AUGUST 2018

AMARAVATI FLOOD MITIGATION WORKS

ENVIRONMENTAL IMPACT ASSESSMENT – ENVIRONMENT MANAGEMENT PLAN REPORT

AMARAVATI DEVELOPMENT CORPORATION LIMITED
ANDHRA PRADESH CAPITAL REGION DEVELOPMENT AUTHORITY

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AD	Anaerobic Digestion
ADCL	Amaravati Development Corporation Ltd.
APCRDA	Andhra Pradesh Capital Region Development Authority
APMDP	Andhra Pradesh Municipal Development Project
APPCB	Andhra Pradesh Pollution Control Board
AWWA	American Water Works Association
BAT	Best Available Technology / Techniques
BOD	Biological Oxygen Demand
CA	Capital Area
CETP	Common Effluent Treatment Plant
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
CPHEEO	Central Public Health and Environmental Engineering Organisation
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
IMD	India Meteorological Department
ISWMF	Integrated Solid Waste Management Facility
KV	Kondaveeti Vagu
LA	Land Acquisition
LPG	Liquefied Petroleum Gas
LPS	Land Pooling Scheme
LA&RR	Land Acquisition & Rehabilitation & Resettlement
MIS	Management Information System
MoEF	Ministry of Environment, Forest and Climate Change
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
PIU	Project Implementation Unit
PMC	Project Management Consultants
PP	Project Proponent
PUC	Pollution Under Control
PV	Pala Vagu
RAP	Resettlement Action Plan
SEAC	State Expert Appraisal Committee
SEIAA	State Environmental Impact Assessment Authority
SPCB	State Pollution Control Board
SS	Suspended Solids
STP	Sewage Treatment Plant
TDS	Total Dissolved Solids
TMC	Thousand Million Cubic Feet
ULB	Urban Local Body
USEPA	United States Environmental Protection Agency
WPCF	Water Pollution Control Federation

WTE	Waste to Energy
WTP	Water Treatment Plant

EXECUTIVE SUMMARY

PROJECT BACKGROUND

The Government of Andhra Pradesh has enacted Andhra Pradesh Capital Region Development Authority Act 2014 (Act No. 11 of 2014) and it got assent of the Governor of the state which was given on 29-12-2014 and it came into force w.e.f., from 30 December 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. The Government of Andhra Pradesh has formed a separate company for development of capital city, namely Amravati Development Corporation Limited (ADCL) formerly known as Capital City Development and Management Corporation Limited (CCDMC).

The Government of Andhra Pradesh in its efforts to build a World Class Capital city have considered all the measures pertaining to city resilience. With regards to the Flood Management works in Amaravati, the Government through Amaravati Development Corporation (ADC) has appointed Blue Consultant for the Flood Management Works in Amaravati Capital City. The Blue Consultant has studied historical occurrence of floods in River Krishna and corresponding rainfall recorded in Kondaveeti Vagu and it's in falling drains.

NEED FOR THE PROJECT

The capital city area is well drained by several canal systems of which Kondaveeti Vagu(KV) and Pala Vagu(PV) are the most important water canal system. The major streams of KV and PV flow across the Capital city area, currently cause floods due to inadequate sizes of cross drainage structures, sharp bends of streams, meanders near Krishnayapalem and absence of bunds at few places. Based on the ground reality and to mitigate the current flood situation the flood management works as proposed to be taken up.

PURPOSE OF THE PROJECT

The purposes of the project are to (i) to widen, deepen and extend the KV, PV and its in-falling drains to accommodate the excess runoff generated due to change in the land use from agriculture to urban and handle 1/100 year return period flood (ii) Building inherent safety systems in coherence with the flash floods by having detention reservoirs

SCOPE OF ENVIRONMENTAL ASSESSMENT (EA)

The environmental assessment scope includes screening and scoping, environmental assessment and environmental management plans for the project. The EA process also envisages to develop a comprehensive environmental management frame work for the entire project. The scope of EIA takes into account the applicable regulatory compliance requirements of Capital City Environmental Clearance and the Judgement of National Green Tribunal.

BASELINE ENVIRONMENT

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

Analysis of Baseline data is based on the fieldwork conducted from March to May, 2015 in EIA-EMP of Amaravati Capital City (September 2015), Preliminary design documents of proposed sub-projects; Institutional interactions. The land use changes in 2017 were taken into consideration for the environmental assessment. The study shows that Air and Noise quality at all the locations is within the Standards.

STAKEHOLDER CONSULTATION

Consultation meetings were organized in Mandadam, Thullur, Neerukonda and Krishnayapalem villages in the month of January 2018. The participants included: land owners, landless, women, labour in the village, local villagers, prominent persons of the village and Vasavya Mahila Mandali (Bank appointed NGO). Prior to the consultation meetings, the draft EIA and EMP were disclosed on the APCRDA website (January 2018). The key concerns expressed by the participants include: expected floods during rainy season, Simultaneous floods in the Krishna River and Kondaveeti Vagu, implementation of NGT judgement, reservoir bunds and strength, development of green buffer, recording the participation of public meetings and etc. The ADCL/APCRDA provided clarifications including the importance of flood mitigation works, design considerations, EC/NGT compliance, minutes of the meetings to be part of the RAP and development proposals about the green and blue envisaged in the city.

ANALYSIS OF ALTERNATIVES/OPTIONS

With the available historical rainfall data, the peak discharge is estimated through hydraulic modelling for a 1 in 100 year event, as 222 mm precipitation in one day.
For efficient discharge of floodwater from Amaravati, three options have been considered

- Option 1: Flood discharge at Undavalli and Vykuntapuram
- Option 2: Flood discharge at Undavalli and proposed government complex
- Option 3: Flood discharge at Undavalli

With reference to detailed analysis, assessment of alternatives pros and cons, discussions and deliberations with relevant sectoral officials, technical expert committee and other relevant stakeholders, Option 1 i.e., Flood discharge at Undavalli and Vykuntapuram has been finalised for implementation and within this option, only Phase-I activities as noted below are being taken up now and part of proposed Bank project. The Phase-I activities on a stand-alone basis are designed / envisaged to deliver the flood mitigation outcomes.

PROJECT COMPONENTS & OTHER ACTIVITIES

Proposed Components to be implemented with the World Bank (Phase-I)	***Phase-II Activities (not part of Project) to be initiated after some years***
1. Widening and Deepening of Kondaveeti Vagu (From Anathavaram to Krishnayapalem) 2. Widening and Deepening of Pala Vagu (From Dondapadu to Krishnayapalem) 3. Construction of Gravity Canal (From Nekkallu to Pichikalapalem) 4. Construction of Sakhamuru Reservoir	1. Widening and Deepening of Kondaveeti Vagu (From Krishnayapalem to Undavalli) 2. Lining works for Kondaveeti Vagu, Pala Vagu and gravity canal 3. Second stage pumping station at Undavalli & Pumping station at Vykuntapuram

Proposed Components to be implemented with the World Bank (Phase-I)	*Phase-II Activities (not part of Project) to be initiated after some years*
5. Construction of Krishnayapalem Reservoir 6. Construction of Neerukonda Reservoir	4. Construction of weirs and mechanical related works of Sakhamuru, Krishnayapalem and Neerukonda Reservoirs 5. Construction of Three (03) reservoirs (Outside Capital City - Lam, Pedaparimi & Vykuntapuram) 6. Feeder Canals from upper catchment to Kondaveeti Vagu and Gravity Canal

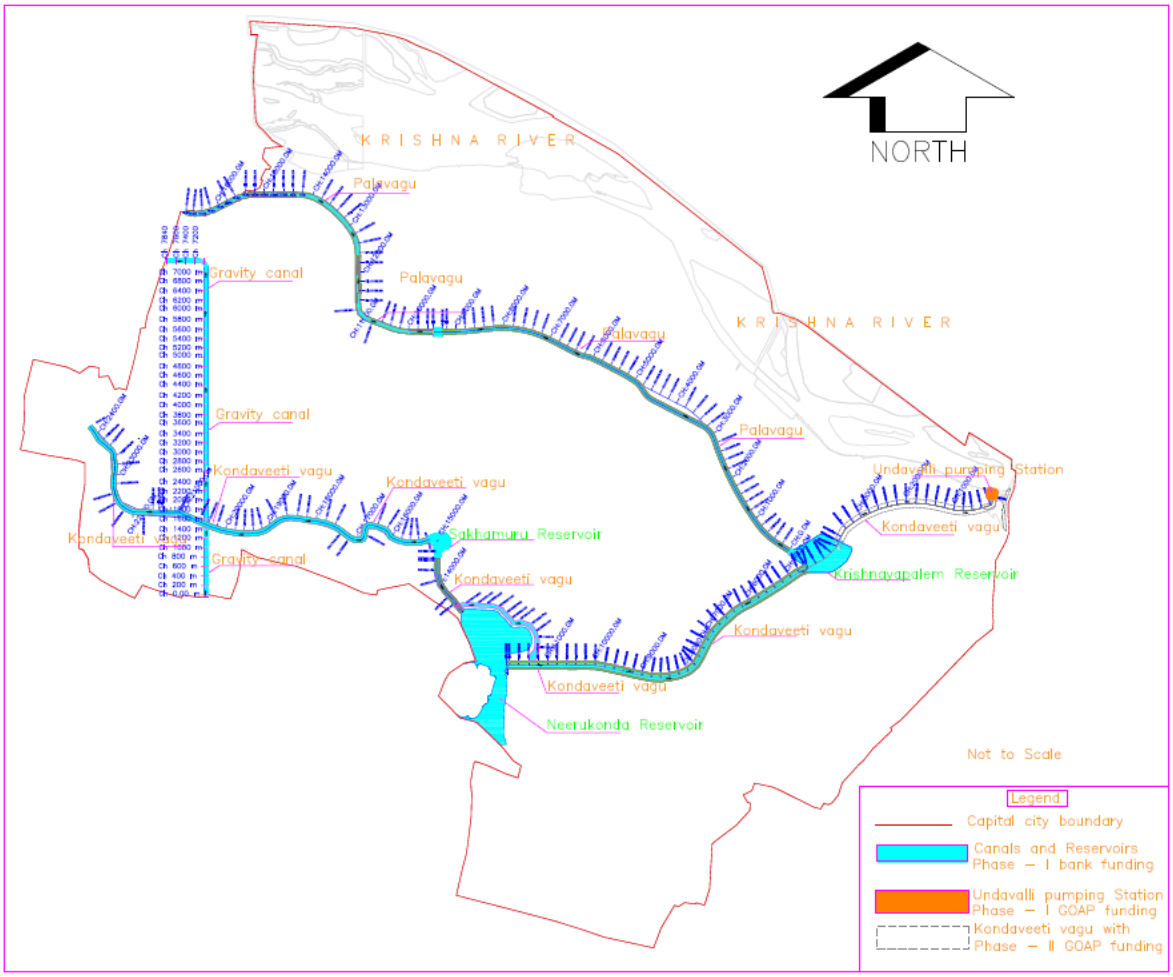


Figure 1: Phase-I Project Details

ASSESSMENT OF IMPACTS

The project is expected to have positive impacts in terms of flood mitigation in the new capital city, generation of employment in the villages associated with the project (Annexure-XXX) activity throughout the project implementation and operation and increase in the vegetation thereby green cover in the city. However, the expected environmental impacts of concern due to

flood mitigation measures have been measured by the activities in the implementation and operation stage.

Impacts due to Earthwork and Embankments

- *Spoil Disposal*: The total quantity of earthwork (excavation) involved in all these works is 41,427,813 Cu.m. (about 41.5 Mil.Cu.m.). Out of this quantity, 444,800 Cu.m. is needed for earthwork in filling at reservoirs, and about 475,000 top soil need to be protected. Given this, about 38.20 Mil.Cu.m. need to be disposed in the sites selected for filling in the Capital City. *Potential air and noise quality impacts* due to fugitive dust emissions at settlements/villages which are within 500 meters radius from the disposal sites including: (i) Nidamarru; (ii) Sakhamuru; (iii) Rayapudi; and (iv) Lingayapalem. In addition, there could be marginal air quality impacts on other villages adjacent to the access roads.
- *Sludge on Natural Stream Bed:* The flows in the streams are intermittent and most part of the year remain dry in the current conditions. The irrigation authorities as part of the routine maintenance works, prior to monsoon, desilt the stream bed which is conventionally utilized by the farmers in the nearby fields. The sludge/silt mostly comprises of alluvial deposits during flash floods occurring during monsoon.
- *Traffic Impacts*: Carting of excavated material will lead to significant increase in traffic on the access roads to the disposal sites for a temporary period of about 9 to 12 months. The relevant access roads include: E3, E8, E10, E14, N4, N9, N14, and N16. These roads have already been constructed as part of capital city's trunk infrastructure development as arterial and sub-arterial roads. No other village roads need to be used as all the disposal sites are next the above referred trunk roads. However, the settlements immediately next to the above referred roads include: (i) Uddandarayapalem; (ii) Venkatapalem; (iii) Mandadam; (iv) Malkapuram; and (v) Velagapudi would be subjected to potential road safety risks and fugitive dust and noise pollution.
- Erosion of disposal sites: This impact is not expected as the disposal sites will be utilized for different land uses as per the master plan.
- *Top Soil*: earthwork excavations would generate about 475,000 Cu.m. of top soil from all the sites. In order to prevent the loss of top soil, the design considerations have already factored to use this quantity within the 30m green buffer on either sides of the canal.
- *Stone Aggregate for Reservoir Lining:* The reservoir embankment uses about 444,800 Cu.m. Soil for raising about 2m from ground level. In addition, about 114,260 Cu.m. of stone will be used for gabion lining. The potential quarries sites approved by Mines and Geology Department, GoAP include Ananthavaram, Endroy, Lemalla and Karlapudi. Development of the quarry sites may lead to environment impacts.
- *Dewatering*: In addition to the above impacts, earthwork excavation along the canal would require dewatering as some parts of the canal would encounter low ground water table. This aspect was analyzed in detail and it is observed that the ground water table is below 6 to 7 meters. However, the dewatering requirement cannot be ruled out as some of the sections encounter areas of shallow water table.
- *Drainage Pattern*: would not be affected with the proposed interventions as the discharges from different sub-streams and area flows will still drain in to the proposed canals.

- *Loss of Vegetation*: Out of the total canal length of 48 km., about 28 km. is in the barren area. Rest of the canal length has about 758 trees on either side. Out of these, about 529 will be affected and an estimated 106 trees can be transplanted in the Green buffer.

Impacts due to Construction Facilities

The construction facilities and the activities could lead to range of impacts including the following

- *Labor Influx: The proposed construction activities at Amaravati is likely to lead to influx of workers to the project site as the local labor is mostly related to agriculture workers with limited or no skill for construction works. While this could lead to some demand triggering local skill base development in the long term, there could be short term adverse social impacts on the local communities. Also, the labor influx could cause impacts relating to public health, socio-economic changes, competing demand for community resources, etc.*
- *Occupational Health and Safety*: The construction activities could lead to occupational health and safety issues if necessary care is not taken to integrate the safety management systems in to the work protocols.
- *Construction Related Pollution*: The construction phase would lead to significant air, noise and water pollution if necessary precautionary measures are not taken up. The villages along the canal include: (a) Krishnayapalem; (b) Mandadam; (c) Malkapuram; (d) Velagapudi; (e) Sakhamuru; and (f) Neerukonda are expected to be impacted.
- *Wastes*: The construction activities will include storage, handling and disposal of petroleum based products such as lubricants, hydraulic fluids, or fuels. Storage/usage and/or disposal could not only cause impacts but also lead to hazards/risks of potential leakage and contamination. Similarly, there would be several other waste which may not be hazardous but could lead to in-sanitary or disorderly conditions in and around construction sites. These include: solid and liquid wastes generated from construction camps, construction waste which is not systematically disposed causing cess pools and associated disease burden, etc.
- *Social Impacts:* The total land requirement for flood mitigation works for a length of about 48.4 Kms and reservoirs (as per the Blue Network DPR) is 1998.86 acres comprising (LPS – 1131.30 acres; 75.46 acres under LA, 781.72 (5.3 acres of land is occupied by encroachers) under Government lands) and 10.38 acres under R1 Zone in Village Habitation). A total of 1913.02 acres of lands are already available with CRDA through LPS corresponding to 1754 landowners who gave lands under LPS and as lands covered in existing blue network (streams), 75.46 acres of land to be acquired under LARR, 10.38 acres within village habitation (R1 zone) to be acquired under Negotiated Settlement policy. LARR Act and Negotiated Settlement Policy are expected to impact [137] families. Among these, 27 families will be physically displaced.
- *Impact on Common property Sites*: Three common property resources including, one temple in Mandadam, one burial ground in Sakhamuru and one burial ground in Mandadam will be affected. The specific details in this regard are detailed out in RAP for flood mitigation works.

Environmental Impacts – Operation and Maintenance

- The proposed commissioning of Canals and Reservoirs is not expected to lead to any major impacts as these structures are not expected to hold significant volume of water above ground level. The green buffer, if not managed as per the design standards, could lead to canal side degradation including encroachments, disposal of municipal waste, construction debris, etc. Discharge of untreated effluents, silt & debris, and solid waste through natural storm water drains could occur. In such an event the aesthetics and the physical environment could be seriously affected. These impacts could be effectively managed since Amaravati City has elaborate waste management strategies integrated in to city development plans. Given open canal configuration, there is potential risk of safety. This aspect has been addressed as part of the design measures by providing access control and safety railing at all the settlement locations.

ENVIRONMENTAL MANAGEMENT PLAN

- **Environmental management plan**

  Environmental Management Plan (EMP) deals with the implementation procedure of the guidelines and measures recommended to avoid, minimize and mitigate environmental impacts of the project. It also includes management of measures suggested for enhancement of the environmental quality along the highways.

  The institutional arrangement made under project will look into the implementation of project as well as EMP and the various legal settings applicable to the project are briefly stated in chapter 2**.**

  The avoidance, mitigation & enhancement measures for protection of the environment have been discussed in detail in this chapter. Social environmental elements have been separately dealt in separate volume namely, Resettlement and Rehabilitation Action Plan (RAP).

- **Objective of EMP**

  The EMP is a plan of action for mitigation / management / avoidance of the negative impacts of the project and enhancement of the project corridor. For each measure to be taken, its location, timeframe, implementation and overseeing / supervision responsibilities are listed. These components of the EMP have been given in Chapter 8 which explains the environmental issues and the avoidance/ mitigation/ minimization or enhancement measures adopted and/or to be adopted during different phases of the project. It also provides the references for the suggested measures, responsible agency for its implementation/ management as well as its timeframe.

