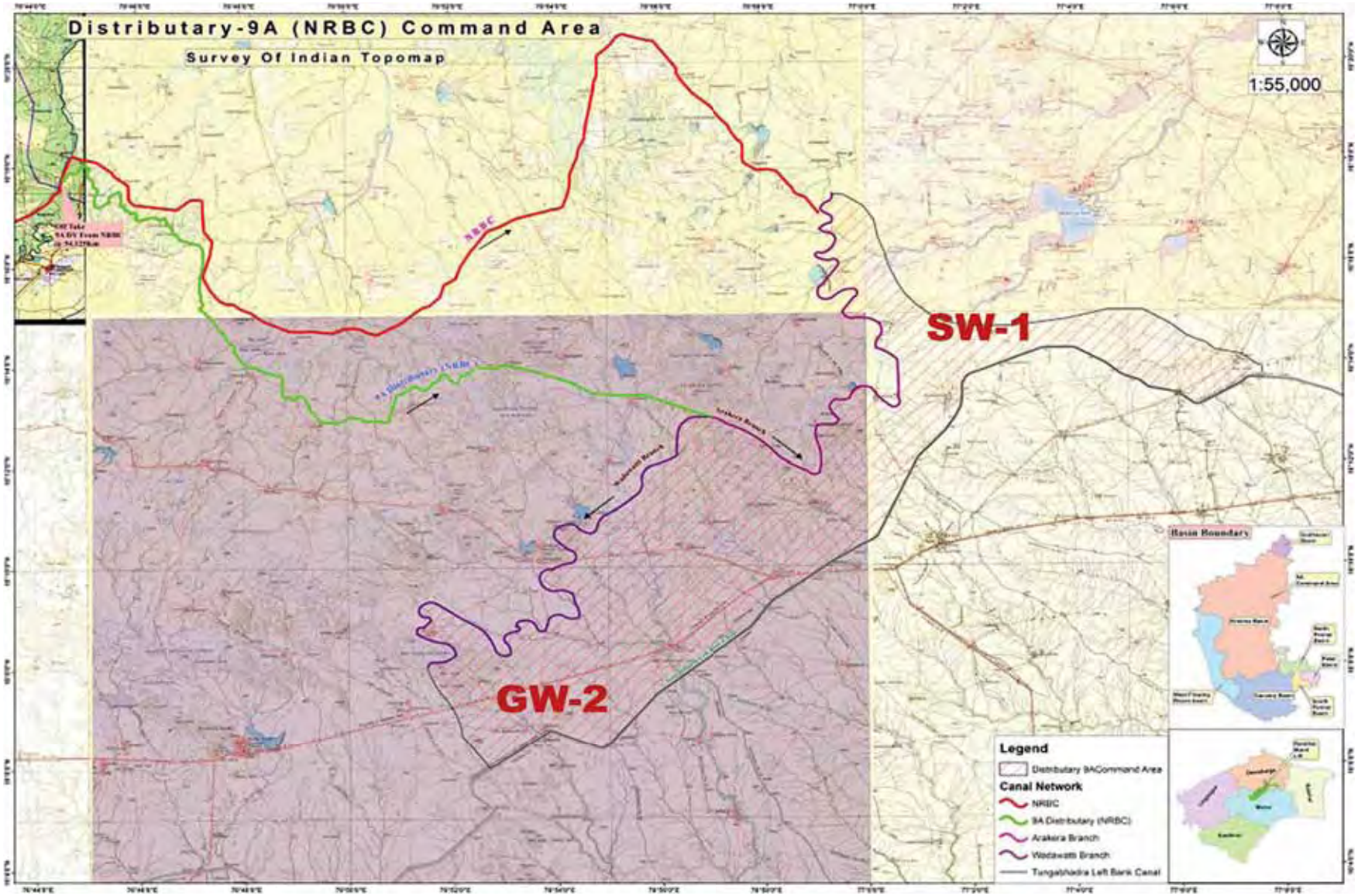


Fig 3.36 Surface and Ground Water Quality sampling locations of 9(A) Distributory

3.2.7 Soil Characteristics

As a consequence of growing Demographic pressure, it is planned to increase food production with an estimated average of 4 tons per hectare from the present 1.5 tons per hectare to meet the growing demand in the country. Due to the great dependence and pressure on land and water resources, obviously, there will be an effect on soil quality and crop productivity. As per some estimates, the soils have been degrading at the rate of one million hectares per year and 57% of geographical area is affected by various forms of degradation viz., water and wind erosion, physical and chemical deterioration. The state department of Agriculture has estimated that about 10% of irrigated (1.27 lakh ha) command area are affected by problems such as water logging, salinity and alkalinity.

Similarly a depletion of ground water levels has also been noticed at an alarming rate in recent times through the rapid depletion of the ground water resources. In this context, it is a great challenge to the scientific community, to evolve and develop appropriate strategies, to increase food production on a sustainable basis. Irrigation is as much an activity with beneficial impact to begin with and continues to be beneficial if proper management strategies are adopted. However, it may also pose problems in terms of change in physico-chemical properties of soil following application of fertilizers and pesticides to boost agricultural production and post irrigation problems like, water logging, salinity etc., Physical deterioration of soil by reduction of soil organic matter, making the land more prone to crusting and increased run off, intensive agriculture from specific crops which leads to a problem of water logging or condition of short/long term water saturation of top soil, which resulting in changes in hydrologic regime, landscape, due to development activities.

The processes leading to flooding are being attributed to increased sedimentation and reduced capacity of the river drainage system. The adverse effects of water logging are being reflected severely on overall ecology, reduced agriculture productivity, limited choice of crops and ageing of soil in the longer term34. Nutrients and soil loss is a major problem where excessive leaching of soil occurs, besides in continuous cropping, without adequate input of fertilizers and organic manure. It is more rampant in areas where agriculture is practiced in poor or moderately fertile soils without application of sufficient fertilizer or manure, which certainly leads to decrease in agricultural production. Loss of soil organic matter, following clearing the natural vegetation is also another way of nutrient loss. Plant nutrients are also depleted from soil through crop removal, run off and soil erosion. Middelton et al., noticed that the eroded material is richer than the original soil in respect of colloidal clay and plant nutrients.

The loss of nitrogen by erosion is probably more serious than loss of any other nutrient, since most of the nitrogen being lost is combined with soil organic matter, which is under threat of erosion. Actual nutrient status of tank silt was not found to be much different from that of the soil in the catchment area in studies carried out by the scientists of the Dry land Agriculture project of the University of Agricultural Sciences, Bangalore and also by the Department of Agriculture (1997). All such soils need different management and reclamation measures. Their sustained use depends more on the economic concerns and identification of sustainable alternative uses rather than agricultural production.

3.2.7.1 Study area

The command area covering the taluk of Bijapur, Bagalkot & Raichur districts which receives moderate rainfall and even this is poorly distributed. The region is subject to frequent drought and crop failure, affecting the life and economic status of the population, who subsist mainly on agriculture. The soil in this region are of shallow to moderate depth (<50 cm), Gravelliness and stoniness accounts for >35% with severe soil erosion and slopes of >3 to >5% and medium to low fertility status overlaid with previous

murrum, which enables cultivation of agricultural crops by way of providing micro irrigation facilities.

3.2.7.2 Soil types in the study area

In the study area the soil types found in the command area are predominantly shallow to deep black, moderately well drained, clay soils with slow permeability. vertisol, Entisol and Incept sols are found in the proposed command. The black cotton soil is rich in bases (alkaline condition) and has a very high water holding capacity. Major area of TBLIS is covered by black, clay soils constitute roughly 95 percent, and are shallow to moderately deep (22.5 to 90 cm), clayey, with 45 to 55 per cent clay and contain free calcium carbonate throughout the profile. There is generally a zone of calcium nodules and gypsum in the soil profile at a depth of 45 to 90 cm, the principal salt being gypsum. Below the gypsum layer disintegrated impermeable murrum layer exists, the internal drainage of the soil is lateral rather than vertical within the profile.

The soil types found in the command area are black colored. The study area is experiencing relatively plain not affected by fully erosion in the past, but the analysis indicates that certain areas were with rill and sheet erosion.

3.2.7.3 Crops and Cropping pattern

Kharif and Rabi crops are grown mainly under rain fed conditions in the command area. In recent periods, bore wells are being drilled in the command area, but their number is small. The crops that are grown in Kharif season are Groundnut, Maize, cotton, chilly, Pulses, Oil seeds, sugar cane and the crops growing in Rabi season are Sorghum, wheat, Bengal gram, etc.

3.2.7.4 Soil status

A reconnaissance soil survey was conducted in the study area and soil sampling locations were identified followed by a wide-ranging sampling programme undertaken during the field survey. Depending on the terrain conditions and soil types, 50 Soil samples were collected from different agricultural lands in the command area. The details of soil textural family of are given below;

Table 3.97 Soil Textural family of Thimmapur LIS

SL. No	Soil Family Texture	%
1	Clayey skeletal	12.56
2	Fine	60.61
3	Habitation mask	0.15
4	Loamy	4.97
5	Loamy Skeletal	0.51
6	Rocky Outcrops	17.35
7	Very Fine	3.26
8	Water Body Mask	0.54
	Total	100

Table 3.98 Soil Textural family of Ramthal(Marol) LIS

SL. No	Soil Family Texture	%
1	Clayey skeletal	30.05
2	Fine	29.58
3	Habitation mask	1.13
4	Loamy	3.99
5	Loamy Skeletal	0.003
6	Rock Outcrops	27.23

SL. No	Soil Family Texture	%
7	Very Fine	6.34
8	Water Body Mask	1.65
	Total	100

Table 3.99 Soil Textural family of Budhihal-Peerapur LIS

SL.No	Soil Family Texture	%
1	Clayey	9.80
2	Clayey skeletal	1.13
3	Fine	47.53
4	Fine loamy	7.69
5	Habitation mask	0.68
6	Loamy	11.79
7	Loamy skeletal	1.76
8	Rock outcrops	0.10
9	Very fine	19.14
10	water body mask	0.33
	Total	100

Table 3.100 Soil Textural family of Nandwadgi LIS

SL. No	Soil Family Texture	%
1	Clayey	10.68
2	Clayey skeletal	0.006
3	Fine	44.87
4	Fine loamy	9.86
5	Habitation mask	0.68
6	Loamy	13.59
7	Loamy skeletal	10.80
8	Rock outcrops	0.49
9	Very fine	8.19
10	water body mask	0.80
	Total area	100

Table 3.101 Soil Textural family of 9(A) Distributory

SL. No	Soil Family Texture	%
1	Clayey	109.48
2	Fine	820.78
3	Fine loamy	125.04
4	Habitation mask	6.93
5	Loamy skeletal	227.19
6	Rock outcrops	81.40
7	Water Body mask	59.15
	Total	100

