# YETTINAHOLE PROJECT

## To lift 24.01 TMC of water for drinking purpose and ground water recharge by filling MI tanks from identified streams on the upper reaches of Western Ghats near Sakleshpur (West) to Kolar and Chikkaballapur districts (East) and other needy areas enroute

## Executive Summary

## 1. Aim of the Project

Drought prone districts in the eastern part of Karnataka such as Kolar and Chikkaballapur are frequently affected due to erratic rainfall and absence of any perennial source of water for drinking purposes for the populace as well as livestock in the region. It is a long standing demand of the people in the region that a permanent and dependable source need to be identified and these areas are supplied with drinking water. Furthermore, the ground water table in these regions has reached alarming depths due to over exploitation, as a consequence of which the available ground water is contaminated with harmful salts like Fluoride, Nitrate, etc. in excess of permissible level.

Government of Karnataka has considered the demand and initiated studies for mitigating the problem faced by the people of Kolar and Chikkaballapur. Various studies were undertaken to identify the source of water as well as supplying it to the districts concerned. During the course of such studies, one of the proposals which was considered apt to be taken up for further consideration was harnessing Yettinahole, Kadumanehole, Kerihole and Hongadahalla originating in the upper reaches of Western Ghats near Sakleshpura.

It is proposed to divert about 24.01 TMC of water from these streams only during the monsoon period from second week of June to November. The proposal is to divert the excess flow by constructing about 8 weirs restricting the height to avoid any submergence.

Government of Karnataka has given its Administrative approval to the said project vide its G.O No. ಜ ಸಂಇ-203-ವಿಭ್ಯಾಇ-2012 ದಿ 13.07.2012 for Rs. 8323.50 Crores.

The project aimed at providing safe drinking water to the drought prone areas of Kolar, Chikkaballapur and other needy areas en route along with filling up of MI tanks to recharge the ground water.

# 2. Description of the work

The said work of diversion of 24.01 TMC of water from streams located in the upper reaches of Western Ghats near Sakleshpura to the East comprises of the following:

## Phase – I (Lift components up to DC-4 near Haravanahalli)

Phase 1 component comprises of the following:

- Construction of 8 diversion weirs across Yettinahole, Kadumanehole, Kerihole and Hongadahalla streams at identified locations
- Construction of suitable Jack well cum pump houses at the identified locations
- Installation of pumping machinery of suitable capacities
- Construction of Raising mains of suitable diameter along the selected route
- Construction of Gravity main of suitable diameter along the selected route
- Construction of Delivery chambers

## Phase – II (Conveyance system beyond DC-4)

Phase 2 component comprises of the following

- Construction of Gravity canal for a length of 273+865 Km including an aqueduct of 12.5 Km to reach the proposed balancing reservoir at Bhairagondlu.
- Construction of storage reservoirs identified in the beneficiary taluks
- Construction of balancing reservoir at Bhairagondlu in Koratagere Taluk
- Construction of raising main from balancing reservoir at Bhairagondlu of length 45 Km to convey the water for Kolar, Chickaballapura and Bangalore rural districts
- Construction of feeder canals to supply required quantum of water to the beneficiary areas through dedicated feeder canals / conveyance system

# 3. Quantity of water that can be diverted (Divertible Yield)

There are many streams originating in Western Ghats which will drain into the sea after joining major river systems. For successful implementation of the proposed scheme, some of the streams carrying substantial flow during the monsoon season have been selected. The selected streams are **Yettinahole, Kadumane hole, Kerihole & Hongadahalla hole** originating in upper reaches of Western Ghats near Sakleshpura.

A detailed study was undertaken to arrive at the quantity of water than can be diverted from the selected streams.

The study indicates the quantum of water which can be diverted from the proposed weirs totals to 24.01 TMC at 50% dependability and 20.58 TMC at 90% dependability. The table showing the available yield at 50%, average and 90% dependability for the proposed scheme is indicated below:

| Weir | Pump Capacity | 90% dependable | | Average | | 50% dependable | |
|---|---|---|---|---|---|---|---|
| | | Inflow | Diversion | Inflow | Diversion | Inflow | Diversion |
| | cumecs | TMC | TMC | TMC | TMC | TMC | TMC |
| 1 | 26 | 6.08 | 5.68 | 8.14 | 6.89 | 7.99 | 6.62 |
| 2 | 4 | 0.90 | 0.85 | 1.20 | 1.04 | 1.18 | 1.02 |
| 3 | 5.5 | 1.22 | 1.16 | 1.64 | 1.42 | 1.60 | 1.40 |
| 4 | 3.5 | 0.93 | 0.85 | 1.25 | 1.01 | 1.23 | 0.98 |
| 5 | 6 | 1.72 | 1.52 | 2.30 | 1.80 | 2.26 | 1.73 |
| 6 | 5 | 3.02 | 1.82 | 4.05 | 2.04 | 3.97 | 2.01 |
| 7 | 30 | 6.91 | 6.52 | 9.26 | 7.96 | 9.09 | 7.76 |
| 8 | 9 | 2.60 | 2.19 | 4.31 | 1.26 | 4.23 | 2.51 |
| | **Total** | **23.38** | **20.58** | **32.15** | **23.42** | **31.54** | **24.01** |

## 4. Identification of beneficiaries

Along the alignment, there are several areas which are in need of drinking water due to absence of permanent source of water and scarcity on account of depleting water table. These areas have been identified and proposed to be brought under the present drinking water supply scheme. The below indicated table gives the details of area covered.

| No. | Name of District | Remarks | Population as per 2011-12 census in Lakhs |
|---|---|---|---|
| 1 | Chickmagalur | **Taluks:** Kadur Taluk (Kasaba hobli, Birur hobli, Hirenallur hobli) | 1.56 |
| 2 | Hassan | **Taluks:** Arsikere Taluk | 3.15 |

| No. | Name of District | Remarks | Population as per 2011-12 census in Lakhs |
|---|---|---|---|
| 3 | Tumkur | **Taluks:** Tumkur Taluk (Kora hobli), Chiknayakanahalli Taluk, Sira Taluk, Pavagada Taluk, Madhugiri Taluk, Koratagere Taluk, Tiptur Taluk (Kasaba hobli, Kibbanahalli hobli, Honnavalli hobli)**,** Gubbi Taluk (Chelur & Nittur Hobli **(villages coming under Hemavathy atchkat are not considered)** | 14.97 |
| 4 | Kolar | **Taluks:** Kolar Taluk, Srinivaspur Taluk, Malur Taluk, Bangarpet Taluk, Mulbagal Taluk | 15.36 |
| 5 | Chikkaballapura | **Taluks:** Chikkaballapura Taluk, Gauribidanur Taluk, Gudibanda Taluk, Bagepalli Taluk, Sidlaghatta Taluk, Chintamani Taluk | 12.55 |
| 6 | Bangalore Rural | **Taluks:** Nelamangala Taluk, Doddaballapur Taluk, Devanahalli Taluk, Hosakote Taluk | 9.91 |
| 7 | Ramanagara | **Taluks:** Ramnagara Taluk, Magadi Taluk, Channapatna Taluk, Kanakapura Taluk | 10.83 |
| | | **Grand Total** | **68.35 Lakhs** |
| | | | **6.83 Millions** |

**Note: - In addition to the above indicated population, the present proposal also envisages supplying water to:**

- Augment T.G.Halli and Hesarghatta reservoirs to take care of the deficit water supply needs of Bangalore, 2.50 TMC (1.70 + 0.80).
- Drinking water supply needs of Devanahalli industrial area and surrounding areas which is about 0.50 TMC.

# 5. Process of arriving at the total quantum of water

In order to arrive at the total quantum of water required for drinking water purpose, a scientific method has been adopted involving the following

1 Present population as per 2011 census.
2 Projecting the population up to 2043.
3 Adopting the requirement of water for towns, rural areas and livestock as per the CPHEEO manual.
4 Calculation of quantum of water as per the above.

The process involved considering the population of each identified town, village etc., falling under the beneficiary districts. The data has been obtained from the Directorate of Census Operations, Karnataka, Government of India. The Directorate has also done the projections of population from 1901 onwards for every ten year period using a mathematical formula used extensively for projecting population figure.

# 6. Allocation of water

The project proposal comprises of two components namely drinking water and tank filling. The main idea with which the project has been formulated is to take care of the drinking water needs of the identified areas. It is observed and established that the total quantum of water required for drinking water component (considering the projected population as on 2023-24) is about 15.029 TMC including augmentation of T.G.Halli and Hesarghatta reservoirs and drinking water supply to Devanahalli industrial area and surrounding areas.

This has resulted in balance availability of 8.981 TMC which has been planned to be utilized for tank filling component. However, the tank filling will be restricted to the identified MI tanks in Palar and Pennar basins and tanks in Arasikere taluk only and filling them to their 50% capacity (average). **Beyond 2023-24, it is necessary that the water being supplied to tank filling need to be curtailed and diverted for drinking water purposes.**

For drinking water component, storage reservoirs have been planned and the water will be fed to them. Further distribution from these storage reservoirs have to be taken up by concerned departments like KUWS & DB, RPED and Local bodies.

Regarding augmentation of water to T.G.Halli and drinking water to Ramnagara district, it is proposed to convey the water by providing an off take at Ch: 248.40 Km through a gravity canal of length 57.0 Km beyond which two tunnels are proposed, one to augment the requirement of T.G.Halli and other to carry the drinking water requirement of Ramnagara district which is led of into a valley which in turn joins Arkavati.

For areas falling under Palar and Pennar basins, the proposal considered distributing the water to the identified storages. Further, the water required for tank filling in these areas and Arasikere Taluk has also been considered for conveying and accordingly the distribution system has been designed.

1. Drinking water requirement has been arrived at 15.029 TMC considering the projected population up to 2023-24. Details are indicated below.

| No. | District | Drinking water requirement for the year 2023-2024 (Including Losses) (TMC) | Selected Taluks for Drinking water |
|---|---|---|---|
| 1 | Chikkamagalur | 0.267 | KadurTaluk (Only Kadur kasba, Birur and Singatagere) |
| 2 | Hassan | 0.512 | ArsikereTaluk |

| No. | District | Drinking water requirement for the year 2023-2024 (Including Losses) (TMC) | Selected Taluks for Drinking water |
|---|---|---|---|
| 3 | Tumkur | 2.433 | TumkurTaluk (Only Kora hobli), Chiknayakanhalli Taluk, Sira Taluk Pavagada Taluk, Madhugiri Taluk, Koratagere Taluk, Gubbi Taluk (Only Chelur & Nittur Hobli (villages coming under Hemavathy atchkat are not considered), TipturTaluk (Only Kasaba hobli, Kibbanahalli hobli, Honnavalli hobli) |
| 4 | Kolar | 2.842 | KolarTaluk, SrinivaspurTaluk, MalurTaluk, BangarpetTaluk, MulbagalTaluk |
| 5 | Chikkaballapur | 2.217 | ChikkaballapuraTaluk, GauribidanurTaluk, GudibandaTaluk, BagepalliTaluk, SidlaghattaTaluk, ChintamaniTaluk |
| 6 | Bangalore Rural | 1.924 | NelamangalaTaluk, DoddaballapurTaluk, DevanahalliTaluk, HosakoteTaluk |
| 7 | Ramnagara | 1.834 | RamnagaraTaluk, MagadiTaluk, ChannapatnaTaluk, KanakapuraTaluk. |
| 8 | Augumentation to T.G.halli Reservoir | 1.70 | |
| 9 | Augumentation to Hesarghatta Reservoir | 0.80 | |
| 10 | Drinking water supply to Devanahalli Industrial Area and surrounding areas | 0.50 | |
| | **Total** | **15.029 TMC** | |

2. Tank filling Requirement is worked out by considering 50% filling (average) of MI tanks as below;

| No. | Name of District/Taluk | Number of MI tanks | Total live capacity in Mcft | Average proposed filling @ 50% of the live capacity | | Remarks |
|---|---|---|---|---|---|---|
| | | | | Mcft | TMC | |
| **1** | **Hassan** | | | | | |
| | Arasikere | 34 | 1569.14 | 784.57 | 0.800 | |
| | **Sub total** | **34** | **1569.14** | **784.57** | **0.800** | |

| No. | Name of District/Taluk | Number of MI tanks | Total live capacity in Mcft | Average proposed filling @ 50% of the live capacity | | Remarks |
|---|---|---|---|---|---|---|
| | | | | Mcft | TMC | |
| 2 | **Tumkur** | | | | | |
| | Tumkur | 6 | 43.53 | 21.77 | 0.022 | |
| | Koratagere | 39 | 1932.98 | 869.84 | 0.870 | |
| | Madhugiri | 45 | 1873.63 | 843.13 | 0.843 | |
| | Pavagada | 23 | 1526.58 | 424.65 | 0.425 | |
| | **Sub total** | **113** | **5376.72** | **2159.39** | **2.160** | |
| 3 | **Kolar** | | | | | |
| | Kolar | 44 | 1966.55 | 786.66 | 0.787 | |
| | Malur | 11 | 530.65 | 212.26 | 0.212 | |
| | Bangarpet | 13 | 1113.75 | 436.91 | 0.437 | |
| | Mulabagal | 35 | 1045.34 | 418.14 | 0.418 | |
| | Srinivasapura | 35 | 523.81 | 209.52 | 0.210 | |
| | **Sub total** | **138** | **5180.10** | **2063.49** | **2.064** | |
| 4 | **Chikkaballapur** | | | | | |
| | Chikkaballapura | 21 | 997.01 | 398.80 | 0.399 | |
| | Bagepalli | 31 | 938.15 | 455.62 | 0.456 | |
| | Chintamani | 19 | 294.59 | 147.30 | 0.148 | |
| | Gudibande | 14 | 692.76 | 320.68 | 0.321 | |
| | Shidlaghatta | 25 | 1462.09 | 584.84 | 0.585 | |
| | Gowribidanur | 86 | 2418.7 | 967.48 | 0.967 | |
| | **Sub total** | **196** | **6803.30** | **2874.72** | **2.876** | |
| 5 | **Bangalore Rural** | | | | | |
| | Nelamangala | 2 | 14.67 | 7.34 | 0.007 | |
| | Doddaballapur | 7 | 151.72 | 75.86 | 0.076 | |
| | Devanahalli | 11 | 671.525 | 335.763 | 0.336 | |
| | Hosakote | 26 | 1296.22 | 648.110 | 0.648 | |
| | **Sub total** | **46** | **2134.14** | **1067.07** | **1.067** | |
| | **Grant total** | **527 Nos** | **21063.40 Mcft** | **8.967 TMC** | | |

# 7. Details of the scheme

## 7.1 Phase – I

It is proposed to construct 8 weirs across Yettinahole, Kadumanehole, Kerihole and Hongadahalla originating in the upper reaches of Western Ghats near Sakleshpura.

The water from Weir 1 received from the independent catchment of Yettinahole is pumped and conveyed through a raising main up to DC 3 near Doddanagara.

Diverting water from Weirs 3, 4 and 5 to Delivery Chamber (DC 2) beyond which, a gravity main is proposed to carry water to the Delivery chamber (DC 3) located beyond Hemavathi River near Doddanagara.

The water from Weir 2 is proposed to be conveyed to Weir 8 through a raising main and then by gravity. The water from Weirs 6, 7 and 8 will then be conveyed through pumping and independent raising mains up to the Jack well cum Pump house situated near Weir 1.

The two Jack well cum Pump houses near Weir 1 will then be used to pump the water received from Weirs 1, 6, 7 and 8 to DC-3 located near Doddanagara in Sakleshpura Taluk.

From DC 3, the water will be pumped and conveyed to Delivery chamber (DC- 4) located near Haravanahalli in Sakleshpura taluk, the starting point of the gravity canal.

## 7.1 Phase - II

### 7.2.1 Gravity Canal

Beyond DC-4, a gravity canal is proposed for a length of 273.865 Km until it reaches Balancing reservoir located near Bhairagondlu. The alignment of the Gravity Canal is proposed along the ridge line bifurcating Krishna and Cauvery basins.

### 7.2.2 Storage Reservoir for drinking water

All along the alignment of the canal, it is decided to supply drinking water to the needy areas facing shortage en route. In order to supply the water, it is necessary to store it and accordingly storage reservoir locations are identified for all the taluks namely Kadur, Arsikere, Tiptur, Chikkanayakanahalli, Gubbi, Madhugiri, Pavagada, Koratagere, Sira, all taluks of Kolar, Chikkaballapura, Bangalore Rural and Ramanagara districts. Further, distribution from these storage reservoirs has to be taken up by departments like KUWS&DB and RDED.

### 7.2.3 Balancing Reservoir

The project proposes to divert 24.01 TMC of water. As per the scheme, it is possible to divert the water during the peak monsoon i.e. June to November annually. The diverted water has to be utilized for the entire year and hence calls for having balancing reservoir so that the water can be drawn depending on the requirement.

A balancing reservoir with a capacity of 5.78 TMC is proposed to be constructed near Bhairagondlu in Korategere Taluk to facilitate continuous supply of water to the Drought prone Districts of Kolar and Chikkaballapura along with taluks of Bangalore rural including drinking water supply to Devanahalli Industrial area and surrounding areas.

Salient feature of the reservoir is indicated below:

| | | |
|---|---|---|
| Length of dam | : | 2900.0 m |
| Location | : | Across Garudachala stream, Upstream of Mavaturu Kere near Bairagondlu village |
| Water spread area | : | 2000 Ha |
| Full Reservoir Level (FRL) | : | 800.0 m |
| Capacity | : | 5.782 TMC |
| Villages under submergence | : | Veerasagar, Lakkamuttanahalli, Belladahalli, Gajamenahalli, Sugadahalli, Lakkenhalli, Garadagallu |
| Roads under submergence | : | 16.0 Km |
| Forest under submergence | : | Nil |
| Latitude | : | 13° 24' 23" |
| Longitude | : | 77° 20' 9" |
| Toposheet No | : | 57 G 07 |
| Taluk | : | Koratagere & Dodballapur |
| District | : | Tumkur & Bangalore rural |
| Basin | : | North Pennar |

### 7.2.4 Raising main

A raising main of length 45.0 Km is proposed to reach RL +910.00 m wherein it is fed into a proposed Delivery chamber (to carry the required quantum of drinking and tank filling water to Kolar and Chikkaballapur districts).

### 7.2.5 Distribution system

The distribution system comprises of:

a. Drinking water to the identified villages and towns in Taluks/Districts,

b. Filling MI Tanks in Palar and Pennar Basins,

c. Filling MI Tanks in Arasikere Taluk,

d. Augment supply to Hesarghatta and T.G.Halli Reservoirs,

e. Drinking water supply to the Devanahalli industrial area and surrounding areas.

As a consequence, detailing of the distribution system has now been arrived at considering the following

- The water is being led into the highest point in the valley thereby allowing it to fill the first tank and further tanks through gravity in a series.
- It is proposed to fill all the MI tanks to their 50% capacity (average) and allowing the excess flow into the next tanks once these tanks are filled as indicated.
- To ensure that the excess water beyond the 50 % capacity (average) flows without any hindrance to the next tank in the series through mother valley, it is proposed to construct an additional sluice in the bund at this level.
- However, it is necessary to ensure that the last tank in the series is filled to its 50% capacity (average) and continued upstream to the first tank in the series.

## 8. Land requirement

The total land required for the Project is 5140.0 Ha.

## 9. Power requirement

The total power required for the Project is about 276.0 MW.

## 10. Environment, Ecology and Forest aspects of the project

Ministry of Environment and Forest, Govt of India (IA-I Division) vide letter J-12011/46/2012-IA-I Dated 28th March, 2013 have opined that the project neither proposes any hydroelectric power generation nor proposes irrigation use/purpose to develop any command area. It is hence noted that it 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

The letter further states that the Govt of Karnataka shall ensure the following steps/measures.

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

# 11. Cost

The estimates were prepared based on SR of 2012-13 of Water resources department.

| | | |
|---|---|---|
| Phase-I: | Lift component | Rs. 3527.17 Crores |
| Phase-II: | Conveyance component | Rs. 9385.19 Crores |

The total cost of the project works out to **Rs.12912.36 Crores**.

# 12. Benefit Cost Ratio

Drinking water supply scheme has to be considered as an obligation on the Government to cater to the basic needs of the citizen. The area which is being proposed to be fed with the drinking water supply is one of the worst affected and drought prone areas in the State such as Kolar and Chikkaballapura districts. However, the Benefit Cost Ratio as per CWC norms cannot be worked out due to the fact that it is not an irrigation project.

The Cost per TMC in this project works out to $\frac{12912.36}{24.01} = 537.79$ Crores

# 13. Conclusion and Recommendation

The project of diverting the water from West to East envisaged under the present scheme is unique by itself since it involves conveying water of high discharge in short duration by pumping it to very high elevation followed by gravity mains.

The needy areas are facing acute water shortage which may lead to draught like situation if water is not supplied from a reliable source immediately. The Western Ghats happens to be very important and environmentally sensitive and hence harnessing or diverting the entire water may affect ecological balance. The present scheme has been carefully planned to utilize 1.20 % of the yield in the Western Ghats in order to meet drinking water demand in areas where there are no reliable water sources.

Getting the water from other perennial rivers close to the affected locations is almost impossible due to tribunal and other constraints. Over and above, the water table in the region has depleted considerably.

**Hence, the present scheme of diverting the water of 1.20 % of the yield in the Western Ghats is well within the purview of the State authority (free from Tribunal) and appears to be the most technically feasible, economically viable and hence the same is recommended.**

# KARNATAKA NEERAVARI NIGAM LIMITED

(A Government of Karnataka undertaking)

DETAILED PROJECT REPORT

## YETTINAHOLE PROJECT

## Estimated Cost - 12912.36 Crores

## VOLUME I - REPORT

**DECEMBER 2013**

**MANAGING DIRECTOR,**
**KARNATAKA NEERAVARI NIGAM LIMITED,**
COFFEE BOARD BUILDING,
NO-1 DR.AMBEDKAR VEEDHI,
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# Document Control

| | |
|---|---|
| Document Type: | DETAILED PROJECT REPORT |
| Document Classification: | CLASSIFIED |
| Document Copyright: | KARNATAKA NEERAVARI NIGAM LIMITED |
| Consultant: | EIT RIP JV |
| Client: | KARNATAKA NEERAVARI NIGAM LIMITED<br>GOVERNMENT OF KARNATAKA |

| Rev. | Description | Date | Author |
|---|---|---|---|
| Rev. 0 | Document created | 03/12/2013 | EIT |

# YETTINAHOLE PROJECT
# SECTION - 1
# CHECK LIST

## (As per CWC Guidelines 2010)

| No. | Particulars | |
|---|---|---|
| **I.** | **GENERAL DATA** | |
| 1) | Name of the project | Yettinahole Project |
| 2) | Location | |
| a) | State(s) | Karnataka |
| b) | District(s) | Hassan, Tumkur, Bangalore rural, Kolar and Chikkaballapura |
| c) | Taluka (s) / Tehsil (s) | Sakleshpura, Hassan, Belur, Arsikere, Tiptur, Tumkur, Kortagere, Doddaballapura, Chikkaballapura and Devanahalli. |
| d) | Longitude/Latitude | Refer Table 1.1 |
| e) | Survey of India Topographical Map reference No. | Refer Table |
| f) | Earthquake Zone number | Zone II |
| g) | Complete address for correspondence along with pin code /E-mail | |
| 3) | Category of the project | |
| a) | Irrigation/Multipurpose | Drinking water supply and ground water recharge by filling MI tanks |
| b) | Storage/diversion | Diversion |
| **II.** | **PLANNING** | |
| 4) | Has the Master plan for overall development of the river basin been prepared and stages of basin development discussed? | -NA- |
| 5) | Have the alternative proposals (including set of smaller developments vis-a-vis a single large | Merits and Demerits of alternative proposals have been discussed in Chapter. |

| No. | Particulars | |
|---|---|---|
| | development) been studied and their merits and demerits discussed? | |
| 6) | Does the scheme fit in the overall development of the river basin and has its priority in the overall development of the basin been discussed? | -NA- |
| 7) | Have the other Departments concerned with the development been informed? | Yes |
| 8) | Is the present scheme proposed to be executed in stages? If so, are various stages of execution and development discussed in the report? | The present scheme is proposed to be executed in stages as Phase 1 and Phase 2, the details of which are discussed in the report. |
| 9) | Are the effects of the scheme on the riparian rights & existing Upstream and downstream projects etc. discussed? | The proposal is to divert the excess flow available during the peak monsoon months during June to November. The weirs are proposed to be constructed only upto the available bank height and the flood in excess will be allowed to the downstream of the streams. |
| 10) | Has the provision for municipal and industrial water supply been made? | The present proposal is to divert the water to Kolar and Chikkaballapura districts in addition to other needy areas enroute to provide drinking water supply. |
| **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 | -NA- |
| b) | Sharing of cost | -NA- |
| c) | Sharing of benefits (irrigation, flood control. Power etc.) | -NA- |
| d) | Acceptance of the submergence by the upstream state(s) | -NA- |

| No. | Particulars | |
|---|---|---|
| e) | Acceptance by the upstream state(s) of compensation of land coming under submergence | -NA- |
| f) | Settlement of oustees | -NA- |
| g) | Any other | -NA- |
| 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 | |
| a) | River surveys | Carried out |
| b) | Reservoir surveys | Carried out |
| c) | Head work surveys (dam(s), dyke(s), barrage(s).weir(s) etc. and auxiliary components) | Carried out |
| d) | Plant and Colonies sites | -NA- |
| e) | Canal(s),branch canal(s) and water distribution system | Carried out |
| f) | Major canal structures | Carried out |
| g) | Power house, switch-yard, surge shafts, tailrace | Carried out |
| 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 | Carried out |
| k) | Surveys for soil conservation | -NA- |
| l) | Any other surveys i.e. archeological right of way. communication etc. | -NA- |
| **V.** | **GEOLOGICAL INVESTIGATIONS** | |
| 13) | Have the geological surveys for the following items been carried out and report on geology of the following appended? | |

| No. | Particulars | |
|---|---|---|
| a) | Region as a whole | Carried out |
| b) | Reservoir | Carried out |
| c) | Head work and energy dissipation area | Carried out |
| d) | Power house and appurtenances | Carried out |
| e) | Intakes and regulators | Carried out |
| f) | Major canal structures | Carried out |
| g) | Tunnel(s),Pen stock(s),hill(s)etc. | -NA- |
| h) | Communication routes | Carried out |
| i) | Any other | -NA- |
| **VI.** | **SEISMIC INVESTIGATIONS** | |
| 14) | Has the seismicity of the region been studied and co-efficient of vertical horizontal acceleration for the various structures discussed? | Effect of seismicity of the region is discussed in the Report |
| 15) | Has the approval of the Standing Committee for recommending design of seismic coefficients for River Valley Project been obtained? | |
| 16) | Is there possibility of liquefaction of foundations? If so whether liquefaction studies been carried out? | No |
| **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) | Detailed Investigations carried out |
| b) | Masonry/concrete dam(s) | -NA- |
| c) | Barrage(s) / Weir(s) / head regulators) etc. | Detailed Investigations carried out. |
| d) | Canal(s) & Canal Structures | Detailed Investigations carried out |
| e) | Power house (t),tunnel (s), transformer caverns), desilting chamber(s), surge tank(s) / | Detailed Investigations carried out. |

| No. | Particulars | |
|---|---|---|
| | shaft(s), intake(s) | |
| f) | Pump House(s) | Detailed Investigations carried out |
| 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) | Detailed Investigations about the availability and quality of the material carried out |
| b) | Sand | Detailed Investigations about the availability and quality of the material carried out |
| c) | Rock and coarse aggregates | Detailed Investigations about the availability and quality of the material carried out |
| d) | Bricks and tiles | -NA |
| e) | Pozzolona | - |
| f) | Cement and lime stone | - |
| g) | Steel | - |
| h) | Any other | - |
| 20) | Have the sources for each of the above material been identified and need etc. indicated? | Sources identified and details collected |
| 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? | Yes |
| | i. Rainfall | Yes |
| | ii. Temperature | Yes |
| | iii. Sunshine | -NA- |
| | iv. Gauge & Discharge | Yes |

| No. | Particulars | |
|---|---|---|
| | v. Sediment | -NA- |
| | vi. Water quality | Yes |
| | vii. Evaporation | Yes |
| | (b) Has the above data been collected & appended? | Appended in the approved booklet |
| **X.** | **HYDROLOGY** | |
| 23) | Is the Hydrology dealt with in detail in a separate volume? Have its brief details been included in this Report? | Details on Hydrology included in this report. |
| 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 attached |
| 25) | Have required detail note. About project-specific-hydro-meteorological data observatories been attached. | yes |
| 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- |
| 27) | Are detail notes about quality, Consistency? Processing and gap filling of the data included. | -NA- |
| 28) | Have hydrological studies been carried out for the following: | |
| a) | To establish the availability of water for the benefits envisaged? | Yes |
| b) | To determine design flood for the various structures (spillway, weir, barrage etc.) | -NA- |
| c) | Sediments storage | -NA- |

| No. | Particulars | |
|---|---|---|
| d) | Design flood for diversion during construction | -NA- |
| e) | Tail water rating curve | |
| 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? | Yes |
| 30) | Have the studies regarding reservoir sedimentation been carried out and revised elevation-area capacity curves been used in the simulation studies (Working Table)? | -NA- |
| 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? | -NA- |
| 32) | Have the details of the simulation studies. (Working Tables) and conclusions arrived, from the various alternatives explaining the factors and assumptions been included and discussed? | Yes |
| 33) | Has the number of failures for different aspects been indicated? | -NA- |
| 34) | Have the likely desirable and, undesirable changes in the hydrologic regime due to-.the project been brought out in the report? | No changes |
| 35) | Is the criteria adopted for selection of the construction diversion flood discussed? | -NA- |
| 36) | Has the basis for determining the storage capacity been discussed? | Yes |

| No. | Particulars | |
|---|---|---|
| 37) | Have integrated working tables (for more than one reservoir in the system) been prepared? | Yes |
| 38) | Has carry over storage been provided? If so. Whether studies for most economic carry over storage been done? | -NA- |
| 39) | Have the flood routing studies been carried out? | -NA- |
| 40) | Have the back water studies been carried out? | -NA- |
| **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? | Discussed in detail in the DPR |
| 42) | Is the basis for provision for land compensation indicated? | Discussed in detail in the DPR |
| 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 | Discussed in detail in the DPR |
| 44) | Is the basis of land acquisition of the submerged area upto FRL/MWL etc. discussed? | Discussed in detail in the DPR |
| **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? | No |

| No. | Particulars | |
|---|---|---|
| 46) | Has the selection of final location of the head works and, appurtenances, in preference to .the other sites investigated been discussed? | Yes |
| 47) | Have the layout of the project Viz location of head work workshop sheds; offices, Colonies. etc. been finalized and discussed? | -NA- |
| 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 |
| 49) | Have the detailed designs been prepared for the following components & got vetted by CDO? | NA |
| a) | Earth or rock fill dam. Masonry or concrete dam; spillway, barrage, weir. etc. and appurtenances. | -NA- |
| b) | Energy dissipation arrangements, training walls etc. | -NA- |
| c) | Openings through dams- galleries head regulators, pen stocks other outlets, sluices etc. | -NA- |
| d) | Regulators | Yes |
| e) | Canal and water conductor system | Yes |
| f) | Canal structures | Yes |
| g) | Pump house, Intake structures | Yes |
| h) | Power House, tunnels, surge shaft | Yes |
| i) | Instrumentation | Yes |
| j) | Power evacuation arrangement | Yes |
| 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 | No |

| No. | Particulars | |
|---|---|---|
| | appurtenances & checking the design profile. of the spillway. Energy dissipation arrangements. Location of outlets/regulators etc.? | |
| 52) | Has the final alignment of canal (s), and branch canal (s) been discussed in the light of various alignments studied? | Yes |
| 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? | No |
| 53) | Are the canals and distribution system being lined and If so what is the minimum capacity of the channel proposed to be lined? | The gravity canal of length 273.865 Km proposed in the scheme will be lined. |
| 54) | Is the location of canal structure on main and branch canals fixed after detailed surveys of the final alignments? | Yes |
| 55) | Are the regulation arrangements of the. offtaking channel both near and away from the cross regulators discussed? | -NA- |
| 56) | Are sufficient escapes including terminal escapes provided on the main/branch canal distributaries/minors? | Yes |
| 57) | Have the basis for adopting water way for the cross drainage works been discussed? | Discussed |
| 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? | Discussed |
| 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? | No |

| No. | Particulars | |
|---|---|---|
| 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? | Sufficient groundwater is not available |
| 67) | Have the semi-detailed soil surveys been carried out for the entire command? If not the extent of area surveyed may be indicated. | NA |
| 68) | Have soil and land Irrigability classifications | NA |

| No. | Particulars | |
|---|---|---|
| | brought out in the report? | |
| 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. | Yes |
| 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? | - |
| 77) | Have the number of blocks selected for detailed surveys for On Farm Development (OFD) works including drainage and total area covered by | NA |

| No. | Particulars | |
|---|---|---|
| | such blocks been indicated? | |
| 78) | Have the existing locations of the Trial cum Demonstration Farm, input centers (seeds, fertilizer and insecticides) in .the command been indicated and proposal to strengthen the same discussed? | NA |
| 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 | -NA- |

| No. | Particulars | |
|---|---|---|
| | project situations been identified and flood intensities worked out at each of the damage center(s) which gets affected? | |
| 87) | Have the following flood aspects been discussed? | |
| a) | Flood cushion in the reservoir. | NA |
| b) | Maximum moderated flood outflows over the spillway etc. and its frequency | |
| c) | Existing and proposed safe carrying capacities of the channel below the dam after construction of flood embankment, channel improvement, river diversion etc. | |
| d) | Synchronized moderated peak floods due to releaser(s) from the dam upstream and un-intercepted catchment up to the damage centers. | |
| e) | Average annual expenditure incurred on flood relief works. | |
| f) | Area and population affected/likely to be affected before/after the project. | |
| g) | Estimated saving in annual loss of life, property, cattle, crops etc. (evaluated in terms of money) due to flood control. | |
| 88) | Have the following drainage aspects of command area been discussed? | |
| h) | Existing Surface and sub-surface drainage network and problems of the drainage congestion, water logging, alkalinity/salinity if any. | NA |
| i) | Studies on sub soil water table (pre-monsoon, post monsoon etc.). | NA |
| j) | Maximum intensity of 1, 2. and 3 day rainfall. | NA |
| k) | Deficiencies in farm drains. | NA |

| No. | Particulars | |
|---|---|---|
| l) | Deficiencies in existing natural drains | NA |
| m) | Proposal for improvement of drainage water logging /alkalinity/salinity of the area along with justification thereof. | NA |
| n) | 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 reach? | -NA- |
| 90) | Is the existing inland transport system being fully utilised? If not, have the bottlenecks in its full utilisation been identified and discussed? | |
| 91) | Have the surveys for goods and passenger traffic been carried out and discussed? | |
| 92) | Is the extent of modification required in the existing system discussed and justified? | |
| 93) | Do design for the canal section and structures take into account the navigation requirements? | |
| 94) | Have the proposals to develop the new scheme and phases of development in the different reaches been discussed? | |
| 95) | If the area is being served by inland water transport, have the following been discussed: | |
| o) | The existing toll rates and registration fees for the crafts (size-wise) | |
| p) | Proposals for revision of tollage rates and fees, | -NA- |

| No. | Particulars | |
|---|---|---|
| | if any. | |
| q) | Concurrence of the competent authorities for revision of rates and fees. | |
| r) | Proposal to subsidies the tariff, tollage, craft registration fee, passenger fare etc. to attract traffic. | |
| 96) | Has the State Inland Water Authority been consulted while finalising the scheme and its view point discussed? | |
| 97) | Has economic justification and viability of the, navigation component of the multipurpose project been discussed? | |
| **XVI.** | **POWER** | |
| 98) | Have the following points been discussed | NA |
| s) | Availability of the power generating capacity in the state as well as in the region from different sources. | |
| t) | Total energy available and peaking capacity of the system, in the state as well as in the region from different sources. | |
| u) | Integrated operation of the system and present status of utilization in the state as well as in the region. | |
| v) | Surpluses and shortfalls in the system in the state as well as in the region. | |
| w) | Future plans of power development from different sources in the State/region. | |
| x) | Fitment of the scheme in planning of power development of the state /region. | |
| y) | Energy generated from the project Firm power, seasonal power and total power. | |

| No. | Particulars | |
|---|---|---|
| z) | Proposal for transmission lines connecting to the existing system / grid. | |
| aa) | 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. | |
| bb) | 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. | |
| cc) | * Whether sufficient surplus of Peak power is available for pumping of water from lower to upper reservoir. | -NA- |
| dd) | *Actual off peak energy requirement of proposed, scheme | -NA- |
| ee) | *Cost of peak-and off peak energy | -NA- |
| | ***for pumped storage schemes only*** | |
| **XVII.** | **CONSTRUCTION PROGRAMME AND 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 Tendered agencies |
| 100) | Have the various alternative construction programme been studied and proper justification furnished for the final programing adopted? | No |
| 101) | Has the proposed Construction programme | Yes |

| No. | Particulars | |
|---|---|---|
| | been prepared and synchronized for timely completion of each of the major component of work including Command Area Development? | |
| 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 | Discussed |
| b) | Earth work in filling-impervious, semi-pervious and pervious | |
| c) | Rock fill-for dam, toe, riprap etc. | |
| d) | Stone for masonry | |
| e) | Coarse aggregate for concrete | |
| f) | Sand-for filter, masonry/ concrete. ' | |
| g) | Gravel-for filter. | |
| h) | Steel of various sizes and type | |
| i) | Cement-normal, quick/slow setting with or without Pozzolona, special types | |
| j) | Lime-surkhi-Pozzolona | |
| k) | Scarce material-special steel | |
| l) | Other material-fuel, electricity, explosive etc. | |
| 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? | Discussed |
| 104) | Have the labour intensive items of the various major components of the project been identified and the quantities of such items worked out? | Discussed |
| 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? | Discussed |

| No. | Particulars | |
|---|---|---|
| **XVIII.** | **FOREIGN EXCHANGE** | |
| 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? | To be covered under State sector |
| **XIX.** | **FINANCIAL RESOURCES** | |
| 110) | Has the Concurrence of the State Finance department been obtained? | Yes |
| 111) | Is the scheme included in the Five Year/Annual Plan? If not what is the present position regarding its inclusion in the plan? | No<br>This being an exclusive drinking water supply scheme proposed to benefit Drought prone districts of Kolar and Chikkaballapur, is taken up as a matter of social obligation by the State Govt and is not included in any of the five year plan. |
| 112) | Whether the scheme has already been started? If so, is the present stage of construction indicated? | Yet to be commenced |
| 113) | Have the year wise requirement of funds been indicated? | Yes |
| 114) | Is the scheme covered or proposed to be covered under any foreign assistance/aid agreement? | No |
| **XX.** | **ESTIMATE** | |
| 115) | Is the separate volume of estimate attached as appendix? | Yes |

| No. | Particulars | |
|---|---|---|
| 116) | Is the year to which the rates adopted in the estimate relate to indicated? | The estimates were prepared based on SR of 2012-13 of Irrigation department |
| 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? | Rate analysis sheet is appended with the cost estimates |
| 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- |
| **XXI.** | **REVENUE** | |
| 119) | Is the basis for the following sources of revenues furnished? | |
| e) | Betterment levy and proposal for its recovery | -NA- |
| f) | Irrigation cess | -NA- |
| g) | Flood protection cess | -NA- |
| h) | Crop wise water rates | -NA- |
| i) | Sale of water for Village / City / Industrial / Power / Water supply | Yes |
| j) | Miscellaneous | --NA- |
| 120) | Have these rates been compared with the existing rates at the other projects in the State/region? | Yes |
| 121) | In case the rates are being enhanced, has the concurrence of the concerned department(s) been obtained? | -NA- at this stage |
| 122) | Have the Organisational set up for the collection of revenue been indicated? | No at this juncture |

| No. | Particulars | |
|---|---|---|
| **XXII.** | **B.C.RATIO** | |
| 123) | Is 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 |
| f) | Any other | - |
| 124) | Have the various departments of the State/Centre agreed to the sharing of the above allocated cost? | KNNL is the nodal agency involved in executing the project |
| 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 acceptable or otherwise justified? | -NA- |
| 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? | -NA- |
| 130) | Have the financial and economic return statements been furnished keeping in view the phasing of development? | Yes |

| No. | Particulars | |
|---|---|---|
| 131) | Are the benefits other than those considered in the B.C. Ratio and financial return statement been identified? | The benefit is in terms of supply of drinking water to the drought prone areas of Kolar and Chikkaballapur including other needy areas enroute |
| 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 | Not anticipated |
| | ii. Water logging, salinity/alkalinity | -NA- |
| | iii. Quality of surface and ground water | Yes |
| | iv. Ground water recharge | Yes |
| | v. Health hazards-water borne diseases, industrial pollution etc. | -NA- |
| | vi. Submergence of important minerals deposits | -NA- |
| | vii. Submergence of monuments/archeological sites | -NA- |
| | viii. Fish culture and aquatic life | -NA- |
| | ix. Plant life (flora) | Yes |
| | x. Wild Life | Yes |
| | xi. Migratory birds | Yes |

| No. | Particulars | |
|---|---|---|
| | xii. National parks and sanctuaries | Yes |
| | xiii. Seismicity due to filling of reservoir | Yes |
| | xiv. Likely changes in the regime of the river | -NA- |
| | xv. Any other | |
| | (b) Have the environmental and forest clearances from MOE&F been obtained? If not what is status thereof? | MOE& F has given its clearance to the project vide its leatter no --------- dt . As per MOE & F, Environmental clearance is not required for the present project. However, EMP report has to be prepared and submitted. |
| **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? | Discussed |
| 136) | Has an estimate of the extent of higher cost involved been made and details discussed? | Discussed |
| 137) | Are the permanent buildings being constructed required for maintenance of the project only? | -NA- |
| 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? | -NA- |
| 139) | Have the interested agencies been consulted for planning of the buildings to suit their requirements later on? | -NA- |
| 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 |

| No. | Particulars | |
|---|---|---|
| b) | Construction | No |
| c) | Improved agricultural practices | -NA- |
| d) | Any other | -NA- |
| 142) | Have-public debates about utility of projects been held and the response thereof outlined in the Report? | Yes |
| **XXVI.** | **SOIL CONSERVATION** | |
| 143) | Is the need for soil conservation measures in the catchment-of the project discussed? | -NA- |

# Contents

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# Abbreviation

| | |
|---|---|
| **CA** | Catchment Area |
| **CBL** | Canal bed level |
| **CD** | Cross Drainage |
| **CGWB** | Central Ground Water Board |
| **Ch** | Chainage |
| **CPHEEO** | Central Public Health and Environmental Engineering Organisation |
| **DC** | Delivery Chamber |
| **Ft** | Feet |
| **FRL** | Full Reservoir Level |
| **FSL** | Full Supply Level |
| **GoK** | Government of Karnataka |
| **GPS** | Global Positioning System |
| **INS** | Inertial Navigational System |
| **Kms** | Kilometers |
| **KNNL** | Karnataka Neeravari Nigam Limited |
| **lpcd** | Litres per capita demand |
| **M** | Meters |
| **mbgl** | metres below ground level |
| **MCM** | Million Cubic Meters |
| **mg/l** | milligrams/litre |
| **MI** | Minor Irrigation |
| **MLD** | Million Litres Per Day |
| **MS** | Mild Steel |
| **m/s** | meters per second |
| **$m^3$** | Cubic Meter |
| **MW** | Megawatt |
| **NH** | National Highway |
| **Ppm** | Parts Per Million |
| **RL** | Reduced Level |
| **Sq. kms.** | Square Kilometers |
| **SR** | Schedule of Rates |
| **SH** | State Highway |
| **TMC** | Thousand Million Cubic Feet |
| **TSC** | Technical Sub Committee |
| **WRD** | Water Resources Department |

# YETTINAHOLE PROJECT

## SALIENT FEATURES

# Salient features

| | |
|---|---|
| Name of the Project | Yettinahole Project |
| Type of Project | Drinking water supply and ground water recharge by filling MI tanks |
| Location | Upper reaches of Western Ghats near Sakleshpura (West) to Kolar / Chikkaballapura Districts (East) |
| River Basin | Netravathy |
| River Tributary | Yettinahole, Kadumanehole, Kerihole and Hongadahalla |
| State(s ) /Districts/Taluks or Tehsils in which the following are located | |
| Reservoir | Karnataka/ Tumkur and Bangalore rural district/ Korategere and Doddaballapur taluk |
| Headwork | Karnataka/ Hassan district / Sakleshpur taluk |
| **Access to the project** | |
| Airport | Mangalore |
| Rail | South Western Railway - Bangalore-Mangalore Section |
| Road | NH - 73/209, NH - 4, NH - 48, SH - 33 |
| **Weirs** | |
| Type of weir | Ogee Weir |
| Capacity | 5.0 Mcft |
| **Weir-1** | |
| FRL/MWL | 800.100 m |
| MDDL | 797.198 m |
| Length of weir | 35.00 m |
| Name of village | Kumbardi Coffee Estate |
| **Weir-2** | |
| FRL/MWL | 816.500 m |
| MDDL | 815.355 m |
| Length of weir | 30.00 m |
| Name of village | Heggadde |
| **Weir-3** | |
| FRL/MWL | 873.000 m |
| MDDL | 871.000 m |
| Length of weir | 25.00 m |
| Name of village | Heggadde |
| **Weir-4** | |
| FRL/MWL | 952.000 m |
| MDDL | 950.200 m |
| Length of weir | 20.00 m |

| | |
|---|---|
| Name of village | Kadumane Estate |
| **Weir-5** | |
| FRL/MWL | 904.400 m |
| MDDL | 903.200 m |
| Length of weir | 35.00 m |
| Name of village | Kadumane Estate |
| **Weir-6** | |
| FRL/MWL | 778.000 m |
| MDDL | 776.000 m |
| Length of weir | 25.00 m |
| Name of village | Kadagarahalli |
| **Weir-7** | |
| FRL/MWL | 729.500 m |
| MDDL | 727.800 m |
| Length of weir | 25.00 m |
| Name of village | Kadagarahalli |
| **Weir-8** | |
| FRL/MWL | 747.750 m |
| MDDL | 745.630 m |
| Length of weir | 25.00 m |
| Name of village | Alavalli |
| **Canal System** | |
| Main Canal | |
| Purpose of canal | Diversion/Water supply |
| Type | Open Canal |
| **Design data** | |
| Length | 273.865 Km |
| Full supply depth | 4.50 m |
| **Cutting reach** | |
| Bed width | 11.30 m |
| Side slope | 1:1 |
| Bed slope | 1:7500 |
| Maximum discharging capacity | 94.01 cumecs |
| **Banking reach** | |
| Bed width | 10.00 m |
| Side slope | 1.5:1 |
| Bed slope | 1:7500 |
| Maximum discharging capacity | 97.75 cumecs |
| Total number of Canal structure | 636 |

| | |
|---|---|
| **Balancing Reservoir** | |
| FRL/MWL | 800.0 m |
| MDDL | 775.0 m |
| Dead storage level | 775.0 m |
| Free board | 1.0 m |
| Live storage | 5.78 TMC |
| **Water supply** | |
| Names of the town/villages served | Kadur Taluk, Arasikere taluk, Tumkur Taluk (Only Kora hobli), Chiknayakanhalli Taluk, Sira Taluk, Pavagada Taluk, Madhugiri Taluk, Koratagere Taluk, Gubbi Taluk (Only Chelur & Nittur Hobli (villages coming under Hemavathy atchkat are not considered), Tiptur Taluk (Only Kasaba hobli, Kibbanahalli hobli, Honnavalli hobli), Kolar Taluk, Srinivaspur Taluk, Malur Taluk, Bangarpet Taluk, Mulbagal Taluk, Chikkaballapura Taluk, Gauribidanur Taluk, Gudibanda Taluk, Bagepalli Taluk, Sidlaghatta Taluk, Chintamani Taluk, Nelamangala Taluk, Doddaballapur Taluk, Devanahalli Taluk, Hosakote Taluk, Ramnagara Taluk, Magadi Taluk, Channapatna Taluk, Kanakapura Taluk. |
| Size of the population served | 6.83 Millions |
| Quantum of water made available | 24.01 TMC |
| Cost of the Project | 12912.36 Crores |
| SR adopted | WRD 2012-13 |

# Chapter 1
# Introduction

## 1.1 Aim of the Project

Drought prone districts in the eastern part of Karnataka such as Kolar and Chikkaballapur are frequently affected due to erratic rainfall and absence of any perennial source of water for drinking purposes for the populace as well as livestock in the region. It is a long standing demand of the people in the region that a permanent and dependable source need to be identified and these areas are supplied with drinking water. Furthermore, the ground water table in these regions has reached alarming depths due to over exploitation, as a consequence of which the available ground water is contaminated with harmful salts like Fluoride, Nitrate, etc. in excess of permissible level.

Government of Karnataka has considered the demand and initiated studies for mitigating the problem faced by the people of Kolar and Chikkaballapur. Various studies were undertaken to identify the source of water as well as supplying it to the districts concerned. During the course of such studies, one of the proposals which are considered apt to be taken up for further consideration was harnessing Yettinahole and other streams originating in the upper reaches of Western Ghats near Sakleshpura..

The project of Yettinahole, in the initial stage comprised of lifting about 10 TMC of water from selected streams like Yettinahole and Kadumanehole which lies just after Sakleshpura in Western Ghats. The proposal was to construct 5 weirs across these streams, provide lifting arrangements to convey the divertible yield of 10 TMC (excess flow) available during the monsoon months only from June to November.

The project aimed at providing safe drinking water to the drought prone areas of Kolar, Chikkaballapur and other needy areas along with filling up of MI tanks in Kolar and Chikkaballapur districts to recharge the ground water.

Feasibility report was prepared based on the above requirement.

- The Government, after deliberations with KNNL and considering the growing demand for drinking water in some of the areas enroute the alignment, felt that 10 TMC of water may not be sufficient to meet the requirement. It was hence decided to explore the possibility of harnessing few more streams nearby which can help in getting additional quantum of water.
- Feasibility report for lifting 10.0 TMC of water at an approximate cost of Rs.8167.00 crores was deliberated in the 114th Technical Sub-Committee (TSC) of KNNL held on 24/9/2010. TSC recommended to consider the above proposal and the same was placed before the 50th Board of KNNL held on 28/9/2010 which gave its approval for taking up the above project.

- Further, the Government, after deliberations with KNNL and considering the growing demand for drinking water in some of the areas enroute the alignment, felt that 10 TMC of water may not be sufficient to meet the requirement. It was hence decided to explore the possibility of harnessing few more streams nearby which can help in getting additional quantum of water.
- Accordingly, a feasibility study was undertaken and additional streams were identified. The streams identified were Yettinahole downstream, Kerihole and Hongadahalla. The additional streams along with the already identified streams yielded about 24.01 TMC of water.

Details of lifting and conveyance system are as under.

- Construction of weirs at the selected locations across the selected streams.
- Construction of pumping stations at all the lifting locations.
- Construction of conveyance system comprising of raising mains to convey the water from selected locations upto the delivery chambers immediately after crossing the Western Ghat.
- Construction of gravity canal of length 233.0 Km to reach RL+800.00m near Tumkur followed by a raising main of length 8.10 Km to reach the proposed Devarayanadurga reservoir.
- Construction of a reservoir of capacity 10.0 TMC near Devarayanadurga for sustainable supply of drinking water.
- Construction of raising mains of length 80.82 km and 55.9 km towards Chikkaballapur and Kolar respectively.

The feasibility report of diverting 10.0 TMC of water from the streams identified to Kolar and Chikkaballapur districts along with other needy areas has been deliberated in 128th and 129th TSC and approved in the 57th Board Meeting of KNNL held on 13/6/2012. The board recommended the same to Government for according administrative approval.

Government of Karnataka has given its Administrative approval to the said project vide its G.O No. ಜ ಸಂಇ-203-ವಿಭ್ಯಾಇ-2012 ದಿ 13.07.2012 for Rs. 8323.50 Crores.

The said Government order stipulates as under:-

Administrative approval is accorded for taking up Yettinahole project to divert flood waters from west flowing streams (near Sakleshpura) and utilizing about 24.01 TMC water at a total cost of Rs. 8323.50 Crores which includes Phase – I lift component works amounting to Rs. 3269.50 Crores and Phase – II works comprising of the works beyond Haravanahalli delivery chamber, conveyance system, construction of reservoir and lifts amounting to Rs. 5054.0 Crores.

As approved by the TSC of KNNL, the Phase – I works based on the detailed estimate submitted amounting to Rs. 3269.50 Crores, covering the lift component works up to Haravanahalli delivery chamber shall be taken up on EPC/Turnkey basis. KNNL, in consultation with the TSC shall decide on taking up the works by dividing it into suitable packages.

Revised estimate (DPR) for this project should be got approved from the Government after the detailed project report is prepared.

Accordingly, the phase-I works have been divided into 5 convenient packages and placed before Technical Sub-Committee and KNNL Board for approval. The Board, after deliberations cleared the proposal to take up the works in 5 identified packages. The tender for the above 5-packages is under process.

Further, the preparation of Detailed Project Report has been entrusted to the consultant M/s E I T RIP JV Bangalore.

### 1.1.1 Description of the work

The said work of diversion of 24.01 TMC of water from streams located in the upper reaches of Western Ghats near Sakleshpura to the East comprises of the following:

**Phase 1**

The perennial streams which are close to Sakleshpura, in the Upper reaches of the western ghat such as **Yettinahole, Kadumanehole, Kerihole** and **Hongadahalla** have been selected for harnessing the water. The water will be harnessed up to an elevation of 733.0 m only from the ridge point of the Western Ghat. In all, about 8 diversion weirs are proposed to be constructed across the streams. They are Weirs 1,2,3,4,5,6,7 and 8.

It is proposed to divert water from Weirs 3, 4 and 5 to Delivery Chamber (DC 2) through a raising main beyond which, a gravity main is proposed to carry water to the Delivery chamber (DC 3) located beyond Hemavathi River near Doddanagara.

The water from Weir 1 received from the independent catchment of Yettinahole is pumped and conveyed through a raising main up to DC 3 near Doddanagara.

The water from Weir 2 is proposed to be conveyed to Weir 8 through a raising main and then by gravity. The water from Weirs 6, 7 and 8 will then be conveyed through pumping and independent raising mains up to the Jack well cum Pump house situated near Weir 1.

The two Jack well cum Pump houses near Weir 1 will then be used to pump the water received from Weirs 1, 6, 7 and 8 to DC-3 located near Doddanagara in Sakleshpura Taluk. From DC 3, the water will be pumped and conveyed to Delivery chamber (DC- 4) located near Haravanahalli in Sakleshpura taluk, the starting point of the gravity canal.

**Phase 2:**

**Gravity canal from DC-4:**

The proposed Gravity canal runs for a length of 233.0 Km before ending at the delivery chamber near Tumkur. The gravity canal runs for a length of Ch: 114+100 Km before reaching the ridge which bifurcates Krishna and Cauvery basins and finally culminates near Tumkur at an elevation of RL 800.00 m.

**Beyond Gravity Canal - Raising mains and the reservoir**

A raising main of length 8.10 Km has been proposed to convey the said discharge into the balancing reservoir near Devarayanadurga with a cumulative capacity of 10.0 TMC. An earthen dam is proposed to be built with the above capacity at the said location to accommodate the discharge.

In order to convey the water to the Kolar and Chikkaballapura districts, two raising mains of length 55.90 Km and 80.82 Km have been proposed. These raising mains will culminate at the highest point of RL 980.00 m for Kolar and Chikkaballapura districts. The water so conveyed will then flow by gravity to various Minor Irrigation / Zilla Parishad tanks located in these districts.

## 1.2 Location of the project

The details of streams along with geographical location, elevation, Catchment Area is furnished in table 1.1.

**Table 1.1: Details of the streams and catchment area**

| No. | Name of the stream | Geographical location | | Elevation (m) | Catchment area (Sq. Km) | Remarks |
|---|---|---|---|---|---|---|
| | | Latitude | Longitude | | | |
| 1 | Yettinahole | 12° 54' 35" N | 75° 44' 11" E | 800 | 48.80 | 1 |
| 2 | Yettinahole Tributary - 1 | 12° 52' 23' 'N | 75° 42' 46" E | 813 | 7.20 | 2 |
| 3 | Yettinahole Tributary– 2 | 12° 53' 22" N | 75° 41' 01" E | 860 | 9.80 | 3 |
| 4 | Kadumane hole – 2 | 12° 53' 37" N | 75° 39' 31" E | 955 | 7.49 | 4 |
| 5 | Kadumane hole-1 | 12° 54' 26" N | 75° 39' 03" E | 903 | 13.79 | 5 |
| 6 | Kerihole | 12° 49' 52" N | 75° 43' 07" E | 775 | 24.25 | 6 |
| 7 | Hongada halla | 12° 48' 04" N | 75° 42' 42" E | 733 | 53.80 | 7 |

| No. | Name of the stream | Geographical location | | Elevation (m) | Catchment area (Sq. Km) | Remarks |
|---|---|---|---|---|---|---|
| | | Latitude | Longitude | | | |
| 8 | Yettinahole down stream | 12° 51' 46" N | 75° 43' 27" E | 743 | 11.61 | 8 |
| | | | | **Grand Total** | **176.74** | |

The extent of catchment area works out to 176.74 sq. km.

**Table 1.2: Details of components beyond Western Ghats ridge**

| No. | Particulars | Geographical location | | Elevation (m) | Remarks |
|---|---|---|---|---|---|
| | | Latitude | Longitude | | |
| 1 | DC-3 near Doddanagara | 12° 57' 19.12" N | 75° 46' 46.74" E | 920.00 | Toposheet level |
| 2 | DC-4 near Haravanahalli | 12° 59' 20.13" N | 75° 51' 02.27" E | 984.32 | GTS Value |
| 3 | Gravity canal Starting point | 12° 59' 20.13" N | 75° 51' 02.27" E | 984.32 | GTS Value |
| 4 | Gravity canal Ending point | 13° 24' 2.02" N | 77° 05' 0.90" E | | |
| 5 | Raising main beyond Tumkur Starting Point | 13° 24' 2.02" N | 77° 05' 0.90" E | | |
| 6 | Raising main beyond Tumkur Ending Point | 13° 23' 7.45" N | 77° 10' 13.77" E | | |
| 7 | Raising main beyond reservoir toward Chikkaballapura - starting point | 13° 23' 35.15" N | 77° 12' 53.51" E | | |
| 8 | Raising main beyond reservoir toward Chikkaballapura - ending point | 13° 19' 55.01" N | 77° 40' 24.82" E | | |
| 9 | Raising main beyond reservoir toward Kolar - Starting point | 13° 22' 43.54" N | 77° 20' 10.09" E | | |
| 10 | Raising main beyond reservoir toward Kolar - ending point | 13° 37' 37.32" N | 77° 40' 33.62" E | | |

### 1.2.1 Districts benefitted

The project is specific to drinking water purpose and the districts benefitted on account of the said project will be Kolar and Chikkaballapura besides some needy areas in Tumkur, Bangalore rural and Ramanagara districts.

## 1.3 Access by air/rail/road/sea/port and other communication facilities

The Project is spread across the southern portion of the Karnataka State.

The initial reaches from where the water is being lifted and conveyed is having good accessibility in the form of NH, SH and other village roads along with Southern railway passing very near to the project.

The nearest airport and Port is at Mangalore located about 90.0 Km from the project site.

The project is accessible in the initial reaches by rail on Bangalore – Mangalore railway line. The Gravity canal path is accessible through Bangalore – Mumbai railway line.

The balance reach of the gravity canal, raising mains and reservoir are all located very near to the SH and other village roads. The nearest airport is Bangalore located at a distance varying from about 145.0 Km to 70.0 Km.

## 1.4 General climatic condition of the project area

As per the Koppen's classification, the project area comes under two different climatic types.

- Coastal Karnataka
- South interior Karnataka

The tropical monsoon covers the entire coastal belt and adjoining areas with the other half beyond the coastal belt experiencing hot, seasonally dry tropical Savanna climate. According to Thronthwartes classification, the coastal and Malnad regions are per humid i.e. those having moisture index of 100% and above. The interior region is semiarid with moisture index 66.7% to 33.3%.

The western slopes of Sakleshpura taluk, where the intakes are located receives very heavy rainfall from southwest monsoon. The rainfall varies from 5500 mm to 6500 mm with certain pockets receiving very heavy rainfall of average 7000 mm and above.

The area is a diverse hot spot in terms of flora and fauna. The subtropical climate and heavy rains during the wet seasons create an environment for unique plant and animal species to flourish.

The rest of the project lies in the eastern plateau where the climate changes from west to east. The eastern portion of the project lies in hot and temperate climate. The rainfall pattern also varies and shows a decreasing trend while proceeding from west to east. While the eastern district of Hassan receives a moderate 1200 mm rainfall, the eastern districts of Chikkaballapura, Kolar, Tumkur, Bangalore Rural and Ramanagara districts receive about 750 mm.

### 1.4.1 Geological features of the Western Ghats

The Western Ghats region is a rich reserve of rock formations. Basalt is the predominant rock types found here. Besides, granites, leptynites, charnockites as well as iron ore, dolerites, laterites and bauxite ores are also found here in varying proportions.

## 1.5 Topography, Physiography and Geology of the project area

### 1.5.1 Topography

The initial reaches of the project lies in the hilly terrain of the Western Ghats. Beyond the ghat section, the gravity canal lies in the ridge separating the Krishna and Cauvery basins. The topography is undulating and generally slopes towards east.

### 1.5.2 Physiography

The project as a whole lies in the Southern Karnataka Plateau covering the districts of Hassan, Tumkur, parts of Bangalore Rural, Kolar, Chikkaballapura and Ramanagar districts. This region largely covers the parts of Cauvery, Krishna, Palar and Pennar basins lying in Karnataka. It is bounded by 600 meters contour and is characterised by a higher degree of slope. In the west and south, it is enclosed by the ranges of Western Ghats with an elevation ranging from 700 m to more than 1000 m with its northern part being an interrupted but clearly identifiable high plateau.

In the east, the valleys of the Cauvery and its tributaries open out to form undulating plains. The general elevation of the region varies from 600 to 900 meters. However, residual heights of 1,500 to 1,750 meters are found in the Biligirirangan hills of Mysore district and the Brahmagiri range of Kodagu district.

The districts of Chikkaballapura and Kolar lie in the Palar and Pennar basins to the north – east and east of Cauvery basin. The topography of the area is generally flat terrain with Nandi hill range being located to the western side of the district where the elevation reaches a height of nearly 1450 m.

### 1.5.3 Geology of the project area

### a. Initial reaches of the project

The initial reaches of the project lies in the Western Ghats region which is a rich reserve of rock formations. Basalt is the predominant rock types found here. Besides, granites, leptynites, charnockites as well as iron ore, dolerites, laterites and bauxite ores are also found here in varying proportions.

### b. The project beyond Western Ghats

#### i. The Archean complex made up of Dharwad schists and granitic gneisses:

These are the oldest formation and are also found in majority of the project area.They are unfossiliferous, crystalline, contrasted and faulted rocks. The chief rocks are gneisses, granites and charnockite, Dharwad schist belt of the Proterozoic alternate with the Archean crystalline rocks. In Dharwar schists, both igneous and altered sedimentary are found in 7-8 well-defined bands running in south-easterly direction. They are known for their mineral ores. They are composed of an assemblage of rocks comprising of dolomite, limestone, gabbro, quartzite, pyroxenite, manganese and iron ores and metabasalt. Gneisses, Granulites and Granites are the interrelated rock types in Karnataka. Granitic gneisses form other Archean systems and cover larger areas. They have been classified into Champion, Peninsular, Nilgiri and Bellary Gneisses.

**ii. The Deccan trappean and intertrappean deposits**

The formation of the Deccan Trap saw the dawn of tertiary era and it represents one of the largest accumulations of basaltic continental lava covering an area of 500,000 km2. This landform mostly consists of greyish to black augite-basalt.

**iii. The tertiary and recent laterites and alluvial deposits**

Over the Deccan Trap, Laterite capping is found which started forming at the cessation of Deccan volcanic activity in the early tertiary period. It is more recent and is found on the coast as well as in several districts of Deccan Plateau. Fossil laterite is a result of sub-ariel weathering and leaching action in different rocks during monsoon in conditions of excessive wetting followed by dryness. The high level laterite found in Belgaum, Bellary, Chikmagalur and Hassan districts are of this type.

## 1.6 Population benefitted

The project is envisaged to provide drinking water along with filling of M I Tanks in Palar and Pennar basins to its 50% capacity (average) in the districts of Kolar, Chikkaballapura, Part of Tumkur, Bangalore rural and Ramanagara districts.

Also the area of Arasikere taluk which is located on upper reach of Tunga Bhadra Sub basin of Krishna basin and part on upper reach of Cauvery Basin does not receive sufficient rainfall and there are no major streams which is due to the fact that the taluk is located on the ridge line bifurcating Krishna and Cauvery basins.

Tiptur and Chikkanayakanahalli which also falls under rain shadow areas located on ridge line have several schemes benefiting them from the Hemavathy Project. Arsikere taluk which is devoid of any perennial streams and do not have any proposed schemes is facing acute ground water table depletion as is the case with tanks in Palar and Pennar basins. Hence, it is now proposed to be included for filling the M I tanks in Arsikere Taluk to their 50% capacity for improvement of water table and providing drinking water facility.

The population which is going to be benefitted with the present scheme of drinking water is about 68.35 lakhs.

## 1.7 Natural Resources

Since this project is for drinking water purposes exclusively, the details of Master Plan for overall development of water Resources does not arise.

## 1.8 Land use and Socio Economic aspects

The main purpose of taking up this project is to supply drinking water to the drought prone districts of Kolar and Chikkaballapura and some areas en route which are facing acute shortage of the potable water.

## 1.9 History (Earlier proposals)

In order to mitigate the drinking water problems being faced by the districts of Kolar and Chikkaballapura, the Government of Karnataka envisaged diverting a portion of water from Bhadra and Krishna as separate projects. However, since the sustainability of the scheme was in doubt, the above projects have not been taken forward.

## 1.10 Choice of the project

### 1.10.1 Alternative studies carried out

The project was originally conceived with the idea of conveying the available divertible yield from the streams on the upper reaches of the Western Ghats near Sakleshpura. The streams identified were Yettinahole, Kadumanehole, Kerihole and Hongadahalla.

The scheme envisaged tapping the excess flow during monsoon by constructing no of diversion weirs across the above streams by restricting the height of the diversion weir to the existing bank level. This was done in order to avoid land acquisition, submersion of forest etc and also allowing the excess water to flow into the streams.

This divertible yield was proposed to be lifted and conveyed to a point beyond the Western Ghats ridge by providing suitable lifting arrangements. This component forms the basis for the project.

The original proposal was to divert about 10 TMC of water (the available yield) by constructing 3 diversion weirs across Yettinahole and Kadumanehole to divert 10 TMC of water. However, after considering the demand for drinking water en route the alignment and ascertaining about excess yield available, a decision was taken to divert about 24.01 TMC of water to the east.

During the process of review on the alternatives, various proposals were considered for studies.

The alternatives were planned beyond the point of DC 4 (located near Haravanahalli), in the conveyance system proposed up to Kolar and Chikkaballapur districts.

**Alternatives as per the original proposal of diverting 10 TMC of water**

The details of the alternatives worked out were for diverting 10 TMC of water and the details are as under:

**Option 1** – Conveying the water from Diversion weir 1 to the above districts by laying the pipeline having suitable lifting arrangements on the foreshore of the Diversion weir including intermediate pumping stations. The proposal was to lift the water from RL 802.00 m to RL 980.00 m and conveying it by 2 rows of 2.6 m dia MS pipes (Raising main) upto 52.00 Km. Beyond this the water was proposed to be allowed to flow by gravity pipes upto Km 100 where an intermediate pumping station was proposed to lift the water from RL 816.00 m upto 920.00 m with a raising main of 75 Km.

**Option 2** – In this option, it was proposed to convey water from weir 1 through a tunnel of dia 6.5 m and a total length of 180.00 Km. It was then proposed to convey the water by a raising main of length 43.00 Km with suitable lifting arrangements. The raising main was 2 rows of MS pipeline 2.6 m in diameter.

**Option 3** – It was proposed to have lifting arrangements at the foreshore of the diversion weir 1 at an elevation of RL 802.00 m. It was proposed to lift the water upto an elevation of RL 900.00 m ( By crossing the western Ghats through a saddle) having a raising main consisting of 2 rows of MS pipes of 2.6 m dia for a length of 8.00 Km. The water was proposed to be let into a delivery chamber from where the water was allowed to flow by gravity into the Hemavathi river. Two weirs, 1 and 2 were proposed to be constructed across Hemavathi River near Channarayapatna at an RL of 800.00 m. The water was then conveyed to the end point by having a pipeline of length 160.00 Km.

**Option 4** – In this option, the water was proposed to be lifted and conveyed to Hemavathy river as envisaged in option 3. The water was then conveyed to a point at a distance of 112 Km by having a tunnel of 6.5 m dia with the entry point being RL 805.00 m and the exit point being RL 772.00 m. From here the water is lifted upto RL 890.00 m by a tunnel of length 52.00 Km.

After studying the various alternatives, in view of availability of excess yield, a decision was taken to make a fresh study to divert about 24.01 TMC of water to the east from the above streams identifying additional streams to accommodate the excess yield.

Accordingly, studies were conducted and the following streams have been identified to tap excess flow during monsoon by constructing weirs across them at identified locations.

1. Yettinahole
2. Yettinahole Tributary 1
3. Yettinahole Tribuary 2
4. Kadumanehole 1
5. Kadumanehole 2
6. Yettinahole downstream
7. Kerihole
8. Hongadahalla

**Alternatives as per the original proposal of diverting 24.01 TMC of water**

**<u>Phase 1</u>**

The present proposal deals with diversion of 24.01 TMC from the above streams by constructing 8 diversion weirs have suitable lifting arrangements like jack well cum pump house located nearby and conveying the water to the identified delivery chambers through raising mains. In case of weirs 3, 4 and 5, even though originally it was planned to convey the water from DC 2 (where the water from the weirs were collected) to DC 1 located near Weir 1, later due to the fact that the terrain permits for conveying the water from DC 2 to DC 3 directly by gravity, it was decided to convey the water through gravity canal.

