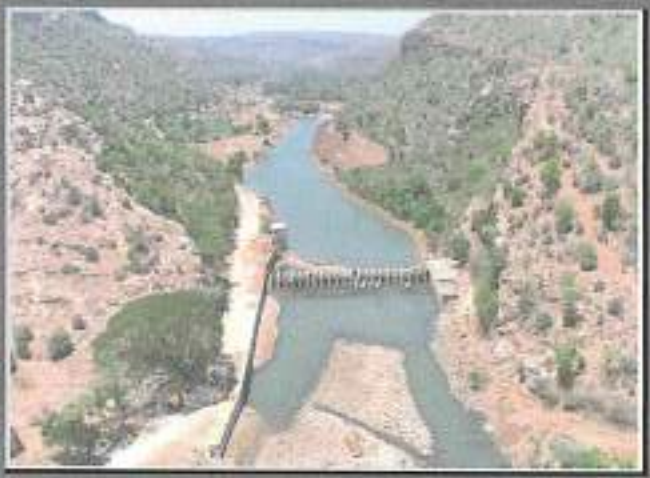
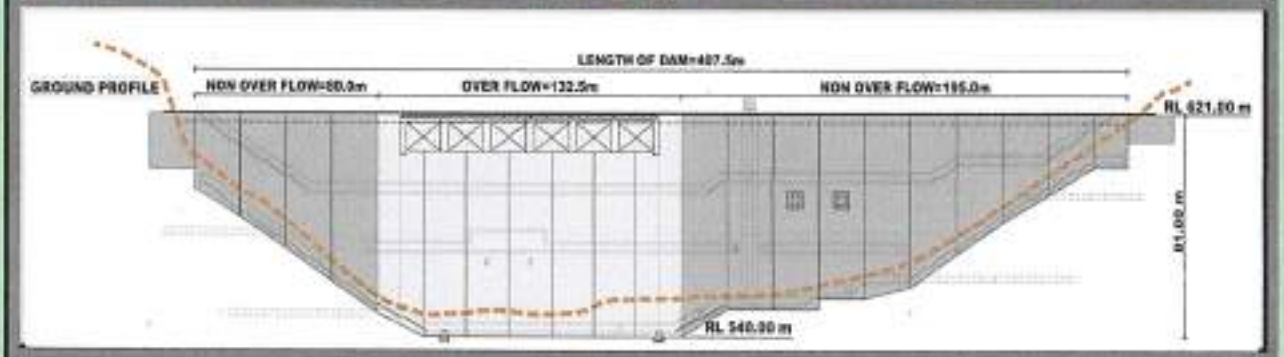
Karnataka Neeravari Nigam Limited

(A Government of Karnataka Enterprise)
4th Floor, Coffee Board Building, No. 1, Dr. B.R. Ambedkar Veedhi,
Infantry Road, Bengaluru, Karnataka 560001

Ghatti Basavanna Drinking Water Project

Construction of Ghatti Basavanna Dam Across Markandeya River In Gokak Taluk, Belagavi District, Karnataka





DETAILED PROJECT REPORT

VOLUME I - Report
Estimated Cost - Rs. 990.00 Crores
March 2022

Consultant	Owner
E I Technologies Private Limited, [ISO 9001:2015 Certified] #1149, 26th Main, Jayanagar 4th "T" Block, Bangalore – 560041. Ph.: +91 (80) 40914714 • Fax: +91 (80) 26650912 www.eitech.in•info@eitech.in	**Karnataka Neeravari Nigam Limited** (A Government of Karnataka Undertaking) **Chief Engineer,** Karnataka Neeravari Nigam Limited, Irrigation (N) Zone, Belagavi.

Document Control

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References to related documents	

Rev.	Description	Issue Date	Author		Checked		Approved	
			Initials	Sign.	Initials	Sign.	Initials	Sign.
00	Document created and submitted to GoK	17/08/2020	HGN		SN		NR	
01	Submitted to CWC	04/09/2021	HGN		SN		NR	
02	Attending to CWC Observations	05/03/2022	HGN		SN		NR	

VOLUME - I - REPORT

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Annexure No.	Details	Remarks
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Abbreviation

CA	Catchment Area
CBIP	Central Board of Irrigation and Power
CEA	Central Electricity Authority
KNNL	Karnataka Neeravari Nigam Limited
CWC	Central Water Commission
KWDT	Krishna Water Disputes Tribunal
DGPS	Differential Global Positioning System
DPR	Detailed Project Report
EIA & EMP	Environmental Impact Assessment and Environmental Management Plan
EL	Elevation
FRL	Full Reservoir Level
GOI	Government of India
GOK	Government of Karnataka
GTS	Geometric Trigonometric Survey
IS	Indian Standards
KPCL	Karnataka Power Corporation Limited
KPTCL	Karnataka Power Transmission Corporation Limited
NA	Not Applicable
PWD	Public Works Department
R & R	Resettlement and Rehabilitation
SIA	Social Impact Assessment
TMC	Thousand Million Cubic Feet
USBR	United States Bureau of Raclamation
REIA	Rapid Environmental Impact Assessment
EMP	Environment Management Plan
mbgl	Meters below ground level
lpm	Litres per minute
lps	Litres per second
MLD	Million litres per day
OSHA	Occupational Safety and Health Administration
PERT	Program Evaluation and Review Technique

CPM	Critical Path Method
BC Ratio	Benefit Cost Ratio
MWL	Maximum water level
MOE&F	Ministry of Environment and Forest

CERTIFICATES

Appendix - A

Certificates

Certificate on Preparation of DPR

This is to certify that Detailed Project Report (DPR) of Ghatti Basavanna Drinking Water Project, Karnataka has been prepared in a consultative mode with the specialized directorates of CWC i.e. Hydrology, Irrigation Planning, Inter-State Matters and Project Planning from concerned unit under Design & Research Wing.

EI Technologies Pvt. Ltd. Bangalore

(signature with seal)

Assistant Executive Engineer
Karnataka Neeravari Nigam Limited
G.R.B.C.C. Sub Divn. No:5, GOKAK.

EXECUTIVE ENGINEER,
KARNATAKA NEERAVARI NIGAM LIMITED
GRBCC DN. NO. 3, GOKAK

Chief Engineer, KNNL
Irrigation (North), Belagavi
Govt. of Karnataka.

Superintending Engineer,
K.N.N.L., G.R.B.C.C. Circle,
Hidkal Dam

CHIEF ENGINEER
K.N.N.L. Irrigation (N) Belagavi

Appendix –H

Certificate on status of action taken for Statutory Clearances

This is to certify that necessary actions have been taken for obtaining Statutory clearances for the Ghatti Basavanna Drinking Water Project project located in the State of Karnataka and status of the action taken is as follows:

a. Environment Clearance from MoEF&CC :

i. EIA in process
ii. EMP in process
iii. Others in process

b. Forest Clearance from MoEF&CC :

In process

c. Clearance in respect of R&R of Tribal population from MoTA:

In process

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Assistant Executive Engineer
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G.R.B.C.C. Sub Divn. No:5, GOKAK.

EXECUTIVE ENGINEER,
KARNATAKA NEERAVARI NIGAM LIMITED
GRBCC DN. NO. 3, GOKAK

Signed by

(Signature, Name with seal)

Chief Engineer, KNNL
Irrigation (North), Belagavi
Govt. of Karnataka.

Superintending Engineer,
K.N.N.L., G.R.B.C.C. Circle,
Hidkal Dam

CHIEF ENGINEER
K.N.N.L. Irrigation (N) Belagavi

Appendix –I

Certificate on mode of construction

This is to certify that the Ghatti Basavanna Drinking Water Project located in the State of Karnataka is going to be constructed through contract / Department and special team has been planned for timely construction of project as per the MoWR, RD&GR "Guidelines for preparation of Detailed Project Reports of irrigation and multipurpose projects. The constitution of the special team is as follows:

No.	Designation of officers of the team
	Will be confirmed

E I Technologies Pvt. Ltd. Bangalore

Assistant Executive Engineer
Karnataka Neeravari Nigam Limited
G.R.B.C.C. Sub Divn. No:5, GOKAK.

EXECUTIVE ENGINEER,
KARNATAKA NEERAVARI NIGAM LIMITED
GRBCC DN. NO. 3, GOKAK

Signed by
(Signature, Name with seal)
Chief Engineer, KNNL
Irrigation (North), Belagavi
Govt. of Karnataka.

Superintending Engineer,
K.N.N.L., G.R.B.C.C. Circle,
Hidkal Dam

CHIEF ENGINEER
K.N.N.L. Irrigation (N) Belagavi

Appendix – J

To

The Chief Engineer,
Project appraisal Organization, Central
Water Commission Sewa Bhavan,
R.K. Puram, New Delhi – 110066

Subject: Clearance of providing DPR of the Ghatti Basavanna Drinking Water Project.

1. The above project has been examined in the centralized design team (KNNL) to review all the designs pertaining to the project and accord approval based on which the designs were presented to an independent Expert Committee – Estimate Review Committee (ERC). The review of planning, design and estimates are reviewed and scrutiny at three levels and the Administrative Sanction by GoK is accorded.

   (i) All necessary surveys and investigations for planning of the project and establishing its techno-economic feasibility have been carried out as per the aforementioned guidelines.

   (ii) 10%/5000 ha. of the command area of the project (whichever is minimum) has been investigated in full details in three patches representing terrain conditions in the command for estimation of the conveyance system upto the last farm gates **– Not applicable.**

   (iii) 100% of Main Canal and 10% of the remaining Canal structures (Branch canals, Distributaries, Minors etc.) have been investigated in full detail **– Not applicable.**

   (iv) Detailed Hydrological, geological, construction material investigations, have been carried out for all major structures i.e. dams, weirs, main canal, branch canal up-to distributaries carrying a discharge of 10 cumecs.

   (v) Soil survey of the command has been carried out in detail as per IS 5510- 1969 **– Not applicable.**

   (vi) Necessary designs for the various components of the project has been done in accordance with the guidelines and relevant Indian Standards for Planning & Design/Safety aspects including design flood estimation etc., of the project which are enclosed. List of Codes is enclosed.

   (vii) Necessary studies for utilization of ground water have been done with special regard to problem of water logging and suitable provisions have been made for conjunctive use of ground water & drainage arrangements **– Not applicable.**

   (viii) The cropping pattern has been adopted in consultation with the State Agriculture Department and are based on soil surveys of the command keeping in view the national policy in respect of encouraging crops for producing oil seeds and pulses. Availability of

water as per Inter-State agreements, awards and consent of co-basin States are also considered **– Not applicable.**

(ix) The cost estimates and economic evaluations are carried out as per guidelines issued by the Central Water Commission.

2. The project has also been examined by the State level Project appraisal / Technical Advisory Committee comprising representative of Irrigation, Agriculture, Fisheries, Forests, Soil Conservation, Ground Water, Revenue and Finance Dept. and State level Environmental Committee etc. and techno-economic feasibility of the project has been established.

3. The project is recommended for acceptance by Central Water Commission and Ministry of Water Resources, River Development & Ganga Rejuvenation.

E I Technologies Pvt. Ltd. Bangalore

Assistant Executive Engineer
Karnataka Neeravari Nigam Limited
G.R.B.C.C. Sub Divn. No:5, GOKAK.

EXECUTIVE ENGINEER,
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Signed by
(Signature, Name with seal)

Chief Engineer, KNNL
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Govt. of Karnataka.

Superintending Engineer,
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Hidkal Dam

CHIEF ENGINEER
K.N.N.L. Irrigation (N) Belagavi

Appendix –K

Certificate on Survey and Investigation

This is to certify that the Ghatti Basavanna Drinking Water Project located in the State of Karnataka for which 100% survey has been carried out. Copy of the report is attached.

E I Technologies Pvt. Ltd. Bangalore

Assistant Executive Engineer
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G.R.B.C.C. Sub Divn. No:5, GOKAK.

EXECUTIVE ENGINEER,
KARNATAKA NEERAVARI NIGAM LIMITED
GRBCC DN. NO. 3, GOKAK

Signed by

(Signature, Name with seal)

Chief Engineer, KNNL
Irrigation (North), Belagavi
Govt. of Karnataka.

Superintending Engineer,
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Hidkal Dam

CHIEF ENGINEER
K.N.N.L. Irrigation (N) Belagavi

Appendix – L

Certificate on Cadastral Survey

This is to certify that proper Cadastral Survey has been carried out for all the property coming under submergence, for reservoir and for the Ghatti Basavanna Drinking Water Project located in the State of Karnataka. The list of properties coming under submergence are as follows:

No.	Name of Properties	
1	**Land in ha (including Roads Bridges Colony etc)** *Forest land:*	616.37 Ha
	Agriculture land:	-
	Revenue land:	118.27 Ha
	Others:	-
	Total	**734.64 Ha**
2	**Houses and Buildings (in Nos.)**	About 70
3	**Other structures such as road bridges, Railway bridges etc. (in Nos.)**	-
4	**Others**	-

E I Technologies Pvt. Ltd. Bangalore

Assistant Executive Engineer
Karnataka Neeravari Nigam Limited
G.R.B.C.C. Sub Divn. No:5, GOKAK.

EXECUTIVE ENGINEER,
KARNATAKA NEERAVARI NIGAM LIMITED
GRBCC DN. NO. 3, GOKAK

Signed by
(Signature, Name with seal)
Chief Engineer, KNNL
Irrigation (North), Belagavi
Govt. of Karnataka.

Superintending Engineer,
K.N.N.L., G.R.B.C.C. Circle,
Hidkal Dam

CHIEF ENGINEER
K.N.N.L. Irrigation (N) Belagavi

SECTION – 1
CHECKLIST

Section - 1
Checklist
(As per CWC Guidelines 2010)

No.	Particulars	Details
I.	**GENERAL DATA**	
1)	Name of the project	Ghatti Basavanna Drinking Water Project
2)	**Location**	
a)	State(s)	Karnataka
b)	District(s)	Belagavi
c)	Taluka (s) / Tehsil (s)	Gokak
d)	Longitude/Latitude	Longitude 74˚ 47' 18" E and Latitude 16˚ 9' 11" N
e)	Survey of India Topographical Map reference No.	47-L-12-(E43U12) & 47-L-16-(E43U16)
f)	Earthquake Zone number	Zone III
g)	Complete address for correspondence along with pin code /e-rnail	**The Managing Director,** Karnataka Neeravari Nigam Limited, 4th Floor, Coffee Board Building No. 1, Dr. B.R. Ambedkar Veedhi Bangalore - 560 001. Ph.: (+91-80) 222 83074-78. Fax: +91-80-223 86015. knnl@knnlindia.com
3)	**Category of the project**	
a)	Irrigation/Multipurpose	(Multipurpose) (Drinking +Tank filling+Industrial)
b)	Storage/diversion	Storage [Drinking water]
II.	**PLANNING**	
4)	Has the Master plan for overall development of the river basin been prepared and stages of basin development discussed?	Present project is envisaged to be developed in single stage to "Providing Utilize the proposed reservoir to meet requirement of drinking water needs of Gokak town and surrounding villages and part of Saundatti, Hukkeri and Bailahongla Taluks in Belagavi district, Karnataka.
5)	Have the alternative proposals (including set of smaller developments vis-a-vis a single large development) been studied and their merits and demerits discussed?	Merits and Demerits of alternative proposals are discussed in the Report, Vol-I Chapter 1, para 1.10
6)	Does the scheme fit in the overall development of the river basin and has its	Discussed in the Report, Vol-I,Chapter 1, para 1.12

No.	Particulars	Details
	priority in the overall development of the basin been discussed?	
7)	Have the other Departments concerned with the development been informed?	Yes, Discussed in the Report, Vol-I,Chapter 1, para 1.13
8)	Is the present scheme proposed to be executed in stages? If so, are various stages of execution and development discussed in the report?	Single Stage
9)	Are the effects of the scheme on the riparian rights & existing Upstream and downstream projects etc. discussed?	Yes, Discussed in the Report, Vol-I,Chapter 3, para 3.4 on Inter State Aspects
10)	Has the provision for municipal and industrial water supply been made?	The project considers the overall scenario which includes the municipal & industrial supplies also
III.	**INTERSTATE AND INTERNATIONAL ASPECTS**	
11)	Are there any International/Interstate issues involved? If so have these issues been identified and present status of agreement or tribunal decision indicated specially in respect of	
a)	Sharing of water	As per KWDT-I (Bachavat) and GWDT Award
b)	Sharing of cost	NA - As project is solely taken up by Karnataka
c)	Sharing of benefits (irrigation, flood control. Power etc.)	NA - Present project is envisaged to be developed in single stage to "Providing storage backing to meet drinking water requirement of Gokak town and other identified towns and villages in Krishna Basin".
d)	Acceptance of the submergence by the upstream state(s)	NA - As submergence is only in Karnataka
e)	Acceptance by the upstream state(s) of compensation of land coming under submergence	NA - As submergence is only in Karnataka, the implementing state
f)	Settlement of oustees	Provision has been made for Rehabilitation and Resettlement of oustees coming under submergence area of the Reservoir as per the latest Land Acquisition Act which is in vogue.
g)	Any other	Nil
NOTE:-If there is no agreement, state the present position against each of the above item		
IV.	**SURVEYS**	
12)	Have the detailed topographical surveys been carried out for the following items and maps prepared as per prescribed scales	

No.	Particulars	Details
a)	River surveys	All the required Survey and Investigation including geological studies have been carried out which are relevant for the preparation of Detailed Project Report.
b)	Reservoir surveys	All the required reservoir Surveys and Investigation have been carried out which are relevant for the preparation of Detailed Project Report.
c)	Head work surveys (dam(s), dyke(s), barrage(s).weir(s) etc. and auxiliary components)	All the required Survey and Investigation including geological studies have been carried out which are relevant for the preparation of Detailed Project Report.
d)	Plant and Colonies sites	All the required Survey and Investigation have been carried out which are relevant for the preparation for the planning of the Plant and Colonies layout including design and estimate as a part of Detailed Project Report.
e)	Canal(s),branch canal(s) and water distribution system	NA
f)	Major canal structures	NA
g)	Power house, switch-yard, surge shafts, tailrace	NA
h)	Tunnel(s), adit(s),penstocks etc.	NA
i)	Surveys (detailed and sample) of areas of the command for OFD and Drainage work	NA
j)	Soil surveys	Preliminary survey has been carried out. Part of the project site (both upstream & downstream) falls under the forest land. KNNL is in the process of obtaining the approval from the forest authority to validate and to carry out further survey and Investigation if required. However, all the required investigation for the preparation of the DPR has been completed in all respects.
k)	Surveys for soil conservation	Preliminary survey has been carried out. Part of the project site (both upstream & downstream) falls under the forest land. KNNL is in the process of obtaining the approval from the forest authority to validate and to carry out further survey and Investigation if required. However, all the required investigation for the preparation of the DPR has been completed in all respects.

No.	Particulars	Details
I)	Any other surveys i.e. archeological right of way. communication etc.	The project proponents have completed site inspection including the survey and there are no sites or monuments which are of archeological importance. Project authorities are in the process obtaining the NOC from the archeological department.
V.	**GEOLOGICAL INVESTIGATIONS**	
13)	Have the geological surveys for the following items been carried out and report on geology of the following appended?	
a)	Region as a whole	Yes, Refer Chapter 4
b)	Reservoir	Yes, Refer Chapter 4
c)	Head work and energy dissipation area	Yes, Refer Chapter 4
d)	Power house and appurtenances	NA
e)	Intakes and regulators	Yes, Refer Chapter 4
f)	Major canal structures	NA
g)	Tunnel(s),Pen stock(s),hill(s)etc.	NA
h)	Communication routes	NA
i)	Any other	Nil
VI.	**SEISMIC INVESTIGATIONS**	
14)	Has the seismicity of the region been studied and co-efficient of vertical horizontal acceleration for the various structures discussed?	Yes, Refer Chapter 4
15)	Has the approval of the Standing Committee for recommending design of seismic coefficients for River Valley Project been obtained?	The project proponents have submitted all the required details including the reports to CWPRS, Pune for their review and recommendation. Consequent to their recommendation the report and findings will be submitted to Standing Committee for recommending design of seismic coefficients for River Valley Project.
16)	Is there possibility of liquefaction of foundations? If so whether liquefaction studies been carried out?	No, The dam is founded on Hard rock
VII.	**FOUNDATION INVESTIGATIONS**	
17)	Have the detailed foundation investigations (including in-situ tests and laboratory tests) for the following structures been carried out and detailed report(s) appended?	
a)	Earth and rock fill dam(s)	NA – Concrete gravity dam is proposed.
b)	Masonry/concrete dam(s)	Concrete gravity dam is proposed. All the required Survey and Investigation including geological studies have been carried out which are relevant for the preparation of Detailed Project Report.

No.	Particulars	Details
c)	Barrage(s) / Weir(s) / head regulators) etc.	NA
d)	Canal(s) & Canal Structures	NA
e)	Power house (t),tunnel (s), transformer caverns), Desilting chamber(s), surge tank(s) / shaft(s), intake(s)	NA
f)	Pump House(s)	NA
g)	Any other	Nil
18)	Are there any Special features affecting the designs?	No
VIII.	**CONSTRUCTION MATERIAL SURVEYS**	
19)	Have the surveys and laboratory tests for the· following Construction materials been carried out and report(s) appended?	
a)	Soils for impervious, semi-pervious and pervious zones of earth and rock-fill dam(s)	NA - As it is a concrete Gravity dam
b)	Sand	Yes, Refer Chapter 4 , para 4.8
c)	Rock and coarse aggregates	Yes, Refer Chapter 4 , para 4.8
d)	Bricks and tiles	Yes, Refer Chapter 4 , para 4.8
e)	Pozzolona	NA
f)	Cement and lime stone	Yes, Refer Chapter 4 , para 4.8
g)	Steel	Yes, Refer Chapter 4 , para 4.8
h)	Any other	Nil
20)	Have the sources for each of the above material been identified and need etc. indicated?	Yes, Refer Quarry map,Vol III - Drawings
21)	Have the proposals for procurement of scarce materials been indicated?	NA
IX.	**HYDROLOGICAL AND METEOROLOGICAL INVESTIGATIONS**	
22)	(a) Have the hydrological and meteorological investigations been carried out and status of following data discussed in report?	
	i. Rainfall	Yes, Refer Chapter 4 , para 4.9
	ii. Temperature	Yes, Refer Chapter 4 , para 4.9
	iii. Sunshine	No
	iv. Gauge & Discharge	-
	v. Sediment	Yes, Refer Chapter 4 , para 4.9
	vi. Water quality	No
	vii. Evaporation	Yes, Refer Chapter 4 , para 4.9
	(b) Has the above data been collected & appended?	Appended in the report as Appendix 3
X.	**HYDROLOGY**	
23)	Is the Hydrology dealt with in detail in a separate volume? Have its brief details been included in this Report?	Hydrology study is carried out and dealt in Chapter 5 – Vol I.

No.	Particulars	Details
24)	Have an index map and bar chart showing locations of various hydro-metric, climatic and rainfall stations existing / ongoing / planned water resources projects and the data availability at those stations been attached?	Index Map showing the location of the proposed reservoir appended in Vol – III - Drawings
25)	Have required detail note about project-specific-hydro-meteorological data observatories been attached.	Yes, Refer Appendix 3 – Vol II
26)	Have required detail in case of Himalayan rivers, if project being planned in upper reaches the satellite imageries of project catchment especially one during snow melt period (March-May) and one during monsoon (June-September) period been attached?	NA – The project is planned in Deccan plateau.
27)	Are detail notes about quality, Consistency. Processing and gap filling of the data included.	Yes. If any further data and information is required the same will be furnished.
28)	**Have hydrological studies been carried out for the following:**	
a)	To establish the availability of water for the benefits envisaged?	Chapter 5.
b)	To determine design flood for the various structures (spillway ,weir ,barrage etc.)	Yes.
c)	Sediments storage	Yes.
d)	Design flood for diversion during construction	Yes.
e)	Tail water rating curve	Yes.
f)	Evaporation rates from reservoirs/concerned area	Yes.
g)	Command area rainfall	NA
29)	Has the Ground Water Potential (existing use and additional availability) been indicated?	No
30)	Have the studies regarding reservoir sedimentation been carried out and revised elevation-area capacity curves been used in the simulation studies (Working Table)?	Yes, Refer Vol I, Chapter 8, para 8.2
31)	Have the ecological requirements of water such as low flow augmentation and water quality control etc. and water requirement for domestic, industrial use and power generation (thermal, Hydel, nuclear) been considered and included in the Project Report and incorporated in the simulation studies?	Yes, Refer Vol I, Chapter 17
32)	Have the details of the simulation studies.	Yes, Refer Vol I, Chapter 5

No.	Particulars	Details
	(Working Tables) and conclusions arrived, from the various alternatives explaining the factors and assumptions been included and discussed?	
33)	Has the number of failures for different aspects been indicated?	Yes, Refer – Working Tables
34)	Have the likely desirable and, undesirable changes in the hydrologic regime due to-.the project been brought out in the report?	Ghatti Basavanna project is meant for Drinking water purpose and hence no hydrologic regime changes are expected
35)	Is the criteria adopted for selection of the construction diversion flood discussed?	No
36)	Has the basis for determining the storage capacity been discussed?	Yes, Refer Vol I, Chapter 5
37)	Have integrated working tables (for more than one reservoir in the system) been prepared?	Working tables for present project is prepared.
38)	Has carry over storage been provided? If so. Whether studies for most economic carry over storage been done?	Carry over storage has not been provided in the proposed scheme.
39)	Have the flood routing studies been carried out?	No, The flood discharge for the spillway design is considered as per CWC recommendation. Refer Vol I, Chapter 7. However, the required data and information has been furnished to KERS, Mysore for conducting Hydraulic model studies (Spillway and Hydraulic jump).
40)	Have the back water studies been carried out?	Yes.
XI.	**LAND ACQUISITION AND RESETTLEMENT OF OUSTEES**	
41)	Have the type and quantum of land proposed to be acquired in the submerged area project area, area coming under canals and distribution system, area required for rehabilitation of the oustees been detailed?	Yes, Refer Vol I, Chapter 8, para 8.8.1
42)	Is the basis for provision for land compensation indicated?	Yes, Refer Vol I, Chapter 8, para 8.8, provisions are made in the Abstarct by the technical advisory committee of the CWC.
43)	Have the rehabilitation measures, amenities and facilities to be provided to the Project Affected Persons been discussed and whether their provisions included in the report? Are these in accordance State's policy/project, specific policy/draft national policy for rehabilitation and resettlement	Yes, Refer Vol I, Chapter 8, para 8.8, provisions are made in the Abstarct by the technical advisory committee of the CWC.
44)	Are the basis of land acquisition of the	Yes, Refer Vol I, Chapter 8.

No.	Particulars	Details
	submerged area upto FRL/MWL etc. discussed?	
XII.	**DESIGNS**	
45)	Does the state have established a Central Design Organization and State level multi-disciplinary /Advisory Committee and whether its composition has been indicated in the report?	Yes. KNNL is the nodal agency appointed by GoK for the implementation of the project. KNNL has dedicated centralized design team to review all the designs pertaining to the project and accord approval based on which the designs will be presented to an independent Expert Committee – Estimate Review Committee (ERC). In other words, the review of planning, design and estimates will undergo review and scrutiny at three levels before the Administrative Sanction is accorded.
46)	Has the selection of final location of the head works and, appurtenances, in preference to the other sites investigated been discussed?	Yes. Refer Vol –I,Chapter 1
47)	Have the layout of the project viz location of head work workshop sheds; offices, Colonies. etc. been finalized and discussed?	Yes
48)	Has the layout of the various major components of the head works been discussed in the, light-of site features, geology, foundation characteristics?	Yes, Refer Vol –I,Chapter 4
49)	Have the detailed designs been prepared for the following components & got vetted by CDO?	Yes. KNNL is the nodal agency appointed by GoK for the implementation of the project. KNNL has dedicated centralized design team to review all the designs pertaining to the project and accord approval based on which the designs will be presented to an independent Expert Committee – Estimate Review Committee (ERC). In other words, the review of pllanning, design and estimates will undergo review and scrutiny at three levels before the Administrative Sanction is accorded.
a)	Earth or rock fill dam. Masonry or concrete dam; spillway ,barrage, weir. etc. and appurtenances.	Yes, Refer Vol –I, Chapter 7, para 7.2
b)	Energy dissipation arrangements, training walls etc.	Yes, Refer Vol –I, Chapter 7, para 7.2
c)	Openings through dams- galleries head regulators, penstocks other outlets, sluices	Yes, Refer Vol –I, Chapter 7, para 7.2

No.	Particulars	Details
	etc.	
d)	Regulators	NA
e)	Canal and water conductor system	NA
f)	Canal structures	NA
g)	Pump house, Intake structures	NA
h)	Power House, tunnels, surge shaft	NA
i)	Instrumentation	Yes, Refer Vol –I, Chapter 7, para 7.6
j)	Power evacuation arrangement	Yes, Refer Vol –I, Chapter 7, para 7.6
k)	Design of Hydro Mechanical equipment's	Yes.
50)	Have the salient features of the above components ·and the assumptions made in the design of above components of the project been indicated and their basis discussed?	Yes,
51)	Have any model studies been carried out for location of the-dam, spillway and other appurtenances & checking the design profile. of the spillway. Energy dissipation arrangements. Location of outlets/regulators etc.?	Model studies is under progress at KERS, Mysore and CWPRS, Pune. The required data and information has been furnished to KERS, Mysore for conducting Hydraulic model studies (Spillway and Hydraulic jump). The project proponents have also submitted all the required details including the reports to CWPRS, Pune to undertake • Site specific seismic study • 3D & 2D Stress analysis by FEM Method • Hydraulic model studies for river/scouring sluice.
52)	Has the final alignment of canal(s) , and branch canal(s) been discussed in the light of various alignments studied?	NA
a)	Does the canal design provide for meeting requirement to rush irrigation?	NA
b)	Have any intermediate storages and tail tanks been considered to reduce the canal capacities?	NA
53)	Are the canals and distribution system being lined and If so what is the minimum capacity of the channel proposed to be lined?	NA
54)	Is the location of canal structure on main and branch canals fixed after detailed surveys of the final alignments?	NA
55)	Are the regulation arrangements of the. off taking channel both. near and away from the cross regulators discussed?	NA

No.	Particulars	Details
56)	Are sufficient escapes including terminal escapes provided on the main/branch canal distributaries/minors?	NA
57)	Have the basis for adopting water way for the cross drainage works been discussed?	NA
58)	Have the proposals for rating the canal section by providing standing wave flumes. rating of the falls, broad crested weirs. V - notches etc. been discussed for the canal and distribution system?	NA
59)	Have any model studies for major canal structure(s) been carried out and if so are the results discussed and incorporated in the design?	NA
XIII.	**IRRIGATION AND COMMAND AREA DEVELOPMENT**	
60)	Have the conveyance and field irrigation efficiencies for paddy and upland crops during kharif, rabi etc. been indicated, discussed and justified?	NA
61)	Have the 10-daily/monthly crop water requirements at the canal head been worked out?	NA
62)	Are there any proposals for introducing Warabandi and if so have these proposals been discussed in the report and sample calculations for a typical distributary / minor / sub- minor furnished?	NA
63)	Has the present position of irrigation in the command through existing canals, tanks, and lift schemes. wells etc. been brought out·in the report?	NA
64)	Are the particulars of all irrigation projects (including minors schemes) existing / proposed in the command been indicated?	NA
65)	Are there any potential areas, where ground water is available? If so, has the quantity & quality of the ground water been indicated?	NA
66)	Has the quantum of available ground water been assessed and plan for its conjunctive use with surface water been prepared and incorporated in the report?	NA
67)	Have the semi-detailed soil surveys been carried out for the entire command? If not the	NA

No.	Particulars	Details
	extent of area surveyed may be indicated.	
68)	Have soil and land irrigability classifications brought out in the report?	NA
69)	Is the method used for determining the crop water requirements discussed?	NA
70)	Has the pre-project cropping pattern and the proposed cropping pattern along with justification been furnished?	NA
71)	Has the proposed cropping pattern been certified by Centre/State Agricultural: Authorities giving the statement of having considered the soil characteristics and land irrigability characteristics of the command area in-deciding the percentage of the command area falling under respective crops as suggested in DPR.	NA
72)	Whether drinking water needs of the population projected for the 25-30 years after construction of the project on enroute and that in the command of the project considered.	The estimated population of the Gokak town and adjoining 3 towns as per census 2011-12 is 1,35,715. Besides there are nearly 131 number of villages with an estimated population of 4,76,448. Considering the growth for next 40 years, the estimated drinking water needs will be 2.76 TMC, and 0.62 TMC for livestock.
73)	Whether the proposed G.W utilization is certified by CGWB and a statement furnished.	NA
74)	Are the areas and percentages of the CCA that will be irrigated during kharif, rabi, two seasonal, summer and perennial been indicated?	NA
75)	Is justification furnished for irrigating perennials and summer crops from the reservoir?	NA
76)	Have the monthly reservoir operation studies been carried out at least for 20 years and summary on annual basis attached?	Summary on Annual Basis attached (Ref. Chapter 5, Table 5.7)
77)	Have the number of blocks selected for detailed surveys for On Farm Development (OFD) works including drainage and total area covered by such blocks been indicated?	NA
78)	Have the existing locations of the Trial cum Demonstration Farm, input centers (seeds, fertilizer and insecticides) in .the command	NA

No.	Particulars	Details
	been indicated and proposal to strengthen the same discussed?	
79)	Have the arrangements for financing the OFD works and proposals, if any, .for strengthening, the same been discussed?	NA
80)	Have the agencies responsible for execution of OFD Works been identified and simultaneous planning of execution of OFD works along with engineering works discussed?	NA
81)	Has-the year wise phasing of irrigation development as a result of the project been discussed?	NA
82)	Is the existing communication system telephone. wireless and roads within command are a sufficient to meet the requirement after full development to irrigation? If not, have the new proposals been planned and discussed?	NA
83)	Is the adequacy of the marketing centers in the Command Area and new proposals to meet the requirements after full development of irrigation been discussed?	NA
84)	Is there any stabilization of existing irrigation proposed?	NA
XIV.	**FLOOD CONTROL AND DRAINAGE**	
85)	Have the various flood control components of the multipurpose project been indicated?	NA
86)	Have the damage areas in pre-project & post project situations been identified and flood intensities worked out at each of the damage center(s) which gets affected?	NA
87)	**Have the following flood aspects been discussed?**	
a)	Flood cushion in the reservoir.	Provision has been made for the flood cushion
b)	Maximum moderated flood outflows over the spillway etc. and its frequency	The spillway has been designed to discharge as per the approved CWC parameters. Refer Vol I, Chapter 5 , para 5.6
c)	Existing and proposed safe carrying capacities of the channel below the dam after construction of flood embankment, channel improvement, river diversion etc.	The river valley downstream of the dam is well defined with high banks on either side. The chances of flood overflanking immediately d/s is remote.

No.	Particulars	Details
d)	Synchronized moderated peak floods due to releaser(s) from the dam upstream and un-intercepted catchment up to the damage centers.	The spillway has been designed to discharge as per the approved CWC parameters which takes into cognizance of the flood releases from upstream dams and un-intercepted catchment.
e)	Average annual expenditure incurred on flood relief works.	Expenses due to flood relief work is not envisaged since such scenario has not been encountered in the Markandeya river basin in Karnataka till date.
f)	Area and population affected/likely to be affected before/after the project.	Only population in some of the hamlets may require rehabilitation and resettlement. Refer Vol I, Chapter 1 , para 1.6
g)	Estimated saving in annual loss of life, property, cattle, crops etc. (evaluated in terms of money) due to flood control.	Consequent to the approval of the report, a comprehensive survey of the submergence area will be carried out in order to identify facilities which are likely to be submerged and requiring relocation including extent of compensation payable etc
88)	**Have the following drainage aspects of command area been discussed?**	
a)	Existing Surface and sub-surface drainage network and problems of the drainage congestion, water logging, alkalinity/salinity if any.	NA
b)	Studies on sub soil water table (pre-monsoon, post monsoon etc.).	NA
c)	Maximum intensity of 1, 2. and 3 day rainfall.	NA
d)	Deficiencies in farm drains.	NA
e)	Deficiencies in existing natural drains	NA
f)	Proposal for improvement of drainage water logging /alkalinity/salinity of the area along with justification thereof.	NA
g)	Identification of the area in Command which will get benefited due to execution of drainage net-work and benefits thereof in terms of relief from crop damage, increased yields etc.	NA
XV.	**NAVIGATION**	
89)	Is the present scheme for remodeling of the existing facilities and/ or extension of the navigable reach or establishing new navigable	NA

No.	Particulars	Details
	reach?	
90)	Is the existing inland transport system being fully utilised? If not, have the bottlenecks in its full utilisation been identified and discussed?	NA
91)	Have the surveys for goods and passenger traffic been carried out and discussed?	NA
92)	Is the extent of modification required in the existing system discussed and justified?	NA
93)	Do design for the canal section and structures take into account the navigation requirements?	NA
94)	Have the proposals to develop the new scheme and phases of development in the different reaches been discussed?	NA
95)	If the area is being served by inland water transport, have the following been discussed:	NA
a)	The existing toll rates and registration fees for the crafts (size-wise)	NA
b)	Proposals for revision of tollage rates and fees, if any.	NA
c)	Concurrence of the competent authorities for revision of rates and fees.	NA
d)	Proposal to subsidies the tariff, tollage, craft registration fee, passenger fare etc. to attract traffic.	NA
96)	Has the State Inland Water Authority been consulted while finalising the scheme and its view point discussed?	NA
97)	Has economic justification and viability of the, navigation component of the multipurpose project been discussed?	NA
XVI.	**POWER**	
98)	**Have the following points been discussed**	
a)	Availability of the power generating capacity in the state as well as in the region from different sources.	NA
b)	Total energy available and peaking capacity of the system, in the state as well as in the region from different sources.	NA
c)	Integrated operation of the system and present status of utilization in the state as well	NA

No.	Particulars	Details
	as in the region.	
d)	Surpluses and shortfalls in the system in the state as well as in the region.	NA
e)	Future plans of power development from different sources in the State/region.	NA
f)	Fitment of the scheme in planning of power development of the state /region.	NA
g)	Energy generated from the project Firm power, seasonal power and total power.	NA
h)	Proposal for transmission lines connecting to the existing system / grid.	NA
i)	Project. Cost. Per kwh installed and per kwh generated at bus bar as compared to the different hydro-electric: thermal generation and gas projects and different sources.in the State as well as.in the region to justify the power component of the project.	NA
j)	Whether the proposed addition to the transmission system has been shown-on a geographical map Whether options considered for the proposed addition have been discussed with statement of justification for the selected option after carrying out supporting studies covering load flow studies , short circuit studies (three phase and single phase) and stability studies.	NA
k)	*Whether sufficient surplus of Peak power is available for pumping of water from lower to upper reservoir.	NA
l)	*Actual off peak energy requirement of proposed scheme	NA
m)	*Cost of peak-and off peak energy	NA
	for pumped storage schemes only	
XVII.	**CONSTRUCTION PROGRAMME & PLANT AND, MANPOWER PLANNING**	
99)	Are the .major components of work proposed to be done departmentally or through contractor?	The construction works are proposed to be executed through Tendering process.
100)	Have the various alternative construction programme been studied and proper justification furnished for the final programing adopted?	Yes, for 1.5 (18 months including monsoon) Years.
101)	Has the proposed Construction programme	Yes, refer Chapter 15. Command area

No.	Particulars	Details
	been prepared and synchronized for timely completion of each of the major component of work including Command Area Development?	development is not envisaged
102)	**Have the year wise quantities of the following materials of construction been worked out for various components of the project.**	
a)	Excavation separately in -soft and hard strata	Yes, Detailed project Work Breakdown Structure (WBS) has been worked out considering the overall project schedule.
b)	Earth work in filling-impervious, semi-pervious and pervious	Yes, Detailed project WBS has been worked out considering the overall project schedule.
c)	Rock fill-for dam,toe, riprap etc.	NA
d)	Stone for masonry	Yes, Detailed project WBS has been worked out considering the overall project schedule.
e)	Coarse aggregate for concrete	Yes, Detailed project WBS has been worked out considering the overall project schedule.
f)	Sand-for filter, masonry/ concrete.	Yes, Detailed project WBS has been worked out considering the overall project schedule.
g)	Gravel-for filter.	Yes, Detailed project WBS has been worked out considering the overall project schedule.
h)	Steel of various sizes and type	Yes, Detailed project WBS has been worked out considering the overall project schedule.
i)	Cement-normal, quick/slow setting with or without Pozzolona, special types	Yes, Detailed project WBS has been worked out considering the overall project schedule.
j)	Lime-surkhi-Pozzolona	Yes, Detailed project WBS has been worked out considering the overall project schedule.
k)	Scarce material-special steel	Yes, Detailed project WBS has been worked out considering the overall project schedule.
l)	Other material-fuel, electricity, explosive etc.	Yes, Detailed project WBS has been worked out considering the overall project schedule.
103)	Have the year wise quantities to be executed by machine labour for each of the major component been worked out for each of the above material?	Yes, Detailed project WBS has been worked out considering the overall project schedule.
104)	Have the labour intensive items of the various major components of the project been identified and the quantities of such items worked out?	Yes, Detailed project WBS has been worked out considering the overall project schedule.
105)	Have PERT chart or CPM diagrams for construction programme of various components been made and included in report? Has organizational setup and frequency for project monitoring been indicated in the report?	Yes, Detailed project WBS has been worked out considering the overall project schedule.
XVIII.	**FOREIGN EXCHANGE**	

No.	Particulars	Details
106)	Have the details of the plant and machinery, spares, instruments and scares material to be imported\ worked out ?	NA
107)	Has the phasing of imports and source(s) of imports been discussed item wise?	NA
108)	Are the imports to be affected under foreign grants/credits or internal resources of the country?	NA
109)	Is the scheme covered under State sector or Central sector?	Covered under State Sector
XIX.	**FINANCIAL RESOURCES**	
110)	Has the Concurrence of the State Finance department been obtained?	Yes, The project has been approved by the competant authority.
111)	Is the scheme included in the Five Year/Annual Plan? If not what is the present position regarding its inclusion in the plan?	The project will be included in the annual plan for the budget before taking up the construction activity.
112)	Whether the scheme has already been started? If so, is the present stage of construction indicated?	Preparation of the DPR is completed. Other reports and studies including statutory approvals will be obtained consequent to the approval of the project
113)	Have the year wise requirement of funds been indicated?	Yes 1st year – Rs. 288.03 Crores 2nd year – Rs. 480.05 Crores 3rd year – Rs. 221.92 Crores **Total - Rs. 990.00 Crores**
114)	Is the scheme covered or proposed to be covered under any foreign assistance/aid agreement?	The scheme is not proposed to be covered under any foreign /aid agreement
XX.	**ESTIMATE**	
115)	Is the separate volume of estimate attached as appendix?	Yes, Refer Vol -II
116)	Is the year to which the rates adopted in the estimate relates to indicated?	The estimates are prepared based on SR of 2018-19 of WRD continued for 2019-20.
117)	Have the analysis of rates for various major items of the work for the major components of the project been furnished and with basis of analysis described?	Yes, Refer Vol -II
118)	**Are the provision for the following items made on the basis of sample survey and sub estimates**	
a)	Distributaries:,minor and sub-minors	NA
b)	Watercourses	NA
c)	Drainage	NA
d)	CAD works	NA

No.	Particulars	Details
XXI.	**REVENUE**	
119)	**Are the basis for the following sources of revenues furnished?**	
a)	Betterment levy and proposal for its recovery	NA
b)	Irrigation cess	NA
c)	Flood protection cess	NA
d)	Crop wise water rates	Not applicable as the present scheme do not envisage any irrigation component
e)	Sale of water for Village / City / Industrial / Power / Water supply	Yes, Refer Chapter 20
f)	Miscellaneous	-
120)	Have these rates been compared with the existing rates at the other projects in the State/region?	Yes, rates have been adopted as per the prevailing rates approved by GoK which is in vouge
121)	In case the rates are being enhanced, has the concurrence of the concerned department(s) been obtained?	NA
122)	Have the Organisational set up for the collection of revenue been indicated?	Yes, refer Chapter 15.
XXII.	**B.C.RATIO**	
123)	**Are the allocated cost for the following components of the multipurpose project worked out and basis there in furnished?**	
a)	Irrigation	NA
b)	Power	NA
c)	Flood Control	NA
d)	Navigation	NA
e)	Water supply	Yes, Refer Chapter 21
f)	Any other	NA
124)	Have the various departments of the State/Centre agreed to the sharing of the above allocated cost?	Yes
125)	Have the crop wise benefits been worked out for irrigated and un irrigated crops being grown before project in consultation with the agriculture department and statement furnished?	NA
126)	Have the crop wise benefits been worked out for proposed cropping pattern after the introduction of irrigation in consultation with the agriculture department and statement furnished?	NA
127)	Is the B.C. Ratio of Irrigation Projects	NA

No.	Particulars	Details
	acceptable or otherwise justified?	
128)	Is the B.C.Ratio for Flood Control Projects acceptable or otherwise justified?	NA-
129)	Is the B.C.Ratio for power component of the project acceptable or otherwise justified?	Yes , Refer Chapter 21
130)	Have the financial and economic return statements been furnished keeping in view the phasing of development?	Yes , Refer Chapter 21
131)	Are the benefits other than those considered in the B.C. Ratio and financial return statement been identified?	Yes , Refer Chapter 21
132)	Is the benefit from Gallper land, if proposed, based on lease rates admissible and statement from concerned Central/State authorities furnished?	NA
133)	Are the benefits from fisheries, horticulture, if proposed, based on lease rates admissible and statement from concerned Central/State authorities furnished	No benefits considered at present
XXIII.	**ECOLOGICAL ASPECTS**	
134)	**(a) Is the area likely to have any of the following environmental and ecological problems due to the altered surface water pattern? If yes, whether preventive measures have been discussed?**	
	Excessive sedimentation of the reservoir and the upper reaches of the river and its tributaries tailing into reservoir	
	i. Water logging, salinity/alkalinity	No effect. Refer Chapter 17
	ii. Quality of surface and ground water	No effect. Refer Chapter 17
	iii. Ground water recharge	Yes
	iv. Health hazards-water borne diseases,	No effect. Refer Chapter 17
	v. industrial pollution etc.	No effect. Refer Chapter 17
	vi. Submergence of important minerals deposits	No effect. Refer Chapter 17
	vii. Submergence of monuments/archeological sites	No effect. Refer Chapter 17
	viii. Fish culture and aquatic life	No effect. Refer Chapter 17
	ix. Plant life (flora)	No effect. Refer Chapter 17
	x. Wild Life	No effect. Refer Chapter 17
	xi. Migratory birds	No effect. Refer Chapter 17
	xii. National parks and sanctuaries	No effect. Refer Chapter 17
	xiii. Seismicity due to filling of reservoir	No effect. Refer Chapter 17
	xiv. Likely changes in the regime of the river	No change is expected in the regime of the river
	xv. Any other	NA

No.	Particulars	Details
	(b) Have the environmental and forest clearances from MOEF&CC been obtained? If not what is status thereof?	The proposals seeking applicability of EIA notification, 2006 and its amendments from MoEF & CC, New Delhi is submitted in PARIVESH portal on 27/11/2020 vide Proposal No. IA/KA/RIV/185340/2020 and is under process. The project neither proposes any hydroelectric power generation nor irrigation use/purpose to develop any command area and hence it does not attract provisions of EIA notification, 2006, and its subsequent amendment, 2009. The proposal for forest clearance is submitted in online portal on 27/11/2020 vide Proposal No. FP/KA/WATER/65437/2020 and is under process.
XXIV.	**COLONIES AND BUILDINGS**	
135)	Has the planning of the colony/building been done keeping in view the ultimate use for optimum utilisation of investment?	Planning is being done for Rehabilitation and Resettlement of ousters coming under submergence of the proposed reservoir.Refer Vol –I, Chapter 8,
136)	Has an estimate of the extent of higher cost involved been made and details discussed?	NA
137)	Are the permanent buildings being constructed required for maintenance of the project only?	Yes
138)	Can the buildings other than required for maintenance of the project being constructed be put to some other use after the completion of the project by the department or any other agencies?	Yes
139)	Have the interested agencies been consulted for planning of the buildings to suit their requirements later on?	Yes
140)	Have the proposals for disposal of temporary buildings been discussed?	NA
XXV.	**PUBLIC PARTICIPATION AND COOPERATION**	
141)	**Are the possibilities of these been discussed in:**	
a)	Planning	Yes
b)	Construction	Yes
c)	Improved agricultural practices	NA
d)	Any other	NA

No.	Particulars	Details
142)	Have-public debates about utility of projects been held and the response thereof outlined in the Report?	Refer above
XXVI.	**SOIL CONSERVATION**	
143)	Is the need for soil conservation measures in the catchment-of the project discussed?	Will be planned during the execution of the proposed scheme.