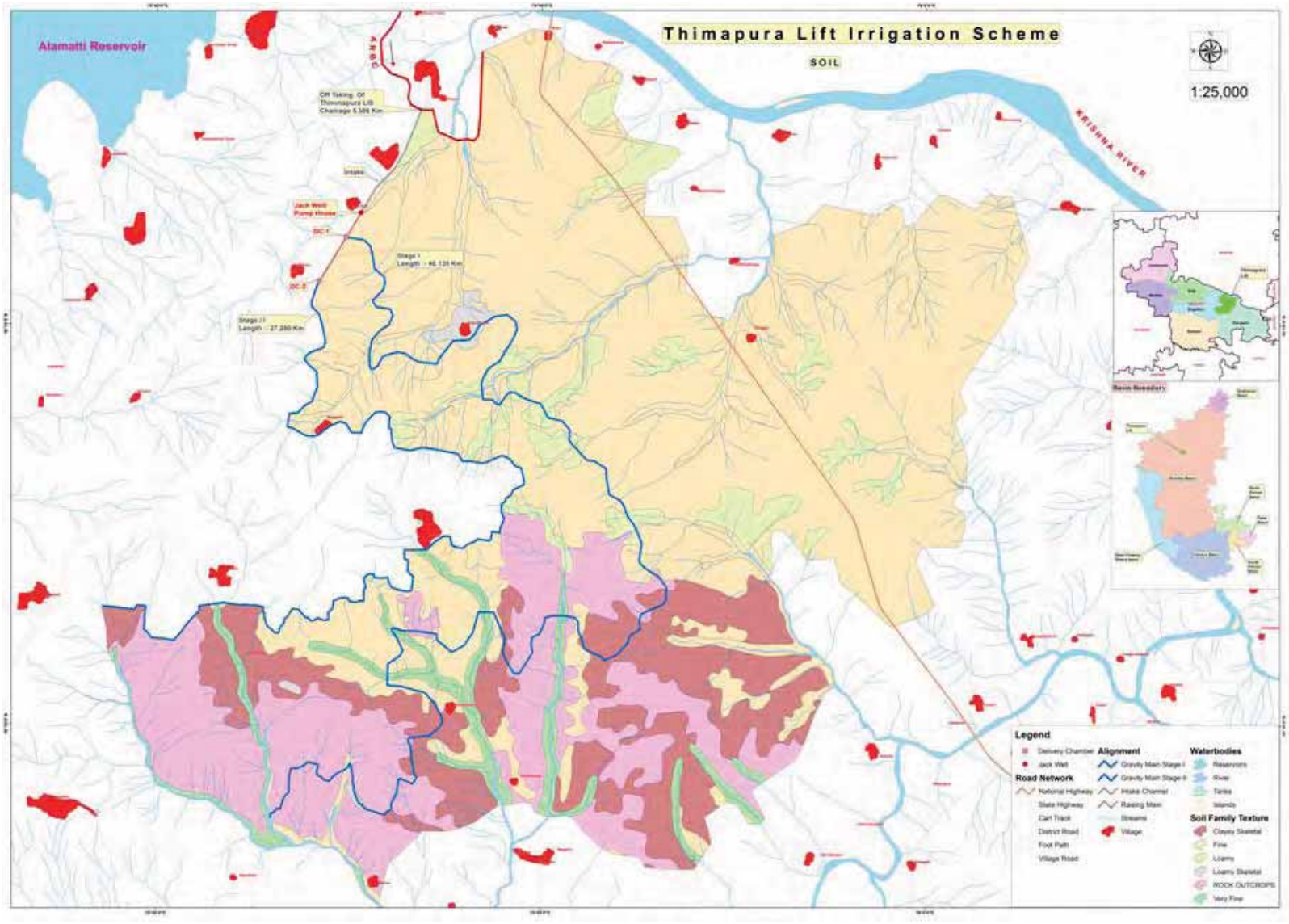


Fig 3.37 Soil textural map of Thimmapur LIS

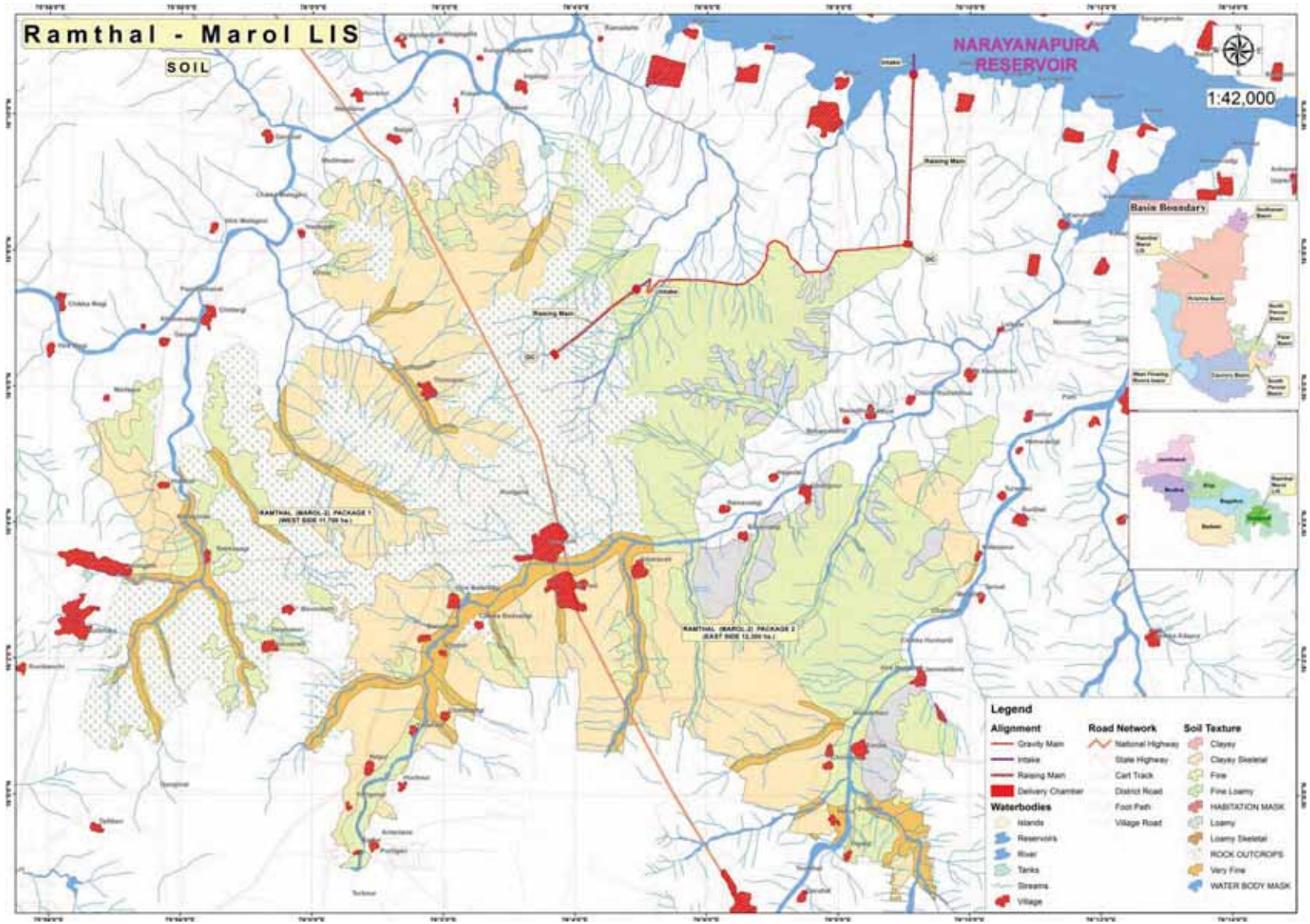


Fig 3.38 Soil textural map of Ramthal (Marol) LIS

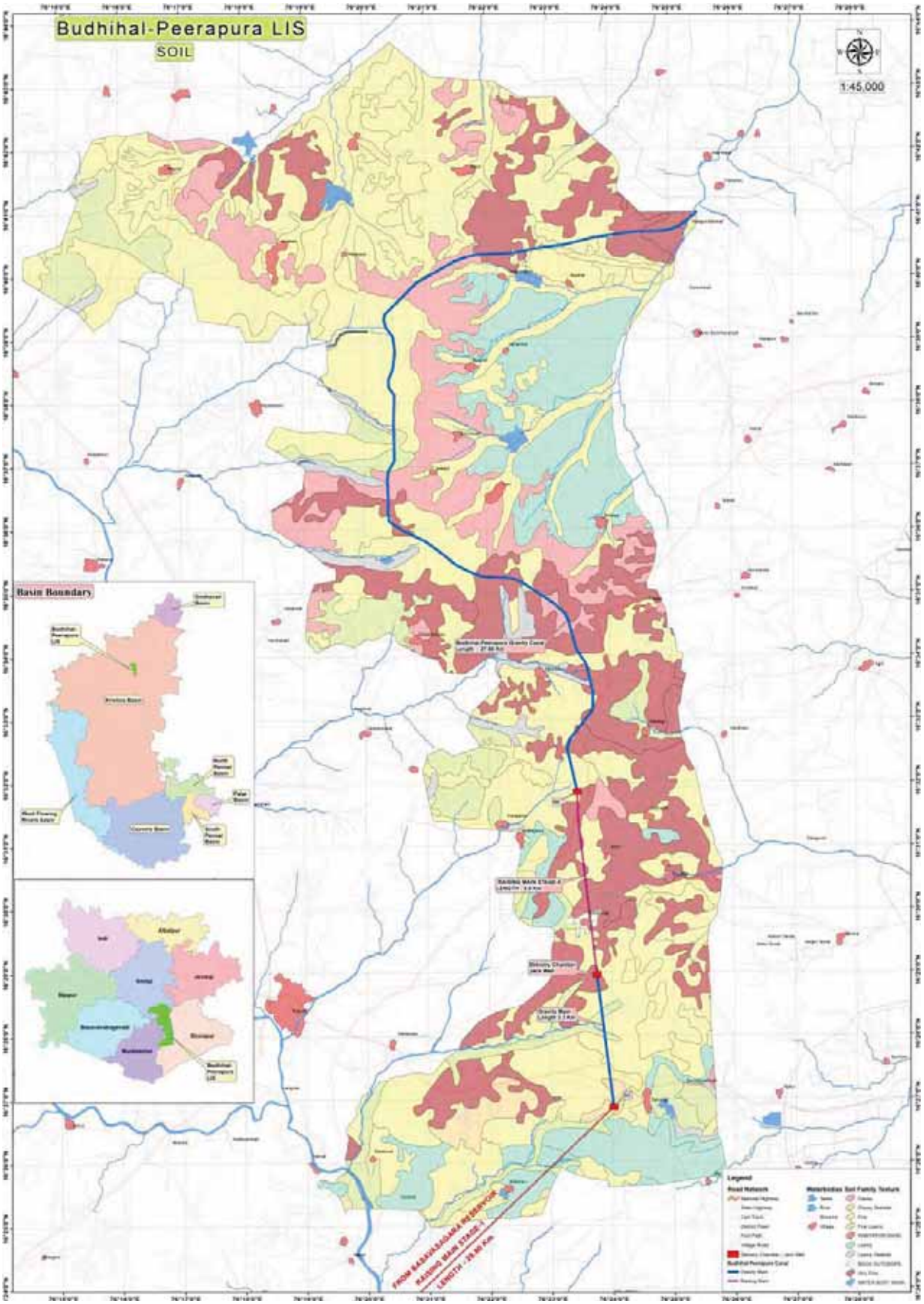


Fig 3.39 Soil textural map of Budhihal-Peerapur LIS

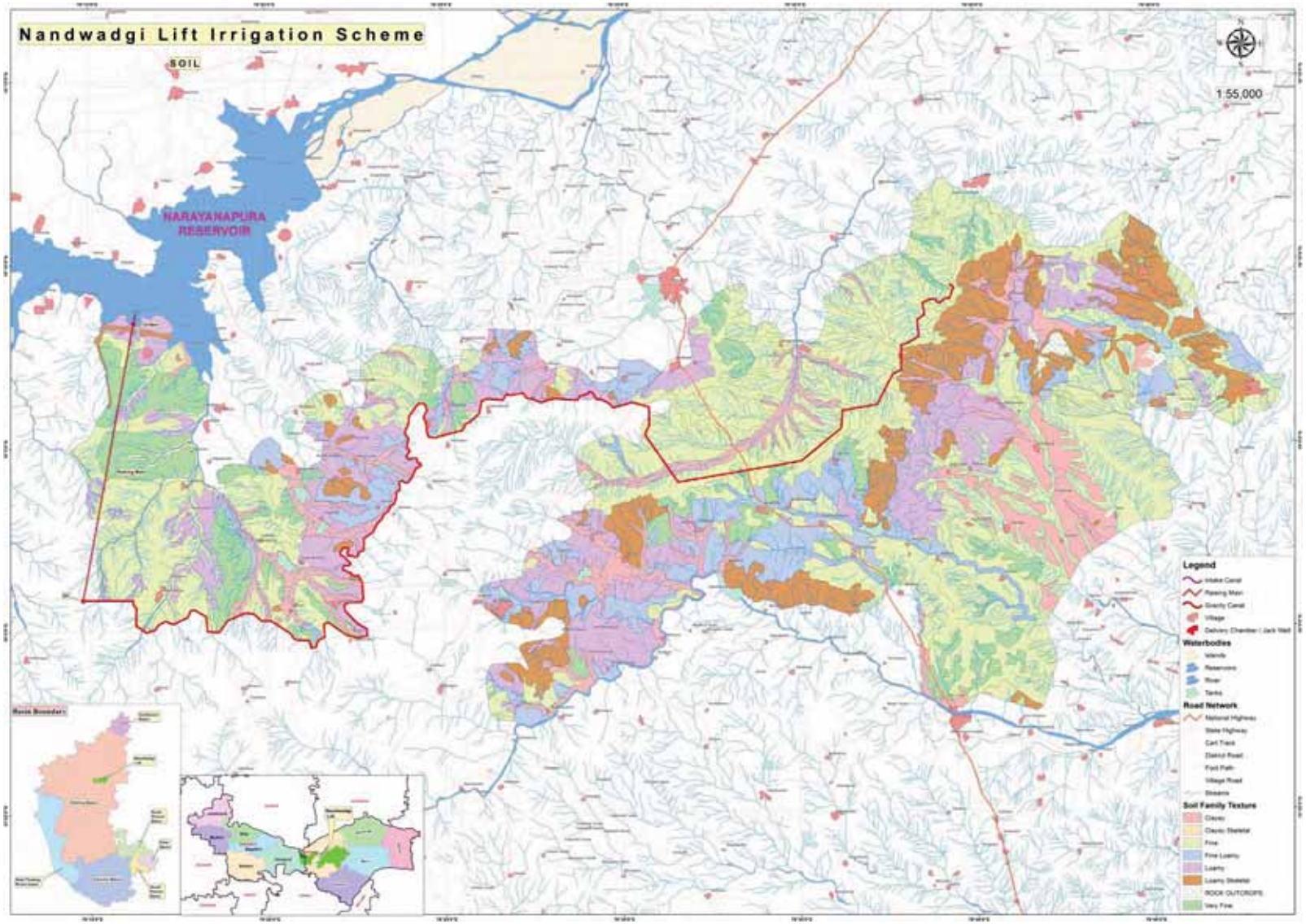


Fig 3.40 Soil textural map of Nandwadgi LIS

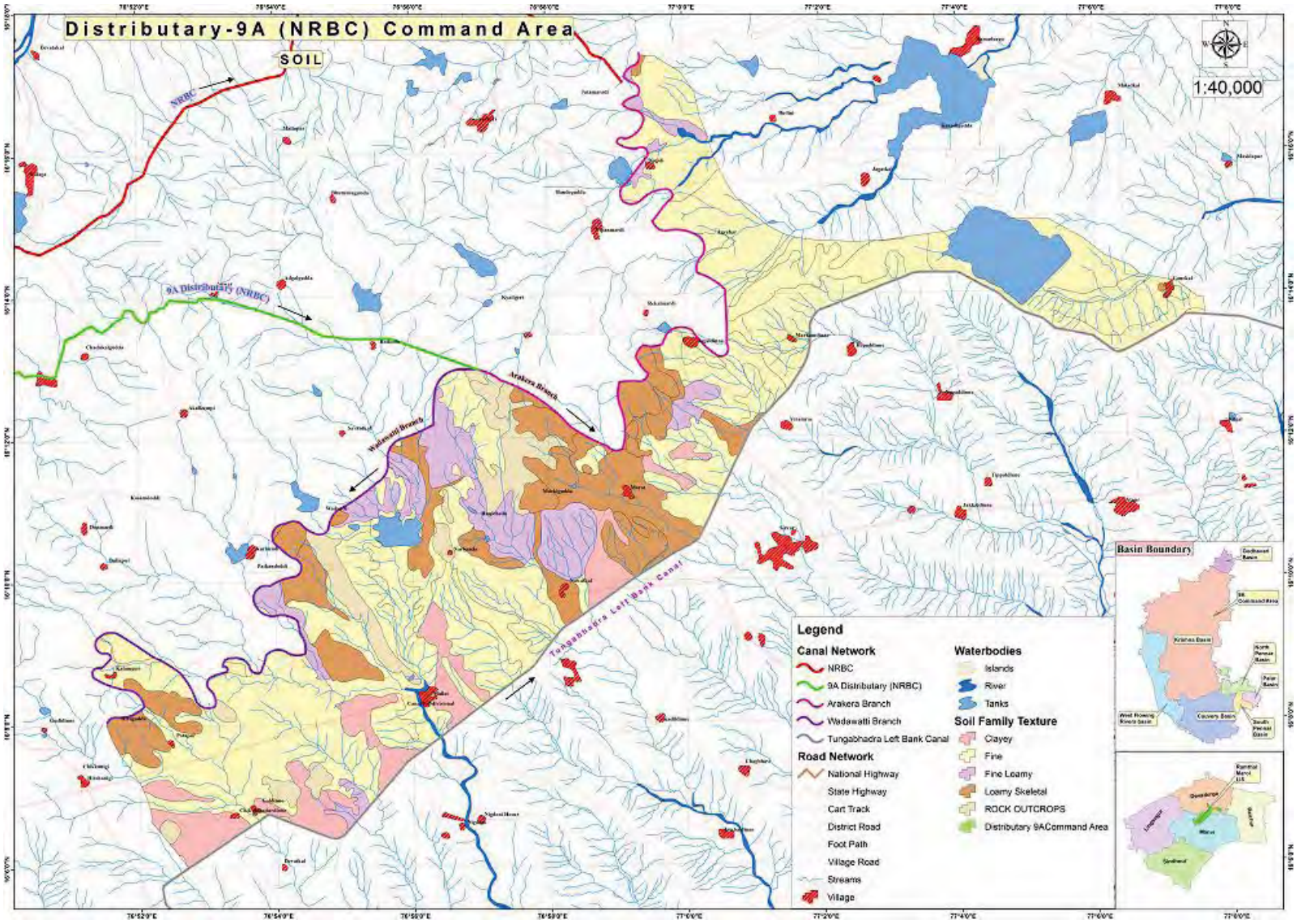


Fig 3.41 Soil textural map of 9(A) Distributory

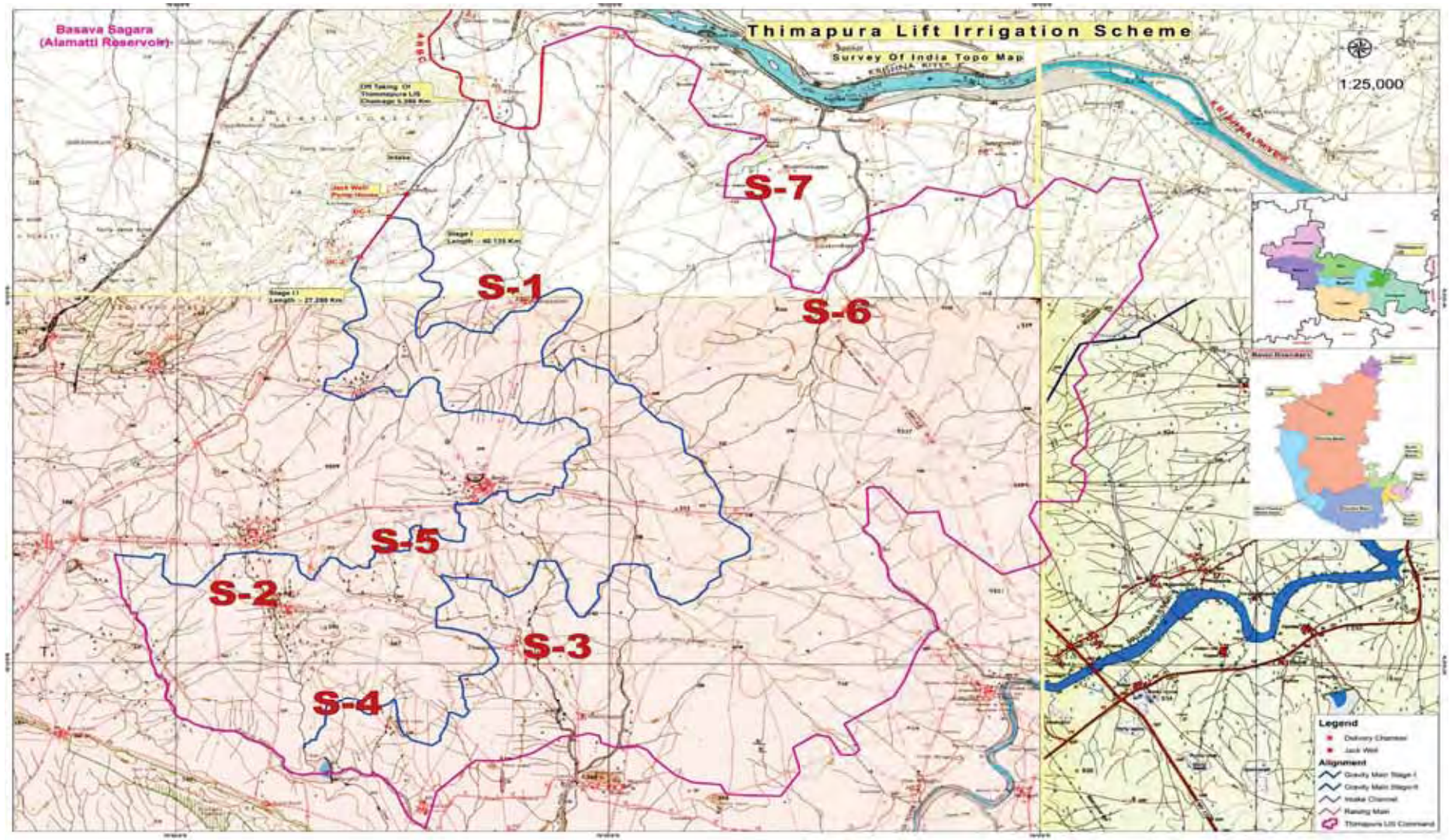


Fig 3.42 Soil sampling locations of Thimmapur LIS

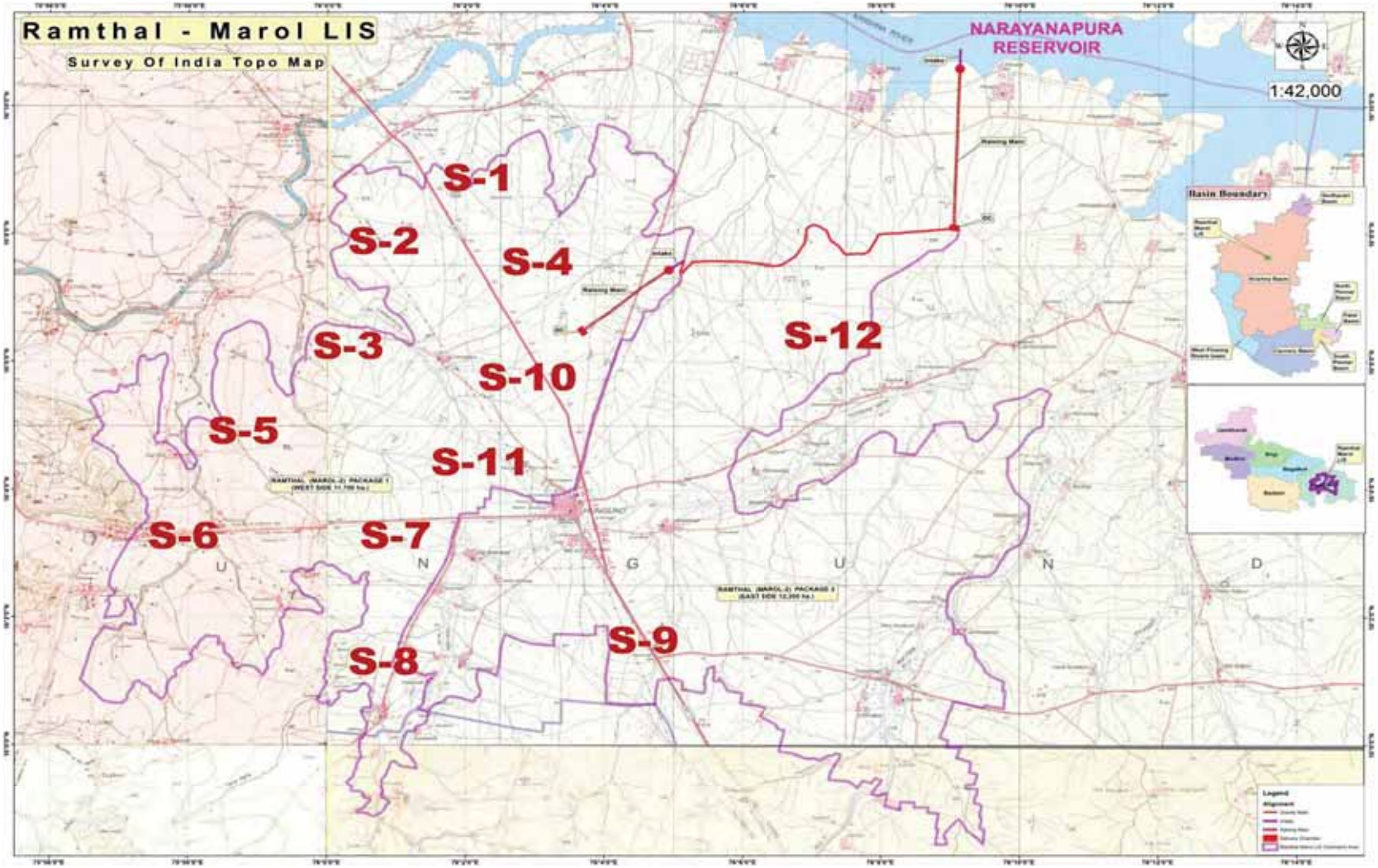


Fig 3.43 Soil sampling locations of Ramthal (Marol) LIS

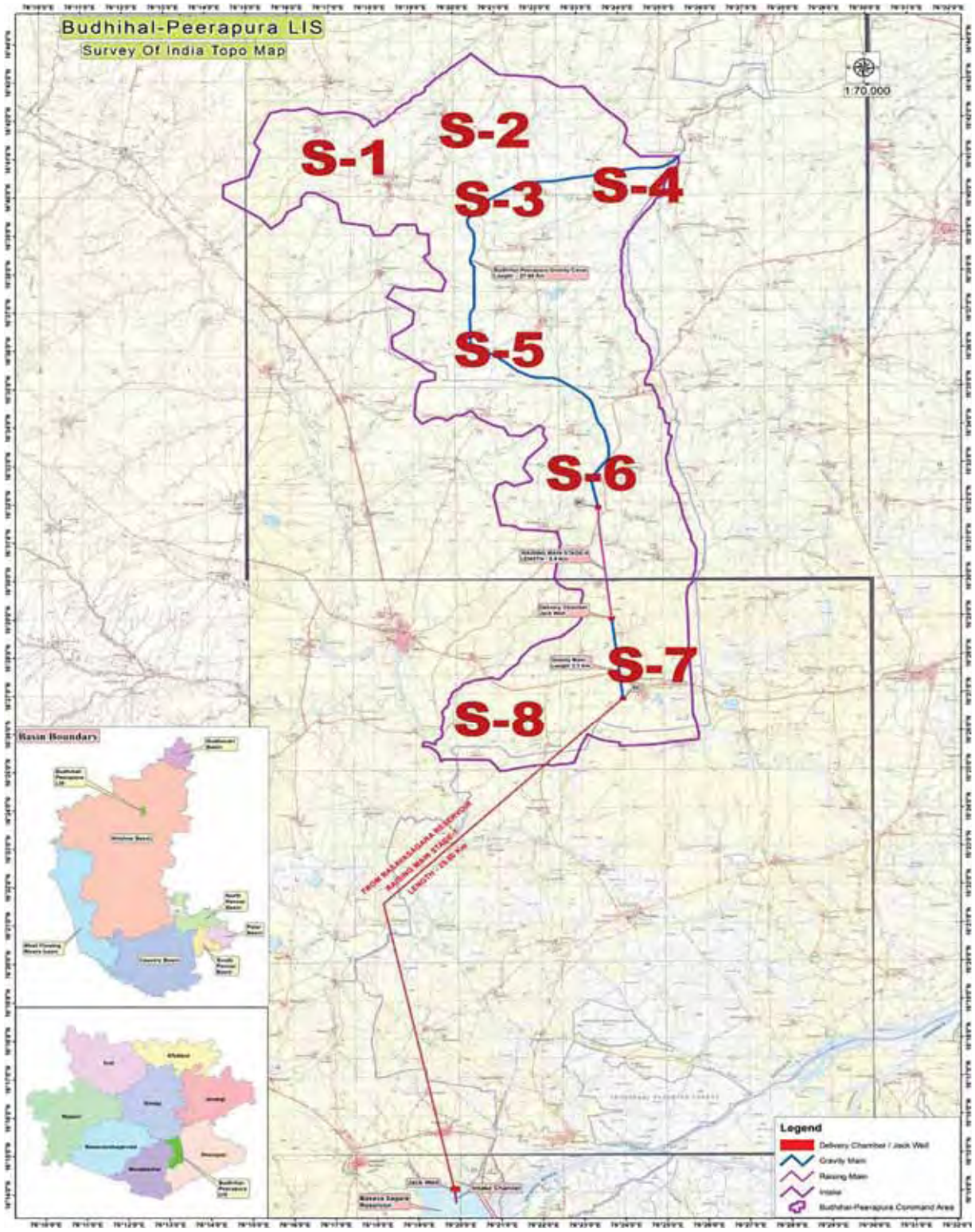


Fig 3.44 Soil sampling locations of Budhihal-Peerapur LIS

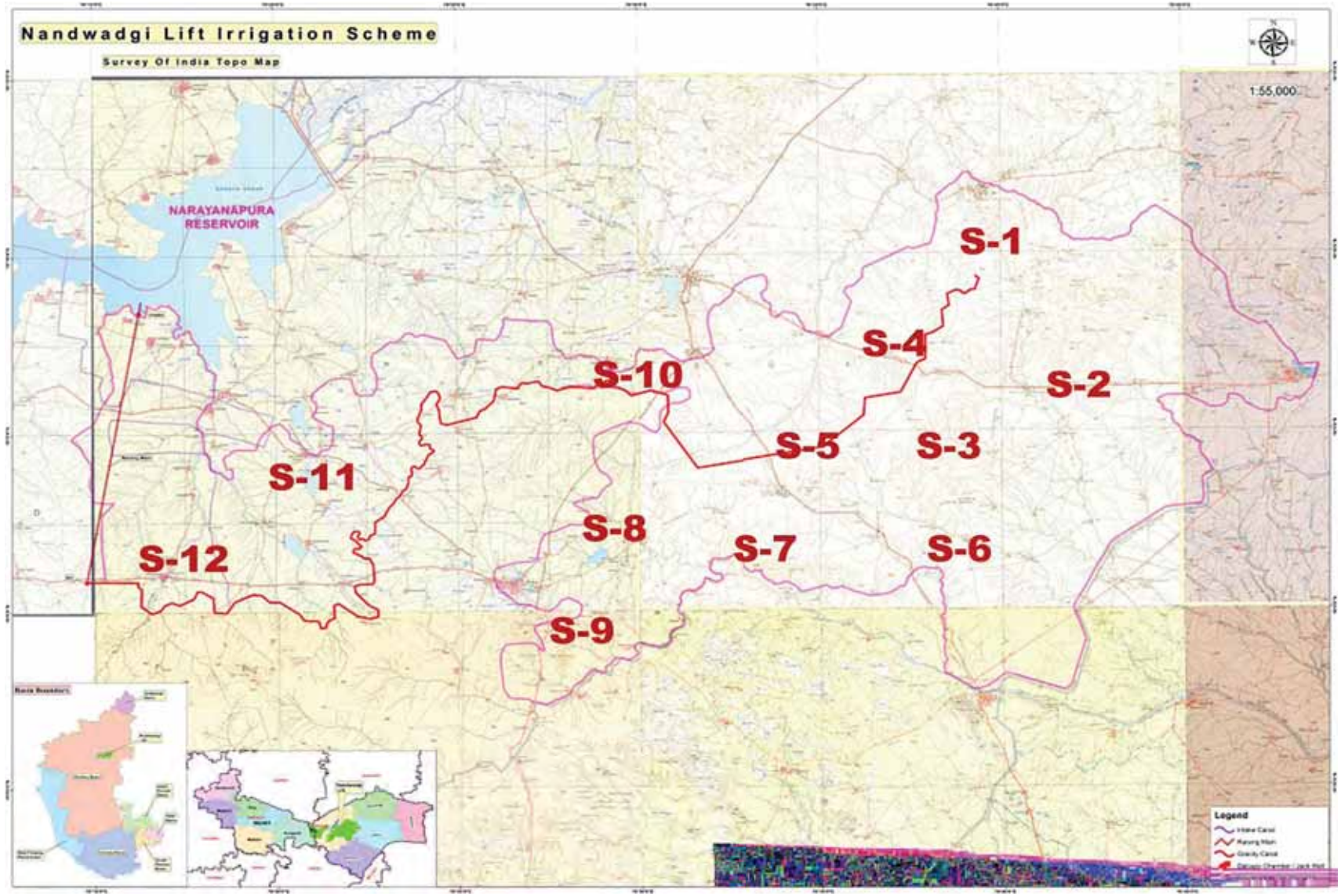


Fig 3.45 Soil sampling locations of Nandwadgi LIS

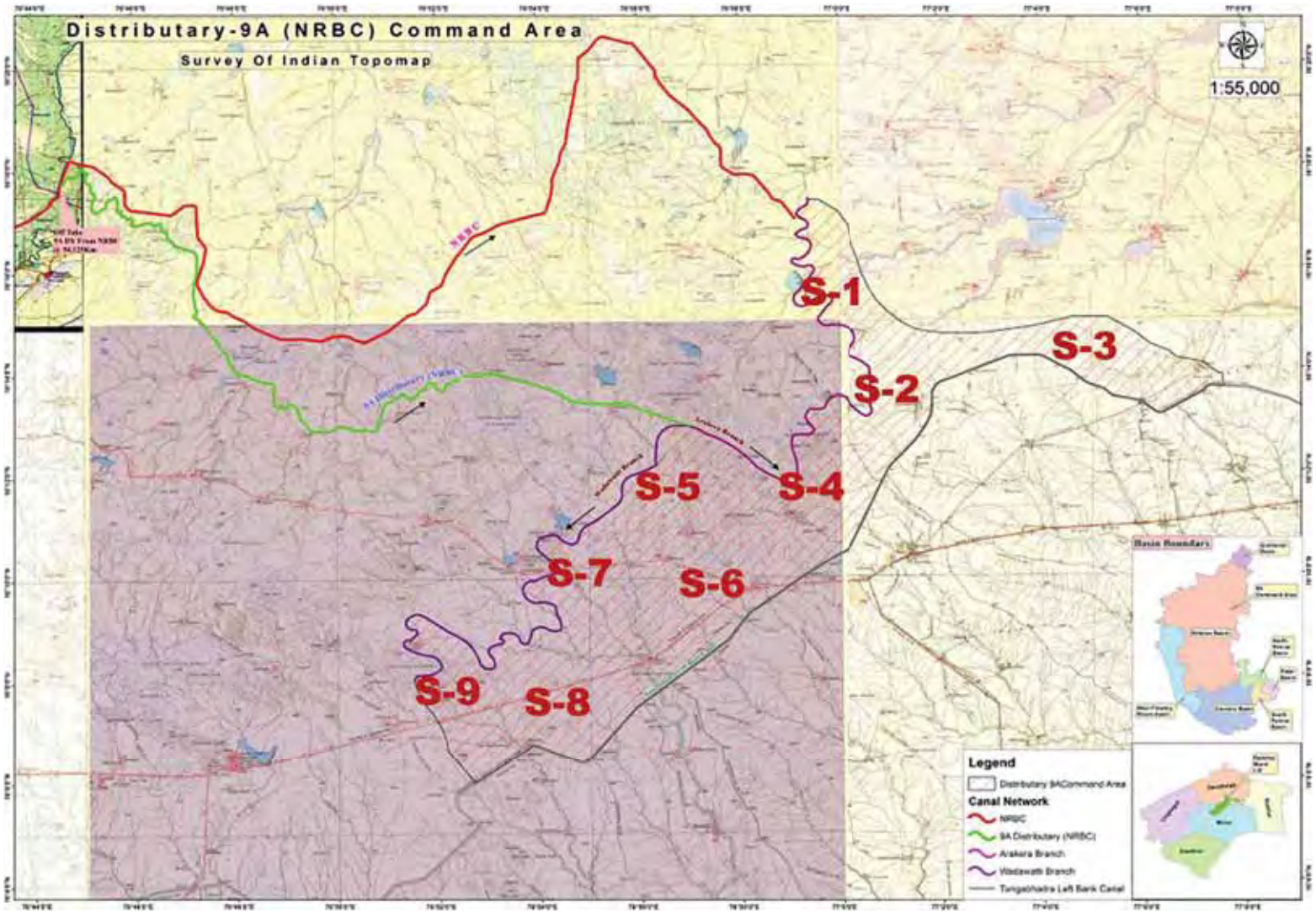


Fig 3.46 Soil sampling locations of 9(A) Distributory

Standard techniques of soil survey were used to obtain qualitative and quantitative data on the soils. Various soil quality parameters viz., pH, electrical conductivity, chlorides, available calcium and magnesium, phosphorus, exchangeable sodium and potassium, available nitrogen etc., were determined employing standard methods of analyses[18].

Table 3.102 Details of soil sampling locations of Thimmapur LIS

Location code	Location	Geographical coordinates	Elevation (m)
A. Thimmapur LIS			
S1	Bodanayakdinni	16°14'31.56"N, 75°54'16.39"E	544
S2	Ambalikoppa	16° 9'20.97"N, 75°54'37.22"E	521
S3	Bhalrmatti	16°10'10.87"N, 75°51'29.25"E	542
S4	Chavdapur	16°10'12.14"N, 75°53'55.12"E	527
S5	Kadival	16° 9'22.67"N, 75°52'47.17"E	549
S6	Devlapur	16°13'55.53"N, 75°57'29.74"E	524
S7	Chitkinakoppa	16°14'43.37"N, 75°57'6.64"E	518
B. Ramthal (Marol) LIS			
S1	Bisnalkoppa	16° 9'35.11"N, 76° 2'45.36"E	514
S2	Belgal	16° 8'7.17"N, 76° 2'5.67"E	546
S3	Medinapur	16° 8'51.45"N, 76° 0'31.27"E	522
S4	Hadagali	16° 7'49.64"N, 76° 0'42.97"E	536
S5	Thimmapur	16° 6'43.95"N, 76° 2'42.45"E	554
S6	Chittarangi	16° 6'3.11"N, 76° 0'38.43"E	527
S7	Huliginal	16° 4'34.64"N, 75°57'43.20"E	523
S8	Rakkasagi	16° 3'36.16"N, 75°58'57.52"E	542
S9	Sulebhavi	16° 2'33.56"N, 75°56'21.55"E	561
S10	Honnarahalli	16° 1'34.30"N, 75°59'24.27"E	566
S11	Bevinamatti	16° 2'11.81"N, 76° 1'37.68"E	581
S12	Hireyaranakeri	16° 3'19.91"N, 75°59'50.37"E	548
S13	Chikkayaranakeri	16° 2'48.57"N, 75°58'3.93"E	544
S14	Hunagundh	16° 3'44.76"N, 76° 3'15.67"E	540
C. Budhihal-Peerapur LIS			
S1	Kalkeri	16°40'7.59"N, 76°18'24.65"E	555
S2	Rampur	16°40'24.00"N, 76°19'57.50"E	549
S3	Kerulagi	16°42'59.72"N, 76°17'2.79"E	541
S4	Bekinal	16°39'3.50"N, 76°21'23.13"E	558
S5	Bannihatti	16°37'31.43"N, 76°21'27.33"E	553
S6	Navadagi	16°30'34.50"N, 76°24'51.67"E	530
S7	Salvadgi	16°27'11.14"N, 76°24'28.60"E	545
S8	Bilebhavi	16°26'0.07"N, 76°22'6.17"E	508
D. Nandwadgi LIS			
S1	Veerapur	16° 9'39.32"N, 76°40'56.30"E	512
S2	Yatgal	16° 8'37.25"N, 76°42'29.23"E	517
S3	Gejjalagatti	16° 7'49.71"N, 76°40'40.53"E	489

[18]Jackson ML (1965) Soil Chemical Analysis - Advanced Course. Department of Soils, University of Wisconsion, Wisconsin, USA

Location code	Location	Geographical coordinates	Elevation (m)
S4	Hirehesaruru	16° 7'40.42"N, 76°38'8.99"E	548
S5	Amarawati	16° 5'45.99"N, 76°37'9.64"E	555
S6	Sanbal	16° 0'54.66"N, 76°40'50.32"E	445
S7	Bedara Karalkunti	16° 2'35.18"N, 76°35'14.38"E	502
S8	Mattur	16° 2'24.96"N, 76°30'31.32"E	514
S9	Jakker Madu	15°59'5.04"N, 76°29'37.59"E	518
S10	Kadadrahal Tanda	16° 1'55.94"N, 76°28'18.92"E	535
S11	Khairwadgi	16° 2'14.98"N, 76°27'41.90"E	554
S12	Killarhatti	15°50'19.77"N, 76°26'20.21"E	498
E. 9(A) Distributory Area			
S1	Huda	16° 2'15.40"N, 76°44'37.67"E	432
S2	Wadavatti	16°10'47.85"N, 76°54'29.65"E	465
S3	Pattakam doddi	16° 8'42.36"N, 76°54'2.55"E	443
S4	Malat	16° 8'27.12"N, 76°55'54.01"E	431
S5	Marat	16°11'12.45"N, 76°59'6.74"E	441
S6	Narabunda	16°10'11.30"N, 76°56'16.47"E	450
S7	Hunichedu	16°10'56.28"N, 76°56'56.31"E	445
S8	Navakal	16° 9'0.98"N, 76°58'17.47"E	423
S9	Sirwar	16°10'28.56"N, 77°1'25.54"E	415

3.2.7.5 Results of soil quality analysis

- **Electrical conductivity (EC)**

1. Thimmapur LIS

Electrical Conductivity, as the measure of current carrying capacity, gives a clear picture of the amount of soluble salts present in the soil. The EC values of the soil samples varied from 190 to 1038 µmhos/cm at Bhalrmatti and Bodanayakdinni villages.

2. Ramthal LIS

Electrical Conductivity, as the measure of current carrying capacity, gives a clear picture of the amount of soluble salts present in the soil. The EC values of the soil samples varied from 170 to 1077 µmhos/cm at Chikkayaranakeri and Chittarangi villages.

3. Budhihal-Peerapur LIS

Electrical Conductivity, as the measure of current carrying capacity, gives a clear picture of the amount of soluble salts present in the soil. The EC values of the soil samples varied from 140 to 306 µmhos/cm at Bekinal and Rampur villages.

4. Nandwadgi LIS

Electrical Conductivity, as the measure of current carrying capacity, gives a clear picture of the amount of soluble salts present in the soil. The EC values of the soil samples varied from 136.5 to 1209 µmhos/cm at Kadadrahal Tanda and Jakker Madu villages.

5. 9(A) Distributory area

Electrical Conductivity, as the measure of current carrying capacity, gives a clear picture of the amount of soluble salts present in the soil. The EC values of the soil samples varied from 197.8 to 1275 µmhos/cm at Huda and Wadavatti villages.

- **Salinity**

Based on the electrical conductivity of the soil, soil salinity can be classified into four classes:

Water class	Electrical conductivity (micromhos/cm at 25˚ C	Approximate salt concentration
Class - I - Low salinity	0 to 250	<0.16
Class - II - Medium salinity	250 to 750	0.16 to 0.50
Class - III - High salinity	750 to 2250	0.50 to 1.50
Class - IV - Very High salinity	2250 to 5000	1.5 to 3

- **CI** water is considered as safe with without any salinity problems.
- **CII** When used for irrigation, moderate leaching is required.
- **CIII** and **CIV** cannot be used on soils with inadequate drainage, since salinity develops.

In the study area most of the soil samples sample falls in all the three classes.

- **Calcium**

1. Thimmapur LIS

There was not much wide variation (26.2 to 60.3 meq/L) in the distribution of Calcium content in the study area. Soil sample collected at Bodanayakdinni had shown least Ca content of 26.2 meq/L whereas, Chavdapur soil shown high calcium content of 60.3 meq/L.

2. Ramthal LIS

There was wide variation (36 to 310 meq/L) in the distribution of Calcium content in the study area. Soil sample collected at Belgal had shown least Ca content of 36 meq/L whereas, Huliginal soil shown high calcium content of 310 meq/L.

3. Budhihal-Peerapur LIS

There was not much wide variation (36 to 118.4 meq/L) in the distribution of Calcium content in the study area. Soil sample collected at Kerulagi had shown least Ca content of 26.2 meq/L whereas, Kalkeri soil shown high calcium content of 118.4 meq/L.

4. Nandwadgi LIS

There was not much wide variation (7.5 to 44.8 meq/L) in the distribution of Calcium content in the study area. Soil sample collected at Khairwadgi had shown least Ca content of 7.5 meq/L whereas, Sanbal soil shown high calcium content of 44.8 meq/L.

5. 9A Distributory area

There was not much wide variation (7 to 37.4 meq/L) in the distribution of Calcium content in the study area. Soil sample collected at Narabunda had shown least Ca content of 7 meq/L whereas, Sirwarsoil shown high calcium content of 37.4 meq/L.

- **Percent Organic Carbon**

1. Thimmapur LIS

Organic Carbon percent shows the organic or microbial load present in the soil. The percent organic carbon was found least at Kadiwal and Bhalrmatti which was 0.06 % and at Ambalikoppa highest Organic Carbon percent was found i.e., about 0.78 %.

2. Ramthal LIS

The percent organic carbon was found least at 4 locations viz., Medinapur, Chittarangi Huliginal and Hunagundh which was 0.06 % and at Thimmapur highest Organic Carbon percent was found i.e., about 0.78 %.

3. Budhihal-Peerapur LIS

The percent organic carbon was found least at Kalkeri which was 0.12 % and at Bilebhavi highest Organic Carbon percent was found i.e., about 1.26 % which was agricultural plot soil.

4. Nandwadgi LIS

The percent organic carbon was found least at Kadadrahal Tanda which was 0.06 % and at Killarhatti highest Organic Carbon percent was found i.e., about 0.96 % which was agricultural plot soil.

5. 9(A) Distributory area

The percent organic carbon was found least at Malat and Navakal which was 0.06 % and at Wadavatti highest Organic Carbon percent was found i.e., about 2.76% which was agricultural plot soil.

3.2.7.6 Discussion on analytical results

- **Electrical conductivity**

Electrical conductivity, as the measure of current carrying capacity, gives a clear picture of the amount of soluble salts present in the soil.

It plays a major role in the salinity of soils. There is a relation between electrical conductivity and salinity, lesser the EC value lower will be the salinity value of soil and vice-versa. The Electrical Conductivity values of the soil samples vary from 136 to 1275 µmhos/s, as shown below.

Sl no	EC values (µmhos/cm)	No. of samples
	Range in EC	
1	10 to 500	41
2	501 to 1000	5
3	1001 to 1500	4
4	1501 to 2000 and above	0

Electrical conductivity values within 800 µmhos/cm are considered as normal nature of soil, and in the present study about 46 all the samples were observed to be in the normal range. While EC values between 800 and 1600 are considered critical for tolerant crops, while EC values ranging between 1600 and 2500 are considered critical for salt tolerant crops, and EC values more than 2500 are not considered safe for most of the crops.

- **Colour**

Soil colour is one of the visual judgment through which the soil type can be classified. The soil colour may vary from region to region or spatially. Soil derives its colour from the source of the material. However, the colour may also vary due to,

- Soil forming process
- Moisture content and drainage
- Nature and amount of organic matter
- Mineral sources

In the study area, the soil samples have shown a wide range of colour. The colour of samples indicated that majority of the samples belong to Deep to very deep black cotton soils.

- **Organic Carbon**

Soil resource is a major anchor to the all life beings, such as plants, animals and microorganisms in various stages of decomposition process, which gives the end products in the form of organic matter. The organic one of the major factor contributing to changes in soil structure, moisture content and the soil nutrient status of the topsoil. The importance of organic matter in the soil is can be observed through improved soil structure and fertility status of the soil, which differentiates the soil and other non-fertile soils.

The percentage of organic matter varied spatially and generally has a higher organic content in the case of thickly vegetated areas. The requirement of optimum level of organic matter required by the plants slightly varies between species, as it is not a single nutrient source required for all the plants and for all the soils. The variation is also dependent on soil type, climate, existing plant and animal species.

Percentage organic carbon	Rating	No of samples
<0.40	Low	28
0.4 to 0.75	Medium	12
>0.75	High	10

In the study area it was noticed that the percent organic carbon was found to be in different ranges in almost all the three season samples i.e., 28 samples contained less than 0.40 percent organic carbon. They are low in organic content. The reason for this might be due to very low level or no application of Back yard manure or compost/green manure and also poor stand of vegetation/green rich trees in the dry land tracts of agricultural lands. 12 samples of soils were of medium level and the other soil samples of 10 are of high rate.

Therefore most of the samples in the area possess low content of percent organic carbon, which is the reason for frequent crop loss and the farmer are getting low yield of crops.

- **Available Phosphorus**

Phosphorus is the second most important macronutrient available in the soil of the biological systems, which covers more than 1% of the dry organic weight. It is a major component of nucleic acids, phospholipids and many phosphorylated compounds. Similarly, it is also a second most limiting factor often affecting plant growth. Chemically, phosphorus exists in the soil in the form of both organic and inorganic forms. Generally Plants are dependent on inorganic phosphorus especially in the form of phosphate ions, whereas organic phosphates are also important sources of phosphorus in almost all types of soils. Comparatively however the phosphorus is, required in small quantities; but it may be the most likely limiting element in productivity of the plant. Therefore ecologically it is very much significant. All the 50 soil samples analysed were found in the grade of Abundant with higher concentration.

Sl. No	Grade	Concentration
1	Low phosphorus	Less than 12.4 Kg/ha
2	Medium phosphorus	12.4 to 22.4 Kg/ha
3	Adequate phosphorus	More than 22.4 Kg/ha
4	Abundant phosphorus	Still higher

Soils of the study area showed maximum range of abundant levels of phosphorous i.e., about 100 per cent of the samples come under this range in the monsoon season. In general, the soil samples showed higher levels of available phosphorus content.

- **Sodium and Potassium**

The sodium values in the study area ranged between 3.99 to 399.19 mg/100gm. Potassium (K) is the third most essential element required by most of the plants. Simultaneously there is a negative effect at higher levels as it affects cell division, formation of carbohydrates, activation of various enzymatic reactions, cell permeability, while it improves resistance of some plants to some diseases. It also plays an important role in water balancing of plants or regulation of osmosis. Generally it forms a most abundant metal cation in plant cell (about 2 to 3 % by dry weight).

Deficient supply of (K)	Less than 113 Kg/ha
Doubtful supply of (K)	113 to 280 Kg/ha
Adequate supply of (K)	More than 280 Kg/ha

In the study area, the soil samples showed a narrow range of potassium level. All samples come under the range of deficient level of exchangeable potassium, which can be balanced by applying potassium rich fertilizers.

- **Water holding capacity (WHC)**

Water holding capacity is the amount of water that can be retained by the soil when all the pores in the soil have been filled with water; soil is saturated with water, accompanied by very poor drainage. The water retained at zero bar tension, is rarely utilized by plants as it reduces the respiration rate and creates anaerobic conditions for the roots.

In the study area the soil samples exhibited a significant correlation between the clay content and water holding capacity. WHC was more in the surface soil layer where a greater accumulation of organic matter, litter and root mass etc., existed. Thereby it supports rather stronger influence of soil organic matter on water holding capacity of the soil. The water holding capacity of the soils is 11.09 % 46.88 %. Few samples indicating cracking nature of soil and poor organic content.

- **Available Nitrogen**

Nitrogen is one among the four primary elements essential for the plant tissues. It is the major component of proteins, nucleic acids and chlorophyll. The atmospheric nitrogen gets trapped in the soil during electro and photo-chemical fixation and also by the action of microorganisms. Soil nitrogen is made available through a process of mineralization. The available nitrogen in soil exists in the form of both organic and inorganic forms. However, relatively most of the nitrogen content in organic form is at the most about 90 per cent. Organic content present in the soil decaying by microbial activity, during process all the organic nitrogen gets converted to ammonium, nitrates and nitrites.Nitrogen is having a major role in maintaining the fertility of the soil and nitrogen content in almost all the soils are observed to be very low and is found as nitrates, nitrite and ammonium. Plants are more dependent upon nitrate nitrogen, during the aerobic conditions and ammonia nitrogen during anaerobic conditions.

Sl. No	Quantity of nitrogen	Rating	No. of samples
1	< 272 Kg/ha	Low	47
2	272 to 554 Kg/ha	Medium	3
3	> 554 Kg/ha	High	0

In the study area, the soil samples are with low to medium quantity nitrogen content. Soil moisture content is having a major contribution to vary the process and also one of

the important factors affecting nitrification. In water logged areas soil suppresses the process of nitrification because of deficient oxygen. However it is totally different in the case of dry soils. As in the case of present study area in the soils however, there will be enough moisture for the process of bacterial metabolism and such soils posses' higher rate of biosynthesis of nitrogen which also contribute to fertility of the soil.

- **Salinity**

Salt affected problems are commonly seen in arid and semi arid regions, in irrigation areas and in the regions where the poor drainage and poor quality / contaminated water is being used for irrigation. Saline soils are those, which dominated/appreciable quantities of soluble salts to interfere growth and productivity of the crops. Generally, they are rich in neutral salts including the salts of chlorides and sulphate of sodium, calcium and magnesium (excluding gypsum) in excess quantities, enough to cause significant effect particularly on growth of the crop plants. In these saturated soils the various soil characteristics such as the pH was observed to be less than 8.5 mainly due to the presence of neutral salts, and the electrical conductivity is more than 4.0 µmhos/cm (at 25˚c) and the Exchangeable Sodium percentage (ESP) is less than 15. Salinity is usually measured/expressed in terms of electrical conductivity and expressed in micromhos/cm (at 25˚C).

- Salinity causing factors

The various natural factors affecting salinity are meteorological, drainage pattern, agricultural practices and soil characteristics

I. Climate: Climate is the most important factor responsible to change and formation of saline soils in a specific region. They mainly occur in regions with arid and semi arid climate as where low rainfall is formed to leach and transport the soluble salts formed during weathering. Arid climate is commonly characterized by maximum evaporation rates, which leads to more and more concentration of salt in the soil surface. Whereas in the humid regions the soluble salts formed due to weathering process are transported downwards to the ground water regime, and, streams finally reach the oceans. Therefore saline soils are non-existent in humid regions except when the soil has been subjected to seawater inundation, as in river deltas and near the sea, where as in the arid regions, leaching and transportation of salts will be very poor, unlike in the case of humid regions.

II. Controlled drainage: This is another important contributing factor for salinity, during formation of saline soils, having a direct connection with the deeper ground water table or low permeability of soils. The depth of the water table often depends upon the topography of the land. In the case of arid regions of low rainfall area, the surface drainage ways are poorly developed, and which leads to the drainage basins without outlets to permanent streams. The salty drainage waters enter from the higher lands of the basin leading to increase in the ground water level to the soil surface on the low lands.

III. Low permeability of soils: Poor drainage mainly causes an effect on the downward movement of water. The low permeability of soil is mainly because of unfavorable soil texture (very fine) or it could be also due to the presence of hard layers in the form of clay pans, caliches layer or a silica hard pan, as a result of ploughing with heavy tillage equipments.

IV. Irrigation practices: This is another important factor which has a bearing effect on salinity of the region. Expansion of irrigation activities has become one of the key strategies to achieving higher food production. In India the net irrigated area has increased from 20 million hectares (1950) to more than 45 million hectares, at present. This extended irrigation activities have been achieved through transported water.

Irrigation practice also contributes to improve the ground water table and when the ground water table is within 2 m of the surface, it contributes significantly to increase in the salinity of the soil due to capillary rise of water and its evaporation from the soil surface. In most of the canal irrigated areas, the problems of salt accumulation is a matter of serious dimension. Soil analysis results for the study period is enclosed as Annexure-12.

3.3 Land use assessment of study area

Land is a limited resource having competing demands. The need to augment the food production, infrastructure and industrial development has serious impacts on land use, resulting in accelerated land degradation. Progress in science and technology has eased out pressure on natural resources to some extent, but developmental projects have created an imbalanced growth and exploitation of natural resources. Land conservation serves many critical purposes in society. It provides open spaces, Parks, and recreational spaces necessary for many critical purposes in urban area. It protects agricultural lands and rural communities from encroachment by development. It promotes biodiversity by preserving plant species and habitat critical to wildlife species. It also maintains ecological processes and functions, such as energy and nutrient flows, temperature and climate effects, renewal of soils, ecologically important disturbance regimes such as floods and processing of the chemical, biological and physical content of air, soils and waters.

Land use refers to a human activity for various category of uses carried out on land' and land cover refers to 'natural vegetation, water bodies, rock/soil, artificial cover and others resulting from land transformations'. Land use is generally inferred based on the cover. The spatial information on land use and their pattern of change are essential for planning, management, industries, environmental studies, economic progress etc.,. Now, with the growing population, and consequent pressure on land and increasing land degradation, the need for optimum utilization of land assumes greater relevance. Land use inventories are assuming increasing importance in various resource sectors like agricultural planning, settlement and cadastral surveys, environmental studies and operations based on agro-climatic zones. Information on land use cover permits a better understanding of land, including grazing land, waste land, and surface water bodies etc., which are vital for developmental planning.

3.3.1 Approach and Methods

For the purpose of study of land use/land cover ARC GIS 9.2 and ERDAS IMAGINE 9.1 are used for extracting the land use, land cover layers, from SOI toposheets and satellite imageries. The land use/land cover classes include agriculture land, forest, wetlands, settlements, built-up land etc. This classification and methodology is performed based on the standard methodology. The feature classes were identified based on the visual interpretation of the satellite imagery coupled with field observations. These datasets were digitized and analyzed to obtain land use/land cover statistics for the areas under each of these categories.

The study has made use of various primary and secondary data. These include Survey of India (SOI) topographic sheets of 1:50,000 scale and satellite image IRS P6 LISS III (PAN merged) geocoded data of 1:10,000 scale. The Indian Remote Sensing Satellite (IRS) data was visually and digitally interpreted by using the image interpretation elements (such as tone, texture, shape, pattern, association etc.) and Arc GIS software was used for processing, analysis and integration of spatial data to reach the objectives of the study. Adequate field checks were made before finalization of the thematic maps.

All these thematic layers were scanned and vectorized using Geographical Information System (GIS). The coverage created is edited to remove any possible errors. All the

features in the GIS coverages are assigned the attributes and GIS data base is created as per the required objectives and the information needed to meet them. The coverages are projected to polyconic projection. The coverages created using digitizer will have digitizer units for its tics.

3.3.2 Results and Observations

3.3.2.1 Project location and Extent

The project site is spread across Vijayapura, Bagalkot and Raichur districts of Karnataka. The climate is moderate (tending towards hotter regime), the maximum temperature observed is 42^0 C, and the minimum is 18^0 C. The region is subject to frequent drought and famine, affecting the life and economic status of the population, which subsists mainly on agriculture.

3.3.2.2 Land Use and Land Cover

The results indicate that the project area is dominated by crop lands followed. It also includes barren rocky land agricultural plantation. The ground truth survey revealed that the crop land shown in the satellite imagery is coming in semi-arid region and farmers depend on monsoon for cultivation.