**Phase 2**

Phase 2 works comprises of conveyance system beyond DC 4.

**Alternatives beyond DC 4:**

As per the original proposal, beyond DC 4, the conveyance system comprised of the following:

- Gravity canal for a length of 233.0 Km to culminate near Tumkur at RL +800.00 m.
- Beyond this point, a raising main of length 8.10 Km to convey the water to the proposed balancing reservoir located near Devarayanadurga
- Construction of a balancing reservoir of capacity 10 TMC near Devarayanadurga (RL +910.00 m)
- Raising mains of length 55.90 Km and 80.82 Km to convey the water to RL +920.00 m (highest points) in Chikaballapura and Kolar respectively.
- No distribution system was proposed beyond these points.

During interaction with the department regarding the alignment and the project components as a whole, several alternate studies have been carried out after due consideration given to the following by the Consultant.

The details are as under:

**1. Identification of beneficiaries and allocation of water:**

After identification of beneficiaries' enroute the alignment such as Taluks and the Hobli population for the year 2023, 2033 and 2043 was projected by considering the base year as 2013-14 (as per the Census of 2011) for computing exact quantum of water required.

Further, in order to utilize the surplus water available after meeting the drinking water needs, the tank filling component is considered by restricting this tank filing to Palar & Pennar basins and Arasikere taluk only with 50% filling.

**2. Alignment of the canal**:

Several discussions were held regarding the proposed alignment of the gravity canal and it was felt that there is scope for modifying the alignment from DC-3 which would help in overall optimization of the project.

## 3. Storage locations and Distribution system for Drinking water and filling of tanks:

The proposal considered having a reservoir at Devarayanadurga with a provision for conveying water to Kolar and Chikkaballapura Districts. However, this involved submergence of forest land to an extent of 578.0 Ha. In order to avoid this, alternative locations are explored. It was also decided to identify storage points near the beneficiary areas.

The distribution system comprises of:

a. Drinking water to the identified villages and towns in Taluks/Districts,

b. Filling MI Tanks in Palar and Pennar Basins,

c. Filling MI Tanks in Arasikere Taluk,

d. Augment supply to Hesarghatta and T.G.Halli Reservoirs,

e. Drinking water supply to the Devanahalli industrial area and surrounding areas.

### a. Drinking water

En route the alignment of the Gravity Canal, it is proposed to identify storages at different locations to store and supply drinking water.

### b. Filling MI tanks

Since the areas falling under Palar and Pennar basins are facing acute shortage of water which in turn has resulted in the Minor irrigation tanks in these areas going virtually dry, it was felt that the MI tanks under Palar and Pennar basins shall be considered for tank filling.

Also the area of Arasikere taluk which is located on upper reach of Tunga Bhadra Sub basin of Krishna basin and part on upper reach of Cauvery Basin does not receive sufficient rainfall and there are no major streams wich is due to the fact that the taluk is located on the ridge line bifurcating Krishna and Cauvery basins.

Tiptur and Chikkanayakanahalli which also falls under rain shadow areas located on ridge line have several schemes benefiting them from the Hemavathy Project. Arsikere taluk which is devoid of any perennial streams and do not have any proposed schemes is facing acute ground water table depletion as is the case with tanks in Palar and Pennar basins. Hence, it is now proposed to be included for filling the M I tanks in Arsikere Taluk to their 50% capacity for improvement of water table and providing drinking water facility.

A list of MI tanks proposed for filling under the scheme has been prepared.

### c. Augmentation of supply to Hesarghatta and T.G.Halli Reservoirs

It is proposed to augment the supply for Hesarghatta and T.G.Halli Reservoirs through a distribution system in order to mitigate the drinking water problem being faced by the areas which have been supplied with the same from these reservoirs.

As per the records of BWSSB these two resevoirs are facing deficit filling in the past decades due to over utilisation and urbanisation in the catchment area. Hence provisions of augumenting the same is made.

### d. Drinking water supply to the Devanahalli industrial area and surrounding area

An industrial area is proposed near Devanahalli which requires water and as such, provision is made for providing drinking water supply to the said industrial area.

Area in and around Devanahalli is developed as a new industrial hub after International Airport has come up in this area. Providing the drinking water requirement and to cater the future development a provision of 0.50 TMC is made.

As already indicated, the project of diverting excess flow during peak monsoon months from the identified streams on the upper reaches of western ghats has been envisaged to supply drinking water to the needy areas in the East especially Kolar & Chikkaballapur district. The scheme has, since its concept has undergone quite a number of iterations compressing of changes in the Phase – 1 components and Phase – 2 components. However, the changes are minimal in Phase – 1 component as compared to changes in the Phase – 2 components. The details of the project and subsequent changes/alternates are detailed below:

**Original proposal:-**

As per the original proposal, it was planned to lift the water from the weirs (8 Nos) and convey it to DC-3 located near Doddanagara at an RL of +920.00 m and further lift it and convey to DC-4 located near Haravanahalli at an RL+960.00 m.

From DC-4, it was proposed to convey the water through an open channel by aligning it along the ridge bifurcating Krishna and Cauvery basins and terminating at an RL+800.0 m near Tumkur. The length of this open channel is 233.00 Km with a gradient of 1:7500.

On reaching the RL +800.00 m, the water was proposed to be lifted and conveyed through a raising main of length 8.10 Km to the reservoir located near Deverayanadurga with an FRL +900.00m. From here on, two raising mains of lengths 55.9 Km and 80.82 Km. have been proposed to convey the water up to an RL of +980.00 m which would cater to the drinking water needs of Chikkaballapura and Kolar districts respectively.

**Modification in the conveyance system has been suggested due to the following factors:**

1. There is a lift of 45.0 m involved in lifting 85.0 Cumecs of water from RL +920.00 m (CBL of DC-3) to RL +960.00 m (DC-4). The lifting involved huge cost on pumping machinery and the raising mains.
2. The power charge for lifting such huge quantum of water to the required height works out to Rs. 24.90 Crores annually. As is the practice, the total cost has to be arrived at considering 15 years as the life cycle of the lifting arrangements. The total cost thus works out to Rs. 373.50 Crores.
3. Further, there will be a recurring expenditure involved for operation and maintenance.
4. The gravity canal on reaching RL +800.00 m near Tumkur requires another lifting to convey the water to the proposed reservoir near Devarayanadurga (RL +900.00 m) with a raising main of length 8.10 Km.
5. The proposed reservoir near Devarayanadurga has the following disadvantages:-
   - It involves submergence of forest lands to a tune of about 578.0 Ha.
   - It involves submergence of major roads.
   - It involves submergence of two villages and one historical place named Naamadachilume.
   - The height of the dam is about 68.0 m with a length of 2050.0 m.
6. Additional lift is involved to convey the water through raising mains from RL +900.00 m to RL +980.00 m to supply water to both the districts of Chikkaballapur and Kolar.

The consultants have explored various alternates beyond Phase-1 works during DPR stage in order to identify a suitable, economical and viable alternative which could be considered for approval and further implementation.

The studies of alternates involved conveyance system and reservoir, the details are indicated below:

1. Alternates for conveyance system beyond DC-3 up to 95.50 Km on original alignment in order to avoid the huge lift involved to convey the heavy discharge from DC 3 to DC 4 ( as per original proposal) which is about 45 M.

2. Alternates for balancing reservoir including conveyance system beyond 95.50 Km on original alignment

## Alternates for conveyance system beyond DC-3 up to 95.50 Km on original alignment

The original alignment proposed to reach the ridge point bifurcating Krishna and Cauvery basins at 95.50 Km. The alternates considered this as the base for conducting further studies.

Three alternates have been studied, the details of which are listed below:-

**Alternate – 1**

Since DC-3 is located at RL +920.00 m and the RL at the meeting point with the ridge at Ch 95.50 Km. is RL +878.50 m, conveying the water through a gravity canal following the contour of RL +920.0 m was considered.

The gravity canal, if runs in contour, traverses for a length of about 155.0 Km before reaching the ridge point as against a length of 95.50 km as per original proposal. Furthermore, it has inherent disadvantages like overlapping of the command areas of Hemavathy and Yagachi reservoirs and involving construction of several major CD structures.

**The cost for this alternative proposal works out Rs. 2767.00 Crores.**

**Alernate-2**

The original proposal comprised of a lift component to convey water from DC-3 to DC-4 involving a lift of 40.0 m and a gravity canal beyond DC- 4 upto 95.50 Km wherein this present Alternate – 2 is now studied.

In this alternate, instead of the lift component and gravity canal up to 95.50 Km on original alignment, a tunnel is proposed to convey the water directly from DC-3 to reach 95.50 Km (on the original alignment) with an approach channel of length 7.40 Km, first tunnel of length of 16.10 Km, cut and cover of length 1.0 Km, another tunnel of length 36.60 Km and exit channel of length 1.40 Km (totalling to 62.50 Km). However, the length of the tunnel in this proposal is 52.70 Km. Beyond this point, the alignment runs in the ridge as proposed in the original alignment.

**The total cost for this alternate proposal with tunneling through TBM (Tunnel boring machine) at Rs. 60.0 Crores per Km inclusive of all other activities as envisaged above works out to Rs. 3389.0 Crores.**

**Alternate-3**

In this alternate, the alignment is proposed to reach the ridge at 52.50 Km on the original alignment. The alignment consists of an approach channel of length 7.40 Km, first tunnel of length 15.6 Km, cut and cover of length 1.40 Km, another tunnel of length 9.00 Km followed by an exit channel of length 8.80 Km (totalling to 42.2 Km) to reach the ridge at 52.50 Km on the original alignment. Beyond this point, the alignment runs in the ridge as proposed in the original alignment.

**The total cost for this alternate proposal with tunneling through TBM (Tunnel boring machine) at Rs. 60.0 Crores per Km inclusive of all other activities as envisaged above works out to Rs. 2544.0 Crores.**

## Alternates for balancing reservoir including conveyance system beyond 95.50 Km on original alignment

**Original proposal of conveying water from 95.50 Km onwards:**

The original proposal was to convey the water through a gravity canal beyond 95.50 Km up to 233.00 Km at RL +800.00 m near Tumkur. From this point, a raising main of length 8.10 Km involving lift of about 110.00 m was planned to lift the water and convey it to the proposed Devarayanadurga reservoir.

In order to avoid this lift and the raising main, alternatives were studied and the details are indicated here under.

**Alternate studies for conveying water beyond 95.50 Km on original alignment**

In these studies, except for Alternate-C, the gravity canal runs in the original alignment up to 169.00 Km beyond which alternatives have been studied.

- Alternate – A:
  Gravity canal from 169.0 Km at RL +840.00 m (on the original alignment) up to 257.500 Km to feed Devarayanadurga reservoir
- Alternate – B:
  Gravity canal from 169.0 Km at RL +840.00 m (on the original alignment) up to 273.865 Km to feed alternate reservoir identified near Bhairagondlu village, Koratagere Taluk (Proposed as an alternate to Devarayanadurga reservoir)
- Alternate – C:
  Proposal to lift water from end point of Gravity Canal (original proposal at RL +800.00 m near Tumkur) through a raising main of length 10.50 Km to reach RL +840.0 m and then follow the alignment to reach the alternate reservoir identified (In lieu of Devarayanadurga reservoir)

**Alternate-A**

The gravity canal takes a detour from the original alignment at 169.00 km to follow the contour of RL 840.0 m. It then runs in saddle (840.0 m to 800.0 m) for a length of 12.50 Km (208.50 km to 221.0 km) through an aqueduct of about 20.0 m height (deepest point being 30.0 m). It crosses the ridge between North Pennar and Krishna basins at 239.0 Km, where it is aligned in a deep cut (varying from 10.0 m to 15.0 m). This canal runs in contour and reaches RL +823.0 m at a distance of about 3.0 km from the proposed balancing reservoir near Devarayanadurga.

At this point, the chainage is 257.50 km. Here, a raising main of length 3.0 Km is proposed to lift the water and convey it to the proposed balancing reservoir.

In between, off takes are provided to meet the requirement of various areas under consideration. This proposal has the disadvantage of construction of reservoir near Devarayanadurga. Further, a raising main of length 56.0 Km is proposed from this reservoir to feed the drinking water and tank filling component in Kolar district and part of Chikkaballapur district, drinking water supply to Devanahalli Industrial Area and surrounding areas, augmenting Hesaraghatta tank and part of Bangalore rural District.

**The cost of this proposal works out to Rs.5470.00 Crores.**

**Alternate – B**

In this alternate, the gravity canal beyond 169.00 Km runs up to 273.865 km (including aqueduct of 12.50 Km proposed in Alternate-A) before reaching an alternate balancing reservoir (FRL +800.00 m) located near Bhairagondlu village, Koratagere Taluk with a capacity of 5.780 TMC. In between, off takes are provided to meet the requirement of various areas under consideration

**This proposal seems feasible** as it avoids the cost towards the lift and construction of the proposed Devarayanadurga reservoir.

Further, raising mains of length 45.0 Km and 31.0 Km are proposed to convey the water for the following purpose:

Towards Kolar and Chickaballapur districts carrying both the requirements of Drinking water and tank filling components and distributed beyond.

Towards Nelamangala, Doddaballapura, Devanahalli and Hoskote Taluks including drinking water requirement of Devanahalli Industrial Area and surrounding areas.

**The cost of this proposal works out to Rs.5000.00 Crores.**

**Alternate – C**

In this proposal, in order to avoid the aqueduct of 18.0 Km proposed in Alternates A & B including the reservoir proposed at Devarayanadurga, a study was conducted keeping the original alignment up to RL +800.00 m as it is and planning the scheme beyond this point. If the proposal of locating the reservoir at Devarayanadurga (RL +900.00 m) is dropped, then the alternate storages located near Tumbadi and Bhairagondlu in Koratagere taluk can be considered as the storage points for the scheme.

Both these storage areas are located at an RL +800.00 m. In view of this, instead of lifting the water from +800.00 m (near Tumkur) to +900.00 m (Devarayanadurga reservoir) as originally envisaged, the lift can be restricted and proposed from +800.00 m to +840.00 m to reach the original alignment at Ch. 258.500 Km. through a raising main of length 10.50 Km with the static head of 40.0 m. Beyond this, the canal runs in the same alignment as per Alternate -B and reaches Bhairagondlu reservoir.

This proposal is not feasible as it again involves lift from RL +800.00 m to RL +840.00 m.

**The cost of this proposal works out to Rs.4941.00 Crores.**

**Considering the merits and demerits of various alternates as indicated above, the most feasible and achievable alternate as a combination had been proposed by the Consultant for consideration which is indicated below.**

The alignment proposal for conveyance system including the balancing reservoir which is feasible and cost effective are Alternate 3 combined with Alternate – B. This proposal includes construction of tunnel including the approach, exit channel and cut and cover. The length of each is detailed below:

**From DC-3 to ridge (52.50 Km on the original alignment)**

- Length of approach channel - 7.40 Km
- Length of the first tunnel – 15.60 Km
- Length of the cut and cover – 1.40 Km
- Length of the second tunnel – 9.00 Km
- Length of exit channel – 1.00 Km
- Length of Gravity canal beyond the exit channel up to the termination point – 7.80 Km

**Note:** The construction of tunnel, even though is difficult and time consuming, the proposal has considered the demerits indicated below and further recommended the same to be considered for implementation.

**Demerits**

- Procurement of tailor made tunnel boring machine of the required diameter consumes more time which may be about one and half to two years from the date of order.
- The cost of tunnel with TBM will be about Rs. 60.0 Crores as compared to Rs. 40.0 Crores with conventional tunneling.
- A thorough detailed geological investigation of the entire alignment in which the tunnel is proposed has to be undertaken which may be about one year.
- Further, methodology, designs, preparation of estimates based on the approved alignment, BOQ and tender process would require about one year.

However, these activities can be taken up simultaneously.

**Merits**

The tunneling through tunnel boring machine has the following advantages:

- The construction of tunnel has become easy due to availability of latest equipment like tunnel boring machine which can bore and help in finishing the lining at the same time.
- Further, detailed geomorphological studies based on the available geological maps of the area have been undertaken and it is seen that tunneling in the said area will not face much difficulties during execution.
- As compared to the manual tunneling, using TBM will help in reducing the time factor to a great extent.
- Care has been taken to see that there are two tunnels in the alignment which can be tackled simultaneously there by reducing the time factor as compared to a single tunnel.
- The alignment predominantly runs in an area where coffee plantation exists and as such by adopting to tunneling, land acquisition is considerably reduced.
- During the detailing process, the possibility of reducing the length of the tunnel will be explored depending on the ground condition by way of increasing the approach, exit channels and cut and cover.

**Geological studies conducted for undertaking Tunnelling:**

In order to assess the geological feasibility of the proposed tunnelling, a detailed study covering the lithology, lineament and geomorphology of the said alignment was undertaken through Dr. Y Lingaraju, Geological expert and is herewith appended**.**

The report and conclusion are as under:

- The Geological map prepared by Geological survey of India is an authentic reference to know the distribution of rock formations. The thematic maps generated using satellite remote sensing is also an authentic reference to know the possible terrain features.
- Integration of this information using Geographic information system (GIS) to match the ground features with the proposed alignment would serve as decision support system. The decision taken on this basis is to be verified by ground based investigations.
- The alignment proposed by M/S EIT based on their feasibility studies are superposed on survey of India Toposheet and the geological maps.
- The thematic maps generated using remote sensing has helped in interpreting and commenting on the feasibility of tunnelling along the proposed alignment.
- This report is prepared following the above methodology.
- However a detailed ground based investigation taking the guidelines from this report has to be undertaken during the pre-construction stage in order to exactly identify the geological formations at the

tunnelling level which would help to a great extent in eliminating any surprises which may be encountered during the project execution.

- The alignment proposed is having congenial rock condition with limited challenges. Hence it can be concluded that there are no major problems foreseen as per the study conducted.

**Tunnelling schedule:**

It is proposed to use a circular Tunnel Boring Machine of dia 7.50 m with a lining thickness of 300mm. Since the alignment comprises of two tunnels of length 15.60 Km and 9.00 Km respectively, with the availability of two openings, the tunnelling operation can be started simultaneously from both the openings in these two tunnels.

The achievable tunnelling from each TBM is approximately about 250.0 m per month. Considering this, if the contracted agency is able to mobilise four TBM's to tackle both 15.60 Km and 9.00 Km tunnels simultaneously, the time schedule can be fixed as under:

<u>For tunnel of length 15.60 Km</u>

- Tunnel boring at 250.0 m per month
- Boring work simultaneously starts from both openings
- Thus, each TBM has to bore about 7.80 Km.
- **To complete 15.60 Km, the time schedule required will be 32 months.**

<u>For tunnel of length 9.0 Km</u>

- Tunnel boring at 250.0 m per month
- Boring work simultaneously starts from both openings
- Thus, each TBM has to bore about 4.50 Km.
- **To complete 9.0 Km, the time schedule required will be 18 months.**

**<u>For geological investigations and analysis</u>**

A detailed geological investigation of the alignment requires about 9 months including analysis of the data.

**<u>Total time schedule</u>**

Time required for tunnelling - 32 months

Time required for geological investigations – 9 months

Total time required – 41 months i.e. 3 years and 5 months

**Table 1.3: Comparison of time schedule for Phase-I and Tunnelling work in Phase-II**

| No. | Activity | Time Schedule |
|---|---|---|
| 1 | Phase-I<br>Construction of Weirs and the lifting component including Delivery chambers | 36 months |
| 2 | Tunnelling work in Phase II<br>Two tunnels of length 15.60 Km and 9.00 Km respectively including Geological investigations | 41 months |

As could be seen from the above table, the time over shoot between Phase-I and the tunnelling in Phase-II is about 5 months. However, the total time required for tunnelling includes 9 months for detailed geological investigations. If a process is initiated during the preliminary Tender process of calling of tender, BOQ, finalisation of tender etc., the time required for geological investigations can easily be reduced by about 5 months which in effect means that the tunnelling work could be completed within the time schedule of 36 months as envisaged for completion of Phase-I works.

**From 52.50 Km (on the original alignment) to the balancing reservoir located at Bhairagondlu**

Length of Gravity canal beyond 52.50 Km (on the original alignment) up to Bhairagondlu reservoir is 235.50 Km as per Alternate - B.

**Reservoir**

Original proposal envisaged construction of a balancing reservoir near Devarayanadurga with a capacity of 10 TMC. However as indicated above it has its own disadvantages (indicated below) which necessitated looking for an alternate location to construct balancing reservoir:

- It involves submergence of forest lands to a tune of about 578.0 Ha.
- It involves submergence of major roads.
- It involves submergence of two villages and one historical place named Naamadachilume.
- The height of the dam is about 68.0 m with a length of 2050.0 m.

As a consequence, the balancing reservoir (FRL +800.00 m) is now proposed to be located near Bhairagondlu village, Koratagere Taluk with a capacity of 5.780 TMC and the present proposal considers the same.

**Raising main**

A raising main of length 45.0 Km is proposed to reach RL +910.00 m wherein it is fed into a proposed Delivery chamber (to carry the required quantum of drinking and tank filling water to Kolar and Chikkaballapur districts).

**Distribution system**

In the original proposal, the project has been envisaged as a bulk water supply project and as such, the requirement of distribution system was not considered in detail.

However, subsequently due to the fact that proper allocation of water including the areas to be benefitted has been frozen, it has become necessary to plan the storages and the distribution system in the project.

Enroute the alignment, the drinking water component is considered and accordingly for areas identified to be the beneficiary, details of the identified storage reservoirs along with the distribution system (like offtake channel) are given hereunder.

- Kadur offtake proposed at 39.0 Km to feed a natural stream which in turn reaches the identified reservoir across Vedavathi valley near Hulikallu Rudradevara gudi (0.267 TMC) in Kadur taluk.
- Arasikere offtake proposed at 104.50 Km to feed a natural stream which in turn reaches the identified reservoir near Lakkehalli village (0.512 TMC) in Arasikere taluk.
- Tiptur offtake proposed at 127.80 Km to feed a natural stream which in turn reaches the identified reservoir near Gopalanahalli village (0.301 TMC) in Tumkur taluk.
- Chikkanayakanahalli offtake proposed at 138.30 Km to feed a natural stream which in turn reaches the identified reservoir near Agasarahalli village (0.347 TMC) in Tumkur taluk.
- Gubbi offtake proposed at 171.80 Km to feed a natural stream which in turn reaches the identified reservoir on upstream of Singadahalli tank near Tirtharampura state forest (0.108 TMC) in Tumkur taluk.
- Madhugiri feeder channel of length 82.00 Km offtaking at 231.70 Km to reach proposed reservoir at Tumbadi and further on to Madhugiri and Pavagada (2.759 TMC).
- T.G.Halli and Ramanagar feeder channel offtaking at 248.40 Km to reach the starting of the tunnels point at 57.00 Km beyond which two tunnels are proposed, one to reach T.G.Halli and another to reach a tributary of Arkavathi river (3.534 TMC)
- Gowribidanur feeder channel offtaking at 274.00 Km to supply water to part of Gowribidanur for tank filling only (1.155 TMC)
- The drinking water component of Gowribidanur taluk shall be met with from the Bhairagondlu reservoir.
- A raising main of length 31.0 Km offtaking from the balancing reservoir to augment Hesarghatta reservoir and feed the identified storage reservoirs in Doddaballapur and Nelmangala to meet the drinking water requirement (1.797 TMC).
- Another raising main of length 45.0 Km off taking from the balancing reservoir is proposed to meet the drinking water and tank filling requirement in Kolar, Chikkaballapur and Bangalore rural districts (11.725 TMC).

## Final proposal as per the decision of the Government

Further to the Consultant's opinion, the Department initiated a meeting with the Hon'ble Minister for Water Resources along with the Principal Secretary, Water Resources and other officers on 6th November 2013.

During deliberations, all the aspects like ease of construction, time frame to execute including environmental issues etc were considered. Further, the previous experience in executing tunnel/s in the state which is not very encouraging has also played a part.

Finally, it was decided to adopt the following as the components of the project.

- Phase 1 component comprising of the following:
  - ✓ Construction of 8 diversion weirs across Yettinahole, Kadumanehole, Kerihole and Hongadahalla streams
  - ✓ Diverting water from Weirs 3, 4 and 5 to Delivery Chamber (DC 2) beyond which, a gravity canal is proposed to carry water to the Delivery chamber (DC 3) located beyond Hemavathi River near Doddanagara.
  - ✓ The water from Weir 1 received from the independent catchment of Yettinahole is pumped and conveyed through a raising main up to DC 3 near Doddanagara.
  - ✓ The water from Weir 2 is proposed to be conveyed to Weir 8 through a raising main and then by gravity. The water from Weirs 6, 7 and 8 will then be conveyed through pumping and independent raising mains up to the Jack well cum Pump house situated near Weir 1.
  - ✓ The two Jack well cum Pump houses near Weir 1 will then be used to pump the water received from Weirs 1, 6, 7 and 8 to DC-3 located near Doddanagara in Sakleshpura Taluk. From DC 3, the water will be pumped and conveyed to Delivery chamber (DC- 4) located near Haravanahalli in Sakleshpura taluk, the starting point of the gravity canal.
- Phase 2 component comprises of the following
  - ✓ Construction of Gravity canal for a length of 273+865Km including an aqueduct of 12.5Km.to reach the proposed balancing reservoir at Bhairagondlu.
  - ✓ Construction of storage reservoirs identified in the beneficiary taluks
  - ✓ Construction of balancing reservoir at Bhairagondlu in Koratagere Taluk
  - ✓ Construction of raising main of length 45 Km to convey the water for Kolar, Chickaballapura and Bangalore rural districts
  - ✓ Construction of feeder canals to supply required quantum of water to the beneficiary areas through dedicated feeder canals / conveyance system

## Allocation of water

The project proposal comprises of two components namely drinking water and tank filling. The main idea with which the project has been formulated is to take care of the drinking water needs of the identified areas. It is observed and established that the total quantum of water required for drinking water component (considering the projected population as on 2023-24) is about 15.029 TMC including augmentation of T.G.Halli and Hesarghatta reservoirs and drinking water supply to Devanahalli industrial area and surrounding areas.

This has resulted in balance availability of 8.981 TMC which has been planned to be utilized for tank filling component. However, the tank filling will be restricted to the identified MI tanks in Palar and Pennar basins and tanks in Arasikere taluk only and filling them to their 50% capacity (average). **Beyond 2023-24, it is necessary that the water being supplied to tank filling need to be curtailed and diverted for drinking water purposes.**

For drinking water component, storage reservoirs have been planned and the water will be fed to them. Further distribution from these storage reservoirs have to be taken up by concerned departments like KUWS & DB, RPED and Local bodies.

Regarding augmentation of water to T.G.Halli and drinking water to Ramnagara district, it is proposed to convey the water by providing an offtake at Ch: 248.40 Km through a gravity canal of length 57.0 Km beyond which two tunnels are proposed, one to augment the requirement of T.G.Halli and other to carry the drinking water requirement of Ramnagara district which is led of into a valley which in turn joins Arkavati.

For areas falling under Palar and Pennar basins, the proposal considered distributing the water to the identified storages. Further, the water required for tank filling in these areas and Arasikere Taluk has also been considered for conveying and accordingly the distribution system has been designed.

1. Drinking water requirement has been arrived at 15.029 TMC considering the projected population up to 2023-24. Details are indicated below.

| No. | District | Drinking water requirement for the year 2023-2024 (Including Losses) (TMC) | Selected Taluks for Drinking water |
|---|---|---|---|
| 1 | Chikkamagalur | 0.267 | KadurTaluk (Only Kadur kasba, Birur and Singatagere) |
| 2 | Hassan | 0.512 | ArsikereTaluk |
| 3 | Tumkur | 2.433 | TumkurTaluk (Only Kora hobli), Chiknayakanhalli Taluk, Sira Taluk Pavagada Taluk, Madhugiri Taluk, Koratagere Taluk, Gubbi Taluk (Only Chelur & Nittur Hobli (villages coming under Hemavathy atchkat are not considered), TipturTaluk (Only Kasaba hobli, Kibbanahalli hobli, Honnavalli hobli) |

| No. | District | Drinking water requirement for the year 2023-2024 (Including Losses) (TMC) | Selected Taluks for Drinking water |
|---|---|---|---|
| 4 | Kolar | 2.842 | KolarTaluk, SrinivaspurTaluk, MalurTaluk, BangarpetTaluk, MulbagalTaluk |
| 5 | Chikkaballapur | 2.217 | ChikkaballapuraTaluk, GauribidanurTaluk, GudibandaTaluk, BagepalliTaluk, SidlaghattaTaluk, ChintamaniTaluk |
| 6 | Bangalore Rural | 1.924 | NelamangalaTaluk, DoddaballapurTaluk, DevanahalliTaluk, HosakoteTaluk |
| 7 | Ramnagara | 1.834 | RamnagaraTaluk, MagadiTaluk, ChannapatnaTaluk, KanakapuraTaluk. |
| 8 | Augumentation to T.G.halli Reservoir | 1.70 | |
| 9 | Augumentation to Hesarghatta Reservoir | 0.80 | |
| 10 | Drinking water supply to Devanahalli Industrial Area and surrounding areas | 0.50 | |
| | **Total** | **15.029 TMC** | |

2. Tank filling Requirement is worked out by considering 50% filling (average) of MI tanks as below;

| No. | Name of District/Taluk | Number of MI tanks | Total live capacity in Mcft | Average proposed filling @ 50% of the live capacity | | Remarks |
|---|---|---|---|---|---|---|
| | | | | Mcft | TMC | |
| **1** | **Hassan** | | | | | |
| | Arasikere | 34 | 1569.14 | 784.57 | 0.800 | |
| | **Sub total** | **34** | **1569.14** | **784.57** | **0.800** | |
| **2** | **Tumkur** | | | | | |
| | Tumkur | 6 | 43.53 | 21.77 | 0.022 | |
| | Koratagere | 39 | 1932.98 | 869.84 | 0.870 | |
| | Madhugiri | 45 | 1873.63 | 843.13 | 0.843 | |
| | Pavagada | 23 | 1526.58 | 424.65 | 0.425 | |
| | **Sub total** | **113** | **5376.72** | **2159.39** | **2.160** | |
| **3** | **Kolar** | | | | | |
| | Kolar | 44 | 1966.55 | 786.66 | 0.787 | |
| | Malur | 11 | 530.65 | 212.26 | 0.212 | |
| | Bangarpet | 13 | 1113.75 | 436.91 | 0.437 | |
| | Mulabagal | 35 | 1045.34 | 418.14 | 0.418 | |
| | Srinivasapura | 35 | 523.81 | 209.52 | 0.210 | |
| | **Sub total** | **138** | **5180.10** | **2063.49** | **2.064** | |

| No. | Name of District/Taluk | Number of MI tanks | Total live capacity in Mcft | Average proposed filling @ 50% of the live capacity | | Remarks |
|---|---|---|---|---|---|---|
| | | | | Mcft | TMC | |
| **4** | **Chikkaballapur** | | | | | |
| | Chikkaballapura | 21 | 997.01 | 398.80 | 0.399 | |
| | Bagepalli | 31 | 938.15 | 455.62 | 0.456 | |
| | Chintamani | 19 | 294.59 | 147.30 | 0.148 | |
| | Gudibande | 14 | 692.76 | 320.68 | 0.321 | |
| | Shidlaghatta | 25 | 1462.09 | 584.84 | 0.585 | |
| | Gowribidanur | 86 | 2418.7 | 967.48 | 0.967 | |
| | **Sub total** | **196** | **6803.30** | **2874.72** | **2.876** | |
| **5** | **Bangalore Rural** | | | | | |
| | Nelamangala | 2 | 14.67 | 7.34 | 0.007 | |
| | Doddaballapur | 7 | 151.72 | 75.86 | 0.076 | |
| | Devanahalli | 11 | 671.525 | 335.763 | 0.336 | |
| | Hosakote | 26 | 1296.22 | 648.110 | 0.648 | |
| | **Sub total** | **46** | **2134.14** | **1067.07** | **1.067** | |
| | **Grant total** | **527 Nos** | **21063.40 Mcft** | **8.967 TMC** | | |

## Cost of the project

The overall cost of the selected scheme as considering the SR of WRD for 2012-13 works out to **Rs. 11,005.36 Crores** and the additional cost for the distribution system works out to **1910.00 Crores.**

A comparative statement has been prepared considering the cost as per original proposal, cost as per current SR considering design changes, change in length of canal, increase in number of major structures and the discharge component for pumping (which has increased from 45.0 cumecs to pump 10.0 TMC to 85.0 cumecs to pump 24.01 TMC in the present proposal) and the cost as per the selected proposal.

**The cost of the project as per original proposal as compared with estimated cost based on current SR of WRD 2012-13 with 2$^{nd}$ stage pumping revised as per proposed water allocation and as per the selected proposal:**

**Table 1.4: Comparitive statement of general abstract**

| No. | Description of Work | Estimated Cost of original proposal as per SR 2011-12 (Administratively approved) in Crore Rupees | Estimated Cost of original proposal (Administratively approved revised as per SR 2012-13 and as per water allocation) in Crore Rupees | Detailed project Cost as per SR 2012-13 in Crore Rupees |
|---|---|---|---|---|
| **Part-A, Works for construction of Lift components upto Haravanahalli Delivery chamber** | | | | |
| **ESTIMATE FOR WORK PORTION** | | | | |
| **1** | **Preliminaries** | | | |
| 1.1 | DPR preparation | 54.68 | 2.68 | 2.68 |
| 1.2 | Survey, investigation, preparation of designs, drawings and Sump model studies and surge analysis | | | |
| 1.3 | PMC and Quality control | | | |
| 1.4 | Telemetry and SCADA system | | | |
| | **Sub Total, 1** | **54.68** | **2.68** | **2.68** |
| **2** | **Construction** | | | |
| **2.1** | **Electromechanical works, Design supply, erection of pumping machinery** | | | |
| 2.1.1 | Lift from Weir-3 (Yettinahole tributary-2) to Weir-1 (Yettinahole) | 20.60 | 29.63 | 29.63 |
| 2.1.2 | Lift from Weir-4 (Kadumane hole-1) to Weir-1 (Yettinahole) | 9.35 | 9.20 | 9.20 |
| 2.1.3 | Lift from Weir-5 (Kadumane hole-2) to Weir-1 (Yettinahole) | 21.90 | 22.94 | 22.94 |
| 2.1.4 | Lift from Yettinahole Weir-1 to commom Intermediate pumping station near Doddanagara ( DC-3) | 147.93 | 110.28 | 110.28 |
| 2.1.5 | Lift from Weir-2 (Yettinahole tributary-1) to Weir-8 (Yettinahole d/s) | 7.05 | 7.69 | 7.69 |
| 2.1.6 | Lift from Weir-6 (Kerihole) to intermediate pumping station near Weir-1 | 10.09 | 11.16 | 11.16 |
| 2.1.7 | Lift from Weir-7 (Hongadahalla) to intermediate pumping station near Weir-1 | 68.1 | 75.51 | 75.51 |
| 2.1.8 | Lift from Weir-8 (Yettinahole d/s) to intermediate pumping station near Weir-1 | 22.6 | 24.47 | 24.47 |
| 2.1.9 | Lift from Intermediate pumping station near Weir-1 to common intermediate pumping station near Doddanagara (DC-3) | 156.56 | 168.77 | 168.77 |
| 2.1.10 | Lift from common Intermediate pumping station to DC-4 near Haravanahalli | 133.38 | 144.82 | 144.82 |

| No. | Description of Work | Estimated Cost of original proposal as per SR 2011-12 (Administratively approved) in Crore Rupees | Estimated Cost of original proposal (Administratively approved revised as per SR 2012-13 and as per water allocation) in Crore Rupees | Detailed project Cost as per SR 2012-13 in Crore Rupees |
|---|---|---|---|---|
| 2.1.11 | Construction of Electrical sub stations and electrical works | 34.65 | 40.01 | 40.01 |
| 2.1.12 | Cost of bringing power supply from nearest KPTCL SubStation to Pump station | 220.00 | 220.00 | 220.00 |
| 2.1.13 | O & M cost for 5 years including spares and tools | 14.00 | 14.00 | 14.00 |
| | **Sub Total, 2.1** | **866.21** | **878.48** | **878.48** |
| **2.2** | **Construction of Raising Mains** | | | |
| 2.2.1 | From Weir-3 (Yettinahole tributary-2) to Weir-1 (Yettinahole) | 26.45 | 253.55 | 253.55 |
| 2.2.2 | From Weir-4 (Kadumane hole-1) to Weir-1 (Yettinahole) | 39.45 | 22.26 | 22.26 |
| 2.2.3 | From Weir-5 (Kadumane hole-2) to Weir-1 (Yettinahole) | 73.70 | 43.99 | 43.99 |
| 2.2.4 | From Yettinahole Weir-1 to commom Intermediate pumping station near Doddanagara ( DC-3) | 336.45 | 220.76 | 220.76 |
| 2.2.5 | From Weir-2 (Yettinahole tributary-1) to Weir-8 (Yettinahole d/s) | 7.30 | 8.59 | 8.59 |
| 2.2.6 | From Weir-6 (Kerihole) to intermediate pumping station near Weir-1 | 51.1 | 56.65 | 56.65 |
| 2.2.7 | From Weir-7 (Hongadahalla) to intermediate pumping station near Weir-1 | 360.6 | 409.43 | 409.43 |
| 2.2.8 | From Weir-8 (Yettinahole d/s) to intermediate pumping station near Weir-1 | 58.75 | 66.63 | 66.63 |
| 2.2.9 | From Intermediate pumping station near Weir-1 to common intermediate pumping station near Doddanagara (DC-3) | 327.9 | 342.54 | 342.54 |
| 2.2.10 | From commom Intermediate pumping station to DC-4 near Haravanahalli | 663.65 | 726.95 | 726.95 |
| | **Sub Total, 2.2** | **1945.35** | **2151.35** | **2151.35** |
| **2.3** | **Civil works** | | | |
| 2.3.1 | Construction of Diversion Weirs - 8 Nos | 48.45 | 42.69 | 42.69 |
| 2.3.2 | Construction of Jack well cum Pump house at 10 locations | 86.02 | 89.60 | 89.60 |

| No. | Description of Work | Estimated Cost of original proposal as per SR 2011-12 (Administratively approved) in Crore Rupees | Estimated Cost of original proposal (Administratively approved revised as per SR 2012-13 and as per water allocation) in Crore Rupees | Detailed project Cost as per SR 2012-13 in Crore Rupees |
|---|---|---|---|---|
| 2.3.3 | Construction of Delivery Chambers at 5 locations | 4.72 | 4.61 | 4.61 |
| 2.3.4 | Construction of approach roads | 48.35 | 6.81 | 6.81 |
| | **Sub Total, 2.3** | **187.54** | **143.71** | **143.71** |
| | | | | |
| | **Total for work portion including preliminaries** | **3053.78** | **3176.22** | **3176.22** |
| | | | | |
| **MISCELLANEOUS** | | | | |
| 3 | Land acquisition charges | 30.00 | 48.75 | 48.75 |
| 4 | KPTCL/Railway and other statutory deposits | 30.00 | 30.00 | 30.00 |
| | **Grand Total** | **3,113.78** | **3,254.97** | **3,254.97** |
| | Add 5.0 % for Establishments, Infrastructure | **155.69** | **162.75** | **162.75** |
| | Add for Miscellaneous and rounding off | 0.03 | 0.28 | 0.28 |
| | **Grand Total, Part-A** | **3,269.50** | **3,418.00** | **3,418.00** |
| **Part-B, Construction of Works beyond the Delivery chamber of Haravanahalli** | | | | |
| **ESTIMATE FOR WORK PORTION** | | | | |
| **1** | **Preliminaries** | | | |
| 1.1 | Survey, investigation, preparation of designs, drawings and Detailed Project Report | 20.00 | 20.00 | 42.44 |
| 1.2 | Sump model studies and surge analysis | | | |
| 1.3 | PMC and Quality control | | | |
| 1.4 | Telemetry and SCADA system | 15.00 | 15.00 | |
| | **Sub Total, 1** | **35.00** | **35.00** | **42.44** |
| **2** | **Construction** | | | |
| **2.1** | **Electromechanical works, Design supply, erection of pumping machinery** | | | |
| 2.1.1 | Lift from tail end of gravity canal to Balancing reservoir at Devarayanadurga | 132.00 | 265.61 | - |
| 2.1.2 | Lift from Balancing Reservoir towards north and south of Nandi hills | 155.00 | 154.95 | 125.61 |

| No. | Description of Work | Estimated Cost of original proposal as per SR 2011-12 (Administratively approved) in Crore Rupees | Estimated Cost of original proposal (Administratively approved revised as per SR 2012-13 and as per water allocation) in Crore Rupees | Detailed project Cost as per SR 2012-13 in Crore Rupees |
|---|---|---|---|---|
| 2.1.3 | Construction of Electrical sub stations and electrical works | 50.00 | 20.98 | 5.46 |
| 2.1.4 | Cost of bringing power supply from nearest KPTCL SubStation to Pump station | 17.00 | 17.00 | 17.00 |
| 2.1.5 | O & M cost for 5 years including spares and tools | - | 5.25 | 1.75 |
| | **Sub Total, 2.1** | **354.00** | **463.79** | **149.82** |
| **2.2** | **Construction of Raising Mains** | | | |
| 2.2.1 | Lift from tail end of gravity canal to Balancing reservoir at Devarayanadurga | 209.00 | 669.90 | - |
| 2.2.2 | Lift from Balancing Reservoir towards north and south of Nandi hills | 1485.00 | 1976.70 | 1126.10 |
| | **Sub Total, 2.2** | **1694.00** | **2646.60** | **1126.10** |
| **2.3** | **Civil works** | | | |
| 2.3.1 | Construction of Jack well cum Pump house at 3 locations | 10.00 | 52.16 | 11.50 |
| 2.3.2 | Construction of Delivery Chambers at 3 locations | 2.00 | 2.49 | 1.66 |
| 2.3.3 | Construction of Gravity Canal | 2330.00 | 3676.00 | 4514.66 |
| 2.3.4 | Construction of Balancing Reservoir | 308.00 | 352.00 | 342.00 |
| | **Sub Total, 2.3** | **2650.00** | **4082.65** | **4869.82** |
| | **Total for work portion including preliminaries** | **4733.00** | **7228.04** | **6188.18** |
| **MISCELLANEOUS** | | | | |
| 3 | Land acquisition charges | 150.00 | 373.80 | 411.50 |
| 4 | KPTCL/Railway and other statutory deposits | 20.00 | 20.00 | 20.00 |
| | **Grand Total** | **4,903.00** | **7,621.84** | **6,619.68** |
| | Add 3.1 % contingency for work portion excluding preliminaries | 145.64 | 222.98 | - |
| | Buildings, Plantation, Special Tools and Plants, Communication, Environment and ecology, Loss on stuck & Unforeseen, Establishment, Tools & Plants | - | - | 964.42 |
| | Add for rounding off | 5.36 | 0.18 | 0.26 |
| | **Grand Total, Part-B** | **5,054.00** | **7,845.00** | **7,584.36** |

| No. | Description of Work | Estimated Cost of original proposal as per SR 2011-12 (Administratively approved) in Crore Rupees | Estimated Cost of original proposal (Administratively approved revised as per SR 2012-13 and as per water allocation) in Crore Rupees | Detailed project Cost as per SR 2012-13 in Crore Rupees |
|---|---|---|---|---|
| | **Grand Total, Part-A & B** | **8,323.50 Crores** | **11,263.00 Crores** | **11,002.36 Crores** |
| | Additional components for conveyance system including distribution system and storage reservoirs | - | 1910.00 | 1910.00 |
| | **Grand Total** | **8,323.50 Crores** | **13,173.00 Crores** | **12,912.36 Crores** |

The difference in cost of the project as per original proposal and estimated cost based on considering current SR of WRD 2012-13 with 2nd stage pumping revised as per proposed water allocation is mainly due to the following reasons:

- Under Gravity Canal
  - Increase in canal length as per actuals.
  - Increase in number of major structures enroute.
  - Change in cost per Km length as per the detailing against line estimate.
- Lift from RL+800.0 m near Tumkur to Devarayanadurga.
  The discharge considered for pumping was 45.0 cumecs (to pump 10.0 TMC) of water against now considered 85.0 cumecs (to pump 24.0 TMC).
- Lift from Devarayanadurga to Kolar and Chikkaballapur
  The discharge considered was 18.0 cumecs to distribute the water for 12 months against now considered is 24.60 cumecs to distribute the water in 6 months only.
- Due to revision of SR of WRD for the year 2012-13 (previous estimate was prepared considering SR for the year 2011-12).

## Distribution System

The distribution system beyond Raising Mains was not envisaged and accounted for in the original proposal due to the fact that a clear picture of the quantum of water required for drinking water purposes and the tank filling was not finalized.

However, these items have been finalized and the exact quantum of water required for above purposes in Kolar and Chikkaballapur Districts along with those areas enroute are arrived at.

As a consequence, detailing of the distribution system has now been arrived at considering the following

- The water is being led into the highest point in the valley thereby allowing it to fill the first tank and further tanks through gravity in a series.
- It is proposed to fill all the MI tanks to their 50% capacity and allowing the excess flow into the next tanks once these tanks are filled as indicated.
- To ensure that the excess water beyond the 50 % capacity (considered for filling) flows without any hindrance to the next tank in the series through mother valley, it is proposed to construct an additional sluice in the bund at this level.
- However, it is necessary to ensure that the last tank in the series is filled to its 50% capacity and continued upstream to the first tank in the series.

Accordingly, the cost towards the distribution system component has been worked out. This has resulted in additional cost of Rs.1910.00 Crores (approximately) as shown below.

**Table 1.5:Cost of additional works**

| No. | Description | Approx. Cost in Rs. (Crores) |
|---|---|---|
| 1 | Madhugiri Gravity feeder canal (82.0 Km) | 123.00 |
| 2 | Gowribidanur Gravity feeder canal (75.0 Km) | 75.00 |
| 3 | T.G.Halli Gravity feeder canal (57.0 Km) | 85.50 |
| 4 | Tunnel- 01 for T.G.Halli (20.0 Km) | 140.00 |
| 5 | Tunnel- 02 for Ramanagara (14.0 Km) | 98.00 |
| 6 | Hoskote Gravity feeder canal (39.0 Km) | 33.15 |
| 7 | Kolar Gravity feeder canal (200.0 Km) | 500.00 |
| 8 | Srinivaspura Gravity feeder canal (100.0 Km) | 250.00 |
| 9 | Gudibande Gravity feeder canal (32.0 Km) | 32.00 |
| 10 | Bagepalli Gravity feeder canal (46.00 Km)** | 46.00 |
| | **Total Cost, I** | **1382.65** |
| 1 | Storage reservoir for Kadur (0.267 TMC) | 15.00 |
| 2 | Storage reservoir for Arsikere (0.512 TMC) | 25.00 |
| 3 | Storage reservoirs in Tumkur District - 4 Nos ( 1.92 TMC) | 85.00 |
| 4 | Storage reservoirs in Bangalore Rural District - 4 Nos ( 1.92 TMC) | 90.00 |
| 5 | Storage reservoirs in Kolar District - 5 Nos ( 2.84 TMC) | 125.00 |
| 6 | Storage reservoirs in Chikkaballapur District - 6 Nos ( 2.217 TMC) | 100.00 |
| 7 | Storage reservoirs in Ramnagara District - 4 Nos ( 1.834 TMC) | 85.00 |
| | **Total cost, II** | **525.00** |
| | **Grand Total, I +II** | **1907.65 Crores** |
| | **Say** | **1910.00 Crores** |

## Total cost of the project

The cost of the project for the selected proposal comprising of the drinking water component as well as tank filling has been arrived at. The details are as under:

| No | Details | Cost in Rs. (Crores) |
|---|---|---|
| 1. | Cost for the lift component (Phase-1) | Rs.3508.80 Crores |
| 2. | Cost of conveyance system (Phase – 2) and distribution system and Storage ( Additional Component) | Rs. 9403.56 Crores |
| | **Grand Total** | **Rs. 12,912.36 Crores** |

## 1.11 Stages / Phases of the development of the project

The original proposal was planned to be executed in stages and the details were as under.

**Part A:**

The work comprises of construction of 8 weirs across the streams at identified locations, construction of Jack well cum pump house and providing and laying raising mains / gravity mains of suitable diameter.

The water will be conveyed to a Delivery Chamber (DC 4) located near Haravanahalli through an Intermediate pumping station (DC 3) located at Doddanagara.

**Part B:**

**Gravity canal from DC-4:**

The proposed Gravity canal runs for a length of 249.550 Km before ending at the delivery chamber near Tumkur. The gravity canal runs for a length of 95+500 Km before reaching the ridge bifurcating Krishna and Cauvery basins and finally culminates near Tumkur at an elevation of RL 800.00 m.

**Beyond Gravity Canal- Raising mains and the reservoir**

A raising main of length 8.10 Km has been proposed to convey the said discharge into the balancing reservoir near Devarayanadurga with a cumulative capacity of 10 TMC. An earthen dam is proposed to be built with the above capacity at the said location to accommodate the discharge.

In order to convey the water to Kolar and Chikkaballapura districts, two raising mains of length 53.020 Km and 64.950 Km have been proposed. These raising mains will culminate at the highest point of RL 980.00 m for Kolar district and RL 920.00m for Chikkaballapura district. The water so conveyed will then flow by gravity to various Minor Irrigation / Zilla Parishad tanks located in these districts. Originally, no distribution system was planned beyond this point.

## 1.12 Fitment of the scheme in overall development of the river basin

This project has been envisaged exclusively as a drinking water supply scheme and as such, overall development of the river basin is not a criteria considered.

## 1.13 Intimation to the other development authorities regarding this scheme

All the authorities concerned like KPWD, Railways, Zilla Panchayat, Forest, Environment, Irrigation and others have been appraised about the project being taken up.

The Project has been undertaken by the Karnataka Neeravari Nigam Limited and being executed by the Chief Engineer, Upper Bhadra Project.

The Government of Karnataka has given its Administrative approval vide no ಜಸಂಒ 203 ವಿಭ್ರಾಇ 2012 after it has been passed by the technical subcommittee of the State.

## 1.14 Public announcements and public hearings

The project being one of the important scheme involving exclusive drinking water supply to the drought prone areas in the east such as Kolar and Chikkaballapur districts , has been given wide coverage. Many public meetings have been held by the Govt. to make the people aware of the importance of the scheme both in the initial reaches and the end reaches of the project.

## 1.15 Interlinking of the scheme with the neighboring schemes

This project has been envisaged exclusively as a drinking water supply scheme and as such, interlinking of the scheme with the neighboring schemes is not relevant and considered.

## 1.16 Interstate / International aspect(s)

The proposed project is a drinking water supply scheme which takes precedence over other aspects and constitutes an obligation on the part of the Government to execute it. Thus, the project does not fall under the Interstate aspect. However, the river / streams proposed to be harnessed are entirely in Karnataka and do not come under the purview of Interstate aspects.

## 1.17 Cost and benefit of the scheme

The Cost and Benefit of the scheme has been worked out considering the Cost of the water being supplied by the Bangalore Water Supply and Sewerage Board to the Bangalore City and its surroundings. The cost per Kiloliter has been considered as the bench mark to arrive at the benefit accruing to the state. However, drinking water supply scheme has to be considered as an obligation on the Government to cater to the basic needs of the citizen. The area which is being proposed to be fed with the drinking water supply is one of the worst affected and drought prone areas in the State such as Kolar and Chikkaballapura districts. However, the Benefit Cost Ratio as per CWC norms cannot be worked out due to the fact that it is not an irrigation project.

## 1.18 Public cooperation and participation

The details of the project have been widely publicized and the people in the areas concerned have been made aware of the project.

The Government on its part has taken views of the elected representatives and the technical experts on the veracity of the scheme before giving approval to it. Even after giving administrative approval, the Department has carried out enough alternative studies to address all the issues concerned such as land acquisition, forest etc. Further deliberations on the scheme has lead to finalizing the most economical, viable and implementable alternative.

## 1.19 Provision for domestic and industrial power supply

No provision has been made in the project for domestic and industrial power supply.

## 1.20 Availability of land

The site inspection and the verification including checking of the available maps and documents has confirmed various activities planned within the Western ghat area such as construction of weir jack well cum pump house , conveyance system including delivery chamber are all located in the private /government lands.

**Reserved Forest Land**

After crossing the Hemavathy river, the conveyance system will cross **Doddanagar reserved forest** for a length of about **0.7 km** which is unavoidable.

**Kadumane Estate:**

Weir 4 & 5 are located within the private land belonging to **Kadumane Estate Company** and requires permission from the organization for taking any activities such as construction of weir, Jack well cum pump house and raising mains.

## 1.21 Statutory clearance

**Crossings**

- The conveyance system generally follows existing tracks and roads maintained by Zilla Panchayat (ZP) and hence needs in principle clearance for taking up any activities in the vicinity.
- The conveyance system will cross NH 48 and Southern railway and needs permission/approval from the concerned.
- The conveyance system will cross MDR and also runs parallel for considerable length and hence needs permission from PWP and IWT Department.
- The conveyance system will cross the perennial Hemavathy River and needs the approval from concerned river authorities
- The conveyance system traverses through Doddanagara RF for a length of about 700 m and requires permission from the forest authorities to take up the activities.

# Chapter 2
# Physical Features

## 2.1 Geographical disposition

The project comprises of the following components

**Initial reach in the Upper reaches of Western Ghats**

Eight Weirs have been proposed to be constructed across streams in the upper reaches of Western Ghat near Sakleshpura. They are Yettinahole, Kadumanehole, Hongadahalla and Kerihole.

**Beyond Western Ghats**

The water from these is being conveyed to a Delivery chamber (DC-4) proposed at Haravanahalli in Sakleshpura Taluk by means of pumping and conveying through raising mains.

From this Delivery chamber, water is conveyed to the eastern plateau through a gravity canal of length 249.550 Km. It ends near Tumkur from where the water is conveyed to a reservoir proposed near Devarayanadurga with a capacity of 11.015 TMC. From here, two raising mains are proposed to carry the water to the districts of Kolar and Chikkaballapura and ending at an elevation of 980 M.

## 2.2 Topography of the project

In the initial reaches where the weirs are located, the topography is hilly terrain with hills ranging in elevation from 1000 M to 700 m above MSL

On crossing the Western Ghats, the terrain starts rolling gently towards east where the gravity canal has been proposed. The canal runs along the ridge separating the Krishna and Cauvery river basins. The elevation difference between the starting point of the canal and ending point is about 165 m. It starts at RL 965.00 and ends at RL 800.00.

Beyond the gravity canal, there is a rise in the elevation upto the proposed reservoir near Devarayana Durga. The difference in elevation is about 100 m with the elevation being RL 900.00 m at the reservoir.

Further beyond, the topography again meets an undulating terrain where the raising mains are proposed towards Kolar and Chikkaballapura districts. The raising mains are proposed to end at an elevation of RL 980.00 m

## 2.3 Geology of the project area

The essential geologic formation (Stratography) is the Archean complex made up of Dharwad Schists and Granitic Gneisses. The Archean or peninsular gneisses is the oldest formation and covers major area. They are unfossiliferous, crystalline contrasted and faulted rocks. The chief rocks are Gneiss, Granites and Charnockites Gneiss. Granulites and Granites are the inter related rock types extensively encountered in the project area.

The predominant soil in the plains is the red soil overlaying the Granite from which it is derived and is found in varying depths. They occur as shades of red and pass on to yellow loamy soils predominant in plantations.

The coastal soils are generally brown to dark reddish brown in colour with high organic matter.

# Chapter 3
# Interstate / International aspects

The streams proposed to be tapped, originate entirely within the state and flows through the state to Arabian Sea. Thus, there is no International / Interstate implication.

# Chapter 4
# Scope of work

The Scope of the work for the entire scheme as envisaged are

- To conduct initial studies for proposed diversion of 24.01 TMC and submit an initial feasibility report based on concept note. The scope shall include,
  - Collection of all relevant topo sheets from Survey of India covering the project area. KNNL will assist in the procurement of restricted topo sheets since part of the area is likely to fall under the restricted zone.
  - Study of the catchment area including demarcation of the same into most feasible zones to divert water.
  - Dividing the catchment area into several sub-catchment and demarcation of the same.
  - Identification of suitable locations for the construction of diversion structures in order to divert the water to a common point / pumping station.
  - Verification of ground realities using available NRSA data, topo sheets, conducting by reconnaissance survey including studies for diversion of water from the proposed catchment its extent, location of diversion weirs, lifts, head works, alignment of rising main, delivery chamber.
  - Identification of suitable location for the main pump house including the raising main till it crosses the ridge line ( near Sakleshpura)
  - Preliminary desk top study for conveying the designated quantity of water through a suitable mode.
  - Routing of gravity canal and to pin point the location of suitable sites for hydro-power generation as proposed in the concept note with necessary details and extent of power generation, exact location of central storage reservoir and other storages
  - Preparation of preliminary planning report of entire diversion scheme.
- Preparation of block level plan, cross section and L-section of the stream, marking of observed HFL by conducting detailed survey and collection of any other data required for design of diversion structure using NRSA survey data and data collected during initial studies including collection of all necessary field data for preparation of DPR,
- Preparation of Geo technical report by conducting all necessary investigations and studies including taking required no. of trial pits

- Working out required storage capacity by capacity tables, preparation of designs and drawings, BOQ for diversion structure, intake arrangements, inlet structures and pump house, preparation of detailed estimate, getting approval, incorporating it in main DPR, furnishing maps, superimposing RS map comprising of all the details
- Detailed planning of electromechanical works such as pumping machinery and its accessories, electrical works, electrical substation, power line, conveyance system etc., complete including design of all components after collecting required data, preparation of drawings, detailed estimate for each pumping station and getting approval, incorporating it in the DPR,
- Conducting block level topographical and detailed survey for conveyance system and service system in the eastern plateau beyond the western ghats using sophisticated equipments such as LiDAR, total station etc., for alignment fixing, contour tracing, location of survey open points with reference to revenue survey numbers, carrying out leveling etc,
- Collection of all necessary field data for preparation of DPR of conveyance system including conducting detailed survey for alignment, finalisation of alignment, generation of 0.5m interval contours covering an area of 300mts on either side of conveyance system, furnishing maps
- Conducting detailed survey for storage reservoir after diversion by identification of technically feasible site for storing of about 10 TMC of Water by using sophisticated equipment such as LIDAR, total station etc covering all technical aspects including finalizing dam alignment, identification of catchment area of storage reservoir, drawing capacity contours at 0.5m intervals, preparation of elevation capacity curve and table, generating L section and cross sections,
- Design of all components of work including hydraulics, earthen dam, spillway, flood routing, service roads, etc., preparing cost estimates of all components of work identification of storage area and marking its boundaries by pegging at 300m intervals,
- Superimposing of reservoir on RS maps, preparation of land acquisition proposal, marking of FTL contour and HFL contour at 300m or at required suitable intervals land acquisition details utilizing the available data of digitized village cadastral maps/RS maps and collecting necessary additional data required,
- Taking required number of trial pits for structures, inlet and outlet, storage area and dam alignment, marking alignment of centre line on ground and pegging at every 300m intervals,
- Preparation of detailed estimate and DPR and getting approval incorporating it in the main DPR, furnishing maps,

- Preparation of Detailed project report (DPR) of conveyance system covering all technical aspects including finalizing alignment, hydrology with stream wise analysis, generating L sections and Cross sections,
- Design of conveyance system, storage structures, diversion structures, jack well, pump houses, escape regulators, delivery chambers, all types of CD works such as Aqueducts, super passages, bridges, railway crossing and other CD works, service roads etc., using NRSA ALTM survey data and data collected by survey in the eastern plateau,
- Cost estimates of all components of work, land acquisition details utilizing the available data of digitized village cadastral maps and collecting necessary additional data required, including taking required number of trial pits for structures, taking trial pits in conveyance system and service canal as per CWC norms (spacing of trial pits/ trial bore = 1 No. in each Km) marking alignment of centre line on ground and pegging at every 300m
- Geo technical investigations for design and detailed estimation for main canal and conveyance mains
  - Earth work excavation for trial pits/ borrow pits and other investigation works in all kinds of soils including boulders upto 30 cm diameter and disposing off excavated soil as directed
  - Earth work excavation for trial pits/ borrow pits and other investigation works in soft rock including disposing off excavated stuff as directed
  - Drilling 80mm dia hole through overburden using casing shoe bit vertical or inclined upto 10 degree to vertical as directed including cost of all materials, machinery, labour, water charges, reaming, collection of wash samples at suitable intervals, logging and labeling, supplying honne wood core box, fixing casing pipes etc., complete for depth upto 30m from surface and submission of report by an expert Geologist regarding Geological classification of strata.
- Preparation of detailed estimate of main canal covering all technical aspects including design of all components of work such as escapes, regulators, distributaries, head sluice, road bridge and all types of CD works etc., cost estimate KM wise and all component of works etc., complete. Estimate is to be prepared as per the Norms of KNNL
- Preparation of detailed estimate for construction of aqueduct across rivers Hemavathy and Yagachi covering all technical aspects including design of all components of work, geotechnical investigation etc., Estimate is to be prepared as per the Norms of KNNL
- Providing and fixing 200x200x750mm roughly dressed boundary/demarcation/ chainage/ arrow stone including cost of all materials, labour, engraving marks, fixing in position, murrum filling etc

- Providing and fixing 200x200x750cm temporary bench mark stone in CC 1:4:8 using 40 mm down size graded coarse aggregate including cost of all materials, labour, dressing top surface, engraving BM data etc., complete
- Conducting Rapid Environmental Impact Assessment Studies and comprehensive Environmental Impact Assessment Studies including formulation of Environmental Management Plan & Rehabilitation and Resettlement plan considering the impact due to implementation of "project for diversion of surplus flood waters from upper reaches of Yettinahole, Kadumanehole, Kerihole and Hongadahalla streams by lifting and conveying it to east to benefit Kolar, Chikkaballapura Districts and other needy areas" in accordance with the guidelines of MOEF, CPCB, KSPCB, etc as per detailed scope of work and furnishing project wise comprehensive study report
- Conducting Finance mobilization Studies for implementation of project including providing suggestions regarding most viable method of project implementation and self-sustaining maintenance mechanism, as per detailed scope of work and conducting other studies for obtaining clearance from Forest, MoTA, National Highways and Railways and furnishing project wise comprehensive study report.

**SCOPE OF WORK FOR GRAVITY CANAL:**

- Conducting block level topographical and detailed survey for conveyance system and service system in the eastern platue beyond the western ghats using sophisticated equipments such as LiDAR, total station etc., for alignment fixing, contour tracing, location of survey open points with reference to revenue survey numbers, carrying out leveling etc, collection of all necessary field data for preparation of DPR of conveyance system including conducting detailed survey for alignment, finalisation of alignment, generation of 0.5m interval contours covering an area of 300mts on either side of conveyance system, furnishing maps comprising of all details in hard copies (minimum 10 copies) and soft copy etc. complete as per detailed specification including labour charges, instrument hire charges, software usage charges, transportation charges etc., complete as per detailed scope of work .
- Preparation of Detailed project report (DPR) of conveyance system covering all technical aspects including finalizing alignment, hydrology with stream wise analysis, generating L sections and Cross sections, design of conveyance system, storage structures, diversion structures, jack well, pump houses, escape regulators, delivery chambers, all types of CD works such as Aqueducts, super passages, bridges, railway crossing and other CD works, service roads etc., using NRSA ALTM survey data and data collected by survey in the eastern platue, cost estimates of all components of work, land acquisition details utilizing the available data of digitized village cadastral maps and collecting necessary additional data required, including taking required number of trial pits

for structures, taking trial pits in conveyance system and service canal as per CWC norms (spacing of trial pits/ trial bore = 1 No. in each Km) marking alignment of centre line on ground and pegging at every 300m including all taxes etc. complete. DPR to be prepared in detail as per the norms prescribed by Central water commission, Government of India, in 10 sets of hard copies & one soft copy comprising of all details including revisions incorporating the comments and suggestions of WRDO

**GEO TECHNICAL INVESTIGATIONS FOR DESIGN AND DETAILED ESTIMATION FOR MAIN CANAL AND CONVEYANCE MAINS:**

a. Earth work excavation for trial pits/ borrow pits and other investigation works in all kinds of soils including boulders upto 30 cm diameter and disposing off excavated soil as directed with all leads and lifts and submission of report by an expert Geologist regarding Geological classification of strata.

b. Earth work excavation for trial pits/ borrow pits and other investigation works in soft rock including disposing off excavated stuff as directed with all leads and lifts and submission of report by an expert Geologist regarding Geological classification of strata.

c. Drilling 80mm dia hole through overburden using casing shoe bit vertical or inclined upto 10 degree to vertical as directed including cost of all materials, machinery, labour, water charges, reaming, collection of wash samples at suitable intervals, logging and lebelling, supplying honne wood core box, fixing casing pipes etc., complete for depth upto 30m from surface and submission of report by an expert Geologist regarding Geological classification of strata.

d. Drilling 76mm dia (NX) hole in hard rock using diamond core bit vertical/ inclined upto 10 degrees to vertical as directed including cost of all materials, machinery, labour, water charges, collection of core samples, logging and lebelling, supplying honne wood core box, including cement grouting and redrilling in case of collapse of sides etc., complete for depth upto 30m from surface.

e. Preparation of detailed estimate of main canal covering all technical aspects including design of all components of work such as escapes, regulators, distributaries, head sluice, road bridge and all types of CD works etc., cost estimate KM wise and all component of works etc., complete. Estimate is to be prepared as per the Norms of KNNL and submit in 10 sets of hard copies and one soft copy comprising of all details .

f. Preparation of detailed estimate for construction of aqueduct across rivers Hemavathy and Yagachi covering all technical aspects including design of all components of work, geotechnical investigation etc., estimate. Estimate is to be prepared as per the Norms of KNNL and submit in 10 sets of hard copies and one soft copy comprising of all details .

- Providing and fixing 200x200x750mm roughly dressed boundary/demarcation/ chainage/ arrow stone including cost of all materials, labour, engraving marks, fixing in position, murum filling etc., complete with all leads and lifts.
- Providing and fixing 200x200x750cm temporary bench mark stone in CC 1:4:8 using 40 mm down size graded coarse aggregate including cost of all materials, labour, dressing top surface, engraving BM data etc., complete with all leads and lifts.

# Chapter 5
# Planning of the project

## 5.1 Needy areas for providing drinking water / Tank filling for rejuvenation of the ground water table

Drought prone districts in the eastern part of Karnataka such as Kolar and Chikkaballapur are frequently affected due to erratic rainfall and absence of any perennial source of water for drinking purposes for the populace as well as livestock in the region. It is a long standing demand of the people in the region that a permanent and dependable source need to be identified and these areas are supplied with drinking water. Furthermore, the ground water table in these regions has reached alarming depths due to over exploitation, as a consequence of which the available ground water is contaminated with harmful salts like Fluoride, Nitrate, etc. in excess of permissible level.

Government of Karnataka has considered the demand and initiated studies for mitigating the problem faced by the people of Kolar and Chikkaballapur. Various studies were undertaken to identify the source of water as well as supplying it to the districts concerned. During the course of such studies, one of the proposals which are considered apt to be taken up for further consideration was harnessing Yettinahole and other streams originating in the upper reaches of Western Ghats near Sakleshpura..

Accordingly, the streams selected comprised of Yettinahole, Yettinahole tributary, Kadumanehole 1, Kadumanehole 2, Yetiinahole downstream, Hongadahalla and Kerihole were considered for studies..Eight (8) Weirs were proposed to be constructed across the streams selected to store water up to their banks and divert the water during the peak monsoon months from June to November, The combined quantum of water which can be diverted from the 8 Weirs is estimated to be about 24.01 TMC at 50% dependabilioty.

The available 24.01 TMC of water is proposed to be utilized under two components namely drinking water and tank filling in the selected areas.

The revised list of component and the beneficiary areas are as under:

1. Providing drinking water to:
    - Kolar district comprising of all Taluks
    - Chickaballapura distrct comprisnig of all Taluks
    - Tumkur district comprising of areas in Palar and Pennar basins including Chiknayakanahalli and Sira Taluks along with selected villages in Tiptur and Gubbi Taluks.
    - Hassan district comprising of villages in Arasikere taluk

- Chikamagalore district comprising of selected villages in Kadur taluk
- Ramanagara district
- Bangalore Rural district comprising of Nelamangala, Doddaballapura, Devanahalli and Hoskote Taluks
- Augmenting the water to T.G.Halli reservoir
- Augmenting water to Hesaraghatta reservoir
- Drinking water supply to Devanahalli Industrial area and surrounding areas

2. Providing water for tank filling purposes to fill selected M I Tanks to their 50 % capacity (average) in the M I tanks falling under Palar and Pennar basins and Arasikere taluk

## 5.2 Water requirement

### 5.2.1 Identification of beneficiary

Along the alignment, there are several areas which are short in need of drinking water due to absence of permanent source of water and scarcity on account of depleting water table. These areas have been identified and proposed to be brought under the present drinking water supply scheme. The below indicated table gives the details of area covered.

**PROPOSED AREAS (ENROUTE) FOR PROVIDING DRINKING WATER FACILITY UNDER YETTINAHOLE DIVERSION SCHEME**

**Table 5.1- Proposed areas for providing drinking water supply under Yettinahole project**

| No. | Name of District | Remarks | Population as per 2011-12 census in Lakhs |
|---|---|---|---|
| 1 | Chickmagalur | **Taluks:** Kadur Taluk (Kasaba hobli, Birur hobli, Hirenallur hobli) | 1.56 |
| 2 | Hassan | **Taluks:** Arsikere Taluk | 3.15 |
| 3 | Tumkur | **Taluks:** Tumkur Taluk (Kora hobli), Chiknayakanahalli Taluk, Sira Taluk, Pavagada Taluk, Madhugiri Taluk, Koratagere Taluk, Tiptur Taluk (Kasaba hobli, Kibbanahalli hobli, Honnavalli hobli), Gubbi Taluk (Chelur & Nittur Hobli **(villages coming under Hemavathy atchkat are not considered)** | 14.97 |
| 4 | Kolar | **Taluks:** Kolar Taluk, Srinivaspur Taluk, Malur Taluk, Bangarpet Taluk, Mulbagal Taluk | 15.36 |

| No. | Name of District | Remarks | Population as per 2011-12 census in Lakhs |
|---|---|---|---|
| 5 | Chikkaballapura | **Taluks:** Chikkaballapura Taluk, Gauribidanur Taluk, Gudibanda Taluk, Bagepalli Taluk, Sidlaghatta Taluk, Chintamani Taluk | 12.55 |
| 6 | Bangalore Rural | **Taluks:** Nelamangala Taluk, Doddaballapur Taluk, Devanahalli Taluk, Hosakote Taluk | 9.91 |
| 7 | Ramanagara | **Taluks:** Ramnagara Taluk, Magadi Taluk, Channapatna Taluk, Kanakapura Taluk | 10.83 |
| | | **Grand Total** | **68.35 Lakhs** |
| | | | **6.83 Millions** |

**Note: - In addition to the above indicated population, the present proposal also envisages supplying water to:**

- Augmentation of T.G.Halli and Hesarghatta reservoirs to take care of the deficit water supply needs of Bangalore, 2.50 TMC (1.70 + 0.80).
- Drinking water supply needs of Devanahalli industrial area and surrounding areas which is about 0.50 TMC.

