EIA & EMP OF AMARAVATI CAPITAL CITY

Prepared for

Andhra Pradesh Capital Region Development Authority and Capital Area, Vijayawada

Andhra Pradesh

Prepared by

TATA Consulting Engineers Limited

4th Floor, Tower A, 247 Park, LBS Marg

Vikhroli (West), Mumbai

September 2015

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Declaration by Experts contributing to the EIA & EMP Study of **Amaravati City**

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

EIA Coordinator Area Development Project, area ≥50 ha. Category B1

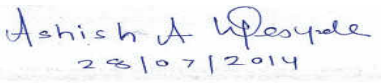
Name: Dr. Alok Kumar

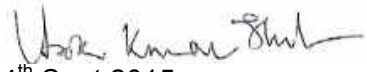
Signature and Date: 4th Sept 2015

Period of involvement: 1st may 2015 to 30th August 2015

Contact information: alokk@tce.co.in Phone: 022 61148181

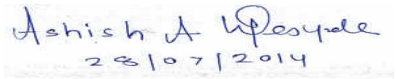
Functional area experts:

S. No.	Functional areas	Name of the expert/s	Involvement (period and task**)		Signature and date
1	AP*	Dr Jyoti Prabha	1st May to 30th Aug 2015	• Baseline study (marking of monitoring location) • Review baseline data • Impact assessment and Management plan	 4th Sept 2015
2	WP*	Ashish Deshpande Team Member Babu Kiran Kumar Sivala	1st May to 30th Aug 2015	• Baseline study selection of sampling locations) • Review baseline data • Review of existing and proposed water balance • Impact assessment and Management plan	 4th Sept 2015
3	SHW*	Dr. Alok Kumar	1st May 2015 to 30th Aug 2015	• Baseline data collection and Quantification • Impact assessment and Management plan	
4	SE*	Mamta Bavaskar	1st May to 30th Aug 2015	• Review of Demographic Characteristics, • CSR Activities, • Impact Assessment and Management Plan	 4th Sept 2015
5	EB*	Dr Alok Kumar	1st May to 30th Aug 2015	• Study of the ecological profile of study area • Impact assessment and report preparation	 4th Sept 2015

S. No.	Functional areas	Name of the expert/s	Involvement (period and task**)		Signature and date
6	HG*	Dr Asok Kumar Gosh	1st May to 30th Aug 2015	• Review of baseline data • Impact assessment	 4th Sept 2015
7	SC*	Dr Alok Kumar	1st May to 30th Aug 2015	• Baseline study selection of sampling locations • Review baseline data • Impact assessment and Management plan	
8	AQ* Team Member Kapil Awtani	Dr Jyoti Prabha	1st May to 30th Aug 2015	• Study of air pollution sources • Impact assessment and Management plan	 4th Sept 2015
9	LU*	Shrikant Patil	1st May to 30th Aug 2015	• Site visit and ground truthing topo sheet and satellite image data • Land use mapping, study and report preparation	 4th Sept 2015
10	RH*	Arshi Bhutani	1st May to 30th Aug 2015	• Study of possible risk, disasters/ hazards and their management	 4th Sept 2015

Declaration by the Head of the accredited consultant organization/ authorized person

I, Ashish Deshpande hereby, confirm that the above mentioned experts prepared the EIA for Amaravati Capital City of Andhra Pradesh in Guntur District. I also confirm that the consultant organization shall be fully accountable for any mis-leading information mentioned in this statement.

Signature: 

Name: Ashish Deshpande

Designation: Deputy General Manager

Name of the EIA consultant organization: TATA Consulting Engineers Ltd.

NABET Certificate No: NABET/ EIA/AR/154

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EIA - FUNCTIONAL AREA CODE

S. No.	Functional Area Code	Complete name of the Functional Areas
1.	**AP**	Air Pollution Prevention, Monitoring & Control
2.	**WP**	Water Pollution Prevention, Control & Prediction of Impacts
3.	**SHW**	Solid Waste and Hazardous Waste Management
4.	**SE**	Socio-Economics
5.	**EB**	Ecology and Biodiversity
6.	**HG**	Hydrology, Ground Water & Water Conservation
7.	**GS**	Geology & Soil
8.	**AQ**	Meteorology, Air Quality Modeling & Prediction
9.	**NV**	Noise/ Vibration
10.	**LU**	Land Use
11.	**RH**	Risk Assessment & Hazard Management

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* The boundaries represented in maps/ figures of this document are based on the Concept Plan. Exact project boundaries are available with APCRDA & CA.

List of Abbreviations

Abbreviation	Expanded version
AD	Anaerobic Digestion
APCRDA & CA	Andhra Pradesh Capital Region Development Authority & Capital Area
APHA	American Public Health Association
APMDP	Andhra Pradesh Municipal Development Project
APPCB	Andhra Pradesh Pollution Control Board
ASI	Archaeological Survey of India
AWWA	American Water Works Association
BAT	Best Available Technology / Techniques
Bgl	Below ground level
BOD	Biological Oxygen Demand
BRTS	Bus Rapid Transit System
CETP	Common Effluent Treatment Plant
CFL	Compact Fluorescent Lamp
CGWB	Central Ground Water Board
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
CPHEEO	Central Public Health and Environmental Engineering Organisation
CSIR	Council of Scientific and Industrial Research
CTE	Consent to Establish
CTO	Consent to Operate
D.G	Diesel Generator
EIA	Environmental Impact Assessment
EMC	Environmental Management Cell
EMP	Environmental Management Plan
EPA	Environmental (Protection) Act
HIG	High Income Group
ICAR	Indian Council of Agricultural Research
IMD	India Meteorological Department
ISWMF	Integrated Solid Waste Management Facility
LED	Light Emitting Diode

LPG	Liquefied Petroleum Gas
LPOC	Land Pooling Ownership Certificate
LSD	Low Sulphur Diesel
MIS	Management Information System
MoEF & CC	Ministry of Environment ,Forests and Climate Change
MRT	Mass Rapid Transit
MSW	Municipal Solid Waste
NAAQS	National Ambient Air Quality Standards
NEERI	National Environmental Engineering Research Institute
NEP	National Environment Policy
NIHL	Noise Induced Hearing Loss
NIO	National Institute of Oceanography
NREGA	National Rural Employment Guarantee Scheme
PP	Project Proponent
PUC	Pollution Under Control
SEAC	State Expert Appraisal Committee
SEIAA	State Environmental Impact Assessment Authority
SPCB	State Pollution Control Board
SS	Suspended Solids
STP	Sewage Treatment Plant
TCE	Tata Consulting Engineers Ltd.
TDS	Total Dissolved Solids
TMC	Thousand Million Cubic Feet
URDPFI	Urban and Regional Development Plan Formulation and Implementation
ULB	Urban Local Body
USEPA	United States Environmental Protection Agency
VGTM	Vijayawada- Guntur-Tenali-Mangalagiri
WPCF	Water Pollution Control Federation
WTE	Waste to Energy
WTP	Water Treatment Plant

Executive Summary

1.0 Introduction

The Government of Andhra Pradesh has decided to establish a green field capital city as a livable, environmentally sustainable and people's capital. For this purpose, the location of the capital was identified between Vijayawada and Guntur cities on the upstream of Prakasam Barrage on the river Krishna, with an area of 217.23 Sq Kms, which is covering a current population of 97960 in 25 villages (As per Primary Census Abstract Tables Census 2011). The proposed capital city is being planned to accommodate a population of 4.5 million by 2050.

The proposed capital city is being developed with 'state-of-the-art' infrastructure including world class roads, water supply facilities, administrative and institutional complexes, drainage, sanitation, Solid Waste Management (SWM) facilities, river front development etc, among others.

The purpose of this proposal including Form 1, Form 1A and Environmental Impact Assessment study is to obtain Environmental Clearance of the proposed Amaravati Capital City of Andhra Pradesh in Guntur District, with an area of 217.23 sq.km. The EIA studies were carried out in accordance with "Standard ToR for EIA / EMP report for Projects/Activities requiring Environmental Clearance under EIA Notification, 2006, April, 2015" published by MoEF & CC, Government of India.

The study and report are prepared considering the concept plan maximum projections for various phases. In case the actual numbers exceed the projections the proponent would approach concerned authorities for seeking amendments.

Scope of this proposal for Environmental Clearance is as per category 8(B) projects of Schedule of EIA Notification 2006 and Amendments thereof. All downstream projects not covered in 8B and attract EC considerations are subjected to prevailing EC guidelines from respective authorities.

1.2 Environmental Setting of the Project

The environmental setting of the project is given in Table 1

Table 1: Environmental Setting of the project

S. No	Particulars	Details
1	Latitude and Longitude	• North East Coordinate- 16º30'30"N, 80º37' E • South West Coordinate- 16º29'N, 80º25' E • North West Coordinate- 16º31'N, 80º22'30" E • South East Coordinate- 16º24'30"N, 80º34' E
2	Elevation above Mean Sea Level	Varying from 18 m to 260 m

S. No	Particulars	Details
3	Nearest Highway	NH16 passing within the boundary of the project site
4	Nearest railway station	K C Canal Railway Station near Tadepalli, 100 m, East direction
5	Nearest airstrip	Gannavaram airport 22 km, North East direction
6	Nearest city	Vijayawada, 3 km North East
7	Rivers	Krishna river on the northern fringes of the project site.
8	Hills/valleys, Monuments	Tadepalli Hills within the project site
9	Archaeologically important places	Undavalli caves and fort within project site.
10	National Parks/ Forest areas	No National Park within the 10km radius. Tadepalli R.F within the project site
11	List of industries in 10 km radius	NTTPS, 4.10 km North East direction
12	Wildlife Sanctuary	None within the 10km radius
13	Core Biosphere reserve	None within the 10km radius

2.0 Project Highlights/ Project Description

The major project highlights are given in Table 2

Table 2: Project Highlights

S. No.	Particulars	Details
General Parameters		
1.	Name of the project	New Capital City - “Amaravati”
2.	Land requirement	217.23 sq km.
3.	Population	4.5 million by 2050
4.	Employment generation	1.8 million jobs by 2050
5.	Phases proposed for development-year-wise	Phase 1: 2015 -2025 Phase 2: 2025 -2035 Phase 3: 2035 -2050
Physical Infrastructure		

S. No.	Particulars	Details
6.	Public transport	135 km of public corridors by 2050
7.	Road network	1000 km of road network by 2050
8.	No. of Bus Rapid Transit (BRT) Lines	5 nos.
9.	Mass Rapid Transit (MRT)	Phase 1: MRT1 (40km) and MRT2 (34 km) Phase 2 : MRT3 (37 km) and MRT4 (36 km)
10.	Power Demand	5530.6 MW by Phase-3
Environmental Parameters		
10.	Water requirement	Municipal : 864 MLD Industrial : 203 MLD Total : 1067 MLD
11.	Capacities of the Water Treatment Plant (WTP)	WTP1 : 260 MLD WTP2 : 500 MLD WTP3 : 400 MLD WTP4 : 70 MLD
12.	Sewage Generation	Municipal Sewage : 1012 MLD Industrial Sewage : 174.6 MLD
13.	Total capacity of STPs	1067 MLD by 2050
14.	Total solid waste generation	3662 TPD by 2050

3.0 Description of the Environment

The primary baseline environmental monitoring survey was conducted during the May - June 2015 for the following parameters

- Micrometeorology
- Ambient air quality
- Noise quality
- Water quality (surface and ground)
- Soil quality
- Terrestrial Ecology
- Socio Economic component

Each of the above parameters has been discussed in brief below:

Micrometeorology

The onsite meteorological parameters viz., wind speed, wind direction, ambient temperature, and relative humidity were recorded for a period of May - June 2015. The automatic weather stations data collected from AP State Planning Department at the three mandal headquarters falling in the project area during the summer

season (March to May, 2015) correlates with monitored data. The winds are predominantly from South and South East direction with speeds of 0.5-2.1 m/s range.

Ambient Air Quality

The baseline ambient air quality was evaluated at 20 locations. All the ambient air quality parameters were found to be within the National Ambient Air Quality Standards (NAAQS, 2009) promulgated by CPCB.

Noise quality

The equivalent noise levels were recorded at 20 locations. The noise levels are within permissible limits for most of the locations falling in the study area. Although, the equivalent noise levels (Leq) both for the day and night time for the residential land use and the commercial land use were found to exceed at certain locations where traffic is more in places like Vijayawada when compared to the ambient air quality standards in respect of noise.

Water quality

- **Ground Water**

The baseline ground water quality was evaluated at 20 locations. The chlorides, fluorides, cadmium, Total Dissolved Solids (TDS) and sulphates at certain locations specifically at Ainavolu village were found to exceed their respective acceptable limits as per IS 10500 for drinking water.

- **Surface Water**

The baseline surface water quality was studied at 15 locations in the study area. The major parameters such as TDS, Chlorides, Sulphates and Nitrates were found to exceed at certain locations, around Lake near Mandadam when compared with the respective acceptable limits as per IS 10500. The Dissolved oxygen levels of some surface water samples show very low levels, indicating contamination of few surface water bodies.

Soil quality

The baseline soil quality was studied at 20 locations. The major parameters such as pH, electrical conductivity and Nitrogen, Phosphorus and Potassium (NPK) were evaluated and compared with the soil classification table published by Indian Council of Agricultural Research (ICAR) and the brief of the results is as under:

- The pH values reflect that the soil showed strongly acidic to moderately alkaline nature during entire study period
- The values of electrical conductivity reflect that the available soil is of good quality within the study area.
- The nitrogen content varies from “less” to “better” as per soil classification table published by ICAR
- The phosphorus content varies from “medium” to “more than sufficient” as per the soil classification table published by ICAR.
- The total potassium varied from “very less” to “average” as per the soil classification table published by ICAR.

Terrestrial Ecology

The ecology and biodiversity studies of the study area show –

Two ecosystems within the project area (aquatic and rocky outcrops) and 3 major ecosystems in the study area - Forest ecosystems (Kondapalli and Tadepalli reserve forests), river ecosystem (Krishna River) and riparian ecosystem (along the banks of Krishna River and Krishna left canal).

There are no rare and endangered species found in the project area as per IUCN list.

Socio - economic survey findings

A baseline socio economic survey was conducted with a sample size of 27 villages out of the 56 villages in the study area. People in the study area are aware of the project activity and they have mostly positive opinion towards the project. The general socio-economic profile in the study area is as follows:

- The main language spoken in the area is Telugu.
- Majority of the villages face the problem of drinking water as the ground water is salty, and people depend on pond water for drinking purpose which is very unhygienic and causes various health problems. A Few people use mineral water for drinking purpose procured from outside, which is expensive.
- Availability of medical facility in the area is poor, and the facilities are available at 4-5 kms away from the villages.
- Education facility is available only up to primary school level in most villages.
- Approach roads to the villages are unpaved (kaccha). The transportation facility is poor. Minimum bus facility is available and the major mode of transportation is private auto- rickshaws and private motor vehicles.
- Electricity is available and is on a satisfactory level and there is no problem of power outage in the area.

The opinions & the expectations of the people from the upcoming project activity are listed below

- Majority of the people opined positively regarding the proposed project and satisfied with the compensation and land pooling process.
- Very few villagers, particularly involved in Jasmine Plantation stated that they are not satisfied with the compensation process.
- Villagers are expecting more information and awareness about project activities.
- Villagers have expectation of improved infrastructure, health facilities and employment from the upcoming project.
- Project Affected People (PAP) mentioned that they have received compensation, but to use it judiciously, they expect authority to provide guidance on entrepreneurial opportunities.

4.0 Anticipated Environmental Impacts and Mitigation Measures

The key impacts along with mitigation measures during the construction phase are listed in **Table 4** below:

Table 4: Environmental/ Social Impacts and Mitigation Measures – Construction Phase

S. No.	Component	Impacts Identified	Suggested Mitigation Measures
1.	Ambient Air Quality	• Emissions from construction equipments, vehicles • Improper handling and storage of construction material • Fugitive dust emissions • Emissions from onsite operation of diesel generators • Burning of waste at camp sites	• Suppression of fugitive dust emissions by spraying water, wetting of the stockpiles, • Proper upkeep of machines and vehicles. • Contractors to maintain proper records for vehicle fleet engaged. • Limited vehicular movement to be permitted on disturbed soil. • Minimum possible drop height to be maintained while unloading /screening of material. • Stockpiling of excess fill material. • Paved roads to be cleaned regularly and un-pave roads to be stabilized and sprinkled regularly. • Vehicle speed to be restricted to 25 km/h on unpaved roads. • Covers and enclosures to be provided for loose construction material at construction site. • Trucks /dumpers engaged to be covered during off site transportation. • Vehicles with valid Pollution under Control (PUC) certificate to be engaged for project. • Upwind fencing to be projects. • Downwash of trucks to be undertaken prior to departure. • Inactive disturbed surfaces to be sprinkled with water on daily basis. • Generators to be used only as backup source.

S. No.	Component	Impacts Identified	Suggested Mitigation Measures
			• Diesel generators to be optimally operated and regularly maintained. • Appropriate stack height as per the CPCB guidelines to be provided for DG sets. • LPG cylinders to be provided in labour canteens and use of fuel wood to be discouraged. • Open burning of waste shall not be permitted.
2.	Water Resources and Quality	• Change in topography and alteration of drainage pattern • Additional pressure on local water resources due to water requirement for construction work and labor camps • Sediment run off from construction area • Disposal of sewage from construction camps • Contamination of surface and groundwater resources	• Water for construction phase to be sourced from existing sources allocated to PP supplemented from authorized sources. • Optimal water conservation measures at camp sites along with adequate awareness programmers to be organized for the workers. • Adequate number of toilets (at least 8-10 toilets per 100 labours) with septic tanks and soak pits arrangements to be provided onsite. • Random disposal of wastewater from labour colonies to be restricted. • Adequate drains and collection sumps to be provided around campsites. • Sludge from waste water treatment systems to be disposed off properly. • Regular removal of debris from construction site to be practiced. • Secondary containment and bund shall be provided around excavated soil or loose construction material. • Storage area to be kept away from the storm water drain. • Oil and grease containing effluents to be pre-treated before discharge. • Silt traps and bunds to be set-up around construction sites. • Adequate slopes and drainage channels to be provided across the project site.

S. No.	Component	Impacts Identified	Suggested Mitigation Measures
			• Rainwater harvesting opportunities to be explored and implemented.
3.	Landscape and Topography	• Change in existing land use from agricultural to mixed use (including industrial and residential) • Change in topography • Change in drainage pattern • Localized flooding and related health issues due to decreased infiltration	• No extra soil to be brought into the site from outside the project boundary for the construction activity. • Excavated soil to be used in level raising; • Greenbelt and green buffers will be developed to improve the landscape. • Land surface contours to be restored in relation to the surroundings. • Construction footprint will be well defined and construction work to be carried out within the Project footprints only.
4.	Soil Resources	• Soil Erosion and compaction • Soil contamination	• Top soil to be preserved and relocated after construction activities. • Clearance of vegetative cover to be minimized to the extent possible and redeveloped latter on. • Site grading and excavation to be undertaken during dry season. • Dikes, berms, drainage swales or ditches to be provided to divert surface run-off. • A retention wall or bund to be provided around the storage areas for excavated soil and other construction material.

S. No.	Component	Impacts Identified	Suggested Mitigation Measures
			• Completed earthworks to be sealed and/or re-vegetated at the earliest with the help of landscape expert. • Stacking of excavated soil material will be made only in earmarked areas. • Excavated soil to be used/ transported at the earliest for filling low lying areas. • Proper routing and adequate capacity of the storm water run-offs drains to be provided. • Movement and parking of heavy machinery and vehicles to be restricted to identified area. • Area used for parking purposes to be restored immediately after completion of each project activity. • All storage facilities to be designed with paved surface, provided with covered shed and adequate containment facility at the construction. • All waste to be handled as per applicable regulations. • Hazardous waste to be handled and disposed off in accordance with the requirements of hazardous waste management rules 2008. • Portable spill containment and cleanup equipment to be made available at construction site and training for use of such equipment to be imparted. • Provision of covered bins at camp sites. • Waste to be segregated in biodegradable and non-biodegradable fraction. • Biodegradable waste to be used for animal feed/ vermi-compost/ manure. • Contaminated sand/ soil shall be prevented during construction activities. • Trainings to be imparted to all workers and subcontractors regarding hazardous waste storage and disposal procedures. • On completion of construction activities, septic tanks for camp sites to be abandoned and

S. No.	Component	Impacts Identified	Suggested Mitigation Measures
			filled with earth.
5.	Traffic and transport	• Increased traffic volume • Damage to existing village roads • Disruption of traffic and increased cases of road related hazards	• Temporary widening at required locations to be undertaken. • Traffic and heavy machinery movement schedule to be communicated clearly to the local inhabitants. Prior consultation with local authorities to be undertaken. • Movement of heavy vehicles to be taken up only during day time in the construction site near habitation areas. • Providing dedicated path within the site for entry and exit of the construction vehicles • Roads damaged due to project vehicles will be continuously repaired. • Provision of adequate training to drivers. • Dedicated parking area to be provided for project vehicles. • Parking along footpaths, single lane roads shall be prohibited. • Detailed plan for signage around the construction areas to be prepared to facilitate traffic movement. • Inventory of the vehicles used in project and construction equipments along with their PUC's to be maintained.
6.	Ambient Noise Quality	• Noise due to Construction activities (such as excavation, grading, erecting equipment, piling, etc) • Noise due to	• Adequate planning to avoid high noise activities to be undertaken. • Acoustic enclosures, noise barriers to be provided in areas of high noise generating sources. • Movement of vehicles during night time to be limited. • Construction workers to use ear muffs /ear plugs in the areas with potential for high noise generation.

S. No.	Component	Impacts Identified	Suggested Mitigation Measures
		operation of heavy equipment and machinery • Movement of vehicles	• Regular maintenance of vehicles and repair of equipments. • Noise barriers will be provided between the activities and the receptors. • Restriction on use of equipments generating high noise during night time. • Working hours and construction activities to be aligned and works to be prohibited during night
7.	Socio-Economic	• Loss of existing village assets • Loss of landholdings • Impact on livelihood of the villages • Loss of livelihood • Loss of Common Property Resources	• All the rules and regulations as per the land pooling act to be observed by the project proponent. • Affected land losers may be considered for benefits like employment, contracts etc. • Compensation for crop entitled persons by the competent authority as per the guidelines of the relevant Acts and Legislations. • Skilled and qualified entitled persons to be given preference in employment and other contractual benefits. • Procurement of community land to be avoided to the extent possible and adequate buffer area to be retained around villages.
8.	Labour Camp Management	• Location of labour camps • Domestic solid waste generation • Firewood for cooking and	• Optimal water conservation measures at camp sites along with adequate awareness programmers to be organized for the workers. • Adequate number of toilets (at least 8-10 toilets per 100 labors) with septic tanks and soak pits arrangements to be provided onsite. • Random disposal of wastewater from labour colonies to be restricted.

S. No.	Component	Impacts Identified	Suggested Mitigation Measures
		burning of garbage • Indoor air quality issues • Waste water generation • Health and hygiene issue	• Adequate drains and collection sumps to be provided around campsites. • Regular removal of debris from construction site to be practiced. • Integrated solid waste management plan will be developed for collection, transportation, treatment and disposal of waste. • Workers to be provided with health and safety training. • Safety measures, including use of temporary fall protection and out edges of elevated work surfaces, such as hand rails and to be boards to prevent materials from being dislodged shall be done for workers while working at heights. • First aid and essential medical services to be provided at site.
9	Occupational Health and Safety	• Injury due to improper handling, operation and execution • Trip and fall, inadequate fall safe arrangements • Exposure to hazardous substances	• Manual transfer of heavy loads to be minimized by proper work site layout. • Good housekeeping practices to be exercised. • Measures such as job rotations and stretch breaks to be adopted. • Proper signage to be provided around construction site. • Use of Personal Protection Equipment (PPEs) to be mandated at work site. • Workers to be provided with health and safety training. • Use of temporary fall protection measures in scaffolds and out edges of elevated work surfaces, such as hand rails and toe boards to prevent materials from being dislodged shall be done. • Safety harness to be ensured for workers while working at heights. • First aid and essential medical services to be provided at site

S. No.	Component	Impacts Identified	Suggested Mitigation Measures
10	Employment and Local Economy	• Increased employment opportunities • Contracting opportunities for locals • Better avenues for Small scale service providers	• Project to utilize the facilities available from the local market to support the local economy to the extent possible. • Wherever possible, labour from local community will be employed for project.
11	Ecology	• Loss of trees and ground vegetation • Habitat destruction • Adverse impact on wildlife due to noise, vehicle movement, poaching, illumination • Increased turbidity and siltation	• Original soil profile shall be retained by storing each excavated layers separately and restoring it later. • Tree felling to be minimized to the extent possible. Contractors shall be instructed to practice the same. • Hunting activities will not be permitted within and around the delineated area. • Raw materials and debris to be stored away from water bodies, streams and run off areas. • Standard noise levels to be maintained during construction activities. • A 'Local Ecological Monitoring Group' will be setup to monitor the environmental and ecological safeguard measures during construction phase.

The key anticipated impacts and mitigations measures during the operational phase are given in Table 6 below

Table 6: Environmental/Social Impacts and Mitigation Measures – Operation Phase

S. No.	Component	Impacts Identified	Suggested Mitigation Measures
1.	Ambient Air Quality	• Emission from power backup/ DG sets • Stack emission from industries • Fugitive emission from industrial processes • Emissions from increase in traffic volume	• Power demand has been estimated as a part of concept plan and dedicated power supply system has been planned for the Capital City Area. • DG sets to be located in the downwind direction with respect to residential areas (village sites). • Stack heights for DG sets to be maintained as per CPCB/ MoEF norms. • Comprehensive planning has been undertaken as a part of concept plan development to mitigate impacts due to industrial zone • Planning ensures that the proposed Industrial areas and existing residential lie in the upwind or cross wind direction. • Residential areas to be separated from industries by the provision of suitable buffers. • Individual industries will be required to obtain adequate approvals such as Consent to Establish / Consent to operate or environment clearance from APPCB / SEIAA / MoEF. • All emission sources to be provided with adequate stack height as per CPCB / MoEF norms. • Low emission fuels to be used by industries. • Air pollution control equipment to be employed by industries. • Good housekeeping to be practiced. • PP to organize seminars and Capacity Building training programmes about the best practices in different industrial sectors. • PP in association with the APPCB to regularly monitor the environmental performance

S. No.	Component	Impacts Identified	Suggested Mitigation Measures
			of the industries.
2	Ambient Noise Quality	• Increase in noise levels in residential areas and adjoining villages • Impact on avifaunal species due to increased noise • Movement of vehicles	• All habitations to have a suitable buffer area delineated around them. • Vegetative barriers in form of green belt to be provided around all industrial areas. • All industrial operations to have acoustic enclosure and employ noise attenuation measures. • All roads and highways to be provided with vegetative barriers and barrier walls.
3.	Water Resources and Quality	• Increase load on fresh water sources • Unplanned disposal of industrial waste water generated and sewage • Inadequate management of storm water • Spills, leaks from	• Individual projects will have separate water meters. • Building and plumbing code will be adhered and dual plumbing layouts are encouraged; • Providing training and education to the public on water conservation habits and the value of drinking water; • Proponent to organize information forums with industry/commercial owners; • To develop a risk management strategy to ensure water safety for the project affected areas; • Monitoring of Unaccounted Flow of Water and detection of leakage shall be done; • A reliable technical department to be formed for maintenance and quality control shall

S. No.	Component	Impacts Identified	Suggested Mitigation Measures
		industries, storage areas • Contamination of natural water sources and ground water aquifers	be established; • Domestic and industrial wastewater generated will be treated separately; • Areas for ground water recharge shall be identified and delineated; • RWH shall be made mandatory for all residential, commercial and industrial buildings and shall be monitored by the Cell periodically. • The cross drainage works will be taken up for free flow of existing runoff channels.
4.	Solid Waste Disposal	• Inadequate collection and treatment of domestic waste • Unhygienic conditions, odour problem • Localized flooding • Contamination of soil and groundwater • Improper disposal of sludge and industrial waste	• Industries generating hazardous waste to comply with the requirements of Hazardous Waste (Management, Handling and Tran boundary Movement) Rules, 1989 and subsequent amendments. • Integrated Solid Waste Management (ISWM) is suggested for management of municipal solid waste. This comprise of waste collection (door-to-door collection), source segregation, transportation, treatment (with biological and thermal processes) and final disposal to landfill (Scientific Landfill (SLF)) of inert and residual waste. • The Municipal Waste (MSW) management is carried out as per MSW Rules 2000 and Draft Rules 2015. • SLF and Waste to Energy (WtE) plants are identified at Naidupet at Guntur (About 30km from Amaravati Capital City). The facility at Naidupet will cater to Vijayawada, Guntur and New capital city. The total area identified is about 78 acres which will suffice to 25 years for waste disposal. • Biomedical waste to be managed in accordance with Bio- Medical Waste (Bio- Medical Waste (Management and Handling) Rules, 1998. • E waste management is as per E-Waste (Management & Handling) Rules 2011. Facilities for E-waste collection and transportation would be provided by Capital Region facility management authorities. Recycling of waste will be carried out off-site by

S. No.	Component	Impacts Identified	Suggested Mitigation Measures
			authorized recyclers. • Recyclable waste to be collected separately and sold to authorized recyclers/ vendors.
5	Traffic Volume	• Increase in traffic flow • Increase in private traffic volume • Traffic congestion • Irregular Parking	• The roads in general to be designed to carry the maximum traffic loads with anticipated future development and on a par with IRC (Indian Road Congress) Standards; • A well planned public transport infrastructure has been planned for the project; • The proposed road circulation shall provide for safe and efficient movement of people; • Maintenance of systematic spatial and technical database for the roads which would enable regular monitoring and feedback on road conditions thereby managing effective periodic maintenance; • Pedestrian Guard Rails, Road safety Signage and overhead signs shall be placed wherever necessary; • BRTS shall be adopted for traffic management, fleet operation, user information and all other relevant parameters. • Also Mass Rapid Transit (MRT) system planned which is as under : Phase 1: MRT1 (40 km) & MRT2 (34 km) Phase 2 : MRT3 (37 km) & MRT4 (36 km) • Non motorized vehicles are encouraged • Each individual project shall develop parking facilities as per the Development Control Regulations (DCR). • Each residential project to provide parking facilities as per applicable norms and regulations.

S. No.	Component	Impacts Identified	Suggested Mitigation Measures
			• Sufficient Loading/unloading space to be provided.
6.	Land use Pattern	• Impacts on existing human settlements	• Adequate buffer has been provided around environmentally sensitive features • Industrial land use has not been proposed in proximity of the sensitive receptors. • All irrigation channels and surface bodies within delineated project area are to be retained. • Measures to be undertaken to restrict unplanned development along the peripheral areas. • To limit the development in the existing settlements, the Urban Planning Department is to define the land use for these regions through the Master Plan and limit the densities in these regions through the application of the local applicable building bye laws.
7.	Ecology	• Impact on flora and fauna of the adjoining green areas • Illegal cutting of trees. • Bird kill • Habitat fragmentation and loss	• The entire capital region would be developed on the theme of Green and Blue. Green represent flora and general greenery of the area, whereas, blue represents water bodies. • All the ecological features like hills and water bodies would be conserved and integrated with the overall development. • Only native and local species will be selected for green belt. • Each industry shall develop green belt in 33% of the total land area as per the CPCB guidelines; • Development around the project area will be regulated and no unauthorized development will be allowed. All migrant workers and local contractors will be provided with fuel arrangements at construction camp site to avoid any discrete collection of fuel wood.

S. No.	Component	Impacts Identified	Suggested Mitigation Measures
			• No activities shall be planned in the green buffer other than approach/ service road, social forestry and horticulture, public amenities (activities which would not result in damaging the green cover). • The fronts of river, drain, canal and Nallas, etc. passing through the town are planned as green areas.
8	Socio-Economic & Cultural Impact	• Increased employment and business opportunities • Improvement in infrastructure • Increased income levels • Stabilization of the rural economies • Potential for cultural conflict • Unplanned secondary development in the adjoining areas	• Proponent to extend the infrastructure facilities such as water supply, power, transportation etc. to the villages in the project area. • Mechanism to train and improve the skill sets of the local community. • MGNREGA Works will be made available throughout the year. • The land pooling benefits will be transferred to the PAP's through dedicated functionary and monitored for its implementation periodically. • Based on the educational levels of local villagers employment opportunities are extended to them in potential areas. • Various ongoing Welfare Schemes of Government of India, Government of Andhra Pradesh Like Pensions, Pavala vaddi scheme for women self help groups, Swachha Bharat Schemes, Stree-Nidhi etc. will be implemented with strengthened mechanism to enable 100% coverage.

6.0 Environmental Monitoring Programme

The environmental monitoring plan for the proposed project has been developed in view of the institutional, scientific and fiscal issues pertaining to the project. For each component, suitable measurable environmental indicators which are appropriate to the impact mechanism and scale of disturbance and have a low natural variability, broad applicability and an existing data series have been defined.

A comprehensive environmental and social monitoring plan has been developed for the various phases of the Capital City area. Monthly review meetings shall be carried out by APCRDA & CA to check for unplanned growth in protected areas. Water resources availability shall be regularly monitored by APCRDA & CA. APCRDA & CA shall also work in association with the Pollution Control Board (PCB) to monitor environmental compliance of individual projects and environmental quality of the region.

A detailed monitoring covering all the environmental parameters is suggested and the costs of which are included in the Report. This monitoring plan and allocated budgets are exclusive of Monitoring Plan that may be separately taken up by regulatory body like the APPCB. APCRDA & CA may actively collaborate and augment the monitoring as well as enforcement efforts together with the APPCB.

7.0 Environmental Management Plan

Amaravati City development is phased over multiple years and as such the priority environmental considerations would require specific attention co-terminus with the development phasing of the project, the EMP submitted herein is a guiding and inclusive document and the development dynamics should be accounted for while implementation.

An Environmental Board and an Environment Management Cell which will monitor the environmental parameters which are crucial to the effective implantation of the environmental protection measures will be established.

The Board and the Cell will be involved in framing of Respective applicable Development Control Regulations (DCRs) for Amaravati and would be part and parcel of enforcement mechanism of APCRDA & CA.

APCRDA & CA has already initiated an EMC structure, for the implementation of the EMP measures for all the components of Environment Management and demonstrate Amaravati as the polestar for all such future developments.

8.0 APCRDA & CA Road Map for Policy

1. Expert level brainstorming workshop and inviting inputs at policy and plan level
2. Draft a detailed Plan of Action - Monitoring to policy
3. Build a repository of baseline data on a timeline
4. Environmental Board and Cell
5. Environmental board - DCR and other guidelines

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CHAPTER 1

INTRODUCTION

1.1. Introduction

The Andhra Pradesh Reorganization Act 2014 (Central Act 6 of 2014), which came into force on 2nd June, 2014, provided for the reorganization of the existing state of Andhra Pradesh. One of the most critical priorities for the new state is the formation of the New Capital city, which is very important from the perspective of economic development, cultural integrity and administrative functioning.

The Government of Andhra Pradesh has decided to establish a green field capital city as a livable, environmentally sustainable and people's capital. For this purpose, the location of the capital was identified between Vijayawada and Guntur cities on the upstream of Prakasam Barrage on the river Krishna, with an area of 217.23 Sq Kms., which is covering a current population of 97960 in 25 villages (As per Primary Census Abstract Tables Census 2011). The proposed capital city is being planned to accommodate a population of 4.4 million by 2050.

The proposed capital city is being developed with 'state-of-the-art' infrastructure including world class roads, water supply facilities, administrative and institutional complexes, drainage, sanitation, Solid Waste Management (SWM) facilities, river front development etc, among others.

As per the EIA Notification, 2006 and its amendments thereof, all projects covering an area of ≥ 50 ha or built up area ≥ 1,50,000 sq.m shall require prior environmental clearance from State Environmental Impact Assessment Authority (SEIAA). Further as per the said Notification these projects fall under the Category of Township and Area Development projects and shall be appraised as 'B1' projects, i.e., will entail an Environmental Impact Assessment (EIA) Report. Also these projects are exempted from the process of public consultation. As the area of the Amaravati City is 21723 hectare this project will also be categorized as B1 project and will require an EIA report.

The present Environmental Impact Assessment study is conducted for obtaining Environmental Clearance of the proposed Amaravati Capital City of Andhra Pradesh in Guntur District of Andhra Pradesh with area 217.23 sq.km.

1.2. Project Proponent

The Government has enacted **Andhra Pradesh Capital Region Development Authority Act 2014** (Act No. 11 of 2014) and it got assent of the Governor of Andhra Pradesh on 29-12-2014 and it came into force w.e.f., from 30-12-2014. Section 3 of the Act enables the State Government to declare by Notification the "Capital Region" and "Capital City Area" for the State of Andhra Pradesh.

Section 4 of the Act enables establishment of **Capital Region Development Authority** for the purpose of planning, co-ordination, execution, supervision, financing, funding and for promoting and securing the planned development of the Capital Region and Capital city area for the state of Andhra Pradesh and for managing and supervising urban services in the new capital area and for the

matters ancillary thereto. The Government notified 7068 Sq. Kms area for Capital Region vide G.O.Ms.No.253 MA & UD (M2) Department dt 30.12.2014.

The application for environmental clearance for Amaravati city development is made by the **Andhra Pradesh Capital Region Development Authority- Capital Area (APCRDA & CA).**

1.3. EIA Consultant

Tata Consulting Engineers Pvt. Ltd. has been appointed by proponent to carry out environmental impact assessment of the proposed Andhra Pradesh Capital City - Amaravati. The company is accredited to perform Environmental Impact Assessment of Category B "Building And Large Construction Projects" and "Township and Area Development Projects" by National Accreditation Board for Education and Training (**NABET**) a mandatory procedure by Quality Council of India (QCI) as mandated by Ministry of Environment and Forests and Climate Change (MoEF & CC), India.

Tata Consulting Engineers (TCE) has multidisciplinary expertise spanning over 50 years in various sectors, viz.- Power , Infrastructure public health Iron & steel, Mining, chemical, construction, ports and harbours, etc. The Environmental division of TCE is engaged in supporting the core business for last 50 years and has multi sectoral expertise.

In order to obtain the required Environmental Clearances, M/s Tata Consulting Engineers Limited, Mumbai, (TCE) has been entrusted with the task of undertaking Environmental Impact Assessment (EIA) study and preparation of Environmental Impact Assessment report. This EIA report is prepared based on the data and information provided by the proponent (APCRDA & CA) and the field studies undertaken by TCE during the summer season 2015. The EIA Report is based on the MoEF Manual for 'Large Area Development' projects.

1.4. Scope of EIA Study

The proposed project falls under the category of Township and Area Development Projects as per the EIA Notification 2006. Recently projects of similar nature like EIA study of Naya Raipur City proposed in Chattisgarh (December 2008) and GIFT City (2009) in Gujarat have received Environmental Clearance as per EIA Notification 2006. The EIA study conducted for the above mentioned projects and the environmental clearance received for the same were considered to refine the scope of the current study.

While the **project area** is the area of the Capital City, i.e. 217.23 Sq Km, the **study area** covers a radius of 10 km around the proposed project site under the Guntur District of Andhra Pradesh State.

The scope of study broadly includes:

- Literature review and collection of relevant data;
- Establishing the baseline environmental status of the study area;

- Identification of existing pollution loads due to various activities in the ambient levels;
- Prediction of the levels of pollutants in the study area due to the proposed activity;
- Preparation of Environmental Management Plan (EMP) outlining the measures for improving the environmental quality for environmentally sustainable development; and
- Identification of critical environmental attributes required to be monitored during the implementation.

1.5. Approach and Methodology of the EIA Study

1.5.1. Approach

The approach developed for EIA study includes following aspects:

- Standard TOR for Area Development issued by Ministry of Environment and Forest and Climate Change (MoEF&CC) is followed;
- Collection of information on the Project from primary and secondary sources;
- Collection of environment and social baseline data with reference to the biological, physical and social components of environment within 10 km radius from the periphery of the project site
- Identification and analysis of existing applicable State and Central legislations
- Identification, prediction, quantification and evaluation of potential impacts of the proposed project
- Delineation of mitigation measures for adverse impacts (during Construction and Operation Phase)
- Generic Risk Assessment and Mitigation Measures for proposed project.
- Preparation of Environmental Management plan (EMP) including mitigation measures and monitoring plan.

1.5.2. Methodology

The reconnaissance survey was conducted by TCE to identify the sampling locations on the basis of predominant wind directions in the study area as recorded by India Meteorological Department (IMD) station at Gannavaram airport, existing topography, location of surface water bodies like ponds, canals and rivers; location of villages/ towns/ sensitive areas; comparison with earlier EIA studies, accessibility, power availability and security of monitoring equipment, pollution pockets in the area; and areas that best represent the baseline conditions.

The field data generated by TCE has been used to: Gauge the baseline status of the area, Identify impacts of the proposed project on natural resources/ community access and predict likely impacts due to the proposed activities, identify mitigation measures and monitoring requirements. The study also provides framework and institutional strengthening for implementing the mitigation measures. Field studies

have been conducted by TCE for various environmental attributes as outlined in **Table 1-1.**

Table 1-1 Environmental Attributes and Frequency of Monitoring

S. No	Attribute	Parameters	Frequency of Monitoring
1	Ambient Air Quality	PM2.5 and PM10, SO2, NOx	24 hourly samples twice a week at 20 locations for one month
2	Meteorology	Wind speed, wind direction, temperature, relative humidity, rainfall, atmospheric pressure	Continuous during study period with hourly recording at the project site as primary data. Data collected from secondary sources like IMD station, Gannavaram, 3 stations from 3 mandal HQs
3	Water Quality	Physical, Chemical and biological parameters	Grab Samples are collected once during the study period from 35 locations. (15 surface and 20 ground water samples)
4	Ecology	Existing terrestrial and aquatic flora and fauna in 10 Km radius.	10 km through field visit for primary data collection
5	Noise Levels	Noise levels in dB (A) in 10 km radius area.	Continuous recording at 20 locations for 24 hours per location once during the study period
6	Soil Characteristics	Parameters related to agricultural and afforestation potential	Once during the study period at 20 locations.
7	Land Use	Trend of land use change for different categories.	Based on primary data published in top sheet of the area and the satellite images
8	Socio-Economic Aspects	Demographic Pattern, occupational structure, health status, etc	Based on data collected from secondary sources Primary Census Abstract 2011 and Primary Survey of the villages.
9.	Geology	Geological history, major features	Based on data collected from secondary sources and field visit.
10.	Hydrology	Drainage area and pattern, aquifer characteristics, recharge and discharge areas	Based on data collected from secondary sources.

1.6. Contents of the Report

The entire EIA report comprises of ten Chapters as per the generic structure outlined by Ministry of Environment Forest and Climate Change in the EIA Notification 2006, the broad level chapter contents of the EIA Report are as follows:

Chapter 1.0 Introduction

This chapter provides background information of the project proposal, need for the project, scope, methodology and organization of the study.

Chapter 2.0 Regulatory Framework

This chapter describes the various regulatory framework in terms of Acts, Laws, Policies and National and International treaties to which India is signatory and are applicable to the project and their respective implications.

Chapter 3.0 Project Description

This chapter presents the background information of the project set up, the project location details and the environmental settings, and the various project related information like land details, the project vision, goals and strategy.

Chapter 4.0 Amaravati City Development Concept Plan

This chapter elaborates the entire development plan of the proposed development including the development strategies, the phasing and the Zoning Plan, Infrastructure development plan etc.

Chapter 5.0 Description of the Environment

This chapter presents the methodology and findings of field studies undertaken to establish the baseline conditions for the various environmental attributes enlisted in Table 1- 1 above.

Chapter 6.0 Anticipated Environmental Impacts and Mitigation Measures

This chapter details the prediction of impacts using available information, assessment of impact of the proposed project activities and identification of areas of concern, which need to be mitigated.

Chapter 7.0 Environmental Monitoring Programme

This chapter presents the environmental monitoring program w.r.t. the general and criteria pollutants w.r.t. various environmental components as per the guidelines of CPCB during and after the establishment of the proposed project.

Chapter 8.0 Environmental Management Plan

This chapter outlines the institutional arrangements and budgetary provision for implementation of the proposed environmental monitoring plan to check the efficacy of the environmental mitigation measures proposed.

Chapter 9.0 Summary and Conclusions

This chapter outlines the findings of the environmental impact assessment and the necessary suggestions for implementation to reduce any significant impact of the project on the environment.

Chapter 10.0 Disclosure of Consultants Engaged

This chapter outlines the brief background of the consultants engaged w.r.t their technical expertise and nature of services undertaken.

CHAPTER 2

REGULATORY FRAMEWORK

The Article 48-A of the Constitution of India states that the State shall endeavor to protect and improve the environment to safeguard the forest and wildlife of the country. At the same time, it shall be the fundamental duty of every citizen of India under Article 51-A (g) of the Constitution of India, to protect and improve the natural environment including forests, lakes, rivers and wild life.

Over the years, the Government of India has framed several policies and promulgated number of Acts, Rules and Notifications aimed at management and protection of the environment. As a result, our country now has a fairly complex body of environmental legislation aimed at ensuring that the development process meets the overall objective of promoting sustainability in the long run.

The present chapter focuses on the rules and regulations pertaining to and applicable for the proposed project. The regulatory framework has been studied covering the applicability and where possible, the project specific implications of relevant legislation. An Environmental Management Plan (EMP) has been formulated to ensure compliance with these Acts.

2.1. Environmental policies

Several environmental policy statements have been formulated in the last few decades as a part of the Government's approach to integrate environmental and developmental aspects of planning. The policies reflect a gradual shift in emphasis from pollution abatement and control to proactive and voluntary approaches for pollution prevention in keeping with global paradigm shifts and trends in environment management.

Following are some of the key policies that have been laid down by the Central Government:

- National Forest Policy, 1988;
- National Conservation Strategy and Policy Statement on Environment and Development, 1992;
- Policy Statement on Abatement of Pollution, 1992.

Despite these policy documents a need for a comprehensive policy statement it had been evident for some time in order to infuse a common approach to the various sectoral and cross-sectoral, approaches to environmental management. As a result, a National Environment Policy (NEP, 2006) has been drawn up as a response to our national commitment to a clean environment, mandated in the Constitution in Articles 48 A and 51 A (g), strengthened by judicial interpretation of Article 21. The National Environment Policy is intended to be a guide to action: in regulatory reform, programs and projects for environmental conservation; and review and enactment of legislation, by agencies of the Central, State, and Local Governments.

2.2. Legal Provisions for Environment for Proposed Development

The proposed project would be governed by various Acts, Rules and regulations enforced by Ministry of Environment and Forests and Climate Change (MoEF&CC)

at the Central level and other regulatory agencies at the State and local levels. Various environmental standards, specifications and guidelines of Central Pollution Control Board (CPCB) and state level agencies will also be applicable.

The various environmental regulations as applicable to the project are briefly described in the following sections below:

2.2.1. Clearance Required

Environmental Impact Assessment Notification, 2006

Projects or activities listed in the Schedule to this notification shall require prior environmental clearance from the Expert Appraisal Committee (EAC) of Ministry of Environment and Forests & Climate Change for developmental activities falling under Category 'A' of the Schedule and from the State Environmental Impact assessment Authority (SEIAA) at the State level for development activities falling under Category 'B' of the said schedule, before any construction work, or preparation of land by the project proponent (PP).

Implication: The Amaravati City development project requires Environmental Clearance from the State Expert Appraisal Committee (SEAC) and State Environmental Impact Assessment Authority (SEIAA) of the state of Andhra Pradesh under the Category 8(b) Township and Area Development Projects as per the EIA Notification 2006. The General Condition (GC) clause as per the EIA Notification is not applicable for this project vide Amendment 22nd December (SO No-3252E) of EIA Notification 2006.

Forest (Conservation) Rules, 2003

Every user agency, that wants to use any forest land for non-forest purposes, shall make its proposal in the appropriate form to the concerned nodal officer authorized on this behalf by the State Government, along with requisite information and documents complete in all respects, well in advance of taking up any non-forest activity on the forest land.

Implication: The Amaravati City development project has a Reserve forest patch of approximately 251.814 hectares, it is decided by the Government that this land will be de-notified. Proposal for de-notification of the same is under process.

2.2.2. Environmental Acts

2.2.2.1. The Environment (Protection) Act, 1986

The Government of India (GOI) has framed an 'Umbrella Act' called the Environment (Protection) Act, 1986 which is designed to provide a framework for the coordination of central and state authorities established under Water and Air Act. The Environment (Protection) Act, 1986 is established by the GOI to fulfill its commitment to protect and improve the human environment. It is applicable to the entire country. From time to time the central government has issued notifications under the EPA, Act 1986 for the protection of ecologically-sensitive areas or issues guidelines for matters under the EPA.

It empowers the Central Government to take necessary measures for the purpose of protecting and improving environmental quality and preventing, controlling and abating environmental pollution. Important powers of the Central Government include laying down standards for environmental quality and emission/ discharge of environmental pollution from various sources. These powers define procedures and establish safeguards for handling of hazardous substances, and establish rules to regulate environmental pollution.

Separate Noise regulations for DG sets of various capacities were introduced in 2002 vide notification of MoEF&CC of 17th May 2002 under the Environmental (Protection) Second Amendment Rules 2002. This requires that all DG sets should be provided with exhaust muffler with insertion loss of minimum 25 dB (A). All DG sets manufactured on or after 1 July 2003 shall comply with these regulations.

Implication: All the applicable rules and regulations shall be followed by AP-CRDA&CA provided in the Act towards planning of activities in the project area. For all the activities to be undertaken in Amaravati City development project; the maximum allowable limits of concentration of various environmental pollutants will be followed as per the standards of quality of air, water, or soil for various areas and purposes.

2.2.2.2. The Water (Prevention & Control of Pollution) Act, 1974 (Water Act)

The purpose of this act is to prevent and control water pollution and to maintain or restore the quality of water. In order to achieve its goals this act empowers the CPCB and SPCB and defines their functions.

This Act requires any new development, industries, local bodies and agencies engaged in any trade to obtain consent from the SPCB for discharge of effluent into water bodies. The SPCBs have the authority to enforce this Act, if any projects discharge effluent in water bodies, land or sea.

The Environment (Protection) Rules under the EPA also lay down specific standards for quality of water effluents to be discharged into different type of water bodies (sewers, surface water bodies like lakes and rivers, marine discharge).

Implication: For any activities falling in categories as per Andhra Pradesh Pollution Control Board (APPCB), Consent to Establish (CTE) will be obtained before starting the construction and Consent to Operate (CTO) before commissioning the activity.

2.2.2.3. The Air (Prevention and Control of Pollution) Act, 1981

The purpose of this act is to prevent, and control air pollution including noise pollution and preserve air quality. In order to achieve its goals, this act empowers the CPCB and SPCB and defines their functions. An important function of the CPCB is to establish Environmental standards.

This Act requires industries, local bodies and agencies engaged in any trade to obtain consent from the SPCB prior to releasing emissions into air. The SPCBs have the authority to enforce this Act.

Implication: For any activities falling under categories as per Andhra Pradesh Pollution Control Board (APPCB), Consent to Establish (CTE) will be obtained

before starting the construction and Consent to Operate (CTO) before commissioning the activity.

2.2.2.4. The Municipal Solid Wastes (Management and Handling) Rules, 2000 and Draft Rules 2015

As per this rule, every municipal authority shall, within the limits of the municipality, be responsible for the implementation of the provisions of these rules, and for any infrastructure development for collection, storage, segregation, transportation, processing and disposal of municipal solid wastes.

The Solid waste management for the proposed project will be as per the; Municipal Solid Wastes (Management and Handling) Rules, 2000 and draft Rules 2015, Ministry of Environment and Forests, The Hazardous Wastes (Management, Handling and Trans-boundary Movement) Rules, 2008, E waste (Management and Handling) Rule, 2011, Bio-Medical Waste (Management and Handling) Rules, 1998 and its amendments thereof and Andhra Pradesh Pollution Control Board (APPCB), Andhra Pradesh Guidelines. Recent technologies for Waste to Energy (WtE) conversion will also be used in the proposed development.

2.2.2.5. The Hazardous Wastes (Handling and Management) Rules, 1989 and subsequent amendments

These rules were notified on 28th July 1989, under the Environment Protection Act, 1986. They aim at controlling the generation, collection, treatment, transportation, and disposal of hazardous wastes. These rules have been amended subsequently in, 2000, 2003 and 2009. Hazardous waste generated during construction & operation phase are covered under the ambit of this act. The industries are required to obtain prior authorization from the SPCB for handling, treatment, storage and disposal of Hazardous Wastes.

2.2.2.6. E waste (Management and Handling) Rule, 2011

This rules covers producer, consumer or bulk handling involved in the manufacture, sale purchase and processing of electrical and electronic equipment or components as specified in this rule. Environmentally sound management of e-waste means taking all steps required to ensure e-waste is managed in a manner which shall protect health and environment against any adverse effects, which may result from hazardous substance contained in such waste.

2.2.2.7. Bio-Medical Waste (Management and Handling) Rules, 1998, amendment 2003

As per this rule it shall be the duty of every occupier of an institution generating bio-medical waste which includes a hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, blood bank by whatever name called to take all steps to ensure that such waste is handled without any adverse effect to human health and the environment. Every occupier, where required, shall set up in accordance with the time-schedule in Schedule VI, requisite bio-medical waste treatment facilities like incinerator, autoclave, microwave system for the treatment of waste or ensure requisite treatment of waste at a common

waste treatment facility or any other waste treatment facility. This rule specifies guidelines for segregation, packaging, transportation, storage, treatment and disposal of biomedical waste.

Implication: Facilities for treatment and disposal of biomedical waste already exist at Guntur and Vijayawada. These facilities will be utilized for the proposed project. Augmentation of the facilities will be done as and when required with respect of the prevailing norms. These two facilities or any new facility that is proposed shall have to comply with the provisions of these Rules.

2.2.2.8. Fly Ash Notification, 1999, amendment 2009

The MoEF&CC, GoI has issued a Notification regarding the utilization of fly ash/ bottom ash generated from coal/ lignite based thermal power plant, with an intention to protect the environment, conserve top soil and prevent the dumping and disposal of fly ash discharged from coal or lignite based thermal power plants. As per this notification, every construction agency engaged in the construction of buildings within a radius of hundred kilometers from a coal or lignite based thermal power plant shall use only fly ash based products for construction, such as: cement or concrete, fly ash bricks or blocks or tiles or clay fly ash bricks, blocks or tiles or cement fly ash bricks or bricks or blocks or similar products or a combination or aggregate of them, in every construction project.

Implication: In view of the existing thermal power plants in vicinity of the proposed development, Proponent and other stakeholders will follow this notification and will use fly ash based construction material as indicated in this notification.

2.2.2.9. Ancient Monuments and Archaeological Sites and Remains Act 1958 and Ancient Monuments and Archaeological Sites and Remains Rules, 1959

This Act provides for the preservation of ancient and historical monuments and archaeological sites and remains of national importance and for the regulation of archaeological excavations and for the protection of sculptures, carvings and other like objects. According to this Act, areas within the radii of 100m and 300m from the "protected property" are designated as "protected areas" and "controlled areas" respectively. No development activity (including building, mining, excavating, blasting) is permitted in the "protected areas". Development activities likely to damage the protected property are not permitted in the "controlled areas" without prior permission from the Archaeological Survey of India (ASI) if the site/remains/ monuments are protected by ASI or the State Directorate of Archaeology.

Implication: Famous Undavalli caves an archeologically important site falls within the project boundary. The proponent will follow respective regulations in this regard.

2.3. National and International Institutional Framework

India's environmental regulatory framework is based on a system of shared central government/ state pollution control administration. Since the passage of the Environment Act of 1986, the enforcement and oversight role of the central government, and particularly of Ministry of Environment & Forests & Climate Change, has been strengthened considerably. At the national level, the Central Pollution Control Board administers air and water regulatory efforts. This board is

responsible for coordination of activities and guidance in formulation of standard for its state counterparts. The State Pollution Control Boards are responsible for enforcing the regulations. The states may adopt standards that are more restrictive than those of the CPCB, but they may not relax them.

2.3.1. Ministry of Environment & Forests and Climate Change

Ministry of Environment and Forests and Climate Change (MoEF & CC) plays a pivotal role in environmental management for sustained development and for all environmental matters in the country. The major responsibilities of MoEF&CC include:

- Environmental resource conservation and protection, including environmental impact assessment of developmental projects.
- Co-ordination with the other ministries and agencies, voluntary organizations and professional bodies on environmental action plans.
- Policy-planning.
- Promotion of research and development, manpower planning and training and creation of environmental awareness.
- Liaison and coordination with international agencies involved in environmental matters.

Project proponents who are planning to undertake developmental activities have been mandated by MoEF&CC to submit Environmental Impact Statements to establish that they have planned to install adequate pollution monitoring equipment in order to comply with the relevant statutes and regulations as applicable to their scope of activities

2.3.2. Central & State Pollution Control Boards

The Central Pollution Control Board is directly responsible for pollution control throughout the boundaries of the country. In addition to the control of air, noise and water pollution it is also responsible for ensuring effective control on disposal of hazardous wastes and storage and handling of hazardous chemicals and substances.

Additionally, with the enactment of air and water pollution laws, states have set-up their own Pollution Control Boards (SPCBs) to monitor industrial emissions and effluents and to approve the operation of new industries after careful scrutiny. The functions of the SPCBs include:

- The planning of comprehensive state programs for the prevention and control of air and water pollution and to ensure the implementation thereof;
- Inspection of control equipment, industrial plants, etc.;
- Establishing norms in consultation with the CPCB with respect to National Ambient Air Quality Standards, gaseous emission standards from industrial plants, automobiles, etc. Different emission standards may be laid down for different industrial plants, with respect to the quantity and

composition of emissions into the atmosphere from such plants and the general pollution levels in the area;

- Advising the State Government on siting of new polluting industry.

2.3.3. Kyoto Protocol

The emission of significant amounts of carbon dioxide and other greenhouse gases, primarily by industrialized and developed nations, has come into sharp focus in the last few decades as it may result in rising raise global temperatures and resultantly cause change in climatic patterns across the globe. To address this issue, the Kyoto Protocol further supplements and strengthens the United Nations Framework Convention on Climate Change - an international treaty on climate change under which developed countries have committed to reduce their emissions of carbon dioxide and five other greenhouse gases. The treaty was negotiated in Kyoto, Japan in December 1997, opened for signature on March 16, 1998, and closed on March 15, 1999. As of September 2005, a total of 156 countries have ratified the agreement (representing over 61% of global emissions).

India has formally accepted the treaty by ratifying on the 26th of August, 2002 and thus, the aim of APCRDA & CA will be to abide by the objectives of the protocol. APCRDA & CA will focus on the minimum emission of green-house gases like CO_2 and the optimal use of fuel resources in Amaravati and environs.

2.3.4. Montreal Protocol & the Vienna Convention

Scientific concerns about damage to the ozone layer prompted governments to adopt the Vienna Convention on the Protection of the Ozone Layer in the year 1985. Then, two years later, in 1987, the Montreal Protocol was legally adopted and required industrialized countries to reduce their consumption of chemicals harming the ozone layer. As of September 2002, 183 countries have ratified the Montreal Protocol which sets out the time schedule to "freeze" and reduce consumption of ozone depleting substances (ODS). India acceded to the Montreal Protocol on 17th September 1992. India commonly produces and uses seven of the 20 substances controlled under the Montreal Protocol. These are CFC-11, CFC-12, CFC-113, Halon-1211, Halon-1301, Carbon tetrachloride and Methyl chloroform. India is presently considered to be the second largest CFC producer in the world, after China. The Government of India has entrusted the work relating to ozone layer protection and implementation of the Montreal Protocol to the Ministry of Environment and Forests (MoEF) and Climate Change which is the coordinating Ministry in India for all matters relating to the Montreal Protocol.

2.3.5. Stockholm Convention

The Stockholm Convention is a global treaty in response to the urgent need to protect human health and the environment from persistent organic pollutants (POPs). The Convention was adopted with the formal voted approval of delegates from 127 countries on 22 May 2001, at Stockholm in Sweden.

POPs are toxic, and have the potential to injure human and other organisms even at concentrations as low as parts per billion (ppb). The 12 initial POPs referred to as "Dirty Dozen" are aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, mirex,

toxaphene, polychlorinated biphenols (PCBs), hexachlorobenzene, dioxins and furans.

The proponent will thrive to ensure that the usage of such chemicals falling under the POPs category is avoided to the extent possible in any of the planned developmental activities.

CHAPTER 3

PROJECT DESCRIPTION

3.1. Background

The Andhra Pradesh Reorganization Act 2014, which came into force on 2nd June, 2014, provided for the reorganization of the existing state of Andhra Pradesh. The formation of a new capital city - critical for its administration, economic development, and cultural integration – is an immediate priority for the Successor State of Andhra Pradesh.

In accordance with Section 6 of the Act, on 28.03.2014, the Government of India constituted "an expert committee to study various alternatives regarding location of the new capital for the successor State of Andhra Pradesh and make appropriate recommendations". The five member expert committee, headed by Shri KC Sivaramakrishnan submitted their final report to the GoI on 27.08.2014. The Committee studied multiple options, and also highlighted the need to ensure balanced regional development. The Committee explicitly acknowledged that the "decisions regarding capital city or location of capital functions is a prerogative of the AP Government in consultation with the Central Government".

In this context, the Cabinet of the Government of Andhra Pradesh met on 01.09.2014, and resolved, "To locate the Capital City in a central place of the state, around Vijayawada, and to go for decentralized development of the State with 3 Mega Cities and 14 Smart Cities. It is proposed to go for Land Pooling System to be worked out by a Cabinet Sub Committee".

In this context, as resolved by the Cabinet, the State Government is of the opinion that the interests of the entire state and its balanced development can be best served by locating the capital city at a central place around Vijayawada. This would enable equal access to people from all regions of the State.

As regards the new Capital, the Government is deeply committed to ensuring that the process of building the new capital involves the participation of people. It is in this context that the Cabinet has suggested the use of Land Pooling schemes to consolidate the land required for the capital. This will enable the local landholders to proactively participate and benefit from the development of the capital city, and will create a win-win situation for the landholders, citizens and the Government. **As a result, the new capital city of the State of Andhra Pradesh can proudly call itself a "people's capital".**

The creation of a world-class capital city at a central location is essential to create a level-playing field for the new State. As experience from across the world demonstrates, a vibrant capital city can act as a catalyst for economic development for the entire state and become an iconic city that is a source of pride for all its citizens.

The Government of AP has decided to establish the new capital city as a livable, environmentally sustainable and people's capital. For this purpose, the location of the capital was identified between Vijayawada and Guntur cities upstream of Prakasam Barrage on the river Krishna.

The proposed development will be based on the Gazette GO-254, MA and UD (M2) Department dated 30th December 2014, read with GO MS No-141- MA & UD (M2) Department dated 9th June. The list of villages with the land area is given in **Table 3-1** below.

Table 3-1 Details of Villages in Proposed Amaravati City Development

S. No.	Mandal	Village	Area in Sq.Km	Population
1	Thulluru	Lingayapalem including Hamlet Villages of Modugulankapalem	14.49	1554
2		Uddandarayunipalem		1503
3		Malkapuram		1360
4		Velagapudi	8.09	2688
5		Nelapadu	5.74	1028
6		Sakamuru	6.58	1218
7		Ainavolu	4.85	1838
8		Mandadam including Hamelt Villages of Tallapalem	20.19	6588
9		Venkatapalem	11.09	3732
10		Ananthavaram	10.30	3391
11		Nekkallu	5.71	1908
12		Thulluru	14.92	7794
13		Dondapadu	4.97	2189
14		Pichukala Palem		54
15		Abbarajupalem	5.86	490
16		Borupalem		1190
17		Rayapudi	24.34	4817
18		Kondaju Palem (De-Populated)	3.43	0
19	Tadepalli	Undavalli	13.05	9743
20		Penumaka	8.85	7918
21		Part of Tadepalli Municipality	1.88	

S. No.	Mandal	Village	Area in Sq.Km	Population
		(Nulakapet,Dolas Nagar etc.,)		
22	Mangalagiri	Krishnayapalem	6.34	1560
23		Nidamarru	11.30	6196
24		Kuragallu including Hamlet Villages of Nerukonda	14.33	4340
25		Nowluru including Hamlet Villages of Yerrabalem & Bethapudi	20.92	24861
		TOTAL	**217.23**	**97960**

3.2. Nature, Size and Location of the Project

The proposed Amaravati City of Andhra Pradesh falls in Guntur district of Andhra Pradesh and at a distance of approximately 30 km from the Vijayawada town. The proposed development site is predominantly of rural character with area of **217.23 sq.km**. This is covered in 25 villages falling in three mandals namely Thulluru, Tadepalli and Mangalagiri. The site is abutting the River Krishna on the west of Old National Highway from Prakasam Barrage to Y-junction at Mangalagiri. The nearest railway station is K C Canal Station near Tadepalli and the nearest airport is at Gannavaram.

The existing land use of the site is consisting of - agriculture, land for grazing, fruit and flower plantations, village settlements and village ponds etc.

3.2.1. Geographic Positioning of Amaravati

The proposed site is towards the west of Vijayawada at about 3 km. The exact coordinates of the site are shown in Figure 3-1 below. While attempt has been made to accurately depict the boundary, in view of the technical limitations minor variations in the boundary may be observed in representation. Official boundary is available with PP and in public domain.

3.2.1.1. Transport Connectivity

Air connectivity

- Existing Gannavaram airport is at 30 minutes drive from the city centre
- Expansion of this airport is planned in near future and it will be upgraded to an international airport.

Road connectivity

- The existing national highway (NH16) will connect the Amaravati city to Vijayawada and Guntur, and further connect to Vishakhapatnam and Chennai.

S No	Longitude	Latitude	S No	Longitude	Latitude
1	80.4525	16.5896	13	80.4967	16.4682
2	80.4540	16.5703	14	80.5061	16.4480
3	80.4390	16.5541	15	80.4973	16.4489
4	80.4281	16.5196	16	80.4937	16.4238
5	80.4097	16.5252	17	80.5324	16.4139
6	80.4073	16.5080	18	80.5361	16.4219
7	80.4199	16.5058	19	80.5604	16.4151
8	80.4190	16.4893	20	80.5661	16.4392
9	80.4300	16.4801	21	80.6000	16.4744
10	80.4489	16.4797	22	80.6040	16.5042
11	80.4509	16.4889	23	80.5537	16.5432
12	80.4840	16.4828	24	80.4832	16.5863

Fig 3-1 Site Coordinates

- A new national highway alignment has been approved in order to increase the Amaravati Capital city's connectivity to the neighbouring Vijayawada city.
- The NH65 will connect the Amaravati Capital city to Hyderabad and Machilipatnam port. Machilipatnam can be developed as an ecotourism destination in near future in coherence with development of Amaravati.

Rail Connectivity

- The Amaravati Capital city has good connectivity to the Vijayawada rail station via NH16. The Vijayawada rail station is one of the busiest rail stations in the country.
- There is also an existing rail station in the Mangalagiri town.
- A new High Speed Rail alignment has also been proposed for connecting the Amaravati Capital city. As illustrated in **Figure 3-2**, this alignment runs along the approved national highway.
- There is a planned MRT network within Vijayawada. There is potential to tap on this public transportation network and extend it into the Amaravati Capital city.

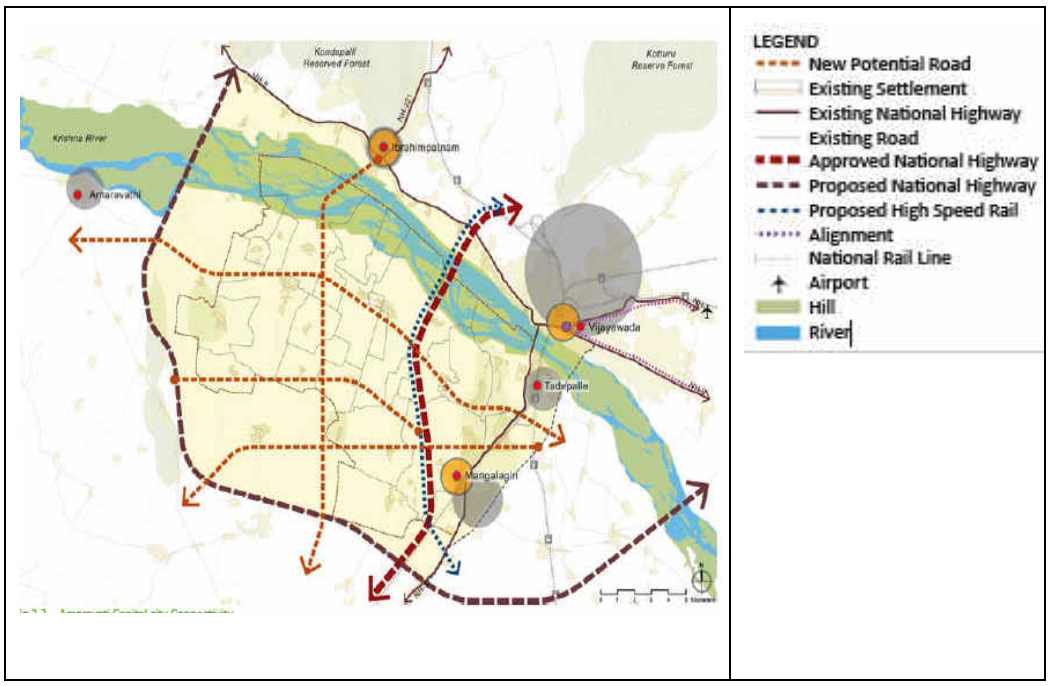


Figure 3-2 Amaravati Capital City Connectivity*

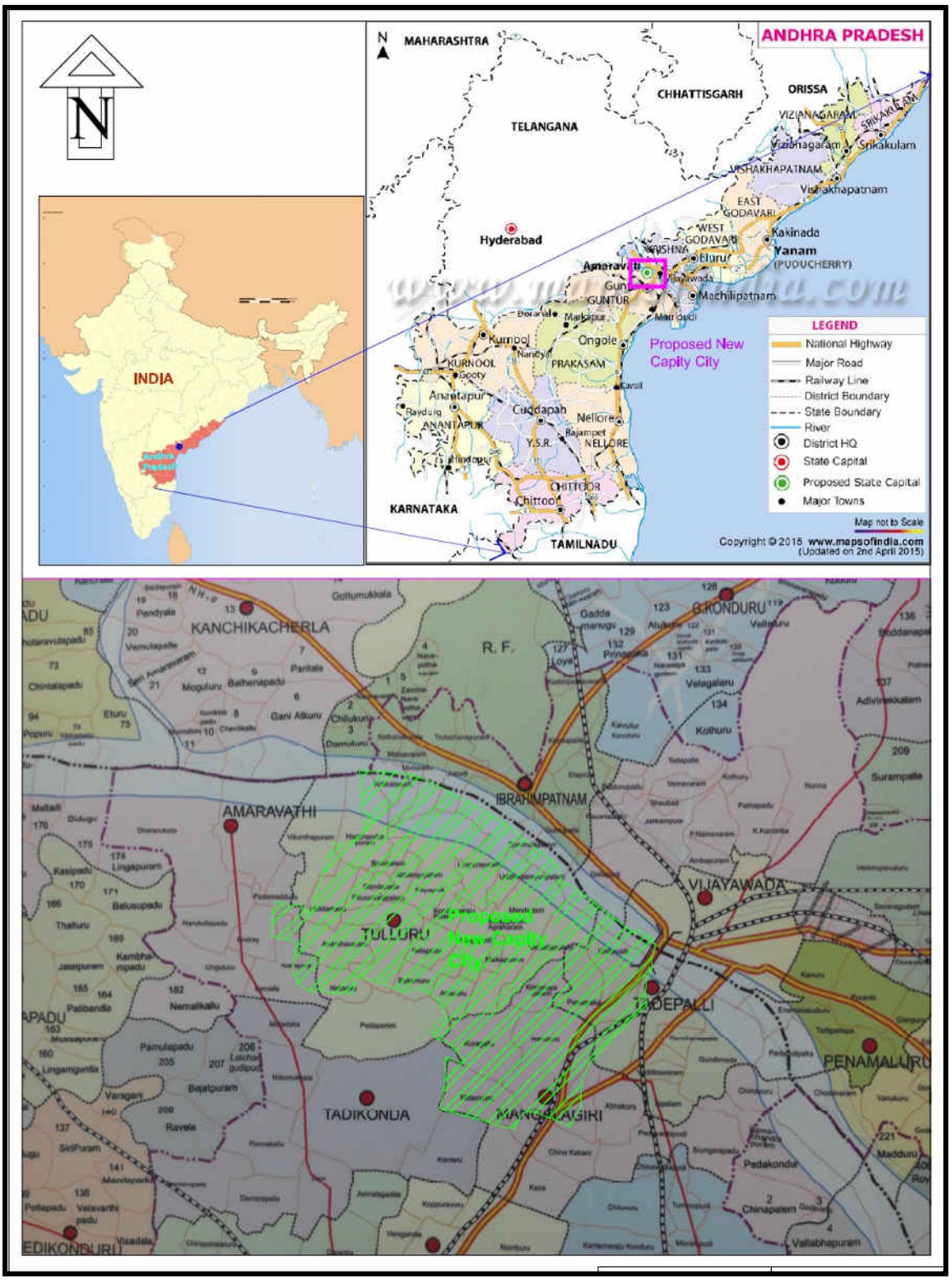


Figure 3-3: Key plan depicting the geographic location of the project*

3.3. Environmental Settings

The environmental setting of the proposed project is given in **Table 3-2.**

Table 3-2 Environmental Setting within 10 Km Radius of the Project

S. .No	Particulars	Details
1	Latitude and Longitude	North East Coordinate- 16º30'30"N, 80º37' E South West Coordinate-16º29'N, 80º25' E North West Coordinate-16º31'N, 80º22'30" E South East Coordinate-16º24'30"N, 80º34' E
2	Elevation above Mean Sea Level	Varying from 18m to 260m
3	Nearest Highway	NH16 passing within the boundary of the project site
4	Nearest railway station	K C Canal Railway Station near Tadepalli, 1 km, East direction
5	Nearest airstrip	Gannavaram airport 22 km, North East direction
6	Nearest city	Vijayawada, 3 km North East
7	Rivers	Krishna river on the northern fringes of the project site.
8	Hills/valleys, Monuments	Tadepalli Hills within the project site
9	Archaeologically important places	Undavalli Caves and fort within project site
10	National Parks/ Forest areas	No National Park within the 10km radius Reserve Forests (R.F) are as under : Tadepalli R.F within the project site Mangalagiri R.F within the study area Karlapadi R.F within the study area Motadaka R.F within the study area Kotturu R.F partially within the study area Kondapalli R.F 3km, North direction
11	List of major industries in 10 km radius	NTTPS, 4.10 km North East direction
12	Wildlife Sanctuary	None within the 10km radius
13	Core Biosphere reserve	None within the 10km radius

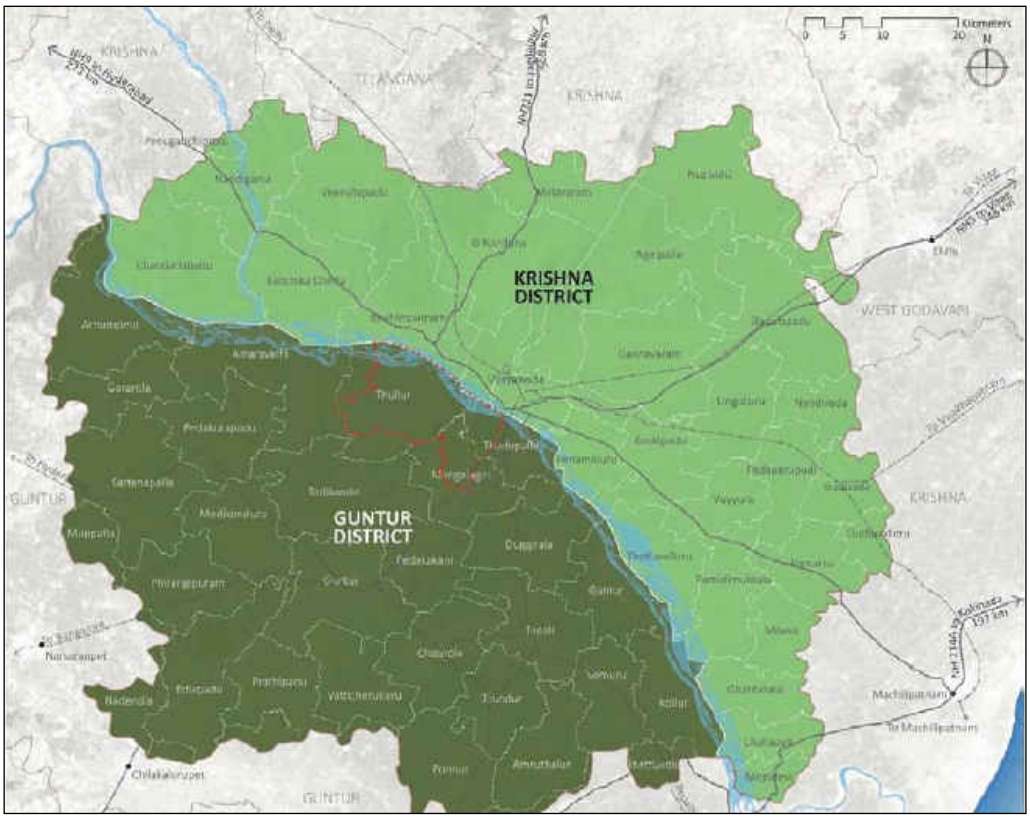
3.4. Project Overview

The Andhra Pradesh Capital Region Development Authority Act (APCRDA & CA), 2014 has come into force on 30th December, 2014. The Act mandates - a) Amaravati City Area as the capital for the state of Andhra Pradesh and b) establishment of a development authority for the purpose of Planning, coordination, execution, supervision, financing, funding and for promoting and securing the planned development of the Capital Region.