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Gokak.

Executive Engineer,
KNNL, GRBCC Division No.3,
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Superintending Engineer,
KNNL, GRBCC Circle.
Hidkal Dam.

Chief Engineer,
KNNL, Irrigation (N) Zone.
Belagavi.

SECTION - 2
SALIENT FEATURES

Section - 2

Salient Features

No	Particulars		Details		
1	**Name of the Project**		Ghatti Basavanna Drinking Water Project		
2	**Type of Project** (Irrigation or Multipurpose)		Multipurpose (Drinking water Project)		
3	**Location**		Longitude 74˚47'18 E Latitude 16˚9'11" N		
3.1	River Basin	a) Name	Ghataprabha sub basin. (Krishna Basin)		
		b) Located in (i) State(s) (ii)Countries (if international river)	 Karnataka India		
3.2	River /Tributary		Markandeya River		
3.3	State(s)/District(s)Taluk(s) or Tehsils in which the following are Located.		**State**	**District(s)**	**Taluka(s)**
	a) Reservoir		Karnataka	Belagavi	Gokak
	b) Headwork		Karnataka	Belagavi	Gokak
	c) Command Area		NA	NA	NA
	d) Power House		Karnataka	Belagavi	Gokak
3.4	Name of the Town/village near the Headwork		Gokak Town, Belagavi District		
3.5	Location of Head Works	a) Longitude	16˚9'11" N		
		b) Latitude	74˚47'18 E		
		c) Lies in Earthquake Zone Number.	Zone No-III		
3.6	Project area Reference to				
	a) Degree Sheets		47-L-12-(E43U12) and 47-L-16-(E43U16). (Scale: 1:50,000)		
	b) Index Plan		Enclosed		
3.7	**Access to the Project**		**Name**	**Distance from project site**	
	a) Airport		Belagavi Airport	61 km	
	b) Rail head		Gokak	10 km	
	c) Road head		Refer Section 1.3		
	e) Sea port		Goa (Sea port)	Mormugoa port 195 km	
3.8	Rail/Road transportation limit of				
	a) Weights (T)		--	---	
	b) Dimensions (LxBxH)		--	---	
4	**International/Interstate aspects of the Project**				
	a)Catchment area of the Basin (Markandeya River Basin)		1052 Sq.km (167 Sq Miles)		
	b) Catchment area in the State		Karnataka - 1052 Sq.km		

No	Particulars	Details	
	c) Submergence due to project		
	(i) In the State	Total area to be acquired is 734.64 Ha Forest lands – 616.37 Ha Revenue lands – 118.27 Ha	
	(ii) In other States	Nil	
	d) Water allocation for the state	KWDT Award - I (Bachavat)= 734 TMC and GWDT Award= 21 TMC, Total=755 TMC	
	e)Water allocation for the other states	Allocations to the States in a normal year as per final KWDT Award 666 TMC for Maharashtra and 1001 TMC Andra Pradesh	
	f) Committed utilization	KWDT Award - I (Bachavat)= 734 TMC and GWDT Award= 21 TMC, Total=755 TMC. Completed and ongoing projects.	
	g) Proposed annual utilisation by the project		
	(i) Irrigation	NA	
	Khariff	NA	
	Rabi		
	Hot weather		
	Total		
	(ii) Water supply	2.76 TMC (comprising of supply of drinking water to Gokak Taluk Region, its surroundings and other identified Villages in the Krishna Basin).	
	(iii) Hydel (evaporation losses)		
	(iv) Thermal Power	NA	
	(v) Livestock	0.62 TMC	
	(vi) Industrial	0.50 TMC	
	(vii) Tank filinling	0.60 TMC	
	h) Minimum agreed/proposed flow in the river for maintaining ecology	As per Statutory requirements.	
5	**Estimated Life of Project (years)**	100 Years	
6	**Irrigation(Ha.)**	**By Flow**	**By lift**
	a) Gross Command Area (GCA)	NA	NA
	b) Culturable Command Area (CCA)	NA	NA
	c) Area under Irrigation (ICA)	NA	NA
	i) Kharif	NA	NA
	ii) Rabi	NA	NA
	iii) Hot Weather	NA	NA
	iv) Two Seasonal	NA	NA
	v) Perennial	NA	NA
	vi) Gross Irrigated Area (GIA)**	NA	NA

No	Particulars	Details	
	iv) Intensity of Irrigation (GIA/CCA) x100	NA	NA
	v) District Benefited	NA	NA
	** Irrigated Area under Khariff, Rabi, Two seasonal, Hot weather and Perennial shall be indicated		
	d) Cost per hectare of gross irrigated area	NA	NA
	e) Cost per 1000 cum of gross storage (TMC)	NA	NA
	f) Cost per 1000 cum of water delivered at the canal head/outlet (TMC)	NA	NA
	g) Water utilization	NA	NA
7	**Flood Control**	NA	
8	**Navigation**	NA	
9	**Water Supply**	Utilize the proposed reservoir to meet requirement of drinking water needs of Gokak town and surrounding villages and part of Saudatti, Hukkeri and Bailahongla Taluks in Belagavi district, Karnataka..	
9.1	Domestic		
	a) Names of the towns / villages served	Gokak Taluk Region, its surrounding areas and other identified villages in the Krishna basin Karnataka.	
	b) Size of population served	5,11,623 (Gokak population -35,715, 131 village population-4, 76,448).	
	c) Quantum of water made available (TMC)	2.76 TMC	
9.2	Industrial Location(s)	NA	
	a) Name (s) (Location(s))	NA	
	b) Quantum of water made available	0.50 TMC	
10	**Project Performance**	**Period of simulation**	**No. of failures**
	a) Irrigation	NA	NA
	b) Power	NA	NA
	c) Flood control	NA	NA
	d) Water Supply	35 years	3 years
	e) Navigation	NA	NA
11	**Hydrology**		
11.1	Catchment		
11.1.1	Catchment Area at Headwork site(Sq.Km)		
	a) Gross	1016.12 Sq Km (At Ghatti Basavanna Dam site)	
	b) Intercepted	690.12 Sq.Km	
	i) By existing Projects		
	Markandeya Dam	432 Sq Km	
	ii) By ongoing Projects		
	Bellary nala dam	258 Sq Km	

No	Particulars	Details			
	iii) By contemplated Projects	690.12			
	c) Unintercepted	326.12			
11.1.2	Catchment area classification according to mode of precipitation				
	a) Rainfed	1016.12 Sq km			
	b) Snow	Nil			
11.2	Precipitation				
11.2.1	Catchments				
		Rainfall (weighted mm)		**Snowfall (mm)**	
		Annual	**Monsoon (June-Oct)**	**Annual**	
	a) Average	881.07	783.71	NA	
	b) Maximum	1372.59	1288.58	NA	
	c) Minimum	582.00	459.60	NA	
	d) Co-efficient of variation	NA	NA	NA	
11.2.2	Command				
		Cropping Season			
		Annual (mm)	**Khariff (Jun –Oct) mm**	**Rabi (Nov- Feb) mm**	**Hot (Mar-May) mm**
	a) Average	NA	NA	NA	NA
	b) 80% dependable	NA	NA	NA	NA
	b) ET_0 (mm)	NA	NA	NA	NA
11.3	Annual yield calculated at the proposed site (Mcum.)				
	Yield at Ghatti Basavanna dam site	6.359 TMC(180.06 M cum)			
11.4	Climatic Data(Command)	Moderate tending to hot			
11.4.1	Name of station(s) and period of records				
	No.	**Names**	**Period of Records**		
			From	**To**	
		Belgaum	1981	2010	
11.4.2	Data (average of all stations in command area)				
			Max	Min	
		a) Air Temperature (℃)	37.2	14.4	
		b) Humidity (%)	91	83	
		c) Wind (km/hr)	8.6	4.3	
		d)Water temperature (℃)	27.1	16	
11.5	Seismic coefficients				
	a)Horizontal	The project falls under Zone III as per IS 1893 and corresponds to basic seismic coefficient α_h = 0.04. with the importance factor of I = 3.0 , the α_h = 0.012. Vertical component is half of this i.e, αv = 0.06			
	b)Vertical				
11.6	Utilisation with in the State (TMC)	KWDT Award – I (Bachavat)= 734 TMC and GWDT			

No	Particulars	Details
		Award= 21 TMC, Total=755 TMC.
11.6.1	Water availability(States share in case of interstate River)	KWDT Award – I (Bachavat)= 734 TMC and GWDT Award= 21 TMC, Total=755 TMC.
11.6.2	Committed Utilisation(Mcum)	
	a) Up stream projects(completed & ongoing)	NA
	b) Downstream projects	Nil
11.6.3	Proposed utilization by the project	
	a)Irrigation	NA
	i)Khariff	NA
	ii) Rabi	NA
	iii) Hot weather	NA
	iv)Perinneals	NA
	Total	NA
	b) Water supply & other purpose	5.96 TMC for Water supply and other purposes
11.7	Flood near the Head Work site	--
11.7.1	Historical period of record	--
11.7.2	Observed period of record	--
	Maximum water level	--
	Maximum discharge	--
	Year of occurrence / Date	--
11.7.3	Estimated Flood in cum/sec	
	a) 50 years return period	--
	b) 100 years return period	--
	c) 1000 years return period	--
	d) Standard Project flood	--
	e)Probable Maximum flood	--
11.7.4	Design flood in cum/sec	
	a) Dam	5525 Cumecs (1,95,110)Cusecs)
	b) Weir / Barrage	NA
	c) Construction Diversion	NA
	d) Flood Control works	NA
11.7.5	River flows(minimum observed)	
	a) Water level (El.Mts)	---
	b) Discharge (cumecs)	---
	c)Months of nil flow, if any	Nil
12	**Reservoir**	
12.1	Water levels (EL.m)	
	a) Maximum Water level (MWL)	618.00 m
	b) Full Reservoir level (FRL)	618.00 m
	c) Minimum Draw Down Level (MDDL)	568.00m

No	Particulars	Details	
	d) Outlet levels	Nil	
	i) Irrigation	Nil	
	ii) Power	NA	
	iii) Others (Please Specify)	565.00 m (River sluice), 553.500 m (Scouring sluice)	
	e) Dead Storage Level	568.00 m	
12.2	Free Board (m)	3.00 m	
12.3	Wave height (m)	0.94 m	
12.4	Live Storage (M.cum)	5.66 TMC (160.43 MCM) (FRL - 618.00 m - Silt level - 564.00 m)	
12.5	Capacity (M.cum)		
	a) Maximum Water Level	618.00 m	
	b) Full Reservoir Level	618.00 m	
	c) Minimum Draw Down Level	568.00 m	
	d) Dead Storage Level	568.00 m	
12.6	Flood absorption capacity (M.cum)		
	a) Below FRL	NA	
	b) Between FRL & MWL	NA	
12.7	Sedimentation (M.cum) and levels after		
	Total Sediment	**50 years**	**100 years**
	b) Above MDDL	Nil	Nil
	c) Below MDDL	Nil	Nil
	d) Encroachment on Live Storage	Nil	Nil
	b)New zero elevation	Nil	Nil
12.8	Average Monthly evaporation losses from reservoir(Mcft)	**Month** / **Evaporation value** Jun 14.13 Jul 14.72 Aug 18.95 Sep 20.43 Oct 25.57 Nov 22.86 Dec 20.43 Jan 20.11 Feb 21.00 Mar 24.72 Apr 22.93 May 20.93 **Total=** **246.78 Mcft**	
12.9	Seepage in the reservoir	NA	
13	**Submergence**		
13.1	Land and Property Submerged-Refer Chpater 8		
13.2	Submergence ratio (with reference to CCA)	Irrigation is not envisaged and as such CCA Is not a part of the proposal	
13.3	Number of families /persons affected		

No	Particulars		Details	
	a) Total		The details form a part of the Detailed Project report which will contain the Chapters on EIA, EMP including R & R. Detailed study are under progress and the required details will be furnished in the Detailed Project Report.	
	b) Scheduled castes			
	c) Scheduled tribe			
	d) Other backward castes			
	e) General			
14	**Head Works**			
14.1	Dam		Concrete Gravity Dam	
14.1.1	Embankment Dam			
	(a)	Type of Dam	NA	
	(b)	Length of Dam at Top	NA	
	(c)	Top Width	NA	
	(d)	Maximum Height above GL	NA	
	(e)	Dyke(s)	NA	
	(f)	Type of cut off and maximum depth	NA	
14.1.2	Masonry and Concrete Dam (Non-over flow section)			
			Left side	Right Side
(a)	Type of Dam		Concrete	Concrete
(b)	EL of top		621.00 m	621.00 m
(c)	EL of deepest foundation		534.50 m	534.50 m
(d)	Length at top		80 m	195 m
(e)	Width at top		7.5 m	7.5 m
(f)	Width at deepest bed level		64.175 m	71.40 m
8	Maximum height above deepest foundation level		86.50 m	86.50 m
14.1.2	Spillway (Over-flow section)			
(a)	Type of spillway (Ogee/chute/side channel/tunnel/syphon/any other type		Ogee	
(b)	Full Reservoir level		618.00 m	
(c)	Maximum Water Level		618.00 m	
(d)	Length		107.50 m	
(e)	Maximum height above the deepest foundation		86.50 m	
(f)	Crest level		607.50 m	
(g)	EL of deepest foundation		534.50 m	
(h)	Number of gates		6	
(i)	Type of gates		Radial	
(j)	Size of Gate		15 x 10.5 m	
(k)	Maximum Discharge Capacity			
	(i)FRL		1.95 lakh cusecs (5525 Cumecs)	
	(ii)MWL		1.95 lakh cusecs (5525 Cumecs)	
(l)	Flood lift			
(m)	Tail water level			
	(i)Maximum		557.205 m	

No	Particulars	Details
	(ii)Minimum	538.000 m
(n)	Type of energy dissipation arrangements	Hydraulic jump type stilling basin
(p)	Type of hoisting arrangement and its capacity	Rope drum Hoist (110 Tonne Capacity)
14.1.4	River sluice(s), Irrigation/Power outlets	River sluice
(a)	Purpose	Regulate the discharge on d/s
(b)	Number	2 Nos
(c)	Size(m)	1.0 x 2.0 m
(d)	Sill level	565.00 m
(e)	Discharge capacity at (m^3/s)	
	(i)Full reservoir level	38.33 m^3/sec
	(i)Minimum draw down level	7.24 m^3/sec
(f)	Type of gates	Slide lift
(g)	Size of gate	1.0 x 2.0 m
(i)	Type of hoist arrangement and its capacity	Double acting Hydraulic hoist -175 T
14.2	Barrage	NA
14.3	Weir	NA
14.4	Head Regulator	NA
15	**Canal system**	NA
16	**Cropping pattern**	NA
17	**Power**	
17.1	Type –Conventional/Pumped storage	NA
17.2	Installed capacity (MW)	NA
17.3	Load Factor	NA
17.4	Annual Energy	NA
	(a)Firm	NA
	(b)Seasonal	NA
	(c)Total	NA
17.5	Off peak requirement for pumping	NA
17.6	Cost per kW installed	NA
17.7	Cost per kW at the bus bar	NA
17.8	Head Race Channel /Tunnel	NA
	(a)Length(m)	NA
	(b)Shape	
	(c)Size(m)	
	(d)Rock type reach-wise-RMR/Q values	
	(e)Rock cover reach-wise	
	(f)Free/Pressure flow	
	(g)Lining type-PCC/RCC/Steel	

No	Particulars	Details
	(h)Reach-wise Design Internal & external pressure	
	(i)Thickness of lining (m)	
	(j)Design Discharge (m^3/s)	
	(k)Invert level at (El-m)	
	(l)Gate-No. Type & size	
17.9	Reservoir	
	(a) Capacity(TMC)	6.04 TMC
	(b) FRL (EL-m)	618.00 m
	(c) Max. Reservoir Level	618.00 m
	(d) Min. Drawdown Level	568.00 m
	(e) Live Storage	5.66 TMC
	(f) Balancing period	NA
17.10	Forebay	
	a) Size of forebay	NA
	b) Sill level of Forebay	
	c) FRL	
	d) Maximum reservoir level	
	e) MDDL	
	f) Duration of storage	
	(g) Number of off-takes	
	(h) Size of off-takes	
	(i) Invert level at off-take(El-m)	
	(j) Capacity of each off-take (m^3/s)	
	(k) Escape arrangement • Location • Length • Discharge capacity (m^3/s)	
17.11	Intakes	
	(a) Upper intake (i) Type & size of intake	NA
	(ii) Energy profile with details of transition	NA
	(iii) Stability of the slope/cut around intake	NA
	(iv) Design velocity through trash rack and bellmouth	NA
	(v) Submergence of the entry below water level	NA
	(vi) Intake gates-Number. Type.	

No	Particulars	Details
	Size	
	(vii) Details of anti-vortex arrangements	
	(viii) Type of hoisting arrangement and its capacity	
	(b) Lower Intake (for pumped storage scheme) (i) Type & Size of intake (ii) Entry profile with details of transition (iii) stability of the slope/cuts around intake (iv) Design velocity through trash rack and bellmouth (v) Submergence of the entry below water level (vi) Intake gates-Number. Type. Size (vii) Details of anti-vortex arrangements	NA
17.12	Surge tank /Shaft	NA
	(a) Nos. & Location (HRT/TRT or both)	NA
	(b) Type height & size	NA
	(c) Orifice-size & position (or any other relevant details)	NA
	(d) Top level (e) Bottom level	NA
	(f) Steady state level	NA
	(g) Capacity	NA
	(h) Lower expansion Chamber-Size and location	NA
	(i) Upper expansion Chamber-Size and location	NA
	(j) Max. Surge Level (El-m)	NA
	(k) Min. Surge level (El-m)	NA
	(l) Size of gates and capacity of hoists	NA
17.13	Penstocks/pressure shafts:	
	(a) Number, diameter, & length	2 no. 4.0 m Ø circular pipe embedded and closed with a bulk head at the face of the dam
	(b) Inclination	Horizontal
	(c) Liner type	Steel

No	Particulars	Details
17.14	Power House (a) Type (Surface or Under Ground) (b) Orientation (c) Rock types encountered-RMR/Q Value (d) Major wedge formations, if any (e) Rock ledge dimension between cavities (f) Maximum head(m) (g) Minimum head(m) (h) Average head(m)	NA
	(i) Head loss in water conductor system	NA
	(j) Design head(m)	NA
	(k) Dimensions (m)	NA
	(l) Unit Capacity	NA
	(m) Installed capacity (MW)	NA
	(n) Type of turbine	NA
	(o) Type of generator	NA
	(p) Type of power house crane	NA
	(q) Number and size of draft tube gates/bulk head capacity of hoists	NA
17.15	Switch Yard (a) Type (b) Voltage level (c) No. of incoming and outgoing bays	NA
17.16	Transformer Cavern (a) Dimension (b) Orientation (c) Rock type encountered – RMR/Q Values (d) Major wedge formations, if any	NA
	(e) Rock ledge-dimension between cavities	NA
17.17	Tail Race Channel (a) Shape & Size (b) Length (c) Recovery Slope (d) Side Slope (e) Max. Tail Water Level (El-m) (f) Min. Tail Water Level (El-m) (g) Average tail water level (El-m)	NA

No	Particulars	Details		
	(h) Tail water level corresponding to one unit discharge. (i) Tail water level corresponding to max flood condition / one in thousand year flood. (j) HFL of recipient river channel at outfall (k) Draft tube gate – Number, Type, Size			
17.18	Tail Race Tunnel	NA		
	(a) Number Shape & Size	NA		
	(b) Length	NA		
	(c) Reach wise Rock cover	NA		
	(d) Reach wise Rock properties-RMR/Q	NA		
	(e) Type of lining	NA		
	(f) Max. Tail Water Level	NA		
	(g) Min. Tail Water Level	NA		
	(h) Avg. Tail Water Level	NA		
	(i) Tail water level corresponding to one unit discharge	NA		
	(j) Tail water level corresponding to Max. flood condition / one in thousand year flood	NA		
	HFL Of recipient river channel at outfall	NA		
	(k) Draft tube gate number, type, size	NA		
18	**Construction facilities**			
19	**Cost**			
19.1	Cost of the Project (Rs. Lakhs)	**Rs. 99000.00 Lakhs**		
	Allocated cost			
	a) Irrigation b) Power c) Flood control d) Navigation e) Water supply & others	Not envisaged in the present project Not envisaged in the present project Not envisaged in the present project Not envisaged in the present project		
20	**Benefits / Revenue**			
20.1	Benefits			
	Item	Benefits		
		Qty	Unit Price	Value in Lakhs
	a) Food Production (tonne)			
	b) Power(kwh)	---	---	---

No	Particulars	Details		
	c) Flood Protection(ha)	---	---	---
	d) Navigation (tonnage)	---	---	---
	e) Water supply (Population served)	---	---	---
	f) Any other (fisheries)	----	----	---
	Total	**---**	**---**	**----**
20.2	Revenue			
	Item	Revenue		
		Qty	Rate	Amount in lakhs
	a) Betterment levy	----	----	---
	b) Water Rates			
	c) Irrigation Cess	----	----	---
	d) Pisiculture rights action	----	----	---
	e) Power rates	----	----	---
	f) Navigation	----	----	---
	(i)Cargo rates	----	----	---
	(ii)Regd Charges	----	----	---
	(iii)Passenger Tax	----	----	---
	(iv) others			
	g) Others	**---**	**---**	
	Total			
21	**Benefit Cost Ratio**			
	(a) B.C.Ratio	1.54 (Based on the NPV)		
	(b) Financial Rate of Return (FRR)	16.34%		

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SECTION - 3
EXECUTIVE SUMMARY

Section - 3
Executive Summary

1.0 Introduction

Karnataka State having a geographical area of 1,91,976 sq.km happens to be the eighth largest State in India with a population of 6,10,95,297 as per 2011 census. Karnataka is blessed with major rivers such as Krishna and Cauvery besides 13 West flowing rivers. In spite of having big river systems, many parts of Karnataka are facing drought like situation resulting in acute drinking water shortage. *Gokak taluk and surrounding villages is falling Ghatapraba Sub Basin of Krishna Basin under Belgavi district is one such area, having major problem regarding drinking water.* Besides drinking water there is a need to meet industrial requirement and also filling of selected tanks in Ghatapraba basin to recharge ground water level.

As per National water policy, providing drinking water to the people is of paramount important and it precedes over all the other needs.

Considering the above factors, a Dam has been proposed to build across seasonal ***Markandeya River***, called as ***Ghatti Basavanna Reservoir***, to meet the Drinking water, Industrial water needs and also fiilling selected tanks in the Ghataprabha basin.

1.1 Justification for taking up the Project

Gokak is a taluka headquarters in the Belgavi District of Karnataka state, India. It is located around 70 Km from Belgaum at the confluence of two rivers, the Ghataprabha and the Markandeya. The population of the town according to 2011 census is approximately 1,35,773.

- Gokak town and its surrounding villages are facing acute drinking water shortage and mostly depended on bore wells to meet their requirements.
- Estimated population of the Gokak town and adjoining 3 towns as per census 2011-12 is 1, 35,715.
- Besides there are nearly 131 number of villages with an estimated population of 4, 76,448.
- Bailahongla, Saudatti and Hukkeri taluks are aslo having acute drinking water problems.
- Considering the growth for next 40 years, the estimated drinking water needs will be 2.76 TMC.
- Drinking water requirement for livestock is 0.62 TMC.

The only nearest source of surface water is Markandeya river. Unfortunately, the river is seasonal and the rainfall is erratic and hence cannot be considered for harnessing the same without storage.

Hence construction of a Dam is inevitable to meet the long term objective of proving drinking water from an assured source.

1.2 Objectives

Ghatii Basavanna Reservoir project is located within the Karnataka and will have a storage capacity of about 6.00 TMC. The proposed project is envisaged to address the following Objectives:

- To facilitate in creating storage to meet the Drinking water requirements of Gokak town and surrounding villages, taluks in the Ghataprabha Basin within Karnataka.
- To meet the industrial water requirement in and around Gokak taluk.
- To feed selected tanks in and around Gokak town to facilitate sustaining livestock and recharging of ground water.
- To protect the Gokak town from inundation during peak floods in Markandeya River.

1.3 Drinking Water Needs

The requirement has been assessed considering the growth for the next 40 years and also requirerment for other needs which are essential is assessed details of which are furnished below.

Table.1: Requirement of Water Needs

No	Particulars	Quantity (in TMC)
A	**Drinking water**	
1	Gokak town	0.56
2	131 Villages in and around Gokak town	1.24
4	Part of Hukkeri taluk	0.26
5	Part of Bailhongala taluk	0.35
6	Part of Savadatti taluk	0.35
7	Live stock	0.62
	Total Drinking water needs	**3.38**
B	**Industrial needs**	0.50
C	**Tank filling**	0.60
D	**Dead storage**	0.38

No	Particulars	Quantity (in TMC)
E	**Evaporation loss**	0.30
F	**Environmental releases**	0.80
	Grand Total	**5.96 Say 6.00**

The yield at the proposed site at 50%, 65% and 75% dependability are 8858 Mcft, 7687 Mcft and 6359 Mcft respectively. It has been estimated in the hydrology report that it is possible to achieve 90 to 91.4% of reliability for supplying the drinking water and as per the standards for drinking water needs reliability should be 90%.

1.4 Water Allocation

The project envisages providing drinking water supply for Gokak and surrounding 131 villages and part of Saudatti, Hukkeri and Bailahongla Taluks. Further, the Ghatti Basavanna project is a multipurpose project which provides water for tank filling and industrial requirements. Hence, the total water utilization under this project will be 4.78 (3.38+0.5+0.30+0.60) TMC.

Ghatti basavanna integrated project is planned to meet evergrowing demand for drinking water needs besides industrial consumptions, livestock and tank filling. The most of the utilisation comes under consumptive use (20% consumption and 80% as return flow) and similarly the industrial needs will be computed @ 2.5% of the gross requirement. In other words, the proposed dam will not be used to meet any of the irrigation needs. The details of the Water allocation of the scheme are as under:-

Table.2: Water Allocation of the Scheme

No	Particulars	Quantity required	Actual utilisation planned	Allocation	Remarks
		TMC			
A	**Drinking water**				
1	Gokak town	0.56	0.56		
2	131 Villages in and around Gokak town	1.24	1.24		
4	Part of Hukkeri taluk	0.26	0.26		
5	Part of Bailhongala taluk	0.35	0.35		
6	Part of Savadatti taluk	0.35	0.35		

No	Particulars	Quantity required	Actual utilisation planned	Allocation	Remarks
		TMC			
7	Live stock	0.62	0.62		
	Total Drinking water needs	**3.38**	**3.38**	**0.676**	Consumptive use @ 20%
B	**Industrial needs**	0.50	0.50	0.0125	Consumptive use @ 2.5%
C	**Tank filling**	0.60	0.60		Allocation as per KWDT -I under MI quota. Hence, not considered.
D	**Dead storage**	0.38			No allocation required
E	**Evaporation loss**	0.30	0.30	0.30	
F	**Environmental releases**	0.80			No allocation required
	Grand Total	**5.96**	**4.78**	**0.9885**	
The gross storage of the dam is estimated to be 6.04 TMC. The extent of utilisation planned based on the allocation of 0.9885 TMC is 4.78 TMC.					

Under the scheme water allocated for drinking water purpose is 3.38 TMC (Consumptive use @ 20%-0.676 TMC), Industrial purpose is 0.5 TMC (Consumptive use @ 2.5%-0.0.0125 TMC), Evaporation losses is 0.30 TMC and for tank filling is 0.6 TMC. The water requirement for tank filling i.e., 0.6 TMC is already included in allocation under Minor irrigation under KWDT-I. Out of the remaining 4.18 TMC 0.9885 TMC (0.676+0.0125+0.30) TMC is consumptive use. This is estimated as per the judgement of Krishna Water Dispute Tribunal. Hence, this additional allocation of 0.9885 TMC needs to be made.

As per the Krishna Dispute (Bachavath) Judgement 734 TMC is allocated to Karnataka. As per Godavari tribunal judgement the state of Andhra Pradesh is diverting 80 TMC of water from Godavari valley to Krishna valley under Pollavaram scheme. Hence, additional 21 TMC of water will be available to Karnataka. Hence, as per the judgement of Bachavath and Godavari Tribunal the total allocation to Karnataka state in Krishna valley will be 755 TMC.

Under the above allocation, provision for Drinking and household purpose is 3.25 TMC (1.50+1.75) and industrial use is 2.25 (0.5+1.75) TMC is made.

The consumptive use of 0.9885 TMC is allocated under the total water utilization of Ghatti Basavanna Drinking Water Project of 4.78 TMC. This can be met under total allocation of

755 TMC (Krishna water Dispute tribunal (Bachavath) (734 TMC) and Godavari Tribunal (21 TMC)) of Krishna waters to the Karnataka State.

The allocation for Ghatti Basavanna Drinking Water Project is made in KWDT-I vide **GO No. WRD 6 VIBYAMA 2020 DATED 24.02.2022.** (Enclosed as **Addendum-3**).

2.0 Markandeya River

Markandeya River (Tributary of Ghataprabha) originates in Bailur village of Khanapur taluk at an elevation of 927.000 M above mean sea level, in the state of Karnataka (Westren Ghats). The river enters Belagavi taluk on northern side and further flows towards eastern side of the Belagavi city and it is a tributary of Ghataprabha River, Krishna Basin.

Markandeya River has a Length 106 Km from origin till it joins Ghataprabha River. It runs for 72 Km in Belagavi Taluk, 21 Km length in Hukkeri Taluk and 13 Km length in Gokak taluk. The total catchment area of the river is 432.00 Sq Km.

Bellary Nala originates near Yellur village in Belgaum Taluka and is a tributary to Markandeya River The length of the Nala up to its confluence with Markandeya river is 57 Km (36 miles). The Markamdeya river is a tributary to Ghataprabha river and inturn Ghataprabha river is a tributary to Krishna River. The catchment area of Bellary Nala is 258.12 Sq Km out of which the area upto Bellary Nala Dam site is 452 Sq Kms

Basin wise, the area falls under Ghataprabha basin, which is a sub basin of Krishna basin. *Hence the project will fall under the ambit of KWDT, awards.*

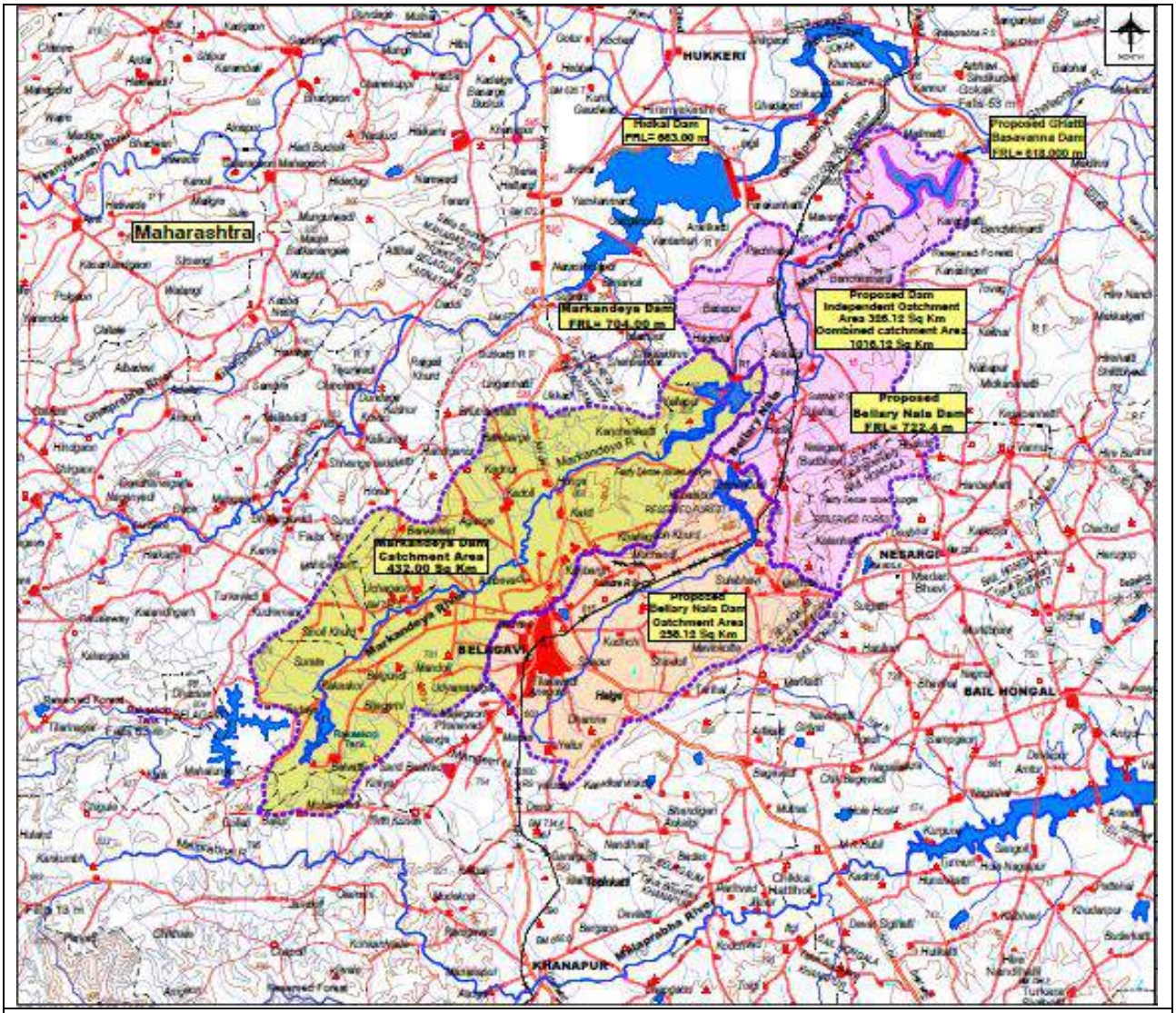

Figure 0.1: Project Location Map

2.1 Location of Project Area

Ghatti Basavanna project is located at Latitude 16˚ 9' 11" N and Longitude 74˚ 47' 18" E Coordinates near Gokak town of Belagavi District, Karnataka State. The location is 3.0 Km South west of Gokak town.

The dam site is located about 25 Km downstream of confluence of Markandeya river and Bellary Nala, 10 Km D/S of Godchanamalki falls.

Location of the Ghatti Basavanna dam site along with catchment area is shown in **Figure 1.4**

3.0 Interlinking of The Scheme With Neighbouring Schemes

The present proposal is planned as an independent scheme to meet exclusively the drinking water needs of the Gokak town and adjoining villages and taluks in the Ghatapraba basin.

3.1 Interstate / International Aspects

Details enumerated in a separate Chapter on Interstate / International aspects.

3.2 Fitment of the Scheme in Overall Development of River Basin

The allocation of water in Markandeya River basin is based on 75% dependable yield. This can be ensured only if sufficient storage is available in the basin. The present project with a storage of 6.0 TMC will help meeting this objective.

The selected locations is most ideal for construction of a high dam with minimum submergence and having suitable founding strata at shallow depth. In view of the height of the dam there is scope for generating the Hydro-Power from the releases and also during the monsoon if the project authorities is wish to consider the same during the project life cycle after taking required statutary permission if any.

4.0 Choice of Project: Alternative Studies Carried out for Various Major Components of The Project and Including Water Resources Planning and Final Choice of Project

Consequent to several studies carried out and also after evaluating merits and demerits, It is finally decided to select the location for the construction of the dam approximately 500 m U/S of existing barrage across Markandeya River. Further studies have been carried out in order to arrive at the height of the dam including the FRL, the details of which is narrated below:

Alternate 1: High dam with a FRL of EL 620.00 m. at existing MI Barrage:

The river bed of the dam site is at EL 546.00 m and the corresponding height of the dam corresponding to EL – 620.00 m is estimated as 74 m. The extent of submergence is about 742.0 Ha and the storage capacity will be 7.02 TMC.

Alternate 2: High-dam with a FRL of EL 618.00 m at 150 m U/S of existing MI Barrage:

The riverbed of the dam site is at EL 544.500 m and the corresponding height of the dam corresponding to EL – 618.00 m is estimated as 73.50 m. The extent of submergence is about 690.00 Ha and the storage capacity was 6.52ss TMC.

Alternate 3: High-dam with a FRL of EL 618.00 m at 500 m U/S of existing MI Barrage:

The riverbed of the dam site is at EL 547.706 m and the corresponding height of the dam corresponding to EL – 618.00 m is estimated as 71 m. The extent of submergence is about 670.88 Ha and the storage capacity was 6.04 TMC.

In order to minimize the submergence of the forest and other lands and also its related impacts, KNNL has decided to restrict the FRL of the proposed Dam to EL 618.00 m and consider the proposal for implementation

At Alternative-1 site, the existing MI barrage has to be dismantelled. And until the dam is brought to certain height and some storage is created present utilisation of the existing MI barrage will not be served.

The Alternative-2 is very close to the existing MI barrage and with stilling basin type energy dissipater (about 100 m length), there is a possibility of interfearance of flows between these two dams. Further, to limit the storage to 6.04 TMC and FRL to EL – 618.00 m as required by KNNL, Alternative-3 which is located further 500m U/S of existing MI barrage is selected for implementation. With this the existing barrage can still be utilised until some improvements to the barrage is taken up.

4.1 Surveys and Investigations

Desktop study has been carried out based on the available data and information and also on 1:50,000 scale toposheets based on which three locations have been identified for further study. Parameters considered during desktop study are as follows;

- Topography (Ridges and valleys)
- Water availability
- Level at which water is available
- Special ground features and soil conditions
- Land use
- Existence of locations of historic and cultural importance.
- Places of worship
- Communication and connectivity

- Any other constraints
- All the available details from the respective field authorities were also considered in the desktop study

5.0 Hydrology (Working Tables, Performance Tables, Flow Tables)

Karnataka Neeravari Nigam Ltd proposes to construct a reservoir on Markandeya river at Ghatti Basavanna to provide water for drinking and industrial uses in Belagavi district. A dam on Markandeya river is already in operation for several years and another dam on Ballari Nala (a tributary to Markandeya) has been proposed near Hudli.

