Initial Environmental Examination

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IND: Karnataka Integrated Urban Water Management Investment Program – Tranche 1 (Harihar 24x7 Water Supply Scheme)

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Prepared by the Karnataka Urban Infrastructure Development and Finance Corporation, Government of Karnataka for the Asian Development Bank.

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Tranche 1: Harihar City 24x7 Water Supply Scheme

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The initial environmental examination (IEE) prepared based on preliminary designs was reviewed and approved by ADB in April 2013. It has been disclosed in KUIDFC and ADB's website (http://www.adb.org/projects/documents/kiuwmip-harihar-uwss-subproject-iee)

The approved draft IEE has now been updated reflecting the detailed design of the HariharTown 24x7 Water Supply Scheme

CURRENCY EQUIVALENTS

(as of September 2016)

Currency unit	–	Equivalent to
Rs1.00	=	$ 0.015
$1.00	=	Rs 66.7

Abbreviations

ADB		Asian Development Bank
ADB SPS		Asian Development Bank Safeguard Policy Statement
APMC		Agricultural Produce Marketing Committee
ASI		Archaeological Survey of India
BOD		Bio-Chemical Oxygen Demand
BPL		Below Poverty Line
CAP		Corrective Action Plan
CBO		Community Based Organizations
CC	-	Cement Concrete
CFE	-	Consent For Establishment
CFO	-	Consent For Operation
CMC	-	City Municipal Council
CPCB	-	Central Pollution Control Board
CGWB	-	Central Ground Water Board
CSS	-	Construction Supervision Specialist
DPD	-	Deputy Project Director
PMDCSC	-	Project Management Design Construction and Supervision Consultant
EA	-	Executing Agency
EIA	-	Environmental Impact Assessment
ELSR	-	Elevated Level Storage Reservoir
EMP	-	Environmental Management Plan
ES	-	Environment Specialist
GRC	-	Grievance Redressal Committee
GRM	-	Grievance Redress Mechanism
HDPE	-	High Density PolyEthylene
IA	-	Implementing agency
IEE	-	Initial Environmental Examination
IWRM	-	Integrated Water Resource Management
KIUWMIP	-	Karnataka Integrated Urban Water Management Investment Programme
Km	-	Kilometres
KMRP	-	Karnataka Municipal Reforms Project
KSCB	-	Karnataka Slum Clearance Board

KSPCB	-	Karnataka State Pollution Control Board
KSRTC	-	Karnataka State Road Transport Corporation
KTCP	-	Karnataka Town and Country Planning
KUIDFC	-	Karnataka Urban Infrastructure Development & Finance Corporation
KUWSDB	-	Karnataka Urban Water Supply & Drainage Board
Lpcd	-	Liter Per Capita Per Day
M	-	Meters
MFF	-	Multi-Tranche Financing Facility
MLD	-	Million Liters Per Day
Mm	-	Milimeters
MoEFCC	-	Ministry of Environment, Forest and Climate Change
NGO	-	Non-Government Organization
PIU	-	Program Implementation Unit
PMU	_	Program Management Unit
RPMU	_	Regional Program Management Unit
PVC	-	Poly Vinyl Chloride
RCC	-	Reinforced Cement Concrete
ROW	-	Right Of Way
SEIAA	-	State Environmental Impact Assessment Authority
SPS	-	Safeguard Policy Statement
STP	-	Sewage Treatment Plant
ULB	-	Urban Local Body
WTP	-	Water Treatment Plant

WEIGHTS AND MEASURES

^{o}C	degree centigrade
dB	Decibels
dia	diameter
kg	kilo gram
Kl	kilolitre
km	kilometre
kmph	kilometre per hour
ha	hectares
HP	Horse Power
LPCD	liters per capita per day
lps	liters per second
lpm	liters per minute
m	meter
m^3	Cubic meter
mg	milli gram
mm	milli meter
m^2/day	meter square per day
M	million
mcm	million cubic meters
ML	Million liters
MLD	million liters per day
sq.km	Square Kilometer

NOTE{S}

In this report, "$" refers to US dollars.

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EXECUTIVE SUMMARY

1. The Karnataka Integrated Urban Water Management Investment Programme (KIUWMIP) aims to improve the level, quality and sustainability of basic water supply services in selected urban local bodies (ULBs), contributing to improved quality of life among the urban poor. KIUWMIP will be implemented over a period of 8 years (four years for Tranche 1) beginning in 2014, and will be funded by a loan via the Multi-tranche Financing Facility (MFF) of the Asian Development Bank (ADB).

2. Harihar 24x7 water supply project is one of the projects proposed in Tranche-1 towns viz., Harihar, Davanagere, Byadagi and Ranebennur. Water supply is currently intermittent and suffers with huge losses and quality issues. ADB requires the consideration of environmental issues in all aspects of the Bank's operations, and the requirements for Environmental Assessment are described in ADB's SPS (2009). This Initial Environmental Examination (IEE) addresses components proposed under Tranche 1 which includes water supply components.

3. **Categorization.** Harihar 24x7 water supply project is classified as Environmental Category B as per the SPS as no significant impacts are envisioned. Accordingly this Initial Environmental Examination (IEE) has been prepared and assesses the environmental impacts and provides mitigation and monitoring measures to ensure no significant impacts as a result of the project.

4. **Updated Subproject Scope**. The project is formulated under this investment program to address gaps in water infrastructure in a holistic and integrated manner. The main objective of the Investment Program is to improve water efficiency, security and have an important effect on public health. The subproject scope in the draft IEE covers: (i) rehabilitation and augmentation of existing WTP; (ii) construction of service reservoirs; (iii) construction of strategic water network and rehabilitation of water distribution network; (iv) installation of water meters. After completion of the detailed design in 2016, there are changes in the project components mostly in terms of detailing the components and finalizing the quantities (eg., length of pipes). Site for all the components like WTP, reservoirs etc., remain unchanged from the preparation stage to detailed design stage.Also, the subproject split into two packages for convenience in implementation one is Bulk water supply comprises (1) Rehabilitation and augmentation of pumping machinery at existing Jack well(2)Construction of new 20 MLD WTP including installation of measuring devices at appropriate locations (3) Providing new raw water main 4.3 km(4)Treated water pumping main10.77 km (5) Construction of 2 nos. new ELSR and rehabilitation of 1 ELSR.Second package comprises(1) Laying of distribution network 178.00 km (2) Placement of bulk flow meter and provision of house service connections. Operation & Maintenance of implemented project of 24 x 7 water supply schemes for 5 years. IEE is now updated reflect these changes and make the IEE in line with the final subproject design.

5. **Implementation Arrangements.** Karnataka Urban Infrastructure Development & Finance Corporation (KUIDFC) is the Executing Agency (EA) responsible for implementing the Investment Program. Investment Program implementation activities is monitored by KUIDFC through a separate Investment Program Management Unit (PMU) for the IWRM Project, which set-up within KUIDFC. At the Executing Agency (i.e. KUIDFC), environmental issues coordinated centrally by an Environmental Specialist (Designated as Assistant Executive Engineer–Environment), reporting to the Task Manager, Assistant Executive Engineer–Environment will ensure that all subprojects comply with environmental safeguards. The IEE/ EIA reports prepared by the Consultant, and will be reviewed by the Assistant Executive Engineer–Environment as per the ADB's Environmental Guidelines and forwarded to ADB for

review and approval. The consultant (Program Management design construction supervision consultant, PMDCSC) includes an environmental specialist to supervise the implementation of environmental safeguards. The consultant team also includes a Construction Supervisor at each ULB/CMC responsible for the supervision of project implementation including environmental safeguards at the ULB/CMC level. Like other town/city, in Harihar Program Implementation Unit (PIU) there is one Assistant Executive Engineer (AEE) responsible for safeguard implementation and environment specialist of PMDCSC assist AEE for environmental compliance. The contractor shall appoint one supervisor (environment & safety officer)who will be responsible on a day-to day basis for ensuring implementation of EMP, coordinating with RE and environment specialists(all levels), community liaison, consultation with interested/affected parties and grievance redressal and necessary reporting.

6. **Description of the Environment.** The existing intake at Harihar is proposed to be used and new intake is not proposed within the bulk water supply scheme. Rehabilitation and replacement of pumping machineries and other necessary accessories at head works of existing Jack well at Kavaluthu village is being proposed. The raw water rising main pipe line will be passes through Kavaluthu village and through Kumarapattanam village. Pipeline will be lay at village environment- vacant place. Other project components are located in Harihar urban area (in all the 9 zones)or in its immediate surroundings which were converted into urban use for many years ago, and there is no natural habitat left at these sites. The project sites are located in existing right of ways (RoWs) and government-owned land. There are no protected areas, wetlands, mangroves, or estuaries in or near the project location. There are no forest areas within or near Harihar. Soils are deep, and do not require cutting of rocks for pipe laying. As per the design only 268.3 m of distribution pipeline will be layed at ASI protected zone in and around Harihareshwara Temple. Necessary permission will be taken before construction at that particular zone.

7.

8. **Environmental Management.** An environmental management plan (EMP) is included as part of this IEE, which includes (i) mitigation measures for environmental impacts during implementation; (ii) an environmental monitoring program, and the responsible entities for mitigating, monitoring, and reporting; (iii) public consultation and information disclosure; and (iv) a grievance redress mechanism. A number of impacts and their significance have already been reduced during design phase. The EMP will be included in civil work bidding and contract documents.

9. Locations and siting of the proposed infrastructures were considered to further reduce impacts. These include (i) locating facilities on government-owned land to avoid the need for land acquisition and relocation of people; and (ii)laying of pipes in RoWs alongside main/access roads, to reduce acquisition of land and impacts on livelihoods specifically in densely populated areas of the city.

10. Potential impacts were identified in relation to location, design, construction and operation of the improved infrastructure. There are no significant location or design impacts. There is a protected monument in the town, however, except a small length of pipeline (~282 m) none of the components are located near the monument. This pipeline will be laid in the streets located around the monument, and prior permission will be taken as required from the ASI. River flow analysis indicate that the water demand is miniscule of the water availability, and even during the lean flow season, the demand is just over 1% of the river flow.During the construction phase, impacts mainly arise from the need to dispose of moderate quantities of waste soil and disturbance of residents, businesses, and traffic. Mitigation measures have been developed in generic way to reduce all negative impacts to acceptable levels.

11. During the construction phase, impacts mainly arise from the need to dispose of moderate quantities of waste soil; and from the disturbance of residents, businesses, and traffic. These are common impacts of construction in urban areas, and there are well developed methods for their mitigation. These are common temporary impacts of construction in urban areas, and there are well developed methods for their mitigation. Measures such as conducting work in lean season and minimizing inconvenience by best construction methods will be employed. Traffic management will be necessary during pipe-laying on busy roads. In the operational phase, all facilities and infrastructure will operate with routine maintenance, which should not affect the environment. Facilities will need to be repaired from time to time, but environmental impacts will be much less than those of the construction period as the work will be infrequent, affecting small areas only.

12. Mitigation measures have been developed to reduce all negative impacts to acceptable levels. Mitigation will be assured by a program of environmental monitoring to be conducted during construction. The environmental monitoring program will ensure that all measures are implemented, and will determine whether the environment is protected as intended. It will include observations onand off-site, document checks, and interviews with workers and beneficiaries. Any requirements for corrective action will be reported to the ADB.

13. **Benefits of the Subproject.** The citizens of the Hariharcity will be the major beneficiaries of this project. With the improved water supply, they will be provided with a constant supply of better quality water, piped into their homes. In addition to improved environmental conditions, the project will improve the over-all health condition of the city. People would spend less on healthcare and lose fewer working days due to illness, so their economic status should also improve, as well as their overall health.

14. The most noticeable net environmental benefits to the population of the city will be positive and large as a result of improved water efficiency and security through expansion and rehabilitation of water supply infrastructure.

15. **Consultation and Disclosure.**The stakeholders were involved in developing and updating of the IEE through discussions on-site and public consultation, after which views expressed were incorporated into the IEE and in the planning and development of the subproject. The updated IEE will be made available at public locations in the city and will be disclosed to a wider audience via the ADB and KUIDFC websites. The consultation process will be continued and expanded during subproject implementation to ensure that stakeholders are fully engaged and have the opportunity to participate in its development and implementation.

16. **Grievance Redress Mechanism**. A project specific grievance redress mechanism (GRM) has been established to receive, evaluate and facilitate concerns of, complaints and grievances of the DPs in relation to project's social and environmental performances. The main objective of the GRM will be to provide time bound action and transparent mechanism to resolve social and environment concerns. The project GRM will cover the project's towns for all kinds of grievances and will be regarded as an accessible and trusted platform for receiving and facilitating project related complaints and grievances. The multi-tier GRM for the program will have realistic time schedules to address grievances and specific responsible persons identified to address grievances and whom the DPs have access to interact easily. Awareness on grievance redress procedures will be created through Public Awareness Campaign with the help of print and electronic media and radio.

17. **Monitoring and Reporting.**The PMU, PIU, and PMDCSC will be responsible for monitoring. The PMDCSC will submit monthly monitoring reports to PMU, and the PMU will send semi-annual monitoring reports to ADB. ADB will post the environmental monitoring reports on its website.

18. **Conclusions and Recommendations.**The proposed subproject is unlikely to cause significant adverse impacts. The potential impacts that are associated with design, construction& operation can be mitigated to standard levels without difficulty through proper engineering design and the incorporation or application of recommended mitigation measures &procedures. Based on the findings of the IEE, there are no significant impacts and the classification of the subproject as Category “B” is confirmed. No further special study or detailed environmental impact assessment (EIA) needs to be undertaken to comply with ADB SPS (2009) or GoI EIA Notification (2006).

I. INTRODUCTION

A. Introduction to KIUWMIP

1. The Karnataka Integrated Urban Water Management Investment Program (KIUWMIP, the Program) aims to improve water resource management in urban areas in a holistic and sustainable manner. Investment support will be provided to modernize and expand urban water supply & sanitation (UWSS) while strengthening relevant institutions to enhance efficiency, productivity and sustainability in water use. The Program focuses on priority investments and institutional strengthening in water supply & sanitation within an IWRM context.

2. The Program implemented over a four-year period beginning in 2014, and is funded by a loan via the Multitranche Financing Facility (MFF) of Asian Development Bank (ADB). The Executing Agency is the Karnataka Urban Infrastructure Development Finance Corporation (KUIDFC) and implementing agencies for the Investment Program is the respective Urban Local Bodies (ULBs). Byadgi, Harihar, Ranebennur and Davangere are the four towns chosen to benefit from the first tranche of the investment.

3. The expected outcome will be improved water resource planning, monitoring and service delivery in 4 towns of the Upper Tungabhadra sub basin. Tranche 1 will have 3 outputs; (i) Expanded efficient UWSS infrastructure in 4 towns of the Upper Tungabhadra sub basin; (ii) Improved water resource planning, monitoring and service delivery in Karnataka; and (iii) KUIDFC strengthened capacity. The IEE is based on an assessment of these components within the project area.

B. Background of IEE

4. Harihar CMC intends to undertake Up gradation of Water supply scheme to 24/7 Water supply scheme and Underground Sewerage Scheme covering the entire town including LPA (local Planning Area) villages. This scheme designed to enhance the water supply, sanitation and environment in the town thus leading to overall improvement in the living conditions.

5. After completion of the detailed design in 2016, the subproject has been updated to (1) improvements to Bulk water supply by Rehabilitation and augmentation of existing Jack well, construction of new 20 MLD WTP including installation of measuring devices at appropriate locations, (2) providing new raw water and treated water pumping mains, (3) construction of 2 nos. new ELSR and rehabilitation of 1 ELSR, (4) laying of distribution network, (5) placement of bulk flow meter and provision of house service connections, (6) Operation & Maintenance of implemented project of 24 x 7 water supply schemes for 5 years.

6. This is the Initial Environmental Examination (IEE) Report for Harihar Town "**Rehabilitation of Water Supply Scheme and upgrading to 24/7 Water Supply Scheme to Harihar Town, City Municipal Council, Harihar in Davanagere District.**Water supply is currently intermittent, unreliable and suffers with huge losses and quality issues. ADB requires the consideration of environmental issues in all aspects of the Bank's operations, and the requirements for environmental assessment are described in ADB's Safeguards Policy Statement (2009). This Initial Environmental Examination (IEE) has been prepared and assesses the environmental impacts and provides mitigation and monitoring measures to ensure no significant impacts as a result of the project.

7.

C. Environmental Regulatory Compliance

8. **Table 1** presents a summary of environmental regulations and mandatory requirements applicable to Harihar 24x7 water supply project.

Table 1: Applicable Environmental Regulations

Law	Description	Requirement
EIA Notification	The EIA Notification of 2006 and 2009 (replacing the EIA Notification of 1994), set out the requirement for environmental assessment in India. This states that Environmental Clearance is required for certain defined activities/projects, and this must be obtained before any construction work or land preparation (except land acquisition) may commence. Projects are categorized as A or B depending on the scale of the project and the nature of its impacts. Category A projects require Environmental Clearance from the Ministry of Environment and Forest (MoEF). Category B projects require Environmental Clearance from the State Environmental Impact Assessment Authority (SEIAA).	Project is not a listed activity in Schedule I of this notification and hence environmental clearance is not required.
Water (Prevention and Control of Pollution) Act of 1974, Rules of 1975, and amendments	Control of water pollution is achieved through administering conditions imposed in consent issued under provision of the Water (Prevention and Control of Pollution) Act of 1974. These conditions regulate the quality and quantity of effluent, the location of discharge and the frequency of monitoring of effluents. Any component of the Project having the potential to generate sewage or trade effluent will come under the purview of this Act, its rules and amendments. Such projects have to obtain Consent For Establish (CFE) under Section 25 of the Act from Karnataka State Pollution Control Board (KSPCB) before starting implementation and Consent For Operate (CFO) before commissioning. The Water Act also requires the occupier of such projects to take measures for abating the possible pollution of receiving water bodies.	None of the components of the project require CFE and CFO under this Act.
Air (Prevention and Control of Pollution) Act of 1981, Rules of 1982 and amendments.	The projects having potential to emit air pollutants into the atmosphere have to obtain CFE under Section 21 of the Air (Prevention and Control of Pollution) Act of 1981 from KSPCB before starting implementation and CFO before commissioning the project. The occupier of the project/facility has the responsibility to adopt necessary air pollution	For the project, the following will require CFE and CFO from KSPCB: (i) diesel generators; (ii) wet mix plants; and (iii) stone crushers, if installed for construction. All relevant forms, prescribed

Law	Description	Requirement
	control measures for abating air pollution.	fees and procedures to obtain the CFE and CFO can be found in the KSPCB website (www.kspcb.gov.in).
Environment (Protection) Act, 1986 and CPCB Environmental Standards.	Emissions and discharges from the facilities to be created or refurbished or augmented shall comply with the notified standards notified.	**Appendix 1** provides applicable standards for ambient air quality.
Noise Pollution (Regulation and Control) Rules, 2000 amended up to 2010.	Rule 3 of the Act specifies ambient air quality standards in respect of noise for different areas/zones.	**Appendix 2**provides applicable noise standards.
Ancient Monuments and Archaeological Sites and Remains Rules of 1959	The Rules designate areas within a radius of 100 meters (m) and 300 m from the "protected property" as "protected area" and "controlled area" respectively. No development activity (including mining operations and construction) is permitted in the "protected area" and all development activities likely to damage the protected property are not permitted in the "controlled area" without prior permission of the Archaeological Survey of India (ASI). Protected property includes the site, remains, and monuments protected by ASI or the State Department of Archaeology.	As per the revised design,withIn the 300 m zone, it is proposed to lay only 268.3 m of 63 mm minimum diameter pipe along the road. No other components are proposed in these zones. Presently, the temple is protected under the Ancient Monuments and Archaeological Sites and Remains Act, 1958 and is conserved and maintained by the Archaeological Survey of India. As per rule, the contractor will be required to follow a protocol as defined in the Environmental Management Plan (EMP) for getting NOC. ASI will provide permission and after that pipe laying can be done at that zone. In case of chance finds, the contractors will be required to follow a protocol as defined in the Environmental Management Plan (EMP).
Land Acquisition Act of 1894	Private land acquisition is guided by the provisions and procedures in this Act. The District Collector or any other officer designated will function as the Land Acquisition Officer on behalf of the Government. There is a provision for consent award to reduce the time for processing if the land owners are willing to agree on the price fixed by the Land Acquisition Officer.	For the project, there will be no land acquisition or temporary resettlement and hence, Resettlement Plan is not required.
Labour Laws	The contractor shall not make employment decisions based upon personal characteristics unrelated to job requirements.	**Appendix 3** provides applicable labour laws including amendments issued

Law	Description	Requirement
	The contractor shall base the employment relationship upon equal opportunity and fair treatment, and shall not discriminate with respect to aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment or retirement, and discipline. The contractor shall provide equal wages and benefits to men and women for work of equal value or type.	from time to time applicable to establishments engaged in construction of civil works.
Biodiversity Act of 2002	The Biodiversity Act 2002 primarily addresses access to genetic resources and associated knowledge by foreign individuals, institutions or companies, to ensure equitable sharing of benefits arising out of the use of these resources and knowledge to the country and the people.	Not applicable to Harihar 24x7 water supply project
Ramsar Convention, 1971	The Ramsar Convention is an intergovernmental treaty that provides the framework for national action and international co-operation for the conservation and wise use of wetlands and their resources. India is one of the signatories to the treaty. The Ramsar convention made it mandatory for the signatory countries to include wetland conservation in their national land use plans.	Not applicable to Harihar 24x7 water supply project
Wildlife Protection Act, 1972	This overarching Act provides protection to wild animals, birds, plants and matters connected with habitat protection, processes to declare protected areas, regulation of wildlife trade, constitution of state and national board for wildlife, zoo authority, tiger conservation authority, penalty clauses and other important regulations.	Not applicable to Harihar 24x7 water supply project(no wildlife sanctuary).
Forest (Conservation) Act, 1980	The Forest (Conservation) Act prevents the use of forest land for non-forest uses without the clearance from Ministry of Environment Forests and Climate Change (MoEFCC), Govt. of India	Not applicable to Harihar 24x7 water supply project (no forest land).
Karnataka Forest Act, 1963 and Karnataka Forest Rules, 1969	This Act makes the basis for declaration of Reserved Forests, constitution of village forest committees, management of reserved forests and penalties and procedures.	Not applicable to Harihar 24x7 water supply project (no forest land).
Karnataka Preservation of Trees Act, 1976 and Karnataka Preservation of Trees Rules, 1977	This Act has put restriction on felling of trees in the State unless until permitted by the Tree Officer. Any person desiring to fell a tree shall apply in writing to the tree officer for permission in that behalf. It further defines clauses for planting adequate number of trees, planting in place of fallen/destroyed trees, preservation of trees and adoption of trees.	Not applicable to Harihar 24x7 water supply project (no tree-cutting required).

9. The ADB guidelines, on the other hand, stipulate addressing environmental concerns, if any, of a proposed activity in the initial stages of project preparation. For this, the ADB SPS categorizes the proposed components into various categories (A, B or C) to determine the level of environmental assessment required to address the potential impacts. Level of environmental assessment required for each category is presented below.

(i) Category A: Project components with potential for significant adverse environmental impacts. An Environmental Impact Assessment (EIA) is required to address significant impacts.
(ii) Category B: Project components judged to have some adverse environmental impacts, but of lesser degree and/or significance than those for Category A. An initial environmental examination (IEE) is required to determine whether significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report.
(iii) Category C: Project components unlikely to have adverse environmental impacts. No EIA or IEE is required, although environmental implications are still reviewed.

10. The environmental impacts of Harihar 24x7 water supply project have been identified and assessed as part of the planning and design process. An environmental assessment using ADB's Rapid Environmental Assessment Checklist for Water Supply was conducted, and results of the assessment show that the project is unlikely to cause significant adverse impacts. Thus, this IEE has been prepared in accordance with ADB SPS's requirements for environment category B projects.

D. Scope of IEE

11. The IEE was based mainly on secondary sources of information and field reconnaissance surveys; no field monitoring (environmental) survey was conducted. Stakeholder consultation was an integral part of the IEE.

E. Report Structure

12. This Report contains eight (8) sections including this introductory section: (i) introduction; (ii) description of Investment Program components; (iii) description of the environment; (iv) screening of potential environmental impacts and mitigation measures; (v) public consultation and information disclosure; (vi) Institutional requirements and EMP; (vii) finding and recommendation; and (viii) conclusions.

II. DESCRIPTION OF THE PROGRAM COMPONENTS

13. Harihar, the second largest urban center in Davanagere District, is located at a distance of 275 km from State capital, Bangalore and 14 km from District headquarter Davanagere. The city is situated on the banks of the River Tungabhadra on National Highway 4 (Puna – Bangalore). The town is the Taluk headquarters of the Harihar Taluk in Davanagere District. The city has good road and rail connections with major towns both in the state and neighbouring states. The City Municipal Council's jurisdiction extends up to an area of 20.99 Sq.km with 14,796 households including 31 wards and 3 Local Panning Area villages with populations of 96,514 as per the census 2011. It is one of the important educational, industrial and commercial trade centers of the District. The agricultural development around the town is extensive due to

the presence of the Bhadra irrigation canal. Owing to the irrigation facilities, agro based industries are also growing at faster. Davanagere and Harihar towns are well connected by both roadways (National Highway No. 4) and railways with broad gauge line. The town has been declared as the City Municipal Council (CMC) under Karnataka Town and Country Planning Act (KTCP Act).

A. Present Situation

14. The subproject is designed to provide drinking water facilities to the communities of Harihar. The first organized Water supply system for Harihar was constructed in 1972 with Thungabhdra River as the source. It was designed to supply 5.0 MLD with plain sedimentation tank with rapid sand filters and now it is abandoned. The second Water supply system was created in year 2003, with Tungabhadra River as source on the upstream of the town at Kavalettu village. The existing water supply within Harihar by all means is totalling to 9.5 MLD supplied in 24 hrs by operation of the pumps at treatment plant. Though the gross supply indicates 116 lpcd, the net supply position does not exceed 80 lpcd (norm is 135 lpcd) after the transmission and other losses of about 30%. The supply is once in a day for duration of about 3 to 4hrs (6am to 9pm) for supply from tanks and 1 to 2hrs from pumping zones and every alternative days during the summer. The existing water supply system is depicted in **Appendix 4.** The shortfall in the existing water supply system are detailed below;

- It is observed that raw water availability is only 12.72 against requirement of around 18.08 MLD in 2016, 24.33 MLD in 2031 and 32.66 MLD in 2046 including the system losses. There is clear deficit of 19.94 MLD for the ultimate year requirement. Therefore it has become necessary to enhance the capacities of the raw water pumping mains and pumping machineries to meet the design requirement of ultimate year 2046 and intermittent year 2031 respectively.

- The present Water Treatment Plant (WTP) is designed for 13 MLD and installed capacity of water treatment plant is 13 MLD clarifloculator with rapid sand filters capacity of 9.00 MLD. Therefore the WTP capacity available is only 9 MLD as against 17.77 MLD in 2016, 23.91 MLD in 2031 and 32.09 MLD for 2046. There is clear deficit of 14.91 MLD treatment plant for the intermittent year requirement. The present water supply is not sufficient. It is to be rehabilitated to utilize the designed capacity of 13MLD and also enhance the capacity of WTP to the intermittent year requirement of 23.91MLD. However the proposed WTP shall be designed for 20 MLD capacity upto clarrifloculator and other components of WTP may be enhanced after 2031.

- The maintenance of the present systems is not being periodically done resulting in the poor condition of the electro-mechanical installations which area already covered nearly 75% of expected life time requiring rehabilitation.
-
- The distribution system which covers only 65% of the total road length is required to be extended for covering the area likely to be developed by 2016. It is estimated that the distribution lines are required to a total length of 178.59 Km by 2016 in addition to existing 102 km and proposed 76.59 km. After review of the condition survey of distribution network it is opined that 100 % replacement of existing pipe line.

15. Thus the focus of water supply scheme in Harihar is on water conservation by reducing leakages through rehabilitation and rectification of existing water supply systems and converting

system in to 24 x 7 - Water supply system with simple automation. Hence, it is necessary to augment the scheme to meet the proposed demands for the projected population for the year 2031, 2046 and accordingly the project is formulated. Information on the current water supply system is given in **Table 2.**

Table 2: Salient Features of Existing Water Supply System in Harihar

Total length of streets	157 Km
Total length of Distribution Network	102 Km
Distribution Coverage in percentage	65 %
Total No of Households	14,796 Nos
Total No of HSC's	7,325 Nos
Total No of Non-domestic connections	119 Nos
Total No of Commercial connections	103 Nos
Total No of Industrial connections	16 Nos
Total No of Public fountains	386 Nos
Present Qty of Water supply	12.72 MLD
Projected water demand for the intermediate stage (2031) including 15% losses.	24.33 MLD
Projected water demand for the Ultimate stage (2046) including 15% losses.	32.66 MLD
Source: 1st Stage - Tungabhadra River (commissioned in 1972)	5.00 MLD
Source: 2nd Stage - Tungabhadra River (commissioned in 2002)	9.00 MLD

16. Location of sub project site is shown in **Figure 1.** Base map of the project city- existing water supply system is shown in **Appendix 4.**

17. During field investigation, it is found that Tungabhadra River is a reliable and sufficient source. There is sufficient flow within the Tungabhadra River throughout the year and hence Tungabhadra River is sustainable source for Harihar Water supply scheme. **Appendix 5** shows sustainable water source analyses.

B. Proposed 24 X 7 Water Supply System

18. The following table presents the proposed works in Harihar to ensure 24x7 water supply.

19. **Figure 2** showsSchematic Diagram of Proposed water supply scheme of Harihar. Figure 3 shows rising main alignment. Location of WTP in Google map is shown in Figure 4. **Figure 5 and 6** shows view of the existing WTP and proposed augmentation respectively. Figure 7 shows layout plan of WTP

20. The proposed water supply system is depicted in **Appendix 6.**

21. **Figure 8** shows distribution zone around Harihareshwara Temple. **Figure 9** shows location of Harihareshwara Temple in Google map. A the same time marking of Harihareshwara Temple at Harihar shown in **Figue 10.**

Table 3: Proposed 24x7 Water Supply Project Components in Harihar

Component	Description of Works	Location
A. Bulk water supply*		
Rehabilitation and augmentation of existing Jack well	Rehabilitation and Replacement of Pumping Machineries and other necessary accessories at head works at Existing Jack well. Replacement of two numbers vertical turbine pump set	Existing Jack well at Kavalettu village. No land acquisition required.
Providing new Raw Water Pumping Main	Providing and laying raw Water Pumping Main of 500mm DI K9 pipe from Jack well at Kavalettu village to WTP at Harihar for length of 4300 meters including river crossing	Parallel to existing rising main. No land acquisition required. ROW is available and sufficient for civil works and has no encroachment.
Rehabilitation and augmentation of existing Water Treatment Plant capacity from 9 MLD to 20 MLD	Construction of 20.00 MLD Water treatment Plant at Harihar including common Back wash tank of capacity 5LL, pure water sump etc Upgraded chlorine handling and dosing facilities (improve safety) Rehabilitation and Replacement of Pumping Machineries and other necessary accessories at WTP, Harihar. The WTP major units consists of flash mixer, tube settler, Rapid sand filter house, Chemical house, chlorine tonner room and related civil, electrical, mechanical works.	Within the boundary of Existing WTP. No land acquisition required.
Providing new Pure Water Pumping Main	Providing and laying Pure Water Pumping Main of different dia varying from 450mm DI K9 pipe to 200 mm dia for a length of 10770 m from WTP to individual storage reservoirs in the town	Pipes will be laid along the roads within the Municipal limit. No land acquisition required. ROW is available and sufficient for civil works and has no encroachment.
Construction of new ELSR	Construction of Elevated storage reservoirs: 1.50 ML capacity Tank at Amaravati colony and one at Guttur 1.0 ML Capacity.	Municipal land at Amaravati colony (zone 5) and at Guttur (zone 2)
Rehabilitation of ELSR	Rehabilitation (strengthening of column and braces) ELSR at Court, and rehabilitation works for other storage tank	Municipal land at court
Bulk Flow Measurements	Provision for Bulk flow meters @ Outlet for jack well and inlet for WTP before aerator, out let of Clear water sump. Inlet of ELSRs	WS Strategic Network and Primary mains Distribution Network
B. Distribution system **		
Distribution Network	Distribution Network of 178.59 Km in all 9 Zones and diameter wise details are given below 63 mm - 138.67 km 75 mm - 3.26 km 90 mm - 8.19 km	Pipes will be laid along the roads, and will almost cover entire city. No land acquisition required. ROW is available and sufficient for civil works and has no encroachment.

Component	Description of Works	Location
	110 mm - 10.24 km 160 mm - 8.12 km 200 mm - 5.36 km 250 mm - 1.24 km 315 mm - 1.61 km 355 mm - 1.90 km	
New House Service Connections	Provision of house service connections (total of 14000)	No land acquisition required.
Bulk meters	Provision of 16 bulk meters	
Operation and Maintenance	Remuneration for Operation and Maintenance of Water supply scheme (including bulk water and Distribution system) including generating bills and delivering to the customer on monthly basis, ascertaining reduction in losses, quantifying NRW, periodical water Quality checking, redressal of complaints in prescribed time and ensuring continuous supply with minimum pressure of 7 m at consumer end etc for 5 years including price escalation charges	
	Developing and commissioning software for billing and collection system, establishing customer care centre office, office infrastructure as per the schedule 7 of bid document including 3 computers, printers, interior as per the requirement and furniture's etc complete	
	O&M cost for bulk water and distribution in Phase-III (for commission and Trial Run period) for one month excluding the cost of power and including cost of consumable and all manpower required for complete the work	

* Package for bulk water supply along Byadgi WS
** Seperate distribution package

22. Excavation for the pipe replacement and pipe laying works will be undertaken through open trenching, which will be ranging from 60 cm to 1 meter width. Excavation, laying of pipes and backfilling will be completed within the day. Subsequent to completion of works, road reinstatement will be undertaken by the contractor as part of the civil works. The same shall be mentioned in the bid document to make it binding on the contractor.

Table 4: Target Outputs and Outcomes for Subproject (Harihar)

Indicator	
Current coverage of water services (%)	65%
Target coverage of water services upon completion of KIUWMIP T1 (%)	95%
Current 24 x 7 Coverage (%)	0%
Target 24 x 7 Coverage (%)	95%
Design Year Population (2016)	116471
Population in 2031	156725
Population in 2046	210369
24 x 7 benefiting population upon T1 completion (2016)	110650

Current average supply (hours per day)	3
Target average supply upon completion of KIUWMIP T1 (hours per week)	24X7
Current household (HH) connections	7325
Additional HH connections after completion of the KIUWMIP T1	4675
Current number of HH meters	0
New HH meters under KIUWMIP T1	12000
Current number of bulk meters (provided under KIUWMIP T1)	0
Proposed bulk water meters under KIUWMIP	16
Current storage capacity (ML)	6.65
Rehabilitated storage capacity (ML)	6.65
Additional storage capacity (ML)	2.5
Current length of piped network (km)	102
New water supply distribution length(km)	178.59

C. Investment Program Implementation Schedule

23. Harihar 24x7water supply project town will be implemented in two phases viz., Phase – I comprising 9 months and Phase – II comprising 18 months and total of 27 months. Tendering has been done on June 2016. Evaluation is under progress and it is expected that work will beawarded by December 2016 end.

Phase - I: Planning, Designing and Procurement – 9 months

Phase	Activity	Activity in Months								
		1	2	3	4	5	6	7	8	9
1	Planning, Designing & Procurement									

Phase - II: Implementation of the sub-projects approved for the respective ULB - 18 months

Phase	Activity	Activity in Months																	
		10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
2	Implementation																		