Table 3.103 Land use and Land cover data for Budihaal-Peerapur LIS

SL.No	Discription	Area Ha	%
1	Agricultural Plantation	13.17	0.06
2	Barren Rocky / Stony Waste / Sheet Rock Area	53.74	0.26
3	Fallow land	385.66	1.90
4	Gullied / Revinous Land	3.24	0.01
5	Kharif + Rabi (Double Crop)	1595.10	7.88
6	Kharif crop	12174.60	60.14
7	Lake / Tanks	56.03	0.27
8	Land with scrub	29.36	0.14
9	Land without scrub	25.52	0.12
10	Rabi crop	5756.09	28.43
11	River / Stream	11.57	0.05
12	Village	138.86	0.68
TOTAL		**20243**	**100**

Table 3.104 Land use and Land cover data for Ramthal (Marol) LIS

SL.No	Discription	Area Ha	%
1	Barren Rocky / Stony Waste / Sheet Rock Area	28.91	0.07
2	Fallow land	550.69	1.44
3	Gullied / Revinous Land	205.90	0.54
4	Kharif + Rabi (Double Crop)	872.07	2.29
5	Kharif crop	3192.51	8.40
6	Lake / Tanks	7.94	0.02
7	Land with scrub	101.07	0.26
8	Mining / Industrial Wasteland	10.78	0.02
9	Rabi crop	31988.72	84.18
10	River / Stream	610.40	1.60
11	Town / Cities	217.53	0.57
12	Village	213.42	0.56
TOTAL		**38000**	**100**

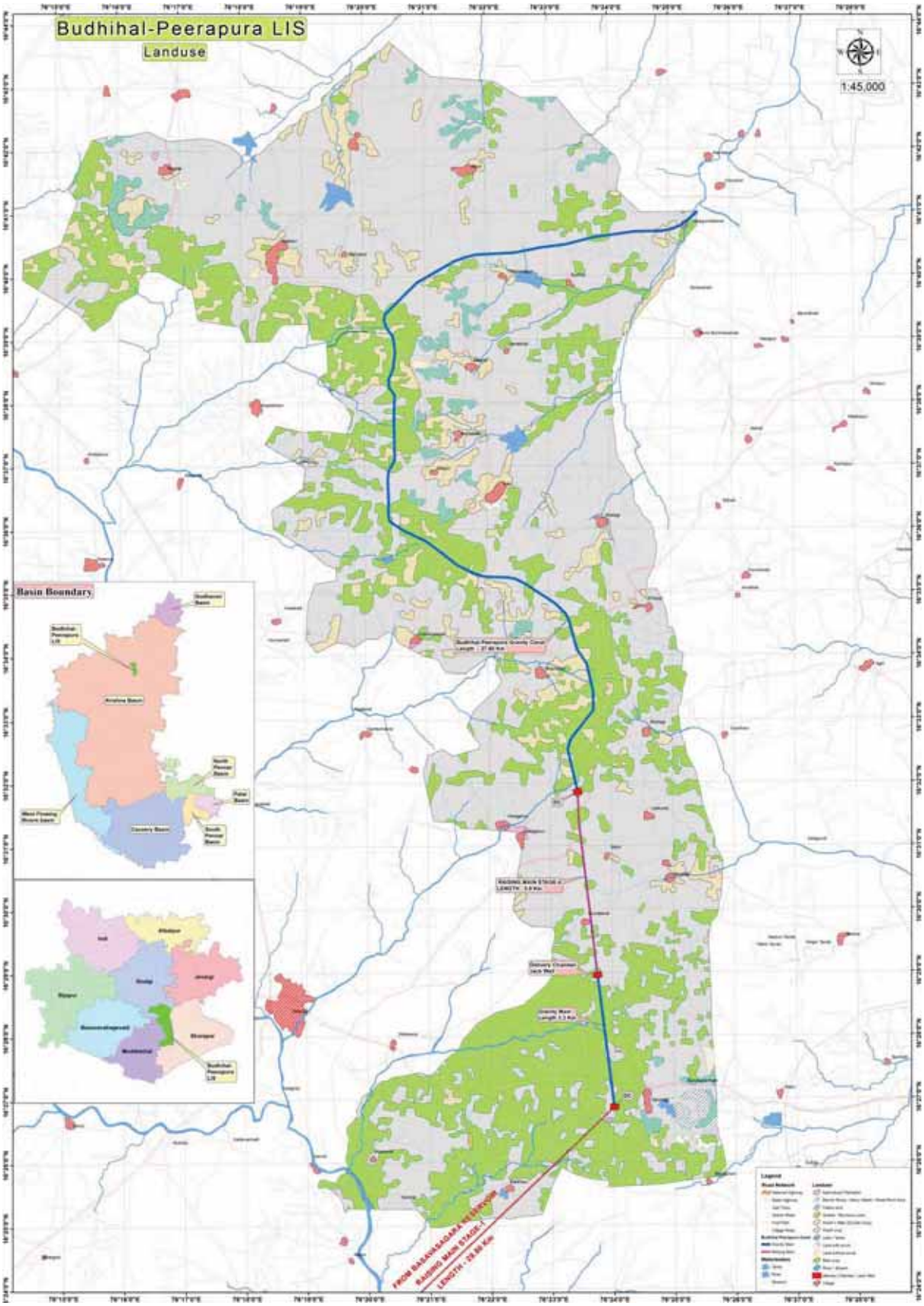


Fig 3.47 Land use/land cover map of Budihaal-Peerapur LIS

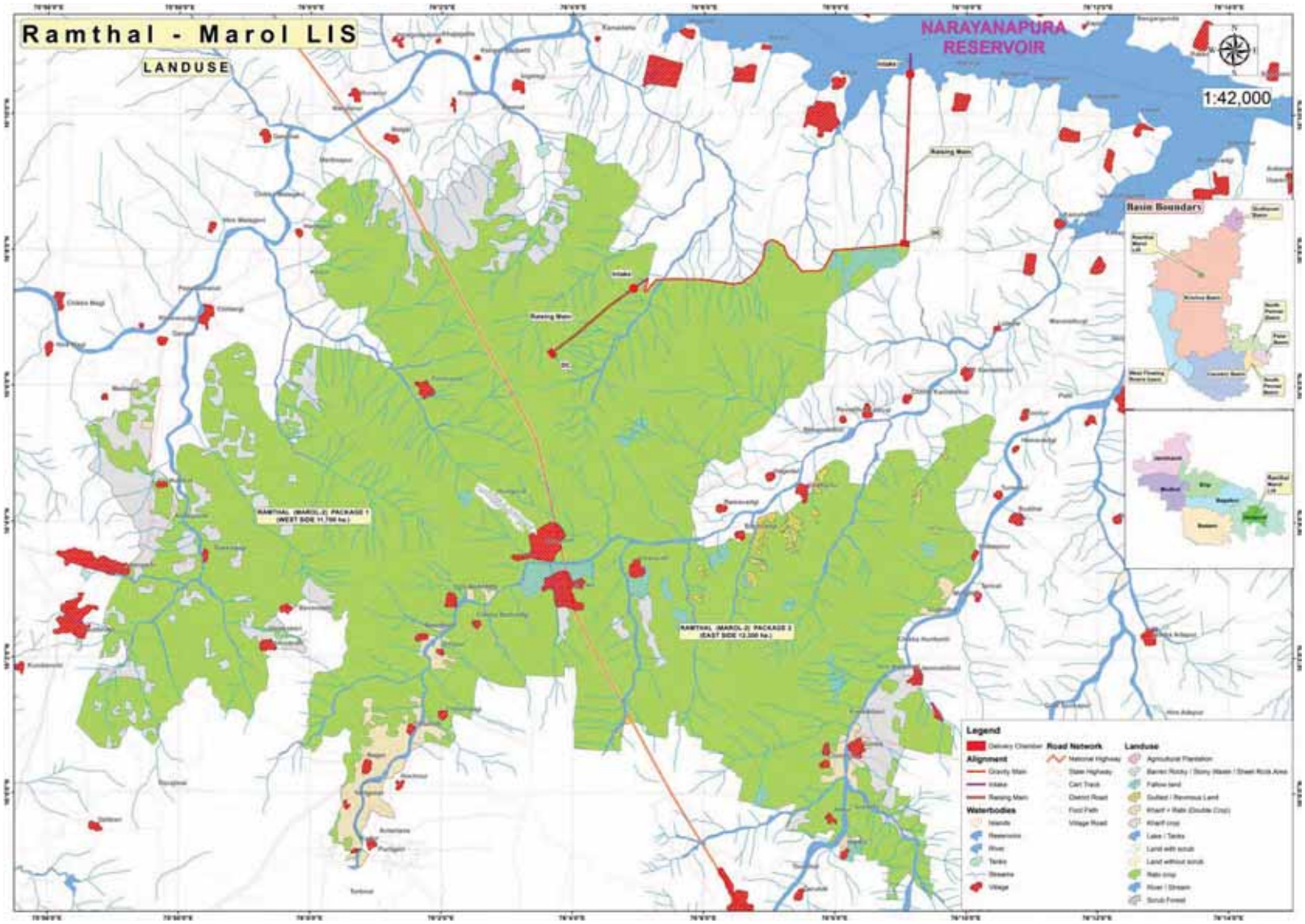


Fig 3.48 Land use/land cover map of Ramthal (Marol) LIS

Table 3.105 Land use and Land cover data for 9(A) Distributory

SL.No	Discription	Area Ha	%
1	Barren Rocky / Stony Waste / Sheet Rock Area	256.84	1.81
2	Degraded Forest	84.34	0.59
3	Fallow land	504.22	3.56
4	Kharif + Rabi (Double Crop)	1190.11	8.42
5	Kharif crop	2918.06	20.65
6	Lake / Tanks	549.62	3.89
7	Land with scrub	661.98	4.68
8	Land without scrub	184.84	1.30
9	Prosophys Juliflora	89.55	0.63
10	Rabi crop	7195.00	43.35
11	Salt Affected Land	1190.05	8.42
12	Scrub Forest	270.29	1.91
13	Village	68.48	0.48
	TOTAL	**15200**	**100**

Table 3.106 Land use and Land cover data for Nandawadagi LIS

SL.No	Discription	Area Ha	%
1	Barren Rocky / Stony Waste / Sheet Rock Area	1212.08	2.24
2	Degraded Forest	602.16	1.11
3	Fallow land	441.37	0.81
4	Gullied / Revinous Land	31.14	0.05
5	Industrial Area	106.23	0.19
6	Kharif + Rabi (Double Crop)	2853.11	5.28
7	Kharif crop	17291.48	32.02
8	Lake / Tanks	302.30	0.56
9	Lake / Tanks (Dry)	8.69	0.01
10	Land with scrub	2434.99	4.50
11	Land without scrub	67.40	0.12
12	Mining / Industrial Wasteland	86.46	0.16
13	Prosophys Juliflora	187.94	0.34
14	Rabi crop	26416.48	48.91
15	River / Stream	174.71	0.32
16	River Island	3.305	0.006
17	Salt Affected Land	848.06	1.57
18	Scrub Forest	524.16	0.97
19	Village	368.26	0.68
	TOTAL	**54000**	**100**

Table 3.107 Land use and Land cover data for Thimmapur LIS

SL.No	Discription	Area Ha	%
1	Fallow land	41.96	0.20
2	Gullied / Revinous Land	6.81	0.03
3	Kharif + Rabi (Double Crop)	589.99	2.93
4	Kharif crop	4080.21	20.30
5	Rabi crop	15205.25	75.64
6	River / Stream	108.50	0.54
7	Village	30.40	0.15
TOTAL		**20100**	**100**

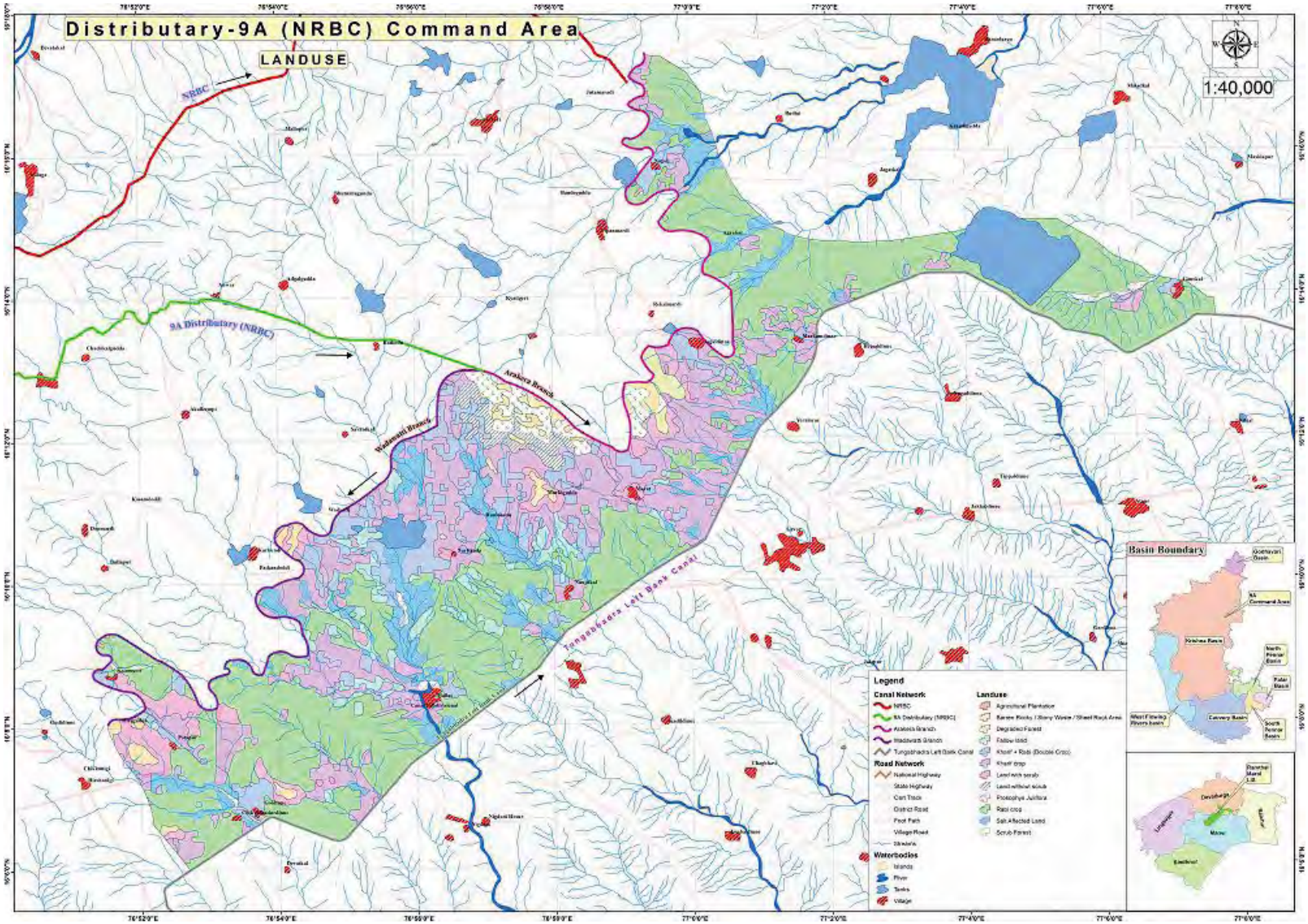


Fig 3.49 Land use/land cover map of 9(A) Distributory

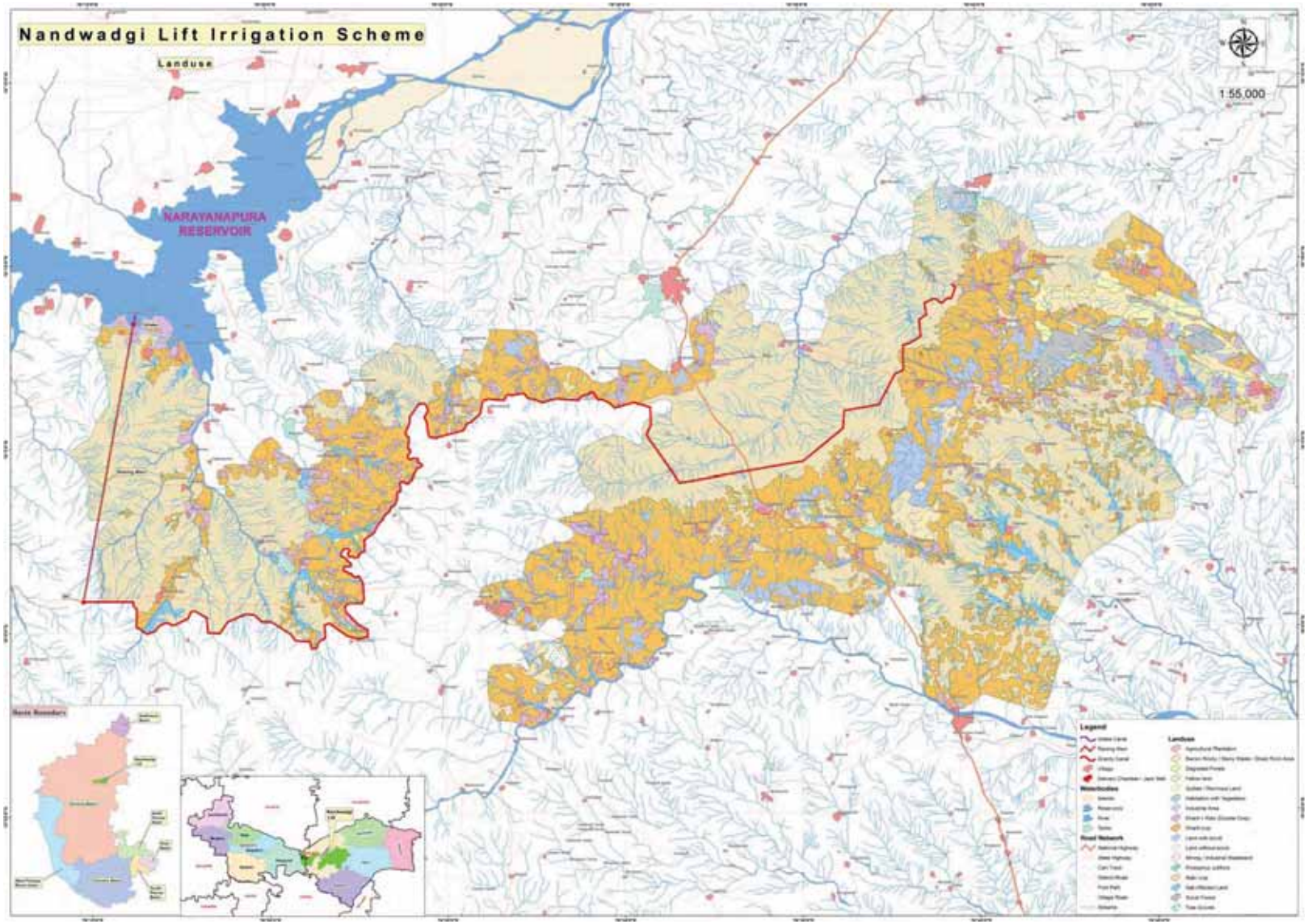


Fig 3.50 Land use/land cover map of Nandawadagi LIS

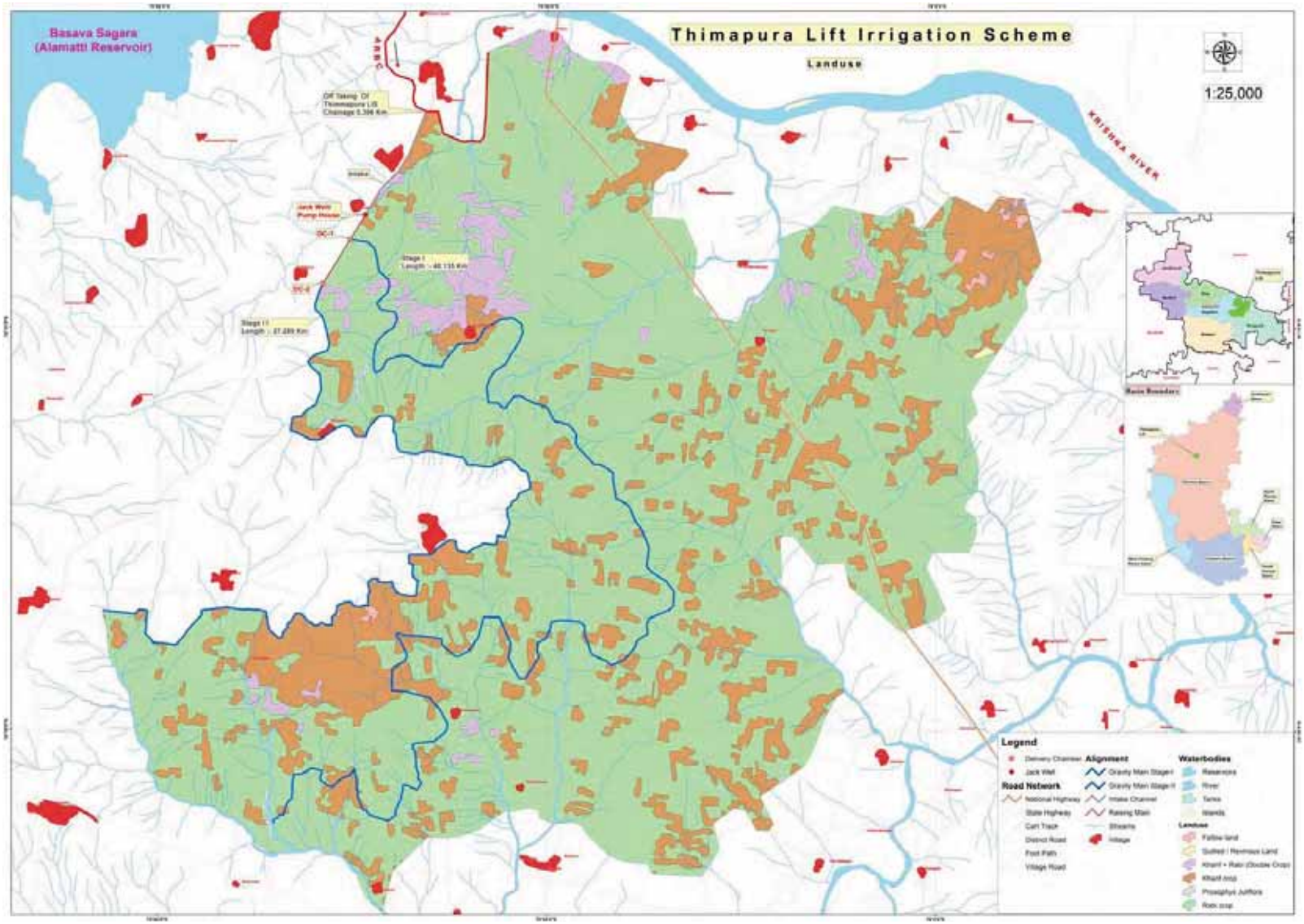


Fig 3.51 Land use/land cover map of Thimmapur LIS

3.4 Biological Environment

3.4.1 Overview of forests in the study area

3.4.1.1 Bagalkot district

Krishna, Malaprabha and Ghataprabha are the major rivers flowing in this district. These rivers are prone to frequent floods and during the last five years Krishna and Ghataprabha rivers caused havocs in Jamakhandi and Mudhol taluks. According to Champion and Seth classification, the forests of Bagalkot district was classified as 'South Indian Dry Deciduous Forests' due to scanty rainfall, shallow soils and dry climate. Bagalkot forest division has 7,90,66.40 Ha of reserve forests contributing 12.25 % of the total geographical area of the district[19].

The major species found in Bagalokot forest division are Chloroxylon swetenia, Albizzia amara, Cassia fistula, Diospyra melanoxylon, Wrighitia tinctoria, Melia azadirachta, Accacia catechu are the most prominent and wide spread species. The species found on the banks of the rivers are Pongamia pinnata, Euginia corymbosa, Alangium lamarkii, Terminalia arjuna, Vitex negundo, etc

Most commonly noticed species in agricultural lands are Bellary Jaali (*Prosopis juliflora*), Karijaali (*Acacia nilotica*), Bevu (*Azadirachta indica*), Hebbevu (*Ailanthus excelsa*), Bilpatre (*Aegle marmelos*), Nilagiri (*Eucalyptus* sp.), etc.

3.4.1.2 Vijayapura district

Vijayapura district has total forest area of 1066.48 Ha of forests contributing 0.1% of the total geographical area of the district. Bijapur forest division is divided into two subdivisions namely Mamadapur and Nidagindi. In Mamdapur subdivision, Reserve Forests (open jungle with thorny scrub) are located around the Mamdapur tank which is 7 Km away from the project site. *Prosopis juliflora* (Jaali) invaded the entire area however as per the forest working plan natural regeneration of Neem and Sandal are more. Commonly found trees in the area are Tugli (*Albizzia amara*), Honnambari (*Cassia auriculata*), Kare (*Randia dumetorum*) and Mashwal (*Chloroxylon swetenia*).

3.4.1.3 Raichur district

Except, perhaps, the banks of the two major rivers, the whole of the district is practically devoid of forest vegetation. The rainfall is inadequate and erratic. There are no distinct hill ranges owing to the geological formation of the land. The dry tropical climate is also not helpful to forest growth. Added to nll this, whatever forest cover the district possessed in the remote past. The forests in Raichur district are of the mixed dry deciduous type, consisting of open scrub jungle, full of weeds and bushes, except in a few parts where some timbers of economic value are grown. The conditions of drought and extreme heat of the summer season preclude any active and profitable regeneration of forests. The area of forest land is only about 4% of the district's total area (8386 sq.km), as against the minimum of 33-1/3 per cent desirable according to the national forest policy. The belts of vegetation that can., if at all, be called forests are confined to the upper and lower reaches of the rivers and are to be found in the taluks of Manvi, Lingsugur, Kushtagi, Deodurg and Sindhanur[20].

The minor forest produce consists of Talwad bark, Tupm (beedi) leaves, Rousa grass, Sharifa or Seetaphal, honey and wax, soapnut and tamarind. The most common shrubs are the Bel Pala!s (Butea superba), Dikmali (*Gardenia gummifera*), Gatti or ChaUe (*Zizyphus xylopyra*), Seetaphal (*Anona squamosa*) and Tarwad or Tangadi (*Cassia auriculata*) and are mostly used for fencing the fields. Commonly found trees in the

[19] Karnataka Forest Dept., (2005) Govt. of Karnataka
[20] K. Abhishankar (1970), Raichur district gazetteer, Govt. of Karnataka

region are *Cassia fistula, Acacia arabica, Tamarindus indica, Pongamia glabra, Wrightia tinctoria, Butea frondosa, Anogeissus latifolia, Albizzia amara, Chloroxylon switenia, Pterocarpus marsupium, Hardwickia binata, Terminalia tomentosa*. In addition to the above ·species, Celastrus sengalersis, Sapindus emarginata, Acacia sundm, Zizyphus a;ylopyra, Dodonea viscosa, Ficus bengaleniffis and Dalbergia latifolia are also found in the district to a little extent.

There are no national parks, wildlife sanctuaries, ecologically sensitive areas, tiger reserves, migratory corridors found in the study area and no forest land is required for the modernization projects.

3.4.2 Approach and Methodology

A participatory and consultative approach was employed for executing the assignment on Ecological Assessment for the proposed project area of coming in Vijayapura, Raichur and Bagalkot districts of Karnataka. A team of consultants from EHS private Ltd have visited the project area and conducted an inventory of flora and fauna during the study period. Meetings were also held during the ecological survey with Forest Officials, Local Community, and Revenue Department Officials. Literature survey included review of forest working plan, census handbook, Gazetteer and other records related to ecology of the region, which were consulted extensively.

3.4.3 Screening of Secondary literature

Besides measuring these parameters, other biodiversity aspects, such as species endemicity (Pascal, 1988; Pascal and Ramesh 1990; FRLHT, 2001), conservation status and life forms, have been collected from published literature. For all the species found in the area during ecological survey, IUCN, Red Data Books of the Botanical Survey of India and Wildlife Schedule, 1 and 2, were consulted extensively, to verify their present conservation status.

3.4.4 Observations - Flora

Table 3.108 List of Tree species observed in the study area

Sl.No	Local Name	Botanical Name	Family	IUCN Conservation Status 2015.4
1.	Ala	*Ficus bengalensis*	Moraceae	Not assessed
2.	Ankole	*Alangium lamarkii*	Cornaceae	Not assessed
3.	Ari,	*Bauhinia recemosa*	Fabaceae	Not assessed
4.	Anjan,	*Hardwickia binata*	Fabaceae	Not assessed
5.	Akash mallige	*Millingtonia hortensis*	Bignoniaceae	Not assessed
6.	Bilpatri	*Aegle marmelos*	Rutaceae	Not assessed
7.	Bela	*Feronia elephantum*	Rutaceae	Not assessed
8.	Bilkumbi	*Albizia odoratissima*	Fabaceae	Not assessed
9.	Banni	*Acacia suma*	Fabaceae	Not assessed
10.	Bilijali	*Acacia leucophloea*	Fabaceae	Not assessed
11.	Babul	*Acacia arabica*	Fabaceae	Not assessed
12.	Hunse	*Tamarindus indica*	Fabaceae	Not assessed
13.	Sandalwood	*Santalum album*	Santalaceae	Vulnerable
14.	Dindal	*Gardenia lucida*	Rubiaceae	Not assessed
15.	Dandoshi	*Dalbergia paniculata*	Fabaceae	Not assessed
16.	Gorvi	*Ixora parviflora*	Rubiaceae	Not assessed
17.	Ghatbor	*Zizyphus xylopyra*	Rhamnaceae	Not assessed
18.	Godambe kai	*Anacardium occidentale*	Anacardiaceae	Not assessed
19.	Hirejali	*Acacia latronum*	Fabaceae	Not assessed

Sl.No	Local Name	Botanical Name	Family	IUCN Conservation Status 2015.4
20.	Hebbevu	*Ailanthus excelsa*	Simaroubaceae	Not assessed
21.	Hanmanki ·	*Flacourtia ramontchi*	Salicaceae	Not assessed
22.	Honge	*Pongamia glabra*	Fabaceae	Least Concern
23.	Kasod	*Cassia siamia*	Fabaceae	Not assessed
24.	Khair	*Acacia catechu*	Fabaceae	Not assessed
25.	Kalagonda	*Diospyros montana*	Ebenaceae	Not assessed
26.	Kari	*Randia dumetorum*	Rubiaceae	Not assessed
27.	Karihannu	*Canthium parviflorum*	Rubiaceae	Not assessed
28.	Bevu	*Azadirachta indica*	Meliaceae	Not assessed
29.	Karijaali	*Acacia nilotica*	Fabaceae	Not assessed
30.	Gajaga	*Caesalptine bonduce*	Caesalpiniaceae	Not assessed
31.	Kakke	*Cassia fistula*	Fabaceae	Not assessed
32.	Kodamurki	*Wrightia tinctoria*	Apocyanaceae	Not assessed
33.	Muttaga	*Butea frondosa*	Fabaceae	Not assessed
34.	Dinndal	*Anogeissus latifolia*	Combretaceae	Not assessed
35.	Mashwal	*Chloroxylon switenia*	Rutaceae	Vulnerable
36.	Raktahonne	*Pterocarpus marsupium*	Fabaceae	Not assessed
37.	Kammar	*Hardwickia binata*	Fabaceae	Not assessed
38.	Mattimara	*Terminalia tomentosa*	Combretaceae	Not assessed
39.	Ala	*Ficus bengalensis*	Moraceae	Not assessed
40.	Ari	*Bauhinia racemosa*	Fabaceae	Not assessed
41.	Kavale	*Carissa caranda*	Apocynaceae	Not assessed
42.	Mullippi	*Capparis mooni*	Capparaceae	Not assessed
43.	Bikke gida	*Gardenia gummifera*	Rubiaceae	Least concern
44.	Mavu	*Mangifera indica*	Anacardiaceae	Data Deficient
45.	Tengu	*Cocus mucifera*	Arecaceae	Not assessed
46.	Kadamba	*Terminalia catapa*	Combretaceae	Not assessed

Table 3.109 List of Shrubs species observed in the study area

Sl. No.	Species	Status as per Red data book	IUCN Status 2015-4
1.	*Bougainvillea glabra*	Common	Not Assessed
2.	*Cactus spp.*	Common	Not Assessed
3.	*Calotropis gigantea*	Common	Not Assessed
4.	*Carissa caranda*	Common	Not Assessed
5.	*Dodonaea viscosa*	Common	Not Assessed
6.	*Eupatorium rugosum*	Common	Not Assessed
7.	*Euphorbhia tirucalli*	Common	Not Assessed
8.	*Gossypium arboreum*	Common	Not Assessed
9.	*Hibiscus cannabinus*	Common	Not Assessed
10.	*Hibiscus rosa-sinensis*	Common	Not Assessed
11.	*Kingeodendron pinnata*	Common	Not Assessed
12.	*Lantana camera*	Common	Not Assessed
13.	*Morus alba*	Common	Not Assessed
14.	*Opuntia dillenia*	Common	Not Assessed
15.	*Prosopis juliflora*	Common	Not Assessed
16.	*Randia dumetorum*	Common	Not Assessed

Sl. No.	Species	Status as per Red data book	IUCN Status 2015-4
17.	*Ricinus communis*	Common	Not Assessed
18.	*Vitex nigundo*	Common	Not Assessed
19.	*Woodfordia fruticosa*	Common	Least Concern
20.	*Xanthium strumarium*	Common	Not Assessed
21.	*Ziziphus oenophilia*	Common	Not Assessed
22.	*Zizupus mauritiana*	Common	Not Assessed

Table 3.110 List of herbs species observed in the study area

Sl. No.	Species	Status as per Red data book	IUCN Status 2015-4
1.	*Abutilon indicum*	Common	Not Assessed
2.	*Achyranthes aspera*	Common	Not Assessed
3.	*Amaranthus virdis*	Common	Not Assessed
4.	*Amaranthus spinosus*	Common	Not Assessed
5.	*Andrographis paniculata*	Common	Not Assessed
6.	*Argemone mexicana*	Common	Not Assessed
7.	*Aristolochia indica*	Common	Not Assessed
8.	*Cissus quadrangularis*	Common	Not Assessed
9.	*Clitoria ternata*	Common	Not Assessed
10.	*Crotolaria paniculata*	Common	Not Assessed
11.	*Croton bonplandianum*	Common	Not Assessed
12.	*Croton sparsiflorus*	Common	Not Assessed
13.	*Cyperus pumilus*	Common	Not Assessed
14.	*Datura metel*	Common	Not Assessed
15.	*Euphorbia hirta*	Common	Not Assessed
16.	*Gloriosa superba*	Common	Least concern
17.	*Ipomoea purpurea*	Common	Not Assessed
18.	*Mimosa pudica*	Common	Least concern
19.	*Ocimum santalum*	Common	Not Assessed
20.	*Opuntia dillenii*	Common	Least concern
21.	*Parthenium hysterophorus*	Common	Not Assessed
22.	*Solanum indicum*	Common	Not Assessed
23.	*Solanum nigram*	Common	Not Assessed
24.	*Solanum trilobatum*	Common	Not Assessed
25.	*Tridax procumbens*	Common	Not Assessed
26.	*Triumfetta anna*	Common	Not Assessed
27.	*Triumfetta rhomboidea*	Common	Not Assessed

3.4.5 Observations - Fauna

Bagalkot, Vijayapura and Raichur districts are poor representation of wild fauna. There is no wildlife sancturies, protected areas, ecologically sensitive areas found in the study area. as reported by the local people and forest officials, Common Mangoose (*Herpestes edwardsi*), Indian Monitor Lizard (*Varanus bengalensis*) and Wild Boar (*Sus scrofa*) also present in the area. List of avifauna, butterflies mammals and reptiles found at project site is give below;

Table 3.111 List of avifauna found at project site[21]

Sl. No.	Common Name	Scientific Name	WL(P)A,1972 Schedule	IUCN Status 2015-4
1	Little cormorant	*Microcarbo niger*	IV	Least Concern
2	Indian pond heron	*Ardeola grayii*	IV	Least Concern
3	Cattle egret	Bubulcus ibis	IV	Least Concern
4	Little egret	*Egretta garzetta*	IV	Least Concern
5	Bar headed goose	*Anser indicus*	IV	Least Concern
6	Green imperial pigeon	*Ducula aenea*	IV	Least Concern
7	Common wood pecker	*Dinopium javanense*	IV	Least Concern
8	Brown-headed barbet	*Megalaima zeylanica*	IV	Not Assessed
9	Common swallow	*Hirundo rustica*	--	Least Concern
10	Black drongo	*Dicrurus macrocercus*	IV	Least Concern
11	Common myna	*Acridotheres tristis*	IV	Least Concern
12	House crow	*Corvus splendens*	V	Least Concern
13	Indian Pea fowl	*Pavo cristatus*	I	Least Concern
14	Gray Purple fowl	*Numida meleagris*	--	Least Concern
15	White-breasted water hen	*Amaurornis phoenicurus*	IV	Least Concern
16	Red wattled lapwing	*Vanellus indicus*	IV	Least Concern
17	Spotted dove	*Spilopelia chinensis*	IV	Least Concern
18	Rose-ringed parakeet	*Psittacula krameri*	IV	Least Concern
19	Common cuckoo	*Cuculus canorus*	IV	Least Concern
20	Drongo-cuckoo	*Surniculus dicruroides*	IV	Least Concern
21	House swift	*Apus affinis*	--	Least Concern
22	White breasted kingfisher	*Halcyon smyrnensis*	IV	Least Concern
23	Small bee eater	*Merops orientalis*	--	Not Assessed
24	Indian roller	*Coracias benghalensis*	IV	Least Concern
25	Common Hoopoe	*Upupa epops*	--	Least Concern
26	Small minivet	*Pericrocotus cinnamomeus*	IV	Least Concern
27	Red-vented bulbul	*Pycnonotus cafer*	IV	Least Concern
28	Yellow-throated bulbul	*Pycnonotus xantholaemus*	IV	Vulnerable
29	Common babbler	*Turdoides caudata*	IV	Least Concern
30	Common tailorbird	*Orthotomus sutorius*	IV	Least Concern
31	Pied bush chat	*Saxicola caprata*	IV	Least Concern
32	Oriental magpie robin	*Copsychus saularis*	IV	Least Concern
33	Paddyfield warbler	*Acrocephalus agricola*	IV	Least Concern
34	Indian robin	*Saxicoloides fulicatus*	IV	Least Concern
35	House sparrow	*Passer domesticus*	IV	Least Concern
36	Small sunbird	*Leptocoma minima*	IV	Not Assessed
37	Black headed Myna	*Sturnia pagodarum*	IV	Not Assessed
38	Lesser Adjutant Stork	*Leptoptilos javanicus*	--	Vulnearable
39	Great cormorant	*Phalacrocorax carbo*	--	Least Concern
40	Brahminy shelduck	*Tadorna ferruginea*	--	Least Concern
41	Greater flamingo	*Phoenicopterus ruber*	--	Least Concern
42	Median Egret	*Mesophoyx intermedia*	--	Not Assessed
43	Western Reef Egret	*Egretta gularis*	--	Least Concern

[21] Salim Ali (2012), The Book of Indian Birds, Bombay Natural History Society, Thirteenth Edition, Revised by J.C Daniel

Sl. No.	Common Name	Scientific Name	WL(P)A,1972 Schedule	IUCN Status 2015-4
44	European White Stork	*Ciconia ciconia*	--	Least Concern

Table 3.112 List of butterflies found at project site[22]

Sl.No.	Common name	Scientific name	WL(P)A Schedule	IUCN Status 2015-4
1.	Common rose	*Atrophaneura aristolochiae*	Common	Not Assessed
2.	Indian cabbage white	*Pieris canida indica*	Common	Not Assessed
3.	Yellow orange tip	*Ixias pyrene*	Common	Not Assessed
4.	Bush brown	*Mycakesis sp.*	Common	Not Assessed
5.	Crimson rose	*Pachiopta hector*	Common	Not Assessed
6.	Common lime	*Papilio demoleus*	Common	Not Assessed
7.	Great orange tip	*Hebomoia glaucippe*	Common	Not Assessed
8.	Common crow	*Euploea core*	Common	Least Concern
9.	Common grass yellow	*Eurema hecabe*	Common	Not Assessed
10.	Yellow pansy	*Junonia hierta*	Common	Least Concern
11.	Plain tiger	*Danais chrysippus*	Common	Not Assessed
12.	Pale grass blue	*Zina otis*	Common	Not Assessed

Table 3.113 List of mammals found at project site

Sl. No.	Common Name	Scientific Name	WL(P)A Schedule	IUCN Status 2015-4
1	Bandicoot Rat	*Bandicoota indica*	Common	Not Assessed
2	Black napped Hare	*Lepus nigricollis*	Common	Least Concern
3	Leopard	*Panthera pardus fusca*	I	Near Threatened
4	Bonnet Macaque	*Macaca radiata*	II	Least Concern
5	Sloth bear	*Melursus ursinus*	I	Vulnearable
6	Five striped Palm squirrel	*Funambulus pennanti*	IV	Least Concern
7	Bat	*Desmodus rotundus*	Common	Least Concern
8	Indian Pangolin	*Manis crasscaudata*	Common	Least Concern
9	Jackal	*Canis aureus*	II	Least Concern
10	Jungle cat	*Felis chaus*	II	Least Concern
11	Wild Boar	*Sus scrofa*	III	Least Concern
12	Common Mangoose	*Herpestes edwardsi*	Common	Least Concern

Table 3.114 List of reptiles found at project site

Sl.No.	Common name	Scientific name	WL(P)A Schedule	IUCN Status 2015-4
1	Rock Gecko	*Hemidactylus maculates*	Common	Not Assessed
2	Common garden lizard	*Calotes versicolor*	Common	Not Assessed
3	Monitor Lizard	*Varanus bengalensis*	I	Least concern
4	Cobra	*Naja naja*	Common	Least concern
5	Rat snake	*Ptyas mucisus*	Common	Not Assessed
6	Russels's viper	*Vipera russeli*	Common	Not Assessed
7	Crocodile	Crocodylus palustris	I	Vulnearable

[22] Arun Pratap Singh (2011), Butterflies of India, Om Book International, Uttar Pradesh.

3.5 Aquatic Environment

3.5.1 Krishna River

The Krishna River flows almost across the Southern India from West to East and is the largest in the peninsular part of the country which also includes the rivers the Cauvery and the Godavari. The river rises near Mahabaleshwar at Ondishi village, close to Wai, at an elevation of 1372m from water spring and around 64km East of Arabian Sea. From its origin, it flows an east-ward course covering a total distance of 1349km through Maharashtra (290kms), Karnataka (483kms) and Telangana – Andhra Pradesh (576kms) and finally joins the Bay of Bengal. The mean annual discharge of water is 67,305m.m3 and it drainage area is 2,68,786sq km of which 26.80% lies in Maharashtra, 43.80% in Karnataka and 29.40% in Telangana – Andhra Pradesh. The river traverses the districts of Satara, Kolhapur in Maharashtra, Belagavi, Vijayapura, Bagalkot and Raichur in Karnataka and Mahboobnagar, Kurnool, Nalgonda, (Telangana) and Guntur and Krishna (Andhra Pradesh). The important tributaries joining river Krishna in the respective states are;-

Maharashtra State: Major tributaries - The Vatali river, the Venna River, the Koyan River, the yerla river, the Verna river and Panch Ganga river. Minor tributaries - the Urwadi river, the Tarali river, The Man river, the Vasna river the Andhaganga river and the Vedganga river.

Karnataka State: Ghataprabha river, the Malaprabha River, The Tungabhadra river, The Bheema river and The Don river.

Telangana – Andhra Pradesh: The Dindhi river, the Muniyeru river, The Musi river, the Palleru river, the Peddavagu river, the Hallia river and scores of minor tributaries (48 large and small).