5.1 Yield Calculations

The daily runoff for each catchment was worked out by the SCS Curve Number method (Handbook of Hydrology, Ministry of Agriculture, Government of India, 1972). The curve numbers were calibrated with reference to the gauged data of Markandeya dam inflows and Ballari Nala at Hudli. The calibrated curve numbers used are 96 for AMC I, 98 for AMC II and 99 for AMC III. The calibration results are shown in **Table 5.4**

Table.3: Comparison of Gauged Flows and Calibrated SCS CN Calculated Flows

No.	Bellary Nala at Hudli			Markandeya Dam		
	Year	Gauged	SCS CN	Year	Gauged	SCS CN
		Mcft	Mcft		Mcft	Mcft
1.	1985-86	2190	1965	2007-08	16018	12761
2.	1986-87	1307	2470	2008-09	11006	9800
3.	1987-88	318	2166	2009-10	11551	14390
4.	1988-89	2437	3487	2010-11	7309	8728
5.	1989-90	1413	3384	2011-12	11935	13791
6.	1990-91	5227	3327	2012-13	4373	10425
7.	1991-92	6922	3968	2013-14	8560	8149
8.	1992-93	5297	2255	2014-15	7931	7777
9.	1993-94	4591	3096	2015-16	1377	4576
10.	1994-95	6816	3156	2016-17	5745	6767
11.	1995-96	2966	2366	2017-18	3348	6734

No.	Bellary Nala at Hudli			Markandeya Dam		
	Year	Gauged	SCS CN	Year	Gauged	SCS CN
		Mcft	Mcft		Mcft	Mcft
12.	1996-97	4167	2949	2018-19	8417	6643
13.	1997-98	3567	6047	2019-20	28757	15982
14.	1998-99	953	1623	Dependable		
15.	99-2000	1307	3550	50%	8417	8728
16.	00-2001	1872	2123	65%	7433	7851
17.	01-2002	530	1592	75%	5745	6767
18.	02-2003	1165	1396	Average	9717	9732
19.	03-2004	600	2152			
20.	04-2005	1095	4224			
21.	06-2006	7275	7006			
22.	06-2007	3637	3003			
23.	07-2008	4097	5816			
24.	08-2009	4803	2905			
25.	09-2010	7628	5945			
50% dependable		2966	3003			
65% dependable		1596	2407			
75% dependable		1307	2166			
Average		3287	3279			

6.0 Hydro Geology

Water table generally follows the topography of the area and is at greater depths in the water divides and topographic highs, but becomes shallower in the valleys and topographic lows and therefore, groundwater moves down and follows the gradient from the higher to lower elevations, that is, from recharge area to discharge area. Therefore, locally direction of flow from higher elevations is towards the rivers. Overall, the general flow direction of ground water in the district is generally towards the east. The district is underlain by gneisses, schist, limestone, sandstone, basalts, alluvium etc. of Archaean to Recent age. Deccan basalts cover an area of 7,650 Sq.Kms. in the northern part of the district and have a maximum thickness of around 256 m, which gradually thins out in the southern

direction. Exploratory drillings were carried out to study the yield potential of fracture systems. Hard rocks occupy a major part of the district; majority of which are basaltic lava flows. Most of these rocks have poor capacity of storing and transmitting water, except through favourable zones and at favourable locations. Aquifer systems encountered are therefore limited in nature.

7.0 Design Features and Criteria for River Valley Structures

Based on the topographical survey of the dam site covering U/S and D/S including submergence area required base map and sections have been generated. Detailed longitudinal sections and cross sections are prepared for the Dam site. Site survey plan for a length of 600 m upstream from the existing MI barrage and downstream is prepared. And used for developing the master plan. Available data and information has been compiled to prepare the capacity contours and storage capacity tables

7.1 Final Layout of all Major Components of Dam

The Government of Karnataka accepted the following proposal for implemenatation.

Construction of Ghatti Basavanna Drinking water dam Project with FRL at EL 618 m (with a free board of 3 m and storage capacity of 6 TMC annually).

The dam can be utilized for the main purpose of the drinking water supply to Gokak town and other nearby needy areas and also to supply water for industrial purpose including tank filling (Selected tanks).

7.1.1 Concrete Gravity Dam

A dam across Markandeya River is proposed near Ghatti Basavanna to store water to meet the drinking water requirement. The height of the dam is 86.50 m with an FRL head of 71.00 m. Hard rock is met throughout the dam alignment. As the rock is met at the reasonable depth in the river bed as well as in banks, concrete gravity dam is suitable and hence the same is considred .

- The maximum height of the dam is 86.5 m.
- The catchment area at the dam site is 1016 Sq Km.
- The maximum flood discharge is estimated to be 5,525 Cumecs.
- High Ogee spillway is proposed to realize high coefficient of discharge.

- 5 gates of 15.0 m x 10.5 m are required to pass the design discharge of 5,525 cumecs at FRL. Additional number of gates to an extent of 10 % are to be provided to account for mechanical failure. As such 6 gates of 15.0 x 10.5 m are proposed.
- Radial gates are proposed with sill at a little lower than the spillway crest. This is kept 0.35 m below crest. The trunnion level is proposed at 610.50 m. The radius of the gate is 11.50 m which will provide sufficient clearance with respect to flow profile for maximum flood discharge design.
- The downstream barrage is located about 500 m from the dam axis such that the arrangement doesn't affect the operation of the radial gates.
- Stop log gates are also proposed on upstream side of the radial gates. Gate grooves are proposed for all the vents in the piers. The stop log gates will be in elements for easy operation and lower hoist capacity Since there are only 6 radial gates it is proposed to have one sets of stop log gate.
- Gantry crane of adequate capacity has also been provided. This helps in inserting and removing the stop log gate elements.
- The total length of the dam is 407.50 m which comprise spillway of 112.50 m, NOF of 185.00 m on right flank and 110.00 m on left flank.
- As per the codal recommendation, galleries are to be provided where the height of dam is more than 10 m. For the dams where the height is much more, galleries may be in 2 or 3 tiers. In this case as the height of the dam is 86.5 m, Galleries are proposed in 3 levels. The first gallery (inspection gallery) is proposed at EL - 592.75 m. An intermediate inspection cum grouting gallery is proposed at EL - 558.75 m and another inspection cum grouting gallery is proposed at EL – 542.00 m.
- The Dam is analyzed as Gravity section for following conditions as per BIS Code 6512-1994.

7.1.2 Non Overflow Section – Design Criteria

The non-over flow section on the left flank is proposed from Ch: 0+044 to Ch: 0+154. and on the right flank it is proposed from Ch:0+266 to 0+452 (Tentative). Stability analysis of the section has been done for the following conditions of loading

7.1.3 Spillway – Design Criteria

The Catchment area at dam site is. 1,016 Sq.kms. The maximum flood discharge is 5,525 cumecs. High Ogee profile with radial gates is proposed for disposing the flood. The flood depth considered over the spillway crest is 10.5 m. 6 gates of 15 m x 10.5 m with 5 piers of 3.5 m thickness and 2 abutments on either side are provided in luding one gate as standby. Two numbers of river sluice with size 1.0m x 2.0 mt are provided inside the body of non overflow section of the dam. Two numbers of scouring sluices of vent size 1.2 m X 2.25 m are provided inside the body of overflow section of the dam. The total length of the spillway between abutments to abutment is 107.50 m.

7.2 Description of Works

- Construction of Concrete Gravity dam at Ghatti Basavanna site with FRL of 618.00 metres having a Gross storage capacity of 6.04 TMC (169.902 MCM).
- Dam will have a spillway in the river course with radial gates to effectively discharge the design flood with hydraulic jump type energy dissipating arrangement with horizontal stilling basin on the downstream side.
- Extent of submergence of the land on the upstream of the Dam with the proposed FRL 618.00 m is 670.88 Ha.

7.3 Stages / Phases of Development of Project

The present Project is proposed to be implemented in a single Stage.

8.0 Irrigation, Command area, Flood Controle, Drainage, Power and Navigation

This project does not envisage Irrigation, Command area, Flood Controle, Drainage, Power and Navigation.

9.0 Construction Program

The construction schedule for the Ghatti Basavanna drinking water Project is considered as **18 months** taking view of the fact that it is a high level dam of length 407.50 m with a height of 86.50 m and comprising of various components.

9.1 Construction Materials

The sources of the major construction materials required for the project have been anticipated as follows:

- Explosives for blasting will be obtained from suppliers in Belagavi.
- Cement in bulk will be obtained from cement factories/ nearest cement dealers.
- Coarse aggregate which will be produced on site from the excavated materials, selected Rock quarries and River Course
- Fine aggregate which will be processed from the excavated material and other nearest local sources if necessary.
- Reinforcement & Structural steel will be obtained from SAIL/TATA or any other approved dealers.

9.2 Abstract of Major Quantities of Construction Materials

Abstract of major quantities of construction materials required for different components of the work are assessed based on Preliminary Designs & Drawings

Table.4: Requirement of Construction Materials

No	Components	Explosive in MT	Sand in cum	Coarse aggregate in cum	Cement in MT	Reinforced steelin MT	Structural Steel in MT
1	Dam and allied works	150.00	4,25,000	7,25,000	2,50,000	5,500	1.560

9.3 Construction Methodology

9.3.1 Introduction

Ghatti Basavanna Project site is located on River Markandeya just 5 Km upstream of its confluence with Ghataprabha River and 25 Km downstream of confluence of Markandeya river and bellary nala in Gokak Taluk, Belagavi District.

The project is located about 70 Km from the District place Belagavi. The project sites are approachable from Belagavi by the State Highway No 134 passing through Ankalgi.

9.3.2 Construction Methodology

The present proposal envisages construction of a Dam and its appurtenant works, and all infrastructure works. The methodology and equipment planning for various works depends on the site conditions prevailing in the project area.

The activities are planned in such a way that the project shall be completed as per schedule with no or minimum spillover. It is assumed that all the pre-construction activities having a bearing on the proposed schedule such as land acquisition, infrastructure works and relevant statutory approvals from the Government are in place before commencement of the construction works.

9.4 Use of Chilled Concrete

Concrete Cooling is a technique by which the temperature of poured concrete is reduced in order to achieve the desired quality and placement temperature. The quality of the concrete is guaranteed and construction can continue smoothly to a certain level. Use of Chilled concrete during construction of high dams especially, in tropical and dry climates gives excellent results in terms of quality. When concrete is poured / placed in predetermined lifts, it releases heat of hydration resulting in rise in temperature of the concrete placed. Concrete cooling is used mainly in parts of the world with a warm climate, in projects where large amounts of concrete are used to minimize the heat of hydration of the cement. The most common way of cooling concrete is to cool the individual components of the concrete before it is mixed.

Concrete is made from water, gravel, sand, cement and often some additives to improve the quality of the concrete. Since the water, sand and gravel together form the major part of the heat capacity of the concrete, only these three components are cooled.

10.0 Environment, Ecology and Forest aspects of the project

Environmental Impact Assessment (EIA), a systematic process to identify, predict and evaluate the significant environmental effects of proposed actions and projects which is applied prior to major decisions and commitments being made. Under this study the social, cultural and health effects form an integral part in order to prevent, mitigate and offset the significant adverse effects of proposed undertakings.

The EIS study provides information for decision-making on the environmental consequences of proposed actions; and promotes environmentally sound and sustainable development through the identification of appropriate enhancement and mitigation measures.

With the infringement of the site the impacts become more complex and larger in scale thus, in order to reduce the burden of environmental impacts it becomes necessary to undertake EIA study for maintaining the sustainability of the project even after the developmental processes.

Table.5: Submergence area in Ha

No.	FRL (in m)	Submergence (in Ha)		Total (in Ha)	Remarks
		Forest	Revenue		
1.	620.00	523.79	75.82	599.62	
2.	618.00	560.00	103.00	670.88	

In order to minimize the submergence of the forest and other lands and also its related impacts, KNNL has decided to restrict the FRL of the proposed Dam to EL 618.00 m.

11.0 Estimates

The Project estimates prepared are based on the " Broad guidelines for preparation of Project Estimates for major & multipurpose Projects" issued by central Water commission and its revisions.

11.1 Preparation of Estimates

The estimate for various components of the project work comprises of two parts. Firstly, the estimate of quantities for the identified items for each work and secondly the cost estimate which is based on rates for each item of work.

Further the estimates comprise of three major categories namely estimate for civil works and estimate of hydro mechanical works. There will be other components like project roads, buildings etc.

The estimate for quantities for civil works is based on the drawings prepared based on preliminary designs and assumptions.

In case of hydro mechanical works, the weight of gates & embedded parts and hoist capacities are worked out based on the empherical formulae provided in the schedule of Rates of W.R.D.O of Govt. Of Karnataka.

The rates for hydro mechanical works is based on S.R of W.R.D.O Government of Karnataka.

For each item of work, provision is made for contingency @ 3% and 2% towards work charged establishment.

The cost arrived at for each item is rounded off to the near rupee in Crores.

Table.6: General Abstract

Sl. No.	Particulars	Amount Rupees in Lakhs	Remarks
1	Survey, investigations, detailed engineering, preparation of designs and detailed construction drawings	1753.70	
2	Cost of Land acquisition and R & R Works	9019.54	
3	Construction of Dam and Allied works	70224.00	
4	Construction of Gates	2519.99	
5	Construction of Buildings	650.00	
6	GST	9122.94	
7	Miscellaneous	5709.83	
	Total	**99000.00 Lakhs**	
		990.00 Crores	
Rupees Nine Hundred and Ninety Crores Only			

12.0 Financial Resources

As a measure to conserve water and also to meet industrial needs besides feeding the selected tanks in Ghatapraba basin, Government of Karnataka is planning to build a reservoir across river Markandeya near Ghatti Basavanna. The total outlay of the project as per the preliminary estimate prepared based on the current Schedule of Rates 2018-19 extended for 2019-20 is estimated to be **Rs.990.00 Crores**.

Consequent to the approval of the scheme, Government of Karnataka would like to make provision for a special outlay in their budget in order to meet the project expenses over a period of two years. To that extent, the State Planning Finance Department of Government of Karnataka will be approached to get the necessary financial outlay.

13.0 Revenues

13.1 Basis of Profitability Analysis

- The profitability of the project is calculated based on "With and without" concept..
- The analysis is based on annualized cost and benefit.
- Full "Free market" conditions are assumed. This means that all the labour and material costs of both inputs and outputs are at their opportunity cost and so no shadow pricing is done.
- Profitability index is used in BC ratio, which is defined as the ratio of **annual benefit to annual cost.**
- While implementing the Ghatti Basavanna Project, the following facts are to be considered in the profitability analysis.
- Construction of Dam with Sluice and appurtenant structures
- Acquisition of 670.88 Ha of land which is going to be submerged.
- The R & R component involved with land acquisition and resettlement of villages.

13.2 Annual Cost Details

- The Capital recovery of civil works is taken as 1% depreciation plus 10% interest (With the existing economic condition 8% interest should be sufficient. However 10% is used as a convention).
- The capital recovery of hydro mechanical components is again considered as depreciation as per norms mentioned above plus 10% interest on capital cost.
- Taxes being only transferred payment are deleted for the cost in calculating economic indices.
- The cost of the land is included in computing the annual cost. So the annual benefit foregone from this land is not considered to avoid double counting.

14.0 Cost & Benefit of The Scheme

Ghatti Basavanna Drinking water project is envisaged to be developed in single stage for ensuring speedy implementation of the project so as to meet the drinking water needs of the people in Gokak taluk and other identified taluks falling under Ghatapraba basin..

The revenue from the project is contemplated only in terms of cost towards drinking water supply to municipalities and industries. Accordingly, the following parameters have been considered while arriving at the value of the gross revenue generated from the project.

No	Particulars	Unit	Quantity	Rate in Rs Lakhs	Amount / Revenue in Lakhs per annum
1	Drinking Water charges	MCUM	78.160	150.00	11724.48
2	Industry water charges	MCUM	14.160	400.00	5664.00
				Total	**17388.48**

B C Ratio and IRR

The financial feasibility of the project is examined through the financial indicators such as NPV, FIRR and B/C ratio. For a project to be feasible, the NPV value at the defined discount rate should be '0' or greater than '0'. The Internal Rate of Return should be more than the lending rates of financial institutions which are normally in the range of 10 to 12%. The Benefit cost ratio shall be more than 1.0 at the predefined discounted rate.

Based on the above guidelines, the financial feasibility in terms of NPV, FIRR and B/C ratio has been worked out for a total duration of 50 years including 4 years construction period. The analysis has resulted in following:

1. NPV at 10% discount rate is Rs. 53801.2 Lakhs which is greater than 0
2. Financial Internal Rate of Return (FIRR) is 16.34 % which is greater than 12.0%
3. B/C ratio is **1.54** which is greater than 1.0

The detailed analysis is furnished as **Appendix 9.**

15.0 Provision For Domestic & Industrial Water Supply

As indicated above, it is envisaged to provide drinking/ industrial water or any other useful requirements of Gokak town and its sorounding 131 villages in the basin within Belagavi district of Karnataka out of the allocated share.

The groundwater condition is expected to improve considerably which may facilitate augmenting drinking water supply and Agriculture in rural areas.

16.0 Conclusion

The present proposal of Ghatti Basavanna Drinking water Project in its entirety helps in achieving the following objectives envisaged.

- To facilitate in creating storage to meet the Drinking water requirements of Gokak town and surrounding villages, taluks in the Ghataprabha Basin within Karnataka.
- To meet the industrial water requirement in and around Gokak taluk.
- To feed selected tanks in and around Gokak town to facilitate sustaining livestock and recharging of underground water.
- To protect the Gokak town from inundation during peak floods in Markandeya River.

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REPORT

Chapter 1
Introduction

1.1 Aim(s) of the Project and Description of Works

Karnataka State having a geographical area of 1,91,976 sq.km happens to be the eighth largest State in India with a population of 6,10,95,297 as per 2011 census. Karnataka is blessed with major perennial/non-perennial rivers such as Krishna and Cauvery besides 13 West flowing rivers , but still faces severe drought and drinking water scarcity frequently, besides facing acute power shortage. As per the data published in the public domain, Karnataka happens to be second state in India i.e. next to Rajasthan in terms of drought area.

In spite of having big river systems, many parts of Karnataka are facing drought like situation resulting in acute drinking water shortage. Gokak taluk and surrounding villages is one such area, having major problem regarding drinking water.

Gokak taluk and its surrounding areas of Belagavi ditsrict falling under Ghatapraba and Malaprabha Sub Basins of Krishna Basin are facing acute drinking water shortage. Besides drinking water there is a need to meet industrial requirement and also filling of selected tanks in Ghatapraba basin to recharge ground water level.

Figure 1.1: Belagavi – District Map

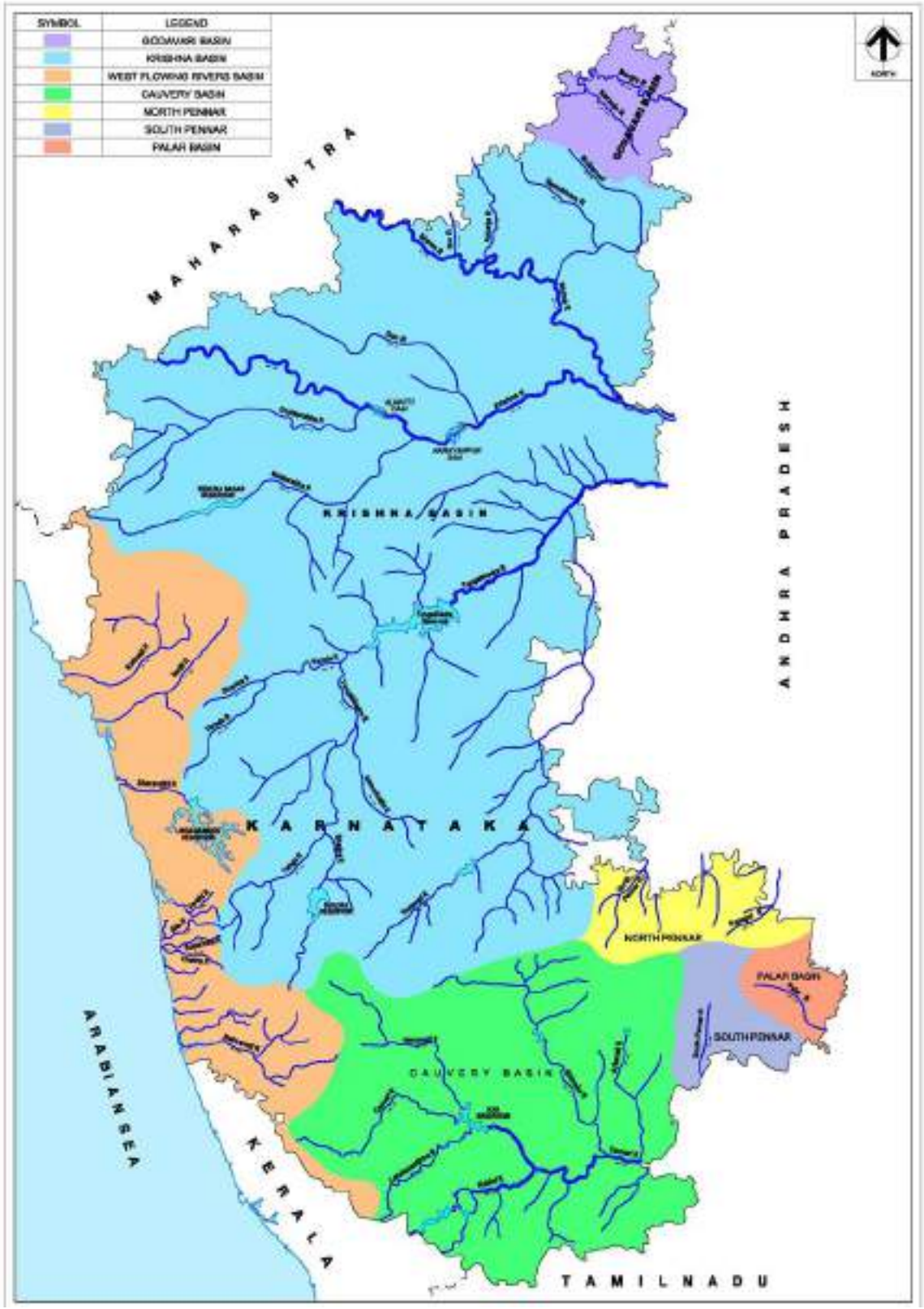

Figure 1.2: River Basin Map of Karnataka

As per National water policy, providing drinking water to the people is of paramount important and it precedes over all the other needs.

Considering the above factors, a Dam has been proposed to build across seasonal Markandeya River, called as ***Ghatti Basavanna Reservoir***, to meet the Drinking water, Industrial water needs and also fiilling selected tanks in the Ghataprabha basin.

Markandeya River (Tributary of Ghataprabha) originates in Bailur village of Khanapur taluk at an elevation of 927.000 M above mean sea level, in the state of Karnataka (Westren Ghats). The river enters Belagavi taluk on northern side and further flows towards eastern side of the Belagavi city and it is a tributary of Ghataprabha River, Krishna Basin.

KNNL has constructed a dam called Markandeya dam at Shirur Village in Hukkeri taluk Belagavi district with impounding capacity of 3.696 TMC and irrigates nearly 19,105 Ha of Land.

Besides Rakkaskoppa reservoir has been constructed to provide drinking water to Belagavi city on upstream of Markandeya dam.

Except these two reservoirs, there are no other dams across Markandeya River till it joins Ghataprabha River.

Markandeya River has a Length 106 Km from origin till it joins Ghataprabha River. It runs for 72 Km in Belagavi Taluk, 21 Km length in Hukkeri Taluk and 13 Km length in Gokak taluk. The total catchment area of the river is 432.00 Sq Km.

Bellary Nala originates near Yellur village in Belgaum Taluka and is a tributary to Markandeya River The length of the Nala up to its confluence with Markandeya river is 57 Km (36 miles). The Markamdeya river is a tributary to Ghataprabha river and inturn Ghataprabha river is a tributary to Krishna River. The catchment area of Bellary Nala is 452 Sq Km out of which the area upto Bellary Nala Dam site is 258 Sq Kms

Basin wise, the area falls under Ghataprabha basin, which is a sub basin of Krishna basin. *Hence the project will fall under the ambit of KWDT, awards.*

1.1.1 Justification for taking up the project

Belgavi and other taluks falling under Belgavi district falls under Ghataprabha and Malaprabha sub basins of Krishna Basin and are facing acute drinking water shortage since both the sub basins are designated as deficit basins. Belgavi and Gokak have grown substantially both in terms of Industries and population. In view of this, present supply is not sufficient to cater to the increased drinking water requirement and hence it has become necessary to augment the supply by proposing new project/s

which can serve the purpose. Markandeya river is the only nearest source of water available and any project or proposal to provide drinking water can only be from this source

Gokak is a taluka headquarters in the Belgaum District of Karnataka state, India. It is located around 70 Km from Belgaum at the confluence of two rivers, the Ghataprabha and the Markandeya. The population of the town is according to 2011 census is approximately 135,773. The common language in use is Kannada.

Gokak is surrounded on one side by a range of hills, and on the other side by a vast plain of black soil. The river Ghataprabha flows from the north side of the city and cascades down through a cleft of 167 ft, to form famous Gokak Falls before flowing through the town. Since the colonial era, the hydroelectric station under the waterfall has been used to power Gokak Mills, one of the largest manufacturers and exporters of yarn in India. The river Markandeya, a tributary of the Ghataprabha, dashes down through 43 ft step wise hill plates to form Godachinamalaki Falls.

- Gokak town and its surrounding villages are facing acute drinking water shortage and mostly depended on bore wells to meet their requirements.
- The estimated population of the Gokak town and adjoining 3 towns as per census 2011-12 is 1, 35,715.
- Besides there are nearly 131 number of villages with an estimated population of 4, 76,448.
- Bhailahongla, Saudatti and Hukkeri taluks are aslo having acute drinking water problems.
- Considering the growth for next 40 years, the estimated drinking water needs will be 2.76 TMC.
- Drinking water requirement for livestock is 0.62 TMC.
- The only nearest source of surface water is Markandeya river. Unfortunately, the river is seasonal and the rainfall is erratic and hence cannot be considered for harnessing the same without storage.

Hence construction of a Dam is inevitable to meet the long term objective of proving drinking water from an assured source.

Supply of adequate quantity of drinking water from a reliable source by way of constructing the dam will help in allround exponential growth of Gokak and surrounding area not only interms of industries but also as an important tourist, culture and heritage destination.

Hence, vision and decision of the GoK is in line with overall development of Karnataka and realizing the same the proposed project has been planned.

The Ghatti Basavanna site is situated at 16˚9’11” N Latitude and 74˚47’18” E Longitude.

1.1.2 Objectives

The **Ghatii Basavanna Reservoir** project is located within the Karnataka state boundary and will have a storage capacity of about 6.00 TMC. The proposed project is envisaged to address the following Objectives:

- To facilitate in creating storage to meet the Drinking water requirements of Gokak town and surrounding villages, taluks in the Ghataprabha Basin within Karnataka.
- To meet the industrial water requirement in and around Gokak taluk.
- To feed selected tanks in and around Gokak town to facilitate sustaining livestock and recharging of ground water.
- To protect the Gokak town from inundation during peak floods in Markandeya River.

1.1.3 Description of Works

- Construction of Concrete Gravity dam at Ghatti Basavanna site with FRL of 618.00 metres having a Gross storage capacity of 6.0 TMC (169.902 MCM).
- Dam will have a spillway in the river course with radial gates to effectively discharge the design flood with hydraulic jump type energy dissipating arrangement with horizontal stilling basin on the downstream side.
- Extent of submergence of the land on the upstream of the Dam with the proposed FRL 618.00 m is 670.88 Ha.

1.2 Location of Project Area

Ghatti Basavanna project is located at Latitude 16˚ 9’ 11” N and Longitude 74˚ 47’ 18” E Coordinates near Gokak town of Belagavi District, Karnataka State. The location is 3.0 Km South west of Gokak town.

The dam site is located about 25 Km downstream of confluence of Markandeya river and Bellary Nala, 10 Km D/S of Godchanamalki falls.

Location of the Ghatti Basavanna dam site along with catchment area is shown in **Figure 1.4**

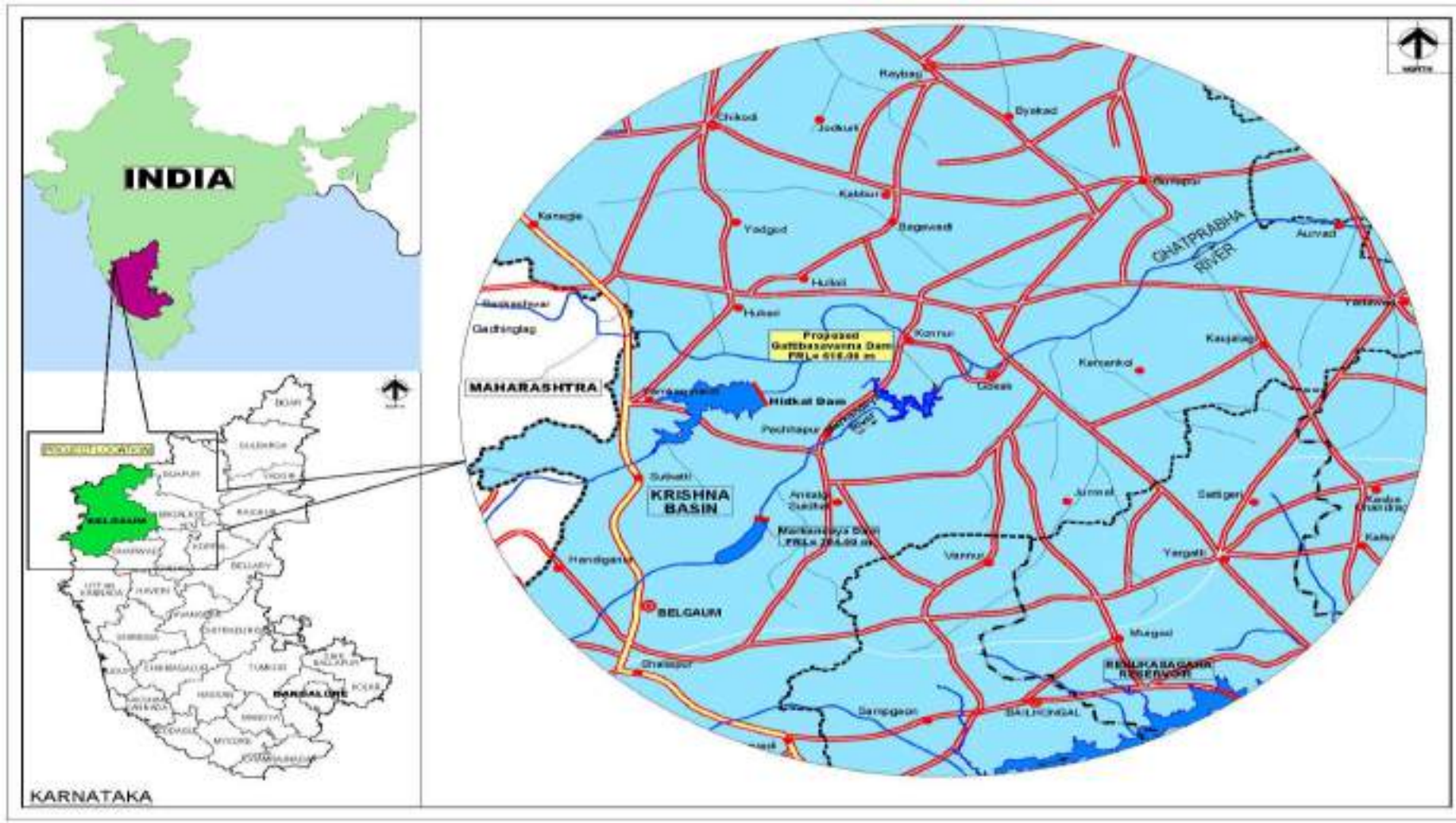

Figure 1.3: Project Service Area

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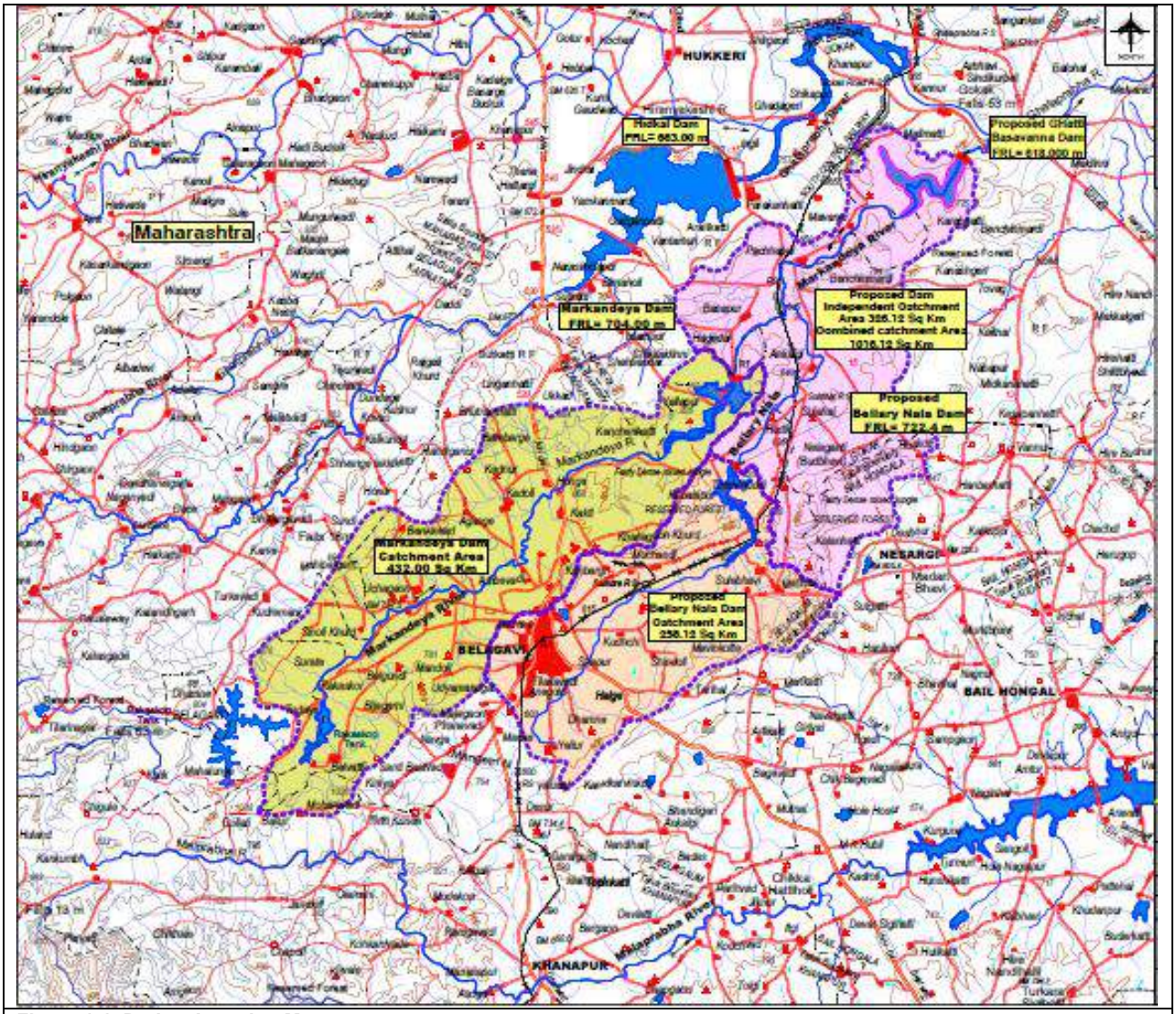


Figure 1.4: Project Location Map

The toposheet mosaic of the project area is shown in **Figure 1.5**

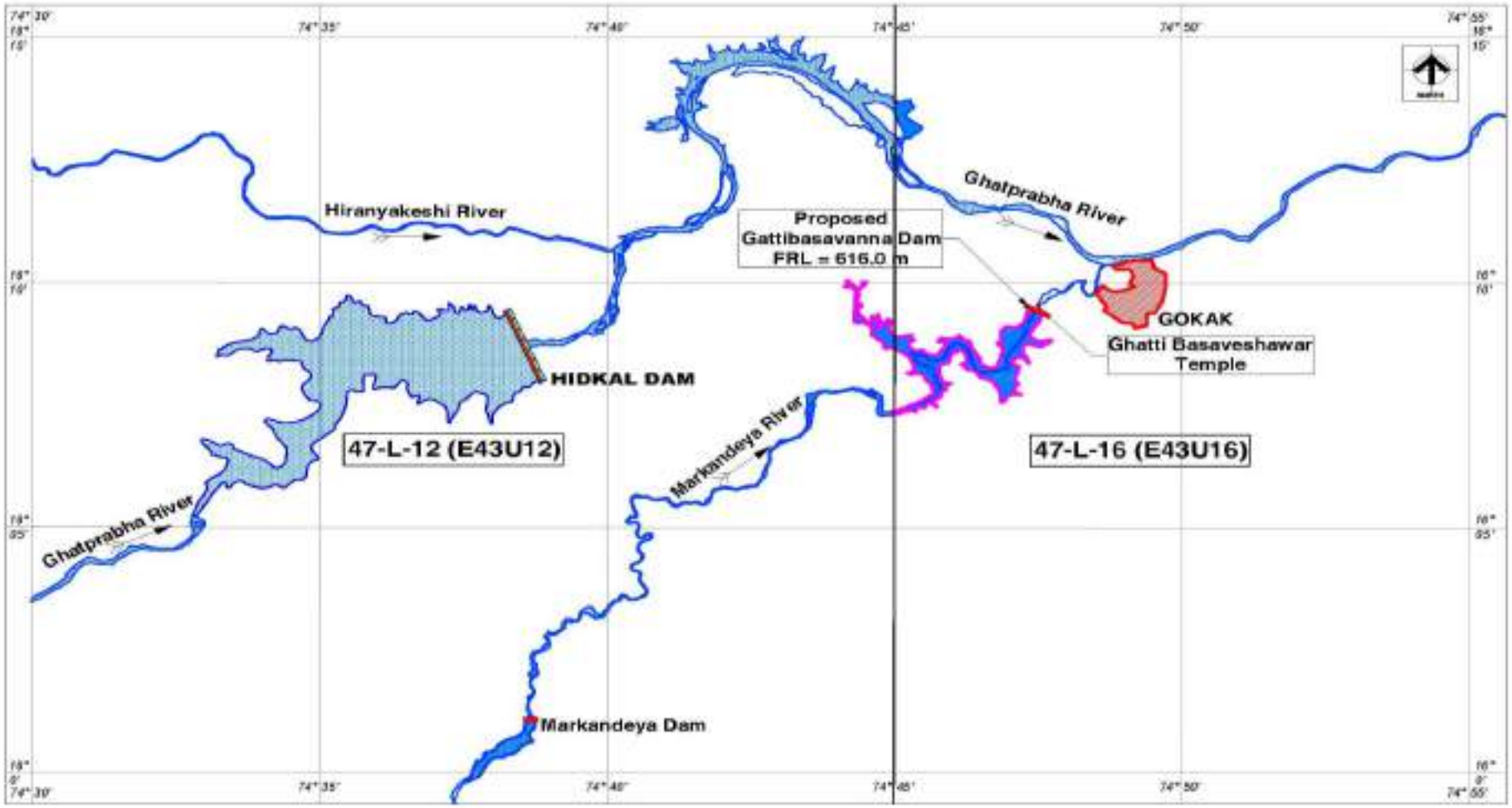


Figure 1.5: Toposheet reference of the project

1.3 Accessibility

Figure 1.6: Accessibility Map

1.3.1 By Road

Ghatti Basavanna dam site is well connected from Belagavi, District headquarters via Ankalagi through a network of SH and MDR to the righjt flank of the dam site covering a length of 70 Km. Similarly . left flank of the dam site is also well connected through NH, SH and MDR covering a length of 85 KM via Thana, Hattaragi and Konnur.

- **Connectivity From Belagavi (Right Flank)**

Ghatti Basavanna dam site right flank can be accesed from Belagavi city through SH-54 about 34 Km to reach Ankalagi then by SH-01 to KadabGhatti road junction at SH-01 covering a distance of 11 Km ther after through a MDR connecting Yogikolla Mallikarjuna Temple covering a distance of 15 Km. further the Gokak town is 7 Km from the temple. Gokak town will be 3 Km from D/S of dam site. And dam site is located 70 Km North East of Belagavi city.

- **Connectivity From Belagavi (Left Flank)**

Ghatti Basavanna dam site left flank can be accesed from Belagavi city through NH-48 connecting Belagavi and Nippani upto Thana Hattaragi covering a distance of 37 Km, from Thana Hattaragi it is required to take SH-134 passing through North and East of Hidkal dam upto Konnur covering a distance of 34 Km. from Konnur it is required to take MDR and travel in the East. further South east

direction upto Km 11 to Gokak beyond which it is required to take a proposed road covering a length of 3 Km to reach a dam left flank of the dam site.

Hence in terms of connectivity Ghatti Basavanna dam site is well connected both in terms of left and right flank.

1.3.2 By Rail

The nearest Railway Station is Gokak road which is located approximately 15 Km from the left flank of the dam site.

1.3.3 By Air

Belagavi Airport (sambre Airport), Belagavi which is located 55 Km north east of the dam site is the nearest Airport .

1.3.4 Port Connectivity

Mormugoa Port will be the nearest sea port and is located 192 Km via Cortalim-Carambolim-Amona-Chorlaghat-Kankumbi -Belagavi-Ankalagi-Gokak,is located South west of Ghatti Basavanna dam site.

For details regarding connectivity and major towns, refer Index map **EIT-1389X-WRE-GD-IND-A008.**

1.4 General Climatic Conditions

Karnataka State witnesses three types of climate. The State has a dynamic and erratic weather that changes from place to place within its territory. Due to its varying geographic and physio-graphic conditions, Karnataka experiences climatic variations that range from arid to semi-arid in the plateau region, sub-humid to humid tropical in the Western Ghats and humid tropical monsoon in the coastal plains.

More than 75 percent of the entire geographical area of Karnataka, including interior Karnataka, witnesses arid or semi-arid climate. Karnataka has about 15 percent of the total semi-arid or 3 percent of the total arid areas identified in India.

Due to the climatic difference Karnataka is divided into three meteorological regions:

Coastal Karnataka: This region stretches over the districts of Udupi, Uttara Kannada and Dakshina Kannada. The entire coastal belt and the adjoining areas have tropical monsoon. The area receives heavy rainfall. The average annual rainfall in Coastal Karnataka is about 3456 mm, which is much more than the rainfall received in the other parts of the State.

North Interior Karnataka: This region extends over the districts of Bagalkot, Belagavi, Bijapur, Bidar, Bellary, Dharwad, Haveri, Gadag, Gulbarga, Koppal and Raichur. This area is an arid zone. North Interior Karnataka receives the least amount of rainfall in the State where the average annual rainfall is just 731 mm.