Phase - III: Operation &Maintenance for 5 years

Phase	Activity	Activity in Years				
		1	2	3	4	5
1	Operation &Maintenance					

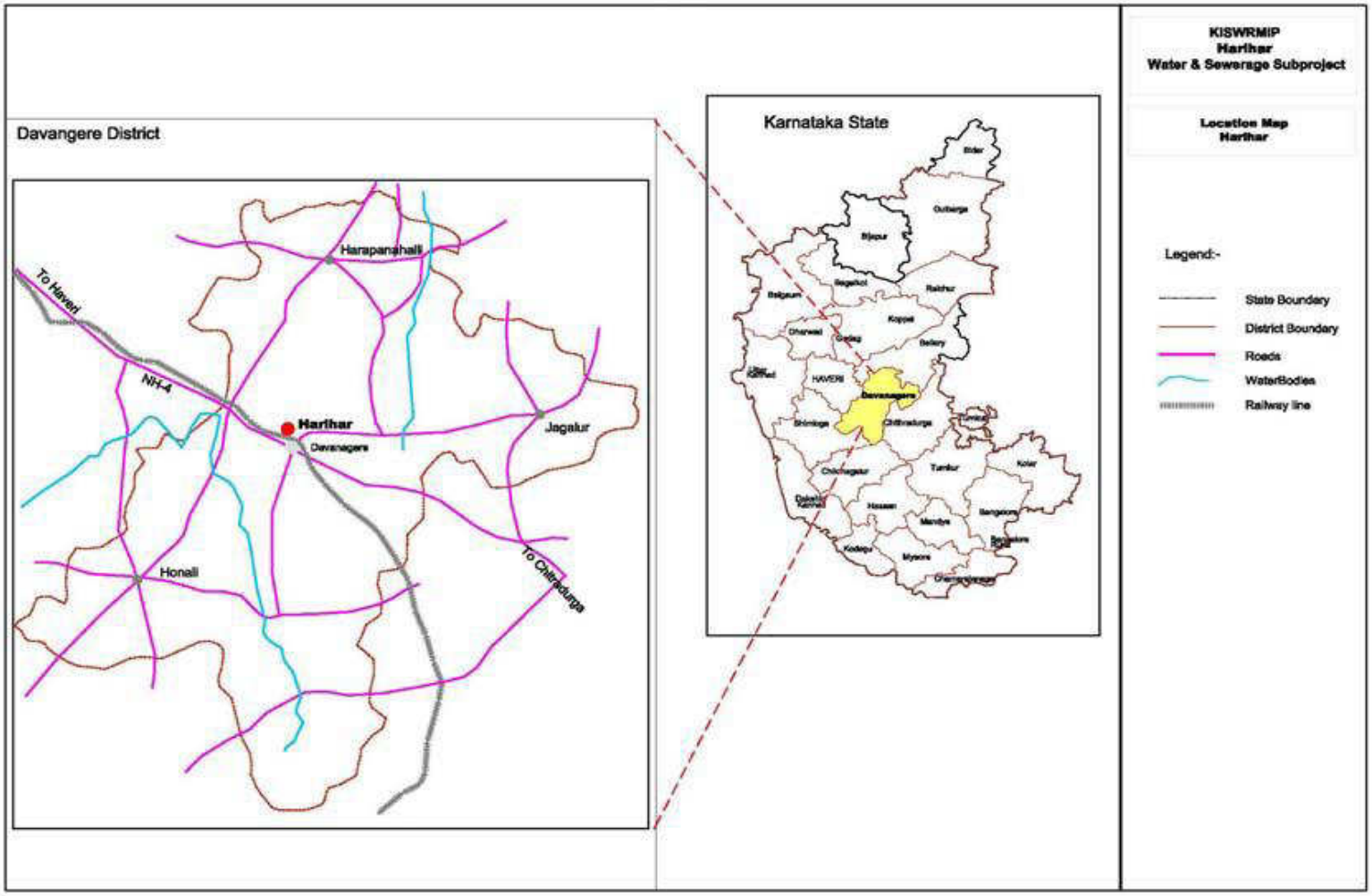

Figure 1: Location of Sub project city

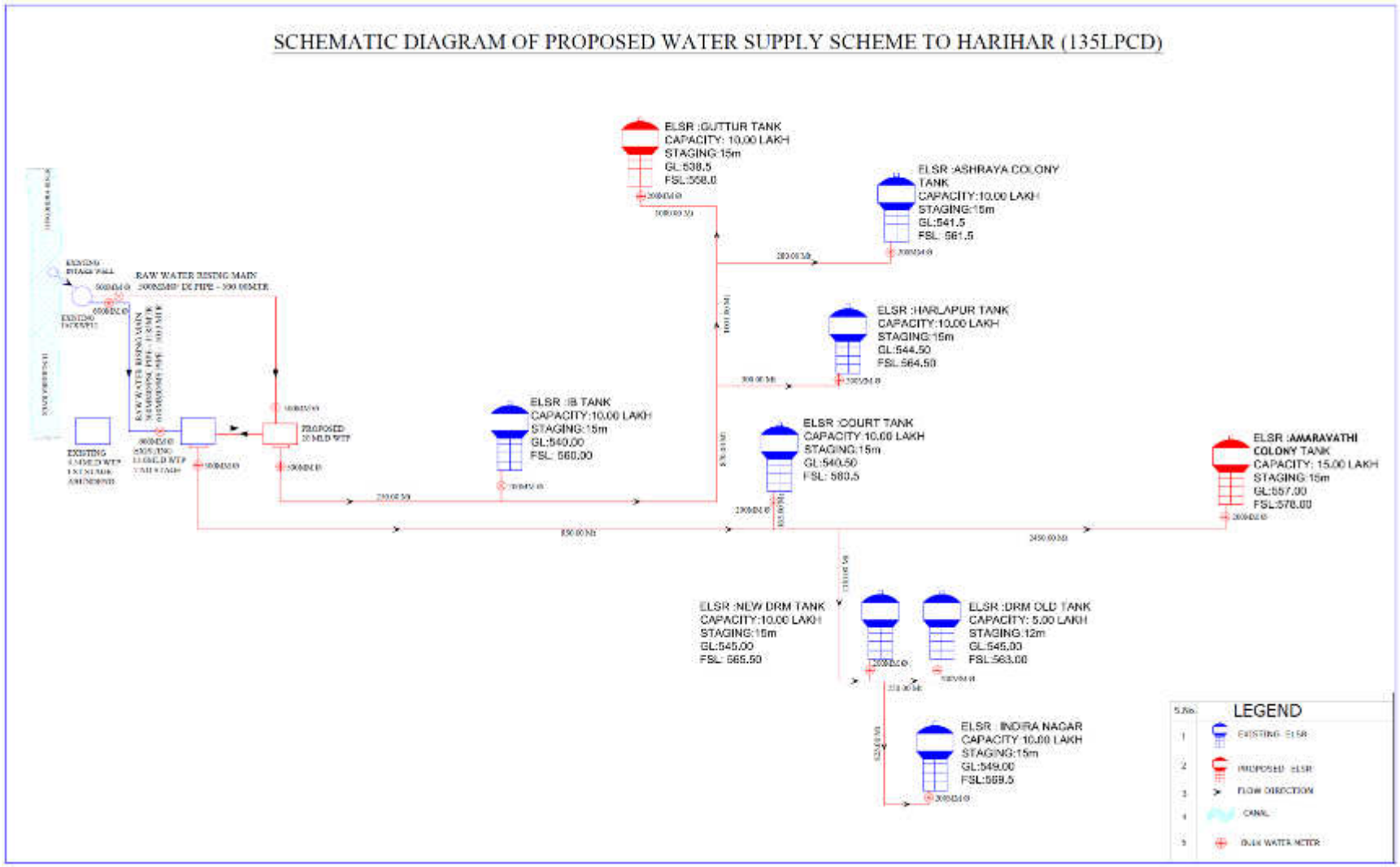

Figure 2: Schematic Diagram of Proposed water supply scheme of Harihar

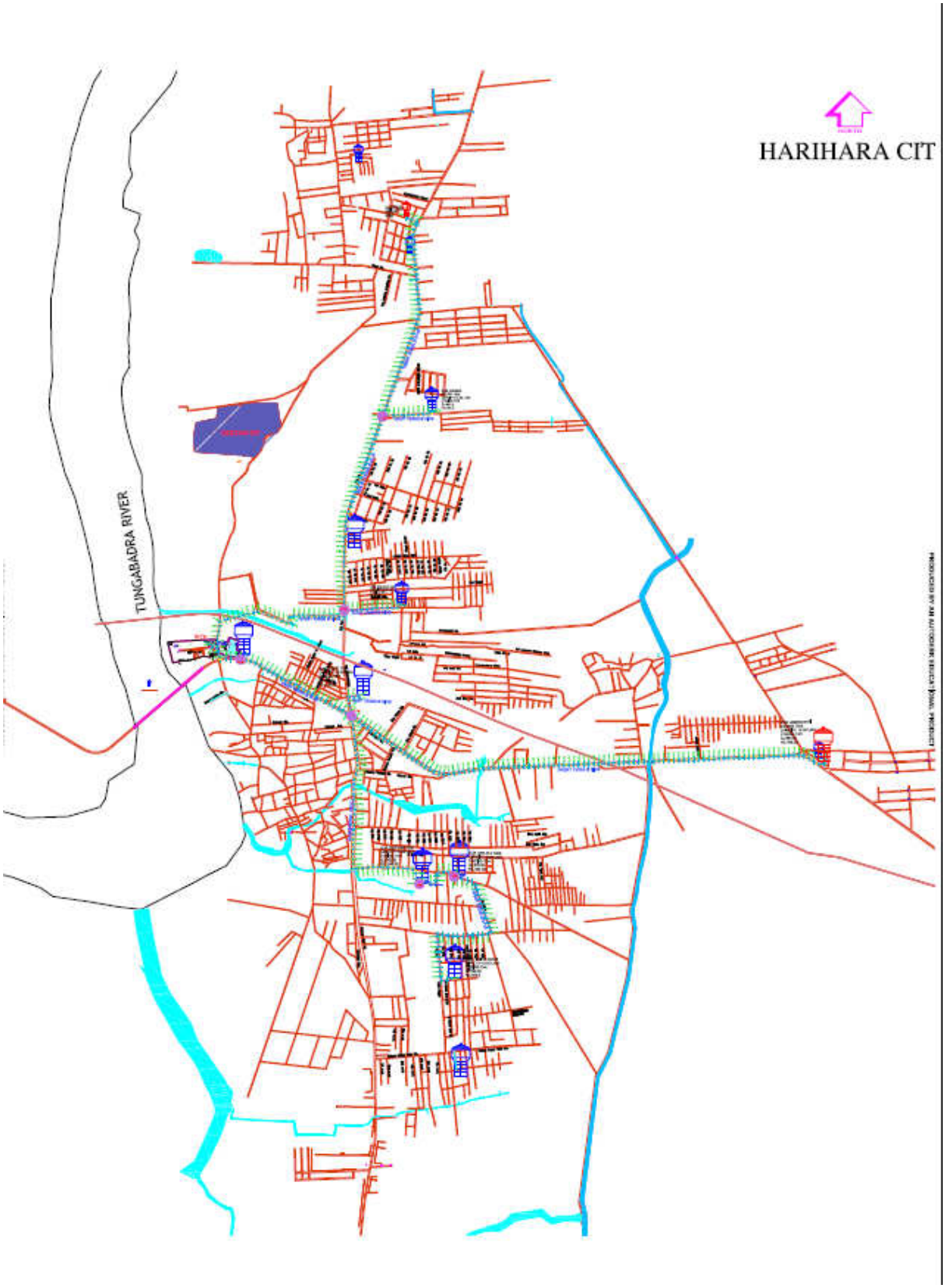

Figure 3: Rising main for Harihar WS

Figure 4: Location of WTP at Harihar in Google map

Figure 5: View of Existing WTP components

Figure 65: Proposed Augmentation at WTP

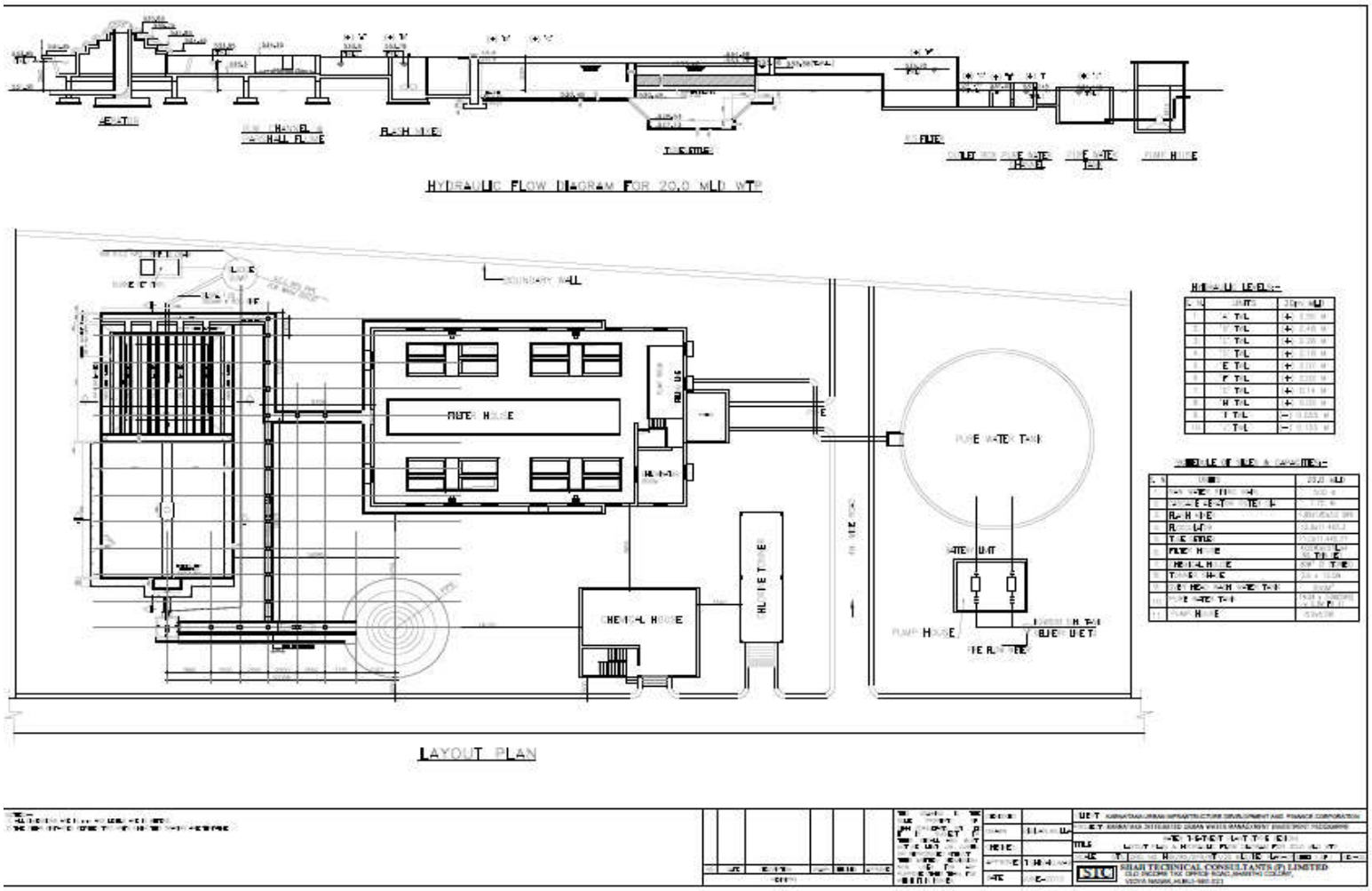

Figure 7: Layout plan of WTP at Harihar

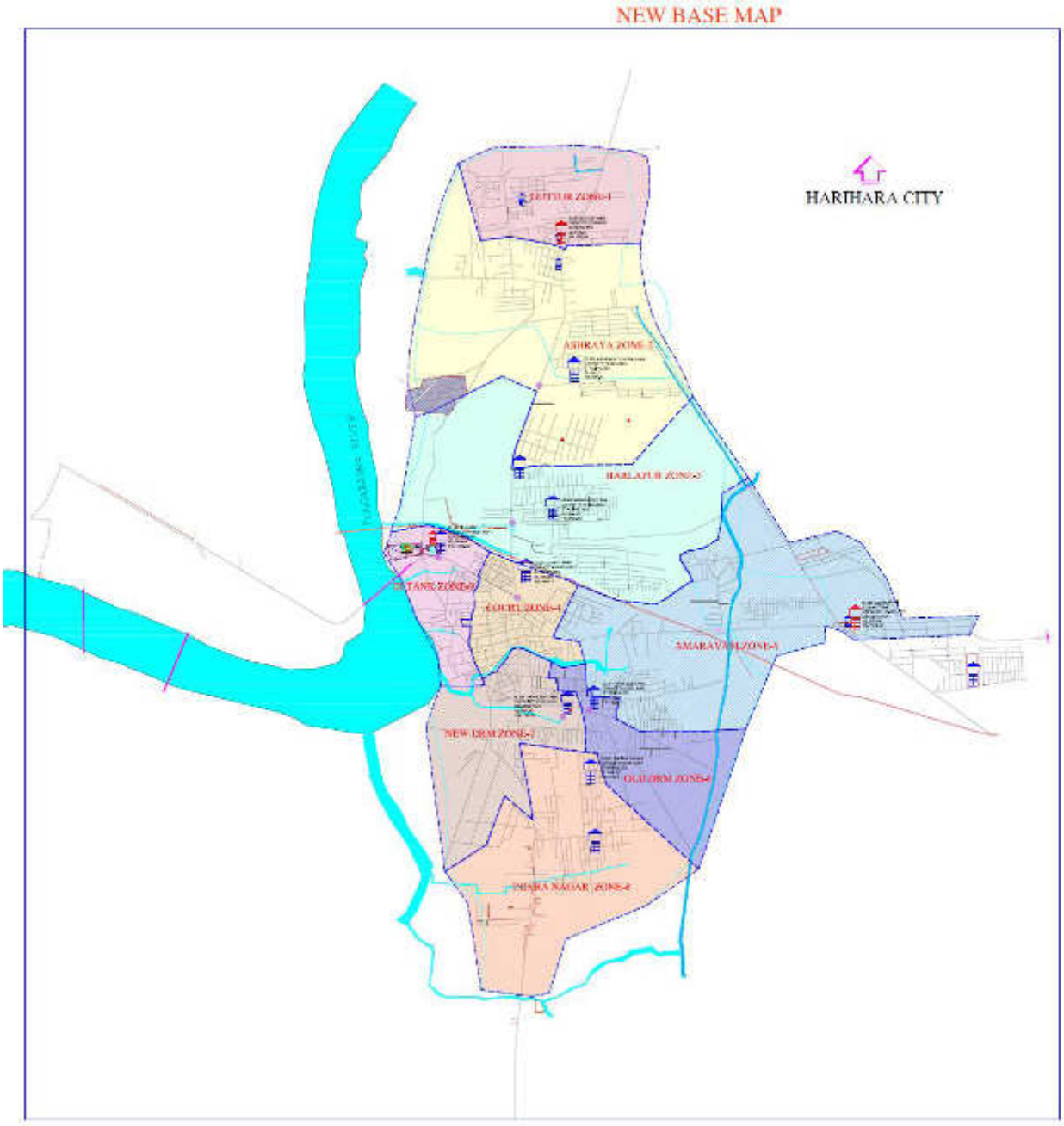

Figure 8: Distribution zone including area in and aroundHarihareshwara temple

Figure 9: Harihareshwara Temple location at Harihar- Google map

Figure 10: Marking of Harihareshwara Temple at Harihar

III. DESCRIPTION OF THE ENVIRONMENT

A.Physical Characteristics

24. Harihar, City Municipal Council (CMC) is the second largest urban center in Davanagere District, is located at a distance of 275 km from State capital, Bangalore and 14 km from District headquarter Davanagere. The city is situated on the banks of the River Tunga Bhadra on National Highway 4 (Puna –Bangalore). The town is the Taluk headquarters of the Harihar Taluk in Davanagere District. The city has good road and rail connections with major towns both in the state and neighbouring states. The City Municipal Council's jurisdiction extends up to an area of 20.99 Sq.km with 14,796 households including 31 wards and 3 Local Panning Area villages with populations of 97,514 as per the census 2011. It is one of the important educational, industrial and commercial trade centers of the District. The agricultural development around the town is extensive due to the presence of the Bhadra irrigation canal. Owing to the irrigation facilities, agro based industries are also growing at faster. Davanagere and Harihar towns are well connected by both roadways (National Highway No. 4) and railways with broad gauge line. The town has been declared as the under Karnataka Town and Country Planning Act (KTCP Act).

25. **Topography and Soils.** Geographically the town lies between 14^{o} 30' N Latitude and 75^{o} 48' E longitude at an altitude of 539 m above Mean Sea Level (MSL). The majority of the town area is sloping towards West from East and part of the area is south to north. All *nallas* originating in the town finally joins to Tungabhadra River in western and northern part of the town. Tungabhadra River flows in the west of the town from south to north direction. Harihar town is developed on the right bank of Tungabhdra River. Topography is plain and slopes gently towards the river in the west. The town is located in Central Dry Zone as per Agro Climatic Zone classifications in the State. The surface soil is composed of murrum soil and black cotton soil mixed with granite boulders. The principal crops grown here are ragi, jowar, pulses and oil seeds.

26. As per the seismic zoning map of India, Harihar Town falls under Zone II, which is the lowest earth quake risk zone in India. This zone is termed as "low damage risk zone".

27. **Air Quality.** The major sources of air pollution in the city are from the vehicles. Karnataka State Pollution Control Board (KSPCB) monitors air and noise pollution in the State in line with Air (Prevention and Control of Pollution) Act, 1981. KSPCB have monitoring stations located at various places across the state; however covers major cities, district headquarters and industrial locations. Data shows that particulate matter is high because of the dry atmosphere, dusty roads and surrounding land, and Respirable Suspended Particulate Matter (RSPM: particles < 10µm) and Suspended Particulate Matter (SPM) exceed National Ambient Air Quality Standards (NAAQS). In contrast, levels of chemical pollutants (oxides of sulphur and nitrogen) are below national standards.

Table 5: Ambient Air Quality in Harihar

MonitoringStation	SPM(µg/m3)	RSPM (µg/m3)	SO2 (µg/m3)	NOx (µg/m3)
Harihar	247	123	1	19
AmbientAirQualityStandard	200	100	80	80

Source:EIAReportofGrasimIndustriesLimitedpreparedbyNEERIin2007

28. The ambient air quality monitoring results at Harihar as generated under this program are presented in **Table 6**. Results indicate that concentrations of parameters are with the CPCB limit except one location(Keshwapur Near Railway Station) at Harihar, where concentration of both PM_{10} and $PM_{2.5}$ are above the limit.

Table 6: Ambient Air Quality Monitoring at Sites of construction

Sampling Locations	Date of Monitoring	Parameters			
		SO_2 µg/m^3	NO_2 µg/m^3	$PM_{2.5}$ µg/m^3	PM_{10} µg/m^3
Guttur Colony Near Panchyat office	05.05.2015	4.26	9.21	52.41	72.48
Keshwapur Near Railway Station	05.05.2015	4.24	9.12	68.48	108.54
Vidyanagar Extension "C" Block	05.05.2015	4.14	9.25	48.15	86.76
Standard as per CPCB		**80.0**	**80.0**	**60.0**	**100.0**

Source – KIUWMIP data generation
Note: CPCB - Central Pollution Control Board, BDL - below detection limit

29. **Climate.** The town can be categorized central dry region of the state of Karnataka. The climate is characterized by dry weather during the major parts of the year and hot summer temperatures are experienced during the months of March to May when mercury level goes as high as 42^0 C.

30. **Temperature.** The temperature in the city ranges between $30^0$and 40^0C during summer months. The period from December to February can be classified as cold season and the minimum temperature is around 17.7^0C to 20^0C.

31. **Rainfall.** The average annual rainfall is about 1040 mm. The rainfall is mostly received during June to November and about 60 percent of the annual rainfall is received during the months of June to September, maximum rainfall is registered during the month of August. Rainfall pattern is shown below.

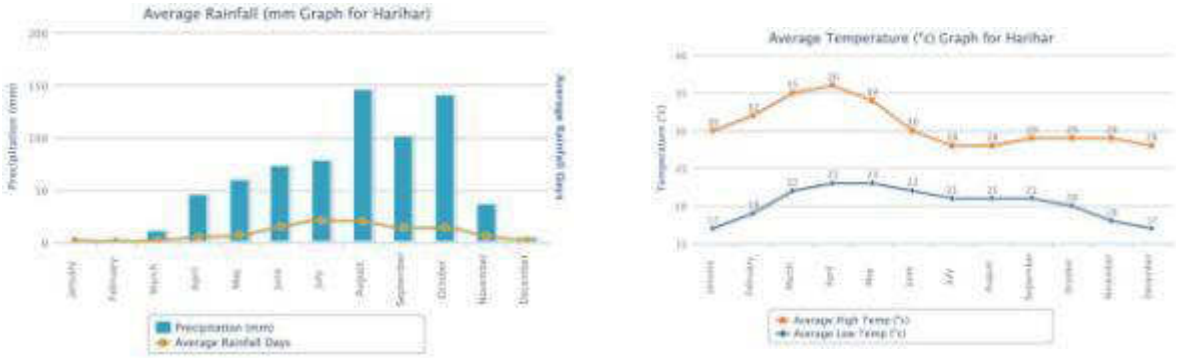

Figure 11: Average monthly temperature and rainfall

32. **Surface Water.**Harihar is situated on the right bank of Tungabhadra River. River flows north-south, and the town gently slopes towards the river on west. Tungabhadra is one of the two largest tributaries of River Krishna. The River is formed by the confluence of two rivers, Tunga and Bhadra, both of which originate in the Western Ghats in Karnataka. The length of Tunga is 147 km while Bhadra is 171 km, before they join together at Kudli near Holehonnur in Shimoga District. From this confluence point at Kudli, the River is called as Tungabhadra and flows down through the plains and meets River Krishna in Mahaboobnagar District of Andhra Pradesh. The length of the river is 531 km through Karnataka and Andhra Pradesh states. In Karnataka, it flows over a distance of 293 km through the districts of Chikmagalur, Shimoga, Davanagere, Haveri, Chitradurga, Bellary and Raichur, and drains are area of 57,671 sq km, which is nearly 81% of total Tungabhadra River Basin. During its course in Karnataka, numerous small and big tributaries join the River. Varada and Heggari are the main tributaries of Tungabhadra in Karnataka State; while the former flows through Shimoga, Uttara Kannada and Haveri Districts, the later flows through Chitradurga and Bellary Districts.River Tunga, Bhadra and Tungabhadra are the main sources of drinking water supply. Almost all the towns depend directly on river (direct pumping, infiltration galleries, shallow wells in the river bed etc); during low flow season, the water supply is supplemented by groundwater. Tungabhadra Dam constructed across the River at Hospet in Bellary district is lifeline of Bellary, Raichur and Koppal districts in Karnataka and parts of Andhra Pradesh State. The river is the main source of water for Harihar and for major and small industries on the left bank side of the river. Besides, water is used for irrigation by farmers alongside river by lift pumps.

33. Water quality monitoring of Tungabhadra River is conducted by Karnataka State Pollution Control Board (KSPCB) in Karnataka. The Tungabhadra water quality is classified as Category C “Drinking water source after conventional treatment and disinfection” in the upstream of Harihar town where the intake is situated. However, in the down steam, due to discharges from various industries and sewage from Harihar and Davanagere, the water quality on the downstream side of Harihar is poor. CPCB identified the stretch between the downstream (d/s) of Harihar to Haralahalli bridge as “polluted”. Following table shows the water quality of the river. The intake for Harihar water supply was originally located near the town. Since this location was close to an industrial waste discharge point, it was decommissioned and a new intake was constructed at 7 km upstream at Kavalettu. The water is currently drawn from this intake.

Table 7: Tungabhadra River Water Quality

Parameters	**Waterqualitycriteria**		**Kudli**	**Honnali**	**Haralahalli**	**Ullanur**
			u/sofHarihar		**d/sofHarihar**	
		Min	25.0	22.0	22.0	26.0
Temp,oC	-	Max	27.0	32.0	32.0	31.0
		Mean	26.0	25.5	25.1	28.0
		Min	5.2	7.3	7.1	6.0
DO,mg/l	>4mg/l	Max	7.0	7.5	7.6	8.0
		Mean	6.0	7.4	7.4	7.2
		Min	7.5	7.3	7.5	7.6
pH	6.5–8.5	Max	8.3	8.2	8.7	8.4
		Mean	8.0	7.9	8.0	7.9
		Min	116	120	136	270
Conductivity,µmhos/cm	<2250	Max	400	500	560	1240
		Mean	259	330	381	847
		Min	2.3	1.2	1.2	1.7

Parameters	Waterqualitycriteria		Kudli u/sofHarihar	Honnali	Haralahalli d/sofHarihar	Ullanur
BOD,mg/l	<3mg/l	Max	3.1	3.4	3.7	5.2
		Mean	2.7	2.6	2.4	3.1
		Min	0.21	0.08	0.1	0.2
Nitrate,mg/l	-	Max	0.54	0.7	0.63	1.4
		Mean	0.33	0.33	0.36	0.54
		Min	-	-	-	-
Nitrite,mg/l	-	Max	-	-	-	-
		Mean	-	-	-	-
	<2500MPN/100ml	Min	80	30	40	1100
FeacalColiform,MPN		Max	240	170	170	9000
		Mean	155	114	82	6872
	<5000MPN/100ml	Min	110	50	60	2200
TotalColiform,MPN		Max	3000	2220	1300	16000
		Mean	1928	1176	932	13109

Source: PHED data source 2013

34. **Groundwater**. In Harihar Taluk, schists are the main water bearing formation. Ground water occurs within the weathered and fractured rocks. Ground water exploration reveals that aquifer systems are encountered from depth of 21 m below ground level to 51 m below ground level. Yield ranged from 0.07 to 3.28 lps. Transmissivity ranged from 1.0 to 8.0m^2/day. During May 2006 (pre monsoon season), the minimum depth to water level and maximum water level was 2.37 m and 8.42 m respectively. During November 2006 (post monsoon), water level ranged from 2.27 m to 7.08 m. Major parts of Davangere, Harpanahalli, Harihar and Jagalpura fall under over exploited category. In Harihar Taluk, 98 percent area falls under over exploited and 2 percent of the area falls under semi critical category. The stage of development of ground water for the taluk is 47 percent, which is the lowest in the district. Table 8shows the summary of ground water estimation studies in Harihar. As per the Central Ground Water Board (CGWB), Flouride content in groundwater is present in excess in the district (Fluoride content more than 1.5 ppm). The Electrical conductivity values in the major part of the district are in the range between 1000 and 2000 micro mhos/cm.

Table 8: Ground Water Development in Harihar Taluk

Particulars	Details
NetAnnualGroundWateravailability(HAM)	6317.29
Existinggross GWdraftforalluses(HAM)	2966.95
Allocationfordomesticandindustrialusefornext25years(HAM)	537.23
NetGW availabilityforfutureirrigationdevelopment(HAM)	3503.09
BalanceGW irrigationpotentialavailable(HA)	4319.48
Stageofdevelopment(%)	47

Source:CentralGroundWaterBoardReport,November2008

35. **Noise Level.** Noise level monitoring has been conducted at 2 locations of Harihar. Results are shown below. Both day and night time noise level is high and above the standard.

Table 9: Noise Level Monitoring at project sites of Harihar

Sampling Locations	Date of Monitoring	Day Time			Night Time Leq dB(A)		
		L Min dB(A)	L Max dB(A)	Leq dB(A)	L Min dB(A)	L Max dB(A)	Leq dB(A)
Near Anjaneya Temple Amaravathi	05.05.2015	49.3	61.6	61.1	50.4	61.5	58.5
Guttur Colony Near Panchyat office	05.05.2015	58.9	69.7	62.7	53.6	64.7	61.7

Source – KIUWMIP data generation
CPCB Limits for Industrial area: Day Time= 75 dB(A), Night Time (9 PM to 6 AM)= 70 dB(A)
Commercial area: Day Time= 65 dB(A), Night Time (9 PM to 6 AM)= 55 dB(A)
Residential area: Day Time= 55 dB(A), Night Time (9 PM to 6 AM)= 45 dB(A)
Silence Zone: Day Time= 50 dB(A), Night Time (9 PM to 6 AM)= 40 dB(A)

C. Ecological Resources

36. Harihar is an urban area surrounded by land that was converted for agricultural use many years ago. There is no remaining natural habitat in the town, and the flora is limited to artificially planted trees and shrubs, and the fauna comprises domesticated animals. There are no forests or any other environmentally sensitive areas in or near the town. Ranebennur Reserve Forest, located at 6 km from the town, is the nearest environmentally sensitive area.

C. Economic Development

37. **Land Use Pattern**. The present town area comprises of 7.77 sq .km of which 6.95 sq. km is in the 'developed category' with an average density of 105 persons per hectare. Town Planning Department has demarcated proposed land use boundary of Harihar with a total area of 20.00 sq. km. Commercial development is mainly concentrated along the two main roads (NH 4 connecting Pune and Mumbai, and SH25 connecting Shimoga and Bellary) passing through the city. **Table 10** shows the existing land use of Harihar.

Table 10: Existing Land Use for Harihar CMC

LandUse	ExistingLandUse(2001)	
	AreainHa	Percent
Residential	128.88	18.52
Commercial	43.68	6.28
Industrial	131.05	18.83
PublicUtilities	6.49	0.93
TransportandCommunication	224.03	32.19
VacantLand	89.39	12.85
Public&SemiPublic	28.84	4.14
Parks,Playgrounds,Openspaces	43.53	6.26
Total	420	100

Source: Economic and statistical data, 2011

1. Industry and Agriculture

38. Owning to its location and connectivity and availability of water, industrial development in Harihar is notable, and it is one of the important clusters in Karnataka. It is well known and important major industrial like - Grasim, Synthetic, Shamanur Sugar's and Harihar poly-fiber, etc. has contributed much for the economic growth of the town. Apart from these, there are a number of other engineering and small manufacturing units and brick kilns.

39. Agriculture: There are vast agriculturally rich lands around the town, cultivated by Tungabhadra water. Maize, paddy, jowar and cotton are the major crops grown in and around Harihar.

2. Infrastructure

40. **WaterSupply**.ThecityofHariharissuppliedbybothsurfacewaterandgroundwater sources.ThesurfacesourceisfromTungabhadraRiveratKawalettuvillagewhichislocatedat adistanceof7kmfromthecity.KUWS&DBhasimplementedacomprehensivewatersupply schemeintheyear2003.Thepresentwatersupply tothetownis9.55MLDwithpercapitarate ofwatersupplyof84LPCD.

41. **SewerageandSanitation**.Currentlythereisnoundergroundseweragesysteminthe town.Thesystemofsoakpitsandseptictanksisusedforthedisposalofsewageinthecity. Thewastewater,includingsullageandsewage,generallyentersintothreemajordrainsofthe town.- Goudarageri*nala*,Matha*nala*andKirloskar*nala*.Interception,diversionandtreatment worksweredeveloped underNational RiverConservation ProjectbyKUWSDB.The wastewater fromthedrainsisintercepted,anddivertedtoatreatmentplant(stabilizationpondbased).This interceptionsystemcaterstoabout35%ofthetown

42. **StormWaterDrainage**.The totallengthofdrains inthecity isapproximately 98.0km.It comprisesofthreemajordrainswithatotallengthof12km.theyareGoudarageri*nala*,Matha *nala*andKirloskar*nala*.Atpresentroadsidedrainscarrybothdomesticwastewaterandsurface runoff.

43. **Transportation**.TheNationalHighwayNo.4connectingBangaloreandPune/Mumbai isthe majorregionalroad runninginthemidstofthe city.The Shimoga–Bellaryroad is another importantroadpassingthroughthecity.Thecityhasdirectrailconnectivitywithabroadgauge lineconnectingBangalore–Hubli.Thisrailwaylinecontributesamajorshareinpassengerand goodstransportation.Withatotallengthof117.6km,internalroadnetworkinthecityiswell developed,howeverarenotingoodincondition.Mostoftheroadsinthecentralpartare congested.Allthemajorcommercial,transportandadministrativebuildingsaresituatedalong NH-4.

44. **PowerSupply**.HydelpoweristhemainsourceofenergyinKarnataka,with61%of totalinstalledcapacity.Remainingismostlyfromthermalpowerstations.Contributionofwind andsolarenergy,althoughincreasing,isnegligible.GovernmentrunKarnatakaPower CorporationLimited(KPCL)isresponsibleforpowergenerationwhileKarnatakaPower TransmissionCorporationLimited(KPTCL)isresponsibleforpowertransmission.The distributiontousersinHariharisprovidedbyregionalcompany–BangaloreElectricitySupply CompanyLimited.Powerissuppliedfromthecentralgridbyoverheadcablescarriedonmetal and concrete poles,mainly located in publicareas alongsideroads.Thepowersupply in Harihar ispoor; there arefrequentoutages inwarmermonths, andfluctuationsinvoltage.

D. Social and Cultural Resources

45. **Population and Communities.**Harihar population has grown from 73,047 in 2001 to 87,744 in 2011 with a growth rate of 20.12 percent, much higher than the previous decade's 9.6 percent. The decadal growth rates never showed a steady growth over the past few decades as shown in the following Table. Present area under CMC jurisdiction is 7.77 sq km. CMC area has remained unchanged from the last three decades. Overall population density of the city is 9401 persons per sq km. While the overall density is moderate, the core area of the city is densely populated as compared to fringe areas of the city.

Table 11: Population Growth of Harihar Town

Year	Population	Decadal Growth Rate
	Nos.	%
1951	15290	
1961	22829	43.40
1971	33888	48.44
1981	52,334	54.43
1991	66,647	27.35
2001	73,047	9.60
2011	87,744	20.12

Source: DPR

46. There are about 17000 numbers of households within the city as per Census 2011. The average household size is 4.9.

47. **Sex Ratio.** As of 2011 census there are 968 females per 1000 male in the city. Sex ratio in general caste is 967, in schedule caste is 981 and in schedule tribe is 971. There are 920 girls under 6 years of age per 1000 boys of the same age in the city. Overall sex ratio in the city has increased by 18 females per 1000 male during the years from 2001 to 2011. Child sex ratio here has increased by 14 girls per 1000 boys during the same time.

48. **Literacy Rate.**Total about 62 thousand people in the city are literate, among them about 33 thousand are male and about 29 thousand are female. Literacy rate (children under 6 are excluded) of Harihar is 85%. 89% of male and 80% of female population are literate here. Overall literacy rate in the city has increased by 2%. Male literacy has gone down by 1% and female literacy rate has gone up by 3%.

2. Physical or Cultural Heritage

49. Harihar is an ancient town located on the banks of Tungabhadra River. According to legend this spot was the capital or stronghold of a giant named Guha or Guhasura. The giant, having by his penance obtained from Brahma the boom of exemption from death at the hands either of Hari (Vishnu) or of Hara (Siva), become in consequence such a tormentor of gods and men that Vishnu and Siva, in order to counteract the spell, combined into one form of Harihar and destroyed him. The descent of this incarnation was at Kudalur, the confluence of the Tungabhadra and the Haridra. Harihar has a rich history of around 1500 years. Predominantly it had been ruled by Hoysalas, Chalukyas of Badami, Cholas, Pandyas, Rashtrakootas, Kaalachooryas, Kings of Vijayanagara, Moghuls and Peshwas. Stone Literatures of Hoysalas, Chalukyas and Kings of Vijayanagara had been found in this place. In 12th century, Hoysala rulers built temple for Sri Harihareshwara. This temple is famous for its rich sculptural works and

architecture. Every year during the month of February, Car Ceremony (Brahma Rathotsava) of Sri Harihareshwara is celebrated with great enthusiasm and thousands of tourists visit the city. With its religious importance, Harihar is also known as "DakshinaKashi". Harihareswara Temple, situated in the centre of the town, is a protected monument under the control of Archaeological Survey of India. Rayara Matha (Raghavendra swami temple on the banks of Tungabhadra) is another important religious place in Harihar.

50. As per the design only 268.3 m of distribution pipeline will be layed at ASI protected zone in and around Harihareshwara Temple. Necessary permission will be taken before construction at that particular zone.

E. Environmental Settings for Subproject Components

51. **Intake and Jack well**. Intake is located within River Tunga-Bhadra at Kavalettu Village and jack well besides the intake and within the land. Water supply system was created in year 2002, with Tungabhadra River as source on the upstream of the town at Kavalettu village by providing intake well in the river. Intake well connected to the Jake well by installing 800mm dia RCC NP3 pipes in two rows. No new construction is being planned within the river. Rehabilitation and Replacement of Pumping Machineries and other necessary accessories at Jack well are being planned.

52. **Raw Water Main**. Water Pumping Main of 500mm DI K9 pipe from Jack well at Kavalettu village to WTP at Harihar for length of 4300 meters. The raw water pipe line passes through Kavaluthu village and through Kumarapattanam. Location of pipe line is within ROW and along the main road.

53. **Water Treatment plant.** Rehabilitation and augmentation of existing WTP capacity from 9 MLD to 20 MLD, and other works related to pumping Machineries and other necessary accessories at WTP, will be conducted within the existing WTP campus in HariharTown near River Tungabhadra. No land acquisition required. Clear water pipes from WTP to reservoirs will be laid along the roads within the Municipal limit.

54. **Water storage reservoirs.** Municipal land at Amaravati colony (zone 5) and at Guttur (zone 2). Rehabilitation (strengthening of column and braces) ELSR at Court.

55. **Water supply distribution pipeline**. Water supply lines are proposed along the roads of densely built up areas of Harihar City where the road width is sufficient to lay the pipe line in the shoulder. The city limit is well developed and there are no environmental hotspots along the proposed areas. As per the design only 268.3 m of distribution pipeline will be laid inASI

regulatedzone in and around Harihareshwara Temple. Necessary permission will be taken before construction at that particular zone.It is proposed use **HDPE** pipes **distributio**n with jointing of electro fusion/ Butt fusion welding. The entire city is covered with water supply distribution system.

56. **Water supply HSCs:** The individual water supply House Service connections have been planned under the present scope of work for over 14000 properties in Harihar CMC. These connections will be provided with water meters protected with meter boxes.

57. The city situated on a comparatively undulating land. The overall ground slope is gradual and from East to West, South to North (part), North to West (part). The maximum contour is 557 m near Proposed Amaravathi Colony Tank. The minimum ground level of 529 m is in Harihareshwara Temple area.Soil strata is black cotton soil predominant in the region, which is fertile and congenial to the growth of paddy, sugarcane, groundnut and sweet corn.

		
Intake Well at Kavalettu Village	**Jack Well RCC Jack Well of 8Mt with pump house is constructed on the bank of the river.**	**Raw water pumping main**
		
Existing WTP at Harihar which is on the bank of the river Thunga Bhadra.	**Transmisson pipeline will be replaced**	**Proposed site for WTP expansion at Hrihar**

		
Old pump needs to be replaced	**Court Tank to be repaired**	**Proposed location of reservoir at Amaravathi colony**

IV.SCREENING OF POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A.Introduction

58. Potential environmental impacts of the proposed infrastructure components are presented in this section. Mitigation measures to minimize/mitigate negative impacts, if any, are recommended along with the agency responsible for implementation. Monitoring actions to be conducted during the implementation phase is also recommended to reduce the impact.

59. Screening of potential environmental impacts are categorized into four categories considering Investment Program phases: location impacts and design impacts (pre-construction phase), construction phase impacts and operations and maintenance phase impacts.

a. **Location impacts** include impacts associated with site selection and include loss of on-site biophysical array and encroachment either directly or indirectly on adjacent environments. It also includes impacts on people who will lose their livelihood or any other structures by the development of that site.
b. **Design impacts** include impacts arising from Investment Program design, including technology used, scale of operation/throughput, waste production, discharge specifications, pollution sources and ancillary services.
c. **Construction impacts** include impacts caused by site clearing, earthworks, machinery, vehicles and workers. Construction site impacts include erosion, dust, noise, traffic congestion and waste production.
d. **O&M impacts** include impacts arising from the operation and maintenance activities of the infrastructure facility. These include routine management of operational waste streams, and occupational health and safety issues.

60. Screening of environmental impacts has been based on the impact magnitude (negligible/moderate/severe – in the order of increasing degree) and impact duration (temporary/permanent).

61. This section of the IEE reviews possible project-related impacts, in order to identify issues requiring further attention and screen out issues of no relevance. ADB SPS (2009) require that impacts and risks will be analyzed during pre-construction, construction, and operational stages in the context of the project's area of influence.

62. The ADB Rapid Environmental Assessment Checklist in http://www.adb.org/documents/guidelines/environmental_assessment/eaguidelines002.aspwas used to screen the project for environmental impacts and to determine the scope of the IEE investigation (**Appendix 7**).

63. In the case of this project (i) most of the individual elements are relatively small and involve straightforward construction and operation, so impacts will be mainly localized and not greatly significant; (ii) most of the predicted impacts are associated with the construction process, and are produced because that process is invasive, involving excavation and earth movements; and (iii) being located in the city, will not cause direct impact on biodiversity values. The project will be in properties held by the local government and access to the project location is thru public rights-of-way and existing roads hence, land acquisition and encroachment on private property will not occur.

B. Pre-Construction Impacts

1. Location impacts

64. TheseImpactsareassociatedwithplanningparticularlyonthesiteselection. Theyincludeimpactsduetoencroachingonsensitiveareasandimpactsonthepeoplewho mightlosetheirhomes orlivelihoodsdue tothe developmentoftheproposed site.

65. Proposed subproject sites are carefully selected to avoid encroachment into sensitive areas and minimise the impacts on people livelihoods and homestead. None of the subproject components require acquisition of private land.

66. All the water pipes will be laid within the municipal boundary, along the roads. Larger diameter pipes will mostly be laid along wider roads where there is enough space between the road carriageway and the buildings. Replacement and augmentation of pumps will be undertaken within the existing pumping station near the WTP.

67. As per the design only 268.3 m of distribution pipeline will be layed at ASI protected zone in and around Harihareshwara Temple. Necessary permission will be taken before construction at that particular zone.

68. **Utilities.**Watersupplypipelines,Telephonelines,electricpoles,andwireswithinthe proposedsubprojectlocationsmayrequiretobeshiftedinfewcasesThemitigatetheadverse impactsduetorelocationoftheutilities,IA will:

- Identifyandincludelocationsandoperatorsof theseutilitiesinthedetailed design documentstopreventunnecessary disruption of services during construction phase;and
- Conductdetailedsitesurveyswiththeconstructiondrawingsanddiscusswith therespective agenciesduring theconstruction phase beforegroundclearance;
- Requireconstructioncontractorstoprepareacontingency plantoinclude actions tobedoneincaseofunintentionalinterruptionofservices.Incaseofdisruption ofwatersupply,alternative supply,throughtankers,shall be provided.

69. Proposedrehabilitationandcapacityaugmentationofthewatertreatmentplant(WTP) willbecarriedoutwithintheexistingWTPsite.Thisexistingsitehassufficientspacefor constructionofadditionaltreatmentcapacitywhichwillconsistofsimilarprocessestothosein theexistingplant.Theexisting"sludgesettlementtanks"willbedemolishedtoprovidethe spaceforthesecondclariflocculatorandpartofthesecondfilterhouse.Theexistingchannel transferringtherawwaterfromtheaeratortotheexistingclariflocculatorwillbemodifiedto supplyanequalflowtobothclariflocculators.TheWTPsiteatpresenthasnonotabletree cover.Environmentalenhancementmeasuressuchastreeplantationshallbetakenupinthe facilityas partofthe subproject.Thiswill also improve aestheticappearance ofthefacility

70. **Siteselectionofconstructionworkcamps,stockpileareas,storageareas,and disposalareas**.Priorityistolocatethesenearthesubprojectlocations.However,if itis deemednecessarytolocateelsewhere,sitestobeconsideredwillnotresultindestructionof property,vegetation,irrigation,anddrinkingwatersupplysystems.Residentialareaswillnotbe consideredforsettingupcampstoprotectthehumanenvironment(i.e.,tocurbaccidentrisks, healthrisksduetoairandwaterpollutionanddust,andnoise,andtopreventsocialconflicts, shortagesofamenities,andcrime).Extremecarewillbetakentoavoiddisposalsnearthe

waterbodies,swamps,orinareaswhichwillinconveniencethecommunity.Alllocations wouldbeincludedinthedesignspecificationsandonplandrawings.Constructionworkcamps shallbelocatedatleast200mfromresidentialareas.Hariharissituatedonthebankof River Tungabhadra.Materialstockpilesshallbeprotectedbybundsduringthemonsoontoarrestthe siltladenrunoffintodrainsandultimatelyintoRiverTungabhadra.Thesubprojectislikelyto generatesoilfromexcavations,whichneedstobedisposedsafely.Thefollowingmeasures should be consideredfordisposalofsurplus/wastesoil.

- Theexcavatedsoilshouldberemovedfromconstructionareaattheearliestforbeneficialre usesuchaslandraising /fillingofexcavatedareas.
- Soilshouldbecoveredwithtarpaulinsheetsduringtransportation.
- Soiltransportationshouldnotbedoneduringpeakhoursandshouldbeavoidnarrowandhe avy trafficroutesandimportant religiousor touristsitesetc.

71. **Siteselectionofsourcesofmaterials.**Extractionofmaterialscandisruptnaturalland contoursandvegetationresultinginacceleratederosion,disturbanceinnaturaldrainage patterns,pondingandwaterlogging,andwaterpollution.Tomitigatethe potential environmentalimpacts,locationsofquarrysite/sandborrowpit/s(forloosematerialotherthan stones)wouldbeincludedinthedesignspecificationsandonplandrawings.Prioritywouldbe sitesalreadypermittedbyMinesandGeologyDepartment.Ifothersitesarenecessary,these wouldtobelocatedawayfrompopulationcenters,drinkingwaterintakesandstreams, cultivablelands,andnaturaldrainagesystems;andinstructurallystableareasevenifsome distancefromconstruction activities.

72. ForHariharsubproject,thequarrymaterialrequiredwillbesandandstoneaggregate, andthenearestquarriesarenearHariharandMedleri(sandquarriesalongRiverTungabhadra)andChat raatMotebennurandHunasikatteinRanebennur Taluka forstoneaggregate. Theseareexistingquarriesandarelicensedby MinesandGeologyDepartment.Thematerial fromthe existingquarrieswillbe adequateforthe subprojectconstruction,and therefore no new quarrysiteswill be developedforthe purpose.

2. Design Impact

73. Theseimpactsarisefromthedesignofthesubprojectincludingthetechnologyused, scaleofoperation/throughput,wasteproduction,dischargespecification,pollutionsources,and ancillaryservices.

74. Asperthepproposedprojectdesign,theTungabhadraRiveriscontinuedtobethe sourceofwatersupplytoHarihar.Tomeetthefuturedemand,itisproposedtoincreasethe waterabstractionfromthe riverfromthe present9 MLDto 20MLD.

75. **Wateravailability intheriver**.RiverTungabhadraisaperennialandanimportantriver ofKarnataka.ThisisformednorthofShimogaTown,bytheunionoftworivers,theTungaand theBhadra,whichriseintheWesternGhatsatanelevationofabout1200metres.TheTunga RiveremergesfromthehillssurroundingVarahaParvata,ataplacecalledGangaMula.The riverflowsthroughsevendistrictsinKarnataka-Chikmagalur,Shimoga,Davangere,Haveri, Chitradurga,BellaryandRaichur.The riverhasa dambuiltacross itatGajanur.Aftertraversing a distance of147kmlong merges with the Bhadra RiveratKoodli atabout610 mabove MSL,a smalltowninShimogaDistrict.Thereisadam acrossriver Bhadra,15km upstreamof BhadravathiTown.TungabhadraDamwasbuiltacrossthe TungabhadraRiverafterittraverses 265kmfromtheoriginin WesternGhats.Thentherivermerges withtheKrishnaRiverin

AndhraPradeshstate.Ithasadrainageareaof71417km^{2}outofwhich57671km^{2}liesin KarnatakaState,andthe lengthofriverin thestate is 293km.

76. River flow fluctuates between very high during monsoon months to very low during summers. Almost all the towns and villages in the basin depend on the river for water supplies. Water for Harihar is abstracted from the river at Kawalettu, 7 km upstream of Harihar. There is no water retaining structure at this point; water is collected in a collection well in the river bed and pumped to the WTP. The river course at this section is comparatively deep. This ensures that there is adequate depth of water available throughout the year to pump from the intake, and this gorge also acts as a sort of storage. Adequate water availability is established.

77. As per the River flow and sustainability analysis provided in **Appendix 16** based on the river flow data of 2009-12, the minimum/lean flow in the river is observed in the months of April and May with a maximum flow of 4263 million litre per day (MLD) and minimum flow of 2369 MLD. The ultimate demand of Harihara (32.7 MLD) is just about 1.38% of maximum flow, an 0.77% of minimum flow observed during the lean season of April – May. The normal flow in the river is very high, and the water abstraction will be insignificant. The river, therefore, will provide adequate water for the project throughout the year, and will have no significant impacts on the downstream flow. Thus no significant impacts envisaged on the downstream.