- **Cost estimates for environmental management**

  Mitigation measures proposed in the EMP will be implemented by the Contractor. The works to be undertaken by the Contractor have been quantified and the quantities included in the respective BOQ items such as earth works, slope protection, noise barriers, safety features, and shrub plantation. Provisional quantities have also been included for additional measures that may be identified during construction and for fencing which will depend on the

Contractors work methods and site locations. Items and quantities have also been included for enhancement measures.

More general environmental management measures to be followed by the contractor have been included in the specifications and this EMP. These cannot be quantified and are to be included in the contract rates.

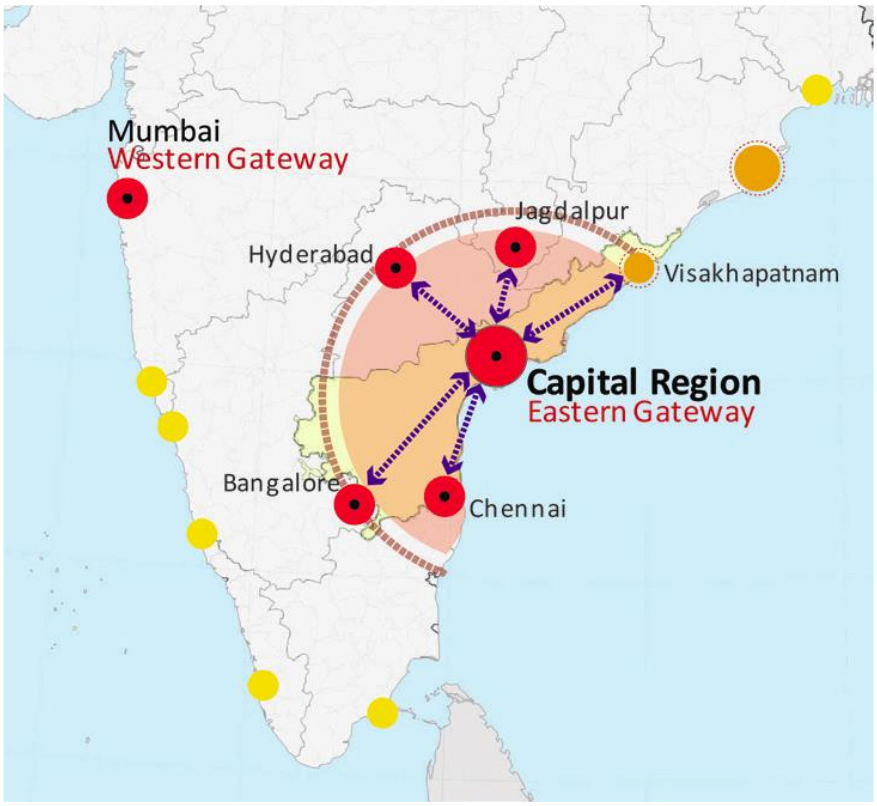
INSTITUITONAL STRUCTURE

To implement the project there is a project implementation unit established in the ADCL. Under the PIU there would be environmental management cell comprising the Chief Engineer, Superintendent Engineer, Executive Engineer, Deputy E.E, Head of the Department (Infrastructure Planning & Design), Environmental Engineer, Environmental Planner, Social Expert. The Environmental Unit of APCRDA would be working closely with ADCL PIU in the implementation, monitoring of the project. ADCL's Project Management Consultant would overview the project activities. The PIU would coordinate with the Contractor and local level officials of ADCL and APCRDA

CHAPTER 1: INTRODUCTION

1.1 Project Background

Government of Andhra Pradesh (GoAP) has embarked 'Amaravati', as a world class capital city for the newly formed State. 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 which was given on 29-12-2014 and it came into force w.e.f., from 30 December 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.



The Government of Andhra Pradesh has formed a separate company for development of capital city, namely Amravati Development Corporation Limited (ADCL) formerly known as Capital City Development and Management Corporation Limited (CCDMC). The capital city development is proposed to be over an area of about 217 km^2. The capital city area is bestowed with rich natural features including hillocks, river islands, abundant water, fertile soil and greenery. While abundance of water is a boon for the capital city, seasonal flooding driven by Kondaveeti Vagu and river Krishna poses a threat to the city.

1.2 Project Location

The proposed project is for the Amaravati Capital City. 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 right bank of river Krishna. The proposed capital city Amaravati is named after historic site of Amaravati known for its Buddhist culture that flourished from 400 BC to 1100 AD.

The geographical coordinates of the capital city site are 16.54^o N latitude & 80.52^o E Longitude. Figure 1-1 below presents the location of the project (Annexure -I).

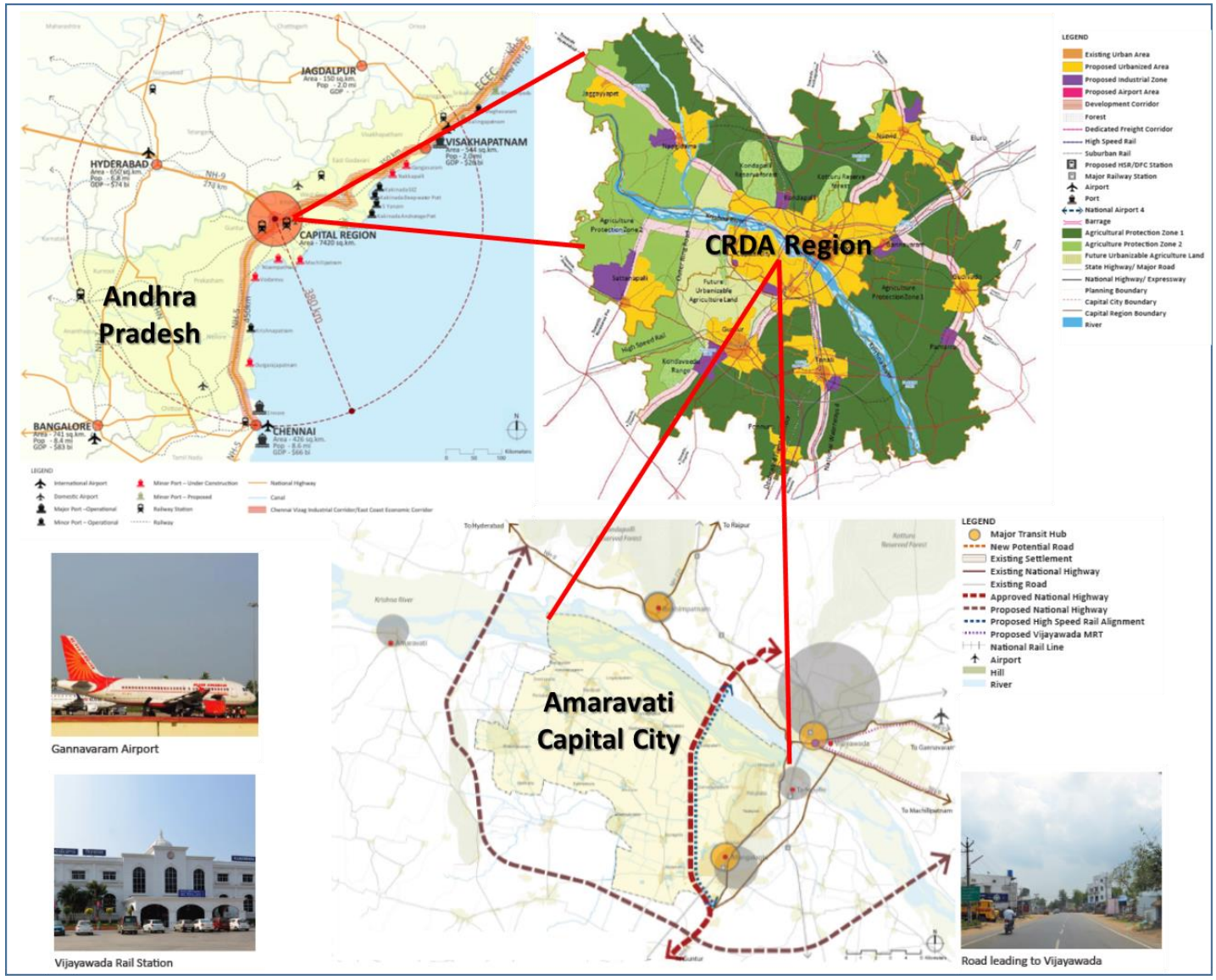


Figure 1-1: Centrally Located Capital Region and Capital City

1.3 Vision for the Capital City

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.

The capital city aims to provide best in class infrastructure, with about 30% green spaces to all its citizens. Existing habitations are largely retained avoiding large scale displacement and associated social impacts which is considered as a vital accomplishment in the city development.

1.4 Amaravati City – Land use Plan

The existing land use of the site is consisting of - agriculture, land for grazing, fruit and flower plantations, village settlements and village ponds etc. The existing village settlements covers about 5.7% of the city.

The proposed land use plan of the Amaravati Capital City proposes the following development strategies within city area of 217 Sq. Km.

The city master plan takes into account only 40.53% 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 30-4050% will be utilized for built up purpose. That implies a ground cover of about 12-1620-25% of the total capital city area only will be utilized for ground coverage. The land use plan of the proposed project is shown in Annexure-II.

1.5 Context of the Project

The capital city area is well drained by several canal systems of which Kondaveeti Vagu (KV) and Pala Vagu (PV) are the most significance. The KV originates in Kondaveeti hills near Pericherla village and the stream passes through Achampeta, Tadikonda, Amaravathi and Mangalagiri mandals and confluences into the Krishna River, upstream Prakasam Barrage. Other streams Pala Vagu, Ayanna Vagu and Kottela Vagu etc. join the KV at different points. The KV catchment location and its boundary are shown in Figure 1-2.

The catchment area of KV is about 421 sq.km approximately and extends beyond the capital city area. The approximate length of the main channel of KV is 31.15 Km and enters capital city at Neerukonda. The current bed widths of KV vary between 6m to 30m and bed slopes range from 1 in 1700 to 1 in 6500, from Lam village to Krishna River outfall. The catchment has steep slopes at the upstream location of Kondaveeti hills at Pericherla (origin, 20 Kms away from capital city boundary). The slopes fall quickly within the middle catchment area at Tadikonda and become very flat in the lower catchment area from Neerukonda.

Pala Vagu (PV), a tributary, joins KV at Krishnayapalem and there is considerable back water effect on this stream from KV during floods. The length of this stream is about 23.85 Km. Total length of in-falling tributary drains within KV catchment is 70 Km approximately and they are as follows with their approximate lengths.

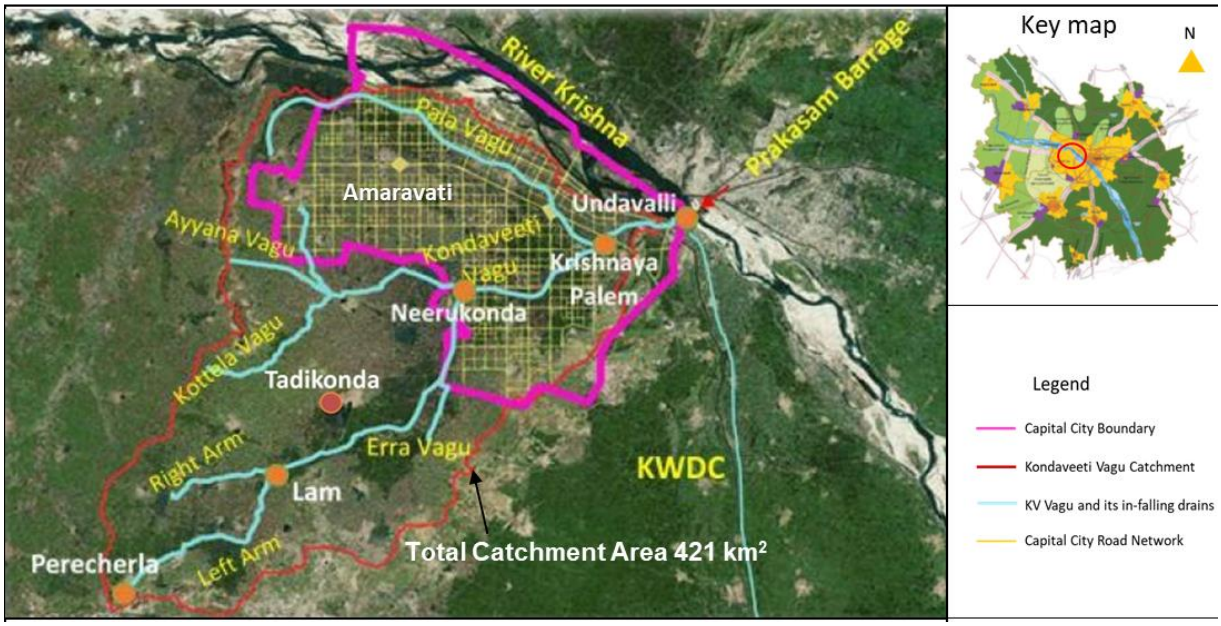


Figure 1-2 Kondaveeti Vagu Catchment Area and capital city area

1.5.1 Existing flood situation

The major streams of KV and PV flow across the Capital city area, currently cause floods in its surrounding region during the times of heavy rains and cause inundation in low lying areas in the city.

This is due to inadequate sizes of cross drainage structures, sharp bends of streams, meanders near Krishnayapalem and absence of bunds at few places along the alignment, which makes the vagus to burst its banks and cause inundation in adjacent areas/fields and overtopping of several causeways.

There is an outfall sluice on KV at Krishna River confluence. The sluice gates at Undavalli are normally in closed condition to prevent the back flow from Krishna River flooding. When River Krishna is in floods and to relieve the flooding situation within KV, there is an escape regulator to divert the part flood flow to Krishna Western Delta Canal (KWDC) with a design capacity 170 cumecs (6000 cusecs). The design capacity of KWDC is 232 cumecs (8200 cusecs). It is observed that even on Oct 5, 2009, when heaviest flood in over a hundred years hit the Prakasam barrage on Krishna River, the capital city area was not flooded thanks to the existing bund between Seethanagarm hill and Vykunthapuram hill on the right bank side of the river and the sluice arrangements.

1.5.2 Future flood situation based on hydraulic modelling

In the context of change of land use envisaged in the city, it is expected that development would increase the amount of impervious surfaces which would reduce natural infiltration and interception of rainfall resulting in increased runoff volumes and peak flow rates.

Based on the existing flood situation and to mitigate the future flood scenario due to the predicted change, a hydraulic model has been carried out. The model predicts flood discharge of 5650 cusec at Vykuntapuram, discharge of 12350 cusec at Undavalli and discharge of 4000 cusec through KWD canal in a 1/100 year return period flood. Based on the model, mitigation measures are defined such as widening, deepening and extending the canal/vagus in the city and construction of detention reservoirs to protect the city from 1/100 year return period flood.

1.6 Purposes and Benefits of the Project

1.6.1 Purposes of the Project

The purposes of the project are (i) to widen, deepen and extend the KV, PV and its in-falling drains to accommodate the excess runoff generated due to change in the land use from agriculture to urban and handle 1/100 year return period flood (ii) Building inherent safety systems in coherence with the flash floods by having detention reservoirs.

1.6.2 Benefits of the Project

The main benefits of the project are to reduce the extent of loss caused by seasonal flooding in the capital city area and protect low lying areas from inundation. Other benefits include promotion of inland water transport, water conservation through the proposed reservoirs, augmenting drinking water arrangements for the capital city.

1.7 Objectives & Scope of Environmental and Social Impact Assessment (EIA) Study:

The objective of this study is to develop an environmental management plan (EMP) for the identified flood mitigation works in the Amaravati Capital City. The study has been carried out duly following MoEF guidelines and World Bank guidelines. The scope of EIA takes into account the applicable regulatory compliance requirements of Capital City Environmental Clearance and the Judgement of National Green Tribunal.

To achieve this objective, the following specific tasks have been undertaken

1) To describe biophysical and social environment, including the existing status of the KV catchment and its in-falling drains;
2) To identify potential environmental and social issue/risks associated with the proposed interventions;
3) To develop a plan for mitigating environmental and social risks associated with construction and operation of the project activities in consultation with the relevant public and government agencies;
4) To identify feasible and cost-effective measures that may reduce potentially significant adverse environmental and social impacts to acceptable levels;
5) To develop a time-bound plan for mitigating environmental and social risks associated with the project;
6) To identify monitoring objectives and specify the type of monitoring with linkages to the impacts assessed and the mitigation measures described above;
7) To provide a specific description of institutional arrangement: the agencies responsible for carrying out the mitigation and monitoring activities;
8) To provide the expected capital and recurrent cost estimates and sources of funds for implementing the EMP as well as inform accordingly the design consultants so that these costs are duly taken into consideration in the Bill of Quantities (BoQs).

1.8 Approach and Methodology

The available secondary data from Irrigation Department, ADCL and APCRDA were collected by the Blue consultant during June-July, 2016 for the entire stretch of Krishna River from Vykuntapuram to Prakasam Barrage, the stretch of Pala Vagu and Kondaveeti Vagu and all the rivulets and canals in and around of the proposed capital city. Field work was undertaken in October 2016 in the project area. The site visit report of the Blue Consultant is placed at **Annexure XVI**.

The EIA study for flood mitigation works is based on the following available reports:

- EIA Study for Amaravati Capital city, 2015, which included master plan proposal for flood mitigation

- DPR for flood management works of Amravati Capital City, 2017

The step wise methodology is as follows:

Phase 1: Review of documents including EIA Study for Amaravati Capital city, 2015, DPR, Environmental Clearance (EC) to Greenfield Capital City Amaravati (October 2015), applicable laws and regulations, etc.

Phase 2: Conducted the reconnaissance survey for the entire stretch of Krishna river from Prakasam Barrage to Vykuntapuram (October 2016).

Phase 3: Analysis of Baseline data from field work conducted from March to May, 2015 in EIA-EMP of Amaravati Capital City (September 2015), Preliminary design documents of proposed sub-projects; Institutional interactions. The land use changes in 2017 were taken into consideration for the environmental assessment. The baseline environmental studies encompassed the disciplines/ environmental attributes of air, water, noise, soil, land-use, terrestrial and aquatic ecology and socio-economic components. 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 (10) is within the NAAQ Standards.

Phase 4: Preparation of Draft Final EIA Report based on the design interventions suggested for flood mitigation works, selection of best suitable option, analysing impacts on the environment and preparation of environmental management plan, focus group discussions, public consultations with the key stakeholders, comments from APCRDA/ ADC and reference of relevant World Bank projects including the APCRDA Project.

Phase 5: Disclosure of the Draft EIA Report. Public Consultation is carried out for the Draft EIA Report.

Phase 6: Finalization of EIA Report considering inputs from stakeholder consultations. Disclosure of the Final EIA Report on APCRDA, ADC and World Bank websites, and in APCRDA offices.

The field data given in the Capital City EIA Report of 2015 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.