3.4.1. Vision, Goals and Strategies of the Amaravati Capital City

Vision: The New Capital of Andhra Pradesh is envisioned to be the pioneer Smart City of India. It aims to be World Class and at par with the standards set forth by countries such as Singapore. The new capital will be an economic powerhouse that will create a range of jobs for existing resident villagers by upgrading their skills, as well as provide high-tech and knowledge based industry jobs to be globally competitive. Housing will be at the core of its planning and will aim to provide affordable and quality homes to all its residents. It will demonstrate global quality of life standards to offer high levels of convenience to people of all ages.

The concept will capitalize on the rich heritage possessed by the region and utilize it to create a unique identity for the new capital. Sustainability and efficient management of resources will form another important pillar of this new capital. It will be supported by maintaining the clean and green character that the site currently demonstrates by mimicking these ideas in to the new capital Concept Plan.



Source: The New Capital Region of Andhra Pradesh: The Capital Region Plan and Report, March 2015

Figure 3-4 Capital region with Mandal Boundaries and Capital City Boundary - shown in red colour *

Goals and Strategies

(I) World Class Infrastructure

Goal: 135 km of Public Transport corridors by 2050 and > 1,000 km of road Network by 2050

Strategies:

- Build state-of- art public transport both for Capital Region and Amaravati Capital city
- Develop a highly efficient road network at par with international standards
- Encourage high percentage of modal share using public transport
- Plan for a long term 2050 horizon and reserve transit corridors where necessary
- High speed Railway to have a station in the Amaravati Capital city
- Develop a world class International Airport to serve the Capital Region
- Capitalize on the opportunity to use National Waterway for trade
- Plan strategically to allow easy transfer between different modes of transport

(II) Jobs and Homes for all

Goal: 4.4 million Resident populations by 2050 and 1.8 Million Jobs by 2050

Strategies:

- Promote high-value added agriculture and agro-based industries
- Create opportunities for existing dwellers to upgrade skills
- Introduce a mix of knowledge based high-tech industries to attract investments
- Encourage home ownership to create a sense of identity for citizens
- Provide sufficient affordable housing to cater to the needful
- Strategize a slum free city through careful planning
- Phase out industries strategically for long term sustained growth
- Create a favourable policy framework to implement and support the Amaravati Capital city development

(III) Green and Clean

Goal: >20% area reserved for green and Blue and 30+ km Public River waterfront

Strategies:

- Create a network of parks and greens by integrating the village ponds
- Ensure access to park for every citizen within easy walking distance
- Make productive use of natural features on the site without damaging them
- Reserve most of the waterfront along Krishna river for public use
- Mandate retaining the green network reserved in the Amaravati Capital city Plan
- Reserve high value agriculture land as no development zone wherever possible
- Utilize the natural features such as forest and hills to create a regional green network.
- Create an image of city sitting within the water and greens

(IV) Quality of living

Goal: Parks and Public Facilities within 5-10 minute walking distance

Strategies:

- Ensure public transit is within easy walking distance for all
- Convenience of neighbourhood centre amenities within walking distance
- Safe environment with universal access for all ages
- Provide opportunities for learning and enhancing careers within the Amaravati Capital city and Region
- Provide excellent health care facilities at affordable costs within easy reach
- Ensure ample opportunities to live, work, learn and play
- Ensure ease of commute within 30 minutes from origin to destination with Amaravati Capital city

(V) Efficient Resource Management

Goal: Flood resistant City towards Net Zero Discharge

Strategies:

- Adopt efficient flood control techniques and protect most waterways in the city
- Promote "Reduce, Recycle and Reuse"
- Establish state of art waste management and disposal systems across the city
- Develop a smart grid in the city for efficient management of power and energy
- Encourage use of renewable energy to maximum extent possible
- Integrate the storm water drainage system with the existing canal and village tank network and utilize for flood management and recreation
- Encourage certification of projects using global standards such as IGBC and LEED

(VI) Identity and Heritage

Goal: > 250 km of Heritage and Tourism Network using Roads, Metro and waterways

Strategies

- Preserve all historic and culturally important sites
- Promote culture and heritage attractions for locals and tourists alike
- Compliment adjacent cities, at the same time establish a unique identity
- Integrate the existing villages as a vital component of city development
- Development nodes within the city that reflect the culture of the State and region.

- Dedicate strategic locations that will allow people to come together and organize cultural activities
- Create a tourism circuit that links all the existing heritage features and new nodes created in the city.

3.4.2. Capital City

The proposed Capital City's outer boundary is about 3 kms away from Vijayawada and 20 km from Guntur. It falls in Thulluru, Mangalagiri, and Tadepalli Mandals of Guntur District with a total area of 217.23 sq. km. The figure 3-4 shows the location of the capital city within the capital region boundary.

This Environmental Impact Assessment study and the Environmental Clearance application has considered the capital city area vide GO-254, MA and UD (M2) Department dated 30th December 2014, read with GO MS No-141- MA & UD (M2) Department dated 9th June 2015 as 217.23 sq.km. The infrastructure planning as outlined in the Concept Plan has been considered while identifying the impacts. The Concept Plan boundary and the capital city boundary are shown in **Fig 3-5**; the land use types for the capital city development are given in **Table 3-3**.

Table 3-3 Existing Land Use Distribution for Proposed Project

S. No	Landuse	Area (Ha)	%
1	Developable Land	16302.2	75
2	Hills	426.5	2
3	Islands	1750.9	8
4	Village Settlements	1449.4	7
5	River	1277.7	6
6	Water Bodies	497.5	2
	TOTAL	21722.2	100

3.4.3. Developmental Phasing

The concept plan for Amaravati city is prepared in three phases and upto 2050. The phased development takes into account the growth potential, vision of the government and aspirational needs of the people. The phases are categorized as Catalyzing, Momentizing and Sustaining.

The details of each phase are furnished below

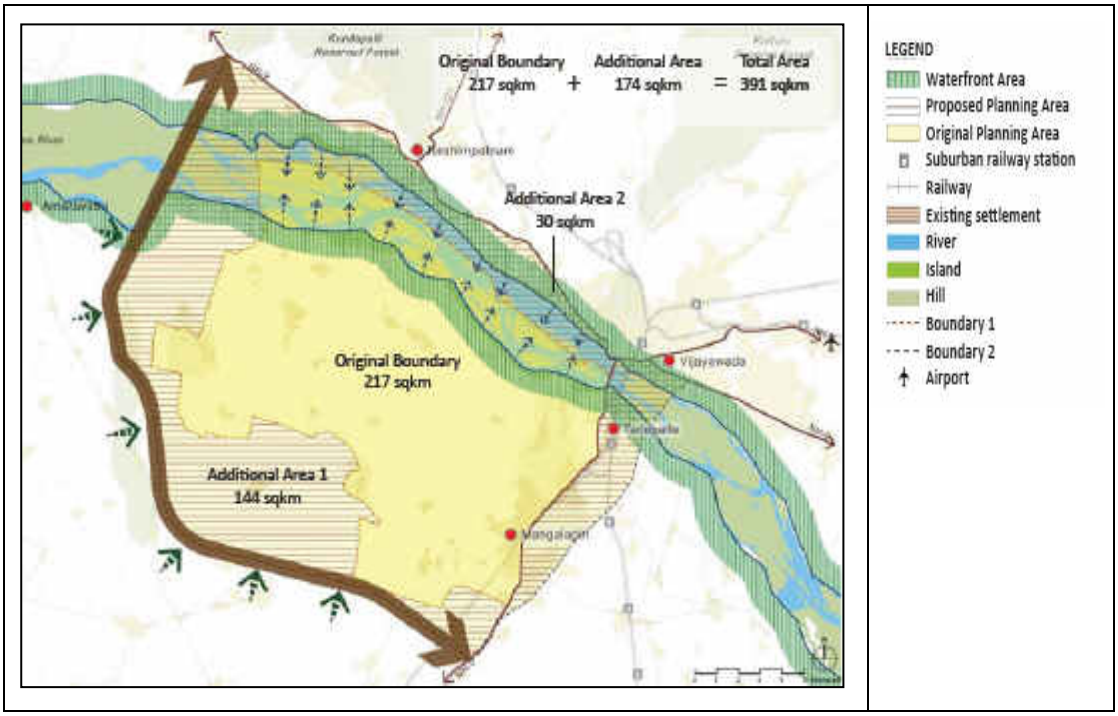


Figure 3-5 Capital City Boundary. Also shown Concept Plan Boundary- Additional Area 1, Additional Area 2*

3.4.3.1. Phase 1- Catalyze

This phase will span for the first 10 years for catalyzing urban developments within the Amaravati Capital city. It will include a large number of infrastructure projects in order to create the critical base for development. This phase will catalyse developments within the capital by tapping on the existing and upcoming infrastructure, including the Vijayawada MRT and the new national highway.

The first phase will provide a variety of housing options for 850,000 population Comprising about 39% of the total Amaravati Capital city Area, this phase will create 350,000 jobs in the civic, commercial and industrial sectors. Shown as **Fig 3-6.**

Key Projects

- Development of the government administrative core along the north-south axis housing the secretariat, high-court, legislative assembly, Chief Minister's Office and other government offices.
- Development of the proposed Business Park within the SEED Development Area.
- Development of the north-eastern Regional Centre housing a transportation hub.
- Development of the light Industrial cluster proposed in proximity to the SEED Development Area (towards west). This cluster will primarily house high-tech light industries.

The land area distribution plan for the Phase 1 of Amaravati Capital City development is shown in **Table 3-4**.

Table 3-4 Phase 1- Land area distribution

S. No	Landuse	Area (Ha)	%
1	Commercial	650.41	4%
2	Primary Green	3924.57	25.68%
3	Secondary green	510.04	3.34%
4	Hotel/Resort	16.36	0.11%
5	Industries	1060.29	6.94%
6	Infrastructure	85.59	0.56%
7	Mixed Use	44.52	0.29%
8	Reserved Sites	30.58	0.20%
9	High Density Residential	386.58	2.53%
10	Medium Density Residential	1292.25	8%
11	Low density residential	25.93	0.17%
12	River	3159.14	20.68%
13	Research and Development	103.47	0.68%
14	Roads	1342.63	8.79%
15	Junior College	12.45	0.08%
16	Primary School	45.41	0.30%
17	Secondary School	42.32	0.28%
18	SEED	469.83	3.07%
19	Sports and Recreation	49.21	0.32%
20	Theme Park	117.46	0.77%
21	University	159.55	1.04%
22	Village settlements	1371.13	8.97%
23	Warehouse	27.73	0.18%
24	Water	349.20	2.29%
25	White Sites	2.99	0.02%

3.4.3.2. Phase 2- Momentize

This phase will focus on the medium term development (2025-2035) in order to momentize urban development within the Amaravati city. Building on the infrastructure developed in the previous phase, Phase 2 will momentize development by creating new employment centers and expanding residential areas.

This phase will span over 10 years (2025 - 2035). Phase 2 will accommodate over 900,000 more people and create 380,000 more jobs for its residents. The land area distribution plan for the Phase 2 of Amaravati capital City development is shown in **Table 3-5**.

Key Projects

- Development of the proposed residential developments in proximity to the western edge of the north-south ceremonial axis aka administrative core.
- Development of the southern industrial cluster along the national highway.

- Development of the Amaravati Capital city central park and water reservoir.
- Development of the proposed MRT network within the city.
- Development of the gateway commercial node on the northern bank of river in close proximity to the existing Vijayawada city

Table 3-5 Phase 2- Land Area Distribution

S. No	Landuse	Area (Ha)	%
1	Commercial	562.20	8%
2	Golf	86.31	1.20%
3	Primary green	789.06	10.96%
4	Secondary green	548.06	7.61%
5	Industries	387.70	5.39%
6	Logistics	106.08	1.47%
7	Mixed use	201.38	2.80%
8	Reserved sites	47.94	0.67%
9	High density residential	382.97	5.32%
10	Medium density residential	1505.22	21%
11	Low density residential	127.3	1.77%
12	River	0.0	0
13	Research and development	77.34	1.07%
14	Roads	773.06	10.74%
15	Junior college	12.08	0.17%
16	Primary school	54.33	0.75%
17	Secondary school	55.55	0.77%
18	SEED	304.20	4.23%
19	Sports and recreation	39.03	0.54%
20	University	350.53	4.87%
21	Village settlements	350.08	4.86%
22	Water	429.75	5.97%
23	White sites	7.61	0.11%

3.4.3.3. Phase 3- Sustain

This phase will focus on the long term development (2035-2050) of the city in order to achieve successful implementation of the overall Concept Plan. This phase will sustain growth and capitalize on the infrastructure developed in the previous phases.

Spanning over 15 years (2035 - 2050), this phase will largely support medium and high density population accommodating 2.4 million people within the Amaravati Capital city.

As the employment centers within the Amaravati Capital city will now be reasonably established, this phase will create over 1 million more jobs for its residents. The land

area distribution plan for the Phase 3 of Amaravati capital City development is shown in **Table 3-6.**

Key Projects

- Development of eco-resorts on the clusters of islands in river Krishna.
- Development of the Sports City
- Proposed within the north-eastern recreation node.
- Development of the national high speed rail ink.
- Development of numerous high density residential clusters in the western and southern parts of the city.
- Development of the downtown (SEED capital) water front cluster.

Table 3-6 Phase 3- Land Area Distribution

S. No	Landuse	Area (Ha)	%
1	Commercial	591.60	4%
2	Golf	297.11	8%
3	Primary green	2573.82	7%
4	Secondary green	856.67	6%
5	Hotel/Resort	492.85	2%
6	Industries	2306.41	13.83%
7	Institution	78.31	0.41%
8	Infrastructure	68.89	0.47%
9	Logistics	81.54	0.49%
10	Mixed Use	666.71	4%
11	Reserved Sites	70.72	0.42%
12	High density residential	1690.48	10.14%
13	Medium density residential	1666.89	10%
14	Low density residential	972.68	5.83%
15	River	1.29	0.01%
16	Research and Development	295.81	1.77%
17	Roads	1776.72	10.65%
18	Junior college	68.51	0.41%
19	Primary school	127.55	0.76%
20	Secondary school	155.74	0.93%
21	SEED	293.13	1.76%
22	Sports and recreation	189.71	1.14%
23	Village settlements	392.81	2.36%
24	Warehouse	73.41	0.44%
25	Water	875.18	5.25%
26	White Sites	15.28	0.09%

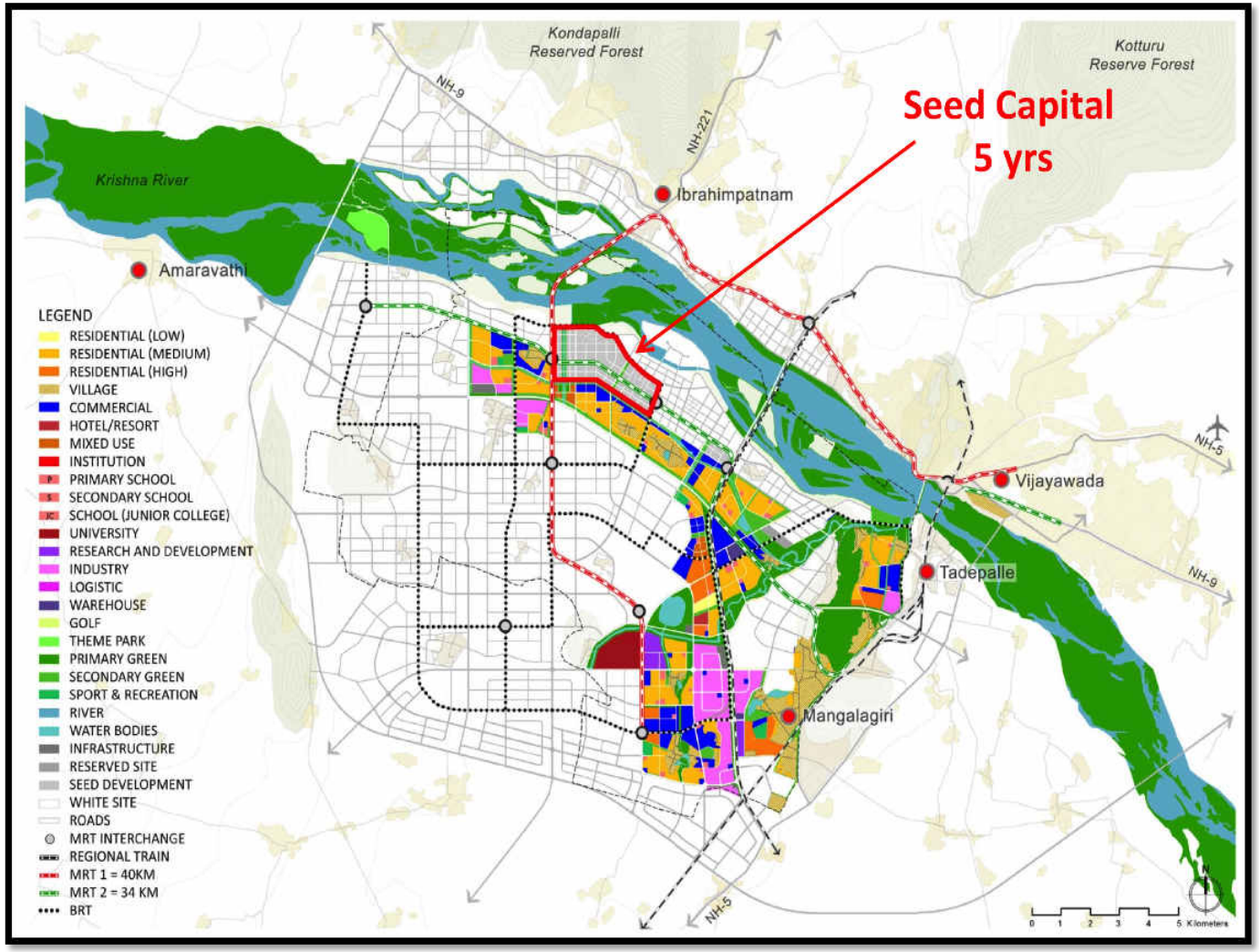


Figure 3-6 Amaravati Capital City- Phase 1 Plan*

3.5. Amaravati City- Vital Statistics

The APCRDA & CA Concept Plan of the Capital region as well as the Amaravati Capital City has worked on demographic projections based on the broad assessment of historic trends in the identified economic uses for the Amaravati Capital city. This has been undertaken with a view to estimate future growth trends in these sectors and have been utilized to project demographic parameters for the next 35 years (till year 2050). This section presents few projections as outlined in the Concept Plan.

Table 3-7 Summary of Demand Assessment for economic uses

S. No	Key Economic Uses	Phase 1	Phase 2	Phase 3
1	Capital complex	800	-	-
2	IT/ITES Complex	143	148	139
3	Corporate Complex	51	62	187
4	Financial Hub	85	103	312
5	Start-UP/ Innovation Hub	44	114	242
6	Industrial Sector	1706	2662	6556
7	Education Hub	1102	1154	1713
	TOTAL	2729	2989	7336

Table 3-8 Summary of Employment Projections

S. No	Key Economic Uses	Phase 1	Phase 2	Phase 3
1	Government	46096	4432	11524
2	IT/ITES Complex	51062	58422	156542
3	Corporate Complex	24692	31727	106931
4	Financial Hub	41153	52879	178218
5	Start-UP/ Innovation Hub	6273	18818	2439
6	Education Hub	5934	7625	25698
7	Industrial Sector	18001	30082	82152
8	Indirect Employment	158409	175550	484242
	TOTAL	**351620**	**379534**	**1047747**

Table 3-9 Summary of Population Projection

S. No	Population in Million	Year 0	Phase 1	Phase 2	Phase 3
1	Incremental population	0.38	0.86	0.90	2.34
2	Total Population (Cumulative)	0.38	1.24	2.15	4.49

Upon estimating the total population projected for the Amaravati Capital city for the next 35 years, the Urban and Regional Development Plan Formulation and

Implementations (URDPFI) guidelines as published by Ministry of Urban Development, Government of India were used to validate the total land requirement for the support facilities such as commercial, healthcare, social-recreational, education, sports facilities and other support uses. The URDPFI guideline 2015 is presented in Table 3.10.

Table 3-10 URDPFI Guidelines 2015

Facilities	No. of Units	Per Population	Area per unit (sq.m)
Commercial Facilities			
Convenience Shopping	1	5,000	1,500
Local Shopping including Service Centre	1	15,000	4,600
Community Centre including Service Centre	1	100,000	50,000
District Centre	1	500,000	400,000
Local Wholesale Markets/ *Mandis*	1	1,000,000	100,000
Healthcare Facilities			
Dispensary	1	15,000	1,200
Nursing Home, Child Welfare and Maternity Centre (25 - 30 beds)	1	100,000	3,000
Polyclinic	1	100,000	3,000
Intermediate Hospital (Category B)	1	100,000	10,000
Intermediate Hospital (Category a)	1	100,000	37,000
Multi Speciality Hospital	1	100,000	63,500
General Hospital	1	250,000	60,000
Family Welfare Clinic	1	50,000	800
Diagnostic Centre	1	50,000	800
Veterinary Hospital	1	500,000	2,000
Dispensary for Pets	1	100,000	300
Educational Facilities			
Pre-Primary School	1	2,500	8,00
Primary School	1	5,000	4,000
Sr. Secondary School	1	7,500	18,000
Integrated School Without Hostel (Class 1-XII)	1	100,000	35,000
Integrated School with Hostel (Class 1-XII)	1	100,000	39,000
School for Physically Challenged	1	45,000	7,000
School for Mentally Challenged	1	1,000,000	2,000
College	125,000	50,000	College
Technical Education Centre (A) ITI + Polytechnic	1	1,000,000	40,000
Technical Education Centre	1	1,000,000	40,000

Facilities	No. of Units	Per Population	Area per unit (sq.m)
(A) ITI + Technical Centre + Coaching Centre			
Engineering College	1	1,000,000	60,000
Medical College	1	1,000,000	150,000
Other Professional College	1	1,000,000	60,000
Nursing & Paramedical Institute	1	1,000,000	2,000
Distribution Services			
LPG Godown/ Gas Godown	1	50,000	520
Milk Distribution	1	5,000	150
Sports Facilities			
Residential Unit Play Area	1	5,000	5,000
Neighbourhood Play Area	1	15,000	15,000
District Sports Centre	1	100,000	80,000
Divisional Sports Centre	1	1,000,000	200,000
Police, Civil Defence and Home Guards			
Police Post	1	50,000	1,600
Police Station	1	90,000	15,000
Traffic & Police Control Room	1	0	0
District Office and Battalion	1	1,000,000	48,000
Police Line	1	2,000,000	60,000
District Jail	1	1,000,000	100,000
Civil Defense and Home Guards	1	1,000,000	20,000
Safety Management			
Disaster Management Centre	1	200,000	10,000

Table 3-11 Summary of Land Demand Computed for Residential and Support Real Estate Uses- in Ha; based on population projected phase wise

S. No	Land use	Phase 1	Phase 2	Phase 3
1	Residential Housing	2739	2842	7663
2	Mixed Use	975	1022	2888
3	Education/ Institutional	1102	1154	3263
4	Sports Facilities	640	670	1893
5	Police, Civil Defense, Safety Management & Distribution Services	103	109	307

CHAPTER 4

AMARAVATI CAPITAL CITY DEVELOPMENT- CONCEPT PLAN

As part of the overall planning process, an Urban Sustainability Framework is established to provide guiding principles and overarching parameters for the subsequent planning processes that will ensure the long term sustainability of the Amaravati Capital City. This chapter will broadly cover the various planning and infrastructure aspects of the proposed development in various sections:

4.1. Amaravati City- Structure Plan

The following broad development strategies are proposed, to translate the concept plan into the Capital City Structure plan, fig 4-1 illustrates all these strategies:

Main city nodes and axes - 3 development nodes have been proposed at the junction of the 3 key axes illustrated in the concept plan. These include civic node, university node and recreational hub.

Downtown - The downtown will be the heart of the Amaravati Capital city. It is planned along the river Krishna waterfront to create an iconic image and skyline. Housing the city's CBD, the downtown sits between the ceremonial and recreational axis making it a central hub of activities.

Industrial hub- The city's main industrial hub will be planned at the southern end of the North-South cardinal axis. The hub will be planned linearly along the regional ring for quick connectivity to national highways.

Expressway & arterial grid- In order to connect the various important nodes, the structure plan proposes a well connected network of expressways and arterial roads.

4 zones - In order to decentralize employment opportunities and residential developments, the city will be clustered into 4 development zones.

Regional centers - Each development zone will be facilitated with a large commercial node, namely, the Regional Centre. These centers will provide employment opportunities close to homes and ease development pressure on the downtown.

Loop road - A loop road connects the downtown and all the 4 Regional Centers. This arterial road will also house the city's public transportation corridor.

Green network - Located in the city centre, the Central Green Hub (Bramhasthan) will be the largest open space of the city. Additionally, the river Krishna waterfront and surrounding hills are also important green nodes within the city. A well woven network of green and blue spines interconnect the green blue nodes of the city, and lead to a vibrant waterfront along river Krishna.

Transit - The Amaravati Capital city will have a well integrated network of public transport which will tap on to the approved Vijayawada MRT line and extend it to the various parts of the city. Additionally the city will also tap on the existing suburban rails and proposed high speed rail network.

4.2. Amaravati City - Landuse Plan

The landuse plan of the Amaravati Capital City proposes the following development strategies within city area of 21723 Ha.

City of Decentralized Employment Centers- 1646 Ha of land has been allocated for numerous commercial and industrial developments across the city. The plan proposes decentralization of the various employment nodes to create jobs closer to homes.

City of Self Sufficient Townships- 4995 Ha of land has been safeguarded for a variety of residential developments across the city. The plan distributes residential developments as per housing densities in line with the township model discussed earlier. The plan protects all the existing village settlements within the city.

Water Networked City - The Concept Plan ensures protection of all the existing rivers and water bodies and integrates them into the proposed green and blue network. These nature areas occupy about 14,800 Ha of the total land area within the Capital city.

Waterfront City - Careful consideration has been given to the river Krishna waterfront which will house the city's CBD, Civic core, mixed use development and high end waterfront housing. The waterfront has been planned in several thematic zones engaging the bund proposed along the river edge.

Pedestrian Friendly City - The Concept Plan proposes a well connected network for non motorized transport along the green and blue corridors of the city. This network will encourage green modes of non motorized transports such as bicycles, skates, seaways, etc.

City with Social Infrastructure - To ensure a good quality of life within the Capital city a set of public facility standards has been prepared. The Concept Plan distributes civic and cultural facilities in compliance with these standards and the township model discussed earlier.

City of Smart Solutions - Modern and smart infrastructure provisions has been proposed for the capital. These provisions will ensure good sanitation, and adequate water and power supply across the city. They will also mitigate the flooding issues within the city.

City with strong cultural roots - The Concept Plan respects and supports the rich cultural and religious heritage of the city. The plan proposes a religious tourism circuit to connect the various attractions within the city.

City with Green Identity - Numerous iconic developments define the city's green identity.

The concept plan takes into account only 40% of the total area of the Capital city for developing residential, commercial, and institutional and other built up spaces. Out of these spaces, as per Development Control Regulations only 30-40% will be utilised for built up purpose. That implies a ground cover of about 12-16% of the total capital city area only will be utilised for ground coverage. The land use plan of the proposed project is shown in Figure 4-2

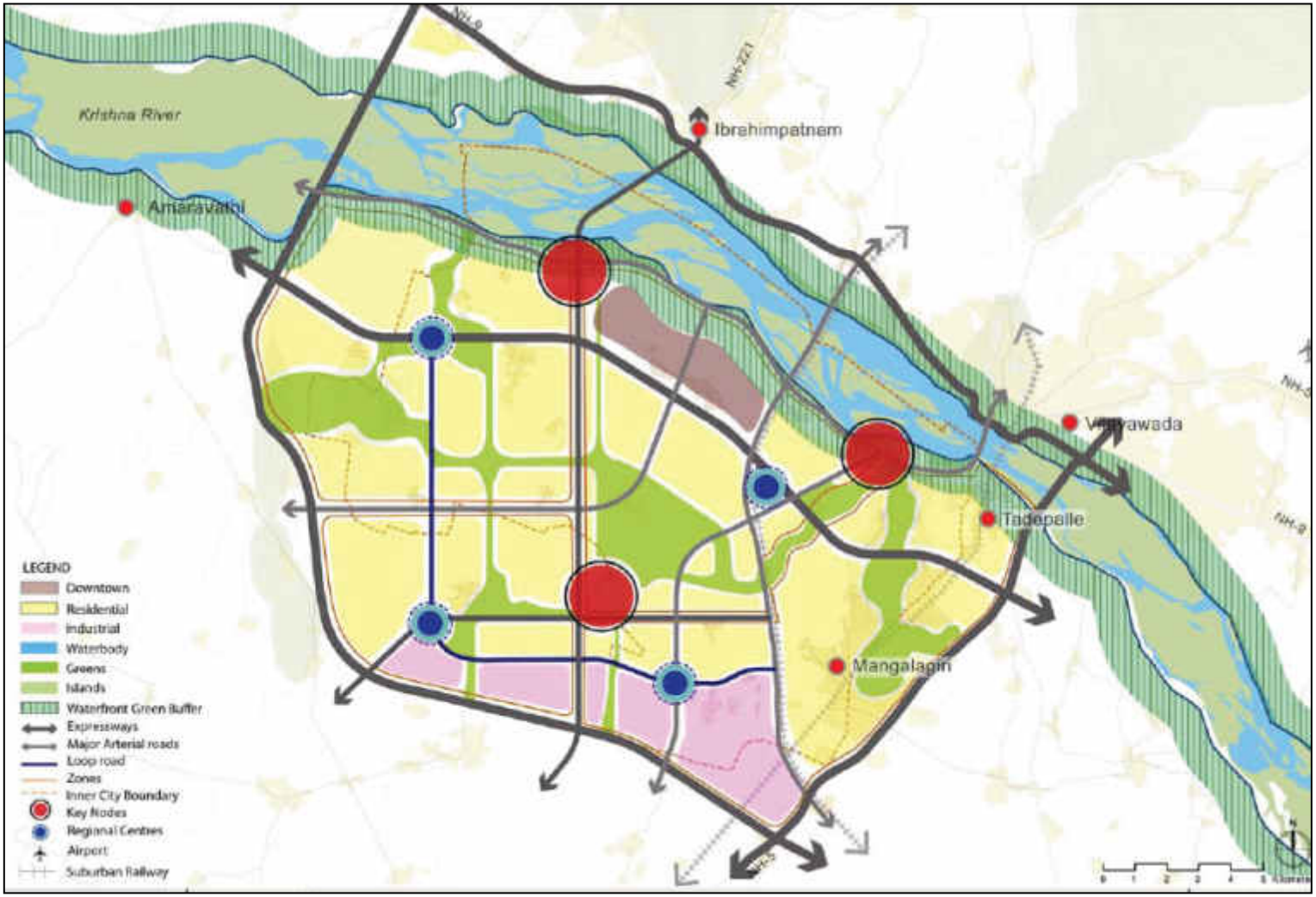


Figure 4-1 Amaravati Capital City Structure Plan*

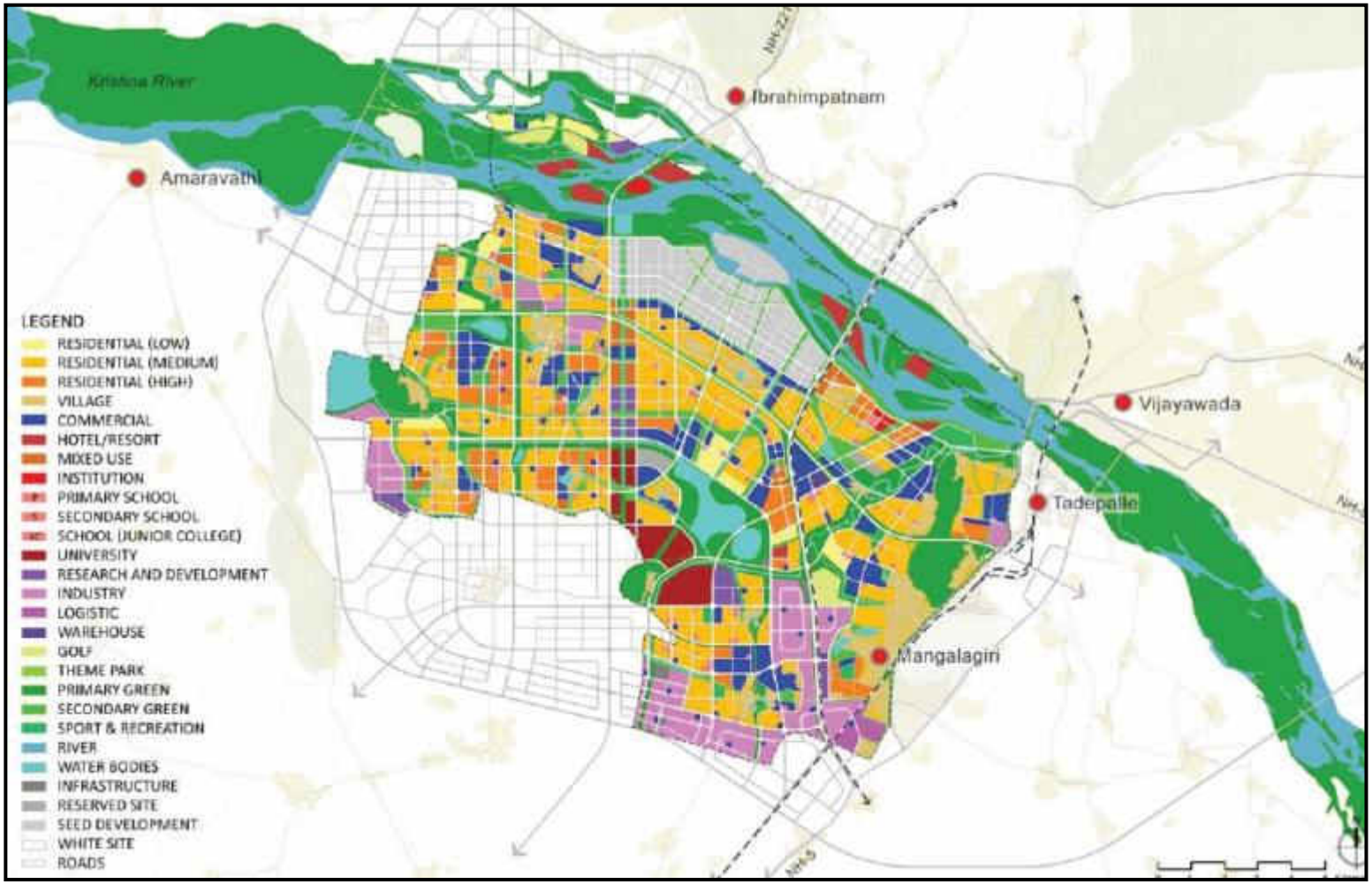


Figure 4-2 Amaravati Capital City Landuse Distribution*

4.3. Amaravati City Zoning Plan

The Capital City is distributed into several zones of development. The plan also proposes a number of reserved sites and special areas for development of important defense, civic and infrastructure facilities. The proposed Zoning Plan for the Amaravati City is (illustrated in Fig 4-3) as follows:

R1 - Low Density Residential Zone - The R1 is a zoning district established to develop low density residential developments. The Zone allows development of detached and semi detached houses.

R1A- Village Residential Zone - R1A is a residential district offering low rise developments within the existing villages. The R1A Zone is intended to offer low rise housing as part of the farming community and complementary public facilities as needed.

R2- Medium Density Residential Zone - R2 is a zoning district established to allow medium density residential developments across the city, and create well planned medium density housing complexes with ample open spaces.

R3- High Density Residential Zone - The High Density Apartment Residential Zone (R4) are multi-family high density housing options planned within the Capital city to provide a high-quality public transport oriented lifestyle.

C1- Mixed-use Commercial Zone - The Mixed Use Commercial Zone (C1) is an area to be used mainly for mixed residential and commercial purposes, which can have up to 20% GFA used for commercial purpose.

C2- Community commercial zone - The Community Commercial Zone (C2) creates attractive small neighborhood level commercial establishments.

C2A- Community commercial zone - The Community Commercial Zone (C2A) includes the commercial land that will be returned to the village land owners under the Andhra Pradesh Land Pooling Act, 2014. This zone creates attractive small mixed use establishments to foster local businesses.

C3- Medium density commercial zone - The Medium Density Commercial Zone (C3) is an area established to create a medium rise commercial zone within the Regional centers.

C4- Retail warehouse zone - The Warehouse Retail Zone (C4) is established to accommodate businesses that encompass elements of retail and warehouse functions together.

C5- Business Park - Business Parks are specifically set aside for less polluting industries and businesses that engage in high technology, research and development (R&D), high value added and knowledge intensive activities.

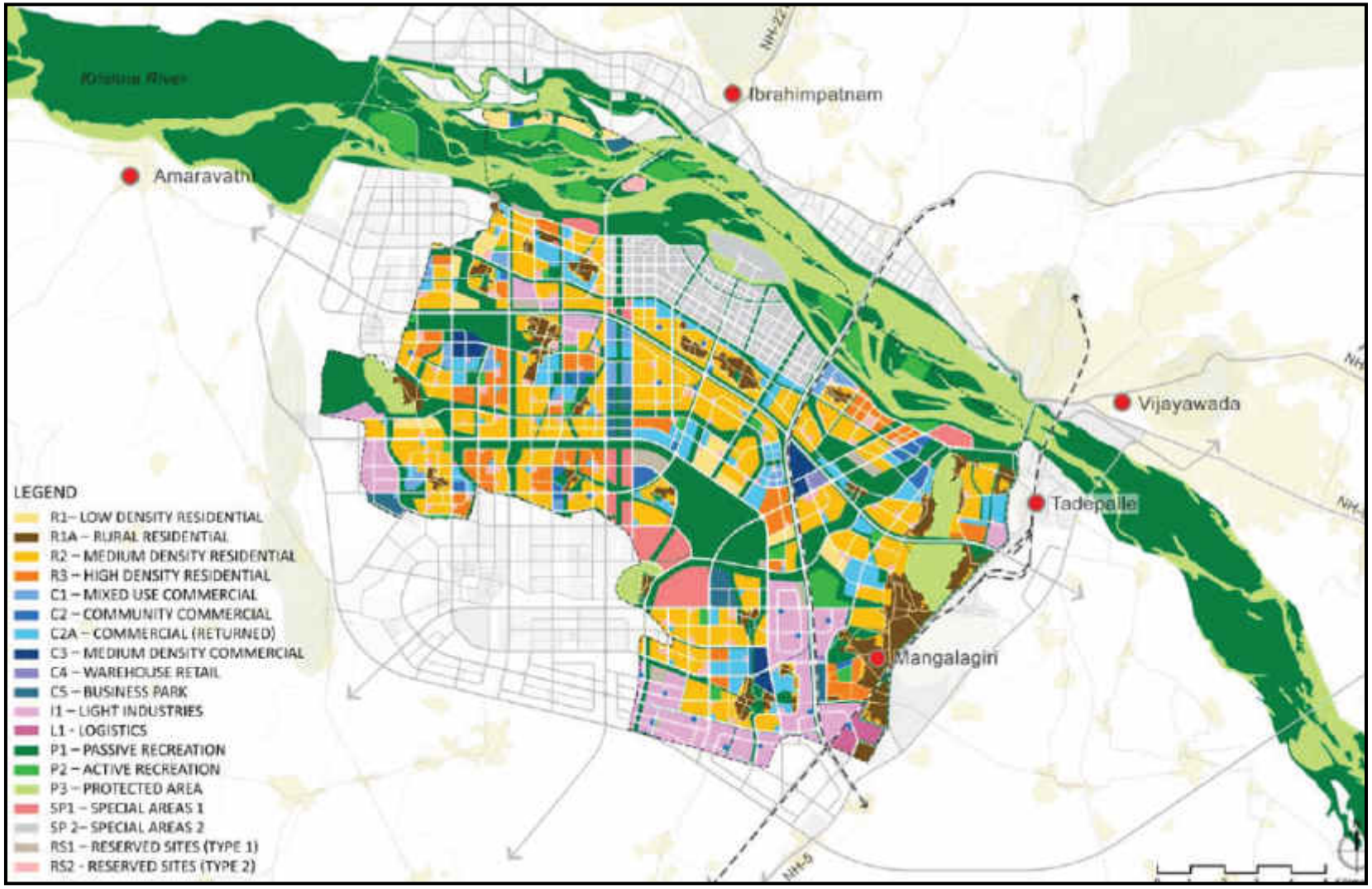


Figure 4-3 Amaravati Capital City Zoning Plan*

4.4. Amaravati City Industrial Plan

A total land area of approximately 1226 ha has been safeguarded within the proposed Capital City boundary (217.23 sq.km) to accommodate the industrial clusters. These Industrial land areas have been categorized into 3 Zones as follows,

- Business Park Zone
- Industrial Zone
- Logistics Zone

The Business Park Zone is specifically set aside for less-polluting industries and businesses that engage in high technology, research and development (R&D), high value added and knowledge intensive activities. The value of the business park zone is between industrial and commercial uses

The Industrial Zone is safeguarded especially for light & clean industries. These include low rise detached, semi-detached and terrace factories to high-rise multi tenanted, multi storied factories. As mentioned earlier, the types of industries envisaged in the Capital City Amaravati are predominantly environment friendly as described below:

- **Clean Industries**: These are industries that do not generate air and water pollution and do not generate noise and smell nuisance which can affect surrounding developments. The factories also shall not use large quantities of hazardous substances such as solvents, acids and other chemicals. No buffer is necessary for such industries.
- **Green Industries:** These industries shall not generate large quantities of trade effluent or solid waste. They shall also not generate excessive impulsive or continuous noise. They shall also not use large quantities of hazardous substances such as solvents, acids & other chemicals. A buffer of 50m-100m is suggested from the nearest residential district for such industries.
- **Orange Industries:** These type of general industries may be allowed subject to adequate buffer from the nearest residential zone.

The intent based on the concept plan is to establish industries with minimal environmental impact. Further categorization of industries will take into account the MoEF & CC Classification of industries based on level of Pollution as per SCHEDULE – VIII [see rules 3(2) and 12].

The Logistics Zone will accommodate the predominant activities related to transport, logistics, goods distribution and storage for regional, national and international transit. Generally, these developments consist of warehouses, loading & unloading bays, open storage facilities and supporting ancillary services with efficient internal vehicular circulation and external multi-modal transport links.

Distribution of Industries

Broadly, the following locational criteria have been used to safeguard the adequate land for Industrial activities.

- Proximity to Vijayawada City, new Amaravati City Centres, existing Machilipatnam Sea Port, existing Gannavaram Airport
- Connectivity to the existing national highways and proposed ring road and rail lines
- Topographical condition
- Environmental consideration
- Availability of the existing and proposed utilities
- Optimum land utilisation (vertical distribution)
- Connectivity to public transport
- Compatible synergy with other land uses such as residential, commercial and recreational uses to promote total business environment

The broad utilities demand as envisaged for the industrial development area in the Amaravati Capital Region, based on various planning assumption is shown in **Table 4-1**:

Table 4-1 Utilities demand for Industrial Plan

S. No	Demand type	Business Park	Light Industrial Zone	Logistics Zone	Total
1	Land Area (Ha)	477	3,754	188	4,419
2	Total Average Water Demand (m^3/d)	29,000	171,000	3,000	203,000
3	Potable Water Demand (m^3/d)	23,000	154,000	500	177,500
4	Recycled Water Demand (m^3/d)	6,000	17,000	2,500	25,500
5	Sewage	20,000	135,500	500	156,000
6	Solid Waste Generated (T/d)	86	676	34	796
7	Power Demand (MVA)	428	1,512	5	1,945
8	Telecom Demand (Lines)	51,500	182,000	5,500	239,000

4.5. Amaravati City- Infrastructure Provisions

The proposed site of Amaravati is Greenfield site and thus requires infrastructure to be put in place. Major investment in infrastructure is required in the coming years to prepare the site as the New Capital of Andhra Pradesh.

4.5.1. Flood Management

4.5.1.1. Inundation of certain areas in Amaravati

The Krishna River is a major inter-state river flowing through the states of Maharashtra, Karnataka, Telangana and Andhra Pradesh. The Capital City is located approximately 100km upstream of the mouth of Krishna River, along the southern bank. Kondaveeti Vagu is a tributary to Krishna River. The Kondaveeti Vagu catchment draining towards the Krishna River has a total area of 453 Sq Km. Kondaveeti Vagu originates from the Kondaveeti Hill Range and joins the Krishna River upstream of existing Prakasam Barrage. Together with its own tributaries, Kondaveeti Vagu flows across the Capital City and causes inundation over about 13,500 acres of land every year during the monsoon season, when the water level in Krishna River is above the discharge level of the Vagu.

This catchment on average receives 1,073 mm of annual rainfall. The total quantity of water received from rainfall is 17.16 thousand million cubic feet (TMC) per year. Storm water runoff is estimated at about 3.84 TMC. Once the reservoir reaches its full capacity from the surface run off and/or other discharges from the upstream flows, about 80% of the surface runoff received from this catchment is discharged to the sea via the Krishna River without any utilisation during the monsoon period.

The inundation of the low lying areas within the Capital City development area will usually last for 5 to 7 days during each spell of heavy rain and this occurs two to three times annually.

Of the 13,500 acres of the inundate area, about 10,600 acres is within the planning area of the Capital City. Therefore, the Kondaveeti Vagu flood issue is an important issue that is being addressed by the proponent. The proponent has initiated hydrogeological studies to address this already.

Fig.4-4 shows the extent of the flooding area within the Kondaveeti Vagu Catchment, as reported by APCRDA & CA. Based on historical records; floods are caused by the following reasons:

- An under-designed local drainage network to convey the storm water
- The high water level in the Krishna River preventing Kondaveeti Vagu from discharging by gravity

There is an existing bund along the Krishna River, which prevents fluvial flooding in the Capital City area when the water level in the Krishna River is high. The level of the existing bund was identified at between 3 to 5 meters above the highest recorded flood level in Krishna River of +21.7m. The bund was constructed using simple earthwork.

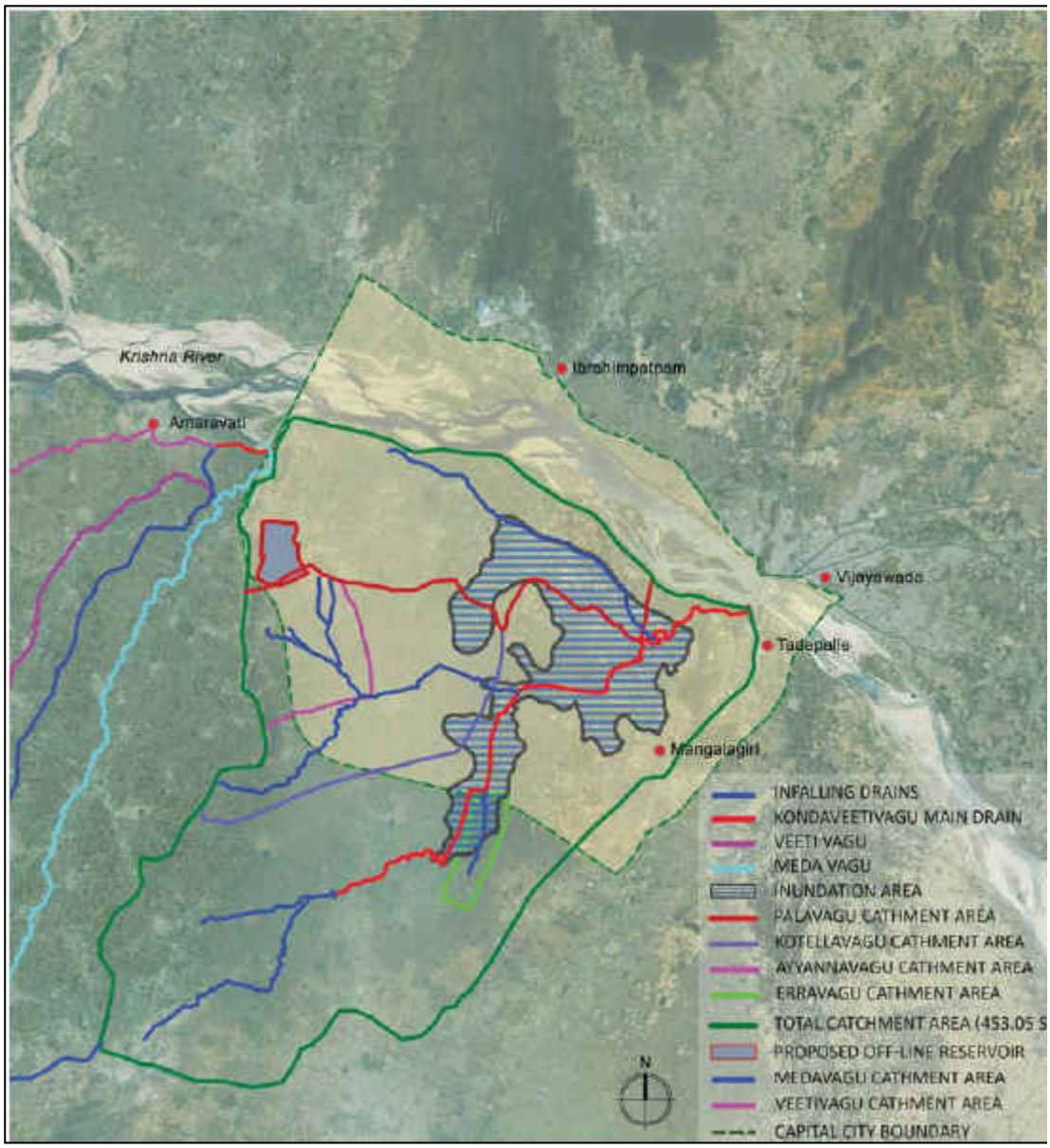


Figure 4-4 Catchment and inundation Area of Kondaveeti Vagu (Source- Concept Plan of APCRDA & CA 2015)*

4.5.1.2. Proposed Flood Management Strategies:

The land in the Capital City area is mostly open space or rural with agriculture land. With the urbanization of the catchment area, the surface runoff volume and speed are expected to increase. Flood risks will rise if there is lack of proper storm water management provision as part of the development. To mitigate the potential flooding issues and to build up a sustainable storm water management system, flood management strategies are proposed as follows:

Prevent: reinforce and realign the existing Krishna River Bund

The existing river bund along the Krishna River is approximately 2 to 5m above the highest recorded flood level of the Krishna River. This bund should be strengthened where required and reinforced to prevent flooding from the Krishna River.

The existing flood bank, connected from Prakasam Barrage to Ananthavaram hills consists of 4 mt top width, and 1.5:1 and 2:1 side slopes. This existing flood bank itself has withstood well for preventing the maximum flood discharge of about 12 lacs cusecs occurred in 2009. However, in order to ensure better safety, the existing flood bank is proposed to be strengthened and widened without any change in the alignment to 22.5 mt top width, without impacting the river width, duly protected by means of providing river protective works as per the norms of River Conservancy.

Control: Detain storm water

Detention ponds will be a key component in the flood management strategy for the Capital City. The ponds can serve as temporary storage to retain storm water runoff, and provide enough buffer to prevent flooding.

Nine detention ponds have been proposed within the Capital City to mitigate flooding and improve the storm water control. Detention ponds are proposed at the low-lying areas, the junctions of two different streams, and at the new water bodies proposed within the green and blue plan. The location of the detention ponds are determined based on the future land use. Most of the ponds are sited within the vicinity of green spaces to maximise their use as green spaces. These detention ponds are to detain storm water runoff during heavy rainfall, and then discharge slowly into the reservoirs for water conservation. Refer **Fig 4-5**

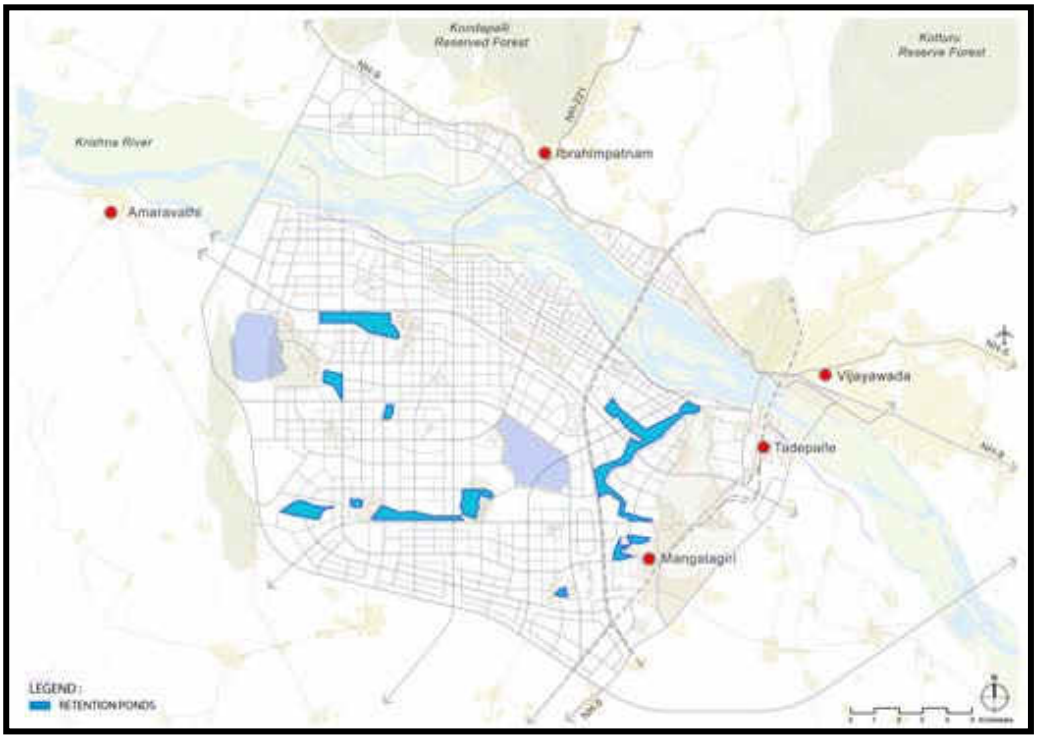


Figure 4-5 Storm water in Internal Detention Ponds*

Control: Detain storm water externally

In addition to the internal detention ponds within the Capital City, it is recommended that two external detention ponds be constructed outside the Capital City boundary to detain water upstream close to source. This will help to reduce surface runoff into

the Capital City planning area. This will also provide additional control measures to retain water upstream during heavy storm events.

The location of the two proposed detention ponds is shown in **Fig 4-6.**

The design and size of these ponds are subject to a detailed hydraulic study of the Kondaveeti Vagu which is under progress.

Conserve: Create raw water storage using Reservoirs

Two reservoirs have been proposed within the Capital City. Reservoir R1 is fed by storm water from the south-eastern half of the City through various detention ponds. Reservoir R2 is located at a high level, and is fed using pumps from Reservoir R1, the Krishna River and the nearby detention ponds within the Capital City.

The two reservoirs will augment water supply to the Capital City by providing raw water storage. The feasibility study of Reservoir R2 is currently being undertaken by the Water Resources Department. The estimated storage capacity of Reservoir R2 is 5 TMCs. A water yield study to determine the storage capacity of Reservoir R1 is required. The tentative location of detention pond is shown in Fig 4-7.

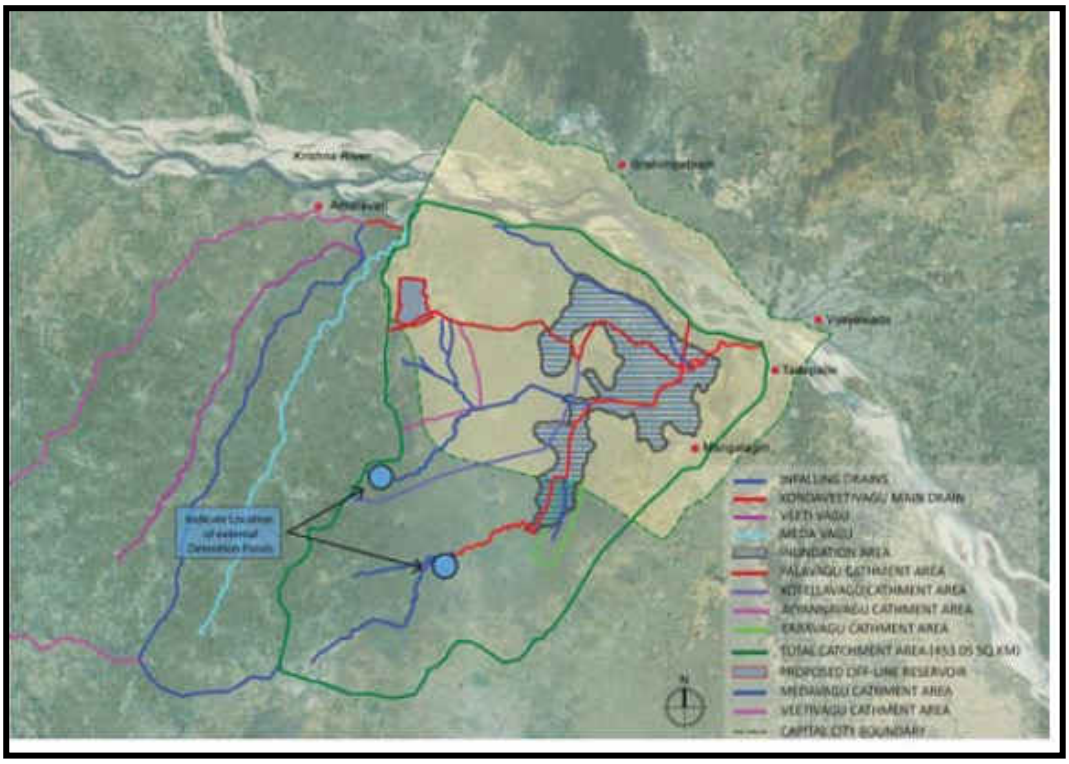


Figure 4-6 Storm-water in External Detention Ponds*

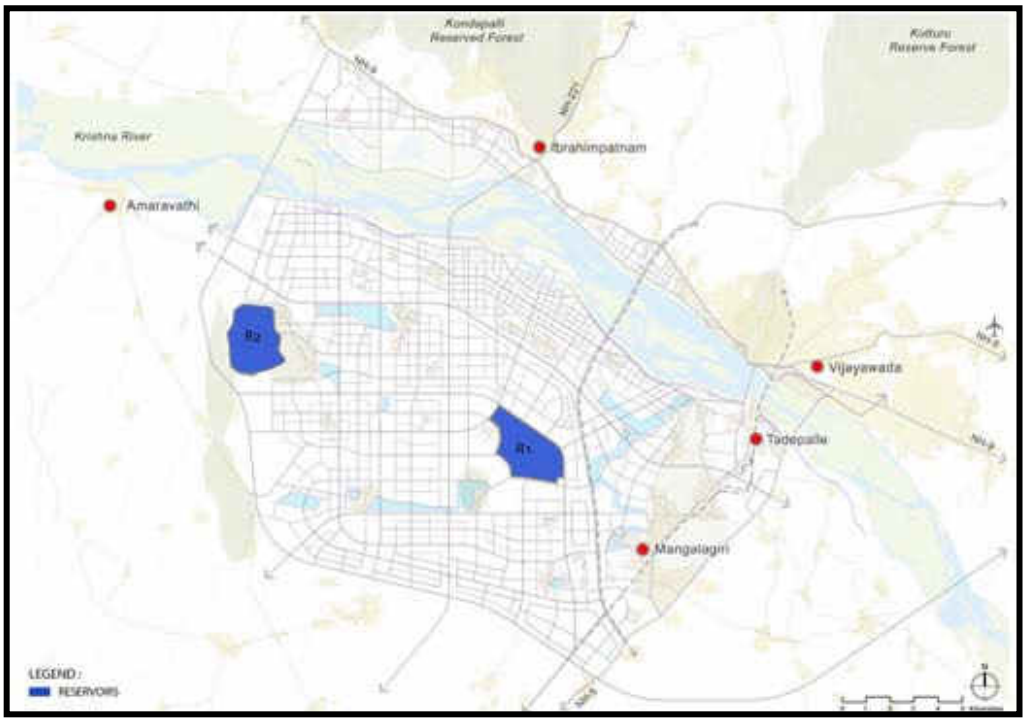


Figure 4-7 Indicative locations of Reservoirs 1 and 2*

Buffer: Provide an extensive green and blue drainage network

There is currently no proper delineated green buffer within the existing land of the Capital City. In terms of flood management, a proper storm water drainage network, including a flood buffer, would be required to collect and discharge the storm water runoff efficiently. An extensive green and blue drainage network has been proposed in the Capital City. A minimum buffer of 30m is proposed to be reserved along all the major canals. In the future, there should be no development of permanent structures within these flood control reserves. Fig.4-8 shows a typical cross-section utilised in the green and blue network.

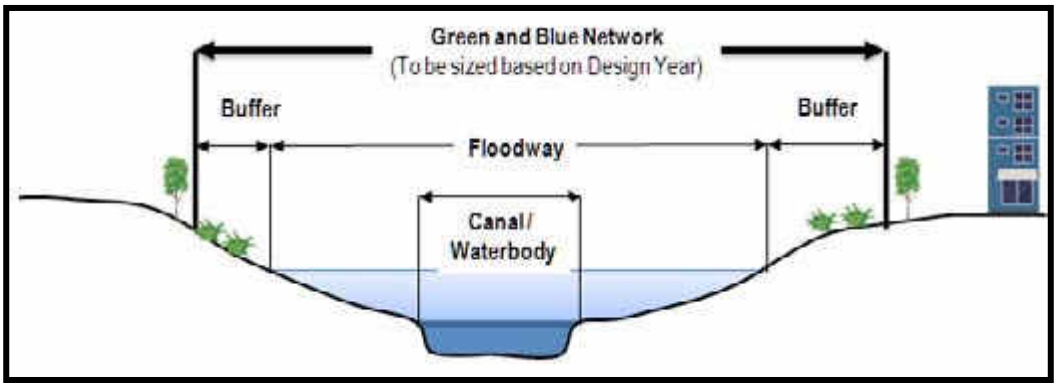


Figure 4-8 Typical Cross-section utilized in the Green and Blue Network

Discharge excess water into Krishna River

As a final measure of protection, it is recommended that a comprehensive system of sluice gates and pumps are provided at the outfalls of the Capital City boundary where the surface runoff discharges into the Krishna River.

When the reservoirs are 100% full, the sluice gates will be opened to discharge the excess storm water into the Krishna River. However, for extreme rainfall events wherein water level in the Krishna River is high and excess storm water cannot be discharged via gravity to the river. The sluice gates will then be closed to prevent backwater effects from the Krishna River, and discharge pumps will be activated to pump out the excess storm water to the further down stream of Krishna River barrage.

Protect: Raising of Platform levels

It is recognized that the Capital City requires extra protection from flooding, for example, the CBD area, major transport corridors, utility installations such as water treatment plants, electrical substations and others.

A minimum development platform level should be set for the Capital City to ensure that these areas are not affected by flooding. This can be done by setting the proposed platform levels of the Capital City higher than the historical flood level within the site. As a rule of thumb, the existing ground level should be topped up to a level higher than the maximum predicted flood level in each particular zone. Based on the topographical survey, as shown in Fig.4-9, it is noted that the ground level of the existing villages are at +25m above mean sea level (AMSL). In addition, it is understood that the historical flood level of the Krishna River is at around +21.7m AMSL. Hence, the minimum platform level for future developments within the Capital City should be set at +25m AMSL or at a level higher than the historical flood level in the particular area.

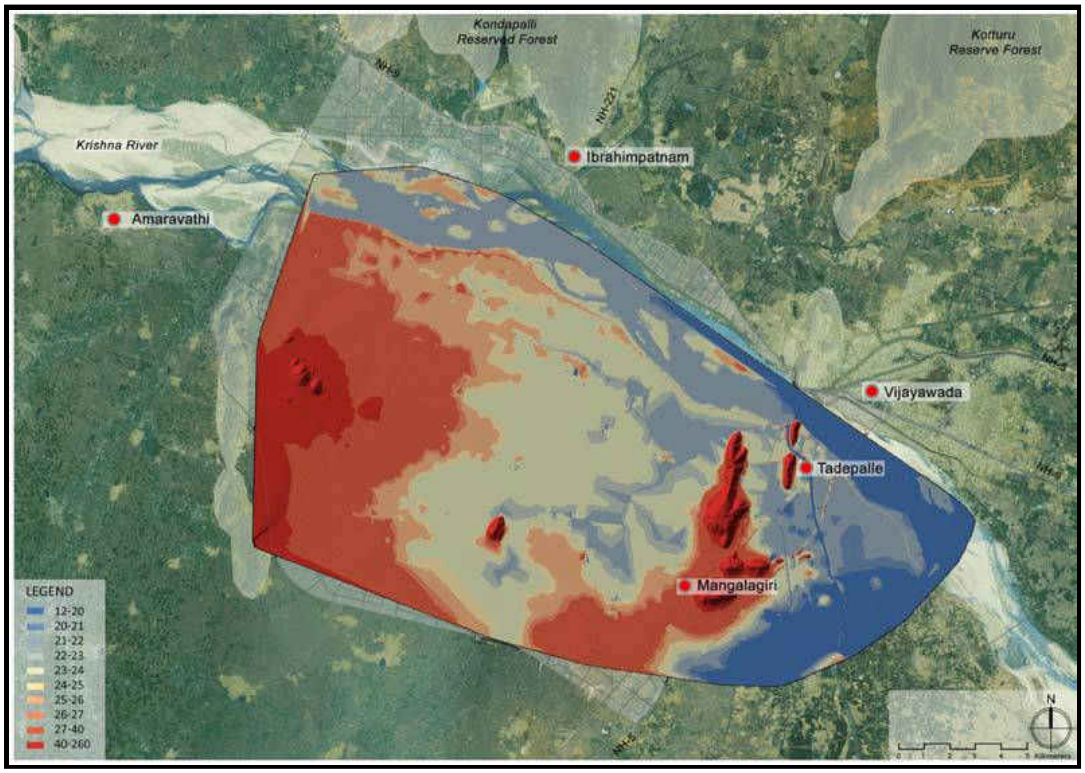


Figure 4-9 2m DEM Contour image showing the low lying areas (Concept Plan, CRDA & CA, 2015)*

4.5.2. Water Supply

4.5.2.1. Existing conditions

The water supply situation in the vicinity of the Amaravati City site, such as in Vijayawada and Guntur is sufficient but may need to be augmented to support the future developments in the Capital City.

There are two major conventional sources of water which can be used for the Capital City:-

- Krishna River; and
- Kondaveeti Vagu

The existing villages located within the Capital City site are supplementing their water supply by extracting ground water. Groundwater extraction is mainly used for irrigation and to meet their daily domestic requirements. This minor source of water is unreliable as it depends on the water table, and is not recommended as a source of raw water for the Amaravati Capital City.

Unconventional sources of water - for example, treated effluent - are also currently used within Vijayawada for irrigation purposes.

4.5.2.2. Water Supply strategies

A reliable water supply system is imperative to support the future developments in the Capital City. To increase the attractiveness of the City, the quality of the potable

water supply to the City should be of a high standard which allows people to drink straight from the tap.

The following strategies are recommended to ensure a long-term and sustainable water supply to the Capital City.

There are three overreaching water supply strategies which will guide the development of this infrastructure in the Capital City:-

- Reliable, Sufficient and Continuous Water Supply
- Clean potable water for all households
- Effective Demand Management

4.5.2.3. Potential Sources of water

Water from Krishna River

As a major raw water source, the Krishna River is shared among four states. The State of Andhra Pradesh is located at the lower reaches of the River. The total water demand for all four riparian states is about 4,200 TMC.