## 5.2.2 Process of arriving at the total quantum of water

In order to arrive at the total quantum of water required for drinking water purpose, a scientific method has been adopted involving the following

1 Present population as per 2011 census.
2 Projecting the population upto 2043.
3 Adopting the requirement of water for towns, rural areas and livestock as per the CPHEEO manual.
4 Calculation of quantum of water as per the above.

The process involved considering the population of each identified town, village etc., falling under the beneficiary districts. The data has been obtained from the Directorate of Census Operations, Karnataka, Government of India. The Directorate has also done the projections of population from 1901 onwards for every ten year period using a mathematical formula used extensively for projecting population figure.

The mathematical formula used for calculating growth rate is:

$$P = Po\ (1+r)^{\wedge t}$$

$$P/\ P\ o = (1+r)^{\wedge t}$$

$$\underline{Log10\ (P/\ Po)} = Log10\ [1+r]$$

t

$$10^{x} = [1+r], \text{ where, } x = \frac{\text{Log10 } (P/Po)}{t}$$

$$r = [10^{x}] - 1$$

Where,

P = Projected Population

P0 = Present Population

t = Number of years

r = Growth rate

(The growth rate is the rate at which a population is increasing (or decreasing) in a given year.)

Based on the report of Directorate of Economics and Statistics, Bangalore following growth rate for identified taluks are considered.

**Table 5.2- Average growth rates for the districts under Yettinahole project**

| No. | Name of District | Growth rate in percent for the decade (2001 – 2011) | Growth rate in percent per year |
|---|---|---|---|
| 1 | Chickmagalur | 3.17 | 0.317 |
| 2 | Hassan | 3.17 | 0.317 |
| 3 | Tumkur | 3.74 | 0.374 |
| 4 | Kolar | 11.04 | 1.104 |
| 5 | Chikkaballapura | 9.17 | 0.917 |
| 6 | Bangalore Rural | 16.02 | 1.602 |
| 7 | Ramanagara | 5.06 | 0.506 |

**For further details of projected population refer Annexure -2.**

### 5.2.3 Projected water requirement

From the table: 2, the average growth rate for the identified districts from 2001 to 2011 has been considered as the datum and the population projection undertaken. Initially, the projection has been done upto the present year i.e 2013 and then on, the population projection has been done for every ten years upto 2043.

For the present proposal, the projected population upto 2023 has been considered for arriving at the quantum of water required.

As per CPHEEO manual, 135 lpcd has to be considered for urban areas (towns), 70 lpcd for rural areas (villages) and 50% of the rural requirement for livestock. Accordingly, the quantum of water required for the project has been arrived at.

**Worked out example of Kolar taluk for calculating the quantum of water required:**

| | | |
|---|---|---|
| Total population of Kolar taluk as per 2011 census | = | 3,85,410 |
| Population in towns | = | 1,38,462 |
| Population in rural areas | = | 2,46,948 |
| Growth rate for Kolar district as per the above table per year | = | 1.104 % |
| Water requirement for towns | = | 135 lpcd |
| Water requirement for rural areas | = | 70 lpcd |
| Water requirement for livestock | = | 50 % of rural requirement |
| Projected population for 2013-2014 in towns | = | Po (1+r) ^ t |
| | = | $138462 (1+1.104/100)^2$ |
| | = | 1,41,536 |
| Projected population for 2013-2014 in villages | = | $246948 (1+1.104/100)^2$ |
| | = | 2,52,431 |

The above procedure shall be adopted for projecting the population for 2023, 2033 and 2043 by changing the r value as number of years of projecting.

| | | |
|---|---|---|
| Water requirement for towns in 2013-2014 | = | (141536 x 135) / 1000000 |
| | = | 19.107 MLD |
| | = | (19.107 x 365) / 1000 |
| | = | 6.974 MCM |
| | = | 6.974 / 28.32 |
| | **=** | **0.246 TMC** |
| Water requirement for villages in 2013-2014 | = | (252431 x 70) / 1000000 |
| | = | 17.670 MLD |
| | = | (17.670 x 365) / 1000 |

| | | |
|---|---|---|
| | = | 6.450 MCM |
| | = | 6.450 / 28.32 |
| | **=** | **0.228 TMC** |
| Water requirement for livestock in 2013-2014 | = | 0.50 x0.228 |
| | **=** | **0.114 TMC** |
| Total water requirement for Kolar taluk as per 2013-2014 | = | 0.246+0.228+0.114 |
| | **=** | **0.588 TMC** |
| 5 % Losses for transmission and storage | = | 0.05 x 0.588 = 0.0294 |
| 5 % Losses for treatment and distribution | = | 0.05 x 0.588 = 0.0294 |
| **Grand total** | = | 0.588 + 0.0294 + 0.0294 |
| | **=** | **0.647 TMC** |

**For list of villages, towns considered under each Taluk/District including population details and water requirement calculations refer Annexure-3.**

The above method has been followed to calculate the demand of water for all the towns and villages in the beneficiary areas. The population as on 2011, projected population as on 2013-14, 2023-24, 2033-34 and 2043-44 has been arrived at and tabulated as shown below.

**Table 5.3- Annual drinking water demand planned under Yettinahole project**

| Sl.No | Description | Total population proposed to benefited | Annual Consumption including losses |
|---|---|---|---|
| | | Lakhs | TMC |
| i) | **As on 2011-2012** | | |
| | Towns | 16.36 | 3.020 |
| | Villages | 51.99 | 4.905 |
| | Livestock (50% of Village requirement) | | |
| | | **68.35** | **7.925** |
| ii) | **As on 2013-2014** | | |
| | Towns | 16.65 | 3.076 |
| | Villages | 52.84 | 4.987 |
| | Livestock (50% of Village requirement) | | 2.494 |
| | | **69.49** | **10.557** |
| iii) | **As on 2023-2024** | | |
| | Towns | 18.23 | 3.375 |
| | Villages | 57.35 | 5.426 |
| | Livestock (50% of Village requirement) | | 2.714 |
| | | **75.59** | **11.514** |
| | | | |
| iv) | **As on 2033-2034** | | |
| | Towns | 20 | 3.708 |
| | Villages | 62.37 | 5.914 |
| | Livestock (50% of Village requirement) | | 2.957 |
| | | **82.38** | **12.580** |
| | | | |
| v) | **As on 2043-2044** | | |
| | Towns | 21.98 | 4.084 |
| | Villages | 67.95 | 6.457 |
| | Livestock (50% of Village requirement) | | 3.228 |
| | | **89.94** | **13.770** |

**Table 5.4- Annual drinking water demand planned under Yettinahole project under each taluk**

| No. | Name of District/Taluk | Drinking water requirement | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2013-2014 | | 2023-2024 | | 2033-2034 | | 2043-2044 | |
| | | Population | Water requirement in TMC | Population | Water requirement in TMC | Population | Water requirement in TMC | Population | Water requirement in TMC |
| **I** | **Chikmagalur** | | | | | | | | |
| 1 | Kadur | **1,57,367** | **0.259** | **1,62,427** | **0.267** | **1,67,650** | **0.275** | **1,73,041** | **0.285** |
| **II** | **Hassan** | | | | | | | | |
| 2 | Arasikere | **3,17,341** | **0.495** | **3,27,546** | **0.512** | **3,38,078** | **0.528** | **3,48,950** | **0.545** |
| **III** | **Tumkur** | | | | | | | | |
| 3 | Tumkur | 45,295 | 0.067 | 47,018 | 0.070 | 48,806 | 0.073 | 50,662 | 0.076 |
| 4 | Chiknayakanhalli | 2,13,720 | 0.334 | 2,21,849 | 0.347 | 2,30,287 | 0.360 | 2,39,046 | 0.374 |
| 5 | Pavagada | 2,47,031 | 0.380 | 2,56,428 | 0.395 | 2,66,181 | 0.409 | 2,76,305 | 0.425 |
| 6 | Madhugiri | 2,69,873 | 0.415 | 2,80,138 | 0.430 | 2,90,793 | 0.447 | 3,01,854 | 0.463 |
| 7 | Koratagere | 1,68,847 | 0.257 | 1,75,269 | 0.267 | 1,81,936 | 0.278 | 1,88,856 | 0.288 |
| 8 | Gubbi | 69,984 | 0.105 | 72,645 | 0.108 | 75,409 | 0.112 | 78,277 | 0.117 |
| 9 | Tiptur | 1,77,642 | 0.290 | 1,84,399 | 0.301 | 1,91,413 | 0.312 | 1,98,693 | 0.325 |
| 10 | Sira | 3,16,109 | 0.495 | 3,28,133 | 0.514 | 3,40,614 | 0.534 | 3,53,569 | 0.554 |
| | **Sub Total** | **15,08,502** | **2.343** | **15,65,879** | **2.433** | **16,25,438** | **2.525** | **16,87,263** | **2.620** |
| **IV** | **Kolar** | | | | | | | | |
| 11 | Kolar | 3,93,967 | 0.647 | 4,39,686 | 0.722 | 4,90,712 | 0.805 | 5,47,658 | 0.899 |
| 12 | Srinivaspur | 2,06,796 | 0.319 | 2,30,794 | 0.356 | 2,57,577 | 0.398 | 2,87,469 | 0.444 |
| 13 | Malur | 2,42,180 | 0.378 | 2,70,285 | 0.421 | 3,01,651 | 0.471 | 3,36,658 | 0.526 |
| 14 | Bangarpet | 4,62,886 | 0.783 | 5,16,603 | 0.875 | 5,76,555 | 0.976 | 6,43,464 | 1.089 |
| 15 | Mulbagal | 2,64,684 | 0.419 | 2,95,400 | 0.468 | 3,29,681 | 0.521 | 3,67,940 | 0.582 |
| | **Sub Total** | **15,70,512** | **2.547** | **17,52,769** | **2.842** | **19,56,176** | **3.172** | **21,83,189** | **3.540** |

| No. | Name of District/Taluk | Drinking water requirement | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2013-2014 | | 2023-2024 | | 2033-2034 | | 2043-2044 | |
| | | Population | Water requirement in TMC | Population | Water requirement in TMC | Population | Water requirement in TMC | Population | Water requirement in TMC |
| **V** | **Chikkaballapura** | | | | | | | | |
| 16 | Chikkaballapura | 2,16,452 | 0.350 | 2,37,140 | 0.383 | 2,59,805 | 0.420 | 2,84,637 | 0.460 |
| 17 | Gauribidanur | 2,96,360 | 0.462 | 3,24,686 | 0.506 | 3,55,719 | 0.554 | 3,89,718 | 0.607 |
| 18 | Gudibanda | 56,861 | 0.089 | 62,295 | 0.097 | 68,249 | 0.107 | 74,772 | 0.117 |
| 19 | Bagepalli | 1,86,879 | 0.293 | 2,04,740 | 0.320 | 2,24,309 | 0.351 | 2,45,748 | 0.385 |
| 20 | Sidlaghatta | 2,18,115 | 0.347 | 2,38,962 | 0.380 | 2,61,801 | 0.416 | 2,86,824 | 0.457 |
| 21 | Chintamani | 3,03,562 | 0.485 | 3,32,575 | 0.531 | 3,64,362 | 0.582 | 3,99,187 | 0.638 |
| | **Sub Total** | **12,78,228** | **2.025** | **14,00,399** | **2.217** | **15,34,246** | **2.430** | **16,80,886** | **2.662** |
| **VI** | **Bangalore Rural** | | | | | | | | |
| 22 | Nelamangala | 2,17,700 | 0.345 | 2,55,200 | 0.405 | 2,99,160 | 0.474 | 3,50,692 | 0.556 |
| 23 | Doddaballapur | 3,09,270 | 0.505 | 3,62,544 | 0.592 | 4,24,994 | 0.694 | 4,98,202 | 0.813 |
| 24 | Devanahalli | 2,16,392 | 0.350 | 2,53,667 | 0.410 | 2,97,363 | 0.481 | 3,48,585 | 0.563 |
| 25 | Hoskote | 2,79,565 | 0.441 | 3,27,721 | 0.517 | 3,84,173 | 0.606 | 4,50,350 | 0.711 |
| | **Sub Total** | **10,22,926** | **1.641** | **11,99,132** | **1.924** | **14,05,690** | **2.255** | **16,47,829** | **2.643** |
| **VII** | **Ramnagara** | | | | | | | | |
| 26 | Ramnagara | 2,69,319 | 0.447 | 2,83,261 | 0.470 | 2,97,925 | 0.494 | 3,13,348 | 0.519 |
| 27 | Magadi | 2,05,909 | 0.322 | 2,16,569 | 0.339 | 2,27,780 | 0.356 | 2,39,572 | 0.375 |
| 28 | Channapatna | 2,63,955 | 0.424 | 2,77,619 | 0.446 | 2,91,991 | 0.469 | 3,07,107 | 0.493 |
| 29 | Kanakapura | 3,54,437 | 0.551 | 3,72,785 | 0.580 | 3,92,084 | 0.609 | 4,12,381 | 0.641 |
| | **Sub Total** | **10,93,620** | **1.743** | **11,50,234** | **1.834** | **12,09,780** | **1.928** | **12,72,407** | **2.028** |
| | **Grand Total** | **69,49,000** | **11.052** | **75,59,000** | **12.029** | **82,38,000** | **13.114** | **89,94,000** | **14.323** |

The total quantum of water required for drinking water purpose including augmentation of Hesarghatta and T.G.Halli reservoirs as well as drinking water supply to Devanahalli industrial area and surrounding areas works out to 15.029 TMC inclusive of losses such as transmission and evaporation losses (at 5% in total for bulk water supply and 5% for treatment and distribution).

**This has resulted in balance availability of 8.981 TMC which has been planned to be utilized for tank filling component. However, the tank filling will be restricted to the identified MI tanks in Palar and Pennar basins only and filling them to their 50% capacity (average).**

Also the area of Arasikere taluk which is located on upper reach of Tunga Bhadra Sub basin of Krishna basin and part on upper reach of Cauvery Basin does not receive sufficient rainfall and there are no major streams wich is due to the fact that the taluk is located on the ridge line bifurcating Krishna and Cauvery basins.

Tiptur and Chikkanayakanahalli which also falls under rain shadow areas located on ridge line have several schemes benefiting them from the Hemavathy Project. Arsikere taluk which is devoid of any perennial streams and do not have any proposed schemes is facing acute ground water table depletion as is the case with tanks in Palar and Pennar basins. Hence, it is now proposed to be included for filling the M I tanks in Arsikere Taluk to their 50% capacity for improvement of water table and providing drinking water facility.

**The tank filling is being proposed exclusively to rejuvenate the water table in the areas and to mitigate the effects of the harmful salts like Fluoride, Nitrate etc which at present is in excess of allowable limits.**

For drinking water component storage reservoirs have been planned and the water will be fed to them. Further distribution from these storage reservoirs have to be taken up by concerned departments.

Regarding augmentation of water to T.G.Halli and drinking water to Ramnagara district, it is proposed to convey the water by providing an offtake at Ch: 248.40 Km through a gravity canal of length 57.0 Km beyond which two tunnels are proposed, one to augment the requirement of T.G.Halli and other to carry the drinking water requirement of Ramnagara district which is led of into a valley which in turn joins Arkavati.

For areas falling under Palar and Pennar basins and Arasikere taluk, the proposal considered distributing the water to the identified storages.

Further, the water required for tank filling in these areas has also been considered for conveying and accordingly the distribution system has been designed.

### 5.2.4 Allocation of water

**Drinking water requirement**

Drinking water requirement has been arrived at 15.029 TMC considering the projected population up to 2023-24. Details are indicated below.

**Table 5.5: Drinking water requirement**

| No. | District | Drinking water requirement for the year 2023-2024 (Including Losses) (TMC) | Selected Taluks for Drinking water |
|---|---|---|---|
| 1 | Chikkamagalur | 0.267 | KadurTaluk(Only Kadur kasba, Birur and Singatagere) |
| 2 | Hassan | 0.512 | ArsikereTaluk |
| 3 | Tumkur | 2.433 | TumkurTaluk (Only Kora hobli), Chiknayakanhalli Taluk, Sira Taluk Pavagada Taluk, Madhugiri Taluk, Koratagere Taluk, GubbiT aluk (Only Chelur&Nittur Hobli (villages coming under Hemavathy atchkat are not considered), TipturTaluk (Only Kasaba hobli, Kibbanahalli hobli, Honnavalli hobli) |
| 4 | Kolar | 2.842 | KolarTaluk, SrinivaspurTaluk, MalurTaluk, BangarpetTaluk, MulbagalTaluk |
| 5 | Chikkaballapur | 2.217 | ChikkaballapuraTaluk, GauribidanurTaluk, GudibandaTaluk, BagepalliTaluk, SidlaghattaTaluk, ChintamaniTaluk |
| 6 | Bangalore Rural | 1.924 | NelamangalaTaluk, DoddaballapurTaluk, DevanahalliTaluk, HosakoteTaluk |
| 7 | Ramnagara | 1.834 | RamnagaraTaluk, MagadiTaluk, ChannapatnaTaluk, KanakapuraTaluk. |
| 8 | Augumentation to T.G.halli Reservoir | 1.70 | |
| 9 | Augumentation to Hesarghatta Reservoir | 0.80 | |
| 10 | Drinking water supply to Devanahalli Industrial Area and surrounding areas | 0.50 | |
| | **Total** | **15.029 TMC** | |

**Tank filling requirement**

Tank filling Requirement is worked out by considering 50% filling (average) of MI tanks as below;

| No. | Name of District/Taluk | Number of MI tanks | Total live capacity in Mcft | Average proposed filling @ 50% of the live capacity | | Remarks |
|---|---|---|---|---|---|---|
| | | | | Mcft | TMC | |
| 1 | **Hassan** | | | | | |
| | Arasikere | 34 | 1569.14 | 784.57 | 0.800 | |
| | **Sub total** | **34** | **1569.14** | **784.57** | **0.800** | |
| 2 | **Tumkur** | | | | | |
| | Tumkur | 6 | 43.53 | 21.77 | 0.022 | |
| | Koratagere | 39 | 1932.98 | 869.84 | 0.870 | |
| | Madhugiri | 45 | 1873.63 | 843.13 | 0.843 | |
| | Pavagada | 23 | 1526.58 | 424.65 | 0.425 | |
| | **Sub total** | **113** | **5376.72** | **2159.39** | **2.160** | |
| 3 | **Kolar** | | | | | |
| | Kolar | 44 | 1966.55 | 786.66 | 0.787 | |
| | Malur | 11 | 530.65 | 212.26 | 0.212 | |
| | Bangarpet | 13 | 1113.75 | 436.91 | 0.437 | |
| | Mulabagal | 35 | 1045.34 | 418.14 | 0.418 | |
| | Srinivasapura | 35 | 523.81 | 209.52 | 0.210 | |
| | **Sub total** | **138** | **5180.10** | **2063.49** | **2.064** | |
| 4 | **Chikkaballapur** | | | | | |
| | Chikkaballapura | 21 | 997.01 | 398.80 | 0.399 | |
| | Bagepalli | 31 | 938.15 | 455.62 | 0.456 | |
| | Chintamani | 19 | 294.59 | 147.30 | 0.148 | |
| | Gudibande | 14 | 692.76 | 320.68 | 0.321 | |
| | Shidlaghatta | 25 | 1462.09 | 584.84 | 0.585 | |
| | Gowribidanur | 86 | 2418.7 | 967.48 | 0.967 | |
| | **Sub total** | **196** | **6803.30** | **2874.72** | **2.876** | |
| 5 | **Bangalore Rural** | | | | | |
| | Nelamangala | 2 | 14.67 | 7.34 | 0.007 | |
| | Doddaballapur | 7 | 151.72 | 75.86 | 0.076 | |
| | Devanahalli | 11 | 671.525 | 335.763 | 0.336 | |
| | Hosakote | 26 | 1296.22 | 648.110 | 0.648 | |
| | **Sub total** | **46** | **2134.14** | **1067.07** | **1.067** | |
| | **Grant total** | **527 Nos** | **21063.40 Mcft** | **8.967 TMC** | | |

**For details of tanks considered (as per MI tank register) including capacities of each tank refer Annexure-4.**

## 5.3 Details of the scheme

After deliberations at all levels, it has been decide to adopt the following components as the final proposal in the Yettinahole project for implementation.

The scheme comprises of two phases namely:

Phase 1 which covers the works to be excuted in the Western Ghats comprising of the following

- Construction of 8 weirs at the identified locations
- Construction of suitable Jackwell cum pumphouses at the identified locations
- Installation of pumping machinery of suitable capacities
- Construction of Delivery chambers, DC 1 and DC 2
- Construction of Raising mains of suitable diameter along the selected route
- Construction of Gravity canal from Weirs 3, 4 and 5 up to DC 3
- Construction of Deliery chambers DC 3 at Doddanagar and DC 4 at Haravanahalli

Phase 2 which covers the works of the conveyance system to be executed beyond DC 4 at Haravanahalli

- Construction of Gravity canal of suitable section to carry the discharge for a length of 273.865 Km to reach the proposed balancing reservoir near Bhairagondlu in Koratagere Taluk
- Construction of reservoirs at selected locations for drinking water needs of identified areas/ Villages in various taluk / district namely Kadur, Arsikere, Tiptur, Chickanayakanahalli, Gubbi, Madhugiri, Pavagada, Koratagere, all taluks of Kolar, Chikkaballapura, Bangalore Rural, Ramanagara districts besides augmenting water to T.G.Halli and Hesaraghatta reservoirs including drinking water supply to Devanahalli Industrial area.

There are two balancing reservoirs which are proposed to be constructed. They are:

- Balancing reservoir at Bhairagondlu to take care of drinking water needs of Chikkaballapura, Kolar and Bangalore rural districts besides tank filling component of Kolar and Chikkaballapura districts. In addition, drinking water requirement of Devanahalli Industria area is also met with from here.(Details are enumerated in a separate chapter)

- Balancing reservoir of 1.298 TMC capacity at Thumbadi near Koratagere to take care of drinking water needs of part of Tumkur Taluk, Madhugiri, Pvagada and Koratagere taluks (Details are enumerated below)

### 5.3.1 Balancing Reservoir at Bhairagondlu

Balancing reservoir at Bhairagondlu is proposed to take care of drinking water needs of Chikkaballapura, Kolar and Bangalore rural districts besides tank filling component of Kolar and Chickaballapura districts. In addition, drinking water requirement of Devanahalli Industria area and surrounding area is also met with from here.

Salient feature of the reservoir is indicated below:

| | | |
|---|---|---|
| Length of dam | : | 2900.0 m |
| Location | : | Across Garudachala stream, Upstream of Mavaturu Kere near Bairagondlu village |
| Water spread area | : | 1800 Ha |
| Full Reservoir Level (FRL) | : | 800.0 m |
| Capacity | : | 5.783 TMC |
| Villages under submergence | : | Veerasagar, Lakkamuttanahalli, Belladahalli, Gajamenahalli, Sugadahalli, Lakkenhalli, Garadagallu |
| Roads under submergence | : | 15990.0 m |
| Forest under submergence | : | Nil |
| Latitude | : | 13° 24' 23" |
| Longitude | : | 77° 20' 9" |
| Toposheet No | : | 57 G 07 |
| Taluk | : | Koratagere & Dodballapur |
| District | : | Tumkur & Bangalore rural |
| Basin | : | North Pennar |

### 5.3.2 Balancing / Storage reservoir for Tumkur, Pavagada, Madhugiri and Koratagere Taluks

As per calculations, the drinking water requirement for Tumkur Taluk (Identified Hobli's) is 0.070 TMC, Pavagada Taluk is 0.395 TMC, Madhugiri Taluk is 0.430 TMC and Koratagere Taluk is 0.267 TMC totaling to 1.162 TMC. A storage reservoir with a capacity of 1.298 TMC has been identified on upstream of Tumbadi tank near Tumbadi village. This will also act as a balancing reservoir in times of need with its additional capacity.

Salient feature of the reservoir is indicated below:

| | | |
|---|---|---|
| Criteria for fixing the location | : | As a storage reservoir for drinking water to Tumkur, Pavagada, Madhugiri and Koratagere taluk |
| Length of dam | : | 750.0 m |
| Location | : | Upstream of Tumbadi tank near Tumbadi village |
| Water spread area | : | 640 Ha |
| Full Reservoir Level (FRL) | : | 800.0 m |
| Capacity | : | 3.058 TMC |
| Villages under submergence | : | Mallekavu, Dogganahalli & Gaurikallu |
| Roads under submergence | : | 6750.0 m |
| Forest under submergence | : | 28 Ha |
| Latitude | : | 13° 34' 20" / 13° 33' 48" |
| Longitude | : | 77° 13' 03" / 77° 13' 00" |
| Topo sheet No | : | 57 G 02 |
| Taluk | : | Koratagere |
| District | : | Tumkur |
| Basin | : | North Pennar |

## 5.4 Storage reservoir for drinking water

All along the alignment of the canal, it was decided to supply drinking water to the needy areas facing shortage enroute. The following taluks have been selected for drinking water supply including augmentation as indicated in Table 4.1. In order to supply the available water, it is necessary to store it and accordingly storage reservoir locations have been identified and the details are indicated hereunder:-

### 5.4.1 Storage reservoir for Kadur Taluk in Chikmagalur district

As per calculations, the drinking water requirement for Kadur Taluk (Identified Hobli's) is 0.267 TMC. A storage reservoir with a capacity of 0.268 TMC has been identified in Vedavathi valley near Hulikallu Rudradevaragudi village to cater to the above requirement.

### 5.4.2 Storage reservoir for Arsikere Taluk in Hassan district

As per calculations, the drinking water requirement for Arsikere Taluk is 0.512 TMC. A storage reservoir with a capacity of 0.666 TMC has been identified near Lakkehalli village to cater to the above requirement.

### 5.4.3 Storage reservoir for Tiptur Taluk in Tumkur district

As per calculations, the drinking water requirement for Tiptur Taluk (Identified Hobli's) is 0.301 TMC. A storage reservoir with a capacity of 0.459 TMC has been identified near Gopalanahalli village to cater to the above requirement.

### 5.4.4 Storage reservoir for Chikkanayakanahalli Taluk in Tumkur district

As per calculations, the drinking water requirement for Chiknayakanhalli Taluk is 0.347 TMC. A storage reservoir with a capacity of 0.552 TMC has been identified near Gopalanahalli village to cater to the above requirement.

### 5.4.5 Storage reservoir for Gubbi Taluk in Tumkur district

As per calculations, the drinking water requirement for Gubbi Taluk (Identified Hobli's) is 0.108 TMC. A storage reservoir with a capacity of 0.505 TMC has been identified on upstream of Singadahalli tank near Tirtharampura state forest to cater to the above requirement.

### 5.4.6 Storage reservoir for Nelmangala Taluk in Bangalore rural district

As per calculations, the drinking water requirement for Nelmangala Taluk is 0.405 TMC. A storage reservoir with a capacity of 0.741 TMC has been identified near Siddayyanapalya village to cater to the above requirement.

### 5.4.7 Storage reservoir for Doddaballapur Taluk in Bangalore rural district

As per calculations, the drinking water requirement for Doddaballapur Taluk is 0.592 TMC. A storage reservoir with a capacity of 0.227 TMC has been identified near Aralamallige village to cater to the above requirement.

### 5.4.8 Storage reservoir for Devanahalli Taluk in Bangalore rural district

As per calculations, the drinking water requirement for Devanahalli Taluk is 0.410 TMC. A storage reservoir with a capacity of 0.200 TMC has been identified near Doddasanne kere village to cater to the above requirement.

### 5.4.9 Storage reservoir for Chikkaballapura Taluk in Chikkaballapura district

As per calculations, the drinking water requirement for Chikkaballapura Taluk is 0.383 TMC. A storage reservoir with a capacity of 2.011 TMC has been identified near Chelamenahalli village to cater to the above requirement.

### 5.4.10 Storage reservoir for Gudibande Taluk in Chikkaballapura district

As per calculations, the drinking water requirement for Gudibande Taluk is 0.480 TMC. A storage reservoir with a capacity of 0.916 TMC has been identified near upstream of Bairasagara kere near Gudibanda village to cater to the above requirement.

### 5.4.11 Storage reservoir for Bagepalli Taluk in Chikkaballapura district

As per calculations, the drinking water requirement for Bagepalli Taluk is 0.320 TMC. A storage reservoir with a capacity of 0.222 TMC has been identified across Chitravati river near Paragodu village to cater to the above requirement.

### 5.4.12 Storage reservoir for Sidlaghatta Taluk in Chikkaballapura district

As per calculations, the drinking water requirement for Sidlaghatta Taluk is 0.380 TMC. A storage reservoir with a capacity of 0.336 TMC has been identified near Marihalli village to cater to the above requirement.

### 5.4.13 Storage reservoir for Chintamani Taluk in Chikkaballapura district

As per calculations, the drinking water requirement for Chintamani Taluk is 0.531 TMC. A storage reservoir with a capacity of 0.626 TMC has been identified near Chinnasandra village to cater to the above requirement.

### 5.4.14 Storage reservoir for Srinivasapura Taluk in Kolar district

As per calculations, the drinking water requirement for Srinivasapura Taluk is 0.356 TMC. A storage reservoir with a capacity of 0.081 TMC has been identified near Tupalli village to cater to the above requirement.

### 5.4.15 Storage reservoir for Kolar Taluk in Kolar district

As per calculations, the drinking water requirement for Kolar Taluk is 0.722 TMC. A storage reservoir with a capacity of 1.606 TMC has been identified near Yanadlahalli village to cater to the above requirement.

### 5.4.16 Storage reservoir for Malur Taluk in Kolar district

As per calculations, the drinking water requirement for Malur Taluk is 0.421 TMC. A storage reservoir with a capacity of 1.231 TMC has been identified near Kutrahalli village to cater to the above requirement.

### 5.4.17 Storage reservoir for Bangarpet Taluk in Kolar district

As per calculations, the drinking water requirement for Bangarpet Taluk is 0.875 TMC. A storage reservoir with a capacity of 0.451 TMC has been identified near Chikkarapanhalli village to cater to the above requirement.

### 5.4.18 Storage reservoir for Mulbagal Taluk in Kolar district

As per calculations, the drinking water requirement for Mulbagal Taluk is 0.468 TMC. A storage reservoir with a capacity of 1.263 TMC has been identified near Meleri village to cater to the above requirement.

**Feeder canals**

Construction of feeder canals, the details of which are as under:

- ✓ Madhugiri Gravity feeder canal of length 82.0 Km
- ✓ Gowribidanur Gravity feeder canal of length 75.0 Km
- ✓ T.G.Halli Gravity feeder canal of length 57.0 Km
- ✓ Tunnel 01 to T.G.Halli of length 20.0 Km
- ✓ Tunnek 02 to Ramanagara of length 14.0 Km
- ✓ Hoskotei Gravity feeder canal of length 39.0 Km
- ✓ Kolar Gravity feeder canal of length 200.0 Km
- ✓ Srinivasapurai Gravity feeder canal of length 100.0 Km
- ✓ Gudibande Gravity feeder canal of length 32.0 Km
- ✓ Bagepalli Gravity feeder canal of length 46.0 Km

- Construction of Raising main of length 45.00 Km from the balancing reservoir near Bhairagondlu to cater to the water needs of Kolar, Chikkaballapura and Bangalore Rural Districts.

# Chapter 6
# Surveys and Investigation

The project being diversion of the available excess flow from the identified streams to the Eastern plateau for supply of drinking water requires detailed survey and investigations in order to have the most economical, viable and implementable scheme. The details of the scope, approach and, methodology adopted for survey and investigation are indicated hereunder:

**Surveys**

## 6.1 Scope of work

The scope of work for detailed Survey has been divided into two types of survey namely

1. Conducting survey by using latest technology available i.e., through 3D mobile LiDAR and
2. Conducting survey by using conventional Total station equipment.

### 6.1.1 Scope of work using 3D Mobile LiDAR

- Conducting block level topographical and detailed survey for conveyance system and service system in the eastern plateau beyond the western ghats using sophisticated equipment such as LiDAR, total station etc., for alignment fixing, contour tracing, location of survey open points with reference to revenue survey numbers, carrying out leveling etc,
- Collection of all necessary field data for preparation of DPR of conveyance system including conducting detailed survey for alignment, finalisation of alignment, generation of 0.5m interval contours covering an area of 300mts on either side of conveyance system, furnishing maps
- Conducting detailed survey for storage reservoir after diversion by identification of technically feasible site for storing of about 10 TMC of Water by using sophisticated equipment such as LIDAR, Conducting block level topographical and detailed survey for conveyance system and service system in the eastern platue beyond the western ghats using sophisticated equipments such as LiDAR, total station etc., for alignment fixing, contour tracing, location of survey open points with reference to revenue survey numbers, carrying out leveling etc, collection of all necessary field data for preparation of DPR of conveyance system including conducting detailed survey for alignment, finalisation of alignment, generation of 0.5m interval contours covering an area of 300mts on either side of conveyance system,

### 6.1.2 Scope of work using conventional Total station equipment

- Establishment of Primary and Secondary control points along the proposed pipeline / canal alignment at regular interval (5 km & 1 km) using DGPS.
- Establishment of TBM along the proposed pipeline / canal alignment using Auto level.
- Preparation of report.

### 6.1.3 Deliverables

- Key map of the project area showing the project site, administrative jurisdiction, road connectivity etc. on a suitable scale.
- Site photographs (Digital photographs).
- List of coordinates.
- List of temporary bench mark.
- Detailed Project Report covering brief background of the project, scope of work, approach and methodology, deployment details of resources, findings of the surveys and conclusions.

## 6.2 Approach

The consultants approach to undertake the assignment, as defined in the scope of work is illustrated in Figure 6-1

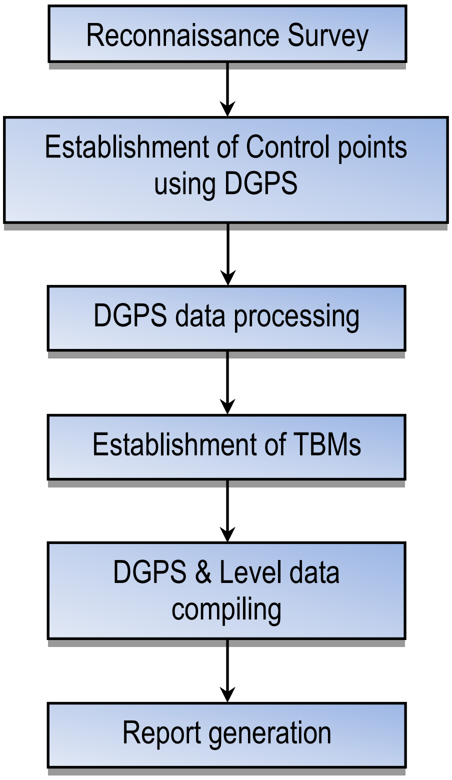



**Figure 6-1: Approach**

## 6.3 Methodology

### 6.3.1 Reconnaissance survey

The survey consultant's team shall undertake a Reconnaissance Survey of the proposed alignment to study the following:

- General topography of the location including accessibility.
- Identify locations for establishing DGPS Control Points.
- Differential global positioning system of high end model shall be used to set up DGPS Control Points on permanent structures.
- Establishment of Control Points
- Differential global positioning system of high end model shall be used to set up DGPS Control Points on permanent structures.

### 6.3.2 Establishment of control points

Dual frequency Global Positioning System (DGPS) of high-end model shall be setup on permanent structure/sheet rock at two places which are intervisible. Satellite observation shall be carried out for a minimum duration of 2 hours & the data shall be downloadable to computer to get rectangular (UTM) co-ordinates.

### 6.3.3 Establishment of temporary bench marks (TBMs)

Tertiary levels shall be carried out from the existing GTS BM and TBMs at regular interval .shall be established using autolevel.

### 6.3.4 Equipment's used

The following equipment's were used.

#### 6.3.4.1 DGPS: - Leica GS 09 Dual frequency Differential Global Positioning System +/- 2 cm

**Figure 6-2: DGPS**

#### 6.3.4.2 Autolevel Leica – NAK 724 & 730

**Figure 6-3: Auto Level**

### 6.3.5 DGPS Control Points

332 number of control points were established at permanent structures / rocks covering the entire pipeline / canal alignment by using DGPS of high end model. Satellite observations were made for about 60 to 120 minutes and the data was processed using proprietary software to get the co-ordinates in UTM.

DGPS control points (Single points) were established at regular interval of 1km along the proposed pipeline/canal alignment. Pair points of DGPS control points were established at 5km interval.

**Figure 6-4: DGPS**

The details of DGPS control points established at 1km interval and Dam are listed and is enclosed to this report as **Annexure – 5**

### 6.3.6 Height control

The following GTS Bench marks were identified along the proposed gravity canal.

- **GTS BM at Sakleshpura** – Engraved on northern side of west abutment of Sakleshpur girder bridge over Hemavathi river, on second pillar from west RL – 900.6374m
- **GTS BM at Yagachi river near Hassan** – Engraved on north east parapet wall of old road bridge across Yagachi nala along Sakaleshpura – Hassan (NH-48) road RL - 914.775m
- **GTS BM at Hassan** – Engraved on veranda of PWD Inspection Bunglow at Hassan with RL - 943.298m.
- **GTS BM at Arasikere** – The bench mark is situated inside the fencing of rain gauge station and 60m east of rain gauge. A masonary reference pillar bearing the incription GTS BM on its northern face stands 1.9m south of the bench mark with RL – 804.1633m.
- **Primary control point of Department of Town & Counry Planning (DTCP) at Tumkur** – RL - 800.124m.

GTS Bench mark on girder bridge across Hemavati river at **Sakleshpura** was considered as reference bench mark at the starting point of gravity canal alignment.

GTS BM marked on north east parapet wall of old road bridge across **Yagachi nala** along **Sakaleshpura – Hassan (NH-48)** road is considered as second reference Bench mark.

GTS BM Engraved on veranda of **PWD Inspection Bunglow at Hassan** was considered as third reference bench mark.

GTS BM inside the fencing of rain gauge station at **Arasikere** was considered as the fourth reference BM.

Primary control point of **Department of Town & Counry Planning (DTCP) at Tumkur** was considered as the fifth reference BM.

Double tertiary levelling in forward and backward direction was carried out using Autolevel connecting the above GTS BM with nearest DGPS control points along the proposed canal alignment. TBM's were also established enroute. Levels were deduced / computed with respect to the above mentioned GTS BM value. The closing error within the premissible limit was distributed and adjusted.

The difference in elevation obtained from the DGPS (Relative heights) between DGPS control points were tabulated and cross verified with GTS BM values at regular interval.

GTS BM at Sakaleshpura, Yegachi, Arsikere separate observations were made for more than 2 hours and suplemented for calculation purposses.


Figure 6-5: GTS BM at Sakaleshpura


Figure 6-6: GTS BM across Yagachi river

Figure 6-7: GTS BM at Arasikere

Figure 6-8: GTS BM at Arasikere


**Figure 6-9: DTCP Control point at Tumkur**

The list of TBM established enroute are enclosed to this report as **Annexure – 6**

### 6.3.7 Detailed survey within the Western ghats

As per the ToR, the detailed drawings such as Cross sections and L sections of the streams for design, arriving at the capacity of the weirs, preparation of plans and GAD for pumping locations, L-sections of raising main was supposed to be based on the Topographical survey data (DEM and satellite imagery) already prepared by NRSA. All the data prepared by NRSA has been collected. However, it is found that this data is not useful for the Part A component that is construction of weirs, Jackwell cum pumphouse, raising mains delivery chambers etc as details are not forthcoming in the NRSA data.

As a result the consultant has resorted to conduct topographical survey using DGPS and Total stations.

### 6.3.8 Detailed survey beyond the Western Ghats

For the detailed survey and investigation after crossing Western Ghats, latest survey equipments such as 3D Mobile LiDAR, Terrestrial LiDAR, DGPS, Total stations and Automatic levels have been used.

### 6.3.9 Survey using Ultra Mobile LiDAR & Terrestrial (static) LiDAR

Survey was conducted beyond the Western Ghats using 3D mobile LiDAR. The survey was carried out from the starting point of the Gravity canal and moved towards the east completing the task in total.

### 6.3.10 Methodology for Route / Alignment Survey

The methodology adopted for the Detailed Topographical survey for fixing of alignment of Gravity canal System comprises of

a) Survey using conventional Total station equipment and
b) Survey using 3D Mobile LiDAR.

## 6.3.11 Survey Methodology for Topographical Survey

- The standards accuracies and specifications that has been followed for the topographical survey are as follows:

  For double tertiary leveling : 0.012 √k meter

  For single tertiary leveling : 0.024 √k meter

  Where K is the length of line in km

  Plan accuracy is 3 cm / km

- The primary bench marks shall be located at a distance of 2.5 Km to 3.5 Km (depending on terrain) intervals along the alignment.
- Secondary bench marks have been established at suitable interval.
- Accuracy of evaluations of co-ordinates of all control stations shall be as per SOI standards.
- Control points have been marked on Insitu and other permanent structures.
- Double Tertiary (DT) leveling is done along the alignment, using automatic levels.
- Three wire readings are taken and the mean of three readings will be in agreement with centre wire reading +/-1mm.
- Auto levels collimation check is done on alternate days.
- The Instruments used for having accuracy in survey results are:
  - Differential Global Positioning System (DGPS)
  - Auto Level
  - Total Station

## 6.3.12 Survey Methodology using Mobile LiDAR

### 6.3.12.1 Mobile LiDAR System

A LiDAR system begins with a laser source that projects a beam of light at a target. A mobile LiDAR laser scanner is mounted in the Top of a motorable vehicle (usually a four wheeler) along with an Inertial Navigational System (INS) and Global Positioning System (GPS). The INS and GPS are necessary to accurately position the LiDAR unit, which is used in conjunction with surveyed ground-based locations in the project area. The LiDAR system projects thousands of laser pulses per second, thus creating a dense swath of laser points on the Earth's surface. The reflected (returned) laser pulses are detected by the system which then, based on the time of travel and the vehicle position computes the latitude, longitude, and elevation of each reflection point. These points may be the bare ground or intermediate objects such as buildings or vegetation.


**Figure 6-10: Mobile LiDAR Survey**

#### 6.3.12.2 Terrestrial LiDAR System

Terrestrial laser scanning is conducted from a ground based tripod and is used to generate an extremely accurate model of the ground in high resolution. It can also be used for above ground objects such as houses, transmission line towers and machinery. It is very useful in measuring river valleys and deep gorges.

All measurements are taken remotely, up to a range from 300m to 6000m, based on the specifications of the instrument used. This mitigates risk to personnel and prevents the need to power down machinery or energized structures whilst the survey is being conducted.

The terrestrial LiDAR method, a 3D laser scanning technique, consists of sending and collecting laser pulses from surface objects to build a point file of three-dimensional coordinates. The time of travel for a single pulse return from a surface is measured along a known trajectory such that the distance from the laser and consequently the exact location can be computed. In addition, visual data on points located within and outside of the laser range can be obtained through the use of a CCD color sensor. A unique aspect of the LiDAR method is the rapid rate of data collection. The laser scanning system can measure the location of up to 8,000 surface points in one second. Thus within a few minutes, an entire surface, be it a structure or levee, can be imaged efficiently with a point file that contains several million position points. The point files from collected scans are typically transformed into three-dimensional surfaces so that cross-sections can be generated and volumetric calculations can be performed between consecutively scanned surfaces.

Figure 6-11: Terrestrial LiDAR Survey

### 6.3.12.3 Methodology for Route / Alignment Survey

The methodology adopted for the Detailed Topographical survey for fixing of alignment of Pipeline and canal system is as follows:

- Reconnaissance survey of the whole allotted area.
- During reconnaissance survey, the total survey area is classified based on the method in which the LiDAR survey is to be carried out.
- Collection of available data from the department, such as Preliminary Investigation reports, Feasibility studies, Topo-Sheets with alignments and any other local information helpful for planning survey operations.
- The available maps are geo referenced and loaded into the LiDAR survey monitoring system.
- In the first phase, Mobile LiDAR survey is initially planned to be carried out along all the motorable roads for a maximum corridor width of 300m on either side of the road. The extent of area covered is clearly available in LiDAR monitoring system which already has a geo referenced maps. Usually for this survey a four wheel vehicle is used.

Figure 6-12: Mobile LiDAR Survey on motorable roads

- After covering a buffer area of 300m on either side of all motorable roads the extent of area not covered for proposed alignment is taken up in the second stage.
- In the second stage of mobile LiDAR planning, an All Terrain Vehicle (ATV) is used to move along the missing areas for the proposed alignment and distributory network (for filling of tanks).

Figure 6-13: Mobile LiDAR Survey using ATV.

- Once both the stages of mobile LiDAR survey are complete, the total area covered is superimposed on the Geo referenced map of the entire project and the missing area to be surveyed is assessed.
- After that, the LiDAR survey of areas unapproachable by vehicle is carried out by Terrestrial LiDAR.

- For planning of terrestrial LiDAR survey, higher accessible ground points are identified during reconnaissance and terrestrial LiDAR is mounted on such places to cover maximum area.

**Figure 6-14: Terrestrial LiDAR Survey.**

- Terrestrial LiDAR has the capacity to capture survey points in an area of radius 1200m based on the visibility and location.
- During Terrestrial LiDAR survey if high ground is not available, then alternate arrangements can be made as shown in the figure below

**Figure 6-15: Terrestrial LiDAR mounted on crane.**

- After completion of both mobile and terrestrial survey, the entire data is superimposed on the geo referenced project map to check if any area has been left out.
- The collected data is then taken to office, cleaned, and following deliverables are obtained
  - Point cloud data with an intensity of about one ten points per square meter for the entire alignment (Soft copy)
  - Digital Elevation model for the entire alignment (main & distributory network) for filling tanks
  - Surveys would begin from a G.T.S. bench mark and finally end at a G.T.S. bench mark, during the progress, wherever possible levels are checked with the G.T.S. or other bench mark, established during surveys.
  - Entire Survey data in relevant format for preparation of design sections and DPR activity

## 6.3.13 Details of survey carried out using 3D Mobile LiDAR

- The Survey team moved to site location at DC4 and GPS control point (GPS15 on the asphalted road from Hebbanhalli to Belgod and near Haravanahalli village ) established by EI Technologies was physically identified and base station GPS and radio link for RTK corrections was setup on the same control point. The Dynascan was installed on the 6X6 Argo Amphibious Vehicle and survey was started, data was captured on the proposed alignment for a strip width of 300m on either side of the proposed alignment. The survey was conducted near Hebbanhalli, Haravanahalli and Shidgalali villages.


**Figure 6-16: Images Showing Identification of GPS Control point, GPS15, Base station setup on the Control point and Mobile lidar equipment Mounted on 6X6 Argo vehicle and initiation of survey**

- The base station for RTK corrections was setup on the GPS15 control point (on the asphalted road from Hebbanhalli to Belgod and near Haravanahalli village). The Dynascan was installed on the 6X6 Argo Amphibious Vehicle and survey was started, data was captured on the proposed alignment and a strip width of 300m on either side of the proposed alignment. The alignment near Hebbanhalli, Haravanahalli, Shidgalali, Mugli, Kudanhalli, Kattepur and Belgod villages was covered.
- GPS control point (GPS17 on the road from Belgod to Kattepur and on the Culvert) established by EI Technologies was physically identified and base station for RTK corrections was setup on the same control point. The Dynascan was installed on the 6X6 Argo Amphibious Vehicle and survey was started, data was captured on the proposed alignment and a strip width of 300m on either side of the proposed alignment. The alignment near Belgod, kattepur, magatvalli and Kudanhalli villages. Proposed alternate alignment was also covered through Kattepur, Magatvalli and Sanklapur.

Images Showing Base station setup on the Control point GPS17 and Mobile LiDAR equipment Mounted on 6X6 Argo vehicle and initiation of survey, dense vegetation at the site

- GPS control point (GPS17 on the road from Belgod to Kattepur and on the Culvert) established by EI Technologies was physically identified and base station for RTK corrections was setup on the same control point. The Dynascan was installed on the 6X6 Argo Amphibious Vehicle and survey was started, data was captured on the proposed alignment and a strip width of 300m on either side of the proposed alignment. The alignment was covered near Sanklapur, Belme and Manjalgod villages. Proposed alternate alignment was also covered trough Sanklapur and Belame

Images Showing Base station setup on the Control point GPS17 andview from the 6X6 Argo survey vehicle

- GPS control point (GPS20A on the Asphalted road from Madbalu to Hulhalli and on the Culvert) established by EI Technologies was physically identified and base station for RTK corrections was setup on the same control point. The Dynascan was installed on the 6X6 Argo survey vehicle and survey was started. Data was captured along the proposed alignment for a strip width of 300m on either side of the proposed alignment. The alignment near Belame, Manjalgod, Madbalu, Madanhalli, Kadadarvalli villages was covered.

Images Showing Base station setup on the Control point GPS20A, rain disrupting the work dense vegetation at the site

- GPS control point (GPS20A on the Asphalted road from Madbalu to Hulhalli and on the Culvert) established by EI Technologies was physically identified and base station for RTK corrections was setup on the same control point. The Dynascan was installed on the 6X6 Argo Amphibious Vehicle and survey was started, data was captured on the proposed alignment and a strip width of 300m on either side of the proposed alignment. The alignment near Kadadarvalli, Kerehalli, Nilanhalli and Timahnalli villages was covered.
- The base station for RTK corrections was setup on the same control point (GPS24 on the road from Karjola to Alur Road and on the sheet rock on tank bund) established by EI Technologies. The Dynascan was installed on the 6X6 Argo survey vehicle and survey was started, data was captured on the proposed alignment and a strip width of 300m on either side of the proposed alignment. The alignment was covered near Timahnalli, Nilanhalli, Kanjuvalli, Balekoppalu and Naganhalli villages.


Images Showing Base station setup on the Control point GPS24 and Mobile lidar equipment Mounted on 6X6 Argo vehicle and initiation of survey, dense vegetation at the site, A Gas Pipeline crossing the alignment @CH11100m

- GPS control point (GPS24 on the road from Karjola to Alur Road and on the sheet rock on tank bund) established by EI Technologies was physically identified and base station for RTK corrections was setup on the same control point. The Dynascan was installed on the 6X6 Argo Amphibious Vehicle and survey was started, data was captured on the proposed alignment and a strip width of 300m on either side of the proposed alignment. The alignment near Virupapur, Erehalli, Gaulakatte, Balekoppalu and Naganhalli villages was covered.

Images Showing Base station setup on the Control point GPS24 and Mobile lidar equipment Mounted on 6X6 Argo vehicle and initiation of survey, paddy fields near the alignment

- GPS control point (GPS28 sheet rock in the fields at Gaulakatte) established by EI Technologies was physically identified and base station for RTK corrections was setup on the same control point. The Dynascan was installed on the 6X6 Argo Amphibious Vehicle and survey was started, data was captured on the proposed alignment and a strip width of 300m on either side of the proposed alignment. The alignment near Gaulakatte, haluhalli, kallukere villages was covered.

- GPS control point (GPS33 sheet rock in the fields at Lakkenahalli) established by EI Technologies was physically identified and base station for RTK corrections was setup on the same control point. The Dynascan was installed on the 6X6 Argo Amphibious Vehicle and survey was started, data was captured on the proposed alignment and a strip width of 300m on either side of the proposed alignment. The alignment near Gaudanakoppalu, Birakanahalli, Adanahalli, Bommanamane, Bellavata, Butenahalli, Lakkenahalli villages was covered.


Images Showing Base station setup on the Control point GPS33 site condition at ch19500m

- GPS control point (GPS33 sheet rock in the fields at Lakkenahalli) established by EI Technologies was physically identified and base station for RTK corrections was setup on the same control point. The Dynascan was installed on the 6X6 Argo Amphibious Vehicle and survey was started, data was captured on the proposed alignment and a strip width of 300m on either side of the proposed alignment. The alignment near Gaudanakoppalu, Birakanahalli, Adanahalli, Bommanamane, Bellavata, Butenahalli, Lakkenahalli villages was covered.

- GPS control point (GPS34 on top of Vate Hole Dam above Left canal takeoff point) established by EI Technologies was physically identified and base station for RTK corrections was setup on the same control point. The Dynascan was installed on the 6X6 Argo Amphibious Vehicle and survey was started, data was captured on the proposed alignment and a strip width of 300m on either side of the proposed alignment. The alignment near Vate Hole Dam, Butenahalli, Lakkenahalli, Channanahalli, Rajanahalli villages was covered.

- GPS control point (GPS34 on top of Vate Hole Dam above Left canal takeoff point) established by EI Technologies was physically identified and base station for RTK corrections was setup on the same control point. The Dynascan was installed on the 6X6 Argo Amphibious Vehicle and survey was started, data was captured on the proposed alignment and a strip width of 300m on either side of the proposed alignment. The alignment near Vate Hole Dam, Butenahalli, Lakkenahalli, Channanahalli, Rajanahalli villages was covered


Images Showing the Vate Hole Dam and topography of the surrounding location

- GPS control point (GPS36 on Road from Madagatta to Santahalli and on tank bund) established by EI Technologies was physically identified and base station for RTK corrections was setup on the same control point. The Dynascan was installed on the 6X6 Argo Amphibious Vehicle and survey was started, data was captured on the proposed alignment and a strip width of 300m on either side of the proposed alignment. The alignment near Madagatta, Santahalli, anduru, dandyakanahalli villages was covered.


- Due to more vegetation it was decided to deploy terrestrial LiDAR system. Testing of the new system for this site was done. Mobilization of a tractor mounted hydraulic lift and the terrestrial scanner was done.


Images Showing Erecting of Terrestrial Lidar system on Tractor elevated Platform

- Due to more vegetation it was decided to deploy terrestrial LiDAR system. Testing of the new system for this site was done. Mobilization and testing of tractor mounted hydraulic lift to elevate the Terrestrial scanner was done

Images Showing Erecting of Terrestrial Lidar system on Tractor elevated Platform and Terrestrial lidar mounted on tripod

- Terrestrial LiDAR instrument was Deployed on the top of Vate hole  Dam as the alignment passes close to the dam crossing the Vatehole River and  two canals the alternate alignment was also passing through the Dam

Images showing testing and survey using Terrestrial Scanner on top of Vate hole Dam

A Suitable Location was identified at suitable intervals along the alignment the tractor was deployed to that location. Base Station was set up on GPS17 control point. 5 tie points were placed around the terrestrial scanner at suitable positions. Scanning with terrestrial LiDAR was done; fine scan of the tie points for accurate registration of points was done. GPS survey for all the tie points was takes for a period of 10 minutes per point

Images showing setup of Terrestrial Lidar and Tractor, Setting up of tie points and GPS survey of tie points

A Suitable Location was identified at suitable intervals along the alignment the tractor was deployed to that location. Base Station was set up on GPS17 control point. 5 tie points were placed around the terrestrial scanner at suitable positions. Scanning with terrestrial LiDAR was done; fine scan of the tie points for accurate registration of points was done. GPS survey for all the tie points was takes for a period of 10 minutes per point, the activity was done from DC4 up to GPS17 at selected locations,

Images Showing Base station setup on the Control point GPS17 and dense vegetation at the site, Lidar Data of the Location

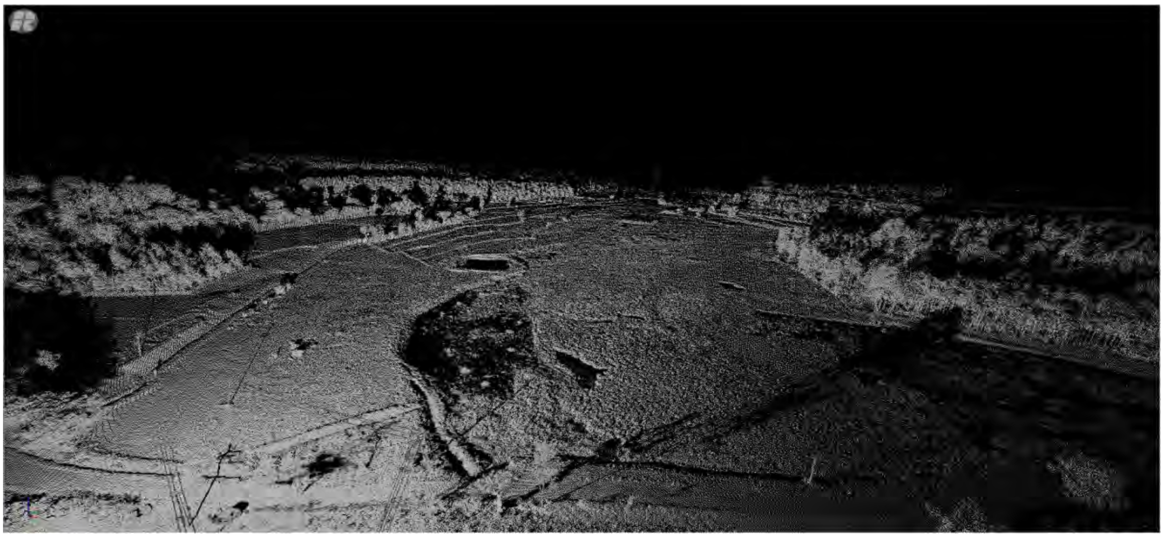
A Suitable Location was identified at suitable intervals along the alignment the tractor was deployed to that location. Base Station was set up on GPS17 control point. 5 tie points were placed around the terrestrial scanner at suitable positions. Scanning with terrestrial LiDAR was done; fine scan of the tie points for accurate registration of points was done. GPS survey for all the tie points was takes for a period of 10 minutes per point. the activity was done from GPS17 up to GPS20 at selected locations

Images showing comparison of Lidar data and Photograph at CH 4500 coffee estate

A Suitable Location was identified at suitable intervals along the alignment the tractor was deployed to that location. Base Station was set up on GPS20A control point. 5 tie points were placed around the terrestrial scanner at suitable positions. Scanning with terrestrial LiDAR was done; fine scan of the tie points for accurate registration of points was done. GPS survey for all the tie points was takes for a period of 10 minutes per point. the activity was done from GPS17 up to GPS21 at selected locations, Survey was done near selected locations from Belgod to Belame from CH 4000m to 6000m

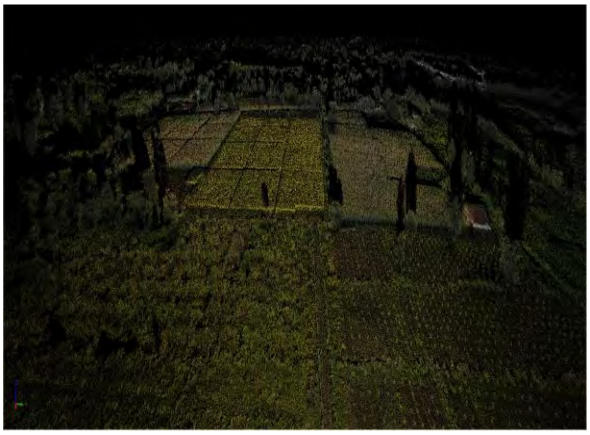
Images showing comparison of Lidar data and Photograph @CH 5000

A Suitable Location was identified at suitable intervals along the alignment the tractor was deployed to that location. Base Station was set up on GPS20A control point. 5 tie points were placed around the terrestrial scanner at suitable positions. Scanning with terrestrial LiDAR was done; fine scan of the tie points for accurate registration of points was done. GPS survey for all the tie points was takes for a period of 10 minutes per point. the activity was done from GPS17 up to GPS21 at selected locations, Survey was done near selected locations from Belgod to Belame from CH 6000m to 9000m



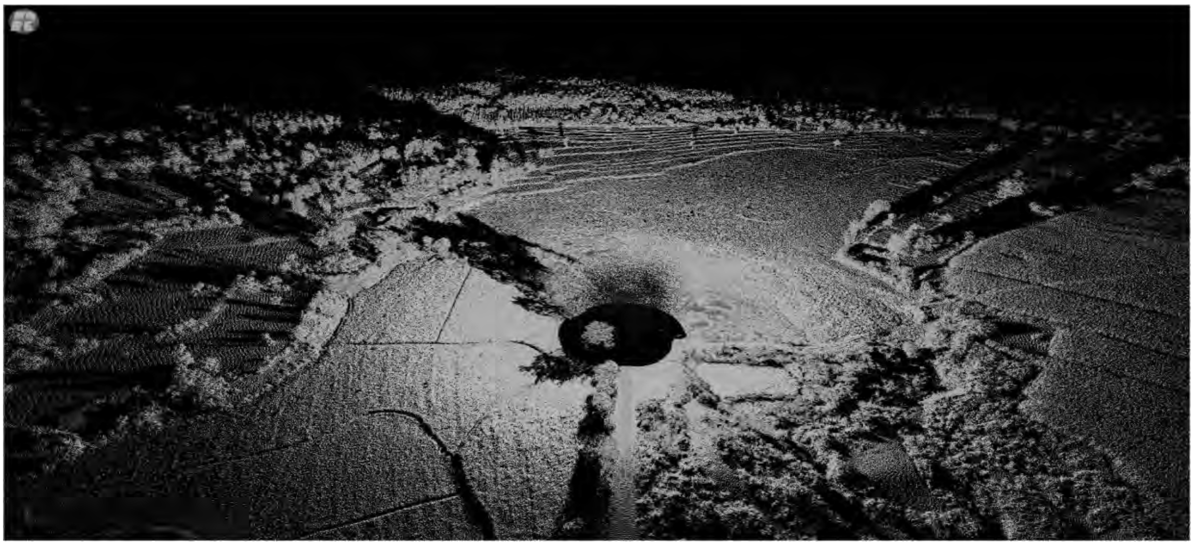
Images showing Lidar data

A Suitable Location was identified at suitable intervals along the alignment the tractor was deployed to that location. Base Station was set up on GPS24 control point. 5 tie points were placed around the terrestrial scanner at suitable positions. Scanning with terrestrial LiDAR was done; fine scan of the tie points for accurate registration of points was done. GPS survey for all the tie points was takes for a period of 10 minutes per point. the activity was done from GPS20 up to GPS24 at selected locations, Survey was done near selected locations from Belgod to Belame from CH 8000m to 11000m



Images showing comparison of Lidar data and Photograph @CH 11000

A Suitable Location was identified at suitable intervals along the alignment the tractor was deployed to that location. Base Station was set up on GPS24 control point. 5 tie points were placed around the terrestrial scanner at suitable positions. Scanning with terrestrial LiDAR was done; fine scan of the tie points for accurate registration of points was done. GPS survey for all the tie points was takes for a period of 10 minutes per point. the activity was done from GPS20 up to GPS24 at selected locations, Survey was done near selected locations from Belgod to Belame from CH 11000m to 15000m



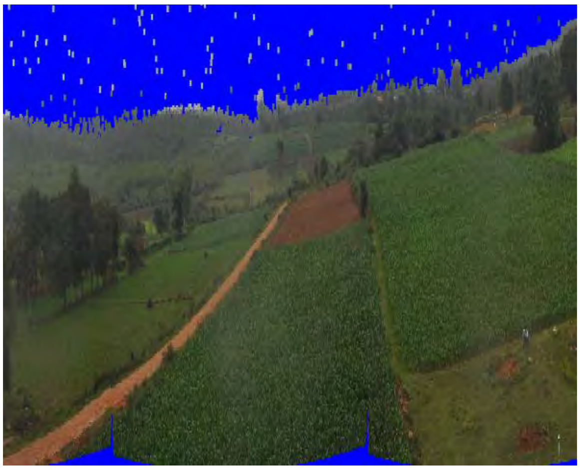
Images showing Lidar data

A Suitable Location was identified at suitable intervals along the alignment the tractor was deployed to that location. Base Station was set up on GPS49 control point. 5 tie points were placed around the terrestrial scanner at suitable positions. Scanning with terrestrial LiDAR was done; fine scan of the tie points for accurate registration of points was done. GPS survey for all the tie points was takes for a period of 10 minutes per point.

Images showing Comparison between Lidar Data and Photograph on a small tank at CH 26000

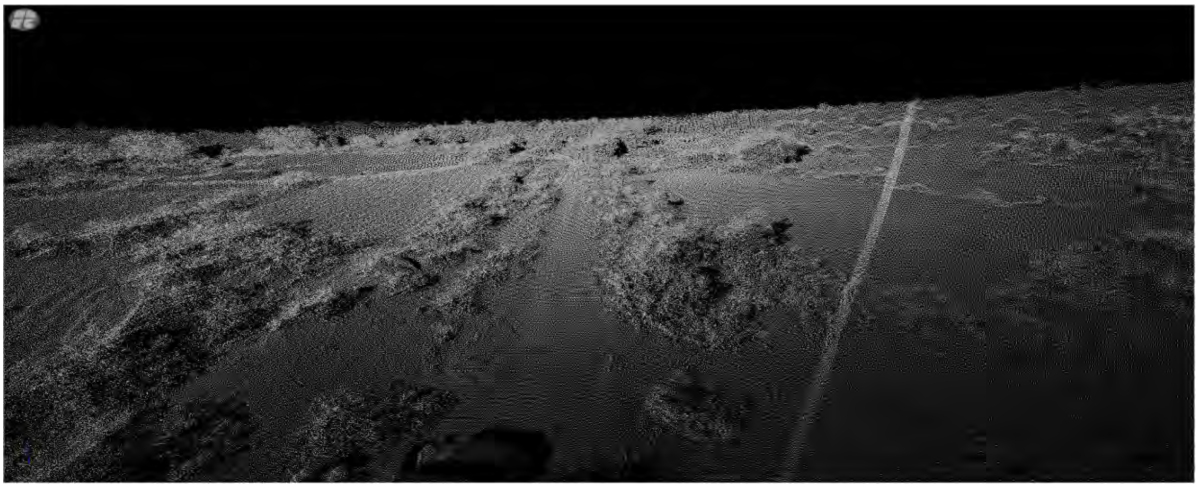
A Suitable Location was identified at suitable intervals along the alignment the tractor was deployed to that location. Base Station was set up on GPS49 control point. 5 tie points were placed around the terrestrial scanner at suitable positions. Scanning with terrestrial LiDAR was done; fine scan of the tie points for accurate registration of points was done. GPS survey for all the tie points was takes for a period of 10 minutes per point.

A Suitable Location was identified at suitable intervals along the alignment the tractor was deployed to that location. Base Station was set up on GPS50A control point. 5 tie points were placed around the terrestrial scanner at suitable positions. Scanning with terrestrial LiDAR was done; fine scan of the tie points for accurate registration of points was done. GPS survey for all the tie points was takes for a period of 10 minutes per point.



Images showing LiDAR data, Terrestrial Scanner conducting survey and Comparison between Lidar Data and Photograph on a small tank at CH 26000

A Suitable Location was identified at suitable intervals along the alignment the tractor was deployed to that location. Base Station was set up on GPS50A control point. 5 tie points were placed around the terrestrial scanner at suitable positions. Scanning with terrestrial LiDAR was done; fine scan of the tie points for accurate registration of points was done. GPS survey for all the tie points was takes for a period of 10 minutes per point.



Images showing LiDAR data @CH 49300

A Suitable Location was identified at suitable intervals along the alignment the tractor was deployed to that location. Base Station was set up on GPS86 control point. 5 tie points were placed around the terrestrial scanner at suitable positions. Scanning with terrestrial LiDAR was done; fine scan of the tie points for accurate registration of points was done. GPS survey for all the tie points was takes for a period of 10 minutes per point.

Images Comparison between LiDAR Data and Photograph at CH 66000

1)The Representatives of EI technologies were taken through selected locations of the Alignment starting from DC4 and crucial locations of the alignment was shown, suggestions as per the site condition were discussed

The representatives were taken to the survey location and Terrestrial LiDAR survey was demonstrated with live survey

2) A Suitable Location was identified at suitable intervals along the alignment the tractor was deployed to that location. Base Station was set up on GPS86 control point. 5 tie points were placed around the terrestrial scanner at suitable positions. Scanning with terrestrial LiDAR was done; fine scan of the tie points for accurate registration of points was done. GPS survey for all the tie points was takes for a period of 10 minutes per point.

A Suitable Location was identified at suitable intervals along the alignment the tractor was deployed to that location. Base Station was set up on GPS110 control point. 5 tie points were placed around the terrestrial scanner at suitable positions. Scanning with terrestrial LiDAR was done; fine scan of the tie points for accurate registration of points was done. GPS survey for all the tie points was takes for a period of 10 minutes per point.