1.9 Structure of the Report

The entire EIA report comprises of eight (8) Chapters. 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 Policy, Legal and Administrative Framework

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

Chapter 3.0 Flood Hazard Modeling & Analysis of Mitigation Options
This chapter presents the background information of the present flood conditions in the city and future predictions using the hydraulic model, analysing different options for flood mitigation and selection of the best option for the same.

Chapter 4.0 Project Description
This chapter highlights on the selected option of flood mitigation, components of the flood mitigation, phasing of the mitigation works and risks involved in the mitigation works.

Chapter 5.0 Environment Baseline
The baseline environmental studies encompassed the disciplines/ environmental attributes of air, water, noise, soil, land-use, terrestrial and aquatic ecology and socio-economic components.

Chapter 6.0 Environmental Impacts and Mitigation Measures
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 Public Consultation
Outlines the findings of the Stakeholder's view and perception through informal and formal public consultation meetings.

Chapter 8.0 Environmental Management Plan
Outlines of the mitigation measures, institutional arrangements and budgetary provision for implementation of the proposed environmental management plan to check the efficacy of the environmental mitigation measures proposed.

Chapter 9.0 Conclusion
The chapter contains the findings of the Environmental Impact Assessment (EIA) and recommendations for implementation to reduce any significant impact of the project on the environment.

CHAPTER 2: POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

A review of the existing institutions and legislations relevant to the environmental issues for the flood mitigation works is presented in this chapter. The regulations concerning procedures and requirements that may directly concern the waterways sub project, have been also addressed in this chapter.

World Bank is financing to implement the sub-project guided by the World Bank OP/ BP 4.01 Environment Assessment policy and 'The Environment (Protection) Act', 1986 Govt. of India. Environmental Assessment evaluates - 'project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation. EA considers natural and social aspects in an integrated way.

The development of flood mitigation and urban waterways would be governed by various Acts, Rules and regulations enforced by Ministry of Environment, Forest and Climate Change (MoEF) 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 present chapter focuses on the rules and regulations pertaining to and applicable for the proposed project. A regulatory framework has been developed covering the applicability and, where possible, the project specific requirements of relevant legislation. An Environmental Management Plan (EMP) has been formulated to ensure compliance with these acts.

The Environmental Clearance (EC) for new capital city is already obtained and the present project of Flood management works is the part of overall capital city development.

ADCL has prepared project implementation unit for the components funded by the World Bank and the same is placed at Annexure XXVII.

2.1 Environmental Framework

The Article 48-A of the Constitution of India states that the every State shall endeavour 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. A regulatory framework has been developed covering the applicability and, where possible, the project specific requirements of relevant legislation. An Environmental Management Plan (EMP) has been formulated to ensure compliance with these acts.

2.1.1 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 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 48A and 51A (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.

2.1.1.1 Legal Provisions for Environment for Proposed Development

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

2.1.2 Clearance Required

Environmental Impact Assessment Notification, 2006

The project for Flood Control measure doesn't require prior Environmental Clearance, however, the entire Capital City has taken EC in year 2015.

Forest (Conservation) Rules, 2003

As per this rule, every user agency, who wants to use any forest land for non-forest purposes, shall make his 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 entire area of Capital city is in possession of Govt. of Andhra Pradesh and there is no forest land involved for flood mitigation work. This rule is not applicable for the present development.

2.1.2.1 Compliance to the Environmental Clearance (EC) Conditions and NGT:

The EC compliance for the Amaravati Capital city is given at **Annexure XVIII.** Additional conditions given by National Green Tribunal (NGT) is also complied and detail is given at **Annexure XIX.**

2.1.3 Environmental Acts

2.1.3.1 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 fulfil 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 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 will be followed for the Flood control project. The project may require adherence to the DG Set rules during construction phase of the project. For all the activities to be undertaken for the 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.

2.1.3.2 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: The project has elaborate planning and design to maintain the water quality in all the Vagus through periodical clearing of water in the canals for every three days and intake of fresh water from River Krishna. A constant flow would be maintained in lean season in the Vagus and streams to avoid any odour due to water stagnation.

2.1.3.3 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 such as Ready Mix plant or machinery etc. falling under categories as per Andhra Pradesh (AP) Pollution Control Board (APPCB), Consent to Establish (CTE) will be obtained before starting the construction and Consent to Operate (CTO) before commissioning the project.

2.1.3.4 Solid Wastes Management Rules, 2016

Ministry of Environment, Forest and Climate Change under the provisions of the Environmental Protection Act, 1986 issued the Solid Waste Management (SWM) Rule, 2016 on 8th April 2016 for management of Municipal Solid Waste. Some of the key functions to ensure adherence include:

- Provide infrastructure and services for collection, storage, segregation, transportation, treatment and disposal of MSW
- Obtain authorization/ technical clearance from the state pollution control board to set up waste processing and disposal facilities
- Criteria are for setting up processing and treatment facility & actions for hilly areas and waste to energy process.
- Publish annual reports of compliance to conditions laid down in the SWM Rules, 2016.
- Reporting of any accidents at the site during managing of MSW as per Form VI in SWM Rules 2016.
- The implication of SWM Rules 2016 is for waste generated from Labour camps during construction phase. During operation phase of the project, the waste from Vagus and Rivulets needs to be treated and disposed of as per the provisions of these rules.

2.1.3.5 Hazardous Wastes and Management Rules, 2016

These Rules were notified on 8th April 2016, under the Environment Protection Act, 1986. They aim at controlling the generation, collection, treatment, transportation, and disposal of hazardous wastes. Hazardous waste generated during construction & operation phase are covered under the ambit of this act. The project proponents are required to obtain prior authorization from the SPCB for handling, treatment, storage and disposal of Hazardous Wastes.

2.1.3.6 Construction and Demolition (C&D) Waste Rules 2016

C&D waste means 'the waste comprising of building materials, debris and rubble resulting from construction, re-modelling, repair and demolition of any civil structure. The rules apply to every waste resulting from construction, re-modelling, repair and demolition of any civil structure of individual or organisation or authority who generates construction and demolition waste such as building materials, debris, rubble. Every C&D waste generator shall:

→ ensure C&D waste not get mixed with solid waste (MSW)
→ prima-facie be responsible for collection, segregation of concrete, soil and others and storage of construction and demolition waste generated
→ shall pay for collection, transportation, processing and disposal
→ Submit waste management plan to local authorities.

Implication: This rule is very much applicable to the present project. The C&D waste generated during the project to be used for filling of low lying areas within the project boundary and any extra material to be disposed of at designated place as per requirement of C&D Waste Rules 2016.

2.1.3.7 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: Undavalli caves are one of the important archaeological and heritage sites within the Capital region. In the capital region development plan, this monument is going to be conserved in its original way and integrated with the overall development plan. It is planned that no activities/ construction to be carried out in the 300m radii of the caves under Flood mitigation projects.

2.1.4 Andhra Pradesh Water, Land and Trees Act – 2002 (APWALTA – 2002)

This act came into force on 19 April 2002 by State government with following Objectives:

- To promote water conservation and Tree cover.
- For protection and Conservation of water sources ,land and matters connected there with
- To regulate the exploitation and use of ground and surface water.

Implication: This Act has comprehensively covered the requirement of ground water uses and recharge such as Rainwater Harvesting (RWH) etc. Tree cutting and compensatory tree plantation is also given.

All the tree cutting permission for the project needs to be taken under WALTA Act 2002. The APWALTA -2002 is attached at **Annexure – XXVIII.**

2.2 National 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, Forest and 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.

2.2.1 Ministry of Environment, Forest and Climate Change

Ministry of Environment, Forest and Climate Change (MoEF) plays a pivotal role in environmental management for sustained development and for all environmental matters in the country. The major responsibilities of MoEF 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 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.

2.2.2 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 APPCB 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.

2.2.3 National Green Tribunal

The National Green Tribunal has been established under the National Green Tribunal Act 2010 for effective and expeditious disposal of cases relating to environmental protection and conservation of forests and other natural resources including enforcement of any legal right relating to environment and giving relief and compensation for damages to persons and property and for matters connected therewith or incidental thereto. It is a specialized body equipped with the necessary expertise to handle environmental disputes involving multi-disciplinary issues. The Tribunal shall be guided by principles of natural justice. The Tribunal's dedicated jurisdiction in environmental matters shall provide speedy environmental justice.

The Tribunal shall consist of full time Chairperson, 10 – 20 full time judicial members, 10-20 full time expert members. The Tribunal may invite any one or more persons having specialized knowledge and experience in a particular case before the Tribunal to assist the Tribunal. Presently the Tribunal is operating out of the Principal Bench in Delhi, four zonal benches and four circuit benches. The Tribunal while passing any order or decision or Award applies the principles of sustainable development, the precautionary principle and the polluter-pays principle. The Award, decision or order of the Tribunal may be contested before the Hon'ble Supreme Court. The Award or order or Decision of the Tribunal shall be executable by the Tribunal as a decree of a civil court and for this purpose, the Tribunal shall have all the powers of a Civil Court.

Implication: NGT in its order Dt. 17-11-2017 has stipulated certain conditions / directions pertaining to streams, water bodies, storm water drains, etc. These directions are suitably incorporated in the preparation of the plans, designs and mitigation measures.

Applicable clearances at project implementation stage has been exhibited in the Table 2-1.

Table 2-1: Applicable Clearances at project Implementation Stage

Sr. No.	Clearances	Applicability	Regulatory/ coordinating authority	Indicative Time Frame	Responsibility		Remarks
					Implementation	Supervision	
1	Consent to Establish and Consent to Operate under Air, Water & Environment Act and noise rules.	For establishment of batching plant, hot mix plant, WMM plant, Crusher etc.	Andhra Pradesh State Pollution Control Board (APPCB)	Construction stage (Prior to initiation of any work.	The Contractor	ADC/ APCRDA	Provide a copy of all necessary clearances to the ADC/ APCRDA ❖ Adhere to all clearance terms and conditions ❖ Obtain written permission from private landholders to use their land for construction activities, prior to commencing any works.
2	Explosive License	For storing fuel oil, lubricants, diesel etc. at the project site	Chief Controller of Explosives/ as applicable		The Contractor	ADC/ APCRDA	
3	Permission for storage of hazardous chemical	Manufacture storage and Import of Hazardous Chemical	Andhra Pradesh State Pollution Control Board (APPCB)		The Contractor	ADC/ APCRDA	
4	Quarry Lease Deed and Quarry License	Quarry operation (for new quarry)	State Department of Mines and Geology		The Contractor	ADC/ APCRDA	
5	Permission/ NOC from State Ground Water department.	For extraction of ground water	State Ground Water department		The Contractor	ADC/ APCRDA	
6	Permission/ NOC for Withdrawal of Surface Water from Rivers, Nala, Water harvesting structure/ Reservoirs/ Ponds/ Irrigation canals	For Withdrawal of Surface water	State Irrigation Department. (The concept for flood mitigation is approved by Irrigation dept.)		The Contractor	ADC/ APCRDA	

Sr. No.	Clearances	Applicability	Regulatory/ coordinating authority	Indicative Time Frame	Responsibility		Remarks
					Implementation	Supervision	
7	Labor license from labor commissioner office	Engagement of Labor	Office of the labor Commissioner		The Contractor	ADC/ APCRDA	
8	Permission under Ancient Monuments & Archeological Sites and Remains Act (1958 & 1959)	Applicable for carrying out construction within 300m of the ancient monuments, Ancient Monuments & Archeological Sites and Remains notified by ASI.	Director General, ASI		The Contractor	ADC/ APCRDA	
9	Tree felling Permission	Applicable, if any tree needs to be felled.	District Administration/ Forest Department	Construction stage (Prior to initiation of any work	The Contractor	ADC/ APCRDA	The tree felling requirement would be in stages of the project. Permission would be sought for tree felling under WALTA Act 2002 at later stage of the project.
10	Environmental Clearance for Borrow Areas	Applicable for Borrow Area	District Level Environmental Impact Assessment Authority (DEIAA)	Prior to operation of borrow area	The Contractor	ADC/ APCRDA	Clearance from the APCRDA/Mines Department

Sr. No.	Clearances	Applicability	Regulatory/ coordinating authority	Indicative Time Frame	Responsibility		Remarks
					Implementation	Supervision	
11	Provision for collection and disposal of Construction & Demolition (C&D) Waste as per C&D Waste Management Rules, 2016	Work Site	State Pollution Control Board		The Contractor	ADC/ APCRDA	Clearance to be taken from SPCB for collection and disposal of C&D waste at authorized site as identified in consultation with local municipal body.
12	Provision for collection and disposal of Solid wastes	Works site/ Camp Site	Municipal Corporation		The Contractor	ADC/ APCRDA	This to be arranged through local municipal body for treatment and disposal.
13	Provision of Building & other construction workers (Regulation of Employment and condition of service) Act 1996	Applicable for health and safety issues of labours	State Labour Department		The Contractor	ADC/ APCRDA	Authorization has to be taken from State Labor Dept.
14	Certificate of Pollution Under Control (PUC) for Vehicles	Applicable for vehicle engaged in construction activities	State Transport Authority	Construction Phase	The Contractor	ADC/ APCRDA	

The various environmental requirements of World Bank, GOI for the project are described below.

2.3 Applicability of various WB Safe Guard Policies

The World Bank has ten safeguard policies; the details and applicability of the safe guard policies to the project (Phase I) are provided in the Table 2-2.

Environmental requirements of the World Bank are specified in detail in its Operational Policy (OP) 4.01 and other related Operation Policies. In instances in which the procedural and regulatory requirements differ, the more stringent applies. The World Bank environmental requirements are based on a three-part classification system.

- Category A- projects require a full Environmental Assessment (EA).
- Category B-projects require a lesser level of environmental investigation.
- Category C-projects require no environmental analysis.

The Amravati Sustainable Capital City Development Project (ASCCDP), supported by the World Bank, involves green-field development of selected urban infrastructure (roads, flood mitigation) and is categorized as Category A. Considering the fact that some of the sub-projects under the ASCCDP are to be designed during the course of its implementation, an Environmental and Social Management Framework (ESMF) was developed.

As specified in the ESMF, the flood mitigation sub-project requires an EIA to be undertaken and an EMP to be developed and implemented. The EIA and EMP will go through an independent technical review by third party agency engaged by ADC.

Table 2-2: Applicability of World Bank Safe Guard Policies

Safeguard Policies Triggered by the Project	Yes	No	Remarks on applicability
Environmental Assessment OP/ BP 4.01	×		As required by this policy, and as specified in the ESMF of the Amaravati Sustainable Capital City Development Project, an EIA has been undertaken for the flood mitigation works and an EMP has been developed.
Natural Habitats OP/ BP 4.04		×	This policy states that the Bank does not support projects that involve the significant conversion or degradation of critical natural habitats (such as protected areas). Proposed flood mitigation works doesn't encompass any natural habitats/endangered flora and fauna species. Hence, there is no impact envisaged to any natural habitats or critical natural habitats such as protective areas from the proposed flood mitigation works. Thereby, the OP4.04 doesn't apply.
Forests OP/ BP 4.36		×	This policy requires that the Bank does not support projects that involve the significant conversion or degradation of critical forest areas. This policy is not applicable as the flood mitigation works do not involve any critical forest areas.
Pest Management OP 4.09		×	This policy is not applicable as there is no pest management activity involved
Physical Cultural Resources OP/ BP 4.11	×		This policy addresses physical cultural resources, which are objects, sites, structures, etc., that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Three cultural/religious structures including, one temple in Mandadam, one burial ground in Sakhamuru and one burial ground in Mandadam will be affected – these are covered as part of RAP with necessary consultations. In addition, at one point, the flood mitigation works are near the Undavalli Cave Temple at a distance of 300 meters at the closest point, which is listed as a

Safeguard Policies Triggered by the Project	Yes	No	Remarks on applicability
			'protected monument' by the Archaeological Survey of India. This site is outside the prohibited and regulated area as per the Handbook of Conservation of Heritage Buildings published by CPWD. The capital region master plan has integrated this monument in its overall plan for capital region development. The monument is identified to be considered in its original entity with specific plans in place. Although there is no impact on PCRs, the applicability of OP 4.11 is considered to facilitate effective management in the event of chance finds during project works. Also, this would help inclusion of relevant construction stage management measures including systematic monitoring to be deployed to rule out any impacts. No physical cultural resources management plan is prepared in addition to these requirements.
Safety of Dams OP/ BP 4.37		×	There are three dams upstream of Prakasam Barrage, which is located near Amaravati City on Krishna River in Andhra Pradesh. These include Srisailam Dam – 215 TMC, Nagarjuna Sagar Dam – 408 TMC, and Pulichintala Dam – 45 TMC. These are located at a distance of about 294 Km, 200 km and 85 Km respectively from Prakasam Barrage. The unlikely event of failure of these dams will not pose serious risk to the project supported infrastructure as the downstream dams have adequate storage and discharge capacities. Further, dam safety mechanisms are in place which render the event of dam failure unlikely. Details are provided in the accompanying footnote[1]. Considering the above, 0P4.37 is not applied.

[1] There are three dams upstream of Prakasam Barrage which is near Amaravati City on Krishna River in Andhra Pradesh. These include Srisailam Dam – 215 TMC, Nagarjuna Sagar Dam – 408 TMC, and Pulichintala Dam – 45 TMC. These are located at a distance of about 294 Km, 200 km and 85 Km respectively from Prakasam Barrage.

In the event of failure of Srisailam Dam, the flows can be withheld at Nagarjuna Sagar Dam. Also, there are regular safety review protocols followed by the Water Resources Department, GoAP and hence the failure is a remote possibility.

In case of Nagarjuna Sagar, Government of Andhra Pradesh has constituted a Dam Safety Review Panel under World Bank financed Andhra Pradesh Water Sector Improvement Project (APWSIP). The panel periodically undertakes comprehensive review of the dam safety and recommends implementation measures. Details of the Committee are placed at Annexure XXXI.

In the unlikely event of failure of the Pulichintala Dam, the 45 TMC water translates to discharge of about 0.5 million cusecs which would not have any impact on Amaravati City as the Prakasam Barrage can handle discharges upto 1.2million cusecs (about 109 TMC per day).

In a 100-year peak rainfall of 222mm in Amaravati City, the total water to be discharged from Amaravati into River Krishna is 0.016 Million Cusecs, this discharge is just 1.5% of Prakasham Barrage daily discharge.

Even in the simultaneous event of failure of Pulichintala Dam (0.52 Million Cusecs) and 100-year flood rain fall in Amaravati, the total water that need to be discharged is 0.54 Million Cusecs (0.52+0.016), which is app. 49% of Prakasham Barrage daily discharge.

Schematic Map with capacities of the Srisailam, Nagarjuna Sagar, Pulichintala, Proposed Vykuntapuram and Prakasham Barrage with respect to Amaravati City has been presented in the Annexure XXXII

From the above analysis, it is evident that failure of dams would not result in any inundation in the Amaravati City.