South Interior Karnataka: This region spreads over the districts of Bangalore Rural, Bangalore Urban, Chitradurga, Chamrajnagar, Chikmagalur, Hassan, Kodagu, Kolar, Mysore, Shimoga and Tumkur. This zone experiences semi-arid type of climate. South Interior Karnataka receives an annual average of 1286 mm rainfall.

1.4.1 Climatic Conditions of the Project Area

Gokak is situated in central region of district which lies in the rugged terrain of north-western Karnataka, Gokak is well known for its moderately hot climate throughout the year except for the monsoon. Gokak receives rainfall from both the north-east and the south-west monsoons and the wettest months are June–September. It has a distinct wet and dry season. December & January are generally cold as compared to the rest of year. The coldest month is January with an average low temperature of 15.2 °C and the hottest month is April with an average high temperature of 35.7º C. Winter temperatures rarely drop below 14º C (54 F), and summer temperatures seldom exceed 34–35º C.

1.4.1.1 Belagavi District

Rainfall and Climate of the district as a whole can be termed as semi-arid. The variation in the maximum temperature during the year ranges from 27^0C to 35.7^0 C and minimum from 13.9^0C to 20.6^0 C. The district experiences pleasant winters and hot dry summers. The hot season extends from March to May, during which the daily maximum temperature often shoots up to 35.7 ^{0}C.

Agro-climatologically the district can be divided into three zones i.e. high rainfall “Hilly zone”, “Northern transitional zone” and “Northern dry zone” from southwest to northeast respectively. The normal rainfall in the district decreases from more than 1859 mm in Khanapur taluk in the southwest, to less than 491 mm in Raybag taluk towards northeasterly direction. Those areas, that receive less than 750 mm annual rainfall are classified as semi-arid and thus drought prone. Hence, the entire district except, the southwestern part is categorized as semi-arid and drought prone. Total normal rainy days vary from 90 in Khanapur to 37 in Athani. Eastern and northeastern parts of the district are prone to drought of mild nature.

The average annual rainfall during the period 1971 to 2001 recorded in the district is 769.1 mm. The standard deviation and Coefficient variation of rainfall for the Belgaum district is 196.2 mm and 25.5% respectively. The highest mean annual rainfall recorded in the district was 1,064 mm in the year 1975 and the lowest rainfall 455 mm in the year 2003.(Source: CGWB Report-2007)

1.5 General Description of Topography, Physiography and Geologyof the Basin

1.5.1 Topography

Topography plays an important role in the land use and cropping pattern of an area relief, slope, drainage, soil types are the important aspects of topographical features and exercise enormous amount of influence both directly and indirect!}' on the agricultural landuse and cropping pattern in the talukas of the districts, and the topography of the Belgaum district is examined with this perspective.

The topography of the study region is expressed in terms of hills, plateaus, plains and terrain features. In the district, three major physiographic divisions have been made by considering the total conditions of wealth phenomena and the crops grown in the district. They are namely, Malnad, Semi-Malnad and Maidan regions

Malnad: The study area experiences malnad type of climatic condition. It is mainly covered with thick forest, heavy rainfall and cool summer. The malnad area is confined only to Khanapur taluka of the district. The area is drained b)^ Malaprabha and its tributaries and the valuable minerals are found in this region are Manganese, Bauxite, Clay and Limestone. This region is covered with rugged hills, streams and well-cut spurs. The upper slopes are almost barren and lower slopes are valleys are fairly wooded with trees like mati, Jambul, nana, hadra, sisra hasan, kumba etc.

Semi-Malnad: Semi-Malnad area lies in the western part of the district ranging from 10 to 40 kilometers width and covering the talukas of North Western part of Belgaum and Bailhongal, Khanapur talukas. It consists of the typical landscape as mentioned above. It receives a moderate amount of rainfall, because it lies in the vicinity of rain shadow region (Fig 2.3).

Maidan: To the east of semi-malnad area, the maidan region lies in the undulating plain region know as Maidan area of the district. It is marked by low rolling base hills. The central belt of the Ghataprabha river basin is 90 to 120 meters above the neighboring valley. The area is covered with rugged hills, near Soundatti. There is a hill range, which divides the tributaries of Ghataprabha and Malaprabha rivers. Athani, Raibag, Chikkodi, Hukkeri, Gokak, Ramdurg, Soundatti, part of Bailhongal talukas come under maidan region.

1.5.2 Physiography

The district is divided in to three physiographical divisions. They are:

- Malenaadu Tract (Western Ghat Region)
- Gadinaadu Tract (Border area Region)
- Bayalunaadu Tract (Plain Land Region)

The "Malenaadu" tract is the Western Ghat area, with lush green forests, sharply undulating topography, and heavy rainfall. Many 1st order streams traverse this area. There are many natural springs in this tract. The "Gadinaadu" (intermediary) tract shows medium range flat to gently rising hills, with shrubby greenery, receiving an average rainfall. The streams are of 3rd & 4th order. The "Bayalunaadu" tract shows vast, flat terrain, with flat topped barren hills. The rainfall received is less than 650 mm. The streams are very gentle.

1.5.3 Geology

The northern part of Karnataka is made up of Kaladgi and Badami and Bhima Group of sediments, approximately of Proterozoic age. Further north the terrain is covered by extensive volcanic flows known as Deccan traps of Cretaceous - Tertiary age. Significantly, about 60% of the state is composed of the Archean complex which consist of gneisses, granites and Charnokites rocks. Laterite capping that are found in many districts over the Deccan Traps were formed after the cessation of volcanic activity in the early tertiary period.

The project area falls within Gokak Taluka of Belgaum district in the northern western part of Karnataka. Various geological formations can be observed in the district. The Schist and Banded Ferruginous Quartzite, the peninsular gneiss by Granite and Gneissic Granites, the Kaladgi formations, Sandstone, Quartzite, Shale and Limestone and Dolomite, Basalt (Deccan Trap) and the Laterite formations are observed in the district.

1.6 Population

1.6.1 Affected

On implementation of the Project and construction of the reservoir, it is expected that due to submergence of part of the villages are likely to be affected. Besides population of few hamlets may get submerged. Hence evacuation or relocation of such hamlets is anticipated. However,mostly dry, cultivation field and forest land will be submerged. Niravnappa temple located at an EL-591.60 m will be submerged. Hence this require suitable rehabilitation or arraangements in terms of connectivity considering the importance and centiments of the locals. Similarly Yogikolla Mallikarjuna temple

located at an elevation of EL-624.00m. the connectivity to the temple requires rehabilitation. All this has been planned and required provisions have been made in the DPR. Consequent to the approval of the DPR, a comprehensive survey of the submergence area will be carried out once again in order to identify the areas which are likely to be submerged and requires relocation including extent of compensation payable other than what has been envisaged.

1.7 Natural Resources

Belgaum district is rich in natural mineral resources and some of the important economic minerals found in the district are iron ore, manganese, bauxite, clay, limestone, sand, building stones etc. Limestone is found in the South of Khanapur taluka and eastern side of the Gokak taluk.

1.7.1 Biodiversity Features

Karnataka, one of the Southern states of India has 3.83 Million ha of recorded forest area which is around 20 percent of its geographical area. Karnataka is endowed with most magnificent forests in the country ranging from majestic evergreen forests of the Western Ghats to the scrub jungles of the plains. The Western Ghats of Karnataka are one of the 25 global priority hotspots for conservation and one of the two on the Indian subcontinent. Several economically important species such as Sandalwood, Rosewood, Teak, White cedar grow naturally in these forests. Karnataka forest is endowed with rich wildlife, harbors 25 percent of the elephant population of India, 10% of the Tiger population. The state has 5 National parks and 21 sanctuaries comprising about 17.3% of total forest area as protected area for wildlife and biodiversity. The state ranks 4th among all the state and union territories in respect of area under tree cover.

Bhimgad forest lies in the districts of Belgaum and Uttar Kannada (North Kanara) in Karnataka. This region is part of the central Western Ghats, forming a large corridor as it is surrounded on all sides by sanctuaries and national parks, except to the east. The site is an excellent representative of Wet Evergreen Rain forests and is home to a diverse flora and fauna. Amidst these forests lie the ruins of an old fort Bhimgad of historical importance.

Bhimgad is covered with Wet Evergreen, Semi-evergreen Moist Tropical Forest and Moist Deciduous Forests, interspersed with grasslands, some degraded forest and cultivation. The vegetation has been described by Thakur et al. (1964) and Vartak (1966). The vegetation changes from Moist Deciduous to Semi-evergreen at higher elevations. At still higher elevations around crest lines, there are isolated patches of typical Tropical Evergreen Forest. These forests contain some endemic species such as Diospyros nigrescens, Connarus ritchiei, Jasminum malabaricum, Memecylon albotianum and Myristica malabarica. The mountain range and valleys are crisscrossed with perennial streams, providing drinking water to millions of people. The Mahadayi river originates here and runs in to Goa as Mandovi, a major source of fresh water for the state.

1.8 Land Use and Socio Economic Aspects

1.8.1 Land Use

The district is primarily located on the eastern side of the Western Ghats and its topography is predominantly undulating. A “rugged terrain” marks the western part of Khanapur and Belgaum taluks with deep cutting ravines on the foothills of the Western Ghats. The elevation of these hills varies from 796 to 1025 m above MSL. Northern portion of the district is a plateau region formed by basaltic lava flows, which represents “Deccan peneplain”. The central and southern parts exhibit moderate to gently “undulating terrain” having sparsely distributed knolls and tors. In some parts, especially in Ramdurg and Saundatti taluks, hills with elevations between 686 and 783m amsl are present. The famous Yellamma temple in Saundatti taluk is located in one of these isolated hills. The remaining part of the district is in general a “plateau area”. The elevation in the plains varies from 534m in the northeastern part to 820 m above MSL in the southwestern part of the district. This has its bearing on the regional slope which is towards northeast. The differential altitude is significant because, it is likely to cause irregular ground water flow patterns on the micro scale.

1.8.2 Soil Types

The soils of Belgaum district can broadly be classified into red soils and black soils. These soils vary in depth and texture, depending on the parent rock type, physiographic settings and climatic conditions. By and large, black soils predominates the Deccan Trap terrain and the red soils are found in the southwestern and southeastern part of the district in gneissic terrain. These soils in turn can be grouped into seven categories as given below, out of which the first five cover large tracks of land while the last two are local in nature.

1.8.2.1 Shallow Black Soils

These soils occur in the Deccan trap region and to some extent are also developed in schist, shale and limestone terrains. They are greyish to dark greyish-brown in colour, with clayey texture. These soils have poor to moderate infiltration characteristics.

1.8.2.2 Medium Black Soils

These soils are predominantly derived from Deccan traps and occupy large parts of the district. They are dark greyish-brown to very dark greyish-brown with clayey texture. These are derived from the weathered products of basalts and limestone and are darker in valleys than in high lands. Their texture varies from loam to clay, with low to moderate infiltration characteristics.

1.8.2.3 Deep To Very Deep Black Soils

These soils occupy large tracts in Deccan trap terrain along the Krishna River and also in the gneissic terrain. These soils are dark greyish-brown to very dark greyish-brown in colour and have clayey texture. These soils occur on plains or lands having gentle slopes. These soils exhibit wide cracks in summers. These are derived from a wide variety of parent rock types, like traps, schists, gneisses and sedimentary rocks. They are generally transported and therefore occur in valleys and depressions. Accumulation of lime, gypsum and soluble salts at varying depths in the soil profile often pose problems. They have poor infiltration characteristics.

1.8.2.4 Mixed Red And Black Soils

These soils occur in the northern parts of the district. They are dark reddish-brown to dark greyish-brown in colour with silty-clay to clayey-loam textures. These soils are derived from gneisses, schists and sedimentary rocks. Red soils having high infiltration characteristics are confined to uplands, whereas, black soils of poor to medium infiltration characteristics occur in valleys and low lands.

1.8.2.5 Red Loamy Soils

These soils occur as small strips in the valleys adjacent to the Western Ghats. They are generally transported and are loamy to silty-loam in texture. They have moderate to good infiltration characteristics.

1.8.2.6 Lateritic Soils

Lateritic soils are red in colour and occur as pockets. They occur at high-levels as insitu in Deccan Trap terrain and at low-levels as transported in Malnad region. They are derived from Deccan traps as well as sedimentary rocks, Dharwarian Schists and peninsular gneisses. These soils have good to moderate infiltration characteristics.

1.8.2.7 Alluvial Soils

These soils are developed over the alluvium deposited by the Krishna River and its tributaries. They are very limited in extent and thickness and are local in nature. These soils have good infiltration characteristics and are composed of coarse sand, sandy-loam and loams.

Figure 1.7: Pictorial view of the project site

The stretch of the Markandeya river from the origin till it reaches Gokak has well defined high banks and looks like Grand canyon. The entire river section or the stretch is ideally suited for siting the dam since it is possible to impound the water of high capacity with minimum submergence. Geologically, several sections of the river are most ideally suited for locationg the dam since reasonably good founding strata is likely to be available at shallow depth. Since the river has deep gorge for most of its length habitation is minimum. This helps in having minimum resettlement and rehabilitation of villages. Hence Markandeya river appears to be one of the ideal River basin for siting the dam in view of several advantages as mentioned above

Figure 1.8: Existing Barrage at project site

Figure 1.9: Valley of the Markandeya River at Ghatti Basavanna Dam site

1.8.3 Socio Economic Aspects

The Concept of water and development has been changing in the recent decade. Water for life, energy, agricultural, industrial and domestic sectors should be widely managed between upstream and downstream sides of the water source. These water managements will mitigate the socio-economic impacts in the local regions. The notion of economic impact refers to the effects, on the local and regional economies, of project construction and subsequent operating activities. These include: direct and secondary demands for labor and services, as well as effects on local resources and thus on the very structure of the local economy. Such economic effects also cause significant social impacts which impinge on economic parameters. Also various impacts stem directly from the project activities and these also have economic implications. Overall, socio-economic impacts endanger a complex dynamic stage which is not easy to predict accurately.

Socio economic factors are of greater interest in the recent years in EIA (Environmental Impact Assessment) as they represent specific aspects of human environment and the changes represent the most critical alterations associated with project implementation.

Further, a detailed study will be conducted which will provide us the understand of how the potential changes could be increase /decrease in population, Disruption of settlement patterns, change in land use, disruption in religious pattern, attitudes and life styles, changes in transportation systems, relocations of highways and rail roads. Detailed studies will be carried out on the Infrastructure and cultural sites located within 10km radius of the project site.

1.9 History (Earlier Proposals)

1.9.1 Proposals

Construction of impounding reservoir across Markandeya River in proximity to Gokak town is being considered since long time. Markandeya River is the only nearest seasonal river near to Gokak town and also surrounding 131 villages including adjoining needy areas which if harvested properly can meet the ever growing drinking water needs. KNNL, & Minor Irrigation Department had plans to have small barrages to meet the drinking water needs. Incidentally the entire section of Markandeya River from downstream of Godchanamalki falls up to Gokak has a deep gorge and most ideally suited for impounding the water with minimum submergence. Studies carried out in the past were contemplating to have series of barrages so as to minimize the submergence.

However during the recent study it has been observed that if a dam of nearly 86.50 meters heigh is proposed then it is possible to store about 6 TMC of water which can meet the drinking water needs of Gokak town, 131 surrounding villages and also adjoining taluks (Bhailahongla, Saudatti and Hukkeri) in Ghattaprabha sub basin. The requirement has been assessed considering the growth for the next 40 years and also requirerment for other needs which are essential is assessed details of which are furnished below.

Table 1.1: Requirement of Water Needs

No	Particulars	Quantity (in TMC)
A	**Drinking water**	
1	Gokak town	0.56
2	131 Villages in and around Gokak town	1.24
4	Part of Hukkeri taluk	0.26
5	Part of Bailhongala taluk	0.35
6	Part of Savadatti taluk	0.35
7	Live stock	0.62
	Total Drinking water needs	**3.38**
B	**Industrial needs**	0.50
C	**Tank filling**	0.60
D	**Dead storage**	0.38
E	**Evaporation loss**	0.30
F	**Environmental releases**	0.80
	Grand Total	**5.96 Say 6.00**

The yield at the proposed site at 50%, 65% and 75% dependability are 8858 Mcft, 7687 Mcft and 6359 Mcft respectively. It has been estimated in the hydrology report that it is possible to achieve 90 to 91.4% of reliability for supplying the drinking water and as per the standards for drinking water needs reliability should be 90%.

In view of this the proposal for building 86.50 m high dam for impounding water in close proximity to Ghatti Basavana with a proposal to store nearly 6 TMC of water at FRL 618 m now contemplated appears to be best. The project consequent to the commissioning will not only address the drinking water needs but also help in improving the ecology and environment besides envisage in creating of job opportunity and also enhancing the ground water recharge.

1.9.2 Water Allocation

The project envisages providing drinking water supply for Gokak and surrounding 131 villages and part of Saudatti, Hukkeri and Bailahongla Taluks. Further, the Ghatti Basavanna project is a multipurpose project which provides water for tank filling and industrial requirements. Hence, the total water utilization under this project will be 4.78 (3.38+0.5+0.30+0.60) TMC.

Ghatti basavanna integrated project is planned to meet evergrowing demand for drinking water needs besides industrial consumptions, livestock and tank filling. The most of the utilisation comes under consumptive use (20% consumption and 80% as return flow) and similarly the industrial needs will be computed @ 2.5% of the gross requirement. In other words, the proposed dam will not be used to meet any of the irrigation needs.

The details of the Water allocation of the scheme are as under:-

No	Particulars	Quantity required	Actual utilisation planned	Allocation	Remarks
		TMC			
A	**Drinking water**				
1	Gokak town	0.56	0.56		
2	131 Villages in and around Gokak town	1.24	1.24		
4	Part of Hukkeri taluk	0.26	0.26		
5	Part of Bailhongala taluk	0.35	0.35		
6	Part of Savadatti taluk	0.35	0.35		
7	Live stock	0.62	0.62		
	Total Drinking	**3.38**	**3.38**	**0.676**	Consumptive use @ 20%

No	Particulars	Quantity required	Actual utilisation planned	Allocation	Remarks
		TMC			
	water needs				
B	**Industrial needs**	0.5	0.5	0.0125	Consumptive use @ 2.5%
C	**Tank filling**	0.6	0.6		Allocation as per KWDT -I under MI quota. Hence, not considered.
D	**Dead storage**	0.38			No allocation required
E	**Evaporation loss**	0.30	0.3	0.30	
F	**Environmental releases**	0.80			No allocation required
	Grand Total	**5.96**	**4.78**	**0.9885**	
The gross storage of the dam is estimated to be 6.04 TMC. The extent of utilisation planned based on the allocation of 0.9885 TMC is 4.78 TMC.					

Under the scheme water allocated for drinking water purpose is 3.38 TMC (Consumptive use @ 20%-0.676 TMC), Industrial purpose is 0.5 TMC (Consumptive use @ 2.5%-0.0.0125 TMC), Evaporation losses is 0.30 TMC and for tank filling is 0.6 TMC. The water requirement for tank filling i.e., 0.6 TMC is already included in allocation under Minor irrigation under KWDT-I. Out of the remaining 4.18 TMC 0.9885 TMC (0.676+0.0125+0.30) TMC is consumptive use. This is estimated as per the judgement of Krishna Water Dispute Tribunal. Hence, this additional allocation of 0.9885 TMC needs to be made.

As per the Krishna Dispute (Bachavath) Judgement 734 TMC is allocated to Karnataka. As per Godavari tribunal judgement the state of Andhra Pradesh is diverting 80 TMC of water from Godavari valley to Krishna valley under Pollavaram scheme. Hence, additional 21 TMC of water will be available to Karnataka. Hence, as per the judgement of Bachavath and Godavari Tribunal the total allocation to Karnataka state in Krishna valley will be 755 TMC.

Under the above allocation, provision for Drinking and household purpose is 3.25 TMC (1.50+1.75) and industrial use is 2.25 (0.5+1.75) TMC is made.

The consumptive use of 0.9885 TMC is allocated under the total water utilization of Ghatti Basavanna Drinking Water Project of 4.78 TMC. This can be met under total allocation of 755 TMC (Krishna water Dispute tribunal (Bachavath) (734 TMC) and Godavari Tribunal (21 TMC)) of Krishna waters to the Karnataka State.

The allocation for Ghatti Basavanna Drinking Water Project is made in KWDT-I vide **GO No. WRD 6 VIBYAMA 2020 DATED 24.02.2022.** (Enclosed as **Addendum-3**).

1.10 Choice of Project: Alternative Studies Carried out for Various Major Components of The Project and Including Water Resources Planning and Final Choice of Project

Consequent to several studies carried out and also after evaluating merits and demerits, It is finally decided to select the location for the construction of the dam approximately 500 m U/S of existing barrage across Markandeya. Further studies have been carried out in order to arrive at the height of the dam including the FRL, the details of which is narrated below:

Alternate 1: High dam with a FRL of EL 620.00 m. at existing MI Barrage:

The river bed of the dam site is at EL 546.00 m and the corresponding height of the dam corresponding to EL – 620.00 m is estimated as 74 m. The extent of submergence is about 742.0 Ha and the storage capacity will be 7.02 TMC.

Alternate 2: High-dam with a FRL of EL 618.00 m at 150 m U/S of existing MI Barrage:

The riverbed of the dam site is at EL 544.500 m and the corresponding height of the dam corresponding to EL – 618.00 m is estimated as 73.50 m. The extent of submergence is about 690.00 Ha and the storage capacity was 6.52ss TMC.

Alternate 3: High-dam with a FRL of EL 618.00 m at 500 m U/S of existing MI Barrage:

The riverbed of the dam site is at EL 547.706 m and the corresponding height of the dam corresponding to EL – 618.00 m is estimated as 71 m. The extent of submergence is about 670.88 Ha and the storage capacity was 6.04 TMC.

In order to minimize the submergence of the forest and other lands and also its related impacts, KNNL has decided to restrict the FRL of the proposed Dam to EL 618.00 m and consider the proposal for implementation

At Alternative-1 site, the existing MI barrage has to be dismantelled. And until the dam is brought to certain height and some storage is created present utilisation of the existing MI barrage will not be served.

The Alternative-2 is very close to the existing MI barrage and with stilling basin type energy dissipater (about 100 m length), there is a possibility of interfearance of flows between these two dams. Further, to limit the storage to 6.04 TMC and FRL to EL – 618.00 m as required by

KNNL, Alternative-3 which is located further 500m U/S of existing MI barrage is selected for implementation. With this the existing barrage can still be utilised until some improvements to the barrage is taken up.

1.11 Stages / Phases of Development of Project

The present Project is proposed to be implemented in a single Stage.

1.12 Fitment of the Scheme in Overall Development of River Basin

The allocation of water in Markandeya River basin is based on 75% dependable yield. This can be ensured only if sufficient storage is available in the basin. The present project with a storage of 6.0 TMC will help meeting this objective.

The selected locations is most ideal for construction of a high dam with minimum submergence and having suitable founding strata at shallow depth. In view of the height of the dam there is scope for generating the Hydro-Power from the releases and also during the monsoon if the project authorities is wish to consider the same during the project life cycle after taking required statutary permission if any.

1.13 Intimation to Other Developmental Authorities

All the other departments concerned like WRDO, MI,, RDPR, KUWS & DB, Zilla Panchayats, Forest etc have been intimated regarding the proposed Project.

1.14 Public Announcements & Public Hearings

As a part of the EIA, EMP, SIA and R & R, Public announcements and Public hearings shall be conducted.

1.15 Interlinking of The Scheme With Neighbouring Schemes

The present proposal is planned as an independent scheme to meet exclusively the drinking water needs of the Gokak town and adjoining villages and taluks in the Ghatapraba basin.

1.16 Interstate / International Aspects

Details enumerated in a separate Chapter on Interstate / International aspects.

1.17 Cost & Benefit of The Scheme

The Cost of the project works out to **Rs. 990.00 Crores**. Project will provide drinking water to nearly 4,76,448 people.

1.18 Public Co-Operation & Participation

The affected people in project area will have both direct and indirect benefits since the implementation of project will address major issues such as drinking water shortages, drought besides energy requirements. The project will generate employment, tourism in the area, besides leading to considerable improvement in the ground water table. During the project implementation, the project authorities will take into confidence the project affected people in terms of bringing awareness before proceeding with the activities of the project. All the efforts will be made to rehabilitate the people if any to the full extent of their satisfaction.

1.19 Provision For Domestic & Industrial Water Supply

As indicated above, it is envisaged to provide drinking/ industrial water or any other useful requirements of Gokak town and its surrounding 131 villages in the basin within Belagavi district of Karnataka out of the allocated share.

The groundwater condition is expected to improve considerably which may facilitate augmenting drinking water supply and Agriculture in rural areas.

Chapter 2
Physical features

2.1 Geographical Disposition

Ghatti Basavanna Dam project is located near Gokak town of Belgavi district in Karnataka.

2.2 Topography of the Basin

The River Markandeya is one of the major tributaries of River Ghataprabha, subsequently joins the River Krishna in the Northern Karnataka. River Markandeya originates in Bailur in Western Ghats and flows for a length of 66 km towards east before joining Ghataprabha near Gokak. A dam (16˚9'11" N latitude and 74˚47'18 E longitude) has been constructed across the river Markandeya to establish reservoir at Shirur village in Gokak taluk. The study area, Markandeya River basin stretches geographically from 15^0 56' to 16^0 08' N latitude and 74^0 37' to 74^0 58' E longitude, positioned in the midst of Belgaum district in the northern part of Karnataka state. The Markandeya dam is having a catchment area of 432 Sq Km (43,200 ha).The gross command area is around 328.31 Sq Km covering part of Gokak (237.98 Sq Km), Saundatti (26.13 Sq Km), Hukkeri (50.6 Sq Km) and Belgaum (13.6 Sq Km) taluks of Belgaum District. Markendaya dam catches a average annual yield of 10.69 TMC, with a gross storage of 3.696 TMC. Upstream area of submergence upto MWL 704.00 m. Will be 898 Hectares, which includes forest area and cultivable area of 142 and 756 hectares respectively. Nearly 2258 peoples were relocated due to the submergence of the 9 villages.

The reservoir water is directed via Markandeya Left Bank Canal (MLBC, 15 Km) and Markandeya Right Bank Canal (MRBC, 71 Km) to irrigate an area of around 8.9 Sq Km (890 Ha) and 182.15 Sq Km (18,215 ha) respectively. Thus, the net irrigable area is around 191.05 Sq Km (19105 ha) covering part of Gokak (95.83 Sq Km), Saundatti (80.37 Sq Km), Hukkeri (8.90 Sq Km) and Belgaum (5.95 Sq Km) taluks of Belgaum District. Markandeya Irrigation project is aimed at providing enhanced irrigation facilities and to improve drinking water system to the villages of four taluks of Belgaum district by means of canal system.

2.3 Geology of the Basin and Reservoir

2.3.1 Geology of the Basin

The northern part of Karnataka is made up of Kaladgi and Badami and Bhima Group of sediments, approximately of Proterozoic age. Further north the terrain is covered by extensive volcanic flows

known as Deccan traps of Cretaceous - Tertiary age. Significantly, about 60% of the state is composed of the Archean complex which consist of gneisses, granites and Charnokites rocks.

The northern part of Karnataka is made up of Kaladgi and Badami and Bhima Group of sediments, approximately of Proterozoic age. In north the terrain is covered by extensive volcanic flows known as Deccan traps of Cretaceous - Tertiary age. Significantly, about 60% of the state is composed of the Archean complex which consist of gneisses, granites and Charnokites rocks. Laterite capping that are found in many districts over the Deccan Traps were formed after the cessation of volcanic activity in the early tertiary period.

The project area falls within Gokak Taluka of Belgaum district in the north western part of Karnataka. Various geological formations present in the district. The Schist and Banded Ferruginous Quartzite, the peninsular gneiss by Granite and Gneissic Granites, the Kaladgi formations, Sandstone, Quartzite, Shale and Limestone and Dolomite, Basalt (Deccan Trap) and the Laterite formations are observed in the district.

Table 2.1: Geological Succession

1	Laterite, Sand deposits	Recent
2	Deccan Basalt	Tertiary
3	Sand Stone, Dolomite, Limestone	Kaladagi series
4	Schist, Gneiss, Granite	Archean

2.3.2 Geology of the Reservoir Site

Sandstone and quartzite's of Kaladgi formation are the main rock types occupying reservoir area. The gently dipping strong sandstone beddings are capping large part of the valley sides of Markandeya River. In many places the FRL level hugs such sandstone horizons. The down below the hill slopes on oth the banks are gentler to moderately steep and part of this under the cover of overbyrden deposites comprising of Talus, Colliual and other slope wash material. The sandstone bed rock which is resistant to general weathering and thick soil formation the bed rock is expected at shallow depths. At some places near the valley bottom the sandstones are unconfirmabaly lying on the basal granite/gneiss rock. As such the contact of these two rock typees observed to be stable and not posing any stability problems.

Generally the sandstone is gently dippimg at 10 to 15 degree towards NW to northerly direction further rockmass is dissected with other two set of joints which are trending along EW and NS directions and

dipping at subvertical angle (75 to 85 degrees). The NS trending joints are generally controlling the rocky cliffs portion of the river valley the river is flowing in South to North direction.

Figure 2.1: Upstream side of dam site looking towards Reservoir area

Figure 2.2: Rocky slopes in reservoir area.

The reservoir area is free from any slope instability like major slide zone, debris flow etc. in view of the prevailing sandstone bed rock all through the length of reservoir it is expected water tight and stable periphery to the reservoir.

Morphology and sandstone formation along length of reservoir to offer stable conditions and required reservoir tightness to avoid escaping of water to other basin.

2.3.3 River System and Basin Characteristics

Markandeya River a tributary of Ghataprabha River rises in the Bailur village of Khanapur taluk at an elevation of 927 m above mean sea level, in the state of Karnataka. Markandeya river generally flows in the east direction and runs Nort of Belagavi town. Markandeya has a drainage area of 1052 Sq.kms and the entire drainage area falls within the geographical boundary of Karnataka. It traverses a length of 106 Km from origin and joins Ghatprabha river 5 Km NE of Gokak town and 15 Km D/S of famous Gokak falls. The river enters Belagavi taluk on northern side and flows towards eastern side of the Belagavi city and is a tributary of Ghataprabha River in Krishna Basin. It runs for 72 Km in Belgaum, 21 Km length in Hukkeri Taluk and 13 Km length in Gokak taluk. The total catchment area of the river is 1052.00 Sq Km. Basin wise, the area falls under Ghtaprabha basin, which is a sub basin of Krishna Basin.

Bellary nala is the only major tributary of Markandeya river which also origantes in the western Ghats near Yellur village in Belgaum. The nala generally flows in the East and N-E direction circumventing Belagavi town from the South. Most of the untreated water of Belagavi town and surrounding industries are being discharging to Bellary nala. These discharges will ultimately finds its way to Krishna river via Markandeya and Ghatapraba rivers respectively. Ghatapraba river joins Krishna which ultimately empties into Bay of Bengal after passing through Telangana and Andra Pradesh states

2.3.4 General

The climate of the region is semi arid . The larger variations in rainfall from year to year both in quantity and distribution through the season render the region prone to drought and famine. The hot season begins by March and extends upto the end of May, followed by Southwest monsoon season from June to September when the weather is cool and damp. The Northeast or the retreating monsoon season period is from October to December, while the cold season is from December to the middle of February. As per Koppen's classification, the regional climate is moderate

2.3.5 Rainfall

The project region experiences an average annual rainfall of 964.3 mm. .Though the total rainfall is not high, the area benifits both from the Southwest and Northeast monsoons. The Southwest monsoon reaches the region by about first week of June. There is a steep rise in Southwest monsoons during the months of September, October and November which brings in, the Northeast monsoon rains. The rains fail in some years.

2.3.6 Temperature

The variation in the maximum temperature during the year varies from 27°C to 35.7°C and minimum temperature varies from 13.9°C to 20.6°C. The region experiences pleasant winters and hot dry summers. The hot season extends from March to May, during which the daily maximum temperature often shoots up to 35.7°C

2.3.7 Humidity

The region on the whole enjoys a moderate climate.

2.3.7.1 Relative Humidity

Most humid conditions are found in the monsoon and post monsoon season. Mornings were more humid than evenings and humidity ranges from high of 54.5 to 89% in day time and low of 24.4 to 78.5% in night.

2.3.8 Cloudiness

Skies are generally clear or lightly cloudy during the months of December to March. Cloudiness begins to increase progressively from April and during monsoon months the skies are heavily clouded on most of the days.

2.3.8.1 Cloud Cover

Sky is generally heavily clouded during the monsoon season. During the post-monsoon months, cloudiness decreases. During the rest of the year, the sky is clear or lightly clouded. The cloud cover in the basin varies from 4.1 to 5.3 oktas.

2.3.9 Wind

Most parts of the area are exposed to strong winds almost throughout the year. By the end of October , fairly constant wind, which gets cooler with the progress of the season, sets in from the Northeast. From November to January, dry and biting winds blow from direction between northeast and southwest. In February, northerly and northwesterly winds are also common in the forenoon and these become more and more predominant in the months of March and April. The afternoon winds are variable in all these three months. With the advance of summer, dust-raising winds add to the discomfort of the hot weather. During the second half of May, winds increase in force and blow from directions between Southwest and Northwest. Although they do not bring rain, these winds are cool and refreshing. With the onset of monsoons, winds strengthen further and blow from directions West and Southwest. By the latter half of September winds begin to weaken and blow from directions between North and East.

2.3.9.1 Wind Speed

The area is generally calm during winter and summer periods, with mean wind speed ranging from 7 to 15 km / hr. The wind speed attain maximum during June & July months (15 Km/hr).

Chapter 3
Interstate Aspects

3.1 States Traversed by Markandeya River and its Tributary

Ghatti Basavanna drinking water project has been planned 25 Km D/S of Markandeya River and Bellary Nala confluence. In view of this only the flows from intercepted catchment can only be utilized for storage besides spillover from the dams and also the regenerated water.

The river Markandeya, a tributary of Ghataprabha river and Ghataprabha river itself is a tributary of Krishna river and Markandeya river run, its entire length in Karnataka territory only. All the tributaries/sub-tributaries are of river Krishna and they are inter-State rivers.

3.2 Distribution of Catchment in the State and Yields from the Catchment

The total catchment area of Markandeya and Bellary Nala basin is 1,504 Sq. Km and the distribution of the same in the basin is as indicated in **Table 3.1**

Table 3.1: Catchment area of Markandeya river and Bellary Nala river Basin in the state

No.	Name of the river basin	Catchment area in (Sq. Km)
1	Markandeya	1052.00
2	Bellary nala	452.00
		1,504.00

3.2.1 KWDT Awards

3.2.1.1 Award - 1

The Bachawat commission (**KWDT I**) went over the matter in detail and gave its final award in 1973 and further report in 1976. While the Tribunal had in its earlier report detailed under Scheme A, pertaining to the division of the available waters based on 75 % dependability, the KWDT in its award outlined the exact share to each state. The award contended based on 75 % dependability that the total quantum of water available for distribution was 2060 TMC and was divided between the three states in the following manner.

Table 3.2: Allocation of Water

No.	State	Allocation in TMC
1.	Maharashtra	560
2.	Karnataka	700
3.	Andhra Pradesh	800

In addition to the above, the states were allowed to use regeneration/return flows to the extent of 25, 34 and 11 TMC respectively by the state of Maharashtra, Karnataka and erstwhile state of Andhra Pradesh.

As per the KWDT Award –I, 734 TMC in enblock allocation for Karnataka. Futher under Godhavari Water Dispute Tribunal (GWDT) award, erstwhile state of Andra Pradesh planned for diversion of 80 TMC of Godhavari water to Krishna river under polavaram scheme. As per the aggrement under this Godhavari scheme, the state of Karnataka got 21 TMC, which is also an enblock allocation. Thus the state of Karnataka has got 734 + 21 = 755 TMC as enblock allocation under KWDT Award –I.

3.3 Allocation of Water

The project envisages providing drinking water supply for Gokak and surrounding 131 villages and part of Saudatti, Hukkeri and Bailahongla Taluks. Further, the Ghatti Basavanna project is a multipurpose project which provides water for tank filling and industrial requirements. Hence, the total water utilization under this project will be 4.78 (3.38+0.5+0.30+0.60) TMC.

Ghatti basavanna integrated project is planned to meet evergrowing demand for drinking water needs besides industrial consumptions, livestock and tank filling. The most of the utilisation comes under consumptive use (20% consumption and 80% as return flow) and similarly the industrial needs will be computed @ 2.5% of the gross requirement. In other words, the proposed dam will not be used to meet any of the irrigation needs.

The details of the Water allocation of the scheme are as under:-

No	Particulars	Quantity required	Actual utilisation planned	Allocation	Remarks
		TMC			
A	**Drinking water**				
1	Gokak town	0.56	0.56		
2	131 Villages in and around Gokak town	1.24	1.24		
4	Part of Hukkeri taluk	0.26	0.26		
5	Part of Bailhongala taluk	0.35	0.35		
6	Part of Savadatti taluk	0.35	0.35		
7	Live stock	0.62	0.62		
	Total Drinking water needs	**3.38**	**3.38**	**0.676**	Consumptive use @ 20%

No	Particulars	Quantity required	Actual utilisation planned	Allocation	Remarks
		TMC			
B	Industrial needs	0.5	0.5	0.0125	Consumptive use @ 2.5%
C	Tank filling	0.6	0.6		Allocation as per KWDT -I under MI quota. Hence, not considered.
D	Dead storage	0.38			No allocation required
E	Evaporation loss	0.30	0.3	0.30	
F	Environmental releases	0.80			No allocation required
	Grand Total	5.96	4.78	0.9885	
The gross storage of the dam is estimated to be 6.04 TMC. The extent of utilisation planned based on the allocation of 0.9885 TMC is 4.78 TMC.					

Regarding water allocation refer GoK Administrative approval vide **GO No. WRD 6 VIBYAMA 2020 DATED 24.02.2022.** (Enclosed as **Addendum-3**).

3.3.1 Opinion of Chief Enginner, ISW

The drinking water supply has an element of human needs which cannot be substituted by any other source and takes highest priority as per the State and National Water Policy. Therfore, the requirement of 0.9885 TMC (Consumptive use) is allocated under KWDT-I Award. As per the **GO No. WRD 6 VIBYAMA 2020 DATED 24.02.2022** has which an allocation of 0.9885 TMC to Gatti Basavanna Scheme under KWDT-I (Bacahwat Award 734 TMC and Godavari Diversion -21 TMC).

3.4 Operation and Regulation of the Project

The present proposal is envisaged primarily to construct the reservoir to meet the drinking water, industrial and tank filling needs of areas falling under Gokak, and part of Hukkeri, Saudatti and Bhailahongla taluks.

3.5 Concurrence of the Riparian State for Additions / Alterations of Existing Project

Not applicable to the pesent proposal

3.6 Details of Quantity of Water Diverted for Drinking / Cooling / Industrial Purpose

Nil.

Chapter 4
Surveys and Investigations

Desktop study has been carried out based on the available data and information and also on 1:50,000 scale toposheets based on which three locations have been identified for further study. Parameters considered during desktop study are as follows;

- Topography (Ridges and valleys)
- Water availability
- Level at which water is available
- Special ground features and soil conditions
- Land use
- Existence of locations of historic and cultural importance.
- Places of worship
- Communication and connectivity
- Any other constraints
- All the available details from the respective field authorities were also considered in the desktop study

Field Reconnaissance Survey has been carried out at selected locations to validate the observations during desktop study. The field inputs and constraints, if any noticed are updated in the base map

4.1 Topographical Survey

Ghatti Basavanna Project site is located on River Markandeya just 5 Km upstream of its confluence with Ghataprabha River and 25 Km downstream of confluence of Markandeya river and bellary nala in Gokak Taluk, Belagavi District. The geographic location of the project site Latitude 16° 9′ 11" N and Longitude 74° 47′ 18" E respectively

Considerable submergence area of Ghatti Basavanna dam site falls under 587.07 Sq Km forest and the accessibility is available only to the right flank.

4.1.1 Establishment of Control Points

The accuracy and precision of any survey and investigation is dependent on Horizontal and vertical controls established for the project site. These control points should be available for reference and future setting outs at the time of reconnaissance survey, detailed engineering survey, geological mapping, geotechnical investigation, cadatral survey, setting out during the construction, demarcation

of FRL, demarcation of the forest boundary etc. In other words they will form the basic framework for planning, Investigation, Identification, locating including setting out of various components of the project. In order to meet all the objective mentioned about, it is proposed to establish a high order and a precise grid reference for the Ghatti Basavanna project site.

4.1.1.1 Establishment of Grid Reference - Horizontal Control

North South line has been established in the site parallel to the True North and observations have been carried out using an high end DGPS in order to establish grid coordinates on WGS-84 system. In all 19 No. of GPS control points have been established near the proposed dam site, in the submergence area, downstream of the proposed dam site. Areas where infrastructure such as accessibility , colony, treatment plant etc and at other important and salient locations such as places of worship, revenue and forest boundary junctions, Godchanmalki falls, Ghataprabha Right bank Canal aqueduct etc.

4.1.1.2 Vertical Control

Vertical control will help in obtaining the elevation of any given point of the project site w.r.t mean sea level. Based on the data and information furnished by the client, nearest Great Trignometric Survey (GTS) benchmark has been identified Doube Tertiry Leveling has been carried out from the identified GTS benchmark (after verifying the stability) and levels have been transferred to all the control points established within the project site.

The said framework so developed will now have X,Y and Z parametres (both horizontal and vertical controls) based on which all the required survey, investigation, mapping further densification of control points can be carried out.

The details of which are furnished in **Table 4.1:-**

Table 4.1: List of Control points

No.	Easting (m)	Northing (m)	Elevation (m)	Point
1.	482727.332	1787666.709	548.500	GTS BM
2.	477723.243	1786233.885	608.630	GPS-1
3.	477710.730	1786282.232	597.560	GPS-1A
4.	477010.688	1784944.162	571.403	GPS-2
5.	476964.156	1784873.488	563.402	GPS-2A
6.	476564.180	1782921.443	599.830	GPS-3
7.	476565.405	1783054.755	591.692	GPS-3A

No.	Easting (m)	Northing (m)	Elevation (m)	Point
8.	475545.425	1784489.790	605.235	GPS-4
9.	475519.597	1784413.105	608.048	GPS-4A
10.	473895.867	1784039.622	628.479	GPS-5
11.	473915.892	1783993.362	628.485	GPS-5A
12.	480191.462	1788254.534	539.955	GPS-6
13.	480194.146	1788295.484	540.028	GPS-6A
14.	482004.539	1788917.360	543.442	GPS-7
15.	482005.874	1788889.245	543.841	GPS-7A
16.	475627.941	1790015.879	608.235	GPS- 9
17.	475591.830	1790017.231	608.820	GPS- 9A
18.	475739.400	1790045.638	605.597	GPS- 9B
19.	475305.709	1790144.863	608.083	GPS- 10
20.	475274.754	1790092.925	608.200	GPS- 10A
21.	474742.789	1790654.927	609.871	GPS- 11
22.	474704.402	1790626.919	609.923	GPS- 11A
23.	473174.531	1791636.048	611.744	GPS- 12
24.	473245.971	1791675.988	613.040	GPS- 12A
25.	473539.396	1791761.894	612.608	GPS- 12B
26.	473594.887	1791785.992	613.374	GPS- 12C
27.	473768.182	1792864.314	615.092	GPS- 13
28.	473783.402	1792949.266	615.125	GPS- 13A
29.	475796.455	1790431.015	614.432	TBM- 1
30.	475875.573	1790405.247	612.633	TBM- 1A
31.	472722.552	1782739.710	640.017	TBM-2
32.	472734.551	1782780.873	640.570	TBM-2A

The details of the equipment used for the survey are indicted in **Table 4.2:-**

Table 4.2: Details of the equipment used for the survey

No.	Type of Equipment	Make
1.	DGPS	Leica GX 1220
2.	Total Station	Leica TC 1201, TC 703, 403
3.	Digital level	Leica sprinter 150 & DNA 10
4.	Automatic level	NAK 724

No.	Type of Equipment	Make
5.	DRONE equipment	Phantom 4K
6.	Required Number of manpower	10 Nos.