Images showing mounting of terrestrial Lidar system on Tripod and comparison of Lidar data and photograph near DC4

Images showing mounting of terrestrial LiDAR system on Tripod and comparison of Lidar data and photograph around DC4

A Suitable Location was identified at suitable intervals along the alignment the tractor was deployed to that location. Base Station was set up on GPS95 control point. 5 tie points were placed around the terrestrial scanner at suitable positions. Scanning with terrestrial LiDAR was done; fine scan of the tie points for accurate registration of points was done. GPS survey for all the tie points was takes for a period of 10 minutes per point

Images Showing Terrestrial Scanner Erected at Site- At Ch 101+000 Km

A Suitable Location was identified at suitable intervals along the alignment the tractor was deployed to that location. Base Station was set up on GPS110 control point. 5 tie points were placed around the terrestrial scanner at suitable positions. Scanning with terrestrial LiDAR was done; fine scan of the tie points for accurate registration of points was done. GPS survey for all the tie points was takes for a period of 10 minutes per point

The Alignment passes near Siddapur, Konehalli, villages. The Alignment intersects Bangalore-Hassan Railway line at CH 115500m and Arsikere-Tiptur Highway at CH 114000m. Very Dense Vegetation of coconut plantation and dense scrubs were found

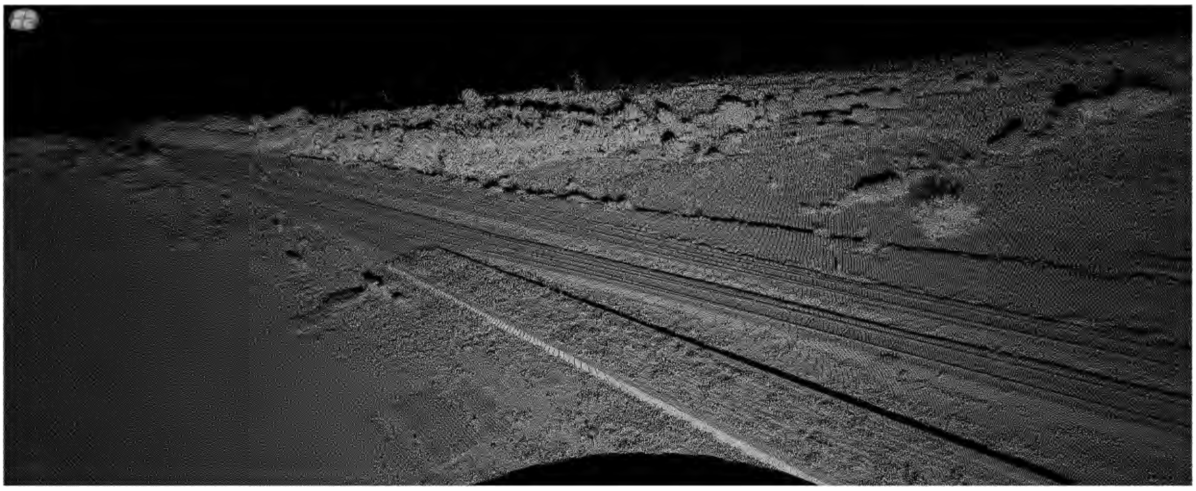


Image LiDAR Data @ CH 114500 and Konehalli Railway Station at GPS 120

The Alignment passes near Madihalli village, Konchaghatta, Tiptur Town, Brahmasandra, Bidanahallipalya villages. The alignment moves in the out skirts of Tiptur which was found to be Residential area with considerable density of houses from Ch 125000m to ch 127000m. High density coconut plantation is found along the alignment.. it is observed that another project interconnecting all the tanks in this region to Hemavathi dam is undergoing and land acquisition marking stones have been laid in most of the villages and tanks

The Alignment passes near Idanahalli, Kallegaudanapalya, senayakkanahalli Brahmasandra, Bidanahallipalya villages. High density coconut plantation is found along the alignment. it is observed that another project interconnecting all the tanks in this region to Hemavathi dam is undergoing and land acquisition marking stones have been laid in most of the villages and tanks

At CH 128700m a new HUDA layout has been formed where the alignment passes exactly on the layout a HT power transmission station(Sub-station) is also present in the Vicinity

| | |
|---|---|
|  |  |

Images comparison between LiDAR Data and Photograph @CH 131000

The Alignment passes near Ramenahalli, Annemaranahalli villages. High density coconut plantation is found along the alignment. it is observed that another project interconnecting all the tanks in this region to Hemavathi dam is undergoing and land acquisition marking stones have been laid in most of the villages and tanks

Due to dense scrub availability of approach to the site is limited

The alignment passes trough Rocky, dense scrubbed Chaudlapura Kaval State Forest with no access to the alignment for next 6 km of alignment

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# Chapter 7
# Hydrology

## 7.1 Hydrologic inputs to the project planning

### 7.1.1 Processing of hydrologic data available

For arriving at the divertible yield from the streams proposed to be trapped, the gauging data of CWC available at Bantwal on the downstream across river Netravathy has been considered as the base is attached as **Annexure - 7**. This has been done in view of non availability of gauged data across the streams considered such as Yettinahole, Kadumane hole, Kerihole and Hongadahalla which lie on the upstream reaches of the Western Ghats.

### 7.1.2 Discussions of the type of proposed data development

There are many streams originating in Western Ghats which will drain into the sea after joining major river systems. For successful implementation of the proposed scheme, some of the streams carrying substantial flow during the monsoon season have been selected. The selected streams are **Yettinahole, Kadumane hole, Kerihole & Hongadahalla hole** originating in upper reaches of Western Ghats near Sakleshpura.

### a) Catchment area

The combined catchment area of selected sub basins at the proposed diversion weir sites is **176.74 sq. km**.

### b) Rainfall

There are some private rain gauge stations within the project area and the rainfall details of the available data at Kadumane estate has been collected and utilized.

### c) Water Availability

### i. Yettinahole and Kadumane hole

Yettinahole is one of the major streams originating in the upper reaches of Western Ghats. A weir (**Weir 1)** is proposed across Yettinahole, to tap the discharge from a catchment area of about 48.8 km$^2$. Water intercepted by this weir is to be diverted to the east.

In order to augment the quantity of water available, Weirs 3,4 & 5 have been proposed across Yettinahole tributary, Kadumane Hole 1and 2 and water from these will be lifted and conveyed directly into Intermediate pumping station (DC 3) by gravity.

For negotiating the elevation difference, an **Intermediate pumping station** /Delivery chamber 3 is proposed at Doddanagara.

The catchment areas of the weirs are given in Table 5.2.

**Table 7.1: Catchment Areas of the four Weirs**

| Sl NO | Weir | Catchment Area in Sq.Km | Remarks |
|---|---|---|---|
| 1 | Weir 1 | 48.8 | All the Weirs are located on right side of the NH 48 while travelling from Sakleshpur to Mangalore. The discharges from Weir 3, 4 and 5 will be diverted to Weir 1. |
| 2 | Weir 3 | 9.8 | |
| 3 | Weir 4 | 13.79 | |
| 4 | Weir 5 | 7.49 | |
| | **Total** | **79.88** | |

## ii. Yettinahole downstream of Weir 1, Yettinahole Tributary 1, Kerihole and Hongadahalla

Diversion weirs have been planned across Kerihole (**Weir 6**), Hongadahalla (**Weir 7**) , Yettinahole downstream of Weir 1 (**Weir 8**) and Yettinahole Tributary 1 **(Weir 2).** The discharge from Weir 6 and Weir 7 will be diverted to DC 1 by having independent raising mains. The water from Yettinahole tributary 1 (Weir 2) will be diverted through a raising main discharging into DC-5 from where the water will travel through a natural nala to Weir 8. A jack well cum pump house has been proposed on the foreshore of Weir 8 (right flank) and the water is conveyed through raising mains to (DC 1). Dedicated pipelines (Raising Mains) have been planned to convey the water by pumping through raising mains, from weirs 6, 7 and 8 up to (DC 1)/Jack well cum pump house. From DC 1, the water from Weir 1,6,7 and 8 will be lifted and conveyed to the Intermediate pumping station (DC 3) located near Doddanagara. The water from Intermediate pumping station (DC 1) will be lifted and delivered to DC 4 near Haravanahalli.

The catchment areas of the weirs are given in Table 5.3.

**Table 7.2: Catchment Areas of the four Weirs**

| SL | Weir | Catchment Area in Sq. Km | Remarks |
|---|---|---|---|
| 1 | Weir 2 | 7.2 | All the weirs are located on the left side of the NH 48 while travelling from Sakleshpur to Mangalore. The discharges from Weir 2, will be diverted to Weir 8 and the combined discharge of weir 2 and 8 along with the discharges from 6 & 7 will be conveyed to DC 1 through independent raising mains |
| 2 | Weir 6 | 24.25 | |
| 3 | Weir 7 | 53.80 | |
| 4 | Weir 8 | 11.61 | |
| | **Total** | **96.86** | |

For the locations of the weirs, catchment area and the alignment of the conveyance system from the respective weirs, Jack well cum pump house till it crosses the saddle of the western Ghats, refer Index map.

## d) Quantity of water that can be diverted (Divertible Yield)

A detailed study was undertaken to arrive at the quantity of water than can be diverted from the selected streams. In the absence of gauge across the streams, it was necessary to look at other alternative data which can be made use of for arriving at the yield from the above streams.

Accordingly, it was thought that the available data at CWC gauge station near Bantwal across Netravati River could be made use of to calculate the yield in the above streams considering the fact that these streams form a part of the Netravati River system.

For the purpose of calculating the yield, the available gauge data from CWC from gauge station has been obtained and the yield from the above streams has been arrived at.

The study indicates the quantum of water which can be diverted from the proposed weirs totals to 24.01 TMC at 50% dependability and 20.58 TMC at 90% dependability. The table showing the available yield at 50%, average and 90% dependability for the proposed scheme is indicated below:

**Table 7.3: Available yield**

| Weir | Storage Capacity | Pump Capacity | 90% dependable | | Average | | 50% dependable | |
|---|---|---|---|---|---|---|---|---|
| | | | Inflow | Diversion | Inflow | Diversion | Inflow | Diversion |
| | TMC | cumecs | TMC | TMC | TMC | TMC | TMC | TMC |
| 1 | 0 | 26 | 6.08 | 5.68 | 8.14 | 6.89 | 7.99 | 6.62 |
| 2 | 0 | 4 | 0.90 | 0.85 | 1.20 | 1.04 | 1.18 | 1.02 |
| 3 | 0 | 5.5 | 1.22 | 1.16 | 1.64 | 1.42 | 1.60 | 1.40 |
| 4 | 0 | 3.5 | 0.93 | 0.85 | 1.25 | 1.01 | 1.23 | 0.98 |
| 5 | 0 | 6 | 1.72 | 1.52 | 2.30 | 1.80 | 2.26 | 1.73 |
| 6 | 0 | 5 | 3.02 | 1.82 | 4.05 | 2.04 | 3.97 | 2.01 |
| 7 | 0 | 30 | 6.91 | 6.52 | 9.26 | 7.96 | 9.09 | 7.76 |
| 8 | 0 | 9 | 2.60 | 2.19 | 4.31 | 1.26 | 4.23 | 2.51 |
| | | **Total** | **23.38** | **20.58** | **32.15** | **23.42** | **31.54** | **24.01** |

### 7.1.3 Analysis of data for preparation of inputs

#### 7.1.3.1 Analysis of data as per the available gauge data near Bantwal

A Hydrology Report on diversion of about 9.1 TMC of water at 75% dependability from three streams in the Yettinahole subbasin (in the upper reaches of Netravati river) to the east of the Ghats was prepared. In the present Report, five more diversion sites are considered in the Yettinahole and neighbouring subbasins and the hydrology and quantity of water that can be diverted from all the eight sites are worked out.

### 7.1.4 Outline of the scheme

In the August 2010 Report, quantity of divertible water from weirs 1, 2 and 3 (respectively on Yettinahole main stem, tributary 1 and tributary 2) was calculated, with waters from weirs 2 and 3 diverted to weir 1 and the combined waters diverted eastward from weir 1. Two more weirs are now considered, one on Kadumanehole1 and another on Kadumanehole 2. Waters from these weirs are also diverted to weir 1 and the combined waters from the five weirs are pumped to a delivery chamber in Phase-I. The catchment areas above the weirs are as follows:

**Table 7.4: Catchment Areas of the eight Weirs**

| WEIR | CATCHMENT AREA, km2 |
|---|---|
| Weir 1 (Yettinahole) | 48.8 |
| Weir 2 (Yettinahole Tributary 1) | 7.2 |
| Weir 3 (Yettinahole Tributary 2) | 9.8 |
| Weir 4 (Kadumanehole1) | 13.79 |
| Weir 5 (Kadumanehole2) | 7.49 |
| Weir 6 (Kerihole) | 24.25 |
| Weir 7 (Hongadahalla) | 53.8 |
| Weir 8 (Yettinahole Downstream) | 11.61 |

In Phase-II, three more weirs are considered, one each on Kerihole, Hongadahalla and Yettinahole downstream of weir 1. They are respectively called weirs 6, 7 and 8. Their catchment areas are also given in Table 1.

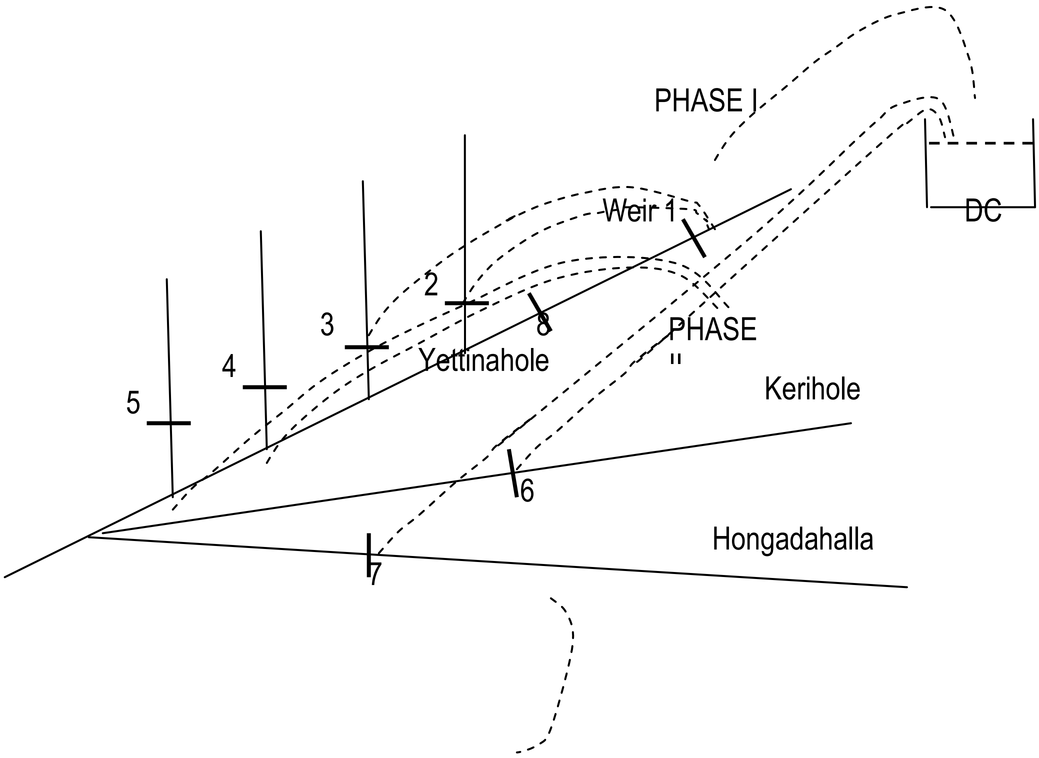



Fig. 1. Line Diagram of the Diversion Scheme

The two phases are shown in a line diagram in Fig. 1. In Phase II, water from weir 7 is diverted to the DC. Water from weir 8 is diverted to weir 6 from where it is pumped either directly to the DC or into the rising main coming from weir 7. In the present Report, only the direct pumping option is studied.

### 7.1.5 Runoff

The 10-daily flows at the weir sites are calculated in the same way as in the August 2010 Report, based on gauged flows in Netravathy at Bantwal.

The 10-daily flows from June to November (in TMC) for 37 years from 1971-72 to 2007-08 are done for all the eight weirs respectively. The months from December to May are not considered since flow dwindles from December onward, and any diversion in those months would affect drinking water supply downstream.

### 7.1.6 Quantity of Water that can be diverted

The amount of water that can be diverted at the three weirs depends in principle on the storage available and the capacity of the pumps at each site. Too small storage or pump capacity will result in large surplus flows over the weirs and small quantities diverted. Too large storage or pump capacity will result in unnecessarily high capital cost and underutilization of infrastructure. In the recent past, environmental concerns have come to the fore in the Western Ghats region, and it is therefore desirable to limit the storage capacities at the weirs to within the river banks. Sensitivity analysis was done on the effect of storage and pumping capacity on divertible water quantity. It showed that storage has a very much smaller effect than pumping capacity on the divertible quantities. Therefore, a nominal capacity of 5 Mcft at each weir is assumed, and pumping capacity is optimized with the help of working tables. While working tables for weirs 2 to 5 in Phase-I are independent, that for weir 1 depends on the amount of water diverted into it from the other four weirs. Similarly in Phase-II, working tables for weirs 7 and 8 are independent, while that for weir 6 depends on the amount of water diverted into it from weir 8.

### 7.1.7 Combined Working Tables

Working tables for weirs 2 to 5 are first developed, since the water pumped from them flows into weir 1. Several pumping capacities for each weir were tried, and then optimized by examining the results from the working tables. Evaporation losses are ignored because of the small storage. When elevation-area-capacity tables are available (at the DPR stage), evaporation losses can be included. Neglecting evaporation at this stage will affect the results only marginally because of the small magnitude of evaporation losses. The 10-daily working tables are prepared from June to November for the years 1971-72 to 2007-08 using the 10-daily flow. The opening storage every year in June is assumed to be equal to the storage capacity (i.e., 5 Mcft). The diversion from Weir 2, 3, 4 or 5 is set equal to the sum of the opening storage and inflow or the pump capacity for the 10- or 11-day period, whichever is lower. Remaining water flows over the weir as surplus. The closing storage is then computed by subtracting the diversion and surplus from the sum of the opening storage and inflow. It will be the opening storage for the next period. For Weir 1, similar computations are done, with the change that the diversions from Weirs 2 to 5 are added to the inflow. The combined working tables are given in Annexure-I for Phase-I with pumping capacities of 45.0, 4.0, 5.5, 6.0 and 3.5 cumecs for weirs 1 to 5 respectively. In Phase-I (i.e., from Weir 1) the divertible quantities are as follows:

| | |
|---|---|
| Average | 12.31 TMC |
| 50% dep | 11.91 TMC |
| 75% dep | 10.89 TMC |
| 90% dep | 10.15 TMC |

The combined working tables are given in Annexure-II for Phase-II with pumping capacities of 15.0, 30.0 and 5.0 cumecs for Weirs 6, 7 and 8 respectively. For Weir 8 (Yettinahole Downstream), in addition to the inflow from its independent catchment, there is a contribution from the surplus over Weir 1 also. This is taken into consideration in preparing working tables for Weir 8. As mentioned earlier, water from Weir

8 is diverted into Weir 6, from where it is pumped to the DC. Water from Weir 7 is separately pumped into the DC. In Phase-II the divertible quantities from Weirs 6 and 7 are as follows:

| | From Weir 6 | From Weir 7 |
|---|---|---|
| Ave | 4.63 TMC | 7.81 TMC |
| 50% dep | 4.42 TMC | 7.68 TMC |
| 75% dep | 4.16 TMC | 6.88 TMC |
| 90% dep | 3.90 TMC | 6.37 TMC |

### 7.1.8 Conclusions and Recommendations

Based on the gauged data of Netravati at Bantwal, 10-daily flows at Weirs 1 to 8 proposed in the Yettinahole, Kerihole and Hongadahalla subbasins are calculated for the months from June to November in proportion to the respective catchment areas and average catchment rainfall for 37 years from 1971-72 to 2007-08.

Combined working tables for the 8 Weirs were developed for a range of values of storage capacities and pump capacities and a sensitivity analysis was carried out. It was found that the storage capacities at all the weirs had only a marginal influence on the average quantities of water that can be diverted. Only a nominal storage capacity of 5 Mcft at each weir is needed.

Based on the sensitivity analysis, it is recommended that pumps of the following capacities be installed at the weirs:

| **Weir** | **Pumping Capacity (cumecs)** |
|---|---|
| 1 | 45.0 |
| 2 | 4.0 |
| 3 | 5.5 |
| 4 | 6.0 |
| 5 | 3.5 |
| 6 | 5.0 |
| 7 | 30.0 |
| 8 | 5.0 |

It is recommended that at the DPR stage, cost analysis for a range of pump capacities around these values be conducted and decision taken to get the optimum benefit in relation to cost

#### 7.1.8.1 Analysis of data as per the available gauge data of Yettinahole-2 as per KPC

While arriving at the divertible yield of 24.0 TMC, the gauge data in any of the streams indicated was not available. However, subsequently during the year 2011-12, KPC has undertaken gauging of Yettinahole2 downstream of the location of Weir 1. As a result, the data available with the KPC was then considered for calculation of available yield across the streams indicated. The divertible yield as per the revision works out to 22 TMC. The details are indicated below.

Working tables were developed in the year 2010 at 8 weir sites in the upper Netravati basin for diversion of water from different tributaries to the east of the Ghats. At that time, gauged flow data on Netravati were available only at Bantwal, near the coast. Flows at the weir sites were derived from the Bantwal data multiplying by the catchment area ratio and average rainfall ratio:

$$Qn = Q \times \frac{AnPn}{Ap} \quad \ldots\ldots\ldots(1)$$

where Qn = Flow at weir n and Q = Flow at Bantwal

An = Catchment area at weir n

A = Catchment area at Bantwal

Pn = Weir n catchment average rainfall

P = Bantwal catchment average rainfall

Now, concurrent gauged flow data are available at Bantwal on Netravati, Mookanamane on Hongadahalla, Marenahalli on Kadumanehole and Bidalli on Kumaradhara for the years 2009-10, 2010-11 and 2011-12. The latter three sites are located near the weir sites. Since measured flow data are now available near the weir sites, the Yettinahole working tables are revised considering this data.

#### 7.1.8.2 Flows at weir sites in the earlier working tables

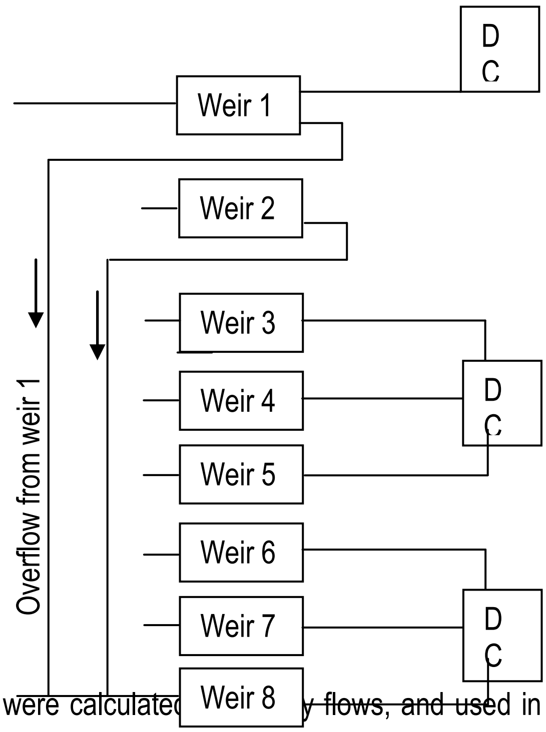
Working tables were prepared earlier using inflows at the weirs from eq (1). Daily flows were available at Bantwal for 37 years from 1971-72 to 2007-08. The Bantwal catchment annual average rainfall was taken as 4658 mm from data available with WRDO. For the Yettinahole area, the average annual rainfall was taken as 6280 mm from rainfall records maintained by owners of plantations in the region.

The catchment areas and average rainfall were taken as follows in the calculations:

**Table 7.5: Catchment area and average rainfall**

| **Site** | **Name of Tributary/River** | **Catchment Area, sq km** | **Average Rainfall, mm** |
|---|---|---|---|
| Weir 1 | Yettinahole | 47.75 | 6280 |
| Weir 2 | Yettinahole Tributary-1 | 6.76 | 6280 |
| Weir 3 | Yettinahole Tributary-2 | 9.66 | 6280 |
| Weir 4 | Kadumanehole-1 | 7.38 | 6280 |
| Weir 5 | Kadumanehole-2 | 13.17 | 6280 |
| Weir 6 | Kerihole | 23.65 | 6280 |
| Weir 7 | Hongadahalla | 55.52 | 6280 |
| Weir 8 | Yettinahole Downstream | 12.06 | 6280 |
| Bantwal | Netravati Main stem | 3184 | 4658 |

The connectivity of the Scheme is shown below, where (i) water from weir 1 is pumped to a DC and the remaining water overflowing weir 1 goes to the downstream weir 8 on the same stream, (ii) water from weir 2 is conveyed to a point upstream of weir 8, (iii) water from weirs 3, 4 and 5 is pumped to a common DC and (iv) water from weirs 6, 7 and 8 is pumped to another common DC.




Ten-daily flows at Bantwal were calculate y flows, and used in eq (1) to derive corresponding flows at each of the 8 weir sites. These flows are given in Annexure-A. Working tables for June to November of every year were prepared and the diversions from each site determined.

### 7.1.8.3 Basis for revision

The Karnataka Power Corporation Ltd (KPCL), as part of its plans for the Gundya Hydel Project, started gauging three streams in the region from July 2009. The gauging stations are located near the weir sites. Details are given below:

**Table 7.6: Details of KPCL Gauging Stations**

| Sl.No | River gauge station | River | Latitude | Longitude | Catchment area in sq km |
|---|---|---|---|---|---|
| 1 | Marenahalli | Kadumanehalla - I | 12° 52' 13" | 75° 42' 38" | 7.79 |
| 2 | Mookanamane | Hongadahalla River | 12° 47' 06" | 75° 43' 16" | 42.12 |
| 3 | Bidalli | Kumaradhara | 12° 40' 14" | 75° 43' 01" | 41.36 |
| Total | | | | | 91.27 |

Gauging stations 1 and 2 are near the sites of weirs 2 and 7 respectively on the same streams, and Station 3 is on a neighbouring tributary near weir 7. The gauging was done by current meter. Data at these three stations are available from July 2009 to October 2012. They are shown in Annexure-B. Concurrent data at Bantwal are available up to May 2012. It is thus possible to compare the Bantwal flows with KPCL flows for three years and arrive at the correlation, which can be used for the years 1971 to 2007 also. Besides, the working tables can be extended for another four years (2009 to 2012) with the KPCL data. The results will then be more accurate than the ones obtained earlier. Hence the revision.

### 7.1.8.4 Correlation between Gauge Data at Bantwal and KPCL-Gauge Data

The daily flows were summed for each month of data. Since diversion from the streams takes place only for six months from June to November, correlations also are considered for those months and December to May period is ignored. Since June flows in 2009 have not been gauged by KPCL, correlations are considered from July 2009 onward. Since Bantwal flows are huge compared to the KPCL-gauged flows, all flows were divided by the respective catchment areas, so that correlation between per sq km flows are examined. Figs. 1 to 9 show the correlations. The trend lines passing through the origin (when flow in the streams is zero, flow at Bantwal is also zero) are shown on these figures. The results are summarized in Table 2:

**Table 7.7: Correlation between Gauge Data at Bantwal and KPCL Data**

| Stream | Year | Ratio to Bantwal flow* | Coefficient of Determination R2 | Fig. No. |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Kadumanehalla | 2009 | 1.0648 | 0.90 | 1 |
| Kadumanehalla | 2010 | 0.662 | 0.81 | 2 |
| Kadumanehalla | 2011 | 0.8861 | 0.87 | 3 |
| Hongadahalla | 2009 | 1.016 | 0.99 | 4 |
| Hongadahalla | 2010 | 0.6894 | 0.90 | 5 |
| Hongadahalla | 2011 | 1.2876 | 0.81 | 6 |
| Kumaradhara | 2009 | 1.2969 | 0.97 | 7 |
| Kumaradhara | 2010 | 1.6289 | 0.83 | 8 |
| Kumaradhara | 2011 | 1.6638 | 0.96 | 9 |

*Ratio to Bantwal flow is the ratio of total June to November flow per sq km of the stream catchment to total June to November flow per sq km of Bantwal catchment in the year mentioned. It is equal to the coefficient of x in the trend line equation displayed on Figs. 1 to 9

It is seen that the correlations are quite good, but the ratio of per sq km flows is not the same for all streams as assumed in preparing the earlier working tables. Even for a given stream the ratio varies from year to year. This can be due to variations in temporal/spatial rainfall distribution. Generally the ratio is greater than unity, as it should be if the rainfall is higher at high elevations than at low ones. In view of the year to year variation, it was decided to use an average ratio to derive the flows at the weirs from the Bantwal flows. The total June to November flow per sq km in the three years 2009, 2010 and 2011 was calculated for the three streams together as well as that for Bantwal were calculated. The ratio between the two comes to 1.107. Thus the following formula is used to determine the flow at any weir site from the Bantwal flow for the years from 1971 to 2007:

$$Qn = 1.107\, Q \times \frac{An}{A} \quad \text{.........(2)}$$

with the same notation as for eq (1). Effectively, this means that the rainfall in the weir catchments is 1.107 times the Bantwal catchment rainfall, which is quite reasonable and appears to be on the conservative side.

For the years from 2009 to 2012, the flows are derived from the KPCL data. Here, the 10-daily flows for all three gauging stations put together is calculated from the daily flows for each year and divided by the total catchment area of the gauging stations (91.27 km2, vide Table 1). This gives the 10-daily runoff per km2 in the project area. Multiplying it by the catchment area at any weir site gives the 10-daily flow at that site.

Flows derived this way were used to prepare working tables for the years from 2009 to 2012.

#### 7.1.8.5 Working Tables

Working tables have been prepared assuming that there is no storage behind the weirs, so that weirs can be within the banks. At each weir, pumps with the same capacities as determined for the earlier working tables are assumed

**Weirs 1, 3 to 7**

Working tables for weirs 1 and 3 to 7 are developed independently of each other, since the water pumped from them flows into the respective DC's. . The 10-daily working tables are prepared from June to November for the years 1971-72 to 2007-08 and 2009-10 to 2012-13 using the 10-daily flows. The diversion from each weir is set equal to the inflow or the pump capacity for the 10- or 11-day period, whichever is lower. Remaining water flows over the weir as surplus.

**Weirs 2 and 8**

For Weir 8 (Yettinahole Downstream), in addition to the inflow from its independent catchment, there is contribution from the surplus over Weir 1 also. Further, the diversion from Weir 2 is added to the river just upstream of Weir 8. This is taken into consideration in preparing working tables for Weir 8.

#### 7.1.8.6 Summary and Conclusions

Availability of daily flow data (gauged by KPCL) at three stations in the neighbourhood of the proposed weirs for four years from July 2009 to October 2012 has enabled a more accurate assessment of flow at the weir sites than was possible earlier.

Correlations were established between the monthly flows at KPCL stations and Bantwal station of CWC for the concurrent period viz 2009 to 2011 (June to November). The correlations are good, but vary from year to year and differ from one station to another. Hence the average per km2 catchment flow at Bantwal from July 2009 to November 2011 was calculated. Similarly the average per km2 catchment KPCL flow at all three stations was calculated for the same period. The ratio of the latter to the former is 1.107. This means that on an average, runoff per km2 in the Yettinahole area is 1.107 times that for the catchment up to Bantwal.

Using the above ratio 1.107, ten-daily flows at each weir site were derived from those at Bantwal for the years from 1971 to 2007. For the years from 2009 to 2012, the 10-daily flow at any weir was obtained by multiplying the per km2 10-daily flow at the 3 KPCL stations together by the catchment area of the weir. Thus a 41 year long flow series at each weir sites was developed.

Ten-daily working tables were then prepared for each year from June to November assuming the same pumping capacities as in the earlier report, as given in Table 3 of 5.

The 50% dependable divertible quantity of water comes to 22.14 TMC, about 10% less than what was calculated in the earlier report.

Detailed working and annual abstracts is attached as **Annexure-8.**

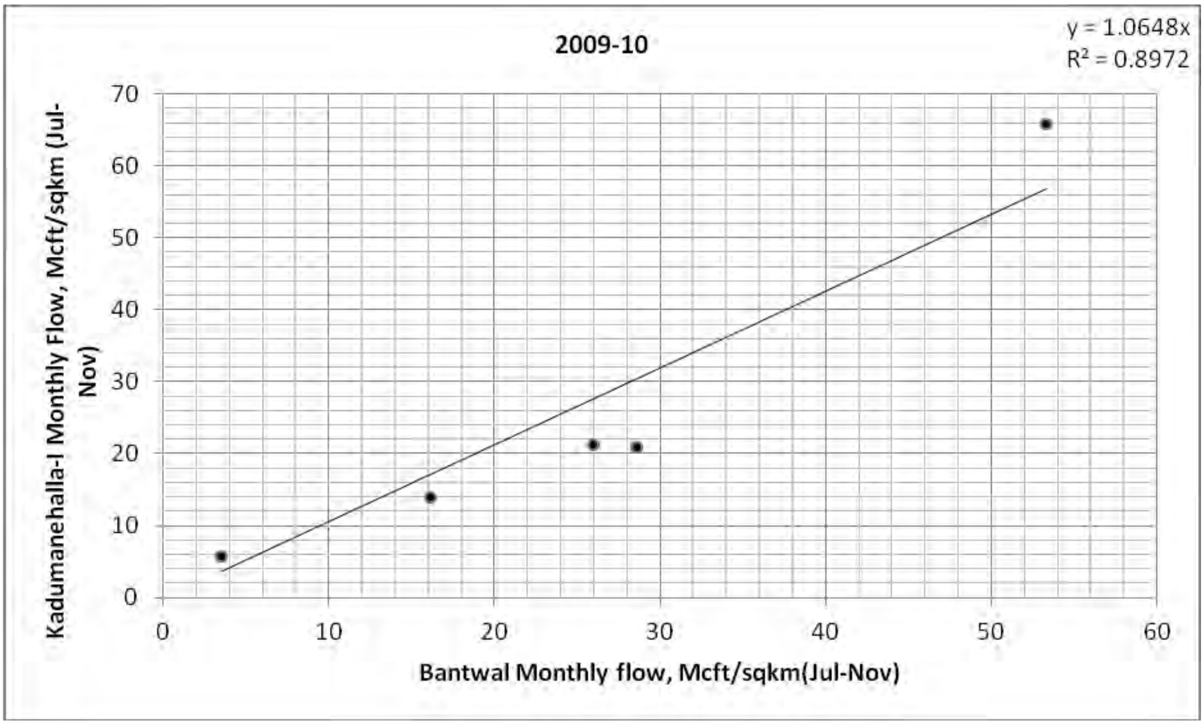



**Figure 7-1: Correlation between Kadumanehalla-1 and Bantwal for Year 2009-10**

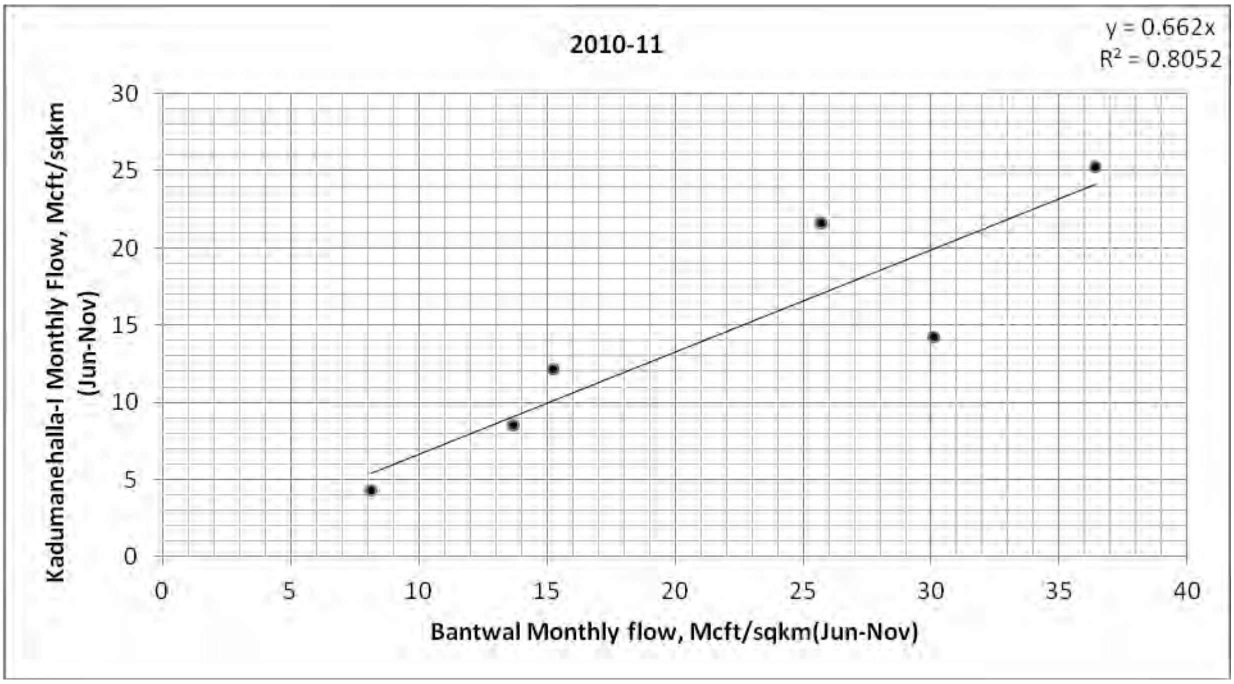



**Figure 7-2: Correlation between Kadumanehalla-1 and Bantwal for Year 2010-11**

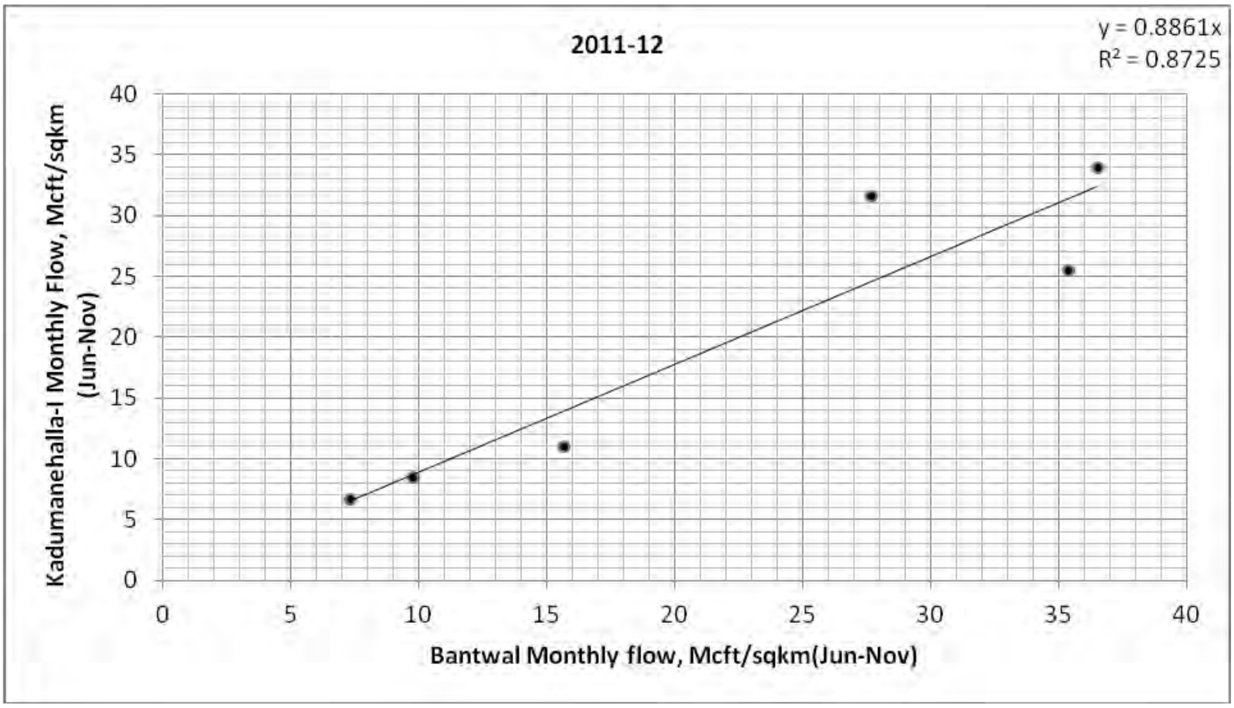



Figure 7-3: Correlation between Kadumanehalla-1 and Bantwal for Year 2011-12

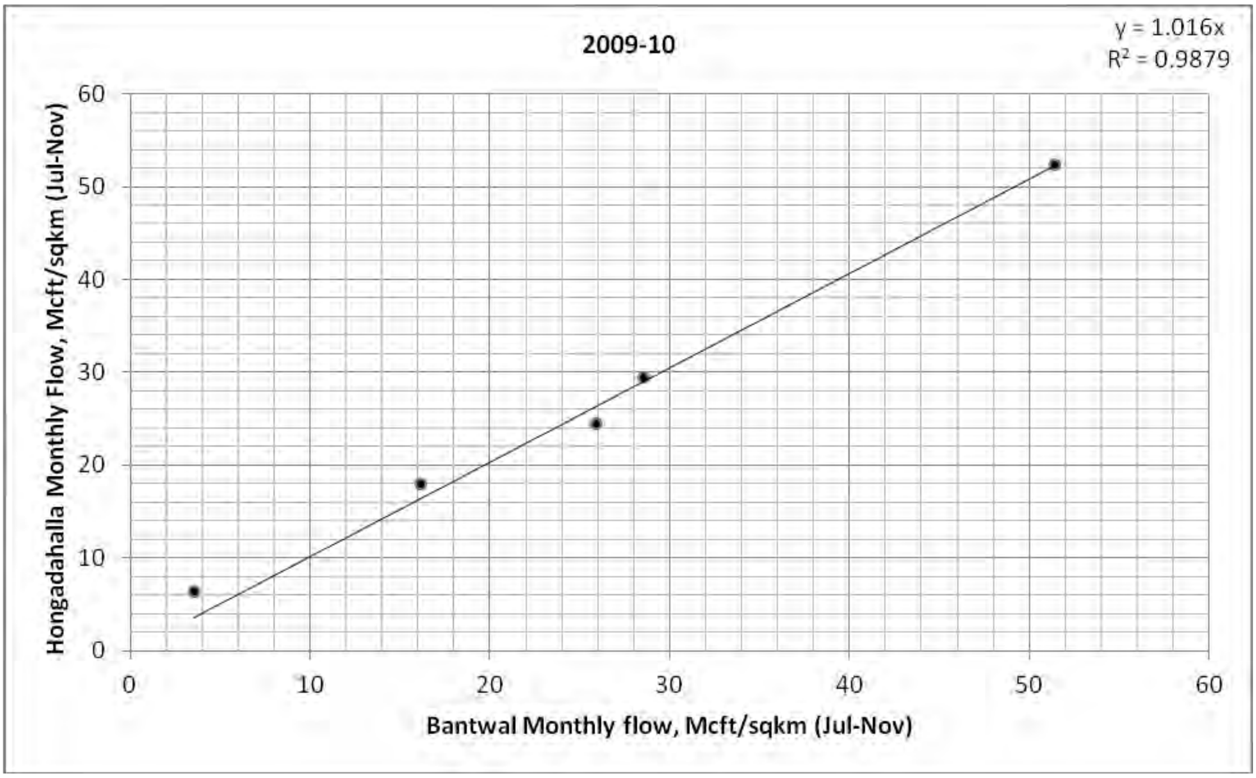



Figure 7-4: Correlation between Hongadahalla and Bantwal for Year 2009-10

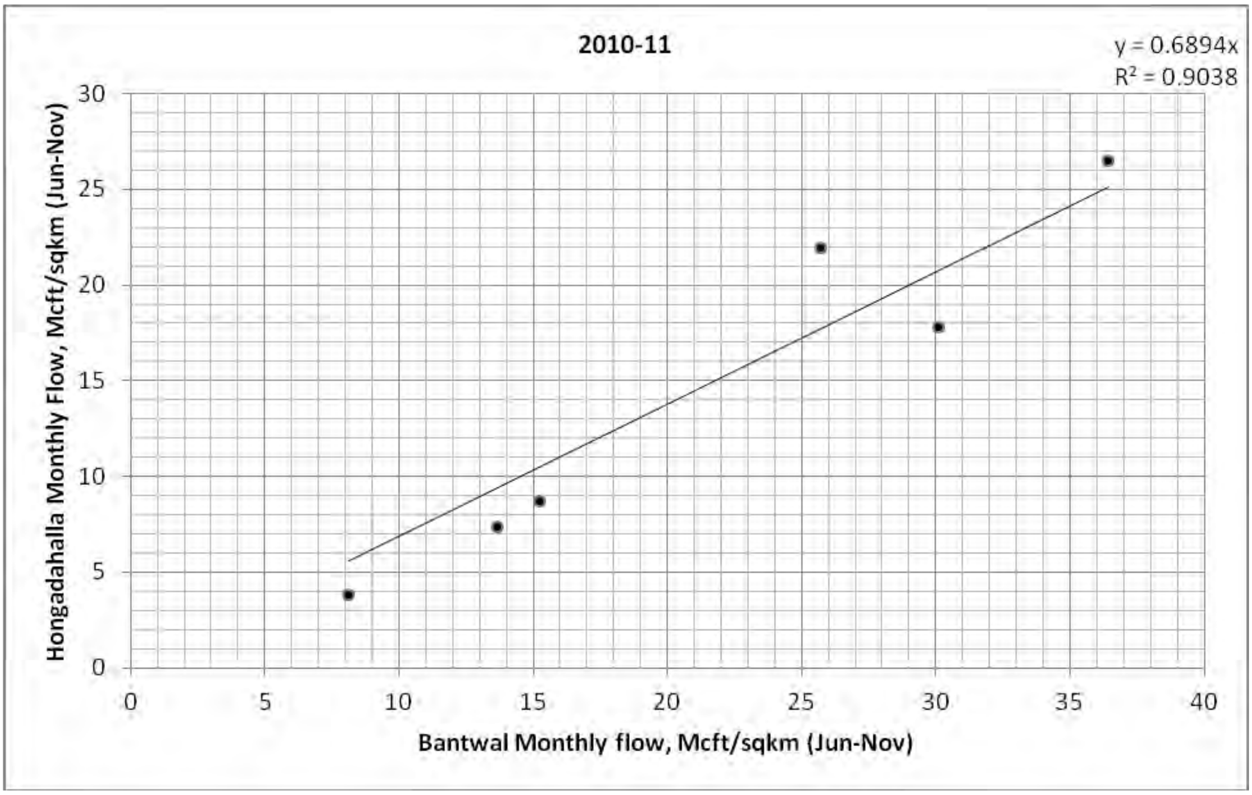



**Figure 7-5: Correlation between Hongadahalla and Bantwal for Year 2010-11**

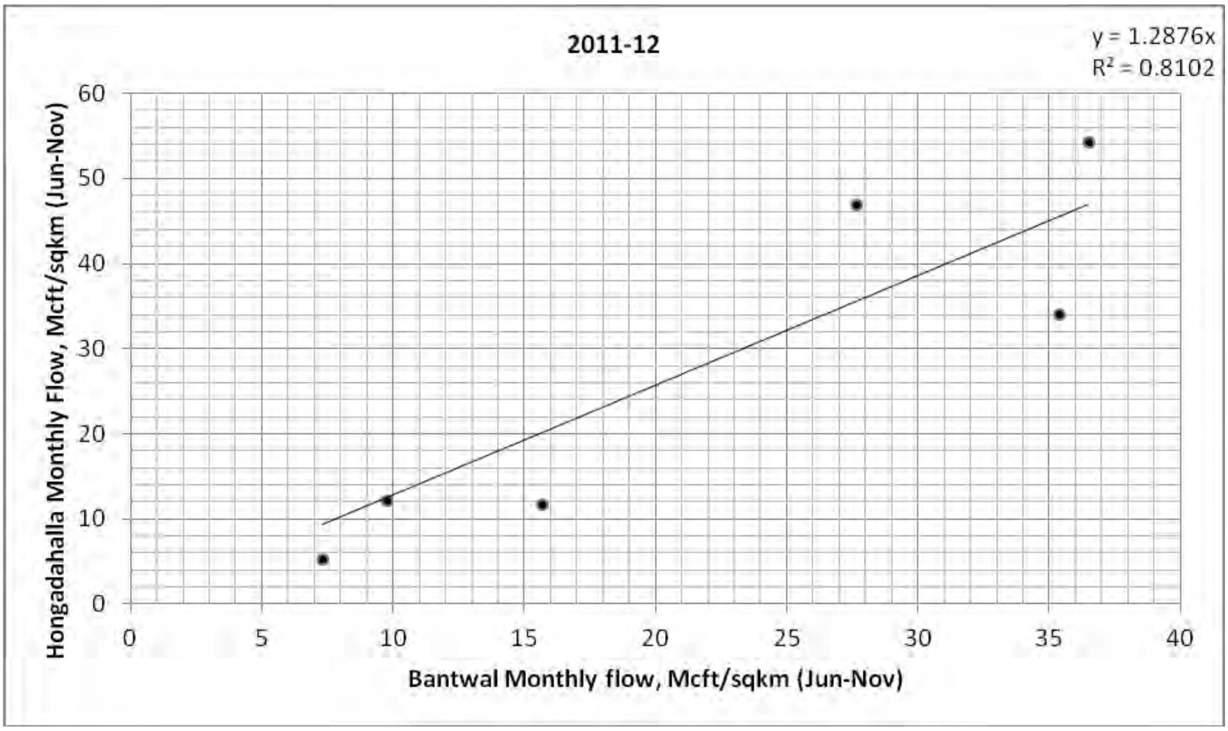



**Figure 7-6: Correlation between Hongadahalla and Bantwal for Year 2011-12**

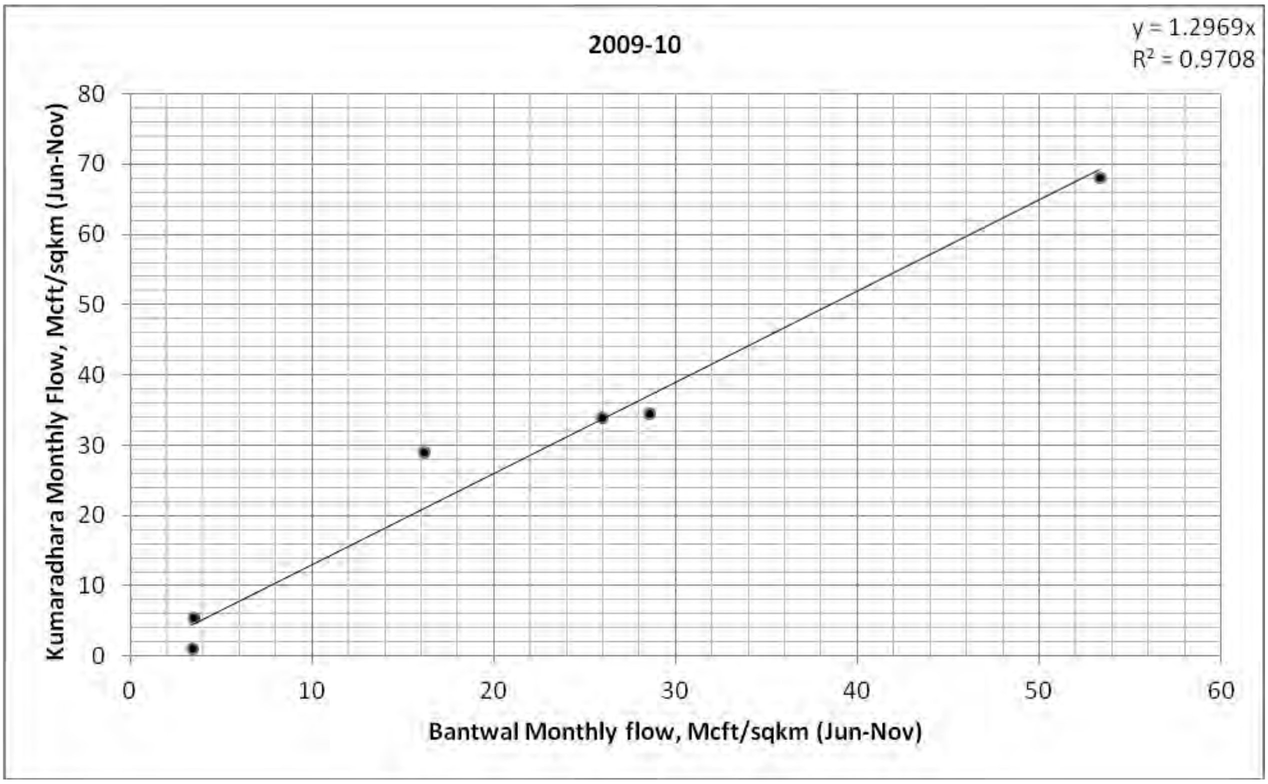



**Figure 7-7: Correlation between Kumaradhara and Bantwal for Year 2009-10**

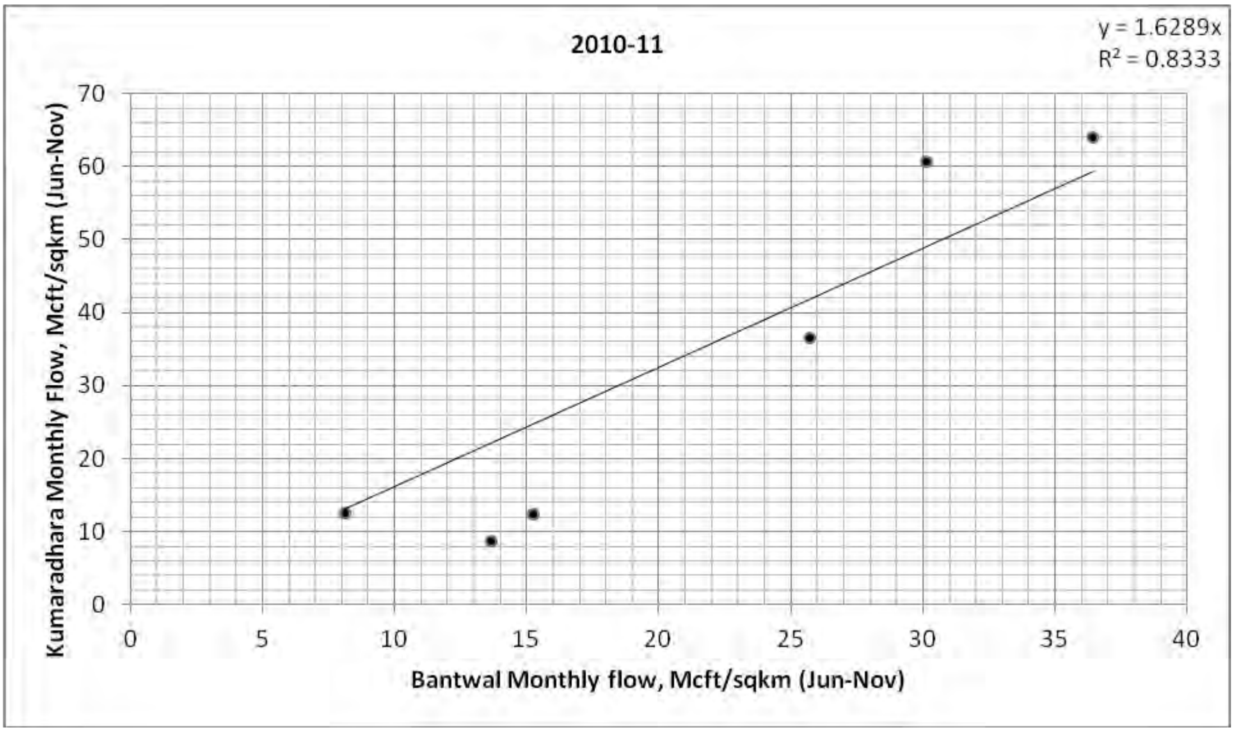



**Figure 7-8: Correlation between Kumaradhara and Bantwal for Year 2010-11**

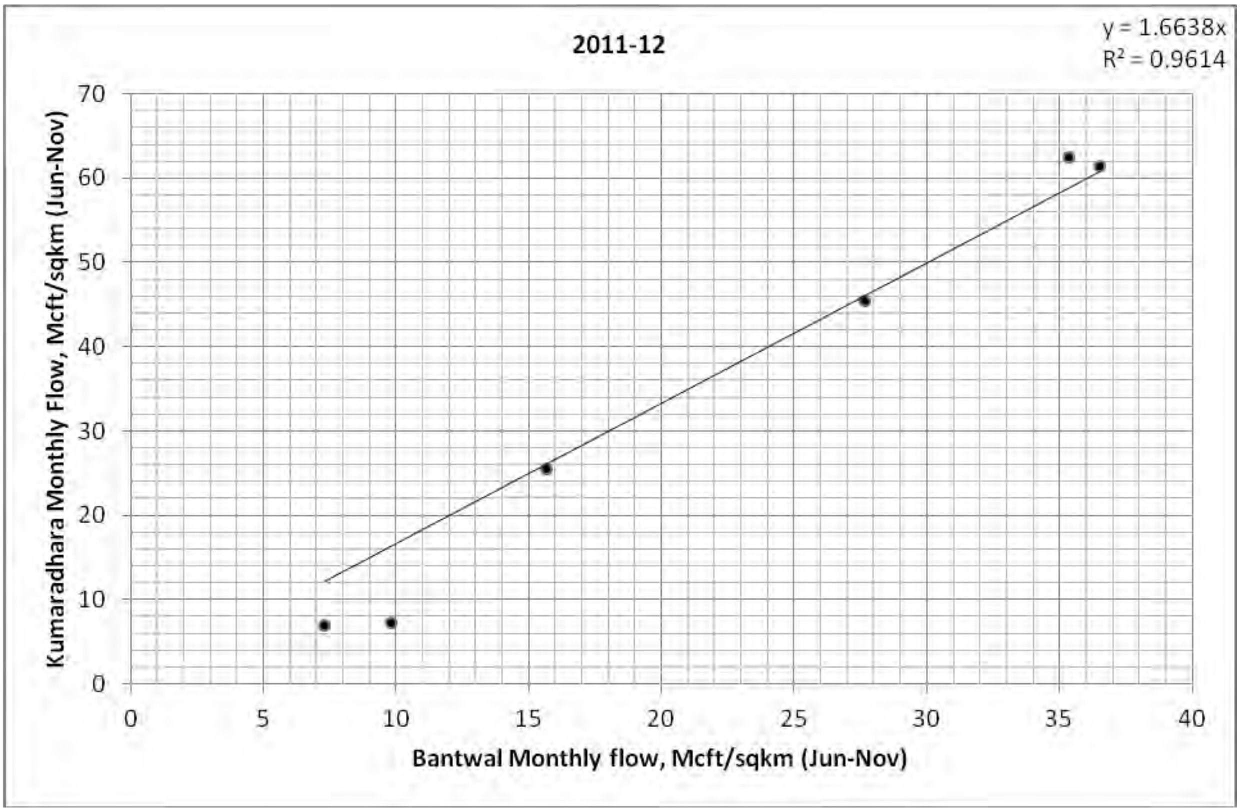



**Figure 7-9: Correlation between Hongadahalla and Bantwal for Year 2011-12**

#### 7.1.8.7 Decision regarding divertible yield

The divertible yield from the streams indicated was originally arrived at as 24.01 TMC with the computations based on the available gauge data at Bhantwal in absence of gauge details across the streams considered. However, subsequently, one of the streams namely Yettinahole-2 was gauged by KPC, the details of which are available to compute the divertible yield from the streams considered. According to the revised computations, the divertible yield has been assessed as 22.14.TMC.

However, Prof.. Rama Prasad , who has conducted the Hydrology studies has opined that the yield of 22.14 TMC at 50% dependability is very much on a conservative side and 24.01 TMC of divertible yield is available across the streams.

This has been taken note off and for the present proposal, 24.01 TMC of water has been considered as the divertible yield from the selected streams to proceed further regarding finalization of the scheme in total.

### 7.1.9 Seriousness of the sediment problem

Since the weirs are proposed to be constructed up to the height of existing banks and the excess flow during the peak monsoon being allowed to be discharged into the stream on the down streams side, no sediment problem is foreseen. However, a sluice will be proposed at the bed level to allow sediments to pass through thereby avoiding the problem of accumulation of the sediments in the up streams of the weirs.

# Chapter 8
# Hydro Geology

The project area as a whole covers the following Districts namely Hassan, Tumkur, Bangalore Rural, Kolar and Chikkaballapur.

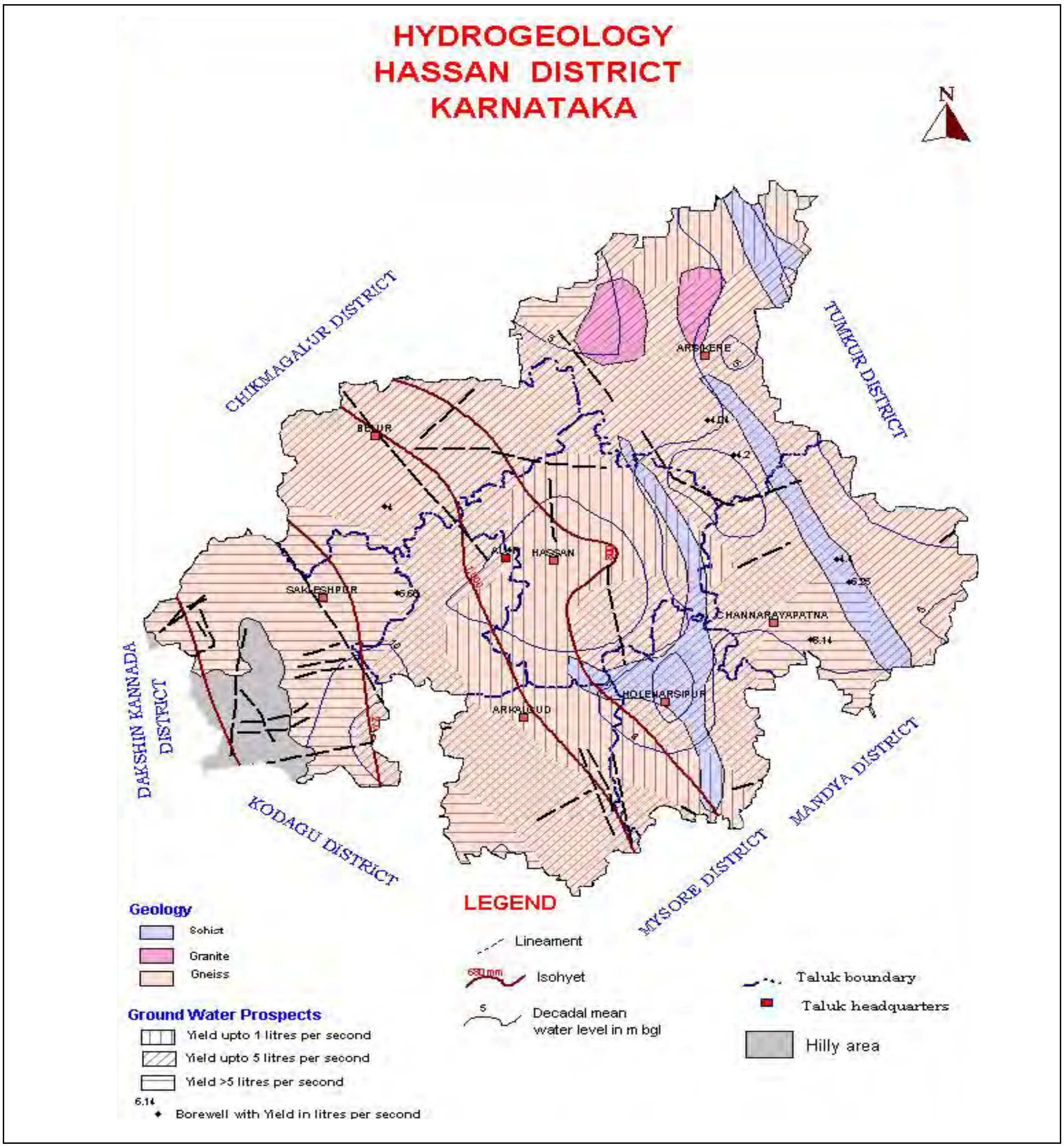
The ensuing sections of the report covers the Hydro Geology of the areas concerned and the details have been sourced from Central Ground Water Board reports of the said Districts.

## 8.1 Hassan District

### 8.1.1 Hydro Geological set up

The Hydrogeological set up of Hassan district where the proposed project is located has the following features.

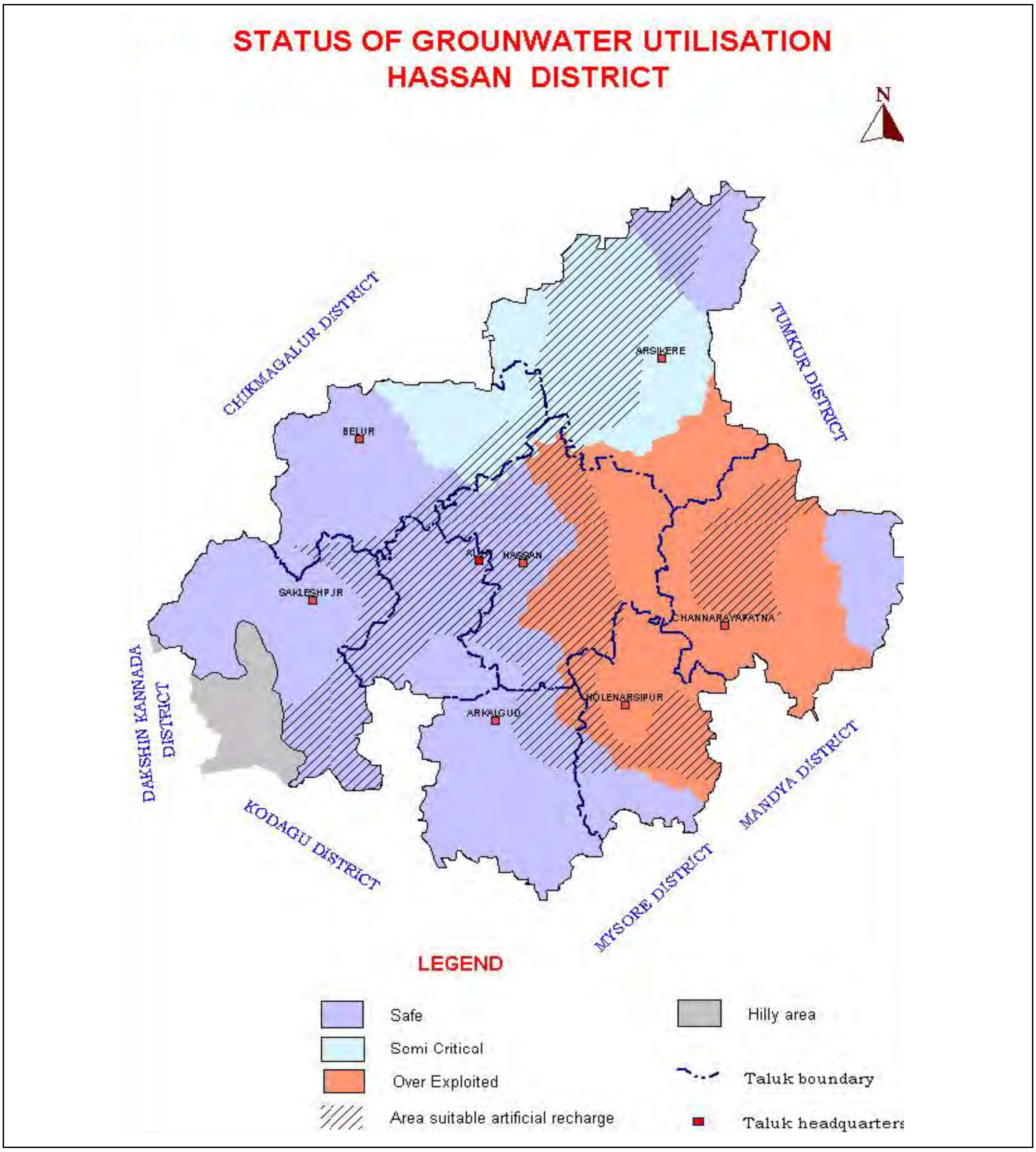
- Weathered and fractured gneiss, granite and schist are the major water bearing formations.
- Alluvial formation of limited thickness and aerial extent is found along the courses of major rivers.
- Groundwater occurs under phreatic (water table) conditions in weathered zones of gneiss, schist and granite and under semi-confined to confined conditions in joints and fractures of these rocks at deeper levels.
- Weathered and fractured gneiss is the predominant aquifer found in the district followed by schistose and granitic aquifers, which occur as isolated patches in a few taluks (Figure3).
- Groundwater occurs under phreatic condition in weathered zone of gneiss and under semi-confined to confined conditions in joints and fractures at deeper level. The depth of weathered zone (shallow aquifer) ranges from less than 10m to more than 20 m.




## 8.1.2 Ground water development prospects

- As per the Ground Water Resource Estimation Studies (GEM-1997), the annual ground water availability is 517.59 MCM and the balance resource availability is 157.31 MCM. This balance resource can create a ground water irrigation potential of 18893.37 Ha.
- The ground water development in the district varies from 39.5% (Arkalgud taluk) to 87.8% (Arsikere taluk) with an average development of 71% for the district.
- There is development of groundwater in Hassan district. As per the Resource Estimation (GEC-1997) as on March 2004, the net groundwater availability for future irrigation development is 157.32 mcm.

- The stage of groundwater development varies from 39.5% in Arkalgud taluk to 87.71% in Arsikere taluk. The average value of development of the district as a whole is 71%.
- Little more than half of the district area (54%) falls under 'safe' category, 16% area under 'semi-critical' category and the remaining 30% is 'over-exploited'




- When considered taluk wise, the entire Sakleshpura and Alur taluk and major parts of Arkalgud, Belur taluks and small parts of Arsikere and Hassan taluks are in 'safe' category.
- Major parts of C.R.Patna, Holenarsipura and Hassan taluks fall under 'over-exploited' category.

- Major part of the Arsikere taluk and almost one-third area of Belur taluk fall under 'semi-critical' category. From the above discussion it is observed that, the western higher rainfall area has a lower groundwater development than the eastern plain, lesser rainfall area.