Approximately 2,060 TMC is available from the Krishna River if 75% dependability, or reliability, is assumed.

Table 4-2 shows the water balance analysis for Krishna River and Prakasam Barrage as shown in the APCRDA & CA Concept Plan. The water balance analysis indicates that there is sufficient raw water supply to support the future developments in the Capital City.

Table 4-2 Water Balance Analysis of Krishna River and Prakasam Barrage

Ref	Description	Quantity (TMC/yr)	Remarks
Krishna River			
A	Total annual effective water available for allocation	2060.00	To be shared among four states
Pulichinthala Catchment			
B	Allocation to Nagarjuna Sagar Reservoir	80.00	Allocated for the Pulichinthala Catchment by Krishna Water Council
C	Deduction from allocation	(20.00)	Deduction due to water savings downstream of Prakasam Barrage.
D	Effective Allocation from Upstream	60.00	
E	Pulichinthala Reservoir's catchment's annual yield	101.00	
F	Evaporation	(9.00)	

Ref	Description	Quantity (TMC/yr)	Remarks
G	Infiltration	(1.00)	
H	Total Inflow to Pulichintala Reservoir	151.00	D+E+F+G
J	Allocation Transfer from Godavari River	(40.00)	Offset by Diversion from Godavari River, (L)
K	Supply to Prakasam Barrage from Pulichintala Catchment	111.00	This represents potential supply to Prakasam Barrage
Godavari Lift Canal Project (projected completion in 2016)			
L	Diversion from Godavari River	80.00	To be released downstream of Pulichinthala Dam
Prakasam Barrage (3-5 TMC storage)			
M	Total Inflow to Prakasam Barrage	191.00	M
N	Wet Season Irrigation (aka 1st crop irrigation)	(136.00)	N
P	Drinking	(15.00)	P
Q	**Estimated Surplus at Prakasam Barrage after completion of Godavari Lift Canal Project**	**40.00**	**Currently 35 TMC/yr allocated to Andhra Pradesh**

Supply from Krishna River to Prakasam Barrage is approximately 111 TMC annually. There is an on-going project - constructing an inter-basin canal from the East Godavari District linking Godavari River to the Krishna River upstream of the Capital City. This increases the potential water supply to Prakasam Barrage to approximately 191 TMC annually.

After deducting current irrigation and drinking demands, there is an estimated surplus of 35 TMC annually. The projected surplus of 35 TMC/yr from Godavari River will be released upstream of Prakasam Barrage. Storage facilities are required to store the surplus from Godavari River. Prakasam Barrage has a storage capacity of 3 to 5 TMCs, and therefore much of the unutilized surplus would flow into the sea.

In the near term, the increase in water demand from the Capital City Development can be met by the raw water currently available in the Krishna River.

Surface Runoff from Kondaveeti Vagu

The second conventional source of water for the Capital City is the Kondaveeti Vagu. Kondaveeti Vagu catchment receives approximately 3.8 TMC of surface runoff every year, and these currently discharge into Krishna River without being utilized.

Upon urbanization of the Capital City, the surface runoff would increase, and would be discharged to the sea if not conserved or retained.

Water from Unconventional Sources

In addition to the conventional sources of water, the unconventional sources of raw water would be explored. Current unconventional sources include treated effluent which can be used to supplement water supply for non-potable use.

In the future, treated effluent can continue to be used in Vijayawada for horticultural and agricultural purposes. In the long run, by treating effluent to higher standards, these treated effluents can even be used by industry.

Dual reticulation systems may also be implemented, and may encourage the reuse of treated effluent.

4.5.2.4. Water Demand Projection

By 2050, the Capital City would have experienced high urbanization and population growth. This will have a huge impact on the future water demand. In the APCRDA & CA Concept Plan, the demands for base municipal and industrial water usage have been projected. These projections are useful in determining the gap between the existing water supply and future demand, and this will then allow the future supply to be planned for.

Municipal Water Demand

Water demand for residential land use was estimated based on the population projection by 2050. For other land uses, i.e. commercial and institutional land uses, the water demand was calculated based on gross floor area (GFA). The water demand unit rates were derived after benchmarking against the various water supply planning guidelines in India, and other countries, the water unit rate consumption is considered as 150 liters per capita per day (lpcd) for residential, 6 l/sq. m/ day for commercial and 2.5 l/sq. m/ day for institutional. The total water demand estimated is presented in **Table 4-3**

Table 4-3 Projected Municipal Water Demand for 2050

S. No	Land Use Type	Water Demand (In MLD)
1	Residential	676
2	Commercial	163
3	Institutional	25
TOTAL		864

Industrial Water Demand

There are 13 proposed industrial clusters in the Capital City, four of which are large industrial zones (in extent) located in the south of the Capital City. The other zones are industrial pockets located within residential townships. The water demand is calculated based on the proposed plot area with the unit rates ranging from 15 to 140 m^3/ ha/ day depending on the type of industry. Total industrial water demand in 2050 is estimated to be 203 MLD, including 177.5 MLD (0.0063 TMC/day) potable

water and 25.5 MLD (0.009 TMC/day) recycled water. It is planned to maximize the use of treated sewage and industrial effluent for industrial purpose.

As summarized in Table 4-4, the total water demand for 2050 is 1041.5 MLD potable water (0.037 TMC/ day) and 25.5 MLD non-potable water (0.009 TMC/ day).

Table 4-4 Summary of Water Demand Projection

Land Use	Water Demand (MLD)		
	Potable	Non Potable	Total
Municipal	864	0	864.0
Industrial	177.5	25.5	203.0
TOTAL	1041.5	25.5	1067.0

4.5.2.5. Water Supply System

The key measures to support the overall water supply systems are:-

- Create storage reservoirs along Krishna River to store raw water from Krishna River and water diverted from Godavari River
- Create storage reservoirs to collect surface runoff and flood water from Kondaveeti Vagu
- Implement rain water harvesting at individual developments
- Reuse of treated wastewater for non-potable use

Water Treatment Plants

There is currently no existing Water Treatment Plant (WTPs) within the Capital City area. The nearest WTP is located at Vijayawada and this plant is reaching its service limit. To ensure the quality of potable water and increase water accessibility, it is necessary to construct new WTPs within the Capital City. For water supply, the entire City shall be divided into various supply zones. Each zone shall be served by one WTP and a corresponding water supply distribution system.

As shown in Fig.4-10, the entire Capital City has been divided into four indicative supply zones, each served by a WTP. The capacities of each WTP are estimated based on the demand projection of their supply zones.

WTP 1 and WTP 4 will take water from the Krishna River. WTP 2 draws water from Reservoir R2 and WTP 3 will draw water from Reservoir R1. The WTP 1 will be built to supply 260 MLD, WTP2 for 500 MLD and WTP 3+4 will supply 1230 MLD of water. Treated water shall be pumped from the WTP to various water distribution centers (WDC) within each supply zone.

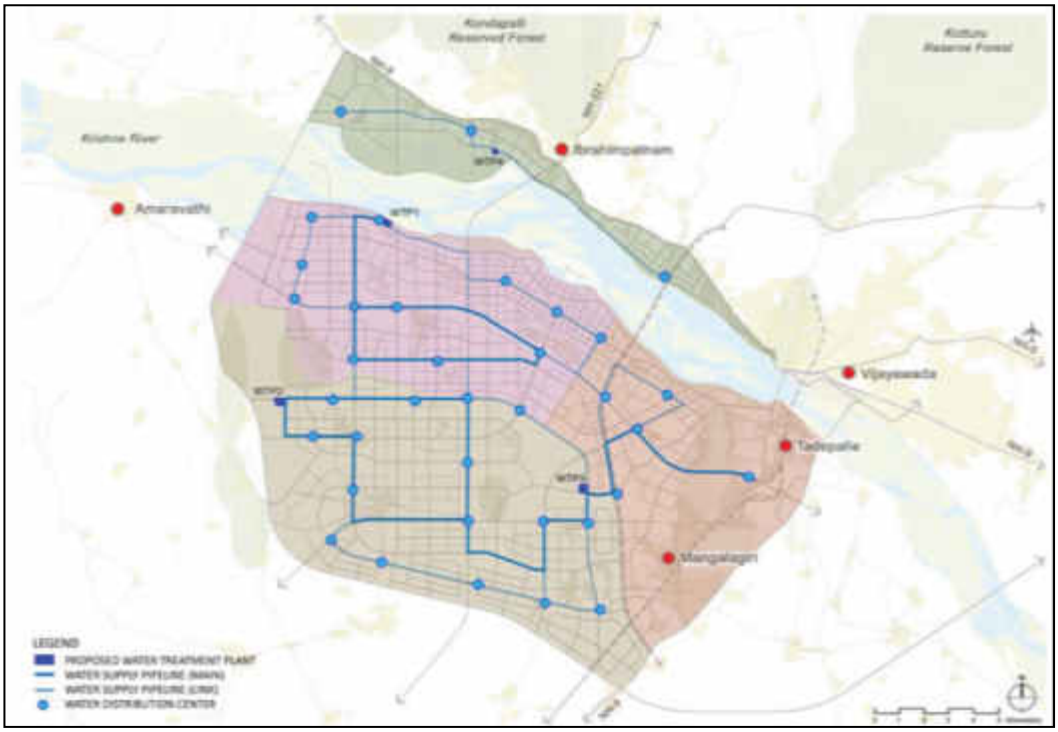


Figure 4-10 Indicative water supply pipeline network, Water Distribution Center and Water Treatment Plants*

4.5.3. Sewerage

4.5.3.1. Existing Condition

There is currently no formal sewerage system within the Amaravati City site. Traditional pit latrines are predominantly used by the local residents in the villages. To be a model city in India, it is essential to develop a modern sewerage network and treatment system for the proposed City. The network should be developed to protect the environment and to ensure the quality of life in the City.

The following strategies are recommended to provide a sustainable and an environmentally friendly wastewater system to the Capital City:-

- Development of a Modern Sewerage System covering 100% of the City
- Wastewater Treatment to International Standards

4.5.3.2. Sewage Flow Projections

Municipal Waste Water

The sewage flow in 2050 is projected based on the assumption that 80% of the potable water consumed daily will be collected as sewage. Sewage generated by the residential areas within industrial clusters is considered as part of the municipal wastewater. The total municipal sewage flow is projected at 702 MLD or 0.025 TMC/day.

Industrial Waste Water

There are 13 proposed industrial clusters in the Capital City. The total industrial waste water flow in 2050 is estimated at 175 MLD or 0.006 TMC/day. It is recommended that for the large clusters, a separate collection system be developed.

4.5.3.3. Sewage Treatment

Separate Sewerage System

To manage the wastewater generated from the daily activities within the Capital City, the Capital City is divided into 5 sewerage catchments. Each catchment would be served by an STP (refer to Fig.4-11). In addition, a dedicated industrial STP should be provided to serve the southern industrial clusters. The proposed STPs are located at the low lying areas to allow collection of sewage by gravity.

The land reserved for the STPs should be sufficient to build the necessary sewage treatment capacity. The STPs will be built in phases using modules and expanded where the need arises, so that the hydraulic and organic load is accommodated as per the demand. The STP1 and STP 2 as shown in the image below will be developed in the initial phase. Sufficient buffer space around STP will be kept.

Comprehensive Sewerage Network

A gravity sewerage system is recommended for collecting the sewage to reduce the need for pumping. It would be designed with minimum number of lifting stations where possible, while maintaining self-cleansing velocities.

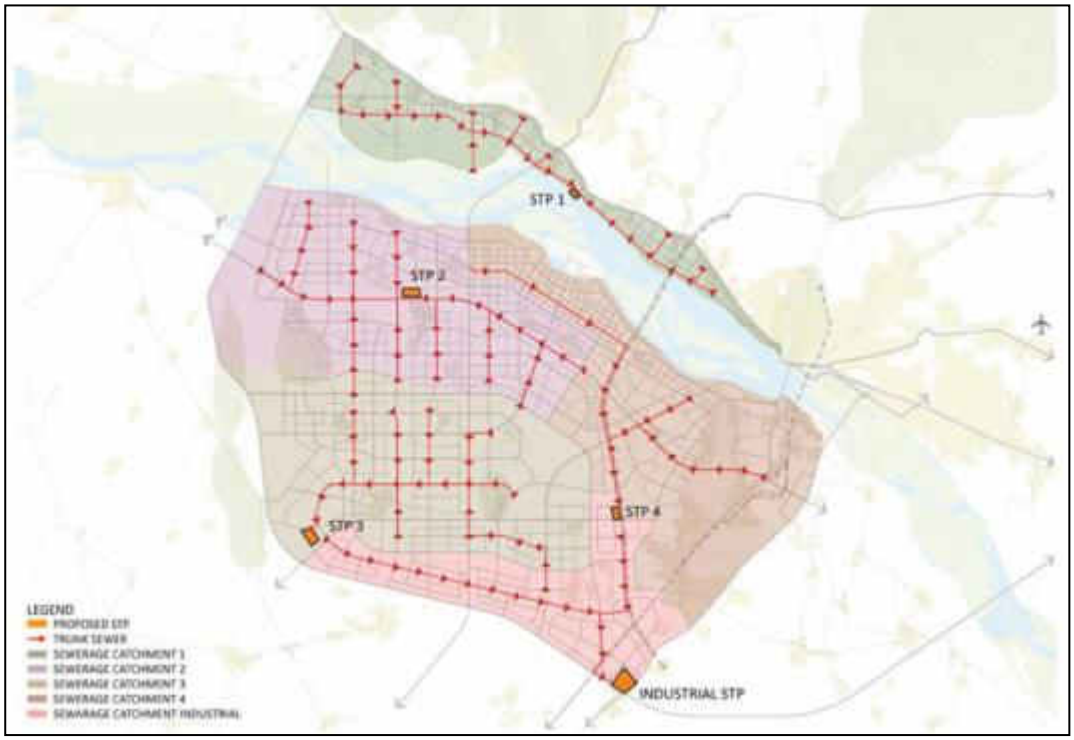


Figure 4-11 Decentralized Waste Water Management System*

The alignment of the trunk sewers will follow the proposed utilities corridor along the arterial road to provide access for installation and maintenance. The dried sludge from the proposed sewage treatment plant will be used as fertilizer.

High Quality Treatment System

The sewage effluent in the STPs is treated to meet stringent standards, which can then be used to supply directly to the industries for non-potable use.

The industrial waste water is pre-treated on-site before discharging into the municipal sewerage network. It is critical to periodically check the quality of the pre-treated industrial waste water before it flows into the municipal sewerage network. This will also improve the quality of the treated effluent, and reduce the cost of the treatment, as there would not be requirement for additional processes i.e. removal of heavy metals etc.

Proper Disposal or Effective Reuse of Recycled Water

Some of the treated sewage effluent generated from the individual STPs is proposed to be stored at the STPs and supply for non-potable use, such as irrigation of the landscaped areas within the Capital City. The treated sewage effluent could be loaded on to water tankers for irrigation during the dry season or distributed to the landscape areas in the parks or along the roadside through a network of irrigation pipelines.

4.5.4. Solid Waste Management

4.5.4.1. Existing Conditions

Current Waste Generation

The Capital City site is largely a green field site with some existing villages, the solid waste collection or processing at the project site is currently informal.

The waste is collected from open collection points by municipal workers and transported in tractors, trucks and auto tippers to the dumping sites.

The dumping sites are located in outskirt of the city/ towns. These are open dumping sites and entire mixed waste is dumped without any processing. The waste is also burnt for recovery of metallic parts from it. Rag-picking is rampant.

The waste management in Guntur, Vijayawada and Tenali are to some extent is organized, however, very limited processing is there. Mixed waste is dumped in the dumping yard.

In Vijayawada, efforts were made for WtE and Biomethanataion (BM) plant in past, however; these plants are presently lying defunct.

Andhra Pradesh (AP) Government has recently taken several initiatives under Swachh Bharat Mission (SBM) and new facilities are being developed for waste management. A Sanitary Landfill Site (SLF) is planned at Naidupet at Guntur. The locations of existing dumpsites are shown in Fig.4-12.

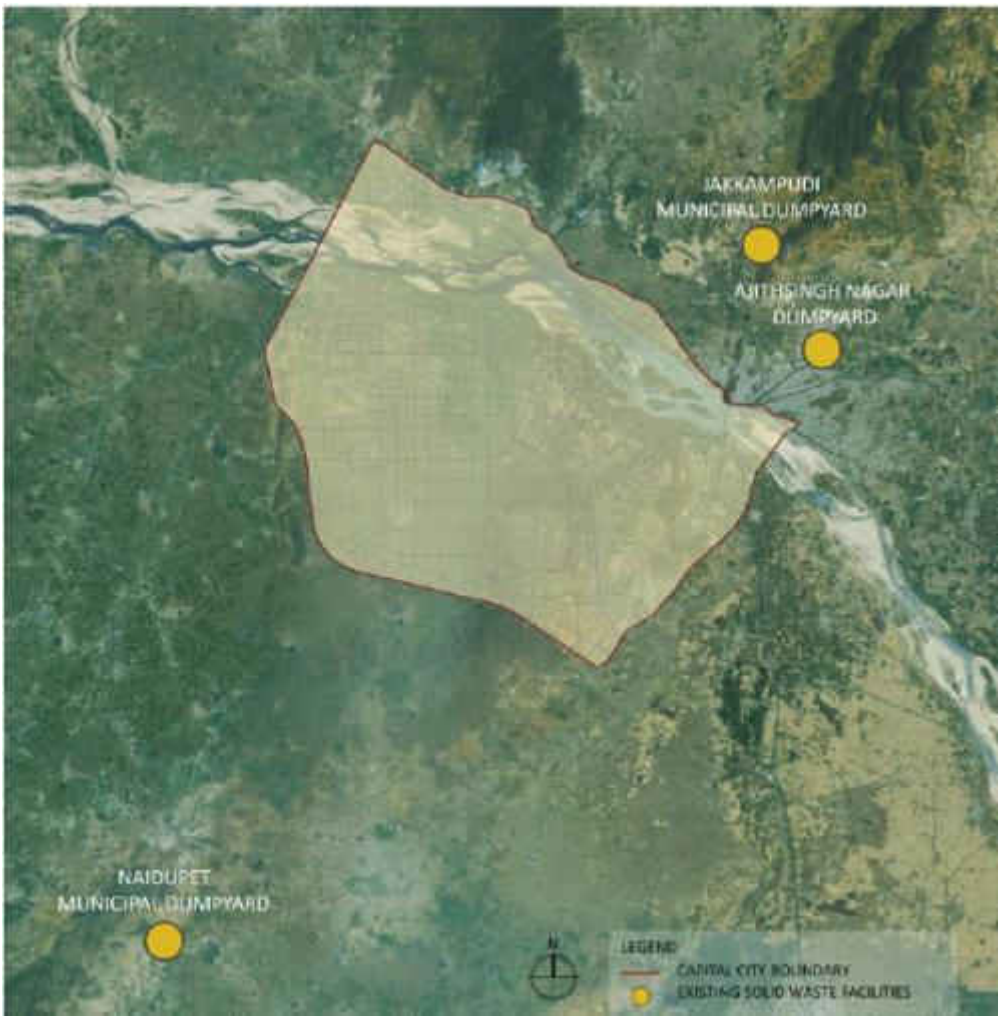


Figure 4-12 Existing Solid Waste Facilities near the Capital City*

Vijayawada and Guntur are the only large Urban Local Bodies (ULB) in the Capital Region with a population of more than 5,00,000. Currently 450 – 500 tons of Municipal Solid Waste (MSW) is collected daily in Vijayawada and disposed at the Jakkampudi dump site. Around 300 tons of MSW are collected daily in Guntur. This is disposed off at the Naidupet dump site.

Current Waste Collection

Very limited door to door collection and source segregation is followed in Vijayawada and Guntur cities. The segregation of waste is mostly in informal sector, where rag pickers and kabariwalas take out recyclable waste and send that to recyclers.

These bin points are dirty, odorous and unhygienic. At these locations, manual sorting takes place, often in the road way, to remove the recyclable and higher value waste items. In some cases, the Lorries move the MSW to another larger transfer point prior to the dumpsites.

Current Waste Treatment

Presently, waste processing is not carried out in Vijayawada or Guntur. Entire mixed waste is being transported to dumping site for disposal. In Vijayawada, several initiatives were taken in past for treatment of waste by different methods. However, none of them are presently functional.

There are two dumping yards, one operating in Vijayawada and one at Guntur. The Naidupet site is approximately 30 hectares and has an expected lifespan of another 20-25 years. The operations and maintenance of the existing dump sites are poor, posing environmental health and nuisance to workers and nearby residential areas.

The dumping yard at Guntur near Naidupet is being developed as scientific landfill site (SLF) under Swachh Bharat Mission (SBM) project. The same location will also act as SLF for 9 ULBs in the cluster for Waste to Energy (WtE) and SLF. Detail of the 9 ULBs formed for WtE is given in Table 4-5 below:

Table 4-5 Detail of Cluster under Lead ULB - Guntur.

S. No	Name of the ULB	Distance from Guntur in Km	Waste Generation tons/ day (2015)	Area and Location for WtE
1.	Guntur	0	350	**Guntur - Naidupet, Chilakaluripet Road - 77 acres**
2.	Vijayawada	37	550	
3.	Tenali	28	50	
4.	Chilakuripeta	40	68	
5.	Sattenapalle	37	40	
6.	Mangalagiri	25	40	
7.	Narasaraopeta	46	51	
8.	Ponnuru	31	35	
9.	Tadepalli	32	25	
	Total		**1209**	

4.5.4.2. Solid Waste Management Strategies

To make the Amaravati City an attractive and livable city, a solid waste management system which is convenient, reliable and consistent in service must be put in place. To provide sufficient capacity for disposal for the Capital City, it is important to develop long and short term plans for Vijayawada and Guntur.

There are a few overarching strategies which will guide the development of solid waste management in the Capital City:-

Solid Waste as a Resource

From the environmental point of view, solid waste does not have to be considered an environmental problem - it can also be considered as a potential resource. By managing waste correctly from the point of the production all the way to disposal, several types of resources can be recovered from the waste:

- Recyclable waste, such as plastics, metals and organic waste;
- Combustible waste for energy production; and
- Organic matter for composting.

Recovery of Energy from Waste

Energy recovery from waste is a concept of converting non-recyclable waste material into heat, electricity, or fuel.

This can be accomplished by the use of Waste to Energy (WTE) Plant. This is most commonly done in the form of an incinerator that can burn solid waste and use this energy to produce electricity.

The following long term proposals will seek to address the requirements of the Capital City when it is fully developed:-

- Rehabilitation of Current Collection Systems
- Treatment of Waste at Integrated Solid Waste Management Facilities (ISWMF)
- Special Solid Waste Management
- Inculcate Responsible Public Behavior on Waste
- Encourage Use of Technology
- Regulation, Legislation and Enforcement
- Flexibility in a Robust Plan

4.5.4.3. Solid Waste Projections

Solid waste generation will increase significantly as a result of the projected population and economic growth in the Capital City. Solid waste generated from the Capital City is projected up to 2050 in this study.

These projections are based on the national average. The following projections are to be used as a starting point for estimating solid waste generation, and are subject to further detailed studies regarding the waste volume and characteristics representative of local waste.

Municipal Waste

The current municipal solid waste generation rate is estimated at 0.5 kg/ capita/day[1]. It is assumed that with the population and economy growth in the Capital City, the solid waste generation rate in the future will increase.

According to the 'Sustainable Solid Waste Management in India' study by Columbia University in 2012, the waste generation rate is expected to increase

linearly over time. Based on this assumption, the waste generation rate is estimated for every 10 year period, the waste generation rate as assumed is tabulated in **Table 4-6 A** and the projected municipal waste generation in year 2050 is tabulated in **Table 4-6 B**.

Table 4-6 A Waste Generation Rate

S. No	Year	Waste Generation Rate (kg/Capita/day)
1	2001	0.439
2	2011	0.498
3	2021	0.569
4	2031	0.693
5	2036	0.693
6	2041	0.741
7	2050	0.813

Table 4-6 B Projected Municipal Solid Waste Generation in year 2050

S. No	Township	Solid Waste (Tons/ day)
1	T1	194
2	T2	180
3	T3	46
4	T4	214
5	T5	255
6	T6	130
7	T7	147
8	T8	150
9	T9	259
10	T10	398
11	T11	157
12	T12	168
13	T13	109
14	T14	121
15	T15	206
16	T16	132
17	T17	412
18	Downtown	138
19	Railway	98
20	River-edge	148
	Total	**3662**

Industrial Waste

Based on the land use distribution and the type of industries, the industrial solid waste generation has been worked out as shown in Table 4-7. The solid waste generation rate varies from 150 to 210 kg/ha/day for different types of industries.

The ultimate solid waste generation for the industrial development has been worked out to be an average of 796 tons per day.

Table 4-7 Projected Industrial Solid Waste Generation for year 2050

S. No	Land Use	Waste Generation Rate (tons/day)
1	Business Park	86
2	Light Industrial Zone	676
3	Logistics Zone	34
	TOTAL	**796**

4.5.4.4. Proposed Short Term Solid Waste Management System

The development of the Amaravati City will take place over many years before the Capital City is fully developed by 2050 as per the Concept plan. Therefore, both short term and long term proposals must be put in place to take care of the solid waste generated from the Capital City.

The short term strategy is to solve the current solid waste problems being faced by Vijayawada and Guntur which in turn will take care of the solid waste from the initial phases of development in the Capital City.

In the short term, it is recommended that the operation and maintenance of the existing dump site at Naidupet be improved to receive the solid waste from the Capital City, Vijayawada and Guntur, as well as the smaller nearby ULBs in the vicinity. An IMSWF must also be developed at the existing dump site at Naidupet. Hence, there is a need to improve the operations and maintenance of Naidupet dump site and upgrade it.

These short-term strategies will lead on to the development of the long-term strategies, for example, the sanitary landfill can also be further developed as one of the facilities in the Integrated Solid Waste Management Facility (ISWMF).

4.5.4.5. Proposed Long Term Solid Waste Management System

For the new Capital City, a modern waste collection system will be put in place to increase the attractiveness of the Capital City. Door-to-door collection systems can be implemented for landed properties where residents dispose the rubbish into bins located outside the properties along the roads.

Rubbish trucks would go from house to house to empty the bins on a regular basis. For high-rise residential buildings, individual refuse chutes or centralized refuse chutes should be provided for residents to dispose rubbish. Rubbish would be collected at collection bins located at the ground floor. These bins would be emptied to a motorized vehicle. The motorized cart or truck would then transfer the waste to a bin centre for collection by larger rubbish trucks. Alternatively, compactors can be provided at the bottom of centralized refuse chutes for direct collection by rubbish trucks without the need of a bin centre as a transfer station.

For high-income group (HIG) housing, modern collection technologies such as pneumatic waste collection systems may be considered. The implementation of

the various modern waste collection systems can be done through a set of building development guidelines. As the system of collection is being modernized, the existing dump site should be upgraded to become an integrated facility. This can help to maximize the lifespan of the facilities and to help mitigate environmental damage such as leachate escaping from the site.

Treatment of Waste at Integrated Solid Waste Management Facility (ISWMF)

Integrated Solid Waste Management is a comprehensive waste prevention, collection, recycling, composting, and disposal programme. The major ISWM activities are waste prevention, recycling and composting, and combustion and as well as disposal in properly designed, constructed, and managed landfills. While the collection of waste can be carried out externally, the segregation of waste from recyclables to compost and even to combustible waste can be carried out at the integrated facility.

Recycling and composting facilities can be co-located with the segregation facility so that waste can be dealt with in the same compound. After these processes, the remaining waste that can be converted to energy at a Waste-to-Energy (WTE) plant, and the by-products of the WTE (mostly ash) can then be transported to an engineered landfill nearby.

The following is a list of typical facilities in an Integrated Solid Waste Management Facility:-

- Sorting/Material Recovery Plant
- Anaerobic Digestion (AD)/Compost Plant
- WTE (Waste-To-Energy) Plant
- Engineered Landfill
- Bio-medical Waste Incinerator
- Construction & Demolition (C&D) Waste Recycling Plant
- Other waste recycling plants and facilities

There are current plans to develop an ISWMF at an existing landfill site in Naidupet, near Guntur, to treat waste from Guntur Municipal Corporation.

The existing open dumping ground at Naidupet has large capacity of 30 hectares. The comparatively short distance to this site from the Capital City means that in the early stages of the development, the existing dump site is suitable to serve the Capital City.

From site observations, there is sufficient volume of MSW collected from Vijayawada and Guntur, which can provide enough waste material for a WTE plant. In addition, the characteristics of the existing MSW may also be suitable for incineration at WTE plants. Further detailed studies such as waste characteristic studies would be needed to verify these before proceeding with the WTE plant in Naidupet. This will help to reduce the volume of waste being dumped at the ISWMF and further extend the lifespan of this site. This energy production would also help to offset energy demands.

The **Figure 4-13** below shows the possible routes for solid waste transfer from the Capital City to the IWSMF in Naidupet Guntur:

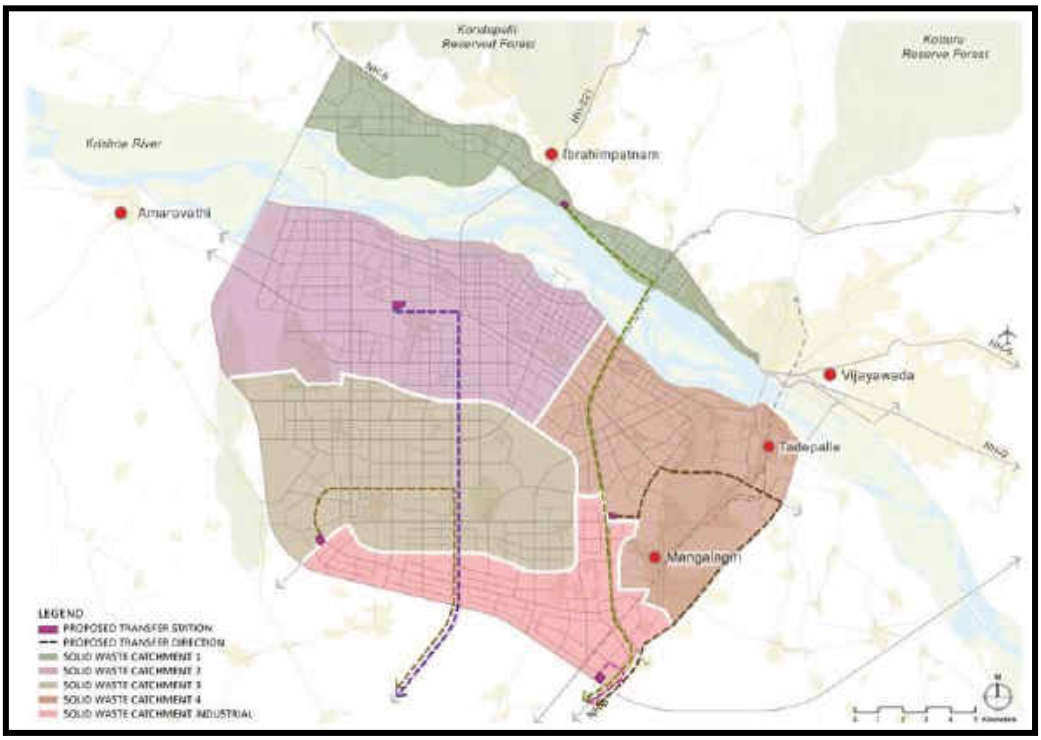


Figure 4-13 Indicative Solid Waste Transfer Stations and the Solid Waste Transfer Direction *

Inculcate Responsible Public Behaviour on Waste

The Capital City Waste Management Strategy will be required to provide guidance on how to engage the stakeholders, for example through Public Education Campaigns, using consistent marketing, working with businesses and residents, solid waste management service providers, and incentive policies.

To address this, a scheme can be introduced for households and waste collection workers where the households would segregate recyclables at source and the profits from sale of recyclables are passed on to the waste collection workers.

Encourage Use of Technology

The technological level of waste collection in India is still at the early stages of development. This provides an opportunity for the Capital City to implement modern and smart technologies for solid waste management.

For example, pneumatic waste conveyance systems for waste collection at household level have been implemented successfully in Singapore and Japan. Automated waste sorting machines using mechanical sorting can be introduced in the Integrated Solid Waste Management Facilities.

The waste processing is key to the ISWM. Thermal processing of waste is developed as an important treatment technology for municipal waste. By this technology, not only the volume of waste is reduced by 90%, and at the same time energy is recovered. As stated in above sections, AP-Govt is already in process of implementing WtE plant at Guntur with SLF under SBM. This facility will also cater to Capital city.

Regulation, Legislation and Enforcement

One of the potential key issues with waste collection in the Capital City is legislative framework and regulations must be in place to support the waste industry. Regulations and legislations for the solid waste management can be implemented at the industrial and commercial level, for example by mandating recycling for certain industries such as packaging, etc. At the commercial and industrial level, audits and incentives may be provided by a regulatory body to ensure that proper waste management is achieved by commercial and industrial entities.

CRDA and CA will put in Regulations at collection level. Regulatory measures can also be introduced at household level by implementing waste collection fees.

Flexibility in a Robust Plan

Ultimately, the infrastructure provisions within the Capital City will depend on the proposed Solid Waste Management framework that will be implemented.

While the Integrated Solid Waste Management Facilities would be located outside the Capital City, technological, social and legislative advances in the next 35 years would guide the development of the collection, segregation and treatment of waste in the Capital City. It is of utmost importance that a robust approach is adapted to ensure solid waste infrastructure can be provided within the City, whatever the form may be.

Therefore, space has been reserved at the Capital City Concept Plan to ensure that infrastructure such as transfer stations, bin centres, sorting centres or even pneumatic waste collection systems can be provided if required.

4.5.5. Power Supply

4.5.5.1. Existing Condition

The nearest power plant is the Vijayawada Thermal Power Plant (VTPP), which is located just outside the northern boundary of the Capital City on the northern bank of the Krishna River. This power plant is coal–fired.

There is an allocation of 1,000 MW and planned 800 MW from the upgrading of the Vijayawada Thermal Power Plant to supply to the Capital City. However, this supply to the Capital City must be guaranteed for the entire Concept Plan to be realized. Even with this committed supply, it is still not sufficient to meet the long-term demand of the Capital City. There needs to be a detailed development strategy in place to ensure that the Capital City power demands are met.

The Capital City area is well located to connect to the national power grid of India. There are currently several transmission lines running through the development area. The power lines currently link the Vijayawada Thermal Power Plant to a primary electrical substation which distributes power to the existing towns and villages within the Capital City area and the south of the Capital City, including Thulluru. Fig.4-14 shows the existing alignments of the overhead power lines running through the development site.

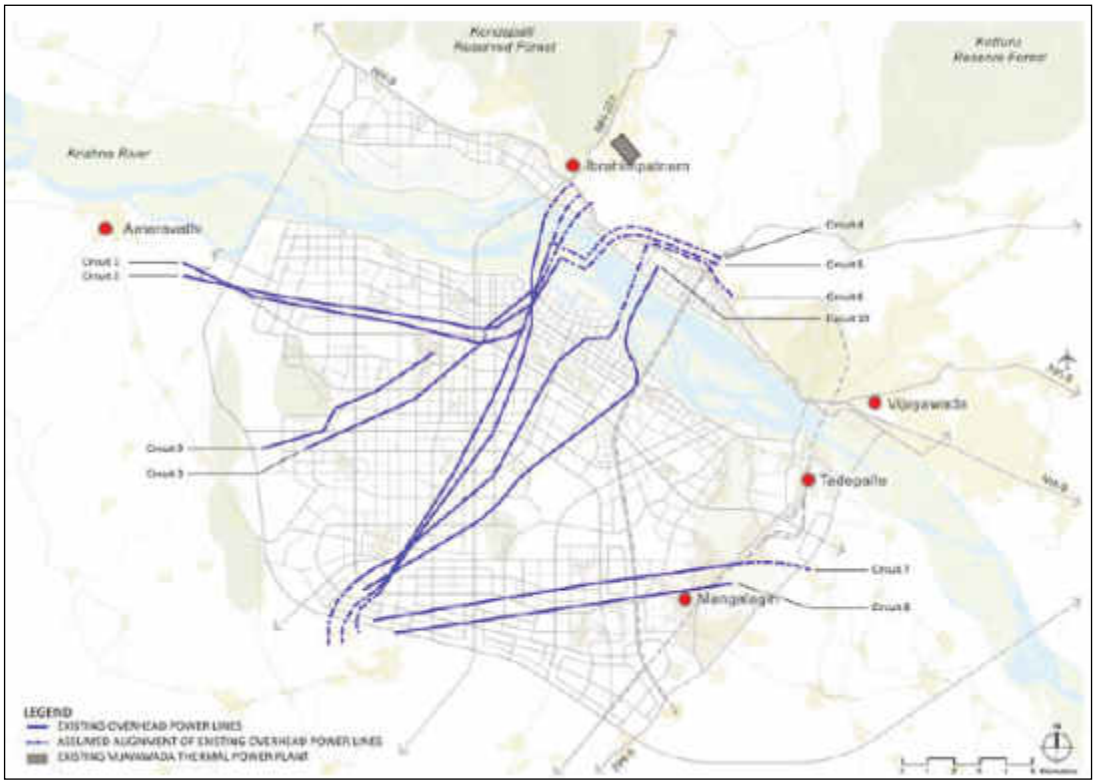


Figure 4-14 Existing Locations of Overhead Power Lines in Capital City Boundary *

4.5.5.2. Power Supply Requirement

4.5.5.3. Power Supply Demand Projections

Power demand is expected to increase as a result of rapid urbanization and population growth. Demand projections for municipal use and industrial use have been established and listed in the Table 4-

Table 4-8 Power Supply Demand Projections (in MW)

S. No	Land Use Type	Phase 18	Phase 2	Phase 3
1	Residential	282	513.4	1439.1
2	Commercial Retail	352	449.1	837.3
3	Business Park/ Office	28.3	56.6	169.7
4	Community Facility	113.5	227.0	681.1
5	Education Facility	23.8	47.7	143.1
6	Industrial	298.8	597.5	1792.6
7	Communal Facilities	134.9	327.6	467.6

The proposed short term and long term transmission line alignment for Capital City is shown in Fig 4-15 and 4-16.

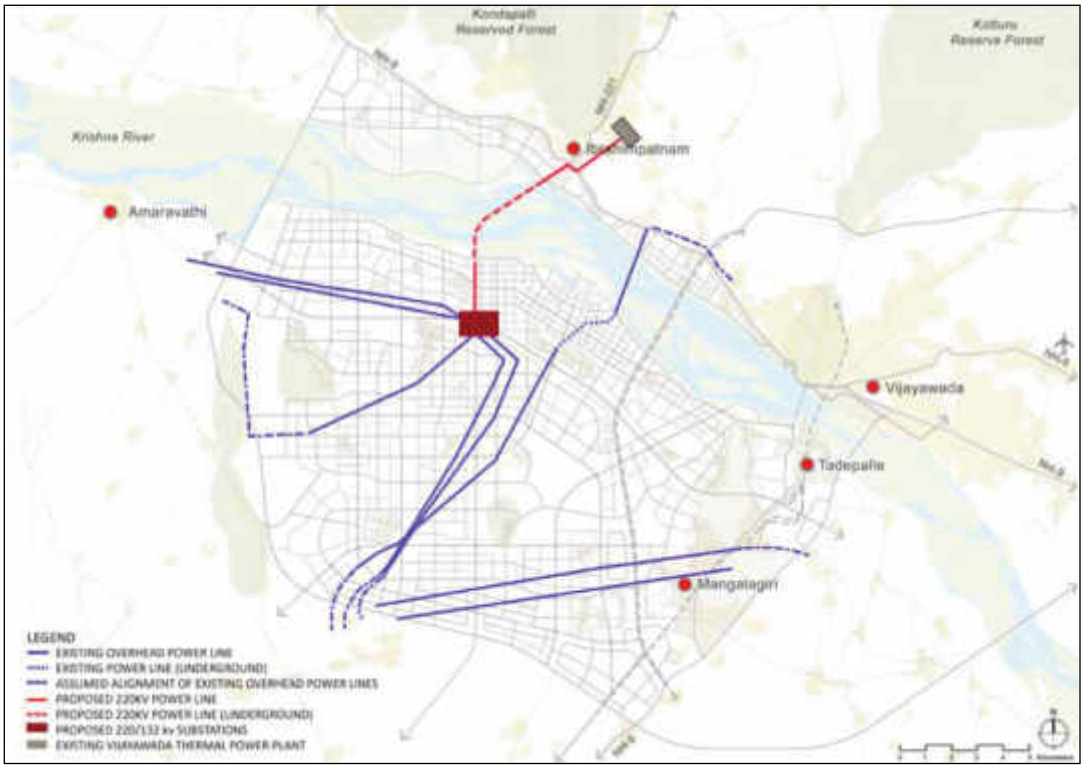


Figure 4-15 Short Term Transmission line Alignment for Capital City *

Figure 4-16 Long term Transmission Line Alignment for Capital city *

4.5.6. Road Network - Efficient grid

A grid network is proposed for the new Amaravati Capital city. The grid network

comprises roads designed and classified based on functions and capabilities.

Four (4) classifications of roads (as prescribed by the Urban and Regional Development Plans Formulation and Implementation Guidelines URDPFI 2014) were identified and used as the major classes of roads in the Master Plan. They are:-

Urban Expressways

Two urban expressways, which connect NH16 and NH65, are proposed to serve the Amaravati Capital city. The main urban expressway will provide circulation along the fringe of the city, therefore allowing through-traffic to bypass the Capital city Core. A semi-expressway will provide a traffic route from the main urban expressway to the CBD Speeds along urban expressway are generally high to minimize travel time along the expressways Major Industrial Zones to be located near the expressways.

Arterial Road Network

An arterial and sub-arterial network is developed to ensure mobility between the major areas within the City and transport hubs. The arterial network also serves as the major transit corridors, especially for rapid transit systems. The sub-arterial network supports the arterial network, and is the primary access to township development zones Infrastructure mains are to be located within or adjacent to the arterial network to ensure access to utilities. Traffic speeds along arterial roads should be maintained at 40-60kmh.

Collector Road Network

The collector road network is the main distributor of traffic at neighborhood level. Access to developments is to be gained from the collector roads. Access and Local roads are to be connected to the collector road network Collector roads are to be generally designed for higher social interaction, and therefore speeds should be limited to no more than 40kmh, depending on context. Village Roads are to be integrated to the Collector Road network

The proposed road network plan is shown in Fig **4-17**.

4.5.6.1. Proposed Public Transportation System

Development of a well connected public transportation is critical for the capital city development. This section illustrates the various modes of public transport that have been proposed for the Capital city.

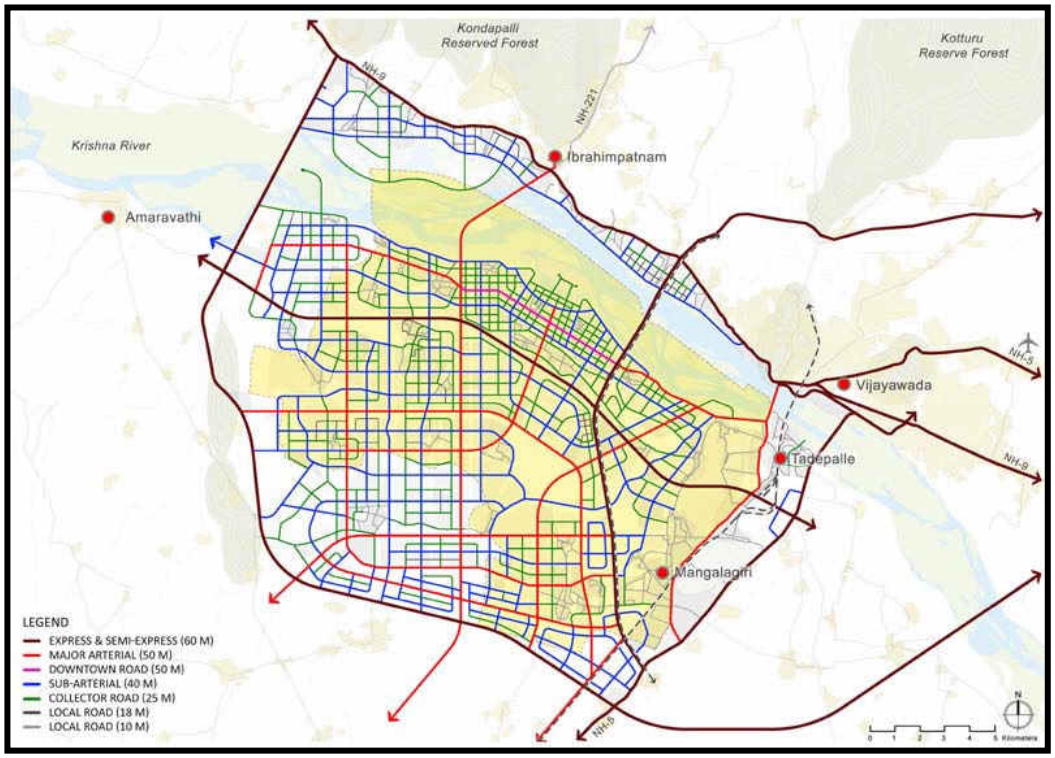


Figure 4-17 Proposed road network *

Bus Network

The Andhra Pradesh State Road Transport Corporation (APSRTC) can start the development of the public transportation system by providing bus routes from nearby towns to provide connectivity between the existing villages, neighbouring towns and cities i.e. Vijayawada. This short to medium term strategy will not only provide the local residents with a convenient mode of transport, it will also provide flexibility in terms of public transport due to the ease of adding additional services or routes to provide public transport coverage to and within the Capital City. Once these routes become fully operational and can sustain demand, a higher capacity system, such as mass transit, can be introduced. The bus routes with high public transport usage and passengers volume can be upgraded to mass transit systems such as Bus Rapid Transit. The mass transit systems will be supplemented by the local public bus system, which would also function as feeder systems connecting to the mass transit. Due to its flexibility in operations and routes, the local bus routes can still run concurrently with the construction of the rapid transit systems to maintain connectivity within the Capital City. These routes running parallel to the mass transit systems can eventually be phased out, or remain as secondary connections, depending on demand and coverage.

Rapid Transit Networks

Rapid transit system has been proposed as a long term strategy. The Rapid transit system is an efficient public transport system operating in urban areas with high capacity and frequency, and grade separation from other traffic. The most common

rapid transit solutions being used around the globe are:

Bus Rapid Transit (BRT)

Bus rapid transit (BRT) is a bus-based mass transit system. A BRT system generally has specialized design, services and infrastructure to improve system quality and remove the typical causes of delay with a fully dedicated right of way (bus way). BRT aims to achieve high capacity and speed with the flexibility, lower cost and simplicity.

Due to BRT's advantages of low initial capital cost and fast implementation, it is purposed to be the initial core transit system for Amaravati. BRT system will be located at only arterial and sub arterial roads where there is sufficient space in the ROW. Five BRT lines in total are purposed and these lines are designed such that all the major townships and vital places in the city such as CBD and transport hub in Amaravati can be reached by BRT system. These BRT lines intersect one another at interchange stations where passengers can change from one BRT line to another and continue their journey until reaching their destination.

Light Rail Transit (LRT)

Light Rail Transit (LRT) is a rail-based rapid transit which uses dedicated tracks to guide its vehicles. Typical systems are trams and guided trains. These systems can be built as part of the road network, or as a separated rail system similar to the BRTS

As a newly established Amaravati Capital city and regional centre, the population in Amaravati is expected to grow exponentially. The BRT system alone cannot meet the future passenger capacity, and the need for fast connection inside the city as well in between Amaravati and Vijayawada.

Mass Rapid Transit (MRT)

Mass Rapid Transit (MRT) is also rail-based, but has a carrying capacity much higher than the LRT system. MRT is typically separated from the roads, running on dedicated rail alignments either elevated or underground, as the vehicle speeds need to be high even in an urban zone. MRT requires high capital and running cost and are only built if there is critical passenger mass.

MRT tracks will be located at elevated corridors above the top-level roads, namely arterial and sub arterial roads. Due to the long implementation time for MRT, the MRT system is to be designed in two phases:

- Phase 1: MRT 1 (40 km) & MRT 2 (34 km)
- Phase 2: MRT 3 (37 km) & MRT 4 (36 km)

High Speed Rail (HSR)

The Indian Ministry of Railways' white-paper "Vision 2020" proposed six potential high-speed rail corridors (HSR) connecting commercial, tourist, and pilgrimage hubs. The corridor which passes through Amaravati city starts from Chennai leads to Vijayawada where it splits into two lines; one towards Hyderabad and the other towards Vijayawada Airport.

Integrated Transport Hubs

Integrated Transport Hubs are a form of Transport-oriented Developments (TOD), and are fully air-conditioned transport interchanges seamlessly linked to rail system, rapid transit and bus stations and adjoining commercial developments such as shopping malls. With this integration, commuters can easily run errands and shop conveniently and comfortably, before transferring to their connecting buses or trains. There are two types of integrated transport hubs proposed in Amaravati.

The first type is located where interactions between multiple transport modes occur. As shown in Figure below, the transport hub is located at the intersections of high speed rail, BRT, MRT 2, MRT 3 and MRT 4. Passengers could change between different modes of transport comfortably inside the air-conditioned buildings, and eating and shopping in between long haul journey.

Figure 4-18 Proposed Public Transportation Plan *

The second type of Transport hubs are relatively smaller in scale than the first type and involve single type of transportation mode. This type of transport hub is located at the interchange stations of different MRT lines where high volume of passengers is expected.

These transport hubs can also act as a hub to allow private vehicle trips to transfer onto public transport. By providing incentives such as car parking, commuters can park at the peripheral transport hubs, and then transferring onto the rapid transit systems to travel to the city centre. This is particularly important for existing villages, as the villagers are likely to travel to these transport hubs before transferring onto a public transit network.

CHAPTER 5

DESCRIPTION OF THE ENVIRONMENT

5.1. Introduction

A comprehensive understanding of the physical, chemical, and biological environment provides the foundation to a well-executed Environmental Assessment. The detailed baseline characterization is used as input to model possible project impacts, which allows specialists to provide timely input to project designs to reduce potentially adverse environmental impacts. This in turn produces a more socially and environmentally sustainable project and enhances the efficiency of the project permitting process.

The baseline environmental studies for the New Capital City project were carried out within the 10 km radius taken from the project boundary which is considered as the study area for executing the Environmental Impact Assessment study as per Ministry of Environment and Forests & Climate Change (MoEF&CC) guidelines. Study area map superimposed on topo-sheet presented as **Annexure B1.**

The baseline environmental studies encompassed the disciplines/ environmental attributes of air, water, noise, soil, land-use, terrestrial and aquatic ecology and socio-economic component.

The baseline studies started with site visits and reconnaissance survey in the study area and monitoring/ sampling locations were fixed for the primary data on the basis of potential impacts of the proposed site. For obtaining relevant secondary data various Government agencies were approached.

To establish the existing environmental scenario, field studies and monitoring were carried out for the summer season; the ambient air quality study is carried in the month of May - June 2015.

5.2. Meteorology

Micro-meteorology plays a pivotal role in the understanding of the weather phenomena and the climatology which in turn affect the dispersion pattern of the pollutants. Thus the micro-meteorological studies are an integral part of the air pollution studies which not only help in interpretation of the extant baseline conditions within the study area- but also serve as an input to the predictive models for air quality dispersion studies.

5.2.1. Methodology

The methodology adopted for monitoring surface observations was as per the standard norms laid down by Bureau of Indian Standards, and the India Meteorological Department (IMD). On site monitoring was undertaken for various meteorological variables in order to generate the site-specific data. The data generated- especially the wind pattern has been compared with the secondary data taken from the Wind Rose Atlas for the nearest IMD station Gannavaram for the year 1971-2000.

5.2.2. Site specific meteorological data

An automatic weather monitoring station was installed at a height of 10 meters from the ground level at Thulluru to monitor parameters of wind speed and wind direction, temperature, & relative humidity. The automatic weather station is shown in Fig-5-1**.** The data is recorded as the maximum, minimum, instantaneous value, and average value of all the readings collected during the proceeding hour. Monitoring was done as per IS: 8829: Micro-meteorological Techniques in Air Pollution.

Figure 5-1 Automatic weather station installed at Thulluru

The details of parameters monitored, equipment used and the frequency of monitoring are given in **Table 5-1**

Table 5-1 Meteorological Parameters Monitored at Site

S. No.	Parameters	Instruments	Frequency
1.	Wind speed	Counter Cup Anemometer	Hourly / Continuous
2.	Wind direction	Wind vane	Hourly / Continuous
3.	Temperature	Thermo sensor	Hourly / Continuous
4.	Relative humidity	Thermo –hygro sensor	Hourly / Continuous

5.2.3. Secondary meteorological data

5.2.3.1. Wind pattern of the IMD station Gannavaram

The wind rose diagrams of the nearest IMD station Gannavaram - for the months of May and June for a period of 1971 to 2000 have been taken from the Wind Rose Atlas published by India Meteorological Department. The wind rose diagrams for the said months are depicted in **Figure-5-2 (A)** and **Figure-5-2 (B)** respectively.

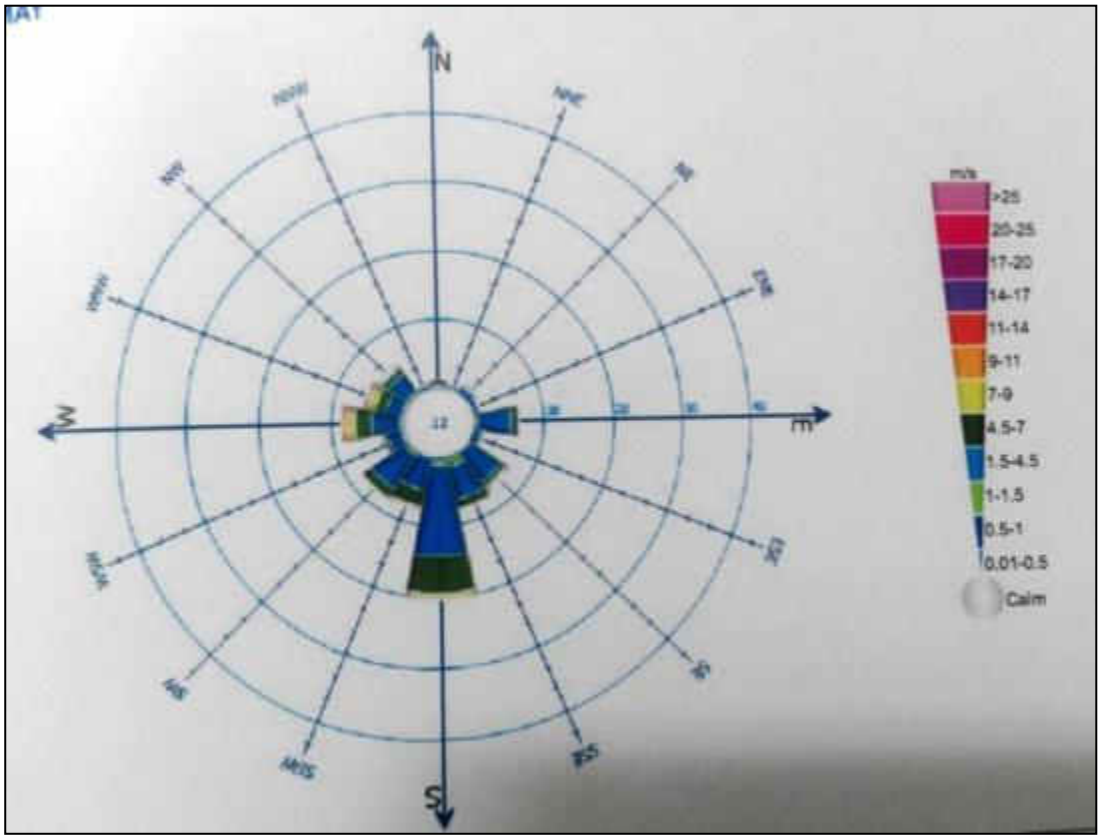


Figure 5-2 (A) IMD Wind Rose Gannavaram for May (1971-2000)

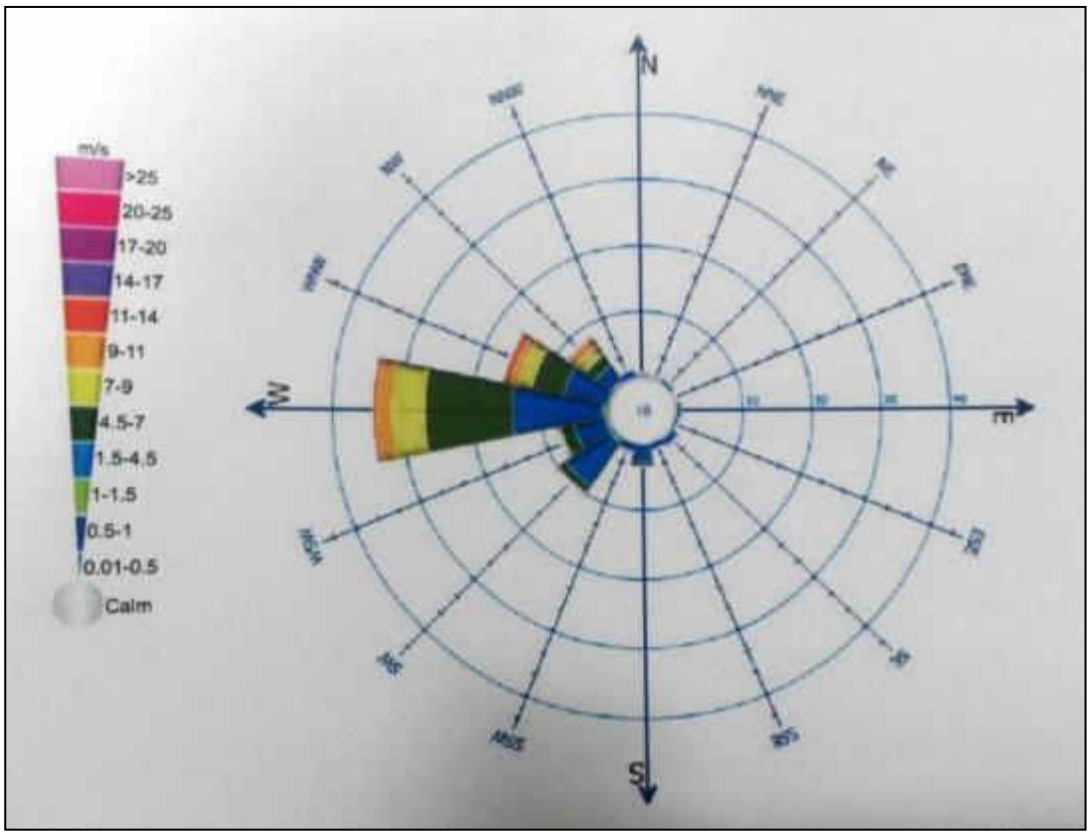


Figure 5-2 (B) IMD Wind rose for *Gannavaram* for June (1971-2000)

5.2.3.2. Climate of Guntur District

As per the report, "Guntur District Ground Water Profile" prepared by Central Ground Water Board, Ministry of Water Resources, published in September 2013, the climate of Guntur Region is defined as below:

- Normal annual rainfall : 853 mm
- Actual rainfall (2010-11) :1,357.6 mm
- Average Annual Rainfall (1999-2011) : 889.1 mm
- Mean Daily Temperature: Maximum 48.5 mm, Minimum: 1 6. 8 mm
- Relative Humidity : Highest-80 % & Lowest -30 %
- Evapo-transpiration :145mm – 350 mm
- Wind Speed: 4.5 to 16.3 km/hr.

5.2.4. Primary survey

The site specific meteorological data including the parameters viz., wind direction, wind speed, relative humidity and ambient temperature were recorded using automatic weather station installed at Thulluru and the same are presented in **Table 5-2.** Automated Weather stations are located at every mandal of the Andhra Pradesh State. Three such monitoring station falls within the project site and two in

the study area. The details of micro-meteorological data from these locations are provided in **Table 5-3**.

Table 5-2 Site specific meteorological data

Month	Wind speed (m/sec)			Temperature (0C)			Humidity (%)		
	Max	Min	Avg.	Max	Min	Avg.	Max	Min	Avg.
May - June 2015	2.7	0	0.4	46.7	21.8	31.4	100	15	78.2

Table 5-3 Site Specific Met Data from Mandals in Project site during summer 2015

Location	Wind speed (m/sec)			Temperature (0C)			Humidity (%)		
	Max	Min	Avg.	Max	Min	Avg.	Max	Min	Avg.
Thulluru	26.2	0	13.1	47.4	16.3	31.8	78.9	5.1	41.9
Tadepalli	11.6	0	5.8	48.2	20.	34.1	83.1	11.3	47.2
Mangalagiri	15.7	0	7.8	48.4	22.2	35.3	80.6	9.8	45.2

5.2.4.1. Wind pattern for the study period

The wind pattern during the study period is depicted in the form of wind rose in the **Figure-5-3.** The wind rose depicts that the predominant wind direction is from the South West quadrant followed by the East direction. The wind frequency class distribution reflects that the calms prevailed for 54.57% of the total period during the study and the 0.5m/sec-2.1 m/sec class prevailed for about 43.8% of the total period.

5.2.4.2. Temperature

The temperature ranged from a minimum of 21.8 ^{0}C to a maximum of 46.7 ^{0}C while the average was found to be 31.49 ^{0}C.

5.2.4.3. Relative humidity

The relative humidity ranged from a minimum of 15% to a maximum of 100% while the average was computed to be 78.2%

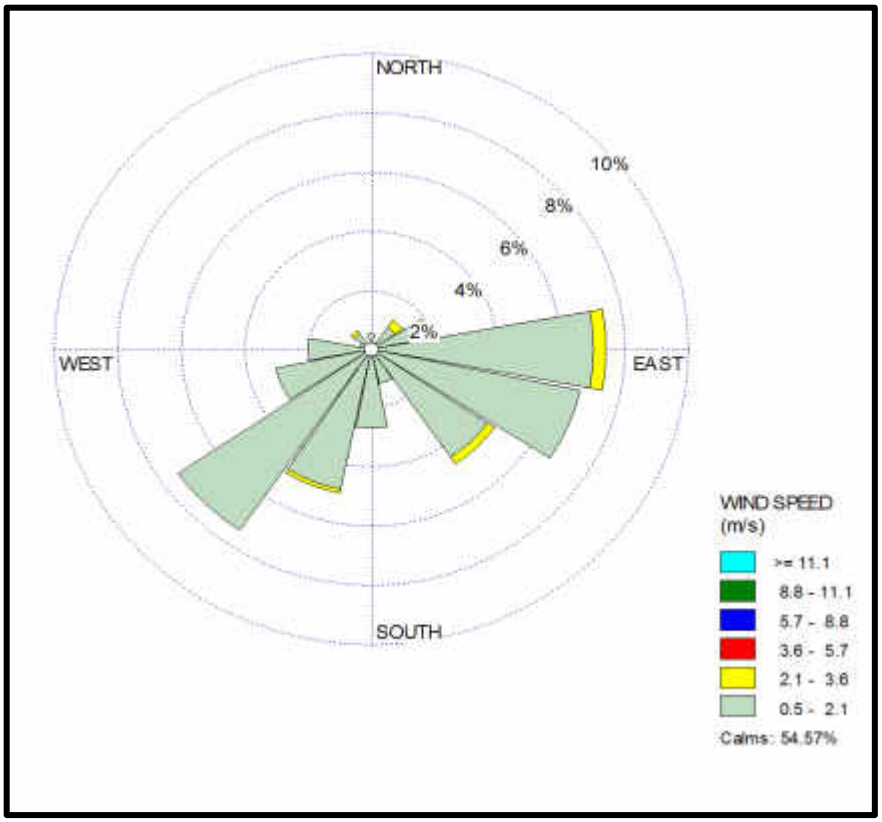


Figure 5-3 Site specific wind rose for the study period (Wind Blowing from)

5.2.5. Observations

5.2.5.1. Secondary data

Wind pattern of the IMD Station Gannavaram

May 1971 – May 2000

The **Figure 5.1** reflects that the predominant wind direction for the month of May from period 1971- 2000 is south.

June 1971-June 2000

The **Figure 5.2** reflects that the predominant wind direction for the month of June 1971 – 2000 is west followed by the wind blowing from the North Western quadrant.

5.2.6. Conclusion

The comparative study of the wind patterns of the IMD station and the onsite wind pattern reflect that the wind directions are not greatly correlating since the project area is adjacent to a large reservoir followed by hill range of Kondapalli whereas IMD station at Gannavaram Airport is in plains. For comparative analysis, meteorological data collected by AP State Planning Department from Automated Weather Stations located in the Mandal Headquarters falling in the study area were also collected. The data from 1st March 2015 to 30th May 2015 (Summer Season) is presented in Fig 5.4 covering.

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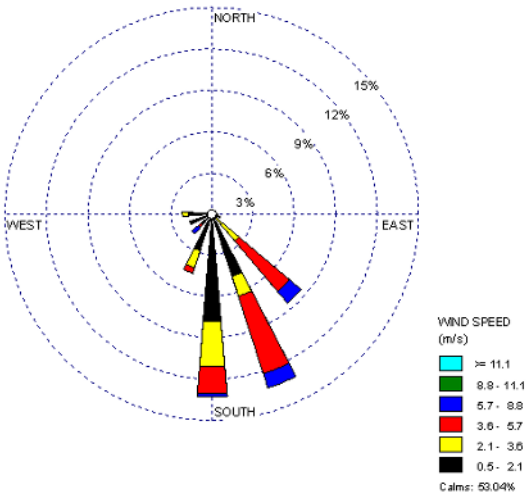
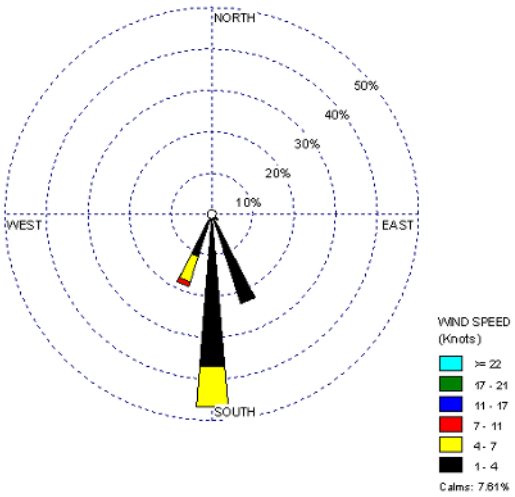
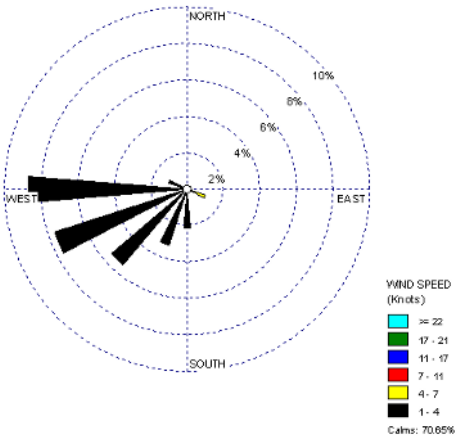
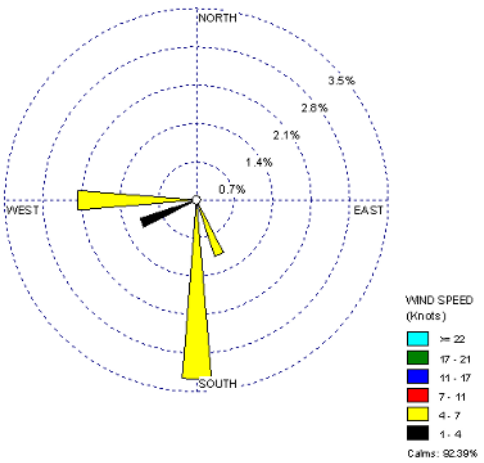
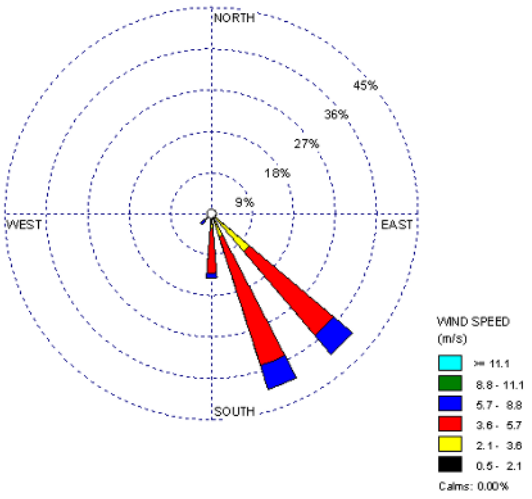
<tr><td> 
</td><td> 
</td></tr>
<tr><td>Tadepalli Wind Rose</td><td>Ananthavaram Wind Rose</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>Mangalagiri wind Rose</td><td>Nuthakki Wind Rose</td></tr>
</table>



Rayapudi windrose

Figure 5-4 Five Mandals Wind Rose of Summer Season in Year 2015

From the wind roses as shown in Fig 5-3 and Fig 5-4 it is evident that the wind pattern in the area is predominantly from South and from South east.

5.3. Ambient Air Quality

The prime objective of the baseline ambient air monitoring was to evaluate the existing air quality of the area while the secondary objective was to establish the baseline levels of air quality on which the predicted ground level concentrations based on air quality modeling exercise would be superimposed. This would also be useful for assessing the conformity to standards of the ambient air quality during the operation of the proposed project. The ambient air quality was monitored at twenty (20) locations in and around the project site.

5.3.1. Methodology adopted for Air Quality Survey

5.3.1.1. Selection of Sampling Locations

The baseline status of the air quality in the study area has been assessed through a scientifically designed ambient air quality monitoring network. The design of monitoring network in the air quality surveillance program has been based on the following considerations:

- Meteorological conditions on synoptic scale such as the predominant wind direction in the study area / project site; the study shows the predominant wind direction is from east to west, three locations namely AQ10, AQ18, and AQ19 are located in the downwind side.
- The methodology for conducting the baseline environmental survey and selection of sampling locations considered the guidelines given in the EIA manual of the MoEF&CC and the CPCB guidelines;

- Topography of the study area keeping into view the terrain in the study area; There are two rocky outcrops in the project site, three air sampling locations namely AQ11, AQ16 and AQ17 are located near these outcrops.
- Representatives of regional background air quality for obtaining baseline status;
- Representatives of likely impact areas; The typical features like the river front, agricultural field, the green area near Mangalagiri, archeologically important site- Undavalli Caves etc are covered in the air quality monitoring network.
- Dense population pockets in the study area- Monitoring locations at all densely populated areas within the study site i.e. Vijayawada, Guntur, Thulluru and Mangalagiri are covered in the monitoring network.