It is also important to mention here that GoAP is planning to construct a new barrage near Vykuntapuram (upstream of Amaravati City) which is approximately 23 kms from Prakasham Barrage. The proposed Barrage will have a capacity of 13 TMC, which will play a vital role in protecting Amaravati City in case of above-mentioned Dam failure events.

Further, in the event of failure of dams in the upstream of the city, flood mitigation provisions proposed under Amaravati City Development, facilitate cutting off the City from the River Krishna. Hence, there is no chance of damage to canals/reservoirs in the City.

CHAPTER 3: FLOOD HAZARD MODELLING & ANALYSIS OF MITIGATION OPTIONS

In efforts to build a world-class capital city, GoAP have considered all the measures pertaining to city resilience. Blue Consultant was entrusted the task of assessing the flood magnitude that needs to be considered for capital city and to suggest remedial measures to mitigate the flood in a safe manner. A map showing the catchment boundary of Kondaveeti Vagu and extent of the proposed capital city area is shown in Figure 1-2.

3.1 Description of the Current Flood Situation

The major streams of KV and PV flow across the Capital city area, currently cause floods in its surrounding region during the times of heavy rains and submerge low lying areas in the city for brief periods. This is due to inadequate size of cross drainage structures, sharp bends of streams, meanders near Krishnayapalem and absence of bunds at few places. The result of the same makes the vagus to burst its banks to flood adjacent areas/fields and overtopping of several causeways to result in the hindrance to traffic and also loss of life due to wash away during the floods.

Existing Flood scenarios in capital city with different flooding conditions are briefed here.

(a) **KV Vagu flood:** Kondaveeti Vagu is a minor stream joining River Krishna, just upstream of Prakasam Barrage. It originates from Kondaveeti hill ranges near Pericherla village in Guntur district and drains a total catchment of about 421 km^2. Kondaveeti Vagu has a steep gradient for a short length, i.e., in its upper reaches and is mostly flat for rest of the catchment. Other minor streams like Pala Vagu, Erra Vagu, Kottela Vagu, etc. join the Kondaveeti Vagu It joins River Krishna through Undavalli sluice outlet.

The flood discharge of Kondaveeti Vagu is entirely dependent on the magnitude of rainfall occurring over the catchment area. Hence, a review of observed rainfall data in the catchment vis-a-visa peak annual flood discharge of Krishna River recorded at Prakasam Barrage, Vijayawada is made considering the recent 25 years period (i.e., 1990-91 to 2014-15).

The rainfall data at Thullur and Tadikonda rain gauge stations which represent significantly the catchment and are located within the catchment of Kondaveeti Vagu is considered for the above stated purpose.

(b) **River Krishna flood:** The Krishna is the second largest Eastward draining River in Peninsular India covering vast area in the States of Maharashtra, Karnataka and Andhra Pradesh. The basin drains an area of 2,58,948 km2. This is nearly 8 % of the total geographical area of India. Based on review of historical flood records of Krishna River at Prakasam Barrage at Vijayawada for the recent 25 years period, a maximum flood discharge of 31,447 m3/s (which corresponds to 100 year peak flood of Krishna River) was observed on 05th October 2009. The corresponding rainfall recorded at Thullur and Tadikonda rain gauge stations on the above date is nil (i.e., 0 mm).

(c) **Simultaneous occurrence of both (a) and (b)**: It is observed from the rainfall data, the rainfall in Kondaveeti Vagu catchment is either nil or marginal when there is peak flood in Krishna river for all years, except for 2005-06. During 2005-06, the peak flood observed in Krishna river is about 20,545 m^3/s (which is about 65% of 100 year flood of Krishna river) and the corresponding average rainfall in Kondaveeti Vagu catchment is about 162 mm (which is less than the 100 year rainfall of 222 mm considered in the design).

From the above, it can be concluded that simultaneous occurrence of peak floods in Krishna River and Kondaveeti Vagu catchment (capital city) has a low probability. Since, flood management of

capital city is regulated with pumping stations; its relevance is only in design of pumping stations. The pumping station will be designed to cater to the above condition. The points briefed in (a), (b) and (c) are discussed in details in DPR- Flood Management.

Future contribution of capital city storm water and wastewater drains to flood is described below.

One of the main constraints encountered in designing the flood management system was the storm water drains in the capital city, which was designed to cater 1 in 5 years storm. Several discussions took place with the Infrastructure Consultant responsible for the design of the same. As per the results of the High Flood levels (HFLs) obtained from the model studies were reduced from RL 17.0m to RL 15.0m[2], especially in the lower reaches at Undavalli. This also resulted in the constraint of having the pumping at Undavalli necessary not only during floods but also at times where the water level in Kondaveeti and Pala Vagu and their in-falling drains need to be brought down to RL 15.0m to facilitate the discharge of storm water from the city surroundings to the canals by gravity. Identification of low-lying areas in the capital city, proposed land-use in the low-lying areas, implications for flood and its management.

The Land used Map is placed at Annexure II. The low laying areas in the Capital City can be identified from the Inundation Map also shown in the Figure 3-5.

3.1.1 Details on Current Floods:

A) During monsoon season, some area of land remains submerged by the flood discharges of Kondaveeti Vagu every year. Currently, the flood discharges of Kondaveeti Vagu cannot be drained directly into River Krishna due to high flood level of Krishna River. To prevent backflow of Krishna River during high floods, Kondaveeti Vagu floods are regulated through an outlet structure located near Undavalli. In order to minimize the inundation, flood discharges of Kondaveeti Vagu are diverted to Krishna Western Delta (KWD) canal through an escape regulator. The hydraulic design capacities of KWD escape regulator and KWD canal are 170 m^3/s (6000 Cusecs) and 232 m^3/s (8200 Cusecs) respectively.

B) During non-monsoon season, the gates of Undavalli sluice outlet are opened to enable drawl of water from Prakasam Barrage to the Guntur canal in order to meet irrigation and drinking water requirements of surrounding areas. This causes inundation within Kondaveeti Vagu catchment as the ground levels in the eastern side of the catchment are lower than the Full Reservoir Level (FRL = RL 17.39 m) of Prakasam Barrage.

Natural discharge from regional water systems as the Kondaveeti Vagu is hindered by the existing bund and its regulating works as well as the regime of the Prakasam Barrage.

Effect of 2009 Flood:

During October 2009, heavy floods exceeding the record of once in 100 years were witnessed in the Krishna River Basin, temporally isolating 350 villages and causing millions homeless (not in the Capital City area). This was an unprecedented event which resulted in heavy damage across the states including the then Andhra Pradesh State. Kurnool, Mahbubnagar, Guntur, Krishna and Nalgonda Districts in Andhra Pradesh were among the effected districts in the state. The Kurnool

[2] Integrating the existing villages has been identified as one of vital components of the Capital City Development's vision. To protect the existing settlements which are constraint for the infrastructure development in Capital City, Amaravati storm water modelling and flood modelling has been undertaken. Model has resulted the RL as 15 at Undavalli in order to discharge the storm water through gravity from these villages as well as other parts of the Capital City.

city was submerged with 3-4 m deep water for nearly 3 days as reported in the National Rainfed Area Authority, Planning Commission in its 2011 report[3].

The details on flood occurred in Oct 5th, 2009 and its severity, reported loss of life, property etc. was widely published in newspapers. The team had discussions with the officials of WRD department, GoAP to confirm on the damage occurred during this event. The details as per the discussions are described below. It was found that the heaviest flood in over a hundred years hit the Prakasam barrage on Krishna River threatening several villages downstream.

It was also mentioned that due to this event a record of 11.03 lakh cusecs of floodwater reached Prakasam barrage. However, there was no threat to human lives as 2.5 lakh people of Krishna and Guntur districts have already been shifted to relief camps.

With nearly 11 lakh cusecs of water in the swollen Krishna cascading from the Prakasam barrage, there was a concern on the ability of the flood banks to withstand the fierce pounding by the swirling river. This is the heaviest flood in more than 106 years as the previous record was 10.30 lakh cusecs in 1903, irrigation authorities said.

The water level touched 21.9 feet as all the 72 sluice gates were lifted to let out the excess waters.

3.2 Kondaveeti Vagu Catchment - Future Scenario

Under current conditions flooding occurs during the monsoon. Change of land use from agriculture to urban environment (due to development of capital city) increases peak runoff resulting in a faster discharge of pluvial water and subsequent higher water levels downstream. As a result the normative condition, i.e. the conditions determining the maximum flood levels, is determined by the future situation in which the city is fully developed. This also implies that the water system has to be defined according to this fully developed situation. The future flooding scenario has been built based on rainfall analysis.

3.3 Rainfall Analysis

The modelling of the Kondaveeti Vagu (KV) catchment is a necessity in the process of flood management works. With the hydraulic model, water levels in the Kondaveeti Vagu catchment can be predicted in different design scenarios. For the model design, conditions are defined as a once in a hundred years precipitation event.

3.3.1 Rainfall Data

Observed daily rainfall data of Thullur and Tadikonda rain gauge stations, which are located within the boundary of Kondaveeti Vagu catchment area have been considered in the study to establish 100 year return period peak rainfall event. Further, hourly rainfall data at Gannavaram rain gauge station has been considered to disaggregate daily rainfall data into hourly rainfall data. A map showing the location of above three rain gauge stations along with catchment boundary of Kondaveeti Vagu is given in Figure 3-1.

[3] http://nraa.gov.in/pdf/krbasin_2009.pdf

Figure 3-1 Location of Rain Gauge Stations

The rainfall observations at Thullur and Tadikonda stations are being carried out by Government of Andhra Pradesh (GoAP) through non-recording and automatic rain gauge stations. Typical photograph showing the type of rain gauge stations used for rainfall measurements at Thullur station is shown in Figure 3-2.

Figure 3-2 Rain Gauge Station at Thullur

Daily rainfall data at Thullur and Tadikonda rain gauge stations for the recent 26 years period during 1989-2014 was collected and the same has been considered for further studies. The average annual rainfall observed at the above stations in 26 years period is found to be about 990 mm and 945 mm respectively. Table 3-1 below exhibits the recorded average annual rainfall in these two stations.

Table 3-1: Recorded Rainfall Details

Station	Avg. Annual Rainfall (mm)	Maximum Daily Rainfall (mm)
Thullur	990	183
Tadikonda	945	140

The observations at Gannavaram rain gauge station are made by Indian Meteorological Department (IMD), Government of India by means of automatic recording type rain-gauge station. Hourly rainfall data at Gannavaram rain gauge station for a period of 29 years (1969-70 to 1997-98) was collected and the same has been considered to disaggregate daily rainfall data into hourly rainfall data for estimation of flood. The average annual rainfall at Gannavaram station for the above period has been found to be about 900 mm.

As per Table 3-1, the variation in average annual rainfall between the three stations is marginal (i.e., about 5-10%). From Figure 3-1 and 3-2, it is seen that Thullur and Tadikonda rain gauge stations are located within the catchment boundary and Gannavaram rain gauge station is located outside the catchment boundary. As per IS 4987:1994 *(Recommendations for Establishing Network of Rain Gauge Stations)*, one rain gauge upto 500 km^2 shall be sufficient in plains. Hence, rainfall data at Thullur and Tadikonda rain gauge stations are considered to adequately represent the rainfall variation within the catchment and therefore, considered for further studies.

3.3.2 Estimation of 100-Year Peak Rainfall

General Extreme Value (Gumbel's) distribution has been found to be the best-fit distribution for the rainfall data. Rainfall frequency analysis has been carried out considering maximum 1-day rainfall for the 26 years period using Gumbel's distribution. Based on the existing 25-year rainfall data, the KV catchment, the highest recorded rainfall at Tadikonda is 140mm and at Thullur is 183 mm (average is about 162 mm). A check has been made to verify the estimated 100 year rainfall event established from data at Thullur and Tadikonda stations with that of the value estimated from observed rainfall data at Gannavaram station. Based on studies carried out, it is found that 100 year peak rainfall estimated using Gannavaram data is almost same as that obtained from Tadikonda and Thullur stations.

The same has been reviewed and recommended by Technical Expert Committee constituted by the Government of Andhra Pradesh consisting Chief Engineers and experts in the sector. Further the same has been discussed with World Bank technical team and WRD, GoAP.

Accordingly, the 100-year peak rainfall of 222 mm in 24 hours has been considered for further studies.

3.3.3 Validation of Available Rainfall Data

Available rainfall data from the rain gauge stations in the Kondaveeti Vagu catchment is further validated for its authenticity by making a comparison of the same with the available meteorological data from the Indian Meteorological Department (IMD). On a review of the data it is observed that the daily rainfall intensity lies between 260 and 280 mm for the area under consideration. However, isopluvial maps cover considerably large area than the Capital City. Given this, the 100 year peak rainfall in the capital, referred above has been considered.

3.3.4 Conclusions on Rainfall data

Based on the existing rainfall data in the Kondaveeti Vagu catchment and the important effective rain gauge data among them and comparison of the factor to be used for extrapolation of the current available rainfall data to 100 year return period following conclusions can be drawn:

1) A 24h T100 rainfall event does not show intensities over 30mm/hour
2) A 24h T100 rainfall event does have a 90% upper limit of 175 to 180mm based on Gumbell Distribution.
3) Raw rainfall data at Guntur region results in an isolated rainfall event of 260 to 280 mm

Considering the above conclusions a rainfall event of 222 mm in 24 hours is used for all calculations of flood flow.

3.4 Flood Hazard Modelling

SOBEK[4] 2.14.001 rural package has been used to undertake Kondaveeti Vagu Catchment flood hazard modeling. From this modelling package the Rainfall Runoff (RR) and 1 dimensional flow (1D-FLOW) modules are used to model this catchment. Initially, the current situation is modeled to determine the competence of the model. After a successful reproduction and analysis of the T100 flood discharge the model can be adapted to simulate the functioning of the water system in the Amaravati Capital City Master Plan.

3.4.1 Flood Hazard Model for Amaravati Capital City with Current Flood Mitigation

The model is based on the available GIS data. Using the DEM the Kondaveeti Vagu catchment is calculated with ArcGIS software. The Catchment area of Kondaveeti Vagu is about 421 km^2 with elevations between 17m and 30m above mean sea level.

3.4.1.1 Cross-Sections

The cross-sections of all channels in the current situation are based on the DEM. For all channels, approximately every 500 m. apart, a transverse line 400 m. long is created. All these lines are then converted to points, 10 m. apart. These points are then assigned the elevation of the DEM pixel on which they lay. The center 2 points are lowered 2.0 m. artificially creating a 20 m. wide channel with a bottom level 2 m. below ground level. All cross-sections are imported to SOBEK (with the tool Turtle[5]) and checked. Irregular cross-sections are deleted. The model contains 172 cross sections.

3.4.1.2 Rainfall Runoff

To accurately include the surface runoff of precipitation, the Kondaveeti Vagu catchment is divided in sub-catchments. All channels are cut into segments of approximately 2000 m resulting in 61 segments. For each segment a sub-catchment is calculated based on the DEM using the DTM2CAT tool. For each channel segment a point is imported to SOBEK. On this point rainfall runoff flows into the channel from unpaved and paved nodes. For each sub-catchment the area and the mean elevation are calculated. In the current situation 95% of a sub-catchment area is appointed to unpaved nodes and 5% to the paved nodes. The model contains 61 unpaved area nodes and 61 paved area nodes.

Due to land use change from agricultural use to urban area there will be an increased paved surface. To include this change in the model the areas represented by paved and unpaved areas are changed.

Within city boundaries the paved area is set to 64% and unpaved set to 36% considering the City Master Plan (parks and open spaces 19%, water bodies 10% and other open spaces 7%).

3.4.1.3 Downstream Boundaries

[4] https://www.deltares.nl/en/software/sobek/

[5] http://www.modelwalhalla.nl/cgi-bin/wiki/view/Tools/TurtleRural

At the downstream end of the Kondaveeti Vagu, the Undavalli outfall and the Krishna Western Delta Canal are the downstream boundaries of this hydrological model. The water level at the Undavalli outfall can be modified to represent low (FRL of Prakasam barrage) or high (HFL of Prakasam Barrage) in the Krishna River just upstream of the Prakasam barrage. In case the water levels are high, pump is used to discharge the water from the Kondaveeti Vagu.[6]

3.4.1.4 Meteorological Input

Modelling is done using daily measurements from the stations in KV catchment, stations Thullur and Tadikonda. To simulate a T100 event a rainfall event is created using the data of a wet monsoon combined with the T100 values. Further analysis of the effect of rainfall data includes the use of the Gannavaram hourly rainfall data. These are normalized for daily totals to obtain hourly distributed rainfall. Analysis shows that hourly rainfall distribution at T100 reaches a simulated peak intensity of 36mm/ hour[3] thus causing minimal differences with daily values.

3.4.1.5 Calibration

With SOBEK it is possible to include evapotranspiration in the model as daily evaporation values. Also soil processes are used in the modelling process. In order to obtain a valid simulation result the parameters in the model need to be adjusted to match model outcome with measured water levels and volumes. In the KV catchment no water levels or discharge measurements are available.

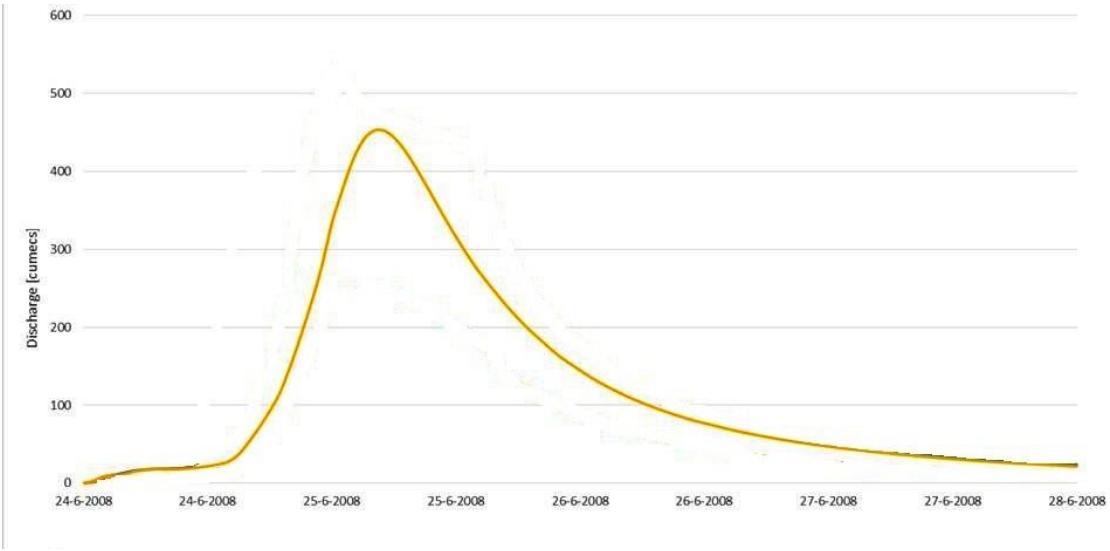


Figure 3-3: Flood Hydrograph (Current Scenario)

The only calibration value is a maximum discharge of 460 cumecs at the confluence point of KV with River Krishna. The resulting flood hydrograph of Kondaveeti Vagu at outfall point (i.e., Undavalli outlet) is shown in Figure 3-3.