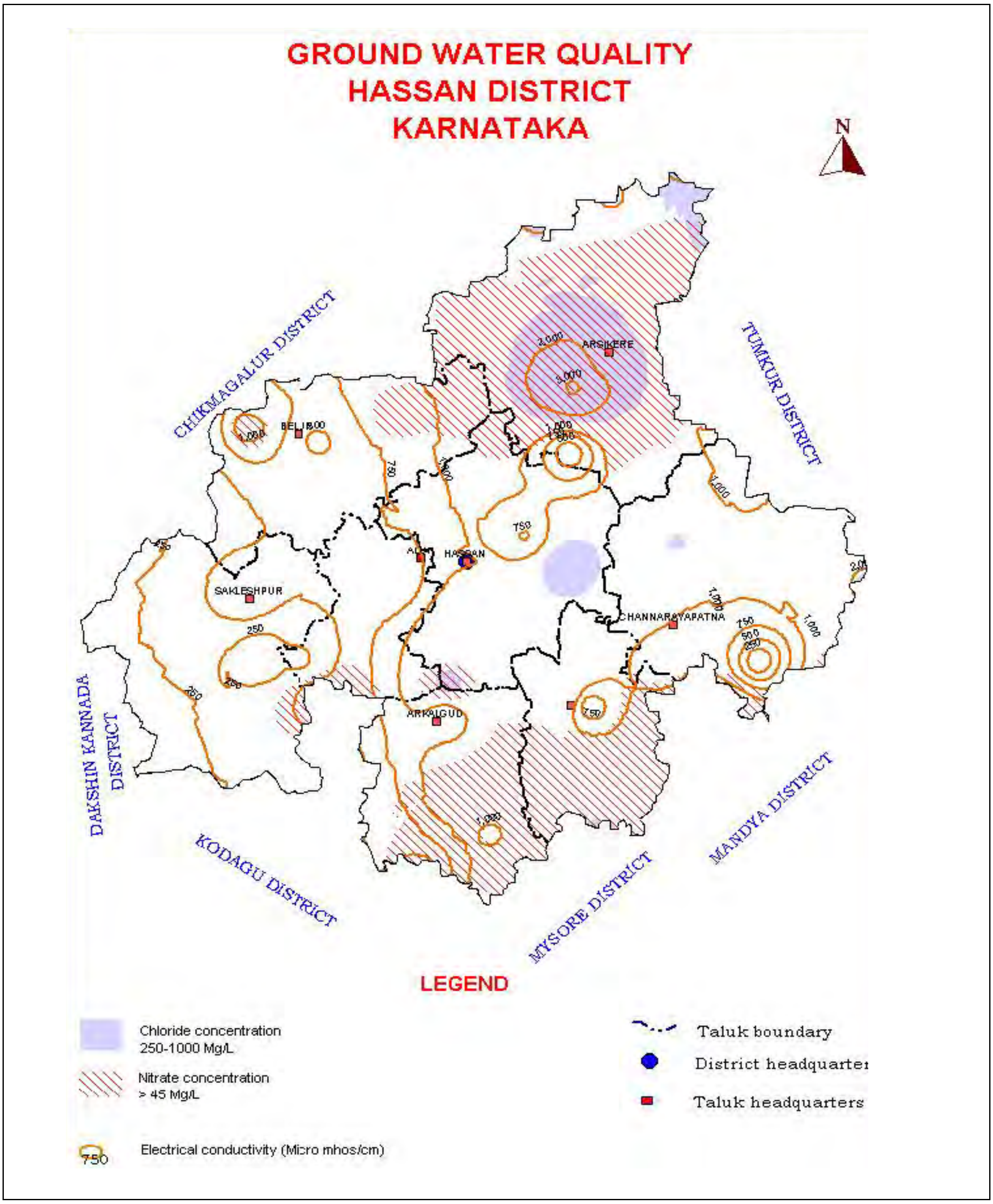
### 8.1.3 Anticipated behavior of ground water on downstream

As indicated above, the higher rainfall areas of the Western Ghats has a lower groundwater development than the eastern plains. Further, this project is not envisaged as an irrigation project and as such the anticipated behavior of the groundwater on the downstream side doesn't arise.

### 8.1.4 Quality of ground water

The study conducted by the Central Ground Water Board indicates the following:

- Quality of groundwater in the district, in general is good and potable.
- It is suitable for domestic and irrigation purposes.
- Water samples from NH Stations were analyzed to decipher the shallow aquifer water quality and samples from exploratory borewells represent water quality of deeper aquifers in the district.
- All the important parameters like EC, pH, TDS and fluoride levels, both in the shallow and the deep aquifers are, in general, within the permissible limits prescribed for drinking water standards.
- Only nitrate and chloride are found in higher concentrations at a few places. The shallow zone groundwater is Calcium-Magnesium Bicarbonate type and suitable for all purposes.
- At the following places the nitrate and chloride concentrations are in excess of permissible limits. Nilavagilu (Alur taluk), Harnahalli, Javagallu and Kanakatte (Arsikere taluk), Halebeedu (Belur taluk), Bragur, Hiresave and Jambur (Channarayapatna taluk), Kattaya and Shantigrama (Hassan taluk).
- The combination of these two ions in excess of permissible limits indicates the pollution from point source in these villages.
- Only nitrate is in above permissible concentration at Ballupet (Sakleshpur taluk), Bychanahalli and Vadrahalli (Arkalgud taluk), and Gorur (Hassan taluk), which indicates the non-point source of pollution and is due to the use of nitrogenous fertilizers in the surrounding area (Figure 7).

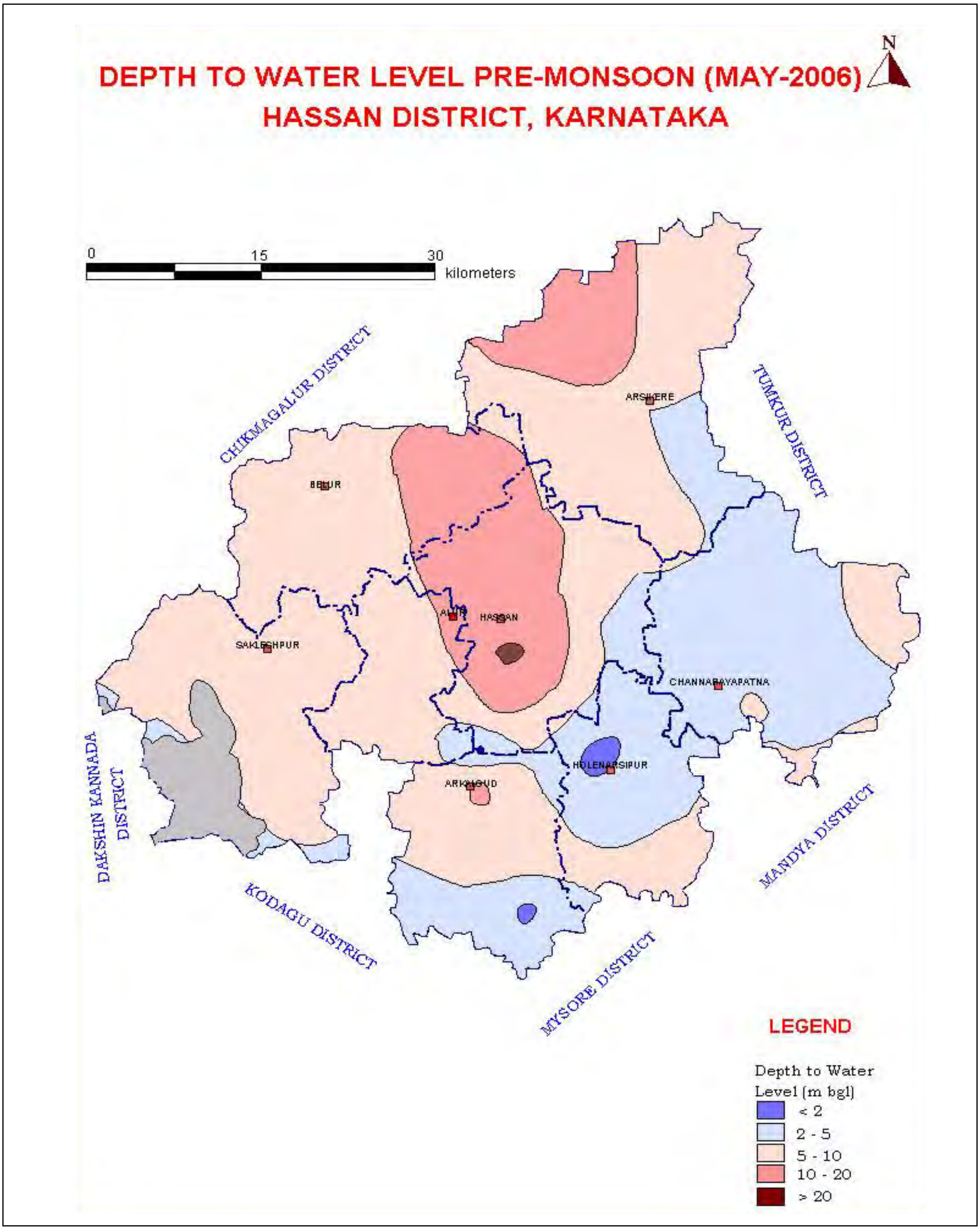



- The Sodium Adsorption Ratio (SAR) ranges between 0.02 and 6.63, which is in 'Excellent' class (being less than 10).
- The deep zone ground water is Calcium-Magnesium Bicarbonate and Chloride type and suitable for all uses.
- Excess nitrate and chloride are noticed at Javagallu and D.M.Kurki (Arsikere taluk), which is due to point source pollution and reached the deep aquifer from shallow zone due to pumping.

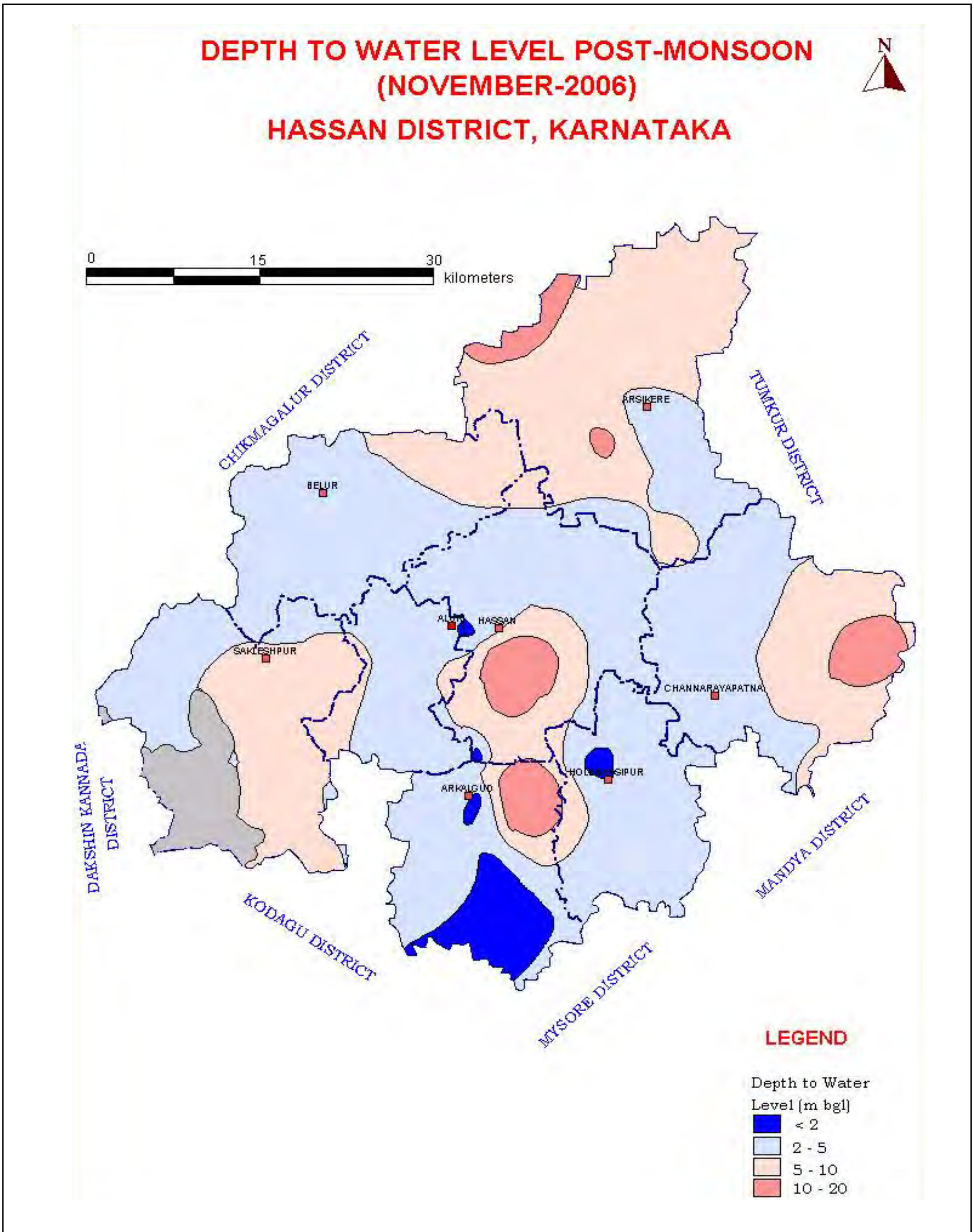
- Only nitrate is in above permissible concentration at A.M.G.Halli (Arkalgud taluk), Shanegere, Mudodi and Banavara (Arsikere taluk), Y.Cross (Channarayapatna taluk) and Kandli (Hassan taluk), which is due to the excess use of nitrogenous fertilizers in the surrounding area.
- Excess fluoride of 1.63 mg/litre is observed at Banavara (Arsikere taluk) alone. The Sodium Adsorption Ratio (SAR) ranges between 0.66 and 3.13, which is in 'Excellent' class (being less than 10).

### 8.1.5 Identification of areas of rising / declining water tables and conjunctive use of surface and ground water

The depth of water level during pre-monsoon (May-2006) ranges from 1.38 mbgl (Gorur) to 21.67mbgl (Hanumanthapura).




During post-monsoon (Nov-2006) it ranges from 0.98 mbgl (Gorur) to 19.42 mbgl (Hanumanthapura).




- The seasonal fluctuation data reveals that 84% of the wells show rise while 16% of the wells show a fall in water level.
- The rise in water level ranges from 0.20 m to 9.20m while, the fall ranges from 0.65m to 5.05m.
- The trend in water level for pre monsoon as well as post monsoon period is quite significant.

- The rising trend in pre monsoon generally indicates the reduction of draft, due to increased dependence on surface water supply. While, a falling trend in pre monsoon indicates the reverse.
- The rising trend in post monsoon indicates effective watershed treatment or high incidence of rainfall, while the falling trend in post monsoon throw light on high level of urbanization by reducing the natural infiltration rates by way of concrete
- The depth to water level ranges from 8.64 mbgl to 13.00 mbgl during pre-monsoon (May-06) and from 3.60 mbgl to 5.36 mbgl during post-monsoon season (Nov-06).
- Average annual fluctuation is 4.6m.The long-term water level trend (1996-2005) shows a rise of 0.31m/year.
- Permeability in the shallow zone is less than 10m/day.
- Potential deep aquifers occur below 25m to 100m (explored depth 196m) in the form of joints and fractures.
- The average yield of borewells (CGWB exploratory wells) is 2.0 lps
- Reason for decline/variation in the groundwater level
- Fast, unchecked and indiscriminate withdrawal of groundwater through different abstraction structures has resulted in the decline of ground water level.
- Further, deforestation and conversion of grass-covered land for other activities has reduced the natural groundwater recharge area.
- Hence, most part of the rain leaves the area as run-off causing floods and heavy soil erosion.

### 8.1.6 Proposal of conjunctive use of surface and ground water

Since this project is envisaged as a drinking water supply scheme to the drought prone districts of Kolar and Chikkaballapur along with other needy areas in the eastern plateau, conjunctive use of surface and groundwater is not a parameter considered.

## 8.2 Tumkur District

### 8.2.1 Hydrogeology

The district is underlain by meta sediments (limestone) and meta volcanic (quartzite and schists) of Dharwar Group, Peninsular gneisses and Clospet granites of Pre Cambrian age, which are intruded by pegmatite and dolerite dykes. Laterite occurs on the top of the hills south of Bukkapatna as small patch.

Joints are observed in general in N. E – S.W to N.N.E – S.S.W and NW – SE to NNW – SSE directions. The alluvial patches are generally seen along the major streams as narrow discontinuous patches particularly in granite country. It comprises medium to coarse grained sand with silt and clay at many places and is largely controlled by topography of the basement crystalline in the area. Themaximum thickness of the alluvium in the Suvarnamukhi basin is 14 m. The alluvium in Jayamangali and Kumudavathy rivers is sandy in nature and attains a thickness of only 10 to 13 m

### 8.2.2 Occurrence and movement of Ground water:

Ground water occurs in weathered and jointed zones of gneisses, granites and schists and alluvium in unconfined or water table conditions where as it occurs in semi confined to confined conditions in fractured formations.

Unconfined aquifer system is developed by dug wells, shallow bore wells and filter points. This zone extends down to 13-20 mbgl depth. The yield range of irrigation dug wells in alluvium is 300-600 m3/day where as the same in weathered formation is 11 to 250 m3/day. The yield of filter points is in the range of 220-350 m3/day. As the filter points are located in alluvium of limited thickness, many of them become dry during summer. Due to over exploitation in many pockets, this zone is getting dried up gradually.

Semi confined to confined aquifer is formed due to fractures in hard formations. This aquifer system is developed by bore wells ranging in depth up to 11 200m. Its yield ranges up to 1200m3/day, and specific yield ranges from 2 to 173 lpm/m.

### 8.2.3 Premonsoon water level (2006)

Premonsoon depth to water level in dug wells (NHS) varies from 1.75mbgl in Tumbadi (Koratgere taluk) to 18.70 mbgl in Haridasana Halli (Turuvekere taluk). A generalised water level map is shown in fig 3. In general major part of the district comes under 5 to10 and 10 to 20 mbgl depth to water level range. Small pockets in northern and southern part of the district are covered by 2 to 5mbgl depth range. A few wells have recorded water level of less than 2 meters, but these are point values and are cannot be generalised.

### 8.2.4 Post monsoon Depth to water level (2006):

Postmonsoon depth to water level in dug wells (NHS) varies from 1.12mbgl in Tiptur to 15.00 mbgl (C.S.Pura, Gubbi Taluk). A generalised water level map is shown in fig 4. In general, major part of the district comes under 5 to10 mbgl depth to water level range. Parts of Gubbi, Tumkur, Kunigal, Madhugiri and Pavagada taluks have shown >10 m water level. Small pockets of water level in the range of 2 to 5mbgl are observed in various parts of the district. A few wells 12 have recorded water level of less than 2 meters, but these are point values and are cannot be generalised.

### 8.2.5 Seasonal Fluctuation (2006)

48% of observation wells have shown seasonal rise of water level in the range of 0.03 to 2.65m where as 36% have shown decline of water level in the range of 0.01 to 2.44m during 1996. 16% of wells have not shown any change of water level.

### 8.2.6 Long term water level trend (1997-2006)

Out of total of 113 observation wells 72 have become dry due to decline of water level. Of the existing 49 wells for which data are available, 76% have shown decadal falling trend in the range of 0.02 to 5.599m with average decline of 0.61m. Decadal rising trend is observed in 24% of wells in the range of 0.14 to 0.93 m with decadal average rise of 0.35m.

### 8.2.7 Specific yield of unconfined aquifer

The studies carried out in the phreatic aquifers through dugwells, reveal that the Specific capacities are in the range of 1.02 to 158 lpm /m.dd, the specific yield of aquifers varies from 1.5 to 3.0. The sustained yield of wells varies from 11 to 126 in Gubbi taluk, 17 to 143 in Kunigal, 90 to 250 in Koratagere taluk, 20 to 47 in Sira taluk, 28 to 64 in Tiptur taluk, 24 to 56 in Tumkur taluk and 46 to 73 m3/day in Turuvekere taluk.

### 8.2.8 Aquifer parameters of confined aquifers

The exploratory bore wells drilled are in the depth range of 69.46 to 204.19 m and the aquifers tested reveal that the gneissic and granitic complex have an effective porosity of about 1 to 3%. The yield cum recuperation tests conducted on the wells show that the general specific capacity ranges from 2.00 to

39 lpm/m/d-d and at places in the higher order of 155 to 173 lpm/m/d-d. The 13 transmissivity of aquifer material in general range from 18 to 52 m2/day, at places it is recorded as high as 176 to 248 m2/day.

### 8.2.9 Ground water Resource

Net annual groundwater availability of the district is 92262.71 ham, draft for all uses is 102247.26 ham, available resource for future irrigation development is 15408.83 ham which can create an irrigation potential of 22632 hectares. 55% area of the district is overexploited, 8% critical, 11% semicritical and only 26% of the area is safe. Talukwise resources and catagorisation is given in table 1 and is shown in Fig 5.

### 8.2.10 Ground water Quality

Water samples are collected from selected dug wells (National Hydrograph monitoring Stations) annually for chemical analysis. The analysis results indicate that in general the quality of ground water is potable for drinking and suitable for irrigation purposes. However high concentration of fluoride (>1.5 mg/lit) is observed in northern part of Pavagada and Madhugiri taluks and as 14 small patches in Sira taluk. High Concentration of nitrates (>45 mg/lit) is observed in major parts of Pavagada, Sira, Madhugiri, Koratagere and central part of Chiknayakanahalli and western parts of Gubbi taluks. This may be attributed to more use of fertilizers. High chloride concentrations are observed in central part of Pavagada and Madhugiri taluks and in northwestern parts of

Chiknayakanahalli taluk. Electrical conductivity is in permissible range in general.

Ground water quality map of the district is shown in fig 6.

### 8.2.11 Status of ground water Development

Wells are the major source of irrigation in the district. There are 13585 dug wells and 77603 bore wells in the district as per 3rd MI census. 1179 dug wells and 1687 bore wells have gone dry in the district due to lowering of water level.

### 8.2.12 Ground water Development

A hydrogeological map showing water bearing formations, yield potential, decadal mean water level, isohyet is shown in fig 7. Sustainability of ground water resource and its judicious use should be given prime importance while making development strategy. In critical and over exploited areas artificial recharge and rainwater harvesting measures are recommended to augment to ground water system.

About 15408.83 ham of ground water resource is available in the district for further development. The development is recommended only in areas categorised as safe and semi critical (Fig 5). In such areas potential aquifers can be located by hydrogeological surveys aided by geophysical

methods. Dug wells and filter points are recommended only in river and valley banks where sufficient thickness of valley fill is available which gets saturated during rainy seasons. Construction of collector wells would be the ideal structures in the alluvial tracts adjoining the river and nallah courses. Development in other feasible areas should be done by bore wells. Spacing norm of 200 m may be strictly adhered to avoid interference. Aquifer should be pumped as per crop water requirement.

### 8.2.13 Water Conservation & Artificial Recharge

About 55% of the area of the taluk is overexploited. More than 50% of the areas of five taluks in the district are over exploited and two taluks have more than 60% area in critical and semi critical category. Water level is showing downward trend. In such a situation there is need to augment ground water recharge by artificial recharge structures and rainwater harvesting structures to harvest noncommittal surface runoff.

However it is recommended that over exploited and critical areas may be taken up on priority basis. 37.74 MCM of subsurface run off is available in the district. This can be harnessed by construction of 15 subsurface dyke, 87 percolation tanks, 290 check dams and 173 filter beds at an estimated cost of Rs 2770 lakhs. This will create an additional irrigation of 3139 hectares.

### 8.2.14 Ground water related Issues & Problems

There is over exploitation of ground water resource in 55% area of the district. This has resulted in the decline of water level of the order of 0.61m per decade. 919 dug wells and 402 bore wells have gone dry in the district. Immediate artificial recharge measures are required to be taken to address the trend. Fluoride concentration of more than permissible limit exists in parts of Pavagada, Sira and Madhugiri taluks of the district. Ground water in younger granites has more fluoride content than the gneisses. The fluoride content increases with depth in same aquifer. The shallow aquifers are having comparatively low concentration of fluoride. In order to reduce or control the problem, it is recommended to recharge ground water by way of artificial recharge structures like percolation tank, desilting of silted tanks, check dams, nalla bunds, farm ponds and subsurface dykes. Ground water can be tapped from valley fills of Pennar and its tributaries for drinking purposes. There are 150 tanks in the Pavagada taluk of which 40 are major, 110 minor tanks. Desilting and maintaining of these tanks are utmost importance, so that the Natural recharge will take place without any hindrance and this will recharge the shallow aquifer mainly, which can be used for drinking use, which is free from fluoride in major part of the area.

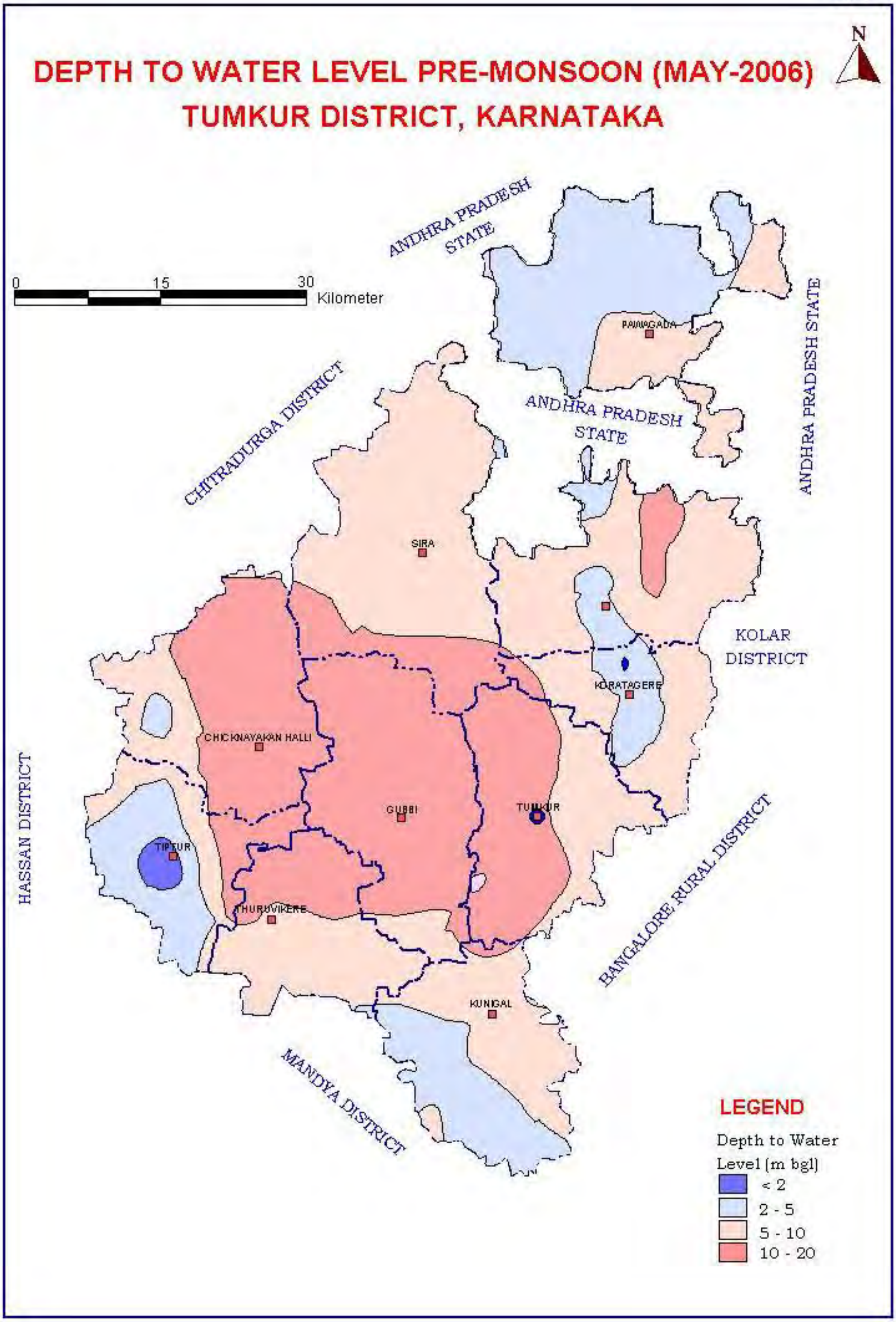

DEPTH TO WATER LEVEL PRE-MONSOON (MAY-2006)
TUMKUR DISTRICT, KARNATAKA
N
0
15
30
Kilometer
ANDHRA PRADESH STATE
ANDHRA PRADESH STATE
ANDHRA PRADESH STATE
CHITRADURGA DISTRICT
KOLAR DISTRICT
HASSAN DISTRICT
BANGALORE RURAL DISTRICT
MANDYA DISTRICT
PAVAGADA
SIRA
KORATAGERE
CHICKNAYAKAN HALLI
GUBBI
TUMKUR
TIPTUR
THURUVIKERE
KUNIGAL
LEGEND
Depth to Water Level (m bgl)
< 2
2 - 5
5 - 10
10 - 20

Fig-4

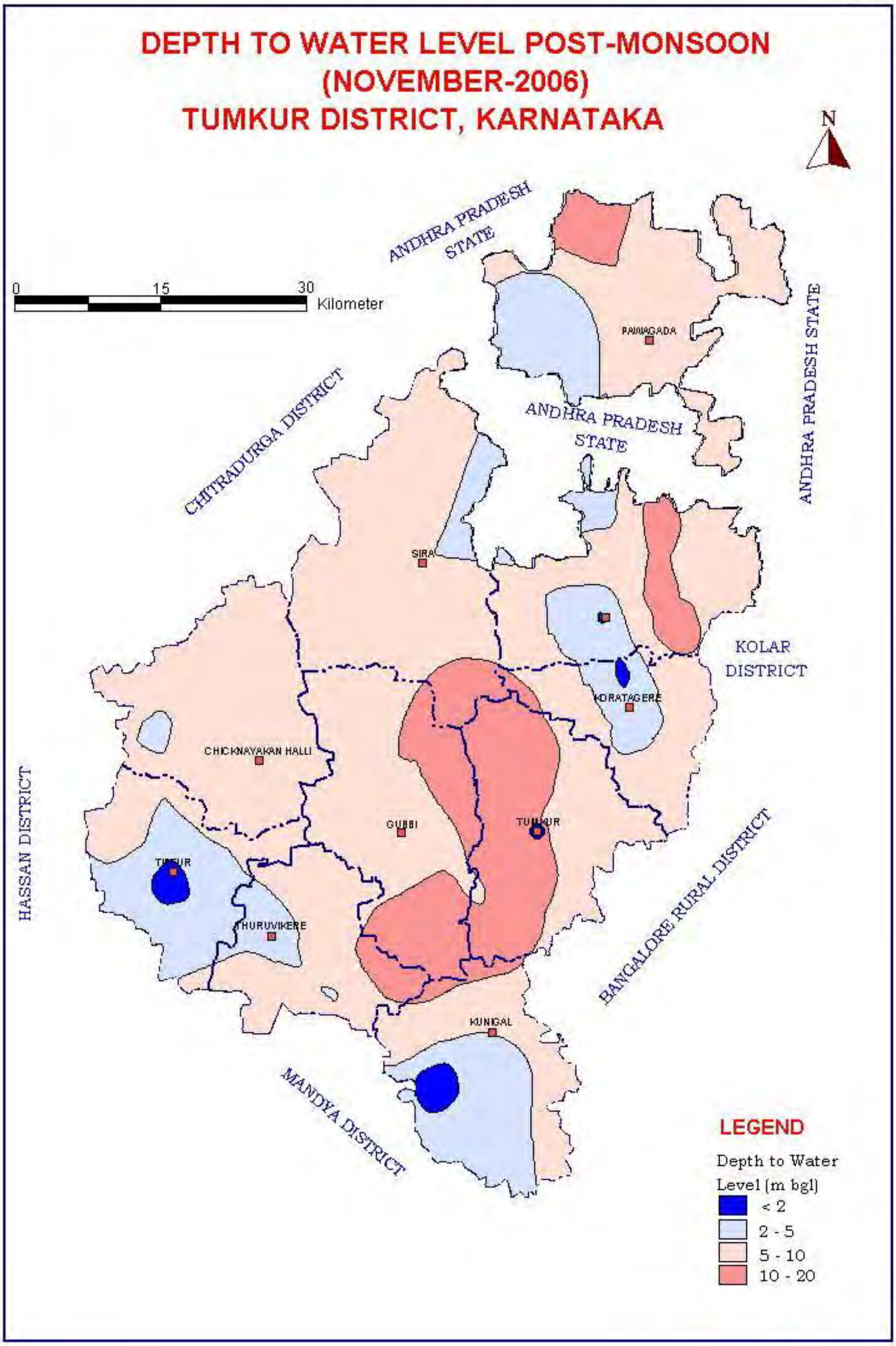

DEPTH TO WATER LEVEL POST-MONSOON
(NOVEMBER-2006)
TUMKUR DISTRICT, KARNATAKA
N
0
15
30
Kilometer
ANDHRA PRADESH STATE
PAVAGADA
ANDHRA PRADESH STATE
ANDHRA PRADESH STATE
CHITRADURGA DISTRICT
SIRA
KOLAR DISTRICT
KORATAGERE
CHICKNAYAKAN HALLI
HASSAN DISTRICT
GUBBI
TUMKUR
TIPTUR
THURUVIKERE
BANGALORE RURAL DISTRICT
KUNIGAL
MANDYA DISTRICT
LEGEND
Depth to Water Level (m bgl)
< 2
2 - 5
5 - 10
10 - 20

Fig- 5

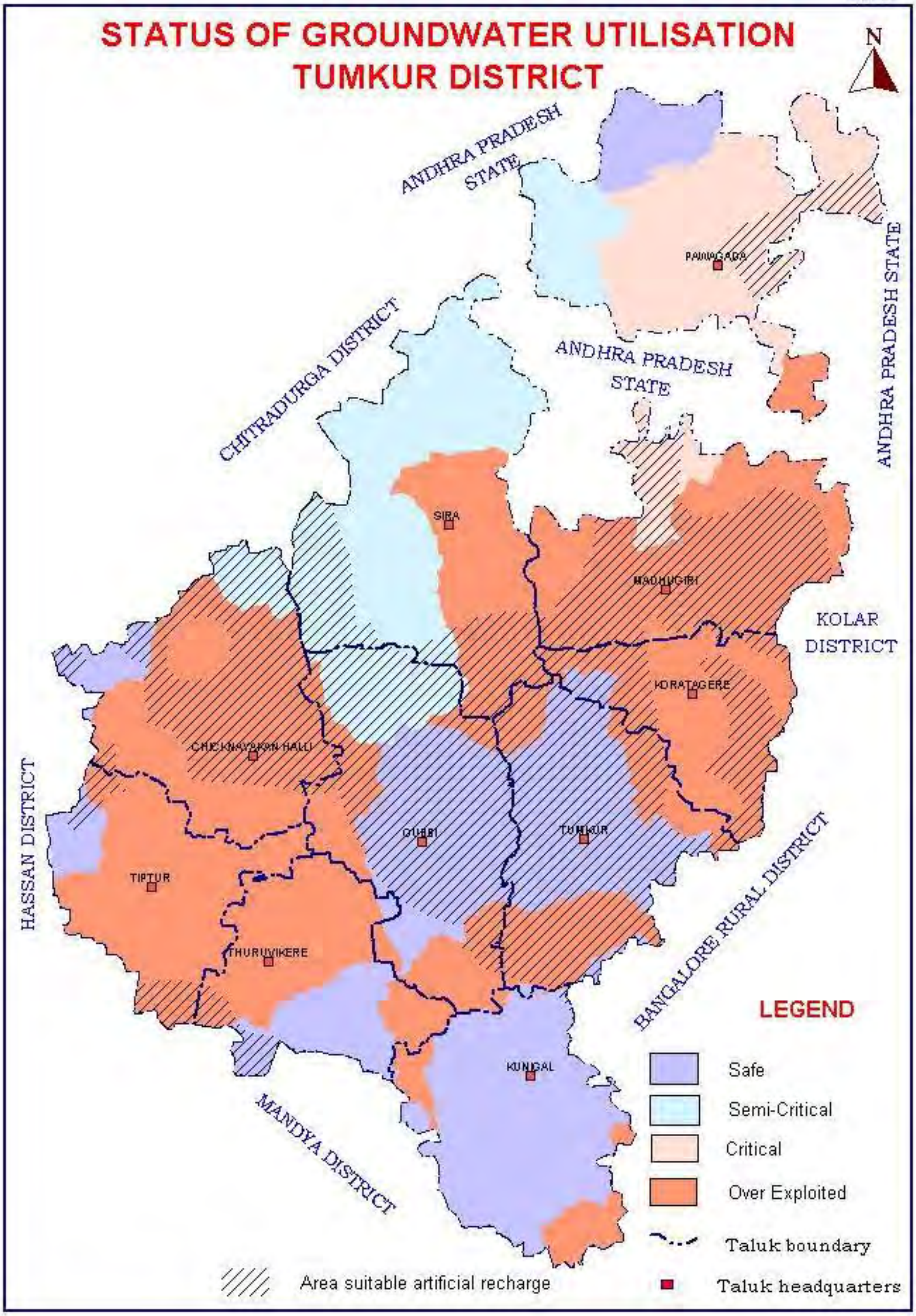

STATUS OF GROUNDWATER UTILISATION
TUMKUR DISTRICT
N
ANDHRA PRADESH STATE
PAVAGADA
ANDHRA PRADESH STATE
ANDHRA PRADESH STATE
CHITRADURGA DISTRICT
SIRA
MADHUGIRI
KOLAR DISTRICT
KORATAGERE
CHICKNAYAKAN HALLI
GUBBI
TUMKUR
HASSAN DISTRICT
TIPTUR
THURUVIKERE
BANGALORE RURAL DISTRICT
KUNIGAL
MANDYA DISTRICT
LEGEND
Safe
Semi-Critical
Critical
Over Exploited
Taluk boundary
Taluk headquarters
Area suitable artificial recharge

Fig- 6

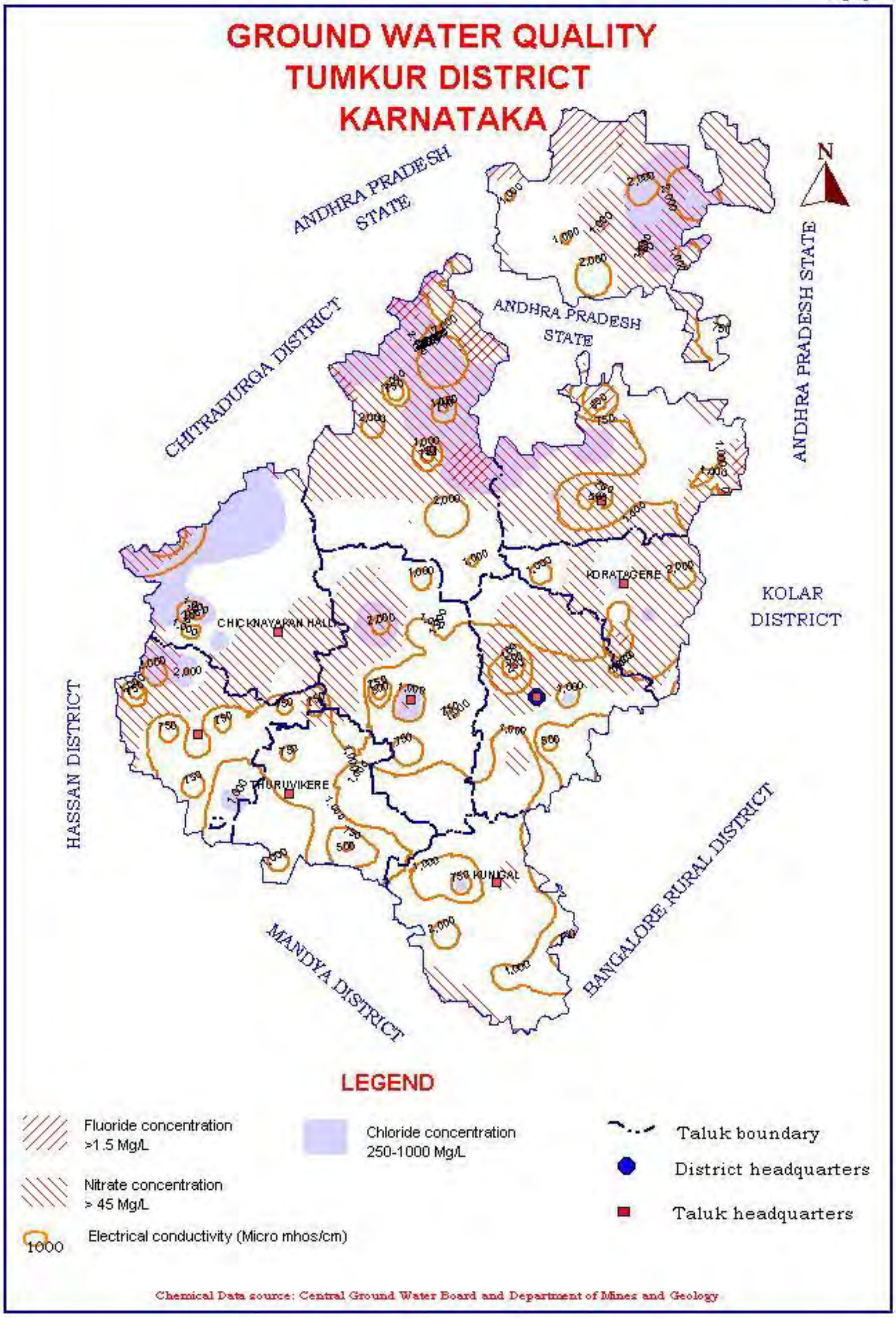
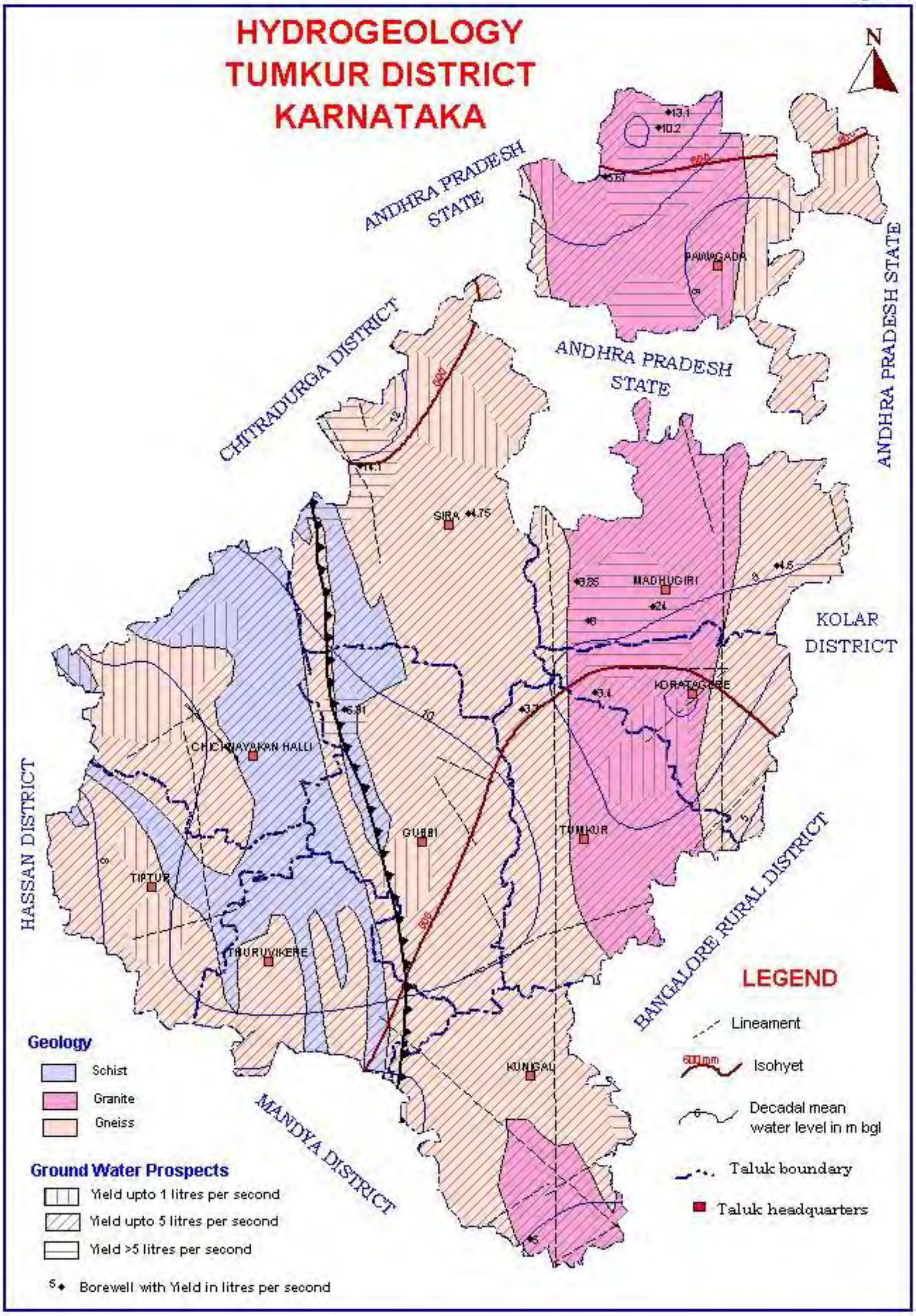

GROUND WATER QUALITY
TUMKUR DISTRICT
KARNATAKA
N
ANDHRA PRADESH STATE
ANDHRA PRADESH STATE
ANDHRA PRADESH STATE
CHITRADURGA DISTRICT
KOLAR DISTRICT
HASSAN DISTRICT
MANDYA DISTRICT
BANGALORE RURAL DISTRICT
CHICKNAYAKAN HALLI
KORATAGERE
THURUVIKERE
KUNIGAL
LEGEND
Fluoride concentration >1.5 Mg/L
Nitrate concentration > 45 Mg/L
Electrical conductivity (Micro mhos/cm)
1000
Chloride concentration 250-1000 Mg/L
Taluk boundary
District headquarters
Taluk headquarters
Chemical Data source: Central Ground Water Board and Department of Mines and Geology

Fig- 7


HYDROGEOLOGY
TUMKUR DISTRICT
KARNATAKA
N
ANDHRA PRADESH STATE
ANDHRA PRADESH STATE
ANDHRA PRADESH STATE
CHITRADURGA DISTRICT
KOLAR DISTRICT
HASSAN DISTRICT
BANGALORE RURAL DISTRICT
MANDYA DISTRICT
PAVAGADA
SIRA
MADHUGIRI
KORATAGERE
CHICKNAYAKAN HALLI
GUBBI
TUMKUR
TIPTUR
THURUVIKERE
KUNIGAL
LEGEND
Lineament
Isohyet
Decadal mean water level in m bgl
Taluk boundary
Taluk headquarters
Geology
Schist
Granite
Gneiss
Ground Water Prospects
Yield upto 1 litres per second
Yield upto 5 litres per second
Yield >5 litres per second
Borewell with Yield in litres per second

## 8.3 Bangalore - rural

### 8.3.1 Hydrogeology

### 8.3.2 Ground water scenario

Geology of the Bangalore rural district is broadly described under two groups (i) the dominating Archaean crystalline formation comprising peninsular gneissic complex with a small patch of horn blend schist in the northern part and intrusive closepet granite all along the western part of the district (ii) smaller stretches of unconsolidated sediments. The granite gneisses are mainly of migmatitic type, highly banded in composition from granite to diorite. The Hydrogeology map of the district is presented as Fig-3. The ground water occurs in the open spaces of weathered fractured gneisses and granites. In these rocks the water bearing and yielding properties are primarily due to weathering and fracturing. In the weathered zone, ground water occurs under water table conditions and in the fractured and jointed formations it occurs under semi confined conditions. In Laterite ground water occurs under phreatic condition. Alluvium along the river courses, though limited in thickness and aerial extent possess substantial ground water potential.

### 8.3.3 Depth to water levels

Out of 31 National Hydrograph stations located in Bangalore Rural District, 8 were found to be dry. The pre-monsoon depth to water level map of the district for the year 2006 is presented as Fig-4. During November 2006 10 National Hydrograph stations located in Bangalore Rural District were found to be dry. The post-monsoon depth to water level map of the district for the year 2006 is presented as Fig-5.

### 8.3.4 Seasonal water level fluctuation

The seasonal water level fluctuation for the year 2006 in 31 national hydrograph network stations were in the range of -0.10 to 2.14m.

Fig- 3

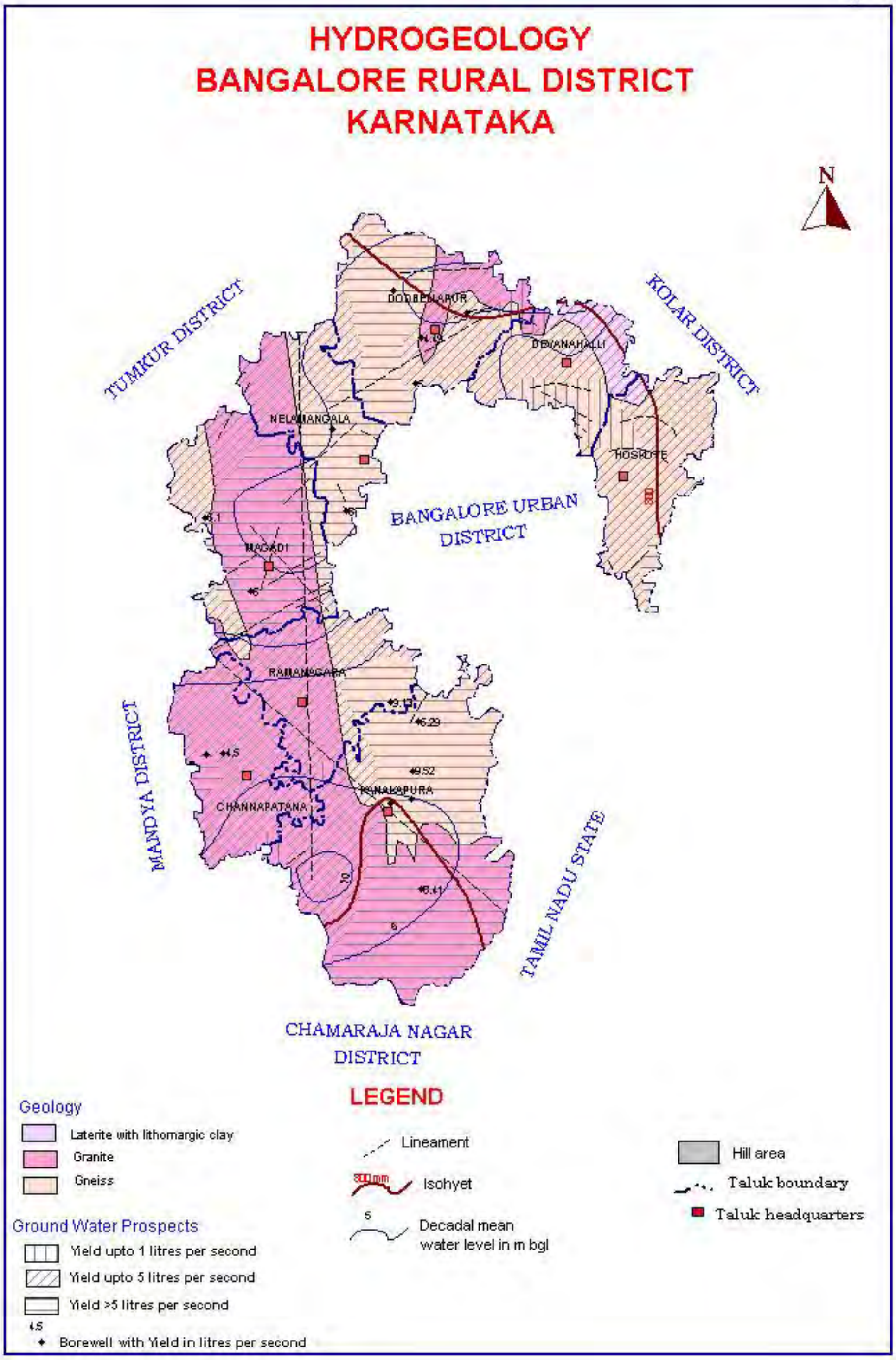

HYDROGEOLOGY
BANGALORE RURAL DISTRICT
KARNATAKA
N
TUMKUR DISTRICT
KOLAR DISTRICT
DODDBALAPUR
DEVANAHALLI
NELAMANGALA
HOSKOTE
BANGALORE URBAN DISTRICT
MAGADI
RAMANAGARA
CHANNAPATANA
KANAKAPURA
MANDYA DISTRICT
TAMIL NADU STATE
CHAMARAJA NAGAR DISTRICT
LEGEND
Geology
Laterite with lithomargic clay
Granite
Gneiss
Ground Water Prospects
Yield upto 1 litres per second
Yield upto 5 litres per second
Yield >5 litres per second
Borewell with Yield in litres per second
Lineament
Isohyet
Decadal mean water level in m bgl
Hill area
Taluk boundary
Taluk headquarters

Fig-4

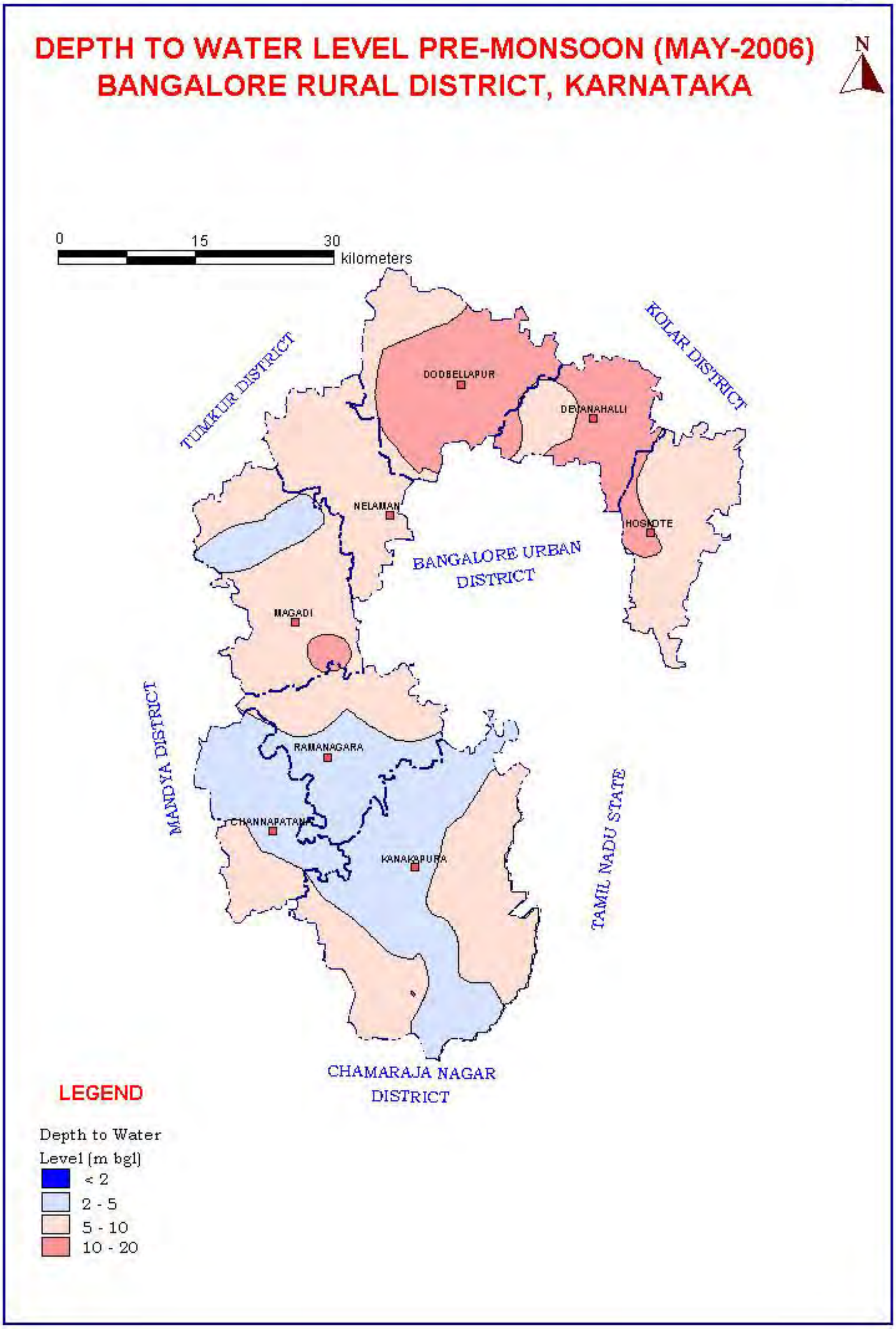
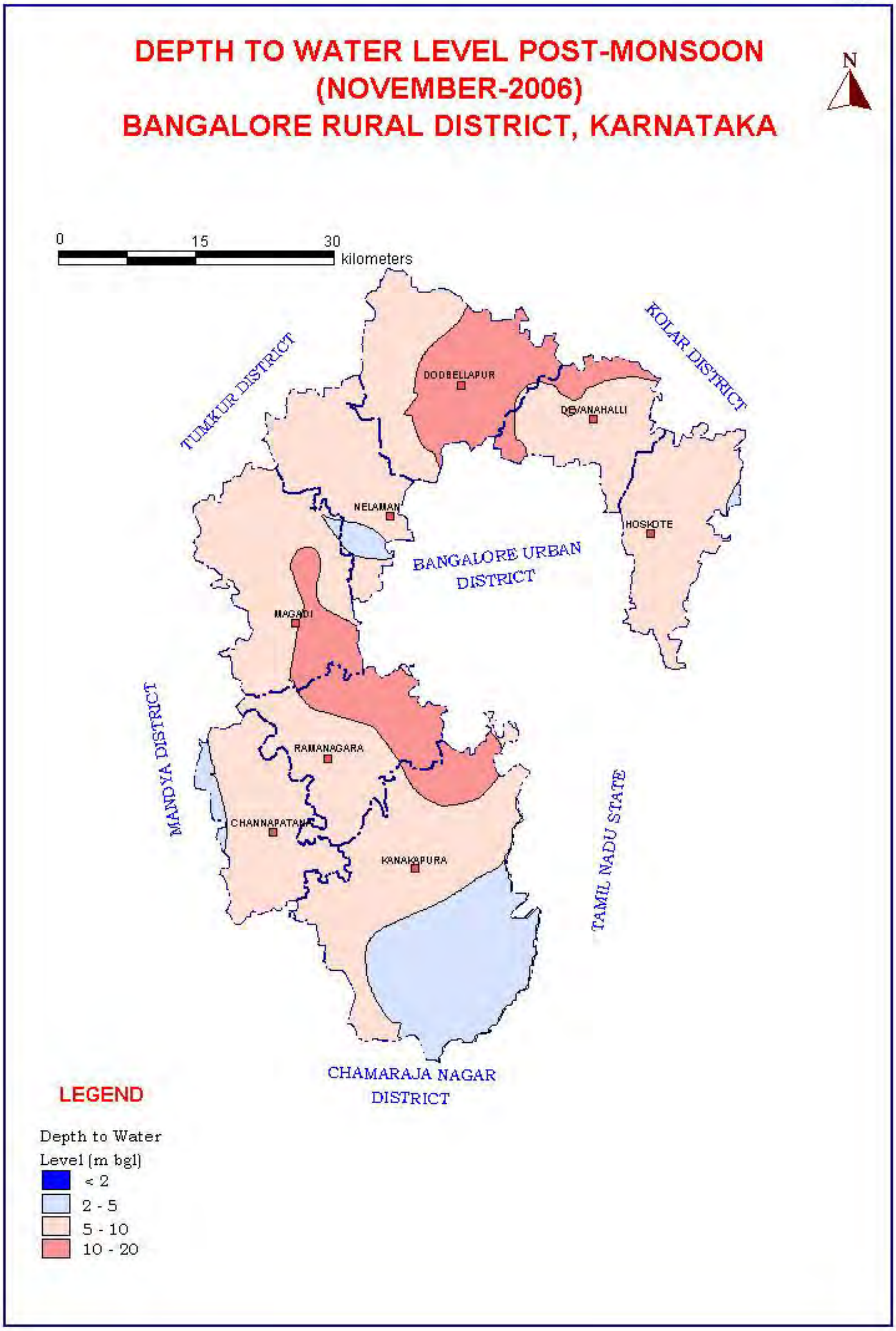

DEPTH TO WATER LEVEL PRE-MONSOON (MAY-2006)
BANGALORE RURAL DISTRICT, KARNATAKA
N
0
15
30
kilometers
TUMKUR DISTRICT
KOLAR DISTRICT
DODBELLAPUR
DEVANAHALLI
NELAMAN
HOSKOTE
BANGALORE URBAN DISTRICT
MAGADI
MANDYA DISTRICT
RAMANAGARA
CHANNAPATANA
KANAKAPURA
TAMIL NADU STATE
CHAMARAJA NAGAR DISTRICT
LEGEND
Depth to Water Level (m bgl)
< 2
2 - 5
5 - 10
10 - 20

Fig-5


DEPTH TO WATER LEVEL POST-MONSOON
(NOVEMBER-2006)
BANGALORE RURAL DISTRICT, KARNATAKA
N
0
15
30
kilometers
TUMKUR DISTRICT
KOLAR DISTRICT
DODBELLAPUR
DEVANAHALLI
NELAMAN
HOSKOTE
BANGALORE URBAN DISTRICT
MAGADI
MANDYA DISTRICT
RAMANAGARA
CHANNAPATANA
KANAKAPURA
TAMIL NADU STATE
CHAMARAJA NAGAR DISTRICT
LEGEND
Depth to Water Level (m bgl)
< 2
2 - 5
5 - 10
10 - 20

### 8.3.5 Long-term water level trends

Out of seventy-seven premonsoon water level trend data available for national hydrograph network stations, Sixteen (20.7%) in the range of 0.0018 to 1.0529m/year are having rising trends and remaining five are having falling trends. In the range of 0.0136 to 2.3539m/year, remaining 59.74% of the wells have gone dry where as long term post monsoon water level trend data at national hydrograph network stations, six (7.79%) wells are showing rising trends in the range of 0.0011m/year and remaining thirty (38.96%) are having falling trends. in the range of 0.0217 to 3.0606 m/year remaining 51.94% were found to be dry

### 8.3.6 Ground Water Exploration

Ground water exploration was undertaken in the district between the period from 1990 to 1996 (First Phase of ground water Exploration) to ascertain the presence of productive aquifer zones, quality of ground water, yield of aquifer zones and determine aquifer parameter. And their occurrence in depth to 250m below ground level the discharge varies from 1 to 8lps.

### 8.3.7 Results of ground water exploration

On the basis of the hydrogeological surveys followed by resistivity surveys total of 29 EW sites were recommended for the deep drilling to a depth of 287.09m. in Bangalore rural district The drilling results available indicated the fractures at 14.0m, 108 m, 110m and 123 m ,134m, 136m, 138mdepth. The exploratory bore wells drilled at a depth range of 33.0 to 287.09m The yield cum recuperation tests conducted on the wells show that the discharge of the wells ranges from 0.10 to 9.13lps. The transmissivity (T) in general ranges from 7.4 to 535.72 m2/day.

### 8.3.8 Ground water resources

The resource estimation and categorization is carried out as per the recommendations of 'Ground Water Resources 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. Pro-rata approach to consolidate the watershed data into talukwise data gives only details on ground water resource, draft, and additional irrigation potential. Pro rata approach cannot be applied for taluk, as a unit, as far as stage of development and categorization is concerned. However average stage of development is given to have over all idea about the taluk.

It is seen from the Fig-6 that all the taluks are completely completely over exploited except Magadi, Nalamangala and Kanakapura taluks. The percentage of safe area in the Magadi taluka is 38.0% and in the Nalamangal taluka it is 8% and the rest of the area all comes under the over exploited area. And in Kanakapura taluka 11% area comes under the critical stage of development no taluka has of semi-critical stage of development.

1. Annual Ground Water Recharge = 46007.40 ham
2. Natural discharge = 4600.74 ham
3. Net Ground water availability = 43880.03 ham
4. Gross Draft Irrigation = 72011.33 ham
5. Gross Domestic and Industrial draft = 3297.00 ham
6. Total Draft = 75308.33 ham
7. Net Ground Water Balance = 4044.31 ham
8. Allocation for Domestic and Industrial
Requirement up to 2029 = 4628.96 ham
9. Net ground water availability for irrigation = 2042.98 ham
10. Stage of development = 171. 62 %

### 8.3.9 Ground water management strategy

A well-planned groundwater resource management strategy is essential to make economical, efficient and judicious use of ground water, to make the availability of ground water, sustainable. Making aware, the water users on ground water conditions in the different terrain conditions and encouraging its judicious use, adaptation of conjunctive use techniques of ground water and surface water can improve the ground water scenario. In view of the ever-growing population and increasing demand for groundwater for various developmental activities, it is suggested to adopt methods to artificially recharge the ground water in the water level depleting areas, in order to increase the ground water availability. The ground water management will also help in Environmental Management and ecological stability in the area. The development of water management model should be resource based and the whole problem should be tackled in its totality, Vis a Vis surface and subsurface resources thereby enabling us to meet the ever-growing demand for this precious natural resource by practicing conjunctive use in canal command areas. Apart from above, farmers should be encouraged to grow crops that require less water for its production and should be discouraged from growing water intensive crops like sugarcane and paddy, especially in the areas where water levels are falling. Transfer of water from areas where water levels are rising to the areas where water levels are falling can also be thought off.

### 8.3.10 Ground water quality

The Electrical conductivity values are in the major part of the district are in the range between 750 to 1000 micro mhos and in magadi and Nelamangala taluka the EC varies from 500 to 750 micromhos. In northern part of Devenahalli taluka EC values are more than 2000 micromhos /cm. have been observed. Southern part of Kanakapura, northern part of Ramanaga, major part of Devenahalli, and in northern part of Hoskote taluka is having excess Nitrate in ground water (Nitrate content more than 45 ppm). Flouride content in Kanakapura, Chennapatna Ramanagara Magadi Nelamangala Devenahalli and Hoskote are within the permissible limits and as a small patch in northern part of Dodaballapur taluk having fluoride concentration more than 1.5mg/L. (Flouride content more than 1.5 ppm) confined.

Chloride problem in the district (Chloride content more than 250 to 1000mg/L) is observed in Central eastern part of Kanakapura taluka and in small patches of Ramanagara Magadi Nelamangala Doddaballapur Devena halli and in Hoskote taluka

### 8.3.11 Ground water development

Further ground water development should be encouraged only in Northeastern part of Magadi taluka, which are categorised as safe. In the major parts of the district, areas categorised as over exploited and critical growing crops like paddy, sugarcane etc having high water requirement from ground water irrigation may be avoided. Advance irrigation methods like drip and sprinkler irrigation may be practiced. And southern part of Kanakapura, North eastern part of Magadi, North western part of magadi, Northwestern part of Nelamangala, Major parts of Dodaballapur, Devenahalli and Hoskote taluk suitable artificial recharge structure may be constructed. In the irrigation command areas conjunctive use of surface and ground water may be practiced to avoid long-term hazards like water logging and ground water as well as soil salinity problems. And the status of Groundwater utilization in Bangalore rural district is presented as Fig-6.

### 8.3.12 Water conservation and Artificial Recharge

In the district where the topography is comparatively rugged, artificial recharge structures like nalla and gully plugs contour bunds and contour trenches and nallabunds may be constructed and in comparatively plain areas percolation tanks and point recharge structures like recharge shafts recharge pits and recharging through existing dug/bore wells may be practiced. In semi-urban areas in the district/Taluka Head quarters like Doddaballapur, Nelamangala, Magadi, Chennapatna, Devanahalli, Hoskote, Kannakapura and Ramanagaram towns, lot of roof area is available for rooftop rain water harvesting. So in these semi-urban areas rooftop rainwater harvesting practices may be encouraged. This will help in reducing the load on urban water supply systems.

### 8.3.13 Recommendations

Considering the prevailing scenario of the groundwater resources and development the following recommendations are made for the optimum drawl with sustainable development of resources in the area.

1. Construction of check dams and sub surface dykes at appropriate places across the nallahs and streams in the water table depleting areas, over exploited, critical and areas of the district and the areas where water quality problem exists may be taken on priority basis.

2. Considering the fresh water scarcity in the district, a comprehensive programme should be formulated to harvest the rain water through roof top, check dams, surface tanks, bunds and subsurface dykes to use the resources directly from the structures, which in turn to arrest the sub surface flows and augment the groundwater resources.

3. The ground water worthy areas such as topographic lows, valley portions low fluctuations zones should be developed with an adequate soil conservation measures to prevent the soil erosions during rainy seasons.

4. Constant monitoring of ground water quality should be carried out in the fluoride-contaminated areas to prevent further deterioration and related problems. The determination of trace elements and organic compound be done to help in categorizing the quality of water.

5. A detailed geophysical study with the help of the state of the art technology should be conducted to demarcate the extent of potential aquifers and it is geometry, especially in central plain region.

6. Except Nelamangala and Magadi other taluks/areas comes under over exploited categories. In these taluks Ground water legislation should be implemented to avoid further adverse effects of ground water system of the area

7. Conjunctive use of both Surface and Ground water to be implemented in the canal command areas, which will improve the quality of ground water, prevent the water logging conditions and availability of canal water to the tail end areas.

## 8.4 Kolar District

### 8.4.1 Hydrogeology

Granites, gneisses, schists, laterites and alluvium underlie the district. Basic dykes intrude the above formations at places. Granites and gneisses occupy major portion of the district. Schists are mostly confined to two places - around Kolar Gold Fields and in the northwestern part of Gauribidanur taluk. Laterites occupy small portions in Kolar, Srinivaspura and Sidlaghatta taluks. Alluvium is confined to river courses. Fractures or lineaments occupy welldefined structural valleys and majority of them trend NE-SW. The occurrence and movement of ground water is controlled by weathered zone and fractures and fissures that exist in hard rocks. In the district, ground water occurs in phreatic and semi-confined to confined conditions. It also occurs in alluvium under water table conditions. The weathered thickness varies from 6 to 18 m in the majority of the area, except in parts of Sidlaghatta and Chikballapura taluks where it ranges from 40 to 60 m. The depth of water level in piezometer generally ranges from 12 to 49 mbgl. The ground water levels are essentially controlled by physiographic features and rainfall distribution. The appreciable change in ground water levels was noticed close to over exploitation areas, where local troughs are observed.The hydrogeology map of the Kolar district is given in Fig - 3

Mode of ground water extraction is through borewells. Among the abstraction structures, borewells are predominant. The yield of borewells in hard rock varies generally from 15 to 200 m3/day. The depth of irrigation borewells range in depth from 100to 300 mbgl and the yield of borewells ranges from 0.5 to 20 m3/hour.

Semi-confined to confined aquifer is formed due to fractures in hard formations. This aquifer system is developed by bore wells ranging in depth up to 300m. Its yield ranges up to 1200m3/day, and specific yield ranges from 2 to 173 lpm/m.