5.3.2. Frequency and Parameters for Sampling

Ambient air quality monitoring has been carried out with a frequency of two days per week at twenty (20) locations during the study period. The ambient air quality parameters along with their frequency of sampling are given in **Table 5-4**

Table 5-4 Monitored Parameters and Frequency of Sampling

S. No	Parameters	Sampling Frequency
1.	Particulate Matter (PM_{10})	24 hourly sample twice a week for three months
2.	Particulate Matter ($PM_{.2.5}$)	24 hourly sample twice a week for three months
3.	Sulphur dioxide (SO_2)	24 hourly samples twice a week for three months
4.	Oxides of Nitrogen (NO_x)	24 hourly samples twice a week for three months
6.	O_3	8 hourly samples twice a week for three months

5.3.3. Instruments used for Sampling

Respirable dust samplers of Ecotech make were used for monitoring PM_{10} (<10 microns), $PM_{2.5}$ (<2.5 microns) and gaseous pollutants like SO_2 and NO_2. Gas Chromatography techniques have been used for the estimation of CO. The ozone was monitored using the online ozone meter. The photographs of the sampling equipment are given in **Fig 5-5**

Respirable Dust sampler

Respirable dust sampler

Figure 5-5 Sampling equipments during monitoring

5.3.4. Sampling and Analytical Techniques

$PM_{2.5}$ and PM_{10} have been estimated by gravimetric method. Modified West and Gaeke method (IS-5182 Part-II, 1969) has been adopted for estimation of SO_2. Jacobs-Hochheiser method (IS-5182 Part-IV, 1975) has been adopted for the estimation of NOx. The techniques used for ambient air quality monitoring and its minimum detectable levels are given in **Table 5-5.** The map depicting AAQM stations is presented in **Fig 5-6,** while the details of ambient air quality monitoring stations are given in **Annexure B2.** The summary of AAQM reports are given in **Annexure-B3**

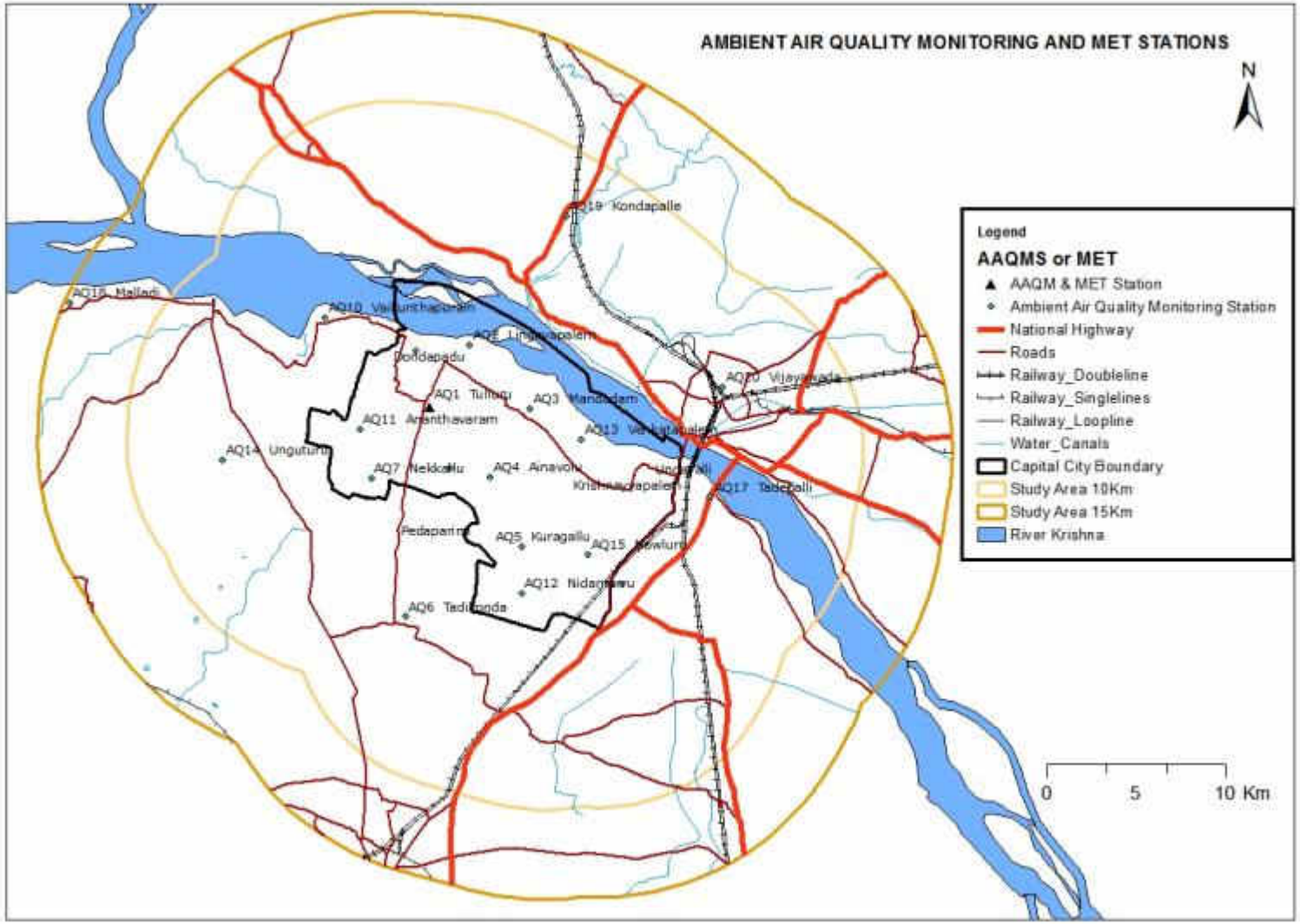


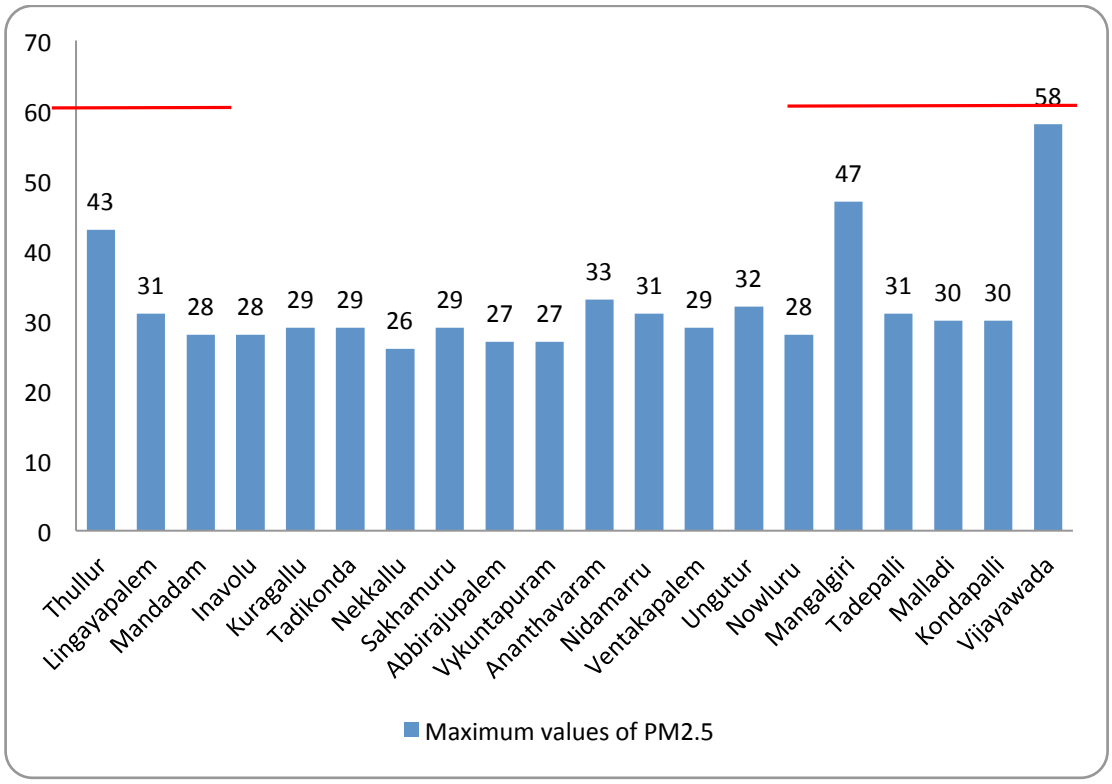
Figure 5-6 Ambient Air Quality Locations

Table 5-5 Techniques Used for Ambient Air Quality Monitoring

S. No.	Parameter	Technique	Technical Protocol	Minimum Detectable Limits (µg/m3)
1.	PM_{10}	Respirable Dust Sampler (Gravimetric method)	IS-5182 (Part-IV)	5.0
2.	$PM_{2.5}$	Respirable Dust Sampler (Gravimetric method)	IS-5182 (Part-IV)	4.0
3.	Sulphur Dioxide	Modified West and Gaeke	IS-5182 (Part-II)	4.0
4.	Nitrogen Oxide	Jacob & Hochheiser	IS-5182 (Part-VI)	4.0
5	CO	Gas Chromatography		
6	O_3	Online Ozone meter		

Source: Bureau of Indian standards

The charts depicting the maximum values of the $PM_{2.5}$, PM_{10}, SO_2 and NO_x are shown from **Chart - 5.1** through **Chart-5.4**



NAAQ standards for SO_2 in residential areas = 80 µg/m^3

NAAQ standards for PM_{10} in residential areas = 100 µg/m^3

Chart - 5.1: Variation of $PM_{2.5}$ during the study period

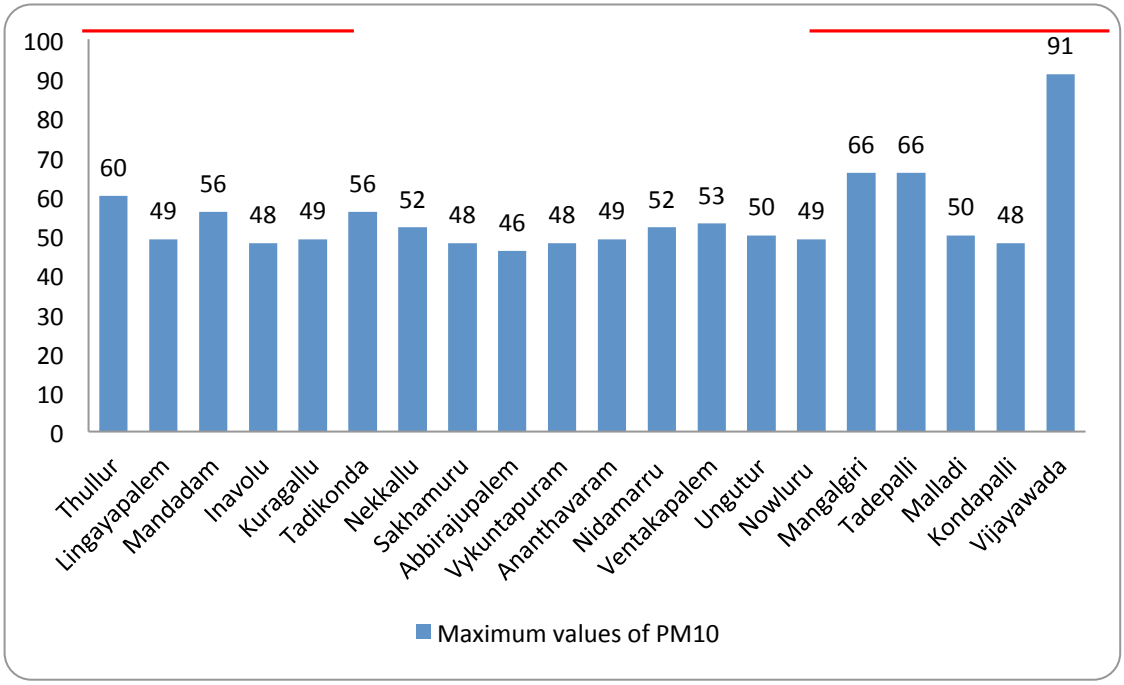


Chart-5.2: Variation of PM_{10} during the study period

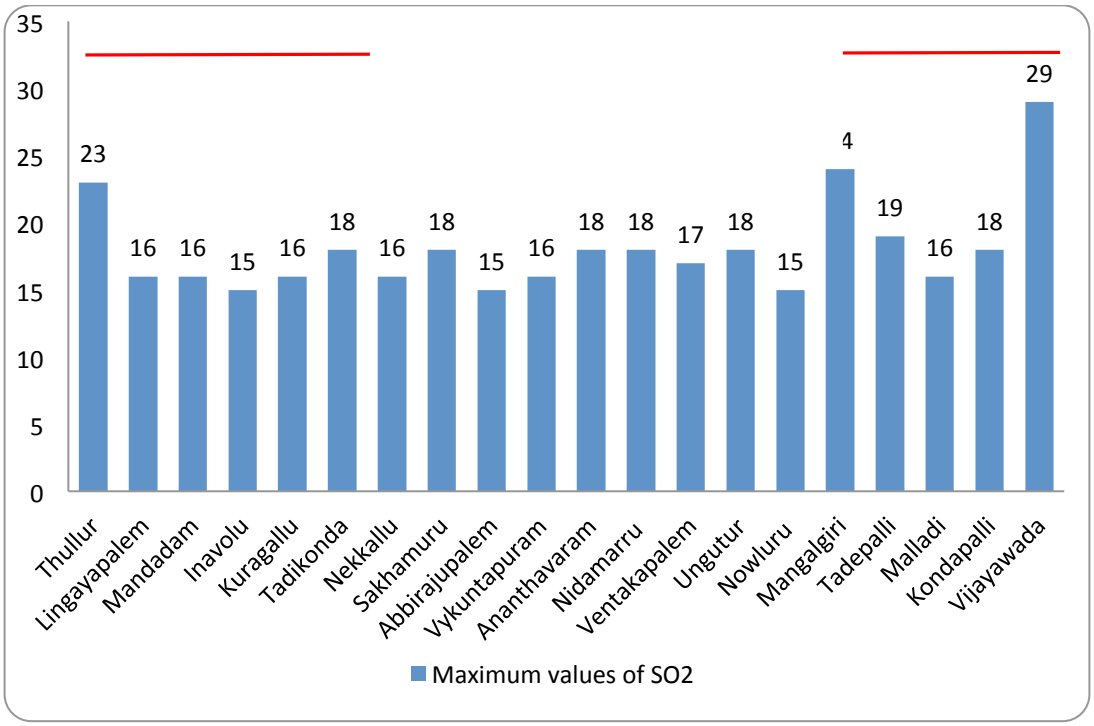


Chart 5-3: Variation of SO_2 during the study period

NAAQ standards for NO_x in residential areas = 80 µg/m^3

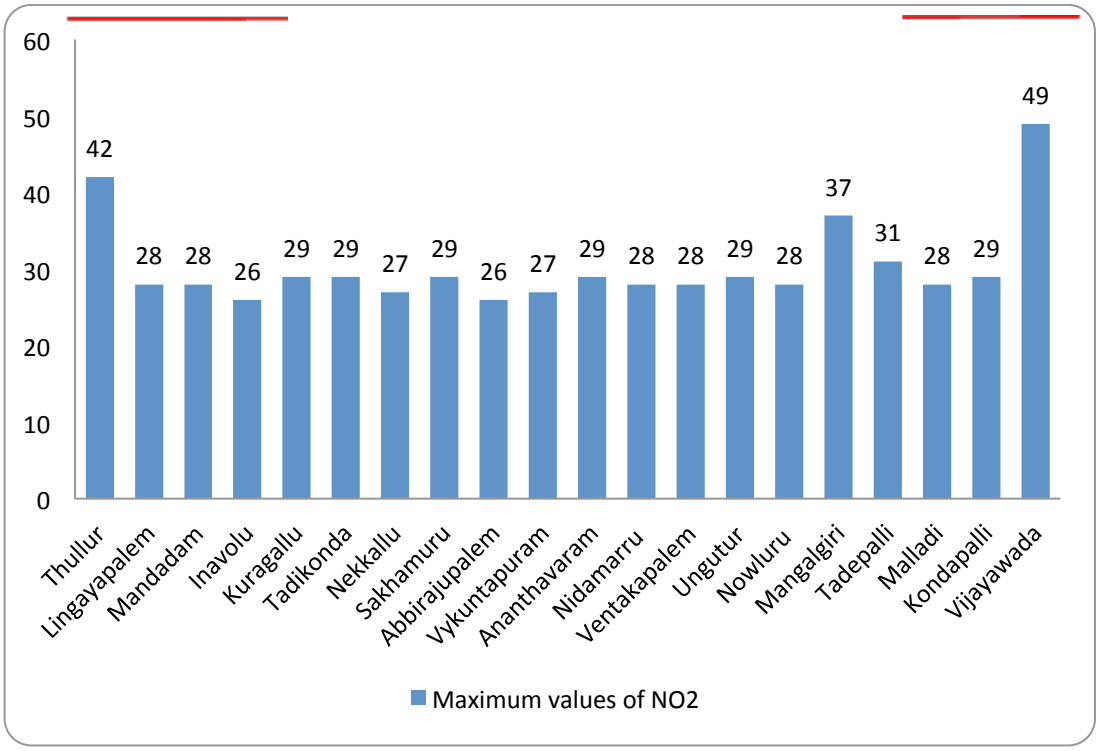


Chart 5-4 Variation of the NO_2 during the study period

5.3.5. Observations

- The concentration of $PM_{2.5}$ was found to be between 15 µg/m^3 (Vykuntapuram) to 58 µg/m^3. (Vijayawada). The average concentration was in the range of 21 to 53 µg/m^3.
- The concentration of PM_{10} was between 35 µg/m^3 (Vykuntapuram) to 91 µg/m^3 (Vijayawada) and the average concentrations were observed in the range of 42.1 to 80 µg/m^3
- The SO_2 concentrations were between 10 µg/m^3 (Abbirajupuram) to 29 µg/m^3 (Vijayawada). The average concentrations were observed in the range between 13.2 µg/m^3 to 27.25 µg/m^3.
- The NO_x concentrations were between 20 µg/m^3 (Nekkallu) to 49 µg/m^3 (Vijayawada) with average values observed in the range of 23.5 µg/m^3 to 42 µg/m^3.

The concentrations of all the air quality parameters as monitored during the baseline study are within the permissible limits as per the NAAQ Standards as prescribed by MoEF&CC.

5.3.6. Secondary Data

The secondary data pertaining to the ambient air quality status of Vijayawada was collated from the few sources which are as under:

5.3.6.1. National Ambient Air quality status 2009 published by CPCB

As per **Table 7.4** titled **"Air Quality of Metro Cities during 2009"** the SO_2 annual average and the NO_x annual average for the Vijayawada city is 5 µg/m^3 and 14 µg/m^3 respectively which are both classified as low, while the annual PM_{10} is reported to be 80 µg/m^3 which is classified as critical.

5.3.6.2. National Ambient Air Quality Status 2010 published by CPCB

As per Table **7.3.17** titled 'Vijayawada' the air quality trend by analysis of five year air quality data of PM_{10} and SO_2 shows a fluctuating trend, while NO_2 shows a decreasing trend. However NO_2 and SO_2 are within NAAQS **(Refer Figure 7.17 - below of the said report).**

The secondary data of Vijayawada city when compared with the baseline air quality of Vijayawada is in concurrence with the values of PM10, $S0_2$ and NO_x values.

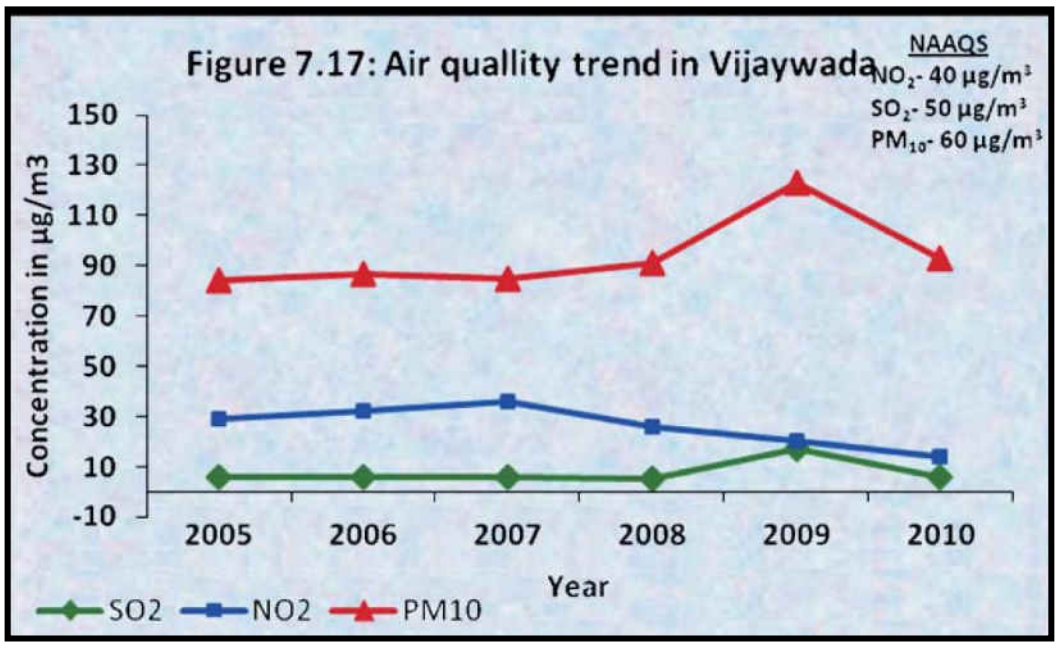


Figure 5-7 Air quality trend of Vijayawada for the last five years

5.4. Noise Level Survey

The physical description of sound concerns its loudness as a function of frequency. Noise in general is sound, which is composed of many frequency components of various loudness, distributed over the audible frequency range. Various noise scales have been introduced to describe, in a single number, the response of an average human to a complex sound made up of various frequencies at different loudness levels. The most common and universally accepted scale is the scale which is measured in dB(A). This is more suitable for audible range of 20 to 20,000Hz and weighs the components according to the response of a human ear.

The impact of noise sources on surrounding community depends on:

- Characteristics of noise sources (instantaneous, intermittent or continuous in nature.)
- The time of day at which noise occurs, for example high noise levels at night in residential areas are not acceptable because of sleep disturbance.
- The location of the noise source, with respect to noise sensitive land use, which determines the loudness and period of exposure.

The environmental impact of noise can have several effects varying from Noise Induced Hearing Loss (NIHL) to annoyance; depending on loudness of noise levels. The main objective of noise monitoring in the study area is to establish the baseline noise levels, and assess the impact of the likely noise expected due to construction and operation of New Capital City.

Noise survey has been conducted in the study area covering two zones viz., Residential, and commercial .The noise monitoring has been undertaken for 24 hrs at each location.

5.4.1. Methodology

A preliminary reconnaissance survey has been undertaken to identify the major noise generating sources in the area. The monitoring has been conducted at 20 locations in the study area. Noise levels were recorded continuously over 24 hour's period. The noise sampling locations are provided in **Fig 5-8** below and the details are provided in **Annexure B4.** Summary of noise monitoring data presented as **Annexure B5.**

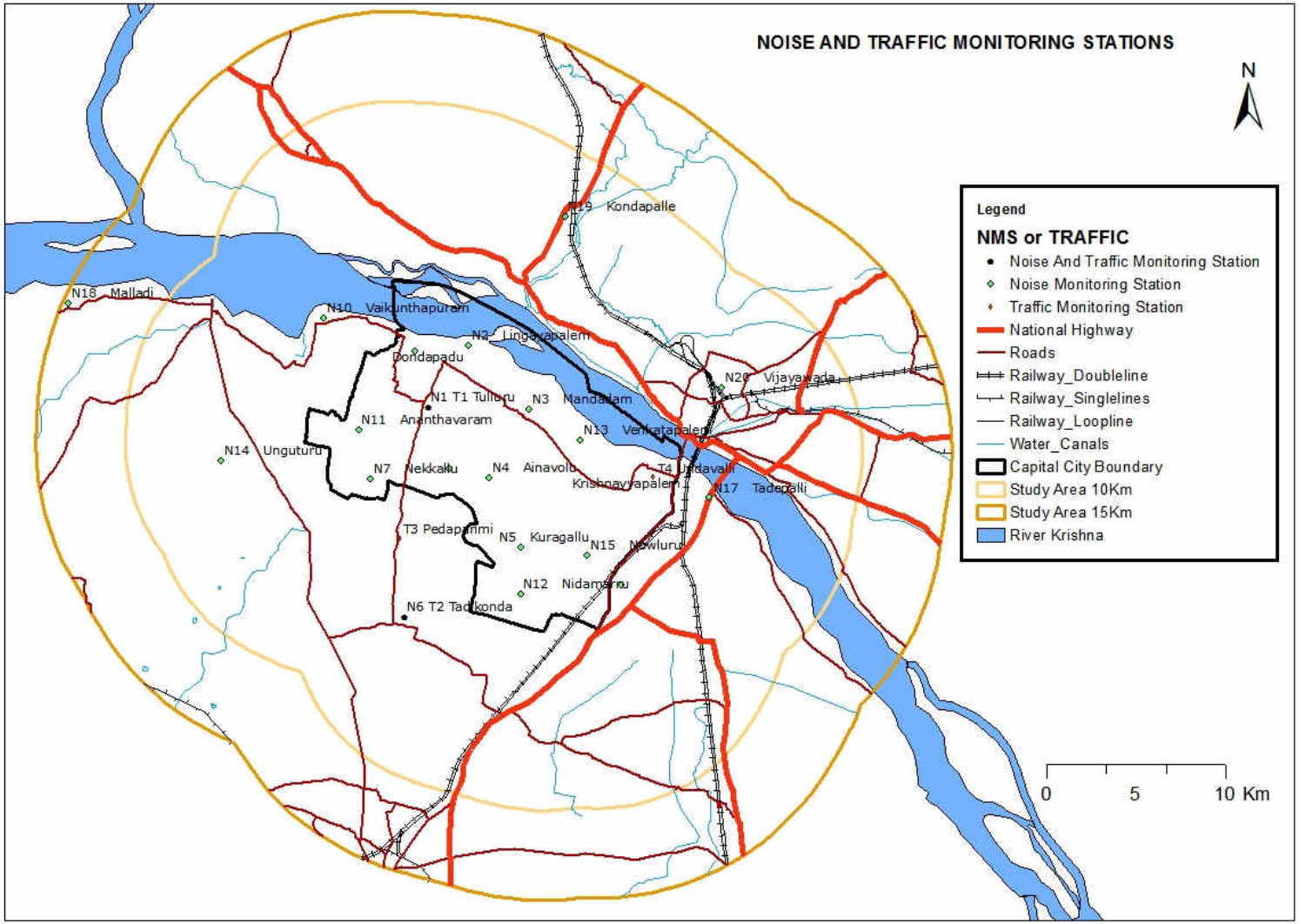


Figure 5-8 Noise Quality Sampling location

5.4.2. Method and Parameters

Noise levels were measured using an Integrating Sound Level Meter manufactured by Rion (model no. NL- 20). The sound level meter measures continuous equivalent noise level (Leq). Noise measurements were undertaken at all location for 24 hours. The day noise level has been monitored during 6 am to 10 pm and night levels during 10 pm to 6 am at all ambient locations. The sampling of noise quality is shown in Fig 5-9.

Noise monitoring outside the CRDA office at Thulluru

:

Noise monitoring at Tadikonda

:

Figure 5-9 Noise quality Sampling

5.4.3. Parameters Measured during Monitoring

Equivalent sound Pressure Level (Leq): The Leq is the equivalent continuous sound level which is equivalent to the same sound energy as the actual fluctuating sound measured in the same period. This is necessary because sound from noise source often fluctuates widely during a given period of time.

The instrument internally performs the statistics of frequency distribution for the set time period (in this case one-hour) and hourly L_{eq} are obtained at each location. These hourly L_{eq} is added logarithmically to obtain 24 hours L_{eq} as well as L_{day} and L_{night} levels. L_{day} is defined as the equivalent noise level measured over a period of time during day (6 am to 10 pm). The L_{eq} value measured for each individual hour and then averaged for 10 am to 6 pm and is known as L_{day}

L_{night} is defined as the equivalent noise level measured over a period of time during night (10 pm to 6 am). The L_{eq} value measured for each individual hour and then averaged for 10 pm to 6 am and is known as L_{night}

5.4.4. Results and discussion

The ambient noise levels measured and analyzed for equivalent noise levels viz. L_{eq} (24hrly), L_{day} , L_{night} at all the noise monitoring locations for the study period are presented in **Table 5-6**

Table 5.6 Leq (day) and Leq (night) at Noise Monitoring Locations

CPCB limit for Leq daytime for residential zone = 55

S. No	Station	Leq day	Leq night
1	Thulluru	55.3	39.4
2	Lingayapalem	51.4	42.6
3	Mandadam	48.6	42.5
4	Ainavolu	53.6	39.6
5	Kuragallu	56.7	38.3
6	Tadikonda	54.4	39.6
7	Nekkallu	53.9	40.0
8	Sakhamuru	58.7	54.6
9	Abbirajupalem	53.2	38.6
10	Vykuntapuram	46.8	41.0
11	Ananthavaram	53.9	38.8
12	Nidamarru	63.2	54.7
13	Venkatapalem	62.3	41.8
14	Unguturu	49.4	37.7
15	Nowoluru	55.4	38.1
16	Mangalgiri	70.8	63.7
17	Tadepalli	64.6	52.4
18	Malladi	62.5	37.0
19	Kondapalli	54.6	37.7
20	Vijayawada	70.6	66.1

The variation of noise levels i.e., Leq during the day and night are graphically represented in the form of **Chart-5.5 and Chart 5.6** respectively.

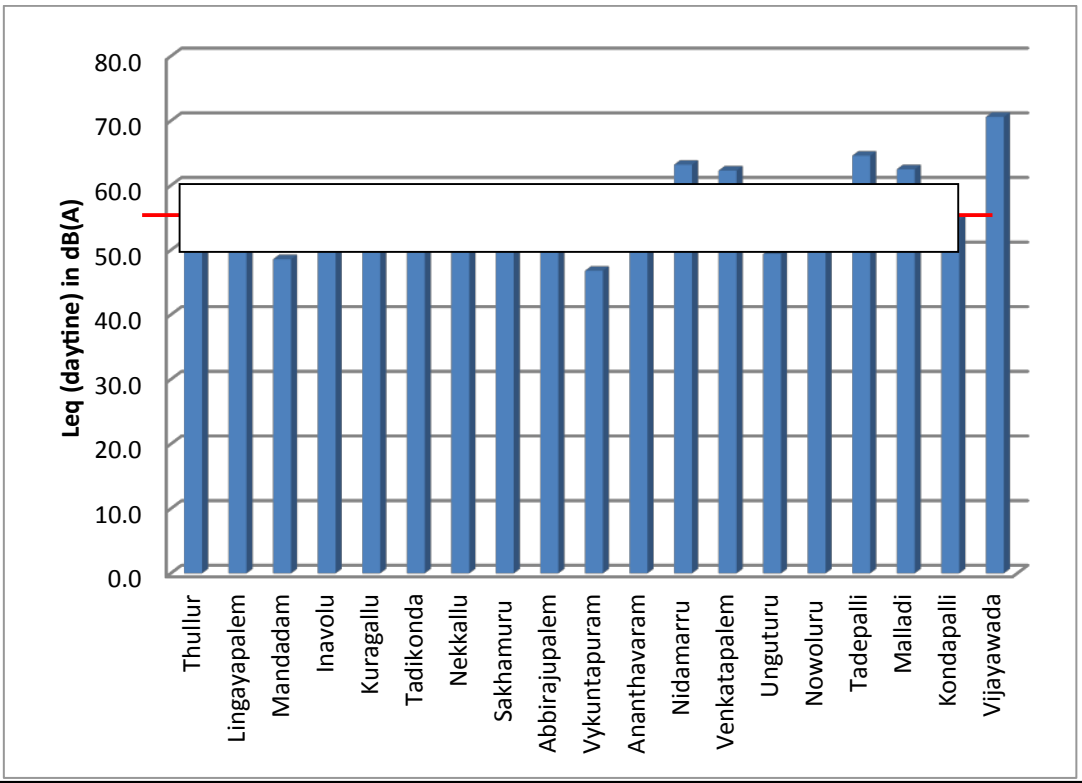


Chart-5-5 – Variation in the Leq (daytime) at the noise monitoring stations (residential)

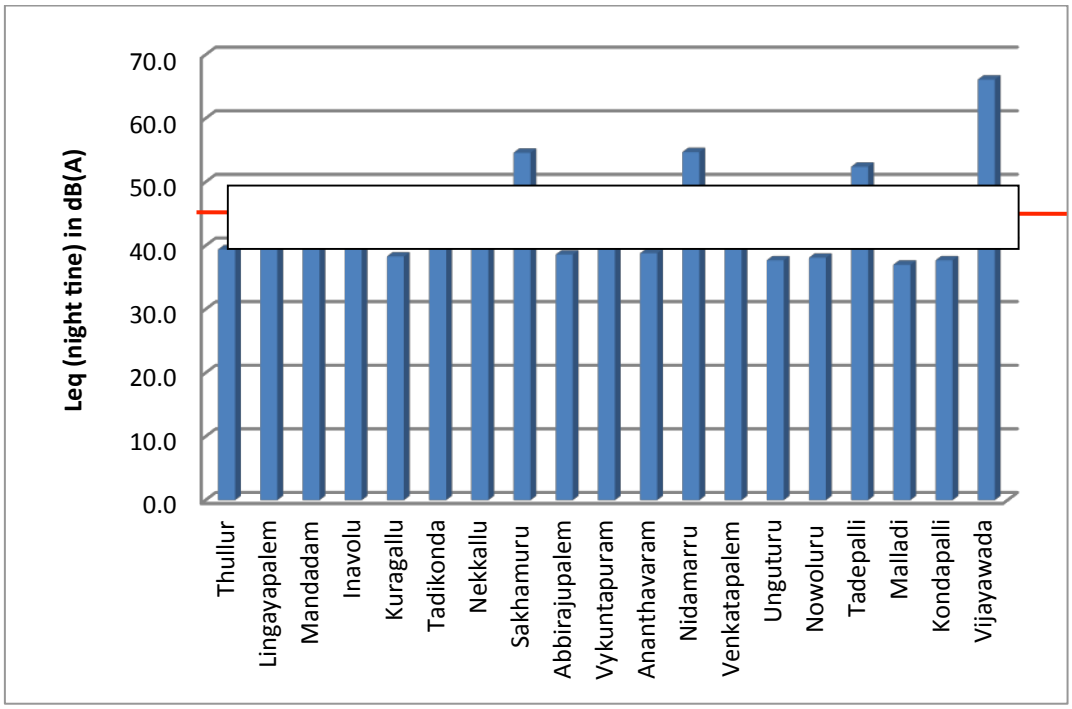


Chart-5-6 – Variation in the Leq (night time) at the noise monitoring stations (residential)

5.4.5. Observations

5.4.5.1. Residential Zone

The Leq day for the residential zone was observed to be in the range of 46.8 dB (A) (Vykuntapuram) to 70.6 dB (A) (Vijayawada).

The Leq night for the residential zone was observed to be in the range of 37.7 dB (A) (Malladi) to 66.1 dB (A) (Vijayawada).

The ambient noise levels in the villages are under the influence of local agriculture and the Leq values are within permissible limits in almost all the villages. The maximum values of Leq during the daytime and night time exceed the CPCB limits for residential zone at the densely populated villages like Tadepalli, Nidamaru and Vijayawada.

5.4.5.2. Commercial Zone

The Leq day for the commercial zone at Mangalagiri was found to be 70.8 dB (A) while the Leq for the night was found to be 63.7 dB (A) and were found to exceed the CPCB limits for the commercial zone –both for the day time and the night time.

5.5. Water Quality

Water quality is a term used to express the suitability of water to sustain various uses or processes. Any particular use will have certain requirements for the physical, chemical or biological characteristics of water; for example limits on the concentrations of toxic substances for drinking water use, or restrictions on

temperature and pH ranges for water supporting invertebrate communities. Consequently, water quality can be defined by a range of variables which limit water use. Although many uses have some common requirements for certain variables, each use will have its own demands and influences on water quality

Quantity and quality demands of different users will not always be compatible, and the activities of one user may restrict the activities of another, either by demanding water of a quality outside the range required by the other user or by lowering quality during use of the water. Efforts to improve or maintain a certain water quality often compromise between the quality and quantity demands of different users. There is increasing recognition that natural ecosystems have a legitimate place in the consideration of options for water quality management. This is both for their intrinsic value and because they are sensitive indicators of changes or deterioration in overall water quality, providing a useful addition to physical, chemical and other information.

The composition of surface and underground waters is dependent on natural factors (geological, topographical, meteorological, hydrological and biological) in the drainage basin and varies with seasonal differences in runoff volumes, weather conditions and water levels.

Human intervention also has significant effects on water quality. Some of these effects are the result of hydrological changes, such as the building of dams, draining of Water bodies and diversion of flow. More obvious are the polluting activities, such as the discharge of domestic, industrial, urban and other wastewaters into the watercourse (whether intentional or accidental) and the spreading of chemicals on agricultural land in the drainage basin. [1]

Keeping the aforesaid in view the water quality (ground and surface) was studied with special reference to the parameters mentioned in the IS 10500. A total of 35 locations were selected to study the water quality out of which the number of surface water locations were fifteen (15) and the ground water sampling locations were twenty (20) within the 10km radius of the project boundary.

The purpose of this study is to:

- Assess the water quality characteristics for critical parameters;
- Evaluate the impacts on agricultural productivity, habitat conditions, recreational resources and aesthetics in the vicinity; and
- Predict the likely impacts of water quality due to the project and related activities.

---

[1] **Water Quality Monitoring - A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes**

Published on behalf of United Nations Environment Programme and the World Health Organization

5.5.1. Methodology

Reconnaissance survey was undertaken and monitoring locations were finalized based on:

- Drainage pattern;
- Likely areas which can represent baseline conditions.
- Likely areas representing different activities/likely impact areas

The water samples collected were analyzed as per the procedures specified in Standard methods for the Examination of Water and Wastewater published by American Public Health Association (APHA). The samples for chemical analysis were collected in polyethylene carboys. The samples collected for metal content were acidified with 1 ml HNO_3. Selected physico – chemical parameters have been analyzed for projecting the existing water quality status in the study area.

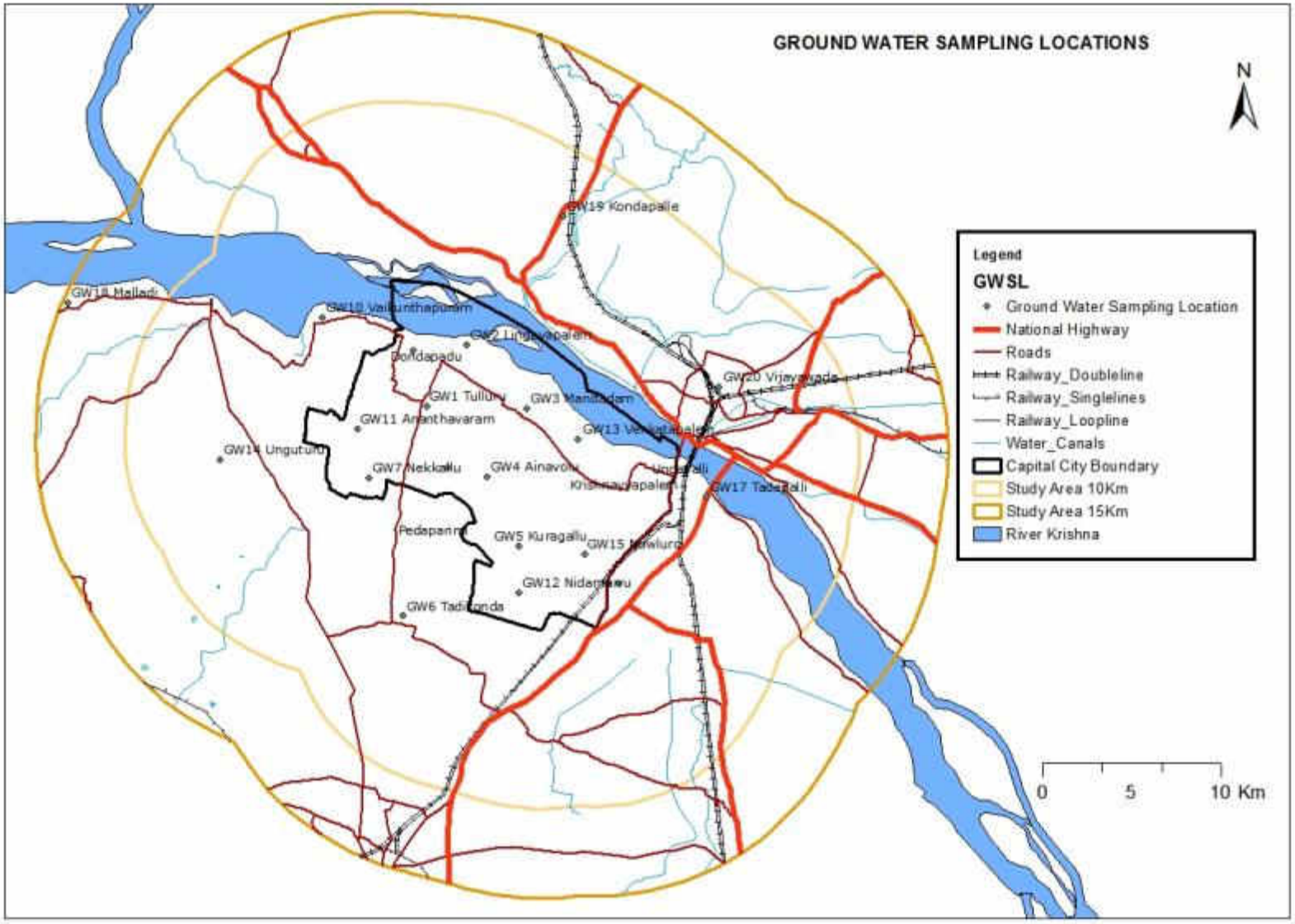
Surface Water sampling

Ground water sample collection from hand-pump

Figure 5-10: Sampling of water

5.5.2. Results of water quality

Fifteen surface water and twenty ground water samples were collected as grab samples and analyzed for various parameters. The analyzed results were compared with the standards for drinking water as per IS 10500. The water sampling locations are shown in **Figure 5-11**. The water quality reports for the thirty five (35) sampling locations are given in **Annexure-B6.**


GROUND WATER SAMPLING LOCATIONS
N
GW19 Kondapalle
GW18 Malladi
GW10 Vallurupalem
GW2 Lingayapalem
Gondapadu
GW1 Tulluru
GW3 Mandadam
GW11 Anathavaram
GW13 Venkatapalem
GW20 Vijayawada
GW14 Ungutur
GW7 Nekkallu
GW4 Ainavolu
Undavalli
Krishnayapalem
GW17 Tadepalli
Pedaparim
GW5 Kuragallu
GW15 Nowluru
GW12 Nidamanuru
GW6 Tadikonda
Legend
GWSL
Ground Water Sampling Location
National Highway
Roads
Railway_Doubleline
Railway_Singlelines
Railway_Loopline
Water_Canals
Capital City Boundary
Study Area 10Km
Study Area 15Km
River Krishna
0
5
10 Km

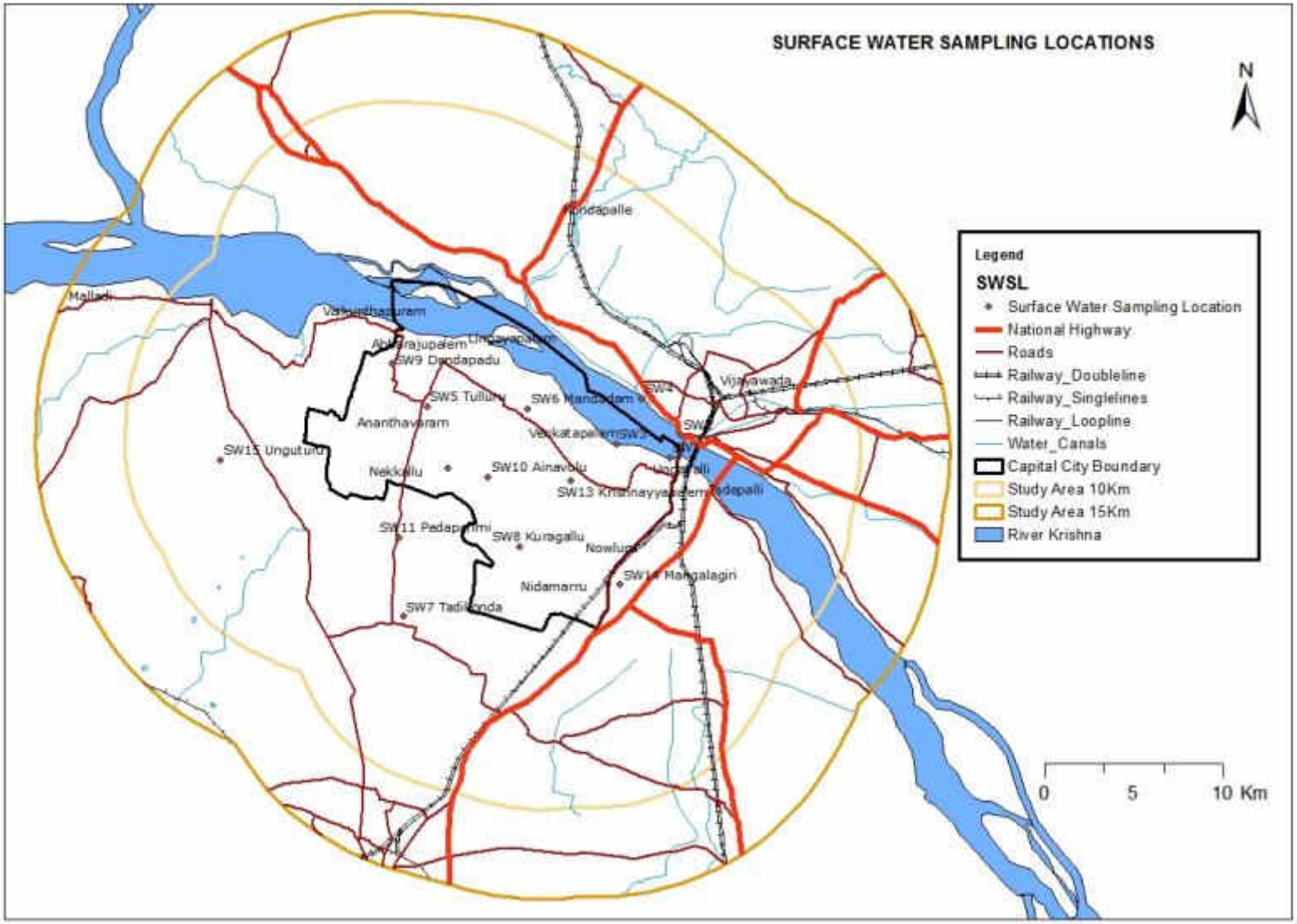


Figure 5-11 Water sampling locations map

5.5.3. Results and Discussion

5.5.3.1. Primary data

Ground water samples

- The maximum value of chlorides (1300 mg/lit) at Ainavolu was found to exceed the acceptable limit as per IS 10500 for drinking water (250 mg/lit) considerably. The chloride content at few other locations like Nowluru, Ananthavaram, etc are also recorded to exceed the permissible limits.
- The maximum value of fluorides (1.1 mg/lit) was found to exceed the acceptable limit for the same as per IS 10500 for drinking water (1.0 mg/lit).
- The maximum value of cadmium (0.003 mg/lit) at Ainavolu was found to exceed the acceptable limit for the same as per IS 10500 for drinking water (0.001 mg/lit). The Cadmium levels at all other locations were below the permissible limit.
- The maximum value of TDS (6658 mg/lit) at Ainavolu was found to exceed the acceptable limit for the same as per IS 10500 for drinking water (500 mg/lit). The TDS value exceeds the permissible limits at many locations in the study area.
- The maximum value of sulpahtes (520 mg/lit) at Ainavolu was found to exceed the acceptable limit for the same as per IS 10500 for drinking water (200 mg/lit). The Sulphate value exceeds the permissible limits at many locations in the study area.

Surface Water Samples

- The value of TDS is very high at Thulluru (3031 mg/lit) and Lake near Mandadam (1464 mg/lit), TDS was found to exceed the acceptable limit for the same as per IS 10500 for drinking water (500 mg/lit) at many locations within the study area.
- The maximum value of chlorides (578 mg/lit) at Lake near Mandadam was found at to exceed the acceptable limit for the same as per IS 10500 for drinking water (250 mg/lit), the values of Chlorides are within permissible limits in all other locations.
- The maximum value of Sulphates (296 mg/lit) was found to exceed the acceptable limit for the same as per IS 10500 for drinking water (200 mg/lit) at only one location in a lake near Mandadam.
- The maximum value of nitrates (86 mg/lit) was found to exceed the acceptable limit for the same as per IS 10500 for drinking water (45 mg/lit) at only one location in a lake near Mandadam.
- The values of dissolved oxygen vary from 3.2 mg/ lit (500 m left from prakasam barrage) to 5.6 mg/ lit (pond in Thulluru). The values of DO are considerably low

at many locations showing biological and chemical contamination of the surface water bodies.

5.5.3.2. Secondary data

Ground water

The secondary data was inferred from the publication "Status of Ground Water quality in India published by Central Pollution Control Board. The inferences drawn by the report on the "Observations on status of ground water quality in Vijayawada (Section 3.9.3 of the said report) are as under:

The report states that "The groundwater quality has indicated higher concentration of electrical conductivity, total dissolved solids, alkalinity, hardness, calcium, chloride, fluoride, iron, manganese, nickel, lead and cadmium vis-à-vis drinking water quality standards".

Surface water

The secondary data of the Krishna River was collated from the report titled "Status of water quality in India-2011". The Table 15.1 titled "Water quality of Krishna River 2011" (Page No. 166) was referred to and the observations for the surface quality of Krishna River at Vijayawada are as under:

- The D.O varied from a minimum of 4.1 mg/lit to a maximum of 8.1 mg/lit. The mean was found to be 6.1 mg/lit.
- The pH varied from a minimum of 7.2 to a maximum of 8.1. The mean was found to be 7.9.
- The electrical conductivity ranged from 534 µmhos/cm to 890 µmhos/cm. The mean was found to be 655 µmhos/cm.
- The BOD ranged from 0.5 mg/lit to 0.6 mg/lit while the mean was recorded to be 0.5 mg/lit
- The nitrates ranged from a minimum of 0.12 mg/lit to a maximum of 0.26 mg/lit. The mean was found to be 0.18 mg/lit.
- The fecal coliform was ranged from a minimum of 4 MPN / 100ml to a maximum of 6 MPN/100ml while the mean was recorded to be 5 MPN / 100ml.
- The total coliforms were recorded from a minimum of 1400 MPN/ 100ml to a maximum of 2700 MPN/100ml. The mean was found to be 2192 MPN/100ml.

5.5.4. Inferences

Ground water

The primary ground water quality data collected from the various locations w.r.t parameters such as fluorides, chlorides, Total Dissolved Solids, Cadmium is in general agreement with the secondary data published in the report mentioned in the section titled "Secondary data".

Surface water

The primary surface water quality data collected from the various locations w.r.t parameters such as D.O, Electrical Conductivity, B.O.D and the nitrates were on the higher side as compared for Vijayawada water sample in particular to the secondary data of the Krishna River published by CPCB. The values of the pH correlate with the pH values of the secondary data of Krishna River published by CPCB.

5.5.5. Ground water levels in the Guntur district

Secondary data was inferred from the **Central Ground Water Board** publication titled **"Ground water brochure"** of Guntur District for the following ground water parameters:

- Pre-monsoon water levels
- Post monsoon water levels
- Water level fluctuation

5.5.5.1. Pr-monsoon water levels

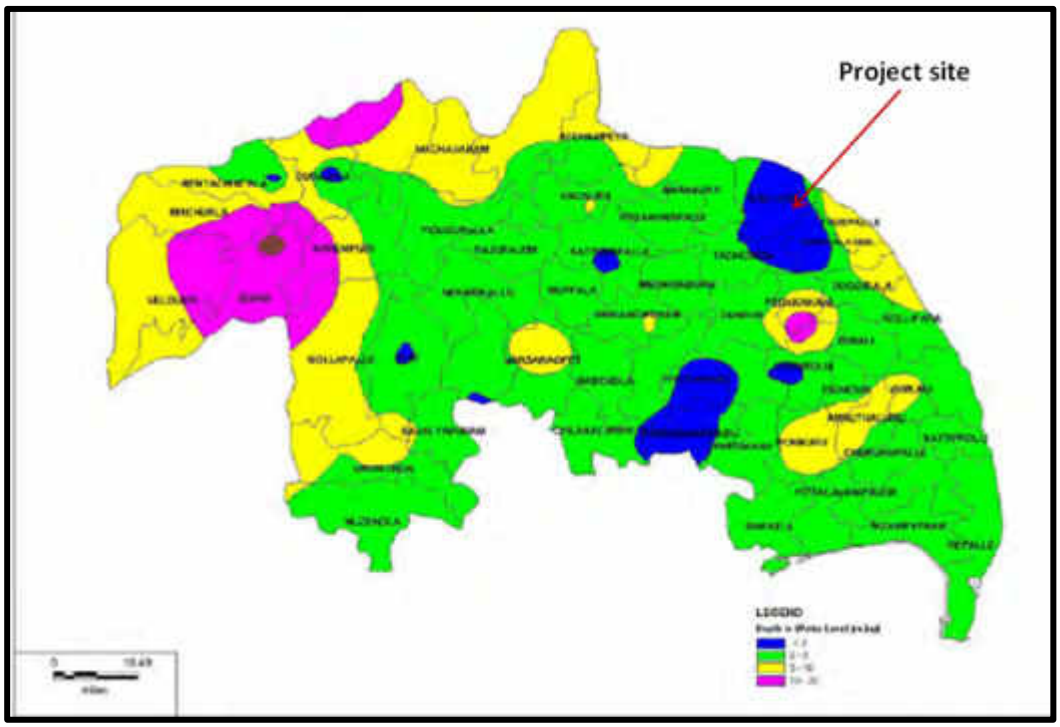
The depth to water levels during pre-monsoon (2012) ranges from 0.64 m to 21.46 m bgl. The shallow water levels of 2 m are observed in southeast and eastern part of the district. The depth to water levels between 2-5 m is observed in majority of the area. Deeper water levels of >10 m bgl are observed in the western parts of the district (Refer Figure 5-12).The depth to water level for pre-monsoon season is depicted in Figure 5-12. The figure reflects that the depth to the water level during May 2012 at the project site was less than 2m.

5.5.5.2. Post monsoon water levels

The depth to Water level ranges from 0.16 to 9.89m bgl during post monsoon period (2012). The shallow water levels of 2 m are observed in eastern part of the district. Water levels 2-5 m are observed in central and western part, 5-10 m and deeper are observed in western and northern part of the district (Refer Figure 5-13).The Figure-5-9 reflects that the depth to the water level during November 2012 at the project site was less than 2m.

5.5.5.3. Water level fluctuation

Majority of the district shows rise in water level between pre and post monsoon period of 2012 (0-2 m). Rise of water level of 2-4 m is observed in central areas in and very small areas in western part. Fall of 2-4 and greater than 4 m is observed as isolated patches in the district (Refer Figure 5-14). The Figure 5-14 further reflects that the water level fluctuation at the project site was in terms of rise in the water table in the range of 0-2 m.



Source: Ground water brochure- Guntur District by CGWB

Figure 5-12 Depth to water level map May 2012 – Guntur District

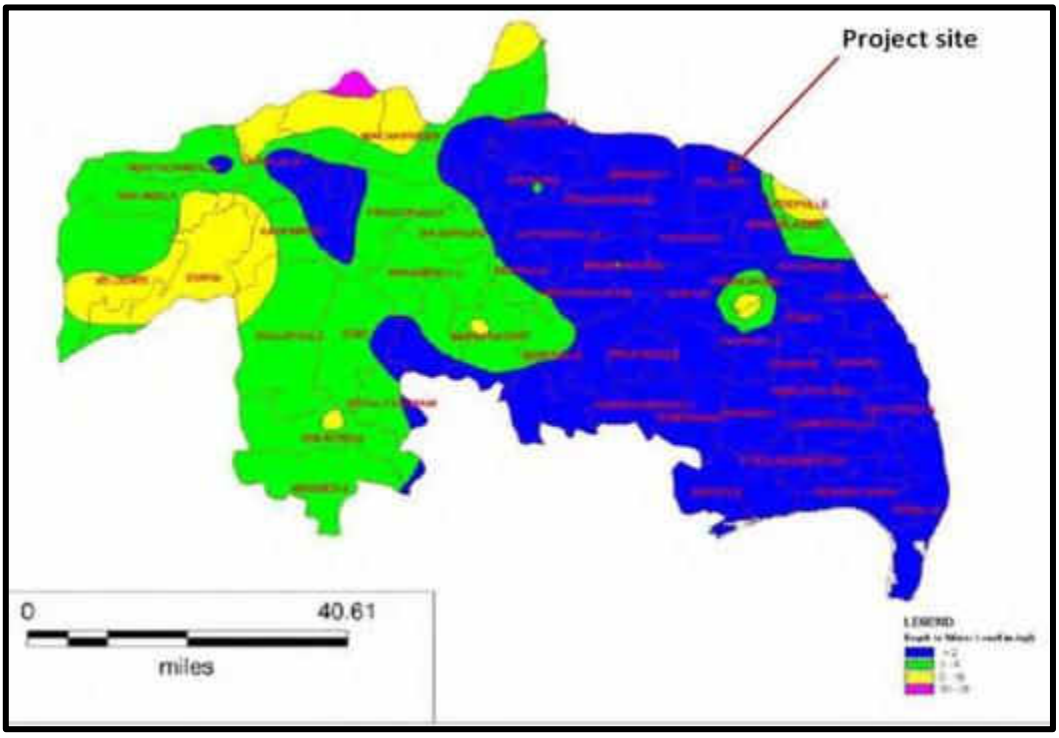


Figure 5-13 Depth to water level map November 2012 Guntur District ,A.P

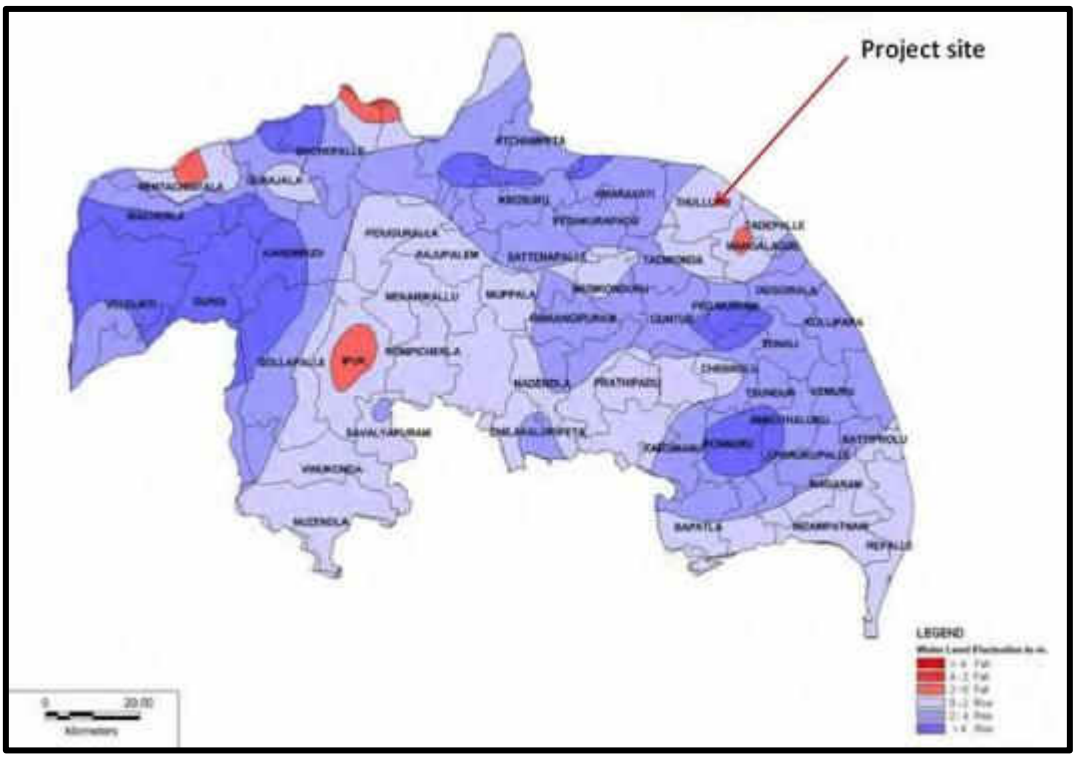


Figure 5-14 Water level fluctuation Map May -12 to November -12- Guntur District (Source: Ground water brochure –Guntur District by CGWB)

5.6. Hydrogeology

Central Ground Water Board Report presents the study area predominantly covered under Alluvium formation. The thickness of alluvium varies from a few meters to over 100m. The deltaic alluvium found in palaeo/buried channels upto 30m depth with thick graveliferous sand. Ground water is being developed in the flood plain areas along river course mostly through filter-points and shallow tube wells with yields ranging from 3 to over 15 lps as observed around Rayapudi and Borepalem areas of Amaravati and Thulluru mandals. The depth to water level in the alluvium ranges from ground level to 5-12m bgl with poor to moderate discharges. In deltaic alluvium ground water is brackish in nature.

National Remote Sensing Centre has delineated the Hydro-geomorphological units of the area under the Rajiv Gandhi Drinking Water Mission Programme. The geological information and satellite are extensively used for delineating various morphic units and the maps are prepared in 1:50,000 scale. The hydrogeological features of the project area and the study area are presented in Fig 5-12.

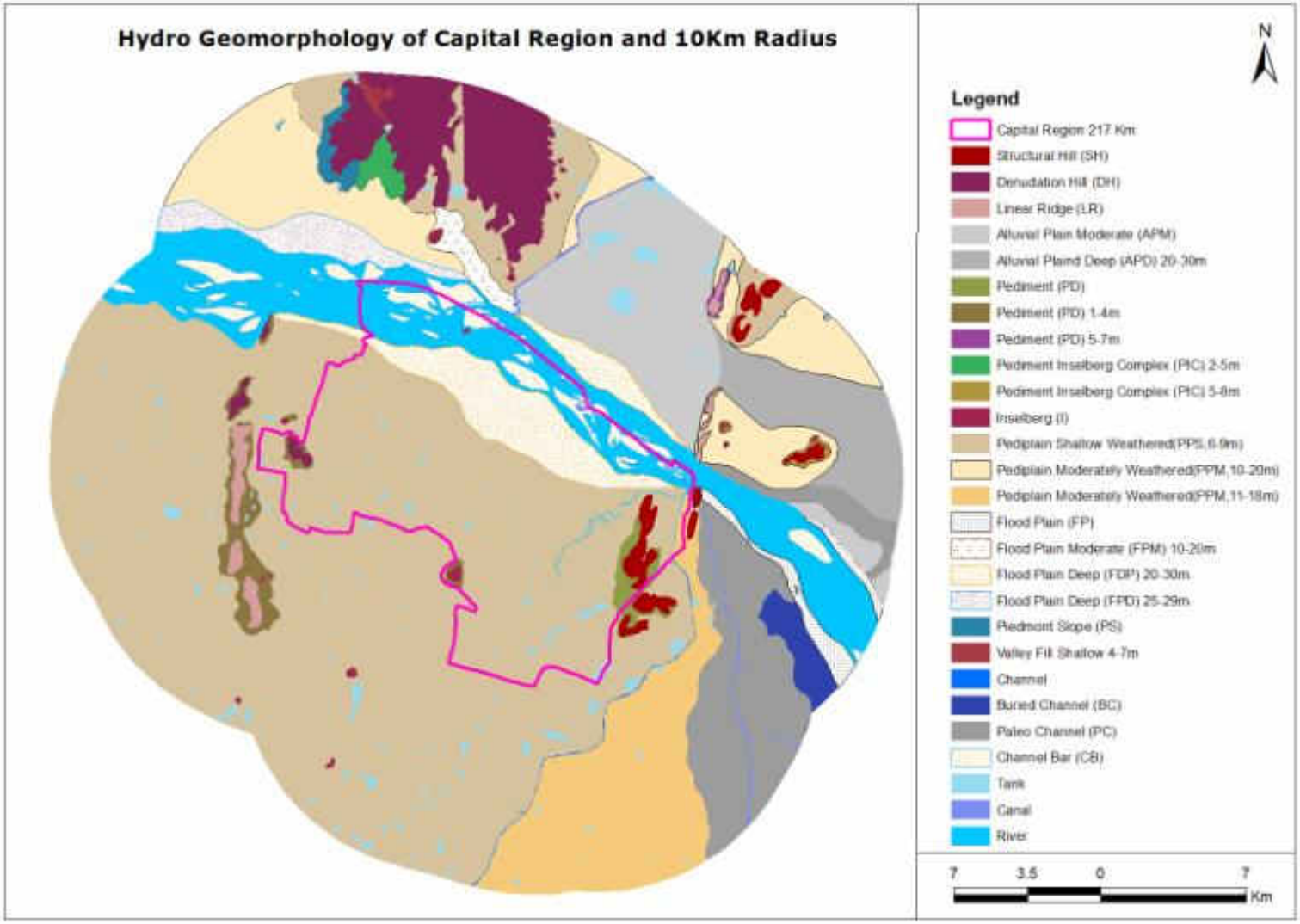


Figure 5-15 Hydrogeology of the Guntur District

The details of hydro-geomorphological unit (HGM Unit) in the project area are given as **Table 5-7**. The units covered under study area alone are given in Table 5-8.

Table 5-7 Hydro-Geomorphological Units in the project area

S. No	HGM_UNIT	Area in Sq Km
1	Canal	0.10
2	Channel Bar (CB)	9.09
3	Denudation Hill (DH)	0.78
4	Flood Plain Deep (FDP) 20-30m	28.76
5	Inselberg (I)	0.45
6	Pediment (PD)	3.17
7	Pediment (PD) 1-4m	1.44
8	Pediplain Moderately Weathered(PPM,11-18m)	1.04
9	Pediplain Shallow Weathered(PPS,6-9m)	141.40
10	River	25.23
11	Structural Hill (SH)	3.44
12	Tank	2.13

Table 5-8 HGM OF Study Area

S. No	HGM_UNIT	Area in Sq Km
1	Alluvial Plain Moderate (APM)	71.36
2	Alluvial Plaind Deep (APD) 20-30m	34.94
3	Buried Channel (BC)	8.45
4	Canal	2.64
5	Channel	0.88
6	Channel Bar (CB)	11.84
7	Denudation Hill (DH)	51.00
8	Flood Plain (FP)	8.56
9	Flood Plain Deep (FDP) 20-30m	9.59
10	Flood Plain Deep (FPD) 25-29m	16.16
11	Flood Plain Moderate (FPM) 10-20m	6.28
12	Inselberg (I)	1.65
13	Linear Ridge (LR)	6.52
14	Paleo Channel (PC)	66.51
15	Pediment (PD)	1.36

S. No	HGM_UNIT	Area in Sq Km
16	Pediment (PD) 1-4m	10.58
17	Pediment (PD) 5-7m	0.60
18	Pediment Inselberg Complex (PIC) 2-5m	3.85
19	Pediment Inselberg Complex (PIC) 5-8m	0.95
20	Pediplain Moderately Weathered(PPM,10-20m)	84.25
21	Pediplain Moderately Weathered(PPM,11-18m)	79.00
22	Pediplain Shallow Weathered(PPS,6-9m)	389.16
23	Piedmont Slope (PS)	3.66
24	River	71.21
25	Structural Hill (SH)	6.58
26	Tank	12.93
27	Valley Fill Shallow 4-7m	1.43

As observed from the hydrogeological map, the project is covered predominantly under Shallow weathered pediplane. Few hilly area falls under Inselberg.

5.7. General Geology of the Guntur District

The district consists of an array of rock formations ranging in age from Archean to Recent. The Archeans consist of Khondalite and Charnockite Groups of Eastern Ghats Super-group and rocks of Peninsular Gneissic Complex, comprising granitods and granitic gneisses, having wide variation in chemical composition and tectonic environment. The granitoids and gneisses are intruded by a number of gabbro, notrite and dolerite dykes. Unconformably overlying in the above rocks, occur the Proterozoic sediments of Cuddapah Super-group and Kurnool Group. The Upper Gondawanas of Carboniferous to Cretaceous age occur as isolated patches spouting through the flood plain deposits. Unconsolidated to semiconsolidated deltaic deposits of Quaternary age are confined to the coastal tracts towards eastern and southeastern parts. [2]

[2] Source :District Resource Map of the Guntur District published by Geological Survey of India.

5.8. Economic minerals of the Guntur District [3]

The district has significant resources of diamond, limestone copper-lead-zinc, glass sand, lime-kankar (caliche), quartz and road mineral

5.8.1. Diamond

Occurrences of diamond were reported in the vicinity of Kollur village of Satenappali taluk, in the gravel beds of Krishna River. The gravel beds occur as terrace deposits laid by Krishna river, over the cumbum phyllites/shales, Narji limestone and Banganpalle comglomerate /quartzite. Jean Baptiste Tavernier (In:Travels in India by Jean Baptiste Tavernier, Oxford University Press ,1925 (Ed.) William Crook), during 1636-1662 observed that a few thousands of people used to be engaged in the mining operations in the gravel beds ,around Kolluru for winning diamonds. Presently workings, seen in the gravel beds, testify to such an activity. The important locations in this line are at Venkatayapalem, Achampeta, Sarangapalle and Mallavaram. These apart, a few workings also exist in the phyllite–quartzite –shale sequence of the Cumbum formation, not far from the gravel occurrences. Even today, extensive dumps of processed and sorted material, left by ancients are seen as stacks, adjacent to the abandoned workings. Local people pick up diamonds, even now, from the old processed dumps as well as intervening virgin patches albeit at intervals.

5.8.2. Limestone

Guntur district produces about 18-20% of all grades of limestone in the state which is being utilized in cement, sugar, textiles, paper and pharmaceutical industries. A number of deposits located at Dachepalli, Macherla, Pillutla, Piduguralla and Pondugala areas are exploited for cement manufacture.

5.8.3. Copper –lead-zinc

Evidences of mining activity, in recent past, for copper, lead-zinc are seen in the vicinity of Bollaplle, Agnigundala, of Vinukonda Taluk and Karempudi of Palnad taluk. Important deposits occur near Bandalamottu, Nallakonda, Dhukonda areas of Ipur Mandalam.

5.8.4. Glass Sand

Beach sands occurring along Bapatla and Chinnaganjam of East Coast are suitable for glass manufacture. A sizeable reserve of economic grade has been established in the above areas.

[3] Source :District Resource Map of the Guntur District published by Geological Survey of India.

5.8.5. Lime Kankar

A number of lime kankar (Caliche) workings are seen near Kaza, Namburu and Nidamarru. Local people burn it in kilns for manufacturing lime. The lime –kankar deposits owe their origin to chemical weathering of charnockite and pyroxene granulite, under oscillatory water table conditions. Owing to the proximity to Tadepalli, where cement plant is located, these deposits are being utilized albeit, in a limited measure, in the cement manufacture, by blending low grade limestone.

5.8.6. Quartz

Quartz occurring near Narsaraopet is being mined for use in the ferro-alloys (ferro-silicon) plants established in other districts.

5.8.7. Road metal

Exfoliated massifs and sheet rocks of charcockite and pyroxene granulite provide excellent road-metal and construction material. The charcockite –pyroxene granulite belt, occurring along Guntur-Vijayawada State Highway, is already under active exploitation by private entrepreneurs at several places for road metal.

5.9. Soil Characteristics

5.9.1. Introduction

Soil health, also referred to as soil quality, is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans. This definition speaks to the importance of managing soils so they are sustainable for future generations.

Healthy soil gives us clean air and water, bountiful crops and forests, productive grazing lands, diverse wildlife, and beautiful landscapes. Soil does all this by performing five essential functions:

- Regulating water - Soil helps control where rain, snowmelt, and irrigation water goes. Water and dissolved solutes flow over the land or into and through the soil.
- Sustaining plant and animal life - The diversity and productivity of living things depends on soil.
- Filtering and buffering potential pollutants - The minerals and microbes in soil are responsible for filtering, buffering, degrading, immobilizing, and detoxifying organic and inorganic materials, including industrial and municipal by-products and atmospheric deposits.

- Cycling nutrients - Carbon, nitrogen, phosphorus, and many other nutrients are stored, transformed, and cycled in the soil.[4]
- Physical stability and support - Soil structure provides a medium for plant roots. Soils also provide support for human structures and protection for archeological treasures.

5.9.2. Methodology

The existing soil conditions were studied by selecting 20 locations in the study area. The physico-chemical properties of the soil were analysed. Soil samples were collected at a depth of 60 cm.

The sampling locations have been finalised with the following objectives:

- To determine the baseline soil characteristics of the study area; and
- To determine the impact on agricultural productivity of soil due to the proposed project.

The soil sampling procedure is shown in **Fig 5-16** and the soil sampling locations are shown in **Fig 5-17,** while the details of the soil quality location are in **Annexure B7** the soil quality reports are enclosed as **Annexure-B8**.