78. River water quality. There are no major pollution sources like industries in the upstream sideoftheintakeatKewalettu.Mostof thevillagesandtowns,however,alongtheriver dischargedomesticwastewaterintotheriverwithoutanytreatment,althoughthereisnosuch disposalpointintheproximityofintake.Theriverwaterqualitymeetsthe“CategoryCquality thatmakeisappropriateas“Drinkingwatersourceafterconventionaltreatmentand disinfection”.Agrabsamplewascollectedfromtheintakeandtestedforpesticidesresidues. Theresultsindicatedthattherearenopesticideresiduesintherawwater.Thesubproject includescapacityaugmentationofexistingwatertreatmentplant,sotherawwaterwillbe treatedto drinking waterstandardsandsupplied to theconsumers.

79. **WTPRehabilitation&Augmentation**.ThepipelinefromtheIntermediatePumping stationwillbranchoff,toanew cascadeaerator,fromwherethewaterwillbeconveyedthrough therawwaterchanneltotheflashmixerandthentothePlate/TubeSettler.Noadditional structuresarerequiredtohousechemicaltreatmentprocessesastheexistingchemicalhouse willbeutilisedforchemicaldosinginboththeexistingandupgradedplant.Provisionforre-cyclingoffilterbackwashwaterwillbeincorporatedtoreducethewaterlossesfromfilterback washwaterfromexistingandproposedfilterhousesandsludgefromclariflocculatorandtube/ platesettlers.

80. EnvironmentalauditoftheexistingWaterTreatmentPlanthasbeenconductingduring the draftIEEpreparationtoassessthecompliancewithenvironmentallegislationandcurrent environmentalperformance.Thisauditidentifiedimprovementsrequiredfortheplant,whichare appropriatelyincludedinthesubproject.Thiswillimprovethecomplianceandenvironmental performance.Environmental Auditreportispresented in**Appendix8**.

81. Thereisinvariablyasafetyriskwhenconsiderablequantitiesofchlorinearehandledat theWTP.(Chlorinecylinderswillbebroughtbytruckstothesite,installedandoperatedto disinfectthewatersupplies).Sincefacilitiesarelocatedintheurbanarea,precautionswillthus be neededto ensurethesafetyofboth workersand citizens.

82. Theaveragedoseofchlorineforpre-chlorinationwillbeabout4mg/landthatforpost-chlorinationwillbeabout2mg/l.Withthepresentwatersupply9MLD,about54kgofchlorine isconsumed daily.Thiswhichwill increase to 120 kgperdaywith the augmented capacityof20MLD.Chlorinecylinders(calledtonners,withcapacityabout900kg)willbeprocuredfrom nearestmanufacturingunitand stored atthe site.Tonnerssufficientforamonth willbe stored in the storage;thiswill be about6tonners(1-working +5-in storage).

83. Toavoidanyrisktoworkersandpublic,thechlorinationfacilityattheWTPis designed/ developedwithallappropriatesafetyfeaturesandequipmenttomeetwithany accidental eventuality,which include

- Chlorine neutralization pitwith alimeslurryfeeder
- Properventilation,lighting,entryand exitfacilities
- Facilityforisolation inthe eventofmajorchlorine leakage
- Personalprotectionandsafetyequipmentfortheoperatorsinthechlorineplant
- Visible and audible alarm facilities toalert chlorinegas leak
- Laboratoryfacilityshall notbehoused within thechlorinationfacility
- Providetrainingtothestaffinsafehandlingandapplicationofchlorine;thisshall be included in thecontractofChlorinatorsupplier
- Developanemergencyresponsesystemforeventslikechlorineleakage**.**
- SupplierofChlorinatorequipmentshallprovidestandardoperatingmanualfor safeoperationandaswellasmaintenanceandrepairs;preferablytheseshallbe provided both in Englishand Kannada Languages

84. **Appendix 10**shows Guidelines and Emergency plan for handling and storing chlorine

85. OwingtohigherelevationofthetowntothatofintakeatKavalettu,theenergyintensive pumpingcouldnotbeavoided.Therawwaterfromtheintakewillbepumpedto WTP,andfrom theWTPtreatedwaterwillbepumpedtoelevatedservicereservoirs(ELSR).FromELSRs, waterissupplied bygravityto the consumers.Tooptimize the powerconsumption,thefollowing have beenconsidered in designandselection ofpumping systems:

- Designpumpingequipmentwithmaximumefficiencytooptimizethe energy consumption
- Variouscombinationsofnumberofpumps, stages, motor speed should be consideredto selectthebestpump with ideal specificspeeds.
- Specificspeedsofthepumpsshouldbeselectedtoachievemaximumefficiency of pumps.Forinstance,asperAmericanStandardforDSCentrifugalPumps issuedbyHydraulicInstitute,NewJersey,thespecificspeedforPumpsshould beintherangeof2000to3000forattainingoptimumefficiency.Thepumps should be designed accordingly.
- Attainableefficiencyforprocuringthepumpsandmotorsshouldbeconsidered as88 to92percentforpumpsand94percentformotors.Itisproposedthat during theprocurement,the evaluation ofbid shall also be intermsofefficiency.
- The pumps shallconformtoIS 1710–1989 SpecificationforPump and IS 5120–1992 TechnicalRequirementsforRoto-dynamicSpecialPurposePumpsand testedto class3ofIS:9137-1978CodeforAcceptanceTestsforCentrifugal, Mixed Flowand AxialFlowPumps.

86. **SludgefromWTP-treatmentanddisposal**.Watertreatmentprocesswillgenerate sludgefromsedimentationofparticulatematterinrawwater, flocculatedandprecipitated materialresultingfromchemicalcoagulation,residualsofexcesschemicaldosage,plankton etc;andwaste from rinsingandbackwashingof filter mediacontainingdebris, chemical precipitates,strainingoforganicdebrisandplankton.Followingareincludedinthesubproject designto disposethe sludgeand backwash:

- Provision ofrecirculationsystemforbackwash water– backwash waterfromfilter beds willberecirculated to WTP inlet and mixed with raw water; this arrangement willminimizewastageof water, which otherwise would have disposed toopen drains, and also avoidsthe pollution ofreceivingwaterbody
- Provisionofsludgedrying-accumulatedsludgefrom clariflocculatorwillbe flushedtosludge drying beds,fornaturaldrying.
- Driedsludgewillbeusedassoilconditioner.Periodictestingofdried sludgewillbeconductedtoensurethatitdoesnotcontainheavymetalsthatmakeitunsuitableforfoodcrops.Testswillbeconducttoconfirmthe concentrationsbelowthefollowingstandards.Astherearenospecificstandards notified for sludge reuse, the compost quality standards notified under theMunicipalSolidWasteManagement&HandlingRules,2000havebeenadopted here.TheMSWMHRulesstipulatethat"Inordertoensuresafeapplicationof compost,thefollowingspecificationsforcompost qualityshall be met,namely;

Table 12: Dried Sludge for Use as Soil Conditioner

Parameters	**Concentration not to exceed (mg/kg dry basis, except pH value and C/N ratio) ***
Arsenic	10.00
Cadmium	5.00
Chromium	50.00
Copper	300.00
Lead	100.00
Mercury	0.15
Nickel	50.00
Zinc	1000.00
C/Nratio	20-40
PH	5.5-8.5
Arsenic	10.00

*Compost(finalproduct)exceedingtheabovestatedconcentration limitsshallnotbeusedforfood crops.However,itmaybeutilizedfor purposesotherthangrowingfoodcrops.

Source:MunicipalSolidWaste(Management&Handling)Rules,2000,GovernmentofIndia

C. Construction Impacts

87. **Construction method for WTP**: These works will be conducted at the existing WTP facility in the town near Tungabhadra River. The rehabilitation works will be within the existing structure. The additional units for capacity augmentation will be constructed on the site adjacent to the existing WTP. The existing "sludge settlement tanks" will be demolished to provide the space for the second clariflocculator and part of the second filter house. Demolition work will be

carried out by workers using appropriate tools such as hand-held pneumatic drills. The WTP will be constructed in reinforced concrete structure and fixed with mechanical parts imported in ready-to-fix state. Most of the structure will be developed above ground except the clear water storage facility which will be constructed below the ground. Work will involve excavation for foundations, concreting, fixing of mechanical elements, finishing and fixing of electrical instrumentation items. Excavated soil will be used in the site for leveling and excess soil will be transported to disposal site. Material (sand, aggregate) will be procured from local quarries, and brought to the site on trucks and stored temporarily. Concrete will be mixed using a mixer at the site, and concrete will be transported by manual labour. The work will be conducted by a team of 50-60 workers and works will be confined to WTP facility compound.

88. **Construction of OHSR**: The cavity for the foundations for the overhead service reservoirs (OHSR) will be excavated by backhoe, with soil being loaded onto trucks for disposal. Aggregate and concrete will be tipped into each void to create the foundations and floor, after which metal reinforcing rods will be added to create the outline of the walls of the reservoir and the vertical supporting pillars. Sections of reinforcing will then be encased in wooden shuttering and concrete will be poured in, and this process will be repeated to gradually create each structure from RCC, including the tank of the reservoirs. Surfaces will be smoothed and finished where necessary by hand. The work will be conducted by a team of 10-15 workers at each site

89. The civil works for water supply projects include earth work excavation for pipeline trenches, pipe laying, installing valves, flow meters and data loggers, shifting of public utilities and providing house service connections. Earth work excavation will be undertaken by machine and include danger lighting and using sight rails and boning rods at every 100 m., while pipe laying works will include laying pipes at required gradient, fixing collars, elbows, tees, bends and other fittings including conveying the material to work spot and testing for water tightness.

90. The excavation to be done in such a way that there will be a minimum depth of 1 m above the pipe line. Sufficient care will be taken while laying of the pipes, so that existing utilities and cables are not damaged and pipes are not thrown into the trenches or dragged, but carefully laid in the trenches. Once they are laid, pipes will be joined as per specification and then tested for any cracks of leakages. The minimum working hours will be 8 hours daily, the total duration of each stage depends on the soil condition and other local features. The excavation of trenches is estimated to generate 1.13 lakh cubic meters of soil, while the residual soil after pipe laying and refilling is expected to be about 10% (i.e. 10,000 cubic meters). This soil shall be used for filling if required or stored/ dumped in approved debris disposal site.

91. Although construction of these project components involves quite simple techniques of civil work, the invasive nature of excavation and the project locations in the built-up areas of the city where there are a variety of human activities, will result to impacts to the environment and sensitive receptors such as residents, businesses, and the community in general. These anticipated impacts are temporary and for short duration.

92. Physical impacts will be reduced by the method of working and scheduling of work, whereby the project components will be (i) constructed by small teams working at a time; (ii) any excavation done near sensitive area like school, religious places and house will be protected as per standard norms etc.

93. Prior to starting of work, the contractor should prepare a method statement for pipeline work. This should be simple and explain the contractor's work process that is actually conducted on site, with safety and safeguard concerns. Method Statement is very important, particularly for

pipeline/sewer works along the roads. Method Statement can be prepared for each stretch (say 1 km) /specific site based on the project area. Method Statement should be in a Table format with appended site layout map and cover the following:

- ✓ Work description
- ✓ No. Of workers (skilled & unskilled)
- ✓ Details of Plant, equipment & machinery, vehicles
- ✓ Work duration (total, and activity-wise, for example for pipe laying, from excavation to road resurfacing/testing)
- ✓ PPE (helmet, gloves, boots, etc) details for each type of work
- ✓ Detailsofmaterialsateach site (type &quantity)
- ✓ Risks/hazardsassociatedwiththework(forexample,Trenchexcavationwill haveriskssuchastrenchcollapse,persons/vehicles fallingintotrench,structural riskto nearbybuildings,damageto buildings,infrastructureetc)
- ✓ Construction waste/debrisgenerated(details&quantity)
- ✓ Detailthesequenceofworkprocess(step-by-step)includingspecificdetailsof each work
- ✓ Contractor'ssupervision&managementarrangementsforthework
- ✓ Emergency:Designate(i)responsible persononsite,and(ii)firstaider
- ✓ Typicalsitelayoutplan including pipe trenching, placement of material, excavated earth,barricadingetc.
- ✓ Thepipelinesaretobelaidalongtheroads,Roadsareprovidedwithside drainstocarryrainwater.Theexcavatedsoil,placedalongthetrenchmayget disturbeddue towind,rainwaterandthemovementofworkers,vehiclesand pedestrians,andspillontoroadway–disturbingroadusers,creatingdust,road safetyissues,etc,andalso intonearbyopendrains.Thefollowingshouldbe included in the site layoutplan:
  - Provide barricading/security personnel at the site to prevent entry/trespassingofpedestrian/vehicles intotheworkzone
  - Location of temporary stockpiles and provision of bunds
  - Separation of stockpiles areas with workers/vehicle movement paths to avoid disturbing the stockpiled soil
  - Wetting of soil to arrest dust generation by sprinkling water
- ✓ Waste/surplussoilandconcretedebrisutilizationanddisposalplan–indicate expectedddurationoftemporarystockpilingalongthetrenchateachsiteand identifyfinalsurplussoil utilization/disposalsite in consultation with PIU

1. Impact on Physical Resource

94. **Topography,Soils&Geology**.Subprojectactivitiesarenotlargeenoughtoaffect thesefeatures;sothere will be no impacts.

95. SourcesofMaterials.Significantamountofgravel,sandandaggregate,willbe requiredforthissubproject.The constructioncontractorwill be requiredto:

(i) Usequarrysites andsources permittedbyMines& Geology Departmentonly
(ii) No newquarrysitesshall be developedforthesubproject
(iii) Verifysuitabilityof allmaterialsourcesandobtainapprovalof implementing agency
(iv) Submitonamonthlybasisdocumentation ofsources ofmaterials.

96. **AirQuality**.Itismostcertainthatworkwill be conducted during thedryseason,sothere ispotential forcreatingdustfromtheexcavationofdrysoil,backfilling,transportationto disposal,andfromtheimportandstorageofsand/gravelforbedding.Emissionsfrom constructionvehicles,equipment,andmachineryusedforexcavationandconstructionwillalso induceimpactsontheairquality intheconstructionsites.Anticipatedimpactsincludedustsand increaseinconcentrationofvehicle-relatedpollutantssuchascarbonmonoxide,sulfuroxides,particulatematter,nitrousoxides,andhydro carbons)buttemporaryandduringconstruction activities only.Tomitigate the impacts,construction contractorswill be required to:

(i) ConsultwithPIUonthedesignatedareasforstockpilingofclay,soils,gravel, and otherconstruction materials;
(ii) Dampdownexposedsoilandany stockpiledonsiteby sprayingwithwaterwhen necessaryduringdryweather;
(iii) Bring materials(aggregates,sand,etcgravel)asand when required;
(iv) Usetarpaulinstocoversandandotherloosematerialwhentransportedby vehicles;
(v) Clean wheelsand undercarriage ofvehicles priorto leavingconstruction site
(vi) Fitallheavyequipmentandmachinerywithairpollutioncontroldeviceswhich areoperatingcorrectly;ensurevalidPollutionUnderControl(PUC)Certificatesforall vehicles and equipmentused intheconstruction activity

82. **NoiseLevels**.Thesoilsaredeepinthesubprojectareaandthereforeactivitieslike rockcutting/blastingthatgeneratehighnoise arenotanticipated.Inisolatedareaswhereahard stratumisencounteredrequiringusingofpneumaticdrills,therewillbehighnoiseduringtheactivity.The demolitionofexistingconcretetanksforWTPwillalsogeneratenoise.Howeverthissiteisnot locatedclosetohabitation.Also,wherethepipelinesarerequiredtobelaidintheroadway, pneumaticdrillswillbeusedtobreakopenthe roadsurface.Inthecentral/oldtownarea,where rehabilitationofwaterpipelinesproposed,mostof theroadsaresurfacedwithconcreteand/orstoneslabs,whichneedtocutforreplacementof pipes.Thisworkwill be confined torehabilitatedsections,notentireareas.

83. Pneumaticdrillstypicallygenerateanequitantnoiseof82-98dBA,at1mdistancefrom theactivityThesensitivereceptorsarethegeneralpopulationandsocio-culturalinstitutionsin thearea.Noisewillbeforashortterm(about2-3daysateachlocation)thusimpactisminimal and short-term.Theconstruction contractorwill be requiredto:

(i) PlanactivitiesinconsultationwiththePIUsothatactivitieswiththegreatest potentialtogeneratenoisearecondutedduringperiodsofthedaywhichwillresultin leastdisturbance;
(ii) Constructionworkshallbelimitedtodaylighthours(6AMto6PM)forallthe workslocatedwithinthetown;forfacilitiesoutsidethetownandhabitations,thetimings maybe relaxed with the permission ofHariharCMC and PIU,howeverno workshould beconducted between 10 PM– 6 AMatanysite.
(iii) Provide priorinformation tothe local publicaboutthe workschedule;
(iv) Ensurethattherearenooldandsensitivebuildingsthatmaycomeunderrisk dueto theuseofpneumaticdrills;ifthereisrisk,cuttherocksmanuallyby chiselling;
(v) Minimizenoisefromconstructionequipment/pneumaticdrillsbyusingsilencers, fittingjackhammerswithnoise-reducingmufflers,andportablestreetbarriersthesound impacttosurroundingsensitive receptor;and
(vi) Maintainmaximumsoundlevelsnotexceeding80 decibels (dbA)when measuredatadistanceof10mormorefromthevehicle/s.

84. **SurfaceWaterQuality**.Harihartopographyisprimarilyplain;thetownreceives moderaterainfall.TheSouth–WestMonsoonwindsbringsrainfallfromJunetoSeptember whiletheNorth–EastmonsoonwindsdeliversfurtherrainfallfromOctobertoDecember.Theaverageannualrainfallreceivedbythetownis1,040mm.Duetothesereasonsandalsothat excavationwillnotcertainlybeconductedduringrains,thereisnoimpactondrainageand surfacewaterqualityisenvisaged.Inunavoidablecaseofexcavationduringmonsoons,there maybetemporaryimpactslikefloodingofconstructionsites,mixingofconstructionwasteand materialwithintherunoff,etc.Thismayleadtosiltingandblockageofdrainsandwaterbodies. Thesepotentialimpactsaretemporaryandshort-termdurationonlyandtoensuretheseare mitigated,constructioncontractorwill be requiredto:

(i) Avoid stockpiling of earth fill especially during the monsoon season unless covered bytarpaulins orplastic sheets
(ii) Prioritizere-useofexcessspoilsand materialsintheconstructionworks.Ifspoils will be disposed, consult with Implementing Agency on designated disposalareas
(iii) Installtemporarysilttrapsorsedimentationbasinsalongthedrainageleadingto the waterbodies
(iv) Provide temporarybundsforstockpiles andmaterials
(v) Placestorageareasforfuelsandlubricantsawayfromanydrainageleadingto waterbodies
(vi) Disposeanywastesgeneratedbyconstructionactivitiesindesignatedsites;disposal siteshouldbeidentifiedpriortothedemolitionofconcretetanksat WTP;

85. **Groundwater.**Subprojectactivitiesdonotinterferewithgroundwaterregime,no groundwaterabstractionproposed nordotheactivities affectgroundwaterquality.

86. **LandscapeandAesthetics**.Theconstructionworkislikelytogenerateconsiderable quantitiesofwastesoil.Thepipelayingworkwillgeneratesurplussoil;assmalldiameter pipesareproposeditwillgenerateonly 5-7%assurplusasmostofthesoilwillbeused forrefillingafterthepipeislaidintrench.Considerablequantitiesofdebriswillalso be generated fromdemolitionofexistingsludgesettlingtanks attheWTPsite.Thesurplussoiland debrisneedstobedisposedsafely.Indiscriminatedisposalofthesoilandwastemayaffectthe localenvironmentatthedisposallocation.Theseimpactsarenegativebutshort-termand reversible bymitigationmeasures.The construction contractorwill be required to:

(i) PrepareandimplementWaste/SpoilManagementPlan–itshouldpresenthowthe surpluswasteandconcretedebrisgeneratedwilltemporarilystockedatthesite, transportedand disposed properly. **Appendix 11** shows content of Spoil Management Plan.
(ii) Avoid stockpiling ofexcess excavated soilsasfaras possible
(iii) Avoiddisposalofanydebrisandwastesoilsinornear waterbodies/rivers;
(iv) CoordinatewithPIUforbeneficialusesofexcessexcavatedsoilsorimmediatelydispose todesignatedareas;
(v) disposalsiteshouldbeidentifiedpriortothedemolitionofconcretetanksat WTP;steelrecoveredfromthedemolitionworksshouldbesentforrecycling;concrete debrismaybeusedtoraisethegroundlevelorfillinglowlyingareasinthetown;

2. ImpactonEcologicalResources

87. Other than the Jack well and WTP all other subprojectsitesarelocatedwithinthetownarea.Thereisno naturalhabitatleftinthese sites,andthereforeno impactsonecologicalresources envisaged. Since no construction is being

considered within the River, no impact on aquatic ecology is envisaged.

3. ImpactonEconomicDevelopment

88. **LandUse.**Subprojectactivitieswillnotaffectthelanduse.Allsubprojectactivitiesare beingconductedinthevacantspacealongtheroadways;andother facilitiesare being developed on government-owned vacantlands.

89. **Accessibility.**Transportinfrastructurewillbeaffectedbythewater pipelayingwork,as inthenarrowerstreets thereisnotenoughspaceforexcavatedsoiltobepiledofftheroad.The roaditselfmayalsobeexcavatedinplaceswherethereisnoavailablelandtolocatepipes alongside.Trafficwillthereforebedisrupted,andinsomeverynarrowstreetsthewholeroad mayneedtobeclosedforshortperiods.Potentialimpactisnegativebutshorttermand reversible bymitigationmeasures.The construction contractorwill be required to:

(i) Plan pipelineworkin consultation with the trafficpolice
(ii) Plan work such that trench excavation, pipe laying, and refilling including compacting,atastretch iscompleted inaminimumpossible time;
(iii) Provideforimmediateconsolidationofbackfillingmaterialtodesiredcompaction-thiswillallowimmediateroadrestorationandthereforewillminimise disturbancetothe trafficmovement;
(iv) Do notclose the road completely,ensure thatworkisconducted onto edge ofthe road;allowtraffictomove on one line;
(v) Inunavoidablecircumstancesofroadclosure,providealternativeroutes,and ensurethatpublicisinformed aboutsuchtrafficdiversions;
(vi) Atallworksitespublicinformation/cautionboardsshallbeprovided– informationshallinter-aliainclude:projectname,costandschedule;executingagencyand contractordetails;natureandscheduleofworkatthatroad/locality;traffic diversiondetails,ifany;entryrestrictioninformation;competentofficial"sname and contactforpubliccomplaints.
(vii) PrepareaTrafficManagementPlan–atemplateisprovidedforreferenceat **Appendix12.**

4. ImpactonSocio CulturalResources

90. SocioCulturalResources–ChanceFinds.HarihareswaraTempleinHarihartownis aprotectedmonument.IngeneralHariharisanhistoricplace.Sotheremaybeariskthatany workinvolvinggrounddisturbancecoulduncoverand/ordamagearchaeologicalandhistorical remains.Templeislocatedinthecentreofthetown,andwherehabitationsaredevelopedall-aroundlongago.Noneoftheworkswilldisturb/damage/interferewiththeprotectedmonument. Excavationsforlayingofwatersupplypipelines(of 283 m length) within300mofTemplerequirespermission fromASI.Itwillalsobenecessarytoadoptaseriesofmeasures,tobothavoidsensitivesites and recognize and protectanychancediscoveries.These include:

(i) Noinfrastructure,exceptunavoidablewatersupplypipelines (if any),shallbe constructedwithin the 300 m ofsites.
(ii) ObtainpermissionfromASIforlayingofpipelineswithin300maroundthe temple
(iii) Ensure that any chance finds are recognized and measures are taken to ensurethey are protected and conserved.
(iv) Ifanychancefindsare recognized,the Contractorshould:

- Stop work immediately to allow further investigation if any finds are suspected;
- InformPIU;callintheASIifafindissuspected,andtakinganyaction theyrequiretoensure itsremovalorprotection insitu.

91. **Impactsonsocialsensitiveareas**.Sincetheworkisbeingconductedinanurban area,sensitiveareaslike schools,hospitalsandreligiouscentre,theexcavationoftrenchesand pipe/sewerlayingactivitywillcreatenuisanceandhealthhazardtochildrenandpeoplewith ailments.Themeasuressuggestedundervariousheadsinthissectionwillminimizetheimpact ingeneralinallareashowever,specialattentionisnecessaryattheselocations.Following measuresshall be implemented in 250 maround the sensitivelocations(schools,hospitals,and religiouscentres):

(i) Nomaterialshouldbestockedinthisarea;materialshallbebroughttothesite as and when required
(ii) Conductworkmanually withsmall group ofworkersandless noise;minimizeuse ofequipmentand vehicles
(iii) No work should be conducted near the religious places during religious congregations
(iv) Materialtransporttothesiteshouldbearrangedconsideringschooltimings; materialshould be inplace before schoolstarts;
(v) Notifyconcernedschools,hospitalsetc2weekspriortothework;conducta30minutea warenessprogramonnatureofwork,likelydisturbancesandrisksand constructionwork,mitigationmeasuresinplace,entryrestrictionsanddosand don"ts
(vi) Implementallmeasuressuggestedelsewhereinthisreport–dustandnoise control,publicsafety,traffic management,strictlyatthe sites.

92. **Socio-Economic–Income**.Excavationoftrenchesandpipelayingworkinthe townwill obstructaccessto residences/commercialbuildingsadjacentto the pipeline.Disruption ofaccesstocommercialestablishmentsmayaffectlivelihood.Sincemanyoftheroadsare narrow,constructionactivitiesmayalsoobstructtraffic.Thepotentialimpactsarenegativeand moderate butshort-termand temporary.Theconstruction contractorwill berequiredto:

(i) Leave spaceforaccessbetween moundsofexcavated soil
(ii) Providewoodenplanks/footbridgesforpedestriansandmetalsheetsforvehicles to allowaccessacrosstrenchestopremiseswhere required
(iii) Consultaffected businesspeople to informthemin advance when workwill occur
(iv) Address livelihood issues, if any; implement the Resettlement Plan (RP) to addressthese issues
(v) Providesign/caution/warningboardsatworksiteindicatingworkscheduleandtraffici nformation;preventpublicentryintoworksitesthroughbarricadingand security;and
(vi) Providesignboardsforpedestrianstoinformnatureanddurationofconstructionworksa ndcontactnumbersforconcerns/complaints.

93. **Socio-Economic–Employment**.Manpowerwillberequiredduringthe24-months constructionstage.Thiscanresulttogenerationofcontractualemploymentandincreasein localrevenue.Thuspotentialimpactispositiveandlong-term.Theconstructioncontractorwill be requiredto:

(i) Employ atleast50%ofthelabour force,orto the maximumextent,localpersons ifmanpowerisavailable;and
(ii) Secure constructionmaterialsfromlocal market.

94. **Socio-Economic–General**.Thebenefitsofimplementing24x7watersupply surpassesthetemporaryconstruction impacts.Typicalbenefitsare[1]:

(i) 24x7 supply delivers better quality water for public health - High levels of bacterial contamination are experienced in the first 10 minutes ofre-pressurizationofanintermittentsystem,insomecasespersistingforupto20 minutes.Maintaining fullpressureremoves thatrisk.

(ii) 24x7supplygivessignificantlybetterservicetoallconsumers-Accesstocleanwaterwithimprovedquantity,timing,andpressure,includingeffective serviceto supplypipe"tailends".

(iii) 24x7 supply revolutionizes service to the poor - Consumers can access more water for improved health and hygiene while saving time in queuing and carrying,and gainfully using the time thus saved for employment opportunities.

(iv) 24x7 supply converts household coping costs into resources for the service provider - Coping costs that consumers need to incur are reduced; they pay for abetter service.

(v) 24x7 supply reduces the burden on water resources - Continuous supply reduces water wastage arising from overflowing storage systems and open taps. It saveson stored household water that is discarded when new supply comes in.Because the network is renewed where needed, it also reduces losses arising from leaks in the old pipes.

(vi) 24x7supplydeliverseffective"supplymanagement"and"demandmanagement"-Continuoussupplymakespossibletheeffectivemanagementofleakagethrough pressuremanagementandflowmeasurement.Waterconservationisalso encouragedthroughmeteringandpricesignalsviaavolumetrictariffto consumers.

(vii) 24x7 supply enables improved efficiency of service provision - Operational efficiencies are achieved because of a reduced need for valve men, and aconversion of these jobs into more efficient ones of meter reading and customercare. It also makes possible the management of illegal connections.

95. **OccupationalHealthandSafety**.Workersneedtobemindfuloftheoccupational hazardswhichcanarisefromworkinginheightandexcavationworks.Potentialimpactsare negativeandlong-termbutreversiblebymitigationmeasures.Theconstructioncontractorwill be requiredto:

(i) Develop and implement site-specific Health and Safety (H and S) Plan which will include measures such as: (a) excluding public from the site; (b) ensuring all workers are provided with and use Personal Protective Equipment; (c) H and S Training[2] for all site personnel; (d) documented procedures to be followed for all site activities; and (e) documentation of work-related accidents;

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[1]Waterand Sanitation Program, The Karnataka UrbanWater Sector ImprovementProject, Field Note, 2010, Available Online URL: http://www.wsp.org/sites/wsp.org/files/publications/WSP_Karnataka-water-supply.pdf

[2]Some of the keyareasthat maybe covered during trainingastheyrelate tothe primarycausesof accidents include (i) slips,tripsandfalls;(ii)personalprotectiveequipment;(iii)ergonomics,repetitivemotion,andmanualhandling; workplace transport; and (v) legislation and responsibilities. Training can provide the foundations of competence but it does not necessarily result in a competent worker. Therefore, it is essential to assess staff competence to ensure that the training provided is relevant and effective. Supervision and monitoring arrangements shall be in place to ensure that training has been effective and the worker is competent at their job. The level of supervision and monitoring required is a management decision that shall be based on the risks associated with the job, the level of competence required, the experience of the individual and whether the worker works as part of a team or is a lone worker.

(ii) Alltrenchesdeeperthan2mshallbeprotectedwithwoodenbracingtoavoid safetyrisksto workers,publicand nearbybuildings/structures
(iii) Ensurethatqualifiedfirst-aidcanbeprovidedatalltimes.Equippedfirst-aid stationsshall be easilyaccessible throughoutthesite;
(iv) Provide medicalinsurance coverageforworkers;
(v) Secure all installationsfromunauthorized intrusion and accidentrisks;
(vi) Provide supplies ofpotable drinking water;
(vii) Providecleaneatingareaswhereworkersarenotexposedtohazardousor noxioussubstances
(viii) ProvideHandSorientationtrainingtoallnewworkerstoensurethattheyare apprisedofthebasicsiterulesofworkatthesite,personalprotectiveprotection, and preventing injuring tofellowworkers;
(ix) Providevisitororientationifvisitorstothesitecangainaccesstoareaswhere hazardous conditionsorsubstancesmaybe present.Ensure alsothatvisitor/sdonotenterhazardareasunescorted;
(x) Ensurethevisibilityofworkersthroughtheiruseofhighvisibilityvestswhen working in orwalking throughheavyequipmentoperatingareas;
(xi) Ensuremovingequipmentisoutfittedwith audible back-upalarms;
(xii) Markandprovidesignboardsforhazardousareassuchasenergizedelectrical devicesandlines,serviceroomshousinghighvoltageequipment,andareasforstorag e and disposal. Signage shall be in accordance with internationalstandardsandbewellknownto,andeasilyunderstoodbyworkers,visitor s,and thegeneralpublicasappropriate;
(xiii) Disallowworkerexposuretonoiselevelgreaterthan85dBAforad urationofmore than8 hoursperdaywithouthearingprotection. The useofhearing protection shall beenforced actively, and
(xiv) Overall, the contractor should comply with IFS EHS Guidelines on Occupational Health and Safety (this can be downloadedfromhttp://www1.ifc.org/wps/wcm/connect/9aef2880488559a983acd36a6515bb18/2%2BOccupational%2BHealth%2Band%2BSafety.pdf?MOD=AJPERES)

96. **CommunityHealthandSafety.**Hazardsposedtothepublic,specificallyinhigh-pedestrianareasmayincludetrafficaccidentsandvehiclecollisionwithpedestrians.Inmostof thecaseslocationofprojectsitesarealongtheroadways,hencesafetyrisktocommunityisto beconsidered.Thesewerlineworkmayrequiredeeptrenchesincludinginnarrowstreets; unprotectedtrenchexcavationmayendangerthestabilityofnearbybuildings/structures. Potentialimpactisnegativebutshort-termandreversiblebymitigationmeasures.The construction contractorwill be requiredto:

(i) Providewoodenbracingforalldeepexcavationsthatmayrequireespeciallyfor sewerlines(>2m);identifybuildingsatriskpriortostartofexcavationworkand take necessaryprecautionsforsafeconductofwork
(ii) Plan materialand wasteroutestoavoid timesofpeak-pedestrian activities
(iii) Liaise with IA/HariharTMC in identifyingriskareas onroutecards/maps
(iv) Maintainregularly the vehicles and use of manufacturer-approved parts to minimizepotentiallyseriousaccidents caused by equipment malfunction or prematurefailure
(v) Provideroadsignsand flagpersonstowarnofdangerousconditions,forallwork sites along theroads
(vi) Overall, the contractor should comply with IFS EHS Guidelines

CommunityHealth and Safety (this can be downloaded fromhttp://www1.ifc.org/wps/wcm/connect/dd673400488559ae83c4d36a6515bb18/3%2BCommunity%2BHealth%2Band%2BSafety.pdf?MOD=AJPERES)

97. **WorkCamps**.Operationofworkcampscancausetemporaryairandnoisepollution frommachineoperation,waterpollutionfromstorageanduseoffuels,oils,solvents,and lubricants.Potentialimpactsarenegativebutshort-termandreversiblebymitigationmeasures. Provisionofproperlivingfacilitiesandbasicamenities(water,sanitation,firesafety,healthand safety,etc)shall beensured.

98. Theconstructioncontractorwillberequiredto:complywiththefollowing.Overall,the contractshouldfollowtheIFCEHSguidelinesspecifictoworkersaccommodation(thiscanbe downloaded fromhttp://www1.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/publications/publications_gpn_workersaccommodation).

(i) ConsultwithPIUbeforelocatingworkerscamps/sheds,andconstructionplants; asfaraspossible located within reasonable distance ofworksite
(ii) Minimize removalofvegetation anddisallowcutting oftrees
(iii) Livingfacilitiesshallbebuiltwithadequatematerials,andshouldbeingood condition andfreefromrubbish and otherrefuge
(iv) The camp site should be adequately drained to avoid the accumulation ofstagnantwater
(v) Providewaterandsanitationfacilities;water,meetingIndiandrinkingwater standardsshallbeprovided,inadequatequantities(supplyof60-80LPCD);all waterstorage structuresmustbe cleaned regularlyand covered properlyto avoid anycontamination
(vi) Provide separate facilities for men and women; sanitary facilities shall be properlybuild andwell maintained;toiletand bathfacilities should be providedonbasisof1 per15orlesspersons
(vii) Trainemployeesinthestorageandhandlingofmaterialswhichcanpotentially cause soil contamination;
(viii) Recoverused oil and lubricantsandreuse orremove fromthesite;
(ix) Managesolid waste according to the following preference hierarchy: reuse, recyclingand disposaltodesignatedareas;
(x) Removeall wreckage,rubbish,ortemporarystructureswhicharenolonger required;and
(xi) Reportinwritingthatthecamphasbeenvacatedandrestoredtopre-project conditionsbefore acceptance*of*work.

D. Operation and Maintenance Impacts

99. As per project design trial run and commissioning is part of the present contract and O & M manuals will be submitted by the contractor and O & m requirements will be updated

100. Operation and Maintenance of the water supply system will be carried out by the CMC. The system have a design life of 30 years, during which shall not require major repairs or refurbishments and should operate with little maintenance beyond routine actions required to keep the equipment in working order. The stability and integrity of the system will be monitored periodically to detect any problems and allow remedial action if required. Any repairs will be small-scale involving manual, temporary, and short-term works involving regular checking and recording of performance for signs of deterioration, servicing and replacement of parts.

101. Recurrence of pipe bursting and leakage problems can be managed by the leak detection and water auditing surveys. The CMC will be required to ensure that the leakage rectification time is minimized.

102. Improper disposal of silt and debris removed from trenches could cause Inconvenience to public. Silt and debris shall be collected in trucks and transported to the Municipal Solid Waste Disposal Site and shall be used as covering material for the waste being landfilled.

103. Repair works could cause some temporary disruption of activities at locations of social and cultural importance such as schools, hospitals, churches, tourist sites etc, so the same precautions as employed during the construction period should be adopted.CMC needs to:

(i) Identify any buildings at risk from vibration damage and avoiding any use of pneumatic drills or heavy vehicles in the vicinity;
(ii) Complete work in these areas quickly;
(iii) Consult the custodians of important buildings, cultural and tourism authorities and local communities in advance of the work to identify and address key issues, and avoid working at sensitive times, such as religious and cultural festivals.

104. **Operation of WTP**. This involves various processes: pre-chlorination, alum dosing, flash mixing, flocculation, clarification, filtration, post-chlorination, wash water re-circulation and sludge disposal systems prechlorination, aeration, alum-mixing, flocculation, clarification, filtration, and disinfection. Chemicals such as Alum and chlorine will be used in the treatment processes.

105. The safety risk due to handling of large quantities of chlorine at the WTP should be negligible if all the suggested safety features and equipment to meet with any accidental eventuality are included in the design and development of the facility. During the operation phase, it is necessary that:

- Chlorinator facility is operated only by trained staff and as per the standard operating procedures
- In case of any accident and/or maintenance activity, the staff should follow documented procedures only
- It is suggested to develop an Emergency Response System (ERS) for the chlorine leakage. A Template for ERS is provided in **Appendix9.** Sensitize and train staff in implementation of ERS.

106. The provision of an improved and expanded water supply and sewerage system is expected to have indirect economic benefits from the expected improvement in the health, environment and economic well-being.

107. The citizens of the Harihar CMC will be the major beneficiaries of the improved water supply, as they will be provided with a constant supply of better quality water, piped into their homes. In addition to improved environmental conditions, the project will improve the over-all health condition of the town as diseases of poor sanitation (such as diarrhea and dysentery) will be reduced.

V. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

A. Project Stakeholders

108. Most of the main stakeholders have already been identified and consulted during preparation of this IEE, and any others that are identified during project implementation will be brought into the process in the future. Primary stakeholders are:

(a) Residents, shopkeepers and businesspeople near the work sites;
(b) Public representatives and prominent citizens of the town
(c) Harihar City Municipal Council
(d) KUIDFC, GoK

109. Secondary stakeholders are:

(a) Other concerned government institutions (utilities, regulators, etc)
(b) NGOs and CBOs working in the affected communities;
(c) Other community representatives (prominent citizens, religious leaders, elders, women's groups);
(d) The beneficiary community in general; and
(e) ADB as the funding agency

B. Consultation & Disclosure till Date

110. Public consultation meetings were conducted during the project preparation and design stages. Various forms of public consultations (consultation through ad hoc discussions on site) have been used to discuss the project and involve the community in planning the project and mitigation measures.

111. A public consultation workshop was conducted on October 3, 2012 at Davangere for all the four project towns to discuss the proposed project and likely environmental issues and mitigation measures. Key stakeholders – public representatives, officials from various agencies, district level officers, from each project town, including Harihar were participated in the workshop. Minutes of this consultation meeting is appended at **Appendix 13**.

112. Public consultation involved focus group discussions. The people residing along the project activity areas were consulted during condition surveys and site visits on 21 June 2013 and due discussions with the 15 participants were made regarding the proposals. It was observed that people are willing to extend their cooperation as the proposed activities are supposed to enhance the living standard of the public. The public expressed their concern regarding the traffic management activities during the construction stage which can have impact on their day to day activities. Public demanded for advance notice before construction and proper warning signs along the construction area to avoid accidents and inconvenience. It was demanded for a strong operation and maintenance system in place for the proposed water supply network for its best functioning to have the maximum health and aesthetic benefits. Public will respond only if they are informed about the project and why it is required and they may react negatively if they are uninformed. Views expressed were incorporated into the IEE and in the planning and development of the subproject. Photographs of Public consultation and details on consultations are presented as **Appendix 14.**

D. Future Consultation & Disclosure

113. EA and IA shall extend and expand the consultation and disclosure process significantly during implementation of the Investment Program.

(i) Consultation during construction:
- Public meetings with affected communities (if any) to discuss and plan work programmes and allow issues to be raised and addressed once construction has started; and
- Smaller-scale meetings to discuss and plan construction work with individual communities to reduce disturbance and other impacts, and provide a mechanism through which stakeholders can participate in subproject monitoring and evaluation;

(ii) Project disclosure:
- Public information campaigns (via newspaper, TV and radio) to explain the project to the wider town population and prepare them for disruption they may experience once the construction programme is underway;
- Public disclosure meetings at key project stages to inform the public of progress and future plans, and to provide copies of summary documents in Kannada; and
- Formal disclosure of completed project reports by making copies available at convenient locations in the study towns, informing the public of their availability, and providing a mechanism through which comments can be made.

114. Based on ADB requirements, the following will be posted on ADB website: (i) draft/final IEE, upon finalization and approval of ADB; (ii) a new or updated IEE, if prepared, reflecting significant changes in the Project during implementation; (iii) corrective action plan prepared during Project implementation to address unanticipated environmental impacts and to rectify non-compliance to EMP provisions; and (iv) environmental monitoring reports. Documents will also be available on the websites of KUIDFC and Harihar CMC.

D. Grievance Redress Mechanism

115. A project specific grievance redress mechanism (GRM) has been established to receive, evaluate and facilitate concerns of, complaints and grievances of the DPs in relation to project's social and environmental performances. The main objective of the GRM will be to provide time bound action and transparent mechanism to resolve social and environment concerns.

116. The project GRM will cover the project's towns for all kinds of grievances and will be regarded as an accessible and trusted platform for receiving and facilitating project related complaints and grievances. The multi-tier GRM for the program will have realistic time schedules to address grievances and specific responsible persons identified to address grievances and whom the DPs have access to interact easily.

117. Awareness on grievance redress procedures will be created through Public Awareness Campaign with the help of print and electronic media and radio.

118. There will be multiple means of registering grievances and complaints by dropping grievance forms in complaint/ suggestion boxes at accessible locations, or through telephone hotlines, email, post or writing in a complaint register book in ULB's project office. There will be

complaint register book and complaint boxes at construction site office to enable quick response of grievances/ complaints for urgent matters. The name, address and contact details of the persons with details of the complaint / grievance, location of problem area, date of receipt of complaint will be documented. The Regional Programme Management Unit (RPMU) officer in charge of environmental safeguards will be responsible at the project level for timely resolution of the environmental and social safeguards issues and registration of grievances, and communication with the aggrieved persons.

E. Grievance Redress Process

119. There will be several tiers for grievance redress process. Simple grievances for immediate redress will first be resolved at site by Contractor. If unaddressed for up to 7 days the complainants may go to PIU officer in ULB responsible for resettlement/social issues. Project engineer and the resettlement NGO will assist in resolving the issues. Name, designation and contact number of personnel responsible for grievance redress at ULB and RPMU will be posted at Contractor's and PMDSC's site office in full visibility of public. NGO will be involved in community mobilization and awareness campaign among the communities. Grievances of immediate nature should be resolved at site/ within ULB/PIU level within 15 days of registration of grievances.

120. All grievances, that cannot be resolved by ULB/PIU within 15 days will be forwarded to RPMU's Social safeguards/R&R Officer and PMDSC specialist who will review and resolve within 15 working days of grievance registration with the assistance of the Resettlement NGO and concerned PIU/ULB personnel, if required.

121. RPMU consists of SDO and PMDCSC Consultant in the GRC will review the grievances if any and the grievances of critical nature and those cannot be resolved at RPMU level should be referred to Grievance Redress Committee (GRC) set up at sub division headed by Special land acquisition officer/the Assistant Commissioner with a team of members. DPD of the concerned subdivision, the commissioner/chief officer of the ULBs, the most affected beneficiary, one vulnerable beneficiary and environmental engineer as members. All documents related to grievances, follow up action taken to resolve along with explanatory note on nature, seriousness and time taken for grievance redress shall be prepared by RPMU Officer in charge of environmental safeguards and circulated to GRC members at least a week prior to scheduled meeting. The decision taken at the GRC level will be communicated to the complainant by environmental specialist/Consultant through ULB/PIU. The GRC should be notified and in place before the starting of construction works by the contractor.