### 8.4.2 Premonsoon water Level (2006)

Out of 113 NHS wells ( averge depth 5-20 mts ) , 78 % wells have been dried up. As per the data available for 24 stations of phreatic aquifer i.e shallow zone for May 2006 premonsoon depth to water level varies from 0.89 mts (Avani, Mulbagal taluk) to 14.31 mts (Bestrahalli, Srinivaspur taluk) .A generalised water level map of premonnsoon is given as Fig- 4 .

In general, major part of the district comes under 10-20 m range except in Mulbagal taluk where less than 5 m is also recorded . Northern part of Chintamani and

Chickbakkpur deeper water levels are noticed. The water level recorded in Piezometer stations which represent semi confined aquifer, depth to water levels range even up to 49.52 m.

### 8.4.3 Post monsoon Depth to water level (2006)

Post monsoon Depth to water level in NHS dug wells ranges from 0.13 mts (Avani, Mulbagal taluk) to 14.51 mts ( Bestrahalli, Srinivaspur taluk ) . A generalized water level map of postmonsoon is given as Fig - 5. In general major part of the district comes under 5-10 m range and parts of Chickballapur and Srinivaspur show more than 10-20 m range

### 8.4.4 Seasonal Fluctuation (2006)

The seasonal fluctuation for the 2006 was available for 20% of the stations . Out of which 75% of the wells have shown seasonal rise of water level ranging 0.10 m to 3.64 m with an average of 1.45 m and 25 % of stations show decline of water level ranging 0.14 m to 1.30 m with average of 0.67 m . For the available 50% of the piezometer stations, 42 % stations show seasonal rise of water level ranging 0.77 m to 7.91 m and 58 % stations show declining trend of water level ranging 0.07 to 9.8 m.

### 8.4.5 Long term water level trend (1997-2006)

Out of 113 observations wells 35 wells have become dry due to decline of water levels. Of the data available for remaining 78 stations, 62% have falling decadal trend ranging from 0.002 m to 3.47 m and 38 % show rising decadal trend ranging from 0.006 m to 2.62 m.

Fig- 4

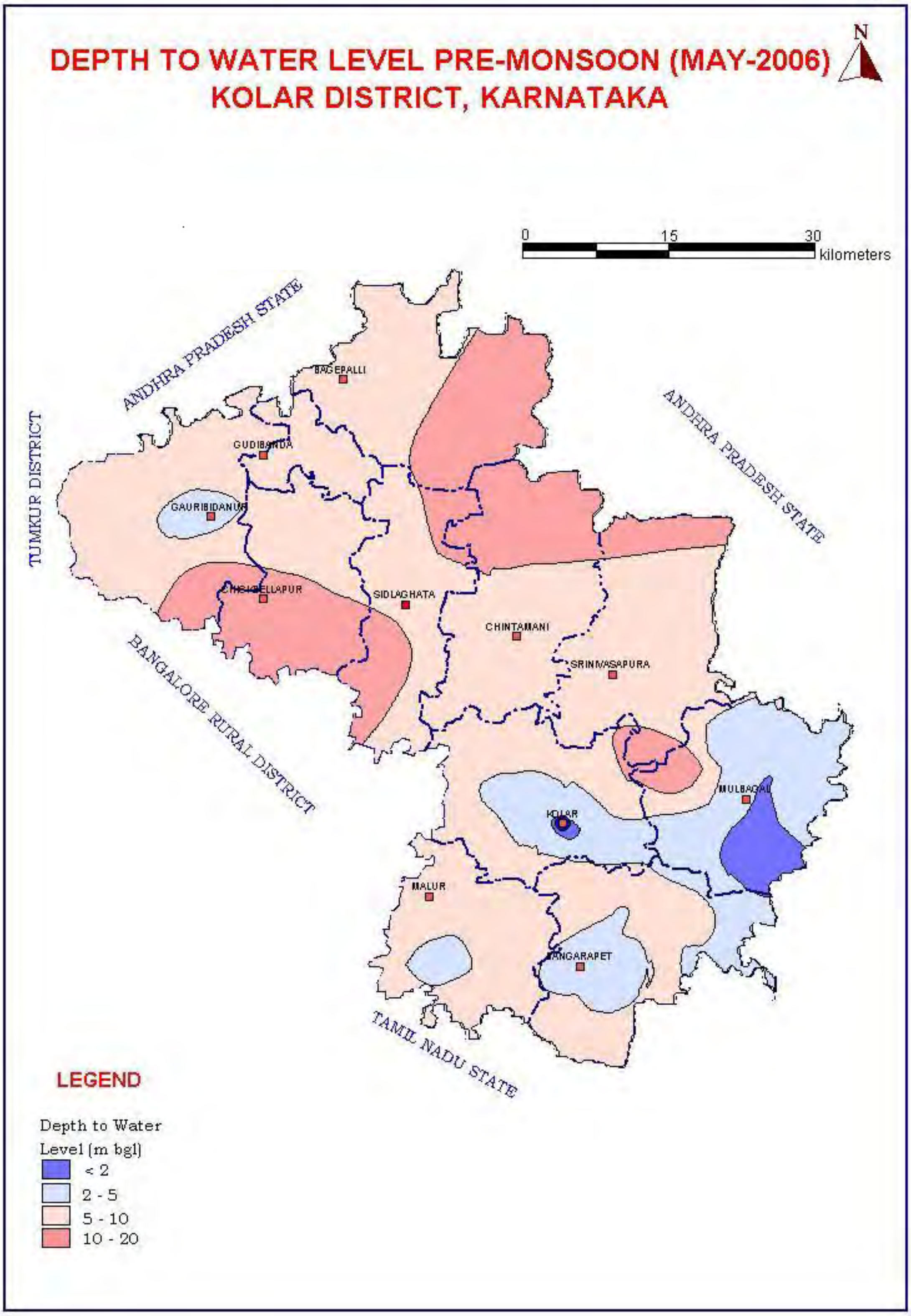

DEPTH TO WATER LEVEL PRE-MONSOON (MAY-2006)
KOLAR DISTRICT, KARNATAKA
N
0
15
30
kilometers
ANDHRA PRADESH STATE
ANDHRA PRADESH STATE
TUMKUR DISTRICT
BANGALORE RURAL DISTRICT
TAMIL NADU STATE
BAGEPALLI
GUDIBANDA
GAURIBIDANUR
CHICKBALLAPUR
SIDLAGHATA
CHINTAMANI
SRINIVASAPURA
KOLAR
MULBAGAL
MALUR
BANGARAPET
LEGEND
Depth to Water Level (m bgl)
< 2
2 - 5
5 - 10
10 - 20

Fig- 5

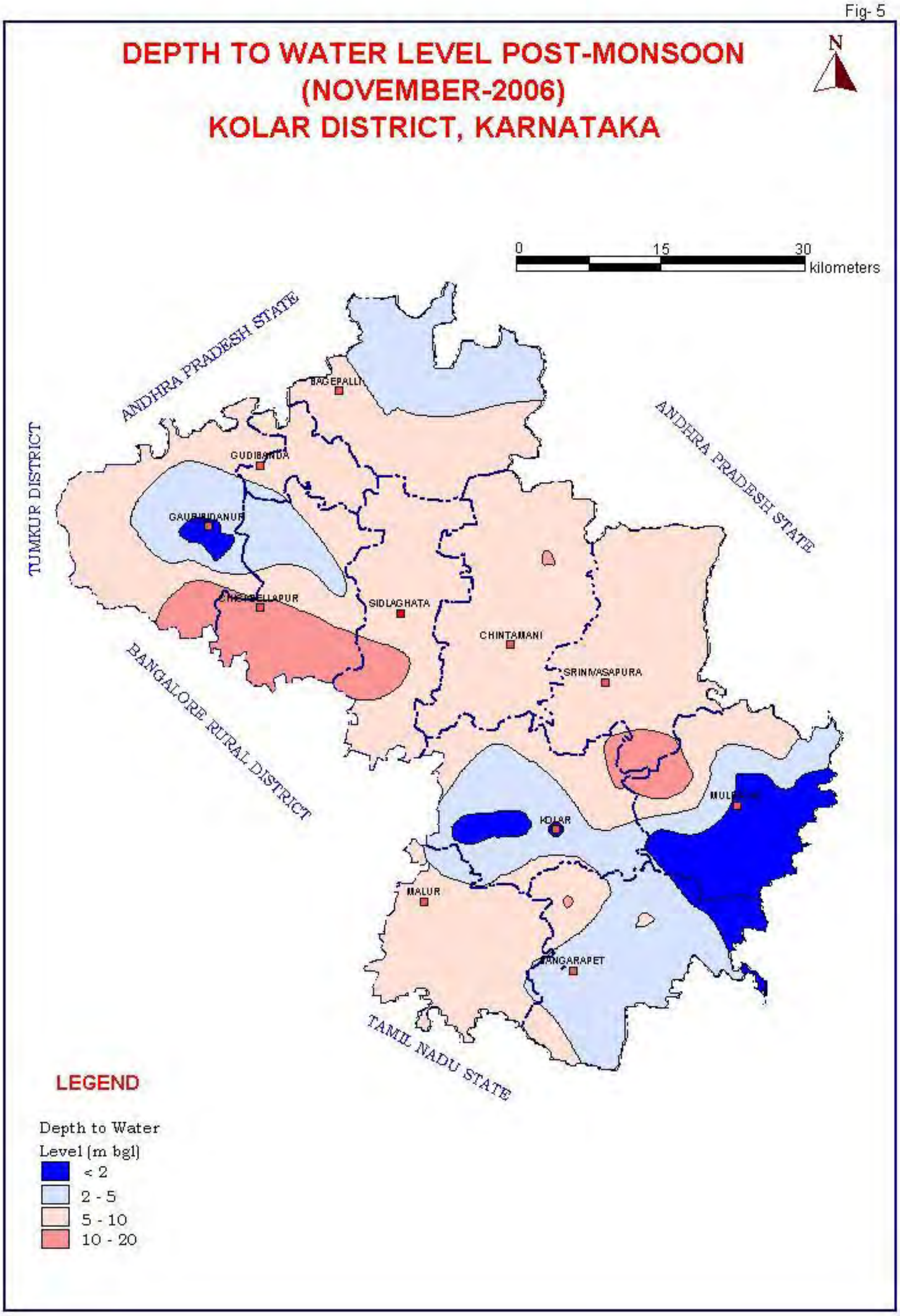
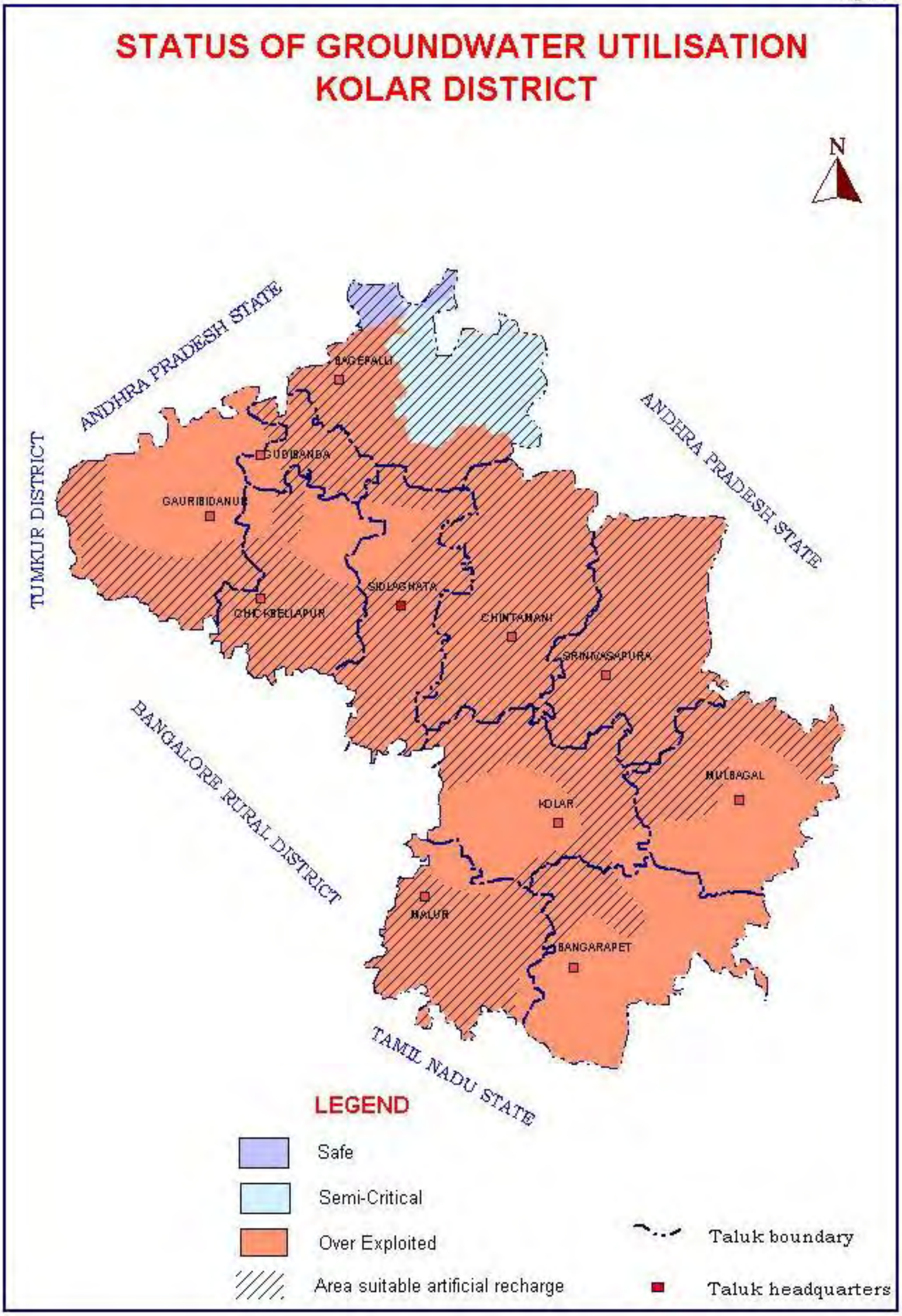

DEPTH TO WATER LEVEL POST-MONSOON
(NOVEMBER-2006)
KOLAR DISTRICT, KARNATAKA
N
0
15
30
kilometers
ANDHRA PRADESH STATE
ANDHRA PRADESH STATE
TUMKUR DISTRICT
BANGALORE RURAL DISTRICT
TAMIL NADU STATE
BAGEPALLI
GUDIBANDA
GAURIBIDANUR
CHIKBALLAPUR
SIDLAGHATA
CHINTAMANI
SRINIVASAPURA
KOLAR
MALUR
BANGARAPET
LEGEND
Depth to Water
Level (m bgl)
< 2
2 - 5
5 - 10
10 - 20

Fig-6

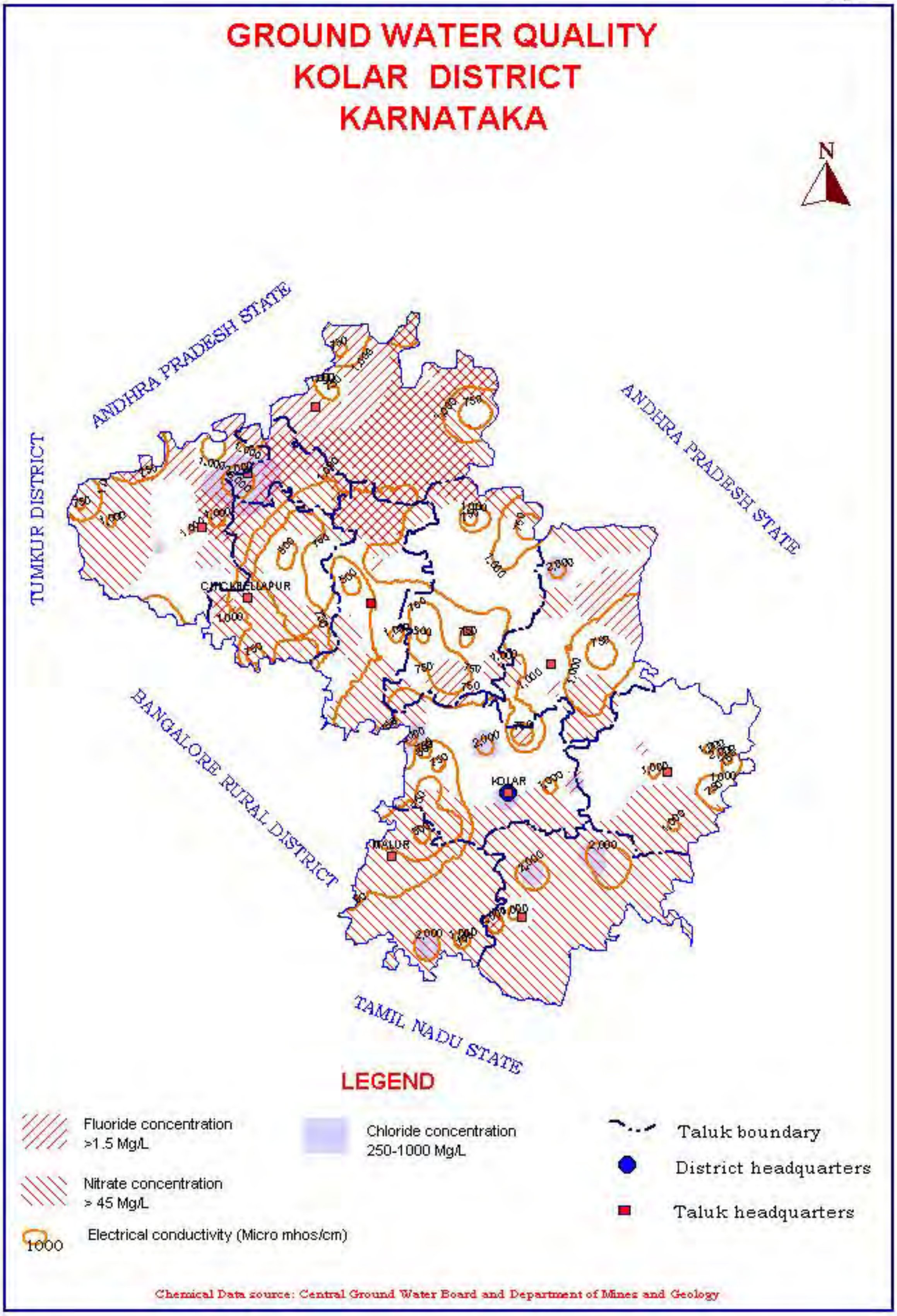

STATUS OF GROUNDWATER UTILISATION
KOLAR DISTRICT
N
ANDHRA PRADESH STATE
ANDHRA PRADESH STATE
TUMKUR DISTRICT
BANGALORE RURAL DISTRICT
TAMIL NADU STATE
BAGEPALLI
GUDIBANDA
GAURIBIDANUR
CHICKBELLAPUR
SIDLAGHATA
CHINTAMANI
SRINIVASAPURA
MULBAGAL
KOLAR
MALUR
BANGARAPET
LEGEND
Safe
Semi-Critical
Over Exploited
Area suitable artificial recharge
Taluk boundary
Taluk headquarters

The net annual ground water availability of the district is 59063 Ham ,draftfor all uses is 115323 ham and available resources for future irrigation development is 1001 ham . Out of 11 taluks 10 are over exploited and in Bagepally taluk about 60% of the area is safe. Average stage of development is - 195 %. There is over draft of 56,260 ham annually in the district. Taluk wise resources and categorization are given in table and Fig- 6.

### 8.4.6 Ground Water Quality

In general, the ground water is of acceptable quality for irrigation and domestic use. The pH value of ground water ranges from 7 to 8.67 indicating that the water is alkaline in nature. In major part of the district the specific conductance values are within 2000 us/cm at 25° C. Fluoride concentration of more than 1.5 mg/l. is reported from Bagepalli taluk. However, some of the exploratory borewells also have recorded fluoride concentration of 2mg/l and above. Nitrate concentration of more than 100 ppm is reported from parts of Mulbagal, Bangarpet and Malur taluks. A ground water quality map is presented as Fig-7.

Fig-7


GROUND WATER QUALITY
KOLAR DISTRICT
KARNATAKA
N
ANDHRA PRADESH STATE
ANDHRA PRADESH STATE
TUMKUR DISTRICT
BANGALORE RURAL DISTRICT
TAMIL NADU STATE
CHICKBALLAPUR
KOLAR
MALUR
LEGEND
Fluoride concentration >1.5 Mg/L
Nitrate concentration > 45 Mg/L
1000 Electrical conductivity (Micro mhos/cm)
Chloride concentration 250-1000 Mg/L
Taluk boundary
District headquarters
Taluk headquarters
Chemical Data source: Central Ground Water Board and Department of Mines and Geology

### 8.4.7 Ground Water Development

Ground water is developed both for the domestic and irrigation purposes. Almost the entire domestic water requirement for 25 lakh population and the live stock is met by ground water. As per MI census 2001, they are accounting for about 86% of the total wells in Karnataka. Well irrigation constitutes about 94% of total irrigation. 10405 tube wells and 52868 borewells in use in the district. As on 2002-03 there are altogether 806 piped water supply and 2414 mini water supply schemes in Kolar district which are wholly dependent on ground water. Even though Kolar district stands first in having the maximum number of irrigation tanks (4488 tanks) in Karnataka, their dependability for irrigation again depends upon rainfall conditions. Hence, ground water has a special significance for the all-round development of this water-starved district and plays a vital role in the development of this drought-prone area.

As per the ground water resource estimation, all taluks, except Bagepalli come under the over-exploited category as shown in Fig-6. There is no resource for further development in these taluks.

### 8.4.8 Water conversation and Artificial Recharge

CGWB has carried out experimental artificial recharge studies under Central Sector Scheme in Gauribidanur and Mulbagal taluks during 1994- 95 to 1998-99. Under this, desilting of two percolation tanks (at Erapothenahalli In Gauridibanur taluk and Manchiganahalli in Mulbagal taluk), watershed treatment in two areas (Basavapura, Gauribidanur taluk, and Bovibikkanahalli, Mulbagal taluk), gravity recharge experiments in two wellfields at Belchikkanahalli and Hussainpura, Gauribidanur taluk, and roof-top rain harvesting structure and point recharge studies at five locations in Hosur (2 Nos.) Baktharahalli & Sonaganahalli in Gauribidanur and Manchiganahalli in Mulbagal taluk were experimented. The above studies have shown favourable results in building up storage in the area to the tune of 3 to 7 m. and resulted in an improvement in the productivity of irrigation borewells

### 8.4.9 Ground water issues and problems

Ground water plays an important role in the economy of the farmers of the Kolar district. This district is popularly known as land of Silk and Milk. Agriculture was mainly dependent on irrigation facility by numerable widely distributed tanks during earlier days. Due to drought situations farmers are now mainly depending upon borewells for their agriculture needs. There are about 122910 bore wells in the district, which reflects on the dependency of farmers on ground water The figure indicates a limited scope for further exploitation of ground water in parts of Bagepalli taluk only. All the other taluks are over exploited. On an average overdraft of 56,363 ham per year is occurring in the district which results in continuous lowering of water table.

Even though Kolar district stands first in having the maximum number of irrigation tanks (4488 tanks) in Karnataka, their dependability for irrigation again depends upon rainfall conditions. Hence, ground water has a special significance for the all-round development of this water-starved district and plays a vital role in the development of this drought-prone area Fluoride concentration of more than 1.5 mg/l. is reported from Bagepalli taluk. However, some of the exploratory borewells also have recorded fluoride concentration of 2mg/l. and above. Nitrate concentration of more than 100 ppm is reported from parts of Mulbagal, Bangarpet and Malur taluks.

# Chapter 9
# Design feature and criteria for the project

## 9.1 Structure and layout

### 9.1.1 Phase 1 - Construction of weirs, Jackwell cum pumphouse, Pumping Machinery and raising mains

The phase 1 works consists of Construction of weirs, Jackwell cum pumphouse, Pumping Machinery, raising mains and Delivery chambers.

There are in all, 8 weirs constructed from which it is proposed to lift the excess water available during the peak monsoon months from June to November and convey it to the delivery chamber 4 located near Haravanahalli via delivery chamber 3 located near Doddanagara in Sakleshpur taluk.

The Jackwell cum pumphouse including the pumping machinery are being housed near the weir locations. On lifting the water from the weir, it is conveyed through dedicated raising mains to the delivery chamber, the details of which are enunciated in detail hereunder.

#### 9.1.1.1 Details of Diversion Weir – 1

It is proposed to construct a Weir designated as Weir 1, across Yettinahole, with an independent catchment of 48.80 Sq. Kms.

- The geographic locations for the construction of the Weir Latitude 12°54'35"N and Longitude 75°44'11"E.
- The width of the Yettinahole at the Weir location is about 50.0 meters and the depth is about 10 meters.
- The condition of the banks is vertical. Exposed rocks have been observed at the bed level.
- The banks are covered with (under growth) vegetation and there is an accessibility to the right flank of the nala from NH 48. The distance from NH 48 upto weir location is about 0.3 kms.
- The average elevation of the bank is about 810 meters and the bed is about 800.0 meters above the mean sea level respectively.
- Sufficient private land is available at the weir location not only for the construction of the jack well cum Pump House, but also for routing the raising main/ conveyance system.

- The land for the above works has to be acquired and fall within the village of Kumbardi Coffee Estate, Sakleshpur Taluk, Hassan District.

## Considerations for the Proposal and Design concept

## Components of the estimate

The present estimate includes:

- Provision towards detailed survey, investigations, preparation of designs and drawings for execution of the scheme.
- Design supply, installation and commissioning of pumping machinery and pump house electrical works.
- Construction of 220 KV/11 KV Electrical sub station
- Construction of weir-1
- Construction of fore bay and Jack well cum pump house
- Construction of raising main
- Construction of Delivery chamber-3
- Construction of Approach Road (AR-1), L=380.0 m
- Provision for Operation and maintenance of the lift scheme for 5 years.

## Diversion of water from Weir 1

The diversion structure planned at Weir 1 will be of ogee type with necessary arrangement on the downstream side to dissipate energy. A jack well cum pump house is planned on the foreshore and right flank of the stream. Metallic Volute pumps have been planned to be installed for lifting the water. The conveyance system will consist of MS pipe 2 rows each of 2.9 m dia. The raising main will off take from a jack well cum pump house from an elevation of 802.0 m (intake level) and discharge will be delivered to DC 3 located at Doddanagar having an elevation of 925.0 m. The static head will be 123.0 m.

From DC 3 the water will be lifted from an elevation of 920.0 m by having metallic volute pumps and will be delivered to DC 4 located at Haravanahalli. The length of the raising main from Weir 1 to DC 3 will be 7.6 Km.

## Routing of the raising main

The Raising Main has been aligned parallel and to the east of Southern Railway, Hassan District, Mangalore section, up to KM 3.6, where the Raising Main will cross the railway line, through an elevated structure (since the railway line is cutting off about 25.0 meters) and there after the pipe line has been aligned parallel and to the west of the railway line.

The Raising Main will cross the Western Ghats Saddle at Km 4.5 (RL 915 m and thereafter, it will cross the perennial Hemavathy River, having a width of 300.0 meters. It is proposed to cross the Hemavathy river above by routing the pipeline over a bridge.

The Raising Main after crossing the Hemavathy river will enter Doddanagar Reserve Forest and covers a length of 0.7.kms and drains to Delivery Chamber No.3, located near Doddanagar Village at an elevation of 925.0 meters.

The entire alignment of the Pipe Line is routed through private lands and it is beyond the ROW of the railway line for the entire section, except for a length of about 0.7.Kms, where it will pass through Doddanagar Reserve Forest, which is unavoidable.

## Diversion weir

It is proposed to provide an ungated ogee type weir for diverting the water. The details of Yettinahole stream at weir location are as under:

- Nala bed level = 800.00 m
- Nala Bank level = 810.00 m
- Width of Nala = 50.0 m
- Proposed length of Diversion weir = 50.0 m
- Type of weir = Ogee type with stilling basin on D/S side

During reconnaissance survey it is found that hard rock is available at bed of stream. Open foundation is proposed for body wall of the weir. Gravity type body wall is proposed for ogee type weir. Provision for downstream energy dissipating arrangements, training wall, key walls and river sluice are made in the estimate.

## Pumping Machinery:

Discharge to be pumped at weir-1 and pump head is 26.0 cumecs and 135.47 m respectively. The selection of pumping machinery shall be pumps and motors having high head and high discharge. The requirement does not falls under manufacturing range of vertical Turbine Pumps. The HT rating required shall be more than 10,000 KW, operating at 11 KV.

Considering the above limitations, it is imperative that selection of individual pump with regard to discharge and head shall be with a view to match the motor rating and have flexibility in achieving the total discharge of 26.0 Cumecs. Therefore, it is proposed to install Metallic Volute Pumps.

It is proposed to install 4 working and one standby pump, thereby discharging individual pump becomes

26 / 4 = 6.5 Cumecs X 3,600 = 23,400 $cm^3/hr$.

- Type of Pump = Metallic Volute Pumps
- Efficiency of Pump = 92%
- Intake Level = 802.00 m
- Delivery Level = 925.00 m
- Static Head = 123.00 m
- Losses (Friction + pump internal+ other) = 12.47 m
- Total Pump Head = 135.47 m
- Number of Pumps = 4 working + 1 Standby
- Total Discharge = 26.0 Cumecs
- Discharge for each Pump = 6.5 Cumecs
- Capacity of each Pump = 14160 HP
- Total Installed Capacity = 52.80 MW
- Total Power Requirement = 39.56 MW
- Electrical Sub-station = 220KV/11KV power transformer with 2 No's of 25 MVA
- The divertible discharge at Weir 1 is 26.0 cumecs. This quantity is to be pumped to intermediate pumping station.

## Intake Forebay

It is proposed to have an Intake forebay and a surge pool to divert the required quantity of water to the Jack well cum pump house.

## Jack Well cum pump house

A rectangular framed structure is proposed for construction of jack well cum pump house to accommodate 5 no's of Metallic volute pumps and motors. (4 working + 1 standy) are proposed to lift water towards Intermediate pumping station and DC – 3 near Doddanagar 2. The details of proposed jack well is as under.

- Intake Level = 802.00 m
- Length of Fore Bay = 24.0 m
- Minimum Water Level = 802.00 m
- Number of Pump Bays = 5

## Raising Main

Designing of M.S. Raising Main is based on following considerations:

i. Velocity of flow shall be as far as possible, limited to 2.0 mtr/sec.

ii. The diameter of pipes shall be around 3.0 mtrs considering the weight of pipe for handling and for ease of CM lining and guniting in site welding, etc.,

iii. Wall Thickness:

  a. D/t ratio not exceeding 175
  b. Safe check for hoop stress
  c. The thickness shall not be less than as specified in IS 1916
  d. Check for design pressure 110% of pump head
  e. Check for 150% of Working Pressure

Details of proposed raising main are as under:

- Length of Raising Main = 7600.0 m
- Peak Discharge = 26.0 Cumecs
- Number of Rows = 2
- Discharge for each Row = 13.0 cumecs
- Velocity considered =2.0 m/sec
- Diameter of Pipe = 2.9 m
- Thickness of Pipe = 16 mm
- Coating Internal = 15mm Thick cement concrete lining
- External coating = 25mm Thick Guniting

Provision of surge protection works, air valves, scour valves are made in the estimate. Provision for thrust blocks and anchor blocks is also made in the estimate.

In absence of the field survey data and L-section of the raising main following assumptions are made.

Air valves- 1 No for every one Km

Scour valves- 1 No for every one km

Thrust blocks- 5 Nos for every one km provided at bends

Anchor blocks- 8 Nos considering 4 of nala crossing and 2 for every crossing.

## Power Requirement and electrical substation :

The total power requirement works out to 47.10 MVA. The power requirement is calculated taking into account of no. of working pumps and auxillary power supply.

The voltage level at which power is required is 11 KV and required transformer capacity is to receive 220 KV power stepping down to 11 KV for feeding HT motors.

It is proposed to install 220 KV/ 11 KV substation with 2 Nos of 25 MVA transformers.

## Delivery chamber

A delivery chamber (DC-3) at end of raising main is proposed for feeding the water to jack well at intermediate pumping station near Doddanagara. The delivery chamber (DC-3) is designed to accommodate combined discharge of 85.0 cumecs, i.e. from Weir-1 (26.0 cumecs), water from gravity main received from weir 3, 4 & 5 (15.0 cumecs) and water from intermediate pumping station near weir-1 (44.0 cumecs) (for pumping water received from Weir 6, 7 & 8).

Delivery chamber is designed for retention period of 1.50 minutes as adopted in running Lift Irrigation schemes in Karnataka.

The details of the proposed delivery chamber are as under:

- Bed Level = 920.00 m (with 0.50 m cushion)
- Full supply depth = 4.45 m
- Delivery Level = 925.00 m
- Top of Delivery Chamber = 925.40 m
- Discharge = 85.0 Cumecs
- Retention Time = 90 Seconds
- Capacity of Delivery Chamber =90 seconds x Discharge = 7650.0 Cum

- Size of Delivery Chamber = 41.50 m x 41.50 m x 5.40 m

- The side walls of the Delivery Chamber designing as RCC retaining walls considering all the loads.
- RCC Floor slab of 0.35 M thick is proposing for bed of Delivery Chamber.
- Cradle concrete is proposing below the delivery pipe for support.
- Friction blocks are proposing in the bed of Delivery Chamber for reducing wave effects.
- G I Hand rails are proposing around the Delivery chamber at top is proposed for additional safety.
- PVC Joints are providing between Toe slab of Retaining wall and base slab of Delivery Chamber

The cost of construction of combined delivery chamber, DC-3 is included in this package estimate.

## Approach road to head works

It is proposed to construct an approach road -1 to weir-1. Total length of approach road works out to 380.0 m. It is proposed to construct a single lane rigid pavement for approach road.

## Geo technical Details

A preliminary reconnaissance of the project location indicates exposed rock at the bed of the river. Estimate for Weir and Jack well is prepared based on this soil strata.

Following soil classification is considered for estimation of trench cutting for raising main.

In All Kinds of Soils- 1.50 m

In soft rock- 1.70 m

In Hard rock- Balance depth of cut beyond 3.20 m

### 9.1.1.2 Details of Diversion Weir – 2

It is proposed to construct a Weir designated as Weir 2, across Yettinahole tributary 1, with an independent catchment of 7.2 Sq. Kms. The water from this stream is diverted to weir 8 by constructing a Jack well cum pump house, lifting the water with the help of lifting arrangements and conveying through a raising main upto the DC-5 at an elevation of 780.000 m which is the starting point of the natural nala leading to weir 8.

- The geographic locations for the construction of the Weir are Latitude 12°52'20"N and Longitude 75°42'46"E.
- The width of the Yettinahole at the Weir location is about 20.00 meters and the depth is about 4.00 meters.
- The condition of the banks is vertical. Soft rocks have been observed at the bed level.
- The banks are covered with (under growth) vegetation and there is an accessibility to the right flank of the nala from NH 48. The distance from NH 48 upto weir location is about 0.200 kms.
- The average elevation of the bank is about 819.000 meters and the bed is about 815.000 meters above the mean sea level respectively.
- Sufficient private land is available at the weir location not only for the construction of the jack well cum Pump House, but also for routing the raising main conveyance system.
- The land for the above works has to be acquired and fall within the village of Heggadde, Sakleshpur Taluk, Hassan District.

## Components of the estimate

The present estimate includes

- Provision towards detailed survey, investigations, preparation of designs and drawings for execution of the scheme.
- Design supply, installation and commissioning of pumping machinery and pump house electrical works.
- Construction of 11 KV/6.6 KV Electrical sub station
- Construction of weir-2
- Construction of fore bay and Jack well cum pump house
- Construction of raising main
- Construction of Delivery chamber-5
- Provision is made for Operation and maintenance of the lift scheme for 5 years

## Diversion of water from Weir 2

The diversion structure planned at Weir 2 for diverting 4.0 cumecs of water will be of ogee type with necessary arrangement on the downstream side to dissipate energy. A jack well cum pump house is planned on the foreshore and left flank of the stream. Vertical turbine pumps have been planned to be installed for lifting the water. The conveyance system will consist of MS pipe of 1.60 m dia. The raising main will off take from a jack well cum pump house from an elevation of 815.000 m (intake level) and discharge will be delivered to DC-5 at an elevation of 780.000 m, the starting point of a natural nala which in turn will lead to Weir 8. The static head will be 40 m since enroute raising main will be negotiating a height of 855.000 m. The total length of the raising main will be 1.510 km.

From Weir 8, the water will be lifted (combined discharge of Weir 8 and 2) through a Jack well cum pump house comprising of Vertical turbine pumps. The level at the intake will be 743.000 m and the water will be conveyed to DC 1/ intermediate pumping station located at an elevation of 805 m near weir 1 through a raising main of 2.40 m dia MS pipe. The length of the raising will be 5.950 Km and the static head will be 62.00m.

## 7.1 Routing of the raising main

The raising main from Jack well cum pump house located at weir 2 (815.000 m) will negotiate an elevation of 855.000 m enroute. Further it will be led into DC- 5 at an elevation of 780.000 m, the starting point of a natural stream. The water will be discharged into this natural stream which will further lead to Weir 8 by gravity. The combined discharge of Weir 2 and 8 will be 13 cumecs.

The Jack Well-cum-Pump House on the foreshore of the Weir 8 and the Raising Main will off-take from an elevation of 743.000 meters and consist of MS Pipe, comprising of 2.40 meters diameter.

The Raising Main runs generally parallel and to the East of the Railway line between the railway line and the Yettinahole Stream in the initial section, beyond which it runs parallel and between NH 48 and Yettinahole and will cross NH 48, below the existing bridge and (runs parallel to Yettinahole) to west of it up to Jack Well-cum-Pump House located at 805.000 meters.

The water will further be lifted from 802.000 meters and the Raising Main will follow the alignment as narrated from Weir 1 up to Delivery Chamber 4.

Note: The raising main has been planned to be taken on pedestal from Weir 8 to DC 1.

## Diversion weir

It is proposed to provide an ungated ogee type weir for diverting the water. The details of Yettinahole stream at weir location are as under:

- Nala bed level = 815.000 m
- Nala Bank level = 818.000 m
- Width of Nala = 20.00 m
- Proposed length of Diversion weir = 20.00 m
- Type of weir = Ogee type with stilling basin on D/S side

During reconnaissance survey it is found that hard rock is available at bed of stream. Open foundation is proposed for body wall of the weir. Gravity type body wall is proposed for ogee type weir. Provision for downstream energy dissipating arrangements, training wall, key walls and river sluice are made in the estimate.

## 7.2 Pumping Machinery:

Discharge to be pumped at weir-2 and pump head is 4.0 cumecs and 44.56 m respectively. Vertical turbine pumps are proposed to be installed for pumping the water.

It is proposed to install 3 working and one standby pump, thereby discharging individual pump becomes

4 / 3 = 1.333 Cumecs X 3,600 = 4800 $m^3$/hr.

- Type of Pump = Vertical Turbine Pumps
- Efficiency of Pump = 90%
- Intake Level = 815 m
- Delivery Level = 855 m
- Static Head = 40 m
- Losses (Friction + pump internal+ other) = 4.56 m
- Total Pump Head = 44.56 m
- Number of Pumps = 3 working + 1 Standby
- Total Discharge = 4 Cumecs
- Discharge for each Pump = 1.333 Cumecs
- Capacity of each Pump = 920 HP
- Total Installed Capacity = 2745.2 KW
- Total Power Requirement = 1.97 MW

- Electrical Sub-station = 1 No of 2.5 MVA 11KV/6.6KV

## Intake Forebay

It is proposed to have an Intake forebay and a surge pool to divert the required quantity of water to the Jack well cum pump house.

## Jack Well cum pump house

A rectangular framed structure is proposed for construction of jack well cum pump house to accommodate 4 no's of Vertical Turbine pumps and motors. (3 working + 1 standy) are proposed to lift water towards DC – 2. The details of proposed jack well is as under.

- Intake Level = 815.000 m
- Length of Fore Bay = 24.00m
- Minimum Water Level = 815.000 m
- Number of Pump Bays = 4

## Raising Main

Designing of M.S. Raising Main is based on following considerations:

iv. Velocity of flow shall be as far as possible, limited to 2.0 mtr/sec.

v. The diameter of pipes shall be around 3.0 mtrs considering the weight of pipe for handling and for ease of CM lining and guniting in site welding, etc.,.

vi. Wall Thickness:

f. D/t ratio not exceeding 175.

g. Safe check for hoop stress

h. The thickness shall not be less than as specified in IS 1916

i. Check for design pressure 110% of pump head

j. Check for 150% of Working Pressure.

Details of proposed raising main are as under:

- Length of Raising Main = 1510.00 m
- Peak Discharge = 4 Cumecs
- Number of Rows = 1
- Velocity considered =2.0 m/sec

- Diameter of Pipe = 1.60 m
- Thickness of Pipe = 10 mm
- Coating Internal = 15mm Thick cement concrete lining
- External coating = 25mm Thick Guniting

Provision of surge protection works, air valves, scour valves are made in the estimate. Provision for thrust blocks and anchor blocks is also made in the estimate.

In absence of the field survey data and L-section of the raising main following assumptions are made.

Air valves- 1 No for every one Km

Scour valves- 1 No for every one km

Thrust blocks- 6 Nos for every one km provided at bends

Anchor blocks- 10 Nos considering 5 of nala crossing and 2 for every crossing.

## Power Requirement and electrical sub station :

The total power requirement works out to 2.35 MVA. The power requirement is calculated taking into account of no. of working pumps and auxillary power supply.

The voltage level at which power is required is 6.6 KV and required transformer capacity is to recieve 11 KV power for feeding HT motors.

It is proposed to install 11 KV/ 6.6KV substation with 1 No of 2.5 MVA transformers.

## Delivery chamber

A delivery chamber (DC-5) at end of raising main is proposed for feeding the water to Weir-8. Delivery chamber is designed for retention period of 1.50 minutes as adopted in running LI schemes in Karnataka.

The details of the proposed delivery chamber are as under:

- Bed Level = 775.05 m (with 0.50 m cushion)
- Full Supply Depth = 4.45 m
- Delivery Level = 780.00 m
- Top of Delivery Chamber = 780.45 m
- Discharge = 4.0 Cumecs

- Retention Time = 90 Seconds
- Capacity of Delivery Chamber =90 seconds x Discharge = 360 Cum
- Size of Delivery Chamber = 9.0 m x 9.0 m x 5.4 m

- The side walls of the Delivery Chamber designing as RCC retaining walls considering all the loads.
- RCC Floor slab of 0.35 M thick is proposing for bed of Delivery Chamber.
- Cradle concrete is proposing below the delivery pipe for support.
- Friction blocks are proposing in the bed of Delivery Chamber for reducing wave effects.
- G I Hand rails are proposing around the Delivery chamber at top is proposed for additional safety.
- PVC Joints are providing between Toe slab of Retaining wall and base slab of Delivery Chamber

## Geo technical Details

A preliminary reconnaissance of the project location indicates exposed rock at the bed of the river. Estimate for Weir and Jack well is prepared based on this soil strata.

Following soil classification is considered for estimation of trench cutting for raising main.

In All Kinds of Soils- 1.50 m

In soft rock- 1.80 m

In Hard rock- Balance depth of cut beyond 3.3 m

### 9.1.1.3 Details of Diversion Weir – 3

It is proposed to construct a Weir designated as Weir 3, across Yettinahole tributary 2, with an independent catchment of 9.80 Sq. Kms. The water from this stream is diverted to proposed combined collection tank/break pressure tank (DC-2) where the diverted water from Weir-4 & 5 are also collected. This total discharge is conveyed to DC-3 by a separate gravity main.

- The geographic locations for the construction of the Weir are at Latitude 12°53’22”N and Longitude 75°41’01"E.
- The width of the Yettinahole at the Weir location is about 30.0 meters and the depth is about 5 meters.
- The condition of the banks is vertical. Soft rocks have been observed at the bed level.
- The average elevation of the bank is about 865.000 meters and the bed is about 860.000 meters above the mean sea level respectively.
- Sufficient private land is available at the weir location not only for the construction of the jack well cum Pump House, but also for routing the raising main conveyance system.
- The land for the above works has to be acquired and fall within the village of Kadumane, Sakleshpur Taluk, Hassan District.

## Considerations for the Proposal and Design concept

## Components of the estimate

The present estimate includes

- Provision towards detailed survey, investigations, preparation of designs and drawings for execution of the scheme.
- Design supply, installation and commissioning of pumping machinery and pump house electrical works.
- Design supply, installation and commissioning of pumping machinery and pump house electrical works.
- Construction of 110 KV/6.6 KV Electrical sub station
- Construction of weir-3
- Construction of fore bay and Jack well cum pump house

- Construction of raising main for a length of 3910.0 m
- Construction of common Break pressure tank ( DC-2)
- Construction of Gravity main from DC-2 to DC-3 for a length of 14140.0 m
- Construction of Approach Road (AR-3), L = 1090.0 m
- Provision is made for Operation and maintenance of the lift scheme for 5 years

## Diversion of water from Weir 3

The diversion structure planned at Weir 3 for diverting 5.5 cumecs of water will be of ogee type with necessary arrangement on the downstream side to dissipate energy. A jack well cum pump house is planned on the foreshore and left flank of the stream. Vertical turbine pumps have been planned to be installed for lifting the water. The conveyance system will consist of MS pipe of 1.90 m dia. The raising main will off take from a jack well cum pump house from an elevation of 860.000 m (intake level) and water will be delivered to DC-2 at an elevation of 1010.000 m. The static head works out to 150.00 m. The total length of the raising main will be 3.910 km.

A pipeline is planned along the existing concrete road which is leading to Hebbasale village. From Hebbasale village the pipeline is planned cross country to cross western ghat ridge and joins Intermediate pumping station near Doddanagara. The pipeline will cross Hemavathy river about 1.0 Km upstream of pipeline crossing of raising mains from Weir-1. On study of topography and ground profile it is found that it is possible to convey the water from Break pressure tank to intermediate pumping station (DC-3) by gravity. There will be a overall savings of about 110 crores in base cost of the scheme and annual savings of energy to a tune of about 22.0 MW.

For routing of gravity pipe refer Drawing No. EIT-WR-1090-IND-001

## Routing of the pipeline

It is proposed to divert about 5.5 Cumecs of water from Weir 3 to Intermediate pumping station (DC-3). The water from Weir 3, 4 & 5 is lifted and conveyed to DC-2 (Break pressure tank) and from DC-2 through gravity pipeline to intermediate pumping station (DC-3).The conveyance system from weir 3 to DC-2 (Break pressure tank) will consist of 1.90 meters diameter MS Pipe raising main, which will off-take from the Jack Well-cum-Pump House, located on the foreshore of the Weir 3 at an elevation of about 860.000 meters and from DC-2 (Break pressure tank) to intermediate pumping station (DC-3) will consist of 3.00 meters diameter MS Pipe gravity main.

The water will be conveyed through a Raising Main, which has been aligned parallel to the existing cart track up to Mulatlu village for initial length and thereafter parallel to Asphalted road connecting NH 48 and Kadumane Estate covering a total length of 3.91 Kms. The break pressure tank is located near Kadumane village at longitude 75°40'01" E and latitude 12°54'46" N

The total length of Raising Main will be 3.910 Kms and the water will be discharged or drained to common Delivery Chamber 2, which is located at an elevation of 1010.000 meters.

Gravity main pipe will follow the existing concrete road leading to Hebbasale village. The alignment runs in nort-east direction and passes through Dekal, Nadahalli, Kumbardi and crosses Yettinahole tributary-2 (Weie-3 stream), Yettinahole stream before reaching Herbbasale village. Further the pipeline is aligned cross country and crosses wester ghat ridge at Ch.12.05 Km and Hemavathy river at Ch. 13.03 Km and connected to common delivery chamber/ intermediate pumping station near Doddanagara village. The total length of Gravity Main will be 14.14 Kms and the water will be discharged or drained to intermediate pumping station (DC-3), which is located at an elevation of 925.000 meters.

## Diversion weir

It is proposed to provide an ungated ogee type weir for diverting the water. The details of Yettinahole stream at weir location are as under:

- Nala bed level = 860.000 m
- Nala Bank level = 865.000 m
- Width of Nala = 30.00 m
- Proposed length of Diversion weir = 30.00 m
- Type of weir = Ogee type with stilling basin on D/S side

During reconnaissance survey it is found that hard rock is available at bed of stream. Open foundation is proposed for body wall of the weir. Gravity type body wall is proposed for ogee type weir. Provision for downstream energy dissipating arrangements, training wall, key walls and river sluice are made in the estimate.

## Pumping Machinery:

Discharge to be pumped at weir-3 and pump head is 5.5 cumecs and 162.00 m respectively. Vertical turbine pumps are proposed to be installed for pumping the water.

It is proposed to install 3 working and one standby pump, thereby discharging individual pump becomes –

5.5 / 3 = 1.833 Cumecs X 3,600 = 6600 $m^3$/hr.

- Type of Pump = Vertical Turbine Pumps
- Efficiency of Pump = 90%
- Intake Level = 860.000 m
- Delivery Level = 1010.000 m
- Static Head = 150.0 m
- Losses (Friction + pump internal+ other) = 12.0 m
- Total Pump Head = 162.0 m
- Number of Pumps = 3 working + 1 Standby
- Total Discharge = 5.5 Cumecs
- Discharge for each Pump = 1.833 Cumecs
- Capacity of each Pump = 4560 HP
- Total Installed Capacity = 13607.04 KW
- Total Power Requirement = 9.59 MW
- Electrical Sub-station = 1 No of 12.5 MVA 110KV/6.6KV

## Intake Forebay

It is proposed to have an Intake forebay and a surge pool to divert the required quantity of water to the Jack well cum pump house.

## Jack Well cum pump house

A rectangular framed structure is proposed for construction of jack well cum pump house to accommodate 4 no's of Vertical Turbine pumps and motors. (3 working + 1 standy) are proposed to lift water towards DC – 2 (Break pressure tank). The details of proposed jack well is as under.

- Intake Level = 860.00 m
- Length of Fore Bay = 24.00 m
- Minimum Water Level = 860.000 m
- Number of Pump Bays = 4

## Raising Main

Designing of M.S. Raising Main is based on following considerations:

vii. Velocity of flow shall be as far as possible, limited to 2.0 mtr/sec.

viii. The diameter of pipes shall be around 3.0 mtrs considering the weight of pipe for handling and for ease of CM lining and guniting in site welding, etc.,.

ix. Wall Thickness:

k. D/t ratio not exceeding 175.

l. Safe check for hoop stress

m. The thickness shall not be less than as specified in IS 1916

n. Check for design pressure 110% of pump head

o. Check for 150% of Working Pressure.

Details of proposed raising main are as under:

- Length of Raising Main = 3910.0 m
- Peak Discharge = 5.5 Cumecs
- Number of Rows = 1
- Velocity considered =2.0 m/sec
- Diameter of Pipe = 1.90 m
- Thickness of Pipe = 12 mm
- Coating Internal = 15mm Thick cement concrete lining
- External coating = 25mm Thick Guniting

Details of proposed gravity main are:

- Length of Gravity Main = 14140.0 m
- Peak Discharge = 15.0 Cumecs
- Number of Rows = 1
- Velocity considered =2.1 m/sec
- Diameter of Pipe = 3.00 m
- Thickness of Pipe = 12 mm
- Coating Internal = 15mm Thick cement concrete lining
- External coating = 25mm Thick Guniting

Provision of surge protection works, air valves, scour valves are made in the estimate. Provision for thrust blocks and anchor blocks is also made in the estimate.

In absence of the field survey data and L-section of the raising main and gravity main following assumptions are made.

Air valves- 1 No for every one Km

Scour valves- 1 No for every one km

Thrust blocks- 6 Nos for every one km provided at bends

Anchor blocks- 8 Nos considering 4 of nala crossing and 2 for every crossing.

The cost of construction of raising main and gravity mains is considered in the present estimate.

## Power Requirement and electrical substation:

The total power requirement works out to 11.42 MVA. The power requirement is calculated taking into account of no. of working pumps and auxillary power supply.

The voltage level at which power is required is 6.6 KV and required transformer capacity is to receive 110 KV power for feeding HT motors.

It is proposed to install 110 KV/6.6KV substation with 1 No of 12.5 MVA transformers.

## Break Pressure Tank (DC-2)

A combined Break pressure tank (DC-2) at end of raising mains from jack well cum pump house 3, 4 and 5 is proposed. Delivery chamber is designed for retention period of 1.50 minutes as adopted in running Lift Irrigation schemes in Karnataka.

The details of the proposed delivery chamber are as under:

- Bed Level = 1005.05 m (with 0.50 m cushion)
- Full Supply depth = 4.45 m
- Delivery Level = 1010.00 m
- Top of Delivery Chamber = 1010.45 m
- Discharge = 15 Cumecs
- Retention Time = 90 Seconds
- Capacity of Delivery Chamber =90 seconds x Discharge = 1350 Cum

- Size of Delivery Chamber = 17.5 m x 17.5 m x 5.4 m

- The side walls of the Delivery Chamber designing as RCC retaining walls considering all the loads.
- RCC Floor slab of 0.35 M thick is proposing for bed of Delivery Chamber.
- Cradle concrete is proposing below the delivery pipe for support.
- Friction blocks are proposing in the bed of Delivery Chamber for reducing wave effects.
- G I Hand rails are proposing around the Delivery chamber at top is proposed for additional safety.
- PVC Joints are providing between Toe slab of Retaining wall and base slab of Delivery Chamber

The cost of construction of combined delivery chamber, Break pressure tank (DC-2) is included in this package estimate.

## Approach road to head works

It is proposed to construct an approach road-3 to weir-3.Total length of approach road works out to 1090.0 m. It is proposed to construct a single lane rigid pavement for approach road.

## Geo technical Details

A preliminary reconnaissance of the project location indicates exposed rock at the bed of the river. Estimate for Weir and Jack well is prepared based on this soil strata.

Following soil classification is considered for estimation of trench cutting for raising main.

| | |
|---|---|
| In All Kinds of Soils- | 1.50 m |
| In soft rock- | 1.50 m |
| In Hard rock- | Balance depth of cut beyond 3.00 m |

#### 9.1.1.4 Details of Diversion Weir – 4

It is proposed to construct a Weir designated as Weir 4, across Kadumanehole 2, with an independent catchment of 7.49 Sq. Kms. The water from this stream is diverted to proposed combined collection tank/break pressure tank (DC-2) where the diverted water from Weir-4 & 5 are also collected. This total discharge is conveyed to DC-3 by a separate gravity main.

The geographic locations for the construction of the Weir are Latitude 12°53’37”N and Longitude 75°39’31"E.

- The width of the Yettinahole at the Weir location is about 20.00 meters and the depth is about 5.00 meters.
- The condition of the banks is vertical. Soft rock has been observed at the bed level.
- The average elevation of the bank is about 960.000 meters and the bed is about 955.000 meters above the mean sea level respectively.
- Sufficient private land is available at the weir location not only for the construction of the jack well cum Pump House, but also for routing the raising main conveyance system.
- The land for the above works has to be acquired and fall within the village of Kadumane Estate, Sakleshpur Taluk, Hassan District.

## Considerations for the Proposal and Design concept

## Components of the estimate

The present estimate includes:

- Provision towards detailed survey, investigations, preparation of designs and drawings for execution of the scheme.
- Design supply, installation and commissioning of pumping machinery and pump house electrical works.
- Construction of 110 KV/6.6 KV Electrical sub station
- Construction of weir-4
- Construction of fore bay and Jack well cum pump house
- Construction of raising main
- Construction of Approach Road (AR-4), L = 530 m

- Provision is made for Operation and maintenance of the lift scheme for 5 years

## Diversion of water from Weir 4

The diversion structure planned at Weir 4 for diverting 3.50 cumecs of water will be of ogee type with necessary arrangement on the downstream side to dissipate energy. A jack well cum pump house is planned on the foreshore and left flank of the stream. Vertical turbine pumps have been planned to be installed for lifting the water. The conveyance system will consist of MS pipe of 1.50 m dia. The raising main will off take from a jack well cum pump house from an elevation of 955.000 m (intake level) and discharge will be delivered to common delivery chamber, DC-2 at an elevation of 1010.000 m. The static head will be 55.00 m. The total length of the raising main will be 9.36 km.

A pipeline is planned along the existing concrete road which is leading to Hebbasale village. From Hebbasale village the pipeline is planned cross country to cross western ghat ridge and joins Intermediate pumping station near Doddanagara. The pipeline will cross Hemavathy river about 1.0 Km upstream of pipeline crossing of raising mains from Weir-1. On study of topography and ground profile it is found that it is possible to convey the water from Break pressure tank to intermediate pumping station (DC-3) by gravity. There will be a overall savings of about 110 crores in base cost of the scheme and annual savings of energy to a tune of about 22.0 MW.

## Routing of the raising main

The total discharge that will be diverted from Weir 4 will be 3.5 Cumecs. The conveyance system will consisting of Jack Well-cum-Pump House located on the foreshore of the Weir 4 and the water will be lifted from an elevation of 955 meters and conveyed through Raising Main consisting of 1.5 meters diameter of MS Pipe up to Delivery Chamber 2, which is located at an elevation of 960 meters. However, the raising main has to negotiate the highest elevation of 1010m (considered for static head computation) enroute which is unavoidable.

After crossing the Kadumane Estate, the Raising Main has been aligned parallel and to the north of the existing MDR connecting NH 48 and Kadumane Estate. The diverted water is delivered to the combined collection tank/ Break pressure tank. The break pressure tank is located near Kadumane village at longitude 75°40'01" E and latitude 12°54'46" N

Further the combined discharge collected from weir-3,4 & 5 is conveyed to intermediate pumping station (DC-3) located near Doddanagara after crossing Hemavathy river by gravity.

The cost of construction of Gravity main is included in Estimate-3 i.e. package estimate for pumping water from Weir-3 to DC-3.

## Diversion weir

It is proposed to provide an ungated ogee type weir for diverting the water. The details of Yettinahole stream at weir location are as under:

- Nala bed level = 955.000 m
- Nala Bank level = 960.000 m
- Width of Nala = 20.00 m
- Proposed length of Diversion weir = 20.00 m
- Type of weir = Ogee type with stilling basin on D/S side

During reconnaissance survey it is found that hard rock is available at bed of stream. Open foundation is proposed for body wall of the weir. Gravity type body wall is proposed for ogee type weir. Provision for downstream energy dissipating arrangements, training wall, key walls and river sluice are made in the estimate.

## Pumping Machinery:

Discharge to be pumped at weir-4 and pump head is 3.5 cumecs and 70.0 m respectively. Vertical turbine pumps are proposed to be installed for pumping the water.

It is proposed to install 3 working and one standby pump, thereby discharging individual pump becomes –

3.5 / 3 = 1.167 Cumecs X 3,600 = 4200 $m^3$/hr.

- Type of Pump = Vertical Turbine Pumps
- Efficiency of Pump = 90%
- Intake Level = 955.000 m
- Delivery Level = 1010.000 m
- Static Head = 55.00 m
- Losses (Friction + pump internal+ other) = 15.00 m
- Total Pump Head = 70.00 m
- Number of Pumps = 3 working + 1 Standby
- Total Discharge = 3.5 Cumecs
- Discharge for each Pump = 1.167 Cumecs
- Capacity of each Pump = 1260 HP
- Total Installed Capacity = 3759.84 KW

- Total Power Requirement = 2.70 MW
- Electrical Sub-station = 1 No of 5 MVA 110KV/6.6KV

## Intake Forebay

It is proposed to have an Intake forebay and a surge pool to divert the required quantity of water to the Jack well cum pump house.

## Jack Well cum pump house

A rectangular framed structure is proposed for construction of jack well cum pump house to accommodate 4 no's of Vertical Turbine pumps and motors. (3 working + 1 standy) are proposed to lift water towards DC – 2 (Break pressure tank). The details of proposed jack well is as under.

- Intake Level = 955.000 m
- Length of Fore Bay = 24.00 m
- Minimum Water Level = 955.000 m
- Number of Pump Bays = 4

## Raising Main

Designing of M.S. Raising Main is based on following considerations:

x. Velocity of flow shall be as far as possible, limited to 2.0 m /sec.

xi. The diameter of pipes shall be around 3.0 mtrs considering the weight of pipe for handling and for ease of CM lining and guniting in site welding, etc.,.

xii. Wall Thickness:

  p. D/t ratio not exceeding 175.

  q. Safe check for hoop stress

  r. The thickness shall not be less than as specified in IS 1916

  s. Check for design pressure 110% of pump head

  t. Check for 150% of Working Pressure.

Details of proposed raising main are as under:

- Length of Raising Main = 4620.00 m
- Peak Discharge = 3.5 Cumecs
- Number of Rows = 1

- Velocity considered =2.0 m/sec
- Diameter of Pipe = 1.50 m
- Thickness of Pipe = 9 mm
- Coating Internal = 15mm Thick cement concrete lining
- External coating = 25mm Thick Guniting

Provision of surge protection works, air valves, scour valves are made in the estimate. Provision for thrust blocks and anchor blocks is also made in the estimate.

In absence of the field survey data and L-section of the raising main following assumptions are made.

Air valves- 1 No for every one Km

Scour valves- 1 No for every one km

Thrust blocks- 6 Nos for every one km provided at bends

Anchor blocks- 8 Nos considering 4 of nala crossing and 2 for every crossing.

## Power Requirement and electrical sub station:

The total power requirement works out to 3.21 MVA. The power requirement is calculated taking into account of no. of working pumps and auxillary power supply.

The voltage level at which power is required is 6.6 KV and required transformer capacity is to receive 110 KV power for feeding HT motors.

It is proposed to install 110 KV/6.6KV sub station with 1 No of 5.0 MVA transformers.

## Break Pressure Tank (DC-2)

A combined Break pressure tank (DC-2) at end of raising mains from jack well cum pump house 3, 4 and 5 is proposed. Delivery chamber is designed for retention period of 1.50 minutes as adopted in running Lift Irrigation schemes in Karnataka.

. The details of the proposed delivery chamber are as under:

- Bed Level = 1005.05 m (with 0.50 m cushion)
- Full Supply depth = 4.45 m
- Delivery Level = 1010.000 m
- Top of Delivery Chamber = 1010.450 m
- Discharge = 15 Cumecs

- Retention Time = 90 Seconds
- Capacity of Delivery Chamber =90 seconds x Discharge = 1350 Cum
- Size of Delivery Chamber = 17.5 m x 17.5 m x 5.4 m

➢ The side walls of the Delivery Chamber designing as RCC retaining walls considering all the loads.

➢ RCC Floor slab of 0.35 M thick is proposing for bed of Delivery Chamber.

➢ Cradle concrete is proposing below the delivery pipe for support.

➢ Friction blocks are proposing in the bed of Delivery Chamber for reducing wave effects.

➢ G I Hand rails are proposing around the Delivery chamber at top is proposed for additional safety.

➢ PVC Joints are providing between Toe slab of Retaining wall and base slab of Delivery Chamber.

The cost of construction of Break pressure tank (DC-2) is included in Estimate-3 i.e. package estimate for pumping water from Weir-3 to DC-3.

## Approach road to head works

It is proposed to construct an approach road - 4 to weir-4. Total length of approach road works out to 530.0 m. It is proposed to construct a single lane rigid pavement for approach road.

## Geo technical Details

A preliminary reconnaissance of the project location indicates exposed rock at the bed of the river. Estimate for Weir and Jack well is prepared based on this soil strata.

Following soil classification is considered for estimation of trench cutting for raising main.

| | |
|---|---|
| In All Kinds of Soils- | 1.50 m |
| In soft rock- | 1.50 m |
| In Hard rock- | Balance depth of cut beyond 3.50 m |

### 9.1.1.5 Details of Diversion Weir – 5

It is proposed to construct a Weir designated as Weir 5, across Kadumanehole 1, with an independent catchment of 13.79 Sq. Kms. The water from this stream is diverted to proposed combined collection tank/break pressure tank (DC-2) where the diverted water from Weir-4 & 5 are also collected. This total discharge is conveyed to DC-3 by a separate gravity main.

The geographic locations for the construction of the Weir are Latitude 12°54’26”N and Longitude 75°39’03"E.

- The width of the Yettinahole at the Weir location is about 30.00 meters and the depth is about 7.00 meters.
- The condition of the banks is vertical. Boulders are observed at the bed level.
- The average elevation of the bank is about 910.000 meters and the bed is about 903.000 meters above the mean sea level respectively.
- Sufficient private land is available at the weir location not only for the construction of the jack well cum Pump House, but also for routing the raising main conveyance system.
- The land for the above works has to be acquired and fall within the village of Kadumane Estate, Sakleshpur Taluk, Hassan District.

## Considerations for the Proposal and Design concept

## Components of the estimate

The present estimate includes

- Provision towards detailed survey, investigations, preparation of designs and drawings for execution of the scheme.
- Design supply, installation and commissioning of pumping machinery and pump house electrical works.
- Construction of 110 KV/6.6KV Electrical sub station
- Construction of weir-5
- Construction of fore bay and Jack well cum pump house
- Construction of raising main
- Construction of Approach Road (AR-2), L = 1700 m
- Provision is made for Operation and maintenance of the lift scheme for 5 years

## Diversion of water from Weir 5

The diversion structure planned at Weir 5 to divert 6.0 cumecs of water will be of ogee type with necessary arrangement on the downstream side to dissipate energy. A jack well cum pump house is planned on the foreshore and left flank of the stream. Vertical turbine pumps have been planned to be installed for lifting the water. The conveyance system will consist of MS pipe of 2.0 m dia. The raising main will off take from a jack well cum pump house from an elevation of 903.000 m (intake level) and discharge will be delivered to common delivery chamber, DC 2 at an elevation of 1010.000 m. The static head will be 107.00 m. The total length of the raising main will be 10.510 km.

A pipeline is planned along the existing concrete road which is leading to Hebbasale village. From Hebbasale village the pipeline is planned cross country to cross western ghat ridge and joins Intermediate pumping station near Doddanagara. The pipeline will cross Hemavathy river about 1.0 Km upstream of pipeline crossing of raising mains from Weir-1. On study of topography and ground profile it is found that it is possible to convey the water from Break pressure tank to intermediate pumping station (DC-3) by gravity. There will be a overall savings of about 110 crores in base cost of the scheme and annual savings of energy to a tune of about 22.0 MW.

## Routing of the raising main

It is proposed to divert 6.0 Cumecs of water from Weir 5. The conveyance system consist of 2.0 meter diameter MS Pipe, which will off-take from the Jack Well-cum-Pump House located on the foreshore of the Weir 5.

The Raising Main has been aligned parallel to an existing Metal/asphalt road maintained by Kadumane Estate initially .After crossing the Kadumane Estate the Raising Main has been aligned parallel and to the north of MDR connecting NH 48 and Kadumane Estate. The length of the raising main will be 10.510 Km.

The diverted water is delivered to the combined collection tank/ Break pressure tank. The break pressure tank is located near Kadumane village at longitude 75°40'01" E and latitude 12°54'46" N

Further the combined discharge collected from weir-3,4 & 5 is conveyed to intermediate pumping station (DC-3) located near Doddanagara after crossing Hemavathy river by gravity.

The cost of construction of Gravity main is included in Estimate-3 i.e. package estimate for pumping water from Weir-3 to DC-3.

## Diversion weir

It is proposed to provide an ungated ogee type weir for diverting the water. The details of Yettinahole stream at weir location are as under:

- Nala bed level = 903.000 m
- Nala Bank level = 910.000 m
- Width of Nala = 30.00 m
- Proposed length of Diversion weir = 30.00 m
- Type of weir = Ogee type with stilling basin on D/S side

During reconnaissance survey it is found that hard rock is available at bed of stream. Open foundation is proposed for body wall of the weir. Gravity type body wall is proposed for ogee type weir. Provision for downstream energy dissipating arrangements, training wall, key walls and river sluice are made in the estimate.

## Pumping Machinery:

Discharge to be pumped at weir-5 and pump head is 6.0 cumecs and 120.50 m respectively. Vertical turbine pumps are proposed to be installed for pumping the water.

It is proposed to install 4 working and one standby pump, thereby discharging individual pump becomes –

6.0 / 4 = 1.5 Cumecs X 3,600 = 5400 $m^3$/hr.

- Type of Pump = Vertical Turbine Pumps
- Efficiency of Pump = 90%
- Intake Level = 903.000 m
- Delivery Level = 1010.000 m
- Static Head = 107.00 m
- Losses (Friction + pump internal+ other) = 13.50 m
- Total Pump Head = 120.50 m
- Number of Pumps = 4 working + 1 Standby
- Total Discharge = 6.0 Cumecs
- Discharge for each Pump = 1.50 Cumecs
- Capacity of each Pump = 2780.00 HP
- Total Installed Capacity = 10369.40 KW

- Total Power Requirement = 7.81 MW
- Electrical Sub-station = 1 No of 10.00 MVA 110KV/6.6KV

## Intake Forebay

It is proposed to have an Intake forebay and a surge pool to divert the required quantity of water to the Jack well cum pump house.

## Jack Well cum pump house

A rectangular framed structure is proposed for construction of jack well cum pump house to accommodate 4 no's of Vertical Turbine pumps and motors. (3 working + 1 standy) are proposed to lift water towards DC – 2 (Break pressure tank). The details of proposed jack well is as under.

- Intake Level = 903.000 m
- Length of Fore Bay = 24.00 m
- Minimum Water Level = 903.000 m
- Number of Pump Bays = 5.0

## Raising Main

Designing of M.S. Raising Main is based on following considerations:

xiii. Velocity of flow shall be as far as possible, limited to 2.0 mtr/sec.

xiv. The diameter of pipes shall be around 3.0 mtrs considering the weight of pipe for handling and for ease of CM lining and guniting in site welding, etc.,.

xv. Wall Thickness:

a. D/t ratio not exceeding 175.

b. Safe check for hoop stress

c. The thickness shall not be less than as specified in IS 1916

d. Check for design pressure 110% of pump head

e. Check for 150% of Working Pressure.

Details of proposed raising main are as under:

- Length of Raising Main = 10510.00 m
- Peak Discharge = 6.0 Cumecs
- Number of Rows = 1

- Velocity considered =2.0 m/sec
- Diameter of Pipe = 2.0 m
- Thickness of Pipe = 12 mm
- Coating Internal = 15mm Thick cement concrete lining
- External coating = 25mm Thick Guniting

Provision of surge protection works, air valves, scour valves are made in the estimate. Provision for thrust blocks and anchor blocks is also made in the estimate.