Soil sampling using augur

Soil sample collection

Figure 5-16 Soil Sampling

[4] US Department of Agriculture : http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/

Table 5-9 Soil classification [5]

S. No.	Soil Tests	Classification	
1.	pH	< 4.50 extremely acidic 4.50-5.00 very strongly acidic 5.00-5.50 strongly acidic 5.50-6.00 moderately acidic 6.00-6.50 slightly acidic	6.50-7.30 neutral 7.30-7.80 slightly alkaline 7.60-8.50 moderately alkaline 8.50-9.00 strongly alkaline 9.00 very strongly alkaline
2.	Electrical Conductivity (mmhos/ cm)	upto 1.00 average 1.01-2.00 harmful to germination 2.01-3.00 harmful to crops sensitive to salts	
3.	Organic Carbon	upto 0.2 : very less 0.21-0.4 : less 0.41-0.5 : medium	0.61-0.8 : on an average sufficient 0.81-1.0 : Sufficient >1.0 : more than sufficient
4.	Nitrogen (kg/ha)	upto 50 very less 51-100 less 101-150 good	151-300 better above 300 sufficient
5.	Phosphorus (kg/ha)	upto 15 very less 16-30 less 31-50 medium	51-65 on an average sufficient 65-80 sufficient above 80 more than sufficient
6.	Potash (kg/ha)	0 – 120 very less 120-180 less 181-240 medium	241-300 average 301-360 better above 360 more than sufficient

[5] Source: Handbook of Agriculture: Indian Council of Agricultural Research (ICAR), New Delhi

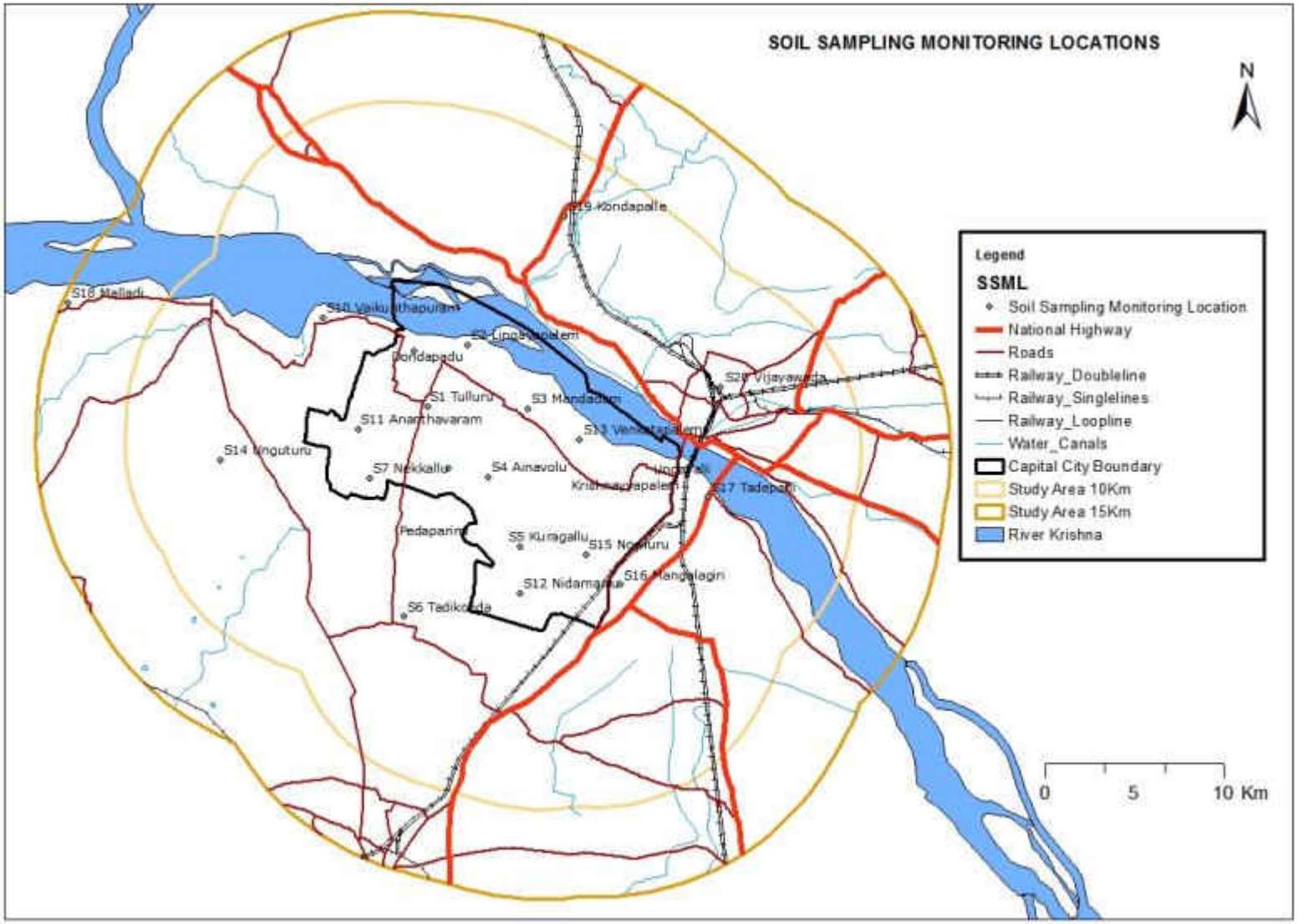


Figure 5-17 Soil Sampling Locations map

5.9.3. Results and discussion

The soil samples were analyzed for all the important parameters like pH, electrical conductance, calcium, magnesium, nitrogen, phosphorus, potassium, etc. The NPK represents the nutrients available in the soil, which directly indicates the soil fertility. The range of variation of different parameters found in the study area is explained briefly below.

pH

Depending on the nature of the parent rock, the degree of watering and the extent of biological activities including the decomposition, the pH of the soils vary widely. A soil may be regarded as neutral, acidic or alkaline if its pH value is seven, below seven and above seven respectively. The pH value of the soil is an important property; plants cannot grow in low and high pH value soils. Most of the essential nutrients like N, P, K, Ca, Mg, S, P and B are available for plant at the neutral pH except for Fe, Mn, and Al, which are available at low pH range. Most plants prefer a pH near neutrality or slightly towards acidity i.e. between pH 6 to 7. Many plants thrive on fairly acid or alkaline soils because they are capable of modifying the pH of the soil water due to excretion of ions like bicarbonates and calcium though their roots and also due to the decomposition of plant products like leaves, roots, flowers etc. Some organisms have a rather small tolerance to variation of pH, but other organisms can tolerate vide pH range. The availability / solubility of some plant nutrients decreases with an increase in pH. Potassium availability is good in neutral and alkaline soil.[6]

The pH values in the study area are varying from 5.4 (Abbirajupalem) to 8.3 (Tadikonda) showing strongly acidic to moderately alkaline nature during entire study period when compared to the soil classification table above.

Electrical Conductivity

The Electrical conductivity of soil represents its behavior to allow the germination and plant growth. If the soil's Electrical Conductivity falls below 1000 micro mhos, it is good; the soil can be classified as normal. If it is above 1000 and below 2000, it becomes critical to some plant species from the germination point of view. The soil becomes unfit if electrical conductivity exceeds more than 4000 micro mhos, this limit may be treated as "Injurious" to most of the crops[7].

The electrical conductivity (20%) in the soil samples was in the range of 205 (Nekkallu) to 1009 µmhos/cm (Lingayapalem)

Hence in study area- the available soil is of good quality.

Nitrogen, Phosphorous and Potassium

[6] Methods Manual : Soil Testing in India Dept. of Agriculture and Cooperation Ministry of Agriculture Govt. of India New Delhi January 2011.

[7] Methods Manual : Soil Testing in India Dept. of Agriculture and Cooperation Ministry of Agriculture Govt. of India New Delhi January 2011.

An abundance of Nitrogen promotes rapid growth, with greater development of dark green leaves & stems and the early maturity of Crop. Although one of the most striking functions of Nitrogen is the encouragement of above, ground vegetative growth which cannot take place without the presence of adequate quantities of available phosphorous & potassium. The recommended dosages for NPK for majority of field crops are in the ratio or 5:3:2 respectively.[8]

The nitrogen content in the soil samples analyzed was in the range of 60 kg/ha (Nekkallu) to 210 kg/ha. (Malladi).The nitrogen content varies from "less" to "better" as per soil classification table above.

The phosphorous presence in the samples analyzed was found in the range of 34 kg/ha (Ananthavaram) to 158 kg/ha (Abbirajupalem). The phosphorus content varies from "medium" to "more than sufficient" as per the soil classification table above.

The total potassium is varying between 49 kg/ha (Ananthavaram) – 256 kg/ha (Lingayapalem). The total potassium varied from "very less" to "average" as per the soil classification table above.

5.10. Traffic Survey

The traffic survey was conducted on four roads for ascertaining the vehicle count on the as per the **Table 5-10 below**

Table 5-10 Details of traffic survey

S. No	Road	Dates of vehicle count	Category of vehicles counted
1.	Amaravati to Thulluru Road	1.6.15 to 2.6.15 6.6.15 to 7.6.15 8.6.15 to 9.6.15 13.6.15 to 14.6.15	2 wheeler 3 wheeler LMV (4 wheeler) Heavy Motor Vehicles
2.	Thulluru to Tadikonda Road	1.6.15 to 2.6.15 6.6.15 to 7.6.15 8.6.15 to 9.6.15 13.6.15 to 14.6.15	
3.	Pedaparimi to Mangalgiri Road	1.6.15 to 2.6.15 6.6.15 to 7.6.15 8.6.15 to 9.6.15 13.6.15 to 14.6.15	
4.	Thulluru to Undavalli Road	1.6.15 to 2.6.15 6.6.15 to 7.6.15 8.6.15 to 9.6.15 13.6.15 to 14.6.15	

[8] Methods Manual : Soil Testing in India Dept. of Agriculture and Cooperation Ministry of Agriculture Govt. of India New Delhi January 2011.

The worst case scenario of traffic i.e., maximum traffic in terms of no. of total vehicles on each road is discussed below and the findings are presented in **Table 5-11**

Table 5-11 Worst case traffic scenarios on each road

S. No	Road	Date	2wheeler Total No of vehicles (% of total)	3Wheeler Total No of vehicles (% of total)	LMV(4wheeler) Total No of vehicles (% of total)	HMV Total No of vehicles (% of total)
1	Amaravati to Thulluru Road	6.6.15 to 7.6.15	4010 (66%)	316 (6%)	927 (15%)	816 (13%)
2	Thulluru to Tadikonda Road	1.6.15 to 2.6.15	7846 (66%)	1035 (9%)	1674 (14%)	1357 (11%)
3	Pedaparimi to Mangalgiri Road	1.6.15 to 2.6.15	4357 (65%)	557 (8%)	1035 (15%)	796 (12%)
4	Thullur to Undavalli Road	6.6.15 to 7.6.15	5505 (64%)	795 (9%)	1448 (2%)	826 (10%)

The Table -5-11 reflects the following trend**:**

Amaravati to Thulluru Road: The highest no. of total vehicles on this road was found to be from 6.6.15 to 7.6.15. The trend reflected that the highest no. of vehicles by category were 2 wheelers (66%) followed by Light Motor vehicles (15%) , Heavy motor vehicles (13%) and lastly 3 wheelers (6%) in descending order.

Thulluru to Tadikonda Road: The highest no. of total vehicles on this road was found to be from 1.6.15 to 2.6.15. The trend reflected that the highest no. of vehicles by category were 2 wheelers (66%) followed by Light Motor vehicles (14%), heavy motor vehicles (11%) and lastly 3 wheelers (9%) in descending order.

Pedaparimi to Mangalagiri Road: The highest no. of total vehicles on this road was found to be from 1.6.15 to 2.6.15. The trend reflected that the highest no. of vehicles by category were 2 wheelers (65%) followed by Light Motor vehicles (15%), heavy motor vehicles (12%) and lastly 3 wheelers (8%) in descending order.

Thulluru to Undavalli Road: The highest no. of total vehicles on this road was found to be from 6.6.15 to 7.6.15. The trend reflected that the highest no. of vehicles by category were 2 wheelers (64%) followed by Heavy Motor vehicles (10%), 3 wheeler (9%) and lastly light motor vehicles (2%) in descending order.

The percentage composition of total traffic in terms of 2 wheelers, 3 wheelers, light motor vehicles and heavy motor vehicles on each road is given in **Figure 5-19.** The photographs of traffic survey are shown in **Fig 5-18**.

Amravathi to Thulluru Road

Thulluru to Tadikonda road

Pedaperimi to Mangalagiri Road

Thulluru to Undavalli Road

Figure 5-18 Photographs of the Traffic Survey

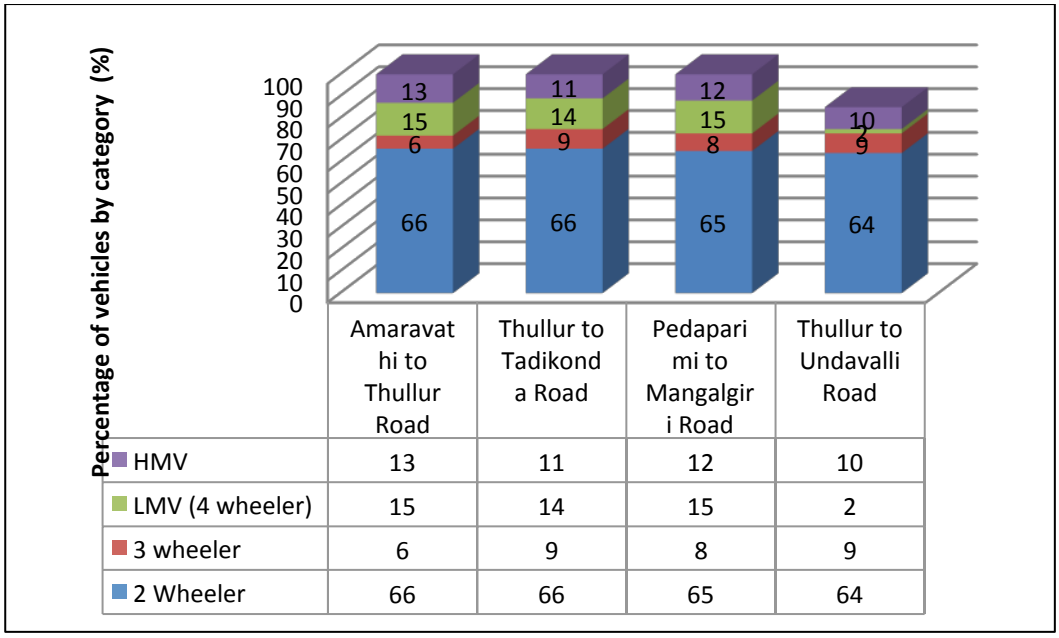


Figure – 5 -19: Percentage Traffic Composition on Each Road

5.11. Ecology and Biodiversity

5.11.1. Objectives of the Terrestrial and Aquatic Ecology Survey

Terrestrial ecology

- Secondary data collection from previous reports
- Requisite data collection from the local Forest Dept. office
- Detailed, quantitative pre-monsoon biodiversity survey for plants, four vertebrates (mammals, avifauna, reptiles, amphibians), and insects using quadrate and transect-based analysis
- Data interpretation and analysis to yield phyto-sociology indices (IVI) and diversity indices including Simpson's and Shannon Wiener's, apart from density and abundance values using standard formulae
- Photo presentation of flora and fauna of the entire study area
- List of flora and fauna species with IUCN category and schedule as per The Wildlife Protection Act, I972

Aquatic ecology

- Collection of 5 sediment samples for analysis of micro and macro benthos – analysis to include characterization, identification, and calculation of univariate diversity indices (Shannon Wiener's, Pielou's Evenness and Margalef's measure of richness)
- Marking of the 5 sampling locations on the map using GPS coordinates
- Collection of 5 water samples for analysis of phytoplankton and zooplankton
- Identification of the fisheries based on the secondary data from the local fisheries office/ department.

- Delineation of impacts due to the project on the terrestrial ecology and the mitigation measures proposed thereof
- In case any rare or endangered species is found within the 10km radius of the project site, species specific conservation plan for the same will be delineated – not applicable.

5.11.2. Methodology

5.11.2.1. Study Area Details

The Villages & Hamlets

Chiefly, 25 villages are covered under 3 mandals – Thulluru, Mangalagiri and Tadepalli. List of the villages has been provided in **Chapter 3.**

Kondapalli Reserve Forest

The Kondapalli reserve forest spreads over an area of 62 Sq. Km. situated in the Eastern Ghats of Andhra Pradesh. The forest spreads in the Deccan plateau in between 16°37'N and 80°31'E - latitudes and 16°45'N and 80°26'E longitudes.

Tadepalli Reserve Forest

Tadepalli reserve is 485 hectares in size and is covered under the Mangalagiri Block. It falls to the east of the study area.

Terrestrial Ecology

15 Transects were laid across the project site and 10km beyond the boundaries, extending to Kondapalli reserve forest in the north, Tadikonda and Peddakonda in the south, Chevapandu in the west and Peddavadiapuddi in the east. Of these, 4 transects were laid inside Kondapalli (**Figures 5-20 to 5-23, Table 5-12.)**. Total direct counts were taken for aquatic birds in ponds/ waterbodies observed along transects. In addition, short line transects were laid along the main longer transects and mammals, avifauna, herpeto-fauna and insects sighted were enlisted along with the number of individuals sighted.

Table 5-12 List of Transects

Transect No	Direction	Length in km	Chief villages/hamlets
1	East-west, parallel to Krishna River	20 km	Venkatpalem is about 500m away
2	East-west, parallel to Transect 1 road	17 km	Krishnayyapalem, Mandadam, Velagapudi, Rayapudi, Abbarajupalem, Borupalem
3	North-south	3 km	Undavalli, Penumaka
4	North-south	21 km	Mangalagiri
5	North-south mostly, east-west in the end	11 km	Peddavadiapuddi

Transect No	Direction	Length in km	Chief villages/hamlets
6	East-west	20 km	Mangalagiri, Nowluru (rural), Kuragullu, Neerukonda, Nekkallu, Chevapadu
7	North-south	11 km	Borapalem, Dondapadu, Ananathvaram, Nekkallu
8	East-west, then a V-shaped transect to Pedda Konda hills	17 km	Tadikonda
9a, b, c, d & e	Kondapalli RF	1.5-2 km	Inside Kondapalli
10	North-south	11.5 km	Venkatpalem to Ainavolu to Sakhamuru to Neerukonda
11	North-south	5 km	Rayapudi to Thulluru to Mandalam Office to Sakhamuru

Figure 5-20 Transect 1: in Red; Transect 2: in Yellow; Transect 3: in Green; Transect 6: in Pink; Transect 7: in Blue; Transect 10 in: Orange and Transect 11: in Purple

Figure 5-21 Transect 4 in White

Figure 5-22 Transect 5: in Aqua; Transect 6: in Pink; Transect 8: in Brown

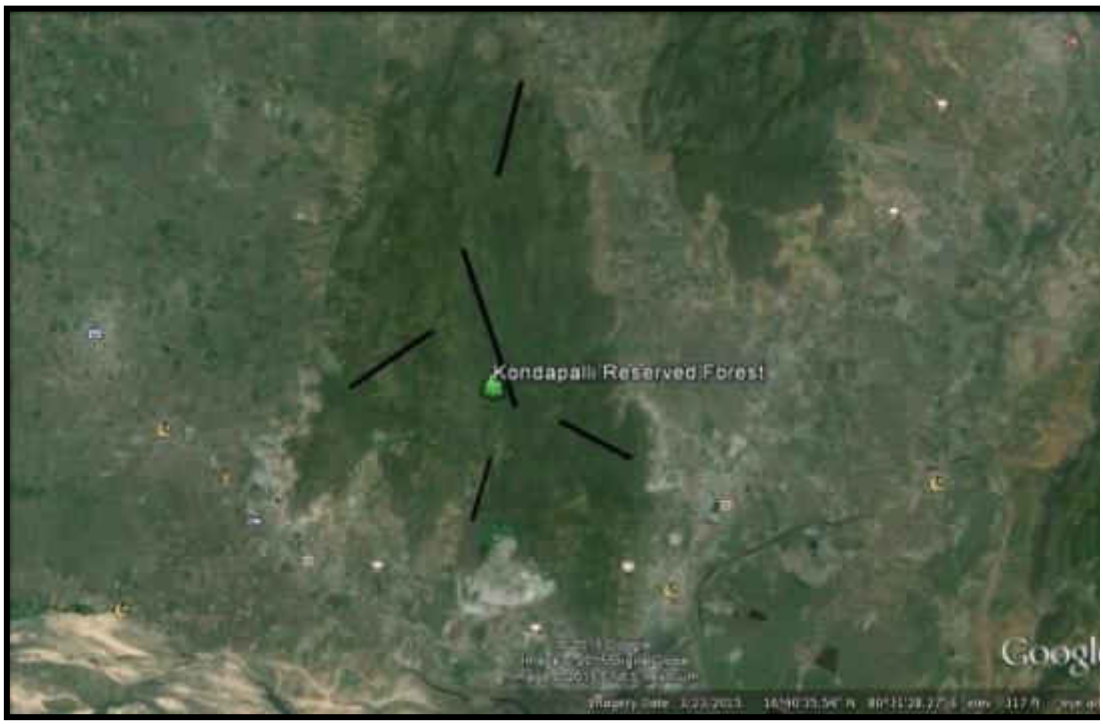


Figure 5-23 Transects in black colour in Kondapalli Reserve Forest

Aquatic Ecology

Benthos and Plankton Sampling from Krishna River

Five spatially separated sampling locations were selected at the distance of one location per 2km. This number was selected based on past experience. Sampling was conducted for benthos and phytoplankton and zooplankton in the Krishna River (list of sampling locations given in **Table 5-13**). Standard methodologies followed by CSIR-NIO were followed for sample collection. Benthos was collected by wading into the river at the given locations and scooping out the sediment using a hand-held plastic scoop (Gordon et al. 2004). Zooplankton was collected using a net with 75 μm -size mesh.

Large-bottle-type samplers have been found to be slightly more efficient for phytoplankton sampling (Kuparinen et al. 2009). The sampling protocol followed was as per USEPA (LG400), with the significant difference that instead of a rosette sampler, a large bottle type sampler was used. Briefly, composite samples were collected at each point till the euphotic depth. Samples were mixed. Sample preservation was with Lugol's iodine (final concentration 1% v/v). Samples were stored in the dark and refrigerated.

The euphotic zone is the layer closer to the surface that receives enough light for photosynthesis to occur. Euphotic zone was measured using a Secchi disk. The Secchi Disk provides a convenient method for measuring light penetration below the water surface. By using the Secchi Disk, one can determine the transparency or limit of visibility of the water and estimates of light transmission can be derived. The limit of visibility is approximately the region of transmission of 5% sunlight (Reid, 1961). Once the limit of visibility is established, calculations can be made to determine the lower limits of the euphotic zone (light) which is usually three times the Secchi Disk depth (Welch, 1948).

Samples were mixed. Sample preservation was with Lugol's iodine (final concentration 1% v/v). Samples were stored in the dark and refrigerated.

Zooplankton was sampled using a standard zooplankton net of mesh size 75μm. The net was dipped slowly in water and raised. It was rinsed thoroughly and the sample was concentrated through sedimentation and decantation. Briefly, sample is collected, preserved with 4-5% formalin (1 part formalin and 9 parts sample) and allowed to stand. The preserved zooplankton settles and the supernatant is discarded. Few drops of Rose Bengal solution was used for sample staining. This protocol was as per NIO Field manual (2004).

Table 5-13 Sampling locations for Benthos and Plankton along Krishna River

S. No	Sampling Point	Global Coordinates
1	Bhavani Island	16°30'56.102'N; 80°35'30.439 E
2	Guntupalli	16°33'24.579'N; 80°32'41.732 E
3	Vedavathi Bridge	16°29'11.836'N; 80°37'18.469 E
4	Tadepalli	16°30'26.477'N; 80°34'23.507 E
5	Prakasam Barrage	16°30'19.96"N; 80°36'17.81"E

Survey of Fishermen

An interview was conducted with voluntary local fishermen to yield a checklist of the fish normally caught from the Krishna River.

Calculation of Diversity Indices

After conducting the transect surveys, 4 diversity indices were calculated for flora and avifauna data, to compare the diversity of the different areas covered in the 11 transects. A brief analysis of the diversity indices has been provided in **Table 5-14**.

Table 5-14 Description of Statistical Diversity Indexes

Statistical Index	Formula	Description	Remarks
Simpson's Index	$D = \frac{N(N-1)}{\sum n(n-1)}$	a measure of the probability that two individuals taken at random from the dataset (with replacement of the first individual before taking the second) represent the same species	A measure of species richness and evenness
Shannon's Index	$H = -\sum_{i=1}^{S} p_i \ln p_i$	quantifies the uncertainty in the species identity of an individual that is taken at random from the dataset	A measure of species richness and evenness
Margalef's Index	$D_{Mg} = \frac{(S-1)}{\ln N}$	a measure of species richness	A measure of species richness
Pielou's Index	$J = H/\ln(S)$	considered as a formulation of adjusted Shannon's index	A measure of species richness and evenness

The use of Margalef's Index is justified by the fact that it measures only species richness, and is simple to use and interpret. Simpson's and Shannon's indices are often used together because both are individually liable to fail. For example, if two ecosystems being compared possess the same entropy (same abundance of all species), Shannon's index will fail to differentiate between them and Simpson's can be used to express the variability between the two. Also, one should be especially careful when using Shannon's index of diversity for comparing populations with different species number or sample size. In short, biologists often use a combination of several indices to take advantages of the strengths of each and develop a more complete understanding of community structure.

5.11.3. Results and Discussion

5.11.3.1. Agriculture and Domesticated Animals

Considering that most of the study area was under agriculture, a list of crops and horticultural plants was prepared with observation and augmented with the interview of local farmers (**Table 5-15**).

Table 5-15 Lists of Agricultural Crops and Plantations

S. No.	Common Name	Scientific Name	Remarks
1	Banana	*Musa* sp.	Transect 1 (at Venkatapalem) Transect 3 (at Undavalli)
2	Gherkins	*Cucumis anguria*	Transect 1 (at Venkatapalem)
3	Rice	*Oryza sativa*	Transect 3 (at Penumaka)
4	Maize	*Zea mays*	Transect 2 (at Krishnayyapalem, Velagapudi) Transect 3 (at Penumaka) Transect 6 (at Chevapadu) Transect 7 (at Dondapadu, Borupalem)
5	Sugarcane	*Saccharum sp.*	Transect 3 (at Velagapudi, Undavalli, Penumaka)
6	Drumsticks	*Moringa oleifera*	Transect 3 (at Undavalli, Penumaka)
7	Cotton	*Gossypium sp.*	Transect 6 (at Chevapadu) Transect 7 (at Borupalem) Transect 10 (at Ainavolu, Velagapudi)
8	Citrus	--	Transect 7 (at Borupalem)
9	Jasmine	*Jasminum* sp.	Transect 6 (at Nidamarru)

In **Table 5-16** a list of domesticated animals has been provided.

Table 5-16 Lists of Domestic Animals

S. No.	Animal	Approximate Number*
1.	Buffalo	1,00,000
2.	Pig	50,000
3.	Cow	200
4.	Sheep	5,000
5.	Goat	1,500

After interaction with locals and with authorities from Vijayawada Veterinary College

N.B. High cattle density observed in Tadepalli

List of global coordinates of the ponds/ waterbodies is provided in **Table 5-17**. Some of these ponds/ waterbodies were found to be dried, semi-dried or covered with water hyacinth.

5.11.3.2. Important Ecosystems Observed Ponds/ waterbodies

Ponds/ waterbodies are areas where a water table is at, near, or just above the surface and where soils are water-saturated for a sufficient length of time such that excess water and resulting low soil oxygen levels are principal determinants of vegetation and soil development.

Significance: Many animals that live in other habitats use ponds/ waterbodies for migration or reproduction. For example, herons nest in large old trees, but need shallow areas in order to wade for fish and aquatic life. Amphibians often forage in upland areas but return to the water to mate and reproduce.

Ecological Role: Ponds/ waterbodies prevent flooding by holding water much like a sponge. By doing so, ponds/ waterbodies help Keep River levels normal and filter and purify the surface water.

Table 5-17: Global Coordinates of Observed Ponds/ waterbodies

No	Location	GPS	
1	Nidamarru	16°25'51.49"N	80°31'48.11"E
2	Near Kolanukonda Railway station	16°27'11.27"N	80°35'48.48"E
3	Tadepalli	16°28'1.59"N	80°35'24.21"E
4	Tadepalli	16°28'36.25"N	80°34'12.81"E
5	Tadikonda	16°24'52.80"N	80°27'10.78"E
6	Mandadam	16°31'5.99"N	80°31'25.06"E
7		16°27'49.45"N	80°33'52.92"E
8		16°28'46.39"N	80°34'25.48"E
9	Manadalam Office	16°31'0.28"N	80°28'57.31"E
10	Ainavolu	16°29'4.11"N	80°29'59.23"E
11	Dondapadu	16°32'41.42"N	80°27'7.91"E
12	Mangalagiri	16°25'27.87"N	80°33'46.02"E
13	Sakhamaru	16°29'23.87"N	80°28'30.89"E
14	Krishnayyapalem	16°29'14.69"N	80°33'20.36"E
15	Kuragullu	16°27'13.15"N	80°31'28.84"E
16	Velagapudi	16°31'36.03"N	80°30'31.11"E
17	Thulluru	16°31'45.93"N	80°27'54.43"E
18	Ananthvaram	80°25'57.59"E	16°30'43.61"N

River ecosystem

Water flow is the main factor that makes river ecology different from other water ecosystems. This is known as a lotic system. The chemistry of the water is often determined by inputs from the surrounding environment or catchment area, the substrate is the surface on which the river organisms live River organism play a significant role in energy recycling which completes the ecosystem cycle.

Significance: Rivers play a vital role in connecting habitats, and their value to plants and animals extends far beyond the surface area they cover as they provide a pool of nutrients for growth. This system inhabits a wide range of species diversity like, fish, amphibians, insects, invertebrate, reptiles etc.

Ecological Role: The major role is fresh water supply, regulatory functions (water and erosion regulation), self-purification, and soil formation, apart from nutrient and water cycling services.

Amaravati is located at the banks of River Krishna. At the length of 1300 km it is the fourth-longest river in India. It is a major source of irrigation for Maharashtra, Karnataka, Telangana and Andhra Pradesh. The Krishna river's source is at Mahabaleshwar near the Jor village in the extreme north of Wai Taluka, Satara District, Maharashtra in the west and empties into the Bay of Bengal at Hamasaladeevi (near Koduru) in Andhra Pradesh, on the east coast.. This river is revered by Hindus as sacred.

Riparian zone

Riparian zones are ecosystems located along the banks of rivers, streams, creeks, or any other water networks. Usually riparian zones are narrow strips of land that line the borders of a water source.

Significance: A healthy riparian zones are superior habitat for fish because (1) the riparian trees provide shade and buffer temperatures, (2) inputs of woody debris creates fish habitat, (3) inputs of organic matter via leaf fall provides food sources for invertebrates and fish.

Riparian zones provide reliable sources of water for wildlife and the greater productivity allowed by the high moisture content of the soil allows for more potential food for wildlife.

Ecological role: Even though the actual area covered by riparian zones is relatively small (they typically make up much less than 1% of land area). Riparian zones provide a variety of ecosystem services including (1) sediment filtering, (2) bank stabilization, (3) water storage and release, and (4) aquifer recharge. In addition, riparian zones provide important habitat for wildlife. They are ecotones or transition zones between aquatic and terrestrial habitats and of high importance because ecotones are known as regions of high biodiversity.

Forest

A forest ecosystem is typically associated with land masses covered in trees and those trees are often classified by foresters into forest cover types.

Significance: A forest ecosystem & its community are directly related to species diversity. This system supports interacting units including trees, soil, insects, animals, and man.

Ecological Role: In addition to assisting in climate control, forests have other ecological benefits. They prevent erosion by reducing the rainfall's force on the soil's surface and by absorbing water and not allowing it to directly run off and remove topsoil. Forests also act as water filters, collecting and storing water and recharging underground aquifers. Forests also increase the atmosphere's humidity by transpiration, which affects temperature and rainfall.

Rocky outcrop

Outcrops along steep ravines & in monumental rocky landscapes forces openings in forest canopies revealing the foundations of terrains contributes Rocky outcrop ecosystem.

Significance: Rocky outcrop ecosystem provide niche habitat to unique and unusual species. The structure & biological composition of Rocks provide important shade & shelter, roosting, feeding, & nursery areas for birds & other species.

Within the study area, rocky outcrops were observed at Undavalli (where the Undavalli caves are present) and Tadepalli, Neerukonda, and Ananthvaram. Beyond its boundary, rocky outcrops were located at Pedukonda and Tadikonda in the south, at Chevapadu in the west and at Mangalagiri in the east.

Annexure B9 provides a quantitative list of flora species observed in the naturally vegetated areas amidst the agricultural plots. The list of fauna is attached as **Annexure B10;** it also includes the list of flora and fauna provided by the Guntur DFO. Secondary data pertaining to this region published in peer-reviewed journals has been collated in **Table 5-18.**

All identifications were made on the basis of field experience and consultation of approved field guides.

Table 5-18: Secondary Data of Flora & Fauna from Peer-Reviewed Journals

Taxon	Species	Remarks	Reference
Trees	*Givotia moluccana, Wrightia tinctoria, Sterculia urens, Albizia amara, Chloroxylon swietenia, Bauhinia racemosa, Boswellia serrata, Commiphora caudata*, *Crateva magna, Gyrocarpus americanus, Lawsonia inermis, Moringa concanensis, Pterospermum xylocarpum*		Krishna and Sujatha (2012); Reddye et al. (2010)
	Pterocarpus, Terminalia, *Anogeissus, Lagerstroemia, Givotia, Gyrocarpus* and *Casuarina*		Prasad et al. (2011)
	Terminalia chebula, Tamarindus indica, Acacia intsia		Ramesh and Kaplana (2015)
Shrubs	*Tephrosia purpurea, Phyllanthus amarus, Phyllanthus reticulatus, Aganosma dichotoma, Azima tetracantha, Canavalia virosa, Datura metel, Grewia hirsuta, Plumbago zeylanica,*		Krishna and Sujatha (2012)
	Cadaba indica, Chomelia asiatica, Pentapetes phoenicea, Pupalia lappacea	*Cadaba indica* is endemic to south India	Reddy et al. (2010)
	Gymnosporia montana, Helicteres isora, Holarrhena antidysenterica, Phoenix humilis, Tephrosia purpurea, Bridelia hamiltoniana, Woodfordla floribunda, Pavetta indica, Asparagus racemosus		Ramesh and Kaplana (2015)
	Argyreia nervosa, Cassytha filiformis, Cayratia auriculata, Ipomoea mauritiana, Marsdenia volubilis, Tylophora indica	*Cassytha filiformis* is an obligate parasitic vine	Krishna and Sujatha (2012)
	Operculina turpethum		Reddy et al.

Taxon	Species	Remarks	Reference
			(2010)
Climbers	*Caesalpinia crista, Hemidesmus indicus, Smilax macrophylla, Cryptolepis buchanani, Tinospora cordifolia*		Ramesh and Kaplana (2015)
Herbs	*Andrographis paniculata, Caralluma adscendens, Cleome gynandra, Cyperus rotundus, Elytraria acaulis, Malachra capitata, Mimosa pudica*		Krishna and Sujatha (2012)
	Bambusa arundinacea, *Pentatropis capensis*	*Bambusa arundinacea* bamboo species was once quite common, but is now reported scattered only	Reddy et al. (2010)
	Dendrocalamus strictus		Ramesh and Kaplana (2015)
Mammals	*Panthera pardus*	Doubtful, as per local survey	Prasad et al. (2011)
	Felis chaus, Melursus ursinus, Hyaena striata, Canis lupus, Sus scrofa, Hystrix indica, Curvus anreus, Aryctolugus cuniculus, Unambulus palmarum, Macaca radiata, Presbytis entellus, Herpestes edwardsi	Jungle cat, bear and hyaena, wild boar, porcupine and wolves are occasionally reported; squirrel, small deer, rabbits, hare, mongoose, bonnet macaques and langurs are relatively more common	Ramesh and Kaplana (2015)
Avifauna	*Pavo cristatus, Forancolinus* sp. *Galleus* sp., *Coturnix* sp.		Ramesh and Kaplana (2015)
Reptiles	*Naja naja, Bungarus, Vipera russeli, Calotes versicolor*	Rat snake, tree snake and water snake also reported	Ramesh and Kaplana (2015)

Taxon	Species	Remarks	Reference
Benthos	*Parastenocaris gayatri, P.savita,* and *P. sandhya*	All these are new species records	Reddy (2001)
	Paracyclops fimbriatus, Haplocyclops (Kiefercyclops) fiersi, Nitokra lacustris, Mesochra wolskii, Cletocamptus deitersi, Delavalia madrasensis, Folioquinpes chathamensis, Parastenocaris curvispinus, Parastenocaris gayatri, Parastenocaris savita, Siolicaris sandhya, Serbanibathynella primaindica, Habrobathynella nagarjunai, Habrobathynella indica, Habrobathynella vidua	*Paracyclops fimbriatus* rarely reported from River Krishna; *Folioquinpes chathamensis Folioquinpes chathamensis* is a one-eyed crustacean. *Delavalia madrasensis*, *Folioquinpes chathamensis*, *Neomiscegenus indicus*, and *Mesochra wolskii* belong to the almost exclusively marine families. Clearly, the occurrence of these species in the truly freshwater conditions of the hyporheic zone of the river Krishna near Vijayawada is indicative of their remarkable euryhaline adaptations.	Reddy (2014)

Aquatic Ecology

Interview of fishermen yielded data of the fish catches obtained from Krishna River (**Table 5-19**). In **Table 5-20**, benthic organisms sampled from 5 locations of River Krishna have been enlisted. Phyto and zooplankton have been enlisted in **Table 5-21 and 5-22**, respectively.

Table 5-19 Lists of Fish and Prawn from River Krishna (as per a survey of local fishermen)

S. No.	Common Name	Scientific Name
1.	Giant snake-head Fish	*Channa micropeltes*
2.	Panchax	*Aplocheilus* panchax
3.	Rohu	*Labeo rohita*
4.	Giant River Prawn	*Macrobrachium rosenbergii*
5.	African Tilapia	*Oreochromis mossambicus*
6.	Guppy	*Poecilia reticulata*
7.	Bronze featherback fish	*Notopterus notopterus*
8.	Giant Danio	*Devario aequipinnatus*
9	Garra	*Garra mullya*
10	Common Rasbora	*Rasbora daniconius*
11	Rohu	*Labeo rohita*
12	Orange-fin Labeo	*Labeo calbasu*
13	Deccan mahseer	*Tor khudree*
14	Barb	*Puntius dobsoni*
15	Wallago	*Wallago attu*
16.	Giant river catfish	*Mystus seenghala*
17.	Stinging Catfish	*Heteropneustes fossilis*
18.	Common Snakehead fish	*Channa punctatus*

Table 5-20 Benthos from River Krishna

	Bhavani Island	Prakasam Barrage	Tadepalli	Vedavathi Bridge	Guntupalli	%
Gastropods	50	175	--	125	--	11.29
Peleypods	100	175	--	25	--	9.68
Brachyclam	25	--	--	--	--	0.81
Ostracods	125	--	--	--	--	4.03

	Bhavani Island	Prakasam Barrage	Tadepalli	Vedavathi Bridge	Guntupalli	%
Polychaetes	25	--	--	--	--	1.61
Oligochaetes	600	325	--	--	100	13.87
Chironomus larvae	300	100	25	--	--	13.71

N.B. **All figures are actual numbers/m^2 sediment sample**

The euphotic zone at the five sampling locations has been provided in Table 5-21 A:

Table 5-21 A: Euphotic depth of sampling

Sampling Point	Global Coordinates	Euphotic Depth
Bhavani Island	16°30'56.102'N; 80°35'30.439 E	4.5 ft
Guntupalli	16°33'24.579'N; 80°32'41.732 E	3.4 ft
Vedavathi Bridge	16°29'11.836'N; 80°37'18.469 E	2.7 ft
Tadepalli	16°30'26.477'N; 80°34'23.507 E	3.5 ft
Prakasam Barrage	16°30'19.96"N; 80°36'17.81"E	3.2 ft

Table 5-21 B Phytoplanktons from River Krishna

	Bhavani Island	Prakasam Barrage	Tadepalli	Vedavathi Bridge	Guntupalli
Navicula	78	30	-	2	6
Suriella	36	50	14	-	4
Tabellaria	6	-	-	-	-
Cyclotella	14	22	-	26	5
Sygnema	6	2	-	-	-
Scenedesmus	24	-	2	150	2
Ulothrix	8	2	-	-	6
Coelastrum	4	-	-	-	-
Netrium	12	-	-	-	-
Closterium	4	-	-	-	4
Cymbella	2	-	-	-	4

	Bhavani Island	Prakasam Barrage	Tadepalli	Vedavathi Bridge	Guntupalli
Synedra	4	-	-	-	-
Oscillatoria	14	24	12	50	-
Asterionella	4	-	-	-	-
Rivularia	4	-	2	2	-
Diatoms	8	22	-	-	-
Ankistrodesmus	-	4	-	-	-
Nitella	-	4	-	-	-
Amphora	-	26	4	-	-
Hvalotheca	-	10	-	-	-
Volvox	-	4	2	6	4
Spirogyra	-	14	-	-	-
Fradillaria	-	1	2	-	-
Closterium	-	4	-	-	-
Microspora	-	1	-	-	-
Pediastrum	-	-	-	30	2

Phytoplankton have been reported as number/ml

High numbers of *Scendesmus* sp. at Varathi Bridge indicate algal growth and early eutrophication at that location. An algal growth is a rapid increase or accumulation in the population of algae (typically microscopic) in a water system. Cyanobacteria blooms are often called blue-green algae. Algal growth may occur in freshwater as well as marine environments.

Table 5-22 Zooplanktons from River Krishna

	Bhavani Island	Prakasam Barrage	Tadepalli	Varath Bridge	Guntupalli
Insect larvae	11	-	2	7	8
Decapod larvae	1	-		-	2
Nauplius	13	-	6	3	6
Cyclopoid	5	-	2	7	1
Diatoms	-	2	-	13	1
Chironomus larvae	6	21	-	21	-

	Bhavani Island	Prakasam Barrage	Tadepalli	Varath Bridge	Guntupalli
Streptocephalus	-	-	-	1	-
Chillodenella	-	-	-	2	-
Daphnia	11	1	1	1	-
Tadpole	-	-	-	11	-
Heterodera	1	1	1	-	-
Brachionus sps	15	4	1	-	-
Amphipods	-	1	-	-	-
Decapod	-	1	-	-	-
Lucifers	-	-	-	-	-
Metepus	7	1	-	-	-
Cocconeis	-	2	-	3	-
Fish larvae	4	4	-	-	-
Sida	-	1	-	-	-
Mysids	3	-	-	-	-

Zooplankton have been reported as number/l

* Nauplius: a larval stage of copepods

**Diatoms are phytoplankton, but dead individuals can be stained among the zooplankton and reported as such.

Comparison of Diversity Indices

Table 5-23 Comparison of Transects on the basis of Diversity Indices: Identifying the Significant areas

Avifauna	Margalef's Index	Simpson's Index	Shannon's Index	Pielou's Index
Transect 1	6.753	0.0479	3.116	0.9074
Transect 2	**8.977**	**0.04897**	**3.342**	**0.863298**
Transect 4	5.765	0.03989	2.824	0.942674
Transect 6	**8.313**	**0.04094**	**3.343**	**0.906237**
Transect 8	3.656	0.1126	2.296	0.870008
Transect 3	**7.135**	**0.0464**	**3.184**	**0.902914**
Transect 11	5.414	0.07039	2.836	0.89237

Avifauna	Margalef's Index	Simpson's Index	Shannon's Index	Pielou's Index
Transect 5	3.613	0.07143	2.318	0.932832
Transect 7	**7.759**	**0.03608**	**3.316**	**0.932679**
Transect 10	6.792	0.05066	3.135	0.90457
Transect 9	**12.09**	**0.03603**	**3.69**	**0.89063**

N.B. Transects 1, 2, 4, 6 & 8 are of comparable lengths and are hence placed together for direct comparison. Similarly, transects 5,7,10 and 3, 11 form two other groups of transects of comparable lengths and hence, suitable for comparison with each other. Transect 9 being a forest area with 4 short transects can be taken separately.

The project site including the study area has been subjected to habitation and cultivation over last several decades. Critical review of research reports and discussion with experts and people on the ground indicated that the cultivation and habitation have been only on the rise. This was corroborated with the secondary information on landuse. The documentation indicated that as a natural consequence of habitation and cultivation the incremental manifestation of biodiversity is not observed and the prime species may not have significant negative impact due to the proposed development. However, based on the ecological assessment following significant areas have been delineated:

- All the 18 ponds/ waterbodies observed in the study area.
- The rocky outcrops at Ananthvaram and Neerukonda (Undavalli and Tadepalli rocky outcrops are already protected as Reserved Forests
- The riparian zone of Krishna River, preferably extending up to the near-horizontal line formed by joining the locations of Tadepalli, Krishnayyapalem, Mandadam, Velagapudi, Rayapudi, Abarajupalem and Borupalem

5.12. Landuse/ Landcover (LU/LC)

Remote Sensing technology has emerged as a powerful tool in providing reliable information on various natural resources and in effective mapping of land use pattern. The term 'landuse' used in this section includes landuse and land cover together. The landuse study was undertaken by utilising three principal resources: namely,

- Survey of India (SOI) Topo-sheets No. E44-U6, U7, U10 and U11 of 1:50,000 scale;
- Digital Globe's WorldView-2 Satellite Image (WorldView-2) in Geo-coded False Colour Composite (FCC) and
- Ground truth validation for the FCC imageries.

The proposed project boundary marked on the topo-sheet, considered for the land use study is shown in Fig 5-25. The satellite image of the project site is presented in Fig 5-26.

5.12.1. Selection of Reference Datasets:

The Survey of India topographic map sheets (scale 1:50000) was proposed to be used for geo-rectification of the satellite images through identification of suitable permanent Ground Control Points (GCPs), projection transfer and preparation of base map through extraction of the topographic features.

5.12.2. Ground Truthing

The Pre-field maps generated in the above process were subjected to a detailed study along with the satellite images and the survey of India topographic map sheets to access the accuracy of the pre-field identification of land features and also identification of doubtful interpretations. About 26 numbers of uniformly distributed locations within the study area were identified on the maps for the purpose of site visit and ground truthing. A detailed traverse plan was prepared using the existing road network to cover as many representative sample areas as possible to observe the broad land use features and field conditions. Detailed field observations and investigations for the identified sites were carried out and suitably marked on the maps. Details of ground truthing location given in **Annexure B11**

5.12.3. Existing Land-use

In order to delineate the baseline information on existing land use pattern, the remote sensing data by WorldView-2 Satellite Image December 2014 along with collateral data (National Remote Sensing Center-Bhuvan Application) is used.

Based on the topo-sheet, Bhuvan tool and WV-2 satellite image using new capital region existing land cover has been considered in the study. In order to delineate the baseline information on existing land use pattern, the remote sensing data have been used.

The remote sensing data of study region shows presence of vegetation (Garden, plantation and Agricultural), river, water bodies, and settlements. Project area general terrain condition is plain, hilly near Undavalli caves area and near Ananthavram village area and gently sloping towards of Krishna river basin area.

The project area covered by Amaravati capital city is 217.23 sq km. It is observed in the project area that highest LU/LC class is agricultural land. The various categories of land uses identified in the project area is shown in Fig 5-26 an the Land use of the study area is shown in Fig 5-27

Agriculture Land (Crop Land)

The sizable 55.76% of the land is under agricultural use, which offer tremendous opportunities for high value agro based economy. The region has some industrial base but mostly in the primary sector. It is scattered near Vijayawada and Guntur. Quarrying activities are found near Kondapalli and Kondaveeti forest. Most of the capital region land in Krishna district is occupied by hills, forests and prime agriculture

land (more than two seasons). This directs urbanization and future expansion towards Guntur District.

Fallow land

It is described as agricultural land which is taken up for cultivation but is temporarily allowed to rest un-cropped for one or more seasons, but not less than one year. These lands are particularly those which are seen devoid of crops at the time when the imagery is taken during Rabi and Kharif. Total fallow land in project site is 6.68%

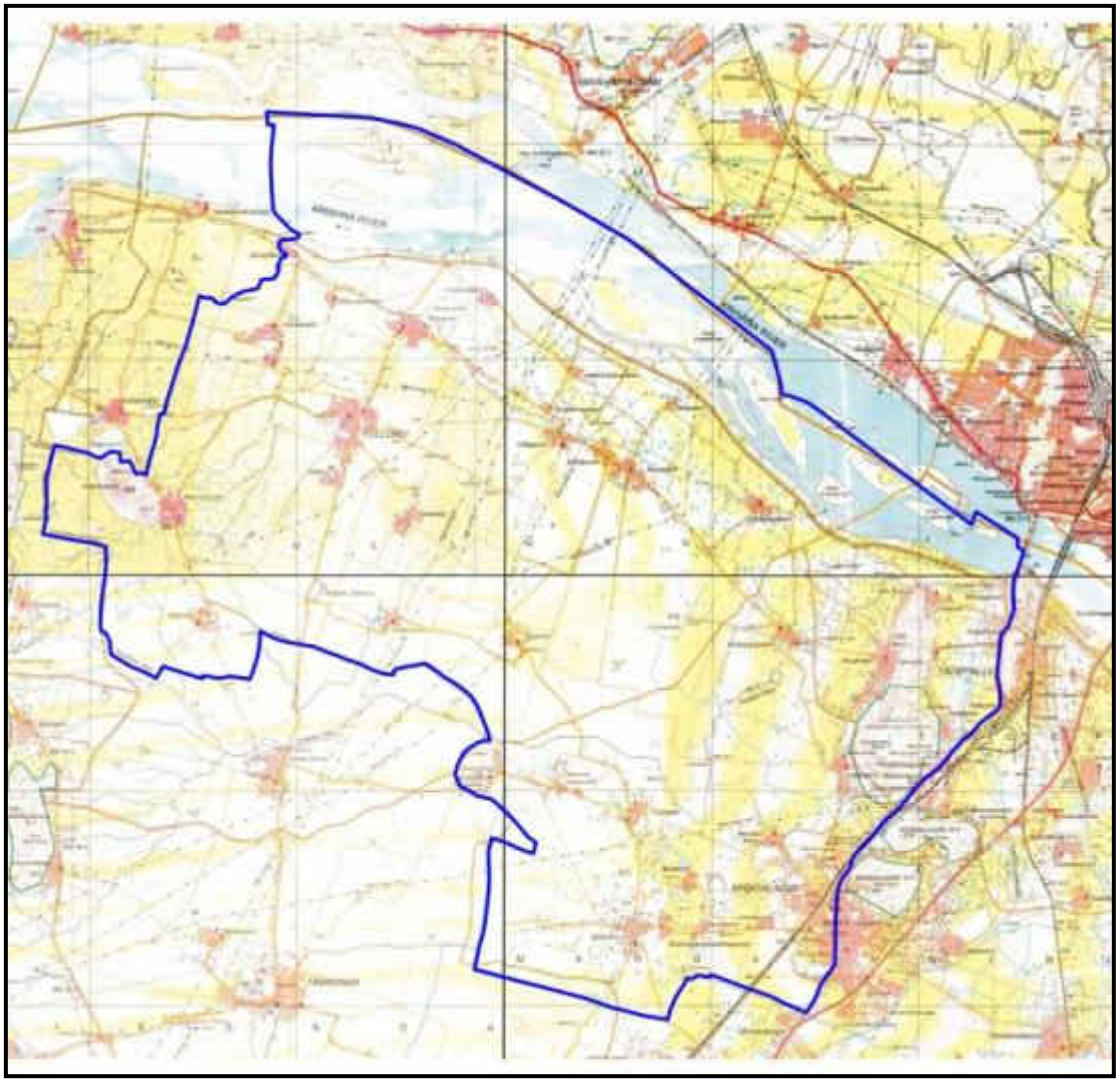


Figure 5-24 Project Boundary Marked on Topo-sheet

Built Up Area

Built up area majority of the land use includes mining, Rural and urban settlements scattered throughout the region. The houses are mainly pucca and clustered with very few houses as semi-pucca. The built up area includes offices, schools, colleges, and hospitals. The built-up area covers approximately 5.18% of the total project area.

River /Stream/Canals

The study area comprises of Krishna River, Canal and small streams. Krishna River cross entire north- east boundary of the new capital region. The major portion is covered by River/ Canals) i.e. 13.65 % of total project area.

The details of land use in the study area and the project area are shown in Table 5-24. The land use analysis shows there is 132 sq. km of agricultural land in the project area. A large area is covered with river, ponds and other water features. The entire area is an agricultural belt as evident from the study area landuse, which shows 543 sq km of cropland (including the buffer area)

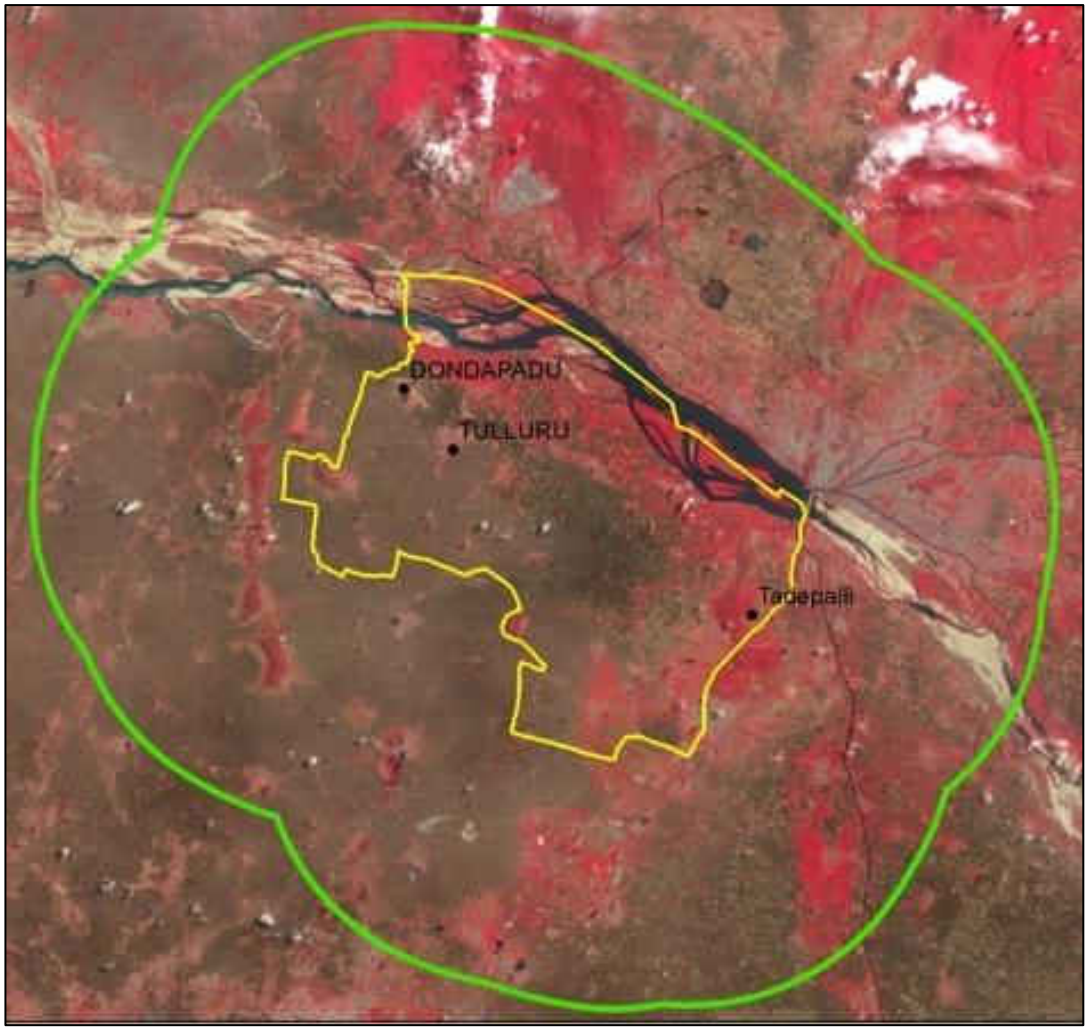
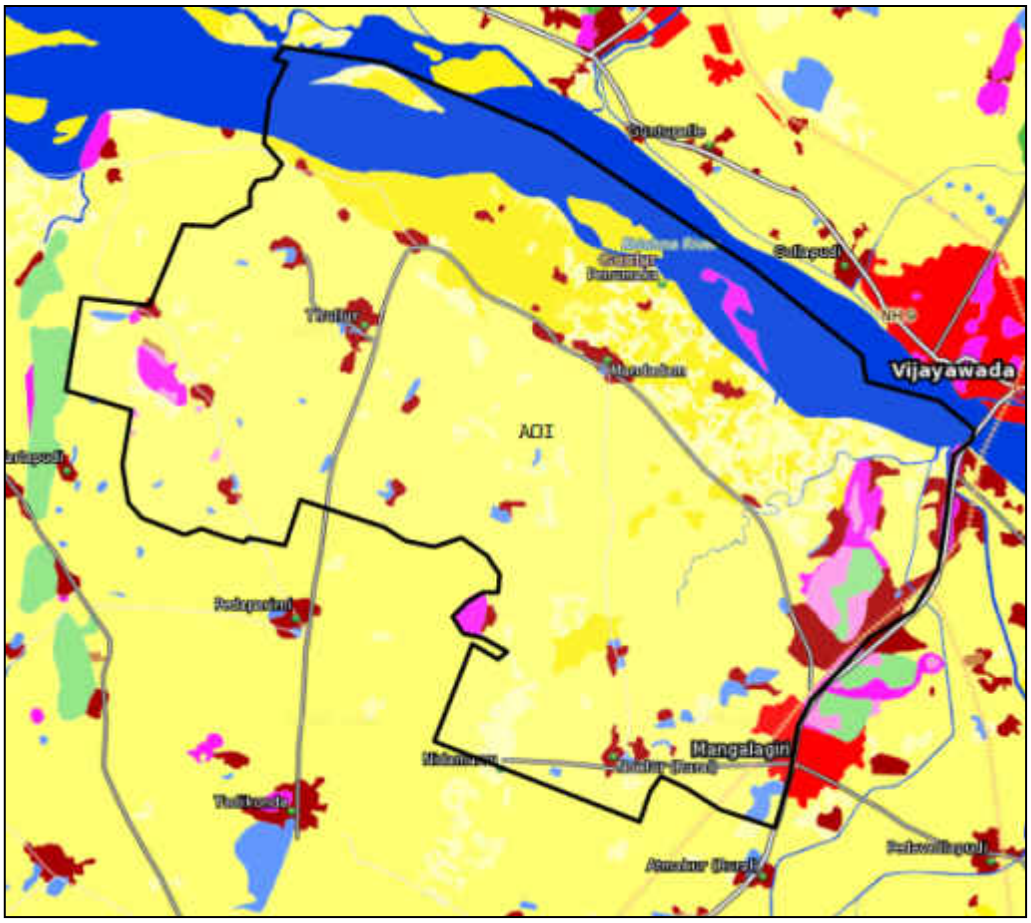


Figure 5-25 Study Area as captured in 2014 Summer Season (Source-LANDSAT 8)



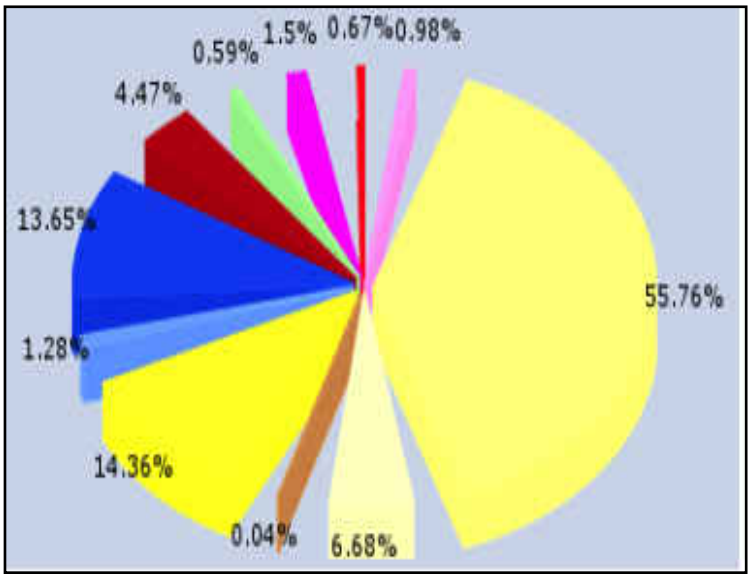
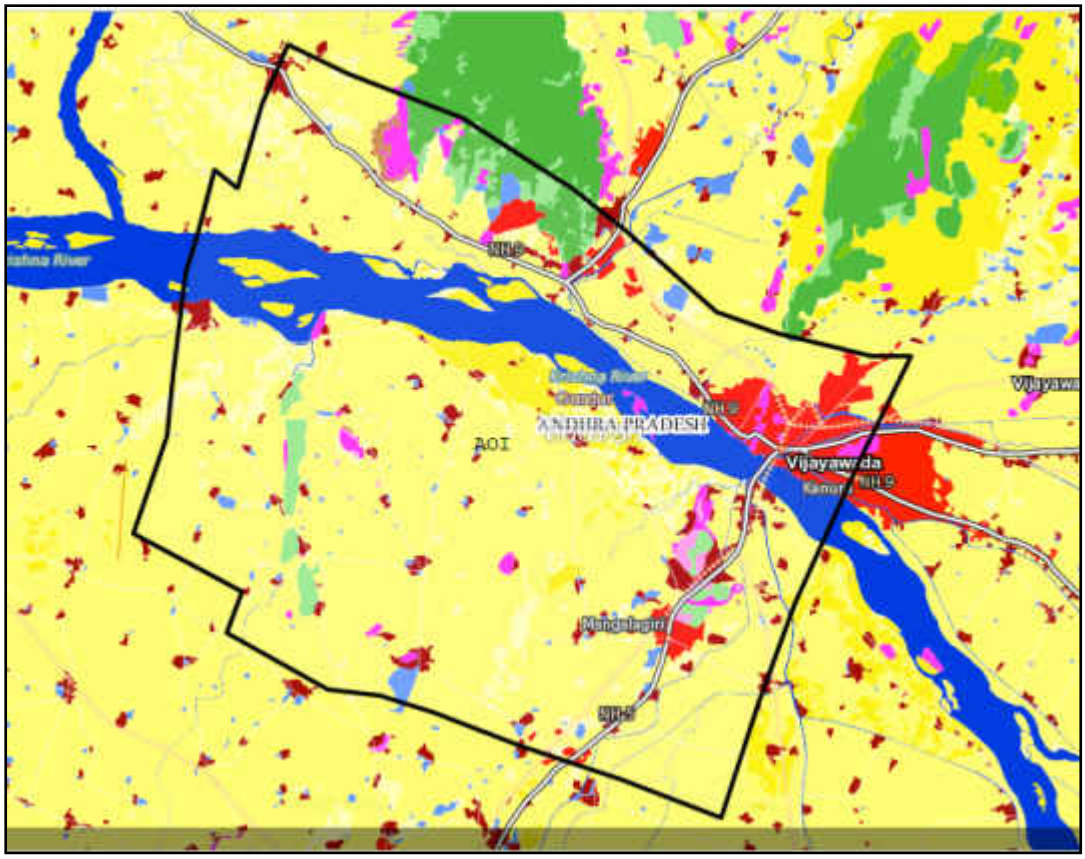


Figure 5-26 Land Use Map of Project Area *



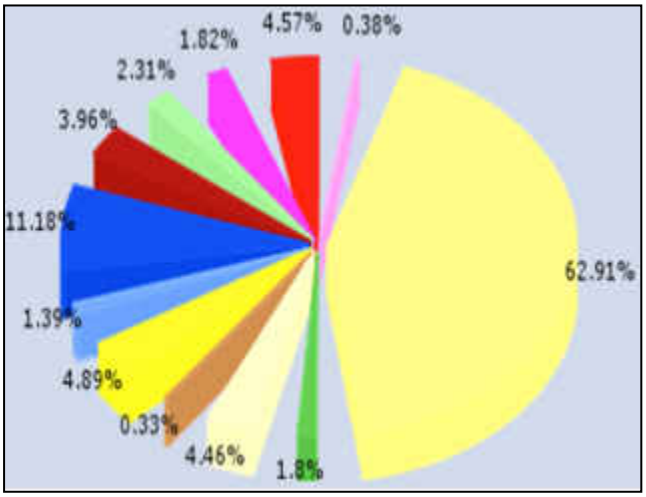


Figure 5-27 Land cover Map of Study Area

Table 5-24 Land Use in Study area and Project Area

Land use and Land Cover Class	Land use of study area (sq. Km.)	%	Land Use of Project Area (sq. Km.)	%
Barren Rocky Area	3.27	0.4	2.13	0.98
Cropland	543.45	62.9	121.17	55.78

Deciduous	15.53	1.8	0	0
Fallow Land	38.53	4.5	14.51	6.68
Mining	2.83	0.3	0.09	0.04
Plantation	42.26	4.9	31.19	14.36
Reservoir/ Lakes/ Ponds	11.97	1.4	2.78	1.28
Rivers/ Streams/ Canals	96.57	11.2	29.65	13.65
Rural	34.23	4.0	9.71	4.47
Scrub Forest	19.99	2.3	1.28	0.59
Scrub Land	15.74	1.8	3.26	1.5
Urban	39.44	4.6	1.46	0.67
	863.81	100	217.23	100

5.12.4. Agricultural productivity of the Project Area

The Government of AP has taken steps to increase the production and Productivity of all the crops there by production at 16.98% - 20% with the implementation of best Agricultural practices like introduction of high yielding, pest & disease resistant crop varieties in larger areas, micronutrient corrections, mechanised farmer operations, adopting alternate methods of Direct sowing/Planting, low cost technologies, etc., and also by creating awareness through best extension systems like., Polampilusthondi Programme and Chandranna Rythu kshetralu. Providing farm equipment on subsidy to farmers, to reduce the cost of cultivation.

The village wise details of the Kharif and Rabi crops sown in the Amaravati Project area is given in Table 5-25.

The capital city area is famous for six crops namely paddy, cotton, pulses, chilli, maize and bengalgram. Table 5-26 shows the comparative statement of cropped area in lakh ha and production in lakh MTS for the Amaravati proposed site and Andhra Pradesh. The percentage sown area and the percentage crop productivity shows that the land and the crop production for any of the six crops in Amaravati development area is less than 1% of the total sown land for total productivity of Andhra Pradesh.

Table 5-25 Village wise Crop Sowing details in Amaravati project area during Kharif & Rabi 2014-15

S. No	Name of the Mandal	Name of The Village	Total Area Sown in ha	Crop wise Area Sown in ha(Kharif)								Crop wise Area Sown in ha(Rabi)						
				Paddy	Cotton	Pulses	Chillies	Sugar Cane	Harticulture Crops	Fodder	Maize	Bengalgram	Greengram	Blackgram	Paddy	Jowar	Harticulture Crops
1	Thulluru	Lingayapalem	345.2	0	2	0	0	2.4	168.8	8	160	0	0	0	0	0	4
		Kondamarajupalem	475.6	80	100	62	0	2	51.6	4	148	20	0	0	8	0	0
		Uddandarayunipalem	240	0	2	0	0	4	152	2	0	0	0	0	0	0	0
		Velagapudi	1119.2	44	76	420	0	4	29.2	4	440	100	0	2	0	0	0
		Nelapadu	499.2	60	128	40	40	3.2	4	4	216	4	0	0	0	0	0
		Sakhamuru	649.2	0	280	44	32	24	7.2	2	260	0	0	0	0	0	0
		Ayinavolu	410	0	240	0	30	0	18	2	80	40	0	0	0	0	0
		Malkapuram	235.6	0	80	6	0	4	5.6	4	112	16	0	0	0	0	8
		Mandadam	1893.2	8	440	5.2	0	2	568	14	180	640	0	0	0	32	4
		Pichikalapalem	404.8	0	228	8	82.8	0	4	2	80	0	0	0	0	0	0
		Venkatapalem	1096	2	140	0	0	8	351.2	12	540	42.8	0	0	0	0	0
		Ananthavaram	737.6	0	396	0	18	0	0	4	300	0	0	0	0	0	0
		Nekkallu	442	0	340	0	18	0	0	4	80	0	0	0	0	0	0

S. No	Name of the Mandal	Name of The Village	Total Area Sown in ha	Crop wise Area Sown in ha(Kharif)							Crop wise Area Sown in ha(Rabi)							
				Paddy	Cotton	Pulses	Chillies	Sugar Cane	Harticulture Crops	Fodder	Maize	Bengalgram	Greengram	Blackgram	Paddy	Jowar	Harticulture Crops	
		Thulluru	1436.8	0	964	0	124	40	16.8	4	200	88	0	0	0	0	0	
		Dondapadu	196	26	60	0	2	0	0	4	80	0	0	0	24	0	0	
		Abbarajupalem	255.6	0	102	0	0	0	54.4	4	95.2	0	0	0	0	0	0	
		Rayapudi	1070	100	200	0	0	6	458	6	248	20	0	0	32	0	0	
		Borupalem	176	0	44	0	0	0	30	2	20	80	0	0	0	0	0	
2	Mangalagiri	Krishnayapalem	354	8	40	0	0	0	164	0	36	48	5	5	0	0	8	
		Kuragallu	698	40	200	0	74	0	96	0	60	100	5	100	0	0	23	
		Kuragallu(Nerukonda)	994	12	640	0	2	0	54	0	20	160	4	92	0	0	10	
		Nowlur	442	210	12	0	0	0	62	0	40	0	60	0	0	0	58	
		Nowluru (Makkivaripeta)	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		Nowluru (Yerrabalem)	664	308	0	0	0	0	52	0	150	0	20	82	0	0	40	
		Nowluru (Bethapudi)	216	80	12	0	0	0	80	0	20	0	5	0	0	0	19	
		Nowluru (Bapujinagar)	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		Nidamarru	1380	26	500	0	88	0	260	0	80	50	28	148	0	0	200	

S. No	Name of the Mandal	Name of The Village	Total Area Sown in ha	Crop wise Area Sown in ha(Kharif)							Crop wise Area Sown in ha(Rabi)						
				Paddy	Cotton	Pulses	Chillies	Sugar Cane	Harticulture Crops	Fodder	Maize	Bengalgram	Greengram	Blackgram	Paddy	Jowar	Harticulture Crops
3	Tadepalli	Undavalli	512.8	208	0	0	2	2.8	296	0	105.6	0	0	0	0	0	106
		Penumaka	451.6	69.6	0	0	3.2	2.4	352.4	0	113.6	0	0	0	0	0	106.8
		Total	**17394**	**1281**	**5226**	**585**	**516**	**104**	**3335**	**86**	**3864**	**1408**	**127**	**429**	**64**	**32**	**586**

Source: Joint Director of Agriculture (FAC), Guntur

Table 5-26 Statement showing the cropped area in APCRDA Region and Production in comparison with Andhra Pradesh

S. No	Crop	Cropped Area (in lakh ha)		Production(in lakh MTS)		% AP CRDA crop production over AP
		AP	CRDA	AP	CRDA	
1	Paddy	17.160	0.013	57.177	0.042	0.074
2	Cotton	8.240	0.052	4.952	0.031	0.633
3	Pulses	5.240	0.016	3.616	0.011	0.301
4	Chillies	1.500	0.005	6.270	0.021	0.336
5	Maize	4.000	0.040	30.936	0.308	0.994
6	Bengal gram	4.750	0.014	5.938	0.018	0.302

Source: Joint Director of Agriculture (FAC), Guntur

5.13. Socio-Economic Environment

Socio-Economic study of the area is a part of Environmental impact assessment study for the proposed new city project area. Socio-Economics, a component of environment includes description of demography, available basic amenities like housing, health care services, transportation, education and cultural activities. Information on the above mentioned parameters has been collected to define the socio-economic profile of the study area (10-km radius)

The socio-economic baseline profile of the study area is a representation of the primary survey done in the sample villages in and around the proposed new city project area. Data from secondary sources like the Primary Census Abstract and Village Directory of 2011, District statistical abstract, has also been utilized to profile the socio-economic condition of the community.

Study consisted of data collation on the baseline social and economic indices of the study area. Relevant data were presented under various subheadings, including: social environment (socio- cultural/, Demography, education and literacy,) economic survey includes the (worker details, employment/unemployment, etc)

5.13.1. Objectives of the study

- To carry out socio-economic, cultural and institutional analysis to identify the project stakeholders and social issues associated with the project
- Assessing potential social and economic impacts both during the construction and in the operation phase;

- Reviewing policies, regulations and other provisions that related to land and other social issues;
- Screen the social development issues in the project area and its vicinity and design the social services that may be provided by the project in order to improve the quality of life and achieve the projects economic and social goals;
- Update the profile of the population and available infrastructure facilities in the study area

5.13.2. Approach and methodology

Approach methodology adopted mainly consists of quantitative and qualitative tools and techniques. The available secondary literature and project related documents were reviewed and consultations were held with the project officials to identify the project area. Preliminary field visits were conducted. The study area was reviewed and the extensive consultations were conducted with people in the study area so as to finalize the methodology and the work plan. Census verification and socio-economic survey was carried out using pre-tested structured questionnaire. Focus Group discussions were also conducted at the village level.