3.5.2 Methodology

Taking note of the topography of the River Krishna, at the site which approximately, over a kilometre in width where the lift irrigation scheme is slated to be commissioned, sampling stations for conducting hydro- biological and fisheries investigations were fixed at strategic points.

3.5.2.1 Limnological Features

- **Water**

The Physio-chemical features of the surface water samples collected from stations-1 to 3, Such as air & water temperatures, colour, odour, turbidity, pH, dissolve oxygen, free carbon-di-oxide, free ammonia, total hardness, total alkalinity, phosphate, nitrate, silicate, iron and specific conductivity were analysed in the field and laboratory by following the standard procedures suggested by the American public Health Association (APHA).

3.5.2.2 Biological Features

- **Plankton**

For the assessment of Plankton constituents, 100 lts of surface water samples from representative portions of the river was strained through a plankton net made of 21XXX nylobolt silk cloth (70 meshes/ cm with aperture size of 0.067 mm) in terms of plankters catching efficiency. The plankton samples so obtained were fixed in 5.0% Formaldehyde solution and were subjected to both qualitative and quantitative analyses by utilising a Microscope and Sedwick- Rafter Plankton Counting Cell.

- **Littoral Fauna**

The littoral fauna were collected by operating a 'D' frame net in the shallow marginal areas of the river for a distance of 20 ft. The collections, along with debris so collected, were sieved through a No. 40 sieve and the fauna segregated- both in the field and the laboratory, were fixed in 5.0% Formaldehyde solution and were subjected to detailed systematic analysis.

- **Fish Species**

Fishing operations, where possible, in the riverine stretches, were arranged by involving local fishermen at the site and in close proximity to the site, by employing cast nets, gill nets of varied mesh – size, marginally operated uduval etc. In view of the drastic draw – down in the river when studies were carried – out, fishing activity all along the river, a reported by the officers of the Department of Fisheries and the locals and migratory fishermen, has not been constantly done. The fish specimens, as observed, are being marketed at fish markets at Ilkal, Muddebihal, Hungund, Karadi, Vijayapura and also locally.

- **Fishermen And Fishermen Cooperative Societies**

Mostly, the migrant-and the local fishermen are engaged in the fishing activities. Around 100 fishermen belonging to Sowgi, Ambigara, Muslims and the migrants from Andhra Pradesh are engaged in the profession, who incidentally, are members of the Fishermen Co-operative societies based at Bagalkot, Ilkal, and Muddebihal etc.

3.5.3 Results and Discussions

3.5.3.1 Krishna River Water Quality and its importance

The physic-chemical features of the water samples collected from the Krishna river at two stations is appended in Annexure-13.

- **Air And Water Temperatures**

Of the Physical features, heat and light are essential for Photosynthetic activities which are related to productivity in an aquatic environment. Water temperature depends on Latitude and altitude, also, on the depth, at a given time, of the water column. The lotic water body situated in the tropical belt (Lat - 16˚04'N and Long76˚04'E), temperature may not be a constraint for production. Air temperature values of 37.0˚-35.6˚C were higher than that of water temperatures readings of 32.3˚-30.0˚C.

- **Colour and Odour**

The river water, during April and June, 2016, was found quite clear and odourless too the water in the river, during April, had receded significantly and by June, 2016, there was some marginal increase.

- **Turbidity**

Light is another physical factor of importance. Its penetration into the medium is governed by the turbidity caused mainly by inorganic suspended solids and shadowing of Plankton bloom. The transparency, in the studies carried out, ranged between 4.94 and 10.3 NTU and appears to be on the higher side on account of water level fluctuations caused.

- **pH**

pH in the alkaline side of neutrality ranging from 7.0-8.0 is ideally suited for sound productivity norms. Acidic water, values between 6.5 and alkaline medium above 8.5 tends to bare 'low' productive status. The river water studied was alkaline in nature with values ranging between 8.2 and 8.8

- **Dissolved Oxygen**

Amongst chemical substances in natural waters, DO is of considerable importance as a regulator of metabolic processes of plants and animals which also is a indicator of the water quality. Oxygen regime, when monitored over a period, will provide data on the nature of the medium and its productive potential. Oxygen profile in the lotic system studied was 'Moderate' and ranged from 6.1 – 6.2mg/L, quite congenial for fish growth.

- **Free Carbon-di-oxide**

Free Carbon-di-oxide values recorded 'nil' values, expressing that the medium is free from pollution threat.

- **Free Ammonia**

The medium at the site sampled indicated 'non - pollutional' features, the values being nil to 0.11mg/L, hence the desirable limit is near to 0.5mg/L.

- **Total Hardness**

Total hardness refers to the concentrations of divalent metal ions in water expressed as equivalent to calcium carbonate which is normally related as the anions of alkalinity and cat ions of hardness. The values in the present instance are 228.0 and 192.0mg/L appears to be marginally on the higher side indicating that the river water is not so 'soft' by nature.

- **Total Alkalinity**

Alkalinity, the acid combining capacity of natural waters, in general is influenced by carbonates and bi-carbonates of calcium and magnesium, with dissolved Carbon Di – Oxide, Carbonate and bi – carbonate form an equilibrium which is of prime importance for the productivity in the given eco-system. The medium of river Krishna indicates that it is on the ascending trend, the values being 104.0 and 116.0mg/L exhibiting productivity range.

- **Phosphate and Nitrate**

The role of phosphorus and nitrogen in the aquatic Productivity has been recognized quite often. Nitrogen, an important constituent of protein, occupies a significant place in the aquatic a system. A concentration of 0.2 -0.5 mg1 of inorganic nitrogen 0.05-0.2 mg/1 of phosphorus have been considered to be quite favorable for 'medium to high' levels of productivity. The nutrient status of the river Krishna studied is in the Nitrate is in the higher range with Phosphate values recording 00.049 and 00.34 mg/1 and the Nitrate readings of 0.1 and 13.62 mg/1 appears to be quite 'high'.

- **Silicate**

In natural waters, Silicon remains in Silicate from which is quite reactable. Normally, Silicate – Silicon (1-3 mg/1), remains in natural waters. At high temperatures and pH, the solubility of Silicate has been greatly increased. As Silica has been an important structural constituent of (Diatoms Bacillariophyceae), it is able to regulate their growth and population. But in the present case, the Silicate recorded values of 8.22 and 4.39 mg/1, appears quite 'low' which had its influence on the over –all diation population.

- **Iron**

Iron, with values of 0.01 and 2.48 mg/1 was in 'poor' concentration end its role in the over-all productivity of the medium was quite inadequate.

- **Specific conductivity**

Specific conductivity is an the amount of water soluble salts present in the medium. Measurements of dissolved salts indicates the total concentration of dissolved ions

having wide bearing on the over-all productivity. It also provide trend of mineralization in any aquatic ecosystem. Its value for fresh waters, often, ranges from 25 to 500 micromhos/cm. The values recorded in the present case, from 764.00 and 538.0 micromhos/cm appears to be on 'higher' side with good productivity trend.

In general, the Krishna river water studied at the project site is 'alkaline in character, optimum in nutrient status and is free e from pollutional threats'.

3.5.3.2 Planktons

The plankton biomass is in moderate concentrations with standing crop varying between 0.1 and 0.2 mi/100lts. Total plankton count was 542 and 508 u/1. Numerically, Zooplankton dominated over Phytoplankton (Annexure-13)

The productivity of a given water body has a direct bearing on the health of the piscine fauna and the role of plankton – the fish food organisms in the tropic cycle. The plankton population is lotic biotopes depends mostly on local conditions where there is constant threat of drawl of water to meet the cash crops needs, the seasons and incidence of discharge of water when precipitation occurs in the catchment areas located close by. The plankton of the Krishna river studied, presented, inherently, a 'poor' picture. It is also true to mention that 'pre- monsoon 'seasons could be categorized being 'poor' plankton production periods and the studies carried –out also comes under the summer/pre-monsoon season only. As details indicated, Zooplankton species-wise, numbers and percentage composition over phytoplankton.

The phytoplankton is represented by 9 u/1 and the Zooplankton by 14 u/1. Phytoplankton is represented by numbers belonging to Mysophyceae, Chlorophyceae and Bacillariophyceae and Zooplankton by Protozoan, Cladocerans, Ostracode and Copepods. (Annexure-13).

3.5.3.3 Littoral Fauna

An important biological component of a given water body, especially, in a lotic environment ,are its faunal elements which are well-suited to face constant natural hazards of considerable impacts such as sudden water-force, occurrence of periodic floods of varied magnitudes, flash floods and rolling and disturbing actions of stones, gravel, boulders etc.

The qualitative material collected by operating a 'D' net in the shallow marginal areas of the river Krishna at the site earmarked for commissioning a Lift Irrigation Project as also the huge Molluscan fauna found littered in the exposed , during lean summer season at various points, in and around the site is systematically presented in Annexure-13.

The littoral organisms are primarily represented, in the present case, by adult and developing stages of Insects belonging to Order–Ephemeroptera, Mollusca by Gastropods and Bivalves, Crustacea by Order- Decapoda. Quite interestingly, the giant Fresh Prawn – Macrobrachium malcomsoni has been recorded for the first time in the river Krishna at Ramathal (Marol) Lift Irrigation site., which indicates, that the species is very much there in this part of the Krishna river in the Stage (Karnataka). Its seed- the juvenile forms are very much available during the season at Dowleshwaram Anicut, Rajamundry (Andhra Pradesh) only. Its record for the first time in the Krishna river, other than river Godavari (Andhra Pradesh) augers well for the development of prawn fishery in this river as lot of food is available for it to be used. The concerned should evince interest by transplanting the species from Rajahmundry, as also, a study has to be carried out to record its fishery along with the fish species of this lotic water body.

Insects (*Ephemeropterans*) are quite often preyed upon by fish. On the contrary, fauna belonging to nymphs of Odonata and Hemiptera are voracious feeders which, during

the seasons, attack fry, advanced fry, fingerlings, small molluscs and several other useful organisms.

Molluscs, in general, a very dominant river fauna as in the present case are coelomate animals. Many fish Species feed on these s recorded by the studies carried out by fish spicies such as *Pangasius, Pangasius, Rita Pavimentata, Tita gogra, Mystus vittatus* etc.

3.5.3.4 Fish Species

Fish spicies of the Krishna river from the site are listed in Annexure-13. Although the Krishna river has been reported to harbour 119 fish spicies in its entire stretch origin to its confluence with the bay of bengal, the ones listed were the ones observed and reported upon by the local authorities in the epartments. The fish spicies listed comes under 7 orders, 16 Families, 51 Genus and 85 species.

As reports indicate, fishery of the riverine stretch is mostly represented by the species indigenous to the system since long. Trasplanted major caps *Catla catla, Labeo rohita,Cirrhinus mrigala* as also the exotic common carp *Cyprinus carpio communis* are rarely caught. The exotic *Tilaias species, Oreochromis mossambica and O. nilotica* , as also the predatory African catfish - *Clarias gariepinus* has already entered the river and is forming a fishery of its own, is a sign of alarm. Its total elimination from the system is to be planned at the earliest since its presence is highly dangerous to the well being of scores of fish indigenous to the system and even to the ones being stocked (Major carp) regularly in the river by the Department/ Socities.

The fisherman of the area, as reported, gets around 5-8 k during off seasons and during the monsoon months, upto 30- 40 kg will be catch per head which includes carps, catfish, exotic fish and is marketed locally or being sold at fish markets located in Hunagunda, Muddebihal< Ilkal, Bagalkot and Vijayapura.

It is a matter of great concern that fish species native to the Krishna river such as *Puntius pulchellus, Labeo bata, porcellus, Labeo potail, Labeo pangusia, Sperata aor, Aperata seenghala, Mystus krishnesis, Rita rita, Rita pavimentat, Proeutropiichtys taakee, Silonia childre Neotropius kavalchor and also the gangtic carp o- catla, L.rohita, C. mirgala and the exotic Cyprinus capio* communis are rarely observed in the fish catch all these fish species, along with few others are rarely very important ones and their conservations, development and their transplantation in the Krishna river and other amenable environments should be accorded prime importance.

3.5.3.5 Migratory corridors & Breeding locations

With the ever increasing and rapid industrialization, majority of the biotopes in the country have been developed by commissioning dams, barrages, weirs etc, across these lotic systems to cater to the needs of agriculture, flood control, hydro power generation, recreation, etc. The river Valley Projects, quite justifiably, interfere, with the fluviatile environment affecting the fishery resource of the respective habitats. The effects of Obstructional installations may be harmful, beneficial or indifferent, depending upon the situations prevailing in the rivers and the fish germplasm present. Effects of dams, barrages, weirs etc. on fish populations, in general, can be categorized under two 'headings 'viz: (i) Obstructional and (ii) Ecological.

Dams, barrages, weirs etc. Acts as physical barriers to migration tending to prevent access to the fish species to move their normal breeding,

Rearing and feeding grounds. The Obstructional or preventive process of migration may ultimately result in permanent irreversible damage/reduction of fish stocks ranging from lowering levels of abundance to total extermination. The ecological changes as a consequent brought about by the river valley Projects on developmental programmers', affect, adversely, both the migratory and the non migratory fish species. Consequent to

establishment of any Obstructional structures across the lotic water bodies like dams, barrages etc., good many marpho – ecological changes occur in the sand system, both above and below. This results in the conversion of the flowing water system into a water body of slow discharge But, it is also true to say that 'effects of dams' and such other structures of the fisheries are not always deleterious. Wherever dams and other structures of the type are constructed in regions beyond the areas of natural occurrences of commercially important fish species, be it resident migratory or non-migratory, the effects of such installations are of no consequence to fisheries and its augmentation. The low level dams/barrages impound water which is being constantly flushed unlike in a storage reservoir where flushing's may be slow. The on soon floods, usually, overflow the crest the barrage/weir or water is let out which, hence, become homogenous in composition, both above and below such structures.

The diverse geographical and climatic conditions of the state are reflected in its riverine resources. The varied river systems of Karnataka, depending upon their individual ecological conditions such as gradient, terrain, flow, depth, temperature, substrate etc. display considerable variations in regard to the destruction and abundance of their respective piscine fauns.

The limnological and fisheries investigations carried out in the Krishna river, in and around the project site, with the exception on the occurrence of Gangetic and Exotic carp, all other fish species listed are indigenous to the system. Majority of the fish species present breed during the monsoon season in ideally suited fish breeding grounds located in the river itself. There are number of streams draining their waters into the main river during monsoon months which also offers ideal breeding and recruitment facilities for the fish from the main to these areas.

The catchment area and the fertile irrigated agri lands on either side of the river banks, all along the lotic water body, helps in the fertilization process when the water drains into the main river which augers well in the production of fish food organisms for the new recruiters after the breeding success. The stock, on attaining further growth and as the draw-down advances during the learn periods, migrate to the main river/impoundment accessing the flow regime from the barrage for further development

Extensive spawn Exploration studies carried out in the Krishna river in the state and elsewhere by the central inland fisheries research institute, Bangalore/Barrackpore, Govt., of India during 1963-65 and also in good many major/minor rivers in the state and other parts of the country, provided enough data that the Indian major carp Catla catla, Labeo rohita and Cirrhinus mrigal does not breed naturally in these lotic system. Their breeding success is possible only by hypophysation techniques, which, incidentally, is in practice since decades and has proved quite effective and productive to meet the demand for the stocking material fish fingerlings. The process helps in mass production of their seed for transplanting programs in various types water bodies located in the state. The process helps in segmenting fish production to cater to the needs of the consumers.

A major threat faced by the mainstream river/reservoir is the prevention of migratory fish from ascending to the upstream structures and also moving.

To the downstream stretches. From the studies carried –out as to providing 'Fish Ladders, Fish Lifts, Fish ways' in the Hirakud and Damodar Valley Corporation dams, it was concluded that, since, there are no migratory fish farming a major fishery whose biology and consequently their stock could be jeopardized, such costly explorations could be avoided. Similar opinion holds good for the present Ramathal Lift Irrigation prject too on the anvil of being established across the river Krishna.

Coracle - a brand ' new' type in inland waters of the Karnataka

Coracle with fishing nets (Disco-balae)

Coracles (Fibreglass and locally fabricated) with gill nets

Fish Species: *1) Puntius pulchellus 2) P. sarana sarana 3) L.bata 4) L.fimbriatus 5) L.calbasu 6) L.potail 7) Cyprinus carpio communis 8) Sperata seenghala 9) Mystus cavasius 10) Channa marulius 11) C. striatus 12) C.orientalis 13) H.fossilis & 14) C. giuris giuris*

Specimens of Giant fish *Mystus krishnensis* grows to 60 Kg

Specimens of giant fresh water prawh *Macrobrachium malcomsoni*

Molluscan shells (dead) - Gastropods and Bivalves

Fish Species - *1) L.bata 2) P.sarana saran 3) L.calbasu 4) Channa striatus 5) Oreochromis mossambica*

Specimens of *1) Sperata aor 2) S. seenghala*

Specimens of *O.bimaculatus 2) M. cavasius*

Specimens of *1) Mastacembelus armatus 2) C. striatus*

Specimens of *Etroplus suratensis*

Fig 3.52 Fish species recorded at Krishna River

Detailed limnological and Fisheries investigations carried-out in the Krishna river, in and around the project site, indicated 'Optimum' features to support and sustain the aquatic biodiversity of the system. This lotic water body, as the data indicates, is free from pollutional influence.

The microscopic fish food organisms – the Plankton, Phyto – and the Zooplankton constituents presented 'low' values, by numbers, species – wise and by percentage composition. Scores of planktivore piscine fauna recorded subsists on the food available which is likely to improve during the post – monsoon period sue to the influx of nutrients as they play a vital role in the over – all biological productivity.

The littoral fauna represented by Insects were in 'poor' concentrations. The Molluscus – Castropods and Bivalves – had a very 'good' representation. This food item, is being under – utilised as there is no molliscicidal fish present in the said river. Attempts, hence, are to be initiated to introduce the non – predatory catfish *Pangasius pangasius* which feeds quite voraciously on this biotal constituent.

The Giant Fresh water Prawn - *Macrobrachium malcolmsoni* recorded for the first time in a riverine eco – system in the State, is an important addition to the aquatic biodiversity of the state. Efforts are to be made to introduce the species in the river Krishna as good amount of food preferred by this Crustacean is available in the system. Their seed – juvenile forms – are available at Dowleshwaram Anicut, Rajahmundra, Andhra Pradesh (Godavari River). Department of fisheries in the state could be approached to make the supply good.

Although, the Krishna river is reported to harbour 119 fish species, from its point of origin to its confluence with the Bay of Bengal; in the studies carried-out in and around the project site, 85 fish species are listed.

The highly predacious African Catfish, Claria gariepinus recorded in the recent past in certain areas of this river, is likely to establish which is quite detrimental to the existing fish germplasm in particular and scores of other aquatic organisms. All-out efforts are to be

made by the concerned Department and also by the fishermen community to eliminate this menace from our water bodies.

Fish seed stocking and the fisheries developmental strategies have been highlighted which should be taken-up with utmost sincerity and seriousness in order to conserve and produce food fish to facilitate scores of fishermen to ekk-out their livelihood[23].

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Chapter 4. Anticipated Impacts & Mitigation Measures

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

4.1 Impacts during construction phase

4.1.1 Air Environment

4.1.1.1 Sources of air pollution

- Pollution due to fuel combustion in equipments: The operation of construction equipments requires combustion fuel. Normally, diesel is used for such equipments. The major pollutant which gets emitted as a result of combustion of diesel is SO_2.
- Dust pollution: The operation of the trucks carrying construction materials to the site, batching plants during the construction phase is likely to generate fugitive emissions, which can move even up to 100 m in predominant wind direction.
- Emissions due to usage of firewood for cooking at labor camps.
- Due to operation of DG sets and excavation, laborers are prone to health problems.
- Construction of intake canal, jackwell & pump house, canal works and distributory requires excavation activites. During excavation, particulate matter will be gets into atmosphere and possibly increase the concentrations of PM temporarily.

4.1.1.2 Mitigation measures

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

4.1.2 Noise Environment

4.1.2.1 Sources of noise pollution

- During construction phase, various sources of noise pollution arise due to excavation, operation of concrete batch plant, Crane, Generator, Tractor, Welder / Torch, Vibrating Hopper etc.,

- Other source of noise pollution includes movement of vehicles for loading and unloading of construction materials, fabrication, handling of equipments.
- Construction activities are expected to produce noise levels in the range of 80 – 95 dB (A). There is no villages nearby to Jackwell cum pump house and hence, there is no impact on nearby villages from the lift locations.

4.1.2.3 Mitigation Measures

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

4.1.3 Water Environment

4.1.3.1 Sources of water pollution

- Improper treatment of sewage from labor camps leads to infiltration into the subsurface soil and finally affects the ground water.
- There will be creation of 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.
- Spillage of excavated earth during construction of intake canal leads to turbidity of river water.

4.1.3.2 Mitigation Measures

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

4.1.4 Soil Environment

4.1.4.1 Sources of soil pollution

- Temporary loss of soil will 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.
- Contamination of soil will take place due to mainatainence of machinary, operation of DG sets, oil spills from the operation of mechanical works, etc

4.1.4.2 Mitigation measures

- Non agriculture land will be chosen for construction of labor camps.
- All the existing roads will be upgraded to avoid creation of haul roads.
- Mainatainence works will be undertaken at the designated construction yards with leak proof polythene as floor material to avoid spillage of oil and any other contamination of soil.

4.1.5 Solid & Hazardous Environment

4.1.5.1 Sources of pollution

- Improper mainatainence of excavated earth and dumping of muck, boulders, etc into the river affects natural flow regime.
- Improper management of domestic solid waste from labor camps and dumping near water bodies leads to water pollution.

4.1.5.2 Mitigation Measures

- Excavated soil earth shall be fully utilised for various construction activities such as inspection path, stabilization of embankments, land leveling, etc.
- Labor camps should be 1 Km away from the river course and domestic solid waste from labor camps will be collected in different bins and handed over to the Haveri Municipal Authority.

4.1.6 Impact on Hydrology & Geology

4.1.6.1 Geological Environment

As the project site i.e. lift point is proposed in the Krishna River the litho unit covering the lift point is Grey & Pink Granite, Argillite, Quartzite and conglomerate while the Lift point at Narayanpur reservoir is falling over Grantie gneiss, Migmatitie of PGC belonging to Archaean Age. There is no structure proposed which will disturb the natural course. Only through pipes water is drawn in to the jack well where pump sets will be installed to raise the water to raising mains and distribute through drips to farmers. All the pipe lines are laid beneath the weathered zone and properly reclaimed on top so that agriculture practices can be carried out. As such there is no disturbance or alteration to the local Geology.

4.1.6.2 Seismic Tectonics

Seismic activity with respect to the proposed lift site was studied at the possibility during the post project scenario. It was observed that no major earth quakes occurred in the region during the past 50 years. However, the recent recorded major earth quake to the

project site was in Latur, Maharashtra. The seismic zoning map has been referred to know the zone in which the project site is falling. The proposed project site is falling on Zone-II which has very low risk of damage (Source : NDMA, GOI).

The following are the major impacts on Groundwater;

- As the agricultural practices flourish with availability of water usage of pesticides and application of fertilizers will naturally increase as such the soil quality deterioration is anticipated.
- The recharge to aquifer will be boosted once extensive agriculture is practiced a portion of water will be infiltrated in to ground recharging the aquifers.
- As the drawl of water is minimized the water table will rise and many of the boreholes yield substantial water.

4.1.6.3 Mitigation Measures

- The sewage generated from the labour camps shall be treated in septic tank and soak pits designed and constructed as per IS 2470 Part-I and domestic solid waste shall be disposed to nearby municipal landfills. Frequent monitoring of surface and groundwater shall be carried out not to deteriorate the water in the river.
- The discharges and leakages of septic tank and soak pits have to arrest by regularly repairing and arrest of malfunctioning.
- The leakages of oil spills from machinery shall be collected in leak proof barrels and then disposed off to KSPCB authorized dealers.
- BOD and COD limits of the water shall be checked regularly as part of EMP to monitor eutrophication.
- Restrictions on time, method and rate of application of fertilizers and pesticides shall be imposed to avoid surface run-off and leaching on to the groundwater regime.
- Since the project is run-off the river scheme the flow of river will not be disturbed.
- Conjunctive use of groundwater.
- 60100 Ha of land will be brought under drip irrigation to conserve the water.
- Artificial recharge of the aquifers by construction of suitable harvesting structures like farm ponds, nala bunds, check dams and also desilting of tanks.
- Scientific development of groundwater exploitation.

4.1.7 Impact on Biological Environment

A total 6.60 Ha of forest area for construction of 9(A) distributory is required for which forest clearance was obtained. There is no reserve forest either in barrage or in proposed canal area of the project. Also there were no trees coming in proposed barrage site and canal area. Hence we can safely conclude that it won't have any impact on biodiversity of the area.

4.1.7.1 Predicted project impacts on Flora and Fauna

The ecological factors that are considered most significant as far as the impact on flora and fauna concerned are:

- Whether there shall be any reduction in species diversity?
- Whether there shall be any habitat loss or fragmentation?
- Whether there shall be any additional risk or threat to the rare or endangered or endemic or threatened (REET) species?
- Whether there shall be any impairment of ecological functions such as (i) disruption of food chains, (ii) decline in species population and or (iii) alterations in predator-prey relationships?
- Whether it is possible to attain the global objectives of '*no net loss'*of biodiversity?
- Whether it is possible to improve the biological diversity through the proposed activity?

Parameter based ecological sensitivity score of the core and buffer areas is shown in Table below. It is evident from the information in Table 4.1 that neither the core area nor the buffer area of the project site is ecologically sensitive. The different parameters and the parameter importance based criteria used for evaluation of impacts are shown in Table below. Based on the above it may be concluded that no impact from the proposed project on flora and fauna of the region.

Table 4.1 Parameter based ecological sensitivity of the study area

Parameter	**Importance scale**	**Weightage**	**Impact in Command Area**
Wildlife importance (Threatened species*)	Number of Schedule-I & II (> 20 numbers)	100	
	Number of Schedule-I & II (10-20 numbers)	50	
	Number of Schedule-I & II (<10 numbers)	25	25
Endemic flora	High(>10 species)	100	
	Medium(5-10 species)	50	
	Low(<5 species)	25	0
Endemic fauna	High(>10 species)	100	
	Medium(5-10 species)	50	
	Low(<5 species)	25	0
State of terrestrial vegetation	Relatively undisturbed forest (Govt/private)	100	
	Totally managed estate with three type of vegetation	50	
	Totally managed estate such as coffee and cardamom	25	
	Agricultural land with crops	0	0
State of wetland vegetation	Relatively undisturbed wetland visited by migratory waterfowl	100	
	Relatively undisturbed wetland not known to be visited by migratory waterfowl	50	
	Other wetlands with frequent human activity	25	
	Agricultural land with crops	10	0
Legal status	National Park	100	
	Wildlife sanctuary	50	
	Reserve forest/wetland	25	
	Agricultural land	0	0

Parameter	Importance scale	Weightage	Impact in Command Area
Conservation importance	Location unique in terms of habitat(world heritage site) or species	100	
	Habitat although present elsewhere is under threat in those places	75	
	Habitat present elsewhere and is not under any serious threat	50	
	Habitat is very common elsewhere	25	0
Parameter based sensitivity score out of a maximum of 700			25

4.1.7.2 Mitigation Measures

The forest area diverted for non forestry activity was already compensated by providing an alternative land equal to the land diverted as per Forest (Conservation) Act, 1986 along with cost for raising compensatory afforestation.

4.1.8 Impact on Aquatic Environment

- Construction Phase - While undertaking the construction of canal and related components in order to lead the water to the main distribution point of the Lift- Irrigation establishment at athe designated spot, controlled blasting has to be resorted- to. The resultant excavated muck, boulders etc. as a regular practice, are likely to be dumped in the close vicinity which may hamper/ impact the aquatic life- fish species in particular in their normal feeding and breeding schedules.
- Operation Phase - Fish species, as a result of the changes in their environment, may get induced to enter canal in order to maintain/ sustain their biological processes such as feeding etc. Suggestions to be incorporated have been listed in the EMP.

4.2 Impacts during Operation phase

4.2.1 Application of fertilizers and pesticides

The popular pesticides and insecticides, which are being used by farmers of the command area, are Monocrotophos, Quinolphos, Carbandygium, Pyrathroides (sinner in), Malathion dust, Wettable sulphur, Carbaryl and Capton.

4.2.2 Mitigation measures

The drip irrigation systems require lesser consumption of pesticides and fertilizers. Optimum quantity of nutrients will be provided to the crops as per Package of Practices (POP) and this will not be increased to the National standards. However, necessary training will be imparted to water users associations by developing organic farming demonstration plots with the help of Agricultural scientists for enabling the farmers to switch over to Organic farming in the long run.

4.3 Evaluation of Impacts

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

Table 4.2 Criteria for evaluation of impacts

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

Table 4.3 Evaluation of 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 Intake canal, jack well cum pump house, sumps, disnets, canal network	M	✓			✓	✓			✓		
		Excavation for laying distributory network and pipes	L	✓			✓	✓			✓		
		Vehicular movement	M	✓			✓	✓			✓		
2	Change in Topography	Construction of Intake canal, jack well cum pump house, sumps, disnets, canal network	M	-	✓	✓	-	✓			✓		
		Excavation for laying distributory network and pipes	M	✓			✓	✓			✓		
3	Loss of Productive Soil	Construction site, temporary offices, workers camps, stockyards	M	✓			✓		✓		✓		
		Construction of Haul roads	L	✓			✓	✓			✓		
4	Compaction of Soil	Site Clearance	L	✓			✓	✓			✓		
		Movement of vehicles	L	✓			✓	✓			✓		

Sl.No	Environmental Attributes	Project Activities	Nature of Impacts										
			Magnitude	Reversible	Irreversible	Long Term	Short Term	Direct	Indirect	Positive	Negative	Without EMP	With EMP
5	Contamination of Soil	Machinery and operation of the Diesel Generator Sets	M		✓		✓		✓		✓		
		Labor camps	H	✓			✓		✓		✓		
2. Impacts on Water Environment													
1	Eutrophication	Sewage from labor camp	H	✓			✓	✓			✓		
		Muck disposal	H	✓			✓	✓			✓		
2	Change in River Water Quality	Construction of Intake canal, jack well cum pump house, sumps, disnets, canal network	M	✓			✓		✓		✓		
		Diversion of river water	H		✓	✓		✓		✓			
		Decomposition of sediments and deposition of organic matter	M	✓			✓	✓			✓		
		Washing of equipments	L	✓			✓	✓			✓		
		Muck disposal	M	✓			✓	✓			✓		
3	Change in surface and ground water quality	Sewage from labor camp	H	✓			✓		✓		✓		
3. Impacts on Air Environment													
1	Increase in dust concentration	Construction equipments, operation of DG sets,	M	✓			✓	✓			✓		

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

Sl.No	Environmental Attributes	Project Activities	Nature of Impacts										
			Magnitude	Reversible	Irreversible	Long Term	Short Term	Direct	Indirect	Positive	Negative	Without EMP	With EMP
	of plants												
3	Diversion of 6.60 ha forest land	Construction of main distributory	M		✓	✓		✓			✓		
3.	Impacts on Fishes and Aquatic Ecosystem	Increase in turbidity of water due to Washing of machineries	M	✓			✓	✓			✓		
		Sewage from labor camp	H	✓			✓	✓			✓		
6. Impact on Socio-economic Environment													
1	Land acquisition	Affecting livelihood	H		✓	✓		✓			✓		
2	Impact on Human Health	Due to water/air borne diseases, traffic movement	H	✓			✓		✓		✓		
B. Operation Phase													
1	Impacts on Land Environment	Application of natural fertilizers and pesticides	H		✓	✓		✓		✓			
2	Impact on water environment	Application of fertilizers and pesticides	M		✓	✓			✓	✓			

Chapter 5. Analysis of Alternatives

5.1 Budihaal-Peerapur LIS

The major main canal in UKP Stage-I and II are contour canal with a specific bed fall in the canal bed level. Due to the bed fall the entire area planned under a specific contour is deprived of irrigation after the designed length till it reaches the end point as planned, and also due to the fixation of contour certain area lying above the contour also is left out without irrigation facilities. Due to the above aspect about 50,000 Ha of command area is left out in-between the existing Narayanpur Left Bank Canal and the proposed Bijapur Main canal of the Mulwad LIS (Fig-5.1). The left out area is drought prone and without any irrigation facilities proposed earlier.

There is a long pending demand from the farmers of these left out area to provide with irrigation facilities and as such the present peoples representatives have requested to plan a separate scheme so that the drone prone area, left out in the earlier schemes are brought under irrigation, which in-turn will improves the socio economic conditions of farmers of that area finally result in the development of the State. Hence, Budihaal-Peerapur LIS was conceived to provide irrigation for the left out areas.

5.2 Ramthal (Marol) LIS

Originally an independent Project called Ramthal Lift Irrigation Scheme was proposed in Krishna basin to provide benefits of irrigation to drought prone area of Hungund taluka situated on the bank of Malaprabha river. About eight alternative sites from Ramthal village to Hoovinahalli village were considered for location of barrage across Malaprabha river in Hungund taluka.

After preliminary studies regarding submergence of land, villages affected, availability of good foundation facilities and idle run of canal in deep cut, it is considered that the site near Ramthal village about 275 meters upstream of new bridge on Bagalkot – Raichur State Highway was advantageous and hence proposed.

However, upon investigations, it was observed that the construction of barrage across river Malaprabha near Ramthal village would cause full submergence of 3 villages and partial submergence of 6 more villages, necessitating rehabilitation and resettlement of about 1200 houses. In addition, it would also submerge about 755 Hectares of fertile land. Considering the gravity of the situation and difficulties involved in shifting and rehabilitating the submerging villages, experts advised to investigate an alternative arrangement by lifting the water from back water of Narayanapur Reservoir so that the submergence and land acquisition could be avoided.

It was observed that the Almatti Right Bank Canal which takes off from Right Bank of Almatti Dam crosses Malaprabha river and the command area served by it after crossing could be served by the canals under Ramthal Lift Irrigation Scheme. This would save the cost of aqueduct to be constructed for ARBC to cross the river and the cost of canal after crossing the river. Therefore it was decided to investigate to include the command area of ARBC after Malaprabha in the Ramthal Lift irrigation Scheme.

Investigations were carried out as per suggestions of the experts and it was found that the water for the Lift Irrigation Scheme could be lifted from the backwaters of Narayanpur Reservoir near Marol and command areas of both the schemes proposed under Ramthal Lift Irrigation Scheme and under ARBC beyond Malaprabha river could be considered for implementation.

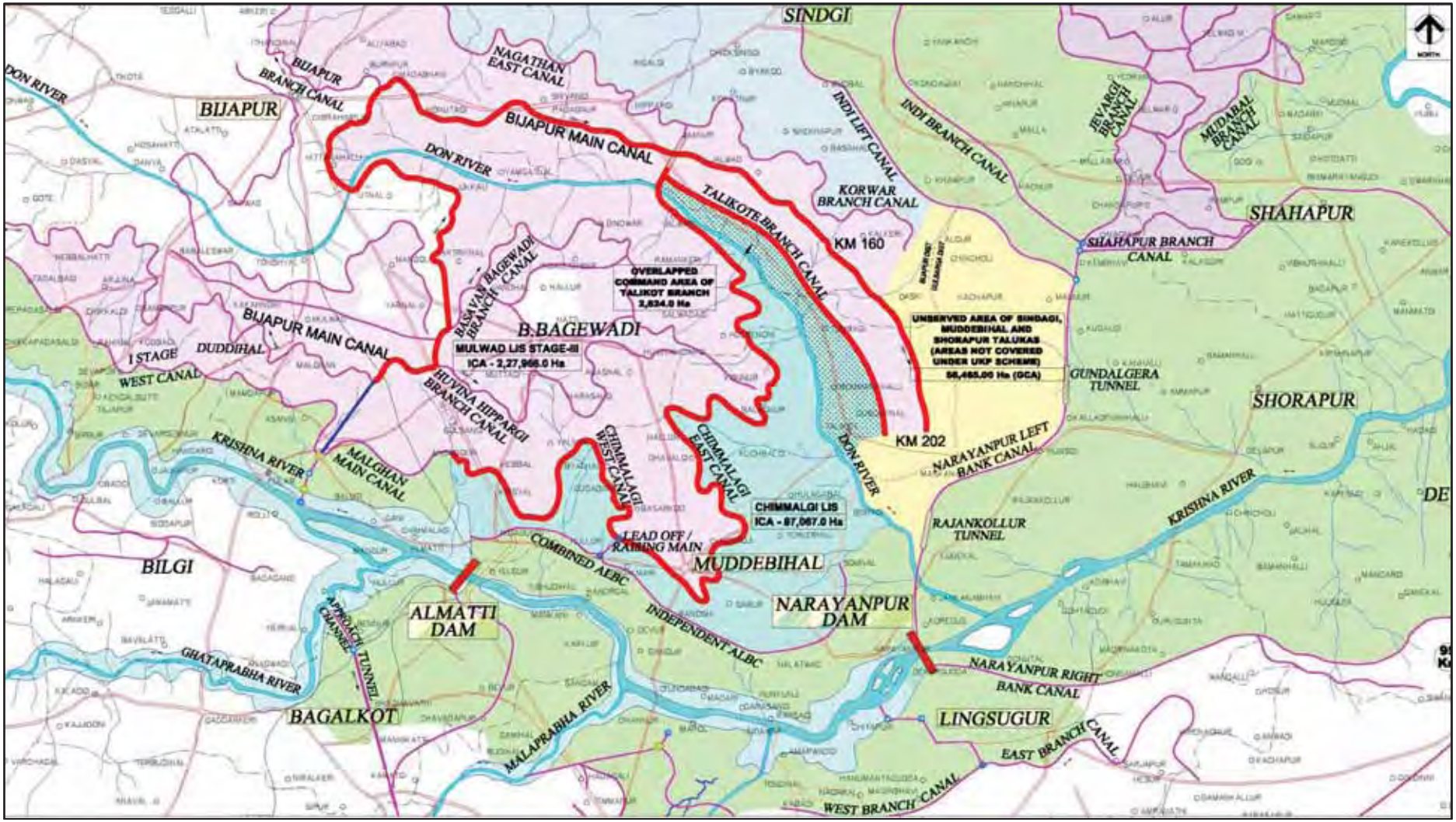

Fig 5.1 Map showing the left out area of NLBC and Bijapur Main canal

5.3 Nandawadagi LIS

The topographical features of the area coming under parts of Hunagund Taluk of Vijayapur district and Lingasugur taluk of Raichur district do not facilitate supply of water through gravity canal system from the Narayanapur storage dam as the areas are lying above the Maximum Full Supply level of Narayanapur Dam. Hence proposing a Lift Irrigation Scheme to cater the required water to these affected areas is more feasible considering the flat topographical terrain. Therefore, Nandawadagi LIS is proposed to irrigate the higher elevated lands by lift irrigation scheme.