In absence of the field survey data and L-section of the raising main and gravity main following assumptions are made.

Air valves- 1 No for every one Km

Scour valves- 1 No for every one km

Thrust blocks- 6 Nos for every one km provided at bends

Anchor blocks- 8 Nos considering 4 of nala crossing and 2 for every crossing.

## Power Requirement and electrical sub station:

The total power requirement works out to 9.30 MVA. The power requirement is calculated taking into account of no. of working pumps and auxillary power supply.

The voltage level at which power is required is 6.6 KV and required transformer capacity is to receive 110 KV power for feeding HT motors.

It is proposed to install 110 KV/6.6KV substation with 1 No of 10.00 MVA transformers.

## Break Pressure Tank (DC-2)

A combined Break pressure tank (DC-2) at end of raising mains from jack well cum pump house 3, 4 and 5 is proposed. Delivery chamber is designed for retention period of 1.50 minutes as adopted in running Lift Irrigation schemes in Karnataka.

The details of the proposed delivery chamber are as under:

- Bed Level = 1005.05 m (with 0.50 m cushion)
- Full Supply depth = 4.45 m
- Delivery Level = 1010.00 m
- Top of Delivery Chamber = 1010.45 m

- Discharge = 15 Cumecs
- Retention Time = 90 Seconds
- Capacity of Delivery Chamber =90 seconds x Discharge = 1350 Cum
- Size of Delivery Chamber = 17.5 m x 17.5 m x 5.4 m

- ➢ The side walls of the Delivery Chamber designing as RCC retaining walls considering all the loads.
- ➢ RCC Floor slab of 0.35 M thick is proposing for bed of Delivery Chamber.
- ➢ Cradle concrete is proposing below the delivery pipe for support.
- ➢ Friction blocks are proposing in the bed of Delivery Chamber for reducing wave effects.
- ➢ G I Hand rails are proposing around the Delivery chamber at top is proposed for additional safety.
- ➢ PVC Joints are providing between Toe slab of Retaining wall and base slab of Delivery Chamber.

The cost of construction of Break pressure tank (DC-2) is included in Estimate-3 i.e. package estimate for pumping water from Weir-3 to DC-3.

## Approach road to head works

It is proposed to construct an approach road- 2 to weir -5. Total length of approach road works out to 1700.0 m. It is proposed to construct a single lane rigid pavement for approach road.

## Geo technical Details

A preliminary reconnaissance of the project location indicates exposed rock at the bed of the river. Estimate for Weir and Jack well is prepared based on this soil strata.

Following soil classification is considered for estimation of trench cutting for raising main.

In All Kinds of Soils- 1.50 m

In soft rock- 1.50 m

In Hard rock- Balance depth of cut beyond 3.30 m

### 9.1.1.6 Details of Diversion Weir – 6

It is proposed to construct a Weir designated as Weir 6, across Kerihole, with an independent catchment of 24.25 Sq. Kms. The water from this stream is diverted to DC 1 by lifting and conveying through an independent raising main of length 10.00 Km.

- The geographic locations for the construction of the Weir are Latitude 12°49’52” and Longitude 75°43’07".
- The width of the Kerihole at the Weir location is about 25.00 meters and the depth is about 5.00 meters.
- The condition of the banks is vertical. Boulders are observed at the bed level.
- The average elevation of the bank is about 780.000 meters and the bed is about 775.000 meters above the mean sea level respectively.
- Sufficient private land is available at the weir location not only for the construction of the jack well cum Pump House, but also for routing the raising main conveyance system.
- The land for the above works has to be acquired and fall within the village of Kadagarahalli, Sakleshpur Taluk, Hassan District.

## Considerations for the Proposal and Design concept

## Components of the estimate

The present estimate includes:

- Provision towards detailed survey, investigations, preparation of designs and drawings for execution of the scheme.
- Design supply, installation and commissioning of pumping machinery and pump house electrical works.
- Construction of 11 KV/6.6 KV Electrical sub station
- Construction of weir-6
- Construction of fore bay and Jack well cum pump house
- Construction of raising main
- Provision is made for Operation and maintenance of the lift scheme for 5 years

## Diversion of water from Weir 6

The diversion structure planned at Weir 6 to divert 5.0 cumecs of water will be of ogee type with necessary arrangement on the downstream side to dissipate energy. A jack well cum pump house is planned on the foreshore and right flank of the stream. Vertical turbine pumps have been planned to be installed for lifting the water. The conveyance system will consist of MS pipe of 1.80 m dia. The raising main will off take from a jack well cum pump house from an elevation of 775.000 m (intake level) and discharge will be delivered to DC 1 at an elevation of 805.000 m. The static head will be 30.00 m. The total length of the raising main will be 10.00 km.

## Routing of the raising main

Weir 6 has been planned across Kerihole. It is proposed to divert 5.0 cumecs of water. The Jack Well-cum-Pump House has been proposed on the foreshore of the Weir 6 and the Raising Main will off-take from the same at an elevation of 775.000 meters.

The Raising Main consists of 1.80 meters diameter MS Pipe, which has been aligned parallel to an existing track from take-off up to Kodagarahalli,. Beyond Kodagarahalli, the Raising Main is aligned across the country (to avoid rugged and raising terrain) and it will circumvent the existing hill and drains into Delivery Chamber 1, which is located at an elevation of 805.000 meters.

From Delivery Chamber 1, the water will be conveyed to the Jack Well-cum-Pump House near Weir 1. The Raising Main has been aligned parallel and to the east of Southern Railway, Hassan District, Mangalore section, up to 3.60 Km, where the Raising Main will cross the railway line, through an elevated structure (since the railway line is cutting off about 25.00 meters) and there after the pipe line has been aligned parallel and to the west of the railway line.

The Raising Main will cross the Western Ghats Saddle at Km 4.50 (RL 915 m and thereafter, it will cross the perennial Hemavathy River, having a width of 300.00 meters. It is proposed to cross the Hemavathy river above by routing the pipeline over a bridge.

The Raising Main after crossing the Hemavathy River will enter Doddanagar Reserve Forest and covers a length of 0.70 kms and drains to Delivery Chamber No.3, located near Doddanagar Village at an elevation of 925.000 meters.

The entire alignment of the Pipe Line is routed through private lands and it is beyond the ROW of the railway line for the entire section, except for a length of about 0.70 Kms, where it will pass through Doddanagar Reserve Forest, which is unavoidable.

The entire length of the Pipe Line between Delivery Chamber 3 to Delivery Chamber 4 runs through a gently rolling terrain interspersed with developments, but it passes through private lands.

## Diversion weir

It is proposed to provide an ungated ogee type weir for diverting the water. The details of Kerihole stream at weir location are as under:

- Nala bed level = 775.000 m
- Nala Bank level = 780.000 m
- Width of Nala = 25.00 m
- Proposed length of Diversion weir = 25.00 m
- Type of weir = Ogee type with stilling basin on D/S side

During reconnaissance survey it is found that hard rock is available at bed of stream. Open foundation is proposed for body wall of the weir. Gravity type body wall is proposed for ogee type weir. Provision for downstream energy dissipating arrangements, training wall, key walls and river sluice are made in the estimate.

## Pumping Machinery:

Discharge to be pumped at weir-6 and pump head is 5.0 cumecs and 52.72 m respectively. Vertical turbine pumps are proposed to be installed for pumping the water.

It is proposed to install 2 working and one standby pump, thereby discharging individual pump becomes –

5.0 / 2 = 2.5 Cumecs X 3,600 = 9000 $m^3$/hr.

- Type of Pump = Vertical Turbine Pumps
- Efficiency of Pump = 90%
- Intake Level = 775.000 m
- Delivery Level = 805.000 m
- Static Head = 30.00 m
- Losses (Friction + pump internal+ other) = 22.72 m
- Total Pump Head = 52.72 m
- Number of Pumps = 2 working + 1 Standby
- Total Discharge = 5.0 Cumecs
- Discharge for each Pump = 2.50 Cumecs

- Capacity of each Pump = 2040 HP
- Total Installed Capacity = 4565.52 KW
- Total Power Requirement = 2.91 MW
- Electrical Sub-station = 1 No of 3.5 MVA 11KV/6.6KV

## Intake Forebay

It is proposed to have an Intake forebay and a surge pool to divert the required quantity of water to the Jack well cum pump house.

## Jack Well cum pump house

A rectangular framed structure is proposed for construction of jack well cum pump house to accommodate 3 no's of Vertical Turbine pumps and motors. (2 working + 1 standy) are proposed to lift water towards DC – 1. The details of proposed jack well is as under.

- Intake Level = 775.000 m
- Length of Fore Bay = 24.00 m
- Minimum Water Level = 775.000 m
- Number of Pump Bays = 3

## Raising Main

Designing of M.S. Raising Main is based on following considerations:

xvi. Velocity of flow shall be as far as possible, limited to 2.0 mtr/sec.

xvii. The diameter of pipes shall be around 3.00 mtrs considering the weight of pipe for handling and for ease of CM lining and guniting in site welding, etc.

xviii. Wall Thickness:

f. D/t ratio not exceeding 175.

g. Safe check for hoop stress

h. The thickness shall not be less than as specified in IS 1916

i. Check for design pressure 110% of pump head

j. Check for 150% of Working Pressure.

Details of proposed raising main are as under:

- Length of Raising Main = 10000.00 m

- Peak Discharge =5.0 Cumecs
- Number of Rows = 1
- Velocity considered =2.0 m/sec
- Diameter of Pipe = 1.80 m
- Thickness of Pipe = 10.00 mm
- Coating Internal = 15.00mm Thick cement concrete lining
- External coating = 25.00mm Thick Guniting

Provision of surge protection works, air valves, scour valves are made in the estimate. Provision for thrust blocks and anchor blocks is also made in the estimate.

In absence of the field survey data and L-section of the raising main following assumptions are made.

Air valves- 1 No for every one Km

Scour valves- 1 No for every one km

Thrust blocks- 3 Nos for every one km provided at bends

Anchor blocks- 6 Nos considering 3 of nala crossing and 2 for every crossing.

## Power Requirement and electrical sub station :

The total power requirement works out to 3.46 MVA. The power requirement is calculated taking into account of no. of working pumps and auxillary power supply.

The voltage level at which power is required is 6.6 KV and required transformer capacity is to recieve 11 KV power for feeding HT motors.

It is proposed to install 11 KV/6.6KV substation with 1 No of 3.5 MVA transformers.

## Delivery chamber

A combined delivery chamber (DC-1) at end of raising mains from jack well cum pump house 6, 7 and 8 is proposed to receive the water and feed to intermediate pumping station near Weir-1. Delivery chamber is designed for retention period of 1.50 minutes as adopted in running LI schemes in Karnataka.

The details of the proposed delivery chamber are as under:

- Bed Level = 800.50 m (with 0.50 m cushion)
- Full Supply Depth = 4.0 m

- Delivery Level = 805.000 m
- Top of Delivery Chamber = 805.450 m
- Discharge = 44.00 Cumecs
- Retention Time = 90 Seconds
- Capacity of Delivery Chamber =90 seconds x Discharge = 3960 Cum
- Size of Delivery Chamber = 29.9 m x 29.9 m x 5.4 m

➢ The side walls of the Delivery Chamber designing as RCC retaining walls considering all the loads.

➢ RCC Floor slab of 0.35 M thick is proposing for bed of Delivery Chamber.

➢ Cradle concrete is proposing below the delivery pipe for support.

➢ Friction blocks are proposing in the bed of Delivery Chamber for reducing wave effects.

➢ G I Hand rails are proposing around the Delivery chamber at top is proposed for additional safety.

➢ PVC Joints are providing between Toe slab of Retaining wall and base slab of Delivery Chamber.

The cost of construction of DC-1 is included in Estimate-9 i.e. package estimate for pumping water from Intermediate pumping station to DC-3 at Doddanagara.

## Geo technical Details

A preliminary reconnaissance of the project location indicates exposed rock at the bed of the river. Estimate for Weir and Jack well is prepared based on this soil strata.

Following soil classification is considered for estimation of trench cutting for raising main.

| | |
|---|---|
| In All Kinds of Soils- | 1.50 m |
| In soft rock- | 1.80 m |
| In Hard rock- | Balance depth of cut beyond 3.30 m |

### 9.1.1.7 Details of Diversion Weir – 7

It is proposed to construct a Weir designated as Weir 7, across Hongadahalla, with an independent catchment of 53.80 Sq. Km. The water from this stream is diverted to DC 1 by lifting and conveying through an independent raising main of length 11.675 Km.

- The geographic locations for the construction of the Weir are Latitude 12°48'54"N and Longitude 75°42'42"E.
- The width of the Hongadahalla at the Weir location is about 30.00 meters and the depth is about
  7.00 meters.
- The condition of the banks is vertical. Boulders are observed at the bed level.
- The average elevation of the bank is about 740.000 meters and the bed is about 733.000 meters above the mean sea level respectively.
- Sufficient private land is available at the weir location not only for the construction of the jack well cum Pump House, but also for routing the raising main conveyance system.
- The land for the above works has to be acquired and fall within the village of Hiradanahalli, Sakleshpur Taluk, Hassan District.

## Considerations for the Proposal and Design concept

## Components of the estimate

The present estimate includes:

- Provision towards detailed survey, investigations, preparation of designs and drawings for execution of the scheme.
- Design supply, installation and commissioning of pumping machinery and pump house electrical works.
- Construction of 110 KV/11 KV Electrical sub station
- Construction of weir-7
- Construction of fore bay and Jack well cum pump house
- Construction of raising main
- Provision is made for Operation and maintenance of the lift scheme for 5 years

## Diversion of water from Weir 7

The diversion structure planned at Weir 7 to divert 30.0 cumecs of water will be of ogee type with necessary arrangement on the downstream side to dissipate energy. A jack well cum pump house is planned on the foreshore and right flank of the stream. Vertical turbine pumps have been planned to be installed for lifting the water. The conveyance system will consist of MS pipe 2 rows off 3.1 m dia. The raising main will off take from a jack well cum pump house from an elevation of 733.000 m (intake level) and discharge will be delivered to DC 1 at an elevation of 802.000 m. The static head will be 72.00 m. The total length of the raising main will be 11.675 km.

## Routing of the raising main

Weir 7 has been planned across Hongadahalla. In order to divert nearly 30.00 cumecs of water, the Jack Well-cum-Pump House has been proposed on the foreshore of the Weir 7.

The conveyance system will comprise of MS Pipe consisting of 2 rows each of 3.1 meter diameter taking off from an elevation of 733.000 meters.

The Raising Main has been planned through an existing tract up to Weir 6, beyond which it will follow the alignment of the conveyance system planned from Weir 6 to Delivery Chamber 1.

The Raising Main planned from Weir 7 up to the Delivery Chamber 1 will involve deep cut of about 15.00 meters of length of 100.00 meters, which is inevitable. The raising main will negotiate the highest elevation of 802.000 m enroute and hence the same is considered for computing the static head.

## Diversion weir

It is proposed to provide an ungated ogee type weir for diverting the water. The details of Yettinahole stream at weir location are as under:

- Nala bed level = 733.000 m
- Nala Bank level = 740.000 m
- Width of Nala = 30.00 m
- Proposed length of Diversion weir = 30.00 m
- Type of weir = Ogee type with stilling basin on D/S side

During reconnaissance survey it is found that hard rock is available at bed of stream. Open foundation is proposed for body wall of the weir. Gravity type body wall is proposed for ogee type weir. Provision for downstream energy dissipating arrangements, training wall, key walls and river sluice are made in the estimate.

## Pumping Machinery:

Discharge to be pumped at weir-7 and pump head is 6.0 cumecs and 89.12 m respectively. Vertical turbine pumps are proposed to be installed for pumping the water.

It is proposed to install 6 working and one standby pump, thereby discharging individual pump becomes –

30.0 / 6 = 5.0 Cumecs X 3,600 = 18000 $m^3$/hr.

- Type of Pump = Vertical Turbine Pumps
- Efficiency of Pump = 90%
- Intake Level = 733.000 m
- Delivery Level = 805.000 m
- Static Head = 72.00 m
- Losses (Friction + pump internal+ other) = 17.12 m
- Total Pump Head = 89.12 m
- Number of Pumps = 6 working + 1 Standby
- Total Discharge = 30.00 Cumecs
- Discharge for each Pump = 5.00 Cumecs
- Capacity of each Pump = 6860 HP
- Total Installed Capacity = 35822.99 KW
- Total Power Requirement = 28.73 MW
- Electrical Sub-station = 1 No of 35 MVA 110KV/6.6KV

## Intake Forebay

It is proposed to have an Intake forebay and a surge pool to divert the required quantity of water to the Jack well cum pump house.

## Jack Well cum pump house

A rectangular framed structure is proposed for construction of jack well cum pump house to accommodate 7 no's of Vertical Turbine pumps and motors. (6 working + 1 standy) are proposed to lift water towards DC – 1. The details of proposed jack well is as under.

- Intake Level = 733.000 m
- Length of Fore Bay = 24.00 m
- Minimum Water Level = 733.000 m

- Number of Pump Bays = 7

## Raising Main

Designing of M.S. Raising Main is based on following considerations:

xix. Velocity of flow shall be as far as possible, limited to 2 mtr/sec.

xx. The diameter of pipes shall be around 3 mtrs considering the weight of pipe for handling and for ease of CM lining and guniting in site welding, etc.,.

xxi. Wall Thickness:

a. D/t ratio not exceeding 175.

b. Safe check for hoop stress

c. The thickness shall not be less than as specified in IS 1916

d. Check for design pressure 110% of pump head

e. Check for 150% of Working Pressure.

Details of proposed raising main are as under:

- Length of Raising Main = 11675.00 m
- Peak Discharge = 30.00 Cumecs
- Number of Rows = 2
- Velocity considered =2.0 m/sec
- Diameter of Pipe = 3.1 m
- Thickness of Pipe = 18.00 mm
- Coating Internal = 15.00 mm Thick cement concrete lining
- External coating = 25.00 mm Thick Guniting

Provision of surge protection works, air valves, scour valves are made in the estimate. Provision for thrust blocks and anchor blocks is also made in the estimate.

In absence of the field survey data and L-section of the raising main following assumptions are made.

Air valves- 1 No for every one Km

Scour valves- 1 No for every one km

Thrust blocks- 5 Nos for every one km provided at bends

Anchor blocks- 8 Nos considering 4 of nala crossing and 2 for every crossing.

## Power Requirement and electrical substation :

The total power requirement works out to 34.20 MVA. The power requirement is calculated taking into account of no. of working pumps and auxillary power supply.

The voltage level at which power is required is 11 KV and required transformer capacity is to recieve 110 KV power for feeding HT motors.

It is proposed to install 110 KV/11KV substation with 1 No of 35.0 MVA transformers.

## Delivery chamber

A combined delivery chamber (DC-1) at end of raising mains from jack well cum pump house 6, 7 and 8 is proposed to receive the water and feed to intermediate pumping station near Weir-1. Delivery chamber is designed for retention period of 1.50 minutes as adopted in running LI schemes in Karnataka.

The details of the proposed delivery chamber are as under:

- Bed Level = 800.50 m (with 0.50 m cushion)
- Full Supply Depth = 4.0 m
- Delivery Level = 805.000 m
- Top of Delivery Chamber = 805.450 m
- Discharge = 44.00 Cumecs
- Retention Time = 90 Seconds
- Capacity of Delivery Chamber =90 seconds x Discharge = 3960 Cum
- Size of Delivery Chamber = 29.9 m x 29.9 m x 5.4 m

➢ The side walls of the Delivery Chamber designing as RCC retaining walls considering all the loads.

➢ RCC Floor slab of 0.35 M thick is proposing for bed of Delivery Chamber.

➢ Cradle concrete is proposing below the delivery pipe for support.

➢ Friction blocks are proposing in the bed of Delivery Chamber for reducing wave effects.

➢ G I Hand rails are proposing around the Delivery chamber at top is proposed for additional safety.

- PVC Joints are providing between Toe slab of Retaining wall and base slab of Delivery Chamber.

The cost of construction of DC-1 is included in Estimate-9 i.e. package estimate for pumping water from Intermediate pumping station to DC-3 at Doddanagara.

## Geo technical Details

A preliminary reconnaissance of the project location indicates exposed rock at the bed of the river. Estimate for Weir and Jack well is prepared based on this soil strata.

Following soil classification is considered for estimation of trench cutting for raising main.

| | |
|---|---|
| In All Kinds of Soils- | 1.50 m |
| In soft rock- | 1.80 m |
| In Hard rock- | Balance depth of cut beyond 3.30 m |

#### 9.1.1.8 Details of Diversion Weir – 8

It is proposed to construct a Weir designated as Weir 8, across Yettinahole downstream, with an independent catchment of 11.61 Sq. Km. An additional discharge is received from Weir 2 to this weir from a catchment of 7.20 sq.km. The combined catchment area will be 18.81 Sq.Km. The water from this stream is diverted to DC 1 by lifting and conveying through an independent raising main of length 5.95 Km.

- The geographic locations for the construction of the Weir are Latitude 12°51’46”N and Longitude 75°43’27"E.
- The width of the Yettinahole at the Weir location is about 30.00 meters and the depth is about 5.00 meters.
- The condition of the banks is vertical. Hard rocks are observed at the bed level.
- The average elevation of the bank is about 748.000 meters and the bed is about 743.000 meters above the mean sea level respectively.
- Sufficient private land is available at the weir location not only for the construction of the jack well cum Pump House, but also for routing the raising main conveyance system.
- The land for the above works has to be acquired and fall within the village of Alvalli, Sakleshpur Taluk, Hassan District.

## Considerations for the Proposal and Design concept

## Components of the estimate

The present estimate includes:

- Provision towards detailed survey, investigations, preparation of designs and drawings for execution of the scheme.
- Design supply, installation and commissioning of pumping machinery and pump house electrical works.
- Construction of 110 KV/6.6 KV Electrical sub station
- Construction of weir-8
- Construction of fore bay and Jack well cum pump house
- Construction of raising main
- Provision is made for Operation and maintenance of the lift scheme for 5 years

## Diversion of water from Weir 8

The diversion structure planned at Weir 8 to divert 9.0 cumecs of water will be of ogee type with necessary arrangement on the downstream side to dissipate energy. A jack well cum pump house is planned on the foreshore and right flank of the stream. Vertical turbine pumps have been planned to be installed for lifting the water. The conveyance system will consist of MS pipe of 1 row of 2.4 m dia. The raising main will off take from a jack well cum pump house from an elevation of 743.000 m (intake level) and discharge will be delivered to DC 1 (Jackwell cum pump house) at an elevation of 802.000 m. The static head will be 62.00 m. The total length of the raising main will be 5.95 km.

## Routing of the raising main

Weir 8 has been planned across Yettinahole downstream of Weir 1. The discharge from Weir 2 will also be diverted to Weir 8 by gravity and the total discharge which will be conveyed from Weir 8 will be 9 cumecs.

The Jack Well-cum-Pump House on the foreshore of the Weir 8 and the Raising Main will off-take from an elevation of 743.000 meters and consist of MS Pipe, comprising of 2.40 meters diameter.

The Raising Main runs generally parallel and to the East of the Railway line between the railway line and the Yettinahole Stream in the initial section, beyond which it runs parallel and between NH 48 and

Yettinahole and will cross NH 48, below the existing bridge and (runs parallel to Yettinahole) to west of it up to Jack Well-cum-Pump House located at 802.000 meters.

The water will further be lifted from 802.000 meters and the Raising Main will follow the alignment as narrated from Weir 1 up to Delivery Chamber 4.

## Diversion weir

It is proposed to provide an ungated ogee type weir for diverting the water. The details of Yettinahole stream at weir location are as under:

- Nala bed level = 743.000 m
- Nala Bank level = 748.000 m
- Width of Nala = 30.00 m
- Proposed length of Diversion weir = 30.00 m
- Type of weir = Ogee type with stilling basin on D/S side

During reconnaissance survey it is found that hard rock is available at bed of stream. Open foundation is proposed for body wall of the weir. Gravity type body wall is proposed for ogee type weir. Provision for downstream energy dissipating arrangements, training wall, key walls and river sluice are made in the estimate.

## Pumping Machinery:

Discharge to be pumped at weir-8 and pump head is 9.0 cumecs and 76.26 m respectively. Vertical turbine pumps are proposed to be installed for pumping the water.

It is proposed to install 3 working and one standby pump, thereby discharging individual pump becomes –

9.0 /36 = 3.0 Cumecs X 3,600 = 10800 $m^3$/hr.

- Type of Pump = Vertical Turbine Pumps
- Efficiency of Pump = 90%
- Intake Level = 743.000 m
- Delivery Level = 805.000 m
- Static Head = 62.00 m
- Losses (Friction + pump internal+ other) = 14.26 m
- Total Pump Head = 76.26 m
- Number of Pumps = 3 working + 1 Standby

- Total Discharge = 9.0 Cumecs
- Discharge for each Pump = 3.0 Cumecs
- Capacity of each Pump = 3530.00 HP
- Total Installed Capacity = 10533.56 KW
- Total Power Requirement = 7.44 MW
- Electrical Sub-station = 1 No of 10 MVA 110KV/6.6KV

## Intake Forebay

It is proposed to have an Intake forebay and a surge pool to divert the required quantity of water to the Jack well cum pump house.

## Jack Well cum pump house

A rectangular framed structure is proposed for construction of jack well cum pump house to accommodate 4 no's of Vertical Turbine pumps and motors. (3 working + 1 standy) are proposed to lift water towards DC – 2. The details of proposed jack well is as under.

- Intake Level = 743.000 m
- Length of Fore Bay = 24.00m
- Minimum Water Level = 743.000 m
- Number of Pump Bays = 4

## Raising Main

Designing of M.S. Raising Main is based on following considerations:

i. Velocity of flow shall be as far as possible, limited to 2 mtr/sec.

ii. The diameter of pipes shall be around 3 mtrs considering the weight of pipe for handling and for ease of CM lining and guniting in site welding, etc.,.

iii. Wall Thickness:

   a. D/t ratio not exceeding 175.

   b. Safe check for hoop stress

   c. The thickness shall not be less than as specified in IS 1916

   d. Check for design pressure 110% of pump head

   e. Check for 150% of Working Pressure.

Details of proposed raising main are as under:

- Length of Raising Main = 5950.00 m
- Peak Discharge = 9.00 Cumecs
- Number of Rows = 1
- Velocity considered =2.0 m/sec
- Diameter of Pipe = 2.40 m
- Thickness of Pipe = 14.00 mm
- Coating Internal = 15.00 mm Thick cement concrete lining
- External coating = 25.00 mm Thick Guniting

Provision of surge protection works, air valves, scour valves are made in the estimate. Provision for thrust blocks and anchor blocks is also made in the estimate.

In absence of the field survey data and L-section of the raising main following assumptions are made.

Air valves- 1 No for every one Km

Scour valves- 1 No for every one km

Thrust blocks- 5 Nos for every one km provided at bends

Anchor blocks- 10 Nos considering 5 of nala crossing and 2 for every crossing.

## Power Requirement and electrical sub station :

The total power requirement works out to 8.86 MVA. The power requirement is calculated taking into account of no. of working pumps and auxillary power supply.

The voltage level at which power is required is 6.6 KV and required transformer capacity is to recieve 110 KV power for feeding HT motors.

It is proposed to install 110 KV/6.6KV sub station with 1 No of 10.0 MVA transformers.

## Delivery chamber

A combined delivery chamber (DC-1) at end of raising mains from jack well cum pump house 6, 7 and 8 is proposed to receive the water and feed to intermediate pumping station near Weir-1. Delivery chamber is designed for retention period of 1.50 minutes as adopted in running LI schemes in Karnataka.

The details of the proposed delivery chamber are as under:

- Bed Level = 800.50 m (with 0.50 m cushion)

- Full Supply Depth = 4.0 m
- Delivery Level = 805.00 m
- Top of Delivery Chamber = 805.45 m
- Discharge = 44.00 Cumecs
- Retention Time = 90 Seconds
- Capacity of Delivery Chamber =90 seconds x Discharge = 3960 Cum
- Size of Delivery Chamber = 29.9 m x 29.9 m x 5.4 m

- The side walls of the Delivery Chamber designing as RCC retaining walls considering all the loads.
- RCC Floor slab of 0.35 M thick is proposing for bed of Delivery Chamber.
- Cradle concrete is proposing below the delivery pipe for support.
- Friction blocks are proposing in the bed of Delivery Chamber for reducing wave effects.
- G I Hand rails are proposing around the Delivery chamber at top is proposed for additional safety.
- PVC Joints are providing between Toe slab of Retaining wall and base slab of Delivery Chamber

The cost of construction of DC-1 is included in Estimate-9 i.e. package estimate for pumping water from Intermediate pumping station to DC-3 at Doddanagara.

## Geo technical Details

A preliminary reconnaissance of the project location indicates exposed rock at the bed of the river. Estimate for Weir and Jack well is prepared based on this soil strata.

Following soil classification is considered for estimation of trench cutting for raising main.

| | |
|---|---|
| In All Kinds of Soils- | 1.50 m |
| In soft rock- | 1.80 m |
| In Hard rock- | Balance depth of cut beyond 3.30 m |

#### 9.1.1.9 Details of Intermediate pumping station ( DC-1)

It is proposed to construct an Intermediate pumping station (DC-1) near Weir-1. The water from weirs 6, 7 and 8 amounting to 44.00 cumecs will be received. A jack well cum pump house has been proposed to lift the received water upto Intermediate pumping station (DC-3). The combined discharge of these three weirs will then be lifted by providing suitable pumping machinery and raising mains.

## Considerations for the Proposal and Design concept

## Components of the estimate

The present estimate includes:

- Provision towards detailed survey, investigations, preparation of designs and drawings for execution of the scheme.
- Design supply, installation and commissioning of pumping machinery and pump house electrical works.
- Construction of 220 KV/11KV Electrical sub station
- Construction of fore bay and Jack well cum pump house
- Construction of raising main
- Construction of Delivery chamber-1
- Provision is made for Operation and maintenance of the lift scheme for 5 years

## Diversion of water from Intermediate Pumping Station (DC-1)

A jack well cum pump house is planned near Weir 1. Metallic Volute pumps have been planned to be installed for lifting the water. The conveyance system will consist of MS pipe 3 rows each of 3 m dia. The raising main will off take from a jack well cum pump house from an elevation of 802.000 m (intake level) and discharge will be delivered to DC 3 located at Doddanagar having an elevation of 925.000 m. The static head will be 123.00 m.

From DC 3 the water will be lifted from an elevation of 920.000 m by having metallic volute pumps and will be delivered to DC 4 located at Haravanahalli.. The length of the raising main from DC-1 to DC 3 will be 7.60 Km.

## Routing of the raising main

The Raising Main has been aligned parallel and to the east of Southern Railway, Hassan District, Mangalore section, up to KM 3.60 Km, where the Raising Main will cross the railway line, through an elevated structure (since the railway line is cutting off about 25.00 meters) and there after the pipe line has been aligned parallel and to the west of the railway line.

The Raising Main will cross the Western Ghats Saddle at Km 4.50(RL 915.000 m and thereafter, it will cross the perennial Hemavathi River, having a width of 300.00 meters. It is proposed to cross the Hemavathi river above.by routing the pipeline over a bridge.

The Raising Main after crossing the Hemavathi river will enter Doddanagar Reserve Forest and covers a length of 0.7.kms and drains to Delivery Chamber No.3, located near Doddanagar Village at an elevation of 925.000 meters.

The entire alignment of the Pipe Line is routed through private lands and it is beyond the ROW of the railway line for the entire section, except for a length of about 0.7 Kms, where it will pass through Doddanagar Reserve Forest, which is unavoidable.

Note: The crossing of the railway line and Hemavathy River involves statutory clearance in terms of location, type of structures, and method of construction from concerned statutory authorities. Hence no provision has been made in the line estimate for these activities.

## Pumping Machinery:

Discharge to be pumped at Intermediate pumping station (DC-1) and pump head is 44.0 cumecs & 135.03 m respectively. The selection of pumping machinery shall be pumps and motors having high head and high discharge. The requirement does not falls under manufacturing range of vertical Turbine Pumps. The HT rating required shall be more than 10,000 KW, operating at 11 KV.

Considering the above limitations, it is imperative that selection of individual pump with regard to discharge and head shall be with a view to match the motor rating and have flexibility in achieving the total discharge of 44.00 Cumecs. Therefore, it is proposed to install Metallic Volute Pumps.

It is proposed to install 6 working and one standby pump, thereby discharging individual pump becomes

44 / 6 = 7.333 Cumecs x 3,600 = 26,400 $m^3$/hr.

- Type of Pump = Metallic Volute Pumps
- Efficiency of Pump = 92%
- Intake Level = 802.000 m

- Delivery Level = 925.000 m
- Static Head = 123.00 m
- Losses (Friction + pump internal+ other) = 12.03 m
- Total Pump Head = 135.03 m
- Number of Pumps = 6 working + 1 Standby
- Total Discharge = 44 Cumecs
- Discharge for each Pump = 7.333 Cumecs
- Capacity of each Pump = 15730 HP
- Total Installed Capacity = 82.11 MW
- Total Power Requirement = 68.82 MW
- Electrical Sub-station = 2 No's of 40 MVA 220KV/11KV

At Weir 8, 4.0 cumecs of water is being received from Weir 2 through DC5 by Gravity. Further, the divertible discharge at Weir 8 is 5.0 cumecs. 35.00 cumecs of water is being received from Weirs 6 &7 – totaling to 44.00 cumecs which is pumped to intermediate pumping station (DC-1).

## Intake Forebay

It is proposed to have an Intake forebay and a surge pool to divert the required quantity of water to the Jack well cum pump house.

## Jack Well cum pump house

A rectangular framed structure is proposed for construction of jack well cum pump house to accommodate 7 no's of Metallic volute pumps and motors. (6 working + 1 standy) are proposed to lift water towards Intermediate pumping station and DC – 3 near Doddanagar 2. The details of proposed jack well is as under.

- Intake Level = 802.000 m
- Length of Fore Bay = 24.00 m
- Minimum Water Level = 802.000 m
- Number of Pump Bays = 7

## Raising Main

Designing of M.S. Raising Main is based on following considerations:

i. Velocity of flow shall be as far as possible, limited to 2 mtr/sec.

ii. The diameter of pipes shall be around 3 mtrs considering the weight of pipe for handling and for ease of CM lining and guniting in site welding, etc.,

iii. Wall Thickness:

a. D/t ratio not exceeding 175.

b. Safe check for hoop stress

c. The thickness shall not be less than as specified in IS 1916

d. Check for design pressure 110% of pump head

e. Check for 150% of Working Pressure.

Details of proposed raising main are:

- Length of Raising Main = 7600.00 m
- Peak Discharge = 44.00 Cumecs
- Number of Rows = 3
- Discharge for each Row = 14.667 cumecs
- Velocity considered =2.1 m/sec
- Diameter of Pipe = 3.0 m
- Thickness of Pipe = 17.00 mm
- Coating Internal = 15.00 mm Thick cement concrete lining
- External coating = 25.00 mm Thick Guniting

Provision of surge protection works, air valves, scour valves are made in the estimate. Provision for thrust blocks and anchor blocks is also made in the estimate.

In absence of the field survey data and L-section of the raising main following assumptions are made.

Air valves- 1 No for every one Km

Scour valves- 1 No for every one km

Thrust blocks- 4 Nos for every one km provided at bends

Anchor blocks- 6 Nos considering 3 of nala crossing and 2 for every crossing.

## Power Requirement and electrical substation :

The total power requirement works out to 78.36 MVA. The power requirement is calculated taking into account of no. of working pumps and auxillary power supply.

The voltage level at which power is required is 11 KV and required transformer capacity is to receive 220 KV power stepping down to 11 KV for feeding HT motors.

It is proposed to install 220 KV/ 11 KV substations with 2 Nos of 40 MVA transformers.

## Delivery chamber

The common delivery chamber (DC-1) which receives water from Weir-6,7 & 8 will feed the water to Jack well cum pump house at Intermediate pumping station.

The details of DC-1 are as under:

- Bed Level = 800.50 m (with 0.50 m cushion)
- Full Supply Depth = 4.0 m
- Delivery Level = 805.00 m
- Top of Delivery Chamber = 805.45 m
- Discharge = 44.00 Cumecs
- Retention Time = 90 Seconds
- Capacity of Delivery Chamber =90 seconds x Discharge = 3960 Cum
- Size of Delivery Chamber = 29.9 m x 29.9 m x 5.4 m

- The side walls of the Delivery Chamber designing as RCC retaining walls considering all the loads.
- RCC Floor slab of 0.35 M thick is proposing for bed of Delivery Chamber.
- Cradle concrete is proposing below the delivery pipe for support.
- Friction blocks are proposing in the bed of Delivery Chamber for reducing wave effects.
- G I Hand rails are proposing around the Delivery chamber at top is proposed for additional safety.
- PVC Joints are providing between Toe slab of Retaining wall and base slab of Delivery Chamber

The pumped water from Intermediate pumping station is proposed to convey through raising main parallel to proposed raising main from weir-1 and delivered to common delivery chamber at Doddanagara (DC- 3). The Delivery chamber DC-3 is designed to hold combined discharge of 85 cumecs. is proposed to be laid. A delivery chamber (DC-1) at end of raising main is proposed for feeding the water to jack well at intermediate pumping station. Delivery chamber is designed for retention period of 1.50 minutes as adopted in running LI schemes in Karnataka.

The details of the proposed delivery chamber-3 are as under:

- Bed Level = 920.00 m (with 0.50 m cushion)
- Full supply depth = 4.45 m
- Delivery Level = 925.000 m
- Top of Delivery Chamber = 925.400 m
- Discharge = 85.0 Cumecs
- Retention Time = 90 Seconds
- Capacity of Delivery Chamber =90 seconds x Discharge = 7650.0 Cum
- Size of Delivery Chamber = 41.50 m x 41.50 m x 5.40 m

The cost of construction of DC-3 is included in Estimate-1 i.e. package estimate for pumping water from Weir-1 to DC-3 at Doddanagara.

## Geo technical Details

A preliminary reconnaissance of the project location indicates exposed rock at the bed of the river. Estimate for Jack well is prepared based on this soil strata.

Following soil classification is considered for estimation of trench cutting for raising main.

In All Kinds of Soils- 1.60 m

In soft rock- 1.90 m

In Hard rock- Balance depth of cut beyond 3.50 m

### 9.1.1.10 Details of lifting water from intermediate pumping station DC-3 to DC-4 at Haravanahalli

It is proposed to lift the combined discharge of 85.00 cumecs received from weir 1 and intermediate pumping station (DC-1) to DC- 4 at Haravanahalli by providing suitable lifting arrangements. A jack well cum pump house has been proposed to lift the received water. The water is conveyed to DC-4 through raising mains.

## Considerations for the Proposal and Design concept

## Components of the estimate

The present estimate includes:

- Provision towards detailed survey, investigations, preparation of designs and drawings for execution of the scheme.
- Design supply, installation and commissioning of pumping machinery and pump house electrical works.
- Construction of 220 KV/11 KV Electrical sub station
- Construction of fore bay and Jack well cum pump house
- Construction of raising main
- Construction of Delivery chamber-4
- Construction of Approach Road (AR-5), L=700 m
- Provision is made for Operation and maintenance of the lift scheme for 5 years

## Diversion of water from Intermediate Pumping Station (DC-1)

A jack well cum pump house is planned near Intermediate Pumping Station (DC-1). Metallic Volute pumps have been planned to be installed for lifting the water. The conveyance system will consist of MS pipe 5 rows each of 3.21 m dia. The raising main will off take from a jack well cum pump house from an elevation of 920.000 m (intake level) and discharge will be delivered to DC 4 located at Haravanahalli having an elevation of 965.000 m. The static head will be 45.00 m. The length of the raising main from DC-3 to DC 4 will be 8.80 Km.

## Routing of the raising main

The Raising Main has been aligned cross country from DC-3 upto DC-4 at Haravanahalli. Care has been taken to avoid settlements and fix the alignment economically.

## Pumping Machinery:

Discharge to be pumped at Intermediate pumping station (DC-3) and pump head is 85.0 cumecs and 58.22 m respectively. The selection of pumping machinery shall be pumps and motors having high head and high discharge. The requirement does not falls under manufacturing range of vertical Turbine Pumps. The HT rating required shall be more than 10,000 KW, operating at 11 KV.

Considering the above limitations, it is imperative that selection of individual pump with regard to discharge and head shall be with a view to match the motor rating and have flexibility in achieving the total discharge of 85.00 Cumecs. Therefore, it is proposed to install Metallic Volute Pumps.

It is proposed to install 5 working and one standby pump, thereby discharging individual pump becomes –

85 / 5 = 17 Cumecs X 3,600 = 61,200 $m^3$/hr.

- Type of Pump = Metallic Volute Pumps
- Efficiency of Pump = 92%
- Intake Level = 920.000 m
- Delivery Level = 965.000 m
- Static Head = 45.00 m
- Losses (Friction + pump internal+ other) = 13.22 m
- Total Pump Head = 58.22 m
- Number of Pumps = 5 working + 1 Standby
- Total Discharge = 85.00 Cumecs
- Discharge for each Pump = 17.00 Cumecs
- Capacity of each Pump = 15725 HP
- Total Installed Capacity = 70.38 MW
- Total Power Requirement = 54.88 MW
- Electrical Sub-station = 2 No’s of 35 MVA 220KV/11KV

41.00 cumecs of water is being received from Weir 1 is pumped to Intermediate pumping station (DC-3). 44.00 cumecs of water is being received from Intermediate pumping station (DC-1) is pumped to Intermediate pumping station (DC-3) – totaling to 85.00 cumecs which is pumped to Delivery chamber-4.

## Intake Forebay

It is proposed to have an Intake forebay and a surge pool to divert the required quantity of water to the Jack well cum pump house.

## Jack Well cum pump house

A rectangular framed structure is proposed for construction of jack well cum pump house to accommodate 6 no's of Metallic volute pumps and motors. (5 working + 1 standby) are proposed to lift water towards DC-4 near Haravanahalli. The details of proposed jack well is as under.

- Intake Level = 920.000 m
- Length of Surge Pool = 40.00 m
- Minimum Water Level = 920.000 m
- Number of Pump Bays = 6

## Raising Main

Designing of M.S. Raising Main is based on following considerations:

i. Velocity of flow shall be as far as possible, limited to 2 mtr/sec.

ii. The diameter of pipes shall be around 3 mtrs considering the weight of pipe for handling and for ease of CM lining and guniting in site welding, etc.,.

iii. Wall Thickness:

  f. D/t ratio not exceeding 175.

  g. Safe check for hoop stress

  h. The thickness shall not be less than as specified in IS 1916

  i. Check for design pressure 110% of pump head

  j. Check for 150% of Working Pressure.

Details of proposed raising main are:

- Length of Raising Main = 8800.00 m
- Peak Discharge = 85.00 Cumecs

- Number of Rows = 5
- Discharge for each Row = 17.00 cumecs
- Velocity considered =2.1 m/sec
- Diameter of Pipe = 3.21 m
- Thickness of Pipe = 18.00 mm
- Coating Internal = 15.00 mm Thick cement concrete lining
- External coating = 25.00 mm Thick Guniting

Provision of surge protection works, air valves, scour valves are made in the estimate. Provision for thrust blocks and anchor blocks is also made in the estimate.

In absence of the field survey data and L-section of the raising main following assumptions are made.

Air valves- 1 No for every one Km

Scour valves- 1 No for every one km

Thrust blocks- 4 Nos for every one km provided at bends

Anchor blocks- 6 Nos considering 3 of nala crossing and 2 for every crossing.

## Power Requirement and electrical sub station :

The total power requirement works out to 65.33 MVA. The power requirement is calculated taking into account of no. of working pumps and auxillary power supply.

The voltage level at which power is required is 11 KV and required transformer capacity is to receive 220 KV power stepping down to 11 KV for feeding HT motors.

It is proposed to install 220 KV/ 11 KV substation with 2 Nos of 35 MVA transformers.

## Delivery chamber

A delivery chamber (DC-4) at end of raising main is proposed for feeding the water to gravity canal. Delivery chamber is designed for retention period of 1.50 minutes as adopted in running LI schemes in Karnataka.

The details of the proposed delivery chamber are as under:

- Bed Level = 960.050 m (with 0.50 m cushion)
- Full Supply Depth = 4.0 m
- Driving head = 0.45 m

- Delivery Level = 965.000 m
- Top of Delivery Chamber = 965.450 m
- Discharge = 85.00 Cumecs
- Retention Time = 90 Seconds
- Capacity of Delivery Chamber =90 seconds x Discharge = 7650 Cum
- Size of Delivery Chamber = 41.5 m x 41.5 m x 5.40 m

➢ The side walls of the Delivery Chamber designing as RCC retaining walls considering all the loads.

➢ RCC Floor slab of 0.35 M thick is proposing for bed of Delivery Chamber.

➢ Cradle concrete is proposing below the delivery pipe for support.

➢ Friction blocks are proposing in the bed of Delivery Chamber for reducing wave effects.

➢ G I Hand rails are proposing around the Delivery chamber at top is proposed for additional safety.

➢ PVC Joints are providing between Toe slab of Retaining wall and base slab of Delivery Chamber

## Approach road to head works

It is proposed to construct an approach road -5 from NH-48 to IPS at Doddanagar. Total length of approach road works out to 700.0 m. It is proposed to construct a single lane rigid pavement for approach road.

## Geo technical Details

A preliminary reconnaissance of the project location indicates exposed rock at the bed of the river. Estimate for Jack well is prepared based on this soil strata.

Following soil classification is considered for estimation of trench cutting for raising main.

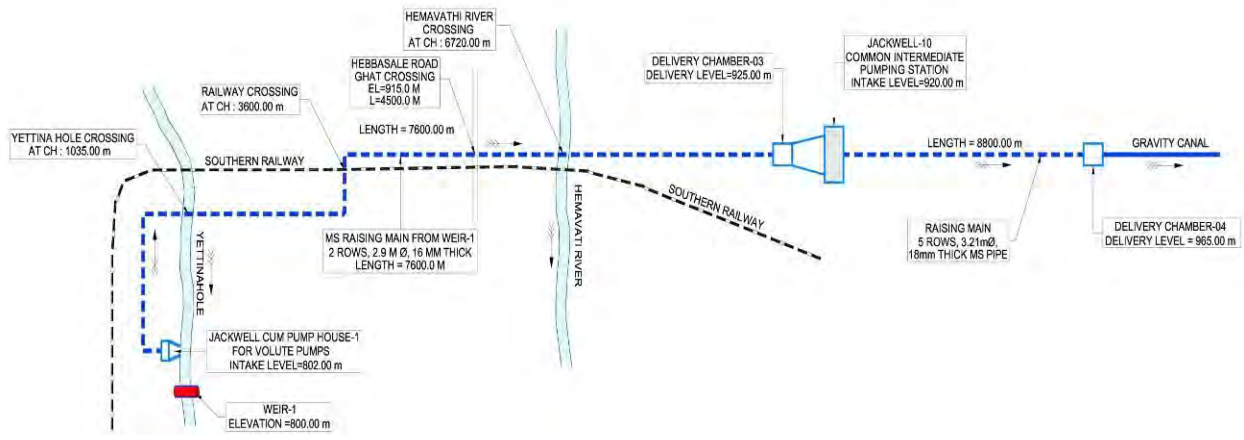
| | |
|---|---|
| In All Kinds of Soils- | 1.50 m |
| In soft rock- | 1.80 m |
| In Hard rock- | Balance depth of cut |

The project is proposed to be taken up in two phases. The details of the phase-1 & Phase -2 is already been innumerated in detail.

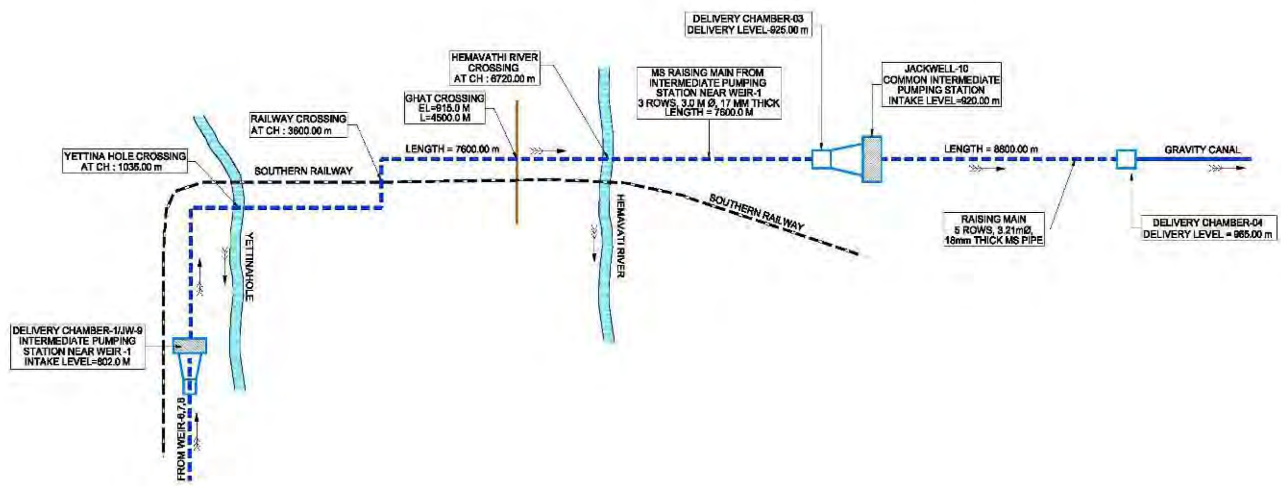
**Tree plan of the Phase 1 works is indicated below beyond 3.30 m**:

Phase 1 works consists of components in the initial reaches of Western Ghats, conveying water upto Delivery Chamber 4 located near Haravanahalli.

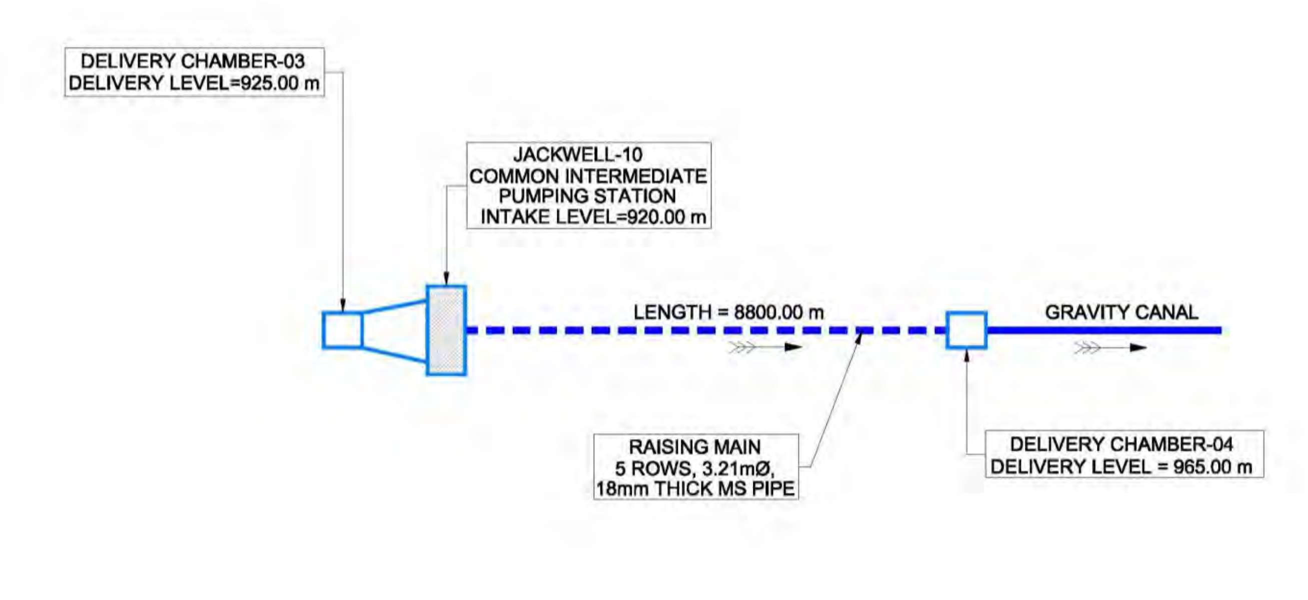
- Construction of Weir no 1, pumping station for housing metallic volute pumps, pumping machinery and MS rising mains for pumping 26.0 cumecs of water up to DC3 located near Doddanagara.



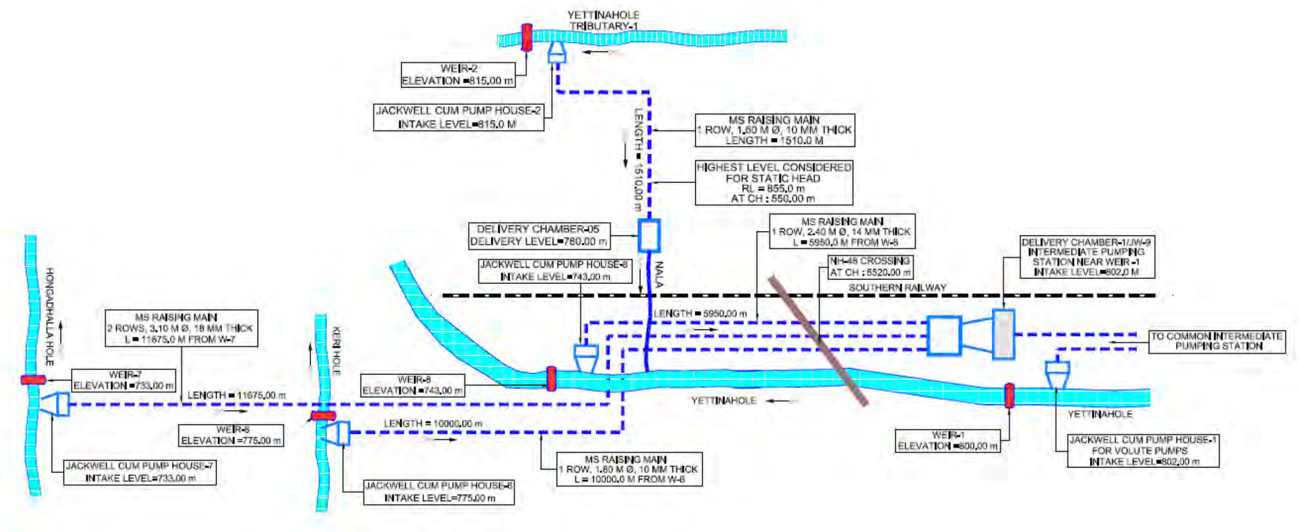

- Construction of lift scheme comprising of receiving chamber (DC-1) intake fore bay, surge pool, pumping station for housing metallic volute pumps, pumping machinery, pump house electrical works, electrical substation, raising main for pumping 44 cumecs of water up to DC3 located near Doddanagara



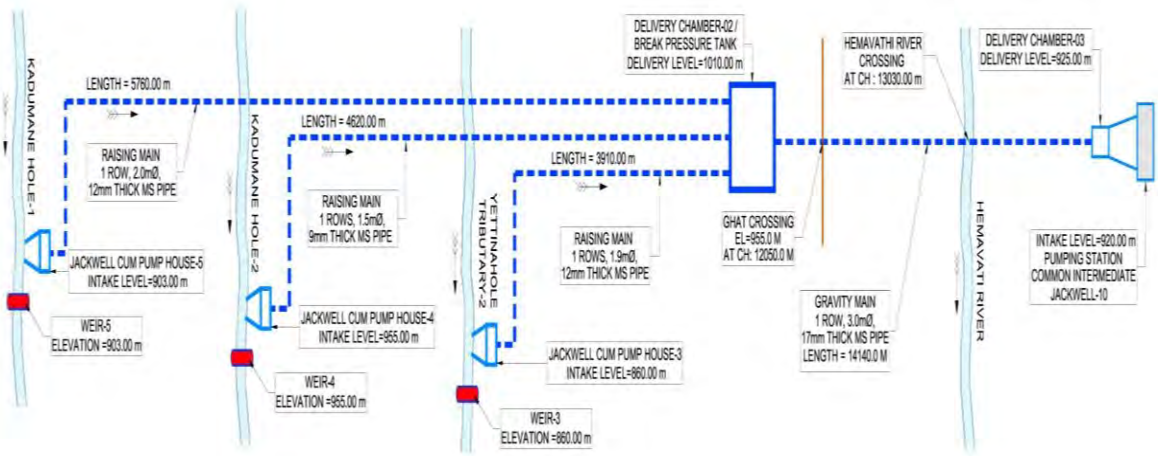
- Construction of Delivery chamber (DC-3), intermediate pumping station for housing metallic volute pumps, pumping machinery and MS rising mains for pumping 85 cumecs of water up to DC4 located near Haravanahalli.




- Construction of Weir no 2, 6, 7 & 8, jack well cum pump house on upstream of respective weirs for housing vertical turbine pumps and MS rising mains, in a common corridor for pumping 44.0 cumecs of water up to DC1 located near weir 1.




- Construction of Weir no 3, 4 & 5 and jack well cum pump house for housing vertical turbine pumps and MS rising mains, in a common corridor for pumping 15.0 cumecs of water to common Break Pressure tank (DC-2) and further flow by lifting it  to Intermediate pumping station (DC-3) located near Doddanagara.




## 9.1.2 Phase 2:

### 9.1.2.1 Gravity canal from DC-4:

Phase 2 works consists of the Gravity canal (of length 273.865 Km) from DC-4 near Haravanahalli upto the end point i.e., the proposed balancing reservoir near Bhairagondlu in Koratagere Taluk at RL +800.00 m The alignment is proposed to be routed avoiding as far as possible populated areas, forests etc.

The details of the alignment are indicated hereunder:

**1. Ch: 0+000 Km to 10+000 Km:**

The gravity canal in the initial reach from Km 0+000 to 3+000 generally runs in an undulating terrain upto 3Km where it takes a detour and runs in south east for a length of 660 m and again runs in the east direction upto Ch: 4+240 km. Here the alignment changes its direction and runs in the north east direction for a length of 1.30 Km where the alternative alignment-1 joins it. Further the alignment runs in North east and east direction upto 10+000 km again in an undulating terrain. The alignment is running through mainly coffee plantations in this reach.

**2. Ch: 10+000 Km to 20+000 Km:**

The alignment beyond 10+000 km runs in the north east direction upto Ch: 10+740 Km where it takes a detour and runs in the south east direction upto Ch: 11+480 Km. Here the canal takes a turn and runs in east direction upto Ch: 13+000 Km. The alignment then runs in North and northwest direction upto Ch: 15+390 Km where it takes a west direction upto Ch: 16+360 Km. The alignment then turns towards northwest upto Ch: 20+000 Km. In between , The alignment crosses State Highway 110 at Ch: 13+760 Km. An alternative alignment 2 has been proposed at Ch: 10+760 Km. Generally , the alignment passes through cultivable lands.

**3. Ch: 20+000 Km to 30+000 Km:**

The alignment generally runs in northwest direction upto Ch: 23+100 Km where it takes a detour and runs in east direction upto Ch: 25+100 Km. From here on, the alignment runs in northeast direction upto Ch: 23+340 Km where it turns and runs in the east direction upto Ch: 30+000 Km. The alignment crosses Yagachi river at Ch: 26+900 Km. Generally, the alignment passes through cultivable lands.

**4. Ch: 30+000 Km to 40+000 Km:**

The alignment runs in the northeast direction upto Ch: 32+100 Km where it takes the detour and travels in east direction upto Ch: 33+200 Km. Again, it takes a turn and runs in the North east direction upto Ch: 33+170 Km. It runs in east direction upto Ch: 35+100 Km and again in northeast direction upto Ch: 37+000 Km . Then it turns east and runs upto 38+100 Km from where it runs in northeast direction upto Ch: 39+100 Km from where it turns towards northwest and ends at Ch: 40+100 Km.

In between, the alignment crosses Hassan Belur road at Ch: 36+100 km. The terrain is undulating and the alignment passes through cultivable lands generally.

**5. Ch: 40+000 Km to 50+000 Km:**

The alignment generally runs in the north and northeast direction up Ch:44+000 Km where it takes a detour and runs in southeast direction upto Ch: 46+000 Km. Beyond this , the alignment runs in east and northeast direction upto Ch: 47+860 Km where it crosses State Highway 21 and proceeds further in North direction upto Ch: 48+350 Km. Then it takes a detour and runs in northwest and north direction upto Ch: 50+000 Km. The terrain is generally sloping towards east with some hill ranges in between. The alignment predominantly runs in cultivable lands.

**6. Ch: 50+000 Km to 60+000 Km:**

The alignment runs in North and northeast direction upto Ch: 51+680 Km where it takes a detour and travels in northwest direction upto Ch: 52+500 Km. The alignment, in between cuts across a MDR. From here on, the alignment runs in the north direction almost parallel to the existing road upto Ch:53+300 Km and again cuts across the same route and traverses in a northeast and predominantly east direction upto Ch:53+930 m and takes a detour towards northeast upto Ch:54+400 Km. It continues and takes a detour at Ch:54+920 Km and travels in predominantly southeast direction to reach Ch:56+400 Km. Again, it detours and takes a predominantly northeast direction to reach Ch: 58+960 Km and further travels in North and northeast direction to reach Ch: 60+000 Km. Generally, the alignment passes through cultivable lands

**7. Ch: 60+000 Km to 70+000 Km:**

The alignment beyond Ch: 60+100 Km travels predominantly in northwest direction upto Ch:61+750 Km wherein it takes a detour and travels in northeast direction upto Ch:63+040 Km where it takes a southeast direction upto Ch:63+600 Km. It then travels in northeast direction upto Ch: 64+350 Km, takes a turn towards east and travels upto Ch:63+400 Km. Here it turns towards south and reaches Ch: 65+140 Km where it takes a predominantly southeast direction Ch:68+000 Km, it then takes east and northeast direction upto Ch: 70+000 Km. It cuts across a Village road at Ch: 69+340 Km. Generally, the alignment passes through cultivable and barren lands

**8. Ch: 70+000 Km to 80+000 Km:**

The alignment runs in the northeast direction upto Ch:71+200 Km where it takes a detour and runs predominantly in northwest direction upto Ch:72+600 Km. It then takes a northeast direction and travels upto Ch:74+600 Km where in it takes a detour and travels in southeast direction upto Ch:74+910 Km. It then travels in east and northeast direction upto Ch: 75+100 Km. It then turns towards southeast and south upto Ch: 77+050 Km and travels in east and northeast direction upto Ch:77+900 Km. It takes a detour towards predominantly southeast direction and reaches Ch:79+030Km where it takes a east direction upto Ch: 80+000 Km. Generally, the alignment passes through cultivable and barren lands

**9. Ch: 80+000 Km to 90+000 Km:**

The alignment beyond Ch: 80+000 Km runs predominantly in south and southeast upto Ch: 80+650 Km wherein it turns towards southwest and travels upto Ch: 81+050 Km. From here, the alignment runs predominantly in southeast direction upto Ch:84+300 Km where it takes a detour and turns towards northeast travelling upto Ch:84+980 Km. The alignment runs in southeast and east direction upto Ch:85+960 Km. It then runs in northeast direction upto Ch:87+200 Km , takes a turn and travels in east direction upto Ch: 88+150 Km. It takes a turn towards southeast and reaches Ch:90+000 Km. In between , the alignment crosses the following roads.

1. Kalyadi to Haranahalli road at Ch:81+100 Km
2. A village road at Ch:83+980 Km
3. A major district road at Ch:84+900 Km
4. SH 102 at Ch:86+680 Km

The alignment from Ch:86+700 Km travels almost hugging the hillock, circumventing it before reaching Ch:90+000 Km. Generally, the alignment passes through cultivable and hilly area.

**10.Ch: 90+000 Km to 100+000 Km:**

The alignment takes a northeast and east direction and travels upto Ch:91+070 Km where it crosses an existing tank and further cuts across SH__ at Ch:91+400 Km, takes a detour at Ch:91+600 Km towards southeast and travels upto Ch:94+750 Km, turns towards the east and cuts across the SH___ and takes a north direction at Ch:95+080 Km, travels in the northeast direction upto Ch:96+400 Km. It then turns towards northwest upto Ch:97+000 Km, turn towards northeast upto Ch:98+150 Km , takes a slight detour and travels upto Ch:99+600 Km. It then turn towards southwest and then travels upto Ch:100+000 Km. Generally, the alignment passes through cultivable lands.

**11.Ch: 100+000 Km to 110+000 Km:**

The alignment will run upto Ch:100+250 Km , takes a turn towards east upto Ch:101+400 Km, takes a detour and runs in the northeast direction upto Ch:102+000 Km. It then further traverses and takes a detour towards east at Ch:102+600 Km. Further at Ch:103+000 Km , it takes a turn towards northeast upto Ch:103+700 Km, takes a turn towards east upto Ch:104+000 Km. It again follows the same pattern upto Ch:105+000 Km, where it turns towards southeast and east and travels upto Ch:105+400 Km. It then turn towards north and travels upto Ch:106+000 Km. From hereon, it travels in northwest direction upto Ch:106+600 Km, turns towards west and travels upto Ch:106+980 Km. It then takes a detour and travels in northwest and north direction at Ch:108+000 Km. Further on, it takes a north east direction upto Ch:108+550 Km turns towards northwest and predominantly runs upto Ch:110+000 Km in the same direction. The alignment cuts across SH 74 at Ch:106+980 Km. It cuts across Mallenahalli road at Ch:108+350 Km

**12.Ch: 110+000 Km to 120+000 Km:**

The alignment in the initial reaches runs in northwest direction , takes a detour towards northeast at Ch:110+200 Km and travels upto Ch:112+970 Km where it takes a right turn towards east and runs parallel to NH 73 upto Ch:113+800 Km, takes a turn towards northeast and cuts across NH 73 at Ch:114+100 Km. It then runs in northeast direction upto Ch:115+150 Km where it takes a slight detour towards right and runs in the same direction upto Ch:116+400 Km. In between, it cuts across Bangalore- Mumbai railway line at Ch:114+700 Km. Beyond this, it takes a little detour to the left and runs in northeast direction upto Ch:117+080 Km It then takes a turn and runs in South east direction upto Ch 117+450 Km, then turn towards north east and travels upto Ch117+850 Km. It turns towards South east at this point and continues in the same direction upto Ch 119+300Km. takes a slight detour to left and reaches Ch 120+000 Km.

Predominantly, the alignment passes through cultivable lands.

**13.Ch: 120+000 Km to 130+000 Km:**

From Ch:120+000 Km, the alignment runs parallel to the railway track till Ch:120+700 Km where it takes a detour and runs in northeast direction upto Ch:121+250 Km. It then takes a turn towards right and follows southeast direction upto Ch:122+100 Km. It then deviates and takes a northeast direction upto Ch:123+200 Km , again takes a right turn follows southeast direction upto Ch:126+700 Km. The alignment further travels in east direction upto Ch:128+100 Km where it changes direction and traverses in a northeast path upto Ch:130+000 Km.

The alignment in between crosses the following roads

1. Power house road from Tiptur at Ch:124+600 Km
2. SH 47 at Ch:124+870 Km
3. Tiptur-Halepalya road at Ch:125+500 Km
4. MDR from NH 73 to Halepalya at Ch:128+800 Km

Predominantly, the alignment passes through cultivable lands.

**14.Ch: 130+000 Km to 140+000 Km:**

The alignment at this juncture is running almost parallel to the Chikkanayakana halli – Tiptur road in a northeast direction. It traverses upto Ch: 131+050 Km where it detours slightly towards right, cuts across Chikkanayakana halli – Tiptur road at Ch:131+400 Km travels upto Ch:131+550 Km. Here, it turns towards left follows , northeast direction running almost parallel to Chikkanayakana halli – Tiptur road upto Ch:131+950 Km where it takes right turn and traverses in east direction upto Ch:132+370 Km, changes direction to left and traverses upto Ch:132+800 Km. Here again it takes a detour and turns towards southeast direction upto Ch:134+000 Km where it crosses a MDR connecting NH 73 with Chikkanayakana halli – Tiptur road. Beyond this it takes a deviation towards northeast upto Ch:134+700 Km, where it takes a detour, follows north and northeast direction upto Ch:136+000 Km. Here it continues in the same direction upto Ch:136+400 Km where it again turns towards left and follows a north direction upto Ch:137+450 Km. The alignment then runs in northeast direction upto Ch:139+100 Km where it takes a detour and moves in southeast direction upto Ch:139+450 Km. It again turns towards left, follows a predominantly east direction upto Ch:139+750 Km where it takes a turn towards right , follows southeast direction and ends at Ch:140+000 Km.

**15.Ch: 140+000 Km to 150+000 Km:**

The alignment runs in southeast direction upto Ch: 140+700 Km, turns left and runs in northeast direction upto Ch:141+700 Km. It then runs in southeast direction upto Ch:142+080 Km where it takes a left turn and runs in northeast direction upto Ch:142+700 Km, turns towards east and traverses upto Ch:143+030 Km. Here it takes a turn towards southeast and runs upto Ch:144+410 Km. It again detours and traverses in northeast direction upto Ch:145+430 Km, changes its course and runs in north and northwest direction up Ch:146+700 Km. From here on, it takes a right turn and traverses in northeast direction upto Ch:147+860 Km. It then turns towards right and follows east direction upto Ch:148+440 Km where it turn right and travels upto Ch:148+760 Km, it then turns left and follows northeast direction upto Ch:149+400 Km. It then follows a northwest direction upto Ch:150+000 Km. No major crossing are expected in this alignment. The alignment runs in hilly areas in the initial reaches followed by cultivable lands.

**16.Ch: 150+000 Km to 160+000 Km:**

The alignment then runs in north and northeast direction upto Ch: 151+950 Km where it takes a right turn and travels upto Ch: 152+360 Km. From here on , the alignment detours and follows a southeast direction upto Ch:156+570 Km where it deviates a little towards left and continues upto Ch:159+000 Km. Here again it turn towards southeast and travels upto Ch:160+000 Km. It crosses SH 58 at Ch:153+350 Km. The alignment runs generally in cultivable lands.