Summary of the population male, female SC and ST is given below and the village-wise population details given in the below **Table 5-27**

The work plan includes the following tasks and activities

- The information relating to social parameters such as Demographic details, basic amenities health status etc was collected through secondary and primary sources during the study period
- All these information was used for identifying, predicting and evaluating the likely impacts of the proposed project activity. The Proper precautionary measures would be suggested for avoiding adverse socio-economic impacts

5.13.3. Field study

The sample size selected for the socio-economic survey was 40-45% from the study area. Out of a total of 56 villages 27 villages were selected as sample size on the basis of random sampling method. The list of sampling villages (within 10 km radius) is given below:

1. Lingayapalem
2. Uddandarayunipalem
3. Velagapudi
4. Nelapadu
5. Sakhamur
6. Ainavolu
7. Malkapuram
8. Mandadam
9. Venkatapalem
10. Ananthavaram
11. Nekkallu
12. Thullur

13. Dondapadu
14. Abbarajupalem
15. Rayapudi
16. Borupalem
17. Nulakapet
18. Dolas Nagar
19. Krishnayapalem
20. Kuragallu
21. Navuluru (OG)
22. Nidamaru
23. Kuragallu
24. Bethapudi
25. Yerrabalem
26. Tallapalem
27. Nerukonda

5.13.4. Socio-Economic profile of the project area

5.13.4.1. Demography

As per the 2011 census the total population of the project area is 97906. Out of the total population of the project area male's population is 48677 and female population is 49229.

Total population of the study area is 262816. Out of the total population the male population is 131383, and female population is 131433 with the sex ratio of the 1000 is higher than the state level which is 940 females per 1000 male. Village-wise Demographic pattern of the project area and study area given in the Annexure-B12. The mandalwise demographic details are given in Table 5-28 and the details of land holders in the capital city area is given in Table 5-29.

Table 5-27 Demographic details of the project area and study area

	Demographic features	Project area	Study area (10kms)
1	Number of Houses	27271	72123
2	Total Population	97906	262816
3	Total Male population	48677	131383
4	Total Female population	49229	131433
5	Sex ratio **(Per 1000 Male)**	1011	1000
6	Total Population (0-6yrs)	9786	25879
7	Male population (0-6yrs)	4975	13121
8	Female population (0-6yrs)	4811	12758
9	Sex ratio (Per 1000 Male) (0-6yrs)	967	972.3344
10	SC population	29051(**29.67%**)	77780(**29.59%**)
11	ST Population	4275(**4.36%**)	9187((**3.49%**)

Source: Census C.D. 2011 of Andhra Pradesh

Table 5-28 Mandal Wise Demographic Data in City Area

Sl. No.	Name of the Mandal	Name of the Village	No.of house holds	Population			Caste wise break up				Occupation wise Main workers				
				Male	Female	Total	SCs	STs	Others	Total	Cultivators	Agrl.labourers	Household workers	Other workers	Total
1	Tullur	Abbarajupalem	133	246	244	490	279	1	210	490	57	241	0	20	318
2	Thulluru	Anantavaram	961	1725	1666	3391	1301	498	1592	3391	372	1374	10	285	2041
3	Thulluru	Borupalem	321	576	614	1190	571	39	580	3881	114	509	6	33	662
4	Thulluru	Dondapadu	610	1084	1105	2189	790	12	1387	2189	366	679	5	150	1200
5	Thulluru	Ainavolu	497	900	938	1838	777	0	1061	2189	149	821	10	72	1052
6	Thulluru	Kondamarajupalem(DP)	0	0	0	0	0	0	0	0	0	0	0	0	0
7	Thulluru	Lingayapalem and Modalingayapalem	442	768	786	1554	643	10	901	1554	199	626	4	67	896
8	Thulluru	Malkapuram	412	661	699	1360	679	117	564	1554	63	519	0	119	701
9	Thulluru	Mandadam and Tallayapalem	1988	3272	3316	6588	3134	442	3012	6588	512	2479	38	589	3618

Sl. No.	Name of the Mandal	Name of the Village	No.of house holds	Population			Caste wise break up				Occupation wise Main workers				
				Male	Female	Total	SCs	STs	Others	Total	Cultivators	Agrl.labourers	Household workers	Other workers	Total
10	Thulluru	Nekkallu	571	936	972	1908	309	7	1592	1908	103	952	0	95	1150
11	Thulluru	Nelapadu	300	494	534	1028	345	8	675	8496	159	386	0	95	640
12	Thulluru	Rayapudi	1268	2419	2398	4817	1001	75	3741	#REF!	227	1741	12	397	2377
13	Thulluru	Sakhamuru	349	583	635	1218	629	27	562	1218	150	626	2	23	801
14	Thulluru	Thullur	2280	3865	3929	7794	2361	674	4759	7794	555	2587	66	929	4137
15	Thulluru	Uddandarayuni palem	408	757	746	1503	824	6	673	9012	169	574	0	89	832
16	Thulluru	Velagapudi	783	1346	1342	2688	1131	264	1293	2688	151	1086	15	162	1414
17	Thulluru	Venkatapalem	1117	1843	1889	3732	1514	244	1974	2688	161	1645	23	315	2144
	Thulluru Mandal Total		**12440**	**21475**	**21813**	**43288**	**16288**	**2424**	**24576**	**43288**	**3507**	**16845**	**191**	**3440**	**23983**
18	Mangalagiri	Krishnaihpalem	471	724	836	1560	682	2	876	1560	284	792	0	50	1126
19	Mangalagiri	Nowluru	2921	5476	5471	10947	3919	212	6816	10947	1200	1350	1300	2959	6809
20	Mangalagiri	Bethapudi (H/o.Nowluru)	721	1368	1330	2698	814	5	1879	2698	530	1893	0	70	2493

Sl. No.	Name of the Mandal	Name of the Village	No.of house holds	Population			Caste wise break up				Occupation wise Main workers				
				Male	Female	Total	SCs	STs	Others	Total	Cultivators	Agrl.labourers	Household workers	Other workers	Total
21	Mangalagiri	Yerrabalem (H/o.Nowluru)	2996	5579	5628	11207	357	943	9907	11207	1394	3004	502	1224	6124
22	Mangalagiri	Kuragallu	776	1350	1391	2741	763	109	1869	2741	797	1000	0	200	1997
23	Mangalagiri	Neerukonda (H/o.Kuragallu)	456	780	823	1603	400	36	1167	1603	790	769	0	4	1563
24	Mangalgiri	Nidamarru	1698	3164	3032	6196	2319	148	3729	6196	1600	3002	0	0	4602
Mangalagiri Mandal Total			**10039**	**18441**	**18511**	**36952**	**9254**	**1455**	**26243**	**36952**	**6595**	**11810**	**1802**	**4507**	**24714**
25	Tadepalli	Undavalli and Undavalli Center	2638	4862	4881	9743	1768	165	7810	9743	224	762	95	2562	3643
26	Tadepalli	Penumaka	2154	3997	3921	7918	2283	602	5033	7918	330	2217	22	1024	3593
27	Tadepalli	Dolas Nagar	280	1300	1200	2500	2450	5	45	2500	0	0	1200	50	1250

Sl. No.	Name of the Mandal	Name of the Village	No.of house holds	Population			Caste wise break up				Occupation wise Main workers				
				Male	Female	Total	SCs	STs	Others	Total	Cultivators	Agrl.labourers	Household workers	Other workers	Total
28	Tadepalli	Nulakapeta	750	1080	920	2000	100	15	1885	2000	0	0	700	20	720
	Tadepalli Mandal		5822	11239	10922	22161	6601	787	14773	22161	554	2979	2017	3656	9206
	Capital City Area Total		28301	51155	51246	102401	32143	4666	65592	102401	10656	31634	4010	11603	57903

Table 5-29 Land holding details (in acres) in Amaravati Area

Sl. No.	Name of the Mandal	Name of the Village	0.00 to 0.50	0.51 to 1.00	1.01 to 2.00	2.01 to 3.00	3.01 to 4.00	4.01 to 5.00	5.01 & above	Total	SC Farmers with their land holding	ST Farmers with their land holding	Other Farmers with their landholdings
1	Thulluru	Abbarajupalem	118	214	190	22	0	5	8	557	37	0	520
2	Thulluru	Ananthavaram	75	219	328	163	82	48	90	1005	110		895

Sl. No.	Name of the Mandal	Name of the Village	0.00 to 0.50	0.51 to 1.00	1.01 to 2.00	2.01 to 3.00	3.01 to 4.00	4.01 to 5.00	5.01 & above	Total	SC Farmers with their land holding	ST Farmers with their land holding	Other Farmers with their landholdings
3	Thulluru	Borupalem	15	12	15	20	10	5	3	80	27	2	51
4	Thulluru	Dondapadu	80	60	85	12	5	3	10	255	33	0	222
5	Thulluru	Ainavolu	59	175	172	49	32	8	12	507	103		404
6	Thulluru	Kondamarajupalem (DP)	43	112	175	76	43	20	25	494	0		494
7	Thulluru	Lingayapalem and Modalingayapalem	58	113	127	66	35	30	0	429	33		396
8	Thulluru	Malkapuram	27	74	76	49	15	9	12	262	7	5	250
9	Thulluru	Mandadam and Tallayapalem	421	365	185	192	98	58	129	1448	352	6	1090
10	Thulluru	Nekkallu	82	156	236	118	50	22	53	717	62		655
11	Thulluru	Nelapadu	38	192	204	102	72	81	50	739	20		719
12	Thulluru	Rayapudi	256	302	364	177	98	43	95	1335	110	4	1221
13	Thulluru	Sakhamuru	52	180	318	275	97	8a3	76	1081	120	2	959
14	Thulluru	Thullur	168	336	520	295	125	64	103	1611	78		1533
15	Thulluru	Uddandarayuni palem	62	109	137	32	18	8	10	376	211		165

Sl. No.	Name of the Mandal	Name of the Village	0.00 to 0.50	0.51 to 1.00	1.01 to 2.00	2.01 to 3.00	3.01 to 4.00	4.01 to 5.00	5.01 & above	Total	SC Farmers with their land holding	ST Farmers with their land holding	Other Farmers with their landholdings
16	Thulluru	Velagapudi	129	272	287	141	60	39	54	982	98	11	873
17	Thulluru	Venkatapalem	205	296	233	118	47	31	42	972	131	3	838
	Thulluru Mandal Total		**1888**	**3187**	**3652**	**1907**	**887**	**557**	**772**	**12850**	**1532**	**33**	**11285**
18	Mangalagiri	Krishnaihpalem	116	154	180	102	31	28	64	675	45	0	701
19	Mangalagiri	Nowluru	350	250	250	125	150	50	35	1210	33	17	1160
20	Mangalagiri	Bethapudi (H/o.Nowluru)	224	150	85	48	12	9	2	530	15	0	652
21	Mangalagiri	Yerrabalem (H/o.Nowluru)	402	295	203	125	250	69	50	1394	73	7	1314
22	Mangalagiri	Kuragallu	180	231	232	99	37	22	24	825	70	20	705
23	Mangalagiri	Neerukonda (H/o.Kuragallu)	150	156	163	111	53	39	90	762	30	30	732
24	Mangalagiri	Nidamarru	130	231	232	99	37	22	24	775	202	28	545
	Mangalagiri Mandal Total		**1552**	**1467**	**1345**	**709**	**570**	**239**	**289**	**6171**	**468**	**102**	**5809**
25	Tadepalli	Undavalli and Undavalli Center	305	218	142	37	12	7	8	729	75	2	950

Sl. No.	Name of the Mandal	Name of the Village	0.00 to 0.50	0.51 to 1.00	1.01 to 2.00	2.01 to 3.00	3.01 to 4.00	4.01 to 5.00	5.01 & above	Total	SC Farmers with their land holding	ST Farmers with their land holding	Other Farmers with their landholdings
26	Tadepalli	Penumaka	244	372	324	124	42	26	35	1167	50	10	908
27	Tadepalli	Dolas Nagar	0	0	0	0	0	0	0	0	0	0	0
28	Tadepalli	Nulakapeta	6	0	0	0	0	0	0	0	5	0	1
Tadepalli Mandal			**555**	**590**	**466**	**161**	**54**	**33**	**43**	**1896**	**130**	**12**	**1859**
Capital City Area Total			**3995**	**5244**	**5463**	**2777**	**1511**	**829**	**1104**	**20917**	**2130**	**147**	**18953**

5.13.4.2. Literacy

As per the table the literacy rate for the project area is 62% which is lower than the state literacy level which is 67%. However, there is a significant gap between male (33%) and female (28%) literacy rate. In the study area male literacy rate is 33% and female literacy rate is 27%.

The details of the literacy rate given in the **Table 5-30** below

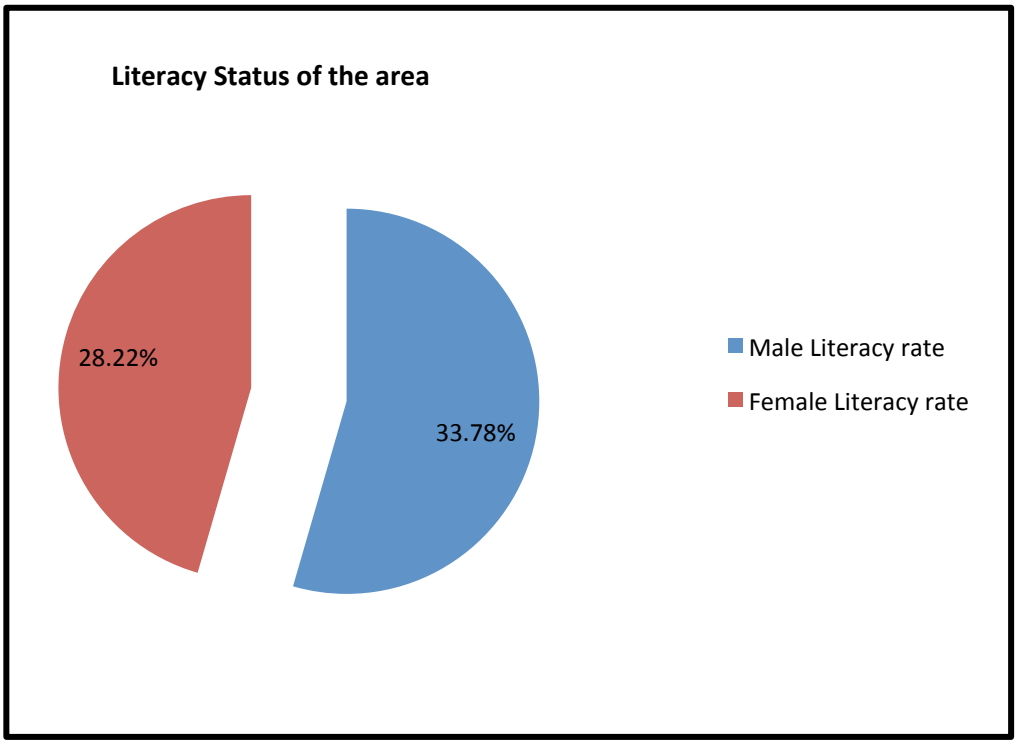


Figure 5-28 Literacy Rate of the study area

Table 5-30 Literacy details of the area

	Literacy level	Project area	Study area (10kms)
1	Total No. of Literates	60706	159399
2	No. of Male Literates	33075	87550
3	No. of Female Literates	27631	71849
4	Total Literacy Rate	62%	60.65%
5	Male Literacy Rate (%)	33.78%	33.31%
6	Female Literacy Rate (%)	28.22%	27.33%

Source: Census C.D. 2011 of Andhra Pradesh

5.13.4.3. Economic Activity

The major economic source of the area is agriculture and allied activities, and the major crops grown are paddy, cotton, chilly, corn, maize, vegetables, etc.

Jasmine flower is the major source of income in the area, the income from the jasmine flower will be mainly impacted from the proposed project activity (as per

discussion with locals). The income from the jasmine flower is approximately 4-5 lakhs per acre /per year

5.13.4.4. Work participation

Work participation in the project area is only 50.47%. From that main workers are 46.45%, from the main workers cultivators are (5.96%) & other allied activity workers are 12.86% and rest is marginal workers which are 4.01%, the non worker population covered the major portion of the population which is 49.52%.

In the study area total main worker population is 45%, from that cultivators are 7%, main allied activity workers are 26%, and household and OT workers are 0.63% & 11%, the marginal population of the area is 5% and the major portion covers the non-worker population which is 49%.the details of the work participation given in the **Figure-5.29** and **Table – 5-31**

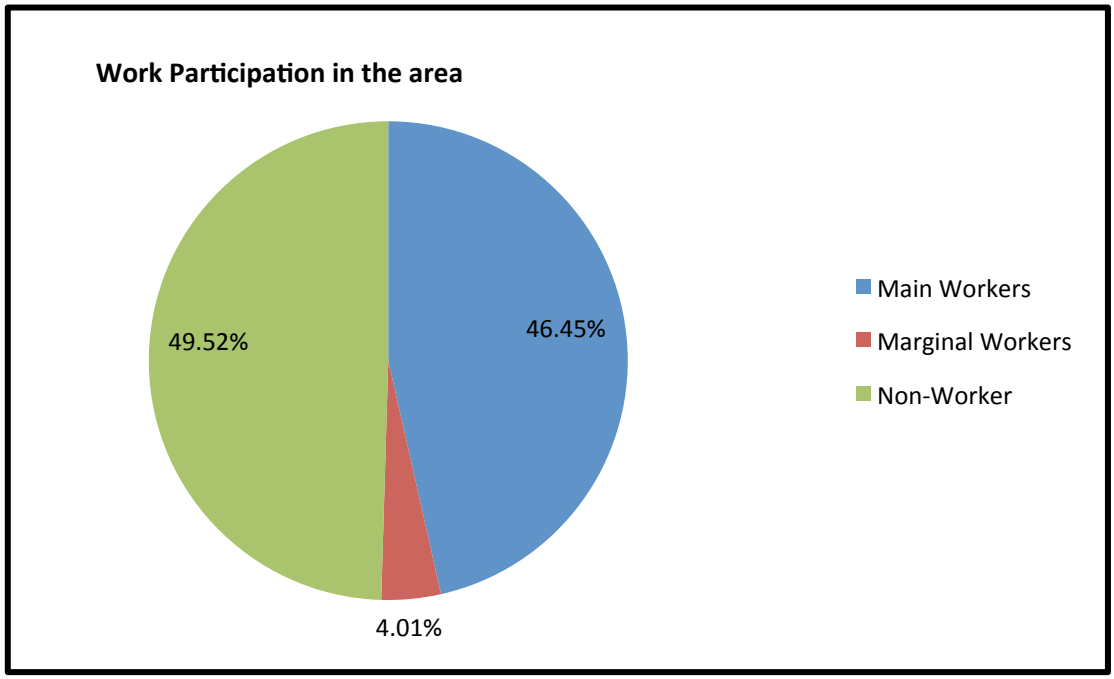


Figure-5-29 Work Participation in the Study Area

Table 5-31 Work participation in the study area

S. No	Work participation	Project area	Study area (10kms)
1	Total Worker	49415(**50.47%**)	133864(**50.93**%)
2	Main Workers	45483(**46.45**%)	120262(**45.75**%)
3	Cultivators	5840(**5.96**%)	18776(**7.14**%)
4	Main AL	26276(**26.83**%)	70585(**26.85**%)

S. No	Work participation	Project area	Study area (10kms)
5	HH Industry	772(**0.78**%)	1665(**0.63**%)
6	OT Workers	12595(**12.86**%)	29236(**11.12**%)
7	Marginal Workers	3932(**4.01**%)	13602(**5.17**%)
8	Non-workers	48491(**49.52**%)	128952(**49.06**%)
9	Male non-worker	18785(**19.18**%)	51514(**19.60**%)
10	Female non-worker	29706(**30.34**%)	77438(**29.46**%)

Source: Census C.D. 2011 of Andhra Pradesh

5.13.4.5. Observations based on primary survey

Following are the observations based on the primary survey

Infrastructure facilities in the study area

The availability of community facility as education, health, potable water, electricity, and transport facilities are important indicators of the well being and Quality of Life (QoL) of villagers. Based on the socio-economic survey Infrastructural facilities exist in the area are as follows:

Facilities

A definitive way to measure the quality of life in this region is to ascertain the presence, accessibility and utility of the social and physical infrastructure in the study area, Lack of access can emerge either due to the absence of social and/or physical infrastructure.

Electricity

As per the survey information 90 % the sample villages having the power supply facility. The average hours of electricity available in the villages has increased during last two years.

Drinking water

Availability and access to safe drinking water has been the most crucial factor involving serious health concerns in the area. All the sample villages have drinking water facility in the form of ponds, because the ground water is salty in most of the villages in the study area.

Sanitation facility

The sanitation status of the sample villages shows that almost all the households had no access to sanitary latrine or constructed toilets in their houses, so people faced the sanitation problem in the area.

Education

The survey of sample villages reveals that there is less number of exclusive schools in the area. However all villages have at least one primary school within each village of the study area, but higher education facility is not available in most of the villages, Most of the schools are found to be approachable through kaccha roads and within the 2-5kms away from their village.

Health Facilities

Government facilities are the only available sources for curative care in the area. The surveys of the sample villages reveal that these villages didn't have access to the primary health centers (PHCs) and the majority of the PHCs were available at a distance of more than 5 kms. Overall, it is reflected that access to health facilities is not easy in most of the Villages.

Other facilities

The facilities in the sample villages as reported during survey, is seen to be rather weak. The nearest bus stop is available within an average distance of 2-5 kilometers. However most of the roads in the area are only kaccha roads.

5.13.5. Stakeholder Consultation Process

The consultations were carried out as a part of the EIA undertaken for the project. The consultations were carried with the various concerned government departments and with the communities affected by the project due to acquisition of land.

5.13.5.1. Summary of Stakeholder Consultation Process

The details of the stakeholder consultations have been presented in detail as part of the report. Findings of stakeholder engagement process with the stakeholders consulted are being summarized below. The consultation was conducted along with other functional area experts of the EIA study. The consultation process goes further to include the villagers other than the affected ones to understand their expectations, apprehensions about the project. The consultation also focused to include the women and the youngsters in villages particularly keeping in view the proposed new city development. The sample survey questionnaire is attached as **Annexure B13.**

Consultation period: *30/06/2015 to 08/07/2015*

Venue: project site

Participant: TCE: Mrs. Mamta Bavaskar, Dr Jyoti Prabha & Mr. Babu Kiran Sivala

Stakeholders: Stakeholders identified in the project include:

- CRDA Representative
- Local Community
- Panchayats members
- Local villagers
- Landowners
- Landless
- Women
- Labors
- Key decision makers in the village, informal representatives

Survey in the Kuragallu village

Survey in the Thulluru Village

Group Discussion in the Nelapadu village

Group discussion in the Nidamaru village

Discussion with the Female members in the village Nowluru

Group discussion in the Bethapudi Village

Figure 5-30 Photographs of Social Survey

5.13.5.2. Socio - Economic Survey, findings,

People in the study area are aware of the project activity and they have mostly positive opinion towards the project activity.

The general socio-economic profile in the study area is as follows:

- The main language spoken in the area is Telugu.

- Majority of the villages face the problem of drinking water as the ground water is salty, and people depend on pond water for drinking purpose which is very unhygienic and causes various health problems. A Few people use mineral water for drinking purpose procured from outside, which is expensive.
- Availability of medical facility in the area is poor, and the facilities are available at 4-5 kms away from the villages.
- Education facility is available only up to primary school level in most villages.
- Approach roads to the villages are unpaved (kaccha). The transportation facility is poor. Minimum bus facility is available and the major mode of transportation is private auto- rickshaws and private motor vehicles.
- Electricity is available and is on a satisfactory level and there is no problem of power outage in the area.

The opinions & the expectations of the people from the upcoming project activity are listed below

- Majority of the people opined positively regarding the proposed project and satisfied with the compensation and land pooling process.
- Very few villagers, particularly involved in Jasmine Plantation stated that they are not satisfied with the compensation process.
- Villagers are expecting more information and awareness about project activities.
- Villagers have expectation of improved infrastructure, health facilities and employment from the upcoming project.
- Project Affected People (PAP) mentioned that they have received compensation, but to use it judiciously, they expect authority to provide guidance on entrepreneurial opportunities.

CHAPTER 6

ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

6.1. Introduction

Impact can be defined as “any alteration of environmental conditions or creation of a new set of environmental conditions, adverse or beneficial, caused or induced by the action or set of actions under consideration”.

This chapter describes various social and environmental impacts identified and assessed with respect to the Capital City Development during construction and operation phases. These impacts have been identified through available project documents – Concept plan and it is details in particular and discussions with the proponents and stakeholders and TCE’s previous project experience in handling assignments of a similar nature.

Analyzing is the *objective* task of identifying impacts/concerns, taking measurement of baseline conditions and predicting the changes to baseline conditions that are likely to occur as a result of the proposed actions.

Evaluation here is a subjective or normative task, which depends on the application of the human values. It involves determining the significance of the effects to the affected parties.

The Amaravati Capital City will involve development of a large urban settlement, large commercial zones and all associated infrastructure facilities such as transport, energy, and all other social infrastructure facilities such as health, education, communication, recreation. All such developments are expected to involve world-class facilities and large amount of investment from Indian and International investors.

The key baseline environmental and social characteristics of the region are as identified in the earlier chapter are:

- Mostly flat terrain with predominant agriculture use
- Another predominant use includes fruit and flower farming
- Occasionally flood prone near the Prakasam Barrage
- Livestock population and biodiversity available
- Presence of seasonal ponds/ waterbodies
- Social impact on population due to loss of agriculture activity

6.2. Environmental Aspects and Impacts Analysis Approach

The approach adopted in assessing environmental impacts and the mitigation measures for this development is focused primarily on ensuring that:

- The landuse and key infrastructure planned for the proposed development is in accordance with Environmental laws and environmental aspects recognised in key sectoral policies (such as Sustainable Habitat, Sustainable Urban transport etc.,)

- Sufficient but optimal space allocation for an activity group or resource (such as water supply, waste management, housing, industrial manufacturing etc.,) in accordance with sizes or quantum's estimated from need assessment
- Optimization of usage of other natural resources: Commitment to adopting approach/ methods such as efficiency of utilising natural resources such as energy, water, topography, hydrology.
- Waste generation and its handling including management

6.3. Impact Analysis for Project Phases

The New Capital City involves development of a large urban settlement, large industrial and commercial zones and all associated infrastructure facilities such as transport, energy, and all other social infrastructure facilities such as health, education, communication, recreation. The development of such large infrastructure is likely to have some environmental impact, an environmental impact matrix has been compiled based on the MoEF & CC Manual on Environmental Impact Assessment Area Development and Large Infrastructure Projects, and this is shown as Table 6-1.

6.3.1. Impact during pre-construction phase

The project is planned in 217.23 Sq kms. Acquiring land of this extent is a mammoth task considering the intricacies involved in implementing the acquisition through the prevailing Acts. Keeping the issues and concern raised out of implementation of Land Acquisition Act in other parts of the country, voluntary land pooling scheme is designed to enable smooth land acquisition and provide maximum benefits to the effected population. In short, the land owner in the proposed capital city area is a partner in the development process and is contributing and benefiting out of the Capital City development – both in the short term and in the long term.

Salient features of the voluntary land pooling scheme as implemented for Amaravati City development is discussed below:

6.3.1.1. The Land Pooling Scheme

In keeping with the will of the Government to build 'people's capital', land procurement mechanism has been designed to be Voluntary and based on consensual process of **land pooling**.

Land pooling mechanism is mainly adopted for development of the capital city area wherein the land parcels owned by individuals or group of owners are legally consolidated by transfer of ownership rights to the Authority, which later transfers the ownership of a part of the land back to the land owners for undertaking of development for such areas. These rules are applicable to the capital city area for which the acquisition schemes are approved. The broad objective of the scheme is to do justice to the families affected by the construction of a livable and sustainable capital city for the state of Andhra Pradesh by making the land owners and local residents as partners in development. The Authority shall guarantee the return of reconstituted land and payment of benefits to the land owners per every acre of original land surrendered under the land pooling scheme.

Table 6-1 Likely impact of the project during Pre-Construction and Construction Phase

			Phase I	Phase II																	
			Pre Construction	Infrastructure Development and Operation																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
ENVIRONMENT	Components		Land Acquirement	Site Preparation / Leveling including development of plots, parking lots, site zoning	Burning of wastes, refuse and cleared vegetation	Construction of Separation between zones within development area	Laying of Roads	Water Supply & Pipelines, Overhead tanks, etc.	Drainage Network	Laying of treated water disposal Pipe Lines	Power connection and laying of transmission lines	Laying of Telecom lines	Laying of Gas Distribution lines	Civil works such as earth moving and building of structures including temporary structures and common facilities	Heavy Equipment operations	Disposal of construction wastes	Influx of construction workers	Transportation of material and traffic movements	Greenbelt Development	Operation of Generator facilities	Storage of chemicals/ flammables
PHYSICAL	**Soil**	Erosion Prevention																	√		
		Soil Quality/ Contamination		√														√			√
	Resources	Fuels/ Electricity		√							√							√			
		Construction material stone, aggregates				√	√				√			√							
		Land especially undeveloped or agricultural land		√															√		
	Water	Interception or Alteration of River Beds																			
		Alteration of Hydraulic Regime				√								√							

		Alteration of surface run-off and interflow																			
		Alteration of aquifers																			
		Water quality							√							√		√			√
		Temperature																			
	Air	Air quality			√	√	√						√	√	√	√	√	√	√	√	√
		Noise		√		√	√							√	√	√	√	√	√	√	
		Climate											√						√		
BIOLOGICAL	**Terrestrial Flora**	Effect on grass & flowers		√			√		√							√		√	√		√
		Effect on trees & shrubs		√					√							√			√		√
		Effect on farmland		√															√		√
	Aquatic Biota	Habitat removal																			√
		Contamination of habitats																			√
		Reduction of aquatic biota																			√
	Terrestrial fauna	Fragmentation of terrestrial habitats		√												√					√
		Disturbance of habitats by noise or vibration		√																	√
		Reduction of Biodiversity		√																	√
SOCIAL	**Economy**	Creation of new economic activities	√				√	√			√	√	√								
		Commercial value of properties	√				√	√		√	√		√								
		Conflict due to negotiation and/ compensation payments	√				√	√		√			√					√			
		Generation of temporary and permanent jobs	√			√	√	√			√		√	√		√	√		√		
		Effect on crops		√					√												
		Reduction of farmland productivity		√																	

	Income for the state and private sector	√					√													
	Electricity tariffs									√		√								
	Savings for consumers & private consumers				√					√	√	√	√							
	Savings in foreign currency for the state											√								
Education	Training in new technologies																			√
	Training in new skills to workers											√								√
Public Order	Political Conflicts	√				√	√		√											
	Unrest, Demonstrations & Social conflicts	√				√	√	√	√	√		√			√	√	√			
Infrastructure and Services	Conflicts with projects of urban, commercial or Industrial development	√				√	√		√			√		√	√	√				
Security and Safety	Increase in Crime															√				
	Accidents caused by									√		√		√	√					
Health	Temporary								√				√	√	√				√	√
	Chronic																			√
	Acute							√												
Cultural	Land use	√	√		√	√	√		√				√							
	Recreation		√	√	√								√							
	Aesthetics and human interest		√	√	√	√			√	√		√	√		√		√	√		√
	Cultural status															√				

Salient features of the Voluntary Land Pooling Scheme

- The land pooling scheme is intended for land owners volunteering to surrender their land against a guaranteed return of a developed and reconstituted plot / Land and certain other benefits
- Ten percent of total area of the scheme for parks, playgrounds, gardens and open spaces;
- Thirty percent of total area of the scheme for roads and utility services;
- Five percent of total area of the scheme for social amenities such as school, dispensary and other community facilities;
- At least five percent of total area of the scheme for providing affordable housing for the poor
- A share of total area of the scheme specified by the Authority for reconstituted plots / land for re-allotment to land owners
- The Authority may maintain the common infrastructure facilities either on its own or authorize a Local body or an elected resident welfare association duly collecting the necessary charges for such maintenance.

Roles and Responsibility of APCRDA & CA with respect to Land pooling scheme:

The role and responsibility of APCRDA & CA towards **land owners/ others** under the land pooling scheme are as follows:

- To undertake the implementation of land pooling scheme and develop the land meant for providing reconstituted plots.
- To return land to the land owners near pooled land / within 5 km radius of pooled land subject to other planning requirements.
- To issue statutory land pooling ownership certificate [LPOC] with alienable rights within 9 months of agreement with all willing land owners.
- To handover physical possession of reconstituted plot within 12 months of the date of notification of final LPS.
- To complete the development of the scheme area within 3 years of issue of LPOC.
- To issue LPOC and pay annuity to the religious institutions or charitable trusts under the purview endowment department in cases where original lands belong to them.
- To provide registration for LPOC without payment of registration charges.
- To provide one time exemption from stamps and registration fee, Non-Agricultural Land Assessment and development fee.
- To exempt registration fee for registering the agreements with Competent Authority for Land Pooling.

- To provide one time agricultural loan waiver of up to one lakh fifty thousand rupees per family to farmers as per prescribed procedure of Government.
- To demarcate village sites / habitations duly following procedures of revenue department.
- To issue possession certificates in village sites in order to enable the occupants to regularize house sites.
- To provide housing to houseless as well as those losing houses in the course of development.
- To provide interest free loan of up to 25 lakhs to all the poor families for self employment.
- To provide free education and medical facilities to all those residing as on 8th December, 2014.
- To establish old age homes
- To establish NTR canteen
- To enhance the limit under NREGA up to 365 days a year per family.
- To establish skill development institution and provide training with stipend to enhance the skills of cultivating tenants, agricultural laborers and other needy persons.
- To engage tractors belonging to residents for construction activity.
- To issue ownership and transit permission through forest department for cutting and sale teak trees in private lands duly exempting the relevant fees.
- To allow standing crop to be harvested.
- Pension of two thousand five hundred rupees per month per family for a period of ten years to all landless families through a capital region social security fund.

The roles and responsibilities of APCRDA & CA towards the development of land under the land pooling scheme are as follows:

- To demarcate all the roads as per layout plan and sector plan within the assembled area and give approval of layout plans/detailed plans.
- To develop of sector roads/internal roads/ infrastructure/services (including water supply lines, power supply, rain water harvesting, sewage treatment facilities, water treatment facilities, etc. falling in the share of the land guaranteed to the land owners.
- To create infrastructure facilities, roads, parks, cremation facility for all religions, community needs etc. at the city level.
- Allot the prescribed built up space/ dwelling units for economically weaker sections.

- To develop identified land in time bound manner with Concept Plan roads,
- Provision of physical infrastructure, and traffic and transportation infrastructure inclusive of metro corridors.
- To complete external development in time bound manner.
- To complete development in time and maintain it with all the neighborhood level facilities i.e. open spaces, roads and services.

Compensation pattern of the land pooling scheme

The Authority shall guarantee the return of reconstituted land and payment of benefits to the land owners per every acre of original land surrendered under the land pooling scheme as follows:

Table 6-2 Details of the payment of benefits to land owners per every acre of land

Land	Category	
	Dry land	**Jareebu (Irrigated)**
Patta		
	1000sq.Yds	1000sq.Yds
	200sq.yds	300 sq.Yds
Assigned		
Residential	800 sq.Yds	800 sq.Yds
Commercial	100 sq.Yds	300 sq.Yds
Yearly payment for 10 years (Rs)	30000	50000
Yearly increase (Rs)	3000	5000
One time additional payment for gardens like lime/sapota/guava (Rs)	50000	

Source: APCRDA & CA, Vijayawada

Note: Owners who gave their land in revenue villages viz. Bethapudi, Navuluru, Yerrabalem, Penumaka and Undavalli, will get 450 sq.yds. of commercial reconstituted land and 1000 sq.yds of residential reconstituted land.

The current status of land pooling for Amaravati is shown as Annexure B14

Table 6-3 Village-Wise Details of the Compensation (Cost)

Name of the village	Type of land	Compensation (Cost)
Bethapudi,	450sq.yds of commercial land	Yearly payment of 50,000 per years with yearly increase of Rs.5000 per year
Navuluru,		
Yerrabalem,	1000 sq.yds of residential	

Name of the village	Type of land	Compensation (Cost)
Penumaka	land	
Undavalli		

Source: The Andhra Pradesh Capital City Land Pooling Scheme (Formulation and Implementation) Rules, 2015 – Amendment

6.3.1.2. Land Related Impacts

The land required for the project has been acquired from the 25 affected villages as listed in Chapter 3. The land for the project is acquired through land pooling system. Present land for the project site area comprises of government owned land and private land. The land area is largely agricultural fields with some fruits and flower farming fields. The land pooling is done excluding the village hamlets as they will remain un-disturbed.

6.3.1.3. Change in feature of Land

The establishment of the project will result in change in features of land, but at a project level, the change will be primarily to develop various facilities as part of the project. The facilities included are Residential, Commercial, institutional, some industrial, Public and Semi – Public Land use, Institutional Hub, UKC Utilities/ Facilities, Recreational /Sports, Open Space/ Green Buffer etc., Transport and Communication, and Truck/Tempo/ Taxi/ Parking Bay. The proposed land use for the project is shown in **Table 6-4.**

Table 6-4 Land Use classification for Amaravati City

S. No	Landuse	Area (Sq. Km)	%
1	Residential	60.77	27.98
2	Commercial	20.29	9.34
3	Public and Semi Public	11.49	5.29
4	Industrial	12.26	5.64
5	Open Spaces and Recreation	52.78	24.29
6	Traffic and Transportation	23.04	10.61
7	Water Bodies	25.78	11.87
8	Heritage	0.15	0.07
9	Seed Capital	10.67	4.91
	Total	**217.23**	**100**

Mitigation Measures

Potential impacts due to land related impacts are attributed to loss of land, change in land use and loss of access. The impacts of the project in change in land-use are significant and irreversible; however the Concept Plan has addressed the issues

and all necessary mitigative measures are planned. The proposed Green and Blue plan in the Amaravati City translates into an implementable land use plan. The plan can be summarized into the following planning strategies and typologies:

Green & Blue lattice:

- Green grid – The green and blue network primary follows the road network creating passive recreational fingers across the city. These fingers are anchored with large parks and open spaces close to the 2 reservoirs. Each finger terminates at the scenic river Krishna waterfront.
- Active, beautiful and clean waterways weave through the Amaravati Capital city. These waterways follow the existing irrigation canals and reservoirs to form an interwoven water network.
- The plan creates a variety of interfaces between the green and blue creating different water themed public spaces such as lake parks, waterfront corridor, linear parks, etc

Primary green spaces:

- 4936 Ha of Primary green spaces including large city parks, lakes, town parks, neighbourhood parks, water bodies and public plazas form the foundation of the city scale recreational network that provides recreation opportunities and improves a sense of community. These parks help in creating large public open spaces which can double up as event spaces for the larger community within the Capital city.
- Primary greens are planned along the existing canals and water bodies to serve as city's main ecological corridors. They play a dual role in flood management, and environmental conservation of the native species.

Secondary green links

- Secondary greens weave through the townships connecting the various town and neighbourhood parks. Planned as the secondary green fingers of the city, these greens act as passive recreational spaces, interactive jogging trails and non motorized transports corridors across the city.

Recreational Landscapes

- 780 Ha of recreational landscapes include theme parks, golf courses, sports and recreational spaces. These areas house active recreational facilities for the Capital city.
- In line with the township model several sports and recreation parcels have been allocated in the town centre, and in proximity to the neighbourhood centre.
- Large city level sports facilities such as cricket stadium, golf courses and theme parks have been strategically distributed across the city.

Water bodies

- 2578 Ha of existing water bodies including rivers, canals, irrigation channels and reservoirs have been carefully protected and integrated with the green spaces as discussed in the previous section

The impacts due to loss of land and loss of access are expected to be minor with the implementation of the land pooling scheme and the following mitigation measures.

- Providing land pooling benefits to the effected
- Payment of replacement cost for lost asset;
- Payment of compensation prior to taking possession of land or any physical displacement;
- Payment of transitional assistance to support economic loss;
- Dissemination of information about the acquisition and compensation calculation process;
- Establishing a grievance redressal mechanism;
- Option for work during project construction period;
- Prior information to harvest the crops or compensation for loss of crop;
- Continuation of community engagement process;
- Provision of access to local villagers to continue with their pre project movement pattern.

6.3.1.4. Impact on Livelihoods

Long term livelihoods have been, or will be, impacted for those families who have surrendered their lands for the project. Most of the people (landowner as well as landless) of the area are dependent on agriculture for their livelihood, and there is permanent loss of current livelihood for almost the entire population. However, due to the provision of giving land in the development to the people losing land- will act as source of livelihood to the landowners on long term basis.

Mitigation Measures

This impact is expected to be insignificant with the implementation of the following mitigation measures

- Payment of compensation for lost asset at replacement cost;
- Preference to the land losers in work during project construction period.
- Provide necessary skill improvement training to affected people to make them employable in project operation phase.

6.3.1.5. Impact on utilities

Impacts have been assessed assuming general utilities such as power line, telephone line, water supply etc. may be affected during the construction. Therefore, the likelihood of significance of impact would be negligible.

Mitigation Measures

This impact is expected to be minor and with the implementation of the following mitigation measures the potential disruption to existing utilities will be further minimised.

- Coordination with respective concerned department for utility relocation;
- Establishing replaced utilities prior to disconnecting or discontinuing the existing one;
- Providing intimation to the people in advance about any disruption to services.

6.3.2. Impact during Construction Phase

The construction phase of the Project involves a number of sequential activities, collectively named as "spread". The area affected by the construction, laying of road, clearing of site, construction of residential, commercial and industrial units, construction of social infrastructure, construction of treatment plant, laying of sewer line, and labour camps areas etc. Based on the assessment of above activities and in consultation with the different stakeholders, the following impacts are being envisaged for the construction phase of the project.

6.3.2.1. Impacts from the Influx of Migrants

The construction phase for the Project can be divided in two phases. The first phase will include civil construction work, whereas the second phase which accounts for operationalization of project. The entire construction phase is expected to continue in a phased manner. This will require labour of unskilled, semi-skilled, skilled and highly skilled nature. However, it is envisaged that outsourced personnel will comprise mostly of skilled labourers and workers.

The peak distributed workforce demand is approximately 10,000 with average workforce requirement of about 5000 during the construction phase of the project. About 20-40 temporary labour camps inhabiting about 250-500 workforce in each camp will be developed for the project within the project site.

The Construction Contractor will be responsible for the construction of temporary labour camps and provide the workers with water supply, electricity, sanitary facilities, medical aid and other basic amenities. It is assumed that the camps would be constructed close to the construction site. **These guidelines will form part of the tender specification and works contract of the developer**.

Following impacts are envisaged due to influx of migrant workers.

Social Impacts of Migrant Workers

Some of the impacts that are likely to arise due to influx of workers include:

- Increased community conflicts due to interface between migrants and locals;
- Frequent movement of vehicles and construction equipment may increase safety and accident issues;

- Pressure on limited local resources;

Community Health and Safety

Possible impacts to community health may arise during construction from the following sources:

- Generation of dust, noise and odour from the construction site which may have health related impacts on the local community;
- Fire Safety from the ongoing construction activities which may include handling and storage of flammable chemicals and materials;
- Improper disposal of sewage into the surroundings;
- Improper disposal of sewage and waste may lead to contamination of ground water;
- Changes in environmental quality due to construction activities;
- Water usage, with a consequent effect on availability of clean water for the community;
- Spread of HIV/ AIDS and sexually transmitted diseases;
- Accident risk to human and animals due to digging up of trenches for laying of pipeline at areas close to settlement areas;
- Increased prevalence of disease arising from the influx of construction workers; and Traffic safety.

Mitigation Measures

Potential impacts during construction period include impact due to the influx of migrants and associated health related risk to the community. These impacts are expected to be moderate and with the implementation of the following mitigation measures the potential impact of loss of livelihood will be further minimised.

- Engage as many locally available unskilled, semiskilled and skilled human resource as practically possible to avoid large scale in migration of labour force;
- Provision of infrastructure and amenities for migrant labour in construction camp to avoid dependence on limited local resources;
- Barriers will be provided to prevent ingress of persons into the construction site and also to protect public exposure to hazards associated with construction activities;
- Additional safety precaution while working in market and settlement areas and especially around the trenches;
- Screening, surveillance and treatment of workers, through the provision of medical facilities and, where required, immunization programmes;
- Undertaking health awareness and education initiatives among workers, especially about sexually transmitted disease ;

- Prevention of larval and adult propagation through sanitary improvements and elimination of breeding habitats close to human settlements in the close vicinity of construction site;
- Implementation of a vector control programme;
- Avoiding collection of stagnant water;
- Educating project personnel and area residents on risks, prevention, and available treatment for vector-borne diseases;
- Promoting use of repellents, clothing, netting, and other barriers to prevent insect bites;
- Following safety guidelines for the storage, transport, and distribution of pesticides to minimize the potential for misuse, spills, and accidental human exposure; and Road safety measures.

6.3.2.2. Impacts on the Local Economy

Creation of Employment and Income Generating Opportunities

The project is likely to create a range of avenues for direct and indirect employment opportunities.

The requirement of skilled, semiskilled and unskilled personnel in the construction phase can spur local labour contracting activities as well as avenues of unskilled labour. It is estimated that the project would generate approximately 10,000 peak distributed labour demand during the construction phase;

A significant number of workers (about 250-500 at each campsite, and around 20-40 labour camps) for the project will be hired locally this will stimulate local labour contracting activities as well as generate opportunities for unskilled labour available in the area;

Employment options for individuals possessing vocational or technical training skills like electricians, welders, fitters etc, which may be sourced locally;

Contracting opportunities for locals possessing tractors, trucks, barges/ trawlers or other vehicles which would be needed during construction phase for material and personnel transportation;

A multiplier effect will be felt on the creation of indirect employment for the local community by catering to the day to day need of the labour community by way of possible rental income for the locals by letting out accommodation to persons engaged in construction activity, which will increase income generating opportunities. Also, it is envisaged that inflow of migrant workers and labourers will lead to increase in demand for locally produced agricultural (including dairy, fish, poultry etc) goods that will benefit the local economy.

Positive Impacts on Local Enterprises

The immediate vicinity of the project area has/ will see a spurt of entrepreneurial activity in the form of locals opening up food joist, tea stalls, and general provisions.

Assessment and experience from similar projects in the past indicated the following economic spin-offs:

- Sudden increase in the demand for goods and services, which may lead to a short-term rise in prices till the shortage of supplies can be met;
- Increase in employment and wages in these shops and establishments to serve the additional demand;
- Establishment of new shops and stores to make good of the sudden economic boom; and
- Development of the local market to supply goods and commodities

Boom and Bust Effect on the Local Economy

The construction phase is likely to last for a few years. In the interim period, some of the short-term economic impacts which would influence the local economy of the immediate project vicinity include:

- Increase in disposable incomes due to increased wages and employment opportunities;
- Influx of more liquidity into the system due to new sources of income like rent, increased expenditure on essential commodities and inflation due to supply side shortages;
- Backward linkages in the supply chain which include increased demand for various goods; and
- Increased short term demand for goods and services of all kinds.

These effects would create a temporary boom in the local economy, and after the construction phase, there may be short-term recession due to several avenues of demand becoming drying up.

6.3.2.3. Impact on Ecology

The potential impact on ecology during the construction phase will be primarily due to:

- Site clearance,
- Excavations,
- Site formation,
- Barging of spoil,
- Filling of habitats with spoil,
- Construction/strengthening of embankment along rivers etc.

Impacts

The construction activities will entail site clearance and development activities which will lead to loss of vegetation and tree felling within the delineated area for the development of the various projects. The loss of trees will result in destruction of habitats for small mammals and birds. The project related construction activities

involving noise and vibrations, construction vehicle movement, illumination at the project site will have adverse impacts on flora and fauna. Use of wood as fuel by cutting trees in the nearby area by construction labour may also result as a threat to the ecology of the area.

Mitigation

Any city cannot exist only on grey infrastructure alone – the importance of incorporating blue and green infrastructure is fast taking roots in many contemporary urban architectural plans. The proposed Green and Blue plan in the Amaravati City translates into an implementable land use plan. The plan is shown as Fig 6-1 and can be summarized into the following planning strategies and typologies:

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Water bodies

- 2578 Ha of existing water bodies including rivers, canals, irrigation channels and reservoirs have been carefully protected and integrated with the green spaces as discussed in the previous section.

Fig 6-1 The Green and Blue Plan for Amaravati *

The suggested mitigation measures to minimize the ecological impact of the project emerging from the baseline assessment of the study area are:

- Conserve all the 18 water-bodies existing in the core area, planning grey infrastructure in a way that they do not encroach upon these functional blue infrastructural units. Some of these water-bodies require partial restoration such as removal of choking water hyacinth. Also, new capital city Concept Plan must ensure that the slopes of these water-bodies are kept natural and not concretized. Further, natural drains that serve as the source of water to these water-bodies must not be blocked by the planned grey infrastructure. Not only will this prevent the water-bodies from drying up, but also mitigate surface water run-off and urban flooding scenarios.
- Conserve all rocky outcrops within the study area and its boundaries, strictly preventing quarrying activities (if any) and overgrazing of scrub vegetation on rocky outcrops
- Planning of ecological corridors, about 50 m wide and consisting of native shrubs, herbs and trees, to connect the water-bodies. These ecological

corridors can run parallel to the newly-planned roadways, cycling and jogging tracks etc., or be constructed as overpasses. Some of these ecological corridors need not be continuous linear passages, but be planned as stepping stones, with gardens and parks with native plant species.

- The new capital city, considering its proximity with two reserve forests, must contain adequate number of informative signages and posters making the citizens aware of the biodiversity around them.
- It was observed that the Kondapalli RF had illegal dwellings at the base of the hill. Besides, tourists inside the RF needed orientation and more awareness towards minimizing the impact of their activities.

Green Belt Development

Green belts are planned strips of vegetation where other infrastructural developmental activities are prohibited. Green belts have many advantages. They protect natural or semi-natural environments, serving as contiguous habitat networks for wild plants, animals and wildlife. They improve air quality within urban areas (Prajapati and Tripathi 2008) and provide noise pollution control (Fang and Ling 2005). They act as carbon sinks, help retain soil moisture, recharge groundwater and moderate the micro-climate (CPCB Guidelines for Green Belt, 2000). In addition to providing aesthetic pleasure, they provide walking, camping, and biking areas close to the cities and towns.

The project has earmarked 25% in Phase 1, 11% in Phase 2 and 7 % in Phase 3 of the area as primary green area – overall achieving a green belt of about 22.7% of the total land area of the capital city in all Zones of development. Proper landscaping will be designed and implemented during operation phase. The Greenbelt plan with a five-fold objective addresses the following issues.

- Mitigation of fugitive emissions from the site;
- Prevention of land degradation due to construction activities such as mitigating soil erosion, etc.;
- Enhancing vegetation cover for increasing the biodiversity of the region and consequently creating a noise barrier;
- Maintaining and enhancing the ecological equilibrium of the area;
- Enhancing the Aesthetic value of the area.

Selection of tree species to be planted in Green Belt depends on various factors, like the suitability of species as per the climate and soil type of a given area. In

addition, some species are better suited for tolerating air pollution (Prajapati and Tripathi 2008, Shannigrahi et al. 2003). Some species are more preferred by birds for nesting (Dutta and Raut 2015; Ranjan and Kushwaha 2013) or butterfly larva for feeding (KFRI report 2010) and hence, have a more important ecological role.

Also, it has been found that shrubs species richness positively affects bird species diversity (Paker et al. 2014; Peters 2014). Hence, a two-tier green belt has been considered superior.

Azadirachta indica, Acacia nilotica, Ficus benghalensis, Delonix regia, Dalbergia sissoo, and *Albizia saman* were among the common tree species observed in the study area and can be included in the green belts. Among shrubs, Calotropis gigantea, Lantana camara, Urena lobata, Cassia alata and Ricinus communis were the commonest and should be retained or planted in green belts. Aquatic plants that can be planted along the edges of Water bodies are *Ipomoea aquatica, Typha domingensis, Ludwigia perennis, Chrozophora rottleri* and *Bacopa monnieri*.

The Central Pollution Control Board (CPCB) prepared an exhaustive list of species capable of air pollution remediation, and classified them as per various bio-climatic conditions. Based on the ecological assessment and the CPCB Guidelines for Green Belt (2000) development, the Table 6-5 enlists the tree and shrub species suitable for the Guntur division,

The Green Belt development will be done for Amaravati Capital City in Consultation with the Divisional Forest office of the Region.

Table 6-5 List of Plants for Green Belt Development

S. No	Scientific Name	Common Name
Trees (15m and above)		
1	*Adenanthera pavonina*	Rakta Kambal
2	*Adina cordifolia*	Haldu
3	*Aegle mormelos*	Bael tree
4	*Alianthus excelsa*	Maharakha
5	*Anthocephalus chinensis*	Kamdamba
6	*Artocarpus heterophyllus*	Kathal
7	*Artocarpus lacucha*	Dahua
8	*Azadirachta indica*	Neem
9	*Bridelia squamosa*	Khaja
10	*Butea monosperma*	Palash/Dhak
11	*Casuarina equisetifolia*	Jangli saru
12	*Cocos nucifera*	Nariyal

S. No	Scientific Name	Common Name
13	*Cordia dichotoma*	Chhota losora
14	*Dalbergia sissoo*	Shisham
15	*Delonix regia*	Gulmohar
16	*Emblica officinalis*	Amla
17	*Erythrina variegata*	Dadap
18	*Ficus benghalensis*	Bargad
20	*Ficus benjamina*	
21	*Ficus elastica*	Rubber tree
22	*Ficus glomerata*	Goolar
23	*Ficus hispida*	Konea dumbar
24	*Ficus religiosa*	Peepal
25	*Mangifera indica*	Aam
26	*Millingtonia hortensis*	Indian cork tree
27	*Phoenix sylvestris*	Khajur
28	*Mimuspos elengi*	Bakul
29	*Moringa oleifera*	Drumstick
30	*Pterygota alata*	
31	*Saraca asoka*	Seeta ashok
32	*Spathodea campalunata*	India tulip tree
33	*Sterculia foetida*	Jungli badam
34	*Syzygium cumini*	Jamun
35	*Tamarindus indica*	Imli
36	*Tectona grandis*	Sagwan/teak
37	*Terminalia arjuna*	Arjun tree
38	*Thespesia populnea*	Portia tree
39	*Kigelia africana*	Sausage Tree
40	*Lagerstroemia speciosa*	Queen's myrtle
41	*Peltophorum Pterocarpum*	Pachaturai
Small Trees & Shrubs (1-10 m)		
1	*Acacia nilotica*	Babul

S. No	Scientific Name	Common Name
2	*Abutilon indicum*	Kanghi
3	*Achras sapota*	Chikoo
4	*Acacia catechu*	Khair
5	*Anona squamosa*	Sitaphal
6	*Anona reticulata*	Luvuni
7	*Bambusa vulgaris*	Bans
8	*Barringtonia racemosa*	Ljjut
9	*Bauhinia racemosa*	Astha
10	*Bahinia varigata*	Kachnar
11	*Caesalpinia pulcherrima*	White gold mohur
12	*Calotropis gigantea*	Akman
13	*Clerodendrum infortunatum*	Bhant
14	*Cassia fistula*	Amaltas
15	*Citrus aurantium*	Nibu
16	*Duranta repens*	
17	*Hamelia patens*	Scarlet bush
18	*Lantana camara*	Lantana
19	*Lawsonia inermis*	Mehndi
20	*Sesbania sesban*	Jainti
21	*Tecoma stans*	
22	*Psidium gujava*	Guava
23	*Trema orientalis*	Gio
24	*Zizyphus maurtiana*	Ber

6.3.2.4. Impact on Ambient Air Quality

The baseline monitoring study conducted suggests that the particulate matter (PM_{10} and $PM_{2.5}$) values and other parameters such as SO_2, NO_x and Hydrocarbons etc are observed to be within the norms. During construction phase, the major sources of air emissions will be from heavy construction operations. The emissions during construction phase will be associated with land clearing, ground excavation, cut and fill operations (earth moving) and construction works and the major pollutant of concern will be particulate matter (PM_{10} and $PM_{2.5}$). Out of the activities listed

above, the earthmoving operations and the emissions from equipment will be the largest contributors of emissions. The dust emissions will vary substantially from day to day based on the level of activity, the specific operations and the prevalent meteorological conditions.

The site grading operations will entail bringing material into site or transport of excess cut material off site and will result in PM_{10} emissions. Following are the details regarding the average emission factors, transit emissions, fire wood burning emissions;

- The average PM_{10} emission factors ranges for loading and unloading operations and will be in the range of 2.8 to 4.7 kg/1000 m^3 respectively.
- The construction phase will also include tail pipe emissions from transport of construction materials and use of construction machinery.
- It is estimated that the transportation of materials will involve movement of 50-400 trucks/day during each phase. The scraper transit emission factors will be in the range of 3.9 – 4.5 kg/ 1000 m^3 /vehicle-km for loaded vehicle and 1.4 - 3.1 kg /1000 m^3 /vehicle–km for empty vehicle1.
- The construction laborers may also use firewood as fuel for cooking purpose resulting in emissions and tree felling. Open burning of waste may also be done by the construction labourers leading to SO_2, NO_x and CO emissions.

The construction activities will be spread over the years 2015 – 2050 and all activities will not occur simultaneously. The emission sources shall be distributed throughout the project site and shall fall under the category of area source. The delineated area is fairly flat and extensive earthwork is not expected. The detailed modeling for estimating the emissions from construction activities will be assessed on individual project basis based on the area under construction and the nature of operations.

Material Handling, transportation and Storage

- To minimize the dust from open area sources, including storage piles, control measures such as installation of enclosures and covers, and increasing the moisture content will be used;
- Suitable cover material such as tarpaulin sheets shall be used for haul trucks to prevent fugitive emissions during transportation of construction materials;
- For minimizing dust from material handling sources, conveyors and bins, covers and/or control equipment (water suppression, automatic sprinklers) will be employed;
- The excess fill material shall be transported and stockpiled prior to loading into the truck;
- Limited vehicular movement shall be permitted on disturbed soils;

- All unpaved roads used for vehicular movement shall be watered daily and the vehicle speeds will be restricted to 25 kmph;
- During backfilling, the material will be emptied slowly to prevent generation of dust plumes;
- The drop height shall be kept to minimum while unloading/screening of material;
- The haul trucks shall be loaded in such a way that the freeboard is not less than six inches when the material is transported on any paved road;
- Contractors shall be required to maintain valid PUC – Pollution under Control certificates and to maintain proper maintenance records for their fleet as part of the contract bid and at regular intervals throughout the life of the contract. A monetary incentive/disincentive provision shall be established to encourage contractors to comply with regular maintenance requirements

Dust Control Measures

- Upwind fencing will be done on large scale individual projects to prevent material movement on site;
- Sloping surfaces shall be stabilized using soil binders;
- Water shall be applied to at least 80 percent of all inactive disturbed surface areas on a daily basis when there is evidence of wind driven fugitive dust or three-sided enclosure shall be installed with walls with no more than 50 percent porosity that extends, at a minimum, to the top of the pile;
- Downwash of trucks (especially tyres) shall be done prior to departure from site to reduce the mud and dirt carryout.

Fuel Emissions Control

- Power will be sourced from the local distribution company,
- DG sets will be used as a backup source only;
- DG sets will be regularly maintained to comply with emission norms;
- The Stack height for DG sets shall be provided as per the CPCB norms;
- The construction camps will be provided with canteen facilities equipped with LPG cylinders and construction labourers will be discouraged to use firewood as cooking fuel;
- Open burning of waste shall not be permitted and will be the responsibility of the contractor.

The overall impact on the air quality is assessed to be moderate, however with the implementation of mitigation measures the impact can be contained with minor residual impacts.

6.3.2.5. Impact on Water Resources and Quality

The impact on water resources and quality from the construction phase of the project arises from the following:

- Change in topography and alteration of drainage pattern
- Requirement of water for construction and labour camps
- Sediment run off from construction area
- Disposal of sewage from construction camps

The project activities will involve minor alteration of topography due to localized leveling of terrain. Small drainage channels may get modified due to change in topography, construction of access roads, pipeline etc.

The construction activities will require setting up of 20-40 construction camps with a capacity to accommodate a peak labour of 250-500 workers at each camp site and peak distributed labour demand of around 10000 workers. The labour camps will require water for domestic consumption of workers as well as for the construction activities such as preparation of concrete mix, curing, housekeeping, dust suppression etc. It is estimated that each construction camp would require about 33 KLD 66 KLD of water during the peak construction period. The requirement of water for construction will put additional pressure on the local resources.

It is expected that during construction phase, there will be generation of sewage and minor quantity of rejected water from testing of utility tanks and pipelines during commissioning of the project. About 27 to 53 KLD of sewage is expected to be generated due to working of 250 to 500 labourers at each construction camp site. There is a potential for contamination of surface and groundwater resources resulting from improper management of sewage.

The construction activities will result in disturbance of topsoil rendering it vulnerable to erosion and runoff. The potential impact on water quality can be due to escape of excavated soil along the existing channels where the loose silt and sand could be washed along the surface drainage. Improper storage of excavated soil, raw material for construction and debris can lead to contamination/siltation of adjoining water bodies. There is potential for contamination of soil and groundwater due to spillage and migration of fuel, lubricants etc. being used for heavy machinery and generators.

Mitigation

The mitigation measures provided shall be implemented by each individual projects based on its applicability to the activities and processes. Construction activities close to water channels shall ensure greater degree of precautions and effectiveness of implementation.

Water Consumption

- Water for the construction phase will be from sources authorized by the proponent;

- The construction campsites will put in place optimal water conservation measures along with adequate awareness measures for the workforces;

Effluent/ Sewage Disposal

- To minimize adverse impacts due to escape/discharge of untreated sewage outside the project site, adequate number of toilets (at least 8 toilets per 100 labour) with septic tanks and soak pits arrangements shall be provided onsite for disposal of sewage as per the design aspects of Bureau of Indian Standards;
- Random disposal of wastewater by workers in the labour colony will be strictly restricted. Adequate drains and collection sumps for recharge of water from bathing areas will be provided at the labour campsites;
- Sludge from sanitary wastewater treatment systems to be disposed in compliance with local regulatory requirements;

Runoff Management

- All the debris resulting from construction activities shall be removed from the site on regular basis to prevent their runoff. Secondary containment and bund shall be provided around excavated soil or loose construction material to prevent runoff to nearby water bodies;
- Construction operations shall be scheduled and performed so that preventative soil erosion control measures are in place prior to excavation in critical areas and temporary stabilization measures are in place immediately following backfilling operations. This would ensure minimal area for cut and fill thereby maintaining the slopes;
- Storage area shall be kept away from the storm water drain to prevent any wash away into water bodies outside the facility;
- Segregation and pre-treatment of oil and grease containing effluents from workshop (e.g. use of a grease trap) shall be undertaken prior to discharge into sewer systems;
- Construction activities shall ensure setting up of silt traps and bunds around the construction area prior to commencement of any other activity to avoid any runoff to adjoining natural ponds
- Implement rainwater harvesting system for all the campsites for effective recharge of groundwater during rainy season

The overall impact on the water resources is assessed to be moderate, however with the implementation of mitigation measures the impact can be contained with minor residual impacts.

6.3.2.6. Impact on Landscape and Topography

The landscape of the area will gradually change over a period of time from rural to urban; with industrial, commercial, residential and mixed land use. The change in topography will be mostly at the micro-level due to leveling of area or modification of terrain. The construction activities such as excavation works for foundations of

various project-components, development of drains, providing proper slopes across the area etc. and ultimately for erection of the associated structures and buildings will change the topography of the area.

The dumping of construction debris or spoil along the course of the Krishna River, natural and manmade ponds on the site and surrounding vicinity can impact the drainage of the area. The filling of the river area can also impact the recharge of the aquifers and can result in decline in the groundwater levels in the downstream areas. Additionally, the runoff from urban areas will be comparatively higher because of replacement of vegetation by impervious built and paved surfaces leading in less infiltration. This can lead to more localized flooding and undesired health issues associated with it.

There is a potential for elevation of air temperatures in urban areas as compared to the surrounding rural areas (urban heat island), and this temperature increase can have negative impacts on human comfort and health.

Mitigation

All projects undertaken as part of the Amaravati New Capital City Development shall ensure following mitigation measures to minimize impact on Landuse, topography, landscape and drainage of each project site and surrounding region. The issues pertaining to urban heat islands and increase in runoff have been addressed as a part of Concept Planning by providing green areas and water bodies and effective storm water drainage system for the region. It is recommended that the project should establish with embedded green elements in all infrastructural development proposed.

- No extra soil shall be brought into the site from outside the project boundary for the construction activity. All excavated soil is used in level raising;
- The construction contractors shall be instructed not to cut any tree. Wherever possible avoid disturbance to existing ecology to improve the landscape of the project site;
- Development of greenbelt will be done to improve the landscape and minimize impact on Landuse, topography
- Restoration of land surface contours in relation to the surroundings followed by developing drains and providing adequate slopes across the project site prior to start of excavation work thereby ensuring adequate cross drainage for quick evacuation of catchment water;
- Diversion dykes would be constructed to channel runoff around the excavated site to avoid surface runoff of excavated material;
- Construction footprint is well defined and construction work to be carried out within the Project footprints only.

The overall impact on the landscape and topography is assessed to be moderate, however with the implementation of mitigation measures the impact can be contained with minor residual impacts.

6.3.2.7. Impact on Soil Resources

The project area has thick agricultural soil cover in most of the land. The construction activities will include site clearing and earthwork which will result in top soil removal and will disturb the soil surfaces. Soil erosion may be caused by exposure of soil surfaces to rain and wind during site clearing, earth moving, and excavation activities. The mobilization and transport of soil particles may, in turn, result in sedimentation of surface drainage networks, which may result in impacts to the quality of natural water bodies and ultimately the biological systems that use these waters.

The movement of heavy vehicle and machinery on unpaved surface during construction works may result in compaction of soil which can reduce the recharge potential. Also, compaction of areas meant for temporary uses can render the land less suitable for agricultural purposes. The construction and decommissioning activities will also include storage, handling and disposal of petroleum based products such as lubricants, hydraulic fluids, or fuels during their storage, transfer, or use in equipment. The improper storage, handling and disposal of these products may pose a risk of potential leakage and contamination of the land. The disposal of sewage/sludge on land can also lead to contamination of soil.

The construction activities will also result in generation of waste such as construction debris, waste from site clearance, excavated materials and municipal waste from labour colonies.

The waste from construction activities has been estimated to be in the range of 40 - 60kg/ sq.m and the waste from each construction camp has been estimated to be 65-125 kg/day. (Source: Utilizaton of Waste from Construction Industry 2001, published by TIFAC). The dumping of municipal waste can lead to contamination of soil and the leaching of the waste material can cause contamination of the surface and groundwater resources in and around the dumping site.

Mitigation

The mitigation measures listed below shall be implemented by each individual project based on the applicability to the individual project's activities and processes.

Top Soil Management

- Excavated top soil is advised to be dumped properly and stabilized with grass and trees or utilized for greenbelt development to avoid its washing due to rains.
- Moreover, the washed soil will also be arrested by creating garland drains, leading to settling pond(s) to allow its settling and avoid its mixing with surface water and result in their silting
- Topsoil (upper 30 cm) will be removed prior to commencement of bulk earthwork and preserved for reuse in landscape development onsite for each individual project within the project area. Ensure loss of good quality top soil is avoided;
- Minimum clearance of vegetation shall be carried out and the vegetative cover shall be redeveloped wherever possible.

Soil Erosion Control Measures

- Major activities pertaining to site grading and excavation for foundation and backfilling will be avoided during monsoons and shall be planned for dry season;
- Surface runoff from the construction site and exposed areas will be diverted using dykes, drainage swales or ditches. The method of choice will depend on the size of the drainage area and the steepness of the slope;
- Retention wall or bund shall be provided around the storage areas for excavated soil and other construction material to check the flow of sediments with storm water in case of rain;
- Excavated soil shall be used/transported at the earliest for filling low lying areas at the site for raising of level as planned;
- Proper routing and adequate capacity of the storm water run-offs drains with catch pits shall be provided at all construction sites;
- Completed earthworks will be sealed and/ or re-vegetated as soon as reasonably practicable with the help of landscape expert;
- The excavated soil material shall be stacked in earmarked areas. It is advised to be dumped properly and stabilized with grass and trees or utilized for greenbelt development to avoid its washing due to rains;
- Moreover, the washed soil will also be arrested by creating garland drains, leading to settling pond/s to allow its settling and avoid its mixing with surface water and result in their silting.

Soil Compaction

- The movement and parking of heavy machinery and other vehicles shall be restricted to identified area to limit the possibility of compaction;
- Restoration of area used for parking of heavy machinery and other storage shall be undertaken immediately after completion of each project activity

Prevention of Contamination

- Storage facilities will be designed within paved surface, provided with covered shed and adequate containment facility at the construction site to prevent contamination of soil due to accidental spills of lubricating oil, fuel oil, paints, thinner, varnishes, chemicals etc.;
- Storage of machine oil, used oil and grease will be provided with adequate secondary containment to avoid any soil contamination;
- Adequate hazardous waste collection and storage facilities shall be provided in a designated place away from storm water drains or watercourses with proper access control and proper labeling;

- All the hazardous waste containers will be properly labeled with the waste being stored and the date of generation;
- The hazardous waste shall not be stored for more than 90 days at the site and will be sold to authorized recyclers;
- An inventory of the hazardous waste generated and sold to recyclers shall be maintained by the contractors;
- A portable spill containment and cleanup equipment will be available at site and training in the equipment deployment will be imparted to the contractors;
- Covered garbage bins shall be provided for the construction camps and will be collected and transferred to the existing/proposed waste management facilities;
- The construction waste shall be used as a fill material for the low lying areas and for construction of roads;
- Empty containers, which may contain some toxic substances such as paints, solvents, adhesives and sealants shall be returned to the manufacturers or disposed appropriately as the case may be;
- Waste generated will be segregated into biodegradable and non-biodegradable contents. All biodegradable wastes from kitchen to be collected for secondary use such as animal feed or for vermi-compost. Other biodegradable wastes to be collected and disposed of in humus pits generated onsite for subsequent use as manure;
- Construction wastes from site such as metal cuttings debris, plastic packing material, wooden logs etc. will be segregated and kept in specially identified waste bins. All metal scrap will be sold while concrete waste/debris and other inert materials that cannot be recycled to be crushed and reused for level raising onsite or in road/pavement development within the site;
- Hazardous wastes including used oil, waste oil and residue containing oil or other hazardous substances will be stored at a designated place at all construction sites for disposal through authorized vendors approved by the State Pollution Control Board;
- Paintbrushes and equipment for water and oil based paints shall be cleaned within a contained area and shall not be allowed to contaminate site soils, watercourses, or drainage systems;
- Segregation of potentially hazardous waste from non-hazardous construction site debris;
- The contractor shall educate the workers and subcontractors about hazardous waste storage and disposal procedures;
- The septic tanks shall be abandoned and filled with earth after the labour camps are evacuated on completion of works.

The overall impact on the soil resources is assessed to be moderate to high. It is assessed that with implementation of suggested mitigation measures the overall impact can be maintained as minor.

6.3.2.8. Impact on Traffic and Transport

The construction phase will entail transportation of construction materials, C&D waste material to and from site and transportation of labour. At present, the National Highway 16, NH-65, NH 221, AH-45, village access roads and canal roads connect the delineated region. The majority of the road network in the area comprises of village roads, which are only 6-10 m wide. The internal road connectivity within the site is reasonably good.

It is assumed that the construction phase will involve a movement of large number of additional trucks per day for transportation of materials. The additional traffic during construction phase will add on to the traffic along existing roads and may lead to traffic congestions and may cause reduction in speeds. Also the turning movement of vehicles to construction camps may lead to further increase in travel time.

The construction activities will not be limited to areas around the major roads and will have to be accessed through internal roads. The major portion of the internal roads comprises of brick paved roads and with increased heavy vehicular movement, the condition of the roads may deteriorate and can cause road blockages.

Mitigation

The following mitigation measures are suggested for minimizing the impacts on the traffic and transportation. These measures will be implemented by the proponent:

- PP shall undertake a preliminary survey to assess the existing conditions of the road such as existing traffic load, carrying capacity of the road, width, horizontal curvature, vertical curves, intersection geometry, drainage structures, height restrictions, load restrictions of existing bridges and culverts, and any locally significant features. Based on the survey, a traffic management plan formulated and will include proposals for repair/widening of roads.
- Construction site will be provided with exclusive entry and exit point of the construction vehicle.
- Prepare detailed plan for signage around the construction to facilitate traffic movement
- Where road widths are insufficient, either temporary widening of the road with gravel or full depth widening of the pavement structure will be undertaken;
- Proponent shall ensure that the access roads to the construction sites are developed well in advance to facilitate smooth movement of traffic;
- Wherever possible, rerouting of construction traffic to wider, less-restrictive road shall be preferred;

- The fleet of vehicles to be employed during the construction phase will be checked for fitness. The contractor shall be responsible for maintaining the maintenance records and 'Pollution Under Control' certificates;
- The contractor shall provide training to the drivers regarding the traffic rules and management provisions. Training records shall be maintained by the contractor;

The overall impact on the traffic and transportation is assessed to be moderate to high. It is assessed that with implementation of suggested mitigation measures the overall impact can be maintained as minor.