5.4 9(A) distributory

The villages coming under the scheme is deprived of irrigation facilities from Tungabhadra Left Bank canal and Narayanapur Right Bank Canal and hence farmers demanded for separate irrigation scheme for these villages. Under such circumstances, various alternatives were explored and decided to offtake from the existing NRBC at Km 54+12 was conceived.

5.5 Thimmapur LIS

Almatti Right Bank Canal is running at an RL of 517.0 m. Hence, providing irrigation for the higher lands located between RL of 540 - 560 m close to Almatti Dam was impossible. People of the region were pressurising to providing irrigation since they are deprived of irrigation from ARBC even though they are located close to Almatti dam.

In order to combat these regional imbalances, Thimmapur LIS was proposed wherein at Km 5+386 an offtake from the existing ARBC was proposed and decided to lift the water to an RL of 560 m with the help of Jackwell cum pump house. Thus, Thimmapur LIS was conceived to provide irrigation for higher lands.

Chapter 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 to carryout environment monitoring programme as given below.

Table 6.1 Environmental Monitoring Program for Construction phase (2 years)

Sl.No	Environmental Parameters	Parameters to be Monitored	Frequency of Monitoring	Locations	Responsibility	Estimated Cost in Rs.
1	Surface water quality of Krishna river	pH, Temperature, EC, TDS Alkalinity, TH, DO, BOD, COD, NO_3, PO_4, Cl, SO_4, Na, K, Ca, Mg, Silica, Oil & grease, MPN, Total coliform	Monthly once until completion of project works	Foreshore of Narayanapur reservoir near Nagabenahal village, Backwater of Narayanpur reservoir near Thimlapur (Mallapura) Village, Backwater of Narayanpur reservoir near Marol Village	Contractors or agencies appointed by KBJNL	15,000/-
2	Ground water quality	pH, Temperature, EC, TDS Alkalinity, TH,NO_3, PO_4, Cl, SO_4, Na, K, Ca, Mg, Silica, Oil & grease, MPN, Total coliform	Once in a month	Near Labor camps (5 Nos.)	Contractors or agencies appointed by KBJNL	25,000/-
3	Soil Quality	pH, EC, Mg, Ca, Alkalinity, Cl, Na, K, Organic Carbon, K, PO_4, SAR, N and Salinity	Once in a month	Near Labor camps (5 Nos.)	Contractors or agencies appointed by KBJNL	45,000/-

Sl.No	Environmental Parameters	Parameters to be Monitored	Frequency of Monitoring	Locations	Responsibility	Estimated Cost in Rs.
4	Air Quality	PM_{10}, $PM_{2.5}$, NO2 and SO_2	As per NAAQ Standards	Nagabenahal village, Thimlapur (Mallapura) Village, Marol Village	Contractors or agencies appointed by KBJNL	24,000/-
5	Noise Levels	Leq Day, Leq Night in dB(A)	Monthly once until completion of construction works	Nagabenahal village, Thimlapur (Mallapura) Village, Marol Village	Contractors or agencies appointed by KBJNL	12,000/-
					Monthly Total	**1,21,000/-**
					For until completion of project works (24 months)	**29,04,000/-**
6	Aquatic life	Limnological and biological studies	Six monthly once until completion	Foreshore of Narayanapur reservoir near Nagabenahal village, Backwater of Narayanpur reservoir near Thimlapur (Mallapura) Village, Backwater of Narayanpur reservoir near Marol Village	Contractors or agencies appointed by KBJNL	1,50,000/-
7	Health check ups	Spirometry, Pulse Oxymetry, Blood Test, Lung Function Test, Eye test, Physical fitness tests	Six monthly once until completion	Labor camp (3 No.)	Contractors or Doctors / PHC appointed by KBJNL	3,00,000/-
					Six monthly total	**4,50,000/-**
					For until completion of project works (24 months)	**18,00,000/-**

Table 6.2 Environmental Monitoring Program for Operation phase (3 years)

Sl.No	Environmental Parameters	Parameters to be Monitored	Frequency of Monitoring	Locations	Responsibility	Estimated Cost in Rs.
1	Surface water quality of Krishna river	pH, Temperature, EC, TDS Alkalinity, TH, DO, BOD, COD, NO_3, PO_4, Cl, SO_4, Na, K, Ca, Mg, Silica, Oil & grease, MPN, Total coliform	Quarterly once for 3 years	Foreshore of Narayanapur reservoir near Nagabenahal village, Backwater of Narayanpur reservoir near Thimlapur (Mallapura) Village, Backwater of Narayanpur reservoir near Marol Village	Agencies appointed by KBJNL	3,60,000/-
	Ground water quality	pH, Temperature, EC, TDS Alkalinity, TH,NO_3, PO_4, Cl, SO_4, Na, K, Ca, Mg, Silica, Oil & grease, MPN, Total coliform	Quarterly once for 3 years	15 locations	Agencies appointed by KBJNL	5,40,000/-
	Soil Quality	pH, EC, Mg, Ca, Alkalinity, Cl, Na, K, Organic Carbon, K, PO_4, SAR, N and Salinity	Quarterly once for 3 years	30 locations	Agencies appointed by KBJNL	10,80,000/-
	Aquatic life	Limnological and biological studies	Yearly once for 3 years	Foreshore of Narayanapur reservoir near Nagabenahal village, Backwater of Narayanpur reservoir near Thimlapur	Agencies appointed by KBJNL	3,00,000/-

Sl.No	Environmental Parameters	Parameters to be Monitored	Frequency of Monitoring	Locations	Responsibility	Estimated Cost in Rs.
				(Mallapura) Village, Backwater of Narayanpur reservoir near Marol Village		
					Total	**22,80,000/-**

Based on the above and as per the guidelines of MoEF under the supervision of Chief Engineer, Dam Zone, Almatti, six monthly compliance reports shall be submitted to Regional Office of MoEF, Bangalore. In order to verify the effectiveness of monitoring program, Regional Office, MoEF, Bangalore and Regional Office, KSPCB, Bagalkot, Vijayapura and Raichur will be the enforcing agency to monitor the project activities.

Chapter 7. Additional Studies

7.1 Social Impact Assessment

Modernization of Upper Krishna Project will be taken up to provide irrigation facility to 291 villages of Bagalkot, Hunagund taluk in Bagalkot district, Muddebihal and Sindhagi taluk of Vijayapura district and Lingasugur and Manvi taluks of Raichur district. Agriculture is the major economic activity of this region which is mainly rain fed and inconsistent monsoons and erratic rainfall impacts the agricultural production badly leading to low economy of the region. Government of Karnataka recognized the need to extend irrigation facilities to these areas and Krishna Bhagya Jala Nigam Ltd, Govt. of Karnataka proposed this project to provide stability to agriculture sector and thereby improve the per capita income and standard of living of the people here.

7.2 Need for Social Impact Assessment

Social impact assessment studies are part of the Environmental Impact assessment studies. This chapter attempts to assess the socio economic conditions of the people in the villages in the project area and possible impact, both positive and negative, due to the project with mitigative measures and suggestions for improvement.

7.3 Villages affected due to the project

One of the direct impacts of the project is Land acquisition and this project requires land from 61 villages as detailed in the Table No 7.1 below.

Table 7.1 Details of project impacted villages

Sl.No	District	Taluk	Impacted villages
A. Thimmapur LIS			
1	Bagalkot	Bagalkot	Thimmapur
2			Bilikerur
3			Rampur
4			Sangapur
5			Badnaikdinni
6			Bevur
7			Hallur
8			Chavadapur
B. Ramthal (Marol) LIS			
1	Bagalkot	Hunagund	Havaragi
2			Ramawadagi
3			Kadiwal
4			Thimmapura
5			Virapura
6			Hirebadwadagi
7			Chinapur
8			Binjawadagi
9			Gattiganur
10			Rakkasagi
11			Hagedal
C. 9(A) Distributory			
1	Raichur	Devdurga	Anavara
2			Alkod

Sl.No	District	Taluk	Impacted villages
3			Chadakalgudda
4			Galaga
5			Nagalpura
6			Ganadal
7			Somanamaradi
8			Devaragudda
9			Moodalagunda
10			Madarakal
11			Ooti
12		Manvi	Huda
D. Nandawadagi LIS			
1	Bagalkot	Hunagund	Kodihaal
2			Kamblihal
3			Nandawadgi
4	Raichur	Lingasugur	Mallapur
5			Halkawadgi
6			Komnur
7			Yerdihal
8			Amadihaal
9			Ashihal
10			Gundsagar
11			Mavinbhavi
12			Hunkunti
13			Gonwar
14			Amaravati
15			Hosur
16			Nilogal
17			Kalillingsugur
E. Budihaal-Peerapur LIS			
1	Vijayapura	Muddebihal	Nagabenal
2			Donkamadu
3			Pheerapur
4			Lakkundi
5			Navadgi
6			Salvadagi
7			Bilebhavi
8			Bhantanur
9		Sindhagi	Aski
10			Jalpur
11			Turakangori
12			Budihaal
13			Algur

7.4 Brief history of the districts

The project impacts two districts viz., Bagalkot, Vijapura and Raichur as detailed above. A brief history of these districts are summarized below

7.4.1 Bagalkot District

Bagalkot district is home to some of the finest temples of the world, famed for their architectural splendor and Pattadakal is a magnificent temple complex listed by UNESCO as a World Heritage Site. Bagalkot, the district headquarters is a commercial town and major hub of the area. Earlier, Bagalkot was a part of Vijayapura/Vijapura district, was later carved out as a separate district vide Government of Karnataka notification, dated 2nd August 1997 .Geographically the district is located in the northern portion of the Deccan plateau. It comprises of six taluks namely, Badami, Bagalkot, Bilgi, Hungund, Mudhol and Jamkhandi. Bagalkot is the district headquarters and is one of the richest places.

7.4.1.1 Highlights – 2011 census

- Bagalkot with a total population of 18,89,752 accounts for 3.1 percent of the total population of the State and stands in the 11th position in the State.
- The Sex ratio of adults in the district is 989 and among the child population in the age-group below 6 years, itis 935.
- The district has a literacy rate of 68.8 percent with 79.2%male literacy rate and 58.4% female literacy rate .The male – female literacy gap in the district is 20.8 percentage points, which is higher than the male – female literacy gap registered by the State (14.4 percentage points).
- The Scheduled Caste population contributes 16.9 percent to the total population of the district and the Scheduled Tribe population contributes 5.1 percent.
- The district has registered a work participation of 43.3 percent and work participation rates for Male and Female population are 53.8 and 32.6 respectively.
- Among the total workers in the district 82.7 percent are Main workers and 17.3 percent are Marginal workers. Major work force of 61.1 percent are engaged in Agricultural sector ie., Cultivators (24.0 percent) and Agricultural Labourers (37.1 percent).Agricultural Labourers constitute 37.1 percent of the total workers in the district and the district holds 10th rank in the State.
- In the district 5.5 percent of the total workers are engaged in Household Industry and 33.5 percent are 'Other workers'. About 56.7 percent of the total population in the district is non-workers.
- The population density for this district is 288 and stands at 16th rank in the State. There are 624 villages, 12 Statutory Towns and 3 Census Towns in the district.

7.4.2 Vijapura District

In Kannada, Vijayapura is called as Vijapura, shortened form of the Sanskrit term "Vijayapura" meaning "City of victory". The town might have got its name after the victory pillar installed during seventh century to commemorate a victory on the eastern side of Ark-Killa. In an inscription found on the wall near Ibrahim Roza, Vijayapura is called "Vidyapur" means "The city of learning". In an Old Persian manuscript map,

Vijayapura is called Darul-Zafar meaning 'abode of victory'. But the place has retained the original name of Vijayapura or Vijapura in Kannada.

7.4.2.1 Highlights – 2011 census

- Vijayapura with a total population of 2177331 is the 7thmost populous district in the State.
- The district has an adult Sex ratio of 960, holds 26th rank in the State. The lowest Sex ratio 931 among the child population , below 6years is recorded in the district.
- The district has a literacy rate of 67.1 percent , male literacy rate is 77.2 percent and the female literacy rate is 56.7 percent.The male – female literacy gap in the district is 20.5 percentage points, which is higher than the male –female literacy gap registered by the State (14.4 percentage points).
- The Scheduled Caste population contributes 20.3 percent to the total population of the district and the Scheduled Tribe population contributes 1.8 percent.
- The district has registered a work participation of 42.6 percent and the lowest work participation rate for Male 52.2 is recorded in Vijayapura and the work participation rate for Female population is 32.6 in the district. Among the total workers in the district 81.9 percent are Main workers and 18.1 percent are Marginal workers. Major work forces of 66.2 percent are engaged in Agricultural sector i.e., Cultivators (28.3 percent)and Agricultural Labourers (37.9 percent).Agricultural Labourers constitute 37.9 percent of the total workers in the district. In the district 2.7 percent of the total workers are engaged in Household Industry and 31.1 percent are 'Other workers'.About 57.4 percent of the total population in the district is non-workers.
- Vijayapura district with area figure of 10498 Sq.Km stands on the 4th position in the State in terms of area. The population density for this district is 207 and stands at 24thrank in the State. There are 692 villages and 6 Statutory Towns in the district.

7.4.3 Raichur District

The district, named after its headquarters town Raichur, has a hoary past. The entire tract of land on the banks of the river Tungabhadra here is identified with Kishkindha, the kingdom of Vanaras. According to Jaina Ramayana, the city of Kishkindha was founded by Srikantha Kumara, brother-in-law of Dhanala Kirti. It was while roaming about in this part of the country during his exile that Rama was accorsted by Hanumantha. Kishkindha Kanda, a section of the epic Ramayana narrates the events and episodes that took place in this tract of land during those legendary days. Historically this district is known to have formed parts of the Mauryan empire. In the Deccan, Suvarnagiri was then a seat of viceroyalty. This place is identified with Kanakagiri in Gangawati taluk by some historians which is now in Koppal taluk and Maski in Lingsugur taluk by others.

7.4.3.1 Highlights – 2011 census

- Raichur with a total population of 1,928,812 is the 10th most populous district in the State.
- The district ranks 8th in terms of rural population and 13th in terms of urban population.

- Raichur district accounts for 3.2 percent of the total population of the State. With the decadal growth rate of 15.5 percent, it ranks 8th in the State in terms of decadal growth rate.
- The sex ratio increased from 983 in 2001 to 1000 in 2011 and the district holds the 6th rank in the State.
- In Sex ratio among the child population in the age-group 0-6, the district shows highest decline of 14 points from 964 in 2001 to 950 in 2011 and holds the 16th rank in the State.
- In the proportion of child population, (0-6 age-group) the district stands for the second position with 14.7 percent.
- The district has a literacy rate of 59.6 percent and is placed at penultimate rank in the State. The male literacy rate in the district is 70.5 percent and the female literacy rate is 48.7 percent.
- The male – female literacy gap in the district is 21.8 percentage points, which is higher than the male – female literacy gap registered by the State (14.4 percentage points).
- The Scheduled Caste population contributes 20.8 percent to the total population of the district and the highest proportion of 19.0 of the Scheduled Tribe population is returned from Raichur.
- The district has registered a work participation rate of 46.8 percent and stands at 12th rank in the State. The work participation rates for Male and Female population are 55.0 and 38.7 respectively in the district. Among the total workers in the district 80.4 percent are Main workers and 19.6 percent are Marginal workers. Major work force of 69.7 percent is engaged in Agricultural sector i.e., Cultivators (27.2 percent) and Agricultural Labourers (42.5 percent). Agricultural Labourers constitute 42.5 percent of the total workers in the district and the district holds 4th rank in the State.
- In the district 2.1 percent of the total workers are engaged in Household Industry and 28.3 percent are Other workers. About 53.2 percent of the total population in the district is non-workers.
- Raichur district with area figure of 8442 Sq.Km stands at 8th position in the State in terms of area. The population density for this district is 228 and it holds 22nd rank in the State. There are 884 villages, 7 Statutory Towns and 2 Census Towns in the district.

7.5 Description of Socio Economic Environment

The socio-economic profile of the project impacted area was analyzed through compilation of primary and secondary data. Primary survey was conducted deploying a team of qualified surveyors and data was collected from PAPs through designed questionnaires (Annexure-13) through field visits. The Consultant also visited the project site and had formal and informal interactions with the various stakeholders. All the primary data so collected were compiled and documented. The secondary data sources referred mainly are detailed below:

- District Census Handbook, 2011-Bagalkot, series30, part XII B
- District Census Handbook, 2011-Vijayapura, series30, part XII B
- District Census Handbook, 2011-Raichur, series30, part XII B
- State Fact sheet-Karnataka 2014-15

- Census Data, 2011-Karnataka
- Official Websites of Bagalkot, Vijayapura and Raichur District and various Departments

7.5.1 Demographic profile of the project villages

Demographic profile of the project villages as per the Census data 2011 is discussed below;

7.5.1.1 Area and Number of Households

The land area of the project impacted villages and numbers of households are summarized in Table 7.2.

Table 7.2 Details of the project villages

Sl.No	District	Impacted villages	No. of Households	Population
A. Thimmapur LIS				
1	Bagalkot	Rampur	963	4816
2		Thimmapur	416	2123
3		Bilikerur	431	2011
4		Hallur	717	3343
5		Sangapur	283	1532
6		Badnaikdinni	388	1815
7		Bevur	1096	5881
8		Chavadapur	299	1781
B. Ramthal (Marol) LIS				
1	Bagalkot	Rakkasagi	356	1860
2		Thimmapura	343	1694
3		Virapura	127	660
4		Hirebadwadagi	270	1488
5		Havaragi	277	1311
6		Chinapur	131	664
7		Kadiwal	174	896
8		Hagedal	118	503
9		Ramawadagi	186	895
10		Binjawadagi	178	844
11		Gattiganur	198	1074
C. 9(A) Distributory				
1	Raichur	Somanamaradi	417	2691
2		Nagalpura	25	115
3		Ganadal	429	2396
4		Ooti	269	1742
5		Moodalagunda	222	1473
6		Galaga	1093	6592
7		Chadakalgudda	225	1499
8		Devaragudda	106	688
9		Madarakal	274	1574
10		Anavara	185	1201
11		Alkod	413	2126
12		Huda	110	754

Sl.No	District	Impacted villages	No. of Households	Population
D. Nandawadagi LIS				
1	Bagalkot	Kodihaal	586	2723
2		Kamblihal	183	992
3		Nandawadgi	721	3917
4	Raichur	Halkawadgi	317	1718
5		Komnur	157	779
6		Ashihal	419	2162
7		Yerdihal	130	703
8		Amadihaal	525	2736
9		Gundsagar	330	1622
10		Mavinbhavi	397	2335
11		Kalillingsugur	216	1217
12		Hunkunti	399	2305
13		Gonwar	293	1613
14		Amaravati	95	535
15		Mallapur	147	893
16		Hosur	285	1530
17		Nilogal	444	2541
E. Budihaal-Peerapur LIS				
1	Vijayapura	Algur	800	4110
2		Turakangeri	177	872
3		Budihaal	214	981
4		Jalpur	219	1087
5		Aski	794	3711
6		Donkamadu	80	511
7		Nagabenal	764	4426
8		Bhantanur	519	2789
9		Pheerapur	283	1645
10		Lakkundi	171	789
11		Navadgi	413	2210
12		Salvadagi	725	3760
13		Bilebhavi	360	2221

7.5.1.2 Population details

Population of each village, male and female population and sex ratio is furnished in Table 7.3 below;

Table 7.3 Population in the project impacted villages

Sl.No	District	Impacted villages	Male	Female	>6 years
A. Thimmapur LIS					
1	Bagalkot	Rampur	2361	2455	599
2		Thimmapur	1016	1107	352
3		Bilikerur	1040	971	264
4		Hallur	1670	1673	417
5		Sangapur	785	747	227
6		Badnaikdinni	875	940	247

Sl.No	District	Impacted villages	Male	Female	>6 years
7		Bevur	2947	2934	805
8		Chavadapur	890	891	276
B. Ramthal (Marol) LIS					
1	Bagalkot	Rakkasagi	910	950	264
2		Thimmapura	873	821	237
3		Virapura	310	350	103
4		Hirebadwadagi	748	740	188
5		Havaragi	650	661	168
6		Chinapur	321	343	84
7		Kadiwal	427	469	127
8		Hagedal	242	261	50
9		Ramawadagi	457	438	116
10		Binjawadagi	406	438	111
11		Gattiganur	579	495	125
C. 9(A) Distributory					
1	Raichur	Somanamaradi	1366	1325	458
2		Nagalpura	56	59	19
3		Ganadal	1182	1214	368
4		Ooti	858	884	312
5		Moodalagunda	726	747	283
6		Galaga	3282	3310	1094
7		Chadakalgudda	728	771	241
8		Devaragudda	383	305	85
9		Madarakal	739	835	237
10		Anavara	606	595	239
11		Alkod	1070	1056	414
12		Huda	364	390	129
D. Nandawadagi LIS					
1	Bagalkot	Kodihaal	1303	1420	309
2		Kamblihal	506	486	134
3		Nandawadgi	2000	1917	535
4	Raichur	Halkawadgi	835	883	293
5		Komnur	368	411	110
6		Ashihal	1072	1090	281
7		Yerdihal	365	338	81
8		Amadihaal	1403	1333	388
9		Gundsagar	815	807	196
10		Mavinbhavi	1127	1208	334
11		Kalillingsugur	582	635	193
12		Hunkunti	1084	1221	362
13		Gonwar	800	813	201
14		Amaravati	245	290	70
15		Mallapur	470	423	128
16		Hosur	783	747	241
17		Nilogal	1272	1269	359

Sl.No	District	Impacted villages	Male	Female	>6 years
E. Budihaal-Peerapur LIS					
1	Vijayapura	Algur	2069	2041	638
2		Turakangeri	412	460	172
3		Budihaal	497	484	160
4		Jalpur	549	538	173
5		Aski	1819	1892	511
6		Donkamadu	268	243	99
7		Nagabenal	2239	2187	762
8		Bhantanur	1395	1394	384
9		Pheerapur	845	800	252
10		Lakkundi	386	403	79
11		Navadgi	1095	1115	347
12		Salvadagi	1909	1851	497
13		Bilebhavi	1109	1112	372

7.5.1.3 Scheduled caste and scheduled tribe population

SC/ST population in the villages is summarized in the Table below. It indicates that maximum Scheduled caste categories are reported in all the villages and Scheduled tribe categories are reported highest in 9A distributory villages followed by Nandavadagi LIS villages.

Table 7.4 Total SC/ST population in project impacted villages

Sl.No	District	Impacted villages	Total SC Population	Total ST Population
A. Thimmapur LIS				
1	Bagalkot	Rampur	913	178
2		Thimmapur	591	3
3		Bilikerur	380	221
4		Hallur	451	164
5		Sangapur	170	74
6		Badnaikdinni	180	0
7		Bevur	1102	760
8		Chavadapur	193	51
B. Ramthal (Marol) LIS				
1	Bagalkot	Rakkasagi	424	0
2		Thimmapura	844	76
3		Virapura	6	0
4		Hirebadwadagi	254	1
5		Havaragi	202	8
6		Chinapur	67	9
7		Kadiwal	226	10
8		Hagedal	61	10
9		Ramawadagi	276	61
10		Binjawadagi	225	4
11		Gattiganur	110	1
C. 9(A) Distributory				

Sl.No	District	Impacted villages	Total SC Population	Total ST Population
1	Raichur	Somanamaradi	416	1413
2		Nagalpura	5	0
3		Ganadal	522	578
4		Ooti	107	1171
5		Moodalagunda	241	1083
6		Galaga	635	3097
7		Chadakalgudda	134	1182
8		Devaragudda	315	142
9		Madarakal	283	249
10		Anavara	79	442
11		Alkod	907	676
12		Huda	32	623
D. Nandawadagi LIS				
1	Bagalkot	Kodihaal	289	97
2		Kamblihal	151	40
3		Nandawadgi	545	60
4	Raichur	Halkawadgi	483	19
5		Komnur	79	111
6		Ashihal	1775	150
7		Yerdihal	76	29
8		Amadihaal	886	10
9		Gundsagar	233	65
10		Mavinbhavi	546	166
11		Kalillingsugur	204	46
12		Hunkunti	430	6
13		Gonwar	150	544
14		Amaravati	3	6
15		Mallapur	139	312
16		Hosur	65	1031
17		Nilogal	578	132
E. Budihaal-Peerapur LIS				
1	Vijayapura	Algur	601	90
2		Turakangeri	34	4
3		Budihaal	97	0
4		Jalpur	188	0
5		Aski	493	198
6		Donkamadu	23	0
7		Nagabenal	1497	229
8		Bhantanur	525	128
9		Pheerapur	247	15
10		Lakkundi	89	11
11		Navadgi	440	284
12		Salvadagi	1009	202
13		Bilebhavi	214	0

7.5.1.4 Educational status

The literacy status of the men and women in the impacted villages shows backward trend compared to the district and state averages. In Bagalkot district the literacy rate of 68.8 percent with 79.2 % male literacy rate and 58.4 % female literacy was reported while in Vijayapura district has a literacy rate of 67.1 percent with a male literacy rate of 77.2 % and the female literacy rate of 56.7 %. In Raichur district reported the literacy rate of 59.6% with 70.5 % male literates and 48.7% female literates. Details are furnished in Table 7.5 below;

Table 7.5 Male- female literacy

Sl.No	District	Impacted villages	Total Literates	%	Total Male	%	Total Female	%
A. Thimmapur LIS								
1	Bagalkot	Rampur	2976	61	1741	73	1235	50
2		Thimmapur	1061	49	633	62	428	38
3		Bilikerur	1033	51	662	63	371	38
4		Hallur	2090	62	1220	73	870	52
5		Sangapur	725	47	457	58	268	35
6		Badnaikdinni	1016	55	618	70	398	42
7		Bevur	3450	58	2044	69	1406	47
8		Chavadapur	930	52	586	65	344	38
B. Ramthal (Marol) LIS								
1	Bagalkot	Rakkasagi	1106	59	675	74.	431	45
2		Thimmapura	981	57	588	67	393	47
3		Virapura	366	55	213	68	153	43
4		Hirebadwadagi	1050	70	605	80	445	60
5		Havaragi	755	57	464	71	291	44
6		Chinapur	438	65	262	81	176	51
7		Kadiwal	513	57	300	70	213	45
8		Hagedal	338	67	205	84	133	50
9		Ramawadagi	538	60	328	71	210	47
10		Binjawadagi	537	63	303	74	234	53
11		Gattiganur	673	62	443	76.	230	46
C. 9(A) Distributory								
1	Raichur	Somanamaradi	891	33	558	40	333	25
2		Nagalpura	71	61	37	66	34	57
3		Ganadal	915	38	535	45	380	31
4		Ooti	631	36	390	45	241	27
5		Moodalagunda	414	28	265	36	149	19
6		Galaga	2467	37	1543	47	924	27
7		Chadakalgudda	429	28	279	38	150	19
8		Devaragudda	379	55	255	66	124	40
9		Madarakal	702	44	419	56	283	33
10		Anavara	511	42	330	54	181	30
11		Alkod	882	41	563	52	319	30
12		Huda	220	29	134	36	86	22
D. Nandawadagi LIS								
1	Bagalkot	Kodihaal	1722	63	1000	76	722	50

Sl.No	District	Impacted villages	Total Literates	%	Total Male	%	Total Female	%
2		Kamblihal	578	58	347	68	231	47
3		Nandawadgi	2080	53	1264	63	816	42
4	Raichur	Halkawadgi	875	50	543	65	332	37
5		Komnur	475	60	288	78	187	45
6		Ashihal	1070	49	667	62	403	36
7		Yerdihal	402	57	251	68	151	44
8		Amadihaal	1329	48	845	60	484	36
9		Gundsagar	894	55	556	68	338	41
10		Mavinbhavi	1153	49	669	59	484	40
11		Kalillingsugur	521	42	322	55	199	31
12		Hunkunti	848	36	498	45	350	28
13		Gonwar	894	55	545	68	349	42
14		Amaravati	392	73	207	84	185	63
15		Mallapur	426	47	295	62	131	30
16		Hosur	488	31	316	40	172	23
17		Nilogal	1438	56	884	69	554	43
E. Budihaal-Peerapur LIS								
1	Vijayapura	Algur	1966	47	1226	59	740	36
2		Turakangeri	282	32	189	45	93	20
3		Budihaal	430	43	282	56	148	30
4		Jalpur	583	53	361	65	222	41
5		Aski	2088	56	1244	68	844	44
6		Donkamadu	188	36	132	49	56	23
7		Nagabenal	2100	47	1337	59	763	34
8		Bhantanur	1414	50	849	60	565	40
9		Pheerapur	913	55	556	65	357	44
10		Lakkundi	479	60	281	72	198	49
11		Navadgi	1015	45	618	56	397	35
12		Salvadagi	2317	61	1316	68	1001	54
13		Bilebhavi	1092	49	717	64	375	33

7.5.1.5 Health status

The efficiency of public health delivery system is low and considerable disparities across districts in terms of per capita availability of hospitals, beds and manpower inputs had adverse impact on improving the life expectancy in the state.

To improve the outcomes in deficient districts like Bagalkot, Vijayapura and Raichur these factoral disparities within the health system need to be improved, linking with adequate infrastructure facilities like safe drinking water supply and sanitation. A considerable increase in medical and public health expenditure in rural areas in the state is required for this purpose. The funds from National Rural Health Mission (NRHM) and rural sanitation schemes, at present, are adding to improve the situation in poorer districts. Besides the significance of factors like rural poverty and disparities in income, overall skewed distribution of income across rural and urban sectors, changing population densities in respective districts as well as lack of gender specific focus of public sector intervention in terms of education and other opportunities should not be

overlooked. These factors have indeed influenced the health outcomes which the direct health sector inputs have not been able to compensate.

Communicable and non-commendable diseases often impose threat to human development. The important non-communicable diseases reported from the Districts include - heart attacks and stroke, cancers, chronic respiratory diseases and diabetes. The important communicable diseases that affect people in the district include Diarrhea, Dengue, Malaria, Measles, HIV/AIDS, and TB. Some studies conducted in Bagalkot, Vijayapura, Raichur districts reveals that the ground water have fluoride concentration but it is below the permissible limits prescribed by ICMR, WHO and ISI. No dental fluorosis and skeletal fluorosis is noticed in study area. However ground water management programme and Environmental awareness of the health implication of fluoride is emphasized through education of public and community participation

7.5.1.6 Occupational status

Table 7.6 Work participation rate of men and women

Sl.No	District	Impacted villages	Total Workers	Total Male workers	Total Female workers
A. Thimmapur LIS					
1	Bagalkot	Rampur	2071	1263	808
2		Thimmapur	954	540	414
3		Bilikerur	1177	561	616
4		Hallur	1826	972	854
5		Sangapur	410	367	43
6		Badnaikdinni	798	480	318
7		Bevur	2462	1529	933
8		Chavadapur	968	491	477
B. Ramthal (Marol) LIS					
1	Bagalkot	Rakkasagi	952	493	459
2		Thimmapura	804	483	321
3		Virapura	337	163	174
4		Hirebadwadagi	682	487	195
5		Havaragi	745	374	371
6		Chinapur	296	162	134
7		Kadiwal	450	238	212
8		Hagedal	151	105	46
9		Ramawadagi	536	273	263
10		Binjawadagi	326	213	113
11		Gattiganur	454	285	169
C. 9(A) Distributory					
1	Raichur	Somanamaradi	1589	798	791
2		Nagalpura	53	30	23
3		Ganadal	1439	709	730
4		Ooti	944	497	447
5		Moodalagunda	666	406	260
6		Galaga	3333	1854	1479
7		Chadakalgudda	916	449	467
8		Devaragudda	188	171	17
9		Madarakal	852	432	420

Sl.No	District	Impacted villages	Total Workers	Total Male workers	Total Female workers
10		Anavara	432	303	129
11		Alkod	974	543	431
12		Huda	423	211	212
D. Nandawadagi LIS					
1	Bagalkot	Kodihaal	1359	755	604
2		Kamblihal	471	296	175
3		Nandawadgi	1517	1038	479
4	Raichur	Halkawadgi	892	431	461
5		Komnur	440	203	237
6		Ashihal	811	519	292
7		Yerdihal	397	206	191
8		Amadihaal	1452	782	670
9		Gundsagar	840	464	376
10		Mavinbhavi	1110	612	498
11		Kalillingsugur	671	331	340
12		Hunkunti	836	575	261
13		Gonwar	834	451	383
14		Amaravati	287	148	139
15		Mallapur	504	262	242
16		Hosur	678	431	247
17		Nilogal	1146	698	448
E. Budihaal-Peerapur LIS					
1	Vijayapura	Algur	1964	1126	838
2		Turakangeri	556	289	267
3		Budihaal	565	293	272
4		Jalpur	567	305	262
5		Aski	1716	997	719
6		Donkamadu	255	139	116
7		Nagabenal	2139	1154	985
8		Bhantanur	1098	687	411
9		Pheerapur	825	436	389
10		Lakkundi	243	231	12
11		Navadgi	1113	625	488
12		Salvadagi	1528	989	539
13		Bilebhavi	1111	609	502

7.6 Land use and land ownership

The land use in the proposed project area is dry land agriculture, subject to vagaries of monsoon rain with low cropping intensity and low productivity. Majority of the population in the area depends on agriculture and the major crops cultivated in the region include Jowar, Bajra, Wheat, Grams and chilly, etc.

7.6.1 Impact of Land Acquisition

The land acquisition details furnished in Table 7.7 shows that 2403 ha of land is required for the modernization works. Out of which, 822 ha were already acquired and remaining 1581 Ha will be acquired as per RFC&T in LA, 2013.

Table 7.7 Extent of land required

Sl No	Name of the Project	Total Land required in Ha	Total land acquired in ha	Total land to be acquired in ha
1	Thimmapur LIS	737	21	716
2	Ramthal (Marol) LIS	763	651	112
3	9(A) Distributory	150	150	--
4	Budihaal-Peerapur LIS	558	--	558
5	Nandawadagi LIS	195	--	195
	Total	**2403**	**822**	**1581**

Therefore, people perception survey was conducted in affected villages of Budihaal-Peerapur LIS and Nandawadagi LIS. The details of the survey is hereunder. The questionnaire used for the survey is enclosed as Annexure-14. Status of land acquistion details for Ramthal (Marol) LIS is enclosed as Annexure-15. Land acquired notifications in respect of Thimmapur LIS and 9(A) Distributory is enclosed as Annexure-16 and Annexure-17 respectively.

7.6.1.1 Budihaal-Peerapur LIS

1. Occupation of the respondents - 97% of the respondents in 15 villages are agriculturists and remaining 3 % are also agriculture labors showing that the area is practicing agriculture as their main occupation.

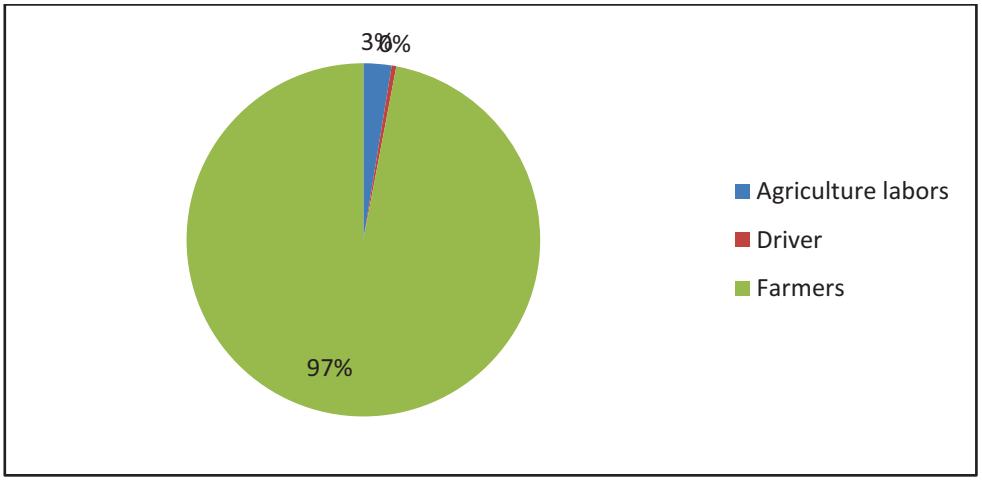

Fig 7.1 Occupation of the respondents

2. Income of the respondents : 34% of the respondents income are in the range of 10,000 to 20000 followed by 40000 to 50000 income by 15% of the respondents indicate that the income of the respondents are too low.

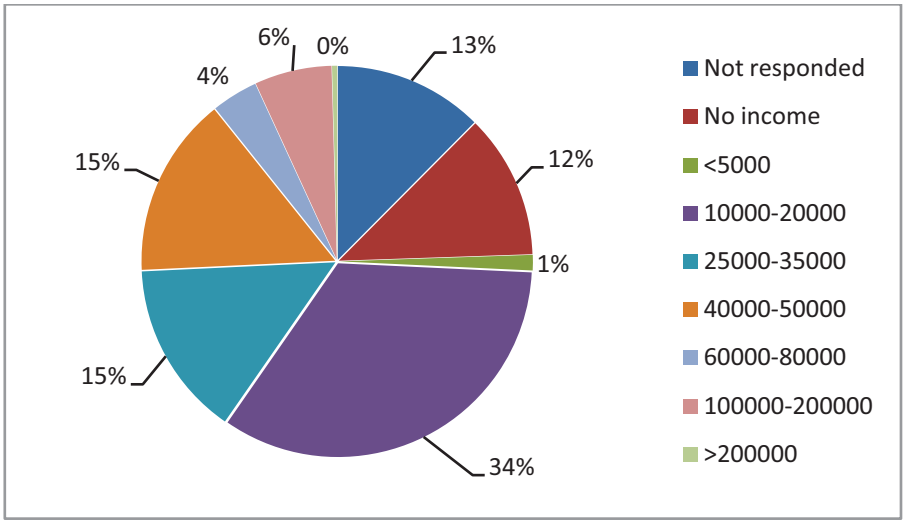

Fig 7.2 Income of the respondents

3. Awareness about the project : 86% of the respondents are aware about the project and only 14% of the respondents are not aware of the proposed project.