122. For any issues that remain unresolved by the GRC or the decision taken at such meetings is not acceptable, the complainants can approach the DLIC and then Court of Law as per Govt. of Karnataka legal procedure.

F. GRC / SC composition and selection of members

123. The GRC for the project will be headed by Special land acquisition officer/the Assistant Commissioner as chairman with members as followed: (1) DPD of the concerned subdivision (member secretary). (2) commissioner/chief officer of the ULBs. (3) The most affected beneficiary. (4) one vulnerable beneficiary.(5) Environmental officer. Appeals against the decision of the GRC are to be addressed to the Deputy Commissioner of the concerned district.

124. In the event when the established GRM is not in a position to resolve the issue,

affected person can use the ADB Accountability Mechanism through directly contact (in writing) to the Complaint Receiving Officer (CRO) at ADB headquarters or to ADB Indian Resident Mission (INRM). The complaint can be submitted in any of the official languages of ADB's DMCs. The ADB Accountability Mechanism information will include in the Project Information Document (PID) to be distributed to the affected communities, as part of the project GRM. The PID will be prepared by the contactor in coordination with the PIU and consultant and get it approved by the EE/AEE in charge of the project .Grievance Redress Mechanism is shown in the Figure 3.

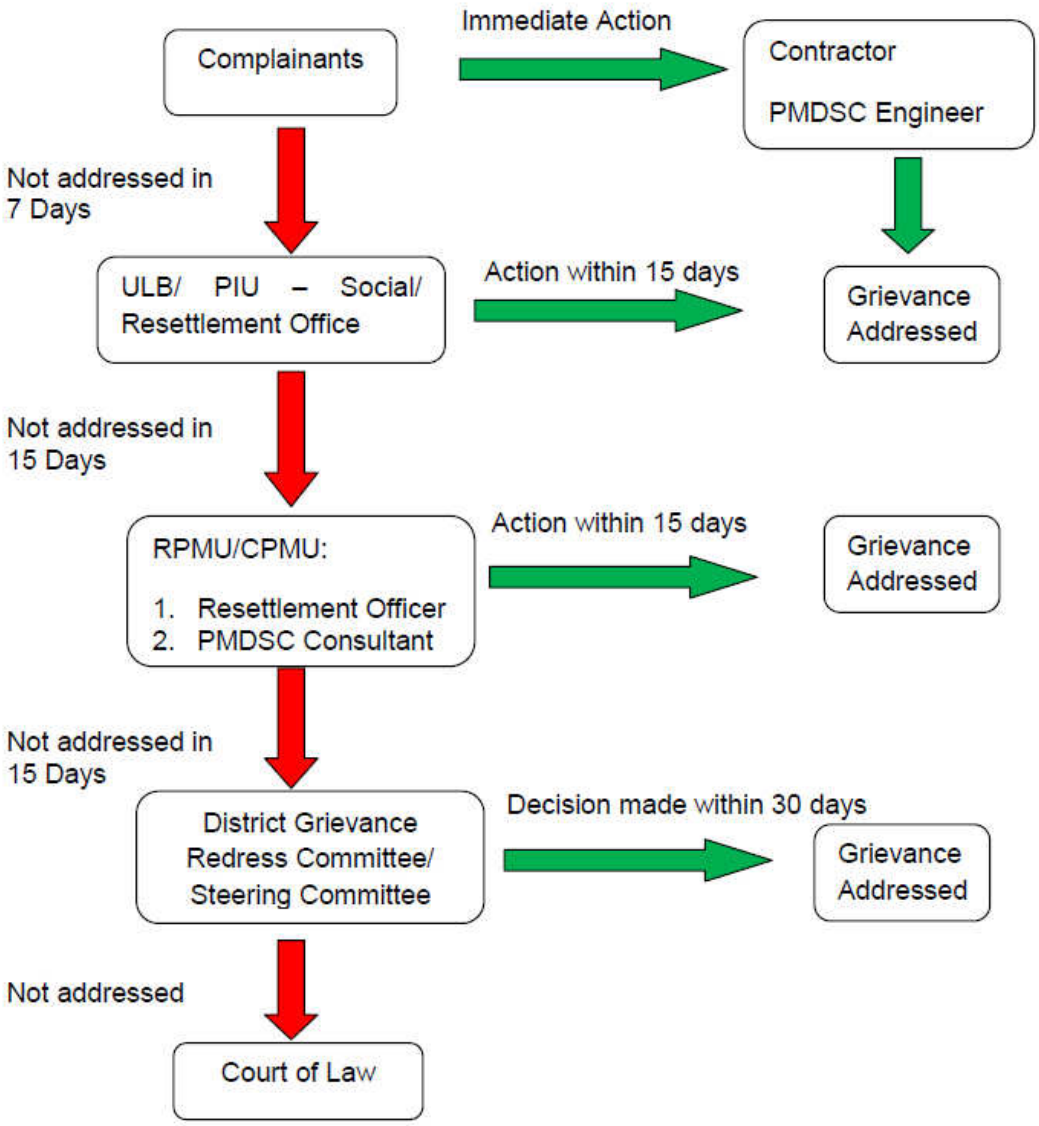


Figure 12: Grievance Redress Process

VI. ENVIRONMENTAL MANAGEMENT PLAN

A. EnvironmentalManagementPlan

126. The purpose of the Environmental Management Plan (EMP) is to ensure that the activities are undertaken in a responsible, non-detrimental manner with the objectives of: (i) providing a proactive, feasible, and practical working tool to enable the measurement and monitoring of environmental performance on-site; (ii) guiding and controlling the implementation of findings and recommendations of the environmental assessment conducted for the project; (iii) detailing specific actions deemed necessary to assist in mitigating the environmental impact of the project; and (iv) ensuring that safety recommendations are complied with.

127. A copy of the EMP must be kept on work sites at all times. This EMP will be included in the bid documents and will be further reviewed and updated during implementation. The EMP will be made binding on all contractors operating on the site and will be included in the contractual clauses. Non-compliance with, or any deviation from, the conditions set out in this document constitutes a failure in compliance.

128. For civil works, the contractor will be required to (i) establish an operational system for managing environmental impacts (ii) carry out all of the monitoring and mitigation measures set forth in the EMP; and (iii) implement any corrective or preventative actions set out in safeguards monitoring reports that the employer will prepare from time to time to monitor implementation of this IEE and EMP. The contractor shall allocate a budget for compliance with these EMP measures, requirements and actions.

129. **Table 13 to** *Error! Reference source not found.***18**shows the potential adverse environmental impacts, proposed mitigation measures, responsible parties, and estimated cost of implementation. This EMP will be included in the bid documents and will be further reviewed and updated during implementation.

Table 13: Environmental Management Plan for Anticipated Impacts – Bulk Water Supply System– Pre- Construction

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
Utilities	Telephone lines, electric poles and wires, water lines within proposed project area	(i) Identify and include locations and operators of these utilities in the detailed design documents to prevent unnecessary disruption of services during construction phase; and (ii) Require construction contractors to prepare a contingency plan to include actions to be done in case of unintentional interruption of services. (iii) Require contractors to prepare spoils management plan and traffic management plan (Appendix 11 and 12)	Contractor in collaboration with ULB.	(i) List of affected utilities and operators; (ii) Bid document to include requirement for a contingency plan for service interruptions (example provision of water if disruption is more than 24 hours), spoil management plan, and traffic management plan	No cost required. Mitigation measures are part of ToR of PMU, design engineers, and supervising consultants.
Source sustainability	Non availability of water due to wrong selection of water source	Establish adequate water availability and ensure that necessary provision is made for Harihar water supply through government statutes as required before the start of detailed design.	PMU & PMDCSC	Design – related to source sustainability	-
Social and Cultural Resources	Ground disturbance can uncover and damage	(i) Consult Archaeological Survey of India (ASI) or	Contractor, PMU &PMDCSC	Chance Finds Protocol	No cost required. Mitigation measures

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
	archaeological and historical remains	concerned dept. of Karnataka Govt. to obtain an expert assessment of the archaeological potential of the site; (ii) Consider alternatives if the site is found to be of medium or high risk; (iii) Develop a protocol for use by the construction contractors in conducting any excavation work, to ensure that any chance finds are recognized and measures are taken to ensure they are protected and conserved.			are part of ToR of PMU, design engineers, and supervising consultants.
Construction work camps, hot mix plants, stockpile areas, storage areas, and disposal areas.	Disruption to traffic flow and sensitive receptors	(i) Prioritize areas within or nearest possible vacant space in the project location; (ii) If it is deemed necessary to locate elsewhere, consider sites that will not promote instability and result in destruction of property, vegetation, irrigation, and drinking water supply systems; (iii) Do not consider residential areas;	PMU and Contractor to determine locations prior to beginning of construction works.	(i) List of selected sites for construction work camps, hot mix plants, stockpile areas, storage areas, and disposal areas. (ii) Written consent of landowner/s (not lessee/s) for reuse of excess spoils to agricultural land	No cost required. Mitigation measures are part of ToR of PMU, design engineers, and supervising consultants.

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
		(iv) Take extreme care in selecting sites to avoid direct disposal to water body which will inconvenience the community. (v) For excess spoil disposal, ensure (a) site shall be selected preferably from barren, infertile lands. In case agricultural land needs to be selected, written consent from landowners (not lessees) will be obtained; (b) debris disposal site shall be at least 200 m away from surface water bodies; (c) no residential areas shall be located within 50 m downwind side of the site; and (d) site is minimum 250 m away from sensitive locations like settlements, ponds/lakes or other water bodies.			
Sources of Materials	Extraction of materials can disrupt natural land contours and vegetation resulting in accelerated erosion, disturbance in natural	(i) Prioritize sites already permitted by the Mining Department; (ii) If other sites are necessary, inform	ULB and Contractor to prepare list of approved quarry sites and sources of materials with the approval of PMDCSC	(i) List of approved quarry sites and sources of materials; (ii) Bid document to include requirement	No cost required. Mitigation measures are part of ToR of PMU, design engineers, and

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
	drainage patterns, ponding and water logging, and water pollution.	construction contractor that it is their responsibility to verify the suitability of all material sources and to obtain the approval of PMU and (iii) If additional quarries will be required after construction is started, inform construction contractor to obtain a written approval from PMU.		for verification of suitability of sources and permit for additional quarry sites if necessary.	supervising consultants.
Chlorine handling at WTP	Risk due to handling and application of chlorine	Design and develop chlorination facility with all safety features and equipment to meet with any accidental eventuality, which may include • Chlorine neutralization pit with a lime slurry feeder • Proper ventilation, lighting, entry and exit facilities • Facility for isolation in the event of major chlorine leakage • Personal protection and safety equipment for the operators in the chlorine	ULB/ PMU	Handling and operation procedure and emergency response procedure	Part of the project cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
		plant • Visible and audible alarm facilities to alert chlorine gas leak • Laboratory facility shall not be housed within the chlorination facility • Provide training to the staff in safe handling and application of chlorine; this shall be included in the contract of Chlorinator supplier • Supplier of Chlorinator equipment shall provide standard operating manual for safe operation and as well as maintenance and repairs; preferably these shall be provided both in English and Kannada Languages • Develop an emergency response system for events like chlorine leakage – an ERS template			

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
		is provided at **Appendix 9**. During operation, it shall be ensured that chlorinator facility is operated only by trained staff and as per the standard operating procedures			
Structural and seismic stability of storage reservoir (OHT) is to be ensured for the safety of people working in and living around these structures.	The failure of the storage structures can be catastrophic.	The design shall incorporate seismicity of the place and all other safety factors. All care shall be taken to ensure a safe and structurally sound construction.	PMU and PMDCSC	Incorporated in final design and communicated to contractors.	No cost required. Mitigation measures are part of ToR of PMU, design engineers, and supervising consultants.
Consents, permits, clearances, NOCs, etc.	Failure to obtain necessary consents, permits, NOCs, etc can result to design revisions and/or stoppage of works	(i) Obtain all necessary consents, permits, clearance, NOCs, etc. prior to start of civil works. (ii) Acknowledge in writing and provide report on compliance all obtained consents, permits, clearance, NOCs, etc. (iii) Include in detailed design drawings and documents all conditions and provisions if necessary	PMU and PMDCSC	Incorporated in final design and communicated to contractors.	No cost required. Cost of obtaining all consents, permits, clearance, NOCs, etc. prior to start of civil works responsibility of PMU. Mitigation measures are part of ToR of PMU, design engineers, and supervising consultants.
Asbestos Cement	Health risk due to	(i) Obtain details from	ULB/CMC and design	(i) Detailed design	No cost required.

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
Pipes	exposure to asbestos materials	ULB/CMC of the nature and location of all water supply infrastructure (ii) Develop an AC pipe protocol (iii) Require all personnel (including manual laborers) to undergo training as per AC pipe protocol	engineers	drawings showing alignment of AC pipes (ii) AC pipe protocol (iii) Trainings as per AC pipe protocol	Mitigation measures are part of ToR of PMU, design engineers, and supervising consultants.

Table 14: Environmental Management Plan for Anticipated Impacts – Bulk Water Supply System– Construction

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
EMP Implementation Training	Irreversible impact to the environment, workers, and community	(i) Project manager and all key workers will be required to undergo EMP implementation including spoils management, Standard operating procedures (SOP) for construction works; occupational health and safety (OH&S), core labor laws, applicable environmental laws, etc.	Construction Contractor / PMU / PMDCSC	(i) Certificate of Completion (Safeguards Compliance Orientation) (ii) Posting of Certification of Completion at worksites (iii) Posting of EMP at worksites	Cost of EMP Implementation Orientation Training to contractor is responsibility of PMU. Other costs responsibility of contractor.
Air Quality	Emissions from construction vehicles, equipment, and machinery used for installation of pipelines resulting to dusts and increase in concentration of vehicle-related pollutants such as carbon monoxide, sulfur	(i) Consult with PIU/ PMU/PMDCSC on the designated areas for stockpiling of clay, soils, gravel, and other construction materials; (iii) Damp down exposed soil and any stockpiled on site by spraying with water when necessary during dry	Construction Contractor	(i) Location of stockpiles; (ii) Complaints from sensitive receptors; (iii) Heavy equipment and machinery with air pollution control devices; (iv) Certification that vehicles are	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
	oxides, particulate matter, nitrous oxides, and hydrocarbons.	weather; (iv) Use tarpaulins to cover sand and other loose material when transported by trucks; and (v) Fit all heavy equipment and machinery with air pollution control devices which are operating correctly.		compliant with Air Act	
Surface water quality	Mobilization of settled silt materials, and chemical contamination from fuels and lubricants during installation of pipelines can contaminate nearby surface water quality.	(i) Prepare and implement a spoils management plan as the part of the Construction Management Plan. (ii) Avoid stockpiling of earth fill especially during the monsoon season unless covered by tarpaulins or plastic sheets; (ii) Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies; (iii) Place storage areas for fuels and lubricants away from any drainage leading to water bodies; (iv) Dispose any wastes generated by installation of pipeline in designated sites; disposal site should be identified prior to the demolition of concrete tanks at WTP, and (v) Conduct surface quality	Construction Contractor	(i) Areas for stockpiles, storage of fuels and lubricants and waste materials; (ii) Number of silt traps installed along trenches leading to water bodies; (iii) Records of surface water quality inspection; (iv) Effectiveness of water management measures; (v) No visible degradation to nearby drainages, *nallahs* or water bodies due to civil works	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		inspection according to the Environmental Management Plan (EMP).			
Noise Levels	Increase in noise level due to earth-moving and excavation equipment, and the transportation of equipment, materials, and people	(i) Plan activities in consultation with PIU/ PMU/PMDCSC so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance; (ii) Horns should not be used unless it is necessary to warn other road users or animals of the vehicle's approach; (iii) Minimize noise from construction equipment by using vehicle silencers, fitting jackhammers with noise-reducing mufflers, and portable street barriers the sound impact to surrounding sensitive receptor; and (iv) Maintain maximum sound levels not exceeding 80 decibels (dbA) when measured at a distance of 10 m or more from the vehicle/s.	Construction Contractor	(i) Complaints from sensitive receptors; (ii) Use of silencers in noise-producing equipment and sound barriers; (iii) Equivalent day and night time noise levels (See Appendix 2 of this IEE)	Cost for implementation of mitigation measures responsibility of contractor.
Landscape and aesthetics	Impacts due to excess excavated earth, excess construction materials, and solid waste such as removed concrete, wood, packaging	(i) Prepare and implement spoils management plan (ii) Avoid stockpiling of excess excavated soils; (iii) Coordinate with ULB/CMC for beneficial	Construction Contractor	(i) Complaints from sensitive receptors; (ii) Worksite clear of hazardous wastes such as oil/fuel (iii) Worksite clear of	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
	materials, empty containers, spoils, oils, lubricants, and other similar items.	uses of excess excavated soils or immediately dispose to designated areas; (iv) Recover used oil and lubricants and reuse or remove from the sites; (v) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas; (vi) Remove all wreckage, rubbish, or temporary structures which are no longer required; (vii) Report in writing that the necessary environmental restoration work has been adequately performed before acceptance of work.; (Viii) After demolition of WTP proposed to hand over serviceable materials to ULB. and and (Ix) Disposal site should be identified prior to the demolition of concrete tanks at WTP; steel recovered from the demolition works should be sent for recycling; concrete debris may be used to raise the ground level or filling low lying areas in the town		any excess excavated earth, excess construction materials, and solid waste such as removed concrete, wood, packaging materials, empty containers	

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
Existing Infrastructure and Facilities	Disruption of service and damage to existing infrastructure at specified project location	(i) Obtain from PIU/ PMU/PMDCSC the list of affected utilities and operators if any; (ii) Prepare a contingency plan to include actions to be done in case of unintentional interruption of service iii) The public should be given notice at least three days in advance and any accidental breaking should be rectified immediately.	Construction Contractor	Existing Utilities Contingency Plan	Cost for implementation of mitigation measures responsibility of contractor.
Ecological Resources – Terrestrial	Loss of vegetation and tree cover	No tree cutting is envisaged as part of this sub project. But in future, if found required (i) Minimize removal of vegetation and disallow cutting of trees; (ii) If tree-removal will be required, obtain tree-cutting permit from the Forest Department; and (iii) Plant two native trees for every one that is removed.	Construction Contractor	PMU/PMDCSC to report in writing the no of trees cut and planted.	Cost for implementation of mitigation measures responsibility of contractor.
Land use	Environmental Issues due to land use change	The impact due to change in land use will be negligible due to this project.	Not applicable	Not applicable	Not applicable
Accessibility	Traffic problems and conflicts near project locations and haul road	Traffic Management Plan should be part of the Construction Management Plan. (i) Plan transportation routes so that heavy	Construction Contractor	(i) Traffic route during construction works including number of permanent signages, barricades and flagmen on worksite	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		vehicles do not use narrow local roads, except in the immediate vicinity of delivery sites; (ii) Schedule transport and hauling activities during non-peak hours; (iii) Locate entry and exit points in areas where there is low potential for traffic congestion; (iv) Keep the site free from all unnecessary obstructions; (v) Drive vehicles in a considerate manner; (vi) Coordinate with Traffic Police for temporary road diversions and with for provision of traffic aids if transportation activities cannot be avoided during peak hours; (vii) Notify affected sensitive receptors 2 days in advance by providing sign boards informing nature and duration of construction works and contact numbers for concerns/complaints. (viii) Plan and execute the work in such a way that the period of disturbance/ loss of access is minimum; and (ix) Provide pedestrian access in all the locations		(Appendix 5); (ii) Complaints from sensitive receptors; (iii) Number of signages placed at project location.	

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		until normalcy is restored.			
Socio-Economic – Income.	Impede the access of residents and customers to nearby shops	(i) Prepare and implement spoils management plan (ii) Leave spaces for access between mounds of soil; (iii) Provide walkways and metal sheets where required for people; (iv) Increase workforce in front of critical areas such as institutions, place of worship, business establishment, hospitals, and schools; (v) Consult businesses and institutions regarding operating hours and factoring this in work schedules; and (vi) Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.	Construction Contractor	(i) Complaints from sensitive receptors; (ii) Spoils management plan (iii) Number of walkways, signages, and metal sheets placed at project location.	Cost for implementation of mitigation measures responsibility of contractor.
Socio-Economic - Employment	Generation of contractual employment and increase in local revenue	(i) Employ at least 50% of the labour force, or to the maximum extent, local persons within the 2-km immediate area if manpower is available; (ii) Procure construction materials from local market. (iii) Comply with core labor laws	Construction Contractor	(i) Employment records; (ii) Records of sources of materials (iii) Compliance to core labor laws (See appendix 4 of this IEE)	Cost for implementation of mitigation measures responsibility of contractor.
Occupational	Occupational hazards	(i) Comply with all national,	Construction	(i) Site-specific OH&S	Cost for

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
Health and Safety	which can arise during work	state and local core labor laws (See Appendix 3 of this IEE) (ii) Develop and implement site-specific occupational health and safety (OH&S) Plan, and include in the Construction Management plan. The OH & S plan will include measures such as: (a) excluding public from the site; (b) ensuring all workers are provided with and use personal protective equipment like helmet, gumboot, safety belt, gloves, nose mask and ear plugs; (c) OH&S Training for all site personnel; (d) documented procedures to be followed for all site activities; and (e) documentation of work-related accidents; (iii) Ensure that qualified first-aid can be provided at all times. Equipped first-aid stations shall be easily accessible throughout the site; (iv) Provide medical insurance coverage for workers; (v) Secure all installations from unauthorized intrusion and accident risks; (vi) Provide supplies of	Contractor	Plan; (ii) Equipped first-aid stations; (iii) Medical insurance coverage for workers; (iv) Number of accidents; (v) Supplies of potable drinking water; (vi) Clean eating areas where workers are not exposed to hazardous or noxious substances; (vii) record of H&S orientation trainings (viii) personal protective equipment; (ix) % of moving equipment outfitted with audible back-up alarms; (x) permanent sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. (xi) Compliance to core labor laws (See appendix 4 of this IEE)	implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		potable drinking water; (vii) Provide clean eating areas where workers are not exposed to hazardous or noxious substances; (viii) Provide H&S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injuring to fellow workers; (ix) Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazard areas unescorted; (x) Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas; (xi) Ensure moving equipment is outfitted with audible back-up alarms; (xii) Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage			

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		equipment, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate; and (xiii) Disallow worker exposure to noise level greater than 85 dBA for a duration of more than 8 hours per day without hearing protection. The use of hearing protection shall be enforced actively. (xiv) Overall, the contractor should comply with IFS EHS Guidelines on Occupational Health and Safety (this can be downloaded from http://www1.ifc.org/wps/wcm/connect/9aef2880488559a983acd36a6515bb18/2%2BOccupational%2BHealth%2Band%2BSafety.pdf?MOD=AJPERES)			
Asbestos Cement (AC) Materials	Health risks associated with AC pipes	(i) Left AC pipes in-situ. (ii) Training of all personnel (including manual laborers) to enable them to understand the dangers of AC pipes and to be able to recognize them in situ;	Construction Contractor	(i) Site-specific OH&S Plan including AC pipe protocol (ii) record of OH&S orientation on AC Cement Materials Protocol (iii) personal	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		(iii) Reporting procedures to inform management immediately if AC pipes are encountered; (iv) Development and application of a detailed OH&S procedure to protect both workers and citizens. This should comply with national and international standards for dealing with asbestos, and should include: (a) removal of all persons to a safe distance; (b) usage of appropriate breathing apparatus and protective equipment by persons delegated to deal with the AC material; and (c) Procedures for the safe removal and long-term disposal of all asbestos-containing material encountered.		protective equipment for AC materials (iv) sign boards for pipe alignment identified as AC pipes.	
Community Health and Safety.	Traffic accidents and vehicle collision with pedestrians during material and waste transportation	(i) Plan routes to avoid times of peak-pedestrian activities. (ii) Liaise with PIU/ PMU/PMDCSC in identifying high-risk areas on route cards/maps. (iii) Maintain regularly the vehicles and use of manufacturer-approved parts to minimize potentially serious accidents caused by	Construction Contractor	(i) Traffic Management Plan; (ii) Complaints from sensitive receptors	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		equipment malfunction or premature failure. (iv) Provide road signs and flag persons to warn of on-going trenching activities. (v)Overall, the contractor should comply with IFS EHS Guidelines Community Health and Safety (this can be downloaded from http://www1.ifc.org/wps/wcm/connect/dd673400488559ae83c4d36a6515bb18/3%2BCommunity%2BHealth%2Band%2BSafety.pdf?MOD=AJPERES			
Work Camps and worksites	Temporary air and noise pollution from machine operation, water pollution from storage and use of fuels, oils, solvents, and lubricants Unsanitary and poor living conditions for workers	(i) Consult with PIU/ PMU/ PMDCSC before locating project offices, sheds, and construction plants; (ii) Minimize removal of vegetation and disallow cutting of trees; (iii) Provide drinking water, water for other uses, and sanitation facilities for employees; (iv) Ensure conditions of liveability at work camps are maintained at the highest standards possible at all times; Prohibit employees from poaching wildlife and cutting of trees for firewood; (v) Train employees in the	Construction Contractor	(i) Complaints from sensitive receptors; (ii) Drinking water and sanitation facilities for employees	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		storage and handling of materials which can potentially cause soil contamination; (vi) Recover used oil and lubricants and reuse or remove from the site; (vii) Manage solid waste according to the preference hierarchy: reuse, recycling and disposal to designated areas; (viii) Ensure unauthorized persons especially children are not allowed in any worksite at any given time.			
Social and Cultural Resources	Risk of archaeological chance finds	(i) Strictly follow the protocol for chance finds in any excavation work; (ii) Request PIU/ PMU/ PMDCSC or any authorized person with archaeological field training to observe excavation; (iii) Stop work immediately to allow further investigation if any finds are suspected; (iv) Inform PIU/ PMU/ PMDCSC if a find is suspected, and take any action they require ensuring its removal or protection in situ.	Construction Contractor	Records of chance finds	Cost for implementation of mitigation measures responsibility of contractor.
Sensitive	Nuisance/ disturbance to	• Conduct work	Construction	Site observation and	Cost for

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
receptors	sensitive areas (schools, hospitals and religious places) due construction work in the proximity (within 250 m of such place)	manually with small group of workers and less noise; minimize use of equipment and vehicles • No work should be conducted near the religious places during religious congregations • Material transport to the site should be arranged considering school timings; material should be in place before school starts; • Notify concerned schools, hospitals etc 2 weeks prior to the work; conduct a 30 minutes awareness program at on nature of work, likely disturbances and risks and construction work, mitigation measures in place, entry restrictions and dos and don"ts • Implement all measures suggested elsewhere in this report – dust and noise control, public safety, traffic management, strictly at the sites.	Contractor	facility for sensitive receptors	implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
Submission of EMP implementation report	Unsatisfactory compliance to EMP	(i) Appointment of supervisor to ensure EMP implementation (ii) Timely submission of monitoring reports including pictures	Construction contractor	Availability and competency of appointed supervisor Monthly report	Cost for implementation of mitigation measures responsibility of contractor.
Post-construction clean-up	Damage due to debris, spoils, excess construction materials	(i) Remove all spoils wreckage, rubbish, or temporary structures (such as buildings, shelters, and latrines) which are no longer required (ii) All excavated roads shall be reinstated to original condition. (iii) All disrupted utilities restored (iv) All affected structures rehabilitated/compensated (v) The area that previously housed the construction camp is to be checked for spills of substances such as oil, paint, etc. and these shall be cleaned up. (vi) All hardened surfaces within the construction camp area shall be ripped, all imported materials removed, and the area shall be top soiled and re-grassed using the guidelines set out in the re-vegetation specification that forms part of this document. (vii) The contractor must	Construction Contractor	PMU/ PMDCSC report in writing that (i) worksite is restored to original conditions; (ii) camp has been vacated and restored to pre-project conditions; (iii) all construction related structures not relevant to O&M are removed; and (iv) worksite clean-up is satisfactory.	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		arrange the cancellation of all temporary services. (viii) Request PMU/PMDCSC to report in writing that worksites and camps have been vacated and restored to pre-project conditions before acceptance of work.			

Table15: Environmental Management Plan for Anticipated Impacts – Bulk Water Supply System– Operation

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
Operation & Maintenance of 24 x 7 Water supply system and WTP	Poor quality of supply water due to improper maintenance	ULB shall ensure that all water supply pipelines are maintained well and water is treated to the required Drinking Water Standards	Harihar CMC	Harihar CMC	CMC cost
Water Quality Monitoring	Non availability of standard water for drinking	Treated water shall be tested for drinking water quality standards – parameters on regular basis and residual chlorine, E-coli to be tested at consumer end point.	Harihar CMC	Harihar CMC	CMC cost
Check for blockage and leakage problems reducing the water losses	It may affect the water supply system	Effectiveness of leak detection and water auditing to reduce the water losses	Harihar CMC	Harihar CMC	CMC cost
Asset management	Reduction in NRW Increased efficiency of the system	Preparation of O & M Manual	Harihar CMC	Harihar CMC	CMC cost
Emergency Response Plan	Non availability of Emergency Response Plan affect water supply system	- An Emergency Response Plan for emergencies such as indications of terrorism or acts of terrorism; Major disasters such as earthquakes, fires, flood, or explosion and Catastrophic incidents that	Harihar CMC	Harihar CMC	CMC cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		leave extraordinary levels of mass casualties, damage, and disruption severely affecting the population, infrastructure, environment, economy, etc. - Emergency Response Plan shall be prepared to address the eight core elements such as • System Specific Information; • Community Water System - Roles and Responsibilities; • Communication Procedures: Who, What and When; • Personnel Safety; • Identification of alternate water sources in emergencies; • Replacement equipment and chemical supplies; • Property protection and • Water sampling and Monitoring - Appropriate safety measures like fencing, notice boards to prevent entry of unauthorized persons shall be provided - All guide and hand railings shall be maintained in a safe and firm condition with WTP to ensure the safety of Personnel working at the plant.			
Health and Safety during O & M period	Impact on human health and safety issues	**Precautionary Working Practices:** - When working with pipes and	Harihar CMC	Harihar CMC	CMC cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		fittings on site, ensure that they are protected from contamination by storing off the ground, capping the ends of pipes and liners, and keeping fittings in wrappings until the time of use. - Excavate trenches to below the pipe level to provide a sump, and keep as dry as possible to prevent water entering a pipe or fitting. - Ensure that sealing materials and lubricants are clean and certified as suitable for contact with potable water supplies. - If a part of the distribution system has been taken out of service for an extended period, treat it as a potentially contaminated new installation. Apply the flushing, disinfection and microbiological sampling procedures that are normally applied to new installations. - As far as is practicable, if general purpose or specialized vehicles are used for water supply construction and repair duties, do not use those vehicles for other duties where contamination may be prevalent (e.g. sewerage work). - Employees and contractors involved in restricted operations should be trained in the hygienic implications of			

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		their work and basic hygienic practices. This training should include details of the personal symptoms that indicate a potential waterborne disease. All staff (employees and contractors) should be encouraged to report such symptoms without prejudice to their employment prospects. - Employers should provide adequate toilet and washing facilities to maintain personal hygiene. Wastes from portable or temporary arrangements should be disposed of without risk to water supplies or the environment. **Cleaning and Disinfection Procedures:** - Before putting into service new, repaired, rehabilitated or modified water main carrying potable water, the main must first be cleaned, disinfected, flushed and sampled to ensure that it is free from contamination. - Contractors and his employees involved in restricted operations should be trained in the hygienic implications of their work and basic hygienic practices. This training should include details of the personal symptoms that indicate a potential waterborne disease. All staff should be encouraged			

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		to report such symptoms without prejudice to their employment prospects. - Employees should be provided with adequate toilet and washing facilities to maintain personal hygiene. Wastes from portable or temporary arrangements should be disposed of without risk to water supplies or the environment. **Handling Chlorine gas cylinders during O & M period:** **Technical precautions:** - Ventilate chlorine rooms adequately. - Use only suitable and tested chlorine gas equipment. - Use only approved gas warning equipment and water spraying equipment (external operation). - Ensure that there are short escape routes into the open. (Escape doors must open outwards.) - Renew the connection seal every time the chlorine cylinders are exchanged. **Handling Chlorine cylinders:** - Proper training shall be given to the staff handling Chlorine gas cylinders and be repeated at least once a year. Only trained and designated staff shall handle gas cylinders containing chlorine.			

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		- Chlorine cylinders shall be stored with the valve cap attached securely together, with a suitable seal and the protecting cap on. Filled and empty gas cylinders should be stored separately. - To prevent heating of the chlorine cylinders, they should be kept out of direct sunlight. - Valves on chlorine gas cylinders should be operated by hand without use of force. Valves of filled or empty chlorine cylinders should always be closed securely with the correct cap. - It is advised to store chlorine gas cylinders in an adequately ventilated room and ensure short escape routes into the open air. - Operating instructions Material safety Data Sheet (MSDS) shall be displayed in accordance with the regulations on hazardous substances. - When exchanging chlorine cylinders and performing vacuum and pressure tests, suitable breathing mask with filter like full face mask shall be used along with suitable protective gloves and shoes. **Procedure in the case of Emergency:** - Proceed according to			

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		Emergency plan and inform the concerned authority immediately.. - If leakage of chlorine gas cannot be controlled using the water spray equipment, call the fire brigade immediately to attend.. - If the chlorine concentration is above the maximum workplace concentration level (0.5 ppm), use suitable compressed air breathing apparatus and a protective chemical suit. - First Aid: • Persons who have inhaled chlorine gas shall be moved to a site with fresh air and they require immediate medical attention. • If the injured persons are breathless, artificial respiration is necessary. Otherwise, they should be made to inhale nebulized dexamethasone. • If chlorine comes into contact with eyes or skin, it should be rinsed off immediately with plenty of water and consult doctor. • Contaminated clothing should be removed immediately.			
Grievance redressal during O & M	Non attending of grievances affect water supply system	- Appropriate registers shall be maintained to record complaints and Junior Engineer/s from ULB shall be assigned to track follow up action to ensure that the	Harihar CMC	Harihar CMC	-

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		complaint is addressed in a timely manner by the contractor. - If the complaint is such that it cannot be dealt with at his level, it can be referred to higher authority to take the required decision and followed up with the contractor for the compliance. - Concerned engineer from ULB shall do frequent vigilant checks at the areas from where maximum complaints have been received.			

Table 15A: Environmental Monitoring Plan– Bulk Water Supply

Sample	Site/s	Responsibility	Parameter to monitor	Frequency	Cost (INR)
Construction phase					
Ambient air quality	3 points (at WTP; at one OHSR work; and, near village along the raw water pipeline)	Contractor	• PM 10, PM 2.5 SOx, NOx • Monitoring method as prescribed by CPCB	Once before start of construction Quarterly (yearly 4-times) during construction	21 measurements (@ 3 points in 18 months) x 10000 = INR 210,000
Noise Level	3 points (at WTP; at one OHSR work; and, near village along the raw water pipeline)	Contractor	• Noise level Day and night time noise (dBA)	Once before start of construction Quarterly (yearly 4-times) during construction	21 measurements (@ 2 points in 18 months) x 2500 = INR 52,500
Surface Water Quality	1 point Tungabhadra River on the downstream side of WTP work site supply	Contractor	• River Water quality – standard parameters	Once before start of construction Quarterly (yearly 4-times) during construction	7 samples (@ 1 points in 18 months) x 10000 = INR 70,000
Operation Stage					
Source (raw) water quality	Intake in Tungabhadra River	Contractor / O & M Operator	• Water quality parameters (all	Once prior to start of operation and	12 measurements per year x 12000 =

			including pesticides, heavy metals)	monthly during operation	INR 144,000
Treated water quality	At the WTP outlet	Contractor / O & M Operator	• All Drinking water parameters	Monthly once during operation	Operating costs (water quality will be tested at the internal laboratory to be established in the project at WTP

Table 16: Environmental Management Plan for Anticipated Impacts – Water distribution System– Pre- Construction

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
Utilities	Telephone lines, electric poles and wires, water lines within proposed project area	(i) Identify and include locations and operators of these utilities in the detailed design documents to prevent unnecessary disruption of services during construction phase; and (ii) Require construction contractors to prepare a contingency plan to include actions to be done in case of unintentional interruption of services. (iii) Require contractors to prepare spoils management plan and traffic management plan (Appendix 11 and 12)	Contractor in collaboration with ULB.	(i) List of affected utilities and operators; (ii) Bid document to include requirement for a contingency plan for service interruptions (example provision of water if disruption is more than 24 hours), spoil management plan, and traffic management plan	No cost required. Mitigation measures are part of ToR of PMU, design engineers, and supervising consultants.
Social and Cultural	Ground disturbance	(i) Consult	Contractor, PMU	Chance Finds	No cost required.

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
Resources	can uncover and damage archaeological and historical remains	Archaeological Survey of India (ASI) or concerned dept. of Karnataka Govt. to obtain an expert assessment of the archaeological potential of the site; (ii) Consider alternatives if the site is found to be of medium or high risk; (iii) Develop a protocol for use by the construction contractors in conducting any excavation work, to ensure that any chance finds are recognized and measures are taken to ensure they are protected and conserved.	&PMDCSC	Protocol	Mitigation measures are part of ToR of PMU, design engineers, and supervising consultants.
Construction work camps, hot mix plants, stockpile areas, storage areas, and disposal areas.	Disruption to traffic flow and sensitive receptors	(i) Prioritize areas within or nearest possible vacant space in the project location; (ii) If it is deemed necessary to locate elsewhere, consider sites that will not promote instability and result in destruction of property, vegetation, irrigation, and drinking water supply systems;	PMU and Contractor to determine locations prior to beginning of construction works.	(i) List of selected sites for construction work camps, hot mix plants, stockpile areas, storage areas, and disposal areas. (ii) Written consent of landowner/s (not lessee/s) for reuse of excess spoils to agricultural land	No cost required. Mitigation measures are part of ToR of PMU, design engineers, and supervising consultants.

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
		(iii) Do not consider residential areas; (iv) Take extreme care in selecting sites to avoid direct disposal to water body which will inconvenience the community. (v) For excess spoil disposal, ensure (a) site shall be selected preferably from barren, infertile lands. In case agricultural land needs to be selected, written consent from landowners (not lessees) will be obtained; (b) debris disposal site shall be at least 200 m away from surface water bodies; (c) no residential areas shall be located within 50 m downwind side of the site; and (d) site is minimum 250 m away from sensitive locations like settlements, ponds/lakes or other water bodies.			
Sources of Materials	Extraction of materials can disrupt natural land contours and vegetation resulting in	(i) Prioritize sites already permitted by the Mining Department;	ULB and Contractor to prepare list of approved quarry sites and sources of	(i) List of approved quarry sites and sources of materials;	No cost required. Mitigation measures are part of ToR of

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
	accelerated erosion, disturbance in natural drainage patterns, ponding and water logging, and water pollution.	(ii) If other sites are necessary, inform construction contractor that it is their responsibility to verify the suitability of all material sources and to obtain the approval of PMU and (iii) If additional quarries will be required after construction is started, inform construction contractor to obtain a written approval from PMU.	materials with the approval of PMDCSC	(ii) Bid document to include requirement for verification of suitability of sources and permit for additional quarry sites if necessary.	PMU, design engineers, and supervising consultants.
Consents, permits, clearances, NOCs, etc.	Failure to obtain necessary consents, permits, NOCs, etc can result to design revisions and/or stoppage of works	(i) Obtain all necessary consents, permits, clearance, NOCs, etc. prior to start of civil works. (ii) Acknowledge in writing and provide report on compliance all obtained consents, permits, clearance, NOCs, etc. (iii) Include in detailed design drawings and documents all conditions and provisions if necessary (iv) Before starting of construction NOC needs to be obtained from ASI for laying of	PMU and PMDCSC	Incorporated in final design and communicated to contractors.	No cost required. Cost of obtaining all consents, permits, clearance, NOCs, etc. prior to start of civil works responsibility of PMU. Mitigation measures are part of ToR of PMU, design engineers, and supervising consultants.

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Monitoring of Mitigation	Cost and Source of Funds
		pipeline around ASI protected Harihareshwara temple.			
Asbestos Cement Pipes	Health risk due to exposure to asbestos materials	(i) Obtain details from ULB/CMC of the nature and location of all water supply infrastructure (ii) Develop an AC pipe protocol (iii) Require all personnel (including manual laborers) to undergo training as per AC pipe protocol	ULB/CMC and design engineers	(i) Detailed design drawings showing alignment of AC pipes (ii) AC pipe protocol (iii) Trainings as per AC pipe protocol	No cost required. Mitigation measures are part of ToR of PMU, design engineers, and supervising consultants.