6.3.2.9. Impact on Ambient Noise Quality

The proposed project is expected to have large scale construction activities, mostly mechanized, related to construction of roads, residential townships, infrastructure facilities etc. The major noise generating sources envisaged during construction phase are given in **Table 6-6**.

Table 6-6 Noise level at 15 m from source as per FTA

S. No	Equipment	Typical Noise Level (dBA) 15 m from Source*
1	Air Compressor	81
2	Compactor	82
3	Concrete Mixer	85
4	Concrete Pump	82
5	Concrete Vibrator	76
6	Crane Derrick	88
7	Crane Mobile	83
8	Dozer	85
9	Generator	81
10	Grader	85
11	Impact Wrench	85
12	Jack Hammer	88
13	Loader	85
14	Paver	89
15	Pile Driver (Impact)	101
16	Pile Driver (Sonic)	96
17	Pneumatic Tool	85
18	Pump	76

S. No	Equipment	Typical Noise Level (dBA) 15 m from Source*
19	Rail Saw	90
20	Rock Drill	98
21	Roller	74
22	Saw	76
23	Scraper	89
24	Shovel	82
25	Spike Driver	77
26	Truck	88

Differing types of noise such as background noise, idling noise, impact noise, rotating noise, intermittent noise, howling, screeches and squeals etc by the above equipments would be the considered as the major source of noise pollution during the construction phase apart from the traffic volume existing in the vicinity. The noise levels at the operating source of construction equipments during various development activities are given in **Table 6-7**.

Table 6-7 Noise produced by various construction activities

S.No	Equipment	Sound Level at Operator	
		Average	Range
Earth Moving:			
1	Front End Loader	88	85-91
2	Back Hoe	86.5	79-89
3	Bull Dozer	96	89-103
4	Roller	90	79-93
5	Scraper	96	84-102
6	Grader	<85	
7	Truck	96	89-103
8	Paver	101	100-102
Material Handling:			
9	Concrete Mixer	<85	
10	Concrete Pump	< 85	
11	Crane	100	97-102
12	Derrick	<85	

S.No	Equipment	Sound Level at Operator	
		Average	Range
Power Units:			
13	Generators	<85	
14	Compressors	<85	
Impacting Equipment:			
15	Pile Driver (diesel and pneum.)	98	82-105
16	Pile Driver (gravity, bored)	82.5	62-91
17	Pneumatic Breaker	106	94-111
18	Hydraulic Breaker	95.5	90-100
19	Pneumatic chipper	109	
Other Equipment:			
20	Poker Vibrator	94.5	87-98
21	Compressed Air Blower	104	
22	Power Saw	88.5	78-95
23	Electric Drill	102	
24	Air Track Drill	113	

* British Columbia, "Construction Noise," Workers Compensation Board of BC

The noise generation during such large-scale construction activities would be considerable and may potentially have impact on the health of construction workers. The impacts during construction phase shall be temporary and would be marginal on the surrounding communities/villages.

6.4. Assessment of Key Impacts of Proposed Development during Operation

The key aspects of the proposed development which need to be considered for identification of impact as well as planning of mitigation measures are

- Transport
- Energy
- Water
- Waste
- Air Emissions & Noise
- Social Environment
- Others - Storm water drainage system, Flood risk mitigation infrastructure

Space allocation has been made as part of Development of all the above linear and area based infrastructure, in accordance with ultimate demand calculations.

Planning of Transport, Energy, Water, and Waste related utility infrastructure have significant implication on environment and natural resources of the region.

6.4.1. Environmental Assessment of Transport

With regard to transportation, integration of transport with landuse planning to minimize transport needs, provision of space for infrastructure that will encourage non-motorised transport as well as access to different means of public transport affordable by various sections of the society, infrastructure to facilitate efficient transport of goods & materials within and outside the Capital city region, and separation of city and outstation traffic has been ensured in the Development Planning. All this will ensure that the transport sector is compatible with the social, economic, and environmental needs of the region. Additional impacts related to the following will also be addressed in development:

• Availability of sufficient cleaner fuel in the region

• Safety of both motorised and non-motorised means of transport.

Following measures will be implemented to minimize impact due to transportation:

- Dedicated cycle tracks and pedestrian paths shall be provided along the major roads. Appropriate access shall be provided for physically challenged people in the pedestrian paths.
- The design of service roads and the entry and exit from the housing complexes shall conform to the norms & standards prescribed by the National Highways Authority of India/ State Public Works Department.
- All the villages shall be connected by an all-weather village road to a higher order road either directly or through another village settlement.
- The road system shall have the road cross sections for general traffic, exclusive ways for public mass transport (bus) system, pedestrian paths and ways, cycle tracks, utility corridors and green strip.
- The major roads shall be free of service lanes to check direct access of abutting property / activity from the main road. An internal road system linked to the main roads at defined locations shall be provided for access to all the activities.
- In the initial period, flexible pavement (as per IRC guidelines for the design of flexible pavement IRC: 37-2001) shall be constructed to allow the consolidation and settling of base. Cement concrete pavement shall be constructed in the later phases. Permeable (porous) paving in the parking areas, and walkways & patio areas should be used to control surface water runoff by allowing storm water to infiltrate the soil and return to ground water.
- All utility lines (electricity, telephone, cable, water supply, sewerage, drainage, etc.) shall be laid below ground level. Ducts shall be provided along and across the roads to lay the utility lines. Major trunk (water/sewerage) lines are to be laid along the utility corridor.

- The road drainage shall be designed to enable quick runoff of surface water and prevent water logging. The road level shall be kept at least 0.5 to 1.0 meter above the observed high flood level. The guidelines on Urban Drainage, IRC: SP-50 shall be followed. Fencing along the outer edge of the road right of way shall be carried out to prevent unauthorized ribbon development. The pedestrian shall be given priority attention in the transport system, which includes footpaths, pedestrian ways (along the ROW of the major roads 100 m / 60m) and pedestrian corridor, pedestrian plazas and other facilities. On the both sides of all roads, well–lit and smooth surfaced footpaths, of minimum 2.0 m width shall be provided. Cycle Tracks, of minimum 3m width shall be provided along the green and pedestrian corridors and ways. The hoardings shall be strictly prohibited along the roads.
- The public mass transport shall include (a) Bus System [Common Carrier] (b) Intermediate Public Transport modes and (c) Rail based Light Rail Transit.
- Adequate provision shall be made to cater the parking needs. Parking spaces standards as given in 'Manual on Norms and Standards for Environmental Clearance of Large Construction Projects' issued by Ministry of Environment & Forests, Government of India shall be adapted. In addition the norms as stipulated in URDPFI guidelines and DCR shall be enforced.

6.4.2. Environmental Assessment of Energy & Infrastructure

Energy sourcing and efficiencies in generation, transmission and distribution has the most significant environmental impacts after transportation, which again consumes a lot of energy in the form of fuel. One of the key impacts associated with generation can be addressed by sourcing energy needs through alternative and renewable sources of energy such as solar, wind, waste-to-energy. The proposed new city development plans for a good mix of such alternative sources of energy utilising the potential of natural resources as well as man-made resources, in addition to coal or natural gas based thermal power generation exclusively to meet the anticipated demand. This is to ensure that fossil fuel based energy requirements are minimised and pressure on the available grid is not increased.

The other aspect on energy is to minimise the need of artificial lighting, ventilation and comfort (cooling) – by designing all building construction using "Green Building" concept and maximising natural sources of lighting, ventilation and comfort to the extent feasible. These practices will be adopted in the various building "bye-laws" to be made applicable in this area.

Enhancing energy efficiency methods such as Smart Grid, and other state-of-the-art methods and technologies will be adopted in the development through institutional tie-ups with world leaders in Energy efficiency. This will primarily ensure that energy consumption and need patterns are matched to avoid some of key operational problems of peak time power in India. This can have a similar positive impact on environment, as in the case of land use integrated transport planning.

6.4.3. Environmental Assessment of Water Resource

Currently the major water needs of the native population are irrigation, drinking and domestic. While irrigation water demand is met through irrigation network canals from the Krishna River as well as rain, availability of fresh drinking water is a problem in most of the villages falling in the proposed project boundary as there is no piped water supply and the ground water is brackish, domestic water requirement is met with by village level ponds and wells and drinking water is mainly from the bottled water sources.

The quality of surface and ground water is of prime concern as identified during the primary and secondary baseline data collection and the various interactions with the villagers. An extensive water supply network to meet the potable water requirement will be designed for Amaravati. The potable water will be treated to meet the drinking water standard at the water treatment plants planned in the development.

As part of sustainability strategy, the new city development will explore the best and state-of-the-art technology options to address water reuse and recycling needs for the entire development planning and screening individual developments. A strategic and rigorous framework will be prepared specifically for Water Management & Conservation for the entire project, and will guide water related aspects of the entire development. This will consider all feasible options towards avoidance of wastewater disposal and avoidance of conflicts between water users and risks to water availability. The Water Management & Conservation Plan will also consider selection of particular industries in these sectors which will adopt technologies that have higher water use efficiencies and lower wastewater generation.

A water balance diagram to show the details of water budget for Amaravati during the wet and dry season for the first phase of development (2015-2025) and the water balance at the year of horizon (2050) is shown in **Fig 6-2 (A-D).**

The basic assumptions for the water balance diagram are:

Water demand calculated as 150 lpcd

Water requirement for landscaping calculated as 7 l/m^2

Rainfall of 1000mm in the region distributed over 20 days with an average of 50mm is considered for monsoon season.

The water collected in the retention pond will dry in the lean season by evaporation.

Treated sewage will be largely used for construction purpose. The water requirement for construction is approximately 20 l/ $feet^2$ of construction.

Make up water requirement for water cooled HVAC systems is about 10 l/Ton of HVAC Usage.

Landscape water requirement for phase 1 will be 1/3^{rd} of to total landscape water requirement.

Amaravati will strive towards effective water and waste water management and the entire sewage will be treated to 10mg/l (BOD and TSS) standards. The EPA standards for reuse of municipal sewage are given in **Table 6-8.**

Table 6-8: EPA Standard of Treated Sewage

Type of Reuse	All types of landscape irrigation, vehicle washing, toilet flushing, use in fire protection systems and commercial air conditioners, and other uses with similar access or exposure to the water
Treatment	Secondary, Filtration, Disinfection
pH	6-9
BOD (mg/L)	≤ 10
Turbidity (NTU)	≤ 2
Faecal Coli/100mL	No detectable Faecal Coli
Residual Chlorine(mg/L)	1

Source: EPA, Guidelines for Water Reuse, September 2004, EPA/625/R-04/108;

The recycling of treated wastewater will be done at the city level. The wastewater will be treated to tertiary level and will be stored in ground level reservoirs for on-line boosting. The use of treated wastewater to meet the water requirements for the project shall further reduce the stress on the water resources in the region. The reuse of the treated Sewage for the project area will be for flushing, gardening, road washing, vehicle washing, fire protection, HVAC etc. Hence, expected standard will be as given in **Table 6-9**.

Table 6-9: Treated Sewage Standards

Parameters	Unit	Desired Values
Colour	-	Acceptable
Total Hardness	mg/lit	<500
BOD	mg/lit	<10
COD	mg/lit	<30
TDS	mg/lit	<1000
Residual Chlorine	mg/lit	<1
Faecal Coliform	No/100ml	14
Turbidity	NTU	<5
pH		6-9
TSS	mg/lit	<10

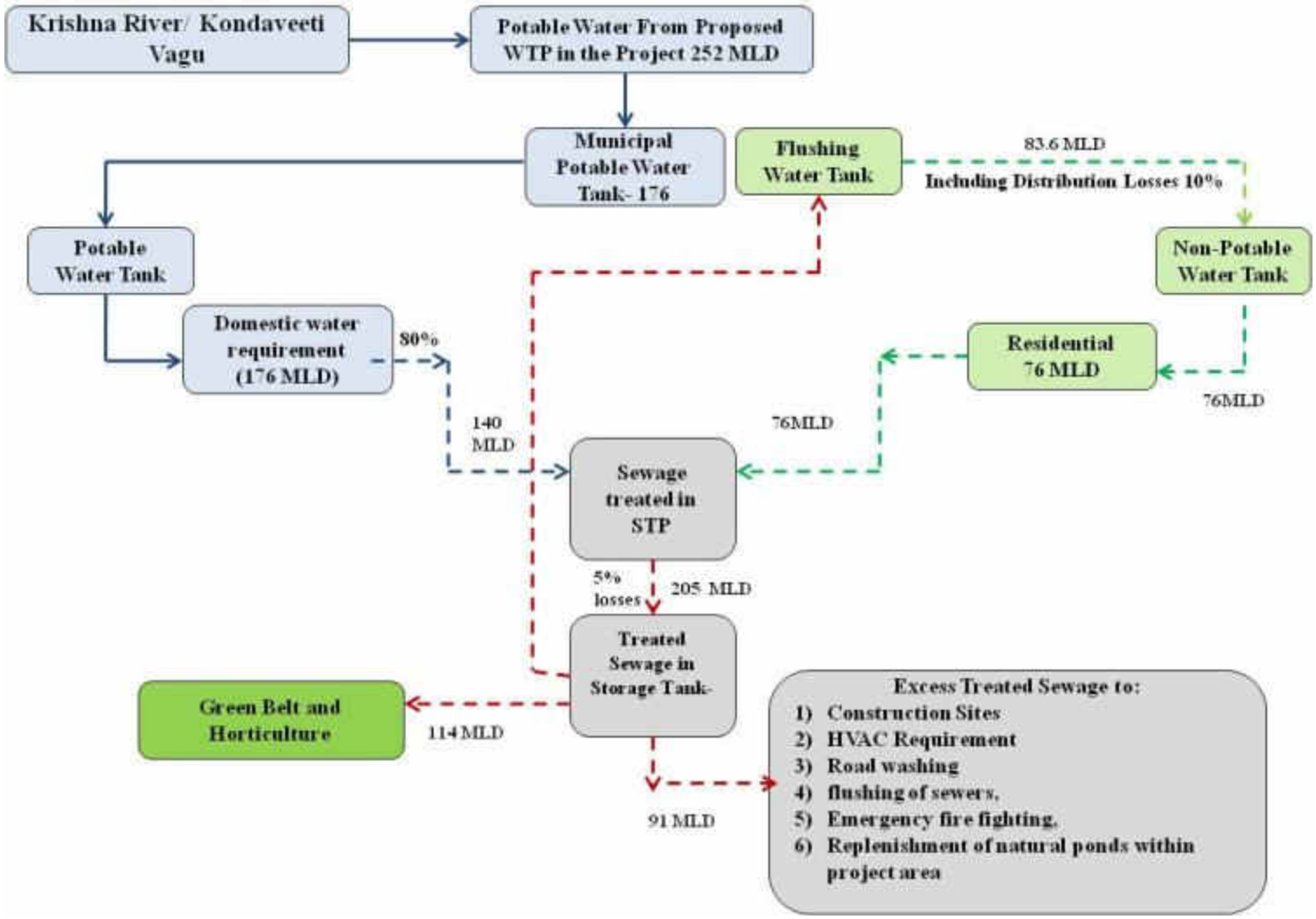

Fig 6-2 A- Water Balance of Amaravati Phase 1 (2015-2025) Dry Season

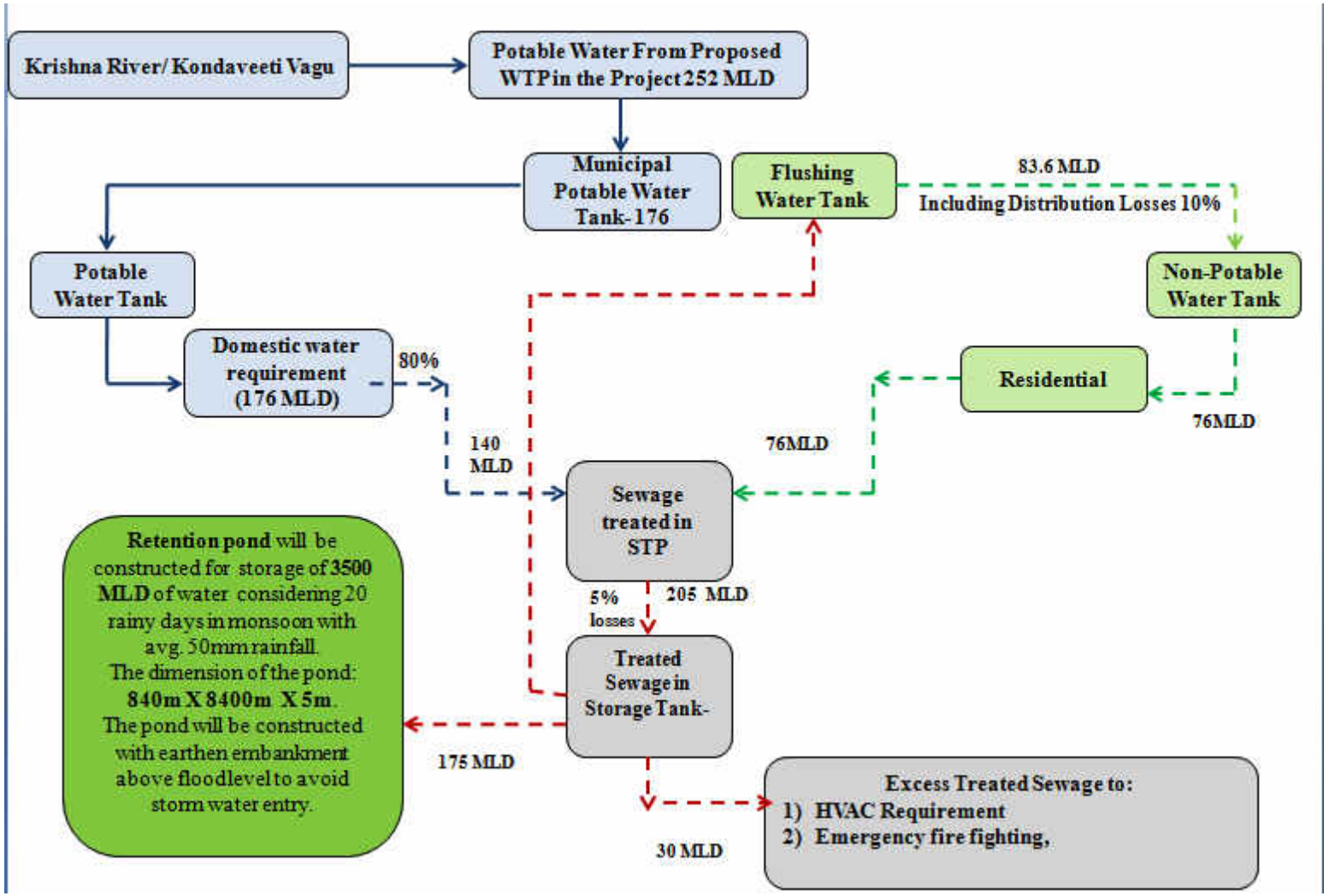

Fig 6-2 B- Water Balance of Amaravati Phase 1 (2015-2025) Wet Season

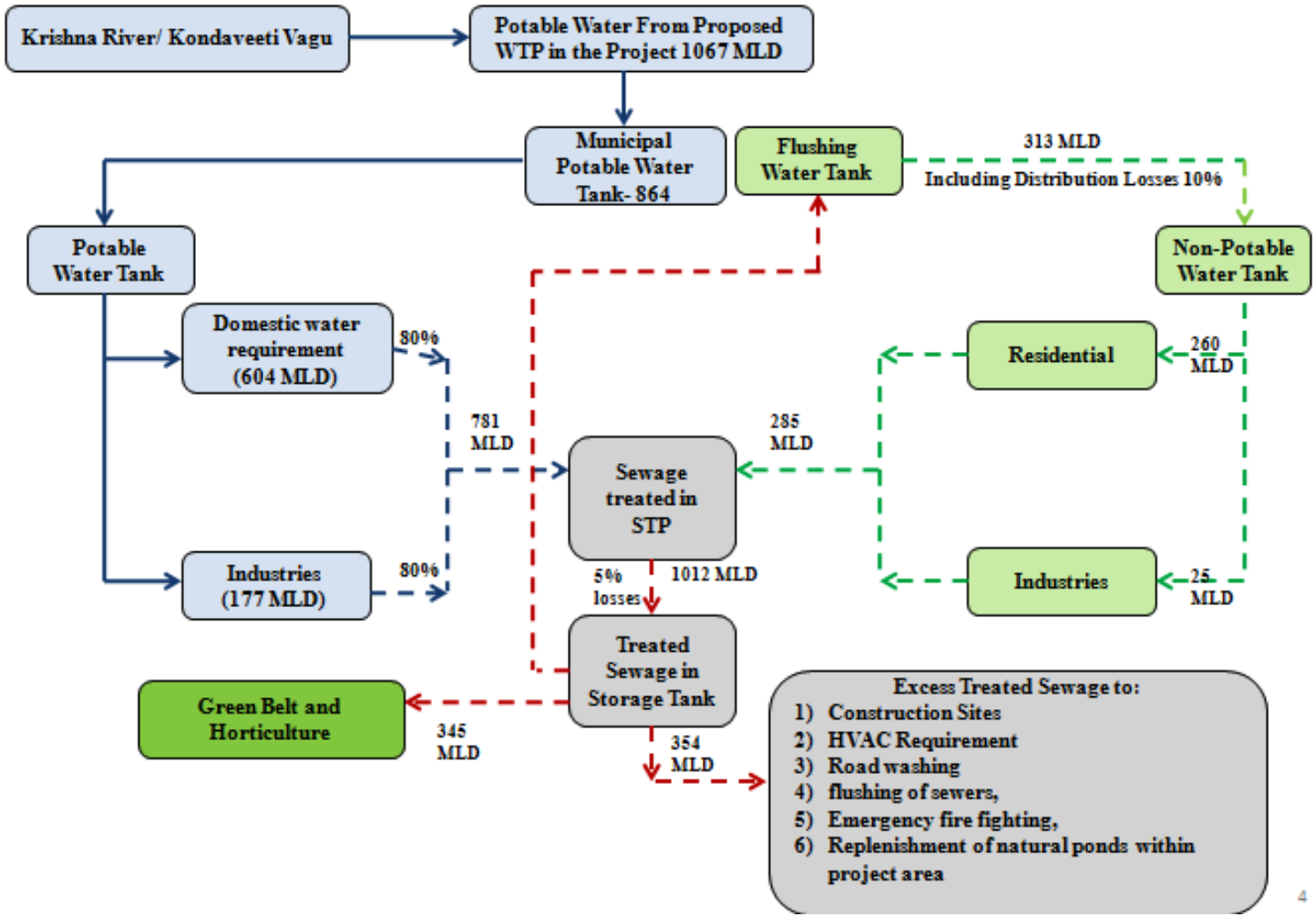

Fig 6-2 C- Water Balance of Amaravati Phase (2050) Dry Season

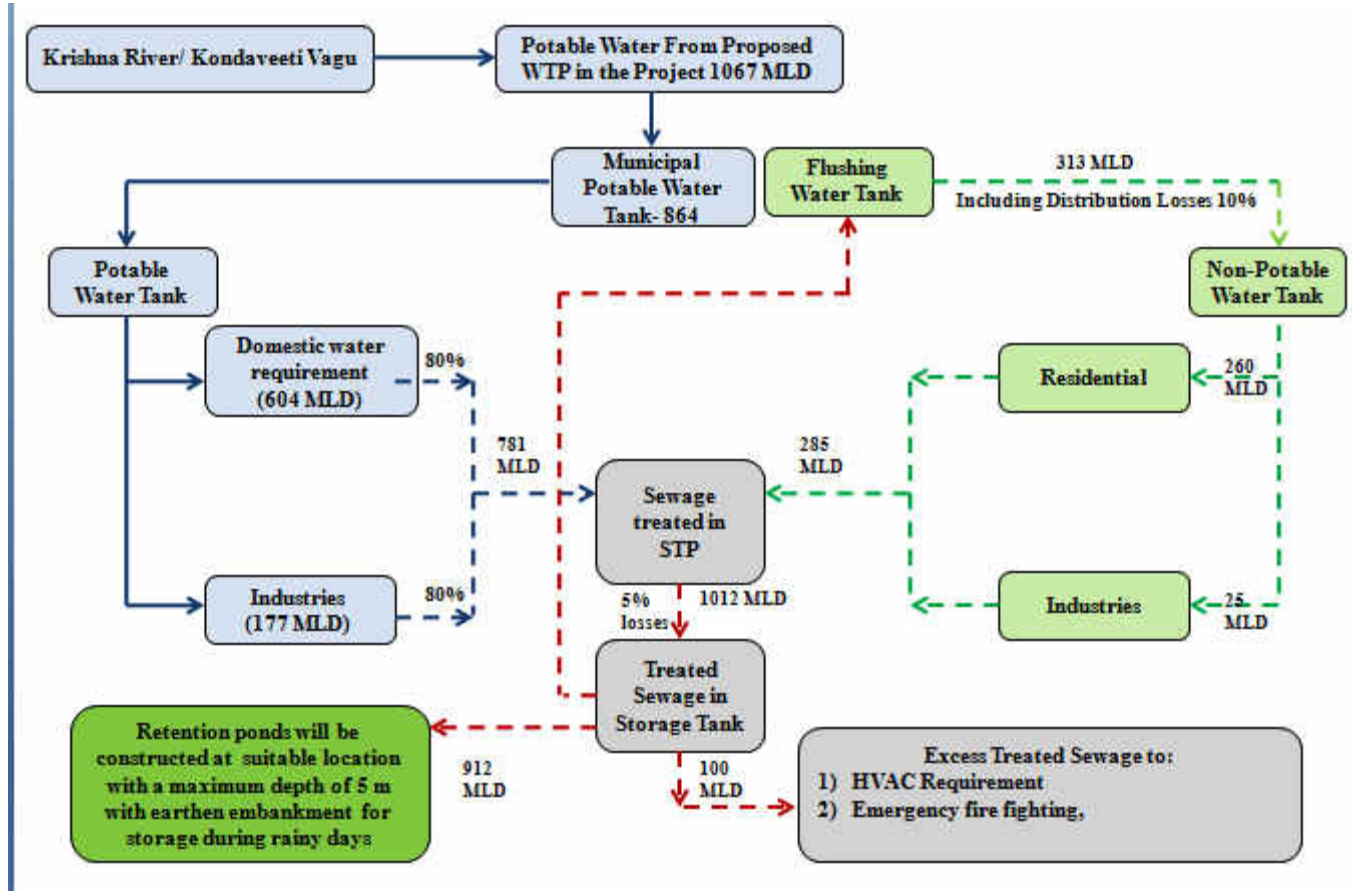

Fig 6-2 D- Water Balance of Amaravati Phase (2050) Wet Season

6.5. Environmental Assessment of Wastewater Management

Waste water treatment plants will be cited in accordance with siting criteria and guidelines applicable as and when needed in phases.

Impacts of treated wastewater on water bodies into which the treated wastewater will be discharged, and impacts on land/soil, ground water, air quality due to storage, treatment and ultimate disposal (including resource recovery) are typically required to be assessed as part of planning these facilities. However, since the development is proposed to adopt maximising re-utlisation of wastewater, resource recovery of solid wastes, and use of recyclable wastes – a detailed framework on Waste Management will be developed based on the latest technology options available for adoption. Moreover, Water Resource Management Planning and Waste Management Planning will be in concurrence.

6.5.1. Environmental Assessment of Solid Waste Management

Solid Waste Management will be one of the essential services necessary for maintaining the quality of life and for ensuring better standards of health and sanitation. It will be cost effective and self managed system which will ensure adequate level of SWM services in the region, through collection, transportation, treatment and disposal of waste in an environmentally and scientifically acceptable manner, following the Supreme Court Committee's recommendations as well as Municipal Solid Waste (Management & Handling) Rules 2000.

The activities associated with the management of solid waste can be grouped into five functional elements namely:

- Waste Generation: People would be made aware of reducing waste at source and segregation of waste in wet and dry waste.
- Storage: The waste will be stored at the source briefly and then it will be transferred to secondary collection points located near the building premises. Transfer of waste from household to secondary collection points would be manual.
- Collection: Primary collection of waste stored at various sources of waste generation by doorstep collection through containerized handcarts/ tricycles, motorized vehicles or through community bins (Secondary collection points).

  Transfer Station (TS) with material recovery facility and secondary segregation of waste is proposed for the city. Waste from TS would be sent to recycling centre and waste processing facilities.
- Transportation: Transportation of the waste stored at waste storage depots at regular intervals is essential to ensure that garbage bins and containers do not overflow and waste is not littered on streets. The transportation system is designed that it is efficient, yet cost effective and will be synchronized with the system of the waste storage depot.

  The waste transportation is to be carried out by only closed vehicles (Compactor trucks are best suited for the city development). The secondary collection bins would be fitted with RFID tag for indication for its filling and

periodic lifting. All the transportation vehicles would be equipped with GPS for optimizing the route and transportation expenses.

- Segregation & Processing: As given in above sections, segregation of waste at source as well as at the common facility will be done based on the usefulness of the waste and suitability of treatment and disposal technology.

  The centralized facility of WtE is already planned at Naidupet for treatment of waste and then further disposal at SLF under SBM. This facility will also cater to the Amaravati capital city.

Waste processing techniques that can be implemented based on the composition of the waste include: Waste to energy techniques, Composting/ vermi-composting; Energy recovery; Biogas generation and Green coal and refuse derived fuel and eco bricks Waste not found suitable for waste processing, pre-processing and post-processing rejects from waste processing sites and non-hazardous waste not being processed or recycled.

Waste quantifications have been made using applicable guidelines and benchmarks, and appropriate space allocations for wastewater and solid waste treatment & disposal facilities in new capital city area after exhausting all the options of upgradation of existing facilities in the nearby towns/ cluster of towns – specifically Vijayawada and Guntur.

Aspects like ensuring recyclability of treated wastewater, composting biodegradable waste, and energy recovery from combustible wastes will also be adopted as part of the waste management approach. A detailed waste management strategy will be developed and adopted to comply with all regulations and in accordance with National & State level waste management policies.

Construction and demolition waste can be reused in earthwork or road projects.

Proposed Integrated Waste Management Concept

An integrated approach will be adopted to efficiently manage the solid waste generated in the region. The waste can be broadly categorized as municipal waste and industrial waste. However, based on composition and characteristics they are further categorised as hazardous waste, bio-medical waste, wet organic waste, dry organic waste, electronic- waste, recyclable waste and inert material.

Approach to Municipal Waste

Municipal waste will be collected and transported to the integrated waste management facility (IWMF). If it has not already been sorted at source, it will be segregated into five components namely 1) Wet Organic waste 2) Dry Organic waste 3) Recyclable waste 4) Inert Materials and 5) electronic- Waste.

- Wet waste will comprise about 20 % to 30 % of total waste. This will be converted into organic compost through proper treatment
- Dry waste will form 30% to 40 % of waste, which can be utilized for making green coal or fluff. After segregation, recyclable waste like rubber, metal, plastic which has economic importance, will be sold

- Segregated E-waste will be sent for processing along with hazardous industrial process waste. At the last stage of the process, inert materials can be partly used for making bricks by mixing it with fly ash. Finally the residue from this process which is as little as 15% to 20% will be sent for landfill in the sanitary landfill site.

Approach to Electronic Waste (E waste)

E-waste comprises of wastes generated from used electronic devices and household appliances which are not fit for their original intended use and are destined for recovery, recycling or disposal. Such wastes encompass a wide range of electrical and electronic devices such as computers, hand held cellular phones, personal stereos, including large household appliances such as refrigerators, and air conditioners.

E-wastes are considered dangerous, as certain components of some electronic products contain materials that are hazardous, depending on their condition and density. Some of the components of e-waste contain materials such as lead, cadmium, mercury, and polychlorinated bi-phenyls (PCBs), which are hazardous in nature. Therefore e-waste should be handled in an environment-friendly manner to prevent this hazardous material polluting the environment. Approach to E waste management will include treatment & disposal according to E waste (Management & Handling) Rules, 2010.

Collection, storage, transportation, segregation, recycling and disposal of E waste will be in accordance with the procedures prescribed in the guidelines published by CPCB from time to time.

E waste generated will be channelized through authorized collection center(s) or registered dismantler(s) or recycled or will be returned to the pick up or take back services provided by the producers and will maintain records of e waste generated by them in Form 2 (prescribed by CPCB), and make these records available for scrutiny by State Pollution Control Board (SPCB) or the Pollution Control Committee (PCC) concerned.

It will be ensured that storage of E waste will not exceed a period of one hundred and eighty days and will maintain a record of collection, sale, transfer, storage and segregation of waste and make these records available for inspection.

Awareness among the residents and staff will be created through publication, advertisements, posters, or by any other means of communication and information booklet accompanying the equipment, with regard to:

- Information on hazardous constituents in electrical and electronic equipments
- Information on hazards of improper handling, accidental breakage, damage and/or improper recycling of e waste
- Instructions for handling the equipments after its use, along with Do's and Don'ts
- Affixing a visible, legible and indelible symbol given on the products or information booklet to prevent e waste from being dropped in garbage bins containing waste destined for disposal.

Approach to Bio-medical Waste

'Bio-medical waste' means any solid and/or liquid-waste including its container and any intermediate product, which is generated during the diagnosis, treatment or immunization of human beings or animals. The physico-chemical and biological nature of these components, their toxicity and potential hazard are different, necessitating different methods for their treatment and disposal. Therefore its treatment and disposal has been proposed following the Bio-medical Waste (Management and Handling) Rules, 1998. The biomedical waste will be segregated, treated and disposed off in the existing bio medical waste facilities in Guntur and Vijayawada. As such no new facility is contemplated as the existing facilities can take the new load as well.

Approach to Hazardous Waste

Different sources of hazardous wastes generation include industrial, commercial, agricultural and even domestic activities. However major source of hazardous wastes is the industrial activities. The proponents will ensure that no hazardous waste is mixed or collected along with municipal solid waste. Hazardous waste will be segregated from municipal solid waste and treated separately in accordance with the Hazardous Waste (Management and Handling) Rules, 2000.

Summary of Waste Management Proposed for Amaravati:

- Source segregation would be encouraged with dual and triple chutes system, (Dry/ Wet or Organic/ Inorganic waste)
- The city will have multiple Transfer Station (TS) with Material Recovery Facility (MRF) for secondary segregation and storage of dry waste. TS will be equipped with using mechanized waste separator system
- The waste transportation would be carried out in closed vehicles only.
- About 15 - 18% of waste (residual waste from bio-methanation plant, ash (from Waste to Energy (WtE) Plant and Inert waste) would be sent to Landfill site proposed near Naidupet at Guntur.
- Optimal route and modern closed trucks equipped with GPS for waste transportation
- ICT enabled and fully automated/ controlled system

6.5.2. Environmental Assessment of Air Emission Management

The proposed development will involve air emissions mostly from vehicular emissions. Transport being the major sources of air emissions, planning has considered several options such as integration of transport and land-use, planning to maximise non-motorised modes (walking, cycling) of transport, maximise access to different modes of public transport, etc. The potential impact on air quality would mainly be from:

- Combustion of fuel in standby Diesel Generators
- The operation of diesel generators would be only during the power interruption from supply from the competent authority, when emissions due to combustion of fuel (High Speed Diesel) will take place. The

anticipated key air emissions from the project would be particulate matter, oxides of nitrogen (NOx), Sulphur dioxide (SO_2) and Carbon monoxide (CO).

- Vehicles plying for transportation of raw and finished materials(concrete, blocks etc,)
- Emission of PM_{10}, $PM_{2.5}$, NOx, SOx from D.G set and Vehicular traffic and also dust emission from vehicular movement may pollute the ambient air quality which in turn cause breathing problem to the patients and student and employees.

Regular monitoring of all the air emissions would be carried out as per the Environmental Management Plan during the operation phase. Also, the air dispersion modeling would be carried out at regular intervals. The results of the same will be superimposed on monitored background pollutant concentrations, and, in case of any exceedence, at any point, the required mitigation measures would be implemented.

Power Back Up Facilities

It is envisaged that with the dedicated power supply system in place, power outages are not envisaged. Also, the following mitigation measures shall be implemented by individual projects:

- Location of DG sets shall be done in such a way that they are located downwind of the residential areas;
- Stack heights for DG sets shall be maintained as per CPCB/ MoEF&CC norms;

Industrial Emissions

The Concept Planning has considered the following aspects to minimize the impact on air quality:

- The industrial areas have been located in such a way that the planned residential developments and the existing residential areas surrounding the project boundary lie in the upwind or cross wind direction;
- All industrial development is proposed within the dedicated industrial hub and away from the proposed residential areas and existing settlements;
- Vegetative barrier between residential and industrial/commercial land use, and around STP has been proposed.

For process emissions from industries, the potential mitigation measures based on the existing best industrial practices are provided below. The measures provided shall be adequately implemented and shall be upgraded from time to time based on the latest technological developments.

Each industry shall take appropriate approvals such as Consent to Establish/ Consent to Operate or environment clearance from Andhra Pradesh Pollution Control Board (APPCB)/SEIAA/ MoEF&CC as per the requirements;

- All emission sources shall be provided with adequate stack height as per CPCB/ MoEF&CC norms;

- The industries shall be encouraged to use low emission fuels such as Natural Gas, Low Sulphur Diesel (LSD) or renewable energy sources such as solar lighting & heating, CFL & LED tubes as much as possible;
- The industries shall install appropriate air pollution control equipments such as scrubbers, bag house filters etc. as per the consent conditions provided by State Pollution Control Boards;
- The APPCB shall ensure that the industries maintain adequate housekeeping facilities to minimize fugitive emissions from storage areas and material handling;
- The nodal agency shall work in association with the APPCB to regularly monitor the environmental performance of the industries;
- PP shall organize seminars for industries about the best practices in different industrial sectors;
- PP shall organize Capacity Building training programmes with international partners for APPCB and industries to keep them up to date with latest technological advancements and APPCB shall further encourage industries to adopt the latest clean technologies.

Vehicular Emissions

A well planned transport infrastructure with adequate public transport infrastructure such as BRT (bus rapid transport) and MRT (mass rapid transport) system has been envisaged for the proposed development. The following mitigation measures are proposed:

- All the public transport infrastructure for New City development including the city bus/ transport fleet plying in the city shall be low emission fuel based;
- The Transport Authority will make necessary linkages with APPCB, Motor Vehicles Department and the Traffic Police to ensure infrastructure for pollution checking is maintained and emission norms are implemented;
- Necessary modifications as per the provisions of the Air (Prevention and Control) of Pollution Act 1981 may be initiated at later stages of the project implementation.

6.5.3. Impact Assessment of Socio economic Environment

The socio-economic impact from the development of the area will include the villages falling in the project area and the entire region due to economic change. The village wise opinion and expectation of the people in the project area are given in Table 6-10 the various impacts of the proposed project on the social aspect is presented in Table 6-11.

Table 6-10 Village wise opinion and expectation of people

S. No	Village name	Opinion	Expectations
1	Lingayapalem	Positive	Employment opportunity & medical facility

S. No	Village name	Opinion	Expectations
2	Uddadarayunipalem	Positive	Employment opportunity, transportation & medical facility
3	Velagapudi	Positive	Employment opportunity & transportation facility
4	Nelapadu	Positive	Water, drainage facility and employment opportunity
5	Sakamaru	Positive	Drainage, transportation & water facility
6	Ainavolu	Positive	Water & transportation facility
7	Malkapuram	Positive	Employment opportunity, transportation and medical facility
8	Mandadam	Positive	Water & medical facility, employment opportunity
9	Tallapalem	Negative	More compensation with all infrastructure facilities &employment opportunity
10	Venkatapalem	Positive	Water, transportation facility & employment opportunity
11	Ananthavaram	Positive	Employment opportunity, water and drainage facility
12	Nekkallu	Positive	Medical facility & employment opportunity
13	Thulluru	Positive	Employment opportunity, drainage facility
14	Dondapadu	Positive	Employment opportunity &more compensation to labors
15	Abbarajupalem	Positive	Employment opportunity, drainage & medical facility
16	Rayapudi	Positive	Employment opportunity & water facility

S. No	Village name	Opinion	Expectations
17	Borupalem	Positive	Water & employment opportunity
18	Nulakapet	Positive	Employment to the skilled and educated people & pucca roads
19	Dolas nagar	Positive	Drinking water & employment facility
20	Krishnayapalem	Positive	Employment opportunity, medical facility and drinking water facility
21	Nerukonda	Positive	Employment opportunity, pucca road and drinking water facility
22	Nowluru	Positive	Drainage,pucca road facility & employment opportunity
23	Yerrabalem	Negative	Employment opportunity, drainage & transportation facility
24	Nidamaru	Positive	Employment and training for self employment
25	Kuragallu	Positive	Medical, water facilities and employment opportunity
26	Bethapudi	Positive	Medical and transportation facility & self employment training
27	Ainavolu	Positive	Employment and self employment opportunities, drinking water facility

Table 6-11 Social Impact Assessment of the Proposed Project

Village Name	Agriculture land loss	Jasmine flower loss	Loss of employment	Loss of labor activity	Social development	Economic Development	Infrastructure development	Improvement in Quality of life	Employment & self employment
	Negative impacts				Positive Impacts				
Lingayapalem	√	√	√	√	√	√	√	√	√
Uddandarayunipalem	√	√	√	√	√	√	√	√	√
Velagapudi	√	√	√	√	√	√	√	√	√
Nelapadu	√		√		√	√	√	√	√
Sakhamur	√		√		√	√	√	√	√
Ainavolu	√		√		√	√	√	√	√
Malkapuram	√		√		√	√	√	√	√
Mandadam	√	√	√	√	√	√	√	√	√
Venkatapalem	√		√		√	√	√	√	√
Ananthavaram					√	√	√	√	√
Nekkallu					√	√	√	√	√
Thullur	√	√	√	√	√	√	√	√	√

Village Name	Agriculture land loss	Jasmine flower loss	Loss of employment	Loss of labor activity	Social development	Economic Development	Infrastructure development	Improvement in Quality of life	Employment & self employment
	Negative impacts				Positive Impacts				
Dondapadu					√	√	√	√	√
Abbarajupalem	√		√		√	√	√	√	√
Rayapudi	√		√		√	√	√	√	√
Borupalem	√	√	√	√	√	√	√	√	√
Nulakapet	√		√		√	√	√	√	√
Dolas Nagar	√	√	√	√	√	√	√	√	√
Krishnayapalem	√		√		√	√	√	√	√
Kuragallu	√		√		√	√	√	√	√
Navuluru (OG)	√	√	√	√	√	√	√	√	√
Nidamaru Kuragallu	√		√		√	√	√	√	√
Navuluru (OG)	√	√	√	√	√	√	√	√	√

Village Name	Agriculture land loss	Jasmine flower loss	Loss of employment	Loss of labor activity	Social development	Economic Development	Infrastructure development	Improvement in Quality of life	Employment & self employment
	Negative impacts				Positive Impacts				
Nidamaru	√	√	√	√	√	√	√	√	√
Kuragallu	√		√		√	√	√	√	√
Bethapudi	√	√	√	√	√	√	√	√	√
Yerrabalem	√		√		√	√	√	√	√
Tallapalem	√		√		√	√	√	√	√
Nerukonda	√		√		√	√	√	√	√

6.5.3.1. Pre-Construction Phase Impacts

The impacts in the pre-construction phase of the project are envisaged as;

Impacts on human settlement

Land for the proposed new city development is under the land pooling process and there is no acquisition of the housing structure

Impacts on cultural resources

The famous Undavalli caves and fort, which are Archeologically Important Sites, are located in the Project area. The area will be left as it is, so no negative impact on the cultural resource is anticipated. Further the area is developed as a tourism attraction in the project site.

Loss of Jasmine flower

The major negative impact of the project includes the loss of jasmine flowers in the project area; land pooling covers a large part of the jasmine flower cultivated area. People will loose the current income from the jasmine flower. The income from the jasmine flower is reported as approximately Rupees 2-3 lakhs per acre/ per year.

Loss of agricultural crops

The land required for the project has been acquired from the twenty five affected villages. The land for the project is already in the possession of APCRDA & CA. Present land for the project site area comprises of government owned land and private land. The land largely is agricultural area.

Impact on Livelihoods of Land owners

Long term livelihoods may be impacted for those impacted families whose land has been acquired for the development of the project. Based on the survey by the Consultant, it has come to light that 49% of the population at the site belongs to Non Worker Category. The proponent has already taken steps regarding employability of this category as well.

6.5.3.2. Construction Phase

The construction phase of the Project involves a number of sequential activities, collectively named as “spread”. The area affected by the construction, laying of road, clearing of site, construction of residential, commercial and industrial units, construction of social infrastructure, construction of treatment plant, laying of sewer line, and labor camps areas etc. Based on the assessment of above activities and in consultation with the different stakeholders, the following impacts are being envisaged for the construction phase of the project.

Impacts from the Influx of Migrants

The entire construction phase is expected to continue in a phased manner. This will require labor of unskilled, semi-skilled, skilled and highly skilled nature. However, it is envisaged that outsourced personnel will comprise mostly of skilled laborers and workers.

- Increased community conflicts due to interface between migrants and locals;
- Frequent movement of vehicles and construction equipment may increase safety and accident issues;

- Pressure on limited local resources

Community Health and Safety

- Generation of dust, noise from the construction site which may have health related impacts on the local community;
- Fire Safety from the ongoing construction activities which may include handling and storage of flammable chemicals and materials;
- Improper disposal of sewage into the surroundings;
- Changes in environmental quality due to construction activities;
- Water usage, with a consequent effect on availability of clean water for the community;
- Accident risk to human and animals due to digging up of trenches for laying of pipeline at areas close to settlement areas;
- Increased prevalence of disease arising from the influx of construction workers; and Traffic safety.

Mitigation Measures

- Transportation facility in the region is quite insufficient and not available in most of the villages so proponent may provide bus facility in the region
- Most of the villages have kaccha road in the project area, so proponent may take up repairing and providing pucca roads in the project area
- Health facility in the region is quite insufficient and not available in most of the villages in the project area, so proponent may provide at least one health sub-center in each village of the project area
- Proponent may provide permanent employment to the landless labourers in the region, as they will be deprived of dependable employment within the project area.
- Proponent may provide the ITI and self employment training in the region to improve the employment & self employment opportunities in the region
- For the occupational health and safety concern, workers may require using properly fitting personal protective equipment (PPF) to avoid injuries and illness. Workers must be provided with full protective gear. These include working boots, overalls, helmets, goggles, earmuffs, masks, gloves etc.
- For the development of the project area proponent should provide the water supply, wastewater management, road improvement, upgradation and expansion of telecommunication in the villages of the project area.
- To improve healthcare, recreation facilities, cultural facilities and education opportunities in the study region
- Proponent may develop the plan based on the sound knowledge of the local situations in terms of environmental and social issues

Mitigation measures with respect to Community Health and Safety during development

Potential impacts during construction period include impact due to the influx of migrants and associated health related risk to the community. These impacts are expected to be moderate and with the implementation of the following mitigation measures, they can be off-set.

- Engage as many locally available unskilled, semiskilled and skilled human resource as practically possible to avoid large scale in migration of labor force;

- Provision of infrastructure and amenities for migrant labor in construction camp to avoid dependence on limited local resources;
- Barriers will be provided to prevent ingress of persons into the construction site and also to protect public exposure to hazards associated with construction activities;
- Additional safety precaution while working in market and settlement areas and especially around the trenches;
- Screening, surveillance and treatment of workers, through the provision of medical facilities and, where required, immunization programmes.
- Prevention of larval and adult propagation through sanitary improvements and elimination of breeding habitats close to human settlements in the close vicinity of construction site;
- Implementation of a vector control programme.
- Avoiding collection of stagnant water;
- Educating project personnel and area residents on risks, prevention, and available treatment for vector-borne diseases;
- Promoting use of repellents, clothing, netting, and other barriers to prevent insect bites;
- Following safety guidelines for the storage, transport, and distribution of pesticides to minimize the potential for misuse, spills, and accidental human exposure; and Road safety measures.

6.6. Project Risk Analysis

The construction and operation stage of Amaravati does not involve any hazardous chemical process which can create potential risk to personnel and property at the site and surroundings. Risk assessment studies has been carried out for identification of hazards associated mainly with the construction activities involved in the project and to enhance the safety.

The primary emphasis in safety engineering is to reduce risk to human life and environment. The broad tools attempt to minimize the chances of accidents occurring. There always exists, no matter how remote, that small probability of a major accident occurring.

6.6.1. Scope of Risk Assessment

- Risk assessment of construction problems, causes, potential Hazards/ Likely environmental, occupational and social risk.
- Identification and systematic evaluation of possible corrective actions Expected outcomes pre & post construction phase-Analysis of specific problems
- Costs/benefits of possible corrective actions
- Corrective action plan that will allow project proponent to maintain (or recover) schedule and avoid accidental losses during & after construction activities

6.6.1.1. Qualitative Risk Assessment

The project is proposed for Residential, Commercial, Industrial Public and Semi Public and Utility Buildings and Educational Institutes along with Medical Hub, Engineering Hub, Industrial Training Institute Hub.

Major civil work excavation required for Water Supply and Fire Fighting network, Sewage Collection System and Treatment, Storm Water Management, Information Communication Technology Network, Domestic Gas Distribution Network, Power Supply, Site Grading and Internal Roads.

The project may cause environmental risk such as loss of flora & fauna, deterioration of air quality due air emission, solid waste disposal etc; however proactive steps will be taken to control air, water noise & environment damages during pre and post construction phase.

Inherent risk during construction like fatal accidents, fire, explosion, falling from height, occupational injuries, excavation, welding, material shifting, Loading/unloading are discussed in this report and relevant mitigation measures are also suggested.

Some of the common risks during operation phase of the project, risk of fire, explosion due to LPG, traffic fatal accidents, Industrial accident due to Manmade & natural calamities.

Infrastructure/ Construction Activities

Transportation

Transportation for sourcing construction material will be required. Trucks and other vehicular movement may lead to risk of accidents and Hazards created by Air, Dust & Noise pollution. This will not only affect workman but also residents of allied village. Qualitative hazards with control measure are stated in Table 6-12.

Table 6-12 Qualitative Risk Assessment during Construction Activities

S. No	Activity	Hazards	Likelihood / Consequence	Control Measures
1	Raw material Stone		D	1) Work as per Safe operating Procedures 2) Use of PPE/PPA 3)Avoid Manual operation 4) Safety supervision / communication
	crusher- coarse		C	
	aggregate and fine aggregate capacity		C	
	truck load 12MT		C	
2	Transportation	Road accidents	C	1) Follow strict Motor Vehicle Rules 2)PPE/PPA/First aid Box/Communication 3) Proper planning for avoiding Traffic congestion 4) Authorized & Trained Driver 5) During unloading using fluorescent colored high visibility apparel. 6) Truck/tipper floor Checks 7) Visual and auditory contact of the road worker
	Crusher to site	Dust evolution	D	
	Tipper/Trucks	Spillage on road	D	
3	Unloading / spreading	Fatal accident	C	1) Permanent right-of-way to provide room for materials 2) Use of PPE/PPA/ Barricade / Safety sign display on Road / Caution board Display
	Leveling	Body injury	D	
4	Site Clearance/ Borrow Pits/ Quarrying using (a)Wheeled and crawler tractors, loaders and dozers;	Fetal Operators may get killed in machine roll-overs	B	1)Roll-over protective structure and a seatbelt to restrain the operator 2) Provide a supplementary steering system 3) Valid approval for

S. No	Activity	Hazards	Likelihood / Consequence	Control Measures
	(b) Motor graders and scrapers; (c) Self-propelled rollers and compactors			operating nuclear gauge from the appropriate authority
5	Earth work	falling or sliding material or article from any bank or side of such excavation	D	1) Provide adequate piling and bracing against such bank or side 2) Provide adequate shoring 3) Excavated material not to store at least 0.65 m from the edge of an open excavation or trench2 4)Provide metal ladders and staircases or ramps are provided
6	Movement of trucks numbers 50 - 500	Fall over Tip Head	C	1)A protective beam or timber Baulk should be used. 2) Back under the control of a signalman
7	Bulldozers	1) Fetal Accident 2) Injuries 3) Dusty environment 4) High Noise hazards	C	1) Avoid side hill travel 2) Avoid obstacles such as rocks or logs 3)Avoid overhanging material to fall due to vibration/ Load 4) Do not work alone in deep water
8	Excavators	1) Fetal Accident 2) Injuries 3) Dusty environment	C	1) When excavating trenches, place the excavated material at least 600 mm clear of the edge9

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S. No	Activity	Hazards	Likelihood / Consequence	Control Measures
		4) High Noise hazards		2) Avoid swinging your boom downhill any further than necessary 3) Maintain Stability, Watch boom clearance when travelling, Avoid jerky swings or sudden braking
9	Backhoe loader	1) Fetal Accident 2) Injuries 3) Dusty environment 4) High Noise hazards	C	1) Operate the backhoe from the correct area, Never from the ground. 2) When operating on a slope, swing load uphill to dump 3) Select a level site While Parking 4) Lower bucket and backhoe to ground and block wheels 5) Engage parking brake, remove ignition key (parking)
10	Motor Grader	1) Fatal Accident 2) Toppled down 3) Physical Injury	C	1) Give the right-of-way to loaded vehicles 2) Drive at a slow speed in congested areas 3) Remove ignition key when leaving grader. 4) Ground the blade when leaving grader unattended. 5) Use colored flags at each end of moldboard when blading. 6) Shift blade to center and lock it when parking.
11	Smooth wheeled tandem roller	1) Fetal Accident 2) Injuries 3) Dusty	C	1) Examine edges for soft Spots before starting work.

S. No	Activity	Hazards	Likelihood / Consequence	Control Measures
		environment 4) High Noise hazards		2) Avoid gear changes on steep sections 3) Park on the flat
12	Vibratory Roller	1) Fetal Accident 2) Injuries 3) Dusty environment 4) High Noise hazards	C	1)Use Rollover Protection safety when the machine is operated over unsafe ground 2) Use a three-point approach when entering or exiting the roller.
13	Surface courses	1) Accident. 2)Fire, severe burns ,Eye Injury, 2)Inhalation of Toxic gases	C	1)Use proper safety equipment 2) Avoid wear rings, wristwatches, jewelry, loose or hanging apparel 3) Keep away from the machine's articulation area when the engine is running.

Note: A-Remote, B- Unlikely, C- Likely, D- Highly likely, E-Near certainty

Site excavation work

Major work during initial project phases is to provide Pipeline for water supply, Natural Drainage system and main trunk road development. Thus some excavation work will be required to be undertaken, as per Concept Plan.

Site excavation Risk:

- A person falling into an excavation
- A person being trapped by the collapse of an excavation
- A person working in an excavation being struck by a falling thing
- A person working in an excavation being exposed to an airborne contaminant.
- To manage the risks, all relevant matters must be considered including: i) The nature of the excavation ii) The nature of the excavation work, including the range of possible methods of carrying out the work
- The means of entry into and exit from the excavation

Identifying the Excavation Hazards

The first step in the risk management process is to identify the hazards associated with excavation work. Examples of excavation specific hazards include:

- Underground essential services including gas, water, sewerage, telecommunications - Underground services network not found being reclaimed land
- Electricity, chemicals and fuel or refrigerant in pipes or lines. Information about the - Underground services network not found being reclaimed land
- Location of these and other underground services, such as drainage pipes, soak wells - Underground services network not found being reclaimed land.
- Any storage tanks, in and adjacent to the workplace, must be established before; Underground services network not found being reclaimed land
- Directing or allowing excavation work to Amaravati Capital City project, Controlled by site engineer through Site supervisor
    - The fall or dislodgement of earth or rock
    - Falls from one level to another
    - Falling objects
    - Inappropriate placement of excavated materials, plant or other loads
    - The instability of any adjoining structure caused by the excavation
- Any previous disturbance of the ground including previous excavation
- The instability of the excavation due to persons or plant working adjacent to the excavation
- Hazardous atmosphere in an excavation – To be checked before work vibration and hazardous noise from Excavators & Overhead essential services (power lines) and ground mounted essential services – During visit, HT/LT overhead lines noticed in propose plot area

6.6.2. Risk Mitigation / Remedial Measures

6.6.2.1. Construction Phase

Controlling the Excavation risks

- Substitution – use an excavator with a rock breaker rather than manual method
- Isolation – Use concrete barriers to separate pedestrians and powered mobile plant to reduce the risk of collision
- Engineering Controls – Apply benching, battering or shoring the sides of the excavation to reduce the risk of ground collapse.

If risk remains, it must be minimized by implementing administrative controls, so far as is reasonably practicable, for example by installing warning signs near the excavation.

Any remaining risk must be minimized with suitable Personal Protective Equipment (PPE), such as providing workers with hard hats, hearing protectors and high

visibility vests. Administrative control measures and PPE rely on human behavior and supervision and used on their own tend to be the least effective in minimizing risks.

Factors for suitable control measures

- Excavating plan - when quantities are large, it may be effective to use for the various materials to be excavated
- Stockpiling arrangements – Proper site may need to be found for temporary stockpiling of materials should not dissolve and drained during Monsoon leads to water pollution
- Material placement - the methods and plant used for excavating, transporting and compaction of the material should be evaluated.
- Dewatering equipment, if required, and the system to be used, transport of the excavated material - the type of plant used length of haul, the nature of the haul route, and the conditions of tipping and/or spreading.

For Excavation planning to minimize functional Risk to workers and society following steps are required:

- Study nature and/or condition of the ground and/or working environment
- Predict weather conditions
- Consider nature of the work and other activities that may affect health and safety
- Calculate static and dynamic loads near the excavation
- Storm Water Management System
- vibration
- Select proper type of equipment used for excavation work
- Plan for public safety
- Go through existing services and their location
- The length of time the excavation is to remain open
- Provision of adequate facilities
- procedures to deal with emergencies

Table 6-13 Common hazards associated with excavation work and examples of control measures:

Potential hazards	Examples of control measures
Ground collapse	The use of benching or the installation of ground support (e.g. shoring)
Water inrush	Pumps or other dewatering systems to remove water and prevent build-up
Hazardous manual	Ramps, steps or other appropriate access into the

Potential hazards	Examples of control measures
task	excavation
Airborne contaminants	Rotating tasks between workers
Buried contaminants **(e.g. asbestos)**	Mechanical ventilation to remove airborne contaminants
Underground services	Obtain information from the relevant authorities on the location of underground services.

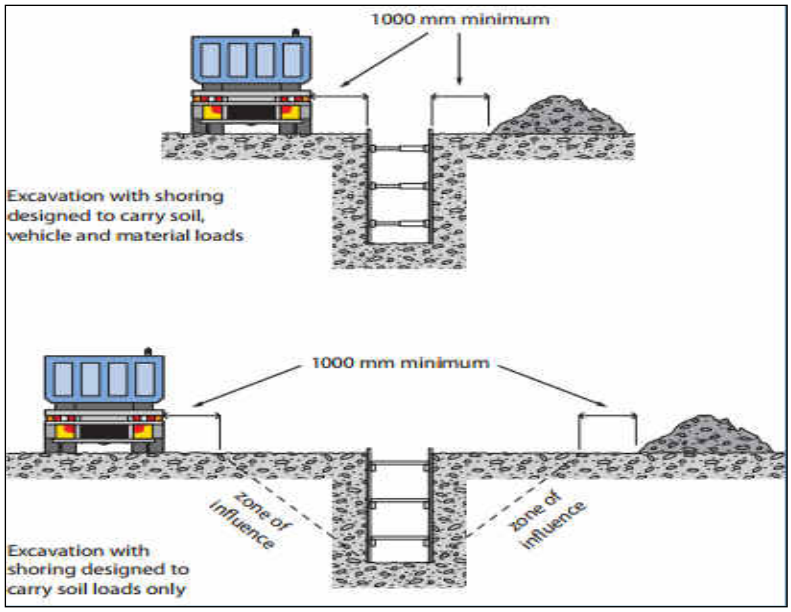

Figure 6-3 Excavated material and loads near excavations

Fig 6-3 shows an excavation with shoring that has been designed to carry vehicle and material loads. This may be required where there is limited space around the excavation for vehicle movement and /or material storage. An excavation with shoring that has been designed only to carry the load of the excavated faces and the related zone of influence.

Any material will add a load to the area where it is placed. It is important that materials are not placed or stacked near the edge of any excavation as this would put persons working in the excavation at risk. For example, the placement of material near the edge of an excavation may cause a collapse of the side of the excavation.

To reduce the risk of ground collapse, excavated or loose material should be stored away from the excavation. Excavated material should be placed outside the zone of influence. Alternatively, a ground support system should be designed and installed to carry the additional loads, including any ground water pressures, saturated soil conditions and saturated materials.

Mobile plant operator blind spots

Powered mobile plant operating near ground personnel or other powered mobile plant should be equipped with warning devices (e.g. reversing alarm and a revolving light).

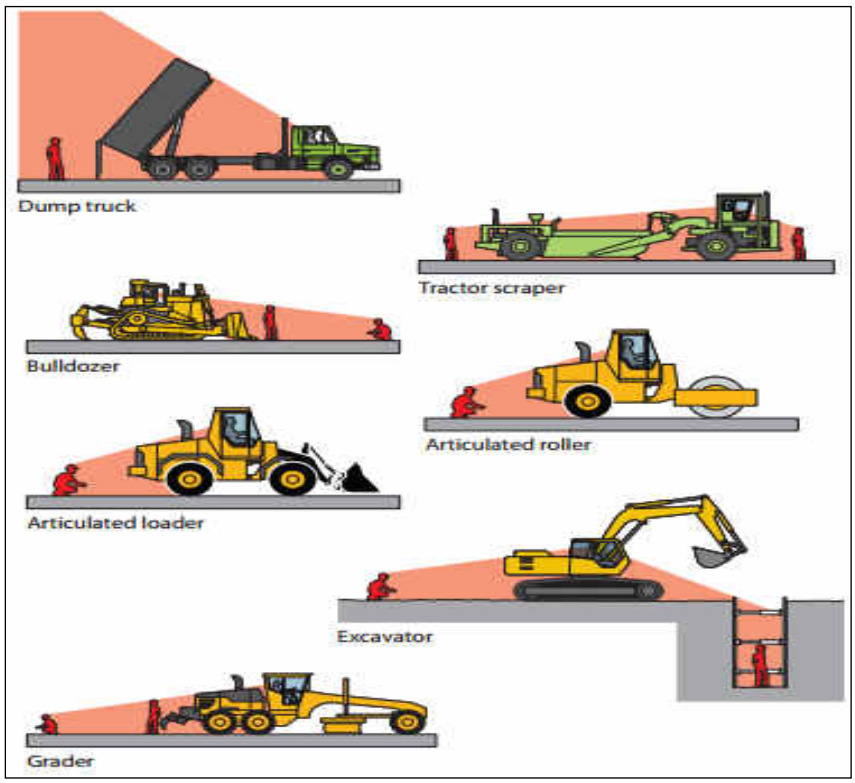

Figure 6-4 Mobile plant operator blind spots

An effective system of communication based on two way acknowledgement between mobile plant operators and ground workers should be established before work commences. Relevant workers should also be trained in the procedures involved prior to the work commencing. The system should stop ground workers from approaching mobile plant until the operator has agreed to their request to approach. Similarly the system should stop operators from moving plant closer than a set distance from ground workers until the operator has been advised by ground workers that they are aware of the proposed movement.

Mobile plant operators and ground workers should be made familiar with the blind spots of particular items of plant being used. Induction training programs should emphasis the dangers of workers working in close proximity to mobile plant, and adequate supervision should be provided.

Mobile plant operators and ground workers should be provided with and required to wear high-visibility clothing.

Table 6-14 presents the risk and remedial measures during the pre and post construction phase.

Table 6-14 Risk and remedial measures pre and post construction phase

S. No	Operations	Risk/Impact	Remedial Measures

S. No	Operations	Risk/Impact	Remedial Measures
1	Tower Crane	Injury. Fatal accident. Contact with High Voltage Live wires	Certified by Competent person Operated by trained personal. Preventive maintenance, Use work permit system. PPE/ PPA use Safe operating Procedures
2	Batching Plant	Reportable Accident , Ice plant Ammonia leakages	Certified by Competent person Operated by trained personal. Preventive maintenance, Use work permit system. PPE/PPA use Safe operating Procedures
3	Construction/material Hoists	Personal injury Accidents	Only approved hoist to be used by trained employees With safe area demarcation Use PPA/ PPE
4	Passenger lift/ Post construction phase	Fatal/ major Accident	Certified/ approved passenger lift to be used by trained employees With safe area demarcation Use PPA/PPE
5	Portable electrical equipment pre & post construction	Burn/fatal	To be checked before use by Approved Electrical safety official/use PPE/ PPA
6	Pressure vessels	Pressure air Rupture	Compressors For Jack Hammer AHU (Air conditioning)Ice Plant Inspection of Safety valve, proper rubber fittings. Vibration to be avoided Use of PPE/PPA. Training
7	Hazardous substances	Fire, explosion	Storage of Bulk Fuel. Paints, Plastic

S. No	Operations	Risk/Impact	Remedial Measures
	paint/ thinner, waxes Plastics sheets	Toxic release Unhygienic Dust.	Plywood Combustible, Store as per HAZMST Rules. PPE/ PPA Training
8	Scaffolding	Fall from Height Fatal accident	Introduction of Working on Height permit system. PPE/PPA/ safety belt/Training
9	Ladders	Accident, Injury	Proper selection. Inspection. PPE/ PPA, Training
10	Lifts	Accidental, Injury Even Fetal	Inspection by competent person. Safe work instruction Correct Use, Training. Testing before use for SWL Use of PPE/ PPA
11	Hoists	Accidental, Injury	Inspection by competent person. Safe work instruction Correct Use, Training. Testing before use for SWL Use of PPE/ PPA Fencing
12	Material handling cranes	Accidental, Injury Even Fetal	Inspection by competent person, Ergonomic training, Use of PPE/ PPA, Safety Guards
13	Rigging during erection work of STP/ Solid waste disposal plant	Accidental, Injury	Inspection by competent person, Ergonomic training, Use of PPE/ PPA, Safety Guards
14	Using tools/equipment with moving part(s)	Nipping Injury to Hand Electrical Shocks Leg Injury	Proper selection of Hand tool. Periodic Inspection Use of proper hand glove PPE/ PPA. Training. Safety guard in case of Grinder,
15	Using tools/ equipment that	Vibration hazard	Inspection by competent person, Ergonomic training,

S. No	Operations	Risk/Impact	Remedial Measures
	vibrate Electrical wiring Asbestos removal Welding	Electrical shocks Asbestosis Eye, Body Burns Toxic gases inhalation	Use of PPE/ PPA, Safety Guards
16	Working around electrical installations/ working near traffic/ working at a height (>3m)/ Working in isolation. Working in a confined space/ demolition work	Electrical shocks, Injury Fatal accident Hazard of toxic Gases inhalation	Work by Authorized trained person, Indian electrical safety rules to be fallowed. Work permit system, Work environment in confined space, Use of PPE/ PPA
17	Work environment Noise Dust/ fumes/ vapours/ gases Extreme temperatures Slippery surfaces/ trip hazards Poor ventilation/ air quality A poorly designed work area for the project/ task	Accidental Injury, Occupational Hazards. Rashes Burn Skin deceases	Enclose noise source, Lubrication. Min time exposure. Use of PPE/ PPA Good Housekeeping , Illumination survey, Trainings

6.7. Disaster Management Plan

This section of the report presents an outline of disaster management plan for the Amaravati city. The purpose of the disaster management plan is to identify potential

foreseeable accidents/ emergency situations and establish and maintain procedures to address or prevent such situations, as well as to test the effectiveness/review/revise such procedures periodically.

It is to be noted that this Disaster Management Plan (DMP) provides only an overview of the applicable norms. The proponent will insist on development and implementation of an individual emergency response plan or disaster management plan by every contractor/ stakeholder that will be involved in the project development. This will be made as a pre-requisite for engagement in the project.

6.7.1. Emergency/ Disaster Preparedness Plan

The basic approach towards preparedness for any major disaster or emergency situation will comprise of the following activities:

- Identify the potential disasters likely to occur;
- Establish a Disaster/ Emergency Response Team (ERT) to implement emergency procedures;
- Develop a detailed Emergency/ Disaster Response Plan with details regarding the course of action to be followed in order to minimize personal injury and property damage in the event of fire, flood, loss of ground, or natural disaster;
- Train the personnel in planning and responding to an emergency;
- Carry out audits of individual establishments on a regular basis to monitor the Emergency Response Plans and the corresponding procedures. The audits will include review of the following:
  - The roles and responsibilities of the respective ERT and support organizations;
  - Adherence of individual project activities to safe practices; and
  - Resource requirements, condition of equipments and their availability.

6.7.1.1. Identified Emergency Situations

The potential hazards identified for the project include the following:

- **Natural Hazards:**
  - Floods
  - Earthquakes
  - Fire hazards
  - Cyclones
- **Technological or Social Hazards**
  - Transportation accidents
  - Hazardous materials releases
  - Social disorder
  - Energy shortages
  - Food and water supply contamination
  - Terrorism

6.7.1.2. Organizational Structure

Disaster Management Committee

Proponent shall constitute a Disaster Management Committee (DMC). This committee will be headed by Commissioner AP CRDA & CA. The DMC will be the apex planning body and will play a major role in preparedness and mitigation of any disaster. The cell will have the following key functions:

- Preparation of comprehensive Disaster Management Plan;
- Setting up of Emergency Control Centre during emergency situations;
- Coordination with District Disaster Control Room of Guntur district;
- To supervise emergency response measures in case of any emergency;
- Keep track of predictable natural hazard events such as floods, cyclones etc.;
- Organize training and capacity building programmes on disaster management for individual establishments in the Project Region;
- Periodic monitoring of Emergency Response Plans and the corresponding procedures of individual establishments;
- Organize post – Disaster evaluation and update DMP accordingly;
- Prepare reports and document on Disaster events and submit the same to District Control Room. The documents shall include:
  - Source & cause of Disaster
  - Description of the response efforts.
  - Recommendation for preventive & mitigation measures.
  - Plan for upgrading emergency preparedness and response plan

The Organizational structure for the Disaster Management Committee is presented in **Figure 6-5**.

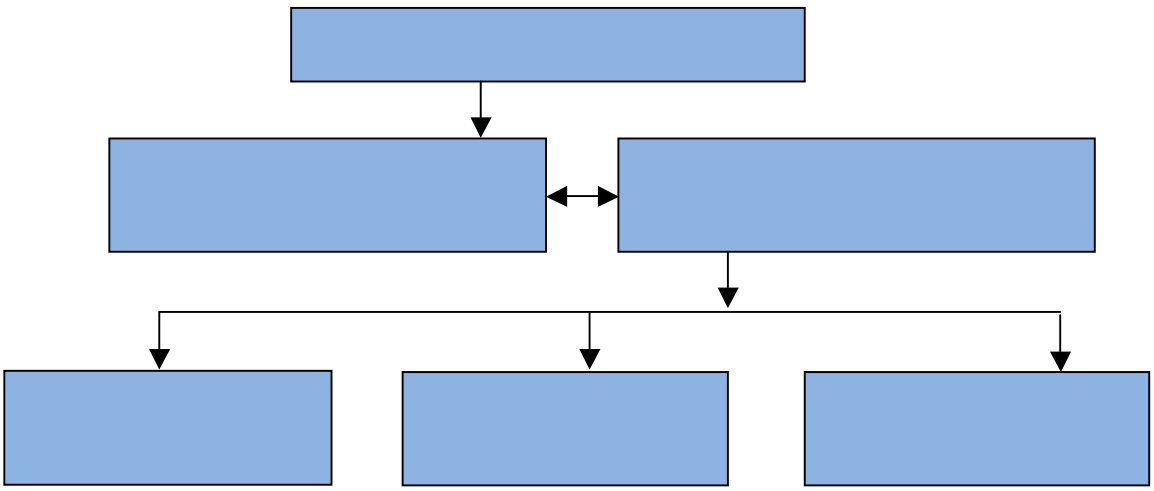

Figure 6-5 Organizational structure for the Disaster Management

The DMC will have the following departments/teams:

Disaster Tracking Unit

The primary function of this unit shall be to keep track of foreseeable natural hazards such as floods, cyclones etc. The unit shall continuously coordinate with the Regional Meteorological Centre (RMC) and Indian Meteorological Department (IMD), Gannamvaram in order to monitor disaster warnings and weather conditions in the region. On account of any extreme event predictions, the unit shall communicate the same to the Disaster/Emergency Response Team which will issue warnings in the entire Region.