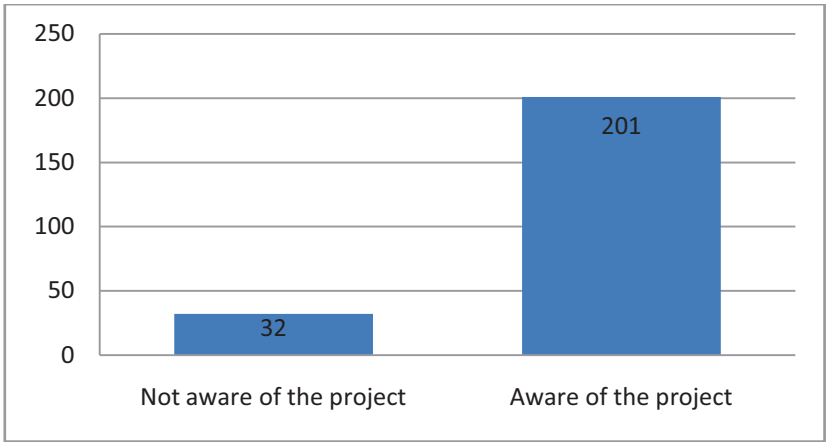

Fig 7.3 Awareness on project

4. Need of the project : Question on requirement of the project was asked to the respondents. All the respondents urged that the project is very much required for the region. At the same time during the survey, it was cross verify why this project is required for the area. Maximum 45% of the respondents is of the opinion that the project is very much required for agriculture activities and 28% of the respondents reveal that it contemplates drinking water needs. 24% of the respondents opinion is that this project is require to serve both drinking water and agriculture. Interestingly, 3% of the respondents is of the opinion that irrigation project bring substantial development in the village in the areas of agriculture, horticulture, education, infrastructure, etc.

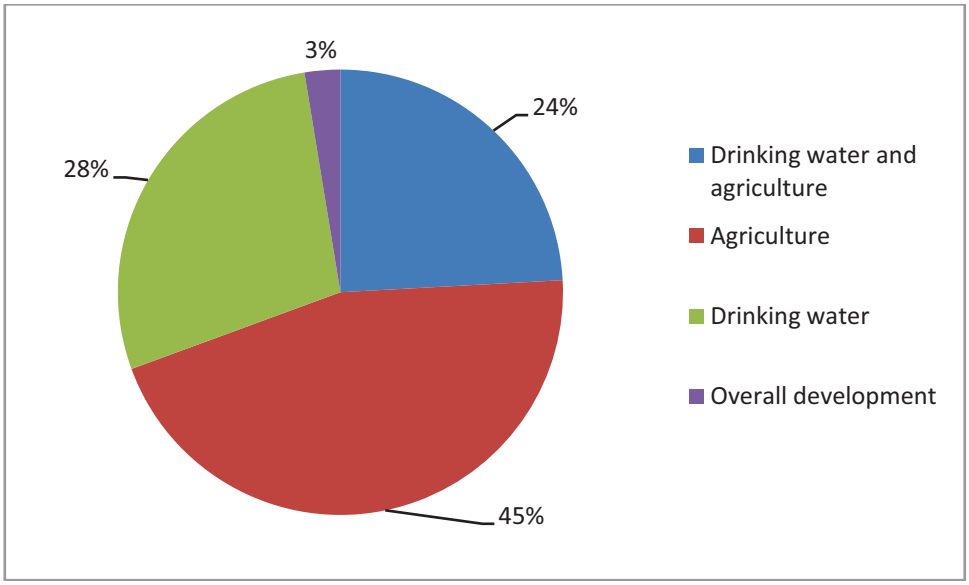

Fig 7.4 Need for the project

5. Land holding size : 32% of the respondents is holding more than 10 acres of land and 31% of the respondents are in the range between 4-9 acres.

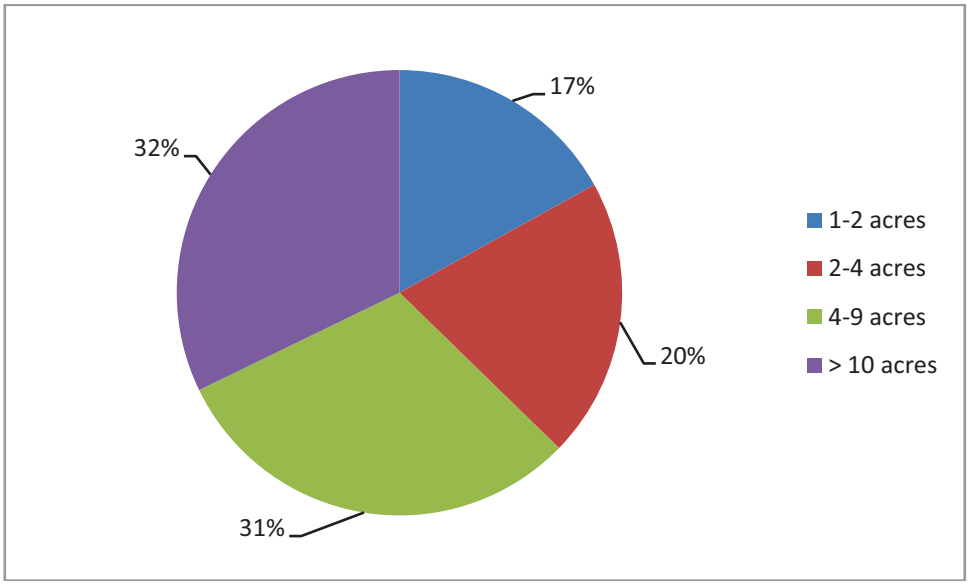

Fig 7.5 Land holding size

6. Willingness to provide land for the project: 87% of the respondents is willing to provide land for the project with suitable compensation. However, 9% of the respondents are denied because of less lesser holding size. Hence, suitable livelihood programmes for these respondents are very much required.

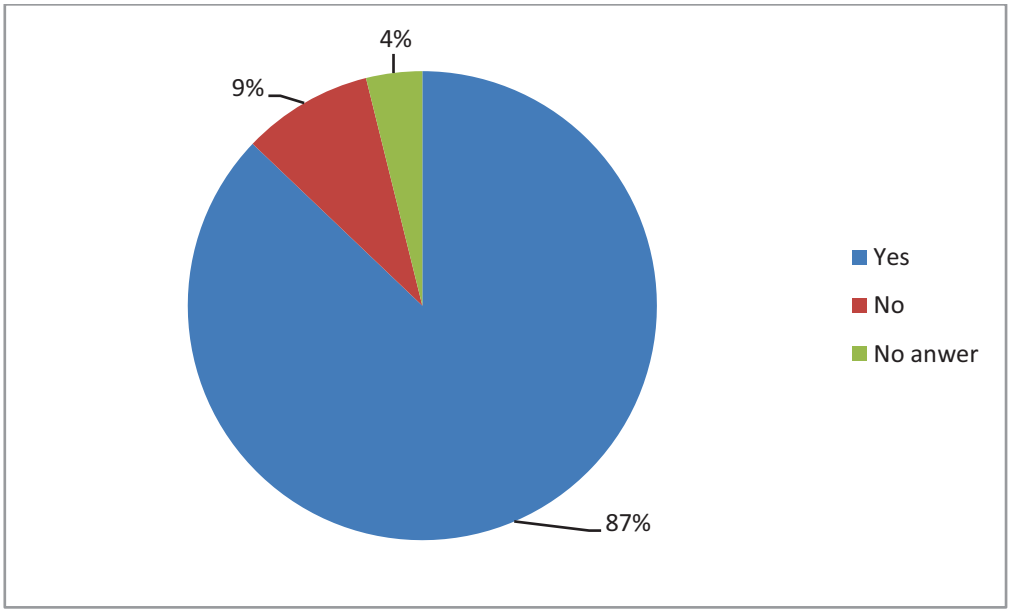

Fig 7.6 Willingness to provide land for the project

7.6.1.2 Nandawadagi LIS

1. Occupation of the respondents - 98% of the respondents in 18 surveyed villages are agriculturists and remaining 2 % drivers showing that the area is practicing agriculture as their main occupation.

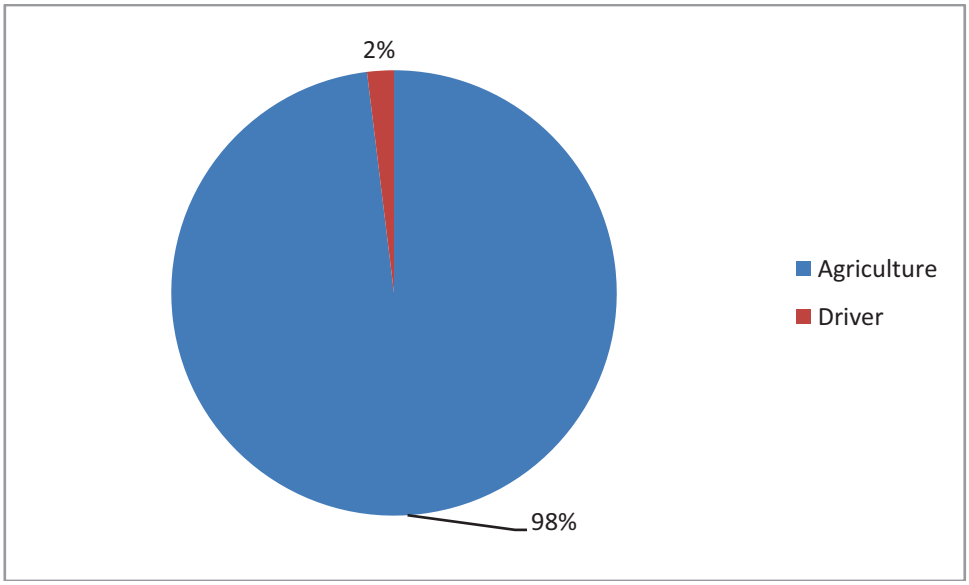

Fig 7.7 Occupation of the respondents

2. Income of the respondents : 39% of the respondents income are in the range of 10,000 to 15000 followed by 15000 to 25000 income by 36% of the respondents indicate that the respondents income is slightly livable when compared to Budihaal-Peerpur LIS villages.

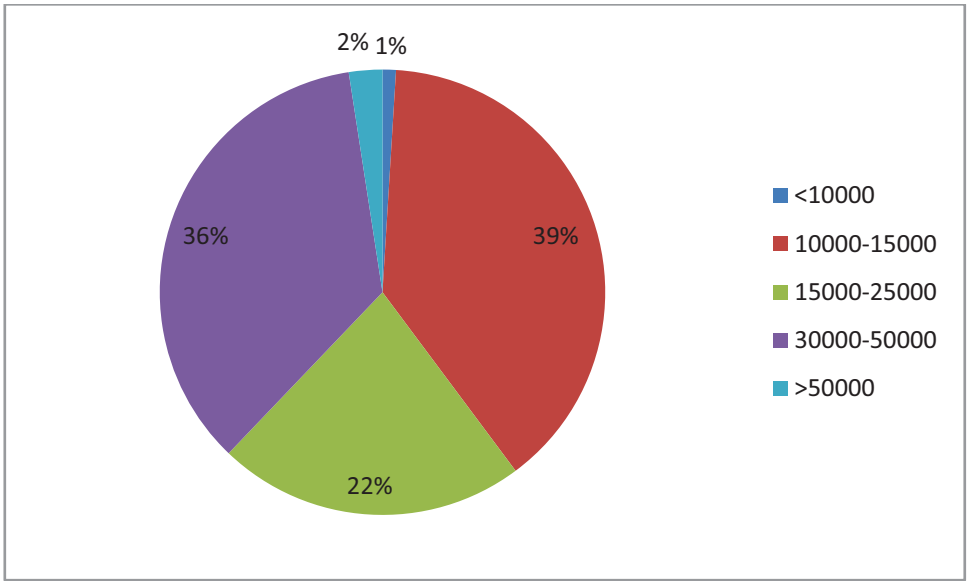

Fig 7.8 Income of the respondents

3. Awareness about the project : All the respondents are aware about the project and it shows that people are eagerly waiting for the project implementation.

4. Need of the project : Question on requirement of the project was asked to the respondents. All the respondents urged that the project is very much required for the region. At the same time during the survey, it was cross verify why this project is required for the area. Maximum 53% of the respondents is of the opinion that the project is very much required for agriculture activities and 46% of the respondents reveal that it contemplates agriculture as well as drinking water needs.

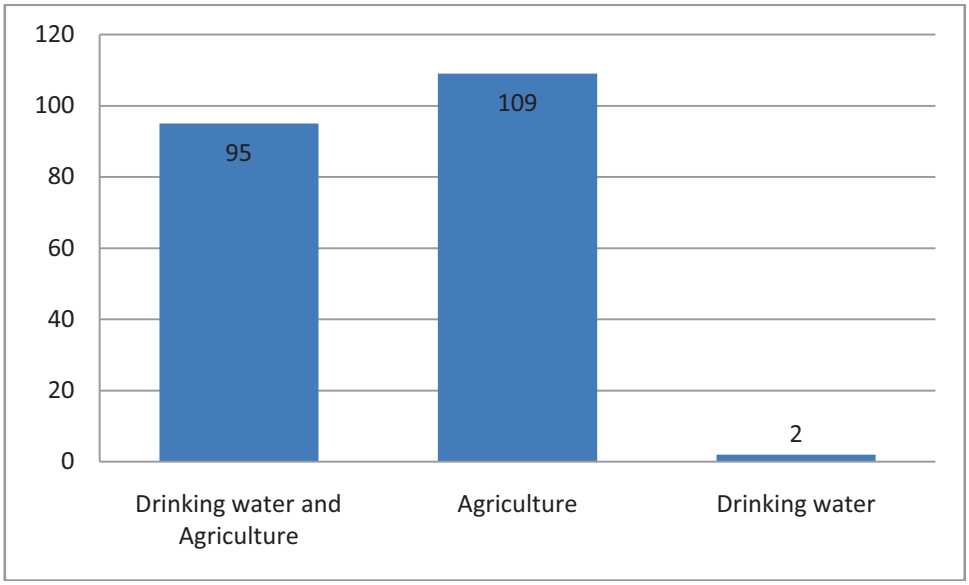

Fig 7.9 Need for the project

5. Land holding size : 34% of the respondents is holding size between 4-9 acres of land and 20% of the respondents are more than 10 acres of land. The land holding size is comparatively good.

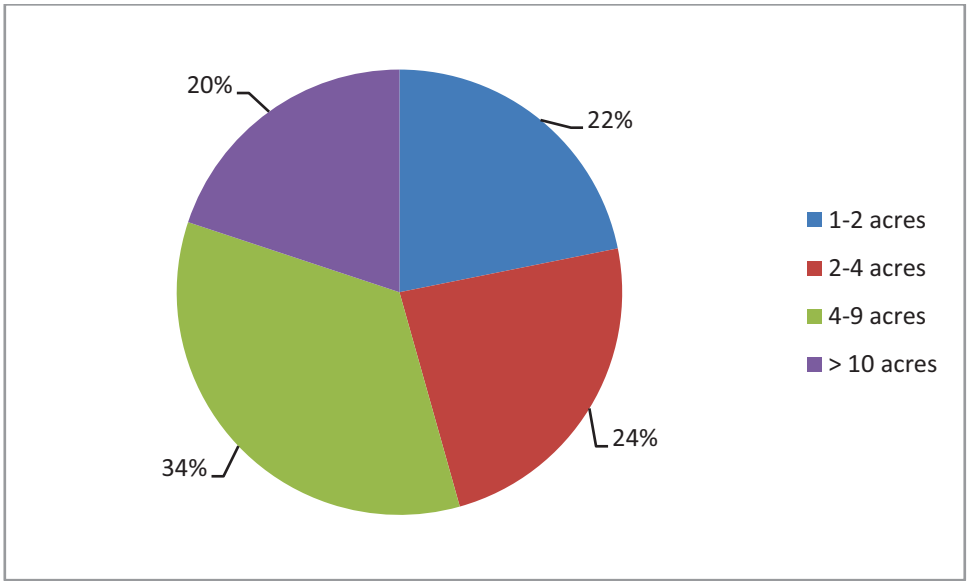

Fig 7.10 Land holding size

6. Willingness to provide land for the project: 92% of the respondents is willing to provide land for the project with suitable compensation. However, 8% of the respondents are denied because of less lesser holding size. Hence, suitable livelihood programmes for these respondents are very much required.

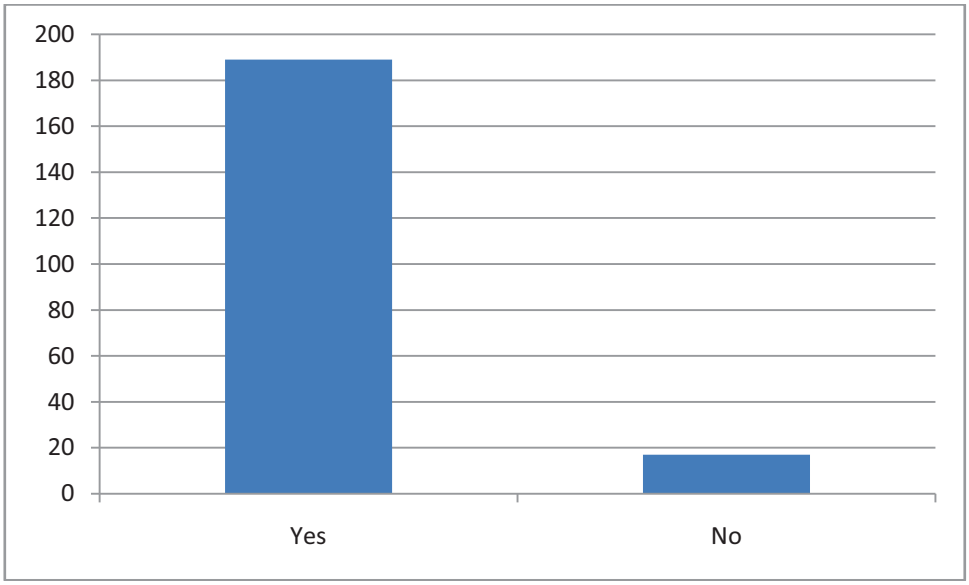

Fig 7.11 Willingness to provide land for the project

7.7 Religious and cultural institutions

Remnants of Chalukyan art and architecture are important tourist attractions in Bagalkot. Historically, Bagalkot was the capital of the Chalukyan Empire. Pattadakallu , a village and an important tourist center in the state is located on the left bank of the Malaprabha river in Bagalkot district, 22 km from Badami and 514 km from Bangalore,is a UNESCO World heritage site (aerially 78 Km away from lift point). There are ten temples here, four are in Nagara style and six are in Dravidian style. The largest of all the temples in Pattadakal is Virupaksha temple. Raichur District was a part of the Hyderabad State till the re-organisation of State on 1st November 1956. The recorded history of the district is traced to as far back as the third century B.C. The fact that three minor rock edicts of Ashoka are found in this district one at Maski in the Lingasugur taluk and the other two

near Koppal, prove that this area was included in the dominions of the great Mauryan king Ashoka (273 - 236 B.C.).


View of Pattadkal temples


View of Aihole temples


Remains of raichur fort

Fig 7.12 View of Archaeologically important temples

7.8 Consultations with the PAPs

Interactions with the project affected persons during the Social survey and other formal and informal interactions provided a feedback of their impressions about the project and expectations as summarized below;

- The farmers expressed their happiness saying that this modernization works are important and need for the hour and is a boon for them especially during dry seasons to cultivate in their farm lands and increase production. As their main subsistence is agriculture they look forward to implement this irrigation project as early as possible.
- Those who are losing land expect sufficient compensation for their loss and hope that their dwelling houses won't be affected.

- Few Respondents expressed their concern about the land value and are waiting for discussions with the Department officials.
- In the interactions villagers expressed their concern about the construction works and its impacts on them, chances for employment and also requested to KBJNL for following supports:
- To develop the linking roads
- To provide drinking water and sanitation facilities
- To complete the project as early as possible
- Consider local people for employment opportunities in the project sites.

7.9 Positive and Negative impact of the Project

- Modernization of UKP will provide irrigation facilities for 291 villages in 3 districts. This will have major impact on the area, especially since 80% of the population depends on agriculture for their subsistence.
- Employment Generation due to the project. During the project construction phase and operation-management phase additional employment will be generated and local labourers will be engaged for works. Around 500 people (100 Technical and 400 construction labourers) are expected to be employed temporarily for the construction work of intake channel, jack well cum pump house, raising main, delivery chambers and distribution network. During operation phase labourers will be appointed for operation and maintenance of the jack well.
- The only negative impact is that 2403 ha of agricultural land will be lost for the project construction purposes, but they will be sufficiently compensated. Out of which, 822 Ha was already acquired and paid Rs. 24.77 crores and for remaining 1581 ha, compensation of Rs. 468.12 crores will be paid as per the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (Karnataka) Rules applicable in the State. None of the residential or commercial properties are impacted and there is no displacement of PAPs .

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

7.10 Land Acquisition Process& Rehabilitation and Resettlement Plan

7.10.1 Land acquisition process

Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (Compensation, Rehabilitation and Resettlement, Development Plan) Rules, 2015 published in the Govt of India Gazette on 18th December, 2015.Government of Karnataka vide Revenue Secretariat notification No. RD 152 AQB 2013, Bangalore, Dated 17 Oct 2015 published these rules.

7.10.2 Request for acquisition of land and initial steps

On completion of Social Impact Assessment, the Requiring Body for whom land is to be acquired shall file the request to the concerned Collector in FORM-I along with the following documents;

- Detailed project report
- Sanction letter of project
- Three copies of Record of Rights and revenue maps of the affected areas
- Information about the classification of land that is, irrigated multi-cropped, single cropped, wasteland, etc
- Any other information required by the Collector

The Collector, on receiving the request constitute a committee of officers deems necessary, to make a field visit along with the representatives of the Requiring Body to make a preliminary enquiry who in turn will submit the report to the collector with the following details.

(i) that the proposed acquisition of land serves public purpose;

(ii) that the extent of land proposed for acquisition is the absolute bare-minimum needed for the project;

(iii) that the acquisition of land at an alternate place has been considered and found not feasible;

(iv) that there is no unutilized land which has been previously acquired in the area;

(v) that the land, if any, acquired earlier and remained unutilized, may be used for such public purpose;

(vi) the recommendations of the committee

On the basis of the report of the committee, the Collector if satisfied that the request is consistent with the provisions of the Act, shall make a preliminary estimate of the cost of the acquisition. The Collector shall inform the Requiring Body to deposit the estimated cost of acquisition or part thereof as specified by the Collector in the designated account of the office of the Collector before the publication of declaration and the Requiring Body shall deposit the same within the said period. The balance cost of acquisition after final estimation as prepared by the Collector or in cases where excess amount is awarded by the Authority or Court, shall be deposited as and when required.

7.10.3 Publication of preliminary notification

Preliminary notification as per section 11 shall be published in FORM II and will be affixed at conspicuous places in the affected areas and also informed to the public . Then the Collector shall ensure completion of the exercise of updating land records as specified below:

- delete the names of deceased persons;
- enter the names of the legal heirs of the deceased persons;
- enter the registered transactions of the rights in land such as sale, gift, partition, etc.;
- make all entries of the mortgages in the land records;
- delete the entries of mortgages in case the lending agency issues letter towards full payment of loans taken through registered reconveyance of mortgaged property deeds;
- make necessary entries in respect of all prevalent forest laws;

- make necessary entries in case of the Government land;
- make necessary entries in respect of assets on the land like buildings, trees, wells, etc.;
- make necessary entries of share-croppers in the land;
- make necessary entries of crops grown or sown and the area of such crops; and
- any other relevant entries.

After the of publication of 11(1) notification a census of the affected families is conducted , within a period of two months. For the purpose of the survey to be conducted and the census of the affected families to be undertaken by the Administrator, he shall take into account;

- The Social Impact Assessment report;
- The records of the Panchayat, Municipality or Municipal Corporation, as the case may be, and other Government records.

The Administrator shall get the data verified by door to door visit of the affected families and by site visits in case of infrastructure projects in the affected area.

The draft Rehabilitation and Resettlement Scheme prepared by the Administrator shall be given wide publicity through the Official Gazette and two daily newspapers being circulated in the locality and shall be uploaded on the website of the appropriate Government.

An officer authorized shall conduct a public hearing in the affected areas by issuing advance notice of three weeks on the date, time and venue mentioned in the said notice in accordance with the provisions of rule.

7.10.4. Publication of declaration for acquisition

The declaration shall be published by affixing a copy thereof in local language at conspicuous places in the affected areas in FORM V.

7.10.5. Land acquisition award

The land acquisition award referred to in section 23 shall be made in FORM VI and FORM VII annexed in the rules.

7.11 Valuation of Land

In determining the amount of compensation to be awarded for land acquired under this Act, the Collector shall take into consideration the market value as determined under section 26 and the award amount in accordance with the First and Second Schedules:

Secondly, the damage sustained by the person interested, by reason of the taking of any standing crops and trees which may be on the land at the time of the Collector's taking possession there of;

Thirdly, the damage (if any) sustained by the person interested, at the time of the Collector's taking possession of the land, by reason of severing such land from his other land:

Fourthly, the damage (if any) sustained by the person interested at the time of the Collector's taking possession of the land by reason of the acquisition injuriously affecting his other property, movable or immovable, in any other manner, or his iamings; in consequence of the acquisition of the land by the Collector, the person interested is compelled to change his residence or place of business, the reasonable expenses (if

any) incidental to such change; the damage (if any) bona fide resulting from dim inution of the profits of the land between the time of the publication of the declaration under section l9 and the time of the Collector's taking possession of the land: and seventhly, any other ground which may be in the interest of equity, justice and beneficial to the affected families.

29(1) The Collector in determining the market value of the building and other immovable property or assets attached to the land or building which are to be acquired, use the services of a competent engineer or any other specialist in the relevant field, as may be considered necessary by him.

(2) The Collector for the purpose of determining the value of trees and plants attached to the land acquired, use the services of experienced persons in the field of agriculture, forestry, horticulture, sericulture, or any other field, as may be considered necessary by him.

(3) The Collector for the purpose of assessing the value Of the standing crops damaged during the process of land acquisition, may use the services of experienced persons in the field of agriculture as may be considered necessary by him.

30. The Collector having determined the total compensation to be paid, shall, to arrive at the final award, impose a 'Solatium,' amount equivalent to one hundred per cent of the compensation amount.

Explanation.-For the removal of doubts it is hereby declared that solatium amount shall be in addition to the compensation payable to any person whose land has been acquired.

(2) The Collector shall issue individual awards detailing the particulars of compensation payable and the details of payment of the compensation as specified in the First Schedule.

(J)In addition to the market value of the land provided under section 26, the Collector shall, in every case award an amount calculated at the rate of twelve percent per annum on such market value for the period commencing on and from the date of the publication of the notification of the Social Impact Assessment study under sub-section (2) of section 4, in respect of such and, till the date of the award of the Collector or the date of taking in possession of the land, whichever is earlier.

7.12 Land acquisition of the project and rough cost estimates

The Project does not displace any houses or shops for the project activities. Only land is required to the extent of 1765 ha and the agricultural land will be acquired , as per the conditions of 'Right to Fair Compensation and Transparency in Land Acquisition , Rehabilitation and Resettlement Act '(RTFC&LARR Act), 2015. The compensation matrix as per this rules are summarized in Table 7.8 below;

Table 7.8 Compensation matrix

Compensation/eligibility	Value/ rates
Compensation for Land value	Rural -market value of land x 2 + 100% solatium of compensation
Value of structures	Value of structures and assets like wells, few pump houses etc may have to be paid
Residential PDPs House owners/ affected family staying in the area for more than 3 years ,if displaced	No residential structures impacted. Hence not applicable
Land for land option (in case of irrigation	Provision for Land for land –as far as

projects)	possible one acre of land in the command area For SC/ST 2.5 acres land . not applicable in the case of this project
Income tax and stamp duty	Stamp duty/registration fee to be paid by the requiring body and not from the PAP

7.13 Eligibility criteria for the Project affected/displaced

- **Project Displaced Persons** are those losing their residence and livelihood due to the land acquisition for the construction of the project. They may be a resident performing agriculture activities or self-employed earning their livelihood, in the project affected area and staying there for a minimum period of one and half year, before the declaration of the project .
- **Project affected families** are families including Husband, Wife, children and others who are residents of the affected area, for period of not less than one year from the declaration of the project under section 4(1) notification date (cut off date).
- **Affected persons /affected land** includes Persons/families owning the land in the affected area which does not exceeds 10 Hectares and is not less than 0.25 Hectares and this land is partially or fully acquired for project , is considered as affected person / affected land.
- **Person/families who doesn't holds the land** in the affected area means those who do not have more than 0.25 Hectares in the project affected area and such or any part which is acquired for project.
- Ex-gratia grant for the project affected families who lost their agricultural land.

1. Joint families who have lost their agricultural land jointly owned , will get the Compensation amount for the land as per LA rules in the name of owner of the property as single Cheque In addition to this other heirs of the property are eligible to obtain single Ex-gratia amount for buying another land .

2. Jointly owned agricultural land will be classified as grade I, II & III respectively, if such case the complete amount of the jointly owned agricultural land is solely belonged to the affected family at any condition on the basis of friction among the hires they cannot be separated and also the affected families cannot be classified.

3. The Agricultural land acquired from the members of affected families either solely or jointly, if the other member of the family hold the land shall be affected will also be calculated as individual agricultural land. But all these hires that possess the land in joint ownership are eligible to get one ex-gratia.

4. The affected families who owned the agricultural land in joint ownership, but if the family members have their individual houses & all the land & house shall be acquired, for such families to buy the agricultural land /under the Revenue scheme the ex-gratia is paid in the name of jointly hired family member, however the jointly hired person shall be sanctioned a site and compensation to construct the house.

5. III category affected families Rs 5000/- is provided as ex-gratia grant and Bank loan of Rs 2,500/- and also Rs 7500/- of share investment has been included. This scheme shall be completely executed and because of no reason the bank loan shall be granted and ex-gratia shall be granted after the investment from the affected families.

7.14 Land value fixation

As detailed above, the District Collector fix up the market value of the land in each village considering the land transactions in the area for the last three years and on mutual discussion with the land owners. Realistic cost estimation can be done only on the basis of this.

But to work out rough estimation of the cost, the market value of the land in the nearby Singtalur irrigation project is considered as detailed in Table 7.9 below;

Table 7.9 Cost Estimates of land

Guidance value of land	Approximate area	Cost as per market value	Market value x 2 x 100% solatium
Dry land (3,00,000/- per acre)	3906 Acres (1581 Ha)	117.03 cr	468.72 crore
Wet land (1,75,500/- per acre)	nil		

There are no R&R costs involved other than the ex gratia payments, as detailed above which need to be further worked out, based on the actual status of the PAPs. Land for land and compensation for some PAPs in the area need to be discussed further to arrives in to consensus but most of them prefer monetary compensations than other supports.

Cost of compensation for the crops under cultivation, trees and plants in the acquired land etc will be worked out at the time of acquisition process to add to the above costs.

The Department has already initiated action to initiate the land acquisition process in association with the District Collectors.

7.14.1 Environmental Public Consultation

Environmental Public Consultation was condcucted at at Nandawadagi Village, Hunagund Taluk, Bagalkot District on 25.07.2016, Salwadagi Village, Muddebihal Taluk, Vijayapura District on 26.07.2016 and Tondihal Village, Lingasugur Taluk, Raichur District on 27.07.2016 respectively as per the procedures laid down in EIA, Notification-2006. Observations rised during the EPC were complied and presented along with the Executive Summary of the project.

7.15 Risks and Hazards associated with the project

It is the major construction activity that includes majority of work of excavation ,followed by civil construction activity ,pumping installation duly integrated with power supply installation infra and command area network infrastructure All activity will be coordinated in staggered manner and in sync. All activities are hazardous in nature due to major construction having inherent risk. Catastrophic events like cloud bursts and flash floods, earthquake or any act of god, arson, sabotage, etc which is beyond control of KBJNL management shall be in the purview of District administration to control and mitigate. They will assess and appraise the offsite DMP prepared by KBJNL and hence take lead at times with discretion . Under NDMA 2007 guideline district authority shall be well equipped to deal with aforesaid eventualities, they mobilize resources and enact all stakeholders to perform with due diligence .

In project when conceived and technically through w.r.t statutory clearance subsequent activity in field work will be planned and arranged . In the irrigation project major activities are likely as under ;

- Excavation for intake canal and for construction of jack well cum pump house and canal networks

- Pumping to lift water to higher level for proposed command area. Dedicated power supply grid for pumping.
- Network for command area for micro irrigation.
- Management for safety, Health and environment .

Towards hazard mapping in this project, summarily following hazards are being identified;

7.15.1 Accident hazards

Falls from elevated surfaces/levels (bridges, dams, high floor of a building veranda/surface without railing, roofs, etc.) or from ladders; falling into acellar, shaft, trench or open pit; falling while working on a project site – falls from cliffs and slopes, falls into pits, etc.

7.15.2 Slip, trip or fall on the level

Injury/death as a result of collapse of an excavation, trench, floor or wall of a building or of an auxiliary structure; collapse/buckling of components in a structure that is being built; collapse and slide of piles of materials or of stored building equipment; landslides of soil and stones

7.15.3 Injury caused by falling objects

- By stepping on sharp objects and by impact and collision with sharp or protruding objects Risk of being hit by heavy mechanical equipment/vehicles working on a site
- Other peripheral risks are Contact with and exposure to extreme temperatures (during outdoors work, at extreme temperatures); or cold/frost bites
- Electrocution as a result of unintentional contact with "live" electric wires during inspection and supervision rounds through the construction area
- Eye injury, caused by flying splinters/particles of stone and metal, building operations in the area Injury as a result of a fire and/or explosion of flammable materials at the site (bitumen, tar, solvents).
- Increased risk of traffic accidents, when working simultaneously on numerous sites, requiring much additional driving.

7.15.4 Physical hazards

Exposure to strong and continuous noise in work areas (emanating from compressors, pneumatic hammers, vibrators, and similar sources) Exposure to various environmental factors, inc. extreme heat or cold, strong solar radiation, heat-load, drying, excessive moisture content, increased or reduced environmental air-pressure, etc.

7.15.5 Chemical hazards

Potential hazard of being exposed to noxious dust when staying on the work site. Dermatitis caused by contact with irritating and allergenic materials (e.g. –cement dust). While visiting the work site an engineer may be exposed to hazards created by other workers – for example: exposure to organic solvents, thinners and paint removers when at the same time a paint job is being performed at the site.

7.15.6 Biological hazards

There are no specific biological hazards, except potential exposure to infectious diseases, like influenza, as a result of close contact with construction workers that contracted such diseases; or development of dermatitis and irritation as a result of

drinking polluted water at the site, contact with allergenic vegetation or with insects (inc. wasps and bees) snakes and similar creatures located on the work site.

7.15.7 Ergonomic, psychosocial and organizational factors

Musculoskeletal injuries, esp. those stemming from work posture, from prolonged driving, etc.Environmental sources of physical and chemical inconvenience and suffering(e.g. – air pollution, bad odours, noxious noise, defective illumination, sick building syndrome, etc).

7.15.8 Preventive measures

All work surfaces shall be properly installed in order to prevent their collapse/breakage, and to prevent people or objects falling out of them; they as well as all cavities and openings, must be securely fenced; safe and stable positioning of ladders is a must; all open pits, in the field and in the work areas must be safely fenced Wear safety-shoes with non-slip soles; it is also possible to roughen (by various techniques) all or some of the work surfaces.
All means for preventing worker injury shall be applied prior to and during excavation; compliance with the specific regulations dealing with excavation is a must. Use of personal protection equipment fit for protecting the whole body, viz., crash helmets, safety shoes and goggles. In order to prevent dehydratation, all workers should drink enough water; use gloves and safety clothes according to need Wear safety shoes that have inherent isolation, and do not work with detective tools.

7.15.9 Excavation Specific Hazards

Hazards in the excavation which is the major activity, can be identified as under – 1)Excavation cave in/collapse 2)Excavated material and handling 3)Falling object/s near site 4)Powered mobile equipment 5)Slip trips and falls 6)Hazardous atmosphere 7)Flooding water 8)underground facilities

Excavation and trenching are among the most hazardous construction operations. It defines an excavation as any man-made cut, cavity, trench, or depression in the earth's surface formed by earth removal. A trench is defined as a narrow underground excavation that is deeper than it is wide, and is no wider than 15 feet (4.5 meters).

7.15.9.1 Dangers of Trenching and Excavation

Cave-ins pose the greatest risk and are much more likely than other excavation related accidents to result in worker fatalities. Other potential hazards include falls, falling loads, hazardous atmospheres, and incidents involving mobile equipment. Trench collapses cause dozens of fatalities and hundreds of injuries each year.

7.15.9.2 Protective Systems

There are different types of protective systems. Sloping involves cutting back the trench wall at an angle inclined away from the excavation. Shoring requires installing aluminum hydraulic or other types of supports to prevent soil movement and caveins. Shielding protects workers by using trench boxes or other types of supports to prevent soil cave-ins. Designing a protective system can be complex because to consider many factors: soil classification, depth of cut, water content of soil, changes due to weather or climate, surcharge loads (eg., spoil, other materials to be used in the trench) and other operations in the vicinity.

7.15.9.3 Competent Person / Safety Engineer

As per standards require that trenches be inspected daily and as conditions change by a competent person prior to worker entry to ensure elimination of excavation hazards. A competent person is an individual who is capable of identifying existing and predictable hazards or working conditions that are hazardous, unsanitary, or dangerous to

employees/labors and who is authorized to take prompt corrective measures to eliminate or control these hazards and conditions.

7.15.9.4 Access and Egress

It requires safe access and egress to all excavations, including ladders, steps, ramps, or other safe means of exit for employees working in trench excavations 4 feet (1.22 meters) or deeper. These devices must be located within 25 feet (7.6 meters).

7.15.10 General Trenching and Excavation Rules

- Keep heavy equipment away from trench edges.
- Keep surcharge loads at least 2 feet (0.6 meters) from trench edges.
- Know where underground utilities are located.
- Test for low oxygen, hazardous fumes and toxic gases.
- Inspect trenches at the start of each shift.
- Inspect trenches following a rainstorm.
- Do not work under raised loads.