4.2 Topographical Survey of the Dam Site

Topographical survey of the project area is essential in order to understand all the topographical and cultural features such as; accessibility, field limit, forest boundary, power lines, telephone lines, roads, tracks, vegetation limits, Nala, grave yard, temples etc. Besides, this will also provide the accurate elevation of various locations including contours which will be drawn by interpolating the heights.

Topographical survey has been carried out based on the grid reference and the height control that has been established to the site using high end total station.

All the topographical features have been captured in the XYZ format with suitable symbols for various topographical features that have been captured. All such data that has been captured using total station has been down loaded to the computer in order to generate topographical base map on 1:5000 scale of the project area.

4.3 Drawing Contours

Contours have been drawn at 0.5 m interval using appropriate software based on the levels that have been captured at required interval and also to all salient points.

4.4 Compilation of Topographical Survey Map

A Topographical map of the entire project area on 1:5,000 scale has been generated by compiling all the data and information. Refer drawing No **EIT-1389X-WRE-GD-TPM-A005.**

Similarly a combined map showing the topographical detailed and Cadastral information has been compiled on a scale of 1: 5000. For details refer drawing No **EIT-1389X-WRE-GD-LAQ-A017.**

Basavanna project, hence no provisions has been made in the DPR and cost estimates for the same . For details, **Refer EIT-1389X-WRE-GD- MTP-A014.**

4.5.5 Drainage Survey

Not applicable

4.5.6 Soil Surveys

Not applicable

4.6 Geology, Geo-Technical Features and Seismicity

4.6.1 Geology and Geotechnical Features

The surface and sub-surface investigations, include surface geological mapping and exploratory drillings carried out at various locations with pre-defined objectives to delineate the foundation level/grades and to assess the geological conditions of foundation, which helps in formulating the treatment plan and design recommendations.

Geological investigations have been planned with following objectives:

- Surface geological mapping of project components as well as the reservoir area to delineate all the geological features exposed at surface.
- Borehole investigations along the river channel and abutments to assess the deepest foundation level, foundation condition, in- situ permeability of rock mass and at the tunnel/cavern grades to assess the rock mass characteristics. The recovered core samples have been subjected to laboratory rock mechanics test to arrive at design geotechnical parameters.
- Geophysical Survey to assess sub-surface foundation condition, which further corroborated with borehole data.
- Exploratory drifting on both the abutments, Intake and power house cavern to access sub surface geological conditions and to conduct various in-situ rock mechanics tests.
- Site Specific Seismic studies to derive earthquake parameters and seismic coefficient

a) Regional Geology

Karnataka state forms the west central part of Peninsular India, its large part of the area occupied by hard rocks consisting of crystalline and older sedimentary and a narrow coastal strip of about 5,000 sq.km of Tertiary and Quaternary sediments.

The geology of Karnataka lay widespread in 5 major eras, namely the Archean, Proterozoic, Palaeozoic, Mesozoic and the Ceonzoic. The geology of Karnataka is largely confined to the two oldest eras; the Archean and the Proterozic. The rest of the great periods from Cambrian to recent are hardly represented but for minor sediments of recent age exposed along the coastal margin to the West.

The state is exposed oldest rocks in Gorur area, Hassan district, Karnataka date back to about 3300 million years. The Precambrian Craton of Karnataka is made up of western and eastern segments. The Precambrians of Karnataka have been divided into older Sargur supercrustals and younger Dharwar supercrustals. The Dharwar supercrustals Supergroup has been further divided into older (Bababudan Group) and younger Chitradurga Group. The schist belts of the Eastern Craton, like Kolar, Hutti, Sandur etc., appear to be approximately equivalent to the Chitradurga Group. The Karnataka Craton has been extensively intruded by granites and granitoids. The eastern Karnataka abounds in these granites and granitoids. The northern part of Karnataka is made up of Kaladgi and Badami and Bhima Group of sediments, approximately of Proterozoic age. Further north the terrain is covered by extensive volcanic flows known as Deccan traps of Cretaceous - Tertiary age. Significantly, about 60% of the state is composed of the Archean complex which consist of gneisses, granites and Charnokites rocks. Laterite capping that are found in many districts over the Deccan Traps were formed after the cessation of volcanic activity in the early tertiary period.

The project area falls within Gokak Taluka of Belgaum district in the northern western part of Karnataka. Various geological formations can be observed in the district. The Schist and Banded Ferruginous Quartzite, the peninsular gneiss by Granite and Gneissic Granites, the Kaladgi formations, Sandstone, Quartzite, Shale and Limestone and Dolomite, Basalt (Deccan Trap) and the Laterite formations are observed in the district.

Table 4.5: Geological Succession

Laterite, Sand deposits	Recent
Deccan Basalt	Tertiary,
Sand Stone, Dolomite, Limestone	Kaladagi series
Schist, Gneiss, Granite	Archean

The Archaen Schist isan extension of the Dharawar schist belt. The formation is overlaid by thick cover of shale, The Schist encountered below shale cover is greyish in colour, exhibit well developed platy structures. Individual plates can be easily separated. It is usually weathered up to 25-30 m. It shows a general trend of NW 10-SW 10SE dipping due east. The Schist formation is observed in Bailhongal, Khanapur, Belgaum and Saundatti talukas.

Phyllite is a hard formation, resembling schist by its grey colour, having trend, dip etc similar and occurring adjoining the schist. Joints and platy structures are poorly developed. It is massive in nature, breaking in to irregular, angular fragments or irregular massive boulders. It shows a trend of NNW-SSE, and occurs parallel to schist. Such formation occupies limited extent in the Central part of Bailhongal taluka and Western parts of Saundatti shallow weathering, and non-porous nature.

The BHQ exposures occur parallel to the schist formation. Exposures of BHQ are observed in the Bailhongal taluka. This is characterized by compact platy structure of hematite and quartz bands. Both Schist and BHQ show a general trend of NNW-SSE direction, dipping due East.

Sandstone, Quartzite and Limestone, Shale bearing Limestone represent the Kaladagis. The project area is located within this rock formation. The Sand stones are horizontally bedded, fine to coarse grained, exhibiting white, buff, pink, yellow colors. Many structural features, like parallel bedding current bedding, ripple marks current bedding, folds, faults, brecciation, conglomeration etc. can be observed. The dam proposed dam site and the reservoir area located on this sanstone rock formation of Kaladgi series. Usually in the lower contours, the rock is weathered up to 25-45 m. Flat topped hill ranges can be seen in Hukkeri, Ramadurga, Saundatti and Bailhongal and Gokak Talukas. This is the second largest formation observed in the district. Lot of sandstone is being used as building material. There are natural springs in Sandstone, such as the spring of Yallamma temple, Sogal-kshetra, Hunashiwari math, Rudrapur fort etc.

Table 4.6: The main rock types present in Gokak taluka is given as under.

No	Taluka	Geological formation	Economical aspects.
1	Gokak	Granite, Gneiss, sandstone, Basalt,Limestone, Dolomite, sand	Basalt and sandstone building material, Limestone, Dolomite in Chemical, and Cement industries.

Source-District Geological report of mines and geology dept , Govt of Karnataka

The Quartzite is a highly siliceous rock. Glossy in nature. With silica up to 94-97 % They are various colours ranging from white, gray, pink etc. Huge quartzite exposures are available in Ramadurga and Saundatti talukas. In few place of Ramadurga and Saundatti talukas, this is being used for refractory and glass industries. Quartzite is being used a builiging material because of its abundant availability.

The Lime stone occurrence restricted to the eastern part of Gokak taluka and NE part of Ramadurga and South, western part of Khanapur taluka. This is greyish coloured, compact, and often thickly bedded. Ca% varies from 42-48%, Mg 14 %-17%. Si02 in Yadwad area ranges up to 7% Limestone of

Belgaum district is massive in nature and occurs as massive deposits. This is being used for prepatation of Lime, and Cement.

Dolomite is observed to occur in Limestone areas of Yadwad in Gokak taluka. A large deposit if Dolomite is observed near YaraGhatti, Yarzarvi villages in Saudatti taluka. Sahley limestone is noticed around sidnal, Godachi village in Ramadurga taluka, Being used as paving stone. Mg % is up to 21-27% with Ca % up to 2930 % The dolomite of this district has not captured much market, probably due to consumers being far away. This is massive in nature, very brittle and often stands as hard, non weathered stretch. In Talaewadi-Krishnapur range of Khanapur taluka there are at least 7-8 huge caves in limestone and dolomite.

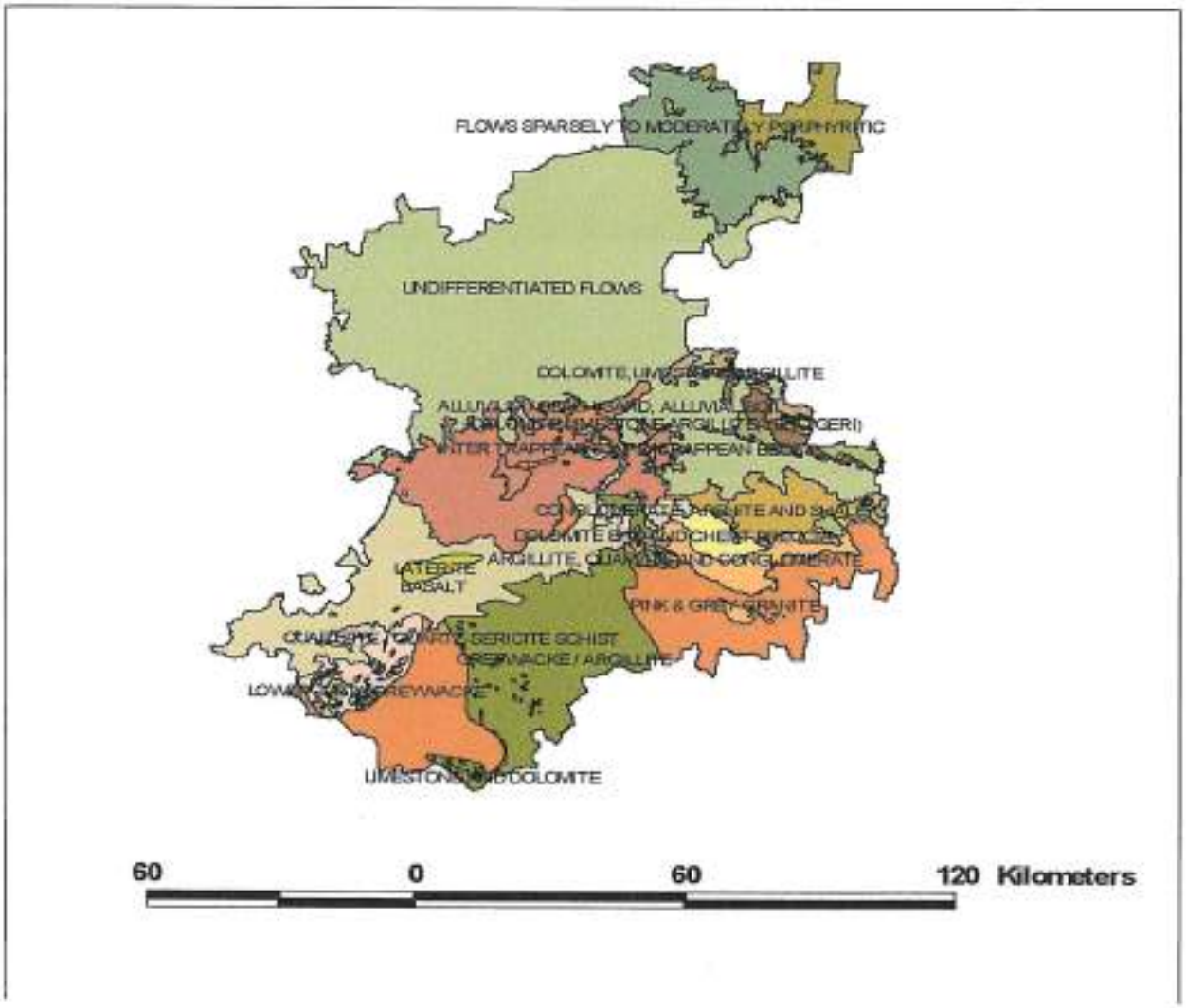


Figure 4.11: Geology map of Belagavi

The Deccan Basalat, generally known as " Trap" of Deccna Trap" occupy a large extent in the Northern part, thinning out towards South. The origin of Trap is resultant of volcanic eruptions in the poona region of Maharashtra State and surface flows in to Karnataka. At least 3-4 volcanic flows can be seen above ground leves, (640m) and 3-4 flows, below surface levels. Individiual trap flow is marked by inter-trappean bed, usually filled with Zeolites, Amygdaloids, Qurtz, jasper, Calcite etc. As cavity filling deposits. Well-developed onion of exfoliation type weathering, vertical and columnar joints can be noticed. Flat-toppded hill ranges can be seen in Belgaum, Khanapur, Hukkeri, Chikkodi, Athani and Raibag talukas. This formation being the younger, it is observed to be over lying sandstone, schist, gneisses, limestone etc. As observed by the drilling of bore wells. At surface the rock is weathered up to 8-15m.

At least 2-3 lava flows are encounterd in drilling. Water is stored in the inter-trappen zones. Hence, bore wells in Deccan trap area, are usually drilled to more than 100 m. to cut through different layers. In many parts of Athani taluka, central parts of Chikkodi and Raibag taluka, the inter-trappean beds are exposed in the form of reddish, deep brownish soil, often mixed with the amygdaloids, jaspers, zeolites etc. The formation being porous, the seepage and evapotation are on higher side. In rainy period the water level rise to as shallow as surface level and go deep to tune of wells going dry. The wells and bore wells in this formation show a fluctuation of 15-25 m. Almost all stone crushers in the district are in trap formation only.

Laterite of this district is an altered product of Deccan trap. In a cross section, one can observe laterite at top followed by leached out alumina clay, grading down in to weathered of massive trap. It is exposed as covering over the trap bedrock. The alumina content is usually less than 30% but some detached, 49-59% alumina rich deposits (Bauxit) are observed in southwestern parts of Khanapur and

Sridhar, Rajeevan M., Sreejith O.P., Satbhai N.S. and Mukhopadhyay B., 2014: MAUSAM, 65, 1(January 2014), pp. 1-18. The following data for 35 years from 1985 to 2019 for the grid points in and near the catchment were downloaded:

Table 5.2: Rainfall data

No.	Grid Point	Longitude	Latitude	Average Annual Rainfall, mm
1.	Station 1	74°15'	15°45'	3114.9
2.	Station 2	74°30'	15°45'	862.8
3.	Station 3	74°45'	15°45'	719.9
4.	Station 4	74°15'	16°00'	1983.3
5.	Station 5	74°30'	16°00'	743.2
6.	Station 6	74°45'	16°00'	672.5
7.	Station 7	74°45'	16°25'	474.5

5.4 Yield Calculations

Figure 5.2 shows the Thiessen polygons for the whole catchment considering the above stations. **Table 5.3** shows the influencing stations and respective polygon areas:

Table 5.3: Grid Stations influencing Catchments of the Three Dams

No.	Markandeya Dam		Ballari Nala Dam		Ghatti Basavanna Dam	
	Grid Rain	Thiessen	Grid Rain	Thiessen	Grid Rain	Thiessen
1	Station 1	56.98	Station 2	132.12	Station 5	12.27
2	Station 2	109.76	Station 3	24.58	Station 6	276.64
3	Station 4	2.76	Station 5	55.57	Station 7	37.63
4	Station 5	250.58	Station 6	45.86		
5	Station 6	11.92				
	Total	**432**	**Total**	**258.13**	**Total**	**326.54**

The daily runoff for each catchment was worked out by the SCS Curve Number method (Handbook of Hydrology, Ministry of Agriculture, Government of India, 1972). The curve numbers were calibrated with reference to the gauged data of Markandeya dam inflows and Ballari Nala at Hudli. The calibrated curve numbers used are 96 for AMC I, 98 for AMC II and 99 for AMC III. The calibration results are shown in **Table 5.4**.

Table 5.4: Comparison of Gauged Flows and Calibrated SCS CN Calculated Flows

No.	Bellary Nala at Hudli			Markandeya Dam		
	Year	Gauged	SCS CN	Year	Gauged	SCS CN
		Mcft	Mcft		Mcft	Mcft
1.	1985-86	2190	1965	2007-08	16018	12761
2.	1986-87	1307	2470	2008-09	11006	9800
3.	1987-88	318	2166	2009-10	11551	14390
4.	1988-89	2437	3487	2010-11	7309	8728
5.	1989-90	1413	3384	2011-12	11935	13791
6.	1990-91	5227	3327	2012-13	4373	10425
7.	1991-92	6922	3968	2013-14	8560	8149
8.	1992-93	5297	2255	2014-15	7931	7777
9.	1993-94	4591	3096	2015-16	1377	4576
10.	1994-95	6816	3156	2016-17	5745	6767
11.	1995-96	2966	2366	2017-18	3348	6734
12.	1996-97	4167	2949	2018-19	8417	6643
13.	1997-98	3567	6047	2019-20	28757	15982
14.	1998-99	953	1623	Dependable		
15.	99-2000	1307	3550	50%	8417	8728
16.	00-2001	1872	2123	65%	7433	7851
17.	01-2002	530	1592	75%	5745	6767
18.	02-2003	1165	1396	Average	9717	9732
19.	03-2004	600	2152			
20.	04-2005	1095	4224			
21.	06-2006	7275	7006			
22.	06-2007	3637	3003			
23.	07-2008	4097	5816			
24.	08-2009	4803	2905			
25.	09-2010	7628	5945			
50% dependable		2966	3003			
65% dependable		1596	2407			
75% dependable		1307	2166			
Average		3287	3279			

The annual yield in Mcft from the independent catchments at the three sites for the study period 1985-86 to 2018-19 are summarised in **Table 5.5**.

Table-5.5

Working Tables for Markandeya Reservoir — Gross Storage Capacity 3666 Mcft; MDDL 1217 Mcft

Year	Opening RL	Opening Capacity	Markandeya Inflow	Irrigation Demand	Issue for Irrigation	Evaporation Losses Qty	Closing Capacity	Closing RL	Surplus	Deficit
	m	Mcft	Mcft	Mcft	Mcft	Mcft	Mcft	m	Mcft	Mcft
						A			B	
1985-86	694.01	1217.00	5807.44	3577.38	3397.70	511.33	1755.46	696.75	5350.94	-179.67
1986-87	696.75	1755.46	10347.82	3577.38	3577.38	538.28	2022.01	698.02	5985.62	0.00
1987-88	698.02	2022.01	6957.18	3577.38	3577.38	547.75	1963.58	697.85	2870.45	0.00
1988-89	697.85	1963.59	12625.62	3577.38	3577.38	516.78	1916.96	697.64	8748.12	0.00
1989-90	697.64	1916.96	12715.30	3577.38	3577.38	512.47	2010.62	697.98	8431.48	0.00
1990-91	697.98	2010.62	11230.10	3577.38	3577.38	564.47	2074.12	701.68	6125.06	0.00
1991-92	701.68	2074.12	12362.87	3577.38	3577.38	622.65	1760.94	696.92	9436.12	0.00
1992-93	696.92	1760.94	10020.10	3577.38	3577.38	542.72	1931.77	697.60	5759.17	0.00
1993-94	697.60	1931.77	12268.77	3577.38	3577.38	587.02	2417.12	699.83	7689.02	0.00
1994-95	699.83	2417.12	16170.48	3577.38	3577.38	550.43	1858.27	697.21	12609.53	0.00
1995-96	697.21	1858.27	7409.58	3577.38	3577.38	523.82	1782.42	696.88	3378.24	0.00
1996-97	696.88	1782.42	10018.33	3577.38	3577.38	535.61	1630.78	696.14	6055.98	0.00
1997-98	696.14	1630.78	20756.17	3577.38	3577.38	585.69	2593.52	700.59	15669.37	0.00
1998-99	700.59	2593.52	8858.69	3577.38	3577.38	550.96	2136.68	698.48	4987.20	0.00
19990	698.48	2136.68	12070.94	3577.38	3577.38	537.63	1883.11	696.58	8269.68	0.00
2000-1	696.58	1883.11	7300.81	3577.38	3577.38	519.31	1647.65	696.23	3359.56	0.00
2001-2	696.23	1647.65	7447.14	3577.38	3577.38	519.39	1979.22	697.83	3618.84	0.00
2002-3	697.83	1979.22	7496.19	3577.38	3577.38	532.18	1845.95	697.18	3519.91	0.00
2003-4	697.18	1845.95	11017.72	3577.38	3577.38	541.09	2684.49	700.76	6980.76	0.00
2004-5	700.76	2684.49	13649.30	3577.38	3577.38	531.17	2048.04	698.12	10159.22	0.00
2005-6	698.12	2048.04	17084.87	3577.38	3577.38	538.25	3327.60	702.82	11687.48	0.00
2006-7	702.82	3327.60	10269.19	3577.38	3577.38	537.10	1728.14	696.58	7792.38	0.00
2007-8	696.58	1728.14	12780.77	3577.38	3577.38	542.55	2617.83	700.65	7243.15	0.00
2008-9	700.65	2617.83	9800.02	3577.38	3577.38	528.43	2042.35	698.11	6269.70	0.00
2009-10	698.11	2042.35	14389.55	3577.38	3577.38	565.69	2304.33	699.29	9984.54	0.00
2010-11	699.29	2304.33	8728.05	3577.38	3577.38	557.89	2532.23	700.38	4384.67	0.00
2011-12	700.38	2532.23	13790.80	3577.38	3577.38	531.85	1491.14	695.47	10722.76	0.00
2012-13	695.47	1491.14	10425.49	3577.38	3577.38	529.18	1922.04	697.55	5688.04	0.00
2013-14	697.55	1922.04	6148.61	3577.38	3577.38	536.35	2515.58	700.30	3441.34	0.00
2014-15	700.30	2515.58	7777.18	3577.38	3577.38	565.44	2547.83	700.46	3602.18	0.00
2015-16	700.46	2547.83	4575.65	3577.38	3577.38	567.49	1744.13	696.69	1294.68	0.00
2016-17	696.69	1744.13	6766.59	3577.38	3577.38	499.82	1647.88	696.23	2788.64	0.00
2017-18	696.23	1647.88	6734.43	3577.38	3577.38	536.51	2831.96	701.22	1445.48	0.00
2018-19	701.22	2831.96	6842.84	3577.38	3577.38	524.55	1472.06	695.38	3800.81	0.00
2019-20	695.38	1472.06	15562.22	3577.38	3534.44	528.33	1708.10	696.52	11693.33	-52.94

Working Table for Ballari Nala Reservoir — Gross Storage Capacity 1315.6 Mcft; MDDL 179.7 Mcft

Year	Opening RL	Opening Capacity	Ballari Nala Inflow	Irrigation Demand	Issue for Irrigation	Evaporation Losses Qty	Closing Capacity	Closing RL	Surplus	Deficit
	m	Mcft	Mcft	Mcft	Mcft	Mcft	Mcft	m	Mcft	Mcft
									B	
1985-86	706.88	179.72	1964.87	1588.81	1574.63	139.57	409.18	711.77	21.31	-14.17
1986-87	711.77	409.18	3460.64	1588.81	1588.81	169.11	619.12	715.37	484.99	0.00
1987-88	715.37	619.12	2166.16	1588.81	1588.81	168.22	638.76	715.66	359.49	0.00
1988-89	715.66	638.76	3486.65	1588.81	1588.81	174.72	413.83	711.86	1048.07	0.00
1989-90	711.86	413.83	3364.47	1588.81	1588.81	164.31	1016.30	719.74	1009.89	0.00
1990-91	719.74	1016.30	3326.68	1588.81	1588.81	219.24	1315.82	722.40	1219.32	0.00
1991-92	722.40	1315.82	3968.35	1588.81	1588.81	183.02	648.46	715.80	2863.67	0.00
1992-93	715.80	648.46	2255.18	1588.81	1588.81	168.29	589.79	714.85	526.76	0.00
1993-94	714.85	589.79	3865.68	1588.81	1588.81	183.68	611.18	715.26	1292.00	0.00
1994-95	715.26	611.18	3155.58	1588.81	1588.81	185.18	461.47	712.78	1531.32	0.00
1995-96	712.78	461.47	2365.73	1588.81	1588.81	157.55	364.17	710.91	716.67	0.00
1996-97	710.91	364.17	2949.03	1588.81	1588.81	153.34	316.06	709.95	1254.58	0.00
1997-98	709.95	316.06	6047.46	1588.81	1588.81	213.95	938.91	719.19	3621.88	0.00
1998-99	719.19	938.91	1922.51	1588.81	1588.81	188.01	553.81	714.42	230.80	0.00
19990	714.42	553.81	3550.05	1588.81	1588.81	172.13	356.13	710.75	1588.80	0.00
2000-1	710.75	356.13	2123.37	1588.81	1588.81	151.03	364.87	710.92	374.79	0.00
2001-2	710.92	364.87	1592.48	1588.81	1493.00	109.43	354.93	710.73	0.00	-95.81
2002-3	710.73	354.93	1396.24	1588.81	1330.63	105.70	314.84	709.92	0.00	-258.16
2003-4	709.92	314.84	2152.38	1588.81	1588.81	155.26	723.16	718.72	0.00	0.00
2004-5	718.72	723.16	4232.68	1588.81	1588.81	183.01	478.02	713.16	2697.29	0.00
2005-6	713.16	478.02	7006.17	1588.81	1588.81	191.53	1281.18	722.14	4422.58	0.00
2006-7	722.14	1281.18	3003.07	1588.81	1588.81	185.08	544.40	714.28	1699.06	0.00
2007-8	714.28	544.40	5816.26	1588.81	1588.81	207.06	1045.51	720.02	3519.28	0.00
2008-9	720.02	1045.51	2804.76	1588.81	1588.81	185.33	723.59	718.72	1452.54	0.00
2009-10	718.72	723.59	5945.46	1588.81	1588.81	210.02	681.96	715.99	4288.21	0.00
2010-11	715.99	681.96	3182.41	1588.81	1588.81	209.93	832.87	717.99	1221.77	0.00
2011-12	717.99	832.87	5487.71	1588.81	1588.81	182.22	267.74	708.57	4291.82	0.00
2012-13	708.57	267.74	4821.76	1588.81	1588.81	187.93	600.02	715.10	2512.50	0.00
2013-14	715.10	600.02	3266.24	1588.81	1588.81	189.59	828.23	717.94	1280.84	0.00
2014-15	717.94	828.23	2546.54	1588.81	1588.81	189.41	609.17	715.23	977.38	0.00
2015-16	715.23	609.17	2880.69	1588.81	1588.81	181.00	482.56	712.90	1087.47	0.00
2016-17	712.90	482.56	1840.49	1588.81	1588.81	159.85	289.71	709.21	264.70	0.00
2017-18	709.21	289.71	3012.56	1588.81	1588.81	181.89	635.90	719.18	616.67	0.00
2018-19	719.18	635.90	1902.43	1588.81	1588.81	181.86	307.97	709.74	759.70	0.00
2019-20	709.74	307.97	5377.64	1588.81	1588.81	175.88	387.93	710.98	3553.50	0.00

Working Tables for Gatti Basavanna Reservoir

Jun-Oct 3221.64 Nov-May 3078.36 Total 5300 Mcft — Average Deficit= -50.615908 Mcft
Success Rate 91 75% dep 5300 90%dep 5300 Mcft
Drinking, TFS, Indus. & Env Demand 5300 Mcft — Gross Storage Capacity 6036 Mcft — FRL 618.00 Mcft
MDDL Drinking 598 380.76 Mcft — MDDL Other 598.00 380.76 Mcft

Year	Markandeya +Ballari Surplus	GBD Catchment Independent Inflow	Year	Opening RL	Opening Capacity	GBD Catchment Combined Inflow	Drinking, TFS, Indus. & Env Demand	Issue for Drinking, TFS, Indus. & Env Demand	Evaporation Losses Qty	Closing Capacity	Closing RL	Surplus	Drinking Deficit
	Mcft	Mcft		m	Mcft	Mcft	Mcft	Mcft	Mcft	Mcft	m	Mcft	Mcft
	1 = A + B	2	3	4	5	6 = (1+2)	7	8	10	11	12	13	14
1985-86	5361.25	786.05	1985-86	568.00	380.76	6177.30	5300.00	4746.27	187.67	1624.12	567.54	0.00	-583.73
1986-87	8450.61	1282.49	1986-87	567.54	1624.12	7733.10	5300.00	5300.00	255.02	2954.59	603.24	347.61	0.00
1987-88	3229.94	2025.59	1987-88	600.24	2954.59	5255.54	5300.00	5300.00	232.10	2682.03	598.04	0.00	0.00
1988-89	10696.19	2893.15	1988-89	598.04	2682.03	13589.34	5300.00	5300.00	280.11	2866.28	597.90	6845.06	0.00
1989-90	9460.36	3169.42	1989-90	597.90	2866.28	12629.80	5300.00	5300.00	257.02	3232.44	602.35	6536.53	0.00
1990-91	7344.36	1014.62	1990-91	602.35	3232.44	8359.25	5300.00	5300.00	270.73	3197.82	602.19	2292.14	0.00
1991-92	12299.99	4428.50	1991-92	602.19	3197.82	16728.49	5300.00	5300.00	273.76	2798.48	598.86	11556.27	0.00
1992-93	9285.96	2571.82	1992-93	598.86	2798.48	8857.57	5300.00	5300.00	268.22	3039.12	600.90	3646.72	0.00
1993-94	8961.02	2853.20	1993-94	600.90	3039.12	11814.23	5300.00	5300.00	273.54	3133.31	601.52	6195.40	0.00
1994-95	14140.85	1887.86	1994-95	601.52	3133.31	16028.71	5300.00	5300.00	276.57	2949.83	600.21	10635.62	0.00
1995-96	4092.01	1381.96	1995-96	600.21	2949.83	5474.98	5300.00	5300.00	249.41	2875.28	599.82	0.00	0.00
1996-97	7310.96	3338.86	1996-97	599.82	2875.28	10649.83	5300.00	5300.00	259.96	2827.83	599.23	5137.52	0.00
1997-98	19272.25	6998.93	1997-98	599.23	2827.83	25265.18	5300.00	5300.00	282.09	3148.11	601.67	19378.62	0.00
1998-99	10275.40	4296.09	19990	601.12	3067.55	14571.48	5300.00	5300.00	267.13	2828.35	599.24	9243.50	0.00
19990	15110.15	6265.92	2000-1	599.24	2828.35	9032.00	5300.00	5300.00	245.25	2823.91	599.20	1091.10	0.00
2000-1	9748.44	1757.17	2001-2	599.20	2823.91	4988.25	5300.00	5300.00	321.66	2290.49	594.56	0.00	0.00
2001-2	3018.84	1968.41	2002-3	594.56	2290.49	4683.20	5300.00	5300.00	193.84	1480.06	585.79	0.00	0.00
2002-3	3519.91	1163.29	2003-4	585.79	1480.06	7221.29	5300.00	5300.00	247.17	2879.15	598.85	325.03	0.00
2003-4	9080.70	1198.59	2004-5	598.85	2879.15	14619.19	5300.00	5300.00	271.13	2788.73	598.82	9138.46	0.00
2004-5	16110.15	6265.92	2005-6	598.82	2788.73	22396.07	5300.00	5300.00	270.52	3263.44	602.58	16356.84	0.00
2005-6	9748.44	1757.17	2006-7	602.58	3263.44	11505.61	5300.00	5300.00	270.45	2811.89	597.44	6697.01	0.00
2006-7	11262.43	5692.80	2007-8	597.44	2811.89	16955.23	5300.00	5300.00	277.97	3558.41	604.67	10438.35	0.00
2007-8	7722.24	1913.83	2008-9	604.67	3558.41	9636.16	5300.00	5300.00	281.09	2868.58	599.57	4804.92	0.00
2008-9	14592.75	1445.06	2009-10	599.57	2868.58	21537.83	5300.00	5300.00	274.19	2967.76	600.35	15965.44	0.00
2009-10	5588.64	2587.19	2010-11	600.35	2967.76	8173.83	5300.00	5300.00	270.83	3427.42	603.76	2143.34	0.00
2010-11	15004.99	6313.30	2011-12	603.76	3427.42	21317.89	5300.00	5300.00	271.20	2948.84	597.98	10534.67	0.00
2011-12	9460.73	4233.86	2012-13	597.68	2948.84	12694.38	5300.00	5300.00	264.18	3214.44	602.22	6495.80	0.00
2012-13	4761.68	1938.21	2013-14	602.22	3214.44	6541.19	5300.00	5300.00	251.67	3189.51	602.04	1214.45	0.00
2013-14	4579.49	3804.67	2014-15	602.04	3189.51	8384.16	5300.00	5300.00	282.43	3582.87	604.83	3436.57	0.00
2014-15	2362.16	1073.34	2015-16	604.83	3582.87	3435.50	5300.00	5300.00	191.84	1539.33	586.37	0.00	0.00
2015-16	3053.34	1161.84	2016-17	586.37	1539.33	4216.98	5300.00	5216.84	146.47	378.00	567.94	0.00	-83.16
2016-17	2062.12	2586.40	2017-18	567.94	378.00	4587.53	5300.00	4155.20	123.54	656.59	573.95	0.00	-1134.76
2017-18	4650.51	981.18	2018-19	573.56	656.59	5641.69	5300.00	5300.00	162.32	836.06	576.62	0.00	0.00
2018-19	15246.02	6086.79	2019-20	576.62	836.06	22143.91	5300.00	5300.00	253.74	2931.90	603.07	14483.97	0.00
			50% dep			8857.57	5300.00	5300.00	281.99			3646.72	
			65% dep			7686.92	5300.00	5300.00	253.53			1883.52	
			75% dep			6359.25	5300.00	5300.00	245.21			162.51	
			90% dep			4885.22	5300.00	5300.00	189.34			0.00	
			Average			11095.97	5300.00	5249.38	246.78			5526.91	

5.5 Working Tables

1. Combined working tables of the three dams for 35 years from 1985-86 to 2019-20 were prepared after aggregating the daily runoff values to 10-daily periods (rainfall data from January to May 2020 are not available and flow was assumed to be zero for these months).
2. The utilisations for Markandeya dam and Ballari Nala dam were taken from their DPR's.
3. Ghatti Basavanna releases for drinking, industrial and Tank filling and environmental flows were taken as 5.3 TMC distributed uniformly through the year.
4. Evaporation rates were taken from Markandeya dam working tables and applied for the Bellary Nala.
5. Evaporation rate is computed on basis of IMD Agroclimatic Zone data for Ghatti Basavanna dam.
6. Inflows to Ghatti Basavanna dam were calculated by adding the surplus from Markandeya and Ballari Nala dams to the independent catchment runoff.
7. The combined 10-daily working tables of all three reservoirs are annexed in two Excel files named Markandeya and Ballari Nala WT, and Ghatti Basavanna WT (Volume-2).
8. The Annual abstract of working tables of all three reservoirs are annexed-1 Markandeya and Ballari Nala WT, and Ghatti Basavanna WT.

5.5.1 Storage Capacity and FRL of Ghatti Basavanna Dam

The storage capacity of Ghatti Basavanna dam should be such that it is sufficient to ensure that 5.3 TMC of water is released at 90% dependability. In addition, it is desirable that in at least 50% of the years, about half of this quantity is available in the reservoir at the end of May since the area is drought prone and has experienced frequent distress in the summer months. After a few trials, it was found that both these conditions can be met with a storage capacity of 6.036 TMC. This corresponds to an FRL of 618.000 m. Annual abstracts of the working tables are presented in Table 6, and show that 5.3 TMC can be supplied at 91.4% dependability, and in 50% of the years the reservoir level at the end of May is 597 m, which corresponds to a storage of 2.56 TMC.

The combined 10-daily working tables of all three reservoirs are annexed in two Excel files named Markandeya and Ballari Nala WT, and Ghatti Basavanna WT.

5.6 Design Flood

The design flood for two of the dams in Markandeya basin are as follows:

Dam	Catchment Area	Design Flood
Markandeya	432 Sq Km	3728 cumecs
Ballari Nala	258 Sq Km	1784 cumecs

In this Feasibility Report, design flood for the Ghatti Basavanna Dam is calculated corresponding to the above two dams by assuming that flood peak Q varies as the two-thirds power of the catchment area A, i.e., Q = CA2/3. Hence C = Q/A 2/3. From the above data, the value of C for Markandeya Dam = (3728/432) 2/3 = 65.24, and that for the Ballari Nala Dam is (1784/258) 2/3 = 44.02. The average value of C is thus (65.24 + 44.02)/2 = 54.63. This is taken to be valid for the whole catchment of Ghatti Basavanna Dam. Thus, Design flood of Ghatti Basavanna Dam = 54.63 × 1016 2/3 = 5521 cumecs.

Table 5.6::Comparison Annual Abstracts of Ghatti Basavanna Reservoir Working Tables

Year	Inflow	Opening RL	Opening Storage	Inflow	Drinking & Environ	Evaporation	Closing Storage	Closing RL	Surplus	Drinking Deficit
	Mcft	m	Mcft	Mcft	Mcft	Mcft	Mcft	m	Mcft	Mcft
1985-86	796	568.000	381	6177	4746	188	1624	587.544	0	-553.73
1986-87	1282	587.544	1624	7733	5300	255	2955	600.244	848	0.00
1987-88	2030	600.244	2955	5260	5300	232	2682	598.037	0	0.00
1988-89	2893	598.037	2682	13589	5300	260	2666	597.903	8045	0.00
1989-90	3169	597.903	2666	12630	5300	257	3232	602.353	6507	0.00
1990-91	1015	602.353	3232	8328	5300	271	3198	602.097	2792	0.00
1991-92	4429	602.097	3198	16728	5300	274	2796	598.983	11556	0.00
1992-93	2572	598.983	2796	8858	5300	268	3039	600.900	3047	0.00
1993-94	2853	600.900	3039	11814	5300	274	3133	601.616	6146	0.00
1994-95	1888	601.616	3133	16029	5300	277	2950	600.207	10636	0.00
1995-96	1382	600.207	2950	5475	5300	249	2875	599.617	0	0.00
1996-97	3339	599.617	2875	10650	5300	260	2828	599.234	5138	0.00
1997-98	5993	599.234	2828	25265	5300	282	3140	601.666	19371	0.00
1998-99	2722	601.666	3140	7940	5300	274	3068	601.117	2439	0.00
1999-00	4296	601.117	3068	14571	5300	267	2828	599.240	9244	0.00
2000-01	2898	599.240	2828	6632	5300	245	2824	599.204	1091	0.00

Year	Inflow	Opening RL	Opening Storage	Inflow	Drinking & Environ	Evaporation	Closing Storage	Closing RL	Surplus	Drinking Deficit
	Mcft	m	Mcft	Mcft	Mcft	Mcft	Mcft	m	Mcft	Mcft
2001-02	1969	599.204	2824	4988	5300	222	2290	594.562	0	0.00
2002-03	1163	594.562	2290	4683	5300	194	1480	585.793	0	0.00
2003-04	1191	585.793	1480	7271	5300	247	2879	599.648	325	0.00
2004-05	1763	599.648	2879	14619	5300	271	2789	598.919	9138	0.00
2005-06	6286	598.919	2789	22396	5300	271	3263	602.581	16351	0.00
2006-07	1757	602.581	3263	11506	5300	270	2612	597.440	6587	0.00
2007-08	5693	597.440	2612	16955	5300	277	3559	604.671	10430	0.00
2008-09	1814	604.671	3559	9536	5300	261	2870	599.572	4665	0.00
2009-10	7445	599.572	2870	21638	5300	274	2968	600.347	15965	0.00
2010-11	2587	600.347	2968	8174	5300	271	3427	603.757	2143	0.00
2011-12	6313	603.757	3427	21318	5300	271	2640	597.682	16534	0.00
2012-13	4234	597.682	2640	12634	5300	264	3214	602.220	6496	0.00
2013-14	1839	602.220	3214	6541	5300	252	3190	602.036	1014	0.00
2014-15	3805	602.036	3190	8384	5300	282	3583	604.829	2409	0.00
2015-16	1073	604.829	3583	3436	5300	192	1526	586.365	0	0.00
2016-17	1162	586.365	1526	4215	5217	146	378	567.936	0	-83.15
2017-18	2505	567.936	378	4568	4165	124	657	573.565	0	-1134.70
2018-19	981	573.565	657	5642	5300	162	836	576.625	0	0.00
2019-20	6897	576.625	836	22144	5300	254	2932	600.067	14494	0.00
50% dep	**2572**			**8858**	**5300**	**261**			**3047**	**Ave= 47**
65% dep	**1837**			**7687**	**5300**	**254**			**1084**	
75% dep	**1570**			**6359**	**5300**	**246**			**163**	
90% dep	**1109**			**4805**	**5300**	**189**			**0**	

Chapter 6
Hydro Geology

6.1 Hydro Geological Setup

Water table generally follows the topography of the area and is at greater depths in the water divides and topographic highs, but becomes shallower in the valleys and topographic lows and therefore, groundwater moves down and follows the gradient from the higher to lower elevations, that is, from recharge area to discharge area. Therefore, locally direction of flow from higher elevations is towards the rivers. Overall, the general flow direction of ground water in the district is generally towards the east. The district is underlain by gneisses, schist, limestone, sandstone, basalts, alluvium etc. of Archaean to Recent age. Deccan basalts cover an area of 7,650 Sq.Kms. in the northern part of the district and have a maximum thickness of around 256 m, which gradually thins out in the southern direction. Exploratory drillings were carried out to study the yield potential of fracture systems. The hydrogeology of the district is depicted in **Figure 6.1**. Hard rocks occupy a major part of the district; majority of which are basaltic lava flows. Most of these rocks have poor capacity of storing and transmitting water, except through favourable zones and at favourable locations. Aquifer systems encountered are therefore limited in nature.