The 100 year peak flood discharges modeled at various locations along the KV considering the current flood mitigation scenario is shown in Figure 3-4.

[6]Report on Flood modeling & management measures of Kondaveeti Vagu, M/s. Aarvee Associates, May 2016

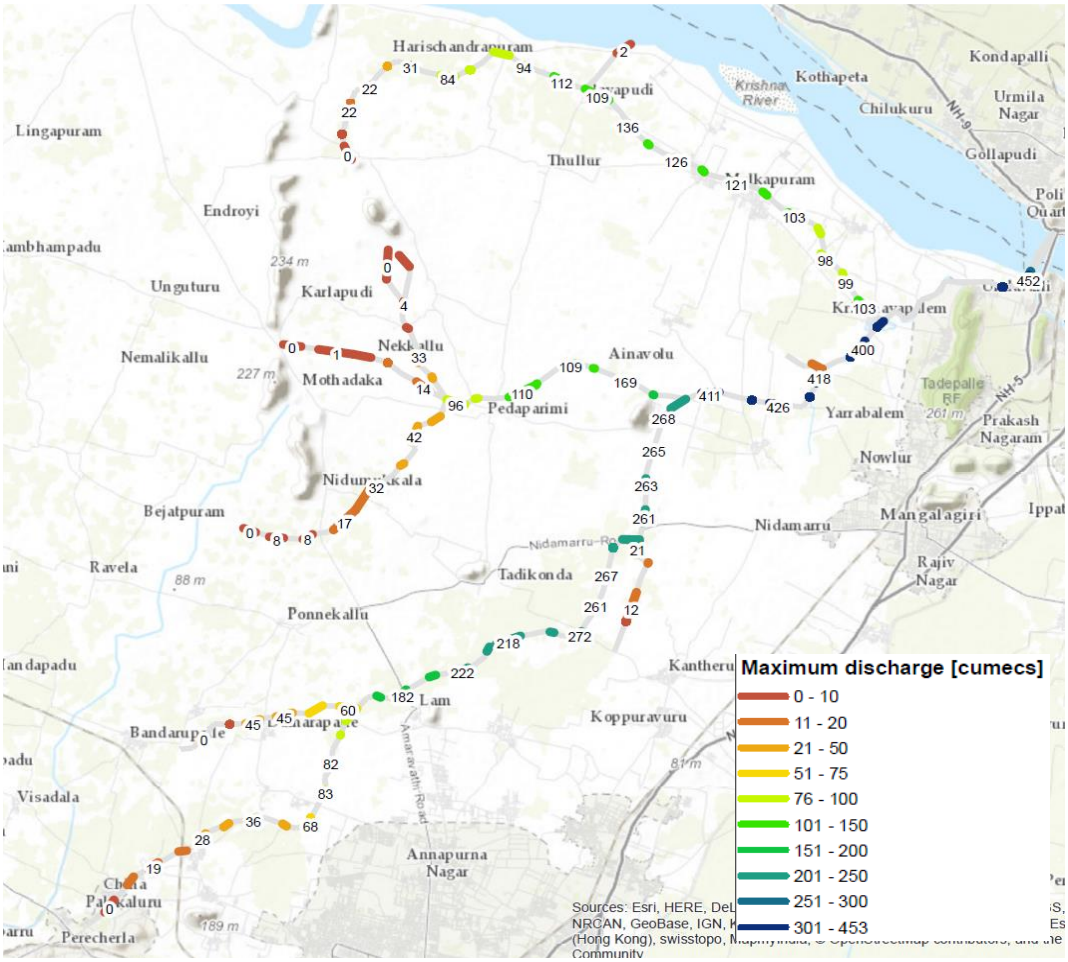


Figure 3-4: Peak Discharges at Various Locations of KV (Current Scenario)

3.4.1.6 Dimensional Modelling

Since the model of the current situation predicts there would be no inundations, a coupled 1D/2D model was made using a 100 by 100m grid based on the DEM. The results show large inundated areas and low peak discharge due to the huge amount of water that is stored at surface level. For the construction of the design model, the Amaravati Master Plan V4 is used. Within city boundaries, the existing channels are removed and the waterways from the master plan are included in the model. The simulated situation is the T100 design flood.

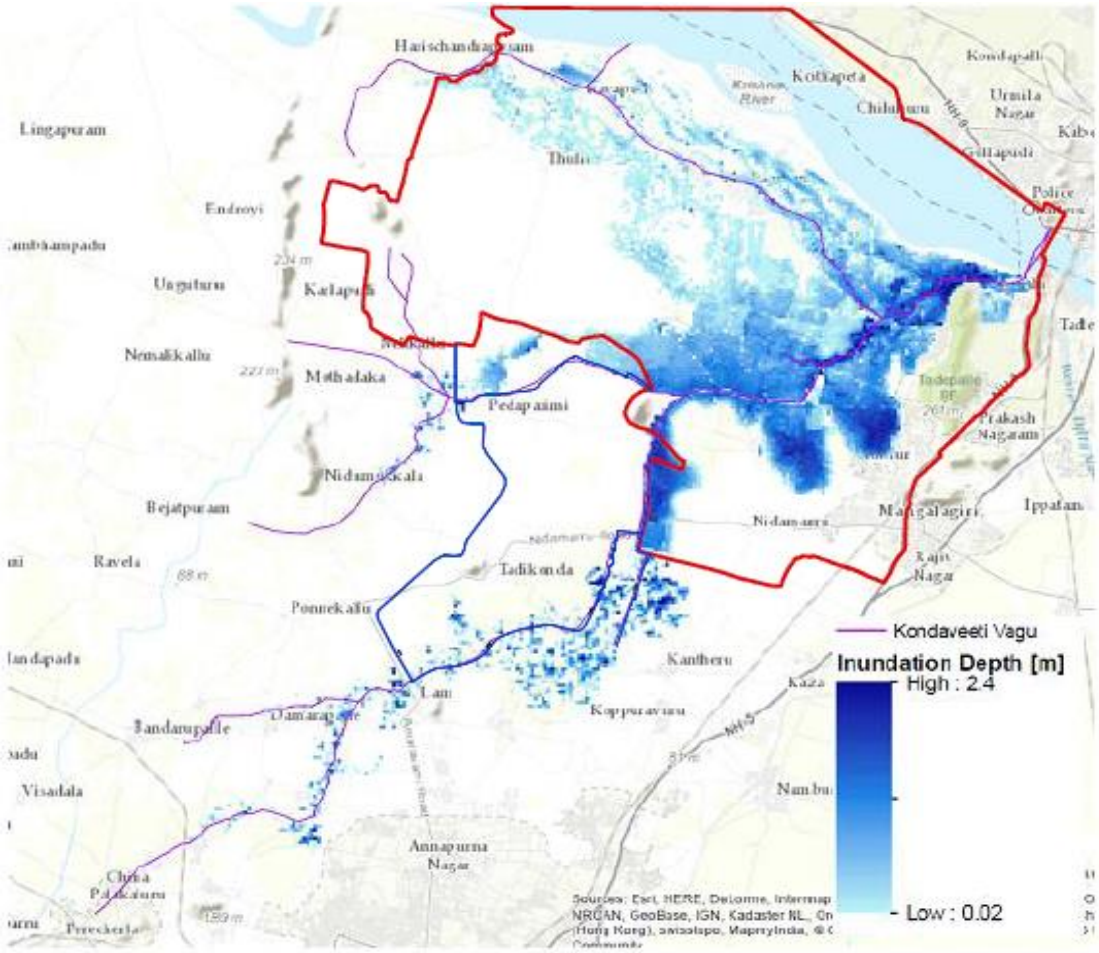


Figure 3-5 Maximum Inundation Levels for T100 Flood Under Current Flood

3.5 Inundation Details:

- Western Area - No inundation
- Southern Area - Marginal/No Inundation
- Northern Area - No inundation
- Eastern Area - Expected depths - 0 to 2.4 m (predominantly in the eastern part of city along the Kondaveeti Vagu).

3.6 Flood Mitigation Options

The spatial restrictions implied by the city design do limit optimization of the water system design. More space for water reservoirs and storage areas has been emphasized in earlier studies. Even with the added room for green areas and water storage areas the need for pumping stations remains. This also has to do with the natural characteristics of the area. The need for permanent pumping capacity is clear and cannot be avoided. The needed capacity can be optimized, with active control of water levels in the reservoirs and a flood early warning system. A conflict of functions occurs as the reservoirs are also designed for water storage/ water conservation. By allowing active water level management during the monsoon with restrictions near the end of the monsoon period a functioning system with optimized pumping capacity can be realized.

Based on study of available data and the discussions held with various stakeholders like ADC, APCRDA, Technical Expert Committee, three flood management works options have been

identified for the capital city. Flood modelling studies have been carried out for the three options and the details of study are summarized in the following sections.

3.6.1.1 Option-1

As shown in Figure 3-6 based on the flood discharges computed, this option involves flood discharge of 5650 cusecs (160 m^3/s) being disposed at Vykuntapuram and a flood discharge of12350 cusecs (350 m^3/s) at Undavalli and 4000 cusecs (113 m^3/s) being discharged through Krishna Western Delta (KWD) Canal.

The discharge from the upper catchment is realized through a gravity canal taking off from Lam Reservoir upto the Vykuntapuram Reservoir via another Reservoir located at Pedaparimi. Thus the upper catchment area of Kondaveeti Vagu is catered to by a gravity canal and three new reservoirs, namely Lam (existing), Pedaparimi and Vykuntapuram Reservoirs.

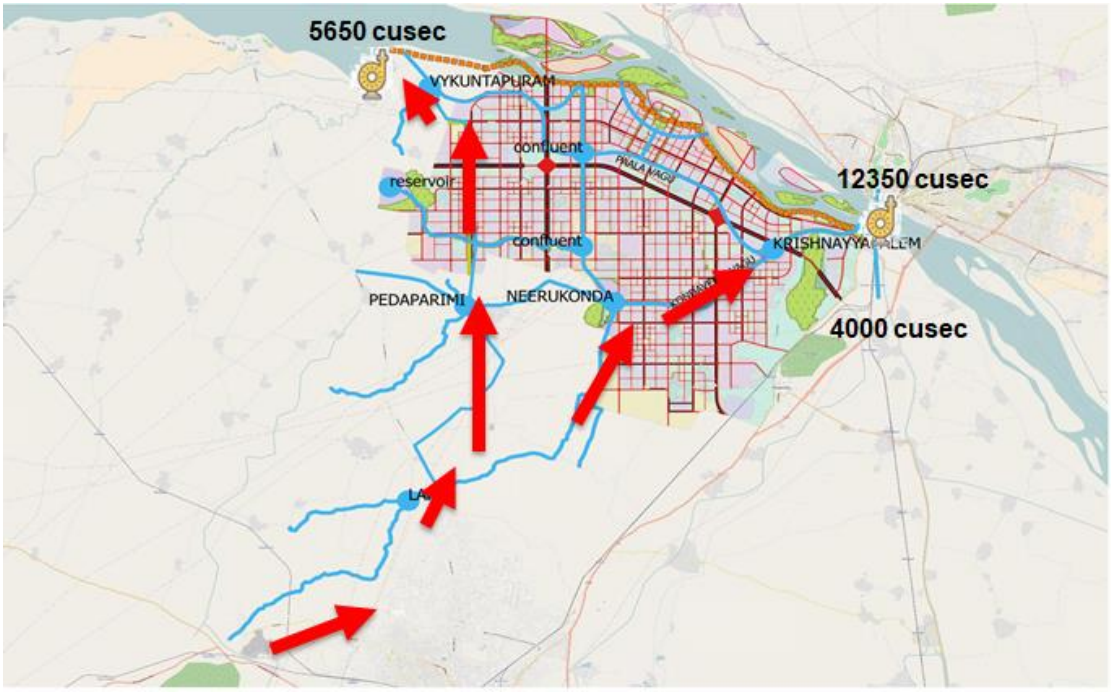


Figure 3-6: Option-1 for Flood Disposal

The lower catchment of the Kondaveeti Vagu catchment in this option is catered to by Kondaveeti Vagu and Pala Vagu and its in-falling drains draining in to Undavalli where the flood water is pumped at Undavalli Pumping Station.

The advantages of this option are as follows:

- The entire catchment is delineated into two sections – upper catchment and lower catchment, easing the burden of works involved;
- The chances of the capital city getting flooded for a 1 in 100 year event gets reduced since the upper catchment flood flow is disposed-off by means of the gravity canal proposed for this purpose that incidentally lies outside the capital city.
- The pumping capacity for a 1 in 100 year event estimated as 470 m^3/s gets distributed as two pumping stations - one at Vykuntapuram corresponding to a flow of 160 m^3/s and the other at Undavalli corresponding to 350 m^3/s is planned. This lessens the burden of having a pumping station of large capacity at one location.

3.6.1.2 Option-2

As indicated in Figure 3-7, there is no gravity canal planned outside the capital city as in Option-1 but instead the flood flow corresponding to 5650 cusecs is planned to be disposed of through the proposed Secretariat Canal starting from Neerukonda Reservoir till the Secretariat Area before disposing to River Krishna. This Option does not involve any new land acquisition for the gravity canal as in Option-1 but since the same is planned through the capital city and that too through the Government Complex of the city, the same is uncalled for.

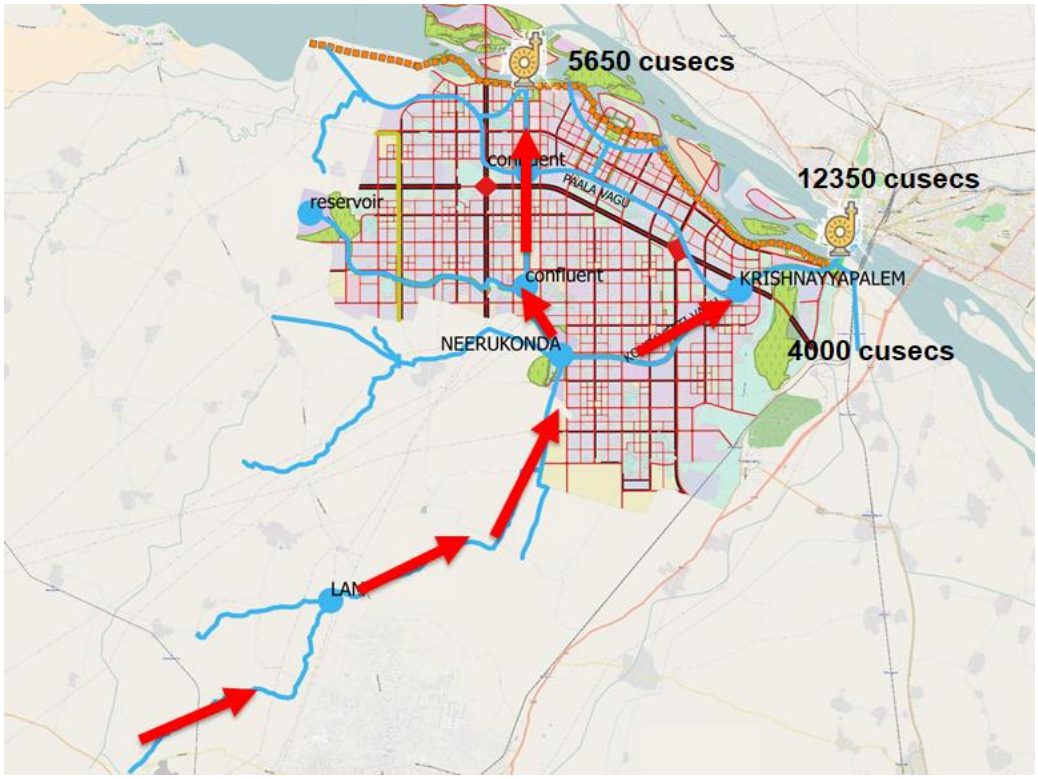


Figure 3-7: Option-2 for Flood Disposal

3.6.1.3 Option-3

This Option for flood disposal involves pumping the entire flood flow of 1 in 100 year storm event corresponding to 18,000 cusecs at a single location at Undavalli. This Option for flood disposal involves pumping the entire flood flow of 1 in 100 year storm event corresponding to 18,000 cusecs at a single location at Undavalli.

The option doesn't require any new canal system. Hence, there will be no additional requirement of land. Having said that, the Option requires a substantial pumping capacity at a single location. Thereby, modelling of this option was difficult to fit the canals leading to the pumping station within the spatial constraints of the city Master plan. With a single pumping station at Undavalli to dispose entire 18000 cusecs of storm water, there is a requirement of substantial land for the pumping station.

Moreover, the redundancy of pumps not working and the dependency of pumping of large flows at one location is very high and therefore the risk involved in this Option is too high. Therefore, this Option is not considered for the study.

As the average water level in the canals had to drop from the earlier proposed 17m to 14m to accommodate the storm water discharge into the canal by gravity, this option becomes technically challenging. The main issue with this option however is the vulnerability and future

extension capability. No redundancy exists if anything unforeseen happens and future capacity enlargement is not possible due to geometric constraints.