7.15.11 Hazards specific to construction activity

This project can be divided into 2 parts. 1)construction period 2)completion .In the construction part we are appraising hazards as well as risk vis-a-vis mitigation measure. In the likelihood of any mishaps offsite DMP shall be ready as per NDMA guideline .

7.15.12 Nature of occupational injuries in construction

Occupational injuries from construction activities in general are classified by Danger of physical injury and fatality; Damage to health. Construction accidents resulting in physical injuries and fatalities can be broadly categorized into the following eight basic groups;

7.15.12.1 Physical injuries and fatalities

1. Falling from heights – involves workers falling from higher floors to lower floors/ground and falling from ground level to excavation level.

2. Struck by falling/moving objects/vehicles – primarily involves workers being struck by equipment, private vehicles, falling materials, vertically hoisted materials and horizontally transported materials.

3. Excavation related accidents – encompasses accidents due to cave-in, contact with underground utilities, subsiding of nearby structures, falling of materials/vehicles/ objects onto people working in the excavation as well as fumes, gases and inrushes of water at the bottom of excavations.

4. Accident by operation of machinery/tools – caused by toppling of machinery, collapsing of the parts of machinery and unsuitable or unsafe hand-held tools.

5. Electrocution – caused by contact with electric current from machinery, tools, appliances or light fixtures, faulty electrical equipments and tools, and contact with overhead/underground power lines.

6. Fire/explosion – accidents resulting from the explosion of pressure vessels or gasoline pipes and fire due to welding/hot works.

7. Failure of temporary structures – accidents owing to the failure of formworks and scaffoldings.

8. Others - e.g. slipping on the same level, oxygen deficiency in confined spaces, lightning strike, etc.

The nature of health hazards that may be caused to construction workers are shown as under:

7.15.12.2 Health damages in construction

1. Skin diseases Contact with cement, slaked lime, paint, varnish thinner, solvents, strong chemicals, grouts, seals and adhesives.

2. Hardness of hearing Noise

3. Respiratory disease Inhalation of toxic dusts, vapor and gases

4. Muscular and bone disease High static stress, unnatural working postures

5. Cancer Carcinogenic materials

6. Mental illness Stress, inhalation of toxic materials affecting brain and central nervous system

7. Disease caused by vibration

The root causes of occupational accidents on construction sites can be listed as under in four clusters. Root causes of construction accidents cluster factor as under:

1. Working condition
    - Type of work
    - Work location
    - Status of tools, equipment and temporary structures
    - Physical layout of the workplace
2. Management failure
    - Poor housekeeping
    - Violation of workplace safety standards
    - Poor supervision and checking of work progress, tools, equipment and temporary structures
3. Unsafe acts of workers
    - Disregarding safety rules
    - Horseplay
    - Skill and training
4. Non-human related events
    - Unexpected ground conditions/terrain
    - Adverse weather/earthquake/tsunami, etc. on site.

The working condition is an inherent hazard with the work owing to the scope and location of the project. The inherent hazard is managed through a safety management system, which can cause occupational accidents when flaws exist. The negligent attitude of workers to forego safety standards also causes accidents, although it is less quantifiable. Non-human related events are beyond control and prediction. Hence the estimation of occupational injury risks in construction projects should assess two factors:(1) project's inherent hazard level and (2) safety management level.

They expose workers to similar hazards and accidents. Workers in the underground construction industry, especially water, sewer and utility line .Traditionally had a higher accident and injury rate than other workers in the heavy construction industry. Accidents in excavation works occur in one of the following ways:

1. Collapse of sides/cave-in: Cave-in is perhaps the most feared and chief cause of accidents in excavation works. It buries workers and/or cause crushing injuries to survivors.

2. Contact with underground utilities: Works in excavations often encounter obstructions from intersecting utilities lines that may cause injuries and/or fatalities to workers by:

(A) electrocution and/or explosion when electrical cables and/or gasoline pipes are damaged; (B) collapse of excavation due to flooding led by damage to water lines and/or sewer lines; and

3. Dangerous atmospheres: Dangerous atmospheres in excavations may result from oxygen deficiency as well as the presence of carbon dioxide, carbon monoxide, nitrous fumes and methane gas, which suffocate workers, kill or cause respiratory problems.

4. Workers being struck by falling materials/objects from top.

5. Workers falling into excavations.

7.15.13 Work at Height Hazards

Cranes are remarkable and invaluable tools for hoisting and carrying, but they are heavily represented in the industrial injury and fatality statistics. Most of them occur in the construction industry.crane fatalities occur in the construction industry.An identified five crane-related hazards:

(1) overturning of a crane or the structural failure of its parts;

(2) dropping of the suspended load;

(3) electrocution;

(4) trapping of people; and

(5) accidents during erection and dismantling as well as loading and unloading. The causes of different crane failures have been infers that the overturning of a crane or parts of it occur due to overloading, differential settlement of the crane support or foundation, operating on slope (for mobile cranes) and/or operating method. It has been reported that basic causes of dropping the load are overloading and improper maintenance of the crane and its parts. Finding also infers that electrocution and trapping are caused due to lack of communications between the operator, slingers and flagman/supervisor whereas erection and dismantling injuries are caused by unsafe work practice of erectors and lack of supervision.

7.15.14 Construction machinery and tools hazards

Of all the construction industry fatalities may also occur with construction machinery The types of machinery involved in accidents include excavators and shovels, earthmoving equipment (i.e. crawler tractors and bulldozers, scrapers and graders), dumpers and dump trucks, forklift trucks, road rollers and lorries. Accidents in construction machinery usage occur in one of the following modes;

- Workers being run-over or struck by machinery moving forward or reversing;
- Collision between machinery or with fixed objects such as false works or scaffoldings;
  Overturning of machinery while in operation; and
  Workers falling from machinery.
- These accidents are caused by the following major factors: Failure of machinery- inoperative back-up alarms, brake failures, etc
- Inadequate site planning resulting in poor visibility, inadequate man oeuvre space, inadequate signboards and poor site traffic control; Lack of supervision and training of workers and operators; and Construction noise that masks the sound of back-up alarms and the sound of plant.

- It is also observed that in the some of event in accidents the primary external factor was hand-held tools as sorted construction tools in descending order of hazard, viz: (1) Knife; (2) Hammer, sledge hammer, etc.; (3)Grinding/cutting machine; (4) Jackhammer; (5) Drill; (6) Manual saw; (7) Crowbar, spit, etc.; (8) Tools for screwing; (9) Welding equipment – gas; (10) Axe; (11) Spade/excavation tools; (12) Gripping, holding, pinching, pulling tools; (13) Chainsaw; (14) Nail gun; (15) Compass saw, hole saw, etc.; (16) Welding equipment –electrical; (17) Circular saw; (18) Cutting tools; and (19) Other tools. Use of construction tools cause injuries and fatalities to workers by the following ways;
- Eye injuries caused by foreign objects getting into eyes by operations such as grinding, welding, cutting, drilling and breaking;
- Finger/hand injuries by cut and burns;
- Injuries caused by moving/broken machine parts;
- Electrocution; and Vibration from powered hand-held tools, causing a group of diseases. One of themis blood circulation disturbance known as "vibration white finger".
- Specialty systems. Most of the hazards are the result of faulty tools and/or unsafe handling of tools. Moreover, the type of tools and duration of use also dictate the hazard.

Major hazards and mitigation measure shall be delineated and shall be considered in OHS management towards safety in all respect due to multidiscipline activity . It also need extremely well coordination and sync in activity under project leader. All contractor s ,team, stakeholders shall comly with OHS policy prepared exclusively . It will be a duty of employer to get all employee aware of hazards and risk they may be vulnerable and ensure that it to be his conscious decision as being instrumental in part of project activity. Mock drill shall also be planned to bring alertness as well as preparedness for the mishaps

We have considered all hazards and risk associated with projects . However it can be checked and stalled with OHS plan in place before and during execution. It should be specific to this particular activity and shall be evaluated at regular interval during construction as well as after construction. Post installation an offsite DMP shall be prepared in line with district authority requirement and shall be approved.

7.16 Dam break analysis for Almatti and Narayanpur Dams[24]

The objectives of dam break study is to estimate the apprehended inundation down stream of the Almatti and Narayanpur dams in the event of dam breach. The Dam break study for Almatti and Narayanpur dams has been carried out by Central Water Commission, Consultants for KBJNL. The Almatti dam is a composite structure of masonry cum earthen and since, earthen portion is more prone to failures in comparison to the masonry portion of the dam, the sensitivity analysis has been carried out for the earthen portion only for six cases of dam breach. Similar condition of earth dam breaching is considered at Narayanpur dam for sensitive analysis for eleven cases.

The backwater of the Narayanpur dam extends up to toe of the Almatti dam. Dam break study is made for a condition of Almatti dam being at FRL at 519.60 M and the design flood impinging on the storage. For an assumed breach of earth dam portion of Almatti dam, breach has been studied using different breach widths, breach development time and side slopes. Maximum discharge through the breach has been worked out considering the maximum water level and the ground level of the

[24] Report on Disaster Management(2005), Water Resource Dept., Govt. of Karnataka

embankment. The breach width, development time and the breach depth has been worked out as per guidelines of the U.S. Federal Energy Regulatory Commission. It is also done for different slopes of the breach, to conclude that breach slope has very little effect on the dam breach flood. The combined outflows through the breach and the spillway, obtained for the breach as per the breach parameters, are taken as inflow for the dam break study of the Narayanpur dam. For another alternative, the initial outflow from Almatti (including flows through breaches) is added with the PMF of Malaprabha dam considering Narayanpur dam as not existing. The water levels reached downstream of Narayanpur dam at various cross sections and the time of occurrence of peak flows is worked out. The time of occurrence of peak flows at various locations has been reckoned from the time of impingement of probable maximum flood (PMF) at Almatti.

From the analysis of the three alternatives, it is seen that, for a condition of breach of both Almatti and Narayanpur dams, the outflow is the highest and the levels of the peak reached at various locations is assessed. To get the maximum water level for the case of failure of both Almatti and Narayanpur dams, the flood hydrographs have been considered as impinging on the Narayanpur reservoir at FRL of 492.5 m.

7.17 Inundation mapping and flood damage (Vulnerability) mapping

The methodology of dam break involves quick estimation of dam break flood wave and its characteristics such as peak flows, peak stages and their respective timings at the dam site and at the specified locations in the downstream of the dam. The basic procedure used for preparation of inundation maps relies on dam breach and the movement of the resulting flood wave down the river valley. The results of sensitivity analysis are applied to prepare the inundation maps. The basic data required for preparation of inundation maps are as follows:

- Hydrological details
- Reservoir details
- Dam details
- Downstream valley cross-sections
- Valley roughness characteristics.

In the dam break analysis study carried out all the above parameters have been considered except downstream valley cross- sections and valley roughness characteristics, which are required for preparing inundation maps. The results of the dam failure flood routing are interpreted and mapped into inundation and/or flood damage maps. Basically, an inundation map depicts isolines of flood depth downstream of the valley.

In order to estimate the likely consequences of dam failure, it is required to carry out the following analysis:

- Flood damage analysis
- Inundation / flood damage mapping
- Hazard assessment.

A hazard assessment will then be carried out to estimate the number of buildings or structures that could be affected. The population at risk in the inundation areas at various locations down stream of the dam where the minimum warring time for effective evacuation could be assessed. In the instant case about 5 days is available from the onset of breach till the flood wave reaches the last cross-section.

The flood inundation maps represent the area prone to flooding by one or more floods with given return periods. The overall objective of the mapping is to reduce flood

damages, through improved land use planning and emergency preparedness. The main target groups for emergency planning at local level would be various Government organizations. The overall objective of the mapping is to reduce flood damages, through improved land use planning and emergency preparedness. The main target groups are, Village Panchayats, Taluk and district level Administrations, Engineering, Transport, Police, Agriculture, Telecommunication Departments; military personnel and non-Governmental organisations.

In the study of dam break analysis, the levels and the time, the peak flood reached at various locations have been worked out for a distance up to 115 kms. Cross sections of the river have been plotted at an interval of 1km up to a distance of 10 kms and at an interval of 5 kms beyond. While, determining the depth of inundation downstream of the dam, river valley cross-sections and valley roughness characteristics are necessary.

The inundation map for the area downstream of Narayanpur dam has been prepared on a scale of 1 : 50,000. In the inundation map the following details are shown as contained in the report of dam break analysis of Almatti and Narayanpur dams.

- Entire area prone to flood risk
- The route of the flood peak shown as the contour line of the maximum water levels
- Computed peak water levels at different cross sections in the downstream and their timing from the start of the failure of the dam.
- Location of important structures/places etc.
- Details of structures and embankment.

7.18 Disaster Management Plan

A flood is defined as a high flow of water that comes from a body of water and overtops the normal confinements and covers land that is normally dry and floods are the most common and wide spread of all natural disasters. River floods are caused by high or over flowing water from a river and typically occur after unprecedented high intensity rains. When such high intensity rainfall generates floods which will impinge on the storage, if the structure like dams fails due to structural instability or overtopping, the downstream areas would be inundated. The dam break analysis is done for a hypothetical case of failure.

In the report on Dam break analysis or Almatti dam, Central Water Commission has made a mention of the emergency action plan and the details it should include. In the summary or the dam break analysis Central Water Commission has stated as under.

"From table No. 13 and profiles it can be seen that there is no inundation of banks of the river at any cross-section for all the above 3 conditions. Hence, the carrying capacity of the river channel downstream of the dam is quite adequate to handle the PMF of Almatti dam and as well as PMF of Malaprabha a river in spite of a dam break event. However the inundation beyond the normal course of the river in the crest of the dam breach flood, is to be plotted on a suitable scale of 1:50,000 to 1:25,000 with contour intervals of 1 to 2m as available for a total reach of 115 kms."

The emergency planning for dam break *scenario* consists of aspects such as:

- Provision of evacuation pathways
- Setting up of alarms and warning systems
- Establishing communication systems.

In the model disaster management plan prepared by Central Water Commission, action to be taken before and during and after floods have been identified separately. There are 23 items of pre-flood arrangements and 17 items of arrangements during and after floods. The items of arrangements contained in the model plan of Central Water Commission, are for general application all over the country. Whereas items of arrangement listed in the report on the dam break analysis of Almatti dam are of specific application. Keeping these specific items, emergency action plan (disaster management plan) has been prepared in the event of breach of Almatti and Narayanpur dams. The action plan contains the following details:

- Maps of the entire area prone to flood risk downstream of Narayanpur dam to a scale of 1:50,000 are prepared to cover a river stretch of 115 kms, showing the inundation area.
- The cross-sections across the river used for the study.
- The probable maximum water level at the cross-sections.
- The habitations in the reach of the river coming within inundation zone are identified and listed.
- The maximum levels attained due to dam breach flood and time of occurrence with reference to the time of impingement of PMF has been identified for all villages within the inundation zone. In addition to the above, the following details have also been included in the emergency action plan.
- Details of infrastructure/facilities available in the villages situated in the inundation zone, which could be mobilized during emergency.
- A list of officers with telephone and code numbers who will be appraised in case of emergency.
- A list of villages situated within the inundation zone with lowest level, highest level and the probable maximum flood level.
- A statement showing the villages coming in the inundation zone and the number of families.
- The number of transport vehicles required for shifting and number of sheds required.
- Statement showing locations where boats are available in case of emergency and could be mobilized.
- A list of locations where wireless sets are available.
- A list showing the villages in which public telephone facilities are available.

For the villages coming under the submergence of Almatti reservoir such action plans were being prepared for duration of five years and relief materials were used to be mobilized. From the time of occurrence of the peak flood at the nearest location downstream of Narayanpur dam it is seen that a minimum period of 128 hrs to 135 hrs is available from the time of breach of both Almatti and Narayanpur dams. It can be seen that there is a time of more than 5 days is available which is good enough for mobilizing relief in case of emergency.

Each year before the onset of monsoon a meeting of all the important district officers and connected officers of KBJNL will be convened by the Managing Director, KBJNL for a briefing about the emergency action plan the infrastructure available and the sources for mobilizing the relief material. In case of occurrences of any emergency situation, immediate information will be flashed to the district heads of Revenue, Police, Health

and Transport departments. The Chief Engineer, KBJNL, UKP, Almatti will be the nodal officer. The officers of the district will move to the inundation area and discharge their assigned functions as per the emergency action plan.

7.19 Likely inundated areas

The map of entire area prone to inundation, due to the breach of Almatti and Narayanpur dams, has been prepared on the contour map of scale 1:50,000 as well as on a map of 1:10,000. The cross sections below Narayanpur dam have been taken at an interval of 1 Km. up to a distance of 10 kms and at interval of 5 Km. beyond 10 Km. Such cross-sections are taken up to a distance of 115 Kms. from Narayanpur dam. The probable maximum water levels at these cross-sections have been worked out.

From the study it is noticed that the maximum level that will reached between Almatti and Narayanpur dams is 493.5m, (492.5 + 1m) and all the villages coming under submergence of Narayanpur dam have already been shifted and rehabilitated. Therefore, no village will come within the flood zone due to reach of Almatti dam.

Below Narayanpur dam, the river traverses through hilly track up to cross-section No.14, i.e., up to 30 kms., from Narayanpur dam. In this reach no village would come under flood zone due to breach of Narayanpur dam. In the river reach, after cross-section No.14, that is from cross-section 14 to 31, villages have been identified, coming within the flood zone.

The villages affected due to inundation, on account of flood up to the determined levels, at every cross-section, are identified. The name of village, flood level and time of occurrence of flood at that particular cross-section have also been identified. Based on these details, the map showing probable level of affected village and cross-sections is prepared. The total number of villages affected will be 68 numbers.

7.20 Emergency action plan

7.20.1 Flood warning system in catchment area:

With the advancement in the technology such as satellite and remote sensing, flood waves can be tracked as they move downwards. The linkages will be established with satellites and information will be utilised through remote sensing equipments. The inflow flood forecasting, in the catchment up to Almatti dam, will be an important input data for regulation of outflow flood from Almatti dam. The spillway gate operation schedule for flood management at Almatti and Narayanpur reservoirs is prepared. In the schedule, recommendation for gate operation procedure during normal flows, sequence of opening or closing of gates. Methodology regulation at Almatti and summary of flood regulation procedure are given.

The Central Water Commission maintains close contacts with the administrative and State engineering agencies, local civil authorities to communicate advance warning for appropriate mitigation and preparedness measures. Except flash floods, the timely evacuation can be planned and managed. Central Water Commission, Government of India is in the charge of flood forecasting for Almatti dam regulation. Action is being taken to regulate the reservoirs as per the gate operation schedule as and when the flood forecasting information is received. The flood forecasting would be done a day earlier with respect to the following day. The flood forecasting will be done at 0730 hours and at 15 hours for the following day and it will be intimated to the Executive Engineers of Dam Division, Narayanpur and Almatti and other Officers in charge of the dams. While communicating, the probable flood inflows into Almatti and Narayanpur, are classified into moderate flood, high flood and very high floods. The classification of floods is as follows:

- Moderate flood - Above 1 lakh cusecs

- High flood - Above 2 lakh cusecs
- Very high flood-Above 3 lakh cusecs

7.20.2 Flood warning system due to breach of Narayanpur dam

The flood warning will be put in place as soon as flood forecasting information is received and assuming the breach of Almatti and Narayanpur dams or either any one of them would probably occur. The emergency staff will be alerted to swing in action immediately. Helpline at important places to assist the people and to meet all types of emergencies would be established. One division headed by Executive Engineer with necessary Sub-divisions is in-charge of Almatti dam and also similar arrangement is made for Narayanpur dam. The various Officers of different establishments will be immediately informed once the breach is apprehended. Even during normal flood conditions, there is a practice through which, the people living downstream of the dam will be alerted by various organizations of the Government.

The widely time tested communication to reach every corner of the flood affected zones have been radio and television. These communications will be utilised to broadcast the information in all the languages, regarding the flood situation for the people to move to safer places by themselves, instead of waiting for external help, though external help is also available. Such initiative by the population will render external help more effective and reduce the cost and time. The community involvement is a must. The affected community will be given information about the infrastructure available in their immediate vicinity like high elevated places, shelters, private transport and will be trained as to how to use them once warning is given.

Immediate communication will be sent to District Officers of Revenue, Police, Health, Transport, Agriculture and as well as other officers through wireless, Phone, Mobile, and other modes. In addition to the existing communication system, additional communication systems are also proposed. The public will be given information through Radio, T.V and Cable network systems. The officers in charge of relief works will also make arrangements to alert people through motor vehicles mounted sound systems to move to safer places. Administration through district, taluk and local self Government officers will take necessary steps to evacuate the people and monitor relief operations. The higher locations near each village are identified for temporary shifting of the population. The roads and pathways will be constructed for reaching such high elevated places. Village wise requirements of vehicles, food materials, health materials have been identified".

Table 7.10 Emergency contact numbers

Sl.No	Name of the Dept.	Contact No.
A. General Emergency Numbers		
1	Police	100
2	Fire	101
3	Ambulance	108
4	DC Office, Bagalkot	08354-235091
5	DC Office, Raichur	08532-229011
6	DC Office, Vijayapura	08352 - 250021

Table 7.11 Emergency contact number of KBJNL

Sl.No	Name of the Dept.	Contact No.
1	Office of the Secretary, WRD, Bangalore	080-22255524
2	Office of the Managing Director, KBJNL, Bangalore	080-22277393
3	Office of the Chief Engineer, Almatti dam, Almatti	08426-281038
4	Office of the Chief Engineer, Narayanpur dam, Narayanpur	08444-229653

Chapter 8. Project Benefits

Upper Krishna project in Karnataka is believed to be lifeline of northern parts of Karnataka. The project is irrigating 6,22,000 Ha command area benefitting most backward districts and drought prone areas. Some of the important project benefits of the current modernization works include:

- Agricultural linkages will be considerably improved.
- The project improves total farm output and hence raises farm income.
- Project improves yields through reduced crop loss due to erratic, unreliable or insufficient rainfall. The details before and after the advent of irrigation is given below.
- No new structures is proposed across the river.
- It allows a greater area of land to be used for crops in areas where rain fed production is impossible or marginal.
- Extensive agricultural production supplies raw materials to the nearby small scale industries thereby increasing the economy in the region.
- Altogether, population of 291 villages belongs to 5 taluks will be benefitted directly under the scheme.
- Direct employment opportunities for 300 members during construction phase and 50 members during operation phase of the project. Further, indirectly labor opportunities will be substantially improved since larger area will be brought under irrigation.
- It improves fodder crops and in turn dairy farming in the command area.
- Increased benefits of water conservation through adoption of drip irrigation for the 60100 command area.
- Zero water logging and salinity problems. Weed and disease reduction due to adoption of micro irrigation.
- Labor requirements will be considerably reduced.
- No rehabilitation and resettlement.
- No tree cutting involved and only 6.60 ha of forest land is required for implementation of the 9A distributory for which forest clearance was obtained under Forest (Conservation) Act, 1980.

Chapter 9. Environment Management Plan

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

Table 9.1 Environment Management Plan

Project Activity	Impacts	Mitigation measures	Advantage	Location	Responsibility & Monitroing Agency	Time frame
A. Construction Phase						
1. Air Environment						
Fuel combustion from construction equipments	Emission of pollutants (PM, SO_2)	High speed Diesel with low sulphur content will be used for the construction equipments/ vehicles which has low ash content	Reduction in pollutants level	Intake canal, jack well cum pump house	Contractor & KBJNL	Thorough out the construction period (24 months)
Vehicular movement and operation of batching plants	Dust pollution	Water sprinkling and vehicles should be covered with tarpaulin, speed limit restrictions	Reduction in fugitive emissions	Intake canal, jack well cum pump house, access roads, around construction site, disnets	Contractor & KBJNL	Water sprinkling - 3 times/day
Burning of fire wood	Emission of pollutants (C, SO_2)	Labor camps supplied with LPG facility	Reduction in emission levels	Labor camp	Contractor & KBJNL	Thorough out the construction period (24

Project Activity	Impacts	Mitigation measures	Advantage	Location	Responsibility & Monitroing Agency	Time frame
Operation of DG sets, excavation	Health problems to labors	Usage of Nose masks	Healthy working environment	Intake canal, jack well cum pump house, access roads, around	Contractor & KBJNL	Thorough out the construction period (24
2. Noise Environment						
Operation of DG sets and usage of construction equipments	Increase is noise levels	PPEs such as, ear plugs and ear muffs will be provided to the workers, Acoustic enclosures for DG sets	Reduction in noise levels	Intake canal, jack well cum pump house, access roads, around construction site, disnets	Contractor & KBJNL	Thorough out the construction period (24 months)
Vehicular Movement	Increase is noise levels	Construction activities shall be restricted only to day time	Reduction in noise levels	Intake canal, jack well cum pump house, access roads, around construction site, disnets	Contractor & KBJNL	Thorough out the construction period (24 months)
3. Water Environment						
Sewage from labor camps	Surface and ground water pollution	Treatment through septic tank and soak pit	Reduction in pollution load	Labor camps	Contractor & KBJNL	Thorough out the construction period (24 months)
Stagnation of water	Mosquito breeding grounds	Providing proper sanitary facilities	Healthy environment	Labor camps	Contractor & KN KBJNL NL	Thorough out the construction period (24 months)
Excavation and operation of DG sets	Muck generation, blockage of natural drains	Reuse of muck at site, disposal of used oil KSPCB authorized preprocessors	Reduction in surface and ground water contamination	Intake canal, jack well cum pump house, disnets	Contractor & KBJNL	Thorough out the construction period (24

Project Activity	Impacts	Mitigation measures	Advantage	Location	Responsibility & Monitroing Agency	Time frame
	and contamination of ground water					months)
Construction of intake canal	Increase in turbidity levels in river	Provision of sand bags	Healthy aquatic ecosystem	intake canal	Contractor & KBJNL	4 Months
4. Soil Environment						
Construction of labor camps, stock yards	Loss of fertile soil	Waste land will be used for erection of labor camps	Land resource optimization	Waste land	Contractor & KBJNL	Thorough out the construction period (24 months)
Mantainance of DG sets and construction machineries	Soil contamination	Maintenance at service centres	Reduction in soil contamination	Intake canal, jack well cum pump house, access roads, around construction site, disnets	Contractor & KBJNL	Thorough out the construction period (24 months)
5. Solid and Hazardous waste Environment						
Excavation	Change in hydraulic regime	Reuse of excavated earth	Natural drainage pattern maintained	Intake canal, jack well cum pump house, disnets	Contractor & KBJNL	Thorough out the construction period (24 months)
Improper dumping of solid waste from labor camps	Water pollution	Labor camps at 1 km away from river, Disposal to Municipal Authorities	Reduction in siltation and eutrophication	Intake canal and river course	Contractor & KBJNL	Thorough out the construction period (24 months)
6. Biological Environment						
Construction activities	Wilting of plants	Water sprinkling	Normal photosynthetic	Intake canal, jack well cum pump	Contractor & KBJNL	Thorough out the

Project Activity	Impacts	Mitigation measures	Advantage	Location	Responsibility & Monitroing Agency	Time frame
			activity	house, access roads, around construction site, disnets		construction period (24 months)
Labor camps	Riverine water pollution	Labor camps at 1 km away from river, restrictions for not using the river water	Zero water pollution	Labor camps	Contractor & KBJNL	Thorough out the construction period (24 months)
Use of fire wood	Cutting of trees	LPG for labor camps	Positive ecosystem services	Labor camps and its surrounding	Contractor & KBJNL	Thorough out the construction period (24 months)
Washing of construction equipments	Reduced DO levels	Washing at authorized service stations	Aquatic system maintained	Krishna river	Contractor & KBJNL	Thorough out the construction period (24 months)
Diversion of 6.60 ha of forest land	Loss of forest area	Compensatory afforestation in an area equal to the forest land to be diverted	Loss of forest can be compensated as per the guidelines	The identification of CA land under progress	KBJNL	As per KFD requirement
7. Socio-economic environment						
Land acquisition	Affecting livelihood	Compensation as RFCLA&TRR Act 2013	Sustainability for livelihood opportunities	In the project impacted villages	KBJNL	6 months
Vehicular movement	Health problems	Water sprinkling and movement of vehicles carrying raw materials only	Healthy environment	In the project impacted villages	Contractor & KBJNL	Thorough out the construction period (24

Project Activity	Impacts	Mitigation measures	Advantage	Location	Responsibility & Monitroing Agency	Time frame
		during night time.				months)
B. Operation phase						
Excess application of fertilizers and pesticides	Soil and water contamination	Awareness on organic farming practices	Reduction in pollution load	Command area	KBJNL and Water user Associations	3 years

9.1 Catchment Area Treatment (CAT) plan

Karnataka is a pioneer state in implementing watershed programmes since 1983.Dry land development boards were constituted at in the divisional level, model watersheds, district level macro watershed programs, DPAP, DDP, IWDP, WGDP, RVP, NWDPRA and more recently from April 2008 Integrated Watershed Development Programme (IWMP).

A state level perspective and Strategic Plan (SPSP) is prepared for the state and entire area (120.85 lakh ha) is contemplated to be treated by the end of XIV th plan period, on 90:10 ratio between centre and state.

In the district of Vijayapura, Bagalkot and Raichur, soil and moisture conservation programmes are being implemented since 1970s and some of the areas are revisited to take up post bund maintenance and similar activities. Desert Development programme is implemented to saturate the rain fed areas for sustainable crop production activities. The details are as under

Table 9.2 Details of watershed treatment

District	Total Sub-watersheds(nos)	Geographical area in (Ha)	Treated Watersheds (Ha)	Available area for treatment (Ha)
Bagalkot	142	659400	589000	70400
Raichur	135	835000	32916	10000
Vijayapura	201	1047500	958200	89300

Some of the methods suggested for soil conservation for the catchment area are given below.

1. Broad based contour bunding on slopes (1-8%)
    - Outward cross slope of 1-8%
    - 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
3. 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
4. Land levelling
    - Low (bottom) flat deep areas levelled.
    - Bench terraces are also levelled by cut and fill.
5. Land slide control
    - Vegetative means
6. Goole
    - 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.

- Needs improvement in regulation.

7. Khatta/khala

- Earthen ponds collecting discharge water of & seepage water.

9.1.1 Cost Estimates as per Soil conservation treatments suggested

- Area to Treated (ha) - 1,14,500
- No. of Check dams (ha)-500
- Cost (Rs. Crores)-10
- Contour bunding /Bench terracing (ha)-11450
- Cost (Rs. Crores)-34.35
- Plantations (ha)-11450 ha
- Cost (Rs. Crores)-37.21

All the horizontal departments such as Horticulture Dept., Agriculture Dept., Forest Dept., Watershed Dept., will be consulted for implmentation of the EMP and the programs of all the deparmtments will be converged in development of the command and catchment area. Year wise, Physical (ha)and Financial Outlay (Rs. crores) Year wise, to treat the watersheds In command area taluks;

Table 9.3 Year wise cost estimates for soil conservation practices

Year	Physical(Ha)	Financial(in lakhs)
2017-18	114500	25
2018-19	80000	15
2019-20	80000	15
2020-21	80000	15
2021-22	80000	11

9.1.2 Reclamation of salt affected soils

- Laying of lateral drains in the proposed command area, the water table should be lowered if it is high and water should be at least 3 to 4 meters below the surface.
- The land should be level or contour farmed so that the surface of the soil will be soaked uniformly by water

9.1.2.1 Management of saline and sodic soils

- Selection of crops or crop varieties that have higher tolerances for salt or sodium
- Use of special planting procedure that minimise salt accumulation around the seed otherwise lowers Germination percentage.
- Use of the appropriate irrigation method for the root characteristics of the crop
- Use of sloping beds and other special land preparation procedures and tillage methods to provide a low salt environment
- Use of canal or surface irrigation water to dilute the salts and to leach out the salts from the root zone for good germination.

- Application of amendments such as manure, compost, etc. for improving soil structure and tilth. Conservation tillage to incorporate crop residues will help create drainage.
- Deep ploughing of soil to break up sodic and other hardpans or other impervious layers to provide internal drainage.
- Use of chemical amendments as described.
- Good, sound agronomic farming practices and careful needbased fertilizer management.

9.2 Command area development plan

9.2.1 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, Almatti and Narayanpur dams.

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,

- Mainatainence of disnets, sumps
- Control structures
- Mainatainence of Automation
- Surface Drainage system
- Farm roads
- Land forming (Smoothening / grading/leveling)

9.2.2 Communication network

- Improved communications in and around command and the reservoir area are necessary for integrated development of the project. These are described as under:
- (a) Ayacut Roads: These are required within the Command Area for transport of inputs and produce.
- (b) Link Roads: These are necessary to connect the command area to ayacut roads. These also include improvement and reconstruction of existing roads to bring them to project standards.
- (c) Transmittal of messages from command areas: A radio/telegraph/telephone network in the command areas is necessary to quickly convey messages, concerning rainfall, demand for canal waters, regulation orders, stage

9.2.3 Training and Agriculture Extension Program

It is important to disseminate information about new technologies so that the farmer is able to make use of the latest agricultural developments. There also exists a gap between research findings and the needs of farmers. For technology to be successful, it is important that it should serve a useful purpose to the end user. The institution that bridges the gap between farmers and agricultural research scientists is the Agricultural Extension Service.

This service works through an Agricultural Research System in the States. Agriculture is a lot more than mere cultivation. Agriculture today is a science that is based on continuing research and a solid foundation of proven data. The more the growers know, the better they cultivate; the more people they can feed, the healthier populations become. There is need to provide farmers training with advanced Agronomy solutions for raising yields, cutting costs and improving quality. In the Training centers experts share knowledge with the farmers.

Hence it is proposed that in the project a training center to be established to train the stake holders and line departments/extension workers. The basic infrastructure like building for training class will be provided by Govt. of Karnataka and the trainers and faculty will be Experts from Drip Industry. A curriculum prepared based on the farmers requirement is given below. The Training rendered to the farmers is:

9.2.3.1 Technical Training

- Introduction to drip Irrigation - Basic drip agronomy and advantages of drip irrigation, Drip irrigation Components, Fertigation and how to Fertigate, Crop wise water requirement and irrigation scheduling
- Maintenance of Drip Irrigation system and chemical treatments (acid ,Chlorination)
- Field visit and practical demonstration on system maintenance
- Crop wise drip protocols & crop production technology with drip irrigation

9.2.3.2 Engineering Training

- Training in Rotation of crops.
- Training in maintenance of Drip system.
- Training in maintenance of Records & Financial aspects.
- Training in Conducting Election of WUA.
- Farmers Interaction with Agricultural department.
- Training in Women's role in Participatory Irrigation management.
- Training on Social behaviour.

9.2.3.3 Agronomical Training

- Training and guidance in Selection of proper plant materials
- Training and guidance in adopting suitable cropping pattern to suit drip irrigation system.
- Training and guidance in Irrigation scheduling through drip Irrigation
- Training and guidance in Fertigation application and scheduling through drip Irrigation

- Training and guidance in Selection of proper fertilizers to enhance productivity.
- Training and guidance in Plant protection practices.
- Training and guidance in Best Management Practices.
- Training and guidance in Harvesting
- Training and guidance in Post Harvest Practices.
- Training and guidance in export packing practices.
- Training and guidance by crop experts in specialized Crops.
- Arranging farmer's field days.
- Arranging farmer's field visits.
- Sharing farmer's experiences.
- Exposure Visits to Progressive Farmers.

9.2.3.4 Mechanical Training

- Training in maintenance aspects of pumping unit.
- Training in maintenance of Centrifugal pumps, Engines and motors.
- Training in installation and adjustments of pumps.