Table 17: Environmental Management Plan for Anticipated Impacts – Water DistributionSystem– Construction

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
EMP Implementation Training	Irreversible impact to the environment, workers, and community	(i) Project manager and all key workers will be required to undergo EMP implementation including spoils management, Standard operating procedures (SOP) for construction works; occupational health and safety (OH&S), core labor laws, applicable environmental laws, etc.	Construction Contractor / PMU / PMDCSC	(i) Certificate of Completion (Safeguards Compliance Orientation) (ii) Posting of Certification of Completion at worksites (iii) Posting of EMP at worksites	Cost of EMP Implementation Orientation Training to contractor is responsibility of PMU. Other costs responsibility of contractor.
Air Quality	Emissions from construction vehicles, equipment, and machinery used for installation of pipelines	(i) Consult with PIU/ PMU/PMDCSC on the designated areas for stockpiling of clay, soils, gravel, and other	Construction Contractor	(i) Location of stockpiles; (ii) Complaints from sensitive receptors; (iii) Heavy equipment	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
	resulting to dusts and increase in concentration of vehicle-related pollutants such as carbon monoxide, sulfur oxides, particulate matter, nitrous oxides, and hydrocarbons.	construction materials; (iii) Damp down exposed soil and any stockpiled on site by spraying with water when necessary during dry weather; (iv) Use tarpaulins to cover sand and other loose material when transported by trucks; and (v) Fit all heavy equipment and machinery with air pollution control devices which are operating correctly.		and machinery with air pollution control devices; (iv) Certification that vehicles are compliant with Air Act	
Surface water quality	Mobilization of settled silt materials, and chemical contamination from fuels and lubricants during installation of pipelines can contaminate nearby surface water quality.	(i) Prepare and implement a spoils management plan as the part of the Construction Management Plan. (ii) Avoid stockpiling of earth fill especially during the monsoon season unless covered by tarpaulins or plastic sheets; (ii) Install temporary silt traps or sedimentation basins along the drainage leading to the water bodies; (iii) Place storage areas for fuels and lubricants away from any drainage leading to water bodies; (iv) Dispose any wastes generated by installation of pipeline in designated	Construction Contractor	(i) Areas for stockpiles, storage of fuels and lubricants and waste materials; (ii) Number of silt traps installed along trenches leading to water bodies; (iii) Records of surface water quality inspection; (iv) Effectiveness of water management measures; (v) No visible degradation to nearby drainages, *nallahs* or water bodies due to civil works	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		sites; disposal site should be identified prior to the demolition of concrete tanks at WTP, and (v) Conduct surface quality inspection according to the Environmental Management Plan (EMP).			
Noise Levels	Increase in noise level due to earth-moving and excavation equipment, and the transportation of equipment, materials, and people	(i) Plan activities in consultation with PIU/ PMU/PMDCSC so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance; (ii) Horns should not be used unless it is necessary to warn other road users or animals of the vehicle's approach; (iii) Minimize noise from construction equipment by using vehicle silencers, fitting jackhammers with noise-reducing mufflers, and portable street barriers the sound impact to surrounding sensitive receptor; and (iv) Maintain maximum sound levels not exceeding 80 decibels (dbA) when measured at a distance of 10 m or more from the vehicle/s.	Construction Contractor	(i) Complaints from sensitive receptors; (ii) Use of silencers in noise-producing equipment and sound barriers; (iii) Equivalent day and night time noise levels (See Appendix 2 of this IEE)	Cost for implementation of mitigation measures responsibility of contractor.
Landscape and	Impacts due to excess	(i) Prepare and implement	Construction	(i) Complaints from	Cost for

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
aesthetics	excavated earth, excess construction materials, and solid waste such as removed concrete, wood, packaging materials, empty containers, spoils, oils, lubricants, and other similar items.	spoils management plan (ii) Avoid stockpiling of excess excavated soils; (iii) Coordinate with ULB/CMC for beneficial uses of excess excavated soils or immediately dispose to designated areas; (iv) Recover used oil and lubricants and reuse or remove from the sites; (v) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas; (vi) Remove all wreckage, rubbish, or temporary structures which are no longer required; (vii) Report in writing that the necessary environmental restoration work has been adequately performed before acceptance of work	Contractor	sensitive receptors; (ii) Worksite clear of hazardous wastes such as oil/fuel (iii) Worksite clear of any excess excavated earth, excess construction materials, and solid waste such as removed concrete, wood, packaging materials, empty containers	implementation of mitigation measures responsibility of contractor.
Existing Infrastructure and Facilities	Disruption of service and damage to existing infrastructure at specified project location	(i) Obtain from PIU/ PMU/PMDCSC the list of affected utilities and operators if any; (ii) Prepare a contingency plan to include actions to be done in case of unintentional interruption of service	Construction Contractor	Existing Utilities Contingency Plan	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		iii) The public should be given notice at least three days in advance and any accidental breaking should be rectified immediately.			
Ecological Resources – Terrestrial	Loss of vegetation and tree cover	No tree cutting is envisaged as part of this sub project. But in future, if found required (i) Minimize removal of vegetation and disallow cutting of trees; (ii) If tree-removal will be required, obtain tree-cutting permit from the Forest Department; and (iii) Plant two native trees for every one that is removed.	Construction Contractor	PMU/PMDCSC to report in writing the no of trees cut and planted.	Cost for implementation of mitigation measures responsibility of contractor.
Land use	Environmental Issues due to land use change	The impact due to change in land use will be negligible due to this project.	Not applicable	Not applicable	Not applicable
Accessibility	Traffic problems and conflicts near project locations and haul road	Traffic Management Plan should be part of the Construction Management Plan. (i) Plan transportation routes so that heavy vehicles do not use narrow local roads, except in the immediate vicinity of delivery sites; (ii) Schedule transport and hauling activities during non-peak hours; (iii) Locate entry and exit points in areas where	Construction Contractor	(i) Traffic route during construction works including number of permanent signages, barricades and flagmen on worksite (Appendix 5); (ii) Complaints from sensitive receptors; (iii) Number of signages placed at project location.	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		there is low potential for traffic congestion; (iv) Keep the site free from all unnecessary obstructions; (v) Drive vehicles in a considerate manner; (vi) Coordinate with Traffic Police for temporary road diversions and with for provision of traffic aids if transportation activities cannot be avoided during peak hours; (vii) Notify affected sensitive receptors 2 days in advance by providing sign boards informing nature and duration of construction works and contact numbers for concerns/complaints. (viii) Plan and execute the work in such a way that the period of disturbance/ loss of access is minimum; and (ix) Provide pedestrian access in all the locations until normalcy is restored.			
Socio-Economic – Income.	Impede the access of residents and customers to nearby shops	(i) Prepare and implement spoils management plan (ii) Leave spaces for access between mounds of soil; (iii) Provide walkways and metal sheets where required for people;	Construction Contractor	(i) Complaints from sensitive receptors; (ii) Spoils management plan (iii) Number of walkways, signages, and metal sheets placed at project	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		(iv) Increase workforce in front of critical areas such as institutions, place of worship, business establishment, hospitals, and schools; (v) Consult businesses and institutions regarding operating hours and factoring this in work schedules; and (vi) Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.		location.	
Socio-Economic - Employment	Generation of contractual employment and increase in local revenue	(i) Employ at least 50% of the labour force, or to the maximum extent, local persons within the 2-km immediate area if manpower is available; (ii) Procure construction materials from local market. (iii) Comply with core labor laws	Construction Contractor	(i) Employment records; (ii) Records of sources of materials (iii) Compliance to core labor laws (See appendix 4 of this IEE)	Cost for implementation of mitigation measures responsibility of contractor.
Occupational Health and Safety	Occupational hazards which can arise during work	(i) Comply with all national, state and local core labor laws (See Appendix 3 of this IEE) (ii) Develop and implement site-specific occupational health and safety (OH&S) Plan, and include in the Construction Management plan. The OH & S plan will	Construction Contractor	(i) Site-specific OH&S Plan; (ii) Equipped first-aid stations; (iii) Medical insurance coverage for workers; (iv) Number of accidents; (v) Supplies of potable drinking	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		include measures such as: (a) excluding public from the site; (b) ensuring all workers are provided with and use personal protective equipment like helmet, gumboot, safety belt, gloves, nose mask and ear plugs; (c) OH&S Training for all site personnel; (d) documented procedures to be followed for all site activities; and (e) documentation of work-related accidents; (iii) Ensure that qualified first-aid can be provided at all times. Equipped first-aid stations shall be easily accessible throughout the site; (iv) Provide medical insurance coverage for workers; (v) Secure all installations from unauthorized intrusion and accident risks; (vi) Provide supplies of potable drinking water; (vii) Provide clean eating areas where workers are not exposed to hazardous or noxious substances; (viii) Provide H&S orientation training to all new workers to ensure that they are apprised of		water; (vi) Clean eating areas where workers are not exposed to hazardous or noxious substances; (vii) record of H&S orientation trainings (viii) personal protective equipment; (ix) % of moving equipment outfitted with audible back-up alarms; (x) permanent sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. (xi) Compliance to core labor laws (See appendix 4 of this IEE)	

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		the basic site rules of work at the site, personal protective protection, and preventing injuring to fellow workers; (ix) Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazard areas unescorted; (x) Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas; (xi) Ensure moving equipment is outfitted with audible back-up alarms; (xii) Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as			

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		appropriate; and (xiii) Disallow worker exposure to noise level greater than 85 dBA for a duration of more than 8 hours per day without hearing protection. The use of hearing protection shall be enforced actively. (xiv) Overall, the contractor should comply with IFS EHS Guidelines on Occupational Health and Safety (this can be downloaded from http://www1.ifc.org/wps/wcm/connect/9aef2880488559a983acd36a6515bb18/2%2BOccupational%2BHealth%2Band%2BSafety.pdf?MOD=AJPERES)			
Asbestos Cement (AC) Materials	Health risks associated with AC pipes	(i) Left AC pipes in-situ. (ii) Training of all personnel (including manual laborers) to enable them to understand the dangers of AC pipes and to be able to recognize them in situ; (iii) Reporting procedures to inform management immediately if AC pipes are encountered; (iv) Development and application of a detailed OH&S procedure to protect both workers and citizens. This should	Construction Contractor	(i) Site-specific OH&S Plan including AC pipe protocol (ii) record of OH&S orientation on AC Cement Materials Protocol (iii) personal protective equipment for AC materials (iv) sign boards for pipe alignment identified as AC pipes.	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		comply with national and international standards for dealing with asbestos, and should include: (a) removal of all persons to a safe distance; (b) usage of appropriate breathing apparatus and protective equipment by persons delegated to deal with the AC material; and (c) Procedures for the safe removal and long-term disposal of all asbestos-containing material encountered.			
Community Health and Safety.	Traffic accidents and vehicle collision with pedestrians during material and waste transportation	(i) Plan routes to avoid times of peak-pedestrian activities. (ii) Liaise with PIU/ PMU/PMDCSC in identifying high-risk areas on route cards/maps. (iii) Maintain regularly the vehicles and use of manufacturer-approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure. (iv) Provide road signs and flag persons to warn of on-going trenching activities. (v)Overall, the contractor should comply with IFS EHS Guidelines Community Health and	Construction Contractor	(i) Traffic Management Plan; (ii) Complaints from sensitive receptors	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		Safety (this can be downloaded from http://www1.ifc.org/wps/wcm/connect/dd673400488559ae83c4d36a6515bb18/3%2BCommunity%2BHealth%2Band%2BSafety.pdf?MOD=AJPERES			
Work Camps and worksites	Temporary air and noise pollution from machine operation, water pollution from storage and use of fuels, oils, solvents, and lubricants Unsanitary and poor living conditions for workers	(i) Consult with PIU/ PMU/ PMDCSC before locating project offices, sheds, and construction plants; (ii) Minimize removal of vegetation and disallow cutting of trees; (iii) Provide drinking water, water for other uses, and sanitation facilities for employees; (iv) Ensure conditions of liveability at work camps are maintained at the highest standards possible at all times; Prohibit employees from poaching wildlife and cutting of trees for firewood; (v) Train employees in the storage and handling of materials which can potentially cause soil contamination; (vi) Recover used oil and lubricants and reuse or remove from the site; (vii) Manage solid waste according to the	Construction Contractor	(i) Complaints from sensitive receptors; (ii) Drinking water and sanitation facilities for employees	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		preference hierarchy: reuse, recycling and disposal to designated areas; (viii) Ensure unauthorized persons especially children are not allowed in any worksite at any given time.			
Social and Cultural Resources	Risk of archaeological chance finds	(i) Strictly follow the protocol for chance finds in any excavation work; (ii) Request PIU/ PMU/ PMDCSC or any authorized person with archaeological field training to observe excavation; (iii) Stop work immediately to allow further investigation if any finds are suspected; (iv) Inform PIU/ PMU/ PMDCSC if a find is suspected, and take any action they require ensuring its removal or protection in situ.	Construction Contractor	Records of chance finds	Cost for implementation of mitigation measures responsibility of contractor.
Sensitive receptors	Nuisance/ disturbance to sensitive areas (schools, hospitals and religious places) due construction work in the proximity (within 250 m of such place)	• Conduct work manually with small group of workers and less noise; minimize use of equipment and vehicles • No work should be conducted near the religious places during religious	Construction Contractor	Site observation and facility for sensitive receptors	Cost for implementation of mitigation measures responsibility of contractor.

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		congregations • Material transport to the site should be arranged considering school timings; material should be in place before school starts; • Notify concerned schools, hospitals etc 2 weeks prior to the work; conduct a 30 minutes awareness program at on nature of work, likely disturbances and risks and construction work, mitigation measures in place, entry restrictions and dos and don‟ts • Implement all measures suggested elsewhere in this report – dust and noise control, public safety, traffic management, strictly at the sites.			
Submission of EMP implementation report	Unsatisfactory compliance to EMP	(i) Appointment of supervisor to ensure EMP implementation (ii) Timely submission of monitoring reports including pictures	Construction contractor	Availability and competency of appointed supervisor Monthly report	Cost for implementation of mitigation measures responsibility of contractor.
Post-construction clean-up	Damage due to debris, spoils, excess construction materials	(i) Remove all spoils wreckage, rubbish, or temporary structures (such	Construction Contractor	PMU/ PMDCSC report in writing that (i) worksite is	Cost for implementation of mitigation measures

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		as buildings, shelters, and latrines) which are no longer required (ii) All excavated roads shall be reinstated to original condition. (iii) All disrupted utilities restored (iv) All affected structures rehabilitated/compensated (v) The area that previously housed the construction camp is to be checked for spills of substances such as oil, paint, etc. and these shall be cleaned up. (vi) All hardened surfaces within the construction camp area shall be ripped, all imported materials removed, and the area shall be top soiled and re-grassed using the guidelines set out in the re-vegetation specification that forms part of this document. (vii) The contractor must arrange the cancellation of all temporary services. (viii) Request PMU/PMDCSC to report in writing that worksites and camps have been vacated and restored to pre-project conditions before acceptance of work.		restored to original conditions; (ii) camp has been vacated and restored to pre-project conditions; (iii) all construction related structures not relevant to O&M are removed; and (iv) worksite clean-up is satisfactory.	responsibility of contractor.

Table 18: Environmental Management Plan for Anticipated Impacts – Water Distribution System– Operation

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
Check for blockage and leakage problems reducing the water losses	It may affect the water supply system	Effectiveness of leak detection and water auditing to reduce the water losses	Harihar CMC	Harihar CMC	CMC cost
Repair works during O & M	Local disturbances during maintenance work	- Contractor shall inform shopkeepers, residents and road users of repair works in advance. - If trenches are dug to locate and repair leaks or remove and replace lengths of pipe or illegal connections, the removed material will be replaced in the trench so there will be no waste. The refilled trench shall be re-compacted and brought to the original condition as soon as the repair works are over. Works shall be completed quickly at sensitive areas. - Proper access shall be provided to the residents during the repair works - If any major maintenance works is to be taken up contractor shall prepare and operate H&S plan to protect workers and public. Contractor may request police to divert traffic if necessary.	Harihar CMC	Harihar CMC	CMC cost
Asset management	Reduction in NRW Increased efficiency of the system	Preparation of O & M Manual	Harihar CMC	Harihar CMC	CMC cost
Emergency	Non availability of	- An Emergency Response Plan	Harihar CMC	Harihar CMC	CMC cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
Response Plan	Emergency Response Plan affect water supply system	for emergencies such as indications of terrorism or acts of terrorism; Major disasters such as earthquakes, fires, flood, or explosion and Catastrophic incidents that leave extraordinary levels of mass casualties, damage, and disruption severely affecting the population, infrastructure, environment, economy, etc. - Emergency Response Plan shall be prepared to address the eight core elements such as • System Specific Information; • Community Water System - Roles and Responsibilities; • Communication Procedures: Who, What and When; • Personnel Safety; • Identification of alternate water sources in emergencies; • Replacement equipment and chemical supplies; • Property protection and • Water sampling and Monitoring - Appropriate safety measures like fencing, notice boards to prevent entry of unauthorized persons shall be provided - All guide and hand railings shall be maintained in a safe			

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		and firm condition with WTP to ensure the safety of Personnel working at the plant.			
Health and Safety during O & M period	Impact on human health and safety issues	**Precautionary Working Practices:** - When working with pipes and fittings on site, ensure that they are protected from contamination by storing off the ground, capping the ends of pipes and liners, and keeping fittings in wrappings until the time of use. - Excavate trenches to below the pipe level to provide a sump, and keep as dry as possible to prevent water entering a pipe or fitting. - Ensure that sealing materials and lubricants are clean and certified as suitable for contact with potable water supplies. - If a part of the distribution system has been taken out of service for an extended period, treat it as a potentially contaminated new installation. Apply the flushing, disinfection and microbiological sampling procedures that are normally applied to new installations. - As far as is practicable, if general purpose or specialized vehicles are used for water supply construction and repair duties, do not use those vehicles for other duties where contamination may be	Harihar CMC	Harihar CMC	CMC cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		prevalent (e.g. sewerage work). - Employees and contractors involved in restricted operations should be trained in the hygienic implications of their work and basic hygienic practices. This training should include details of the personal symptoms that indicate a potential waterborne disease. All staff (employees and contractors) should be encouraged to report such symptoms without prejudice to their employment prospects. - Employers should provide adequate toilet and washing facilities to maintain personal hygiene. Wastes from portable or temporary arrangements should be disposed of without risk to water supplies or the environment.			
Grievance redressal during O & M	Non attending of grievances affect water supply system	- Appropriate registers shall be maintained to record complaints and Junior Engineer/s from ULB shall be assigned to track follow up action to ensure that the complaint is addressed in a timely manner by the contractor. - If the complaint is such that it cannot be dealt with at his level, it can be referred to higher authority to take the required decision and followed	Harihar CMC	Harihar CMC	-

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Monitoring of Mitigation	Cost and Source of Funds
		up with the contractor for the compliance. - Concerned engineer from ULB shall do frequent vigilant checks at the areas from where maximum complaints have been received.			

Table 18A: Environmental Monitoring Plan– Distribution Network

Sample	Site/s	Responsibility	Parameter to monitor	Frequency	Cost (INR)
Construction phase					
Ambient air quality	3 points (in the town to be selected during implementation)	Contractor	• PM 10, PM 2.5 SOx, NOx • Monitoring method as prescribed by CPCB	Once before start of construction Quarterly (yearly 4-times) during construction	21 measurements (@ 3 points in 18 months) x 10000 = INR 210,000
Noise Level	3 points (in the town to be selected during implementation)	Contractor	• Noise level Day and night time noise (dBA)	Once before start of construction Quarterly (yearly 4-times) during construction	21 measurements (@ 2 points in 18 months) x 2500 = INR 52,500
Operation Stage					
Supplied water at consumer end	Consumer end-random sampling in all zones (atleast 1 sample from 1 zone/ward)	Contractor / O & M Operator	• All Drinking water parameters	Monthly once during operation	Operating costs (water quality will be tested at the internal laboratory to be established in the project at WTP)

B. Institutional Arrangements

130. **Executing Agency (EA):** Karnataka Urban Infrastructure Development & Finance Corporation (KUIDFC) is the executing agency (EA) responsible for implementing the Investment Program. Investment Program implementation activities will be monitored by Program Management Unit (PMU) of KIUWMIP, headed by Task Manager KIUWMIP Head Office Bangalore.

131. A new Regional Program Management Unit (RPMU) established at Davangere. A Consultant Team (PMDCSC) appointed by EA and the team work under the Deputy Project Director (DPD) and they involved in project planning, preparation of subproject and cost estimates, co-ordination, technical guidance and supervision, financial control, training and overall subproject management.

132. Interactions with GoK, GoI and ADB shall be conducted through the KUIDFC office at Bangalore.

133. **Implementing Agency (IA):** The ultimate implementation responsibility lies with respective ULBs (in this case Harihar City Municipal Council). A Programme Implementation Unit (PIU) established in each ULB.

134. Other than the above institutional setup, District Level Implementation Committee set up in each district to monitor implementation of subprojects and institutional reforms. The District Level Implementation Committee shall consist of Deputy Commissioner of District, Deputy Project Director from concerned RPMU, Municipal Commissioners' / Chief Officers of ULB and PMDCSC representative.

135. At the Executing Agency (i.e. KUIDFC), environmental issues coordinated centrally by an Environmental Specialist (designated as Assistant Executive Engineer-Environment), reporting to the Task Manager. Assistant Executive Engineer – Environment will ensure that all subprojects comply with environmental safeguards. The IEE/EIA reports prepared by PMDCSC and will be reviewed by the Assistant Executive Engineer-Environment as per the ADB's Environmental Guidelines and forwarded to ADB for review and approval. The Assistant Executive Engineer-Environment, KUIDFC, Head office will be assisted by an Environment Specialist of PMDCSC, stationed at Davangere.

136. The responsibility fulfilling environmental requirements of GoI/GoK and conducting required level of environmental assessment as per ADB guidelines lies with the implementing agency, i.e. Harihar CMC. The PMDCSC will assist the CMC in this regard.

137. The mitigation measures identified through IEE/are incorporated into the Investment Program cycle. Mitigation measures, which are to be implemented by the Contractor, shall form part of the Contract Documents. The other mitigation measures are undertaken by the IA (itself or in assistance with the Consultant Team) as specified in the IEE. During the construction phase, environmental Consultant team will monitor the implementation of the EMP and report to the PMU. The Implementation of EMP and other environmental related measures and the results of environmental monitoring conducted during implementation will be reported to ADB through semi-annual Environmental Monitoring Reports. These will also be made available on executing agency (KUIDFC) website for wider public access.

138. **Consultants:** Deputy Project Director is being assisted by a consultant team (PMDCSC) in project planning, preparation of project and cost estimates, coordination, technical guidance and supervision, financial control, training and overall project management. The consultant team includes an environment specialist to supervise the implementation of environmental safeguards at the RPMU level. The consultant team also includes a Resident Engineer (RE) at each ULB/CMC responsible for the supervision of project implementation including environmental safeguards at each ULB/CMC level.

139. **Contractor**: The contractor shall appoint one supervisor who will be responsible ona day-today basis for i) ensuring implementation of EMP ii) Coordinating with the RE and environment specialists (all levels) iii) community liaison, consultation with interested / affected parties and grievance redressal and iv) reporting.

140. KUIDFC will ensure that bidding and contract documents include specific provisions requiring contractors to comply with all: (i) applicable labour laws and core labour standards on (a) prohibition of child labour as defined in national legislation for construction and maintenance activities, on (b) equal pay for equal work of equal value regardless of gender, ethnicity or caste, and on (c) elimination of forced labour; and (ii) the requirement to disseminate information on sexually transmitted diseases including HIV/AIDS to employees and local communities surrounding the project sites.

141. The following figure and table summarizes the institutional responsibility of environmental safeguards at all stages of the project.

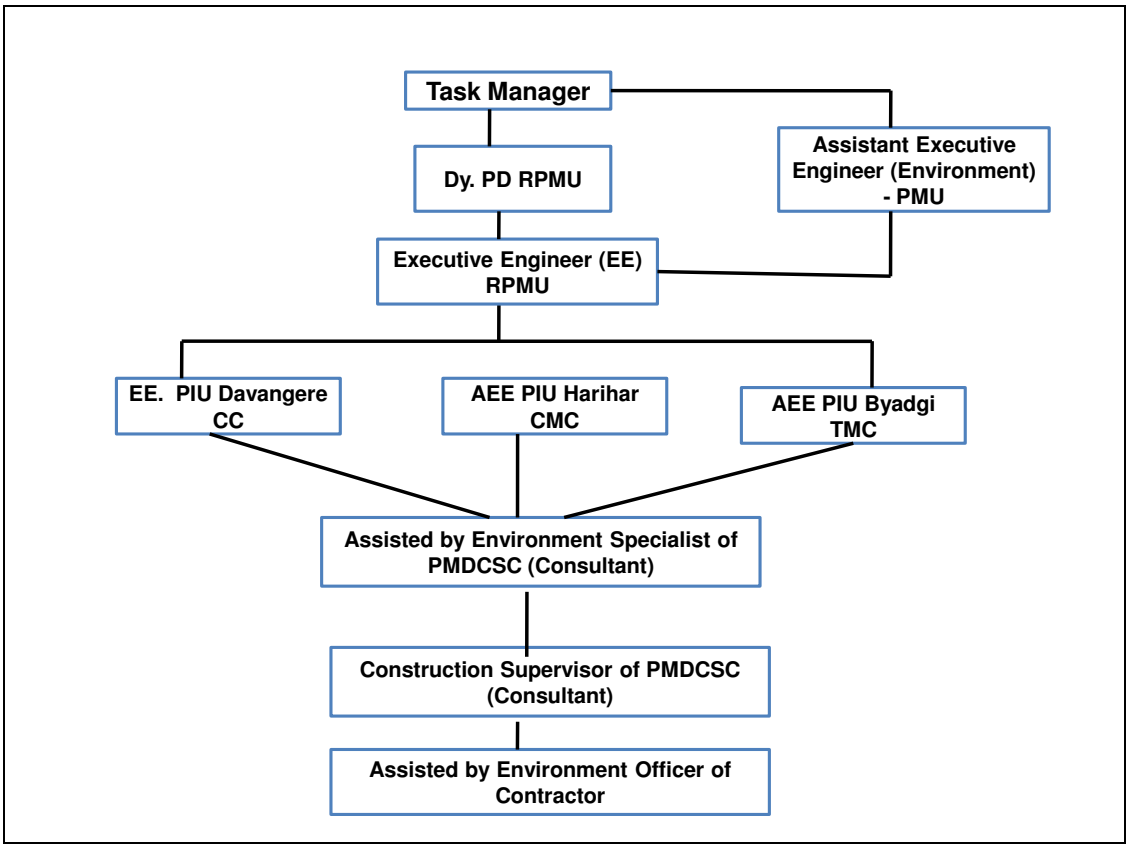


Figure 13: Environmental Safeguard Implementation Arrangements

Table 19: Institutional Roles and Responsibilities

Responsible Agency	Responsibility		
	Pre-Construction Stage	**Construction Stage**	**Post-Construction**
Task Manager	(i) Review REA checklists and assign categorization based on ADB SPS (ii) Review and approve EIA/IEE (iii) Submit EIA/IEE to ADB for approval and disclosure in ADB website (iv) Ensure approved IEEs are disclosed in KUIDFC website and summary posted in public areas accessible and understandable by local people. (v) Ensure environmental management plans (EMPs) are included in the bid documents and contracts (vi) Organize an orientation workshop for PMU, ULBs/CMCs,/ TMCs and all staff involved in the project implementation on (a) ADB SPS, (b) Government of India national, state, and local environmental laws and regulations, (c) core labor standards, (d) OH&S, (e) EMP implementation especially spoil management, working in congested areas, public relations and ongoing consultations, grievance redress, etc. (vii) Assist in addressing any grievances brought about through the Grievance Redress Mechanism in a timely manner as per the IEEs (viii) Organize an induction course for the training of contractors preparing them on EMP implementation, environmental monitoring requirements related to mitigation measures; and taking immediate actions to remedy unexpected adverse impacts or ineffective mitigation measures found during the course of	(i) Task Manager is responsible for over-all environmental safeguards compliance of the project (ii) Review and submit to ADB semi-annual monitoring reports (iii) Review and submit Corrective Action Plans to ADB (iv) Organize capacity building programs on environmental safeguards (iv) Coordinate with national and state level government agencies (vi) Assist in addressing any grievances brought about through the Grievance Redress Mechanism in a timely manner as per the IEEs	Compliance monitoring to review the environmental performance of project component, if required and as specified in EMP
Assistant Executive Engineer (Environment)		(i) Assist in the preparation of semi-annual monitoring reports (ii) Monitor and ensure compliance of EMPs as well as any other environmental provisions and conditions. (iv) If necessary prepare Corrective Action Plan and ensure implementation of corrective actions to ensure no environmental impacts; (v) Organize capacity building programs on environmental safeguards at regional / divisional level (vi) Coordinate with regional level government agencies (vii) Assist in addressing any grievances brought about through the Grievance Redress Mechanism in a timely manner as per the IEEs (viii) Assist in overseeing implementation of the EMP during construction including environmental, health and safety monitoring of contractors;	Compliance monitoring to review the environmental performance of project component, if required and as specified in EMP

Responsible Agency	Responsibility		
	Pre-Construction Stage	**Construction Stage**	**Post-Construction**
	implementation. (ix) Ensure compliance with all government rules and regulations regarding site and environmental clearances as well as any other environmental requirements (x) Assist PMU, PIUs, and project NGOs to document and develop good practice construction guidelines to assist the contractors in implementing the provisions of IEE. (xi) Assist in the review of the contractors' implementation plans to ensure compliance with the IEE.	(ix) Coordinate with the General Manager, environmental Experts, ULBs/CMCs/TMCs, NGOs, consultants and contractors on mitigation measures involving the community and affected persons and ensure that environmental concerns and suggestions are incorporated and implemented	
ULB/CMC	(i) Conduct initial environmental assessment for proposed project using REA checklists and submit to PMU (ii) Prepare EIA/IEE based on categorization and submit to PMU for approval (iii) Ensure IEE is included in bid documents and contract agreements. Ensure cost of EMP implementation is provided. (iv) Disclose approved EIAs/IEEs. (v) Obtain all necessary clearances, permits, consents, NOCs, etc. Ensure compliance to the provisions and conditions. (vi) EMP implementation regarding sites for disposal of wastes, camps, storage areas, quarry sites, etc. (vii) Ensure contractors undergo EMP implementation orientation prior to start of civil works	(i) Ensure EMP implementation is included in measuring works carried out by the contractors and certifying payments. (ii) Ensure Corrective Action Plan is implemented. (ii) Conduct public awareness campaigns and participation programs (iii) Prepare monthly reports. (vi) Address any grievances brought about through the Grievance Redress Mechanism in a timely manner as per the IEEs	(i) Conducting environmental monitoring, as specified in the EMP. (ii) Issuance of clearance for contractor's post-construction activities as specified in the EMP.
Environment Specialist PMDCSC (Consultant)	(i) Assist ULBs/CMCs/TMC in preparation of REA checklists and EIAs/IEEs (ii) Assist ULBs/CMCs/TMC in obtaining all necessary clearances, permits, consents, NOCs, etc. Ensure provisions and conditions are	(i) Monitor EMP implementation (ii) Recommend corrective action measures for non-compliance by contractors (iii) Assist in the review of monitoring reports submitted by contractors	(i) Assist in the inspection and verification of contractor's post-construction activities.

Responsible Agency	Responsibility		
	Pre-Construction Stage	**Construction Stage**	**Post-Construction**
	incorporated in the IEE and detailed design documents. (iii) Assist in ensuring IEE is included in bid documents and contract agreements. Assist in determining adequacy of cost for EMP implementation. (iv) Assist in addressing any concern related to IEE and EMP. (v) Assist in summarizing IEE and translating to language understood by local people.	(iv) Assist in the preparation of monthly reports and semi- annual report (vi) Assist in addressing any grievances brought about through the Grievance Redress Mechanism in a timely manner as per the IEEs	
Contractors	(i) Ensure EMP implementation cost is included in the methodology. (ii) Undergo EMP implementation orientation prior to award of contract (iii) Provide EMP implementation orientation to all workers prior to deployment to worksites (iv) Seek approval for camp sites and sources of materials. (v) Ensure copy of IEE is available at worksites. Summary of IEE is translated to language understood by workers and posted at visible places at all times.	(i) Implement EMP. (ii) Implement corrective actions if necessary. (iii) Prepare and submit monitoring reports including pictures to ULB/CMC (iv) Comply with all applicable legislation, is conversant with the requirements of the EMP; (v) Brief his staff, employees, and laborer about the requirements of the EMP and provide environmental awareness training to staff, employees, and laborers; (vi) Ensure any sub-contractors/ suppliers who are utilized within the context of the contract comply with all requirements of the EMP. The Contractor will be held responsible for non-compliance on their behalf; (vii) Bear the costs of any damages/compensation resulting from non-adherence to the EMP or written site instructions; (viii) Ensure that ULBs/CMCs and PMDCSC are timely informed of any foreseeable activities related to EMP implementation. (vi) Address any grievances brought about through the Grievance Redress	(i) Ensure EMP post-construction requirements are satisfactorily complied (ii) Request certification from ULBs/CMCs/TMC

Responsible Agency	Responsibility		
	Pre-Construction Stage	Construction Stage	Post-Construction
		Mechanism in a timely manner as per the IEEs	

C. Training Needs

142. The following table (**Table 16**) presents the outline of capacity building program to ensure EMP implementation. The estimated cost is Rs. 85,000.00 (excluding trainings of contractors which will be part of EMP implementation cost during construction) to be covered by the project's capacity building program. The detailed cost and specific modules will be customized for the available skill set after assessing the capabilities of the target participants and the requirements of the project.

Table 20: Outline of Capacity Building Program on EMP Implementation

Description	Target Participants	Estimate (INR) – (Lump sum)	Cost and Source of Funds
1. Introduction and sensitization to environment issues (1 day) - ADB Safeguards Policy Statement - Government of India and Karnataka applicable safeguard laws, regulations and policies including but not limited to core labor standards, OH&S, etc - Incorporation of EMP into the project design and contracts - Monitoring, reporting and corrective action planning	All staff and consultants involved in the project	10,000.00	PMU cost
2.EMP implementation (3 days) - Roles and responsibilities - OH&S planning and implementation - Wastes management (water, hazardous, solid, excess construction materials, spoils, etc.) - Working in congested areas, - Public relations - Consultations - Grievance redress - Monitoring and corrective action planning - Reporting and disclosure - Post-construction planning	All staff and consultants involved in the project All contractors prior to award of contract	25,000.00	PMU cost
3. Plans and Protocols (3 days) - Construction site standard operating procedures (SOP) - AC pipe protocol - Site-specific EMP - Traffic management plan - Spoils management plan	All staff and consultants involved in the project All contractors prior to award of	25,000.00 25,000.00	PMU cost Contractors cost as compliance to

Description	Target Participants	Estimate (INR) – (Lump sum)	Cost and Source of Funds
- Waste management plan - Chance find protocol - O&M plans - Post-construction plan	contract or during mobilization stage.		contract provisions on EMP implementation (refer to EMP tables)
4. Experiences and best practices sharing - Experiences on EMP implementation - Issues and challenges - Best practices followed	All staff and consultants involved in the project All contractors All NGOs	25,000.00	PMU Cost
5. Contractors Orientation to Workers on EMP implementation (OH&S, core labor laws, spoils management, etc)	All workers (including manual laborers) of the contractor prior to dispatch to worksite	10,000.00	Contractors cost as compliance to contract provisions on EMP implementation (refer to EMP tables)
Total cost for Capacity Building Programme on EMP Implementation		1,20,000.00	

PMU Fund Rs. 85,000.00
Contractor Cost Rs. 35,000.00
Total cost for Capacity Building Programme Rs. 1,20,000.00

D. Monitoring and Reporting

143. Prior to commencement of the work, the contractor will submit a compliance report to ULB/CMC ensuring that all identified pre-construction environmental impact mitigation measures as detailed in the EMP will be undertaken. ULB/CMC with the assistance of the environment specialist will review the report and thereafter ULB will allow commencement of works.

144. During construction, results from internal monitoring by the contractor will be reflected in their weekly EMP implementation reports to the Resident Engineer. These weekly report will be retained in PMDCSC for reference. Resident Engineer will review and advise contractor for corrective actions if necessary. Monthly report summarizing compliance and corrective measures taken will be prepared by Resident Engineer to be reviewed and endorsed by ULB and consolidated monthly report will be submitted to PMU.

145. Based on monthly reports and measurements, PMU will draft, review, and submit to ADB, 6-monthly (twice a year) EMP implementation progress report **(Appendix.13**). Once concurrence from the ADB is received the report will be disclosed in the KUIDFC /ULB website.

146. ADB will review project performance against the KUIDFC's commitments as agreed in the legal documents. The extent of ADB's monitoring and supervision activities will be commensurate with the project's risks and impacts. Monitoring and supervising of environmental and social safeguards will be integrated into the project performance management system.

E. EMP Implementation Cost

147. Most of the mitigation measures require the contractors to adopt good site practice, which should be part of their normal procedures already, so there are unlikely to be major costs associated with compliance. Regardless of this, any costs of mitigation by the construction contractors or consultants are included in the budgets for the civil works and do not need to be estimated separately here. Mitigation that is the responsibility of ULB/CMC will be provided as part of their management of the project, so this also does not need to be duplicated here. Cost for the capacity building program is included as part of the project. The EMP cost includes cost for environment quality monitoring (air, noise, water etc.,), the cost for providing water supply and sanitation facilities for the workers. In addition to this, hard barricades need to be provided at the work sites to prevent any entry of the public or animals into the worksite and to prevent any possible accident

Table 21Cost Estimates to Implement the EMP – Bulk Water System

No	Particulars	Stages	Unit	Number	Rate	Cost (INR)	Costs Covered By
I	**Construction**						
A.	**Monitoring Measures**						
1	Air quality monitoring-	Construction	Per Sample	21	10,000	210,000	Civil works contract
2	Noise levels monitoring-	Construction	Per sample	21	2,500	52,500	Civil works contract
3	Surface water quality monitoring	Construction	Per sample	7	10,000	70,000	Civil works contract
	Sub Total					**332,500**	
B	**Capacity Building**						
1	Introduction and sensitization to environment issues	Pre-construction	lump sum			5,000	PMU
2	EMP implementation	Construction	lump sum			15,000	PMU
3	Plans and Protocols	Construction	lump sum			15,000	PMU
			lump sum			15,000	Civil works contract
4	Experiences and best practices sharing	Construction/ Post-Construction	lump sum			15,000	PMU
5	Contractors Orientation to Workers on EMP implementation	Prior to dispatch to worksite	Lump sum			5,000	Civil works contract
	Subtotal (B)					**70,000**	
C	**Civil Works**						
1	Construction of shelters	Construction	Lump			2,00,000	Civil

No	Particulars	Stages	Unit	Number	Rate	Cost (INR)	Costs Covered By
	for workers.		sum				works contract
2	Providing Water Supply Facility for the workers	Construction	Lump sum			1,00,000	Civil works contract
3	Providing Sanitation Facility for the workers	Construction	Lump sum			1,00,000	Civil works contract
4	Barricades at the worksite (MS Sheet of 20 gauge of size 5 x 3 meters, having vertical support by MS flat (65 x 65 x 6 mm) along the sides and at 1.5 m and 3.5m, horizontal support by MS flat (65 x 65 x 6 mm) along the sides and at the center, supported by 50mm MS hollow pies of 4 meter height at the ends and at the center.	Construction	Per unit	10	15,000	1,50,000	Civil works contract
6	Retro reflectorized Traffic Signs as per IRC:67, M 15 grade, 60 x 60 mm square; fixed over Aluminum sheeting supported on MS angle iron.	Construction	Per unit	2	2500	5,000	Civil works contract
	Sub Total (C)					**555,000**	
	Total (A+B+C)					**957,500**	
II	**Operation**						
A	**Monitoring measures**						
1	Source (raw) water quality	Operation	Per sample	12	12,000	144,000 per year	
2	Treated water quality	Operation	LS	-	-	Part of lab operating costs	

The air and noise quality monitoring will be done near to sensitive receptors like hospitals, educational institutions and major junctions.

PMU Fund	-	50,000
Contractor Cost	-	907,500
Total	**-**	**INR 957,500**

Table 22 Cost Estimates to Implement the EMP – Bulk Water System

No	Particulars	Stages	Unit	Number	Rate	Cost (INR)	Costs Covered By

No	Particulars	Stages	Unit	Number	Rate	Cost (INR)	Costs Covered By
A.	**Monitoring Measures**						
1	Air quality monitoring-	Construction	Per Sample	21	10,000	210,000	Civil works contract
2	Noise levels monitoring-	Construction	Per sample	21	2,500	52,500	Civil works contract
	Sub Total					**262,500**	
B	**Capacity Building**						
1	Introduction and sensitization to environment issues	Pre-construction	lump sum			5,000	PMU
2	EMP implementation	Construction	lump sum			15,000	PMU
3	Plans and Protocols	Construction	lump sum			15,000	PMU
			lump sum			15,000	Civil works contract
4	Experiences and best practices sharing	Construction / Post-Construction	lump sum			15,000	PMU
5	Contractors Orientation to Workers on EMP implementation	Prior to dispatch to worksite	Lump sum			5,000	Civil works contract
	Subtotal (B)					**70,000**	
C	**Civil Works**						
1	Construction of shelters for workers.	Construction	Lump sum			2,00,000	Civil works contract
2	Providing Water Supply Facility for the workers	Construction	Lump sum			1,00,000	Civil works contract
3	Providing Sanitation Facility for the workers	Construction	Lump sum			1,00,000	Civil works contract
4	Barricades at the worksite (MS Sheet of 20 gauge of size 5 x 3 meters, having vertical support by MS flat (65 x 65 x 6 mm) along the sides and at 1.5 m and 3.5m, horizontal support by MS flat (65 x 65 x 6 mm) along the sides and at the center, supported by 50mm MS hollow pies of 4 meter height at the ends and at the center.	Construction	Per unit	45	15,000	6,75,000	Civil works contract
5	Retro reflectorized	Construction	Per unit	10	3000	30,000	Civil

No	Particulars	Stages	Unit	Number	Rate	Cost (INR)	Costs Covered By
	Traffic Signs as per IRC:67, M 15 grade, 80 x 60 mm rectangular; fixed over Aluminum sheeting supported on MS angle iron.						works contract
	Sub Total (C)					**1,205,000**	
	Total (A+B+C)					**1,537,500**	
II	**Operation**						
A	**Monitoring measures**						
1	Supplied water quality consumer end	Operation	LS	As required in all zones (once in a month)	-	Part of lab operating costs	

The air and noise quality monitoring will be done near to sensitive receptors like hospitals, educational institutions and major junctions.

PMU Fund	-	50,000
Contractor Cost	-	1,487,500
Total	**-**	**INR 1,537,500**

148. The total cost to implement EMP for water supply system – for both bulk water and distribution system is INR 24,95,000

VII. FINDINGS AND RECOMMENDATIONS

A. Recommendation

149. The process described in this document has assessed the environmental impacts of all elements of the Harihar Water Supply System project. All potential impacts were identified in relation to pre-construction, construction, and operation phases.

150. Planning principles and design considerations have been reviewed and incorporated into the site planning process whenever possible; thus, environmental impacts as being due to the project design or location were not significant. However, the social impacts (access disruptions) due to construction activities are unavoidable, as the residential and commercial establishments exist along the project corridor.

151. Tungabhadra River is the source of water supply scheme to Harihara town. Normally the Tunga-Bhadra river flows all 365 days and hence it is perennial river. During February to May end the flow will be minimum. The raw water for the scheme is drawn in the downstream side of the Bhadra dam on river Tungabhadra at a distance of 80Km from the dam. During lean period 2.00TMC of water is allowed to flow in the river for drinking purposes from January to April end ie. Commencement of rain season. River flow analysis indicate that the water demand is miniscule of the water availability, and even during the lean flow season, the demand is just over 1% of the river flow.Hence sufficient water is available throughout the year for drinking purpose, and there are no significant impacts envisaged on the downstream.

152. In the 300 m zone from Harihareshwara temple (ASI protected area) it is proposed to laying of about 268.3 m of 63 mm minimum diameter pipe along the road. No other components are proposed in these zones. Presently, the temple is protected under the Ancient Monuments and Archaeological Sites and Remains Act, 1958 and is conserved and maintained by the ***Archaeological Survey of India***. NOC needs to be obtained from ASI for laying of the pipe line at that area.

153. During the construction phase, impacts mainly arise from the need to dispose waste soil; and from the disturbance of residents, businesses, traffic and important buildings by the construction work. These are common impacts of construction in urban areas, and there are well developed methods for their mitigation. Since the pipe line works are conducted along the roads, there is potential to create disturbance. To minimize this, the contractor should develop a Method Statement, which should be approved by the PIU prior to start of work, and should conduct the work strictly in line with the Method Statement.

154. There were limited opportunities to provide environmental enhancements, but certain measures were included. For example it is proposed that the project will employ in the workforce people who live in the vicinity of construction sites to provide them with a short-term economic gain; and ensure that people employed in the longer term to maintain and operate the new facilities are residents of nearby communities.

155. Anticipated impacts during operation and maintenance will be related to detection and repair of leaks and pipe bursts, failure of WTP. These are, however, likely to be minimal, as proper design and selection of good quality pipe material shall mean that leaks are minimal. Leak repair work will be similar to the pipe-laying work.

156. Environmental audit has been conducted for existing WTP which considered for renovation.

157. Mitigation will be assured by a program of environmental monitoring conducted during construction and operation to ensure that all measures are implemented, and to determine whether the environment is protected as intended. This will include observations on- and off-site, document checks, and interviews with workers and beneficiaries, and any requirements for remedial action will be reported to the PIU/PMU. There will also be longer-term surveys to monitor the expected improvements in the quality of domestic water and the health of the population.

158. The public participation processes undertaken during project design ensured stakeholders are engaged during the preparation of the IEE. The planned information disclosure measures and process for carrying out consultation with affected people will facilitate their participation during project implementation.

159. The project's grievance redressal mechanism will provide the citizens with a platform for redressal of their grievances, and describes the informal and formal channels, time frame, and mechanisms for resolving complaints about environmental performance.

160. The EMP will assist the PMU, PMDCSC, and contractors in mitigating the environmental impacts, and guide them in the environmentally sound execution of the proposed project. The EMP will also ensure efficient lines of communication between the implementing agency, project management unit, and contractors.

161. A copy of the EMP shall be kept on-site during the construction period at all times. The EMP shall be made binding on all contractors operating on the site, and will be included in the contractual clauses. Non-compliance with, or any deviation from, the conditions set out in this document shall constitute a failure in compliance.

162. The citizens of the Harihar Town will be the will be the major beneficiaries of the improved water supply, as they will be provided with a constant supply of better quality water, piped into their homes. In addition to improved environmental conditions, the project will improve the over-all health condition of the town as diseases of poor sanitation (such as diarrhea and dysentery) will be reduced

VIII. CONCLUSION

163. The Harihar 24x7 Water Supply System subproject is unlikely to cause significant adverse impacts. The potential impacts that are associated with design, construction, and operation can be mitigated to standard levels without difficulty through proper engineering design and the incorporation or application of recommended mitigation measures and procedures.

164. As per design, a small length of distribution pipeline (282 m)will be laid near Harihareshwara temple (ASI protected monument) in the town. Permission from the ASI will be obtained prior to start of construction in this section.

165. Based on the findings of the IEE, the classification of the Project as Category “B” is confirmed, and no further special study or detailed EIA needs to be undertaken to comply with ADB SPS (2009) or GoI EIA Notification (2006).

Appendix 1: National Ambient Air Quality Standards

Sl No:	Pollutants	Time weighted average	Concentration in ambient air		Method of measurement
			Industrial, Residential, Rural & Other Areas	Ecologically Sensitive Areas	
1	Sulphur Dioxide (SO_2) $\mu g/m^3$	Annual 24 hours	50 80	20 80	Improved West and Geake-Ultraviolet fluorescence
2	Nitrogen Dioxide (NO_2) $\mu g/m^3$	Annual 24 hours	40 80	30 80	Modified Jacob &Hochheiser (Na-Arsenite) Chemiluminescence
3	Particulate Matter (Size less than 10 µm) or PM_{10} $\mu g/m^3$	Annual 24 hours	60 100	60 100	Gravimetric -TOEM -Beta attenuation
4	Particulate Matter (Size less than 2.5 µm) or $PM_{2.5}$ $\mu g/m^3$	Annual 24 hours	40 60	40 60	Gravimetric -TOEM -Beta attenuation
5	Carbon Monoxide (CO) mg/m^3	8 hours 1 hours	02 04	02 04	Non Dispersive Infra Red (NDIR) Spectroscopy

Appendix 2: Applicable Noise Standards

Area code	Category of area/zone	Limit in dB (A)	
		Day time	Night time
1	Industrial area	75	70
2	Commercial area	65	55
3	Residential area	55	45
4	Silence zone	50	40

Appendix 3: Salient Features of Major Labor Laws Including Amendments Issued From Time To Time Applicable To Establishments Engaged In Construction Of Civil Works

(i) Workmen Compensation Act, 1923 - The Act provides for compensation in case of injury by accident arising out of and during the course of employment.