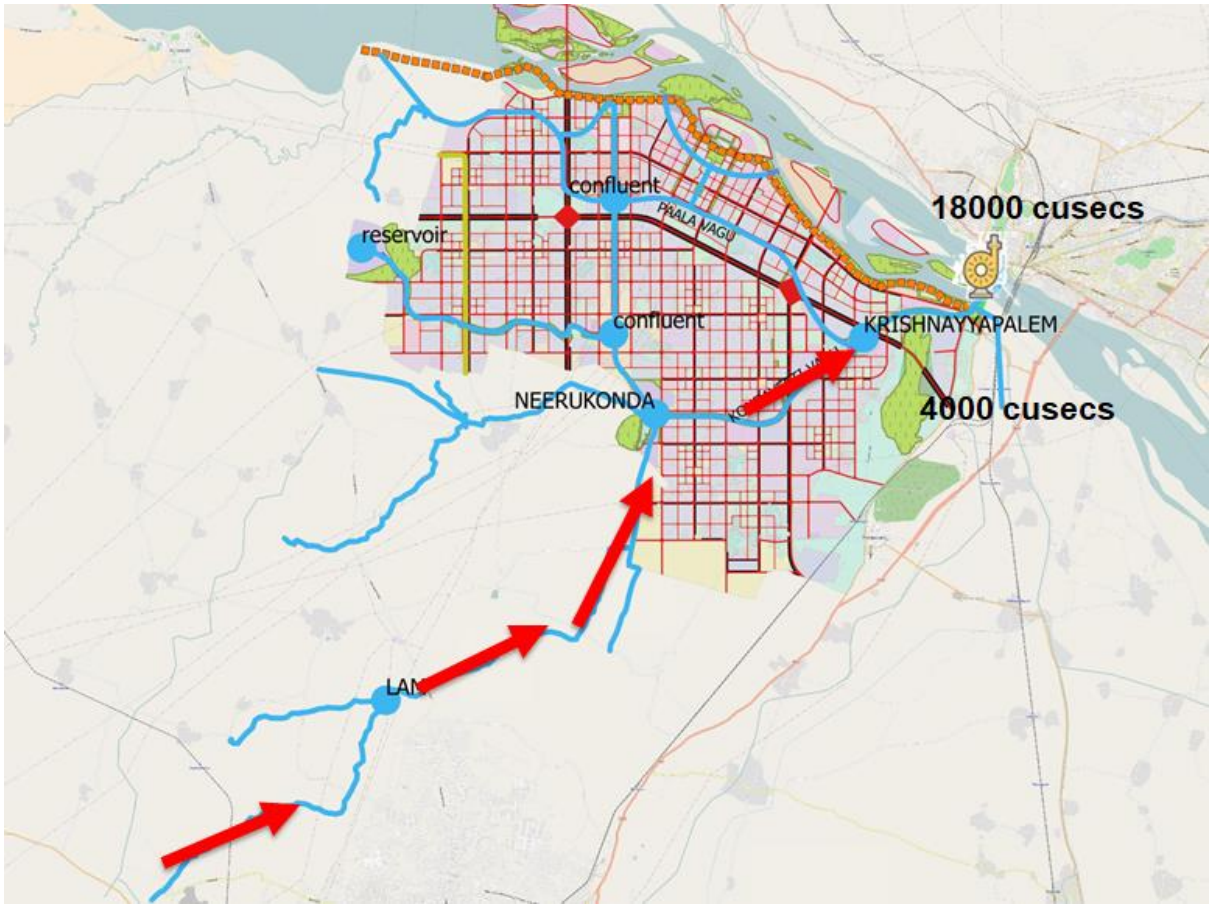


Figure 3-8: Option-3 for Flood Disposal

3.6.2 Comparison of Flood Mitigation Options

The Option 1 has been selected as the preferred option for flood mitigation based on the recommendations of the Technical Expert Committee (TEC) and discussions with stakeholders. The constitution of the TEC & list of key stakeholders consulted enclosed as **Annexure – XVII**. Summary of the comparative analysis of the 3 Options is provided in Table 3-2 and summary of strengths and weaknesses of each option has been presented in the Table 3-3.

Table 3-2: Summary of the Comparative Analysis of the Proposed Flood Management 3 Options.

Sr. No.	Environmental Considerations	Remarks		
		Option 1	**Option 2**	**Option 3**
1.	Land Availability	Land for the proposed width (vary from 120 to 175m) for the canal network and three reservoirs is available with the agency.	Proposed width of the canal under this option is in line with the Option 1. The required land is available for the development of canals and reservoirs is available with the agency. However, the proposed network at the government complex splits the area into two parts for about 8km. and thereby distorting to the Government Core. It also requires at least 3 additional major bridges to integrate the area	Land required for the three reservoirs is available with the agency. However, the proposed width for the canal network varies from 175 to 225 m requiring additional land which is not earmarked in the master plan. Also the land for additional pumping requirements at Undavalli is not available.
		Proposed Reservoirs at Lam (477 acre), Pedaparimi (470 acre), and Vykuntapuram (519 acre) will be located outside the capital city, APCRDA will reserve the land as per the requirement.	Proposed Reservoirs at Lam (477 acre), Pedaparimi (470 acre) will be located outside the capital city, APCRDA will reserve the land as per the requirement.	Proposed Reservoirs at Lam (477 acre), Pedaparimi (470 acre) will be located outside the capital city, APCRDA will reserve the land as per the requirement.
2.	Impact on existing land forms and topography	The option has been derived based on the proposed Land Use of the Capital City, without, altering any landforms and topography.	Same as Option 1. However, to avoid additional infrastructure costs, the proposed canal at the government complex has been converted as an	Expected to change the topography and land form as portion of the canal network would impact the Reduced

Sr. No.	Environmental Considerations	Remarks		
		Option 1	**Option 2**	**Option 3**
			ornamental canal, without altering any landforms and topography	Levels of the infrastructure and thereby increasing earthwork.
3.	Socio-Economic Impact	About 30 families will be displaced.	Physical displacement will be same as Option I	Physical displacement will be substantial than other two options
4.	Impact on Ecology	The study area doesn't have any vulnerable or endangered species. About 500 trees would be affected		Additional canal width would affect another 500 trees than expected under Option 1 and 2
5.	Disposal of excess earth material	About 40 million m^3 earth material would be generated from widening and deepening of the canals, Vagus and reservoirs. Sites for disposal of the excess has been identified within the capital city		This options calls for more excavation of earth and disposal of the same.
6.	Operation & Maintenance	Operation and Management under this option there would be two pumping stations at Vykuntapuram and Undavalli to discharge the excess amount of flood water minimizing the operation costs.	This option requires higher energy consumption than of Option I due to multiple pumping stations.	Under the option-3, the pumping station is proposed only at Undavalli resulting higher operation costs.

Table 3-3: Strengths and Weaknesses of Flood Mitigation Options proposed for Amaravati

Options	Strengths	Weaknesses
Option 1	1. Availability of Land for improvement of PV and KV and city reservoirs 2. Ease of operations and maintenance 3. Possibility for Cost optimization 4. Fits with Amaravati Capital City development phasing plan 5. Low Risk in the event of 1/100 years storm 6. Can be developed in the limited time framework	1. Loss of vegetation due to cutting/rehabilitation of about 500 trees 2. Displacement of 30 families 3. land requirement to construct reservoir at Vykuntapuram and gravity canal
Option 2	1. Availability of Land for improvement of PV and KV and city reservoirs 2. Lesser cost than the other two 3. Moderate Risk in the event of 1/100 year storm	1. Distorting the Core Government Complex 2. Higher infrastructure costs due to the additional number of crossing and bridges to be constructed across the canal 3. Higher operation and maintenance costs 4. Displacement of 30 families. 5. Loss of Vegetation due to cutting/rehabilitation of about 500 trees. 6. Land requirement to construct reservoir at Vykuntapuram and gravity canal.
Option 3	1. No new construction of canal requirement 2. No requirement of Vykuntapuram Reservoir	1. High risk in the event of 1/100 year storm considering pumping station at Undavalli alone 2. High operation and maintenance cost 3. Higher level of displacement of families compared to other two options considering additional requirement of land towards widening of the canals beyond the Master Plan provisions in the city. 4. Loss of vegetation beyond the other two options 5. Change in the landform expected due to further widening of the canals.

Based on the above analysis and limitation on the availability of land it is concluded that option – I is selected for the Amaravati flood mitigation works. Further within Option-1, only Phase-I activities as noted below are being taken up now and part of proposed Bank project. The Phase-I activities on a stand-along basis are designed / envisaged to deliver the flood mitigation outcomes. Phase-II activities would only be taken up as appropriate after some years and outside of this project.

Table 3-4: Works/ components under three different options & Implementation Strategy

S. No	Component	Implementation Strategy		Options		
		*Phase I	#Phase II	Option 1 (Preferred one)	Option 2	Option 3
Canals/Vagus						
1	Widening and deepening of Kondaveeti Vagu (19.85 Km) and Pala Vagu (16.7 Km) – earth works	√		Yes	Yes	Yes
2	Construction of Gravity Canal (8Km) – earth works	√		Yes	No	No
3	Secretariat Canal from Neerukonda to Secretariat			No	Yes	No
4	Feeder Canals from upper catchment to Kondaveeti Vagu and Gravity Canal – earth works		√	Yes	Yes	Yes
5	Lining of the Canals		√	Yes	Yes	Yes
6	Widening and deepening of Kondaveeti Vagu (3.75 Kms)- earth works		√	Yes	Yes	Yes
Reservoirs						
1	Krishnayapalem Reservoir – 0.1 TMC	√		Yes	Yes	Yes
2	Sakhamuru Reservoir – 0.03 TMC	√		Yes	Yes	Yes
3	Neerukonda Reservoir – 0.4 TMC	√		Yes	Yes	Yes
4	Vykuntapuram Reservoir– 0.2 TMC		√	Yes	No	No
5	Pedaparimi Reservoir – 0.3 TMC		√	Yes	Yes	Yes
6	Lam Reservoir– 0.3 TMC		√	Yes	Yes	Yes
7	Construction of weirs and mechanical related works of Sakhamuru, Krishnayapalem and Neerukonda Reservoirs		√	Yes	Yes	Yes

S. No	Component	Implementation Strategy		Options		
		*Phase I	#Phase II	Option 1 (Preferred one)	Option 2	Option 3
Pumping Stations						
1	Pumping station at Undavalli (i) about 5000 cusec is being implemented by WRD, GoAP		5000 Cusec is completed and due for commissioning in next one month[7]			
	(ii) 7350 cusecs to be taken up with additional 5650 cusec in Option-3		√	Yes (7350 Cusec)	Yes (7350 Cusec)	Yes (13000 Cusec)
2	Pumping station at Vykuntapuram		√	Yes (5650 Cusec)	No	No

*Phase I: works are to be implemented with the World Bank funding; #Phase II: works are expected to be implemented with other source of funding

[7] Undavalli Pumping Station with a capacity of 5000 Cusec has been planned before Bank engagement using GoAP funds and the construction has been completed recently and is outside of Bank funding. The flood mitigation EIA, doesn't include this pumping station as the EHS requirements have been implemented considering the State departmental standard operating procedures. There are no residual environmental issues relating to construction of pumping station. The environmental impacts during O&M phase has already been covered in the EIA report.

CHAPTER 4: PROJECT DESCRIPTION

Further to selection of the Option -1, Phase-I (hereafter referred as "the Project") for the flood mitigation works, detail analysis on the project with respective to the proposed works have been presented in this chapter. MA&UD, GoAP, have constituted an expert committee for flood management of Kondaveeti Vagu with vide G.O.Rt.No.22. The Committee having looked into the data generated through model studies and the historical information has suggested that the peak discharges can be estimated approximately 470 cumecs. However, looking at the historical data, where a 70 mm rainfall can occur in one hour with 222 mm in a day, it is suggested that the canals may be designed for a flow of 470 cumecs for the entire catchment region, while provision for pumping facilities can be made for an additional capacity in the range of 100-120 cumecs". The Chief Engineer, Central Designs Organization, Water Resources Department of Government of Andhra Pradesh, also vetted the proposed flood mitigation works and subsequently principal approval has been received from the World Bank. Project components have been depicted at Annexure-I.

4.1 Overview of the Project

The overview of the proposed flood mitigation component is as follows. Based on the hydrological study to establish the flood flow and considering the various options for flood disposal from the proposed capital city and discussions with various stake holders, it has been established that following flood mitigation measures can encounter a 1 in 100-year storm event and avoid flooding of the capital city.

- Widening and deepening of existing Kondaveeti Vagu (for widened and deepened canal cross-sections please refer drawing no.TCE.10244A-CV-3023-SI-30004 to TCE.10244A-CV-3023-SI-30019). Attached as Annexure – III.
- Widening and deepening of existing Pala Vagu (for widened and deepened canal cross-sections please refer drawing no.TCE.10244A-CV-3023-SI-30020 to TCE.10244A-CV-3023-SI-30040). Attached as Annexure – III.
- Construction of the Gravity Canal from Nekkallu to Vykuntapuram (please refer drawing no.TCE.10244A-CV-3023-SI-30041 to TCE.10244A-CV-3023-SI-30055). Attached as Annexure – III.
- Construction of 3 numbers of Reservoirs within the capital city – Neerukonda, Krishnayapalem and Sakhamuru (for Reservoir Details refer drawing no.TCE.10244A-CV-3025-SK-30056 to TCE.10244A-CV-3025-SK-30068). Attached as Annexure – IV.

Table 4-1 below provides typical sectional widths to be undertaken in this option.

Table 4-1: Typical Sectional Widths

Section	Approx. Length (Km)	Bottom Width of Canal (m)	Top Width of Canal (m)	Green Width on each side (m)	Top Width with Green Buffer (m)	Navigable (Yes/No)
Kondaveeti Vagu (19.85 km)						
Krishnayapalem to Neerukonda	7.2	75	115	30	175	Yes

Section	Approx. Length (Km)	Bottom Width of Canal (m)	Top Width of Canal (m)	Green Width on each side (m)	Top Width with Green Buffer (m)	Navigable (Yes/No)
Neerukonda to Sakhamuru	3.6	14	65	20	105	No
Sakhamuru to Anantavaram	9	10/15	30/55	20	105	No
Pala Vagu (16.7 km)						
Krishnayapalem to Secretariat	9.3	25	65	20	105	Yes
Secretariat to Dondapadu	7.4	12	45	30	105	No
Gravity Canal (8 km)						
Vykuntapuram gravity canal	8	40	70	20	110	No
Total Length (Km)	**48.3**					

4.2 Project Components:

The following are the components to be implemented with the World Bank (Phase-I) funding

Components

- Widening and Deepening of Kondaveeti Vagu (From Anathavaram to Krishnayapalem, a length of approx.19.85 Kms)
- Widening and Deepening of Pala Vagu (From Dondapadu to Krishnayapalem a length of approx.16.70 Kms)
- Construction of Gravity Canal (From Nekkallu to Pichikalapalem a length of approx. 7.83 km)
- Construction of Sakhamuru Reservoir (Approx. 0.03 TMC capacity)
- Construction of Krishnayapalem Reservoir (Approx.0.1 TMC Capacity)
- Construction of Neerukonda Reservoir (Approx.0.4 TMC Capacity)

Physical Activities under the proposed components

Canal / Vagu Activities*	Reservoir Activities#
1. Site clearance 2. Excavation 3. Disposal of spoil 4. De-watering	1. Site clearance 2. Excavation works 3. Providing Disposal of excavated soil 4. Levelling of soil 5. Dewatering 6. Providing Earthen Embankment 7. Providing Geo-Textile 8. Providing Gabion wire Mesh 9. Providing Stones 10. Providing Back filling with impervious Soil 11. Providing Back filling with impervious Soil with approved borrow area soil 12. Providing sand cushion layer

*Cross section details of Kondaveeti vagu and Pala vagu canals refer Annexure – III.
Cross sections details of reservoirs refer Annexure – IV and for pumping stations refer Annexure – V.

4.3 Detailed Description of Project (Option 1) for Flood Mitigation

Figure 4-1 presents the way in which the Kondaveeti Vagu catchment model under study is designed to cater to two basic divisions of the entire catchment (421 sq. km) into upper catchment (190 sq. km) and lower catchment (231 sq. km).

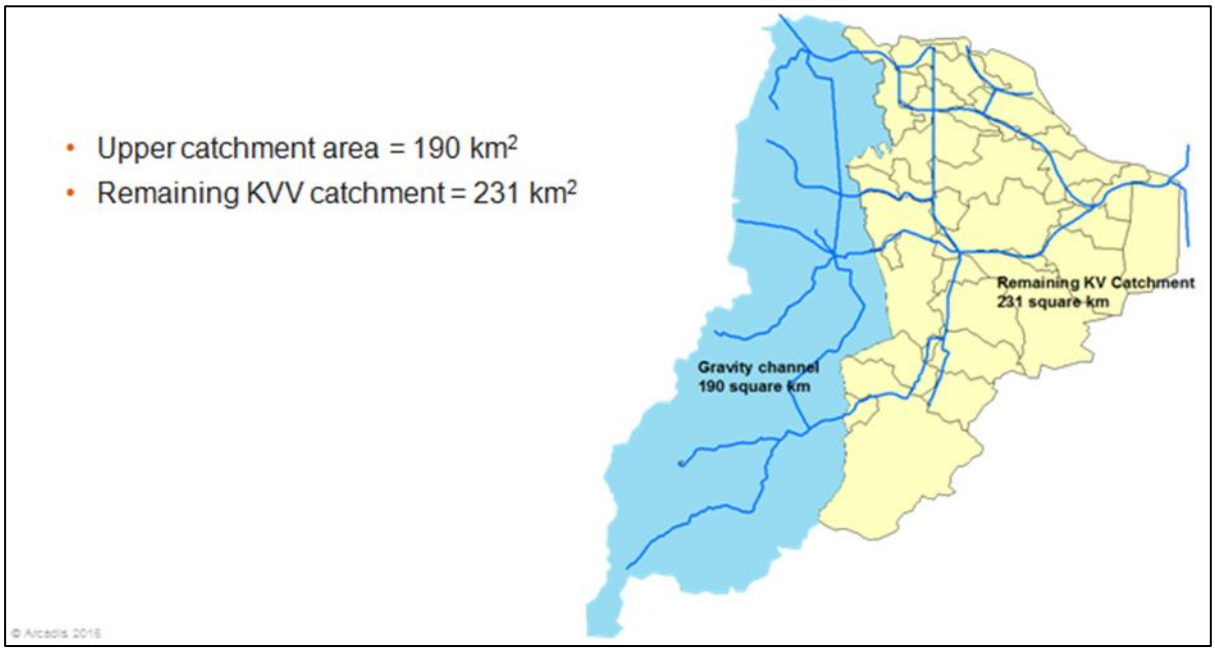


Figure 4-1: Model Design of Kondaveeti Vagu Catchment

The network of canals and location of flood control reservoirs considered in the model are shown in Figure 4-2.