Ground water occurs both in weathered and fractured zones. Ground water occurs in all weathered formations. of the district under phreatic conditions and in fractured and jointed formations under semi-confined conditions. Deccan basalts act as a multilayer aquifers having low to medium permeability. In Deccan basalts that comprise different flows, fractures and interstitial pore spaces of vesicular zones, are good repositories of ground water. Groundwater occurs under phreatic conditions in weathered zone of these basalts and under semi-confined to confined conditions in inter-trapeans and also in joints and fractures at deeper levels. In limestone, solution cavities are considered to be more potential than weathered and fractured ones. In gneisses and schist, weathered zone varies from 7 to 12 m and water-bearing zones extend down to 80m. The aquifers occurring within the shallow depth range of 0 to 20 m bgl are mainly weathered and fractured formations. Groundwater occurs in these formations under phreatic conditions and the average thickness of these aquifers ranges from 5 to 15m. In general, 60% area of the district is having the weathered thickness in the range of 5 to 10 m. About 25% of the district area has weathered thickness in the range of 10 to 15m and 15% in the range of 15 to 20m. The depth to water level in the district during pre-monsoon period i.e. May 2011 ranged from 0.89 to 18.35 mbgl. Out of 70 nos. of wells monitored for water level, it is seen that 5.7% wells showed a water level less than 2 m., 27% wells had water level in the range of 2 to 5 m., 48.6% wells had

water level between 5 to 10m. And the remaining 18.6% wells had water levels in the range of 10 to 20 mbgl. During the post monsoon period, i.e. Nov 2011, the depth to water level in the district ranged from 0.81 to 12.78mbgl. Out of the 70 nos. of wells monitored, the depth to water level was less than 2m in15.71% wells, 2 to 5m in 40% wells, 5 to 10m in 35.7% wells and 10 to 20m in the remaining 8.6% wells. To know the long term changes in the water levels in the district, the depth to water level during pre- and post- monsoon period of 2011 in the district was compared with the mean water level of the preceding decade. The change in water level during May 2011 as compared with the mean pre monsoon water levels of the preceding decade.It is seen that out of 68 wells for which water levels were compared, 64.7% wells showed a rise in water level and the remaining 35.3% wells showed a fall in water level as compared to the preceding decade. In the rise category, 45.58% wells showed a rise in the range of 0 to 2m, 17.64% wells showed a rise of 2 to 4m and 1.47% wells recorded a rise of >4m. In the fall category, a fall in water level in the range of 0 to 2m is seen in 26.47% wells, fall of 2 to 4m is seen in 7.35% wells and a fall of >4m is seen in 1.47% wells.

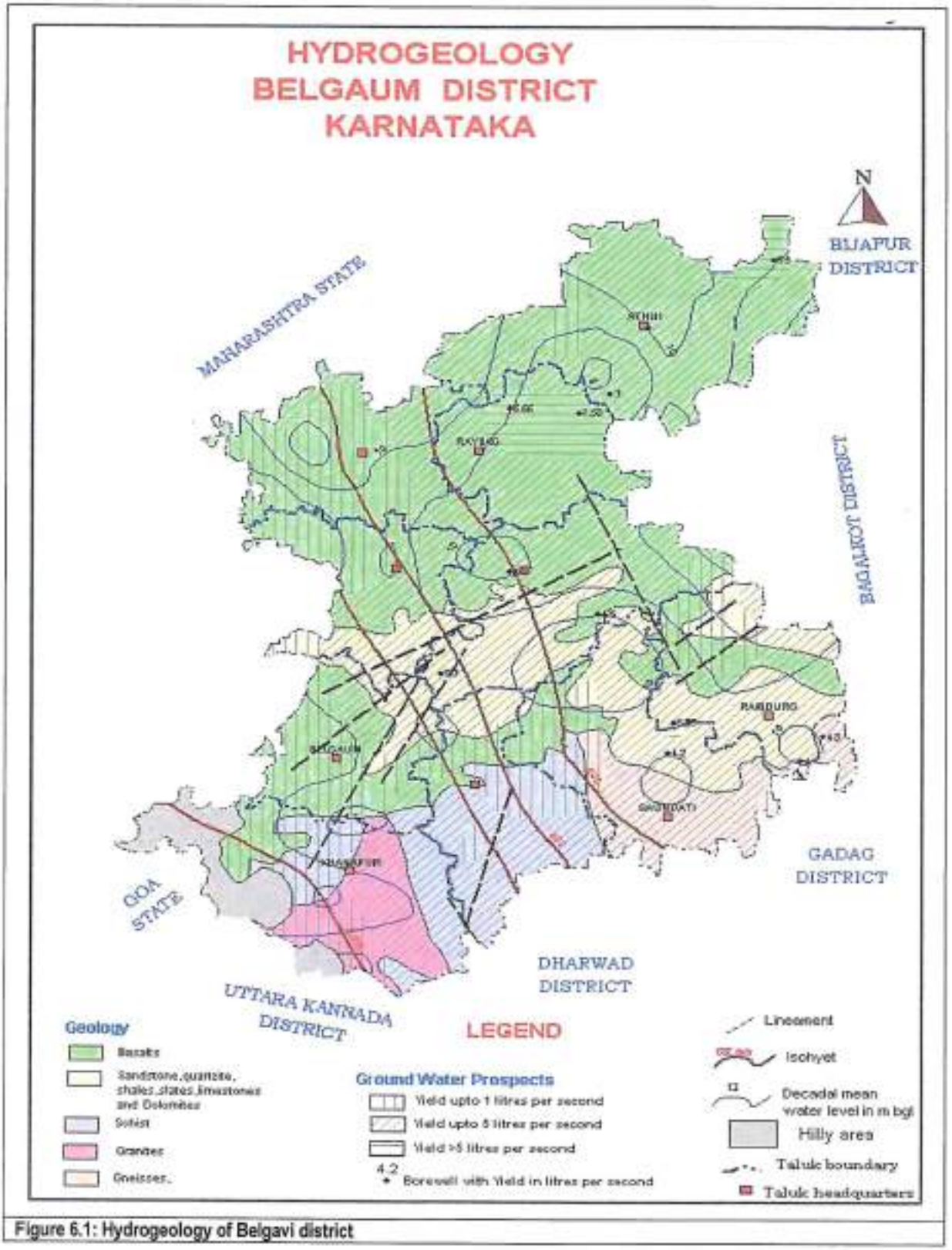


Figure 6.1: Hydrogeology of Belgavi district

6.2 Ground Water Resource Availability

The resource estimation and categorization is carried out as per the recommendations of 'Ground Water Estimation Methodology – 97 ' (GEM – 97) considering water shed as a unit. Water shed and hydrological boundaries do not match with the administrative boundaries. As a result different parts of taluk fall in different watersheds having different stages of ground water development and categorization. However for administrative convenience talukwise data is preferred. Hence talukwise resource and average stage of development is computed on prorata basis from watershed data and presented in table 7. Resources estimated are as follows: 1. Net Ground water availability = 1,13,799 ham 2. Total Draft = 1,21,866 ham 3. Groundwater availability for future irrigation = 19,941 ham Areas falling in different categories of stage of development in the district. It is seen from the figure that in the entire district, only in Khanapur taluk 100% taluk area falls in 'safe' category followed by Belgaum taluk, in which about 91% of the area is in the safe category, bothe of which receive high rainfall. All the remaining taluks are at different states of high stage of development. While Chikkodi and Hukkeri taluks have about 50% of the area under critical /Over Exploited (OE) stage, all the remaining taluks have more than 70% of the taluk areas under critical / OE categories. Major portions of the taluks under very high stage of ground water development in the district is seen in Athani, ramdurg and Bailhongal taluks.

6.3 Ground Water Development Prospects

6.4 Anticipated Behavior of Ground Water on Downstream After Implementation of the Project

The project development and the creation of reservoir due to impounding of water u/s of dam could lead to substantial increase in the ground water table around the nearby reaches of the Reservoir which in turn benefit the people.

6.5 Quality of Ground Water

The analyses of groundwater samples of the district between 2005 and 2007 revealed that the groundwater quality was in general found to be potable in nearly half of the district. It was also found suitable for irrigation purposes in the major parts of the district (**Figure 6.2**) Drinking water: It is essential to know the quality of water as it affects the health of those who consume it. Therefore, quality of groundwater was compared with BIS standards and parameters like Chloride, nitrate, pH and fluoride were evaluated. Chloride concentrations in general are within permissible limits i.e. 1,000mg/l in the district. Gokak (2,691mg/l) is the only station where chloride concentration is more than permissible

limits. Though major part of the district have chloride concentration within desirable limits i.e. less than 250mg/l, isolated patches of higher concentration but below permissible limits i.e.

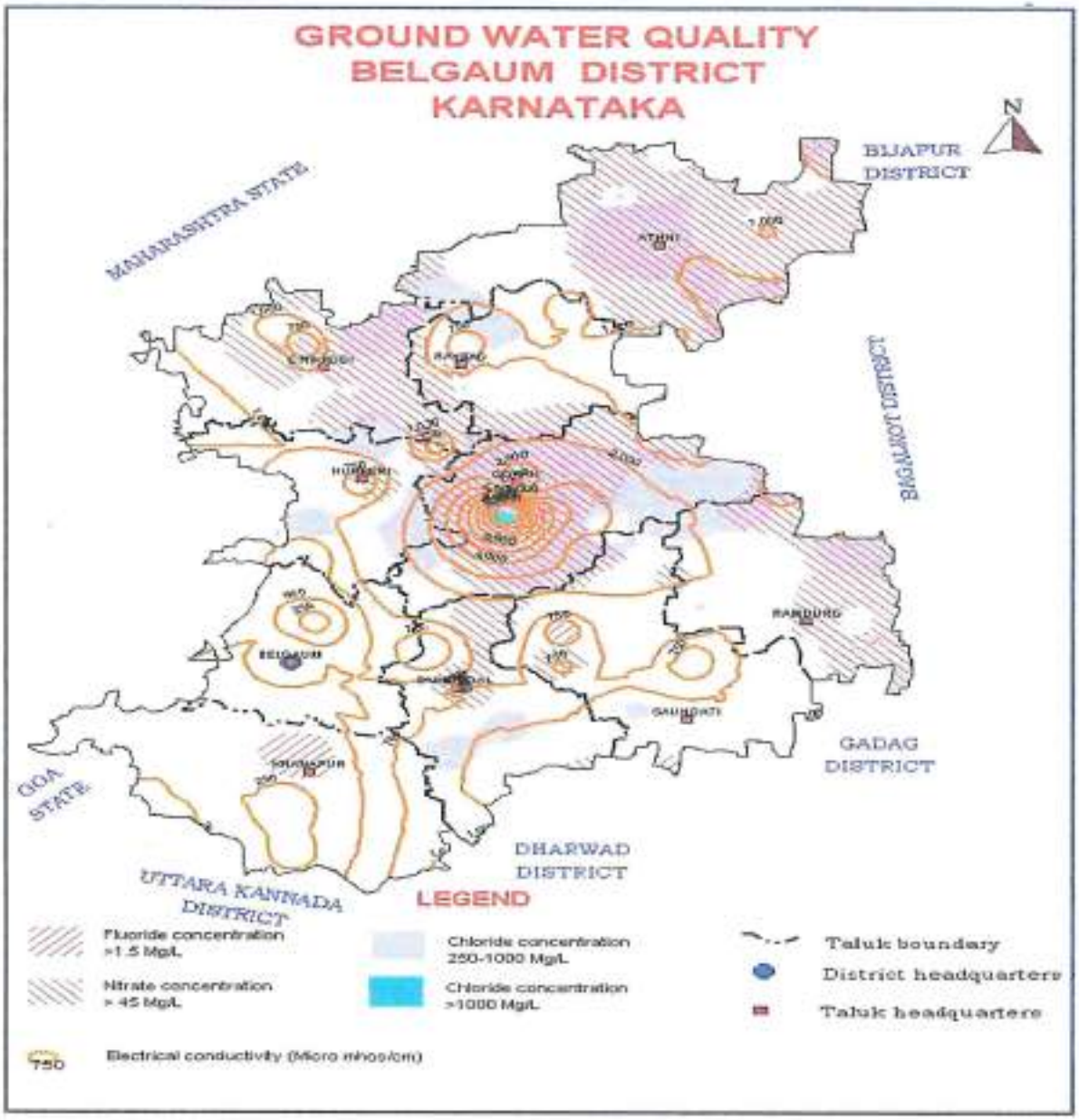


Figure 6.2:Groundwater quality of Belgavi District

6.6 Proposal of Conjunctive Use of Surface Water

The present project doesn't envisage conjuctive use of surface water.

Chapter 7
Design Features and Criteria for River Valley Structures

7.1 Structure and Development

7.1.1 General Brief

Based on the topographical survey of the dam site covering U/S and D/S including submergence area required base map and sections have been generated. Detailed longitudinal sections and cross sections are prepared for the Dam site. Site survey plan for a length of 500 m upstream from the existing MI barrage and downstream is prepared and used for developing the master plan. Available data and information has been compiled to prepare the capacity contours and storage capacity tables.

a) Reasons for Choice of Layout

The dam is located about 500 m u/s of the existing MI barrage and is called Ghatti Basavanna site. The present location identified is free from major faults. Requirement of grouting is minimum. In addition, a head of 10 to 12 m is available in view of the natural narrow gorge present at the site. There is scope to generate relatively cheap hydro power by utilizing the available head, and river flows during monsoon months.

b) Type of Structure

As per the assessment of the geological aspects by geologist from surface geological features and bore hole data bed rock is available at dam site: The bed rock is exposed at and above EL 590.00 m on both the banks/abutment side. The bed rock is also exposed at and around FRL/dam top levels. The remaining abutment slope below down upt to river bed portion is generaly devoid of rock exposures and covered with overburden deposites mainly consisting of slope wash/talus/detritus material having more of angular sandstone fragments along with loose sandy/silty soil matrix. The thickness of thses deposits is expected to vary from 3.0 m to 5.0 m on the abutment slope.

The river bank and bed portions are mainly covered with depositional material/River borne material (RBM) having fine/ silt and clay rich soil with boulders and cobbeles, pebbles etc. The thickness may vary from 1.5 m to 3 m along the river banks and in the river bed portion, it may vary around 4 m to 6 m. Pockets of deeper (6-7 m) can also be expected. Accordingly the rock level is available at 4 to 6 m from the existing river bed level the minimum river bed level is taken as EL - 547.706 m and the foundation levls of the overflow portion in the deepest section is fixed at EL-534.500 m.

The Geotechnical investigation has indicated presence of sandstone, quartzite bed rock belonging to Kaladgi formation whuich is the prominent rock in and around the project site. The sandstone at the project site is fine to medium grained, massive, thickly bedded formation. Even though it is metamorphosed quartzitic sandstone but, because of several sedimentary rock characteristics and as commonly referred here, this is termed generally as sandstone in this report. Besides sand stone/quartzite, exposure of gneiss rock is also observed on the left bank of the river upstream of dam axis. Geologically, the identified location provides excellent conditions to have gravity structure since presence of good quality rock is reported closure to surface and hence gravity dam is recommended.

7.1.2 Geology, Seismisity and Foundation - Brief

The Karnataka state where the proposed project is located is exposed with oldest rocks dating back to about 3300 million years. The Precambrian Craton of Karnataka is made up of western and eastern segments. The Precambrians of Karnataka have been divided into older Sargur supercrustals and younger Dharwar supercrustals. The eastern Karnataka abounds in these granites and granitoids. The northern part of Karnataka is made up of Kaladgi and Badami and Bhima Group of sediments, approximately of Proterozoic age. Further north, the terrain is covered by extensive volcanic flows known as Deccan traps of Cretaceous - Tertiary age. Significantly, about 60% of the state is composed of the Archean complex which consist of gneisses, granites and Charnokites rocks considered as shield, stable rock formations.

The project site comprise of strong rocks that belong to Kaladgi formation The Project area falls under seismic Zone-III as per the seismic zoning map of India published in IS: 1893-1993.

The proposed dam foundation are on Hard rock. Foundation treatment such as Consolidation and curtain grouting is proposed to make the foundation strong and water tight and reduce seepage through or from the dam foundation.

7.1.3 Alternative Studies Carried Out for Selection of Site

As narrated in Chapter 4.0, three locations have been identified namenly Alternate 1 , Alternate 2 and Alternate 3 for the construction of storage dam with a storage capacity of about 6 TMC. The length of dam at these dam sites are shown in **Table 7.1**

Table 7.1: Alternative Studies Carried out for the Selection of the Dam Site

Alternate	Dam Length / River width at (in m)		Remarks
	At FRL (EL-618.000 m)	At Top (EL-621.000 m)	
1	450.000	480.000	Near the existing MI barrage
2	380.000	415.000	150 m U/S of existing MI barrage
3	407.500	427.500	500m U/S of existing MI barrage

7.1.4 Final Layout of all Major Components

The Government of Karnataka accepted the following proposal for implemenatation.

Construction of Ghatti Basavanna Drinking water dam Project with FRL at EL 618 m (with a free board of 3 m and storage capacity of 6.04 TMC annually).

The dam can be utilized for the main purpose of the drinking water supply to Gokak town and other nearby needy areas and also to supply water for industrial purpose including tank filling (Selected tanks).

7.1.5 Design Flood and Sediment Studies - Brief

Refer Chapter 5.

7.1.6 Freeboard

As per IS 6512:1984 , freeboard is calculated and provided.

7.1.7 River Diversion Arrangements

The construction programme envisaged for construction of dam and related structures is 18 months including monsson from the zero date. The execution will be taken up at multiple location of the dam layout in order to complete all activities in the scheduled completion period of 18 months. During 1st phase of the working period, diversion of river for the construction activity is planned by constructing diversion bunds and rising the dam height to the maximum extent possible including the abutment blocks which are above the maximum flood levels. At the end of the working season of the phase-1, even during monsoon period it can be planned to rise dam blocks on the right side so that these constructed river bed blocks can be used to pass monsson floods over them. By the end of second phase, river bed block and non overflow blocks on both the bank can be planned to be raised to higher levels. The two river sluice/ scouring sluices can be used to pass the flows in the river.

7.1.8 Construction Materials - Brief

Refer Chapter 15, para 15.2

7.1.9 Model Studies

Since it is a high dam,it is necessary to conduct hydraulic model studies regarding spillway discharging capacity and energy dissipating arrangements.

Model studies is under progress at KERS, Mysore. The required data and information has been furnished to KERS, Mysore for conducting Hydraulic model studies (Spillway and Hydraulic jump).

The project proponents have also submitted all the required details including the reports to CWPRS, Pune to undertake

- Site specific seismic study
- 3D & 2D Stress analysis by FEM Method

Hydraulic model studies for river/scouring sluice.

7.2 Dam

7.2.1 Embankment Dam

Not Applicable

7.2.2 Concrete Gravity Dam

A dam across Markandeya River is proposed near Ghatti Basavanna to store water to meet the drinking water requirement. The height of the dam is 86.5 m with an FRL head of 71.00 m. Hard rock is met throughout the dam alignment. As the rock is met at the reasonable depth in the river bed as well as in banks, concrete gravity dam is suitable and hence the same is considred .

- The maximum height of the dam is 86.5 m.
- The catchment area at the dam site is 1016 Sq Km.
- The maximum flood discharge is estimated to be 5,525 Cumecs.
- High Ogee spillway is proposed to realize high coefficient of discharge.
- 5 gates of 15.0 m x 10.5 m are required to pass the design discharge of 5,525 cumecs at FRL. Additional number of gates to an extent of 10 % are to be provided to account for mechanical failure. As such 6 gates of 15.0 x 10.5 m are proposed.

- Radial gates are proposed with sill at a little lower than the spillway crest. This is kept 0.35 m below crest. The trunnion level is proposed at 610.50 m. The radius of the gate is 11.50 m which will provide sufficient clearance with respect to flow profile for maximum flood discharge design.
- The downstream barrage is located about 500 m from the dam axis such that the arrangement doesn't affect the operation of the radial gates.
- Stop log gates are also proposed on upstream side of the radial gates. Gate grooves are proposed for all the vents in the piers. The stop log gates will be in elements for easy operation and lower hoist capacity Since there are only 6 radial gates it is proposed to have one sets of stop log gate.
- Gantry crane of adequate capacity has also been provided. This helps in inserting and removing the stop log gate elements.
- The total length of the dam is 407.50 m which comprise spillway of 112.50 m, NOF of 185.00 m on right flank and 110.00 m on left flank.
- As per the codal recommendation, galleries are to be provided where the height of dam is more than 10 m. For the dams where the height is much more, galleries may be in 2 or 3 tiers. In this case as the height of the dam is 86.5 m, Galleries are proposed in 3 levels. The first gallery (inspection gallery) is proposed at EL - 592.75 m. An intermediate inspection cum grouting gallery is proposed at EL - 558.75 m and another inspection cum grouting gallery is proposed at EL – 542.00 m.
- The Dam is analyzed as Gravity section for following conditions as per BIS Code 6512-1994.

    1. Load combination A – Reservoir Empty
    2. Load combination B – Reservoir Full upto FRL with no tail water
    3. Load combination C – Maximum Flood discharge condition
    4. Load combination D – Combination A with Earthquake condition
    5. Load combination E – Combination B with Earthquake condition
    6. Load combination F – Combination C with extreme uplift(Drains inoperative)

7. Load combination G – Combination E with extreme uplift(Drains inoperative)

- The area falls under Zone III, where the basic seismic coefficient αh is 0.04. With importance factor of 3.00, the seismic coefficient becomes, αh = 0.012. Vertical component to an extent of ½ αh , i.e., 0.06 is considered.
- Rocky strata is available and hence hydraulic jump type stilling basin with horizontal apron is proposed for energy dissipation. However as this is a major structure, model studies will be conducted for its suitability and configuration befor implementation.
- Free board in the dam is given to cater for wave height and wave wash. The wave height is calculated as per IS 6512:1984 considering the submergence area. The free board works out to 2.07 m. Accordingly the top of the dam is proposed at RL 621.000 m
- The analysis of the dam is done to determine the factor of safety against sliding. In the formula, factors like Cohesion of the material at the plane is considered and coefficient of internal friction of the material is also considered as per geologist the value of C=30.6 tonne/m^2 and $\Phi=40^0$. In the preliminary designs these values are assumed based on the results of other projects. However before finalization, its in-situ foundation rock C and Φ values are assessed by field tests on exposed foundation grade rock. Therefore field tests will be carried out to determine the actual values for C and Φ which shall be adopted in the final design.
- Vertical lift tower and adits are proposed to facilitate access to the main gallery.
- The structural design of gallery is done as per IS:12966(part-01)-1992 considering it as an opening in gravity mass. The size of the gallery provided is 2 m X 2.5 m and all the approach galleries are also of the same size and cross galleries are provided to interlink the intermediate galleries.
- As it is a high dam, instrumentation is also proposed to assess the stress, strain, deflection etc.
- Foundation treatment is also proposed.
- Consolidation and curtain grouting is proposed to make the foundation string and reduce seepage losses.

7.2.2.1 Non Overflow Section – Design Criteria

The non-over flow section on the left flank is proposed from Ch: 0+044 to Ch: 0+154. and on the right flank it is proposed from Ch:0+266 to 0+452 (Tentative). Stability analysis of the section has been done for the following conditions of loading

- considering full uplift at the u/s heel reduced by 2/3rd of the head at the line of drains and to zero at the d/s toe of the dam. The uplift pressure is assumed to be acting over the acting on 100% of the base area.
- Seismic co-efficient αh = 0.012 corresponding to Zone III is considered in the design.

The base width proposed is 70.058 m at the maximum section. The section is checked at various levels i.e., 534.500 m and 543.25 m. The stresses developed are tabulated and enclosed.

2 m thick rich concrete surface layers of M30 grade on the U/S face with 1 m thick and base of the dam is proposed to achieve imperviousness.

7.2.2.2 Spillway – Design Criteria

The Catchment area at dam site is. 1,016 Sq.kms. The maximum flood discharge is 5,525 cumecs. High Ogee profile with radial gates is proposed for disposing the flood. The flood depth considered over the spillway crest is 10.5 m. 6 gates of 15 m x 10.5 m with 5 piers of 3.5 m thickness and 2 abutments on either side are provided including one gate as standby. Two nos. sluices of vent size 1.5 m X 2.25 m is provided inside the body of overflow section of the dam . The total length of the spillway between abutments to abutment is 107.50 m. Details of the spillway are as under:

a)	Max discharge	5525 cumecs (1,95,110 cusecs)
b)	No. of gated Span for spillway	6
c)	Type of gate	Radial
d)	Crest level	607.50 m
e)	FRL/ MWL	618.00 m
f)	Top of Dam	621.00 m
g)	Thickness of pier	3.5 m

7.2.2.3 Spillway Section

The base width proposed for the Spillway blocks of the dam is 70.058 m. The section is checked at deepset foundation level in the river bed at EL 534.500 m. The stresses developed are tabulated and enclosed. It is seen that there is no tension at the base of the spillway.

7.2.2.4 Transverse Contraction Joints

The length of left flank non-over flow dam is 80 m. The founding levels vary to a considerable extent based on the rock profile as given by the geologist and as per Codal recommendation, transverse contraction joints are provided at 18.5 m C/C in over flow section and @ 20 m spacing in non overflow section to suit the methods of construction, materials of the dam, and easy placement of the blocks to the local temperature condition.

7.2.2.5 Spillway Cap

Ogee shape is proposed for the spillway with U/S and D/S profile as recommended in IS 6934-1973, for high ogee overflow spillway. Piers are proposed at 15 m c/c with radial gates. For the control of the cracks in the spillway crest, crest reinforcement is provided both on U/S and D/S. as per IS-13551-1992 The crest reinforcement starts from EL-534.500 and along the periferi of the oggee spillway section upto the stilling basin junction of the D/S slope.

7.2.2.6 Pier

3.5 m thick RCC peirs with grooves for stop log gates and provision for hoisting arrangements for the operation of the radial gates is proposed .

The stability analysis of the pier is done as per IS-13551-1992 considering Zone-I, Zone-II and Zone-III above the crest level as given in the above mentioned IS.

7.2.2.7 Spillway Bridge

7.5 m RCC T-Girder bridge is proposed with 18.50 m span. Three longitudinal girders of 0.4 m x 1.125 m and four cross girders of 0.3 m x 1.0 m are proposed in one span. The total length of spillway is 107.50 m

7.2.2.8 Energy Dissipating Arrrangements

The FRL/MWL of the spillway is RL 618.00 m with the deepest bed level at RL 547.706 m. The maximum head will be 71.00 m. The discharge considered is 5,525 cumecs. The discharge per unit

length of spillway works out to 51.40 cumecs. The tail water level works out at D/S at a distance of 100 m from the dam axis for which the tail water level works out to 557.205 m

Since it is a high dam,it is necessary to conduct model studies for confirming the theoretical designs of energy dissipating arranements.

7.2.2.9 Training Wall

Training wall is designed for earth pressure by considering the following combination of loading.

Case A: No water in the River

Case B: Case A + Earth quake

Case C: Case B + Earth pressure due to backfill behind training wall

The stability analysis has been done considering the permissible stresses both in compression and tension, vide IS 12720:1993 for structural design of spillway training walls and divide walls.

7.2.2.10 Foundation Levels

The foundation levels proposed for various blocks in the Non Over Flow section and Over Flow section (Spillway) are furnished in the following table.

A) N.O.F - Left Flank

Sl No.	Block No.	Founding Level
1.	NOF-01	598.50 m to 586.50 m
2.	NOF-02	586.50 m to 575.50 m
3.	NOF-03	575.50 m to 562.00 m
4.	NOF-04	559.20 m to 545.70 m
5.	NOF-05	545.70 m to 537.20 m

B) Spillway

Sl No.	Block No.	Founding Level
1.	NOF /SPILLWAY-06	534.50 m
2.	SPILLWAY-07	534.50 m
3.	SPILLWAY-08	534.50 m
4.	SPILLWAY-09	534.50 m
5.	SPILLWAY-10	534.50 m
6.	SPILLWAY -11	534.50 m
7.	SPILLWAY /NOF-12	534.50 m

C) N.O.F - Right Flank

Sl No.	Block No.	Founding Level
1.	NOF-13	534.50 m to 546.20 m
2.	NOF-14	546.20 m
3.	NOF-15	549.00m
4.	NOF-16	549.00 m to 557.00 m
5.	NOF-17	557.00 m to 570.00 m
6.	NOF-18	570.00 m to 581.50 m
7.	NOF-19	581.50 m to 590.00 m
8.	NOF-20	590.00 m to 600.00 m
9.	NOF-21	600.00m

7.2.2.11 Gauge Well

A gauge well is proposed in block no 5 to measure the water level in the reservoir at any time. The gauge well will be abutting the upstream face of the dam.The gauge well proposed is of Perforated Mild steel having inner diameter of the gauge well is 0.50 m The top level of the gauge well will be at the top level of the dam i.e.RL: 621.000 m.

7.2.3 Opening Through Dam

a) **River Sluice/Scouring sluice:** 2 numbers of Scouring sluices of size 1.50 x 2.25 m are provided in Block No. 8 and 9 at an elevation EL-553.50 m for scouring of silt deposition.

2 numbers of River sluice of size 1.00 x 2.00 m are provided in Block No. 16 at an elevation EL-565.00 m to discharge minimum river flow during the non monsoon period into the river to maintain ecology of the D/S of dam.

b) **Galleries and Approach Adit Gallery :**

Gallery : As it is a high dam, galleries are proposed at three different levels viz, Drainage cum grouting gallery near the foundation about 2 m above foundation level all along the length of the dam. The foundation gallery level varies from EL-542.00 m to EL-598.925 m on the left flank in block no.-1 to EL-602.00 m on the right flank in block no. 21. Intermediate inspection gallery cum sluice gallery at EL 558.75 m and top Inspection gallery at EL 592.75 m. The three galleries are interconnected vertically. The size of the galleries are 2.0 m x 2.5 m.

A D/S foundation gallery of size 2.0 X 2.5 m, same as the other gallery is also proposed in the block no.4 to block no.12. these gallery is located 40 m D/S of the axis of the dam. These gallery is proposed to take care of uplift due to the tail water condition.

Approach Adit Gallery: Approch adit gallery of size 2.0 m X 2.5 m are provided at an elevation EL-566.00 on Left bank in NOF block no.17 and at elevation EL-566.00 on Right bank NOF block no.5 to approach the drainage gallery, instrumentation gallery and cross galleries from D/S away from the dam. Suitable approach roads shall be constructed at corresponding approach adit gallery levels for bringing drilling equipments and other mainatanance inside the drainage gallery.

7.2.4 Hydro-Mechanical Works (Gates, Type, Size and Hoist Arrangements)

6 nos of Radial gates of 15 m X 10.5 m height are proposed for the spillway to regulate the floods. The radius of the gate proposed is 11.50 .mtrs. The trunnion level kept at EL-610.50 m such that there is sufficient free board available for the trunion against the upper nappe created due to flood over the crest. Further trunion is located such that the tail water has no interfearance with the trunion operations during the flood and is seated well above the tail water eelevation. The gate seat level is EL-607.150 m. Sufficient clearance is ensured between the spillway bridge and the gate so that during the operation the spillway bridge will not inerfear with the gates. Rope drum hoist of suitable capacity (110 Tonnes.) is provided for the radial gate. Further Stop log gates are provided on U/S of radial gates for attending repairs and maintenance of the service gates during the regulation period or as necessary. These stop log gates are in 6 elements to minimize the lifting capacity of gantry crane, which is used or lifting the stop log. The stop log elements are suitabaly dogged by dogging arrangements over the peirs in each spillway vent.

Two numbers of scouring sluice gates having size 1.50 m X 2.25 m for each sluice (Service and Emergency gates) are operated by means of hydraulic hoist from the operation gallery located above the sluice barrel and at an elevation EL-558.75 mts in the overflow blocks of (Block-8 and Block-9). The size of the operation gallery 6.75 m (W) X 6.50 m (H).The operation gallery is connected to drainage gallery at EL-558.75 m for bringing materials machinery etc. through the Adit at an elevation EL-566.00 m for transportation and erection of gates and related components and also for the operation of the gates.

Refer **Appendix 6** for Designs.

7.3 Barrage

Minor Irrgation Department has constructed a barrage 500 m downstream of the proposed Ghatti Basavanna dam. Presently the barrage is in dilapidated condition and requires rehabilitation and strengthening. Releases for meeting the drinking water and other needs can be met through this barrage.

7.4 Canals

Not envisaged in the present proposal.

7.5 Canal Structures / Gates etc.

Not applicable.

7.5.1 De-Silting Arrangements

Not applicable.

7.6 Instrumentation for Dam

1. The instrumentation of the dam and monitoring and analysing the data obtained would help in understanding the structural behaviour of the dam and also help us to evaluate the assumptions made in the design of various components. The Ghatti Basavanna Dam being a high dam, 86.5 m, it becomes mandatory to provide instrumentation. Two blocks have been selected for instrumentation, namely one over flow block and one Non over flow block. The blocks selected for instrumentation are Block-11 and Block-5.
2. The various parameters proposed for measurement and evaluation are as below:
    a) Stresses in the body of the dam near the foundation.
    b) Strain meters in Rosette form to evaluate principal stresses-5 Strain meter Rosettes.
    c) Thermometers to measure the temperature in the body of dam.
    d) Joint meters: These are provided at the block joints to know the opening/closing of the joints.
    e) Uplift pressure cells near the foundation of the dam and also in the body of dam (at one level)
    f) Tilt meters to measure deflection of dam.
    g) Upright and Inverted pendulums to know the deflection of the dam and also the horizontal movement of the dam with respect to the foundation.

h) Foundation deformation meters to know the deformation or settlement of the foundation under hydraulic and dam loads.

3. To monitor the data from each instrument, read out units which are portable and data logger which is used for reading instrument data remotely are also proposed.
4. Provision for required cables are proposed.
5. Similarly Earthquake measuring instruments like strong motion accelerographs are also proposed.
6. In addition, provision is also made for automatic weather station and water level measuring equipment.

The Instruments proposed are of Vibrating wire type.

Layout of Instruments:

1. **Strain Meters:** Strain meters are arranged in groups of 5 in Rosette form the plane normal to the axis of dam. Three of them are arranged at 45° for measuring principal strains. The fourth one is for confirmation of the values obtained from first three. An additional strain meter provided in the plane parallel to the dam axis. These sets are provided one near the foundation.
2. **Stress Meters:** Stress meters, are provided near each group of strain meters for direct measurement of stress. The stress values thus obtained , help verify the stress values obtained from the strain meters.
3. **No-Stress Strain Meters:** The strain due to heat of hydration, shrinkage and hardening of concrete is also experienced in the dam in additional to the strain resulting from external loads, "No-stress" strain meters help to measure such strain. One "No stress" Strain meter is incorporated at a group of strain meters.
4. **Thermometers:** Thermometers are provided in a grid form for temperature measurement of the dam concrete. Thermometers are also provided for measurement of temperature of the reservoir water.
5. **Uplift Pressure Cells:** These instruments are used to measure the uplift pressures at the foundation and also to know in advance abnormality of the uplift pressure, if any.
6. **Rock Deformation Meters:** These are embedded at the foundation of the dam for measuring deformation in the foundation rock, if any.

7. **Normal Pendulum:** The normal pendulums, one each in blocks 10 and 12 are provided for measuring the deflection of the dam under the reservoir water load.
8. **Inverse Pendulum:** Inverse pendulums record the elastic movement of foundation rock or sliding of the dam. The pendulum is anchored in a 150mm to 200mm diameter hole drilled in the foundation and the float is provided in an oil bath located in a gallery. The essential requirement is that the drill hole should be truly vertical so that the pendulum wire has adequate clearance from the periphery of the hole to record movement of the foundation. The pendulum wire is anchored at the bottom of the drilled, which is about 30m deep into the foundation. At such deep, it is expected that anchor will not get disturbed. Provision of two inverse pendulums, one each in block 10 and 12 is made.
9. **Cables and Splicing:** Cables from the instruments are taken into a niche in a gallery where they are connected to a junction box. The cables need to be of good quality since a good instrument without a good cable is of no use.
10. **Reading Schedule and Analysis:** Readings of the instruments are taken through read out sets. Initially, readings are taken at close intervals.
11. With a view to studying the seismic activity prior to and after construction of the dam, seismic instruments are provided in the form of strong motion accelerographs. The instruments mentioned above will be supplemented if necessary with other types like, crest collimation, surface targets. Measurements from these instruments are taken by precision survey instruments.
12. **Estimates for Instrumentation:**

    The estimate for instrumentation of dam is generally based on preliminary drawings showing the proposed type of instruments, their location in dam blocks selected for the purpose, their numbers and cost of such instruments. There are a number of agencies who supply such instruments like M/s. Encardio Rite, M/s. AIMIL and M/s Sensors & Measurements Enterprises etc.

For the purpose of estimates, budgetary details have been obtained from M/s Sensors & Measurements Enterprises, Lucknow.

The cost estimate is based on the rates given by the agency for similar dam proposed in Karnataka is also included.

Chapter 8
Reservoir

8.1 Fixation of Storage and Reservoir Levels

8.1.1 Dead Storage

As per the standard practice, the Dead Storage is fixed at 10 % of the Total storage. Considering this, the Dead Storage will be 0.6 TMC.

Provisions for the sediments have been made based on the studies carried out for the Markandeya dam which is located 34 Km upstream. After analyzing the probable accumulation of sediment which may accrue at the end of 50 years as per the relevant IS Code, it is seen that about 6377.42 Metric Tonne will be lost in this period.

8.1.2 Low Water Level

Silt level has been fixed at 564.00 m.

8.1.3 Full Reservoir Level

The Full Resevoir Level is fixed at EL 618.00 m

8.1.4 Maximum Water Level

Maximum Water level is EL 618.00 m

8.1.5 Maximum Back Water Level at FRL & MWL and Its Effect.

Back water effect / FRL will reach upto 3.40 Km on the upstream of the dam-close to Godchinmalki falls. Construction and commisionoing of the dam will not have any impact on Godchinmalki falls, neither due to submergence nor due to back water effect.

8.1.6 Saddles Present Along the Rim of the Reservoir

There are no saddles along the rim of the reservoir

8.1.7 Fetch

Effective fetch computed is as per IS 6512 – 1084 and the length of the effective fetch is 0.96 km. Maximum fetch will be 3.40 Km.

The design wave height will be 0.914 m with the computed free board as 2.07 M. Hence, the top of the dam is proposed at 621.00 m

8.1.8 Direction of Wind Velocity

8.1.8.1 Wind

Most parts of the area are exposed to strong winds almost throughout the year. By the end of October, fairly constant wind, which gets cooler with the progress of the season, sets in from the Northeast. From November to January, dry and biting winds blow from direction between northeast and southwest. In February, northerly and northwesterly winds are also common in the forenoon and these become more and more predominant in the months of March and April. The afternoon winds are variable in all these three months. With the advance of summer, dust-raising winds add to the discomfort of the hot weather. During the second half of May, winds increase in force and blow from directions between Southwest and Northwest. Although they do not bring rain, these winds are cool and refreshing. With the onset of monsoons, winds strengthen further and blow from directions West and Southwest. By the latter half of September winds begin to weaken and blow from directions between North and East.

8.1.8.2 Wind Velocity

The area is generally calm during winter and summer periods, with mean wind speed ranging from 7 to 15 km / hr. The wind speed attain maximum during June & July months (15 Km/hr).

8.2 Sedimentation Data and Studies

It is necessary to study the sediment data before finalizing the planning and implementation of a Reservoir which is proposed to be used for multipurpose usage. In this connection, it is pertinent to note that storage reservoirs built across rivers tend to loose their capcacity over years on account of deposition of sediment. The sediment accumulation in a reservoir is progressive which reduces its active capacity thereby affecting the capacbilty to provide required quantum of water for use through passage of time.

The accumulation of sediment near the dam will affect the furure functioning of water intakes. The reservoir may also face problems of rise in flood levels in the head reaches which will definetly affect the area in question.

Before planning of a new project, it is necessary to view the sedimentation as an additional factor and study its effect and evaluate the performance of the reservoir.

8.2.1 Planning of New Storage Reservoir

Before planning of any new storage reservoir, it is necessary to assess the seriousness of the sediment problem and classify it as insignificant , significant or serious. This is usually done by comparing the expected average annual volume of sediment deposition with the gross capacity of the reservoir.

In case, ratio is greater than 0.5% per year, the problem is usually considered serious and special care needs to be taken in estimating the sediment yield from the catchment.

In case it is less than 0.1% per year, the problem is insignificant and changes in reservoir capacity can be neglected for study of reservoir performance.

For cases falling in between these two limits, the problem is considered significant and requires further studies.

8.2.2 Rates of Sedimentation

Before fixing the capacity of reservoir it is necessary to compute the sediment yield for predicting the probable sediment distribution in the reservoir below the normal FRL.

The measurement of sediment yield/ estimation is done by any one of the following methods

a. Sedimentation surveys of reservoirs with similar catchment characteristics or
b. Sediment load measuremnts of the stream

8.2.3 Sedimentation Fraction Expected

The following are the sediment fraction expected in the reservoir as per the available data at Markandeya dam and Bellary nala dams.

- Medium and Coarse fraction
- Fine fraction

8.2.4 Quantity of Sediment

As per DPR of Bellary Nala Dam, Average estimated sediment load 6377.42 Metric Tonne. The Rate of sedimentation estimated at the dam site is 0.00764 Ha-m/year/Sq. Kms

8.2.5 Sedimentation Studies

Catchment area at Hudli in Sq.Km	279.72				
Catchment area between Hudli and Dam site in Sq.Km	304.52	117.54	Sq.miles		
Average estimated sediment load in MT	6377.42	(As per DPR of Bellary Nala Dam)			
Add Bed load at 10% (in MT)	7015.17				
Rate of sedimentation (Ha-m/year/Sq. Kms)	0.00764				
Estimate the life of the Reservoir					
	MCM	**Ha-m**			
Capacity of the Reservoir upto FRL	170.91	17091.12			
Average estimated annual inflow	84.1076	8410.76			
Storage capacity upto Sill level	0.000161	0.0161			
As suggested by CWC for Markandeya Reservoir in Miles S = 100 Acre ft /Year/Sq. Miles					
A sediment rate of 1.00 Acre-ft/Year/Sq.miles (14.11 Ha-m/Year for 117.54 Sq.Miles) which is adopted for computation of Life of Reservoir					
Average sedimentation inflow in to the reservoir	0.141	14.11			

8.2.6 Type and shape of reservoir

It is a Ogee type concrete gravity dam.

8.2.7 Sediment Studies

Refer Section 8.2.5

8.3 Life of Reservoir in Years with Basis

8.4 Capacities

8.4.1 Capacities (Mcum)

The capacity of the proposed reservoir before sedimentation at FRL 618.00 m is 6 TMC (170.93 MCM)

8.4.2 Water Tightness of the Reservoir

All the parameters required for designing the water tightness of the reservoir are considered.

8.5 Effect on Sub Soil Water Table in the Adjoining Areas

The resultant ponding of water due to storage in the proposed reservoir will help in energizing and improving the sub soil water table in the adjoining areas.

8.6 Reservoir Rim Stability

Slopes are stable and no possibility of any slope failures in the reservoir area

8.7 Area of submergence in Ha at FRL 618.00 m

The submergence area at FRL 618.00 m = 580.42 Ha:

No.	FRL (in m)	Submergence (in Ha)		Total (in Ha)	Remarks
		Forest	Revenue		
1.	618.00	587.07	83.81	670.88	

8.8 Land Acquisition, Property Submerged and Rehabilitation

8.8.1 Land Acquisition

The proposed project involves land acquisition im view of submergence and for seating of dam, construction of approach roads and related activities. The acquisition comprises of forest lands and revenue lands.