(ii) Payment of Gratuity Act, 1972 - Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years' service or more or on death at the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees.

(iii) Employees' PF and Miscellaneous Provisions Act, 1952 - The Act provides for monthly contributions by the employer plus workers @10 % or 8.33 %. The benefits payable under the Act are: (a) Pension or family pension on retirement or death as the case may be; (b) deposit linked insurance on the death in harness of the worker; (c) payment of PF accumulation on retirement/death etc.

(iv) Maternity Benefit Act, 1951 - The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc.

(v) Contract Labour (Regulation and Abolition) Act, 1970 - The Act provides for certain welfare measures to be provided by the Contractor to contract labor and in case the Contractor fails to provide, the same are required to be provided by the Principal Employer by Law. The principal employer is required to take Certificate of Registration and the Contractor is required to take a License from the designated Officer. The Act is applicable to the establishments or Contractor of principal employer if they employ 20 or more contract labor.

(vi) Minimum Wages Act, 1948 - The employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employment.

(vii) Payment of Wages Act, 1936 - It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers.

(viii) Equal Remuneration Act, 1979 - The Act provides for payment of equal wages for work of equal nature to Male and Female workers and not for making discrimination against Female employees in the matters of transfers, training and promotions etc.

(ix) Payment of Bonus Act, 1965 - The Act is applicable to all establishments employing 20 or more workmen. The Act provides for payments of annual bonus subject to a minimum of 8.33 % of wages and maximum of 20 % of wages to employees drawing Rs. 3,500/- per month or less. The bonus to be paid to employees getting Rs. 2,500/- per month or above up to Rs.3,500/- per month shall be worked out by taking wages as Rs.2,500/- per month only. The Act does not apply to certain establishments. The newly set up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of the Act.

(x) Industrial Disputes Act, 1947 - The Act lays down the machinery and procedure for resolution of industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.

(xi) Industrial Employment (Standing Orders) Act, 1946 - It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to 50). The Act provides for laying down rules governing the conditions of employment by the employer on matters provided in the Act and get the same certified by the designated Authority.

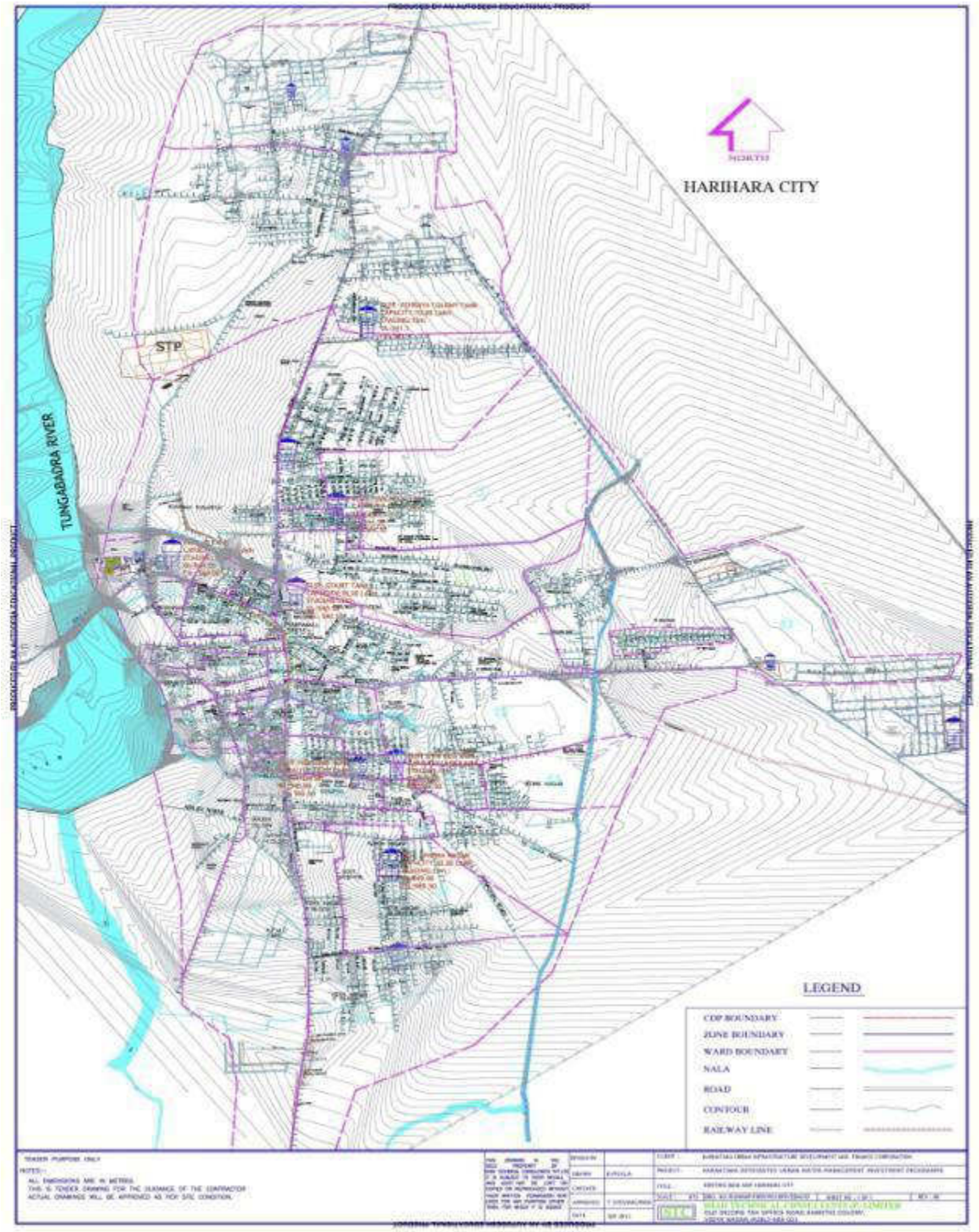
(xii) Trade Unions Act, 1926 - The Act lays down the procedure for registration of trade unions of workmen and employees. The trade unions registered under the Act have been given certain immunities from civil and criminal liabilities.

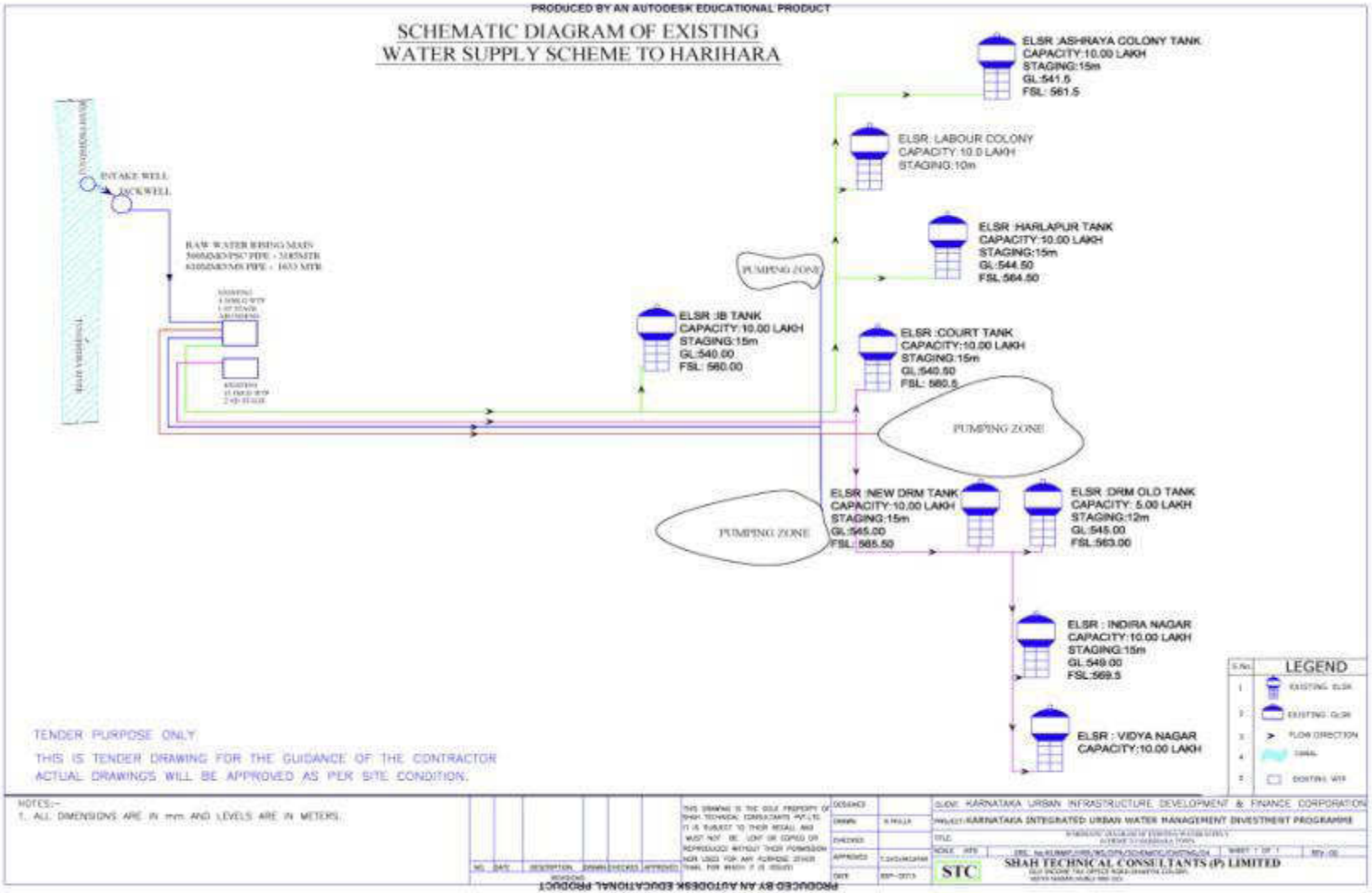
(xiii) Child Labor (Prohibition and Regulation) Act, 1986 - The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of child labor is prohibited in Building and Construction Industry.

(xiv) Inter-State Migrant Workmen's (Regulation of Employment and Conditions of Service) Act, 1979 - The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The inter-state migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, traveling expenses from home up to the establishment and back, etc

(xv) The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 and the Cess Act of 1996 - All the establishments who carry on any building or other construction work and employ 10 or more workers are covered under this Act. All such establishments are required to pay Cess at rate not exceeding 2% of the cost of construction as may be notified by the Government. The employer of the establishment is required to provide safety measures at the building or construction work and other welfare measures, such as canteens, first-aid facilities, ambulance, housing accommodation for workers near the workplace etc. The employer to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the Government

Appendix 4: Existing water supply – base map

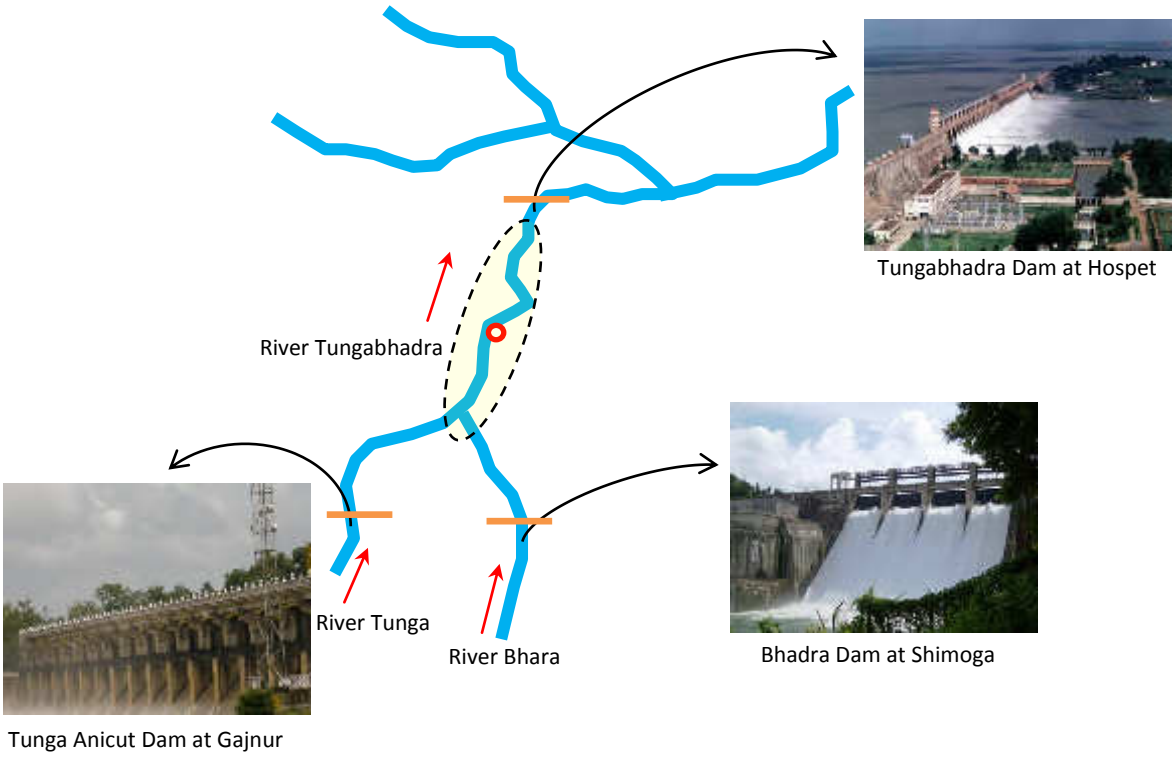




APPENDIX 5: SOURCE SUSTAINABILITY OF RIVER TUNGABHADRA

1.1 General Information

The Tungabhadra (TB) River is a composite river of two east flowing rivers namely – The Tunga andThe Bhardra. The Tunga rises at Gangamula in the Gangrikal hill ranges north of Kudremukh. The Bhadra rises near Samse in the Aroli Hill range of Kudremukh. The Tunga River initially flows northeast, turns north and subsequently takes an easterly course. The Bhadra River also initially flows easterly,changing course to north and joins the Tunga at KUDLI in Shimoga district. The Tungabhadra Riverflows up to 298 km and is formed by the confluences of the Tunga and Bhadra Rivers at Kudli of Shimoga district then flows through Karnataka and some parts of Andhra Pradesh and joins the Krishna River. The catchment and command area comprises 27 taluks of 7 districts and covers an area of48,000 Sq. km.



Map of study area, Tungabhadra River

Details of various administrative units in TB basin

Bhadra Catchment/Command	TungaCommand	Tungabhadracommand	ClosetoTBDam
Chikamagalore	Koppa	Honnali	Bellary
N.R.Pura	Sringeri	Channgiri	Hospet
Tarikere	Theerthahalli	Hanagal	Sirugoppa
Bhadravathi	Shimoga	Haveri	Dadurga
		Harikerur	Gangavathi
		Ranebennur	Koppal
		Shiggoan	Raichur
		Davangere	Sindhunur
		Harihar	
		H.B.Halli	
		Harappanahalli	

Source: Water Resource department

1.2 Ecology of the River

As per the study conducted by the Institute for Social and Economic Change (ISEC), the entire river stretch can be divided into three distinct regions, viz:

a) Region of Surplus

This area comprises the area from the point of origin to the Tunga Anicut and Badhra Reservoir Project. Somavahini River, draining the area inside the crater passes through a narrow gap in the mountain wall and joins Bhadra River at Hebbe. Bhadra River is dammed up at BR project area forming a vast (about 200 sq. km) reservoir whose backwaters extend nearly 13 km backwards. In addition to these major water sources, there are numerous streams and tanks scattered all over the area, some of them being perennial sources.

b) Controlled Flow Region

This is the area from BRP till TBR at Hospet. During the monsoon period, this region has natural flowswhile in lean periods the flows are governed by agreement with the TB board. Intense cultivation is practiced in this region. Return flows from urban settlements and Industrial units contribute to theriverine flow, but these Return flows are of poor quality, for instance, from Bhadravathi (firsturban settlement after Bhadra reservoir) to Kudli, confluence.

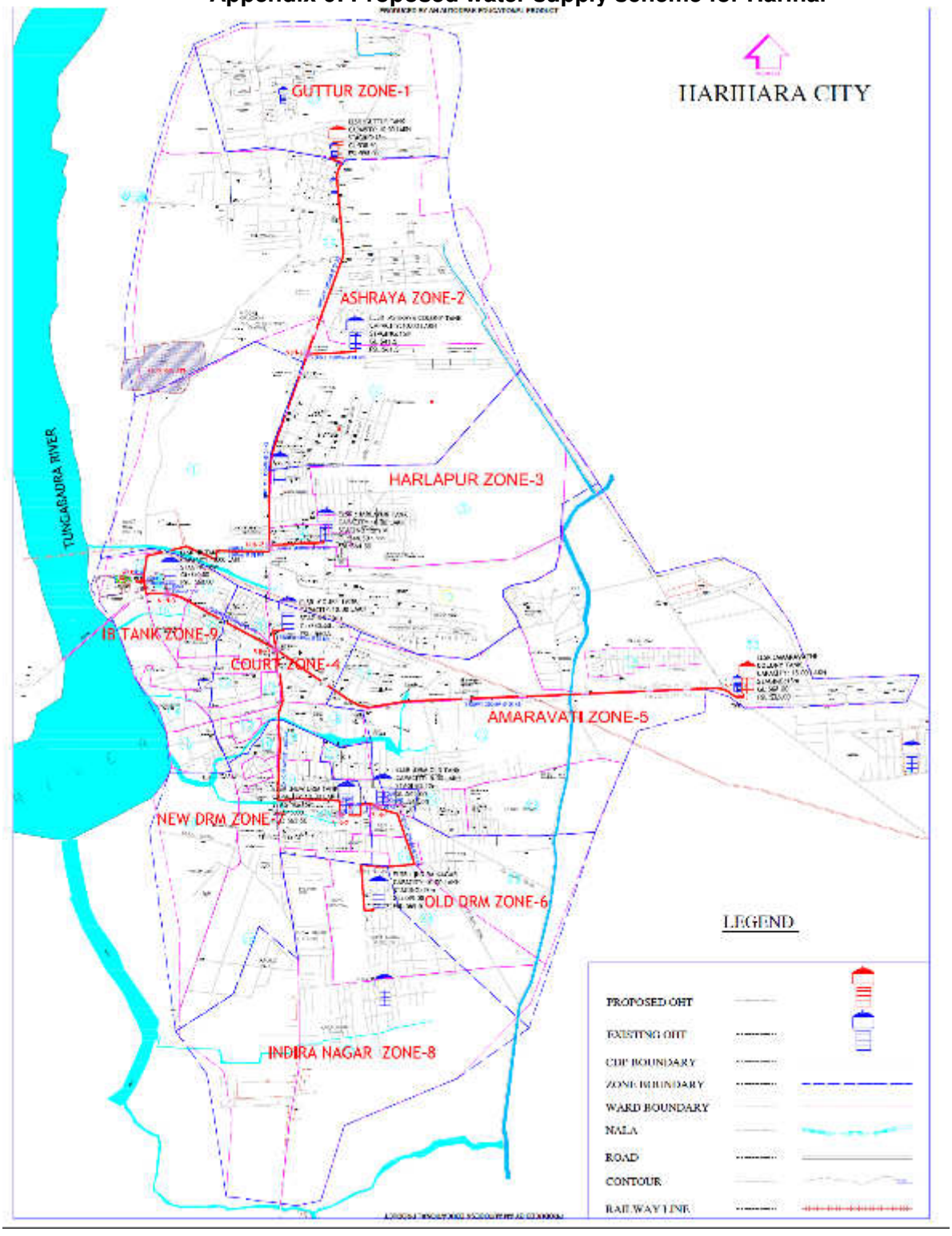
c) Region of Deficit

This region is marked from Tungabhadra reservoir till the confluence with River Krishna. Downstream TB Dam there is 12 anicuts on the left and right banks of the river to facilitate water extraction for irrigation. The water flow regime downstream has undergone extreme changes and for some years it has had insignificant flow.

1.3 Flow status in the River Basin

From the Table below it can be ascertained that there is sufficient flow within the Tungabhadra River throughout the year and hence Tungabhadra River is sustainable source for Harihar Water supply scheme.

Appendix 6: Proposed water supply scheme for Harihar



Appendix 7: Rapid Environmental Assessment (REA) Checklist
Harihar Water Supply Subproject

Instructions:

(i) The project team completes this checklist to support the environmental classification of a project. It is to be attached to the environmental categorization form and submitted to the Environment and Safeguards Division (RSES), for endorsement by Director, RSES and for approval by the Chief Compliance Officer.

(ii) This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB's (a) checklists on involuntary resettlement and Indigenous Peoples; (b) poverty reduction handbook; (c) staff guide to consultation and participation; and (d) gender checklists.

(iii) Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts. Use the "remarks" section to discuss any anticipated mitigation measures.

Country/Project Title: India / **Karnataka Integrated Urban Water Management Investment Programme (KIUWMIP)**

Sector Division: **Urban Development**

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting Is the project area…			
▪ Densely populated?	√		Subproject activities extend to the entire City including the densely populated areas. There are no major negative impacts envisaged, because water supply will be located in unused government lands alongside the existing roads and can be constructed without causing disturbance to, houses, and commercial establishments. In narrow streets, disruption to road users is likely, and measure like best activity scheduling, alternative routes, prior information to road users, houses and shops will minimize the impact to acceptable levels.
▪ Heavy with development activities?	√		Harihar is a developing town; urban expansion is considerable
▪ Adjacent to or within any environmentally sensitive areas?		√	None
• Cultural heritage site		√	Hariherswara Temple in the town is a protected monument under Archaeological Survey of India. None of subproject components will disturb/damage the monument; except water lines rehabilitation, none of the components are located close to this. Permission from ASI will be obtained if these lines are located within 300 m of monument.

SCREENING QUESTIONS	Yes	No	REMARKS
• Protected Area		√	NA
• Wetland		√	NA
• Mangrove		√	NA
• Estuarine		√	NA
• Buffer zone of protected area		√	NA
• Special area for protecting biodiversity		√	NA
• Bay		√	NA
B. Potential Environmental Impacts Will the Project cause…			
▪ Pollution of raw water supply from upstream wastewater discharge from communities, industries, agriculture, and soil erosion runoff?		√	Subproject will utilize existing intake. The source sustainability and raw water quality issues are under the scope of work. Through IWRM's Water Resources Component, adequate quantity of water of requisite quality will be made available to Harihar
▪ Impairment of historical/cultural monuments/areas and loss/damage to these sites?		√	There is no historical / cultural monument in the project location.
▪ Hazard of land subsidence caused by excessive ground water pumping?		√	Subproject utilizes surface water
▪ Social conflicts arising from displacement of communities ?		√	The subproject does not involve land acquisition or displacement
▪ Conflicts in abstraction of raw water for water supply with other beneficial water uses for surface and ground waters?		√	No. Overall water resource balance in Tungabhadra River Basin and measures for assurance of water availability within the Tungbhadra River for public water supply and other uses will be proposed within the project, Government policy is for priority to be given to public water supply and it is therefore assumed that adequate water resources will be available without effecting current downstream uses.
• Unsatisfactory raw water supply (e.g. excessive pathogens or mineral constituents)?		√	Raw water quality is satisfactory; water will be treated to meet drinking water standards before supply
▪ Delivery of unsafe water to distribution system?		√	Raw water quality is satisfactory; water will be treated to meeting drinking water standards before supply
▪ Inadequate protection of intake works or wells, leading to pollution of water supply?		√	Existing water intake is located ideally; there are no water pollution sources in the vicinity
▪ Over pumping of ground water, leading to salinization and ground subsidence?		√	No ground water is proposed to be abstracted.

SCREENING QUESTIONS	Yes	No	REMARKS
▪ Excessive algal growth in storage reservoir?		√	Regular cleaning of storage reservoir shall be ensured to avoid algal growth in the reservoir.
▪ Inadequate disposal of sludge from water treatment plants?		√	Disposal will be as per sludge management plan
▪ Inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances and protect facilities?		√	Buffer zones proposed for WTP
▪ Impairments associated with transmission lines and access roads?		√	Subproject do not include transmission mains and/or access roads
▪ Health hazards arising from inadequate design of facilities for receiving, storing, and handling of chlorine and other hazardous chemicals.		√	Adequate safety measures are included in the subproject for chlorine storage, handling and application
▪ Health and safety hazards to workers from the management of chlorine used for disinfection and other contaminants?		√	Adequate safety measures including training for workers are included in the subproject
▪ Dislocation or involuntary resettlement of people		√	Subproject does not involve land acquisition or displacement. However, there may be temporary disturbance to business and squatters/vendors during construction. Appropriate measures will be suggested to mitigate the impact.
▪ Social conflicts between construction workers from other areas and community workers?		√	Not anticipated; local workers shall be encouraged for engaging for different construction activities.
▪ Noise and dust from construction activities?	√		Short term impact on air quality due to dust generation during construction activities is anticipated. Appropriate dust suppression measures will be taken to minimize dust generation due to construction activities at site. No significant increase in noise level is anticipated due to construction. All equipment and machineries will conform to the Statutory norms.
▪ Increased road traffic due to interference of construction activities?	√		Proper traffic management and planning will be ensured during construction.
▪ Continuing soil erosion/silt runoff from construction operations?		√	No excavation/earth work activities will be conducted during rainy season. Necessary measures will be implemented in case of work during rains, to arrest erosion and silt runoff from construction sites.
▪ Delivery of unsafe water due to poor O&M treatment processes (especially mud accumulations in filters) and inadequate chlorination due to lack of adequate monitoring of chlorine residuals in distribution systems?		√	Trained and skilled staff will be deployed for O&M. Also, quality of treated water will be regularly monitored through water sample testing to ensure delivery of safe water to consumers.

SCREENING QUESTIONS	Yes	No	REMARKS
▪ Delivery of water to distribution system, which is corrosive due to inadequate attention to feeding of corrective chemicals?		√	HDPE PE 100 PN6 pipes will be used for distribution system and are non corrosive in nature.
▪ Accidental leakage of chlorine gas?		√	Necessary measures included
▪ Excessive abstraction of water affecting downstream water users?		√	No. Overall water resource balance in Tungabhadra River Basin and measures for assurance of water availability within the Tungbhadra River for public water supply and other uses is proposed. Government policy is for priority to be given to public water supply and it is therefore assumed that adequate water resources will be available without effecting current downstream uses.
▪ Competing uses of water?		√	No; same as above
▪ Increased sewage flow due to increased water supply	√		Sewerage system is presently under construction inHarihar; the areas uncovered by this system will be covered with this subproject; adequate capacity of WWTP is already under construction
• Increased volume of sullage (wastewater from cooking and washing) and sludge from wastewater treatment plant	√		Sewerage system is presently under construction in Harihar; the areas uncovered by this system will be covered with this subproject; adequate capacity of WWTP is already under construction
• Large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		√	No such impact anticipated as the import of workforce will be limited to skilled workers; local communities in the vicinity of the project would be employed as much as possible.
• Risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during operation and construction?		√	Not applicable. Construction will not involve use of explosives and chemicals.

SCREENING QUESTIONS	Yes	No	REMARKS
• Community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		√	Operational area will be clearly demarcated and access will be controlled. Only worker and project concerned members will be allowed to visit the operational sites. During operation no such issues anticipated.

Climate Change and Disaster Risk Questions The following questions are not for environmental categorization. They are included in this checklist to help identify potential climate and disaster risks.	**Yes**	**No**	**Remarks**
Is the Project area subject to hazards such as earthquakes, floods, landslides, tropical cyclone winds, storm surges, tsunami or volcanic eruptions and climate changes (see Appendix I)?		X	There is a low risk of natural hazards in the project areas. All towns are land locked and expansively cultivated. The general topography of the towns is plains with isolated hills fringing some of the towns. The towns are located in an area of low seismological intensity. The towns are generally dry throughout the year except during the monsoon from June to September. Davanegere and Rannebenur receive the lowest rainfall (annual average rainfall between 300 – 600mm). Whereas Byadgi and Harihar receive higher rainfall (annual average rainfall between 700 – 1000 mm).
Could changes in temperature, precipitation, or extreme events patterns over the Project lifespan affect technical or financial sustainability (e.g., changes in rainfall patterns disrupt reliability of water supply; sea level rise creates salinity intrusion into proposed water supply source)?	X		Low precipitation and increased temperatures could result in disruption to water supply and security. The project proposes improved water security through the rehabilitation and restoration of river bank reservoirs in selected vulnerable towns.

Are there any demographic or socio-economic aspects of the Project area that are already vulnerable (e.g. high incidence of marginalized populations, rural-urban migrants, illegal settlements, ethnic minorities, women or children)?		X	The project will improve the socio-economic conditions of both the poor and non-poor populations of the towns.
Could the Project potentially increase the climate or disaster vulnerability of the surrounding area (e.g., by using water from a vulnerable source that is relied upon by many user groups, or encouraging settlement in earthquake zones)?		X	Not applicable.

* Hazards are potentially damaging physical events.

Appendix 8: Environmental Audit of the Existing Water Treatment Plant in Harihar

I. Introduction

The objectives ofthisenvironmentalauditare to (i)assessthecomplianceofthe existing watertreatmentplant(WTP)toberehabilitated/augmentedduringtheimplementationof KISWRMIPwithenvironmentallegislation;(ii)improveenvironmentalperformancethrough monitoringtheeffectivenessofthemanagementsystem;and(iii)increasetheHariharCMC"s knowledgeofitselfanditsactivities,thusincreasingitsabilitytocontinuallyimproveand minimize futurepotentialliabilities.

Theenvironmentalauditwascarriedoutfor the existing WTP.Themethodologyadoptedforthisauditwasto initiallyreviewexistingplansandtechnicalinformationandlistvariousactivitiesbeingcarried outintheWTP.Duediligencewascarriedouttophysicallycheckwhetherenvironmental performance,healthandsafety,etc.wereincompliancewithnationalandstateprescribed standardsandguidelines.TeamvisitedtheWTPwasandobservedoperations.Meetingsand discussionswithkeypersonnelwereheldinthevariousstagesoftheaudit.Various documentationsregarding theoperationalaspectswerealso checked.

II. Description of Existing Water Treatment Plant at Harihar

Location	HariharTown Latitude:14°31"N Longitude:75°48"E
Startofoperation(year)	2003
Ownedby	CMCHarihar
Contactpersonanddesignation	Mr. MalateshCM JuniorEngineer +919845140606
Capacity	13millionlitersperday(MLD)
Watersupplysource	TungabhadraRiver(intakeatKawaletty5kmfromupstreamofHarihar
Watertreatmentprocess	Technology: The treatment process isconventional,andhasfollowingunits:CascadeAerator,RawWaterChannelwithParshallFlume orcontinuousflowmeasurement,Coagulant&Flocculentchemicalmakeuptanks,FlashMixingtank,Clarifierincludingaflocculationzoneinthe centre,Foursandfilters,Chlorinegasstoragecylinders anddosingunit,backwashwater storage

	for filters Materials: All civil structures are made of reinforced cement concrete, and mechanical units like the clariflocculator bridge, etc. are of mild steel. Process: the water from raw water pumping main enters into the inlet, and the first unit is cascade aerator. After aeration water passes through parshall flume, where flow is measured. Coagulant and flocculent chemicals (alum and polymer) are added to the water, and mixed in the flash mixer tank, and then flows into clariflocculator. Clarified water flows into sand filters (4 no,s) for filtration and the filtered water is disinfected with chlorine, and allowed to flow into clear water tank from where water pumped into service reservoirs for distribution
Backwash water and sludge management	-filter backwash water is let into open drains as there is no recycling of backwash into inlet - the settled sludge from the bottom of the clarifier tank is periodically flushed into the drains. -This practice of discharge of backwash and sludge directly into the drains, wastes water, pollutes and silts receiving water bodies. -the untreated backwash and sludge flushing ultimately reaches disposed into River Tungabhadra which is flowing near the site.
Chlorination system	Chlorine dosage system is not proper; there are no safety precautions in place. Chlorine cylinders (900 kg tonners) are placed haphazardly at the facility; the dosage system is not properly functional; no safety systems like leak detection or emergency alarm or lime slurry pit available in the facility. Operators are not aware of safety measures or actions to be performed during any emergency.

III. CompliancewithApplicableNationalandState Laws,Rules,and Regulations

Law,Rules,and Regulations	**DescriptionandRequirement**	**WTPatHarihar**
		Y=compliant(ifapplicable,specifyexpirationdateofpermit/clearance)N=non-compliant[1] *N/A=notapplicable(state*
EIANotification	TheEIANotificationof2006and2009(replacingtheEIANotificationof1994) statesthatenvironmentalclearanceisrequiredforcertaindefinedactivities/projects.	N/A EnvironmentalclearanceisnotrequiredasWTPsarenotlistedintheEIANotification's"ScheduleofProjectsRequiringPriorEnvironmentalClearance"

Manufacture,Storage,andImportofHazardousChemicalRules,1989	Storageofchlorine(thresholdquantitygreaterthan10tonsbutlessthan25tons)inWTPswillrequireclearancefromKarnatakaPollutionControlBoard(WBPCB).	N/A Normally1or2tonners(ofcapacity900kg)arestoredatthesite
Water(PreventionandControlofPollution)Actof1974,Rulesof1975,andamendments	ConsenttooperatefromKSPCB	N/A InKarnataka,WTPsdonotrequireconsentfromKSPCB
Air(PreventionandControlofPollution)Actof1981,Rulesof1982andamendments.	ConsenttooperatefromKSPCB	nosourceofairemissions(e.g.,standbypowergenerators)
Environment(Protection)Act,1986andCPCBEnvironmentalStandards	Emissionsanddischargesfromthefacilitiestobecreated,refurbished,orauggmentedshallcomplywiththenotifiedstandards.	
	a.Airemissions	nomonitoringconducted
	b.Effluent	nomonitoringconducted
CPHEEODrinkingWaterQualityStandards	Applicablestandardsfordrinkingwateratttheconsumerend	N– NoregularmonitoringIsconducted;Althoughperiodmonitoringissaidtobeconductedwiththehelpofoutsidelaboratoriesnoresultsarereadilyavailable ThereisnolaboratoryattheWTP
NoisePollution(RegulationandControl)Rules,2002 amendedupto2010	Applicableambientnoisestandardswithrespecttonoisefordifferentareas/zones	nomonitoringconducted
NationalInstituteofOccupationalSafetyandHealth(NIOSH)PublicationNo.98-126	Applicablenoiseexposurelevelsanddurationthatnoworkerexposureshallequalorexceed	nomonitoringconducted
Forest(Conservation)Act,1980andForestConservationRules,2003asamended	AsperRule6,everyuseragency,whowantstouseanyforestlandfornon-forestpurposesshallseekapprovalofthecentralgovernment.	N/A WTPsarenotlocatedinnotifiedforestlands.

AncientMonumentsand ArchaeologicalSites andRemainsRulesof 1959	Nodevelopmentactivityispermittedint he“protectedarea,”andall developmentactivitieslikelytodamag etheprotectedpropertyare notpermittedinthe“controlledarea” withoutpriorpermissionoftheArchaeol ogicalSurveyofIndia(ASI).Protectedp ropertyincludesthesite, remains,andmonumentsprotectedby ASIortheStateDepartmentofArchaeol ogy.	N/A
TheChildLabor(Prohi bitionandRegulation) Act,1986	Nochildbelow14yearsofagewillbeem ployedorpermittedtowork in anyoftheoccupationssetforthin theAct‟sPartAoftheScheduleorin anyworkshopwhereinanyofthe processessetforthinPartBoftheSched ulearepresent.	Nochildrenbetweentheagesof14and18 willengageinhazardous work.

IV. InstitutionalArrangement

Parameter	Harihar WTP
Operations	7daysaweek 24hoursaday 3workingshiftsperday
Managerpershift	1juniorengineer
Watersupplyengineeron-site	
Estimatednumberoftechnicalemployeeson-site pershift	2-3staff
Estimatednumberoflaborerson-sitepershift	-
Estimated number of employees in charge of environmentalmanagementandmonitoring	-
Frequencyofwaterqualitymonitoring(rawwater)	-
Frequency of water quality monitoring (treated waterfordistribution)	-
Frequency of water quality monitoring (sludge supernatant)	notconducted
Frequency of water quality monitoring (WTPeffluents)	notconducted
In-house laboratory for water quality analyses (Yes/None).Ifnone,providenameofthird-partylaboratory.	Noinhouselaboratory

V. CorrectiveAction Plan

	Gaps	Corrective Action	Time Frame	Responsible Person	Indicator for CMC/ KUIDFC	Indicator for ADB	Budget
A. Compliance With National, State,and Local Laws andRules							

1	Monitoring of rawand treatedwater asper CPHEEO Drinking Water Quality Standards	Conduct regular monitoring of water (frequency, parameters and methodology asper CPHEEO Manual requirements for drinking water supply.	O&M phase	Harihar CMC (during O&M phase)	Provision of laboratoryas part ofthe subproject and budget Inclusion in the Environ-mental Monitoring Program	ADB to approve IEE with EMP prior to bidding	Includedin CMC cost (during O&M phase)
2	Monitoring of air emissions and effluent not being conducted	EMP to includeair emissions and effluent monitoring	Construction phase O&Mphase	Contractors (during construction phase) Harihar CMC (during O&M phase)	EMP implemen-tation to include monitoring of air emissions and effluent.	ADB to approve IEE with EMP prior to bidding	Includedin contractors cost(during construc-tionphase) Includedin CMC cost (during O&M phase)
3	Monitoring of ambient noise levels not being conducted	EMP to includenoise level monitoring	Construction phase O&Mphase	Contractors (during construction phase) Harihar CMC (during O&M phase)	EMP implemen-tationto include monitoring of ambientnoise levels.	ADB to approve IEE with EMP prior to bidding	Includedin contractors cost(during construc-tionphase) Includedin CMC cost (during O&M phase)
4	Monitoring of workers"nois e exposure levelsand duration not being conducted	EMP to include worker noise exposure level and duration monitoring	Construction phase O&Mphase	Contractors (during construction phase) CMC (during O&Mphase)	EMP implemen-tation to include monitoring of workersnoise exposure levelsand duration.	ADB to approve IEE with EMP prior to bidding	Includedin contractors cost(during construc-tionphase) Includedin CMC cost (during O&M phase)
B. Institutional Arrangement							
1	Unidentified employees responsible for environ-mental management and monitoring	PMU to designate environmental coordinatorsfor EMP implementation	During program implement-tation	CMC	PMU Environ-mental Coordinators to work closelywith WTPstaff. IEE with EMP to specify TOR of PMU Environmental Coordinators	Institutional arrangement for EMP implementa-tionclearly defined in the IEE. ADB to approve IEE with EMP prior to bidding.	Includedin CMC cost

2	No information on capacity ofWTP engineersto conduct environ-mental quality monitoring	Buildcapacity of CMC, PMU Environ-mental Coordinators, andWTP operators	During program implement-tation	PIU/ consultant Team	Numberof trainings conducted	Semi-annual report to include document-tation of trainings conducted	Includedin PMDCSCc ost
C. Others							
1	No documenta-tionof complaints/ grievances frompeople regarding noise/odor	Public consultation to include stakeholders from communities adjacentto theWTP	During program implement-tation	PMDCSC, Contractors, and CMC	GRM document-tation and reporting all throughout the program implement-tation	Semi-annual report to include summaryof complaints/ grievances, remedial actionstaken, and,if necessary, additional environmental mitigation measures	Includedin CMC cost
2	Physical and chemical qualityof supernatant not being determined prior to discharge.	EMP to include supernatant monitoring	Decommis-sionphase and defects liability period O&Mphase	Contractors (during decommis-sioningand defects liability period) CMC (during O&M)	Resultsto be submitted to PMU	Semi-annual report to ADB (during decommis-sioningand defectsliability period)	Includedin contractors cost(during decommis-sioningand defects liability period) Includedin CMC cost (during O&M phase)
3	Sludge qualitynot being determined prior to reuseasraw materialin manufactu-ring bricks	EMP to include sludge quality monitoring	Decommis-sionphase and defects liability period O&Mphase	Contractors (during decommis-sioningand defects liability period) CMC (during O&M)	Resultsto be submitted to PMU	Semi-annual report to ADB (during decommis-sioningand defectsliability period)	Includedin contractors cost(during decommis-sioningand defects liability period) Includedin CMC cost (during O&M phase)

Appendix 9: Emergency Response Plan Template –Water supply work

Section1

SystemInformation

Keepthisbasicinformationeasilyaccessibletoauthorizedstaffforemergencyresponders,repairpeople,and thenewsmedia.

Systeminformation

SystemNameandAddress	HariharaCitywater supply	
DirectionstotheSystem		
BasicDescriptionandLocationofSystemFacilities		
PopulationServedand ServiceConnections	_____people	_____connections
SystemOwner	HariharaCMC	
Name,Title,andPhoneNumberofPersonResponsibleforMaintainingandImplementingtheEmergencyPlan		_____Phone _____Mobile

Section2

ChainofCommand–Linesof Authority

The firstresponsestepinanyemergency istoinformthepersonatthetopofthislist,whoisresponsibleformanagingtheemergencyandmakingkeydecisions.

Chainofcommand–linesofauthority

NameandTitle(asrequired)	**ExamplesofResponsibilitiesDuringanEmergency**	**ContactNumbers**
Mr/Ms……. Asst.Executive Engineer (Water supply Manager)	Responsibleforoverallmanagementanddecisionmakingforthewater supplySystems.TheManageristheleadformanagingtheemergency,providinginformationtoregulatoryagencies,thepublicandnewsmedia.Allcommunicationstoexternalpartiesaretobeapprovedbythemanager.	Phone: Mobile:
Mr/Ms……..(JuniorEngineer) Water SystemOperator	Inchargeofoperatingthewater supplysystems,performinginspections,maintenance andprovidingrecommendationstothesystemmanager.	Phone: Mobile:

NameandTitle(asrequired)	ExamplesofResponsibilitiesDuringanEmergency	ContactNumbers
Mr/Ms..... SewerInspector (Water supplySystemOperator)	Inchargeofperforminginspections,maintenanceassessingfacilities,andprovidingrecommendationstothesystemmanager.	Phone: Mobile:
Mr/Ms…….. OfficeAdministrator	Responsibleforadministrativefunctionsintheofficeincludingreceivingphonecallsandkeepingalogofevents.Thispersonwillprovideastandardcarefullypre-scriptedmessagetothosewhocallwithgeneralquestions.Additionalinformationwillbereleasedthroughthewater supplysystemmanager.	Phone: Mobile:
Mr/Ms…… FieldStaff(crew)	Deliversdoorhangers,postsnotices,andsupportswater supplysystemoperator.	Phone: Mobile:

Section3

EventsthatCauseEmergencies

Theeventslistedbelowmaycause water supply systememergencies.Theyarearrangedfromhighesttolowestprobablerisk.

Eventsthatcauseemergencies

TypeofEvent	ProbabilityorRisk(High-Med-Low)	Comments
Burstofwaterline		
Leakofwaterline		

Section4Emergency Notification

Notificationcall-uplists-Usetheseliststonotifyfirstrespondersofanemergency.

EmergencyNotificationList				
Organizationor Department	**Name&Position**	**Telephone**	**NightorCell Phone**	**Email**
Harihara,CMC	..... Water			
Harihara,CMC	..... JuniorEngineer			
Harihara,CMC	..... Asst.Exe.Engineer			
PriorityCustomers				

Organizationor Department	Name&Position	Telephone	NightorMobile Phone	Email
HospitalsorClinic(s)				
PublicorPrivateSchools				

NotificationList				
Organizationor Department	**Name&Position**	**Telephone**	**NightorMobile Phone**	**Email**
Police				
RegulatoryAgency				

Service/RepairNotifications				
Organizationor Department	**Name&Position**	**Telephone**	**NightorMobile Phone**	**Email**
HubliElectricitySupply Company				
Electrician				
Water supply Systemoperator/m				
Plumber				
PumpSupplier				
“CallBeforeYouDig”				
RentalEquipmentSupplier				
PipeSupplier				

Notificationprocedures

Notifywater supplysystemcustomers

WhoisResponsible:	
Procedures:	

Alertlocallawenforcement,orregulatoryofficials,andlocalhealthagencies

WhoisResponsible:	
Procedures:	

Contactserviceandrepaircontractors

WhoisResponsible:	
Procedures:	

Proceduresforissuingahealthadvisory

WhoisResponsible:	
Procedures:	

Otherprocedures,asnecessary

WhoisResponsible:	
Procedures:	

Section5

EffectiveCommunication

Designatedpublicspokesperson

Designateaspokesperson(andalternate)andcontactregulatoryagencyfordeliveringmessagestothenews mediaandthepublic.