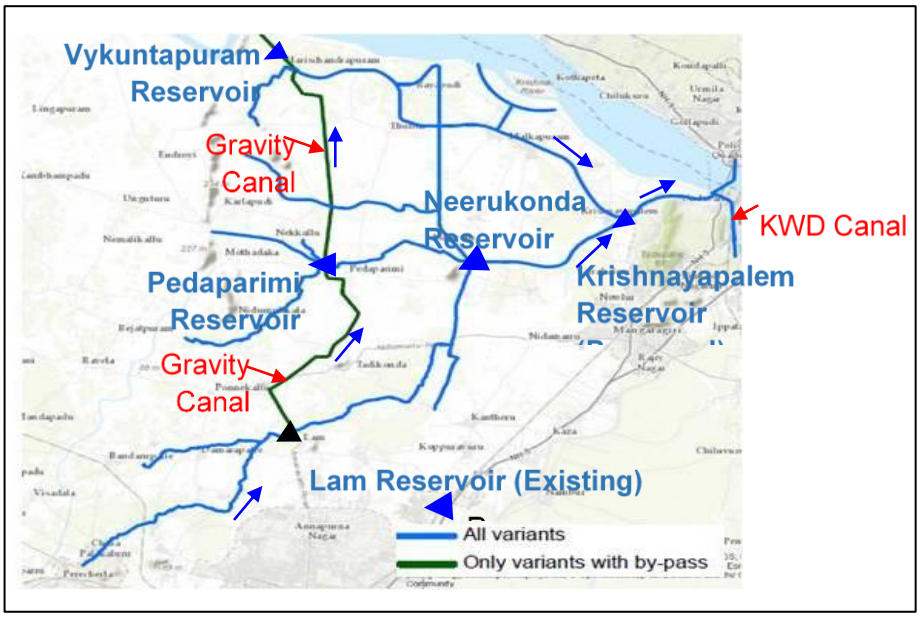


Figure 4-2: Layout of Canals & Flood Detention Reservoirs

4.3.1.1 Detailed Description of Canal Works for Flood Mitigation

The existing canals of Kondaveeti Vagu and Pala Vagu shall be widened and deepened to accommodate the 1 in 100-year return period that has been computed from SOBEK modelling. The flood flow at Undavalli from the catchment area works out to 470 cumecs. The flows that are predicted in various locations along the Kondaveeti Vagu and its in-falling drain are considered for the respective canal stretches. A summary of the design information of canals is indicated in Table 4-2 below.

Table 4-2: Details of Major Canals

Sl. No.	Canal Reach	Design Flow(m^3/s)	Length (km)	Bottom Width(m)	Side Slope	Depth of Flow (m)
1	Kondaveeti Vagu (Ananthavaram to Neerukonda)	60	10.3	14	2.0	4.0
2	Kondaveeti Vagu (Neerukonda to Krishnayapalem)	230	7.2	75	2.0	4.4
3	Pala Vagu (Dondapadu to Secretariat)	40	7.4	12	1.5	3.8
4	Pala Vagu (Secretariat to Krishnayapalem)	250	9.3	25	1.5	5.3
5	Gravity Canal (Nekkallu to Pichikalapalem)	300	8.0	40	1.5	3.8

Considering the type of soil, flow velocities in the canal, aesthetics, maintainability of canals, availability of material, protection against waves and currents due to ship movement, c*anal lining works is proposed to be taken up two years after construction of canals, after assessing the results from the seepage observation wells proposed along the canals.*

Reduced canal sizes conforming to the required flat green area on either side of the canal and to fit into the total width provided for the respective water way as per the Master Plan was adopted for various canals in the capital city.

4.3.1.2 Detailed Description of Reservoir Works for Flood Mitigation

Reservoirs planned in the Kondaveeti Vagu catchment under study are mainly from the point of view of attenuation of a 1 in 100-year storm that is likely to be encountered. The concept of flood management works using these reservoirs is the concept of pre-emptying them before the monsoons. The sizes of these reservoirs are stipulated in the Master Plan Version-IV and the same is used for flood management works purposes. The details of reservoirs are furnished in Table 4-3.

Table 4-3: Details of Reservoirs within KV Catchment

Sl. No.	Reservoir	Storage Capacity (TMC)	Full Reservoir Level (RL in m)	Height of Embankment (in m)	Location	Remarks
1.	Neerukonda	0.4	19.00	2	Lower catchment	Proposed under Phase I
2.	Krishnayapalem	0.1	15.00	1.7	Lower catchment	
3.	Sakhamuru	0.03	17.00	0	Lower catchment	
Total Storage Capacity		**0.53**				

The above Table 4-3 presents details of three numbers of Reservoirs planned from flood management works point of view. These include reservoirs at Neerukonda and Krishnayapalem. Apart from these two there is one smaller reservoir proposed at Sakhamuru which is virtually an ornamental confluence point. As indicated in the table, these reservoirs are small and the total volume of all these reservoirs put together works out to 0.53 TMC. The Full Reservoir Levels of each of these reservoirs is as indicated with the highest being for Neerukonda Reservoir with 19 m and lowest being for Krishnayapalem with 15m.

For design purposes, it is assumed that water level in the reservoirs will be maintained at a lower level than the design FRL to absorb the flood volume. The numerical model shows a significant reduction in peak discharges and water levels in canals if the reservoirs are actively managed. Hence, it is suggested to have a flood warning system in place to ensure proper control of reservoirs during peak flood event.

All three reservoirs are to be constructed within the capital city. The construction of these reservoirs shall be in parallel with the widening and deepening of the interconnecting canal Kondaveeti Vagu. The said works will be taken up in the first phase since the LPS scheme for land acquisition in the capital city is in process and therefore will not be time consuming as compared to the reservoirs outside the capital city. From the point of view of flood management works also the reservoirs inside the capital city area proves crucial for flood attenuation even of normal storm intensities. The details of each of the reservoirs planned inside the capital city is provided in the following paragraphs.

4.3.1.2.1 Neerukonda Reservoir

The details of Neerukonda Reservoir are presented in drawing no.TCE.10244A-CV-3025-SK-30057 and 30058 **(Annexure – IV)**. The total area of this reservoir is around 455 acres. The depth of the reservoir is planned at 8 m. The topography of the area is even without major undulations. The entire reservoir needs to be evolved from excavation alone. Therefore, the embankment portion of the reservoir is the depth to which the necessary freeboard needs to be provided of the order of 2 m.

Neerukonda reservoir has interconnections from the southern side with the Kondaveeti Vagu bringing cargo movement from Undavalli via Krishnayapalem. This reservoir therefore serves as an important boarding point of ship movement and therefore the southern part of the reservoir with two portions, one for the Ship lock aiding the movement of the ship and the other portion facilitating the reservoir outlet.

Reservoir outlet portion consists of overflow section and the other non-overflow section. While the overflow section has an Ogee spillway proposed, the non-overflow section is facilitated by Stop logs and Gates.

From the flood management works point of view, Neerukonda Reservoir has to be pre-emptied before the monsoon rains so that it is effective in flood attenuation. For this purpose, Neerukonda reservoir therefore has to be pre-emptied till its MDDL(Minimum Drawled Drown Level) allowing for its filling. The pumps at Undavalli will be signaled to start once the water level in Neerukonda reservoir reaches its Full Reservoir level (FRL) of RL 19.0m. This is achieved by instrumentation and Control (I&C) system between Undavalli Flood pumping station and Neerukonda reservoir. The details of Neerukonda Reservoir is presented in Table 4-4.

Table 4-4: Details of Neerukonda Reservoir

Sl. No.	Description	Value	
I	**General**		
a)	Location	Amaravati	
b)	Nearest Village	Neerukonda	
c)	Tehsil	Mangalagiri	
d)	District	Guntur	
e)	Purpose	Flood Control, Water Supply & Navigation	
f)	River/Vagu	Kondaveeti Vagu	
g)	Area of Reservoir	440 Acres	
II	**Reservoir**		
a)	Full Reservoir Level	RL 19.00 m	
b)	Reservoir Bed Level	RL 11.00 m	
c)	High Flood Level	RL 19.60 m	
d)	Top Bund Level	RL 21.50 m	
e)	Gross Storage	0.43 TMC (12.2 Mm^3)	
III	**Spillway/Outlet Arrangements**		
a)	Design Discharge	230 m^3/s	
b)	Type of spillway	Gated	Un-gated
c)	Length of overflow	25.4	24.6 m
d)	Sill Level	RL 14.00 m	RL 19.00 m
e)	No. of openings	Four (4)	-
f)	Width of each opening	5.0 m	-
g)	Height of each opening	3.0 m	-
IV	**Scouring Sluices**		
a)	Location	Un-gated spillway (Refer Bid Drawings)	
b)	No. of sluices	2	
c)	Diameter of sluice	0.6 m	
d)	Bottom level of sluice	RL 11.30 m	

4.3.1.2.2 Krishnayapalem Reservoir

This reservoir is basically a confluence point of Kondaveeti Vagu and Pala Vagu. This reservoir basically forms a meeting junction of the two vagus and therefore no control structure for this reservoir is necessary. All the cargo moving from Undavalli to Neerukonda reservoir essentially passes through this reservoir. The Full Reservoir Level is maintained at RL 15.0 m which incidentally is the HFL of the Kondaveeti Vagu. The details of Krishnayapalem Reservoir are

shown in drawing no.TCE.10244A-CV-3025-SK-30063 and 30064**(Annexure – IV)**. Table 4-5 shows the details of this reservoir.

Table 4-5: Details of Krishnayapalem Reservoir

Sl. No.	Description	Value
I	**General**	
a)	Location	Amaravati
b)	Nearest Village	Krishnayapalem
c)	Tehsil	Mangalagiri
d)	District	Guntur
e)	Purpose	Navigation & Recreation
f)	River/Vagu	Kondaveeti Vagu
g)	Area of Reservoir	190 Acres
II	**Reservoir**	
a)	Full Reservoir Level	RL 15.00 m
b)	Reservoir Bed Level	RL 11.00 m
c)	High Flood Level	RL 15.40 m
d)	Top Bund/Bank Level	RL 17.20 m
e)	Gross Storage	0.09MC (2.6 Mm^3)

4.3.1.2.3 Sakhamuru Reservoir

This reservoir is a confluence point of Kondaveeti Vagu and Secretariat canal. This reservoir proposed for ornamental purpose without any control structure. The Full Reservoir Level is maintained at RL 17.0 m. The details of reservoir are shown in drawing no.TCE.10244A-CV-3025-SK-30065 to TCE.10244A-CV-3025-SK-30068**(Enclosed as Annexure – IV**). Table 4-6 shows the details of this reservoir.

Table 4-6: Sakhamuru Reservoir

Sl. No.	Description	Value
I	**General**	
a)	Location	Amaravati
b)	Nearest Village	Sakhamuru
c)	Tehsil	Thullur
d)	District	Guntur
e)	Purpose	Ornamental/Recreation
f)	River/Vagu	Kondaveeti Vagu
g)	Area of Reservoir	50 Acres
II	**Reservoir**	
a)	Full Reservoir Level	RL 17.00 m
b)	Reservoir Bed Level	RL 11.00 m
c)	High Flood Level	RL 17.50 m
d)	Ground Level	RL 21.50 m
e)	Gross Storage	0.03 TMC (0.8 Mm^3)

4.3.1.3 Detailed Description of Flood Pumping Station Works for Flood Mitigation

4.3.1.3.1 Location and Capacity of Pumping Stations

The location and number of flood pumping stations required along with quantum of flood discharge required to be pumped at each of the selected locations has been fixed based on the estimated peak flood discharge and considering the requirement of restricting the maximum

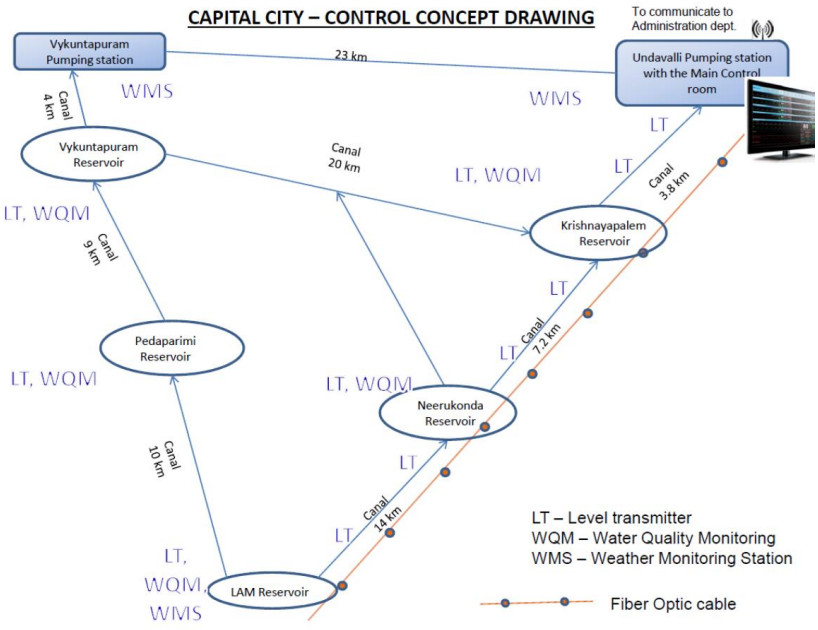
high flood level at Undavalli outlet to RL 15.00 m in order to facilitate gravity drainage of storm water runoff from existing villages.

Accordingly, one flood pumping station has been proposed for the capital city under this project, viz., at Undavalli. Irrigation Department (ID), Government of Andhra Pradesh has recently taken-up the execution of flood pumping station at Undavalli with a capacity of 150 m^3/s, to prevent flooding of the capital city in the immediate future. The pumping station has been located near the existing KWD escape regulator. The contract for construction of Undavalli pumping station has been awarded and the works are ongoing. 17 nos. (15 working + 2 standby) of Vertical Turbine pumps have been considered for the pumping station.

4.3.2 Operation and Monitoring for Flood Mitigation

The flood mitigation measures recommended for the capital city have been designed considering the estimated 100-year peak flood discharge. In order to minimize the overall cost (capital and operation) of flood management works, within the spatial limitations of Master Plan and other technical constraints (as described elsewhere in the report), proper management of entire network of canals, reservoirs and pumping stations has been considered. The capacities of flood pumping stations at Undavalli and Vykuntapuram have been optimized with the assumption that canals and reservoirs will be pre-emptied before the onset of major storm events in order to accommodate the incoming flood volume (i.e., contribution of storage in reservoirs and canals is considered for reduction of flood peaks), thereby reducing the flood discharge that needs pumping.

A 24/7 online based flood and water quality monitoring system has been suggested to be implemented for the entire Kondaveeti Vagu catchment to manage the available infrastructure to prevent flooding of capital city. The monitoring system will involve installation of weather monitoring stations, level transmitters and water quality sensors at major locations along the canals, reservoirs and pump sumps. All the individual systems are interconnected and relayed to the master control room (proposed to be set up at Undavalli Pumping Station) through optical fiber cable network and wireless communication system. Water levels and quality will be measured along the canal, reservoirs and pump sumps, whereas discharge will be measured at reservoirs.



Schematic Drawing of Online based Flood and Water Quality Monitoring System

The flood management works system for the entire capital city will be monitored and operated from master control room at Undavalli. The data collected from other locations will be relayed and displayed at the master control room. Based on the weather forecast/ warnings issued by the local meteorological station (IMD Gannavaram) and data observed within the catchment area

(from Automatic Weather Monitoring Stations/ Automatic Rain Gauge Stations), reservoirs and canals will be pre-emptied by operation of pumps at any of the three or all the pumping stations.

4.3.3 Risks to Flood Mitigation and Required Measures

The details of Flood Risks and Mitigation Measures are presented in Table 4-7.

Table 4-7: Flood Risks and Mitigation Measures

Sl. No.	Cause	Effect	Risk	Suggested Mitigation Measure(s)
1.	Increase in paved area due to development of capital city	Increase in peak flood discharge	Inundation of low lying areas in the eastern boundary of capital city during occurrence of peak flood event	a) Improvement of Kondaveeti Vagu, Pala Vagu and other in-falling drains b) Management of reservoirs c) Construction of flood pumping stations d) Diversion of flows from upper catchment area along the western boundary of capital city
2.	Gravity canal not available	Excess water cannot be diverted	Flooding near Undavalli and along the course of the Pala Vagu and Kondaveeti Vagu between Undavalli and Neerukonda	a) Augmentation of KWD escape regulator to divert flows by gravity.
3.	Reservoir at Neerukonda not constructed or smaller than design assumptions	Peak flow cannot be stored and will cause flooding upstream and or downstream of Neerukonda	Flooding near Undavalli and along the course of the Pala Vagu and Kondaveeti Vagu between Undavalli and Neerukonda.	a) Dimension reservoir (capacity) at correct measures, as given in designs b) Construct additional reservoirs upstream of Neerukonda (may be difficult due to land acquisition issues)
4.	Reservoir at Neerukonda is filled before the peak flow arrives	Peak flow will cause overflow of reservoir	Flooding near Undavalli and along the course of the Pala Vagu and Kondaveeti Vagu between Undavalli and Neerukonda.	a) Empty reservoir before peak event is occurring (pre-emptive) Reservoir management plan should be available b) Flood early warning system based on weather predictions should be available

Sl. No.	Cause	Effect	Risk	Suggested Mitigation Measure(s)
5.	Pump failure (mechanical)	Pump capacity is insufficient to remove excess water	Partial flooding near Undavalli and along the course of the Pala Vagu and Kondaveeti Vagu between Undavalli and Neerukonda. Extent of flooding depends on loss of pumping capacity.	a) Maintenance of pumps according to the standards b) Provision of standby pumps
6.	Pump failure (Electrical failure or power outage)	Pump capacity is unavailable	Flooding near Undavalli and along the course of the Pala Vagu and Kondaveeti Vagu between Undavalli and Neerukonda. See report for expected area to be flooded	a) Install backup power (for example diesel generator) at least for a few pumps. b) Install emergency electrical network or c) Install a dedicated electrical network with direct connection to power plant(s). d) Augmentation of KWD escape regulator to divert flows by gravity

4.4 Inlets and Outlets of Water in Canals

Water is planned to be sourced from River Krishna near the Rayapudi Village. Availability of water in the river at this location is reliable both for short term and long term scenario. Since River Krishna is proposed to be connected to national Waterway-4 (NW-4), availability of water at RL of 17.0m is assured throughout the year. Water will be sourced therefore by gravity through an inlet arrangement. Further, water from here can be conveyed to the waterways in the capital city through a diversion canal from Rayapudi till Pala vagu.

Minimum water depth or level in the canals should be maintained at 3 m for Class I vessels and for commutation and recreation purposes the largest ships need approximately 1.5 m of water depth.

Water from the various waterways (canals) in the capital system needs to be disposed of either to empty them before replenishing or to empty any excess water. The excess water shall be diverted to River Krishna through pumping. Three (3) nos. of 3 m^3/s pumps at Undavalli can be used to remove the water from canals. Further diversion of water by gravity, either to KWD canal or Guntur canal can be made from Prakasam barrage.

The details of inlet & outlet of water in canals and different option study is presented in **Annexure – XXIII**.

CHAPTER 5: BASELINE 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 environmental setting of the proposed project is given in Table 5-1.

Table 5-1: Environmental Setting within 10 Km Radius of the Project (Kondaveeti Vagu, Pala Vagu & Pillala Vagu)

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 within project site (Undavalli caves at about 0.30 km from the Kondaveeti Vagu)
10	Wildlife Sanctuary	None within the 10km radius
11	Core Biosphere reserve	None within the 10km radius

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

The baseline data for all the environmental and social parameters is based on the EIA study carried out for the New Capital city in year 2015.

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 (10) 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. The Soil quality results show that the soil is suitable for agriculture and construction purposes.

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.

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 (BIS), 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.