Total area to be acquired is 734.64 Ha

- Forest lands – 616.37 Ha
- Revenue lands – 118.27 Ha

8.8.2 Details of Properties

About 70 buildings are propsed to be acquired which comes under the submergence

8.8.3 Details of Project Affected Families

About 70 families are likely to be displaced.

Chapter 9
Irrigation Planning

This project is conceived as a Drinking water project and a reservoir in order to generate power and as well as regulating / allowing the required quantum of water as per KWDT award, no irrigation component has been envisaged.

Chapter 10
Command Area

This project is conceived as a drinking water project and a reservoir in order to generate power and as well as regulating / allowing the required quantum of water as per KWDT award, there will be no commanding area

Chapter 11
Flood Control

Flood control is not a part of the present proposal.

Chapter 12
Drainage

Since the present proposal is for construction of reservoir and not for irrigation purposes, this is not a part of the report.

Chapter 13
Power

Power component is not a part of the present proposal.

Chapter 14
Navigation

This project is not conceived as a power project and reservoir in order to generate power and as well as regulating / allowing the required quantum of water as per KWDT award. There is no proposal to use for Navigation purposes.

Chapter 15
Construction Methodology, Schedule, Manpower and Plant Planning

15.1 Construction Program

The construction schedule for the Ghatti Basavanna drinking water Project is considered as 18 months taking view of the fact that it is a high level dam of length 407.50 m with a height of 86.50 m and comprising of various components.

The attached construction schedule details the main activities of each individual component and considers its interrelationship and dependency on the activities of other component. The planning for the time of construction is considered as days on the basis of 24 hours working per day. Every Sunday is deemed to be weekend and has been considered as a workday off.

Due to the nature of hydrology, the full phase construction is affected during the monsoon season i.e. Second half of June, July, August and September when the river discharge is high, making it difficult to work at the areas below the flood level. This effect has been considered in preparing the schedule.

15.2 Key materials Planning

15.2.1 Construction Materials

The sources of the major construction materials required for the project have been anticipated as follows:

- Explosives for blasting will be obtained from suppliers in Belagavi.
- Cement in bulk will be obtained from cement factories/ nearest cement dealers.
- Coarse aggregate which will be produced on site from the excavated materials, selected Rock quarries and River Course
- Fine aggregate which will be processed from the excavated material and other nearest local sources if necessary.
- Reinforcement & Structural steel will be obtained from SAIL/TATA or any other approved dealers.

15.2.2 Abstract of Major Quantities of Construction Materials

Abstract of major quantities of construction materials required for different components of the work are assessed based on Preliminary Designs & Drawings

Table 15.1: Requirement of Construction Materials

No	Components	Explosive in MT	Sand in cum	Coarse aggregate in cum	Cement in MT	Reinforced steel in MT	Structural Steel in MT
1	Dam and allied works	150.00	4,25,000	7,25,000	2,50,000	5,500	1.560

15.2.3 Transportation Method

All the Hydro- Mechanical equipment, materials required for civil works such as cement, reinforcement steel, pipes, shuttering materials etc., including explosives are to be transported from Belagavi by road on state highway. Other materials required in small quantity could be procured from nearby towns.

15.3 Construction Power Requirement and Proposed Supply Arrangement

The total Power requirement would be 10 MVA. The details are as follows:

Air Compressors	1 MVA
Aggregate Processing Plant	2 MVA
Batching Plant	1 MVA
Dewater Pumps	1 MVA
Grout Pumps	0.5 MVA
Other Facilities	2 MVA
Welding Machine	2.5 MVA
Bending Machine	
Total	**10 MVA**

Any additional power requirement needs to be supplemented with the help of temporary power supply from DG sets.

15.3.1 Telecom Facility

In order to establish 24/7 communication, required infrastructure will be established with the help of DOT which will also be continued during the period of O & M

15.3.2 Wireless System

The project will be tendered and work will be entrusted to a single or multiple agencies, Respective implementing agency will be directed to maintain required communication system in terms of wireless system after taking necessary approval from the concerned department / s

15.3.3 Land Requirement for Infrastructure Development of the Project

All the above facilities require land. The tentative requirement of land for various component of the project is as below:

No.	Description	Area in sqm
1	Project Roads	2,21,000
2	Dump Yard	10,000
3	Stack Yard including cement godowns	15,000
4	Magazine Building	2,500
	Total land in Sqm	**2,48,500**
	Total land in Ha	**24.85**

15.4 Plant / Equipment Planning

Requirement of plant/ machinery for the deployment for the works has been proposed based on the works involved and similar works carried out in other projects. List of various plant/machinery to be deployed is given below. The list is indicative since same equipment can also be planned for the use for nearby works depending on the planning of the construction agency.

Table 15.2: List of plant/machinery

No	Equipment	Vertical horizontal pressure shafts	Power house & transformers cavern & allied works	Surge shaft cavern	Tail race tunnel	Construction adits	Road works	Total
1.	Tippers (20/25t)	10	15	10	20			55
2.	Tippers (5.0 m3)	5	5	5	10			25
3.	Excavators (1.5 m3)	5	3	2	5			15
4.	JCB	3	2	2	3			10
5.	Compressors (500cfm/600cfm)	2	3	1	2			8
6.	DG set(250 KVA)	2	2	1	2			7
7.	Dewatering pumps		As	Per	Required			
8.	Shotcrete machine (30m3/HR)	1	2	1	2			6
9.	Concrete placer	1	2	1	2			6
10.	Concrete pump (38m3/hr)	1	2	1	2			6
11.	Grouting pump	1	2	2	2			7
12.	Transit mixer (6.0m3)	5	8	3	5			21
13.	Batching plant (30m3/hr)	-	1	-	1			2
14.	D-8 Dozer (200 HP)	3	3	2	3			11
15.	Vibrators		As	Per	Requirement			
16.	Jack hammers			As	Required			
17.	Mobile crane (10t)	1	2	1	2			6
18.	Water tanker (11000ltrs)	2	2	2	2			8
19.	Crawler drill	1	2	1	1			5
20.	Concrete mixers (14/10)	2	2	2	2			8
21.	Rock bolter	1	1	1	1			4
22.	Vibratory compactor	5	5	5	5			20
23.	Road roller			As	Required		3	3
24.	Electric winch (5t)	-	2	-	-			2
25.	Excavator BC -30	-	1	1	2			4
26.	Explosive van	1	1	1	1			4
27.	Ambulance	-	-	1	-			1
28.	Bus/mini bus	1	1	1	1			4
29.	Workshop equipment	Common	To	All	Components			
30.	Ventilation ducting	As	Per	Site	Requirement			
31.	Diesel tanker 7000 ltrs	1	1	-	2			4
32.	Water sprinkler 10000 ltrs	-	1	-	2		4	7

15.5 Manpower Planning

15.5.1 Peak Deployment of Man Power

The approximate number of man power required is given below and is indicative only and depends on construction agency's methodology of execution of works, machinery deployed schedule etc.

Works	Managers and Supervisors	Highly Skilled	Skilled	Unskilled	Total
Dam and appurtenant works	20	20	50	250	340

15.6 Construction Methodology

15.6.1 Introduction

Ghatti Basavanna Project site is located on River Markandeya just 5 Km upstream of its confluence with Ghataprabha River and 25 Km downstream of confluence of Markandeya river and bellary nala in Gokak Taluk, Belagavi District.

The project is located about 40 km from the District place Belagavi. The project sites are approachable from Belagavi by the state Highway No 134 passing through Ankalgi.

15.6.2 Construction Methodology

The present proposal envisages construction of a Dam and its appurtenant works, and all infrastructure works. The methodology and equipment planning for various works depends on the site conditions prevailing in the project area.

The activities are planned in such a way that the project shall be completed as per schedule with no or minimum spillover. It is assumed that all the pre-construction activities having a bearing on the proposed schedule such as land acquisition, infrastructure works and relevant statutory approvals from the Government are in place before commencement of the construction works.

It is proposed to execute the project as under:

- Civil works:
  - ✓ Civil works of dam and appurtenant works including energy dissipation arrangements, Intake structure etc
- Hydro Mechanical Works
  - ✓ Hydro Mechanical Works comprising of gates, hoists, erection etc.

15.6.3 Methodology of Assessment of Construction

It is necessary to assess the methodology of construction in the present proposal. The works involve taking them up simultaneously which includes hydro mechanical and electro mechanical components. There is a need to see that the work shall continue uninterrupted till completion of the project by identifying critical item which will have a bearing on the execution of the project.

15.6.4 Pre-Construction Activity

For a project to be implemented in a systematic manner and to complete it within the time schedule, it is imperative to see that certain pre construction activities are completed in a proper manner. Some of the activities which are proposed to be undertaken during this period will be:

- Detailed Topographical Survey and marking the Layout at site, Pre- construction geotechnical investigation
- Clearance from Government agencies like Pollution control board, Public health, Irrigation and Forest Clearance
- Acquisition of Land including muck disposal areas
- Financial closure
- Detailed design and preparation of tender documents for Civil, Electro-mechanical, Hydro mechanical works including pre construction investigation.
- Award of Contracts
- Setting up of Site office and store
- Arranging of construction power
- Construction of approach roads and bridges
- Formation of project team

15.6.5 Equipment Planning

"Guidelines for preparation of Detailed Project Reports of River Valley and multipurpose Projects" issued by Central water Commission have been used for the planning of equipment. Assumptions made for planning of equipment for various construction activities are indicated hereunder:

15.6.5.1 Working Hours

It is necessary that the work will progress systematically with an intention to complete the activities as per schedule. Accordingly, it is assumed that works is proposed to be done in three shifts with effective working hours at 20 Hrs per day of 25 days in a month.

15.6.5.2 Densities of Materials

All the calculations are based on capacity of hauling units. The densities of different types of materials are not considered for excavation and fill material.

15.6.5.3 Conversion Factor for Earth Volume

Standard norms have been adopted for conversion of volumes in natural, loose and compacted state.

15.6.5.4 Efficiency of Operation

The efficiency of operation for various equipment's are considered as per standards

15.6.6 Construction Methodology for Different Activities of Civil Works

15.6.6.1 Diversion of River During Construction

During the construction of civil activities for Head Works, it is necessary to divert the river for smooth execution of civil works. The construction activity for dam needs to be taken up during the non-monsoon months when the flow is less. The water in the river has to be diverted to one side of construction by providing temporary cofferdams for the construction of upstream works. The cofferdam will be made of river bed material properly compacted to the required level to prevent overtopping. An impervious material will be provided to prevent seepage through the body of the dam. Rip rap protections will be provided on the river side to prevent scouring of the dam. It is expected that the cofferdam will be damaged during the monsoon season which will be repaired for the dry season.

The construction of dam structure will be done in two stages and cofferdam will be provided accordingly. In the first stage, the river will be diverted towards the left bank. During the period, construction work on the right bank will be done. The work includes construction of Spillway, under sluice, Intake, Feeder Channel, intake structures and flood walls, upstream and downstream aprons and stilling basins. Likewise, the remaining bays of spillway that are on the left bank will be constructed during the second phase. During the period, the river will be diverted through the Under sluice and gated Spillway. The cofferdam will create the dry space on the left bank during this period.

15.6.6.2 Cofferdam Works

The deposits on the river bank shall be removed to have enough space for construction activities. The deposit will be used for the river diversion work and for rip rap protection works. The construction of cofferdam will be taken up parallel with the removal of deposits. The construction of Coffer dam would be taken up with Dozers and Hydraulic Excavators of required capacity, Vibratory Roller and sufficient number of 15/20 T Dumpers. The Coffer Dam is planned to be completed in a shortest time.

15.6.6.3 Proposed Roads:

GOK/KNNL and other agencies are planning to develop network of roads and this will facilitate in speedy movement of the men and material to the site. Ghatti Basavanna Dam site will have good connectivity and hence the site can be accessed during all seasons. Any additional pathways and connectivity's are required; the same can be developed by the Contractor during the construction. Further it will be the responsibility of the contractor to make good of all the roads used during the construction before demobilizing from the site.

The width of all the new access roads is 7.50 m.

15.7 Use of Chilled Concrete

15.7.1 General

Concrete Cooling is a technique by which the temperature of poured concrete is reduced in order to achieve the desired quality and placement temperature. The quality of the concrete is guaranteed and construction can continue smoothly to a certain level. Use of Chilled concrete during construction of high dams especially, in tropical and dry climates gives excellent results in terms of quality. When concrete is poured / placed in predetermined lifts, it releases heat of hydration resulting in rise in temperature of the concrete placed. Concrete cooling is used mainly in parts of the world with a warm climate, in projects where large amounts of concrete are used to minimize the heat of hydration of the cement. The most common way of cooling concrete is to cool the individual components of the concrete before it is mixed.

Concrete is made from water, gravel, sand, cement and often some additives to improve the quality of the concrete. Since the water, sand and gravel together form the major part of the heat capacity of the concrete, only these three components are cooled.

15.7.2 Chilled Water

A frequently applied method for cooling concrete is to cool the water before it is added to the concrete mix, instead of using water at ambient temperature. The water is cooled by means of a refrigerating machine and stored in a cold-water tank so that a stock is available for daily use.

To cool 1 m³ concrete by 1°C, about 33 kg of cold water at 5°C is required. By only using cooled water in the mix, a reduction in temperature of 3 to 5°C can be achieved. The cooled water system is relatively straightforward, can be easily operated and needs little maintenance.

15.7.3 Flake Ice

One common method for cooling concrete is to replace part of the water added to the mix with flake ice. Since the flake ice only melts during mixing, and the transition from ice to water absorbs a lot of energy, the temperature of the mix lowers significantly.

In order to be able to produce this ice, an ice factory needs to be installed at the construction site. This consists of a flake ice production unit and a storage facility. Ice is transported from the storage facility to the batching plant by means of a suitable conveyor system. After weighing, the ice is added to the mix.

The use of flake ice instead of cold water has a much greater effect on the temperature of the concrete mix, due to the large amount of heat that is necessary to melt the ice in the aggregate.

15.7.4 Aggregate Cooling with Water

In order to reduce the temperature of the concrete mix, cooled gravel can be used. The cooling takes place on a special conveyor (wet belt) between gravel storage and mixer.

The gravel is in transit on the wet belt is sprayed with chilled water. Used heated water is collected and pumped back to the chiller. Using a sediment basin. In order to prevent the aggregate warms up from the environment heat or sun, the wet belt placed in an insulated casing.

15.7.5 Aggregate Cooling with Air

Cooling gravel with air is an established method for cooling concrete and takes place in gravel storage silos. Cold air is blown through the filled silos in order to cool the gravel. The silos are modified in order to optimise the streaming of cold air, and insulated in order to prevent warming by the environment or the sun.

15.7.6 Sand Cooling with Air

A technique that helps reduce the temperature of the aggregate considerably is cooling the sand. The sand is passed through a horizontal rotating drum, where it is turned over.

Cold air is blown in the opposite direction through the drum, comes into contact with the sand and cools the sand. The warmed air, which remains cooler than the surroundings, is re-circulated in order to increase the efficiency of the system.

15.8 Concrete Dam Construction

15.8.1 Aggregate Production.

The acceptability of natural aggregates is judged upon the physical and chemical properties of the material and the accessibility, proximity to the site and economic workability of the deposit.

15.8.2 Concrete Handling, Placing and Consolidation.

The procedure to be adopted for moving concrete from the mixers on to the dam will be governed by site conditions. The problem is to transport it to the dam with the least possible segregation or change in its consistency so it may be compacted uniformly into the dam without unreasonable effort. The cableway is probably the simplest arrangement. The tilting mixers will feed the buckets; these are then moved to a pick up point under the cableway, transported smoothly to the block and emptied quickly through an air operated gate.

15.8.3 Three Tower Cableway / Tower Crane

The use of a belt conveyor has also been considered, but problems occur in keeping the belt temperature stable in warm weather and also in windy conditions. The conveyors are usually covered and cold air is blown over the concrete to lower its placing temperature.

- The placing of a low-slump concrete, four layers in 2.3 m lift
- Tractor mounted vibrators.
- Proper consolidation of low-slump concrete is laborious and requires continuous supervision. The most efficient compactor is usually the two man hand-held high-speed vibrator.

15.8.4 Formwork

Probably the most widely used lift is 1.5m, however, on large dams a height of 2.3-3.0m is frequently used. With the larger lifts there are fewer movements of forms and fewer horizontal lift surfaces to be cleaned. The high-lift formwork is unique and expensive with less prospect for re-use, heavier

equipment is required for lifting the forms and the heat problems and risks of cracking in the concrete are accentuated.

15.9 Project Organization

15.9.1 General

The project area is spread over a length of about 500 m on the left and right flanks of River Markandeya. Any planning of construction of a major dam including its components shall be supported by a proper infrastructures all located within the project area. They are but not limited to

- Permanent and temporary colonies
- Offices
- Roads
- Workshops etc

The present project envisages completing all the activities within 18 months including the required infrastructure facilities.

The construction proposal considers carrying out the construction through contracting agencies by dividing the project into probable suitable packages as under:

- Access roads, slope stabilization and cross drainage works. Permanent and temporary buildings, water supply, electrification of colonies, communication systems, workshops and stores, etc.
- Constructions of dam and other appurtenant works including energy dissipation arrangements, etc
- Hydro mechanical works including fabrication and erection of gates and Hoist etc.

The terrain in which the project is proposed is a hilly terrain and the quantum of design and construction work involved is substantial. For ensuring timely completion of the project, close coordination is required with all the stake holders. The organization of the project has, therefore, been planned keeping the above in view. Broad features of this organization structure are described in the following paragraphs.

15.9.2 Project Organization

The implementation of the project to meet the schedule of completion will be under the purview of various officers of the department. In this connection, an organization chart has been prepared as under:

The overall supervision will be under a Chief Engineer specially designated for the Ghatti Basavanna Project. The Chief Engineer would be assisted by separate wings to look after the planning, construction management, quality control, administration, financial and accounts aspects of the project. There will be a circle, headed by a Superintending Engineer to monitor all the activities envisaged in the project. For civil works and other infrastructure development there will be 6 divisions headed by 6 Executive Engineer, 3 for dam works and 2 for other infrastructure works and 1 for Quality control work. Each Executive Engineer will be assisted by 3 Assistant Executive Engineers, and 6 Assistant Engineers and other support staff.

Table 15.3: Details of Technical staff

Sl No.	Technical Staff	Number of Staff	Remarks
1	Executive Engineer	6	
2	Assistant Executive Engineer	20	
3	Assistant Engineer	54	

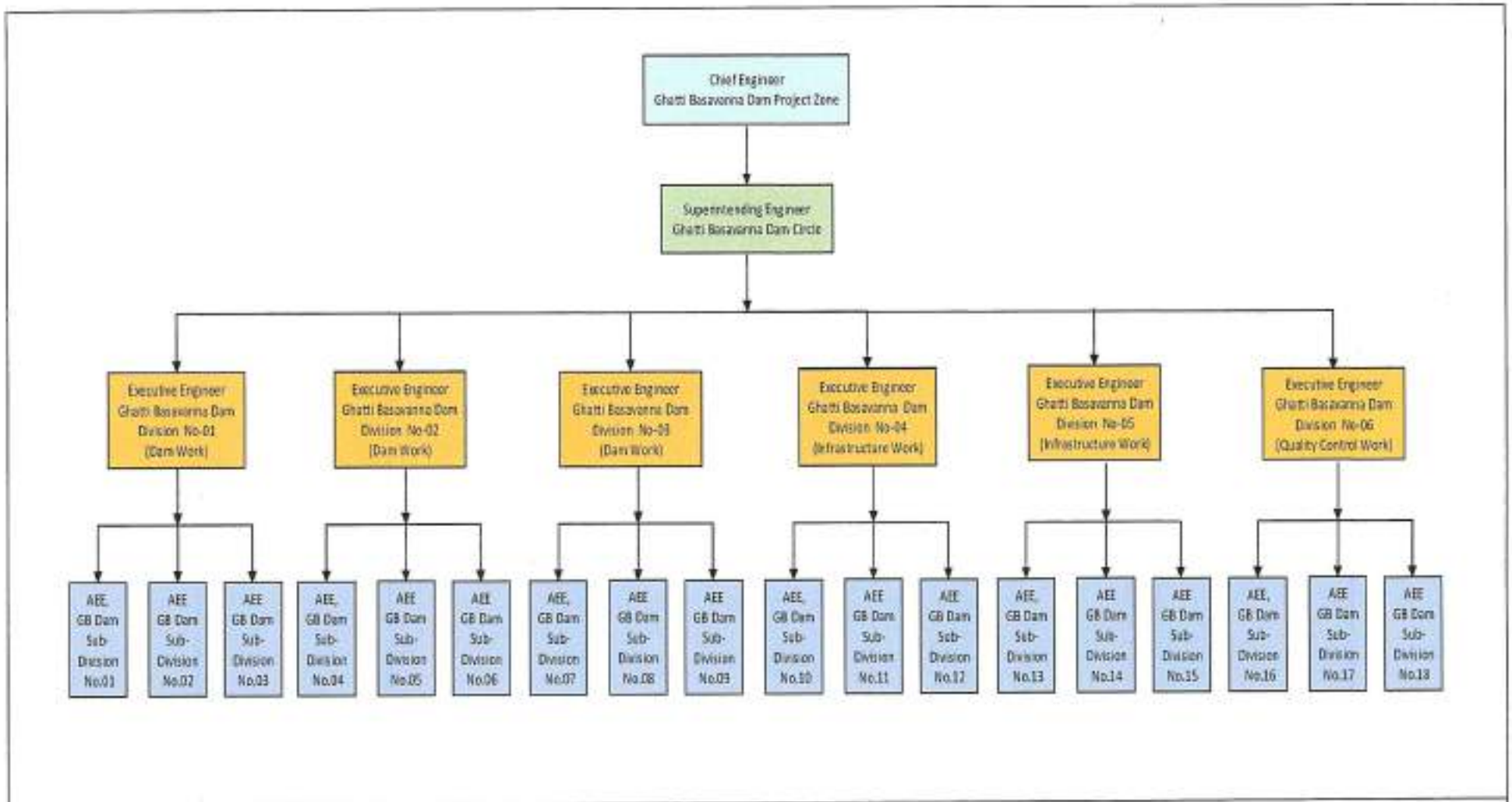


Figure 15.1: Organisation Chart

15.9.3 Project Administration

The Project Administration which also includes maintenance of colonies, dispensaries, public relations, welfare etc. are looked after by an Assistant executive Engineer (Administration) posted in the office of the Chief Engineer.

It is also proposed to have a Security officer along with supporting staff to carry out aspects concerned with vigilance and security of the project areas.

The organization structure will be reviewed and firmed up as part of the detailed planning in the pre-construction stage.

The project management shall function as a fully integrated team dedicated to the implementation of the project. Every member of the team shall report regularly to his officer-in charge and shall be subject to review of his performance.

The Chief engineer assumes responsibility for all aspects of the project. His deputies have to ensure that their reports reflect the up to date status of the project at any point of time. It is their duty to periodically review the progress of works, identify the problem areas, suggest remedial measures including their implementation and have a realistic forecast of the status of the project in the intermediate time frame.

To achieve the above objective, the Divisional Engineers shall ensure that they and their personnel are interacting regularly on a day-to-day basis with all the concerned personnel of the project whose work has a direct impact on the progress of their own work, and take corrective actions, wherever called for, to adhere to work schedule.

15.9.4 Technical Advisory Committee

A Technical Advisory Committee comprising of renowned experts in respective fields shall be constituted by KNNL. This committee will advise the project team through the Chief Engineer on all critical aspects of project planning, design and construction activities

15.9.5 Reporting / Reviews

The project will be subject to monthly reviews so that all concerned are aware of progress to date. The monthly report will give details of manpower, productivity, schedule and costs. The purpose of these reviews will be to highlight the problem areas and provide the required additional supervision and action to resolve the problem. The reports will be prepared using inputs from consultants, contractors, construction supervisors, procurement officers etc., so that a realistic picture of the project is available for review and report.

Chapter 16
Foreign Exchange Element

No Foreign Exchange Element is envisaged in this project.

Chapter 17
Environment, Ecology and Forest aspects of the Project

17.1 Introduction & Background

Environmental Impact Assessment (EIA), a systematic process to identify, predict and evaluate the significant environmental effects of proposed actions and projects which is applied prior to major decisions and commitments being made. Under this study the social, cultural and health effects form an integral part in order to prevent, mitigate and offset the significant adverse effects of proposed undertakings.

The EIS study provides information for decision-making on the environmental consequences of proposed actions; and promotes environmentally sound and sustainable development through the identification of appropriate enhancement and mitigation measures.

With the infringement of the site the impacts become more complex and larger in scale thus, in order to reduce the burden of environmental impacts it becomes necessary to undertake EIA study for maintaining the sustainability of the project even after the developmental processes.

As per the guidelines of Ministry of Environment and Forest, Govt of India (IA-I Division) the drinking water schemes does not attract provisions of EIA notification, 2006, and its subsequent amendment, 2009 although there are some issues involved like submergence and R& R which may be appropriately addressed by the State Government.

In view of the above, since the Ghatti basavanna project is a drinking water scheme EIA Clearance for the scheme shall be exempted. Further, the following issues shall be addressed to ensure the following steps/measures.

1. Necessary permission / clearance for diversion of forest land for the project will be obtained from the designated authority before commencement of the project.
2. Any other mandatory clearance / statutory permission from any other organization / department will be obtained by the project proponent.
3. An adequate R & R plan will be prepared and implemented wherever necessary with adequate compensation to the project affected families.
4. Environment safeguard measure/management plans will be implemented in a timely manner.
5. During the construction period environmental good practices such as dust suppression/control, noise control etc will be followed.

17.2 Project Description

The proposed location of project area is at Ghatti Basavanna at Latitude 16° 9′ 11" N and Longitude 74° 47′ 18" E in Gokak taluk of Belagavi district. The Catchment area of river Markandeya up to the proposed reservoir project is 1,016 Sq. Km. A fall of about 85 m is available in River Markandeya in the reach between proposed site and Godchanmalki falls. Considering the height of the dam and also narrow gorge available at the dam site it is also possible to generate cheap hydro-electric power.

Figure 17.1: Google Map of the Current location

Figure 17.2: Google earth Image showing aerial view

The Ghatti Basavanna project consists of the following main components:

17.3 Forest types in Study Area

Belgaum district has fifth place in forest area among the districts of the state. It has 14.16 percent of its total geographical area under forests. Due to various factors like rainfall, edaphic, biotic and management practices the forests of Belagavi districts can be broadly classify into the following categories;

- Southern Tropical Dry Deciduous Forest (Dry Teak Forest) - Tectona grandis, Terminalia crenulata, Largerstroemia etc
- Southern Tropical Dry Deciduous Forest (Southern dry mixed deciduous forest) - Anogeissus latifolia, acacia catechu & Choroxylon swietenia etc
- Southern Tropical Thorn Forests (Southern thorn forest) - Chloroxylon swietenia, Albizzaia amara & Acacia chundra etc
- Southern Tropical Thorn Forest (Southern thorn scrub) - Albizza amara, Azadirachta indica etc
- Southern Tropical Thorn Forests (Southern Euphorbia scrub) - Euphorbia tirucalli, Dodonaea etc

In the study area, Southern Tropical Thorn Forest and Southern Tropical Thorn Forests are found in the region with rocky outcrop and stunted vegetation.

17.4 Flora

17.4.1 Trees

Commonly found trees in the region are Acacia Arabica(Karijali), Albizzia amara (Tugli), Albizzia lebbek(Bage), Albizzia odartissima(Godda hunsi), Artocarpus integrafolia (Halasu), Azadirachtu indica (Bevu), Bambusa Arundianaeca(Dowga), Cassia fistula (Kakke), Carissa caranda(Kawli), Ficus species (Atti, Ala, Arali), Hardiwickia binate(Kamara), Inga dulce(Ilati Hunse), Imperata cylindrical (Elephant grass, Holoptelia integrifolia (Tapsi), Pongania pinnata(Hulgal), Prosopis juliflora (Ballari jali),

Randia dumetorum (Kari), Syzigium specieas (Nerale), Shorea talura (Salari), Streblus asper (Mittal), Terminalia arjuna (Holematti) and Zizyphus species (Bare, pargi etc).

17.4.2 Shrubs

Acacia latronum, Bridelia stipularis, Caesalpinia mimosoides, Callicarpa tomentosa, Canthium dicoccum, Carissa carandas, Clerodendrum viscosum, Desmodium pulchellum, Eranthemum roseum, Helicteres isora, Holarrhena antidysenterica, Ixora arborea, Lantana camara, Randia dumetorum, Solanum giganteum, Strobilanthes callosus, Ipomoea Illustris, etc. Climbers such as Phanera vahlii, Acacia pennata, Calycopteris floribunda, Dalbergi avolubilis, Gnetum ula, Ipomea spp., etc Bamboos such as Bambusa arundinacea, Dendrocalamus strictus, Oxytenanthera monostigma, Ochlandra scriptoria, etc.

17.4.3 Medicinal Plants

Achyranthes aspera, Ageratum conyzoides, Alternanthera pungens, Alternanthera sessilis, Arundo donax, Chrozophora rottleri, Chrysanthymum indicum, Croton bonplandianum, Cynodon dactylon, Oxalis corniculata, Calotropis gigantea, Clerodendrum inerme, Duranta repens, Lantana camara, Parthenium hysterophorus, Waltheria indica, etc

17.5 Fauna & Avifauna

17.5.1 Ghataprabha Bird Sanctuary

Ghataprabha Bird Sanctuary is situated between 160 10' 00" to 160 14' 46" North latitudes and between 700 40' 13" to 740 50' 00" East longitudes at an area of 29.78 square kilometres, and its boundaries enclose a stretch of about 28 km of the Ghataprabha River, including the reservoir resulting from the dam built near Dhupdhal. The sanctuary is known for migratory birds such as the Demoiselle crane and European white stork, along with endemic birds like peacocks, Egrets (Cattle, large & Little), white ibis, Lesser pied, snakebird, storks (open billed), Little cormorants, spoon bill, king fisher, Red wattle lapwing etc.

The proposed project falls at a distance of 2.7 Km of Ghataprabha Bird Sanctuary involving Ghataprabha River of near Konnur and Gokak RF. The proposed project is located at a distance of 2.7 km from the Ghataprabha Bird Sanctuary where most of the area are barren and dry. One of them at west of Dhupdal lake is swampy and another has a good growth of Acacia arabica, (karijali), Pithecallobium dulce (Sihunce) and Bambusa arundianaeca (Dowga) both are introduced species. Acacia arabica and Imperata cylindrica (Elephant grass) are considered of special interest, as they are

good for nesting. Acacia auriculiformis is the most dominant tree species followed by Corymbia citriodora and Azadirachta indica.

The avifauna found in the sanctuary area Ploceus philippinus(Baya weaver bird), Halcyon pileata (Black capped king fisher), Columba livia (Blue Rock Pigeon), Dicrurus ad similis (Black cdrongu), Cagttle Egret(Cagttle Egretx), Acridotheres tristis (Common Myna), Anhinga rufa (Darter or Snake bird), Anthropvides virgo (Demoiselle crane), Ciconia (Europian white storks), Bubo Zeylonensis (Fish owls), Francolinus Pondicerianus(Grey partridge), Corvus splendens (House crow), Passez domesticus (House Sparrow), Cursorious bitorquatus (Jerdon's Double banded Courser), Corvus macrorhynchos (Jungle Crow), Eudynamys Scolopocea (Koel), Egretta garzetta (Little Egret), Ardeola alba (Large Egret), Psittaculo eupatria (Large Indian Parakeet), Phylacrocorox niger (Little Cormorant), Motacilla mader aspatensis (Large pied wagtail), Anastomus oscitans (Open billed Stork), Ardeola grayii (Pond Heron), Pavo cristatus (Peocock), Vanellus indicus (Red wattled lapwing), Pelargopsis capansis (Stork billed king fisher), Platalea leucorodia (Spoon bill), Threskiornis melonacephala (White ibis), Ciconia (White wrock).

17.5.2 Mammals

The commonly found in the sanctuary area are Herpestes edwardsi (Common mangoose), Vulpes benghalensis (Indian Fox), Hystrix indica (Indian Porcupine), Lepus rigricoltis (Indian Hare) and Caris aureus (Jackal).

17.5.3 Fishes

The river Ghataprabha flowing around the boundaries for the stretch of about 28 kms of the Bird Sanctuary remains home for the various fish species such as Cyprinus carpio, Tor Khudree, Hypselobarbus Kolus, Hypselobarbus pulchellus, Ompok bimaculatus, Wallago attu, Oreochromis mossambicus, etc.

17.6 Environmnetal Impacts and Mitigation Measures

17.6.1 Impact on Biological Environment During Construction Phase

17.6.1.1 Air Impacts on Flora

- Construction activities lead to deposition of dust on leaves thereby affecting photosynthetic activities of trees causing wilting/necrosis of leaves.
- Mitigation measures: water sprinkling activities will be carried out to avoid deposition of dust on trees.

17.6.1.2 Noise Impacts on Avifaunal Species of Ghataprabha Bird Sanctuary

- The noise generated due to blasting, construction activities, vehicular movements, DG sets, operation of construction equipment's, etc will affect the avifaunal behavior of Ghataprabha Bird Sanctuary and the local region.
- Mitigation measures: Construction activities will be carried out during day time. Controlled blasting shall be adopted for blasting activities.

17.6.1.3 Water Impacts on Aquatic Biodiversity

- Improper storage and management of muck or debris, solid waste and sewage from labour camps leads to water pollution thereby affecting water quality and aquatic biota.
- Mitigation measures: Segregation of wastes and disposal of wastes to municipal authorities, storage of muck properly in designated areas, hanging solar fences etc will be implemented.

17.6.1.4 Land use Impact on Biodiversity

- The project involves land acquisition of 622.90 Ha and diversion of 513.10 Ha of forest land thereby affecting the land use and land cover of the region. Removal of trees for construction activities leads to loss of habitat. Construction of dam leads to submergence of 580.42 Ha of land.
- Mitigation measures: Land acquisition will be carried out as per The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013. Green belt development and compensatory afforestation activities will be carried out as per the provisions of Forest (Conservation) Act, 1980.

17.6.1.5 Impacts During Construction Activities

- Hunting, poaching, road kills and accidents of avifauna and smaller mammals may be noticed during construction activities. Construction of dam affects the movements of fishes in the Ghataprabha river. Construction of dam involves submergence of 470.62 Ha of forest land leading to habitat loss of biodiversity.
- Mitigation measures: Awareness to the labourers with respect to importance of scheduled species and RET species will be provided to avoid hunting of animals. Sluice gates will be provided in the dam for movement of fishes. Introduction of fingerlings enhances proliferation of fishes thereby improving aquatic fauna of Ghataprabha River. The project upon implementation will enhance the local biodiversity, create habitats in the backwaters.

The detailed impacts and mitigation measures will be studied during EIA/EMP studies.

17.6.2 Impact on Biological Environment During Operation Phase

- There will be creation of wildlife habitats in the backwaters of the proposed dam.
- There will be proliferation of fish species.
- There will be increase in the diversity of floral and faunal species.
- It acts as water hole for the medium and small sized mammals of the region and it also improve prey-predator relationship.
- Upon implementation it enhances the avifaunal biodiversity of the Ghataprabha Bird Sanctuary located at a distance of 2.7 Km from the proposed dam.

17.7 Compensatory Afforestation and Net Present Value

The project involves diversion of 587.07 Ha of forest land which is under submergence area. Therefore, the land of Compensatory afforestation activities will be identified and the Management Plan with respect to Forest activities will be implemented.

Chapter 18
Estimate

18.1 Broad Guidelines for Preparation of Project Estimates for Major Irrigation and Multipurpose Projects.

The Project estimates prepared are based on the " Broad guidelines for preparation of Project Estimates for major & multipurpose Projects" issued by central Water commission and its revisions.

18.2 Classification of Units

The project works have been grouped into the following units:

i. **Unit-I:** Head-Works including main dam, spillway, outlet works,energy dissipation devices, regulators including diversion works.

ii. **Unit-II** -Main canals, branches, and distribution system inclusive of all pucca works – Not a part of the present project

iii. **Unit III - Hydro-Electric Installation-** Not a part of the present project

iv. **Unit-IV-** Navigation works - Not a part of the present project

v. **Unit-V** -Water supply works-Not a part of the present project. However provisions have been made to release the water. Locations have been marked in the master plan for establishing treatment before supplying potable water.

vi. **Unit-VI**- Command Area Development Works-Not a part of the present project

18.3 Account Heads

18.3.1 Minor Heads

(i) Direct Charges

These shall include the followings:

I. Works
II. Establishment
III. Tools and Plant
IV. Suspense.
V. Receipts and recoveries on capital account

(ii) Indirect Charges:

These shall include the following:

a) Capitalized value of abatement of land revenue, and

b) Auditand account charges.

18.3.2 Detailed Sub – Heads Under I – Works

The details of the Sub-heads under I – Works are indicated below.

A - Preliminaries
B- Land
C- Works
D- Regulators
E- Falls(for canals only)
F- Cross Drainage works(for canals only)
G- Bridges (for canals only)
H- Escapes
I- Navigation works
J- Power plants civil works
K- Buildings
L-for canals only
a) Earth work
b) Lining
c) Service roads
M-Plantation
N- Tank and Reservoir
O- Miscellaneous
P- Maintanance
1% of cost of I - works less(A+B+M+O+Q+X+Y)
Q- Special T and P
R- Communication
S- Power plant and Electrical system
T- Water supply works(LS)
U- Distributaries,Minors & sub minors
V- Water courses and Field channels
W- Drainage
X- Environment and ecology
Y- Loss on stock & Unforeseen

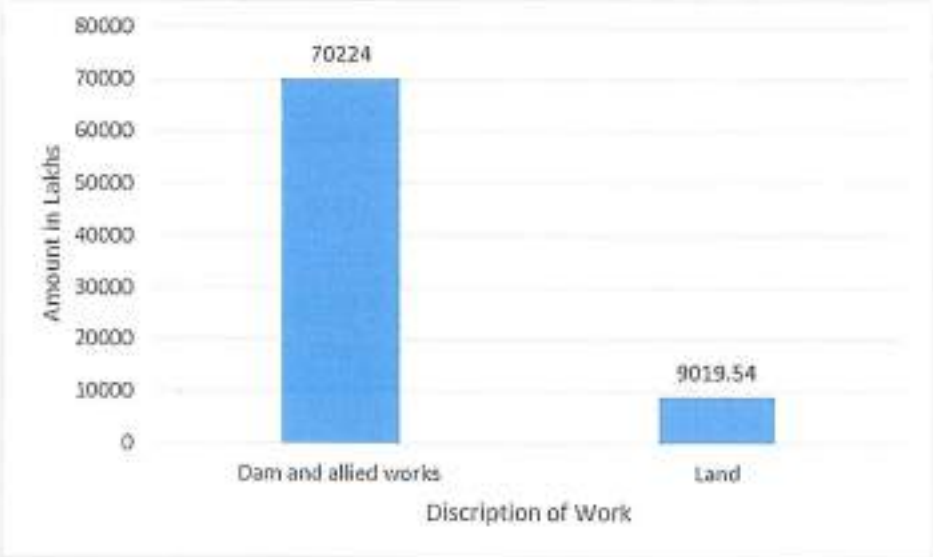
18.4 Abstract of Cost

No.	Particulars	Total Rupees in Lakhs	Remarks
1	A- Preliminary	1753.70	Details Enclosed
2	B- Land	9019.54	Details Enclosed
3	C- Works	70224.00	Details Enclosed
4	D- Regulators	2519.99	

No.	Particulars	Total Rupees in Lakhs	Remarks
5	E- Falls(for canals only)	NIL	
6	F- Cross Drainage works(for canals only)		
7	G- Bridges (for canals only)		
8	H- Escapes		
9	I- Navigation works	NIL	
10	J- Power plants civil works	NIL	
11	K- Buildings	650.00	Details Enclosed
12	L-for canals only	NIL	
	a) Earth work		
	b) Lining		
	c) Service roads		
13	M-Plantation	20.00	Details Enclosed
14	N- Tank and Reservoir	NIL	
15	O- Miscellaneous	72.00	Details Enclosed
16	P- Maintanance		
	0.5% of cost of I - works less(A+B+M+O+Q+X+Y))	366.97	
17	Q- Special T and P	60.00	Details Enclosed
18	R- Communication	NIL	Details Enclosed
19	S- Power plant and Electrical system	NIL	
20	T- Water supply works(LS)	NIL	
21	U- Distributaries,Minors & sub minors	NIL	
22	V- Water courses and Field channels	NIL	
23	W- Drainage	NIL	
24	X- Environment and ecology	3756.00	Details Enclosed
25	Y- Loss on stock & Unforeseen		
	0.25% of I works less (A+B+M+O+Q+X+P))	183.48	
	Total cost of I works	**88625.68**	
II	Establishment (1 % of cost of I works less B - Land)	702.24	
III	Tools & Plants (1% of I works including B)	NIL	
IV	**Suspense**	NIL	
V	**Receipts and recoveries on capital account**		
	a) Recoveries on account of K-building 15 % salvage value of building cost.	NIL	

No.	Particulars	Total Rupees in Lakhs	Remarks
	b) Recoveries towards resale transfer of special T & P @ 75 % of machinery & 20% of cost of vehicle	NIL	
	Total Direct charges	**89327.92**	
	INDIRECT CHARGES		
	a) Capitalised value of abatement of land revenue(1 % of B land)	90.20	
	b)Audit and Account charges (0.5 % of cost of I works)	443.13	
	Total Indirect charges	**533.32**	
	TOTAL DIRECT AND INDIRECT CHARGES	**89861.24**	**Lakhs**
	GST	**9122.94**	
	TOTAL DIRECT AND INDIRECT CHARGES WITH GST	**98984.19**	
	Rounding off	**15.812**	**Lakhs**
	Total cost of the project with GST	**99000.00 Lakhs**	
		990.00 Crores	
(Rupees Nine Hundred and Ninety Crores Only)			

The graphical representation of the cost components are given hereunder:



18.5 Preparation of Estimates

The estimate for various components of the project work comprises of two parts. Firstly, the estimate of quantities for the identified items for each work and secondly the cost estimate which is based on rates for each item of work.

Further the estimates comprise of three major categories namely estimate for civil works and estimate of hydro mechanical works. There will be other components like project roads, buildings etc.

The estimate for quantities for civil works is based on the drawings prepared based on preliminary designs and assumptions.

In case of hydro mechanical works, the weight of gates & embedded parts and hoist capacities are worked out based on the empherical formulae provided in the schedule of Rates of W.R.D.O of Govt. Of Karnataka.

The rates for hydro mechanical works is based on S.R of W.R.D.O Government of Karnataka.

For each item of work, provision is made for contingency @ 3% and 2% towards work charged establishment.

The cost arrived at for each item is rounded off to the near rupee in Crores.

18.6 Detailed Estimates of Costs I - Works

I. Works

A. Preliminary

A provision of **Rs. 2073.70 lakhs** is made for charges for detailed survey, investigation, preparation of Designs, Drawings, Estimates and DPR, Third Party Quality Auditing etc and other preliminary works as required for the project.

B. Land

A provision of **Rs. 9019.54 lakhs** is made in the estimate towards Land acquisition for construction of Dam And allied works

C. WORKS

A provision of **Rs 70224.00 lakhs** is made in the estimate towards, construction of Dam and allied works

D. Regulator and Measuring Device

A provision of **Rs 2519.99 lakhs** is made towards Hydro Mechanical works of Dam, construction of spillway gates, river sluice gates, and Hydro Mechanical works.