Designateaspokespersonandalternates

Spokesperson	Alternate

Section6

TheVulnerabilityAssessment

ThisisanevaluationofeachSeweragesystemcomponenttoidentifyweaknessesordeficienciesthatmaym akethemsusceptibletodamageorfailureduringanemergency.Italsoassessesfacilitiesforsecurityenhanc ementsthatmayguardagainstunauthorizedentry,vandalism,orterrorism.

Facilityvulnerabilityassessmentandimprovementsidentification

SystemComp onent	Description andConditi on	Vulnerability	Improvements or MitigatingActions	SecurityImpro vements
Supply/ distributionSystem				
WTP water Pumping				
Other Considerations				

Section7

ResponseActionsforSpecificEvents

Inanyeventthereareaseriesofgeneralstepstotake:

1. Analyzethetypeandseverityoftheemergency;
2. Takeimmediateactionstosavelives;
3. Takeactiontoreduceinjuriesandsystemdamage;
4. Makerepairsbasedonprioritydemand;and
5. Returnthesystemtonormaloperation.

The followingtables identify the assessment, set forth immediateresponseactions,define whatnotificationsneedtobemade,anddescribeimportantfollow-upactions.

A. Poweroutage

Assessment	
ImmediateActions	
Notifications	
Follow-upActions	

B. Collectionsystemblockageorlinebreak

Assessment	
ImmediateActions	
Notifications	
Follow-upActions	

C. Collectionsystempumpingfacilitiesfailure

Assessment	
ImmediateActions	
Notifications	
Follow-upActions	

D. Vandalismorterroristattack

Assessment	
ImmediateActions	
Notifications	
Follow-upActions	

E. Flood

Assessment	
ImmediateActions	
Notifications	
Follow-upActions	

F. Earthquake

Assessment	
ImmediateActions	
Notifications	
Follow-upActions	

G. Hazardousmaterialsspillintocollectionsystem

Assessment	
ImmediateActions	
Notifications	
Follow-upActions	

H. Electronicequipmentfailure

Assessment	
ImmediateActions	
Notifications	
Follow-upActions	

I. Other

Assessment	
ImmediateActions	
Notifications	
Follow-upActions	

Section8

ReturningtoNormalOperation

Returningtonormaloperations

Action	DescriptionandActions

Section9

Planapproval

Thisplanisofficiallyineffectwhenreviewed,approved,andsignedbythefollowingpeople:

Name/Title	Signature	Date

Section10

CertificateofCompletion

IcertifytotheGovernmentofKarnatakathatthiswater supplysystem ofHariharaCity,hascompletedanEmergencyResponsePlan(ERP).

Icertifythatthisdocumentwaspreparedundermydirectionorsupervision.

SewerageSystems: _____

SystemName: _____

Address:

_____

PrintNameofPersonAuthorizedtoSignthisCertificationonbehalfoftheSystem:

Title:

Signature:

Phone: Fax: Email:

Completionofthefollowing:

□ SecurityVulnerabilityAssessment
□ EmergencyResponsePlan

Appendix 10. Guidelines and Emergency plan for handling and storing chlorine

1. Instructions for Storage and Handling of Chlorine Cylinders

(Based on the 'Manual on Operation and Maintenance of Water Supply Systems' published by the Central Public Health and Environmental Engineering Organization (CPHEEO) in 2005)

1.1 Storage Area

a) Obtain storage license from controller of explosives under Gas Cylinder Rules 2004 if the quantity of Cl_2 containers to be stored is more than 5 Nos.

b) Storage area should be cool, dry, well ventilated, and clean of trash and protected from external heat sources. Please refer to Manual on "Water Supply and Treatment", (1999 Edition), for further details.

c) Ventilation must be sufficient to prevent accumulation of vapour pockets. The exhaust should be located either near the floor or duct be provided extending to the floor. All fan switches should be outside the storage area.

d) Do not store container directly under the sun.

e) Weather cock should be installed near the storage to determine wind direction.

f) The storage building should be of non-combustible construction with at least two exits opening outside.

g) Neutralization system should be provided.

h) Continuous monitoring of chlorine leak detection equipment with alarm should be installed in the storage area.

i) The area should be free and remote from elevators, gangways or ventilating system to avoid dangerous concentration of Chlorine during leak.

j) Two portable foam type fire extinguishers should be provided in the premises.

k) Corrosive substances shall not be stored nearby which react violently with each other.

l) Unauthorized person should not be allowed to enter into the storage area.

m) The floor level of storage shed should be preferably 30 cms (at least one foot) higher from the ground level to avoid water logging.

n) Ensure that all containers are properly fitted with safety caps or hooks.

1.2. Cylinder & Drum Containers

a. Store chlorine cylinders upright and secure them so that they do not fall.

b. Drum containers should be stored on their sides on rails, a few inches above the floor. They should not be stacked one upon the other. They should be stored such that the valves are in vertical plane.

c. Keep enough space between containers so as to have accessibility in case of emergency.

d. Store the containers in a covered shed only. Keep them away from any source of heat as excessive heat may increase the pressure in container which will result into burst.

e. Do not store explosives, acids, turpentine, ether, anhydrous ammonia, finely divided metals or other flammable material in the vicinity of Chlorine.

f. Do not store containers in wet and muddy areas.

g. Store filled and empty containers separately.

h. Protective covers for valves are secured even when the containers are empty, except during use in the system.

i. Never use containers as a roller to move other equipment.

j. Never tamper with fusible plugs of tonners.

k. Check leakages every day by means of ammonia torch. However, it should not be touched to brass components like valves of container for safety.

l. Never carry out any welding work on the chlorine system as combustion of steel takes place at 2510C in presence of chlorine.

m. The boxes containing emergency kit, safety applications and self contained breathing apparatus should be kept in working order in an easily approachable area.

1.3. Use of Cylinders & Drum Containers in Process System

a. Use containers in the order of their receipt, as valve packing can get hardened during prolonged storage and cause gas leaks.

b. Do not use oil or lubricant on any valve of the containers.

c. Badly fitting connections should not be forced and correct tool should always be used for opening and closing valves. They should never be hammered.

d. The area should be well ventilated with frequent air changes.

e. Transport the cylinders to the process area by using crane, hoist or railings etc.

f. The drum containers should be kept in a horizontal position in such a way that the valves are in a vertical plane. The upper valve gives out gas and the lower one gives out liquid chlorine.

g. The cylinder should be kept in upright position in order to release gas from the valve. For liquid chlorine withdrawal, it should be inverted with the help of an inverted rack.

h. Connect the containers to the system by using approved accessories.

i. Use copper flexible tube, with lead washer containing 2 to 4% antimony or bonded asbestos or teflon washer. Use yoke clamp for connecting chlorine container.

j. Never use rubber tubes, PVC tubes etc. for making connections.

k. Use the right spanner for operating the valve. Always keep the spanner on the valve spindle. Never use ill fitting spanner.

l. After making the flexible connection, check for the leakage by means of ammonia torch but it should not come in contact with a valve.

m. Keep minimum distance between the container valve and header valve so that during change-over of the container, minimum amount of gas leaks.

n. The material of construction of the adopter should be same as that of valve outlet threads.

o. The valve should not be used as a regulator for controlling the chlorine. During regulation due to high velocity of Chlorine, the valve gets damaged which in turn can cause difficulty in closing.

p. The tools and other equipment used for operating the container should be clean and free of grease, dust or grit.

q. Wear breathing apparatus while making the change-over of the container from the process header.

r. Do not heat the container to withdraw more gas at faster rate.

s. Use pressure gauge and flow measuring device to control the flow and to know the quantity of gas left in the container.

t. Use an inverted U type barometric leg or vacuum breaking arrangement for connecting the container to the process piping.

u. Withdrawal of the gas should be stopped when the gas pressure inside the container is between 0.1 to 0.5 kg/cm2 approximately.

v. If withdrawal of the gas from the container connected to the process system has to be suspended for long intervals, it should be disconnected from the system, and the valve cap and hood replaced.

w. Gas containers should be handled by trained persons only.

1.4. Disconnecting Containers from Process System

a. Use breathing apparatus before disconnecting the container.

b. First close the container valve fully. After removal of chlorine the process valve should be closed.

c. Remove the flexible connection, plug the flexible connection in order to avoid entry of humid air. Replace the valve cap or hood on the container.
d. Put the tag on the empty container & bring it to storage area marked for empties.
e. Check for the leakage.

1.5. Loading and Unloading of Containers

a. The handling of containers should be done under the supervision of trained and competent person.
b. It should be done carefully with a crane, hoist or slanted ramp. Do not use magnet or sharp object for lifting the containers.
c. Small cylinders should not be lifted by means of valve caps as these are not designed to carry the weight.
d. The containers should not be allowed to strike against each other or against any hard object.
e. Vehicles should be braked and isolated against any movement.
f. After loading, the containers should be secured properly with the help of wooden wedges, rope or sling wire so that they do not roll away.
g. The containers should never be dropped directly to the ground or on the tyre from the vehicle.
h. There should be no sharp projection in the vehicle.
i. Containers must have valve caps and plugs fitted properly.
j. Check containers for leakage before loading/unloading.

1.6. Transportation of Container

a. The name of the chemical along with diamond pictorial sign denoting the dangerous goods should be marked on the vehicle.
b. The name of the transporter, his address and telephone number should be clearly written on the vehicle.
c. The vehicle should not be used to transport any material other than what is written on it.
d. Only trained drivers and cleaners should transport hazardous chemical
e. The driver should not transport any leaking cylinder.
f. The cylinder should not project outside the vehicle.
g. The transporter must ensure that every vehicle driver must carry “Trem Card” (Transport Emergency Card) and ‘Instructions in writing booklet’ and follow them.
h. Every driver must carry safety appliances with him, viz; Emergency kit, breathing apparatus etc.
i. The vehicles must be driven carefully, specially in crowded localities and on bumpy roads. Do not apply sudden brakes.
j. Check for the leakage from time to time.
k. In the case of uncontrollable leakage the vehicle should be taken to an open area where there is less population.

1.7. Emergency Kit

It consists of various tools and appliances like gaskets, yokes, studs, tie rods hoods, clamps, spanners, mild steel channels, screws, pins, wooden pegs etc. of standard sizes. Separate kits are used for cylinders and tonners. All the gadgets are designed for using in controlling or stopping the leakages from valves, fusible plug and side walls of cylinders and containers used for handling chlorine.

a. Leakage may occur through the valve. There are basically four types of valve leaks.
    I. Valve packing
    II. Valve seat
    III. Defective inlet thread
    IV. Broken valve thread

b. Leakage may occur through container wall. For controlling such leakages, clamps are used for cylinders and chain and yoke arrangement is used for tonner. Sometimes wooden peg is used by driving into the leaking hole as a temporary arrangement.

c. Leakage may occur through fusible plug.

   i. If the leakage is through the threads of fusible plug, yoke, hood and cap nut arrangement is used to control the leak.

   ii. If fusible metal itself in the plug is leaking, yoke and stud arrangement is used to control the leak.

2. First Aid to be Provided for a Person Affected by Chlorine

a. General

Remove the affected person immediately to an uncontaminated area. Remove contaminated clothing and wash contaminated parts of the body with soap and plenty of water. Lay down the affected person in cardiac position and keep him warm. Call a physician for medical assistance at the earliest.

Caution: Never attempt to neutralize chlorine with other chemicals.

b. Skin Contact

Remove the contaminated clothes, wash the affected skin with large quantity of water. Caution: No ointment should be applied unless prescribed by the physician.

c. Eye Contact

If eyes get affected with liquid chlorine or high concentration of chlorine gas, they must be flushed immediately with running water for atleast 15 minutes keeping the eyelids open by hand.

Caution: No ointment should be used unless prescribed by an eye specialist.

d. Inhalation

If the victim is conscious, take him to a quiet place and lay him down on his back, with head and back elevated (cardiac position). Loosen his clothes and keep him warm using blankets. Give him tea, coffee, milk, peppermint etc. for making good effect on breathing system.

If the victim is unconscious, but breathing, lay him down in the position mentioned above and give oxygen at low pressure until the arrival of doctor. If breathing has stopped, quickly stretch him out on the ground or a blanket if available, loosen his collar and belt and start artificial respiration without delay. Neilson arm lift back pressure method is useful. Automatic artificial respiration is preferable if available. Continue the respiration until the arrival of the doctor. Amboo bag can also be used for this purpose.

3. On-Site Emergency Plan to Cover the Leakage of Chlorine

3.1. Introduction

As chlorine is a hazardous chemical, handling and storage of it demand adequate precautions to avoid possible hazards. Leakage of chlorine may develop into a major emergency. Therefore the emergency procedure to cover this eventuality is essential. It is drawn in the form of on-site emergency plan. The elements of onsite emergency plan are as follows:

3.2. Identification of Hazard Chart

In this case the site risk is evaluated by the expert and the extent of the probable damage is calculated on the basis of stored chlorine quantity, nearby population, wind direction, type of equipment failure etc. For this purpose hazard analysis is conducted in which case all the hazardous properties of chlorine are considered. If evacuation is required, the range of it is calculated.

3.3. Appointing Key Persons

In order to control the incident like chlorine leakage, it is essential to appoint various persons with their well defined responsibilities. Taking into account the various activities likely to be involved, the following key persons are appointed (i) Site Controller, (ii) Incident controller, (iii) Shift Executive Incharge, (iv) Communication Officer, (v) Safety Officer, (vi) Fire and Security Officer, (vii) Utilities and Services Incharge, (viii) Traffic Controller, (ix) First Aider

3.4. Assembly Points

These points are set up where persons from the plant would assemble in case of chlorine leakage. At these points the in-charge for counting the heads will be available.

3.5. Emergency Control Center

The control centre is the focal point in case of an emergency from where the operations to handle the emergency from are directed and coordinated. It contains site plan, telephone lines, public address system, safety equipment, first aid boxes, loud speaker, torches, list of essential telephone numbers, viz. fire brigade, police, hospital, civil defence, collector, factory inspector, organizational authorities, chlorine suppliers, mutual aid group, social workers, list of key persons and their addresses, copy of chemical fact sheet, location plan of fire hydrant, details of dispersion model of chlorine gas, population distribution pattern, location of alarm system.

3.6. Procedure to Meet Emergency

The actions to be taken by the staff and authority are given below; Emergency Alarm: An audible emergency alarm system is installed through out the plant. On hearing the alarm the incident controller will activate the public address system to communicate with the staff about the emergency and give specific instructions for evacuations etc. Any one can report the occurrence of chlorine leakage to section in-charge or incident controller through telephone or intercom or in person.

3.7. Communication

Communication officer shall establish the communication suitable to that incident.

3.8. Services

For quickness and efficient operation of emergency plan the plant is divided into convenient number of zones and clearly marked on the plan. These are emergency services viz. fire fighting, first aid, rescue, alternative source of power supply, communication with local bodies etc. The incident controller will hand over the charge to the site controller of all these coordinating activities, when the site controller appears on the site. The site controller will coordinate all the activities of the key persons. On hearing the emergency alarm system all the key persons will take their charge. Incase of their absence other alternatives are nominated.

The person nominated for personnel and administration purposes will be responsible for informing all statutory authorities, keeping account of all persons in the plant including contract labour, casual workers and visitors. He will be responsible for giving information to press or any outside agencies. He is also responsible for organizing canteen facilities and keeping informed the families of affected persons.

The person nominated as security officer should guide police, fire fighting and control the vehicle entries. The site controller or any other nominated person will announce resumption of normalcy after everything is brought under control.

The on site emergency plan needs to be evaluated by mock drill. Any weaknesses noticed during such drills should be noted and the plan is modified to eliminate the weaknesses.

3.9. Emergency Measures

In case of leakage or spillage of Chlorine, the following emergency measures should be taken:

a) Take a shallow breath and keep eyes opened to a minimum.
b) Evacuate the area.
c) Investigate the leak with proper gas mask and other appropriate Personal protection.
d) The investigator must be watched by a rescuer to rescue him in emergency.
e) If liquid leak occurs, turn the containers so as to leak only gas.
f) In case of major leakage, all persons including neighbours should be warned.
g) As the escaping gas is carried in the direction of the wind all persons should be moved in a direction opposite to that of the wind. Nose should be covered with wet handkerchief.
h) Under no circumstances should water or other liquid be directed towards leaking containers, because water makes the leak worse due to corrosive effect.
i) The spillage should be controlled for evaporation by spraying chilled water having temperature below $9.4^{o}C$. With this water crystalline hydrates are formed which will temporarily avoid evaporation. Then try to neutralize the spillage by caustic soda or soda ash or hydrated lime

solution carefully. If fluroprotein foam is available, use for preventing the evaporation of liquid chlorine.

j) Use emergency kit for controlling the leak.

k) On controlling the leakage, use the container in the system or neutralize the contents in alkali solution such as caustic soda, soda ash or hydrated lime.

Caution: Keep the supply of caustic soda or soda ash or hydrated lime available. Do not push the leaking container in the alkali tank. Connect the container to the tank by barometric leg.

l) If container commences leak during transport, it should be carried on to its destination or manufacturer or to remote place where it will be less harmful. Keeping the vehicle moving will prevent accumulation of high concentrations.

m) Only specially trained and equipped workers should deal with emergency arising due to major leakage.

n) If major leak takes place, alert the public nearby by sounding the siren.

o) Any minor leakage must be attended immediately or it will become worse.

p) If the leakage is in the process system, stop the valve on the container at once.

3.10. Safety Systems Required at Chlorination Plant

The following safety systems should be kept ready at the chlorination plant:

a. Breathing apparatus.
b. Emergency kit.
c. Leak detectors.
d. Neutralisation tank.
e. Siren system.
f. Display of boards in local language for public cautioning, first aid and list of different authorities with phone numbers.
g. Communication system.
h. Tagging system for equipments.
i. First aid including tablets and cough mixtures.
j. Exhaust fans.
k. Testing of pressure vessels, chlorine lines etc. every year as per factory act.
l. Training & mock drill.
m. Safety showers.
n. Eye fountain.
o. Personal protective equipments.
p. Protecting hoods for ton-containers.
q. Fire extinguishers.
r. Wind cock.

Appendix 11Sample Outline Spoil Management Plan

I. Spoils information

   A. Materials type
   B. Potential contamination
   C. Expected volume and sources
   D. Spoil classification

II. Spoils management

   A. Transportation of spoil
   B. Storage of spoil
   C. Contaminated spoil
   D. Approved reuse and/or disposal sites

III. Records of reuse and/or disposal

Appendix 12: Sample Outline Traffic Management Plan

A. Principles for TMP around the Water Pipes Construction Sites

1. One of the prime objectives of this TMP is to ensure the safety of all the road users along the work zone, and to address the following issues:

(i) the safety of pedestrians, bicyclists, and motorists travelling through the construction zone;
(ii) protection of work crews from hazards associated with moving traffic;
(iii) mitigation of the adverse impact on road capacity and delays to the road users;
(iv) maintenance of access to adjoining properties; and
(v) addressing issues that may delay the project.

B. Operating Policies for TMP

2. The following principles will help promote safe and efficient movement for all road users (motorists, bicyclists, and pedestrians, including persons with disabilities) through and around work zones while reasonably protecting workers and equipment.

(i) Make traffic safety and temporary traffic control an integral and high-priority element of every project from planning through design, construction, and maintenance.
(ii) Inhibit traffic movement as little as possible.
(iii) Provide clear and positive guidance to drivers, bicyclists, and pedestrians as they approach and travel through the temporary traffic control zone.
(iv) Inspect traffic control elements routinely, both day and night, and make modifications when necessary.
(v) Pay increased attention to roadside safety in the vicinity of temporary traffic control zones.
(vi) Train all persons that select, place, and maintain temporary traffic control devices.
(vii) Keep the public well informed.
(viii) Make appropriate accommodation for abutting property owners, residents, businesses, emergency services, railroads, commercial vehicles, and transit operations.

3. **Figure A2 to Figure A12**illustrates the operating policy for TMP for the construction of water pipes and the sewers along various types of roads.

C. Analyze the impact due to street closure

4. Apart from the capacity analysis, a final decision to close a particular street and divert the traffic should involve the following steps:

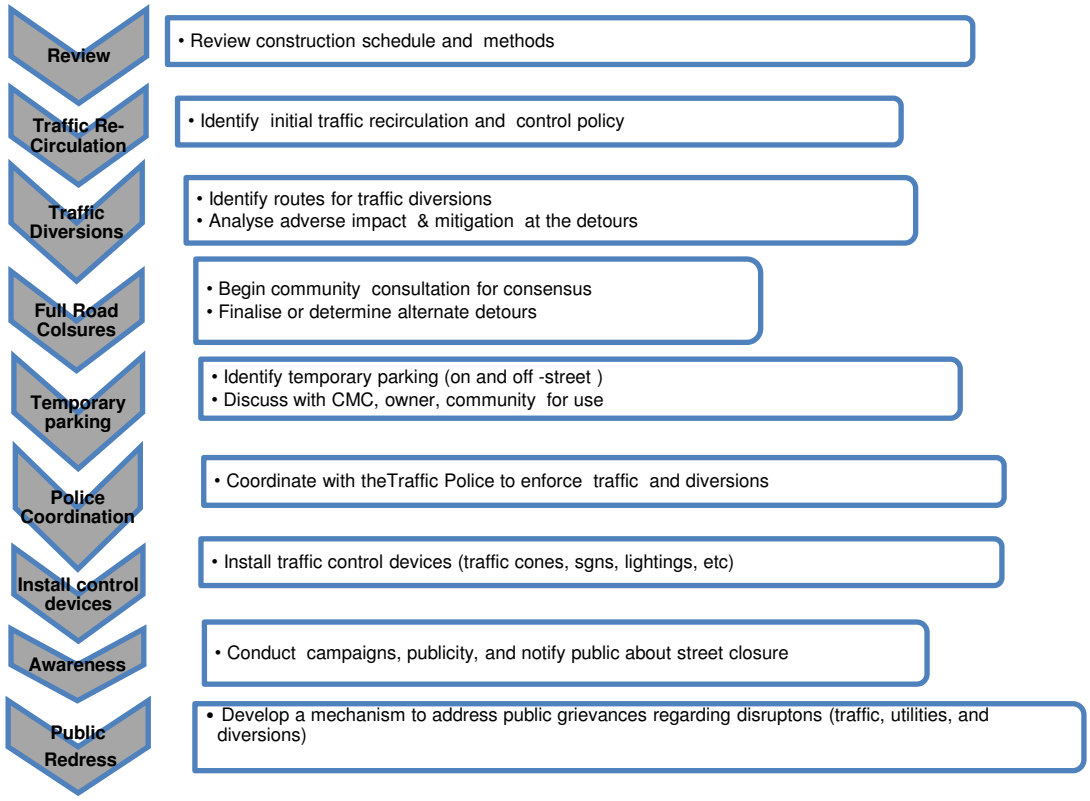
(i) approval from the ULB/CMC/Public Works Department (PWD) to use the local streets as detours;
(ii) consultation with businesses, community members, traffic police, PWD, etc, regarding the mitigation measures necessary at the detours where the road is diverted during the construction;
(iii) determining of the maximum number of days allowed for road closure, and incorporation of such provisions into the contract documents;
(iv) determining if additional traffic control or temporary improvements are needed along the detour route;
(v) considering how access will be provided to the worksite;

(vi) contacting emergency service, school officials, and transit authorities to determine if there are impacts to their operations; and

(vii) developing a notification program to the public so that the closure is not a surprise. As part of this program, the public should be advised of alternate routes that commuters can take or will have to take as result of the traffic diversion.

5. If full road-closure of certain streets within the area is not feasible due to inadequate capacity of the detour street or public opposition, the full closure can be restricted to weekends with the construction commencing on Saturday night and ending on Monday morning prior to the morning peak period.

Figure A1: Policy Steps for the TMP



D. Public awareness and notifications

6. As per discussions in the previous sections, there will be travel delays during the constructions, as is the case with most construction projects, albeit on a reduced scale if utilities and traffic management are properly coordinated. There are additional grounds for travel delays in the area, as most of the streets lack sufficient capacity to accommodate additional traffic from diverted traffic as a result of street closures to accommodate the works.

7. The awareness campaign and the prior notification for the public will be a continuous activity which the project will carry out to compensate for the above delays and minimize public claims as result of these problems. These activities will take place sufficiently in advance of the time when the roadblocks or traffic diversions take place at the particular streets. The reason for this is to allow sufficient time for the public and residents to understand the changes to their

travel plans. The project will notify the public about the roadblocks and traffic diversion through public notices, ward level meetings and city level meeting with the elected representatives.

8. The PIU will also conduct an awareness campaign to educate the public about the following issues:

(i) traffic control devices in place at the work zones (signs, traffic cones, barriers, etc.);
(ii) defensive driving behaviour along the work zones; and
(iii) reduced speeds enforced at the work zones and traffic diversions.

9. It may be necessary to conduct the awareness programs/campaigns on road safety during construction.

10. The campaign will cater to all types of target groups i.e. children, adults, and drivers. Therefore, these campaigns will be conducted in schools and community centres. In addition, the project will publish a brochure for public information. These brochures will be widely circulated around the area and will also be available at the PIU, and the contractor's site office. The text of the brochure should be concise to be effective, with a lot of graphics. It will serve the following purpose:

(i) explain why the brochure was prepared, along with a brief description of the project;
(ii) advise the public to expect the unexpected;
(iii) educate the public about the various traffic control devices and safety measures adopted at the work zones;
(iv) educate the public about the safe road user behaviour to emulate at the work zones;
(v) tell the public how to stay informed or where to inquire about road safety issues at the work zones (name, telephone, mobile number of the contact person; and
(vi) indicate the office hours of relevant offices.

E. Install traffic control devices at the work zones and traffic diversion routes

11. The purpose of installing traffic control devices at the work zones is to delineate these areas to warn, inform, and direct the road users about a hazard ahead, and to protect them as well as the workers. As proper delineation is a key to achieve the above objective, it is important to install good traffic signs at the work zones. The following traffic control devices are used in work zones:

- Signs
- Pavement Markings
- Channelizing Devices
- Arrow Panels
- Warning Lights

12. Procedures for installing traffic control devices at any work zone vary, depending on road configuration, location of the work, construction activity, duration, traffic speed and volume, and pedestrian traffic. Work will take place along major roads, and the minor internal roads. As such, the traffic volume and road geometry vary. The main roads carry considerable traffic; internal roads in the new city areas are wide but in old city roads very narrow and carry considerable traffic. However, regardless of where the construction takes place, all the work zones should be cordoned off, and traffic shifted away at least with traffic cones, barricades, and temporary signs (temporary “STOP” and “GO”).

13. **Figure A2 to Figure A12** illustrates a typical set-up for installing traffic control devices at the work zone of the area, depending on the location of work on the road way, and road geometrics:

- Work on shoulder or parking lane

- Shoulder or parking lane closed on divided road
- Work in Travel lane
- Lane closure on road with low volume
- Lane closure on a two-line road with low volume (with yield sign)
- Lane closure on a two-line road with low volume (one flagger operation)
- Lane closure on a two lane road (two flagger operation)
- Lane closure on a four lane undivided Road
- Lane closure on divided roadway
- Half road closure on multi-lane roadway
- Street closure with detour

14. The work zone should take into consideration the space required for a buffer zone between the workers and the traffic (lateral and longitudinal) and the transition space required for delineation, as applicable. For the works, a 30 cm clearance between the traffic and the temporary STOP and GO signs should be provided. In addition, at least 60 cm is necessary to install the temporary traffic signs and cones.

15. Traffic police should regulate traffic away from the work zone and enforce the traffic diversion result from full street closure in certain areas during construction. Flagggers/ personnel should be equipped with reflective jackets at all times and have traffic control batons (preferably the LED type) for regulating the traffic during night time.

16. In addition to the delineation devices, all the construction workers should wear fluorescent safety vests and helmets in order to be visible to the motorists at all times. There should be provision for lighting beacons and illumination for night constructions.

Figure A2 & A3: Work on shoulder or parking lane & Shoulder or parking lane closed on divided road)

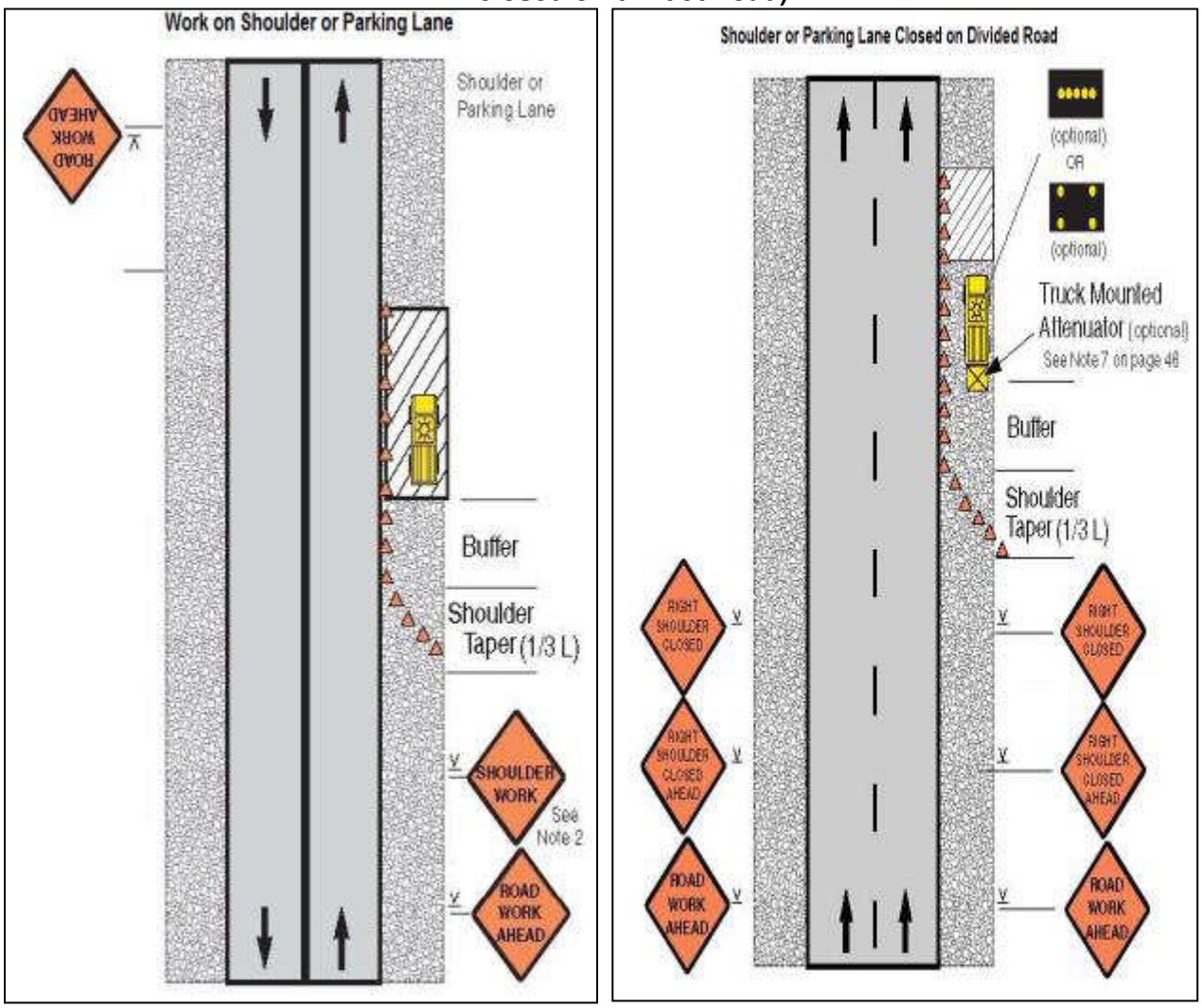


Figure A4 & A5: Work in Travel lane & Lane closure on road with low volume

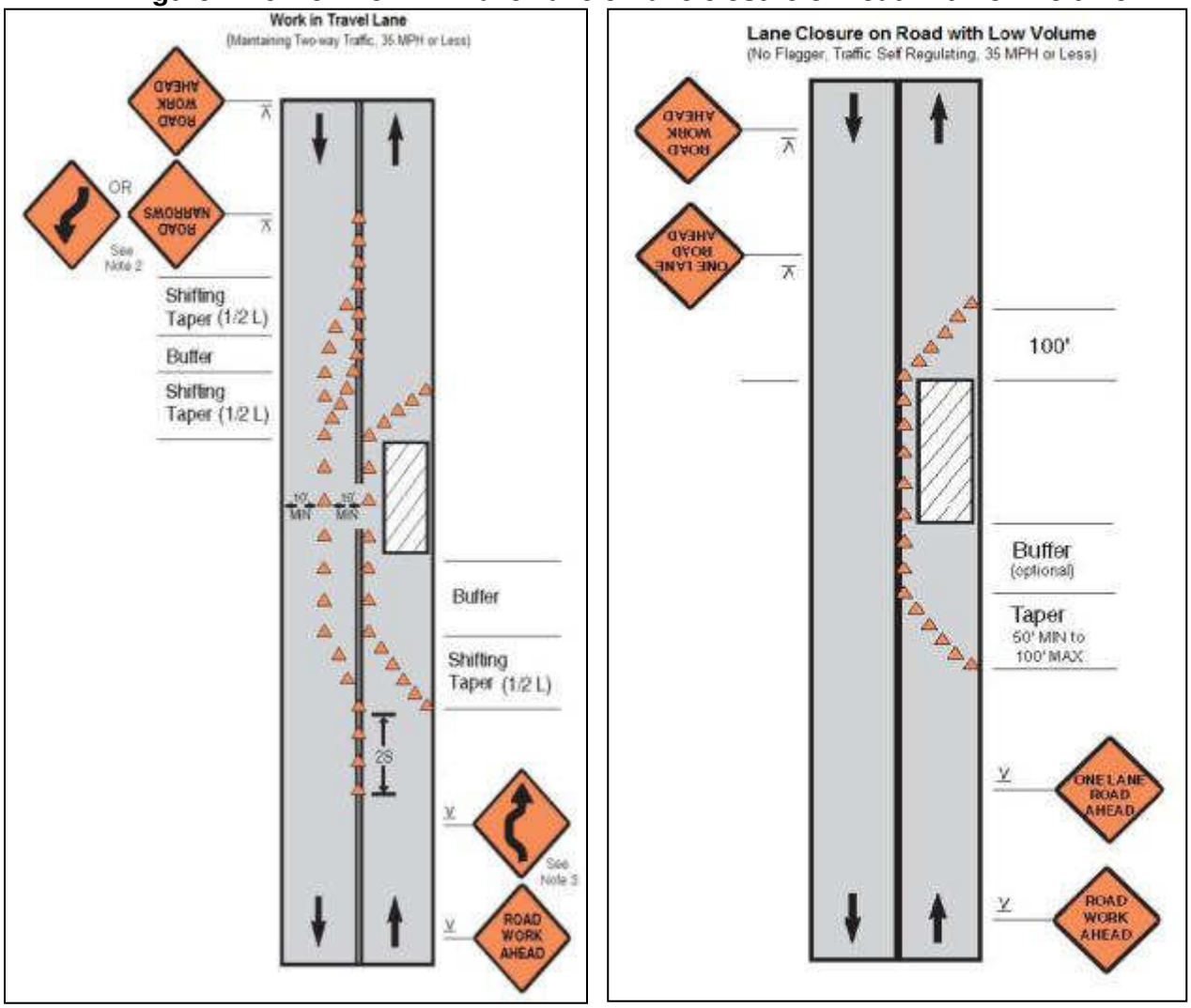
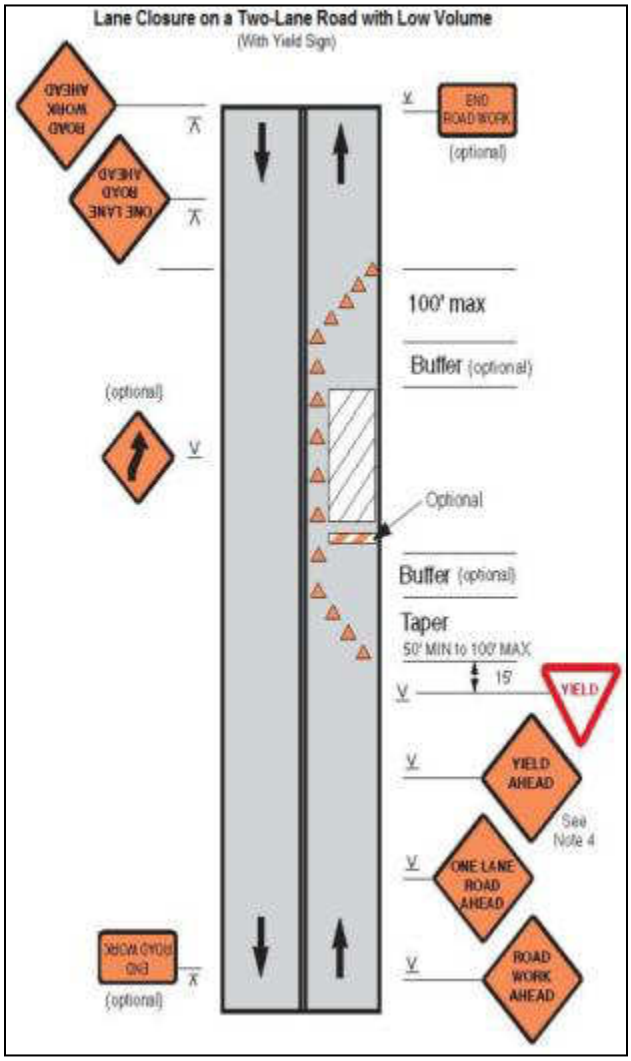


Figure A6 & A7: Lane closure on a two-line road with low volume (with yield sign) & Lane closure on a two-line road with low volume (one flagger operation)



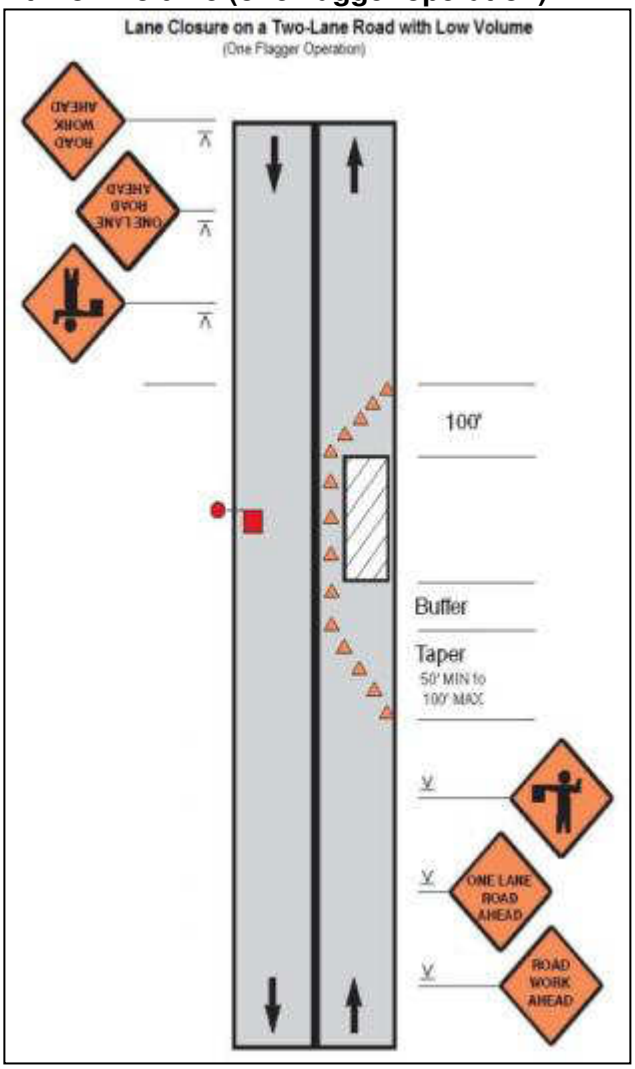


Figure A8 & A9: Lane Closure on a Two-Lane Road (Two Flagger Operation) & Lane Closure on a Four-Lane Undivided Road

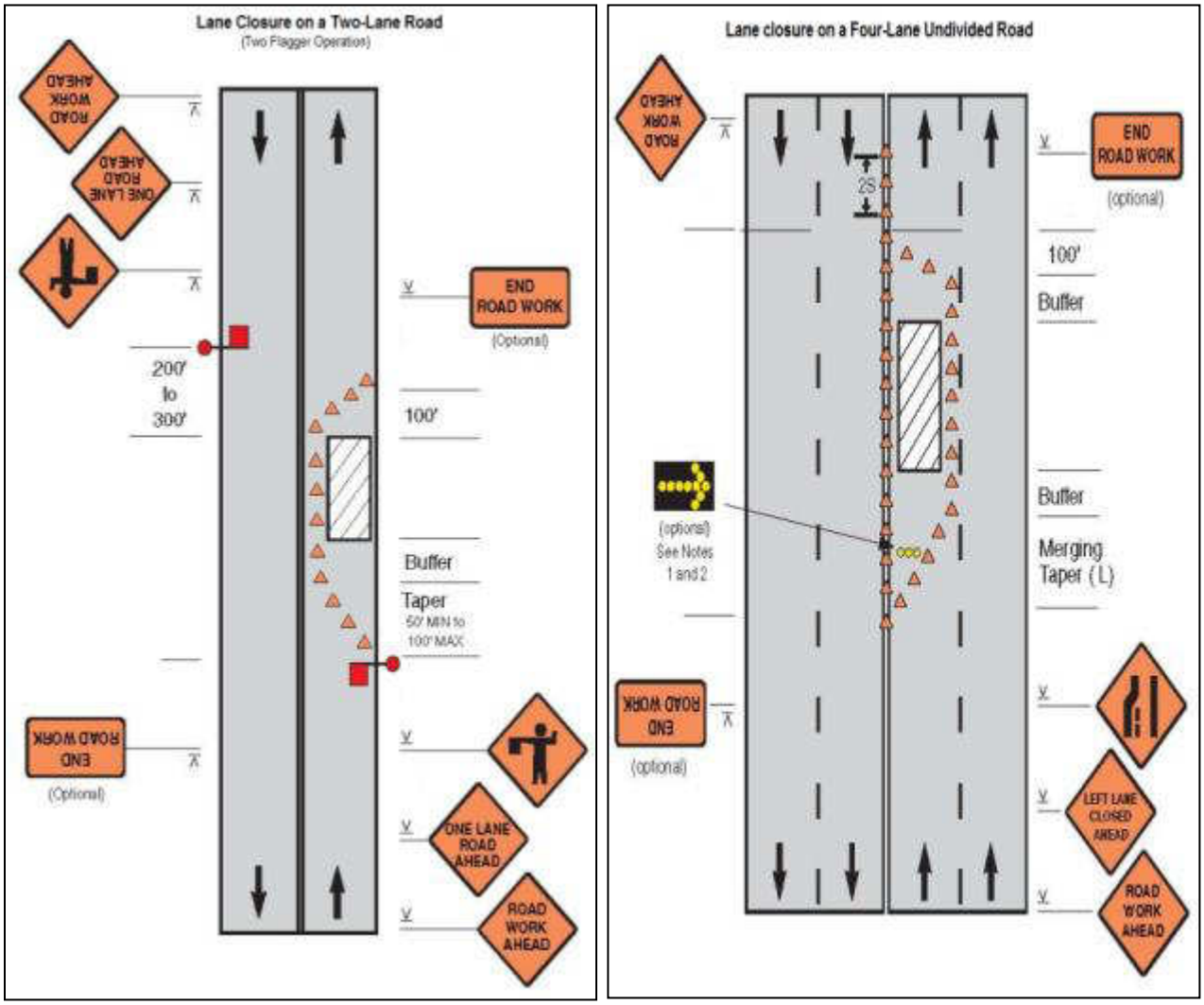


Figure A10 & A11: Lane Closure on Divided Roadway & Half Road Closure On Multi-Lane Roadway