Disaster/ Emergency Response Team

The Emergency Response Team shall perform the following functions:

- Advise the DMC as to whether the declaration of an emergency is recommended;
- Advise the DMC on the need to designate all or part of the Amaravati City as an emergency area;
- Appoint an Emergency Control Centre;
- Determine if the location and composition of the Emergency Control Centre are appropriate;

The Emergency Response Team shall form an Emergency Control Centre (ECC) in case of any emergency situations. The Team shall coordinate with other agencies such as:

- Fire Brigade
- Police Department
- Hospitals/Ambulance
- Technical Departments such as Factory Inspectorate, Pollution Control Board etc.
- Local; Authorities/District Administration

Training Centre

The training centre shall be responsible for the following activities:

- Dissemination of information about the Comprehensive DMP developed;
- Organize capacity building workshops for the personnel of the Disaster Management Cell;
- Organize training programs such as mock drills, emergency evacuation procedures in schools, offices, residential colonies and industrial areas;
- Work in association with Residential Welfare Associations and Industrial Groups for creating awareness about the disaster preparedness.

6.7.1.3. Emergency Response Procedures

Effective command and control starts with a clear definition of the overall command and control structure, and description of the duties of key personnel with specific responsibilities for emergency response. The control of emergencies will consider the minimum number of persons required to provide an adequate response to emergencies.

- All emergencies occurring as a result of project activities shall be managed according to the following order of priorities:
- Preservation of Life (self, team, community);
- Protection of the Environment;
- Protection or Property/assets; and,
- Preservation of Evidence.

The roles and the responsibilities of various departments during emergency situations as defined in Section have been discussed in the following section:

Emergency Control Centre (ECC)

The emergency control centre shall be formulated in case of emergency situations by the DMC. The ECC shall be chaired by the head of Regional Development Authority and will have representatives from Police, Fire Department, Hospitals, Factory Inspectorate and District Administration. The interaction matrix between ECC and other departments has been presented in **Figure 6-5**. The ECC shall perform the following functions:

- Co-ordinate the acquisition, distribution and scheduling of various modes of transport (i.e. public transit, school buses, trains and trucks) for the purpose of transporting persons and/or supplies, as required;
- Determine if additional transport is required for evacuation or transport of persons and/or supplies;
- Discontinue utilities or services provided by public or private concerns without reference to any consumers in the region, or when continuation of such utilities or services constitutes a hazard to public safety within an emergency area;
- Disperse people not directly connected with the operations who by their presence are considered to be in danger or whose presence hinders in any way the efficient functioning of emergency operations;
- Authorize the evacuation of those buildings or sections within an emergency area which are themselves considered to be dangerous or in which the occupants are considered to be in danger from some other source;
- Authorize casualty collection and evacuation in support of emergency health care authorities;
- Coordinate with other departments such as Police, Fire Department etc;
- Arrange for services and equipment from local agencies not such as private contractors, volunteer agencies etc.;
- Arrange for accommodation and welfare, on a temporary basis, of any residents who are in need of assistance due to displacement as a result of the emergency;
- Arrange assistance from senior levels of Government as per requirements.

The following information and equipment shall be available at the Emergency Control Centre (ECC).

- Intercom, telephone;
- P and T telephone;
- Breathing apparatus;
- Fire suit/gas tight goggles/gloves/helmets;
- Hand tools, wind direction/velocities indications;
- Public address megaphone, hand bell, telephone directories (internal, P and T);
- Emergency lamp/torch light/batteries;
- Emergency shut-down procedures;
- List of key personnel and list of Emergency coordinators;
- Duties of key personnel;
- Address with telephone numbers and key personnel, emergency coordinator, essential employees;

- Important address and telephone numbers including Government agencies, neighboring industries and sources of help, outside experts, chemical fact sheets, population details.

Police Department

The Police Department shall perform the following actions:

- The overall responsibility of police shall be to maintain law and order during and post disaster situation in the context of disaster management;
- Prepare a departmental disaster response plan and Standard Operating Procedure (SOP) in which roles and responsibilities are clearly defined. The plan and SOP shall be submitted to the DMC;
- Prepare a database of nodal person at State, District and taluka level and share with DMC;
- Police personnel shall be trained in search and rescue (flood rescue, collapse structure, rope rescue, etc) during normal time and database of such trained personnel shall be shared with the DMC;
- Overall traffic management (access roads to disaster site, roads to be made one-way, to be blocked, alternate routes, etc.) and patrolling;
- Provide security in transit and relief camps, affected areas, hospitals and medical centers and identify areas to be cordoned off;
- Establish communication with the ECC, District Control Room and nearest Police station to the disasters site;
- Additional deployment of police, if required, to inquire into and record of deaths;
- Provide convoys for relief materials;

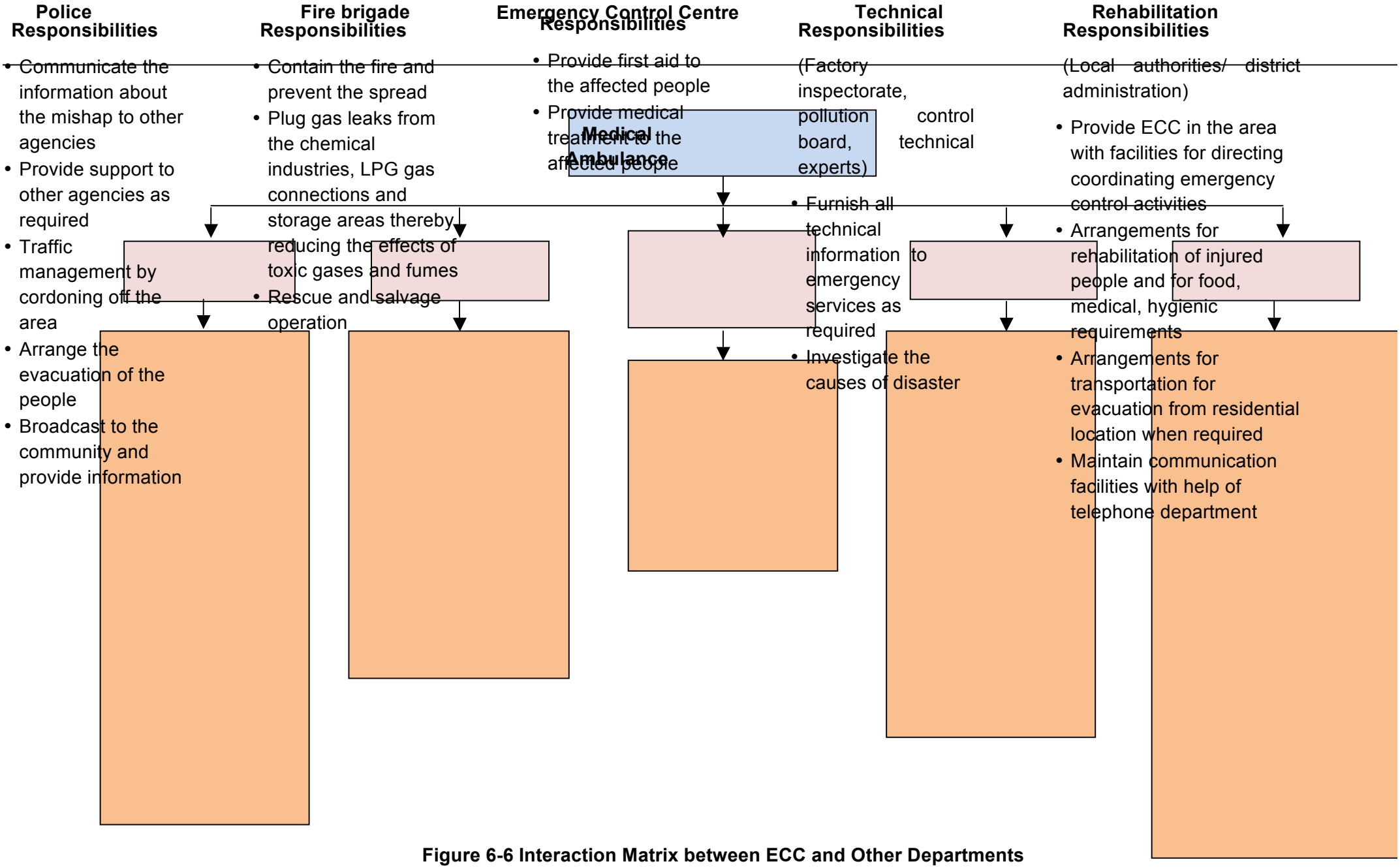

Figure 6-6 Interaction Matrix between ECC and Other Departments

- A public information system to be activated for passing information related to injured, dead, missing persons, etc.;
- Regularly conduct mock drill by simulating different disasters to check preparedness, coordination and scope of improvement. The report shall be submitted to the DMC;
- Assist DMC and ECC in evacuation of people from the vulnerable areas.

Fire Department

The Fire Department shall perform the following actions:

- The overall responsibility of fire department shall be to effectively and efficiently undertake the emergency fire evacuation procedures;
- Prepare a departmental disaster response plan and Standard Operating Procedure (SOP) in which roles and responsibilities are clearly defined. The plan and SOP shall be submitted to the DMC;
- Prepare a database of nodal person at State, District and taluka level and share with DMC;
- Fire personnel shall be trained in fire evacuation procedures during normal time and database of such trained personnel shall be shared with the DMC;
- Establish communication with the ECC, District Control Room and nearest Fire station to the disasters site;
- Additional deployment of fire safety personnel, if required, to inquire into and record of deaths;
- Regularly conduct mock drill by simulating different disasters to check preparedness, coordination and scope of improvement. The report shall be submitted to the DMC;
- Assist DMC and ECC in evacuation of people from the vulnerable areas.

Health Department

The Health Department shall perform the following actions:

- The overall responsibility of health department is to effectively and efficiently undertake the emergency heath activities in the aftermath of disasters and take measures to check the outbreak of epidemic in the post disasters situation;
- Prepare a departmental Emergency Health Management Plan including, hospital specific plan shall also be prepared. Apart from plan, SOP shall be prepared which clearly delineates the roles and responsibilities;
- The plan shall cover mass casualty management, triage (prioritization of patients), trauma counseling, mobile team which may be deployed at sites, procedure for coordinating with private hospitals and availing its services, etc.;
- A database of nodal officer at State, district and hospital specific shall be prepared for emergency health services and shared with the DMC;
- Periodic review of the stocked emergency medicines and equipment required during the disasters;
- The epidemic surveillance and water quality monitoring shall be done at transit camps, relief camps, affected areas and feeding centers;
- The central warehouse shall be kept informed for dispatch of supplies likely to be needed, to hospitals, on an emergency priority basis;

- Establish communication with the ECC District Control Room, Police and the medical team at the disasters site;
- A public information system to be activated for passing information related to patients admitted at the hospital;
- Mock drill on mass casualty management at hospital level and Project level shall be organized twice in year. The mock drill shall check the activation and response time of emergency medical teams, coordination with other agencies, areas of improvement, etc. The report shall be submitted to the DMC
- The medical officers and staffs shall be trained in triage (system for prioritization of patients).

Electricity Department

The Electricity Department shall perform the following actions:

- The overall responsibility of Electricity Board is to restore the power supply at the earliest in the aftermath of disasters and ensure uninterrupted power to all vital installation, facilities and sites.
- Prepare a departmental and district specific disaster management plan and submit it to the DMC. In addition to the plan, SOP shall be prepared which clearly delineates the roles and responsibilities.
- The plan shall cover basic information, vulnerability analysis, response plan, preparedness measures and long-term measures. The long-term measures include construction of multi-hazard resistant future power facilities and premises and retrofitting of existing department buildings.
- A disaster management team and emergency tool kit comprising cable cutters, pulley blocks, jungle knives, axes, crowbars, ropes, hacksaws and spanners shall be kept in the state of readiness at each sub-station. Tents for work crews shall also be part of the kit.
- A database of nodal officer at State and district shall be prepared for emergency power services and shared with DMC respectively.
- Standby arrangements for temporary electric supply or generators made for hospitals, water department, Collect orate, police stations, telecommunications buildings, transit camps, feeding centers, relief camps and other critical buildings and installations in case warning for disaster is received.
- Immediately undertake inspection of high tension lines, towers, substations, transformers, insulators, poles and other equipment from the time of receipt of alert warning.
- Establish communication with the ECC, District Control Room and teams at the disasters site.
- Mock drill on mass casualty management at state and district level shall be organized twice in year. The mock drill shall check the activation and response time of emergency power restoration teams, coordination with other agencies, areas of improvement, etc. The report shall be submitted to DMC.
- The officers and staffs shall be trained in emergency management.

Water Supply Department

The Water Supply Department shall perform the following actions:

- The overall responsibility of Water supply department is to ensure supply of regular water;
- Prepare a departmental and district specific disaster management plan and submit it to the DMC. In addition to the plan, SOP shall be prepared which clearly delineates the roles and responsibilities;
- Plan shall cover basic information, water supply plan in the event of disasters, prioritization of water supply services to the critical installations, water supply restoration plan in the event of disaster, formation of emergency team;
- A database of nodal officer at State and district shall be prepared for emergency water services and shared with DMC respectively;
- Several teams of engineers and assistants for restoration of water supply services shall be constituted as precautionary measure;
- It shall also make provisions to acquire tankers and establish other temporary means of distributing water on an emergency;
- Required stock of lengths of pipe, connections, joints, hydrants and bleaching powder. Adequate tools shall be on hand to carry out emergency repairs. Also generator shall be identified for the emergency;
- In case of receipt of disaster warning, wells, intake structures, pumping stations, buildings above ground, pumping mains and treatment plant shall be monitored;
- After any repair of the distribution system, the repaired main shall be flushed and disinfected with a chlorine solution;
- Establish communication with the ECC, District Control Room and teams at the disasters site;
- A public information centre shall be established with a means of communication, to assist in providing an organized source of information. It may keep the community informed of its potential and limitations in disaster situations;
- Mock drill on emergency water management shall be conducted at State and district level at least once in year. The report shall be submitted to DMC

Public Works Department

The Public Works Department shall perform the following actions:

- The overall responsibility of public works department [PWD] is to restore the damaged public buildings and structures;
- Prepare a departmental and district specific disaster management plan and submit it to the DMC. In addition to the plan, SOP shall be prepared which clearly delineates the roles and responsibilities;
- The plan shall cover basic information, response structure of PWD team, restoration plan for public utility structures in case of disasters, formation of emergency team;
- A database of nodal officer at State, district and hospital specific shall be prepared for emergency health services and shared with the DMC;
- Several teams of engineers and assistants for restoration of PWD structures & roads shall be constituted as precautionary measure;

- It shall prepare database and stock the emergency equipment such as cranes, dumpers, earth movers, crosscut saws, axes, power chain saw with extra fuel, oil, sharpening files, chains and tightening wrenches, pulley with chain, ropes etc.;
- It shall inspect all buildings and structures of the state government (including hospital buildings) by competent engineer once in a year and may be before monsoon;
- Establish communication with the ECC, District Control Room and teams at the disasters site;
- A public information centre shall be established with a means of communication, to assist in providing an organized source of information. It may keep the community informed of its potential and limitations in disaster situations;
- Mock drill on emergency management shall be conducted at State and district level at least once in year. The report shall be submitted to DMC.

CHAPTER 7

ENVIRONMENTAL MONITORING PROGRAMME

7.1. Introduction

Regular monitoring of environmental parameters is of immense importance to assess the status of environment during project operations. With the knowledge of baseline conditions, the monitoring programmed will serve as an indicator for any deterioration in environmental conditions due to operation of the project, to enable taking up suitable mitigation steps in time to safeguard the environment. Monitoring is as important as that of control of pollution since the efficiency of control measures can be determined by monitoring.

7.2. Objectives of Environmental Monitoring Plan

The key issues associated with the life cycle of a project are the monitoring of environmental parameters. Three types of environmental monitoring are associated with the project, which project period to determine existing conditions ranges of variation and process of change. Effects/impact monitoring involves measurements of environmental variable during construction and operation phase of the project to assess the impact that may have been caused by the project. Finally compliance monitoring takes the form of periodic sampling and continuous measurements of level of pollutant emissions in the air, waste discharge on land or water, level of noise to ensure that standards are met. The basic objective of the environment monitoring program is:

To ensure implementation of mitigation measures during project implementation;

- To provide feedback to the decision makers about the effectiveness of their actions;
- To determine the project's actual environmental impacts so that modifications can be made to the mitigation measures;
- To identify the needs for enforcement action before irreversible environmental damage occurs;
- To provide scientific information about the response of an ecosystem to a given set of human activities and mitigation measures.

7.3. Environmental Monitoring and Reporting Procedure

Proponent will set up an Environmental Monitoring Cell (EMC) to review the effectiveness of environment management system during construction and operational phase of New Capital City. EMC will work out a schedule for monitoring and will meet regularly to review the effectiveness of the EMP implementation. The data collected on various EMP measures would be reviewed by EMC and if needed corrective action will be formulated for implementation.

Monitoring shall confirm that commitments are being met. This may take the form of direct measurement and recording of quantitative information, such as amounts and concentrations of discharges, emissions and wastes, for measurement against corporate or statutory standards, consent limits or targets. It may also require measurement of ambient environmental quality in the vicinity of a site using ecological / biological, Physical and chemical indicators. Monitoring may include

socio-economic interaction, through local liaison activities or even assessment of complaints.

7.4. Monitoring Methods and Data Analysis

All environmental monitoring and relevant operational data will be stored in a relational database and linked MIS system. This will enable efficient retrieval and storage and interpretation of the data. Regular data extracts and interpretive reports will be sent to the regulator.

7.4.1. Air Quality Monitoring

7.4.1.1. Ambient Air Quality Monitoring

The ambient concentrations of SPM, SO_2, NO_x, CO and HC in the ambient air will be monitored at regular intervals. Any abnormal rise will be investigated to identify the causes, and appropriate action will be initiated. Green belt shall be developed for minimizing dust propagation. The ambient air quality data should be transferred and processed in a centralized computer facility equipped with required software. Trend and statistical analysis should be done.

7.4.2. Noise Levels

Ambient noise levels near habitations shall also be monitored once in three months. Audiometric tests should be conducted periodically for the employees working close to the high noise sources.

7.4.3. Water and Wastewater Quality Monitoring

To ensure a strict control over the water consumption, flow meters shall be installed for all major inlets. All leakages and excess shall be identified and rectified. In addition, periodic water audits will be conducted to explore further possibilities for water conservation.

Methods prescribed in “Standard Methods for Examination of water and Wastewater” prepared and published jointly by American Public Health Association (APHA), American Water Works Association (AWWA) and Water Pollution Control Federation (WPCF); Manual on water and wastewater Analysis published by NEERI, Nagpur are recommended.

7.4.3.1. Monitoring of Wastewater

All the Wastewater streams in the project area shall be regularly monitored for flow rate and physical and chemical characteristics. Such analysis is carried out for wastewater at the source of generation, at the point of influent into the wastewater treatment plant and at the effluent point for final discharge. These data should be properly documented and compared against the design values for any necessary corrective action.

7.4.3.2. Monitoring Of Groundwater

The groundwater samples shall be taken from representative locations periodically and analyzed for necessary corrective actions, if any.

7.4.4. Land Environment

The effectiveness and constant strengthening of green belt development should be made in and around the project site and associated facilities.

7.4.5. Biological Environment

- Development of green belt with carefully selected plant species is of prime importance due to their capacity to reduce air and noise pollution impacts by attenuation / assimilation and for providing food and habitat for local micro and macro fauna. This not only overcomes the problem but also enhances the beauty of area that will attract bird and insect species and by this way ecology of the area will maintain to great extent.
- The planting of evergreen species may have certain advantages that may reduce the environmental pollution.
- Survival rate of the planted trees should be closely monitored and the trees which not survive should be counted. Equal number of trees should be replaced and their survival should be replaced and their survival should be closely monitored.
- Treated sewage and effluent in the best combination should be used for green belt development. The rain water harvesting should be done.

7.4.6. Socio-Economic Environment

- In order to mitigate the impacts likely to arise out of the proposed project and also to maintain goodwill of local people for the proposed project, it is necessary to take steps for improving the social environment. Necessary social welfare measures by the proponent shall be useful in gaining public confidence depending on local requirement.
- Some basic amenities, viz. education, safe drinking water supply, regular medical check up in the villages may be taken up.
- Formal and informal training to be provided to the employees of the effected villages due to the project shall be taken up on priority basis. Job oriented skill training, courses may be organized.

7.5. Data Analysis

The monitored data will be analyzed and compared with the baseline levels as established in the EIA study and the regulatory standards specified by different government agencies. The standards against which the different environment components will be compared are as per **Table 7-1.**

Table 7-1 Applicable Standards for Different Environmental Components

S. No.	Component	Applicable Standards
1	Ambient Air Quality	National Ambient Air Quality standards, CPCB

S. No.	Component	Applicable Standards
2	Noise Quality	Ambient Air Quality Standards with Respect to Noise, CPCB
3	Surface water Quality	IS:2296: Class 'C' Water, CPCB
4	Ground water Quality	IS: 10500 Standards, BIS
5	Soil Quality	--
6	Treated Sewage Water Quality	IS 2490(1974) – Discharge into surface water IS 3306(1974) – Discharge on land, IS 3307(1974)- Discharge for agricultural use

7.6. Reporting Schedules of the Monitoring Data

It is proposed that voluntary reporting of environmental performance with reference to the EMP should be undertaken. The environmental monitoring cell shall co-ordinate all monitoring programmers at site and data thus generated shall be regularly furnished to the state regulatory agencies. The frequency of reporting shall be on six monthly basis to the local SPCB officials and to SEIAA, A.P. The frequency of monitoring and the parameters to be analysis etc. is presented in **Table- 7.2**

Table 7-2 Environmental Monitoring Plan

S. No.	Type	Locations	Parameters	Period and Frequency	Institutional Responsibility	
					Implementation	Supervision
Construction Phase						
1	Ambient Air Quality	15 locations as selected during baseline study	PM10, $PM_{2.5}$, Sulphur dioxide (SO_2), Oxides of nitrogen (NO_2), Carbon monoxide (CO), Hydrocarbon (HC), Volatile Organic Compounds (VOC's)	24-hr (8hr for CO) average samples every quarter	Contractor through MoEF approved agency	APCRDA & CA
2	Ground Water	20 locations as selected during baseline study	pH, TSS, TDS, DO, BOD, Salinity, Total Hardness, Fluoride, Chloride and MPN (No. of coli forms / 100ml), Heavy Metals	Quarterly	Contractor through MoEF approved agency	APCRDA & CA
3	Surface Water	20 locations as selected during baseline study	pH, TSS, TDS, DO, BOD, Salinity, Total Hardness, Fluoride, Chloride and MPN (No. of coli forms / 100ml), Heavy Metals	Quarterly	Contractor through MoEF approved agency	APCRDA & CA
4	Noise	15 locations as	24hrly Day and Night	Quarterly	Contractor through	APCRDA & CA

S. No.	Type	Locations	Parameters	Period and Frequency	Institutional Responsibility	
					Implementation	Supervision
		selected during baseline study	time Leq levels		MoEF approved agency	
5	Soil	20 locations as selected during baseline study	Organic matter, C, H, N, Alkalinity, Acidity, heavy metals and trace metal, Alkalinity, Acidity	Quarterly	Contractor through MoEF approved agency	APCRDA & CA
			Operation Phase			
1	Ambient Air Quality	15-To be selected after consultation with APPCB	PM10, PM2.5, Sulphur dioxide (SO_2), Oxides of nitrogen (NO_2) Carbon monoxide (CO) Hydrocarbon (HC) (VOC's)	24-hr (8hr for CO) average samples every quarter	CRDA through MoEF approved agency	APCRDA & CA
2	Ground Water	20-To be selected after consultation with APPCB	pH, TSS, TDS, DO, BOD, Salinity, Total Hardness, Fluoride, Chloride and MPN (No. of coli forms / 100ml), Heavy Metals	Quarterly	APCRDA & CA through MoEF approved agency	APCRDA & CA
3	Surface Water	20-To be selected after consultation with APPCB	pH, TSS, TDS, DO, BOD, Salinity, Total Hardness, Fluoride, Chloride and MPN (No.	Quarterly	APCRDA & CA through MoEF approved agency	APCRDA & CA

S. No.	Type	Locations	Parameters	Period and Frequency	Institutional Responsibility	
					Implementation	Supervision
			of coli forms / 100ml), Heavy Metals			
4	Noise	15 Locations covering the project site and in the surrounding to be identified in consultation with APPCB	24hrly Day and Night time Leq levels	Quarterly	APCRDA & CA through MoEF approved agency	APCRDA & CA
5	Soil	20- To be selected after consultation with APPCB	Organic matter, C, H, N, Alkalinity, Acidity, heavy metals and trace metal, Alkalinity, Acidity	Quarterly	APCRDA & CA through MoEF approved agency	APCRDA & CA
6	Treated potable water quality	1 sample from all 4 Water Treatment Plant	Parameters for horticulture use - BOD, pH, S.S, Coliforms	Half Monthly	APCRDA & CA through MoEF approved agency	APCRDA & CA
7	Treated Sewage Water Quality	1 sample from all 4 STPs	Parameters for horticulture use - BOD, pH, S.S, Coliforms	Half Monthly	APCRDA & CA through MoEF approved agency	APCRDA & CA
8	Treated Effluent Quality	1 sample from ETP	As per IS 10500 – potable water standards	Half Monthly	APCRDA & CA through MoEF approved agency	APCRDA & CA

7.7. Infrastructure for Monitoring of Environmental Protection Measures

Monitoring of environmental components during operation phase is a part and parcel of the environmental mitigation measures. Only frequent monitoring can assess the functioning and efficiency of all pollution control equipment. Thus the project proponent has to establish a separate full-fledged environmental laboratory to monitor air, water, noise level. Monitoring activity is mainly envisaged for raw water quality, treated effluent quality to analyze the performance of Sewage Treatment Plant / effluent treatment plant, noise level in the working areas.

A well-equipped laboratory with consumable items shall be provided for monitoring of environmental parameters in the site. Alternatively, monitoring can be outsourced to a MOEF certified and NABL Accredited laboratory. The following equipment and consumable items shall be made available in the site for environmental monitoring.

Air quality and Meteorology

High volume samplers, Stack monitoring kit, Respirable Dust sampler, Central Weather Monitoring Station, Spectrophotometer (Visible range), Single pan balance, Flame photometer, Relevant chemicals as per IS:5182.

Water and Wastewater Quality

The sampling shall be done as per the standard procedures laid down by IS:2488. The equipments and consumables required are:

BOD incubator, COD reflex set-up, Refrigerator, Oven, Stop watch, Thermometer, pH meter, Distilled water plant, pipette sets, Titration set, Dissolved Oxygen Analyzer, Relevant chemicals.

Noise Levels

Noise monitoring shall be done utilizing an integrating sound level meter to record noise levels in different scales like A-weighting with slow and fast response options.

7.8. Cost of Environmental Monitoring

The Environmental Monitoring will be conducted by MoEF registered and NABL certified monitoring agency. The approximate annual cost of Environmental monitoring program is given in Table 7-3.

Table 7-3 Cost of Environmental Monitoring

S. No	Parameter	No of samples per annum	Cost per sample	Total Amount
A	**Construction Phase**			
1	Ambient Air Quality	45	15000	675000
2	Noise Quality	45	4000	180000
3	Ground Water	80	10000	800000
4	Surface Water	80	10000	800000
5	Soil Quality	80	6000	480000

S. No	Parameter	No of samples per annum	Cost per sample	Total Amount
	Total Cost			2935000
	Operation Phase			
1	Ambient Air Quality	45	15000	675000
2	Noise Quality	45	4000	180000
3	Ground Water	80	10000	800000
4	Surface Water	80	10000	800000
5	Soil Quality	80	6000	480000
6	Treated Sewage Water Quality	96	6000	576000
7	Treated Effluent Quality	24	6000	144000
8	Treated Potable water Quality	96	10000	960000
9	Waste Characterisation	100	6000	600000
	Total Cost			5215000

The above cost is exclusive to monitoring and does not include expenditure made by APCRDA & CA and other government agencies for implementing measures for environmental improvement.

7.9. Compliances to Environmental Statutes

- Submission of the "Environmental Statement" to the State Pollution Control Board in Form V under Rule 14 of the Environment (Protection) Second Amendment Rules 1992 of the Environment (Protection) Act, 1986.
- Renewal of Consent to Operate under the Water and Air Acts.
- Filing the Cess returns to the State PCB under the Water (Prevention and Control of Pollution) Cess Act, 1977.

CHAPTER 8

ENVIRONMENTAL MANAGEMENT PLAN

An Environmental Management Plan (EMP) can be defined as “an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction, operation and decommissioning of a project are prevented; and that the positive benefits of the projects are enhanced”. EMPs are therefore important tools for ensuring that the management actions arising from Environmental Impact Assessment (EIA) processes are clearly defined and implemented through all phases of the project life cycle. This plan also helps an organization map its progress toward achieving continual improvements. The EMP typically consists of the following:

- Environment Protection Plan to reduce impacts and risks. Issues related to existing legislation, codes of good engineering practice, proponent commitment, and similar other tasks are also discussed here.
- Summary of Impacts and Risks. These are the actual expected impacts and risks of the projects, which shall need to be managed, monitored, and reported.
- Impact Management and Environmental Enhancement to balance adverse impacts by providing alternate benefits to adversely impacted persons or biophysical systems.
- Environmental Affects monitoring (monitoring plans).
- Impact Reporting.

8.1. Environmental Management Plan

The implementation of the Environmental management plan depends on:

- Institutional strengthening needs
- Training and technical assistance needs
- EMP Implementation Schedule
- EMP Costs

The emphasis is on identifying issues and options, to guide the detailed design of specific EMP measures as part of programme. Environmental Management Planning gives the tools to assess and manage environmental issues during every phase of project or operations. The outcome minimizes the risk of costly, time consuming environmental issues, while maximizing productivity and performance. It provides a framework through which environmental priorities, responsibilities and risks are systematically managed. EMPs, which are often a key component of a project's regulatory filings, provide the basis for assurance that environmental factors shall be carefully managed throughout the project lifecycle. The proposed plan discusses appropriate measures to be considered during construction as well as operation phases. The various EMP measures during pre construction and infrastructure development phase are listed in Table 8-1.

Table 8-1 Environmental Management Plan (EMP) during Pre- Construction and Infrastructure Development phase

I-General Requirement

S No.	Procedure/practices	Descriptions	Responsibility
I.1	Building and Other Construction Workers (Regulation of Employment and working Conditions) Act, 1996) The building & Other Construction Worker's welfare Cess Act, 1996	• This act is applicable for those construction activity which cost is more than Rs. 10, 00000/-. Since the project cost is above 10 lakhs, This Act is applicable to this project. All rules and procedure under this rule should be followed as – - Registration of establishment under this Act. -Provision of registration of building worker under this Act. -Provision of health and Safety measures for the construction workers in conformity with ILO convention No. 167 concerning safety and Health in construction.	Owner/Operator
I.2	Safety officer	The activity carried out by 500 or more worker, appointment of Safety officer required under the building and Construction Act, 1996.	Owner/Operator
I.3	Temporary shelter	• The housing for construction workers may be in the form of temporary structures to be removed after the completion of the project. • Construction camp and temporary labour sheds shall be located away from the construction site. • Construction camps shall be provided for construction personnel to avoid indiscriminate settlement of construction workers and labourers.	Owner/Operator

		• Provision shall be made for the housing of construction labour within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, crèche etc	
I.4	Medical Services, First Aid, Sanitation	• Provide First –Aid box at suitable location. This first –Aid box should be approved by consulting physician. • Facility for the treatment of injury person should be pre-defined. • Telephone no. of physicians, hospitals or ambulances shall be available. Sufficient & safe portable drinking water should be available at site. • Adequate toilet facilities should be arranged at site.	Owner/Operator

II-Occupational Safety

S. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility
II.1	Personal protective Equipment	Personal Protection	Necessary approved PPE like helmet, eye protection, safety belt should be provided to the employee and arrange training & awareness program for the effective use of PPE.	Operator/ Contractor
II.2	Site Preparation	Accessibility	Accessibility of site should be safely and properly marked for any danger point like slippage, deep hole, and mud should be identified and barricade.	Operator/ Contractor
		Entry	Prevent un-authorize roaming near to danger Location/point.	Operator/ Contractor

S. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility
		Site leveling	Maximize the reuse of Topsoil or available soil within the project area for leveling purpose.	Operator/ Contractor
		Excavation Activity	All excavation activity should be done in the planed way. All deep holes should be barricaded, to avoid falling hazards.	Operator/ Contractor
II.3	Spillage of oil and lubricant	Soil contamination and slippage	• To prevent surface and ground water contamination by oil/ grease, leak proof containers will be used for storage and transportation. • An oil trap should be provided in the drainage line to prevent contamination from accidental spillage of oil. • The floors of oil/ grease handling area will be kept effectively impervious. Any wash off from the oil/ grease handling area will be drained through impervious drains to avoid any contamination.	Operator/ Contractor
II.4	Sign, Signals and Barricades	Precaution measures	All necessary location should be sign, symbols and accident prevention tags for compliance to safety norms.	Operator/ Contractor
II.5	Material Storage, Handling, Disposal	Falling or tap hazards	• All material stores in tiers stacked, racked, blocked, interlocked or otherwise secured to prevent from sliding, falling or collapse. • Aisles and passageways kept clear and in good condition.	Operator/ Contractor
II.6	Hand and Power Tool	Cutting, shearing, electric shock,	• Hand tool should be maintained in Safe condition. • Ensure that all portable hand tools are periodically tested	Operator/ Contractor

S. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility
			and certified. • Ensure that all power tolls, belts, gears, shaft, pulleys, sprockets, spindles, drums, fly wheels, and chains are properly guarded. • All electric power operation tools equipment are properly grounded or double insulated.	
II.7	Ladders and Scaffoldings	Falling from height	• Ensure that all ladders and Scaffoldings' are good and in safe condition. • Ensure that Scaffolds should be capable of supporting at least four times their maximum intended load. • Ensure that footing or anchorage for scaffolds are sound, rigid and capable of bearing maximum intended load without settling or displacement. • Ensure that ropes, slings, hangers, platforms, and other supporting parts of two point suspended scaffolding are in proper position. Inspect these equipments before every installation.	Operator/ Contractor
II.8	Cranes, Derricks, Hoists, Elevators, Conveyors	Breaking, physical hazard	• Rated load capacity, recommended operating speeds, and special hazard warnings posted on all equipment and visible from operator's station. • Equipment should be tested /inspected annually and maintain the records for the same.	Operator/ Contractor

S. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility
			• Before leaving crane unattended, its boom should be lowered to the ground level. • The carrying load should not be exceeding the Safe working load.	
II.9	Floor and Wall opening	Fall from height	• Ensure that all floor and wall opening properly guarded with standard railings. • Ensure that open platforms are located two meter or more above ground or floor levels should be guarded by standard railing.	Operator/ Contractor
II.10	Welding and Cutting	Toxic gas inhalation, Explosion in the gas Cylinder	• Ensure that effective and appropriate use of eye and face protection equipments are placed in this operation. • Ensure that cutting & welding fumes concentration are not exceeding the TLV. Proper mechanical ventilation system should be in place which helps to exhaust the toxic gases. • Ensure that all compressed gas cylinder secured are in an upright position at all time. • Ensure that Arc frames of all Arc welding and cutting machine are grounded. • Arc torch should be inspected for leaking shut off valves, hose couplings, and tip connection at the beginning of starting the job.	Operator/ Contractor

S. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility
II.11	Electrical equipment and connection	Electrical Shock	• Live part of all electric equipment should be guarded against accidental Contact. • Ground Fault interrupters should be used to protect the user. • Path of cable from Circuit should be safe and free any heat radiation, sharp edges etc. Polarity of the conductor should be correct.	Operator/ Contractor
II.12	Traffic/Vehicle management	Noise and emission	• Effective traffic management plan will be implemented to ensure proper movement of vehicles without any delay in and around the project area. • Parking area of the vehicle should be clear and marked. • The keys of the all unattended vehicle should be kept with driver. • Restriction of unnecessary blowing of horn. • Compulsion of PUC certificate.	Contractor/Owner
II.13	Occupational health	Worker health	• All the labourers to be engaged for construction works shall be screened for health and adequately treated before issue of work permits. • Periodic health check-up of construction workers	Contractor/Owner

III- Air Pollution & Prevention

S. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility
III.1	Particulate emission, fugitive dust, gaseous emissions from construction activity emergency/temporary use of DG sets , traffic movement,	Impact of humans and environment	• There will be emissions of gases and Particulate matter (PM) due to use of D.G. sets during construction phase which will be emergency and temporary in nature. • More emphasis should be given on deployment of vehicles with Pollution Under Control (PUC) certificates even for contractor vehicles/transporters. • Low sulphur diesel type diesel generator sets should be used during construction phase.	Contractor/Owner
III.2	Unpaved roads	Fugitive dust, impact of human health and environment	• Covers and water suppression; • Use of Ready-Mix concrete is recommended for this project. Otherwise batching plant to be established away from the settlement area. • Increased moisture content for open material storage piles; • Each contractor to develop and submit a dust control plan, an Air Quality Management Plan and Emissions Monitoring/Testing Plan. • Workers shall be provided with protection masks, • Dust covers will be provided on trucks that would be used for transportation of materials prone to fugitive dust emissions • Water sprinkling shall be done at the location wherever	Contractor/Owner

S. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility
			dust generation is anticipated.	
III.3	Exhaust emissions from vehicle movements	Fugitive dust, impact of human health and environment	Specify use of modern properly maintained vehicles.	

IV- Ambient Noise and vibration

S. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility
IV.1	Temporary increases in noise levels at the nearest residential receptors and mixed use area	Impact on nearest residents and workers	• Select inherently quiet equipment wherever possible; use low noise design construction equipment typical for a world-scale facility of this magnitude. • Ensure machinery is properly maintained, particularly engine exhaust silencers; • Ensure that all rotary driven construction equipment has appropriate noise suppression devices installed, and is well maintained. • Machinery should be turned off when not in use (not left idling); • Where practicable, make use of screening afforded by spoil stockpiles for high noise activities; • The construction site will be staffed with on-site	Operator/ Contractor

S. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility
			mechanics to properly maintain the construction equipment and noise suppression devices; • The construction personnel will be required to wear hearing protection when necessary in the construction site. Ear plugs and earmuffs are considered as proper personnel hearing protection devices; • Diesel generator sets during construction phase shall have acoustic enclosures and shall conform to Environment (Protection) Rules, 1986 prescribed for air and noise emission standards	
IV.2	Pile and foundation construction, road construction, operation of machinery like compressors, compactors, concrete plant, cranes etc. as well as transportation of vehicles.	Impact on workers at high noise level areas.	• Noise protection equipments such as noise shields for high noise producing equipments and PPEs like ear muffs/plugs to workers shall be provided during construction activities. • Maximum efforts shall be made to restrict use of noisy construction equipment during night hours	Operator/ Contractor
IV.2	Vibrations are caused due to heavy dumpers, ,and	Impact on workers.	Vibration control damped tools shall be used and the number of hours that a worker used them will be limited.	Operator/ Contractor

S. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility
	construction machineries			

V- Land Environment

S. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility
V.1	Construction of approach roads	Impact on land environment - soil erosion	Top soil will be separately taken and utilized for land scoping activity.	Owner/ Contractor
V.2	Dumping of construction spoils (plastics, glass, fiber insulation, roofing, steel piping)	Impact on land environment	• Solid waste management during construction phase will be done as follows: The construction waste will be reused within the site, the waste generated from the labour camps will be treated as per the MSW Norms. • The asbestos waste, from demolition debris, if any, shall separated and shall be disposed at proposed Common Hazardous Wastes • Earth material generated from excavation shall be reuse to the maximum possible extent as filling material during site development. • The construction debris and surplus excavated material shall be disposed off by mechanical transport in suitable	Contractor

			pre-identified dumping areas to avoid land degradation and water logging due to indiscriminate dumping. • Dumping areas shall be biologically reclaimed through topsoil cover and plantation	

VI- Water Quality Management

S. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility
VI.1	Site excavations	Land/ water body contamination	To prevent surface and ground water contamination by oil/ grease, leak proof containers will be used for storage and transportation.	Contractor
VI.2	Accidental spills of paints, oils, grease or other materials	Impacts on surface water quality and land environment.	• Leak proof containers will be used for storage and transportation of oil and greases. • Segregating all waste oils and lubricants from maintenance of construction equipment and disposing of them properly through approved agency/ disposal areas. • Construction workers will be trained for proper handling, storage and disposal of hazardous or toxic materials.	Contractor
VI.3	waste generation due to workers in the site	Sanitation	Pit latrines and community toilets with temporary soak pits and septic tanks will be constructed for construction workers.	Contractor

S. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility
VI 4	Water Usage	Surface and Ground Water	• Water usage during construction shall be optimised to avoid any wastage. • Ground water shall not be used for construction works during construction phase.	Contractor/ Operator
VI.5	Alteration of drainage characteristics (including dewatering) and modification of the storm water flow and recharge regime.	Surface and Ground water regime	• Provide a temporary or alternative pathway for storm-water drainage during the construction phase, avoiding the elimination or the temporary closure of the natural run-off pathways. • Careful design of the final land elevations could reduce the requirement to dewater and excavate below the water table. • If dewatering is required, then appropriate site specific design and disposal of ground waters is needed. • Develop and initiate a groundwater monitoring programme to monitor groundwater quality. • Ensure that the drainage system is cleaned from time to time, so it is always able to carry the volume of storm water for which it was designed.	Contractor/ Operator

VII- Use of Natural Resources

S. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility

VII.1	Natural resources	Impact on ecology	Avoid the wastage of natural resources such as water, fuel etc. Building construction should be planned in an environment friendly manner such as water harvesting, natural lighting etc.	Contractor

VIII- Hazardous Substances

Sr. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility
VIII.2	Use of Solvent/Painting/ all types of batteries	Health hazard	• Painting and varnishing activity should be done in proper & safe manner with help of suitable PPE. • Hazardous material should be collected and store separately and dispose in secured landfill	Contractor
VIII.3	Minor accidental releases and spills of hazardous materials during construction	Soil and ground water contamination	• Develop a comprehensive Spill Prevention and Containment Plan to ensure safe onsite storage of hazardous materials; handling and containment of accidental spills and releases. The plan shall also address the transfer and disposal of spilled materials as hazardous waste and mitigating measures documented to contain any spills. Continually monitor and re-evaluate the effectiveness of the plan. • Implement procedures indicating the characteristics of the transportation vehicles to be used, trying to minimize as much as possible potential release/spills related to the bad condition of the materials (valves, pumps in the trucks, etc). • Pre-casting of concrete structure will be conducted in	Contractor

Sr. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility
			paved areas, with a large enough extent and gradient to prevent spillage of concrete or cement onto bare soil. • Keeping the amounts of stored hazardous materials to a minimum and always within controlled areas • During construction, designate an offsite fuel distribution facility (for construction and transportation vehicles and equipment) that is equipped with spill containment and prevention measures including integrity tested double-wall storage tanks, distribution lines and equipment. If due to project requirements, the re-fuelling of construction vehicles and equipment needs to take place on the site, a fuel storage and distribution facility with appropriate spill containment and prevention measures should be built as part of the facilities' • Develop and initiate a groundwater monitoring programme to monitor groundwater quality	
VIII.4	Minor accidental releases and spill during occasional maintenance of construction equipment and vehicles	Soil and ground water contamination	• The site will have a designated site for the occasional maintenance activities of vehicles and construction equipment. The maintenance area will have a comprehensive spill prevention and containment plan to ensure the safe handling and containment of accidental spills and releases, onsite storage of hazardous materials and the transfer and disposal of spilled	Owner

Sr. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility
			materials. Continually monitor and re-evaluate the effectiveness of the plan. • Keep onsite vehicle and equipment maintenance activities to a minimum or within the appropriate designated maintenance areas. Only emergency repairs (such as those needed to stop a spill of hazardous material) should be conducted outside the maintenance area. • Washing of concrete mixers and trucks should only take place in paved or lined areas with appropriate wastewater collection measures. It is recommended that the wastewater generated during washing of concrete mixers and trucks be given sufficient time to allow for the settlement of solids, prior to its treatment and/or disposal. Treatment of the remaining wastewater should take into consideration its pH and dissolved solids load	

IX Ecology and Biodiversity

S. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility
IX.1	Removal of vegetation and potential foraging sites for nocturnal	Impact on ecology	• Land based works should to be assessed in relation to the following issues: • The impact on vegetation within the footprint of the	Contractor/ Operator

	animals		operational site; • The impact on vegetation at locations which are to be used as temporary compounds or storage areas; • The effects of construction on other aspects of terrestrial ecology.	
IX.2	Effects of dust & noise from earth moving, vehicle movements, etc. on vegetation and fauna onsite or adjacent to the site	Impact on ecology	The use of modern properly maintained vehicles together with other driving policy measures like minimizing off road driving and transporting materials in bulk to minimize trips, should reduce the local impact of emissions on the biological environment from vehicle movement to and from the site during all phases of the project.	Contractor/ Operator

X Hazard

S. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility
X.1	Seismicity	Impact of structure	Project falls under the seismic zone-III. Seismic factors shall be taken care of in design of all structure	Owner
X.2	Fire and explosion hazards	Impact on Structure	On-site and off-site emergency planning, which should include, at a minimum, the preparation and implementation of an Emergency Management Plan and a Communication Plan prepared with the participation of local authorities and potentially affected communities.	Owner

XI Social

Sr. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility
XI.1	Reduction in number of Immigrant workers post peak.	Decreased income.	• Arrange workshop with the community to inform them about project activities and potential employment opportunities. • An appropriate decommissioning plan should be developed and implemented. • Conducting focus groups or workshops workers and community in coordination with OWNER to gauge feedback from workers and the community on expectations towards employment opportunities and project duration	Owner
XI.2	Foreign workers separated from their families	Impact of immigrant workers	Improve communication systems between workers and families by installing pay telephones at the workers accommodation.	Owner
XI.3	Incidence of disease transmission between the workers and the population of the local communities.	Social health	• Provide employee counselling, health screening, health and cultural training and awareness, and vaccination programmes. • Pre employment physical and inoculation for contagious diseases • Develop an awareness and prevention programmes and health policies and procedures as well as an integrated programme addressing the health and social implications;	Owner

Sr. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility
			• Management of workers' accommodation in ways that reduce risky behaviors, including provision of recreational facilities; • A health survey campaign to collect data on the most common communicable diseases in the area is recommended. Tracking and monitoring of incidence rates throughout project implementation would provide valuable information for the design of health programs; • Ensure that the requirement to monitor and screen for communicable diseases is incorporated into the contractor's contract. The operator should enforce and audit against the contract; • Ongoing commitment to health education and support of local programmes to control the spread of communicable diseases is recommended	
XI.4	Potential increase in road traffic accidents	Social health Impact	• Management and vehicle standards should be specified and safety measures should be implemented. A road transport safety programme should be developed and implemented over the lifetime of the project. • Supporting regional road safety programmes and providing input into management of the road work network can further reduce the impact of the	

Sr. No.	Aspect	Impact	Proposed Mitigation measures	Responsibility
			development. • Coordinate with the local authorities to promote traffic safety and coordination on transport is recommended. This coordination should be included in the stakeholder consultation program.	

8.2. Environment Management Action Plan

It is recommended that a number of action plans be developed for all the project phases. The action plans should define desired outcomes and actions to address the issues raised in the risks and impacts identification process, as measurable events to the extent possible, with elements such as performance indicators, targets, or acceptance criteria that can be tracked over defined time periods, and with estimates of the resources and responsibilities for implementation.

During construction and pre-commissioning phase, the development of the plans will be responsibility of the Contractors and the Owner will review and approve the plans before they are implemented**.** Table below include the plans/ programs foreseen.

Table 8-2: Action Plans/ programs

S. No	Plan/Program	Description
1	Air Quality Management Plan	It will comprise and describe the mitigation and monitoring measures related to impacts in air quality.
2	Emissions Monitoring/Testing	A plan establishing the details of the monitoring/testing measures for ensuring maintenance of the air quality conditions (air quality measurements, equipment inspection and maintenance) will be developed following the generalities of the air quality plan.
3	Spill Prevention and Containment Plan	It will ensure safe onsite storage of hazardous materials; handling and containment of accidental spills and releases. The plan, applicable through all the phases of the project shall also address the transfer and disposal of spilled materials as hazardous waste. Effectiveness of the plan will be continually monitored and re-evaluated
4	Chemical Management Plan	It will be focused mainly in establishing management practices that will avoid impacts in the environment (pollution due to chemical releases on soil, water or atmosphere) and in the health of workers and nearby population due to direct contact on skin, inhalation, etc... The chemical management plan will set chemical handling and storage procedures. In case of hazardous chemicals the plan will be linked to the

S. No	Plan/Program	Description
		spill prevention and containment plan and to the emergency response plan.
5	Groundwater Monitoring Programme	It will include control wells down gradient of SRBs and the wastewater treatment unit. It will be designed to be implemented during operation.
6	Water Optimization and Management Plan	According to the Construction Framework, a water optimization and management plan should be developed and implemented by the contractor. The Plan will tailor the water management practices to implement in all the project phases (careful design and planning of construction in order to reduce the requirement to dewater and excavate below the water table, hydro-testing water abstraction and use, trying to reuse as much as possible) following applicable BAT as far as possible
7	Waste Management Plan	It will comply with internationally accepted industry standards to ensure safe handling, onsite storage, transfer and disposal will be developed for the lifetime of the project. The effectiveness of the plan should be continually monitored and re-evaluated. Section 4.5.4-2 through 5 of this report discusses in detail the SWM strategies, projections, short term and long term management approaches. The waste management Plan will take into account the above referred sections as well as the impacts and mitigation measures discussed in section 6.5.1.
8	Sedimentation and Siltation Monitoring Plan	According to the Construction Framework it should be developed and implemented by the contractor for the construction phase. It will be focused on minimization of sedimentation and siltation alterations due to the construction activities to be performed.
9	Noise Monitoring/	It will be designed prior to construction

S. No	Plan/Program	Description
	Testing Plan	and implemented during all the project phases.
10	Road Traffic Plan	A traffic management plan (and logistics) will be developed and implemented for the lifetime of the project in partnership with the proponent.
11	Road transport safety Programme	It should be developed and implemented over the lifetime of the project.
12	Health policies and Procedures	An integrated programme addressing the health and social implications should be developed as well as awareness and prevention programmes.
13	Handling and storage of Hazardous Materials Plan	It will tailor the development and implementation of procedures for handling and storage of hazardous materials.
14	Archaeological chance find procedure	Should be developed prior to construction means to ensure awareness of employees and contractors of archaeological features of interest and on how to proceed in the event of an archaeological find. Supervisors to be trained.
16	Decommissioning Plan	It should be developed and implemented.

8.3. Environmental Management Cell

Apart from having an Environmental Management Plan, it is also necessary to have a permanent organizational set up charged with the task of ensuring its effective implementation of mitigation measures and to conduct environmental monitoring.

APCRDA & CA will form a board for Environment Management, the board will comprise of the APCRDA Commissioner, Director Environment and eminent experts from the field of Environment. The Environment Board will oversee the function of the Environment Management Cell. The major duties and responsibilities of Environmental Management Cell shall be as given below:

- To implement the environmental management plan;
- To ensure regulatory compliance with all relevant rules and regulations;
- To ensure regular operation and maintenance of pollution control devices;

- To minimize environmental impacts of operations as by strict adherence to the EMP;
- To initiate environmental monitoring as per approved schedule;
- Review and interpretation of monitored results and corrective measures in case monitored results are above the specified limit;
- Maintain documentation of good environmental practices and applicable environmental laws as ready reference;
- Maintain environmental related records.
- Coordination with regulatory agencies, external consultants, monitoring laboratories.
- Maintain of log of public complaints and the action taken.

8.4. Hierarchical Structure of Environmental Management Cell

The hierarchical structure of a suggested Environment Management Cell is given in following **Figure -8-1.** The staffing requirement is shown in **Table 8-3**.

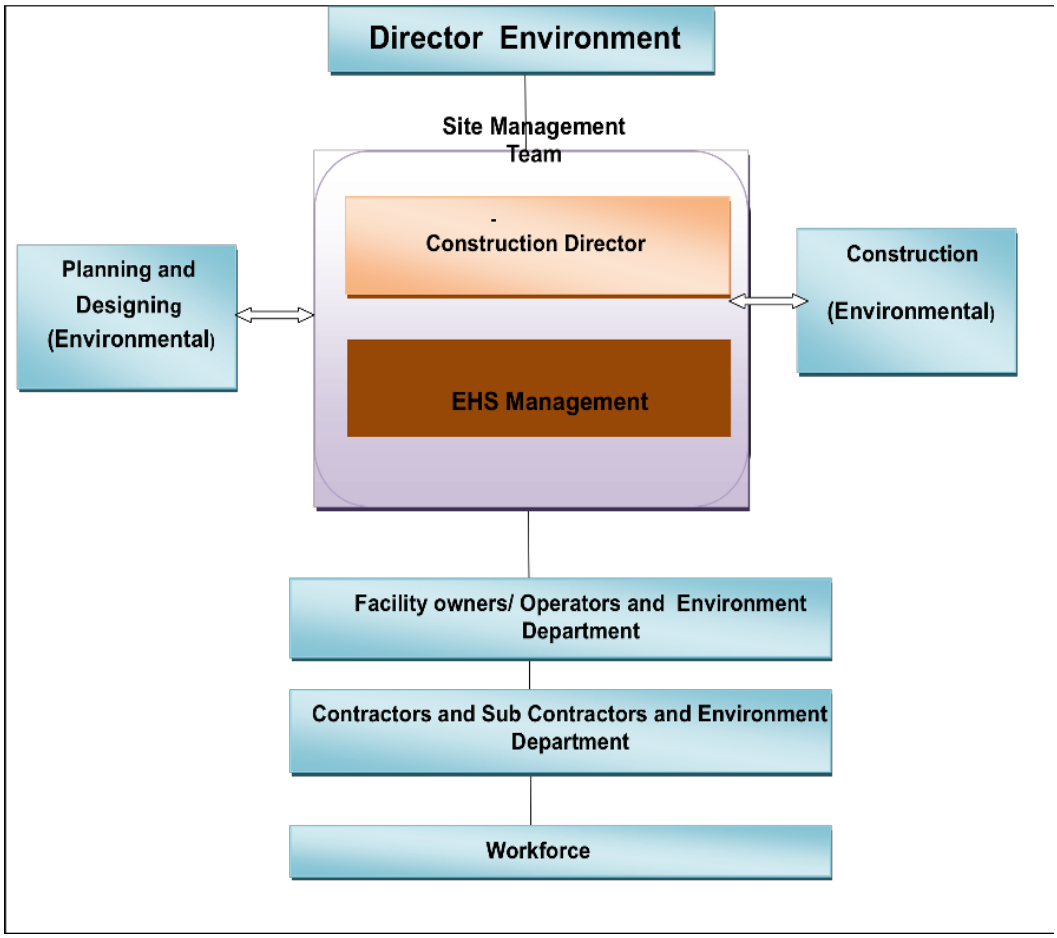

Figure 8-1: Environmental Management Cell

Table 8-3: Staffing Requirement

S. No.	Designation	No of positions
1	Director, Environment	1
2	Planning and Designing (Environment)	1
3	Safety and Health	1
4	Regulatory Compliance	1
5	Construction and Operation Supervision (Environment) Lakes and Landscape Air Environment Solid Waste Management Waste Water Management	4
6	Environmental Laboratory	
	Chief Chemist	1
	Chemists	4
	Laboratory Assistants	3
7	Field Assistants- Sample Collection, monitoring Station Maintenance	6

8.5. Awareness and Training

Training and human resource development is an important link to achieve sustainable operation of the facility and environmental management. For successful functioning of the project, relevant EMP should be communicated to the following groups of people:

8.5.1. Staff and Contractors

The staff and contractor must be made aware of the importance of waste segregation and disposal, water and energy conservation. This awareness can be provided through trainings and periodic meetings. They should be informed of their responsibilities for successful operation of various environmental management schemes inside the premises of the proposed development.

8.5.1.1. Site Staff:

Relevant personnel at site must be trained for the following:

- Collection, transport, treatment and disposal of solid and hazardous waste

- Requirements of the Disaster Management Plan in case of an emergency.
- Techniques for waste minimization, water conservation and energy conservation.
- Applicable environmental, health and safety regulations and compliance requirements for the same.
- Functioning of the Environmental Management System including environmental monitoring, reporting and documentation needs.

8.6. Record Keeping and Reporting

Record keeping and reporting of performance is an important management tool for ensuring sustainable operation of the proposed development. Records should be maintained for regulatory, monitoring and operational issues. Typical record keeping requirements for the proposed development is summarized in **Table 8-4.**

Table 8-4 Record Keeping Requirements

S. No	Parameter	Particulars
1.	Solid Waste Handling and Disposal	Daily quantity of waste received Daily quantity treated and recycled Daily quantity sent for disposal
2.	Hazardous Wastes	Quantity of waste generated Quantity of wastes sent out for treatment/disposal. Waste manifests as per regulations
3.	Regulatory Licenses (Environmental)	Environmental Permits / Consents from SPCB / MoEF Copy of waste manifests as per requirement
4.	Monitoring and Survey	Records of all monitoring carried out as per the finalized monitoring protocol.
5.	Accident reporting	Date and time of the accident Sequence of events leading to accident Name of hazardous waste involved in the accident Chemical datasheet assessing effect of accident on health and environment Emergency measure taken Step to prevent recurrence of such events

S. No	Parameter	Particulars
6.	Other	Log book of compliance Equipment inspection and calibration records, where applicable Vehicle maintenance and inspection records

8.7. Environmental Audits and Corrective Action Plans

To assess whether the implemented EMP is adequate, periodic environmental audits will be conducted. These audits will be followed by Corrective Action Plans (CAP) to correct various issues identified during the audits.

8.8. Environment Management Cell Cost

Per month cost of operation of the Environmental Management Cell is given in Table 8-5.

Table 8-5 Cost of Environmental Cell (Cost per Month)

Sr. No.	Designation	No of positions	Cost per person (in Lakhs)	Total Cost
1	Director, Environment	1	2.5	2.5
2	Planning and Designing (Environment)	1	1.5	1.5
3	Safety and Health	1	1.5	1.5
4	Regulatory Compliance	1	1.5	1.5
5	Construction and Operation Supervision (Environment)	4	1	4
	Lakes and Landscape			
	Air Environment			
	Solid Waste Management			
	Waste Water Management			
6	Environmental Laboratory			
	Chief Chemist	1	1.5	1.5
	Chemists	4	1.0	4
	Laboratory Assistants	3	0.5	1.5
7	Field Assistants- Sample Collection, monitoring Station Maintenance	6	0.5	3

Sr. No.	Designation	No of positions	Cost per person (in Lakhs)	Total Cost
	TOTAL			**21**

8.9. Environment Management Commitments

APCRDA & CA is developing a road map for investments regarding environmental management:

Some key investments are listed below:

Massive Plantation drive

250 cr released in current year, about 10,00,000 saplings to be planted, 18 nursuries, about 60,000 man days of employment

3 yr plan with about 750 crore budget.

Solar and NRE

About 10% of demand by Solar – 120 MW, about 500 cr capital investment

Initial investment of 100 cr in wind energy.

STP

Phase I about 300 cr

Retention ponds, green and blue plan

Detailed Engineering budgets under progress

CHAPTER 9

CONCLUSIONS AND RECOMMENDADTION

Land and agriculture

The project involves predominantly agricultural land. The land is made available through land pooling scheme. This is leading to large scale loss of land by villagers and loss of agriculture. Compensation to project affected people has been given as per the scheme.

Change of land use

Landuse is converted from primarily agriculture to residential, commercial, institutional, industrial, open and green spaces, sports and recreational facilities. The change in landuse is planned in a way that building footprint of the total construction is restricted to 20%. The green area is enhanced to 22.7 % as compared to the existing green area of 14% in all zones. All the water bodies are retained as is. In addition to this an extensive green and blue plan to integrate extensive landscaping and plantation and development of existing and new water bodies are planned.

Topography

The elevation difference of the current site varies from 18m to 260m. The slope is towards the north east side of the project boundary along the Krishna River. Three rocky outcrops were observed at Undavalli which is in East of South East, Ananthavaram in the North West and Kuragallu in the South west of the project site with maximum elevation of up to 260m. The center of the project site has a large area with elevation variation from 23 m to 24.5 m. Some part of the project site falls within the Krishna River, the elevation of this land is ranges from 14m to 20m. Excluding the hilly areas, the general slope of the terrain is – Rolling with about 1% slope.

The topography of the site will be maintained to the extent possible. The hills will be retained as is, so no major cutting is involved.

As a part of flood management Plan, it is planned to raise the ground level of the flood prone zone to 25m to avoid inundation. This filling will be done by material cut within the site and no nearby areas will be disturbed.

Vegetation

The project area has 14.36% of land under green cover currently and there is one patch of Reserve forest at Tadepalli. As per the Concept Plan the area covered under green space is 4936 ha, which is 22.72 % of the entire development in all zones.

Large Avenue plantation and parks and green spaces are planned in the proposed development. The proposal to de-notify Tadepalli reserve forest is in process. The proponent will follow WALTA ACT as applicable. The reserve forest patch will remain undisturbed due to the proposed development.

The environment cell will ensure the implementation of the green and blue plan, with three tier plantation.

Water Bodies and Natural Drainage

The project is located along the banks of Krishna River all along the East to north boundary. Eighteen small water bodies are present within the project site. The project falls in the catchment of Kondaveeti Vagu, few streams pass through the project site at some locations.

All the water bodies will be retained as is within the site.

Stream crossings at any location within the project site will be addressed through cross drainage works. There are no alterations to the stream flows.

Overall the natural drainage and hydrology of the area is not disturbed.

Flood Hazard

The catchment of Kondaveeti Vagu has a low lying area spread across the eastern side of the proposed project boundary, during heavy rainfall condition, this area gets. A detailed Flood Management plan with the following strategies is developed for the management of Inundation in the low lying areas:

- Prevent: Reinforce and realign the existing Krishna River Bund
- Control: Detain storm water
- Control: Detain storm water externally
- Conserve: Create raw water storage using Reservoirs
- Buffer: Provide an extensive green and blue drainage network
- Protect: Raising of Platform levels

Hydrological studies are in progress to address the flood management through engineering interventions at Kondaveeti Vagu.

Employment

Based on the social assessment of the study area as per the CENSUS 2011 data and site survey it is observed that about 49% of population are Non Workers. The proposed project will create about 1.8 million jobs in the area by 2050. The Phase wise employment generation of the project is as follows:

- Phase I- 3,51,620 – by 2025
- Phase II- 3,79,534 – by 2035
- Phase III- 10,47,747 – by 2030

The locals will get ample job opportunities based on their skill sets. Programs for skill sets upgradation during pre-construction, construction and operational phase to ensure employability will be a part of the proponent's initiatives continuously.

Existing Environment

The baseline studies in the project site and study area were conducted for air, noise, water, soil, ecology and social aspects during the summer season. The study shows that:

- Air quality at all the locations (20) is within the NAAQ Standard.
- The ground water and surface water results shows that few parameters like Chlorides and Total Dissolved Solids are higher than permissible limits of drinking water quality for both surface and ground water.
- Noise levels are high at locations which has more traffic like Vijayawada.
- The Soil quality results show that the soil is suitable for agriculture.
- The ecological assessment shows two ecosystems within the project area (aquatic and rocky outcrops) and three major ecosystems in the study area (riverine and riparian ecosystems). There are no rare or endangered species in the project area.

The environmental monitoring program as outlined in Chapter 7 of the report to be implemented to assess the environmental Quality during construction as well as operation phase. In case any parameter is found beyond permissible limits, immediate actions to be taken by the Environment Management cell.

Solid waste Management

Total 3662 TPD of Solid Waste will be generated for the year 2050. The Solid waste management for the proposed project will be as per the; Municipal Solid Wastes (Management and Handling) Rules, 2000, Ministry of Environment and Forests, The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008, E waste (Management and Handling) Rule, 2011, Bio-Medical Waste (Management and Handling) Rules, 1998 and its amendments thereof and Andhra Pradesh Pollution Control Board (APPCB), Andhra Pradesh Guidelines. Recent technologies for Waste to Energy conversion will also be used in the proposed development.

Facilities for treatment and disposal of biomedical waste existing at Guntur and Vijayawada. These facilities will be utilized for the proposed project. Augmentation of the facilities will be done as and when required with respect of the prevailing norms.

Considering the availability of fly ash generated from NTTPS, and the availability of four fly ash brick manufacturing facility in the vicinity, fly ash will be used as building material in the construction as per provision of Fly Ash Notification under EPA.

Water and Waste Water Management

The water requirement for Amaravati city is **1067 MLD by 2050.** There are two major conventional sources of water which can be used for the Capital City i.e. Krishna River and Kondaveeti Vagu. Four water treatment plants are proposed for treatment of raw water for domestic supply.

The sewage generation from the proposed project is 879 MLD; this will be treated in four STP's. The treated sewage water (703MLD) will be used for landscaping, flushing, construction sites and industrial uses.

Rain water harvesting, storm water management etc will be in integral part of the project.

Labour Camps

Temporary labour camps will be established suitably keeping in view the following key requirements:

- Safe and secure accommodation
- Mobile toilets
- Clean drinking water
- Hygienic sanitation facility
- Community level gas supply for fuel
- Pre-primary education and nutrition development will be executed through *Anganwadi Centers.*

Non Conventional Energy

Exploiting solar energy is a key initiative in the Amaravati City. Depending on the development type (commercial, residential, institutional, industrial etc) corresponding solar energy guidelines will be implemented. The entire development is designed to be energy efficient with focus on maximising solar energy uses for utilities, community infrastructure within the complexes and outside as well.

It is targeted that a minimum of **10 %** of the localised daily use of energy will be derived from solar sources.

It is estimated as per the APCRDA- Draft Concept Plan that the power generated out of exploiting solar energy source at the city level at the end of project will need to be connected to the grid after meeting the local requirements.

Development Control Rules of the proponent will define structural design aspects in accordance with the Seismic Zone and their adherence will be monitored for the structural safety of High Rise Building Clearance.

Emergency Evacuation and first aid facilities will be provided at all location, throughout the project phases.

Standard Operating Procedures for Safety and safety drill will be done every fortnight for safe operation during all phases.

The proponent has already initiated MRTS and other Public Transport measures; they will be put in place co-terminus with the development phases of the project.

Proponent will constitute a committee of stakeholder department's concerned with for the monitoring and review of the emergency preparedness and adherence to the emergency management guidelines as stipulated.

Various ongoing Welfare Schemes of Government of India, Government of Andhra Pradesh Like Pensions, Pavalavaddi scheme for women self help groups, Swachha Bharat Schemes, Stree-Nidhi etc. will be implemented with strengthened mechanism to enable 100% coverage.

APCRDA & CA Road Map for Policy

1. Expert level brainstorming workshop and inviting inputs at policy and plan level
2. Draft a detailed Plan of Action - Monitoring to policy
3. Build a repository of baseline data on a timeline
4. Environmental Board and Cell
5. Environmental board - DCR and other guidelines

CHAPTER 10

DISCLOSURE OF CONSULTANTS ENGAGED

10.1. Profile of Tata Consulting Engineers

TATA Consulting Engineers Ltd. (TCE) is a part of TATA Group, a leading business conglomerate in India with an annual turnover exceeding US $ 100.00 billion and having on its rolls more than 4,56,000 people. TATA Consulting Engineers Ltd. (TCE) formerly known as TCE Consulting Engineers Limited is a leading Consultant in India in the field of power plant engineering and other areas too. TCE was established in 1962 as a partnership firm between Tata Electric Companies now named as The Tata Power Company Ltd; the largest private utility in India and Ebasco Services Incorporated of US to indigenously design and Execute 150 MW Thermal Power project for the former. The business and undertaking of Tata Consulting Engineers, hitherto a division of Tata Sons Ltd since 1968, were transferred to a new company – TCE Consulting Engineers Ltd. incorporated in December 1999 and is now a wholly owned subsidiary of Tata Sons Ltd. Since its inception past five decades, TCE has grown into one of the leading consulting engineering organizations in India, employing over 3000 technical professionals and operating from 7 offices in India namely, Mumbai, Bangalore, New Delhi, Pune, Kolkata and Jamshedpur. TCE has executed over 7500 assignments of varied nature covering power, chemical, industrial, IT, infrastructure, water supply and sewerage projects.

TCE has always endeavoured to provide state of the art technology and cost – effective solutions to its clients, this is turn has helped TCE to earn an international reputation and awards for engineering excellence. TCE has successfully carried out several assignments overseas – in South East Asia, the Middle East, Africa, Europe, Asia Pacific, Australia and the Americas. TCE has executed projects funded by:

- **World Bank**
- **Asian Development Bank**
- **United Nations Development Programme**
- **Japan Bank for International Cooperation**
- **United National Industrial Development Organization**
- **World Health Organization**
- **United Nations Agency for International Development**

TCE is also a Quality Council of India –NABET certified / accredited consultant for conducting Environmental Impact Assessment (EIAs) for the sectors of Ports and Harbours, Thermal Power Plants, Area Development and Township projects, Building and Construction Projects , Common Municipal Solid Waste Facilities, Coke Oven Plants, Primary Metallurgy (Ferrous only).

TCE is having professionals with certification in OSHAS, Environmental Management Systems and LEED for green buildings.

The design offices are located in several cities in India – Mumbai, Bangalore, New Delhi, Chennai, Kolkata, Pune and Jamshedpur and branch offices in the USA and South Africa.

10.2. Details of Consultants Engaged

The following team members / personnel of the Environmental and Ecology vertical were engaged in the preparation of the EIA Report for the Capital City Area:

S. No.	Name of the Personnel	Highest Qualification Held	Designation	Role
1	Mr. Ashish Deshpande	M.Tech. Environmental Engineering	Senior General Manager	Team Member Review of the EIA report and suggesting mitigation measures for the water pollution abatement. Accredited by QCI - NABET as an EIA Coordinator for the sector of Township and Area Development Projects and functional area of WP as per NABET scheme.
2	Dr. Alok Kumar	PhD. Ecology & Environmental Sciences	Deputy General Manager	Team Leader Coordinating and guiding the overall project and Preparation of EIA report. Review of the Ecology and Biodiversity component, Municipal Solid Waste Management component and Soil quality component in the EIA report. Accredited by QCI-NABET as an EIA Coordinator for Township and Area Development Projects and for the functional area of Ecology and Biodiversity and Solid Waste Management for category 'B' projects

S. No.	Name of the Personnel	Highest Qualification Held	Designation	Role
3	Dr. Jyoti Prabha	PhD Environmental Science	Senior Manager (Environment)	Deputy Team Leader Coordinating and guiding the overall project and Preparation of EIA report. Accredited by QCI-NABET as an EIA Coordinator for Township and Area Development Projects and for the functional area of AP and AQ as per the NABET scheme
4.	Mr. Kapil Awtani	B.E. Civil	Senior Manager (Civil)	Team Member Assistance in the preparation of the EIA report under the guidance of EIA Coordinators. Collection of secondary data from the various agencies such as Geological Survey of India, Survey of India., etc. Collation, compilation and interpretation of baseline environmental data based on inputs of various FAEs Accredited by QCI-NABET for functional area of AQ as per the NABET scheme.
5.	Shrikant Patil	M.Sc Environmental Science	Manager (Environment)	Team Member Preparations of the land use write up in the EIA report. Accredited by QCI-NABET for the functional area of AQ as per the NABET scheme for the

S. No.	Name of the Personnel	Highest Qualification Held	Designation	Role
				category 'A' projects and land use for the category 'B' projects.
6	Mr. Babu Kiran Kumar Sivala	M.Tech Environmental Management	Manager (Environment)	Team Member Assistance in the Baseline data collection surveys under the guidance of the EIA Coordinator and various FAEs and collection of data from the project proponent.
7.	Mrs. Mamta Bavaskar	Master of Social Work (MSW)	Assistant Manager	Conducted and overseeing of the baseline social surveys to gauge the expectation of the people from the project. Collation of data from the Primary Census Abstract 2011 and compilation of the same. Accredited by NABET as an FAE for the functional area of SE for category 'A' projects
8.	Mrs. Arshi Bhutani	M.E. Chemical Engineering	Assistant General Manager	Team Member Risk identification and Preparation of Onsite and Offsite Disaster Management Plan Accredited for the functional area of Risk and Hazard for category 'B' projects.
9.	Mr. Asok Ghosh	PhD Hydrology and Hydro geology	Consultant , Mining	Team Member Review of the write –up of geology and Hydrogeology Accredited by QCI –NABET for the functional area of HG as per the NABET scheme.

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