9.3 Green belt development plan

9.3.1 Existing catchment area treatment details

KBJNL under UKP stage-I and II various catchment area treatment works were undertaken since implementation of the project. The details are given under;

9.3.2 Agro forestry activities in command area

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

Table 9.4 Details of area planted by KBJNL Forest Division, Almatti

Sl No.	Stage	Year	Almatti Catchment						Narayanpur Catchment					Grand Total (8+13)
			Block	Road	Village	Canal	Total		Block	Road	Village	Canal	Total	
			(in ha)	(in km)	(in ha)	(in km)	(in ha)		(in ha)	(in km)	(in ha)	(in km)	(in ha)	(in ha)
1	Stage I Phase - II	1993	294.77	-	-	-	294.77		8.00		3.60		11.60	306.37
		1994	589.00	24.00	2.00	-	615.00		36.00	44.00	113.00		193.00	808.00
		1995	37.05	57.00	33.00	-	127.05		34.00	67.20	8.00	56.00	165.20	292.25
		1996	169.60	49.95	20.00	-	239.55		85.20	40.00			125.20	364.75
		1997	138.50	-	-	-	138.50		120.00		18.56	21.00	159.56	298.06
		1998	256.55	-	-	-	256.55		237.20		36.00		273.20	529.75
		1999	-	-	-	-	0.00		509.87	48.00	19.22		577.09	577.09
		2000	12.00	-	20.00	-	32.00		131.73	17.77	66.85	108.25	324.60	356.60
		2001	203.94	-	-	-	203.94		490.50	207.62	49.62	180.37	928.11	1132.05
		2002	50.47	36.00	-	12.00	98.47		30.48	73.20		123.20	226.88	325.35
		Total	**1751.88**	**166.95**	**75.00**	**12.00**	**2005.83**		**1682.98**	**497.79**	**314.85**	**488.82**	**2984.44**	**4990.27**
2	Stage I Phase - III	2003	60.30				60.30		53.68	107.00		106.00	266.68	326.98
		2004	69.50				69.50		69.79		52.51	62.40	184.70	254.20
		2005	1031.00				1031.00		280.00	192.00		111.40	583.40	1614.40
		2006	1049.35	188.00	9.00		1246.35		593.50	31.72	120.04	109.00	854.26	2100.61
		2007	31.60	109.20		13.00	153.80			49.60		50.00	99.60	253.40
		2008	376.00	10.00		30.00	416.00						0.00	416.00
		Total	**2617.75**	**307.20**	**9.00**	**43.00**	**2976.95**		**996.97**	**380.32**	**172.55**	**438.80**	**1988.64**	**4965.59**
3	Stage II	2004	0.00				0.00		194.10				194.10	194.10
		2005					0.00		134.90				134.90	134.90
		2006					0.00		155.00	11.00		83.28	249.28	249.28

Sl No.	Stage	Year	Almatti Catchment						Narayanpur Catchment					Grand Total (8+13)
			Block	Road	Village	Canal	Total		Block	Road	Village	Canal	Total	
			(in ha)	(in km)	(in ha)	(in km)	(in ha)		(in ha)	(in km)	(in ha)	(in km)	(in ha)	(in ha)
		2007					0.00		5.00	25.00		25.00	55.00	55.00
		2008					0.00		345.00	10.00		10.00	365.00	365.00
		2009					0.00						0.00	0.00
		2010					0.00		16.00				16.00	16.00
		2011					0.00					17.00	17.00	17.00
		2012					0.00		240.00			50.00	290.00	290.00
		2013					0.00						0.00	0.00
		2014					0.00		35.00			55.00	90.00	90.00
		Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1125.00**	**46.00**	**0.00**	**240.28**	**1411.28**	**1411.28**
Grand Total			**4369.63**	**474.15**	**84.00**	**55.00**	**4982.78**		**3804.95**	**924.11**	**487.40**	**1167.90**	**6384.36**	**11367.14**

Table 9.5 Details of canal bank plantation carried out by KBJNL Forest Division, Almatti

Sl No	Name of The Canal	District covered	Taluks covered	Length of Main Canal	Distributory length	Total	Planned Command area
				(in km)	(in km)	(in km)	(in ha)
1	**NLBC** (Narayanpur Left Bank Canal)	Yadgir	Shorapur	78.00	158.36	236.36	24223
2	**SBC** (Shahapur Branch Canal)	Yadgir	Yadgir,Shorapur &Shahapur	76.00	150.32	226.32	122120
3	**JBC** (Jevaragi Branch Canal)	Gulbarga	Jevargi	86.00	124.99	210.99	57100
4	**IBC** (Indi Branch Canal)	Bijapur & Yadgir	Indi, Sindagi, Shorapur	173.00	550.67	723.67	131260
5	**ILIS** (Indi Lift Irrigation Scheme)	Bijapur	Indi, Sindagi	96.00	242.82	338.82	41900
6	**ALBC** (Almatti Left Bank Canal)	Bijapur	Muddebihal, B. Bagewadi	103.00	390.00	493.00	20235

Sl No	Name of The Canal	District covered	Taluks covered	Length of Main Canal	Distributory length	Total	Planned Command area
				(in km)	(in km)	(in km)	(in ha)
7	**ARBC** (Almatti Right Bank Canal)	Bagalkot	Bagalkot & Hunagund	121.00	95.00	216.00	16100
8	**MLIS** (Mulawad Lift Irrigation Scheme)	Bijapur & Bagalkot	Bijapur & Jamakhandi	95.00	120.00	215.00	30850
9	**NRBC** (Narayanapur Right BankCanal)	Raichur	Lingasur & Devadurga	95.00	256.00	351.00	84000
10	**HBC** (Hunasagi Branch Canal)	Yadgir	Shorapur	11.40	82.03	93.43	23000
11	**MBC** (Mudabal Branch Canal)	Yadagir & Gulbarga	Shahapur & Jevargi	51.00	178.97	229.97	51000
12	**RLIS** (Rampur Lift Irrigation Scheme)	Raichur	Lingasur	44.00	75.00	119.00	20235
		Vijayapur					
13	Chimmalagi LIS Headworks , Combined Canal	0.00 to 2.60		2.60		2.60	
14	West Main Canal	0.00 to 54.00		54.00		54.00	
15	East Main Canal	0.00 to 137.00		137.00		137.00	
16	Baluthi Headworks to DC-1	0.00 to 0.60		0.60		0.60	
17	Hanamapur Headworks to Dc-2	0.00 to 0.80		0.80		0.80	
18	DC-2 to Masuthi Headworks	0.00 to 9.91		9.91		9.91	
19	DC-3 to Combined Canal	0.00 to 1.17		1.17		1.17	
20	Malghan West Main Canal	0.00 to 118.00		118.00		118.00	
21	Bijapur Main Canal	0.00 to 202.00		202.00		202.00	
22	Basavan-Bagewadi Branch Canal	0.00 to 72.00		72.00		72.00	
23	Babaleshwar Branch Canal	0.00 to 43.00		43.00		43.00	
24	Managuli Branch Canal	0.00 to 38.00		38.00		38.00	
25	Huvin Hipparagi Branch Canal	0.00 to 63.00		63.00		63.00	
26	Tidagundi Branch Canal	0.00 to 63.00		63.00		63.00	
27	Salvadgi Branch Canal	0.00 to 34.00		34.00		34.00	

Sl No	Name of The Canal	District covered	Taluks covered	Length of Main Canal	Distributory length	Total	Planned Command area
				(in km)	(in km)	(in km)	(in ha)
28	Sankanal Branch Canal	0.00 to 27.00		27.00		27.00	
29	Dindavar Branch Canal	0.00 to 10.00		10.00		10.00	
30	Takkalaki Branch Canal	0.00 to 19.00		19.00		19.00	
	Total			**1924.48**	**2424.16**	**4348.64**	**622023.00**
	Area already Planted by KBJNL Forest Division (in km) up to 2014-15					**1486.62**	
	Area available for Planting (in km)					**2862.02**	

Table 9.6 Green belt development Plan

Area proposed for Green belt	No. of saplings	Source for saplings	Time frame	Responsible agency for implementation
Thimmapur LIS	7000	Bagalkot KFD Nursery	After completion of site works	KBJNL and KFD
Ramthal LIS	2500			
Nandawadagi LIS	2500			
Budihaal-Peerpapur LIS	6700			
9A Distributory	8700			

Table 9.7 Species recommended for plantation

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	Halasu	*Artocarpus heterophyllus*	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*

Further, to obtain sustainable results in the green cover management, it is suggested that the green belt development be handed over to the Horticulture Department, Government of Karnataka and compensatory forestry, canal bank and agro-forestry program be handed over to the Forest and Agriculture Department, Government of Karnataka.

9.4 Fisheries Development Plan

The over-all activities of the Project across the river Krishna involve construction of canals, in-take/ distribution components and related facilities. The 'Mitigation' measures to be accessed to ward-off adverse impacts, if any, during the 'Construction and Operation' phases have been documented in the following format. It is to be considered that the 'Potential' impacts scripted earlier are 'Predicted' ones considering the 'Mitigative' measures to be adopted to check the negative influences, if any, while undertaking construction of all the components connected with the envisaged Ramthal Lift- Irrigation Project.

Construction phase	Operation phase
There will not be any change in the quality and quantity of the river water since no industries are located in the upstream stretches of the river. Apt measures will be undertaken to prevent entry of wastes etc. In order to maintain hygiene and quality of the river water.	There will not be any type of negative impacts on the quality and status of the river water.
Health Risks And Water-Borne Diseases	
Since the human settlements/ villages are located close- by and also quite away from the Project site, the quality of the river water getting affected/ altered causing medical problems to the inhabitants may have to be ruled- out. However, the labour force are gathered in quite a large numbers to build the Lift- Irrigation Complex and its components, a population density, such as this, the area may have never seen earlier, offers opportunities and facilities for the transmission/ spread of communicable diseases, the prevalence of which in the area may be permanently affected. While an impoundment is established for a specific purpose to cater to the needs of the Lift-Irrigation processes, riparian people and the labour force brought-in, must move away from their temporary dwellings, it is hoped, according to an orderly plan.	No medical/ health problems to the original inhabitants in the earlier established settlements and to the labour forces on contract could be 'forecast'- However, precise and adequate medical facilities are to organised to meet any emergency.
Ecological aspects	Aquatic life
During this phase, while constructing the canal and related components, good lot of muck, earth, boulders etc. are being extracted which, normally are dumped in close vicinity only. In order to prevent their sliding back/ entry into the water body affecting normal flow in it, the generated products are to be safely stacked, quite away from the river/ project site in particular. Also screens of desirable mesh- sizes, depending upon the height and width of canal and at the in-take distribution point/s be installed so as to prevent of fish along with the water.	There will not be any adverse impact on the aquatic life, fish fauna of the river in particular on the implementation of the suggestions made. Flow of water, as envisaged, in the downstream stretch of the Lift- Irrigation complex, will be maintained adequately to keep the pools harbouring fish germplasm in live conditions to sustain their proliferation. However, after commissioning of the said project, Limnological and fisheries investigations need be organised for a period of at least 3 to 5 years to assess the overall picture on the Physico-chemical features of the river water in and around the Project site, biological aspects such as fish food organisms- plankton, benthic/ littoral fauna, aquatic vegetation and fish species in order to maintain normal ecological features; also to introduce corrective feasible measures based on the data generated.

Post-Project Environmental Monitoring

- A 'Monitoring Technical cell/ committee' be constituted with representatives from Fish and Fisheries disciplines to over- see the effective implementation of the suggestions made.
- Limnological and Fisheries investigations for a period of 3 to 5 years be organized 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 prevailing based on the scientific know-how available.

9.4.1 Enrichment of Riverine Fish Fauna

The richness of the wide spectrum of native flora and fauna, especially in the lotic and lentic water bodies, is governed by their zoogeagraphical locations. Majority of the lotic water bodies in the country, on account of such revise demarcations, inherently, do not harbour the fast- growing fish species of economic importance. Thus, in order to auger enrichment of indigenous fish germplasm and to auger considerable fish production from such biotopes, efforts to transplant several indigenous as well as exotic fish from one river to the other or from rivers to the lakes and reservoirs. Farm- grown fish fingerlings of major carp and exotic carp are also stocked in lotic water bodies so as to improve the stock and to retard the extinction of existing fish species.

To a large extent, it is possible to raise the productivity of a water mass by introducing and acclimatization may be carried- out through 'supplanting' a more valuable commercial fish species into the biotope which uses the same food web as the less valuable member of the local fauna. This leads to establishment of new food niches, ultimately resulting in high fish yield.

Transplantation of indigenous and exotic fish species in river systems in the state, however, is not so common; but whatever little has been accomplished in the recent past, has produced quite encouraging results. Proper attention in this sphere has to be directed towards large- sized indigenous fish species, sport- fish, cold- water fish after studying the environmental factors and zoogeographical distribution pattern of each.

So, as a recourse to this 'OBJECTIVE', around 10 lakhs of fish fingerlings comprised of Gangetic major carp- *Catla catla*- 40.00%, *Labeo rohita*- 30.00% and *Cirrhinus mrigala*- 30.00% in the size of over 75 mm are to be stocked in the river Krishna *annually*, in and around the project site. Fisheries Division at Basavasagara reservoir, Narayanapura Fish farm, Saudatti Fish Far, Tungabhadra Dam Fish Farm and Bhadra Dam Fish farm will meet the fish seed requirement needed to be introduced. The project authorities could also contribute their service and also submit their indents well- in-advance during January- February of each year to the respective officers who, on their part, will make sure to effect the supply of fish seed required around August- September. The process helps in increased fish production from the river Krishna and the impounded water to be established. The entore exercise will positively help scores of fishermen engaged in the profession since years to modestly ekk- out their livelihood.

9.5 Muck Disposal plan

Table 9.8 Muck disposal plan

Name of the Scheme	Qty of Excavation in Cum	Utilization (Cum)						
		Service road & Inspection paths	Embank ments	Land Leveling	Filling trenches	Construction material for CD works, Roads Etc	Restoration works for canal banks. Cum	Total Utilisation.Cum
Ramthal Marol LIS	1400000	420000	210000	560000		140000	70000	1400000
	1800000	90000	--	--	1710000	--	--	1800000
Budihaal Peerapur LIS	2024300	607290	303645	809720	--	202430	101215	2024300
Thimmapur LIS	2010000	603000	301500	804000	--	201000	100500	2010000
Nandawadagi	2707500	135375	--	--	2572125	--	--	2707500
9A Distributory	1520000	675000	525500	152000	--	167500	--	1520000
Total	**9957000**	**2530665**	**1340645**	**2325720**	**4282125**	**710930**	**271715**	**9957000**

9.6 Ground Water Management Plan

Due to the provision of irrigation facilities to individual farmers the drawl of groundwater is likely to decrease and vast areas will be put to use for cultivation. The crop acreage is increased substantially. As such the groundwater levels will increase and further exploitation will be minimized. After a few years the monitoring programme should be envisaged to study the potential of groundwater and conjunctive management could be planned.

9.7 Public Health Delivery plan

Periodical health check ups (once in 6 months) is proposed for construction labors. Taluk Health Hospital, Jamakhandi is located at a distance of 10 Km from the construction site, necessary arrangements will be done to consult the Hospital.

9.8 Sanitory and Solid Waste Management Plan

- Solid waste generated at the labor camps will be collected in different bins and the recyclable waste will be handed over to the Jamakhandi Municipal authroity.
- Provision of toilets and bathrooms will be provided at labor camp to avoid open defecation.
- The dometic waste water will be treated with septic tank and soak pit.

9.7 Cost for implementing EMP

Table 9.9 Cost for implementing EMP

Item	Particulars	Estimated Cost in Rs.
I. Construction Phase		
A. Air Pollution Control		
Water sprinkling	400/- x 6 tractors x 3 trips per day x 12 months x 25 (excluding rainy season and holidays)	21,60,000.00
Personnel protective equipments	Lumpsum	1,50,000.00
Chimney to DG sets	Lumpsum	2,50,000.00
LPG as cooking fuel	4 cylinders per unit x 50 units x 550 x 2 years	26,40,000.00
	Sub-total A	**52,00,000.00**
B. Noise Pollution Control		
Personnel protective equipments	Lumpsum	1,50,000.00
	Sub-total B	**1,50,000.00**
C. Water Pollution Control		
Septic and soak pit	Lumpsum	9,00,000.00
Sand bags	Lumpsum	1,50,000.00
	Sub-total C	**10,50,000.00**
D. Solid & Hazardous Waste Management		
Solid waste collection bins with shed	Lumpsum	1,50,000.00
Hazardous waste collection area with shed	Lumpsum	1,50,000.00
	Sub-total D	**3,00,000.00**
E. Biological Environment		
Plantation works	27400 saplings x 500 rs	1,37,00,000.00
Agro forestry development	1145000 saplings x 10 rs	1,14,50,000.00
Fisheries development	Lumpsum	10,00,000.00
	Sub-total E	**2,61,50,000.00**
F. Socio-economic Environment		
Land acquired cost	--	24,77,88,998.00
Land acquisition	5407 acres x 3 lakhs x 2 x 100 % solatium	468,72,00,000.00
Awareness and Training	15 lakhs per year x 3 years	45,00,000.00
	Sub-total F	**493,94,88,998.00**
G. Environmental Monitroing during construction period		47,04,000.00
	Sub-total G	**47,04,000.00**
	Total (A-G)	**497,70,42,998.00**
II. Operation Phase		
Environmental Monitoring for 3 years		22,80,000.00
Green Belt mainatainence for 3 years		15,00,000.00
Awareness and Training for 3 years		6,00,000.00
Soil conservation measures and implementation of CAT plan for 5 years		81,00,00,000.00
	Total	**81,23,28,000.00**

Chapter 10. Summary and Conclusion

- Upper Krishna irrigation project across Krishna river provides irrigation facility for drought prone areas of Bijapur, Bagalkot, Kalaburgi, Yadagir and Raichur districts in northern Karnataka.
- The project involves construction of 2 major dams near Almatti and Narayanapur to facilitate the irrigation.
- The Upper Krishna project was executed in 2 stages. Stage-I of the project is irrigating 4,24,903 Ha and Stage-II is irrigating 1,97,120 Ha. Both Stage-I & II was accorded Environmental Clearance from MoEF vide letter Nos. J-12011/41/86-IA dated 05.04.1989, J-12011/31/96-IA.I dated 18.07.2000 and J-12011/30/96-IA.I dated 04.10.2000 respectively.
- KBJNL has initiated water conservation measures by adopting Govt. of India program on 'National Water Mission (NWM)' as a part of National Action Plan for Climate Change. The main objective of NWM is conservation of water and minimizing wastage and ensuring its more equitable distribution both across and within states through 'Integrated Water Resource Development and Management (IWRM)'.
- To eradicate regional imbalances in the command area and to fulfill the persistent demands of the formers and public representatives of the adjoining command areas, KBJNL is proposed to take up modernization works to provide irrigation facilities to drought prone areas within the gross command area.
- Technological advancement in lift irrigation schemes helps in providing irrigating facility to higher lands to eradicate regional imbalances.
- Expansion proposal involves lifting of water from Krishna River directly at 3 places Viz., Budihaal-Peerapur LIS, Nandawadagi LIS and Ramthal (Marol) LIS and whereas for Thimmapur LIS and 9(A) distributory, water will be drawn from existing ARBC and NRBC respectively to provide irrigation facilities for the drought prone areas.
- The water required to irrigate the additional command area is achieved by reducing the irrigation intensity of Upper Krishna Project from 108%, 115% to 100%.
- The additional lifting of water neither involves submergence nor Rehabilitation & Resettlement. Further, there are no ecologically sensitive area, national parks, wildlife sanctuaries, Reserve Forests in the command area and no forest land is required to implement the scheme. Hence, there is no impact on environmental components.
- The proposal allows a greater area of land to be used for crops in areas where rain fed production is impossible or marginal.
- By adopting drip irrigation in 60,100 ha there will be considerable saving in water and water use efficiency will be increased.
- In order to assess the baseline environmental status, command area, 10 Km radius from the main project components were considered and the data was collected for one Season (Mar 2016 to May 2016).
- The area is flat and continuous sloping without undulations towards the Krishna river.

- During the study period, maximum temperature of 420C was recorded and minimum would be 18 0C.
- The results of ambient air quality reveal that, PM10 was in the range between 54-87.96μg/m3and whereas PM2.5 was in the range between 24-30.72 μg/m3. SO2 and NO2 are in the range between 1.63-1.88 μg/m3 and 4.8-5.81 μg/m3respectively. The air quality index in the study area is found to be satisfactory for PM10 and PM2.5 and good for gases (SO2 and NO2). All other parameters within the CPCB standards.
- The results of ambient noise levels were compared with Residential standards and results reveal that, noise levels are well within the CPCB standards.
- The Project site and the command areas forms part of the Krishna River Basin. Hire Halla, Kud Don Halla, Kunt Don River and Don River are the other major tributaries of River Krishna in the study area. Most of these are seasonal rivers which drain in to River Krishna. Drainage pattern is observed to be dendritic to sub-dendritic with drainage varied density.
- The main rock type observed in the command area is Basalt belonging to Deccan Traps of various flows belonging to Upper Cretaceous to Lower Eocene Age. Laterite is observed as patches to a limited extent. Dolomite, Quartzite and Conglomerate of Raidurg Formation belonging to Middle Proterozoic Age are observed in the area.
- In the study area the soil types found in the command area are predominantly shallow to deep black, moderately well drained, clay soils with slow permeability. vertisol, Entisol and Incept sols are found in the proposed command. The black cotton soil is rich in bases (alkaline condition) and has a very high water holding capacity. Major area of TBLIS is covered by black, clay soils constitute roughly 95 percent, and are shallow to moderately deep (22.5 to 90 cm), clayey, with 45 to 55 per cent clay and contain free calcium carbonate throughout the profile. There is generally a zone of calcium nodules and gypsum in the soil profile at a depth of 45 to 90 cm, the principal salt being gypsum. Below the gypsum layer disintegrated impermeable murrum layer exists, the internal drainage of the soil is lateral rather than vertical within the profile.
- Land use / land cover in the study area is dominated by crop lands followed by rocky outcrops.
- Commonly found trees in the region are Cassia fistula, Acacia arabica, Tamarindus indica, Pongamia glabra, Wrightia tinctoria, Butea frondosa, Anogeissus latifolia, Albizzia amara, Chloroxylon switenia, Pterocarpus marsupium, Hardwickia binata, Terminalia tomentosa.
- A total of 46 tree species, 22 shrub species and 27 species belongs to herb species were recorded in the study area.
- The field sighting and published records for the region indicated that 12 mammals were reported for the region. Of which only Sloth bear and leopards are belongs to Vulnerable and near threatened category. There are about 44 birds recorded for the region, which are more common found in outside the project area. There are 12 species of butterflies were observed in core and buffer area of the project. Majority of the fauna recorded or reported for the region were also observed outside the project area in semi-arid region of Karnataka.

- Detailed Physico-chemical and Biological studies carried-out in the river Krishna, in and around the project site, presents 'optimum' features to support/sustain varieties of aquatic life present. The river is found to be 'free' from pollution threat.
- The Plankton community, Phyto- and the Zooplankton constituents, in effect, presented 'low' status, by diversity and numerical density. However, scores of planktivores fish species recorded subsists on the food available presently which, during the prime season(monsoon and thereafter) is likely to improve for the resident and migrating fish germplasm. The littoral fauna also were in 'low' concentrations, constituted by Insects and Molluscs: the latter group had a fairly good representation by Castrapods and Bivalves and members belonging to the Crustacean group.
- Fish species constituted by Carps and Predatory fish species presented a 'poor' picture – could be on account of the low-level of water in the river and on-set of lean season when even the fishing activity was quite minimal, as reported. The Immigrant African Catfish ,Clarias gariepinus, recorded in the upper reaches may migrate to other parts of the said lotic water body, may establishes itself dominating the fishery as a whole. The situation is quite alarming which calls for initiating concrete steps for its total elimination from the area/river as such.
- Fish stocking and its augmentation has been highlighted which should be taken-up with all sincerity and seriousness in order to enhance the fish production to facilitate scores of local and migratory fishermen to ekk-out their livelihood.
- The environmental impacts is conferred only to the construction phase which are short term, temporary in nature. No major structures are proposed in the project except Jack well, pump house, intake canal and distributory network. During operation phase, excess application of fertilizers and pesticides will have impact on soil and water.
- Environmental Monitoring is proposed during the construction and operation phase of the project Rs. 18 Lakhs was estimated for environmental monitoring during construction phase (24 months) and Rs. 22.8 lakhs is estimated for operation phase of the project. All the horizontal departments such as Horticulture Dept., Agriculture Dept., Forest Dept., Watershed Dept., will be consulted for implmentation of the EMP and the programs of all the deparmtments will be converged in development of the command and catchment area.
- The project will impact 61 villages and the total land required for the modernization works are 2403 Ha. Out of which, 822 ha were already acquired and remaining 1581 Ha will be acquired as per RFC&T in LA, 2013. Total cost of 468.72 crores is worked for compensation to be paid for the land losers.
- Altogether, population of 291 villages belongs to 5 taluks will be benefitted directly under the scheme.
- Direct employment opportunities for 300 members during construction phase and 50 members during operation phase of the project.
- Zero water logging and salinity problems in the command area. Weed and disease reduction due to adoption of micro irrigation.

- Effective EMP is proposed to mitigate the impacts during construction and operation phase of the project on various environmental components such as air, water, noise, soil, solid and hazardous waste, biological and social environment. Catchment area treatment plan, command area development plan, green belt development plan, muck disposal plan and fisheries development plan for implementation. A total EMP cost of 497.70 Crores is estimated for implementation of mitigation measures during construction phase and Rs. 81.23 Crores is estimated for operation phase of the project.
- Overall, the project will have minor impacts during construction phase but the project will bring substantial improvement on environment during operation phase of the project.

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Chapter 11. Disclosure of Consultants

M/s Environmental Health and Safety Consultants Pvt. Ltd is located at Rajajinagar, Bangalore have been involved in obtaining environment clearances for various developmental projects from the Ministry of Environment, Forests & Climate Change (MoEF), New Delhi since 2002.

In accordance with the orders and notifications of the MoEF, Govt. of India, the organisation is ISO 9001:2008 certified and accredited as 'A' category organisation from National Accreditation Board for Education and Training (NABET) in seven sectors viz., River Valley and Hydroelectric Projects, Metallurgical Industries, Roads and Highways, Sugar Industries, Distilleries as well as building & construction projects and townships.

The company comprises of highly dynamic and well qualified team of Environmental Engineers and subject experts, both in-house and empanelled in various fields such as Ecology and Biodiversity, Socio-economics, Soil Conservation, Land Use studies, Hydrology, Geology, Risk Assessments, etc.

The organisation has state of art in-house environmental laboratories at Bengaluru and Belgaum capable of conducting all types of sampling and analysis related to Air, Water, Noise and Soil. Bangalore laboratory is accredited by National Accreditation Board for Testing and Calibration Laboratories (NABL) for 310 parameters and recognized from MoEF under the E(P) Act, 1986 and also certified for ISO 9001:2008, 14001:2004 and OHSAS 18000:2007. Whereas, the Belgaum Laboratory is recoginised from MoEF under the E(P) Act, 1986.

EHS Group – Corporate Office, Bangalore

EHS Group - Belagum Office

Monitoring Vehicles

Sohisticated instruments

Chapter 12. Compliance to Terms of Reference

Sl. No.	TORs	Compliance with respect to Final EIA Report
8(i)	One season baseline data collection shall be undertaken in the additional command area (within the gross command area) for various environmental components.	Complied
8(ii)	Based on the above, draft EIA report shall be submitted to Karnataka State Pollution Control Board for conducting Environmental Public Consultations in three districts viz., Bagalkot, Bijapur and Raichur	Noted
9	The consultant engaged for preparation of EIA/EMP report has to be registered with Quality Council of India (QCI)/NABET under the scheme of Accreditation and Registration of MoEF. This is a prerequisite.	Complied
10	Consultant shall include a "Certificate" in EIA/EMP report regarding EIA/EMP report prepared by them and data provided by their organisation (s) / laboratories including status of approval of such laboratories.	Complied
11	The additional ToR will remain valid for 4 years from the date of issue of this letter for submission of EIA/EMP report.	Noted
12	The EIA/EMP report must contain an index showing details of compliance of all ToR conditions. The index will comprise of page no. etc vide which compliance as a specific ToR is available. It may be noted that without this index, EIA/EMP report will not be accepted.	Complied

Chapter 13. Photographs

Expert Field visit

Soil sampling


Surface water collection


Ground water collection


Noise level monitoring


AAQ monitoring




Socio-Economic Survey

Chapter 14. Compliance to previous Environmental Clearances

(1) Environmental Clearance for Upper Krishna Project Stage-I, Phase-III (No.J-12011/36/ 96-IA-I dated 18.07.2000

<table>
<tr><th>Sl.No</th><th>Conditions</th><th>Compliance</th></tr>
<tr><td colspan="3">3. Part A - Specific Condition</td></tr>
<tr><td>(i)</td><td>Year wise action plan for the treatment of 8300 ha. degraded area under Narayana reservoir, 7825 ha. under Almatti Reservoir in the catchment area and plantation on 1552.22 Ha. area on the periphery of the two reservoirs should be implemented as proposed. These areas should be identified on an index map submitted to the ministry within three months.</td><td>
<table>
<tr><th>Details</th><th>Target</th><th>Achievement</th></tr>
<tr><td>Afforestation of catchment area of Narayanpur reservoir (Ha)</td><td>8300</td><td>7373.72</td></tr>
<tr><td>Afforestation of catchment area of Almatti reservoir (Ha)</td><td>7825</td><td>8930.95</td></tr>
<tr><td>Afforestation of peripheral area of Narayanpur and Almatti Reservoir (Ha)</td><td>1552.15</td><td>1219.46</td></tr>
<tr><td>Total</td><td>17677.15</td><td>17524.13</td></tr>
</table>
</td></tr>
<tr><td colspan="3">Part B - General Conditions</td></tr>
<tr><td>(i)</td><td>Adequate free fuel arrangements should be made to the labor force engaged in construction work at project cost so that indiscriminate felling of trees prevented.</td><td>All the works of Phase-III have been entrusted on tender basis. The contractors are executing the works by engaging heavy earth-moving and other machineries. Labour force required is very minimum. The labourer engaged are from the local villages and they are transported every day from the villages and sent back to their. homes in the evening. Separate camps are not established. For the skilled labourers and other labourers, contractors are supplying, the fuel. Therefore there is no de-forestation on account of construction activities.</td></tr>
<tr><td>(ii)</td><td>Fuel depot may be open on the site to provide the fuel (kerosene/wood).Medical facilities as well as recreational facilities should also be provided to labourers.</td><td>The supply of fire wood by opening fire wood depot has been tried with the help of Karnataka State Forest industry Corporation a Govt. of Karnataka establishment, but there was-. no demand from the labourers, since skilled labourers engaged for mechanized works are using kerosene/ Gas for cooking. Local labourers are using agriculture waste as fuel. Medical facilities are extended from project health organisation. Parks, and Gardens created near the Dam site, provide recreational facility to labourers also.</td></tr>
</table>

Sl.No	Conditions	Compliance
(iii)	All the labourers to be engaged for construction works should be thoroughly examined by health personnel and adequately treated before issuing them permit.	Regular screening of labour force is done by project health office and spread of malaria and other communicable diseases is controlled effectively.
(iv)	Restoration of construction area including dumping site of excavated matter dam site should be ensured leveling ,filling up of borrow pits ,landscape etc., the area should be properly afforested with suitable plantation .	The construction area downstream of Almatti dam is restored by developing ornamental garden. The consultancy has been engaged for the development of ornamental garden. An area of 77 Acres is being developed in the style of Moghal , French and Italian garden etc., remaining work under progress. A biodiversity park is developed in an area of 80 Acres , of which the rock garden covers 30 Acres by local materials. The Krishna garden is developed in an area of 3 Acres. The lava kusha garden developed in area of 4 Acres on right pan. An area of about 50 Acres is being planted with local tree species on old 214 Acres of the project area around Almatti dam is being developed with tree parks and landscaping.
(v)	Down stream of the dam, flood zoning approach should be done. no settlement should be allowed within the flood zone.	The Narayanapura dam is on the downstream of Almatti dam. Submerging villages have been rehabilitated sufficiently above floods zone base on back water calculation link road have been provided. In case of Almatti dam, flood zone approach is done and no settlement is allowed within the flood zone.
(vi)	Six monthly monitoring reports should be submitted to the ministry and Regional Office , at Bangalore for review.	Six monthly progress reports are being submitted regularly to the ministry and regional office.
4.	Officials from regional office, MOEF Bangalore would be monitoring implementation of environmental safeguards should be given full co-operation facilities and documents /data base project proponents during their inspection.	The Krishna Bhagya Jala Nigam bears the overall responsibility of the implementation of safeguard of environment with active involvement of States Revenue Department, Agricultural Department, Health Department, Forest Department and Command Area Development Authority.
5.	The responsibility of implementation of environmental safe gaurds rests fully with the Krishna Bhagya Jala Nigama Limited	Agreed
6.	In case of change in the scope of the project, project would require a fresh appraisal .	Agreed

Sl.No	Conditions	Compliance
7	The ministry reserves the right to add additional safe guards measures subsequently if found necessary and to take action including revoking of clearance under the provisions of the Environmental (Protection) Act, 1986 to ensure effective implementation of this listed safe guard measures in bound satisfactory manner .	Agreed
8	This clearance letter is valid for period of 5 years from the date of issue of EC letter.	Adhered accordingly
9	A copy of clearance letter will be mark to concerned panchyat / local NGC if any, from whom any suggestion/ representation has been received while processing the proposals .	Adhered accordingly
10	State Pollution Control Board/ Committee should display a copy of the clearance letter at the regional office, district industries center and collectors office, Tehsildar's office for 30 days.	A copy clearance letter is made available to the State Pollution Control Board in this regards.
11	The project proponent should advertise atleast in two local news paper widely circulated in the region around the project 1 of which shall be in the veranucular language of the locality concerned informing that the project has been accorded environmental clearance and copies of clearance letters are available with the State Pollution Control Board /committee may also be seen at website of the Ministry of Environment and Forest's at http://www.envfor.nic.in	This is done. The details as under: • Samyuktha Karnataka (Kannda Daily) dated: 20-9-2000 • Prajavani (Kannda Daily) dated: 20-9-2000 • Deccan herald (English Daily) dated: 20-9-2000 • Indian Express (English Daily) dated: 20-9-2000

(2) Environmental Clearance for Upper Krishna Project Stage-II, (No.J-12011/30/96-IA-I dated 04.10.2000

<table>
<tr><th>Sl.No</th><th>Conditions</th><th>Compliance</th></tr>
<tr><td colspan="3">3. Part A - Specific Condition</td></tr>
<tr><td>(i)</td><td>Year wise action plan for the treatment of 3755 ha. degraded catchment area of Narayana reservoir and peripheral area o be treated under afforestation in Almatti and Narayanpur Reservoir during UKP Stage – II as proposed in the EIA report should be followed in total.</td><td>Afforestation works are being carried out as per action plan, the progress achieved till date is as follows. The balance works are in progress. In addition, 3453.56 Km of canal bank plantation works completed n UKP Stage-I and II.
<table>
<tr><th>Details</th><th>Target</th><th>Achievement</th></tr>
<tr><td>Afforestation of catchment area of Naravanpur reservoir (Ha)</td><td>3775</td><td>3665.94</td></tr>
<tr><td>Afforestation of peripheral area of Naryanpur and Almatti Reservoir (Ha)</td><td>5711.76</td><td>5705.75</td></tr>
<tr><td>Total</td><td>9486.76</td><td>9371.69</td></tr>
</table></td></tr>
<tr><td>(ii)</td><td>Dam break analysis and disaster management plan should be submitted within six months from the data of issue of this letter.</td><td>The dam break analysis of Almatti and Narayanpur dams has been carried out by CWC and the report is made available by CWC vide letter no. CWC/DBAG/FE&SA/21/2001/165 dated 15.02.2002. The copy of the same was submitted to the Secretary, MoEF, New Delhi on 11-09-2003. The report of 2002 has been revised in June 2006by the FE & SA directorate , New Delhi. Based on the revised dam break analysis, Disaster Management Plan has been prepared. The copies of the report are sent to Joint Directorate, MoEF, Bangalore on 01.03.2007.</td></tr>
<tr><td>(iii)</td><td>To identify areas needing salinity control and drainage measures a reconnaissance survey of the problem areas followed by a detailed survey for designing and executing suitable measures should be undertaken and report to the Ministry within</td><td>The soil survey of command area prior to irrigation has been completed. An area of 1200 Ha in the total 1.97 Lakh Ha belonging to UKP Stage – II command is identified as area required treatment. Drainage measures are taken up by CADA.</td></tr>
</table>

Sl.No	Conditions	Compliance
	six months.	
(iv)	The project proponent should undertake soil loss study in the streams flowing to the reservoirs and the reservoir sedimentation survey at an interval of 5 years. The former may be undertaken for a few selected flood events within the current monsoon and the result used to project the reservoir sedimentation rate. Such studies for selected storm events may be done routinely every year. The first reservoir sedimentation survey may conducted within a year to give bench mark information and followed by at least two surveys during the next ten years to assess the impact of elaborate plantation activities for soil conservation.	Sedimentation studies have been conducted and made available to CWC, Govt. of India, New Delhi in connection with clearance of UKP State – II project report. The UKP State – II project report is cleared by the Planning Commission during Dec, 2000. The accepted values of sedimentation by CWC are 1.22 acres feet / sq.mile for Narayanpur reservoir and 0.732 acres feet / sq.mile for Almatti reservoir. Revised area capacity tables have been worked out and included in UKP Stage – II project report to assess the performance the reservoirs. Further the sedimentation survey of Almatti reservoir was entrusted to KERS. The sedimentation survey reports of Almatti and Narayanpur reservoirs are submitted by the Director, KERS, K R Sagar during Geb-2008. In addition to this as per kind orders of Krishna Water Dispute Tribunal -2, the sedimentation survey of Almatti reservoir has been got carried out.,
(v)	On farm water management – Presently, the operation schedule, vis-à-vis the incompleteness of the distribution network, is conducive neither to better utilization nor to equitable distribution. A systematic water delivery schedule needs to be worked and implemented when the distribution network is ready. In view of the planned defecit irrigation, it will be better if irrigation in any rotational period starts from the tail reach.	For better distribution and equitable distribution of water, a systematic water delivery schedule such as Wara-Bandi system is implemented.
Part B - General Conditions		
(i)	Adequate free fuel	All the works are entrusted on tender basis.

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	arrangements should be made to the labor force engaged in construction work at project cost so that indiscriminate felling of trees prevented.	The contractors are using earth moving equipment and other machinary while executing the works. For skilled labourers, the contractors are supplying, fuel/ Kerosene. Unskilled laborers are engaged from neighbourng villages are using agriculture wasteand lobs of Bellary Jali for cooking. Therefore there is no de-forestation due to construction activities.
(ii)	Fuel depot may be open on the site to provide the fuel (kerosene/wood).Medical facilities as well as recreational facilities should also be provided to labourers.	The supply of fire wood by opening fire wood depot has been tried with the help of KSFIC, but there was no demand from the labourers, since skilled labourers engaged for mechanized works are using kerosene/ Gas for cooking. Local labourers are using agriculture waste as fuel. Medical facilities are extended from project health organisation. Parks, and Gardens created near the Dam site, provide recreational facility to labourers also.
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(v)	Down stream of the dam, flood zoning approach should be done. no settlement should be allowed within the flood zone.	The Narayanapura dam is on the downstream of Almatti dam. Submerging villages have been rehabilitated sufficiently above floods zone base on back water calculation link road have been provided. In case of Almatti dam, flood zone approach is done and no settlement is allowed within the flood zone.
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5.	The responsibility of implementation of environmental safe gaurds rests fully with the Krishna Bhagya Jala Nigama Limited	Agreed
6.	In case of change in the scope of the project, project would require a fresh appraisal .	Agreed
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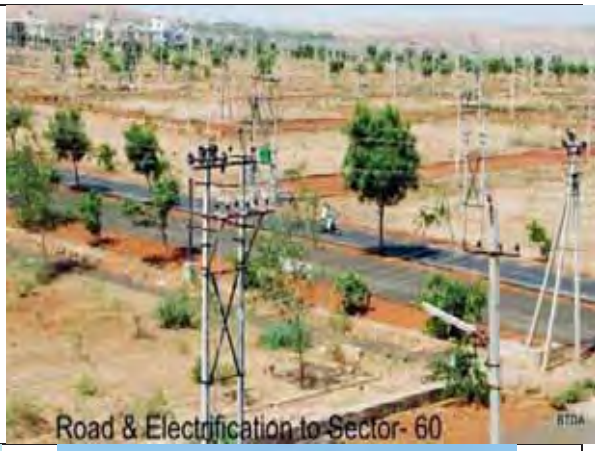
3. Compliance photographs



Rehabilitation and Resettlement


Civic amenities and garden at Almatti




Rock garden at Almatti

Canal bank plantation | Pit plantation

Avenue plantation

Peripheral area plantation

Block plantation

Plantation at R&R Centre