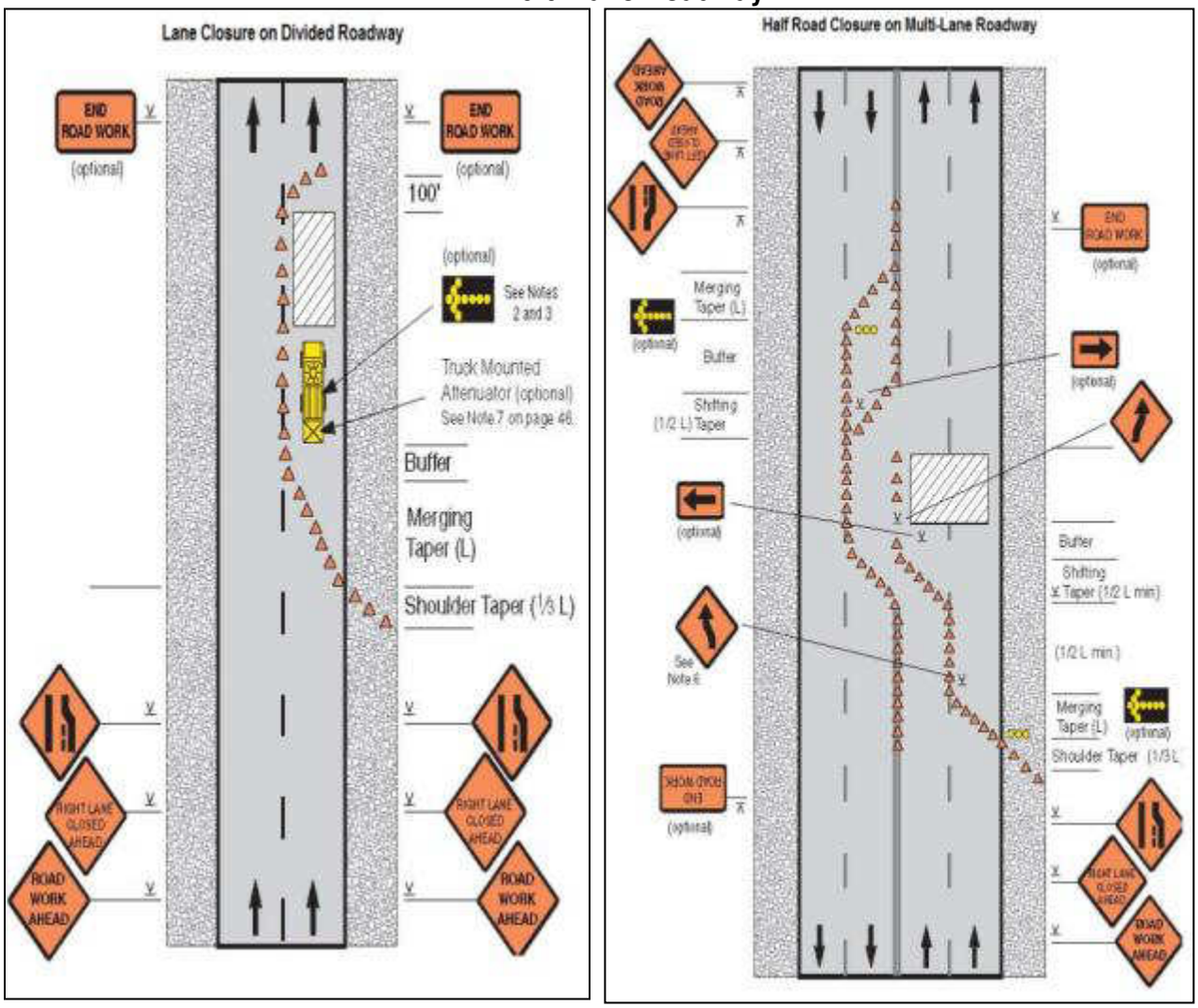
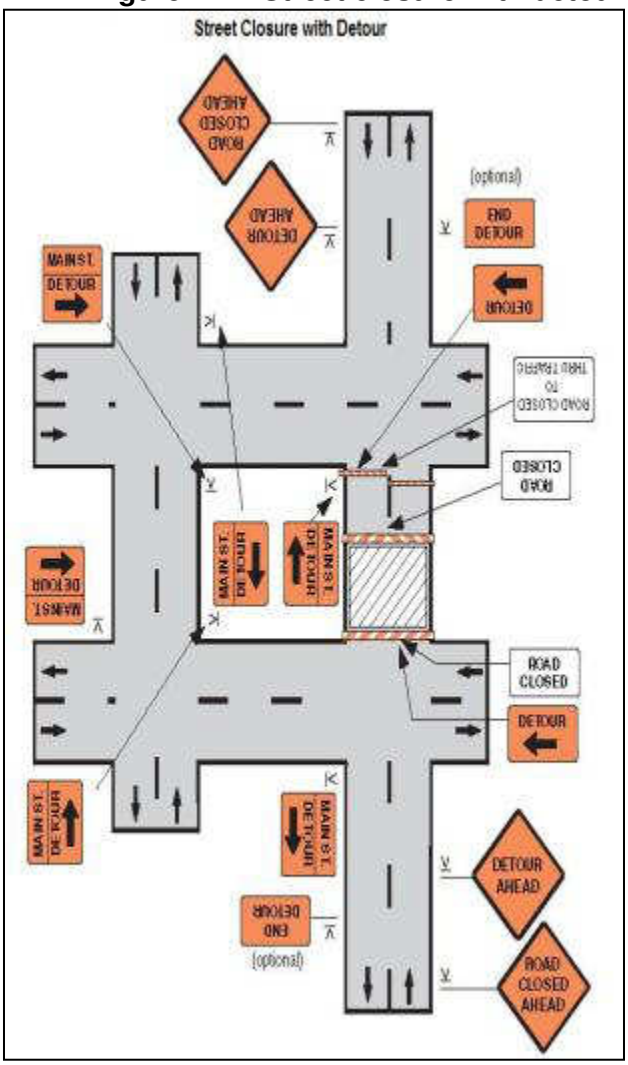


Figure A12: Street closure with detour



Appendix 13: Minutesof theStakeholderConsultationMeeting(October 3, 2012, Davangere)

Themeetingwasattendedbykeystakeholdersfromfourprojecttownsof Byadgi,Ranebennur,HariharandDavangereincludingpublic/electedrepresentativesfromeachtown,ULBofficials,officialsfromotherlinedepartmentsandexecutingagencyKUIDFC,andNGOs/CBOs.ThemeetingwaschairedbyDavangereDistrict DeputyCommissioner,
ThePPTAconsultantsmadedetailedpresentations– inKannadaandEnglishonoverallprogram,pilottowns,technicalstudies,povertysocialdevelopmentaspects,andenvironmentalandsocialsafeguardissuesrelatedtoproposedsubprojectsinrespectivetowns.

III. KUIDFC

- TaskManager(NKUSIP)statedthat,theDraftFeasibilityStudies(DFSs)aresubject to changetoaddressstakeholder commentsandconcerns.
- TaskManager(NKUSIP)suggestedtouseAshrayaSchemeGovernmentOrder(GO)forland acquisitioninByadgiandotherULB,ifrequired.(GOstatesthat,compensationforlandacquisitioncanbepaidat3timestotheguidancevalueoftheland)

IV. Otherdiscussions

- ProvisionforSewerConnections– includeconnectioncostasaseparateitem.Checkwithproject staffofKMRP/KUIDFC.
- SurroundingareasofULBsandgapsintheexistingseweragesystemofthetown– CheckwhetherthevillagesandsettlementsarewithintheULB'sjurisdiction/ boundaryandalsopopulationdensities.
- DemarcatetheroadswherelargerdiametersewersandWSmainsareproposedinallULBs,to carryoutsamplesurveysand to checkimpactsduringconstruction.Identifystreetswherecompleteroadclosureisrequired?
- Mapsordrawingstobepreparedtoshowproposals/optionsforwatersupplyandwastewatersystem, seweragenetworkandpublicsanitation.
- Refinethecostestimatestoshowfollowingitemsseparately:Layingofsewernetwork:Roadrestorationcost;Constructionofcollectionchambersandconnections fromindividualpropertiestocollectionchambers;LandcostforSTPsandPumpingStations;Construction cost ofSTP
- Identifyindustrialdemandandlocationfor recyclingtreatedwastewater
- Preparationofcomparisontablefortheselectionofpipematerialforsewerageandwatersupply system
- Assessexistingseweragesystem(about22km)inRanebennurtoidentifyneedforthe sewerrenovationorreplacement.
- Planawarenessprogramforthe sanitationineachULB

Appendix 14: Public consultation at Harihar

Project Components: Rehabilitation of Water Supply Scheme and upgrading to 24x7 Water Supply Scheme to Harihara Town, CMC Harihara in Davanagere District

Table 5.2 : Public consultation

Sl	Name, Ward No. and address of the person consulted	Present condition of Water supply	What improvement is required in the present condition	Proposed project is beneficial Yes/No	May proposed project cause any social issue	Any suggestion for the proposed project
1	Sanoulla, baig ward No-[illegible] Gandhi ngr HRR	poor	Pipe dia change	yes	NO	Road Both side pipe laying
2	Ravikumar. B word No13 [illegible]	Drinking water not quality	pressure is low	yes	Small gallis in this ward	fast complete project
3	[illegible] & Team [illegible] Temple rd wrd-8	weekly 3 times	Daily they want water	yes	poor people water bill problem	water Bill amount yearly paid.
4	Sangmesh. Kale DRM college ward-5	good	Removing old pipe	yes	NO	meter adapting is [illegible]
5	Nagaraj ward-30 vidhy ngr HRR	good	Higher Dia pipe laying	yes	Road cutting problem	Wide road so, Both side Pipe laying
6	Pervez, M. ward-15 Imam mohalla HRR	poor	weekly 3 times water they want	yes	Small roads in this area	water should reach 3rd floor
7	Ramesh. Simpi ward no-5, [illegible]	Low Quality water	Avoid public Taps.	yes	poor people living Here	They want pressure flow
8	Saleem. Kazi ward-no-10 [illegible] ngr HRR	old CI pipe. Pipe used	Treated water Supply	yes	-NO-	Need off public [illegible]
9	Samimbanu. H.M ward-23 [illegible] ngr HRR	weekly Two times	24 hour water they want	yes	NO	[illegible] water [illegible] they want
10	Manjunath. V. Donni ward no-26 S.C. Colony	Small gallis not sufficient water	Quality pipe laying	yes	Concrete road cutting problem	meter proposed is good
11	Maridorappa ward No-4 [illegible] HRR	over Dia pipe used	no control valves	yes	NO	good Quality meter use for [illegible]
12	Ashok. Kurbar ward-No-22 [illegible] ngr	water not flow properly	adopt valves for pressure	yes	NO	They want Quality water
13	Sivaji. Kataswakar ward-No-16 [illegible] HRR	old PVC pipes	Stop leakaging water	yes	NO	Now they getting sufficient water
14	Senkar. Naidu ward-No-11 [illegible] HRR	Pipe leakages.	Full ward pipe changes	Yes.	Slum people lived Here. They want cisterns.	Good pipe used for project
15	Hanumant. Ridani ward-27 [illegible]	pipe leakage	Pipe should Be changing	yes	NO	water Bill amount should Be in budget









Appendix15: Sample Monthly Reporting Format for Construction Supervision

This template must be included as an appendix in the EIA/IEE that will be prepared for the project. It can be adapted to the specific project as necessary.

I. Introduction

Overall project description and objectives

Description of sub-projects

Environmental category of the sub-projects

Details of site personnel and/or consultants responsible for environmental monitoring

Overall project and sub-project progress and status

No.	Sub-Project Name	Status of Sub-Project				List of Works	Progress of Works
		Design	Pre-Construction	Construction	Operational Phase		

II. Compliance status with National/ State/ Local statutory environmental requirements

No.	Sub-Project Name	Statutory Environmental Requirements	Status of Compliance	Action Required

III. Compliance status with environmental loan covenants

No. (List schedule and paragraph number of Loan Agreement)	Covenant	Status of Compliance	Action Required

IV. Compliance status with the environmental management and monitoring plan

Provide the monitoring results as per the parameters outlined in the EMP. Append supporting documents where applicable, including Environmental Site Inspection Reports.

There should be reporting on the following items which can be incorporated in the checklist of routine Environmental Site Inspection Report followed with a summary in the semi-annual report send to ADB. Visual assessment and review of relevant site documentation during routine site inspection needs to note and record the following:

- What are the dust suppression techniques followed for site and if any dust was noted to escape the site boundaries;
- If muddy water was escaping site boundaries or muddy tracks were seen on adjacent roads;
- adequacy of type of erosion and sediment control measures installed on site, condition of erosion and sediment control measures including if these were intact following heavy rain;
- Are their designated areas for concrete works, and refuelling;
- Are their spill kits on site and if there are site procedure for handling emergencies;
- Is there any chemical stored on site and what is the storage condition?
- Is there any dewatering activities if yes, where is the water being discharged;
- How are the stockpiles being managed;
- How is solid and liquid waste being handled on site;
- Review of the complaint management system;
- Checking if there are any activities being under taken out of working hours and how that is being managed.

Impacts (List from IEE)	Mitigation Measures (List from IEE)	Parameters Monitored (As a minimum those identified in the IEE should be monitored)	Method of Monitoring	Location of Monitoring	Date of Monitoring Conducted	Name of Person Who Conducted the Monitoring
Design Phase						
Pre-Construction Phase						
Construction Phase						
Operational Phase						

V. Summary Monitoring Table

VI. Overall Compliance with CEMP/ EMP

No.	Sub-Project Name	EMP/ CEMP Part of Contract Documents (Y/N)	CEMP/ EMP Being Implemented (Y/N)	Status of Implementation (Excellent/ Satisfactory/ Partially Satisfactory/ Below Satisfactory)	Action Proposed and Additional Measures Required

VII. Approach and methodology for environmental monitoring of the project

- Brief description on the approach and methodology used for environmental monitoring of each sub-project

VIII. Monitoring of environmental IMPACTS on PROJECT SURROUNDINGS (ambient air, water quality and noise levels)

- Brief discussion on the basis for monitoring
- Indicate type and location of environmental parameters to be monitored
- Indicate the method of monitoring and equipment to be used
- Provide monitoring results and an analysis of results in relation to baseline data and statutory requirements

As a minimum the results should be presented as per the tables below.

Air Quality Results

Site No.	Date of Testing	Site Location		Parameters (Government Standards)		
			PM10 µg/m3	PM2.5 µg/m3	SO2 µg/m3	NO2 µg/m3

Site No.	Date of Testing	Site Location		Parameters (Monitoring results)		
			PM10 µg/m3	PM2.5 µg/m3	SO2 µg/m3	NO2 µg/m3

Water Quality Results

Site No.	Date of Sampling	Site Location	Parameters (Government Standards)					
			pH	Conductivity µS/cm	BOD mg/L	TSS mg/L	TN mg/L	TP mg/L

Site No.	Date of Sampling	Site Location	Parameters (Monitoring Results)					
			pH	Conductivity µS/cm	BOD mg/L	TSS mg/L	TN mg/L	TP mg/L

Noise Quality Results

Site No.	Date of Testing	Site Location	LAeq (dBA) (Government Standard)	
			Day Time	Night Time

Site No.	Date of Testing	Site Location	LAeq (dBA) (Monitoring Results)	
			Day Time	Night Time

IX. **Summary of key issues and remedial actions**

- Summary of follow up time-bound actions to be taken within a set timeframe.

X. **Appendixes**

- Photos
- Summary of consultations
- Copies of environmental clearances and permits
- Sample of environmental site inspection report
- Other

XI SAMPLE ENVIRONMENTAL SITE INSPECTION REPORT

Project Name

Contract Number

NAME: _____ DATE: _____

TITLE: _____ DMA: _____

LOCATION: _____ GROUP: _____

WEATHER CONDITION:

_____

INITIAL SITE CONDITION: _____

CONCLUDING SITE CONDITION:

Satisfactory _____ Unsatisfactory _____ Incident _____Resolved _____ Unresolved _____

INCIDENT:

Nature of incident:

_____

Intervention Steps:

_____

Incident Issues

Resolution

Project Activity Stage	**Survey**	
	Design	
	Implementation	
	Pre-Commissioning	
	Guarantee Period	

Inspection

Emissions	Waste Minimization			
Air Quality	Reuse and Recycling			
Noise pollution	Dust and Litter Control			
Hazardous Substances	Trees and Vegetation			
Site Restored to Original Condition	Yes		No	

Signature

_____

Sign off

_____ _____

Name **Name**

Position **Position**

SAMPLE CHECKLIST FOR CONSTRUCTION SAFETY

Sl. No.	Safety Issues	Yes	No	Non-Compliance	Corrective Action	Penalty	Remarks
1	Appointment of qualified construction safety officers						
2	Approval for construction safety management plan by the SC						
3	Approval for traffic management/control plan in accordance with IRC: SP: 55-2001						
4	Maintenance of the existing road stretches handed over to the contractor.						
5	Provision of temporary traffic barriers/barricades/caution tapes in construction zones						
6	Provision of traffic signboards						
7	Provision for flags and warning lights						
9	Providing plastic crash barrier						
10	Provision of adequate staging, form work, and access (ladders with handrail) for works at a height of more than 3 m						
11	Provision of adequate shoring/ bracing/barricading/lighting for all deep excavations of more than 3 m depth.						
12	Demarcations (fencing, guarding, and watching) at construction sites						
13	Provision for sufficient lighting, especially for nighttime work						
14	Arrangements for controlled access and entry to construction zones						
15	Safety arrangements for road users/pedestrians						
16	Arrangements for detouring traffic to alternate facilities						
17	Regular inspection of work zone traffic control devices by authorized contractor personnel						
18	Construction workers' safety - Provision of personnel protective equipment						
19	A. Helmets						
	B. Safety shoes						
	C. Dust masks						
	D. Hand gloves						
	E. Safety belts						
	F. Reflective jackets						
	G. Earplugs for labour						
20	Workers employed on bituminous works, stone crushers, concrete batching plants, etc. provided with protective goggles, gloves, gumboots, etc.						
21	Workers engaged in welding work shall be provided with welder protective shields						
22	All vehicles are provided with						

Sl. No.	Safety Issues	Yes	No	Non-Compliance	Corrective Action	Penalty	Remarks
	reverse horns.						
23	All scaffolds, ladders, and other safety devices shall be maintained in safe and sound condition.						
24	Regular health checkup for labour/ contractor's personnel						
25	Ensuring sanitary conditions and all waste disposal procedures and methods in the camps.						
26	The contractor shall provide adequate circuit for traffic flow around construction areas, control speed of construction vehicles through road safety and training of drivers, provide adequate signage, barriers, and flag persons for traffic control						
27	Provision of insurance coverage for the contractor's personnel						

Contractor: _____

Consultant: _____

Appendix 16

1. SOURCE SUISTANABILITY OF RIVER TUNGABHADRA

1.1 General Information

The Tungabhadra (TB) River is a composite river of two east flowing rivers namely – The Tunga andThe Bhardra. The Tunga rises at Gangamula in the Gangrikal hill ranges north of Kudremukh. TheBhadra rises near Samse in the Aroli Hill range of Kudremukh. The Tunga River initially flows northeast,turns north and subsequently takes an easterly course. The Bhadra River also initially flows easterly,changing course to north and joins the Tunga at KUDLI in Shimoga district. The Tungabhadra Riverflows up to 298 km and is formed by the confluences of the Tunga and Bhadra Rivers at Kudli ofShimoga district then flows through Karnataka and some parts of Andhra Pradesh and joins the KrishnaRiver. The catchment and command area comprises 27 taluks of 7 districts and covers an area of48,000 Sq. km.

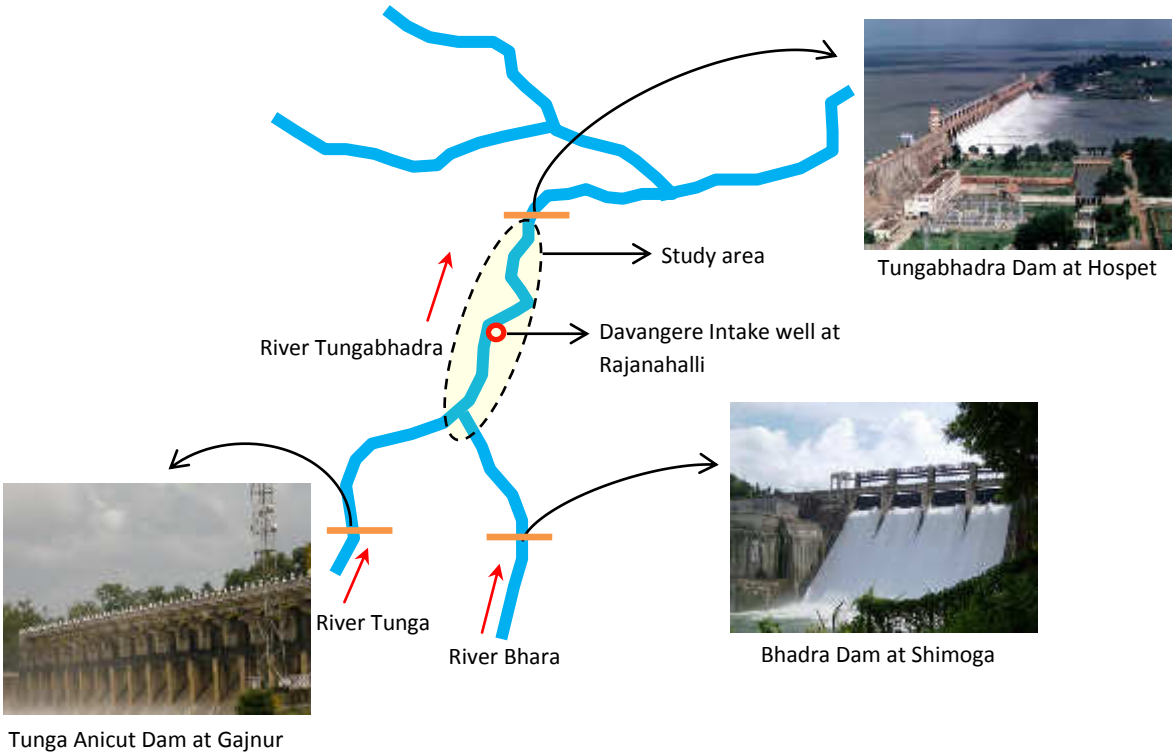


Figure 0: Map of study area, Tungabhadra River

Table 0: Details of various administrative units in TB basin

Bhadra Catchment/Comman	TungaCommand	Tungabhadracommand	ClosetoTBDam
Chikamagalore	Koppa	Honnali	Bellary
N.R.Pura	Sringeri	Channgiri	Hospet
Tarikere	Theerthahalli	Hanagal	Sirugoppa
Bhadravathi	Shimoga	Haveri	Dadurga
		Harikerur	Gangavathi
		Ranebennur	Koppal
		Shiggoan	Raichur
		Davangere	Sindhunur
		Harihar	
		H.B.Halli	
		Harappanahalli	

Source: Water Resource department

1.2 Ecology of the River

As per the study conducted by the Institute for Social and Economic Change (ISEC), the entire river stretch can be divided into three distinct regions, viz:

d) Region of Surplus

This area comprises the area from the point of origin to the Tunga Anicut and Badhra Reservoir Project.Somavahini River, draining the area inside the crater passes through a narrow gap in the mountain walland joins Bhadra River at Hebbe. Bhadra River is dammed up at BR project area forming a vast (about 200 sq. km) reservoir whose backwaters extend nearly 13 kms backwards. In addition to these majorwater sources, there are numerous streams and tanks scattered all over the area, some of them beingperennial sources.

e) Controlled Flow Region

This is the area from BRP till TBR at Hospet. During the monsoon period, this region has natural flowswhile in lean periods the flows are governed by agreement with the TB board. Intense cultivation ispracticed in this region. Return flows from urban settlements and Industrial units contribute to theriverine flow, but these Return flows are of poor quality, for instance, from Bhadravathi (firsturban settlement after Bhadra reservoir) to Kudli, confluence.

f) Region of Deficit

This region is marked from Tungabhadra reservoir till the confluence with River Krishna. DownstreamTB Dam there are 12 anicuts on the left and right banks of the river to facilitate water extraction forirrigation.The water flow regime downstream hasundergone extreme changes and for some years it has had insignificant flow.

1.3 Flow status in the River Basin

From the Table below it can be ascertained that there is sufficient flow within the Tungabhadra River throughout the year and hence Tungabhadra River is sustainable source for Davangere 24 x 7 Water supply scheme.

1.4 Water Availability

The distance from Honnalli river gauging station to the Byadgi water supply intake point is about 32.5 Km, the distance from Honnalli river gauging station to the Davanagere water supply intake point is about 42 Km and distance from Honnalli river gauging station to the Harihara water supply intake point is about 45.5 Km.

The water available in difference months from the year 2009 to 2013 at the Honnalli river gauging station about 42 Km from the intake work at Rajenahally for Davanagere water supply scheme is provided in annexure 1 to 4. The details are downloaded from the Central water commission web site http://india-wris.nrsc.gov.in.

As seen from the annexure-1 to 4, the minimum average water available in the month of Apr-May based on daily discharge data is 2369 MLD and the maximum water available at the station is 4263 MLD. The water supply requirement for the year 2046 for Davanagere is 160 MLD, Harihra is 32.7 MLD, Byadgi is 9.2 MLD and Ranebennur town is 33.50 MLD. The total water demand for the four towns is about 236 MLD only and this can be met from the river discharge flow.

Also based on the estimation of water availability at 50 %, 75 % and 95 % dependability at this nearest river gauging station for the month of April based on the data for the years 2010 to 2013 is 3116 MLD, 2679 MLD and 2328 MLD respectively.

The dependability is studied for the summer season months of April and May. Also based on the estimation of water availability at 50 %, 75 % and 95 % dependability at this nearest river gauging station for the month of May based on the data for the years 2010 to 2013 is 3193 MLD, 2689 MLD and 2398 MLD respectively. It is also to be noted that the distance from the river gauging station upto the final intake point of four towns is only 45 Km.

It is also to be noted that from the daily discharge data, that water is flowing on all the days showing that the river is sustainable source for Byadgi, Harihara and Davangere 24 x 7 Water supply scheme.

Table 2: Flow (MLD) measurement data of River Tungabhadra basin (Source: Water Resource Information System of India)

Gauge station	Year	June	July	August	September	October	November	December	January	February	March	April	May
Shimoga	2009	1,132	102,718	35,462	35,717	19,558	5,759	2,114	391	-	-	-	-
	2010	8,290	43,729	54,070	32,636	17,192	10,376	2,450	-	-	-	-	-
	2011	21,991	58,198	55,191	45,656	10,519	5,190	2,239	528	287	245	373	237
Honalli	2009	2,935	98,395	40,453	54,360	33,240	8,625	3,631	4,731	2,268	2,677	3,431	4,405
	2010	9,412	44,654	52,425	41,570	29,496	24,516	6,755	2,939	2,402	2,083	4,175	3,822
	2011	21,707	55,962	58,766	64,898	14,858	5,803	2,504	1,436	4,828	3,133	4,011	2,745
Holehonnur	2009	2,167	15,607	9,123	19,013	11,999	3,237	1,703	4,802	2,814	3,442	4,661	5,335
	2010	3,936	9,126	8,549	7,400	9,747	13,888	5,046	2,186	4,097	3,284	5,998	5,241
	2011	2,693	8,822	9,556	19,224	7,173	2,770	890	2,150	7,803	5,050	5,492	3,121
Haralahalli	2009	4,204	91,761	42,519	55,407	36,816	10,885	4,341	4,369	1,252	1,049	2,570	5,610

	2010	8,739	35,916	54,370	48,538	37,735	33,176	7,655	2,548	378	-	3,594	3,806
	2011	19,462	49,792	49,304	60,602	15,878	6,086	2,667	320	2,472	1,422	4,298	3,848

Note: Honalli is located at a distance of 42 Km from Rajanahalli on the upstream of River Tungabhadra.

Annexure 1Thungabhadra River Discharge from (WRIS WebGIS-CWC WEB SITE)

Discharge Data: Honnali

Period: 2009-2010

Date/Mor	Jun		Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Paramete	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)
1	2255040	2894400	78848640	50466240	62674560	9953280	6955200	15258240	2194560	2030400	3300480	4579200
2	2393280	3032640	96422400	49714560	50760000	11232000	5201280	16320960	2557440	2168640	3084480	4397760
3	2643840	3533760	56980800	61525440	55693440	9927360	4484160	7283520	2557440	2185920	2816640	4190400
4	2410560	50414400	40703040	55296000	179712000	7905600	4328640	3456000	2557440	1961280	2643840	4034880
5	1900800	66700800	51796800	78494400	154569600	5425920	3620160	4760640	2574720	1969920	2626560	4052160
6	1944000	75193920	51114240	280022400	81164160	5270400	3525120	7663680	2583360	2263680	2600640	4086720
7	1797120	99360000	37091520	182234880	36262080	7966080	3257280	6998400	2436480	2229120	2332800	4164480
8	1797120	69984000	30533760	98012160	30352320	8631360	3248640	7447680	2393280	2280960	2263680	4078080
9	2116800	72023040	32797440	64048320	21582720	5961600	4596480	7940160	2384640	2324160	2272320	4276800
10	8259840	99239040	37955520	46612800	20528640	7032960	4216320	6359040	2505600	2324160	2272320	4302720
11	7171200	92491200	26559360	32840640	18506880	11335680	3611520	4855680	2583360	2324160	2367360	4700160
12	4795200	61810560	19517760	8812800	14852160	13063680	2790720	3499200	2566080	2108160	2358720	4276800
13	3663360	69068160	31423680	15750720	11767680	18178560	2514240	2332800	2401920	2142720	2540160	4760640
14	2782080	67806720	16640640	22619520	45627840	9702720	2868480	1961280	2574720	1710720	2332800	4069440
15	2643840	133781760	5270400	23587200	28745280	8631360	2937600	1788480	2427840	3879360	4993920	3888000
16	3317760	270138240	3749760	28391040	22757760	7560000	3697920	1607040	2427840	3957120	4259520	3309120
17	2514240	315446400	18878400	32037120	20485440	6989760	3663360	2643840	2453760	4043520	4034880	2989440
18	4492800	271900800	54086400	11232000	16277760	6575040	3697920	3188160	2522880	3879360	4786560	7473600
19	2782080	232761600	35743680	60471360	10670400	10713600	3922560	3196800	2410560	3119040	4812480	5451840
20	3352320	141212160	43200000	70485120	9132480	11439360	3905280	3421440	2522880	2756160	4985280	7473600
21	2782080	89449920	30983040	34655040	12191040	7801920	3948480	3404160	2367360	2643840	4881600	6877440
22	2384640	73707840	17400960	42223680	12035520	5970240	3775680	3179520	2324160	2592000	3153600	5313600
23	2557440	81846720	28019520	55563840	11076480	5227200	3594240	2185920	2332800	2246400	2816640	4527360
24	2419200	70459200	36408960	63313920	7810560	11698560	2764800	2790720	2350080	2453760	2877120	3792960
25	2289600	52012800	28728000	48098880	8631360	15716160	1831680	2825280	2548800	2626560	3663360	3723840
26	2289600	39182400	92067840	25557120	8277120	9011520	1304640	3015360	2160000	2669760	4138560	3749760
27	1961280	34663680	53991360	20891520	10687680	6471360	1010880	2730240	2160000	2609280	4147200	3309120
28	1632960	29868480	47770560	13711680	8208000	4795200	976320	2453760	2160000	2643840	4881600	2868480
29	2177280	53654400	35233920	27907200	7456320	4432320	941760	2453760	0	2410560	4639680	2652480
30	2522880	108552960	39182400	26231040	8933760	4138560	1270080	2747520	0	2332800	4043520	2540160
31	0	119664000	34482240	0	9771840	0	10480320	2160000	0	3421440	0	2237760
Q(cubic meters per month)	2935008	95221161	39147840	54360288	32167835	8625312	3514250	4578364	2346207	2590606	3430944	4262865
Q (MLD)	2935	95221	39148	54360	32168	8625	3514	4578	2346	2591	3431	**4263**

Annexure 2: Thungabhadra River Discharge from (WRIS WebGIS-CWC WEB SITE)

Discharge Data: Honnali

Period: 2010-2011

Date/Mor	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar		May
Paramete	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)
1	3464640	8190720	1.08E+08	1.26E+08	42569280	9685440	9970560	4769280	1866240	2712960	2764800	4147200
2	2816640	4847040	78390720	57888000	39882240	10169280	9573120	4320000	1883520	2617920	3006720	5400000
3	3672000	3533760	57965760	48504960	55157760	10506240	9685440	4155840	1978560	2056320	3827520	5054400
4	3214080	34171200	38568960	36270720	1.01E+08	14299200	9650880	4302720	1961280	1840320	3741120	4466880
5	2782080	29514240	1.29E+08	50889600	79410240	16320960	9529920	4449600	1952640	1866240	3792960	4069440
6	2721600	31250880	74053440	33704640	1E+08	17297280	9547200	4596480	3049920	1883520	3836160	3628800
7	2574720	52937280	45195840	40651200	39493440	40219200	9573120	4138560	2877120	1840320	4207680	3248640
8	2376000	19491840	93312000	41057280	44608320	31008960	8700480	3300480	2903040	1719360	4570560	2980800
9	2185920	28512000	75902400	82088640	31942080	47796480	9236160	2617920	2626560	1442880	4579200	2833920
10	1944000	22109760	53766720	56358720	20321280	33445440	6315840	3024000	2617920	1512000	4406400	2652480
11	1814400	16865280	24865920	54432000	19535040	21738240	5736960	2220480	2894400	1918080	2877120	2678400
12	2894400	5520960	29764800	47485440	18092160	41757120	7093440	1944000	2669760	1944000	3689280	2773440
13	2142720	15102720	29833920	39242880	16450560	83842560	7957440	1874880	2687040	2013120	3300480	2859840
14	2384640	7482240	33955200	28788480	17504640	53352000	3888000	1883520	2833920	1909440	3041280	3706560
15	2471040	3931200	44219520	27216000	17599680	26334720	2462400	1814400	2868480	1857600	3689280	3905280
16	2946240	3326400	22127040	13789440	16614720	21384000	2574720	1641600	2617920	1874880	5460480	5132160
17	3153600	4881600	30395520	32892480	16502400	20113920	4147200	1831680	2566080	1598400	5460480	5011200
18	49127040	16148160	32158080	22101120	17755200	26576640	4121280	2427840	2678400	1451520	4345920	5201280
19	31000320	24287040	36305280	28391040	15292800	29514240	4147200	2557440	2617920	1356480	4043520	4708800
20	23267520	15655680	23284800	17081280	14722560	22282560	3939840	2574720	2410560	1468800	3222720	4199040
21	13754880	53714880	20736000	15327360	15621120	17599680	4311360	2566080	2687040	1382400	3248640	4060800
22	11136960	50431680	45187200	17677440	15197760	14437440	5391360	2574720	2704320	1391040	3741120	3507840
23	7957440	58449600	32952960	28209600	14402880	16675200	5304960	2548800	2609280	2626560	6281280	3265920
24	4423680	41506560	51926400	48833280	18541440	17435520	5857920	2609280	2609280	2643840	6791040	2903040
25	3170880	33575040	56851200	51278400	22559040	22455360	7594560	2635200	2617920	2799360	6307200	2592000
26	2496960	88637760	65439360	36936000	15206400	19275840	7292160	2756160	2687040	2168640	5037120	2557440
27	2479680	1.04E+08	51088320	48453120	14506560	14878080	6082560	2790720	2833920	2073600	4207680	3075840
28	49204800	82373760	41109120	48453120	9123840	11923200	5935680	2488320	2756160	2229120	4104000	3335040
29	25790400	1.65E+08	45187200	47675520	13435200	11957760	5918400	2505600	0	2583360	4026240	3196800
30	12985920	1.6E+08	47770560	19422720	10618560	11188800	5944320	2272320	0	2851200	3646080	3231360
31	0	1.54E+08	53369280	0	11335680	0	5166720	1978560	0	2851200	0	4268160
Averate Q(cubic meters per month)	9411840	43213099	50733523	41569632	28544052	24515712	6537135	2844232	2485043	2015628	4175136	3698477
Q (MLD)	9412	43213	50734	41570	28544	24516	6537	2844	2485	2016	4175	**3698**

Annexure 3: Thungabhadra River Discharge from (WRIS WebGIS-CWC WEB SITE)

Discharge Data: Honnali

Period: 2011-2012

Date/Months	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Parameter	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)
1	4078080	21643200	36478080	110073600	18463680	9763200	4648320	872640	2842560	10722240	2056320	4803840
2	3991680	17642880	32158080	228026880	16657920	9244800	3913920	907200	2514240	10558080	2358720	3594240
3	4587840	13037760	64929600	190840320	14135040	8415360	6350400	924480	2410560	8095680	2514240	2617920
4	4311360	23016960	92741760	215913600	12018240	8259840	6514560	820800	2419200	4095360	2756160	2376000
5	3188160	16891200	80049600	147700800	11508480	8510400	3853440	622080	2393280	2963520	2609280	2410560
6	2419200	21548160	100396800	88197120	11197440	12251520	2393280	604800	2574720	2488320	3049920	2125440
7	1961280	22680000	101088000	67314240	9875520	13530240	2064960	613440	3300480	2548800	2859840	2229120
8	2168640	23803200	117158400	67659840	10730880	8372160	2816640	527040	2825280	2393280	2609280	2134080
9	4121280	24848640	89631360	78969600	7395840	9728640	2885760	397440	2833920	2263680	2522880	2160000
10	7948800	22066560	71305920	59996160	7119360	8354880	2825280	397440	3326400	2289600	2540160	2229120
11	10022400	8225280	62441280	63720000	4993920	8519040	2747520	622080	3343680	2255040	2712960	2471040
12	12882240	18368640	46578240	40184640	22222080	5374080	2790720	622080	2972160	2401920	2730240	2920320
13	15621120	16917120	63599040	46984320	15724800	4907520	2643840	673920	2998080	2445120	2756160	5158080
14	26213760	18420480	59071680	38983680	30084480	4622400	2609280	777600	3015360	2013120	2678400	5114880
15	22602240	37730880	46301760	42154560	27129600	4872960	2635200	872640	2859840	2039040	2540160	4656960
16	45351360	33523200	38871360	41662080	37869120	4665600	2643840	786240	2989440	2056320	2548800	3836160
17	28278720	91065600	26853120	99843840	19716480	3792960	2419200	673920	8095680	2151360	2280960	3144960
18	18100800	195480000	43070400	49325760	27950400	2911680	2324160	613440	8069760	2194560	2306880	2773440
19	16839360	164272320	31700160	36538560	19517760	2280960	2134080	786240	9573120	2168640	2505600	2419200
20	23137920	161161920	28062720	39476160	16545600	2272320	1382400	1373760	6410880	2496960	3352320	2056320
21	15785280	107118720	34706880	32719680	8199360	2298240	1088640	1494720	4872960	2488320	3473280	2134080
22	9521280	110324160	57196800	27250560	18636480	2635200	1010880	1805760	3265920	2203200	2825280	2082240
23	8009280	71297280	30862080	27388800	6177600	2626560	1010880	1702080	7931520	2194560	2738880	2099520
24	54216000	73206720	35700480	20381760	4259520	4389120	1097280	1831680	9408960	2237760	4570560	1952640
25	40927680	96396480	41152320	19353600	10627200	3879360	1391040	3231360	8268480	2324160	5149440	1840320
26	36123840	84196800	28581120	16735680	10333440	2851200	1373760	3283200	9573120	2177280	4708800	1702080
27	71383680	38378880	35648640	13763520	8648640	2911680	1382400	3637440	8216640	1823040	4734720	1503360
28	57214080	38612160	35268480	13443840	8121600	3360960	1391040	2894400	8069760	1831680	12856320	1805760
29	61076160	39329280	50518080	11767680	8035200	3913920	1123200	2825280	7464960	1935360	19344960	1952640
30	39139200	25211520	52721280	10558080	12726720	4561920	907200	2980800	0	1995840	7629120	2099520
31	0	42431040	128131200	0	9115200	0	751680	2894400	0	2125440	0	1935360
Averate Q(cubic meters per month)	21707424	54156356	56870152	64897632	14378632	5802624	2423381	1389368	4994516	3031525	4010688	2656103
Q (MLD)	21707	54156	56870	64898	14379	5803	2423	1389	4995	3032	4011	**2656**

Annexure 4: Thungabhadra River Discharge from (WRIS WebGIS-CWC WEB SITE)

Discharge Data: Honnali

Period: 2012-2013

Date/Mont	Jun	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	Apr	May
Parameter	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)	Q(cubic meter per day)
1	1955578	20649600	30774125	57175114	11205907	4458499	1669334	640829	1305245	2371075	2492035	3390077
2	1657584	20046787	25591766	102729600	17383680	21485693	1632096	584755	1235779	2927578	2475706	3307478
3	1041984	18627062	26062301	61171373	12583469	34157722	1533859	591149	1188000	2974752	2350771	3022877
4	763776	66727584	40579229	72460397	11024813	27077760	1520554	664330	1576282	2773094	1948320	2767651
5	499133	26055043	138240000	77048323	14660870	13836614	3511987	691114	1827706	2765491	1773446	2906496
6	479434	21495802	86650387	59391187	6701270	7829309	3355344	729130	1694650	2217802	1464134	2623190
7	436493	19190822	174017117	44692128	6397056	7731504	2404166	634954	1224202	1704154	1355616	2787869
8	399946	17910720	270074045	35045050	8815824	12134016	1771373	572314	1199232	1554509	1354925	3074890
9	407981	12787632	186556003	34326720	7498397	8862134	1228608	545011	1581638	1563408	1345594	2362781
10	375754	8857728	127089562	20887805	5052931	8738496	960854	547344	1632096	1536192	1316909	1893888
11	430445	12269664	137225405	27600912	7409664	8024832	917395	1265414	2197843	1571875	1355616	2259014
12	385776	18164045	118022400	34239197	7668432	9288000	837821	1020211	2337379	1563322	1563062	1780704
13	390442	12469075	94172198	33865517	6083770	8942832	1256602	1033344	2321395	1641341	1806710	1391126
14	301882	6543590	60552835	41485046	5857056	7341235	2060208	996192	2486160	1653523	1832544	1181088
15	296179	18982080	21219840	31447094	5194973	7377523	2144362	1005350	2853878	2016835	1452816	1075939
16	295229	10758355	33031152	26870400	4612550	6034003	1937952	996451	3048970	2206051	1284250	1066781
17	264038	3929386	31454957	26256442	4202582	5064163	2207347	1010621	3113856	2102112	1273363	930614
18	298512	10317110	32004806	13903402	3494362	4004640	1442275	938822	3536525	2315866	1330560	1063152
19	306634	12624854	28157760	22567680	3382733	3444854	1340928	732326	4374950	2386973	1425600	1033344
20	507168	5265043	79030080	19474042	3397766	5868115	1082851	759802	4387219	2422915	6634310	2378678
21	514771	14058144	34160918	14230858	4649184	5008090	978307	652320	4042397	2300400	5961600	2933798
22	516845	35985600	25933997	8656330	9672912	4342810	923011	579571	4445366	2290637	3358368	15427238
23	536544	65838528	17213040	13901760	7788874	6599405	890784	544752	7524662	2296080	2459290	5848934
24	21219840	55942013	16581802	10744099	6507648	5917622	709171	548813	5658336	2158272	2454624	2836771
25	10839139	22750762	16879018	10374653	6482678	3741984	823565	925344	2825280	2136154	2455402	2158272
26	4841856	32342544	20649600	9120816	6075302	2461363	753667	1148256	2373494	2116973	2848003	1583712
27	25767418	44420141	31806000	11091427	5440608	2177798	703210	1228608	2385245	2292883	3106685	1427587
28	15232925	107350272	51272784	6810134	4094496	1812672	759456	1263168	2271024	2415830	3328992	2249424
29	9067939	98668800	35780832	10200038	3342211	2044138	1026778	1264637	0	2516832	3409344	2262125
30	6910186	91769155	74329056	10920960	3362170	1655078	856656	1519258	0	2525818	3857069	2131747
31	0	36808646	50027933	0	3351283	0	772157	1454803	0	2579040	0	1797984
Q(cubic meters per month)	3564714	30632471	68230353	31622950	6883725	8248764	1419764	873838	2737457	2190251	2369189	2675975
Q (MLD)	3565	30632	68230	31623	6884	8249	1420	874	2737	2190	2369	2676