E. Falls

No provision is made in the estimate.

F. CD Works

No provision is made in the estimate.

G. Bridges

No provision is made in the estimate.

H. Escapes

No provision is made in the estimate.

I. Navigation Works

No provision is made in the estimate.

J. Power Plant Civil Works

No provision is made in the estimate.

K. Buildings

A provision of **Rs 650.00 lakhs** is made in the estimate towards construction of office buildings and staff quarters in the project area.

L. Earthwork

No provision is made in the estimate as construction of canals is not envisaged in the present project

M. PLANTATION

A provision of **Rs. 20.00 lakhs** is made for planting trees along the periphery of the submergence area, approach roads and at colonies.

N. Tanks and Reservoirs

No provision is made in the estimate.

O. Miscellaneous

A provision of **Rs. 72.00 lakhs** is made in the estimate

P. Maintenance

At 0.5 % of cost of I - works less (A+B+M+O+Q+X+Y), a provision of **Rs. 366.97 lakhs** is made in the estimate.

Q. Special Tools and Plants

A provision of **Rs. 60.00 lakhs** is made in the estimate

R. Communications

No provision is made in the estimate.

S. Power Plant and Electrical Mechanical System

No provision is made in the estimate

T. Water Supply Works

No provision is made in the estimate.

U. Distributaries Minors and Sub-Minors

No provision is made in the estimate.

V. Water Courses

No provision is made in the estimate.

W. Drainage and Protective Works

No provision is made in the estimate.

X. Environment and Ecology

A provision of **Rs. 3756.00 lakhs** is made towards Catchment area treatment, restoration of land, public health measures,control of acquatic weeds and supply of here fuel wood for workers

Y. Losses of Stock

A provision of **Rs. 183.48 lakhs** is made in the estimate at 0.25% of the cost of I – works less A, B,O,M,P,Q and X as per CWC guidance.

Total of I Works – Rs. 88625.68 lakhs

18.7 Detailed Estimates of Costs II - Establishment

The project will be executed by existing set up of KNNL offices. A provision of **Rs 702.24 lakhs** is made towards Establishment charges i.e. 1 % of total I works

18.8 Detailed Estimates of Costs III – Tools & Plants

Small T&P 1% OF I - Works

No provision is made in the estimate

18.9 Detailed Estimates of Costs IV - Suspense

No provision is made in the estimate.

18.10 Detailed Estimates of Costs V – Receipts and Recoveries on Capital Account

a) Recoveries on account of K – Building at 15% salvage value of building cost	-Nil-
b) Recoveries towards resale, transfer of special T & P @ 75% of machinery and 20% of cost of vehicle	-Nil-

18.11 Direct and Indirect charges

Total Direct Charges

A provision of **Rs. 89327.92 lakhs** is made in the estimate.

Indirect Charges

a) Audit and accounts charges (1% of I – works)	Rs 90.20 lakhs
b) Capitalized value of abatement of land revenue (5% of the cost of B lands)	Rs 443.13lakhs

Total Indirect Charges

A provision of **Rs. 533.32 lakhs** is made in the estimate

Total Direct and Indirect Charges

Rs. 89861.24 Lakhs

Grand Total

Rs. 99000.00 Lakhs

Say 990.00 Crores

Refer **Addendum-3** for A to Z Abstracts.

Chapter 19
Financial Resources

19.1 Present Position of the Scheme Regarding its Inclusion in the Plan – Concurrence of the State Planning Finance Department

As a measure to conserve water and also to meet industrial needs besides feeding the selected tanks in Ghatapraba basin, Government of Karnataka is planning to build a reservoir across river Markandeya near Ghatti Basavanna. The total outlay of the project as per the preliminary estimate prepared based on the current Schedule of Rates 2018-19 extended for 2019-20 is estimated to be **Rs.990.00 Crores**.

Consequent to the approval of the scheme, Government of Karnataka would like to make provision for a special outlay in their budget in order to meet the project expenses over a period of two years. To that extent, the State Planning Finance Department of Government of Karnataka will be approached to get the necessary financial outlay.

19.2 Provision for the Sector / for the Scheme in the Plan

Consequent to the approval of the scheme by the statutory authority such as CWC, and also from Ministry of environment Forest and Climate Change, the project implementation agency / authority will revise the estimate and update the same to the current year of Schedule of Rates before start of implementation.

The revised estimate will be presented to the State Planning Finance Department of Government of Karnataka for giving its concurrence and obtain necessary project funds. Besides, the extent of project funding approved by the Finance Department will be allocated in the budget of the respective year.

19.3 Central / Foreign Aid Contemplated, If Any

The present project envisaged by the Government of Karnataka meets the basic requirement of common man such as, drinking water and ecology and environment conservation. As such, it is the responsibility of the Government of Karnataka to ensure when such projects are implemented, necessary funds are allocated.

To that extent, Government of Karnataka is committed and hence necessary allocation will be made in the budget for the speedy implementation of the project.

19.4 Information on Similar / Related Pending Projects in the State, Their Status. Stage / Percentage of Completion, Percentage of Expenditure Incurred and Average Annual Expenditure by the state on these Projects Put Together Year-Wise During the Last 5 Years

Not applicable.

19.5 Commitment on the Work in Progress in the Plan and Allocation Available for Starting New Scheme

As narrated in the earlier paragraph, looking into the need for meeting the basic requirement such as drinking water and improving the Ecology and Environment, Government of Karnataka is likely to earmark necessary budget to meet the initial project expenses and also the entire project cost. Government of Karnataka will definitely initiate action in making further allocation for the speedy implementation of the project.

19.6 Effect of Inclusion of the Scheme in the Plan on the Schedule of Other Works in Progress Budget Staff, etc

Government of Karnataka has excellent track record in terms of managing the revenue and also allocating the budgets for projects of national importance and projects which will meet the basic needs of the people.

Hence, while allocating the necessary budget, it will be ensured that other on-going similar projects will not be disturbed due to the inclusion of this and to that extent necessary provision will be made.

19.7 Requirement of Funds for the Scheme and its Yearly Phasing as in Project Report

The project is proposed to be completed in a span of two years and accordingly the budget will be as under:

No	Year	Amount in INR Crores
1.	First Year	288.03
2.	Second Year	480.05
3.	Third Year	221.92
	Total	**990.00**

19.8 Adequate / Strengthening of Organizational Set Up for Execution for all Projects Together as Contemplated

KNNL, the nodal agency for executing the projects in the Ghataprabha basin will be the implementing agency. Under this, it is proposed to have a separate zone for the said project headed by the Chief Engineer and assisted by Superintending Engineers, Executive Engineers and Asst. Executive Engineers. Refer**Figure 15.1: Organisation Chart**

19.9 Advance Action Proposal for Starting the Preliminaries of the Project, If Any

Government of Karnataka is likely to allocate required amount in their budget for the current year in order to carry out the preliminary activities such as preparation of detailed Project Report and other appurtenant activities.

Chapter 20
Revenues

20.1 Basis of Profitability Analysis

- The profitability of the project is calculated based on "With and without" concept..
- The analysis is based on annualized cost and benefit.
- Full "Free market" conditions are assumed. This means that all the labour and material costs of both inputs and outputs are at their opportunity cost and so no shadow pricing is done.
- Profitability index is used in BC ratio, which is defined as the ratio of annual benefit to annual cost.
- While implementing the Ghatti Basavanna Project, the following facts are to be considered in the profitability analysis.
- Construction of Dam with Sluice and appurtenant structures
- Acquisition of 734.64 Ha of land which is going to be submerged.
- The R & R component involved with land acquisition and resettlement of villages.

20.2 Annual Benefits

Annual benefits will be worked out in terms of meeting the drinking water and industrial needs.

20.3 Cost Component Considerations

20.3.1 General

While implementing Schemes, the following costs are to be apportioned into each scheme in proportion to the respective Irrigated Command Area. The various costs and other pertinent information are:

- The land coming under submersion is 670.88 Ha, which is to be acquired. The cost of land coming under submergence is **Rs 5920.27 Lakhs**
- The R&R component involved will be for land acquision and resettlement of villages costing **Rs 1770.00 lakhs**
- Cost of construction of Concrete dam and related appurtenant structures including river bed sluice at a cost of **Rs 70224.00 Lakhs**

20.3.2 Operation and Maintenance (O&M) Charges

The present rate of operation and maintenance per TMC of potential (inclusive of establishment) considered is 0.5 to 1.50 % of the works portion

20.4 Annual Cost Details

- The Capital recovery of civil works is taken as 1% depreciation plus 10% interest (With the existing economic condition 8% interest should be sufficient. However 10% is used as a convention).
- The capital recovery of hydro mechanical components is again considered as depreciation as per norms mentioned above plus 10% interest on capital cost.
- Taxes being only transferred payment are deleted for the cost in calculating economic indices.
- The cost of the land is included in computing the annual cost. So the annual benefit foregone from this land is not considered to avoid double counting..

Chapter 21
B.C.Ratio, Financial Return and Internal Rate of Return

Ghatti Basavanna Drinking water project is envisaged to be developed in single stage for ensuring speedy implementation of the project so as to meet the drinking water needs of the people in Gokak taluk and other identified taluks falling under Ghatapraba basin..

The revenue from the project is contemplated only in terms of cost towards drinking water supply to municipalities and industries. Accordingly, the following parameters have been considered while arriving at the value of the gross revenue generated from the project.

No.	Particulars	Unit	Quantity	Rate in Rs Lakhs	Amount / Revenue in Lakhs per annum
1	Drinking Water charges	MCUM	78.160	150.00	11724.48
2	Industry water charges	MCUM	14.160	400.00	5664.00
				Total	**17388.48**

B C Ratio and IRR

The financial feasibility of the project is examined through the financial indicators such as NPV, FIRR and B/C ratio. For a project to be feasible, the NPV value at the defined discount rate should be '0' or greater than '0'. The Internal Rate of Return should be more than the lending rates of financial institutions which are normally in the range of 10 to 12%. The Benefit cost ratio shall be more than 1.0 at the predefined discounted rate.

Based on the above guidelines, the financial feasibility in terms of NPV, FIRR and B/C ratio has been worked out for a total duration of 50 years including 4 years construction period. The analysis has resulted in following:

4. NPV at 10% discount rate is Rs. 51593.4 Lakhs which is greater than 0
5. Financial Internal Rate of Return (FIRR) is 16.34% which is greater than 12.0%
6. B/C ratio is **1.54** which is greater than 1.0

The detailed analysis is furnished as **Appendix 9.**

Chapter 22
Future Utilization of Facilities Created (Buildings)

Most of the facilities such as buildings, accessibility, communication network, treatment plants (STP & WTP) and other infrastructures will be located above the FRL and the same will be retained after carrying out minimum repairs and maintenance and utilized during O & M.

Chapter 23
Conclusion and Recommendations

23.1 Conclusion

The present proposal of Ghatti Basavanna Drinking water Project in its entirety helps in achieving the following objectives envisaged.

- To facilitate in creating storage to meet the Drinking water requirements of Gokak town and surrounding villages, taluks in the Ghataprabha Basin within Karnataka.
- To meet the industrial water requirement in and around Gokak taluk.
- To feed selected tanks in and around Gokak town to facilitate sustaining livestock and recharging of underground water.
- To protect the Gokak town from inundation during peak floods in Markandeya River.

23.2 Recommendation

23.2.1 General

The project involves construction of conventional civil structures as detailed below. The project construction work is recommended to be taken up on fast track basis and construction shall be completed in a period of 18 months including 6 months for development of infrastructurefacilities.

The project component includes:

- Civil works comprising of Dam and appurtenant works
- Related Infrastructure and rehabiltisation of 2 temple s.

23.2.2 Preliminary and Pre Construction Works

To ensure project completion in 18 months, it is essential to accomplish the following activities in a period of 3 months before start of Main Civil works. However some of the activities will continue during project phase. The following main activities are required for preconstruction and construction phases of the project:

- Techno economic Clearance
- Pre-construction investigation
- Environment, Forest and other statutory clearances
- Acquisition of land
- Completion of main infrastructure facilities such as roads and buildings.
- Completion of detailed design and specifications

- Financial Closure
- Tender and Award of main Civil and Hydro Mechanical works including related infrastructure works.
- Commissioning related activities.

23.2.3 Civil & Hydro Mechanical Works

For completion of the Civil & Hydro Mechanical works, the total time proposed is 18 months. Adequate construction equipment planning has been done to achieve the desired progress rates.

Timely completion of construction works also depends on the timely supply of construction material to Diversion site, through existing approach roads. Sufficient storage shall be ensured at project site to ensure continuous construction and implementation within the schedule.

23.2.4 Construction Power

Availability of adequate construction power plays a major role in the scheduled completion of construction works. Construction power required for various components shall be mainly arranged by contractors. Power for project offices and colony shall be supplied through dedicated D.G.Sets. However, if power is available in the local grid the same shall also be utilized for construction of the project.

23.2.5 Project Cost

The total cost of the Ghatti Basavanna Drinking water Project is worked out to be **Rs.990.00 Crores.**

23.2.6 Recommendation

The proposed Ghatti Basavanna Drinking water Project, on implementation will serve these major purposes for which it has been envisaged.

- Assured supply of drinking bwater to all the people envisaged in the project within Ghatapraba basin.
- Assured supply of water to industries located within Gokak Taluk and surrounding areas.
- Help in augmenting the tank filling scheme and recharge of under ground water table.
- Supply of assured quantum of water for sustaining live stock.
- Improving the ecology and environment of the river basin.
- Creation of job opportunities and the location will be an important tourist destination.

Ghatti Basavanna Drinking water Project with an FRL of 618.00 m and having a storage capacity of 6 TMC proposed in this DPR is techno-economically viable and the project is recommended for implementation.

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Executive Engineer,
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Gokak

Superintending Engineer,
KNNL, GRBCC Circle.
Hidkal Dam.

Chief Engineer,
KNNL, Irrigation (N) Zone.
Belagavi.

KARNATAKA NEERAVARI NIGAM LIMITED

GHATTI BASAVANNA DRINKING WATER PROJECT

CONSTRUCTION OF GHATTI BASAVANNA DAM ACROSS MARKANDEYA RIVER
IN GOKAK TALUK, BELAGAVI DISTRICT, KARNATAKA

DETAILED PROJECT REPORT

VOLUME - I

Addendum -1

Abstract Cost Estimate

(A to Z Cost as per CWC format)

Owner:Karnataka Neeravari Nigam Limited

Ghatti Basavanna Drinking water Project
Detailed Project Report

KARNATAKA NEERAVARI NIGAM LIMITED
GHATTI BASAVANNA DRINKING WATER PROJECT
CONSTRUCTION OF GHATTI BASAVANNA DAM ACROSS MARKANDEYA RIVER IN GOKAK TALUK, BELAGAVI DISTRICT, KARNATAKA
GENERAL ABSTRACT
AS ADOPTED BY THE TECHNICAL ADVISORY COMMITTEE OF CWC

Sl. No.	Particulars	Amount Rupees in Lakhs	Remarks
I	**Direct Charges of Works**		
1	A- Preliminary	1753.70	
2	B- Land	9019.54	
3	C- Works	70224.00	
4	D- Regulators	2519.99	
5	E- Falls(for canals only)	NIL	
6	F- Cross Drainage works(for canals only)		
7	G- Bridges (for canals only)		
8	H- Escapes		
9	I- Navigation works	NIL	
10	J- Power plants civil works	NIL	
11	K- Buildings	650.00	
12	L-for canals only	NIL	
	a) Earth work		
	b) Lining		
	c) Service roads		
13	M-Plantation	20.00	
14	N- Tank and Reservoir	NIL	
15	O- Miscellaneous	72.00	
16	P- Maintanance		
	0.5% of cost of I - works less(A+B+M+O+Q+X+Y)	366.97	
17	Q- Special T and P	60.00	
18	R- Communication	NIL	
19	S- Power plant and Electrical system	NIL	
20	T- Water supply works(LS)	NIL	
21	U- Distributaries,Minors & sub minors	NIL	
22	V- Water courses and Field channels	NIL	
23	W- Drainage	NIL	
24	X- Environment and ecology	3756.00	
25	Y- Loss on stock & Unforeseen		
	0.25% of I works less (A+B+M+O+Q+X+P)	183.48	
	Total cost of I works	**88625.68**	
II	Establishment (1% of cost of C-Works)	702.24	
III	Tools & Plants (1% of I works including B)	NIL	

Consultant: E I Technologies Pvt. Ltd.

Owner:Karnataka Neeravari Nigam Limited

Ghatti Basavanna Drinking water Project
Detailed Project Report

Sl. No.	Particulars	Amount Rupees in Lakhs	Remarks
IV	Suspense	NIL	
V	Receipts and recoveries on capital account		
a)	Recoveries on account of K-building 15% salvage value of building cost.	NIL	
b)	Recoveries towards resale transfer of special T & P @ 75% of machinery & 20% of cost of vehicle	NIL	
	Total Direct Charges	89327.92	
VI	Indirect Charges		
a)	Capitalised value of abatement of land revenue (1% of B-Lands)	90.20	
b)	Audit and Account charges (0.5% of cost of I works)	443.13	
	Total Indirect Charges	533.32	
	Total Direct and Indirect Charges	89861.25	
VII	GST	9122.94	
	Total Direct and Indirect Charges with GST	98984.19	
	Rounding off	15.806	
	Total cost of the project with GST	99000.00 Lakhs	
		990.00 Crores	
Rupees Nine Hundred Ninety Crores Only			

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Superintending Engineer,
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Hidkal Dam.

Chief Engineer,
KNNL, Irrigation (N) Zone.
Belagavi.

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Consultant: E I Technologies Pvt. Ltd.

KARNATAKA NEERAVARI NIGAM LIMITED
GHATTI BASAVANNA DRINKING WATER PROJECT
CONSTRUCTION OF GHATTI BASAVANNA DAM ACROSS MARKANDEYA RIVER IN GOKAK TALUK, BELAGAVI DISTRICT, KARNATAKA

A-PRELIMINARIES

Sl. No.	Description	Amount (Rs. in Lakhs)	Remarks
PREPARATION OF DETAILED PROJECT REPORT AND EIA/EMP STUDIES			
1	Consultancy services for detailed survey, investigation, preparation of Feasibility report, Detailed project report, power potential studies, detailed designs, drawings, estimates and bid documents	498.00	
2	Consultancy services for preparation of Detailed project report as per CWC guidelines, liasioning with all directorates of CWC for obtaining clearance, land acquisition, R& R studies, formation of RC centered, preparation of designs, drawings, estimates, detailed project report and bid documents for rehabilitation works	489.70	
3	Consultancy services for preparation of EIA/EMP report	170.00	
4	Estimate for Consultancy services for obtaining forest clearance	198.00	
5	Consultancy services for dam break analysis, preparation of inundation maps and preparation of emergency action plan	118.00	
	Total	**1473.70**	
PREPARATION OF DETAILED CONSTRUCTION DRAWING DURING CONSTRUCTION			
6	Mobilisation/demobilisation of Technical experts, Geotechnical investigation equipments, topographical survey equipments, etc., all inclusive for detailed survey, investigation, preparation of Designs, construction drawings, detailed estimates, preparation of bid documents, preparation of land acquisition, R & R proposals, designs of RC centres, preparation of Bid documents, Tender evaluation for construction of Dam and Allied works. 0.5 % of the cost of work portion.	180.00	

Sl. No.	Description	Amount (Rs. in Lakhs)	Remarks
QUALITY CONTROL AND PMC			
7	Quality control, PMC and Model studies. 0.50% of the cost of work portion.	100.00	
	Total	1753.70	
	Add 18% GST	315.67	
Rupees Seventeen Crore Fifty Three Lakh(s) Seventy Thousand Only			
COST OF A-PRELIMINARIES Rs. 1753.70 LAKHS			

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CONSTRUCTION OF GHATTI BASAVANNA DAM ACROSS MARKANDEYA RIVER IN GOKAK TALUK, BELAGAVI DISTRICT, KARNATAKA

B-LANDS - Dam and Allied Works

Details of land acquisition

Sl. No.	Details of land	Area		Remarks
1	**Total area of submergence**	**670.88**	**Ha**	
1.1	Area of submergence in Reserved forest	587.07	Ha	
1.2	Area of submergence in Revenue land	83.81	Ha	
2	**Land required for seating of dam**	**3.35**	**Ha**	
2.1	Forest Land	1.30	Ha	
2.2	Revenue Land	2.05	Ha	
3	**Land required for construction of Dam office and Guest house**	**4.57**	**Ha**	
3.1	Forest Land	4.57	Ha	
4	**Land required for construction of View point**	**8.57**	**Ha**	
4.1	Forest Land	8.57	Ha	
5	**Land required for construction of WTP & Colony**	**3.04**	**Ha**	
5.1	Revenue Land	3.04	Ha	
6	**Land required for construction of Project roads**	**23.03**	**Ha**	
6.1	Total length of road in forest land = 10500.0 m			
	Width of road = 15.00 m			
	Total area in forest land	13.78	Ha	
6.2	Total length of road in revenue land = 4200.0 m			
	Width of road = 15.00 m			
	Total area in revenue land	9.25	Ha	
7	Land required for Retaining wall	**0.36**	**Ha**	
	Forest land	0.24		
	Non Forest land .	0.12		
8	Land Required for steps	**0.84**	**Ha**	
	Forest land	0.84		
9	Land Required for rehabilitation center	**20.00**	**Ha**	
	Forest land			
	Non Forest land .	20.00		

	Total area of acquisition in Forest land		616.37	Ha	
	Total area of acquisition in Revenue land		118.27	Ha	
	Total extent of land to be acquired		734.64	Ha	
I	DAM AND ALLIED WORKS				
Sl. No.	Particulars	Unit	Quantity (Ha)	Rate (Rs. in Lakhs)	Amount (Rs. in Lakhs)
1	Acquisition of land for seating of Dam and Reservoir submergence etc.,				
	i) Revenue Land	Ha	118.27	13.20	1561.16
	ii)Alternative/compensatory revenue land for afforestation*	Ha	616.37	8.20	5054.23
2	i)Compensation for other properties in submergence area. 70 families will be displaced, each family to be paid average of Rs. 25,000/-	Nos	70.00	0.25	17.50
	ii) Temples and Masjids	Ha	1.00	20.00	20.00
3	Cost of standing crops	Ha	118.27	0.20	23.65
4	Solatium charges for compulsory acquisition for 15% of the cost of revenue land				234.17
5	Establishment charges at 6.25%of revenue land cost				97.57
6	Interest rate between award and actual payment @ 12% on cost of revenue land per anum, for 1 years				187.34
7	Litigation charges at 2.5 % of revenue land cost				3.90
8	Relocation of communications like roads, telegraphic etc (lum sum considered)				25.00
9	Joint measurement charges and rounding				25.00
				Total	7249.54
	COST OF B-LANDS FOR DAM AND ALLIED WORKS Rs. 7249.54 LAKHS				

*- Compensatory afforestation considered for 616.37 Ha at Rs. 4,10,000/- per Ha x twice the area of forest diversion (degraded forest)

IMPLEMENTATION OF REHABILITATION AND RESETTLEMENT PLAN

R& R PACKAGE AS PER THE NATIONAL POLICY ON R & R -2007

Sl. No.	Particulars	Cost (Rs. in Lakhs)	Remarks
1	Cost of Acquisition of Structures (70 Structures @ Rs. 10.0 lakhs per str)	700.00	
2	Cost of providing infrastructure facilities	450.00	
3	Cost of Benefits to PAFs	300.00	
4	Staff payment of RO office	300.00	
	Total	**1750.00**	
	Miscellaneous and rounding off	20.00	
	Grand Total	**1770.00**	

Grand Total= 7249.54 + 1770.00

= 9019.54 Lakhs

= 90.20 Crores

Rupees Ninety Crore Nineteen Lakh(s) Fifty Four Thousand Only

COST OF B-LANDS Rs.9019.54 LAKHS

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KARNATAKA NEERAVARI NIGAM LIMITED
GHATTI BASAVANNA DRINKING WATER PROJECT
CONSTRUCTION OF GHATTI BASAVANNA DAM ACROSS MARKANDEYA RIVER IN GOKAK TALUK, BELAGAVI DISTRICT, KARNATAKA

C-WORKS

Sl. No.	Description	Amount (Rs. in Lakhs)	Remarks
1	Construction of Dam and Allied works	70224.00	Details enclosed- Refer page 398 of Volume II
	Total	70224.00	
	Add 12% GST	8426.88	
Rupees Seven Hundred And Two Crores Twenty Four Lakhs Only			
COST OF C-WORKS Rs. 70224.00 LAKHS			

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D-REGULATORS

Sl. No.	Description	Amount (Rs. in Lakhs)	Remarks
1	Hydro mechanical works of Dam - Construction of spillway gates, river sluice gates	2519.99	Details enclosed- Refer page 427 of Volume II
	Total	2519.99	
	Add 12% GST	302.40	
ees Twenty Five Crore Nineteen Lakh(s) Ninety Eight Thousand Five Hundred Ten And Paise Fifty Seven			
COST OF D-REGULATORS Rs.2519.99 LAKHS			

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K - BUILDINGS

Sl. No.	Particulars	Nos.	Plinth Area Sqmt	Rate per Sqmt. Rs. In Lakhs	Amount (Rs. in Lakhs)	Remarks
I.	**Non - Residential Buildings**					
1	Executive Engineer office	1	20.00	1.75	35.00	
2	Asst. Executive Engineer office	1	20.00	1.75	35.00	
3	QC laboratory	1	20.00	1.75	35.00	
4	Hospital	1	15.00	2.00	30.00	
5	Information centre	1	15.00	2.00	30.00	
6	SCADA remote control operation Building	1	15.00	2.00	30.00	
	Total for Non-Residential buildings				**195.00**	
II.	**Residential Buildings**					
7	Inspection bunglow	1	50.00	2.00	100.00	
8	Residential quarters- A Type	1	20.00	2.00	40.00	
9	Residential quarters- B Type	2	15.00	2.00	60.00	
10	Residential quarters- C Type	4	15.00	2.00	120.00	
11	Residential quarters- D Type	4	12.50	2.00	100.00	
	Total for Residential buildings				**420.00**	
III	**Miscellaneous works**					
12	Land levelling				25.00	Lump sum considered
13	Fencing around the colony				10.00	
	Total				**35.00**	
	Grand Total				**650.00**	
	Add 12% GST				**78.00**	
	Rupees Six Crore Fifty Lakh(s) Only					
	COST OF K- BUILDINGS Rs. 650.00 LAKHS					

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KARNATAKA NEERAVARI NIGAM LIMITED
GHATTI BASAVANNA DRINKING WATER PROJECT
CONSTRUCTION OF GHATTI BASAVANNA DAM ACROSS MARKANDEYA RIVER IN GOKAK TALUK, BELAGAVI DISTRICT, KARNATAKA

M-PLANTATION - Dam and Allied Works

Sl. No.	Particulars	Unit	Quantity	Rate (Rs. in Lakhs)	Amount (Rs. in Lakhs)
1	Plantation along the periphery of the submergence area	Km	35.00	0.50	17.50
2	Plantation along the approach road	Km	1.70	0.50	2.20
				Total	**19.70**
				Say	**20.00**
Rupees Twenty Lakh(s) Only					
COST OF M-PLANTATION Rs. 20.00 LAKHS					

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GHATTI BASAVANNA DRINKING WATER PROJECT
CONSTRUCTION OF GHATTI BASAVANNA DAM ACROSS MARKANDEYA RIVER IN GOKAK TALUK, BELAGAVI DISTRICT, KARNATAKA

O - MISCELLANEOUS - Dam and Allied Works

Sl. No.	Items	Unit	Quantity	Rate in (Rs.)	Amount in (Rs.)
1	Capital cost				
2	Telegraphs and Telephone Equipments	No	30.00	3000.00	90,000 / -
3	Maintenance and service	Job	1.00	50000.00	50,000 / -
4	Wireless/mobile phones at all sites & one near Dhavaleshwar & one @intermediate pumping station 7 division office.	No	3.00	10000.00	30,000 / -
5	Electrification	Job	1.00	500000.00	5,00,000 / -
6	Water supply	Job	1.00	100000.00	1,00,000 / -
7	Sewage disposal	Job	1.00	100000.00	1,00,000 / -
8	Fire fighting equipments	Job	1.00	200000.00	2,00,000 / -
9	Maintenance and service	Job	1.00	100000.00	1,00,000 / -
10	Electrification	Job	1.00	300000.00	3,00,000 / -
11	Water supply	Job	1.00	500000.00	5,00,000 / -
12	Sewage disposal	Job	1.00	500000.00	5,00,000 / -
13	Security	Year	3.00	200000.00	6,00,000 / -
14	Fire fighting equipments	Year	3.00	25000.00	75,000 / -
	Other items				
1	Visit of dignitaries.	LS			5,00,000 / -
2	Records	LS			2,00,000 / -
3	Compensation to work men	LS			3,00,000 / -
4	Boundary marking	LS			5,00,000 / -
5	Models	LS			10,00,000 / -
6	Publicity	LS			5,00,000 / -
7	Providing flood warning system	LS			5,00,000 / -
8	Retrenchment	LS			5,00,000 / -
				Total	**71,45,000 / -**
				Say	**72,00,000 / -**
Rupees Seventy Two Lakh(s) Only					
COST OF O- MISCELLANEOUS DAM WORKS Rs. 72.00 Lakhs					

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GHATTI BASAVANNA DRINKING WATER PROJECT
CONSTRUCTION OF GHATTI BASAVANNA DAM ACROSS MARKANDEYA RIVER IN GOKAK TALUK, BELAGAVI DISTRICT, KARNATAKA

Q- SPECIAL TOOLS AND PLANTS - Dam and Allied Works

Sl. No.	Description	Amount (Rs. in Lakhs)	Remarks
1	Vehicle required for KNNL officials - 4 Nos @15.0 Lakhs	60.00	
	Total	60.00 Lakhs	
Rupees Sixty Lakh(s) Only			
COST OF Q- SPECIAL TOOLS AND PLANTS Rs. 60.00 Lakhs			

Assistant Executive Engineer,
KNNL, GRBCC Sub division No.5,
Gokak.

Executive Engineer,
KNNL, GRBCC Division No.3,
Gokak

KARNATAKA NEERAVARI NIGAM LIMITED
GHATTI BASAVANNA DRINKING WATER PROJECT
CONSTRUCTION OF GHATTI BASAVANNA DAM ACROSS MARKANDEYA RIVER IN GOKAK TALUK, BELAGAVI DISTRICT, KARNATAKA

X - ENVIRONMENT AND ECOLOGY - Dam and Allied Works

Sl. No.	Description	Amount (Rs. in Lakhs)
A.	**Construction Phase**	
1	Environmental safeguard measures to control air, noise and water pollution	20.00
2	Green belt development	8.00
3	Conservation of Schedule I species and RET species	7.00
4	Public health delivery system	8.00
5	Sanitation and Solid waste management plan	7.00
6	Environmental monitoring programme	15.00
	Total, A	**65.00**
B.	**Operation Phase**	
1	Catchment area treatment plan	100.00
2	Local area development plan	40.00
3	Green belt development	12.00
4	Fisheries conservation and management plan	20.00
5	Environmental monitoring programme	7.00
6	Reservoir RIM Treatment	10.00
7	Energy conservation measures	25.00
8	Net Present Value+	3476.33
	Total, B	**3690.33**
	Grand Total, (A+B)	**3755.33**
	Roundig off	0.67
	Grand Total	**3756.00**
Rupees Thirty Seven Crore Fifty Six Lakh(s) Only		
COST OF X - ENVIRONMENT AND ECOLOGY FOR DAM WORKS Rs. 3756.0 LAKHS		

+ - NPV considered for Tropical dry deciduous forest and thorn forest (Open forest) for 616.37 Ha at Rs. 5,64,000/- per Ha

Assistant Executive Engineer,
KNNL, GRBCC Sub division No.5,
Gokak.

Executive Engineer,
KNNL, GRBCC Division No.3,
Gokak

KARNATAKA NEERAVARI NIGAM LIMITED

GHATTI BASAVANNA DRINKING WATER PROJECT

CONSTRUCTION OF GHATTI BASAVANNA DAM ACROSS MARKANDEYA RIVER
IN GOKAK TALUK, BELAGAVI DISTRICT, KARNATAKA

DETAILED PROJECT REPORT

VOLUME - I

Addendum -2

GO for Adminitrative Approval for the
Detailed Project Report

TRANSLATED COPY

Proceedings of the Government of Karnataka

Subject: According Administrative approval for the Detailed Project Report of Ghatti Basavanna Drinking Water Supply Project in Gokak Taluk, Belagavi District for Rs. 990 Crores-reg.,

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Reference:

1. Managing Director, Karnataka Neeravari Nigam Ltd letter no. KNNL/ICZ/Ghatti Basavanna/13/2020/1672, Dated: 07.08.2020
2. Managing Director, Karnataka Neeravari Nigam Ltd letter no. KNNL/ICZ/Ghatti Basavanna/13/2020/1775, Dated: 10.08.2020
3. Managing Director, Karnataka Neeravari Nigam Ltd letter no. KNNL/ICZ/Ghatti Basavanna/13/2020/3688, Dated: 03.11.2020

Preamble:

The Managing Director, Karnataka Neeravari Nigam Ltd vide letter reference no. (1) and (2) reported that, the project progress review meeting was held on 25.05.2020 and 26.05.2020 at Belagavi under the Chairmanship of Hon'ble Minister for Water Resource Department. During the meeting, Hon'ble Minister instructed to take up Ghatti Basavanna Drinking Water Supply Project in Gokak Taluk, Belagavi District by constructing a barrage across Markandeya river for providing drinking water facilties to Gokak and other surrounding villages.

The Managing Director further reported that, under the project, it is proposed to construct the dam across Markandeya river after the confluence point with Bellary Nala to store 5.96 (About 6 TMC) including 2.76 TMC allocated for drinking water to Gokak and other 131 surrounding villages including villages of Hukkeri, Bailahongal and Saudatti Taluks.

Further, the Managing Director vide letter reference (1) and (2) reported that, it is a multi-purpose project and apart from providing drinking water facilities, it is also proposed to fill minor irrigation tanks, providing water to industrial needs and to protect the Gokak town from floods of Markandeya river. Accordingly, the Detailed Project Report of Ghatti Basavanna Drinking Water Supply Project in Gokak Taluk, Belagavi District for Rs. 990 Crores (as per 2018-19 Standard Rates) has been prepared and the Managing Director requested for according Administrative approval for the Detailed Project Report.

EXECUTIVE ENGINEER,
KARNATAKA NEERAVARI NIGAM LIMITED
GRBCC DN. NO. 3, GOKAK

Vide letter reference (3), the project proposal was placed in the 69th Estimate Review Committee meeting held on 29.06.2020 and decided to place before the Karnataka Neeravari Nigam Ltd Board of Director meeting. The proposal was placed before the 93rd Board of Directors meeting held on 05.10.2020 and the Board has approved to take up the Ghatti Basavanna Drinking Water Supply Project for Rs. 990 Crores with a condition to obtain water allocation from the concerned authority. Based on the Board direction, the Managing Director, Karnataka Neeravari Nigam Ltd while submitting the proposal for according Administrative approval, it was informed that, the project requires 3 financial years for implementation and hence the financial allocation of Rs. 300 crores in the first year, Rs. 400 Crores in the second year and Rs. 290 Crores in the third year shall be earmarked.

The aforementioned proposal was reviewed and accordingly the following order has been issued;

Government order no. WRD 6 VIBYAMA 2020, Dated 24.11.2020

As explained in the preamble, the Administrative approval for the Detailed Project Report of Ghatti Basavanna Drinking Water Supply Project in Gokak Taluk, Belagavi District for Rs. 990 Crores is herewith accorded with a condition to incur maximum expenditure of Rs. 300 crores in the first year, Rs. 400 Crores in the second year and Rs. 290 Crores in the third year.

Further, the project has to be implemented by tender only after obtaining necessary clearances pertaining to Environmental Clearance, Forest Land and Water allocation.

The administrative approval has been issued with the consent of Finance Department Note No: FD 169 FC-1/2020 dt 03.08.2000 (E-office) dated 10.11.2020.

By order and in the name of
Governor of Karnataka
Sd/-
(Ravindra Konda)
Under Secretary to Government (Technical -4) (I/c)
Water Resource Department

EXECUTIVE ENGINEER,
KARNATAKA NEERAVARI NIGAM LIMITED
GRBCC DN. NO. 3, GOKAK

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2) The Principal Account General (E & R S A), Karnataka, Bangalore.
3) The Principal Account General (G & S S A), Karnataka, Bangalore.
4) Personal Secretary to Hon'ble Chief Minister, Vidhana Soudha, Bangalore.
5) Personal Secretary to Hon'ble Water Resource Minister, Vidhana Soudha, Bangalore.
6) Personal Secretary to Chief Secretary (Cabinet section), Vidhana Soudha, Bangalore (Cabinet Section No. C: 549, Dt: 12.01.2020).
7) Deputy Secretary to Government (Cabinet section), Vidhana Soudha, Bangalore (Cabinet Section No. C: 549, Dt: 12.01.2020).
8) Personal Secretaries to Additional Chief Secretary to Government, Vidhana Soudha, Bangalore.
9) Personal Secretary to Additional Chief Secretary to Government and Development Commissioner, Vidhana Soudha, Bangalore.
10) Personal Secretary to Additional Chief Secretary to Government, Finance Department, Vidhana Soudha, Bangalore.
11) Personal Secretary to Additional Chief Secretary to Government, Water Resource Department, Vikasa Soudha, Bangalore.
12) Personal Secretary to Secretary to Government, Water Resource Department, Vikasa Soudha, Bangalore.
13) Personal Assistant to Additional Secretary to Government, Water Resource Department, Vikasa Soudha, Bangalore.
14) Managing Director, Karnataka Neeravari Nigam Ltd, Bangalore.
15) Chief Engineer, Karnataka Neeravari Niagm Ltd, Irrigation North Zone, Belagavi.
16) Chief Engineer, Water Resource Development Organisation, Bangalore.
17) Special Officer and Deputy Secretary to Government, Public Works Department (Finance Cell), Vidhana Soudha, Bangalore.
18) Deputy Secretary to Government (KBJNL), Water Resource Department, Vikasa Soudha, Bangalore.
19) Director, State Huzar Treasury, Bangalore.
20) Director, State Gazette Department, Vikasa Soudha, Bangalore, 10 Copies.

EXECUTIVE ENGINEER,
KARNATAKA NEERAVARI NIGAM LIMITED
GRBCC DN. NO. 3, GOKAK

KARNATAKA NEERAVARI NIGAM LIMITED

GHATTI BASAVANNA DRINKING WATER PROJECT

CONSTRUCTION OF GHATTI BASAVANNA DAM ACROSS MARKANDEYA RIVER
IN GOKAK TALUK, BELAGAVI DISTRICT, KARNATAKA

DETAILED PROJECT REPORT

VOLUME - I

Addendum -3

GO for Water Allocation

TRANSLATED COPY

Proceedings of the Government of Karnataka

Subject: Water allocation to the Drinking water supply Project at Ghatti Basavanna in Gokak taluk of Belagavi district.

Reference:

1. GO No. WRD 6 VIBYAMA 2020 DATED 24.11.2020 and 06.01.2021
2. Managing Director, Karnataka Neeravari Nigam Limited, Letter No. KNNL/Irrigation (N)Zone/Ghatti Basavanna/13/2020/4409 dated 29/11/2021
3. Chief Engineer, Inter Sate water Dispute , Water Resource Department Organization letter No.WRD/Ghatti Basavanna DWS /AE/11/1359/2021 dated 25/01/2022

Preamble

Administrative approval was accorded vide ref (1) to the Drinking water supply Project at Ghatti Basavanna in Gokak taluk of Belagavi district.

2) The project envisages providing drinking water supply for Gokak and surrounding 131 villages and part of Saudatti, Hukkeri and Bailahongla Taluks. Further, the Ghatti Basavanna project is a multipurpose project which provides water for tank filling and industrial requirements. Hence, the total water utilization under this project will be 4.78 (3.38+0.5+0.30+0.60) TMC.

3) Under this scheme water allocated for drinking water purpose is 3.38 TMC (Consumptive use @ 20%-0.676 TMC), Industrial purpose is 0.5 TMC (Consumptive use @ 2.5%-0.0.0125 TMC), Evaporation losses is 0.30 TMC and for tank filling is 0.6 TMC of water is planned for utilization. The water requirement for tank filling i.e., 0.6 TMC is already included in allocation under Minor irrigation under KWDT-I. For utilization of remaining 4.18 TMC, consumptive use is 0.9885 TMC (0.676+0.0125+0.30). This is estimated as per the judgement of Krishna Water Dispute Tribunal. Hence, this additional allocation of 0.9885 TMC needs to be made.

4) As per the Krishna Dispute (Bachavath) Judgement 734 TMC is allocated to Karnataka. As per Godavari tribunal judgement the state of Andhra Pradesh is diverting 80 TMC of water from Godavari valley to Krishna valley under Pollavaram scheme. Hence, additional 21 TMC of water will be available to Karnataka in Krishna Basin Hence, as per the judgement of Bachavath and Godavari Tribunal the total allocation to Karnataka state in Krishna valley is0. 755 TMC.

5) Under the above allocation, provision for Drinking and household purpose is 3.25 TMC (1.50+1.75)

and industrial use is 2.25 (0.5+1.75) TMC is made.

6) The Managing Director, Karnataka Neeravari Nigam Limited has submitted a proposal for water allocation to Ghatti Basavanna Drinking Water Project to the Government vide Letter No. (2).

7) The Chief Engineer, Interstate water dispute, submitted a letter dated 17.04.2021 vide Letter No. 3 to Government regarding allocation of water to Ghatti Basavanna Drinking water Project. He has stated that Drinking water is a primary importance as per State and National water policies. Hence, there is a provision for allocating water to Ghatti Basavaana project under the 734 TMC allocation of Krishna waters under the judgement of Krishna water Dispute Tribunal (Bachavath). The opinion of CE, ISWD is also accepted and recommended by CE, WRDO, Bangalore.

8) Water requirement/allocation for Ghatti Basavanna Drinking Water Project i.e., 0.9885 TMC (consumptive use) under total allocation of 755 TMC to the state under Krishna Dispute (Bachavat) and Godavari Dispute Tribunal is reviewed by the Government.

Hence the following order is issued.

GO No. WRD 6 VIBYAMA 2020 DATED 24.02.2022.

As explained under the preamble, 0.9885 TMC (consumptive use) water allocation for utilization of 4.78 TMC to the Ghatti Basavanna Drinking Water Project in Gokak taluk of Belagavi District is made under total allocation of 755 TMC (Bachavath -734 TMC, Godavari Tribunal 21 TMC) to the State of Karnataka as per the judgement of Krishna water Dispute Tribunal (Bachavath) and Godavari Tribunal.

By order and in the name of Governor
of Karnataka

Sd/- (Veerendra K)
Under Secretary to Government (Technical -4)
Water Resource Department

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12) Chief Engineer, Water Resource Development Organisation, Bangalore.
13) Chief Engineer, Inter State Water Dispute, Water Resource Development Organization, Bangalore.
14) Technical Assistant, Water Resource Department, Vikasa Soudha, Bangalore.
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