**17.Ch: 160+000 Km to 169+000 Km:**

The alignment crosses NH 73 at Ch:160+140 Km and traverses predominantly in southeast direction upto Ch:161+950 Km where it turns left and traverses upto Ch:162+750 Km. Here, it turns towards northeast direction and travels upto Ch:163+200 Km. It then detours and travels in southeast direction upto Ch:165+180 Km. Here it takes a right turn and travels upto Ch:165+480 Km. It then turns towards southwest and travels upto Ch:166+080 Km where it takes a left turn and follows a southeast direction upto Ch:166+700 Km and then crosses the road connecting NH 73 with Ammasandra at Ch:166+850 Km. It then proceeds in the same direction upto Ch:167+100 Km where it takes a turn towards left and follows predominantly northeast direction upto Ch:169+100 Km. Here, it turns towards right and follows southeast direction upto Ch:169.00 Km

**18.Ch: 169.00 Km to 180+000 Km:**

The alignment takes a detour towards Northeast at CH 169.000 follows in the same direction upto CH 169+100 Km where it turns towards North and moves in the same direction (almost North Northeast) and reaches CH 170 + 050 Km where again it turns towards Northeast and travels upto 170+500Km , takes a turn towards right, follows Northeast direction to reach CH 172+600 Km. Here, it takes deviation towards North Northeast and travels upto CH 173+900 Km. From hereon, it detour and continues in the Northeast direction upto CH 175+600, again detour towards North Northeast continues upto 176+800 Km. Here, it takes a right turn continues in the nOrtheast direction upto CH 179+050, turns towards left, and reaches 179+600 Km. where it again turns towards left and goes in the north Northwest direction upto CH 180+000Km. In between, the alignment crosses through Neralekere - Doddaguni Road , at CH 174+400 Km, then it crosses another road at CH 174+ 700 Km. It crosses Sigehalli – Doddaguni Road at CH 175+550 Km. Generally the alignment runs in irrigable lands and with some hillocs encountered in between.

**19.Ch: 180+000 Km to 190+000 Km:**

The alignment, from 180+050 takes a deviation towards right, follows a northeast direction upto CH 184, where it takes a deviation towards right, follows Eastern direction upto CH 186+000 Km, where it takes a detour towards left follows northeast direction upto CH 186+900 Km. Here it takes a turn towards left follows North-Northwest direction upto CH 189+650 Km. It then takes a turn and follows North direction till it reaches CH 190+000 Km. The alignment, generally runs in irrigable lands upto CH 184+250 Km beyond which it runs in dry lands upto CH 189+600 Km, where it encounters irrigable lands upto CH 190+000 Km.

**20. Ch: 190+000 Km to 200+000 Km:**

The alignment beyond CH 190+000 Km. continues in North direction upto CH 190+900 Km where it takes a slight right turn and reaches 192+000 Km, wherein it takes a detour towards right continues in the East direction upto CH 193+300 Km. It then takes a turn towards left, and follows Northeast direction upto 196+150 Km. It then turns towards right, follows to Southeast direction upto CH 196+500 Km. Here, it turns towards south and reaches CH 198+000 Km. The alignment, then turns towards left follows Southeast direction upto CH198+700 Km. where it takes complete left and follows northeast direction upto CH 200 Km . In between, the alignment runs in dry and cultivable lands.

**21.Ch: 200+000 Km to 210+000 Km:**

At CH 200+000 Km, the alignmnent deviates towards left and continues in the Northeast direction upto CH 201+900 Km. Where it turns towards left and travels in the North direction upto CH 202+150 Km, takes a deviation towards left and continues in North Northwest direction upto CH 203+600 Km. It deviates towards right follows Northeast direction upto CH 206+300 Km, beyond which it follows Northeast direction upto CH 206+750 Km. It deviates towards right follows the East direction upto CH 207+600 Km. where it takes a right turn continues in East Southeast direction upto CH 208+000 Km. It then takes a turn towards left and continues upto CH 208+900 Km. where it deviates and follows East Northeast direction upto CH 209+300 Km. Here it takes a detour and continues in East direction upto CH 210+000 Km. The alignment , passes through cultivable lands for short distances.

**22.Ch: 210+000 Km to 220+000 Km:**

The alignment, further continues in the East direction upto CH 208+500 Km. where it meets a valley. An aqueduct in proposed to be constructed from this point in order to maintain the level and address the level difference. The aqueduct continues upto 211+500 Km. The Aqueduct then takes a right turn, continues in Southeast direction upto CH 215+000 Km. The aqueduct then turns left and continues in Southeast direction upto CH 218+100 Km. again takes a slight bend towards left and reaches CH 220+000 Km. The alignment in this streach generally runs in cultivable lands.

**23. Ch: 220+000 Km to 230+000 Km**

The Aqueduct continues in the same direction upto Ch:220+600 Km, where it turns towads left and follows Northeast direction upto CH 221+000 Km. where it culminates. The canal (alignment) then continues upto 223+300 Km. where again it turns towardsright and follows Northeast direction upto CH 224+300 Km, it then turns towards left and continues in Northeast direction upto CH 226+200 Km. where it crosses NH 4.

It then turns towards right continues in the same direction upto CH 228+000 Km. where it turns towards left and continues in North – Northeast direction upto CH 229+000 Km. It then detours towards right and continues in Northeast direction upto CH 230+000 Km.

**24. Ch: 230+000 Km to 240+000 Km:**

The alignment further runs in same direction upto CH:230+600 Km, where it takes a turn towards right and follows predominantly East – Northeast direction upto CH 231+500 Km. Then turns towards southeast and continues upto CH 232+000 Km.. Beyond 232+000 Km. it agsin turns towards right and continues in Southeast direction upto CH 234+000 Km. It then turns towards left follows a predominantly East – Northeast direction upto CH 234+400 Km where it turns right and follows Southeast direction upto CH 236+200 Km. It then turns towards right and follows predominantly South-Southeast direction upto CH 237+000 Km. and continues beyond in Southeast direction upto CH 238+300 Km. where it turns towards left continues upto 238+600 Km. and further turns right and continues upto CH 239+200 Km, continues beyond in Southeast direction upto CH 240+200 Km.

**25. Ch: 240+000 Km to 250+000 Km:**

The alignment runs in the same direction upto Ch: 240+100 Km. where it turns slightly towards right continues in Southeast direction upto CH 241+100 Km it then turns towards left follows a predominantly East – Southeast direction upto CH 242+400 Km. where it crosses an MDR and continues in the same direction upto CH 243+150 Km. where it turns slightly towards left and continues upto CH 244+000 Km. and continues beyond upto CH 245+850 Km. where it turns towards left, follows Northeast direction upto CH 246+500 Km crossing a hillock and then turns towards east continues in the same direction upto CH 248+600 Km. It then turns towards left, follows predominantly East-Northeast direction upto CH 250+000 Km.

**26. Ch: 250+000 Km to 260+000 Km:**

The alignment continues in the same direction upto CH 250+100 Km. where it takes a right turn and continues in the East direction upto CH .251+900 Km. where it takes a turn towards right and follows Southeast direction upto CH. 253+300 Km. where it again turns right further and continues upto CH 254+100 Km. It then turns towards right and follows predominantly South –Southwest direction upto CH. 254+600 Km. It then turns towards right continues in the Southwest direction upto CH 255+900 Km. where it turns towards left and takes a Southeast direction upto CH 256+650 Km. it again turns towards left and further continues in predominantly East-Southeast direction and continues beyond upto CH 258+650 Km. It then turns towards left and follows Northeast direction. and continues beyond upto CH .260+000 Km.

**27. Ch: 250+000 Km to 260+000 Km:**

The alignment continues is in the same direction upto CH 260+100 where it takes a left turn and follows predominantly North-Northeast direction upto Ch. 261+000 Km. here it takes a deviation towards right and follows Northeast direction upto Ch 261+750 Km. takes a slight detour towards right and continues upto CH 262+650 Km. It then turns towards right and follows a predominantly East Southeast direction upto CH 263+300 Km takes a right turn continues upto Ch. 263+750 Km. and further takes a left turn and continues in the Southeast direction upto CH 264+700 Km. it then turns towards right continues in Predominantly South-Southeast direction upto Ch . 266+700 Km. It turns towards left, takes a southeast direction upto CH . 267+800 Km. It then turns towards right follows predominantly south –southeast direction upto CH. 269+100 Km. where it takes a turn towards left follows Southeast direction, crosses in MDR at CH. 269+650 Km. and reaches CH 270+000 Km.

**28. Ch: 270+000 Km to 273+865 Km:**

The alignment then takes a turn towards left in the east direction, continues upto CH 271+300 Km. where it turns towards right and follows Southeast direction upto CH. 273+700 Km. where it turns towards East and reaches the starting point of balancing reservoir at Bhairagondlu at CH. 273+865 Km.

### 9.1.3 Beyond Gravity Canal- Balancing Reservoir at Bhairagondlu in Koratagere taluk

The Gravity canal ends at Ch 273+865 km draining the water into the balancing reservoir at Bhairagondlu. The reservoir is an earthen dam and located at RL + 800.00 m. It has a capacity of 5.78 TMC.

The gravity canal, then continues to run beyond the reservoir as a feeder canal towards Gowribidanur to carry the tank filling component.

From the reservoir, a raising main of length 45.0 km runs and reaches RL + 915.00m, where it ends. From this raising main, the drinking water and the tank filling of Kolar, Chikkaballapur Districts along with Nelmangala, Devanahalli, Doddaballapur & Hoskote Taluks including drinking water to Devanahalli Industrial area and surrounding areas is proposed to be met with.

Balancing Reservoir

A balancing reservoir is proposed near Bhairagondlu with a capacity 5.78 TMC. The details are as under:

| | | |
|---|---|---|
| Length of dam | : | 2900.0 m |
| Location | : | Across Garudachala stream, Upstream of Mavaturu Kere near Bairagondlu village |
| Water spread area | : | 1800 Ha |
| Full Reservoir Level (FRL) | : | 800.0 m |

| | | |
|---|---|---|
| Capacity | : | 5.783 TMC |
| Villages under submergence | : | Veerasagar, Lakkamuttanahalli, Belladahalli, Gajamenahalli, Sugadahalli, Lakkenhalli, Garadagallu |
| Roads under submergence | : | 15990.0 m |
| Forest under submergence | : | Nil |
| Latitude | : | 13° 24' 23" |
| Longitude | : | 77° 20' 9" |
| Toposheet No | : | 57 G 07 |
| Taluk | : | Koratagere & Dodballapur |
| District | : | Tumkur & Bangalore rural |
| Basin | : | North Pennar |

Raising main beyond the balancing Reservoir

Beyond the balancing reservoir, a raising main of length 45.0 Km is proposed to carry the required quntum of water towards Kolar and Chikkaballapur districts. The same raising main will also cater to the drinking water needs and tank filling in Nelmangala, Doddaballapura, Devanahalli and Hoskote taluks of Bangalore rural district including drinking water supply to Devanahalli industrial area.

## 9.1.4 Geology, Seismicity and foundation – Brief


The project area lies in the seismic Zone II which indicates that the seismic activity is least in these areas. The area lies in a geographical formation of weathered and fractured gneiss, granite and schist.

## 9.1.5 Choice of final layout of all major components of the project

### 9.1.5.1 Selection of the Sub-Basin/Catchment

There are several streams which are very close to the Sakleshpura which have been selected for harnessing water. It is proposed to construct diversion weirs at an elevation of around RL +800 m and down upto RL +730m. These weirs form the starting point of lifting component envisaged in the project. The water collected in these weirs during the peak monsoon months from June to November (excess flow) is proposed to be lifted and taken beyond the western ghats for further conveying it to the needy areas of Kolar, Chikkaballapur parts of Tumkur, Bangalore Rural and Ramanagara Districts. En-route the alignment, it is proposed to identify needy areas which are to be provided with the drinking water facility.

Western Ghats is home to thousands of animal species including at least 325 globally endangered species. For ensuring ecological balance and sustainability of various species in the Western Ghats, it is of paramount importance that any scheme proposed should have least impact on the environment and also not affect its beneficiaries on the downstream side. Hence water will be diverted only during peak monsoon that too for a limited period.

It is prudent to mention that the developmental projects in the coastal region namely for power generation (example Sharavathy, Kali, Varahi etc.) has not resulted in any ecological imbalance in the region. If the present scheme is compared to already developed projects in the Western Ghats, the extent of impact on environment is negligible and is not expected to bring any major ecological impact on the basin.

Yettinahole and other streams have been considered for harnessing water, since it is encountered immediately after entering Western Ghats. The extent of catchment area as per the study is about 176.74 sq. km.

### 9.1.6 River diversion arrangements

The project envisages diverting water from the streams like Yettinahole, Kadumanehole, Kerihole and Hongadahalla on the upper reaches of the Western Ghats to the eastern plateau.

It is proposed to construct about eight weirs across the streams, the details of which are given below.

**Table 9.1: Details of the streams and catchment area**

| No. | Name of the stream | Geographical location | | Elevation (m) | Catchment area (Sq. Km) | Remarks |
|---|---|---|---|---|---|---|
| | | Latitude | Longitude | | | |
| 1 | Yettinahole | 12° 54' 35" N | 75° 44' 11" E | 800 | 48.80 | 1 |
| 2 | Yettinahole Tributary - 1 | 12° 52' 23' 'N | 75° 42' 46" E | 813 | 7.20 | 2 |
| 3 | Yettinahole Tributary– 2 | 12° 53' 22" N | 75° 41' 01" E | 860 | 9.80 | 3 |
| 4 | Kadumane hole – 2 | 12° 53' 37" N | 75° 39' 31" E | 955 | 7.49 | 4 |
| 5 | Kadumane hole-1 | 12° 54' 26" N | 75° 39' 03" E | 903 | 13.79 | 5 |
| 6 | Kerihole | 12° 49' 52" N | 75° 43' 07" E | 775 | 24.25 | 6 |
| 7 | Hongada halla | 12° 48' 04" N | 75° 42' 42" E | 733 | 53.80 | 7 |
| 8 | Yettinahole down stream | 12° 51' 46" N | 75° 43' 27" E | 743 | 11.61 | 8 |
| | | | | **Grand Total** | **176.74** | |

The available divertible water will then be lifted and conveyed to the eastern plateau by providing proper lifting arrangements and appurtenant structures.

# 9.2 `Weirs / Head regulators

## 9.2.1 Yettinahole, Kadumanehole 1 & 2

Yettinahole is one of the major streams originating in the upper reaches of Western Ghats. A weir (**Weir 1)** is proposed across Yettinahole, to tap the discharge from a catchment area of about 48.8 $km^2$. Water intercepted by this weir is to be diverted to the east.

**Weir 3** is proposed across its tributary, and water from this will be let to DC 2 after initial pumping and Delivering to it.

Further augmentation of the water is proposed by harnessing Kadumane Hole 1 and 2 by proposing **Weir No. 4 and 5** respectively.. The discharge from weirs 3, 4, and 5 will be lifted and conveyed to DC 2 beyond which it is poposed to take the water by gravity and discharging it to the Intermediate pumping station ( DC3) located near Doddanagara directly.. The discharge from Weir 1 is also conveyed to DC3 through a raising main.

The catchment areas of the weirs (1, 3, 4 & 5) are given in Table 7.2.

**Table 9.2: Catchment Areas of the Weirs (1, 3, 4 & 5)**

| Sl NO | Weir | Catchment Area in Sq.Km | Remarks |
|---|---|---|---|
| 1 | Weir 1 | 48.8 | All the Weirs are located on right side of the NH 48 while travelling from Sakleshpur to Mangalore. The discharges from Weir 3, 4 and 5 will be diverted to Weir 1. |
| 2 | Weir 3 | 9.8 | |
| 3 | Weir 4 | 13.79 | |
| 4 | Weir 5 | 7.49 | |
| | **Total** | **79.88** | |

## 9.2.2 Yettinahole downstream of Weir 1, Yettinahole Tributary 1, Kerihole and Hongadahalla

Diversion weirs have been proposed across Kerihole (**Weir 6**), Hongadahalla (**Weir 7**), Yettinahole downstream of Weir 1 (**Weir 8**) and Yettinahole Tributary 1 **(Weir 2).** The discharge from Weir 6 and Weir 7 will be diverted to DC 1 by having independent raising mains. The water from Yettinahole tributary 1 (Weir 2) will be diverted through a raising main discharging into DC-5 from where the water will travel through a natural nala to Weir 8.

A jack well cum pump house has been proposed on the foreshore of Weir 8 (right flank) and the water is conveyed through raising mains to (DC 1). Dedicated pipelines (Raising Mains) have been planned to convey the water by pumping through raising mains, from weirs 6, 7 and 8 up to (DC 1)/Jack well cum pump house.

The water from DC 1, combined discharge of Weir 1, 6,7 & 8 is then lifted and conveyed to DC3 near Doddanagara. Further negotiation of level is required before the water can enter into the Eastern plateau. This has necessitated providing an additional delivery chamber (DC 4) located near Haravanahalli in Sakleshpur Taluk. At Doddanagara, the elevation is RL +920.00 m and at Haravanahalli it is RL +960m. Suitable liftinig arrangements have been provided at DC 3 and the water collected in it is then lifted and conveyed to DC 4.

The catchment areas of the weirs (2, 6, 7 & 8) are given in Table 7.3.

**Table 9.3: Catchment Areas of the Weirs (2,6,7 & 8)**

| Sl NO | Weir | Catchment Area in Sq. Km | Remarks |
|---|---|---|---|
| 1 | Weir 2 | 7.2 | All the weirs are located on the left side of the NH 48 while travelling from Sakleshpur to Mangalore. The discharges from Weir 2, will be diverted to Weir 8 and the combined discharge of weir 2 and 8 along with the discharges from 6 & 7 will be conveyed to DC 1 through independent raising mains |
| 2 | Weir 6 | 24.25 | |
| 3 | Weir 7 | 55.52 | |
| 4 | Weir 8 | 12.06 | |
| | **Total** | **99.03** | |

For the locations of the weirs, catchment area and the alignment of the conveyance system from the respective weirs, Jack well cum pump house till it crosses the saddle of the Western Ghats, refer Index map.

## 9.3 Gates, types, size and hoist arrangements

The weirs are proposed to be constructed upto the height of the existing banks and allowing the excess flood to flow over it. As such, no gates/ hoisting arrangements are envisaged.

## 9.4 Conveyance pipes and Canal

### 9.4.1 Description of Conveyance and canal system

The project being a drinking water supply scheme envisages construction of weirs, suitable lifting arrangements and appurtenant structures including the gravity canal after crossing the western ghat ridge. The details of the conveyance system are given below.

a) Raising mains in the initial reaches

b) Gravity canal

c) Raising main beyond the gravity canal

### 9.4.2 Study of integrated network of Conveyance and canal system

As could be seen from the above, sufficient care has been taken to integrate the network of conveyance and canal system to have an optimum system of conveyance of the available yield from the upper reaches of the Western Ghats to the eastern plateau.

### 9.4.3 Design of canal network

The canal has been designed considering the discharge as 85.0 cumecs to be conveyed upto the balancing reservoir.

### 9.4.4 Cross section of canals:

Generally Trapezoidal section is proposed. Box sections are proposed for cross drainage works and Trough sections for aqueduct reaches. Full supply depth of 4.5 m is maintained for the entire length of gravity canal with varying bed width based on the cutting / banking reaches and bed gradients. A free board of 1 m is provided.

### 9.4.5 Proportion of Bed width to Depth of canal:

B/D ratio = 1.0 to 2.50.

### 9.4.6 Design of Canal

For calculating the velocity, Manning formula is used as under

$V=1/N \times R^{2/3} \times (S)^{1/2}$.

Where

R = Hydraulic mean depth in mtrs (A/P)

A = Area of flow in $m^2$

P = Wetted perimeter in m.

S = Canal Bed slope

N = Co-efficient of rugosity

V = Mean value of flow in m/sec.

**Q = A x V Cumecs**

Where Q = Discharge capacity in cumecs.

**Rugosity Co-efficient N Value.**

For Lined Section 0.018

### 9.4.7 Normal Bed gradient:

The bed gradient of Gravity canal 1: 7500, Further the Bed gradient is changed to Steeper slope of 1: 6000 in deep cut reaches and aqueduct reaches. A bed gradient of 1:2000 is proposed wherever aqueducts are proposed to accommodate the head loss for the structure.

### 9.4.8 Top width of canal banks.

Service Road : 4.5m

Inspection Path : 4.5m.

### 9.4.9 Allowable Velocity in Canals:

For Lined canals:

1. Main canal /Branch Canal - 0.7 to 1.5m/s
2. Type of lining and Thickness:
   a. In situ concrete (M-15-20) paver lining for side slopes 1:1 & 1.5:1.

### 9.4.10 Lining in Canals:

The Canal is proposed to have a CC M-15 grade paver lining for a thickness of 10 cm. Hence a side slope of 1:1 or 1.5:1 is maintained in the water prism as per section design and beyond the water prism the slope of the canal changes as per the soil conditions. The following are the side slopes for the canal met with different soil condition above water prism is as follows:

a. HR = 0.25:1
b. SR,SRB = 0.5:1
c. AKS =1:1
d. BCS=1.5:1

A free board of 1.0 m is provided and the canal is lined upto half free board level.

## 9.4.11 Lining in expansive soils:

The thickness of CNS layer depends upon the swelling characteristics of the expansive soils, the recommended thickness is as bellow.

| No. | Discharge in the canal(cumecs) | Thickness of CNS layer in cms. | |
|---|---|---|---|
| | | Swell pressure of expansive soil 50 KN/m$^2$ to150 KN/m$^2$ | Swell pressure of expansive soil more than 150 KN/m$^2$ |
| 1 | More than 2.124 cumecs | 75 | 90 |
| 2 | 1.416 to 2.124 cumecs | 60 | 75 |
| 3 | 0.708 to 1.416 cumecs | 50 | 60 |
| 4 | 0.283 to 0.708 cumecs | 40 | 50 |
| 5 | 0.028 to 0.283 cumecs | 30 | 40 |

For the field channels in full cutting reaches it is not necessary to provide CNS treatment behind lining, even if the channel is running in expansive soils.

**Berms in Canal:**

A Berm of 3.0 m width is proposed on both sides for laying rail for Paver machine. Berms of 1 m width are proposed in deep cuts for every 6 m depth above Free Board Level upto Ground Level.

**Side drains:**

Side drain of size 0.50m x 0.50m is proposed with a side slope of 1:1on IP side for a depth of 0.5 m.

**Embankment reaches:**

An outer side slope of 2: 1 is proposed for banking reaches. Hearting is proposed at Top of Lining level i.e., at FSL + ½ times free board. The top width of hearting is 0.5 m. with a side slope of 0.25:1 on both sides. Key trench is also provided with a bottom width of 2.2 m and depth of key trench as maximum value of h/2 or

2.50 m with a side slope of 0.5:1. Inclined filters are provided throughout the heavy embankment reaches for a width of 0.6m. Mat filter is proposed at 6m interval c/c for a width of 1m and depth of 0.6m. Provision for rock toe and toe drains are also done on either sides.

**Template walls:**

CC M-15 Template walls of 200 x 150 mm thick are proposed at every 15 m c/c in straight reach and at every 10 m c/c in the curved reach.

**Expansion Joint:**

Expansion joints are provided at 75 m c/c.

**Transition reaches:**

A Transition is proposed wherever the bed width of the canal changes due to change in side slope. A transition of 1 in 5 is provided and the transition length is checked at Full Supply level as well as the bed level, the maximum is considered.

The Hydraulic particulars for the cutting reaches are as mentioned below:

| No. | Particulars | |
|---|---|---|
| 1 | Discharge required in Cumecs | 93.5 |
| 2 | Discharge designed in Cumecs | 94.009 |
| `3 | Canal Section (m) B x D | 11.30 x 4.50 |
| 4 | Side slope (H : V) | 1:1 |
| 5 | Velocity in m/sec | 1.322 |
| 6 | n - Rugosity Coefficient | 0.018 |
| 7 | Bed Gradient | 1:7500 |
| 8 | Total free board -m | 1.00 |
| 9 | Lined free board-m | 0.50 |

The Hydraulic particulars for the Deep cut /Partial cutting reaches are as mentioned below:

| No. | Particulars | |
|---|---|---|
| 1 | Discharge required in Cumecs | 93.5 |
| 2 | Discharge designed in Cumecs | 97.746 |
| 3 | Canal Section (m) B x D | 10 x 4.50 |
| 4 | Side slope (H : V) | 1.5:1 |
| 5 | Velocity in m/sec | 1.297 |
| 6 | n - Rugosity Coefficient | 0.018 |
| 7 | Bed Gradient | 1:7500 |
| 8 | Total free board -m | 1.00 |
| 9 | Lined free board-m | 0.50 |

## 9.4.12 Structures

**C-D works:**

Suitable cross-drainage structures such as Super Passages, Box culverts are proposed for nala / valley crossings syphons are generally avoided.

**Regulators:**

Cross regulators at every 15 km along the gravity canal are proposed and also prior to major nala crossings. cross regulators are located preferably before high embankment reaches, aqueducts and major off takes and wherever bed gradient changes.

**Aqueducts:**

RCC Trough Aqueducts are proposed wherever heavy banking (i.e., where ever bed filling of 6 m) reaches are identified.

**Bridges:**

Road Bridges are proposed as per MOST for all major Road crossings such as National Highway, State Highway, and MDR. Village road bridges are proposed for metalled / mud road crossings, Cart track crossings.

**Diversion works:**

Diversion of nalas / valleys are proposed to nearest C-D works if discharge of nala /valley is less than
1 cumec and length of diversion is within 300m.

### 9.4.13 Storage of water just before pumping and after pumping for ensuring uninterrupted water supply

It is proposed to allow the excess water during the peak monsoon above the weir to flow into the downstream. However, the water collected in the weir upto the top level will be pumped continuously on 24x7 basis.

The water will then be pumped by using the required capacities of pumps provided in the Jackwell cum pumphouse located at suitable places.

This water will then be temporarily stored in the intermediate delivery chamber (DC3 located near Doddanagara) enroute to the main delivery chamber DC 4 located near Haravanahalli from where the water will be conveyed through a gravity canal of length 273+865 Km directly in to the balancing reservoir located near Bhairagondlu in Koratagere Taluk. From here on, it is then conveyed through a raising main to further distribute it to the identified areas, the details of which are enunciated else where in the report.

## 9.5 Canal structures

The project envisages the following structures to be constructed for successful completion.

| No | Type of Structure | Total |
|---|---|---|
| 1. | Super passage | 167 |
| 2. | Super passage cum Village Road Bridge | 13 |
| 3. | Box culvert | 111 |
| 4. | Drop culvert | 32 |
| 5. | Village Road Bridge | 140 |
| 6. | Road Bridge | 121 |

| | | |
|---|---|---|
| 7. | Aqueduct | 12 |
| 8. | Canal regulator/Escapes | 16 |
| 9. | Head regulators | 7 |
| 10. | Measuring device | 10 |
| 11. | Crossing for Railway Bridge | 1 |
| 12. | Crossing for State Highway | 1 |
| 13. | Crossing for National Highway | 1 |

## 9.6 Power house

No Power generation is envisaged.in the present proposal

# Chapter 10
# Balancing Reservoir

A balancing reservoir with a capacity of 5.78 TMC is proposed to be constructed near Bhairagondlu in Korategere Taluk to facilitate continuous supply of water to the Drought prone Districts of Kolar and Chikkaballapura along with taluks of Bangalore rural including drinking water supply to Devanahalli Industrial area and surrounding areas.

Fixation of Storage and Reservoir levels

## 10.1 Dead storage level

The dead storage level is fixed at RL 775.00 m

## 10.2 Full reservoir level

The full reservoir level is fixed at RL 800.00 m

## 10.3 Capacity

Cumulative capacity of the reservoir is 5.78 TMC

## 10.4 Effect on sub soil water table in the adjoining areas

After the reservoir is completed and water is stored, it is envisaged that the water table in the adjoining areas will show an increasing trend and also helps in reducing the harmful salt content in the available water.

## 10.5 Area of submergence

### 10.5.1 At FRL

About 1800.0 Ha of land is likely to be submerged at FRL.

## 10.6 Land acquisition, property submerged and rehabilitation

The details of Land acquision, property submerged and rehabilitation works proposed will be furnished in the final DPR as they are under process.

## 10.7 Pissiculture

The proposed balancing Reservoir can be used to promote Pissiculture thereby improving the economy of the surrounding area.

## 10.8 Need and recommendation for soil conservation measure in the catchments

Soil conservation measures are not envisaged in the present proposal as the catchment lies in dense forest areas of Western Ghats.

# Chapter 11
# Irrigation Planning

The present scheme is an exclusive drinking water supply project and as such, no irrigation aspect has been envisaged and irrigation Planning is not a part of the scheme.

# Chapter 12
# Command area

The present project is an exclusive drinking water supply project and as such, no irrigation aspect has been envisaged and command area is not a part of the scheme.

# Chapter 13
# Flood control

The present project being an exclusive drinking water supply project, the flood control measures are not a part of the scheme.

# Chapter 14
# Drainage

The present project being an exclusive drinking water supply project, the drainage is not a part of the scheme.

# Chapter 15
# Power

No Power generation is envisaged.in the present proposal

# Chapter 16
# Navigation

The present project being a drinking water supply scheme, navigation is not a part of it

# Chapter 17
# Construction program and man power and plant planning

## 17.1 Construction program

The Yettinahole project comprising of diversion of flood waters from streams on the upper reaches of Western Ghats near Sakleshpura is proposed to be completed in 48 months.

In order to execute the project, it is necessary to identify critical works which form a major part of the scheme and consumes time.

Such works which have been identified to be taken up simultaneously in order to complete the project within the time schedule are:

Phase 1 works comprising of

- ✓ Construction of Weirs
- ✓ Construction of jackwell, cum pump house near the weir locations
- ✓ Construction of raising mains
- ✓ Construction of Delivery chambers

Phase 2 works comprising of

- ✓ Construction of Aqueduct
- ✓ Construction of Storage and Balancing reservoirs

It is pertinent to state here that land acquisition forms a major stumbling block in the progress of a project and its completeion. It is necessary to initiate proceedings of land acquisition immediately in order to execute the project within the time schedule.

The gravity canal proposed including feeder canals, CD works etc., forms major part of the scheme and as such can be divided into suitable packages helping in execution of them simultaneously.

The raising main part in Phase 2 involving lifting arrangements shall also be takenup along with the gravity canal component.

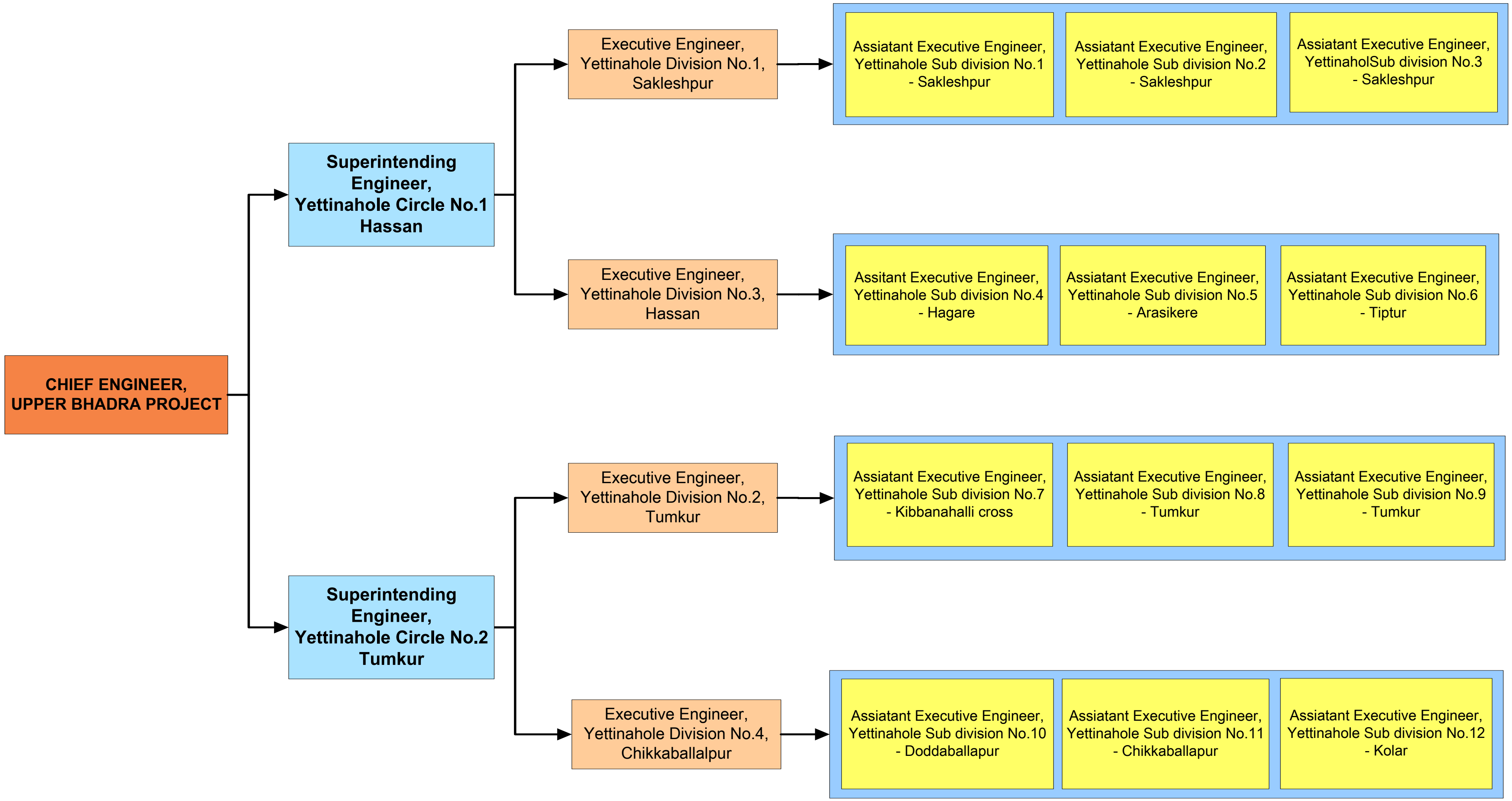
## 17.2 Organisation Set up

The execution of the project is under taken by the Chief Engineer,Upper Bhadra Project ,whose office is situated in Chitradurga.

Two separate circles, headed by the Superintending Engineer, is proposed to be formed. Under each circle, two Executive Engineers heading the divisions will be working. These divisions, put together will have twelve sub-divisions.

The organisation chart is indicated below.

## ORGANISATION CHART FOR YETTINAHOLE PROJECT



## 17.3 Construction power requirement and proposed supply

The project, in total requires power of about 276 MW. The entire power supply needs to be sourced from the state grid.

# Chapter 18
# Foreign exchange element

No Foreign Exchange Element is involved in the project

# Chapter 19
# Environment, Ecology and Forest aspects of the project

Ministry of Environment and Forest, Govt of India (IA-I Division) vide letter Dt. 28-03-2013 have opined that the project neither proposes any hydroelectric power generation nor proposes irrigation use/purpose to develop any command area. It is hence noted that it 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

The letter further states that the Govt of Karnataka shall ensure the following steps/measures.

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

The Environment management plan (EMP) has been prepared and is appended with this report (Annexure-

# Chapter 20
# Estimate

## 20.1 Guidelines

The estimates are based on IS 4877 – 1968 entitled “Guidelines for preparation of estimates for River valley projects”, Part 1- namely “Guidelines for preparation of detailed Project Reports of Irrigation and Multipurpose Projects”.

## 20.2 Account heads

### 20.2.1 Detailed sub heads under I – Works

#### A. PRELIMINARY

A provision of **Rs. 4512.68 lakhs** is made for consultancy charges for detailed survey and investigation and other preliminary works for Construction of Weirs, Jackwell cum pumphouse, Raising mains, Delivery chambers, Gravity canal and Reservoir as required for the project.

#### B. LAND

A provision of **Rs. 46025.00 lakhs** is made in the estimate towards Land acquision for construction of weirs, jackwell cum pumphouse, electrical substation and delivery chamber, pipeline, canal network, reservoirs and lift from balancing reservoir to Kolar.

#### C. WORKS

A provision of **Rs 480462.00 lakhs** is made in the estimate towards construction of Lift Components upto Haravanahalli Delivery Chamber, Earthen dam for the Balancing Reservoir including R & R, Lift Components from Reservoir to Kolar / Chikkaballapur Districts and cost of bringing power supply from nearest KPTCL Substation to pump station.

#### D. REGULATOR AND MEASURING DEVICE

A provision of **Rs. 675.00 lakhs** is made in the estimate towards construction of Regulators and Measuring device.

#### E. FALLS

A provision of **Rs. 2730.00 lakhs** is made in the estimate towards construction of falls.

### F. CD WORKS

A provision of **Rs 141564.00 lakhs** is made in the estimate towards construction of cross drainage works along the alignment of the Gravity canal.

### G. BRIDGES

A provision of **Rs 31698.00 lakhs** is made in the estimate towards construction of Bridges along the alignment of the Gravity canal.

### H. ESCAPES

A provision of **Rs 2400.00 lakhs** is made in the estimate towards construction of cross regulator cum escapes along the alignment of the Gravity canal.

### 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 10638.00 lakhs** for each building is made under Part A and Part B towards construction of office and residential buildings at sub divisions.

### L. EARTHWORK

A provision of **Rs.272398.00 lakhs** is made in the estimate towards Earth work excavation for gravity canal, lining and formation of Service Roads.

### M. PLANTATION

A provision of **Rs. 140.28 lakhs** is made for plantation on either side of the Gravity canal and periphery of reservoir.

### N. TANKS AND RESERVOIRS

Provision for reservoir has been considered under C-Works.

### O. MISCELLANEOUS

A provision of **Rs. 5091.94 lakhs** is made in the estimate towards miscellaneous expenses encountered during the execution of the project including statutory deposits.

### P. MAINTENANCE

A provision of **Rs. 11335.65 lakhs** is made towards maintenance at 1% of the cost of I – works less A, B,O,M,P,Q and X as per CWC guidance. This covers the cost of maintenance of buidings, roads and other structures during the period of construction.

### Q. SPECIAL TOOLS AND PLANTS

A provision of **Rs. 145.62 lakhs** is made in the estimate towards procurement of inspection vehicles for officers of WRD.

### 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

A provision of **Rs 191000.00 lakhs** is made in the estimate towards construction of distribution system and storage reservoir.

### 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. 3213.50 lakhs** is made towards compensatory afforestation, catchment area treatment, control of aquatic weeds, public health measures, drainage in command area etc.

### Y. LOSSES OF STOCK

A provision of **Rs. 2833.91 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 guidelines.

## Z. PROVISION FOR POWER GENERATION

No provision is made in the estimate.

**TOTAL OF I WORKS – 1206863.59 LAKHS**

## I. ESTABLISHMENT CHARGES

A provision of **Rs. 58041.28 lakhs** is made in the estimate

## II. TOOLS AND PLANTS

**SMALL T&P 1% OF I - WORKS**

A provision of **Rs. 12068.64 lakhs** is made in the estimate

## III. SUSPENSE

No provision is made in the estimate.

## IV. RECEIPTS AND RECOVERIES ON CAPITAL

| | |
|---|---|
| Resale value of special tools & plants @ 75% cost of machineries | Rs (-) 109.22 lakhs |

**TOTAL DIRECT CHARGES**

A provision of **Rs. 1276864.94 lakhs** is made in the estimate

**INDIRECT CHARGES**

| | | |
|---|---|---|
| a) | Audit and accounts charges (1% of I – works) | Rs 12068.64 lakhs |
| b) | Capitalized value of abatement of land revenue (5% of the cost of cultivable lands) | Rs 2301.25 lakhs |

**GRAND TOTAL = 1291234.82 LAKHS**

**SAY = 1291236.00 LAKHS OR 12912.36 CRORES**

Abstract estimates (A-Z) format is attached as **Annexure 1**

# 20.3 Abstract of cost

# 20.4 Preparation of estimates

## 20.4.1 Capital cost

The capital cost of the project is **Rs. 12912.36 Crores** which includes all cost associated with investigations, design, construction and maintenance during construction period of the project.

## 20.4.2 Analysis of rates for various items

The analysis of rates for various items of works is done considering the cost of materials, carriage, Handling, storing including labour and costing machines.

## 20.4.3 Quantitative assessment of material requirement

This has been done considering the unit cost of materials prevalent in the region which includes fright, unloading, cartage, storage, inspection and testing.

## 20.4.4 Guidelines on use rates of machinery, hire charges etc

The rates considered are as per schedule of rates of the department which includes the rates for machinery, higher charges etc.

## 20.4.5 Contingencies and work charged establishment

Provision for contingencies and work charged establishment between 3% to 5%.

## 20.4.6 Communication facilities

The initial reach of the project lies in Western Ghats with completely hilly terrain and is approachable by NH-48 and Bangalore-Mangalore railway line.

The gravity canal portion of the project lies in undulating leading to plain terrain till its end point and is approachable through State Highway, Bangalore-Mumbai railway line and other routes.

The portion of the project beyond the gravity canal lies in plain and hilly terrain which is again approachable through State Highway, National Highway and other routes.

# Chapter 21
# Financial resources

The resources for executing the above project in stages will be shared by the State and the Central Governments.

# Chapter 22
# Revenues

## 22.1 Financial

This is more of a management issue than a technical one. The water which is being supplied for drinking water purpose has a production cost (including operation cost and maintenance cost) which has to be met by either charging the beneficiary or as subsidy from the government. Since water is a state subject (as a matter included in entry 17 of list 11 that is, the state list of the Constitution of India), every state independently fixes the rates of water that is chargeable to the beneficiaries with the balance being borne by the state exchequer.

It is proposed in principle to consider the rate charged by the Bangalore Water Supply and Sewerage Board to the residents of the BBMP areas as the base for fixing the rate to be charged to the consumers. However, a decision has to be taken at the appropriate level to either follow this rate or charge a modified rate as the case may be.

The scheme being a drinking water supply project to the drought prone areas, particularly Kolar and Chikkaballapur, the revenue earning may not be an important factor to be considered.

# Chapter 23
# Benefit Cost ratio

Drinking water supply scheme has to be considered as an obligation on the Government to cater to the basic needs of the citizen. The area which is being proposed to be fed with the drinking water supply is one of the worst affected and drought prone areas in the State such as Kolar and Chikkaballapura districts. However, the Benefit Cost Ratio as per CWC norms cannot be worked out due to the fact that it is not an irrigation project.

The Cost per TMC in this project works out to $\frac{12912.36}{24.01}$ = 537.79 Crores

.

# Chapter 24
# List of Drawings

| No. | Name of Drawing | Drawing No. |
|---|---|---|
| 1 | Index map of Yettinahole Project | EIT-WR-1090-IM-001 |
| 2 | Master plan of Yettinahole Project | EIT-WR-1090-MP-002 |
| 3 | Schematic diagram of Yettinahole Project | EIT-WR-1090-SD-003 |
| 4 | Catchment area map for identified streams under Yettinahole Project | EIT-WR-1090-CA-004 |
| 5 | Master plan showing proposed streams for diversion, location of weirs, catchment area and pipeline routing upto crossing of western ghats & delivery for gravity canal | EIT-WR-1090-MP-005 |
| 6 | Index map showing the beneficiaries taluks under Yettinahole Project | EIT-WR-1090-BT-006 |
| 7 | Line diagram of Yettinahole Project | EIT-WR-1090-LD-007 |
| 8 | Map showing proposed balancing reservoir location near Bhairagondlu for the proposed scheme | EIT-WR-1090-BR-008 |
| 9 | Typical cross section of raising main | EIT-WR-1090-RM-CS-009 |
| 10 | Typical cross section of gravity canal | EIT-WR-1090-GC-CS-010 |


CLIENT

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| Rev. | Description. | Date. | Drw. | Dsg. | Chk. | App. |
|---|---|---|---|---|---|---|
| 0 | For Approval | 12.09.13 | NK | SN | SN | NR |

PROJECT TITLE

SCHEME FOR DIVERSION OF FLOOD WATER FROM SAKLESHPURA (WEST) TO KOLAR/CHIKKABALLAPUR (EAST)

DRAWING TITLE

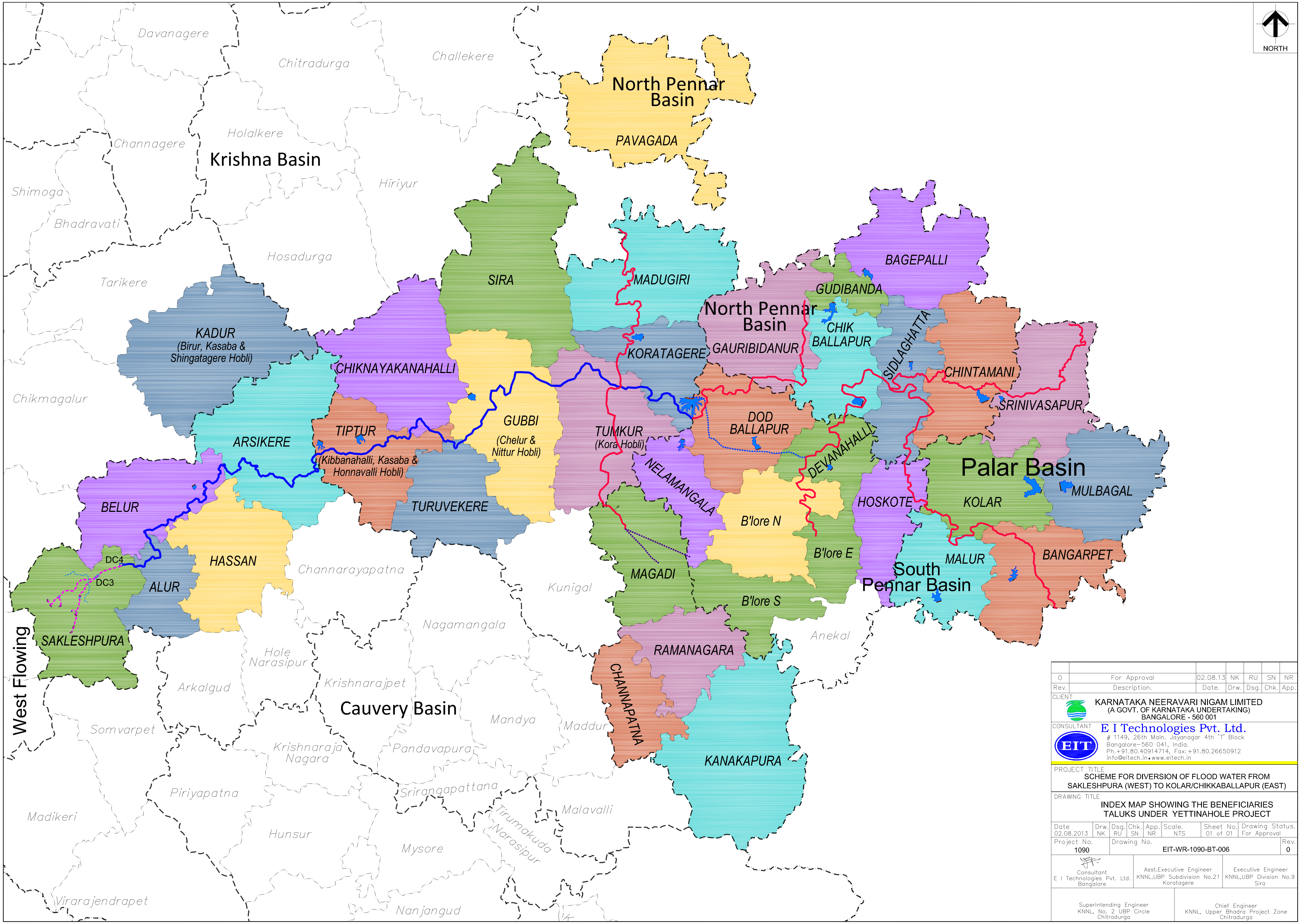
# INDEX MAP OF YETTINAHOLE PROJECT

| Date | Drw. | Dsg. | Chk. | App. | Scale. | Drawing Status. |
|---|---|---|---|---|---|---|
| 12.09.2013 | NK | SN | SN | NR | 1:5,00,000 | FOR APPROVAL |

| Project No. | Drawing No. | Sheet No. | Rev. |
|---|---|---|---|
| 1090 | EIT-WR-1090-IM-001 | 01 of 01 | 0 |

| | | |
|---|---|---|
| Consultant<br>E I Technologies Pvt. Ltd.<br>Bangalore | Asst.Executive Engineer<br>KNNL,UBP Subdivision No.21<br>Koratagere | Executive Engineer<br>KNNL,UBP Division No.9<br>Sira |

| | |
|---|---|
| Superintending Engineer<br>KNNL, No. 2 UBP Circle<br>Chitradurga | Chief Engineer<br>KNNL, Upper Bhadra Project Zone<br>Chitradurga |




| | | | | | | |
|---|---|---|---|---|---|---|
| 0 | For Approval | 02.08.13 | NK | RU | SN | NR |
| Rev. | Description. | Date. | Drw. | Dsg. | Chk. | App. |

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PROJECT TITLE
SCHEME FOR DIVERSION OF FLOOD WATER FROM SAKLESHPURA (WEST) TO KOLAR/CHIKKABALLAPUR (EAST)

DRAWING TITLE
INDEX MAP SHOWING THE BENEFICIARIES TALUKS UNDER YETTINAHOLE PROJECT

| Date | Drw. | Dsg. | Chk. | App. | Scale. | Sheet No. | Drawing Status. |
|---|---|---|---|---|---|---|---|
| 02.08.2013 | NK | RU | SN | NR | NTS | 01 of 01 | For Approval |

| Project No. | Drawing No. | Rev. |
|---|---|---|
| 1090 | EIT-WR-1090-BT-006 | 0 |

| | | |
|---|---|---|
| Consultant E I Technologies Pvt. Ltd. Bangalore | Asst.Executive Engineer KNNL,UBP Subdivision No.21 Koratagere | Executive Engineer KNNL,UBP Division No.9 Sira |

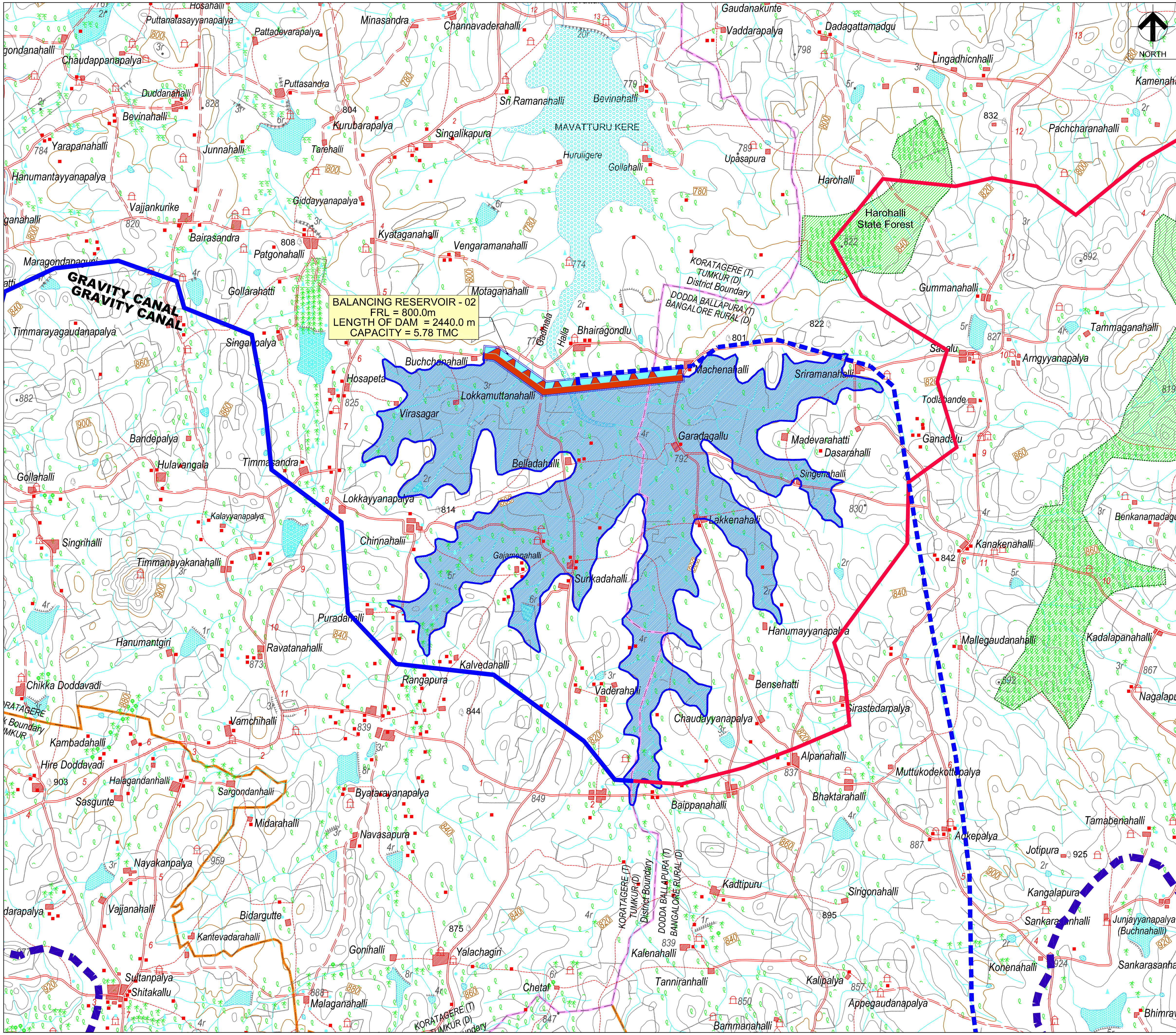
| | |
|---|---|
| Superintending Engineer KNNL, No. 2 UBP Circle Chitradurga | Chief Engineer KNNL, Upper Bhadra Project Zone Chitradurga |

# KARNATAKA NEERAVARI NIGAM LIMITED
# YETTINAHOLE PROJECT - LINE DIAGRAM


CLIENT
KARNATAKA NEERAVARI NIGAM LIMITED
(A GOVT. OF KARNATAKA UNDERTAKING)
BANGALORE - 560 001

PROJECT TITLE
YETTINAHOLE PROJECT

DRAWING TITLE
LINE DIAGRAM FOR YETIINAHOLE PROJECT




## LEGEND

Roads
National Highway, State Highway, Other Roads
Unmetalled Roads, Cart track, Foot path
Railways
Broad gauge with station, Other gauge
Boundary
Boundary : State, District, Taluk, Forest
Buildings
Temple, Chatri, Tomb, Mosque, Graves, Village limits, Hut
Transmissions Lines
Main power line, Power line, Telephone lines
Heights
Relation spot height, Spot height, Traingle station
Contour with value, Bench mark
Water Features
River, Reservoir, Canal, Channels, Stream
Pond, Well, Tank
Other Features
Climits, Embankment, Culvert, Gate, Broken ground
Tree, Grass, Wire Fence, Cliff
Sheet rock, Rocky Area, Boulders

RESERVOIR

## NOTES

1) ALL DIMENSIONS ARE IN METRES.

| Rev. | Description. | Date. | Drw. | Dsg. | Chk. | App. |
|---|---|---|---|---|---|---|
| 0 | For Approval | 12.09.13 | NK | SN | SN | NR |

CLIENT

KARNATAKA NEERAVARI NIGAM LIMITED
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BANGALORE - 560 001

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PROJECT TITLE

SCHEME FOR DIVERSION OF FLOOD WATER FROM SAKLESHPURA (WEST) TO KOLAR/CHIKKABALLAPUR (EAST)

DRAWING TITLE

MAP SHOWING PROPOSED BALANCING RESERVOIR LOCATION NEAR BHAIRAGONDLU FOR THE PROPOSED SCHEME

| Date | Drw. | Dsg. | Chk. | App. | Scale. | Drawing Status. |
|---|---|---|---|---|---|---|
| 12.09.2013 | NK | SN | SN | NR | 1:50,000 | FOR APPROVAL |

| Project No. | Drawing No. | Sheet No. | Rev. |
|---|---|---|---|
| 1090 | EIT-WR-1090-BR-006 | 01 of 01 | 0 |

| | | |
|---|---|---|
| Consultant<br>E I Technologies Pvt. Ltd.<br>Bangalore | Asst.Executive Engineer<br>KNNL,UBP Subdivision No.21<br>Koratagere | Executive Engineer<br>KNNL,UBP Division No.9<br>Sira |
| Superintending Engineer<br>KNNL, No. 2 UBP Circle<br>Chitradurga | Chief Engineer<br>KNNL, Upper Bhadra Project Zone<br>Chitradurga | |


| Rev. | Description. | Date. | Drw. | Dsg. | Chk. | App. |
|---|---|---|---|---|---|---|
| 0 | For Approval | 12.09.13 | NK | SN | SN | NR |

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PROJECT TITLE

SCHEME FOR DIVERSION OF FLOOD WATER FROM SAKLESHPURA (WEST) TO KOLAR/CHIKKABALLAPUR (EAST)

DRAWING TITLE

SCHEMATIC DIAGRAM OF PROPOSED DIVERSION SCHEME

| Date | Drw. | Dsg. | Chk. | App. | Scale. | Drawing Status. |
|---|---|---|---|---|---|---|
| 12.09.2013 | NK | SN | SN | NR | NTS | FOR APPROVAL |

| Project No. | Drawing No. | Sheet No. | Rev. |
|---|---|---|---|
| 1090 | EIT-WR-1090-SD-003 | 01 of 01 | 0 |

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| | |
|---|---|
| Superintending Engineer<br>KNNL, No. 2 UBP Circle<br>Chitradurga | Chief Engineer<br>KNNL, Upper Bhadra Project Zone<br>Chitradurga |

# Appendix-2

## Proforma for preparation of Preliminary Project Report for bilateral financial co-operation

Request for seeking financial co-operation from Japan International Co-operation Agency (JICA)

| Sl.No. | Description of requirements | Replies |
|---|---|---|
| **Part-I Project summary** | | |
| 1. | Project Name | Yettinahole Project |
| 2. | Project Implementing Agency | Karnataka Neeravari Nigam Limited,<br>(A Government of Karnataka undertaking) |
| 3. | • Central Line Ministry (in case of Central project )<br>• Administrative state Government (in case of State Sector projects) | • Not applicable<br>• Water Resources Department , Government of Karnataka |
| 4. | Sectoral area of the project. | Water Resources |
| 5. | Central Sectoral Line Ministry. | Ministry of Water Resources,<br>Government of India |
| 6. | Broad objectives of the project. | • To lift 24.01 TMC of water, diverting water from west flowing streams in the upper reaches of Western Ghats near Sakleshapura to the east by supplying in bulk for drinking purposes and ground water recharge by filling Minor Irrigation tanks.<br>• To mitigate the drinking water shortages in the seven districts ; Hassan, Ramanagara, Chikmagalur, Bangalore rural, Tumkur, Kolar & Chikkaballapur |
| 7. | Location of the Project<br>(specify district) | Near Sakleshpur<br>(Hassan district, Karnataka state)<br>Lat : 12°54'35"N<br>Long : 75°44'11"E |
| 8. | Total estimated cost of the project<br>(in.Rs.Crores) | Rs.12912.36 Crores. |
| 9. | Components of total estimated cost<br>(in Rs. Crores) | i) Phase-I. Lift component: Rs. 3527.17 Crores<br>ii) Phase-II. Conveyance component: Rs. 9385.19 Crores |

| | | | | | **Rupees in Crores** |
|---|---|---|---|---|---|
| **Source** | **Loan / Credit** | **Grant** | **Equity** | **Other (specify)** | **Total** |
| Government of Karnataka | | 1291.24 | 10 % | | 1291.24 |
| JICA | 11621.12 | | 90 % | | 11621.12 |
| Total estimated cost | | | | | 12912.36 |

**Note:** As the project is meant for providing drinking water to Kolar and Chikkaballapur districts (East) and other needy areas enroute which are drought prone, it is proposed under 90:10 Grant : Loan basis.

| Sl.No. | Description of requirements | Replies |
|---|---|---|
| 10. | • Total Bilateral development assistance proposed.(Specify both in Rs. and in donor currency)<br>• Additional technical co-operation component, if any and activities proposed to be implemented through technical co-operation. | • Rs 116211.2 Million Rupees ( INR)<br>204066.9 million yen (Y)<br>(1 Rupee=1.75 Japanese Yen)<br>• Capacity building of technical, administrative staff & accounts staff in JICA procurement guidelines, accounting and technical matters etc is envisaged. |
| 11. | Project Implementation period. | 4 years |
| 12. | Whether any separate institutional arrangement is required to be established for implementation of the project? | The Project is being implemented by Karnataka Neeravari Nigam Ltd, which is a 100% Government owned company incorporated under the provisions of the Companies Act 1956. |
| 13. | Details of statutory clearances required for implementation of the project. | Forest Clearance is required. |
| 14. | Statutory clearances obtained. | Since it is a drinking water project, there is an exemption from Environmental clearance and same is communicated by MoEF vide letter No. J-12011/46/2012-IA-I Dated 28th March, 2013. |
| 15. | Details of debt sustainability clearance from the Department of Expenditure for state sector project. | Will be obtained |
| 16. | Details of previous phase(s), if any. Whether any impact assessment has been made for previous phase? | New project |
| **Part-II Basic design of the project** | | |
| 17. | Goals and objectives of the project and its linkages with government priority and programmes. | This project is proposed to provide drinking water to drought prone areas as well as filling tanks for ground water recharge indicated above.<br>**Drinking water project - Top priority** |
| 18 | Activities proposed in the project. | In the Phase-1, it is proposed to lift water from the selected streams on the upper reaches of the Western Ghats and diverting the same towards the eastern plateau.<br>In the Phase-II, it is proposed to convey the lifted water through canal for a length of about 274 Km, to reach the proposed balancing reservoir located near Bhairgondlu village in Koratagere Taluk of Tumkur District. In between, the identified needy areas enroute will also be catered to. Beyond this, it is proposed to convey the water to the proposed identified areas in Kolar and Chikballapur districts. |
| 19. | Quantifiable outputs and outcomes of the project. | • Providing drinking water facility to 68.35 Lakh people,<br>• Providing water to about 35 Lakh livestock and<br>• Filling of 527 Nos of Tanks for recharging of ground water and dilution of fluoride in groundwater. |
| 20. | Target population. | 68.35 Lakhs |
| 21. | Does the project require a sector adjustment policy formulation? If yes give details. | No.<br>The said project falls exclusively under Water Resource sector and there is no need for any sector adjustment policy. |

| Sl.No. | Description of requirements | Replies |
|---|---|---|
| 22. | Whether any feasibility study/ pre-appraisal/pre-investment study has been conducted? If yes, its details of its findings. | Yes, details enclosed. |
| 23. | Linkages with completed or ongoing project(s) of similar nature. | Not applicable. |

| Sl. No. | Name of the project | Implementation period | Quantifiable outcome achieved/targeted | Other (specify) |
|---|---|---|---|---|
| 1 | Proposed project | Not applicable | | |
| 2 | Completed projects | | | |
| 3 | On-going projects | | | |

| Sl.No. | Description of requirements | Replies |
|---|---|---|
| 24. | Details on costs of following to be funded from the bilateral official development assistance.<br>• Separate institutional arrangement to be established, its organizational arrangements, responsibility and accountability of the key personnel.<br>• Numbers of experts and personnel to be resourced from outside the Project implementing agency and Government.<br>• Procurement of equipment and services. | • The Project is being implemented by Karnataka Neeravari Nigam Ltd, a 100% Government owned company is incorporated under the provisions of the Companies Act 1956.<br>• It has the necessary infrastructure and organisational capability including expertise in the field of Water Resources to implement the project.<br>• The project is proposed to be implemented by identifying suitable and capable agencies through tender process. |
| 25. | Detailed year wise physical and financial target plan with quantifiable and qualitative (verifiable) target indicators. The target plan should also include year-wise utilization of proposed bilateral development assistance. | (see table below) |

| Year | Physical | Financial (Rupees In Crores) | Fund required (Rupees In Crores) |
|---|---|---|---|
| 1st Year | Phase- I works | 1000.00 | 900.00 |
| 2nd Year | Phase- I & II works | 4500.00 | 4050.00 |
| 3rd Year | Phase- I & II works | 6000.00 | 5400.00 |
| 4th Year | Phase- II works | 1412.36 | 1271.12 |
| Total | | 12912.36 | 11621.12 |

| Sl.No. | Description of requirements | Replies |
|---|---|---|
| 26 | Does the project involve land acquisition? If so please indicate.<br>i) Total land to be acquired<br>ii) Actual land acquired so far.<br>iii) Target Land acquisition completion date.<br>iv) Is there any legal issue or any other obstacle being faced by the acquisition authority which could push the target dates mentioned? If so please write in detail. | Yes,<br>i) 5140.0 Ha<br>ii) Nil<br>iii) By the end of the 3rd year<br>iv) As on date, no such issues are foreseen |

| Sl.No. | Description of requirements | Replies |
|---|---|---|
| 27. | Does the project involve resettlement and rehabilitation? If so, indicate its magnitude, cost and present status of plan. | Yes. The project involves resettlement and rehabilitation of seven villages which comes under submergence in the proposed balancing reservoir located near Bhairgondlu village in Koratagere Taluk of Tumkur District. The estimated cost of resettlement and rehabilitation is Rs. 52.0 Crores. |
| 28. | Whether environmental Impact Assessment clearance required? If yes, whether the proposal to MoE&F has been submitted? If not when it is likely to be submitted. | Since it is a drinking water project, there is exemption from Environmental clearance and same is communicated by MoEF vide letter No. J-12011/46/2012-IA-I Dated 28th March, 2013. |
| 29. | Whether forest clearance required? If yes, whether the proposal to MoE&F has been submitted? If not, when likely to be submitted? | Yes.<br>The proposal for obtaining clearance for Phase – I works is submitted to the Nodal officer, Forest Department, Government of Karnataka on 21/01/2014. |
| 30 | Whether the private sector or NGO participation is also proposed in the project? If yes, please describe the nature of the proposed involvement. | No. |
| 31. | Brief description on the effects and impacts on: | |
| | i) Environment including land, water, air, bio-diversity etc. | i) Provides basic need of drinking water, results in Socio economic development. Diseases caused due to unhygienic conditions caused by water shortage will be eliminated. The high concentration of salts and fluorides in the groundwater will be diluted. |
| | ii) Women and children. | ii) Nil |
| | iii) Employment. | iii) Employment opportunities for locals will be generated. |
| | iv) Poverty alleviation and | iv) Nil |
| | v) Productivity and economic growth | v) Due to non-availability of a safe drinking water and depletion of ground water table in the villages concerned, majority of the populace are migrating to towns and cities. Such a migration could be avoided to a great extent by providing drinking water and also ground water recharge by way of filling of tanks. |

**Chief Engineer**
**KNNL, Upper Bhadra Project Zone**
**Chitradurga**

# Appendix – 5

## An outline Matrix

| Strategy | Indicators | Sources/Means of verification | Assumptions/ Risks |
|---|---|---|---|
| **Goal**<br>(Linked up with a government priority programme/policy)<br>In line with National Water Policy-2012 and State Water Policy-2002, a quantum of 24.01 TMC of water will be made available in bulk to identified areas in seven districts of eastern part of Karnataka. | By 2017<br>Enhanced drinking water will be available to identified areas in seven districts. | Project monitoring reports of KNNL | **Assumption**<br>The required quantum of water is available annually which is dependent on corresponding amount of rainfall. |
| **Objectives**<br>(Purpose/expected benefits)<br>**Objective**<br>Providing safe drinking water to the drought prone areas of Kolar, Chikkaballapur and other needy areas en route along with filling up of MI tanks to recharge the ground water.<br><br>**Expected benefits**<br>Improvement in socio economic status in the area, enhanced life expectancy, reduction in migration of people to urban areas, decrease in water borne diseases, enhanced greenery and improvement in the environment. | • No shortage of drinking water.<br>• No water-borne diseases<br>• Overall improvement in health of people of the area. | • Project monitoring reports of KNNL<br>• Reports of district administration<br>• Reports by Health Department | **Assumption**<br><br>The required quantum of water is available annually which is dependent on corresponding amount of rainfall. |
| **Output / Results**<br>(Goods/services/materials/expected changes, the target population will get, which they cannot achieve on their own without intervention of the project)<br><br>• Enhanced availability of drinking water.<br><br>• Store water in the MI tanks for groundwater recharge<br><br>• Dilute the groundwater having high concentration of salts. | • Per capita consumption increases to designed level.<br>• Improvement of groundwater levels<br><br>• Reduction in dissolved salts/fluorides in groundwater | • Monitoring reports of KNNL/District administration.<br>• Reports by Department of Mines & Geology.<br>• Environment Monitoring reports by KNNL. | **Assumption**<br>The required quantum of water is available annually which is dependent on corresponding amount of rainfall. |

| Strategy | Indicators | Sources/Means of verification | Assumptions/ Risks |
|---|---|---|---|
| **Activities**<br>(Tasks/actions to be carried out by utilizing resources, viz. human, financial, equipment, etc.) | | Scheme monitoring reports of KNNL | **Assumptions**<br>• The farmers give land consent for taking up civil works in their lands.<br>• All the issues related to design and executions are resolved in a time bound manner.<br>• There is uninterrupted flow of funds as per plan. |
| • Establish the field offices in the entire project area by March 2015.<br>• Allocate funds for the project as per plan<br>• Call for tenders in Packages for the conveyance system of 274 Kms (Phase-II) of main canal by March 2015.<br>• Obtain Forest Clearance by March 2015.<br>• Complete the lift works (Phase-I) by March 2017.<br>**Phase-I**<br>➢ Construction of weirs (8 Nos)<br>➢ Construction of jack well cum pump houses (10 Nos)<br>➢ Construction of raising mains(82.0 Km)<br>• Complete the conveyance and distribution system by March 2018.<br>**Phase - II**<br>➢ Construction of gravity canal (274.0 Km)<br>➢ Construction of balancing reservoir (5.78 TMC)<br>➢ Construction of jack well cum pump houses (1 No)<br>➢ Construction of raising mains(45.0 Km)<br>➢ Construction of delivery chamber (2 Nos)<br>➢ Construction of distribution system (665.0 Km) | • Reports of KNNL<br>• State budget document<br>• Reports of KNNL<br>• Reports of KNNL<br>• Reports of KNNL<br>• Reports of KNNL | | |

**Chief Engineer**
**KNNL, Upper Bhadra Project Zone**
**Chitradurga**