An automatic weather monitoring station was installed at a height of 10 meters from the ground level at Thullur 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.

The details of parameters monitored, equipment used and the frequency of monitoring are given in **Table 5-2**

Table 5-2: 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

Figure 5-1: Automatic weather station installed at Thullur

5.2.2 Findings

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 Thullur and the same are presented in Table 5-3. 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 5-4.

Table 5-3: Site specific meteorological data

Month	Wind speed (m/sec)			Temperature (^{0}C)			Humidity (%)		
	Max	Min	Avg.	Max	Min	Avg.	Max	Min	Avg.
May - June 2015	2.7	0	0.40	46.7	21.8	31.49	100	15	78.2

Table 5-4: Site Specific Met Data from Mandals in Project site during summer 2015

Location	Wind speed (m/sec)			Temperature (^{0}C)			Humidity (%)		
	Max	Min	Avg.	Max	Min	Avg.	Max	Min	Avg.
Thullur	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	9.87	45.2

5.2.3 Wind pattern for the study period

The wind pattern during the study period is depicted in the form of wind rose in the Figure-5-2. 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 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.

5.2.5 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%

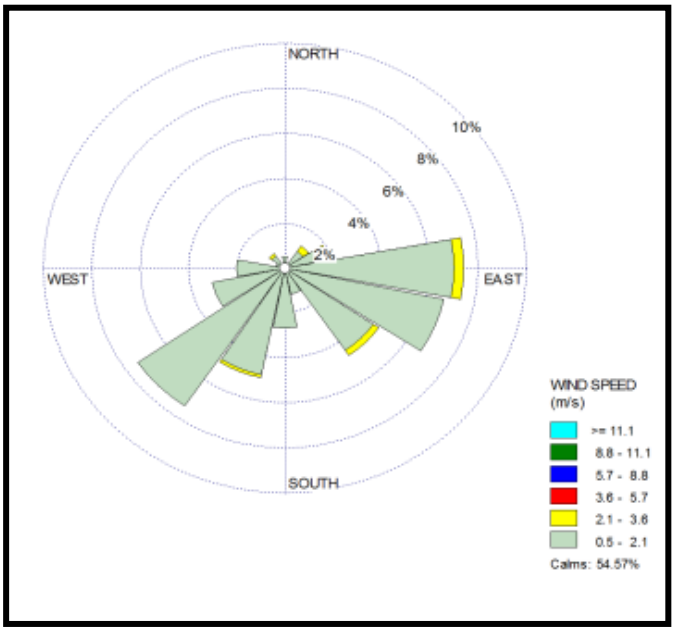


Figure 5-2: Site specific wind rose for the study period (Wind Blowing from)

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 modelling 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 ten (10) locations in and around the project site.

5.3.1 Methodology

Ambient air quality monitoring has been carried out with a frequency of two days per week at ten (10) locations during the study period. The ambient air quality parameters along with their frequency of sampling are given in Table 5-5.

Table 5-5: 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

S. No	Parameters	Sampling Frequency
5.	O_3	8 hourly samples twice a week for three months

5.3.2 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 5-6.

Table 5-6: Techniques Used for Ambient Air Quality Monitoring

S. No.	Parameter	Technique	Technical Protocol	Minimum Detectable Limits ($\mu g/m^3$)
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

Ambient air quality monitoring analysis report enclosed as **Annexure – VII.**

5.3.3 Findings

- The concentration of $PM_{2.5}$ was found to be between 15 $\mu g/m^3$ (Vykuntapuram) to 47 $\mu g/m^3$. (Mangalagiri).
- The concentration of PM_{10} was between 35 $\mu g/m^3$ (Vykuntapuram) to 53$\mu g/m^3$ (Venkatapalem).
- The SO_2 concentrations were between 10 $\mu g/m^3$ (Abbirajupuram) to 18 $\mu g/m^3$ (Venkatapalem).
- The NO_x concentrations were between 20 $\mu g/m^3$ (Nekkallu) to 29 $\mu g/m^3$ (Sakhamuru).

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.

5.4 Noise Levels

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.

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 proposed project.

5.4.1 Methodology

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.

5.4.2 Findings

The ambient noise levels measured and analysed for equivalent noise levels viz. L_{eq} (24hrly), $L_{day,}$ and $L_{night\ at}$ all the noise monitoring locations for the study period are presented in Table 5-7.

Table 5-7: Leq (day) and Leq (night) at Noise Monitoring Locations

S. No	Station	Leq day dB(A)	Leq night dB(A)	WB-EHS Guidelines Leq day dB(A)	WB-EHS Guidelines Leq night dB(A)
1	Thullur	55.3	39.4	55	45
2	Mandadam	48.6	42.5	55	45
3	Ainavolu	53.6	39.6	55	45
4	Kuragallu	56.7	38.3	55	45
5	Nekkallu	53.9	40.0	55	45
6	Sakhamuru	58.7	54.6	55	45
7	Abbirajupalem	53.2	38.6	55	45
8	Vykuntapuram	46.8	41.0	55	45
9	Venkatapalem	62.3	41.8	55	45
10	Mangalgiri	70.8	63.7	55	45

5.4.2.1 Residential Zone

The Leq day for the residential zone was observed to be in the range of 46.8 dB (A) (Vykuntapuram) to 62.3 dB (A) (Venkatapalem).

The Leq night for the residential zone was observed to be in the range of 38.3 dB (A) (Kuragallu) to 54.6 dB (A) (Sakhamuru).

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.

5.4.2.2 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 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.

5.5.1 Methodology

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 12 locations were selected to study the water quality out of which the number of surface water locations were five (5) and the ground water sampling locations were seven (7) within 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.

Fifteen surface water and twenty ground water samples were collected as grab samples and analysed for various parameters. The analysed results were compared with the standards for drinking water as per IS 10500.

Surface and ground water sample analysis report enclosed as **Annexure – VIII.**

5.5.2 Findings

5.5.2.1 Finding on Ground water samples

- The maximum value of chlorides (580 mg/lit) at Anantavaram was found to exceed the acceptable limit as per IS 10500 for drinking water (250 mg/lit) considerably.
- The maximum value of TDS (2692 mg/lit) at Anantavaram 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 sulfates (258 mg/lit) at Ananthavaram was found to exceed the acceptable limit for the same as per IS 10500 for drinking water (200 mg/lit).

5.5.2.2 Finding on Surface Water Samples

- The value of TDS is very high at Thullur (1464 mg/lit) and Lake near Mandadam (3031 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 Sulfates (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 higher values of the parameters which exceed the desirable limits as per IS10500 may be potentially attributed to the agricultural activity and localized anthropogenic activities.
- 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.

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 Borupalem areas of Amaravati and Thullur 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.

The details of hydro-geomorphological unit (HGM Unit) in the project area are given as Table 5-8.

Table 5-8: 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

As observed from the hydrogeological map, the project is covered predominantly under Shallow weathered Pediplain.

5.7 Soil Characteristics

Table 5-9: Soil classification

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

5.7.1 Results and discussion

The soil samples were analysed 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. Soil Quality analysis report enclosed as **Annexure – IX.**

5.7.2 pH

The pH values in the study area are varying from 5.4 (Abbirajupalem) to 8.2 (Ainavolu) showing strongly acidic to moderately alkaline nature during entire study period when compared to the soil classification Table 5-9 above.

5.7.3 Electrical Conductivity

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.

5.7.4 Nitrogen, Phosphorous and Potassium

The nitrogen content in the soil samples analysed was in the range of 60 kg/ha (Nekkallu) to 204 kg/ha. (Abbarajapalem & Sakhamuru).The nitrogen content varies from "less" to "better" as per soil classification table above.

The phosphorous presence in the samples analysed 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.

5.8 Traffic Situation

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 Thullur 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.	Thullur 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.	Thullur 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	

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 Thullur Road	06.06.2015 to 07.06.2015	4010 (66%)	316 (6%)	927 (15%)	816 (13%)
2	Thullur to Tadikonda Road	01.06.2015 to 02.06.2015	7846 (66%)	1035 (9%)	1674 (14%)	1357 (11%)
3	Pedaparimi to Mangalgiri Road	01.06.2015 to 02.06.2015	4357 (65%)	557 (8%)	1035 (15%)	796 (12%)
4	Thullur to Undavalli Road	06.06.2015 to 07.06.2015	5505 (64%)	795 (9%)	1448 (2%)	826 (10%)

Amaravati to Thullur Road: The highest no. of total vehicles on this road was found to be from 6.6.2015 to 7.6.2015. 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.

Thullur to Tadikonda Road: The highest no. of total vehicles on this road was found to be from 1.6.2015 to 2.6.2015. 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 Mangalgiri Road: The highest no. of total vehicles on this road was found to be from 1.6.2015 to 2.6.2015. 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.

Thullur to Undavalli Road: The highest no. of total vehicles on this road was found to be from 6.6.2015 to 7.6.2015. 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.

5.9 Ecology and Biodiversity

5.9.1 Terrestrial ecology

5.9.1.1 Methodology

- 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

Chiefly, 25 villages are covered under 3 mandals – Thullur, Mangalagiri and Tadepalli. 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 (Table 5-12). 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	Venkatapalem is about 500m away
2	East-west, parallel to Transect 1 road	17 km	Krishnayapalem, 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
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	Venkatapalem to Ainavolu to Sakhamuru to Neerukonda
11	North-south	5 km	Rayapudi to Thullur to Mandalam Office to Sakhamuru

5.9.1.2 Findings

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 5-13).

Table 5-13: 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)

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. However, there is forest cover in the project area.

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.

The list of trees (Floral species) found in the study area is given in Table 5-14.

Table 5-14: Floral list in Study area

Sr. No.	Tree/ Plant Species	Frequency	Number
1.	Azardhrichta indica	135	590
2.	Acacia Nilotica	144	749
3.	Delonix regia	53	148

Sr. No.	Tree/ Plant Species	Frequency	Number
4.	Ficus benhgalensis	15	42
5.	Thespesia populnea	18	39
6.	Ficus religiosa	20	39
7.	Tamarindus indica	6	25
8.	Mangifera indica	15	44
9.	Albizia saman	36	81
10.	Borassus flabellifer	29	59
11.	Ancardium occidentale	8	14
12.	Ficus hispida	6	14
13.	Syzygium cumini	5	15
14.	Leucaena leucocephala	13	27
15.	Grewia asiatica	32	88
16.	Dalbergia sissoo	19	34
17.	Albizia lebbeck	8	18
18.	Tectona grandis	3	8
19.	Saraca asoca	12	26
20.	Gliricidia sepium	2	77
21.	Eucalyptus	10	25
22.	Maerua apetala	4	6
23.	Cordia dichotoma	1	1
24.	Ixora pavetta	1	2
25.	Psidium guajava	1	3
26.	Annona Squamosa	1	2
27.	Ficus arnottiana	1	3
28.	Pongamia Pinnata	1	2
29.	Trema orientalis	5	15
30.	Phoenix syvestris	2	4
31.	Peltophorum pterocarpum	7	12
32.	Cassia fistula	13	29
33.	Lannea coromandalica	1	2
34.	Wrightia tomentosa	32	55

5.9.2 Tree Survey along the Proposed Canals

Tree survey is carried out for all the proposed canals of it's both banks for the purpose of relocating and cutting. The summary of the affected trees along different canals are given in Table 5-15.

Table 5-15: Summary of the Affected Trees

Sr. No.	Canal	No. of Trees		Affected Trees	
		Right Bank	Left Bank	To be cut	To be re-located
1.	Kondaveeti Vagu	255	234	296	85
2.	Pala Vagu	117	152	127	21
Total		**372**	**386**	**423**	**106**

The list of species for each canal with details like its DBH, health, length and location etc. are given at **Annexure XXIV.**

5.9.3 Aquatic Ecology

5.9.3.1 Methodology

- 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)
- 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

5.9.3.2 Findings

An interview of fishermen yielded data of the fish catches obtained from Krishna River (**Table 5-16**). In **Table 5-17**, benthic organisms sampled from 5 locations of River Krishna have been enlisted. Phyto and zooplankton have been enlisted in **Table 5-18 and 5-19**, respectively.

Table 5-16: List of Fish from River Krishna (as per a survey of local fishermen)

S. No.	Common Name	Scientific Name	IUCN Status
1.	Giant snake-head Fish	Channa micropeltes	Least Concern
2.	Panchax	Aplocheilus panchax	Least Concern
3.	Rohu	Labeo rohita	Least Concern
4.	Giant River Prawn	Macrobrachium rosenbergii	Least Concern
5.	Tilapia	--	Least Concern
6.	Guppy	Poecilia reticulata	Least Concern
7.	Barb	Barbus sp.	Least Concern

Table 5-17: Benthos from River Krishna

Name	Bhavani Island	Prakasam Barrage	Tadepalli	Varath Bridge	Guntupalli	%
Gastropods	50	175	--	125	--	11.29
Peleypods	100	175	--	25	--	9.68
Brachyuran	25	--	--	--	--	0.81
Ostracods	125	--	--	--	--	4.03
Polychaetes	25	--	--	--	--	1.61
Oligochaetes	600	325	--	--	100	13.87
Chironomus larvae	300	100	25	--	--B	13.71

N.B. All figures are actual numbers/kg sediment sample

Table 5-18: Phytoplankton's from River Krishna

Name	Bhavani Island	Prakasam Barrage	Tadepalli	Varath 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

Name	Bhavani Island	Prakasam Barrage	Tadepalli	Varath Bridge	Guntupalli
Ulothrix	8	2	-	-	6
Coelastrum	4	-	-	-	-
Netrium	12	-	-	-	-
Closterium	4	-	-	-	4
Cymbella	2	-	-	-	4
Synedra	4	-	-	-	-
Oscillatoria	14	24	12	50	-
Asterionella	4	-	-	-	-
Rivularia	4	-	2	2	-
Diatoms	8	22	-	-	-
Ankistrodesmus	-	4	-	-	-
Nitella	-	4	-	-	-
Amphora	-	26	4	-	-
Hydrilla	-	10	-	-	-
Volvox	-	4	2	6	4
Spirogyra	-	14	-	-	-
Fradillaria	-	1	2	-	-
Closterium	-	4	-	-	-
Microspora	-	1	-	-	-
Pediastrum	-	-	-	30	2

High numbers of *Scendesmus* sp. at Varathi Bridge indicate algal bloom and eutrophication at that location.

Table 5-19: Zooplanktons from River Krishna

Name	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	-
Streptocephalus	-	-	-	1	-
Chillodenella	-	-	-	2	-
Daphnia	11	1	1	1	-
Tadpole	-	-	-	11	-
Heterodera	1	1	1	-	-
Brachionus sps	15	4	1	-	-
Amphipods	-	1	-	-	-
Decapod oona	-	1	-	-	-
Lucifers	-	-	-	-	-
Metepus	7	1	-	-	-
Cocconeis	-	2	-	3	-
Fish larvae	4	4	-	-	-
Sida	-	1	-	-	-
Mysids	3	-	-	-	-

Long term impact of aquatic ecology should be monitored in up-stream and downstream for Kondaveeti Vagu, Pala Vagu and Krishna River. The aquatic life may get impacted not only due to new Capital city, but also due to several other projects planned on Krishna River. A comprehensive study is recommended for this aspect.

The Krishna river Bio-resources study is referred for the analysis of findings for flora and fauna for the river[8].

5.10 Other Fauna Species

The following list of aquatic birds has been compiled based on primary sightings.

Table 5-20: Aquatic Birds

Sr.No	Common Name	Scientific Name
1	Common moorhen	*Gallinula chloropus*
2	White-breasted waterhen	*Amaurornis phoenicurus*
3	Common coot	*Fulica atra*
4	Pond heron	*Ardeola grayii*
5	Purple heron	*Ardea purpurea*
6	Cattle egret	*Bubulcus ibis*
7	Great egret	*Ardea alba*
8	Little cormorant	*Microcarbo niger*
9	Asian Open bill	*Anastomus oscitans*
10	Common kingfisher	*Alcedo atthis*
11	Pied kingfisher	*Ceryle rudis*
12	Bronze-winged jacana	*Metopidius indicus*
13	Pheasant-tailed jacana	*Hydrophasianus chirurgus*
14	Spot-billed duck	*Anas poecilorhyncha*
15	Little grebe	*Tachybaptus ruficollis*

During the primary survey no aquatic mammals and amphibians were sighted. Hence, secondary data was collated from approved field guides. Range of the amphibians as shown by Daniel J.C. (2002) was used to compile the following list.

Table 5-21: Amphibians

Sr.No	Common Name	Scientific Name
1.	Common Indian Toad	*Bufo melanostictus*
2.	Common tree Frog	*Polypedates maculatus*
3.	Skittering Frog	*Euphlyctis cyanophlyctis*
4.	Indian Bull frog	*Hoplobatrachus tigerinus*

Reference: Daniel, J.C. (2002). The Book of Indian Reptiles and Amphibians: Oxford

In addition, domesticated animals have been observed in the project area. Details of the same has been presented hereunder

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*

[8] http://faunaofindia.nic.in/PDFVolumes/occpapers/160/index.pdf

5.11 Physical and Cultural Resource

5.11.1 Undavalli Caves

The famous Undavalli caves an archeologically important site falls within the project boundary. The proponent will follow respective regulation in this regard.

Table 5-22: Sensitive cultural/ religious property within 10km radius of the Kondaveeti vagu canal

S. No	Name of the sensitive cultural/ religious property	Distance between sensitive cultural/ religious property of Kondaveeti Vagu (Km)
1	Undavalli Caves	0.30
2	Durga Devi Temple	5.4
3	Mangalagiri Panakala Swamy Temple	8.4

The Undavalli Caves – also referred to as the Rock Cut Cave Temple at Undavalli – is a protected monument so identified by the Archaeological Survey of India, Government of India. It is a four storied rock-cut temple about 29 meters long and 16 meters wide dating back to the 6th – 7th century AD.

The capital region master plan has integrated this monument in overall plan for the capital region development. This monument will be conserved in its original entity. All the activities under Flood mitigation project would be carried out beyond the 300m radii of this important monument.

5.11.2 Ancient Monuments and Archaeological Sites and Remains Rules 1959

Enclosed as Annexure – XIII.

5.12 Land use/ Land cover (LU/LC)

The term 'land use' used in this section includes land use and land cover together. The land use 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 Color Composite (FCC) and
- Ground truth validation for the FCC imageries.
- During DPR stage Land Use (LU) pattern of 2013-14 has been considered as provided by Amaravati Development Corporation (ADC). The LU is given at Annexure II.

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

5.13.1 Methodology

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 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.)

5.13.2 Findings

5.13.2.1 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. The proportion of SC/ST population is 29.67% & 4.36%. Demographic details are presented in the Table 5-23 below

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. It is indicates that the male and female population ratio is equal in the study area .the proportion of the SC and ST population is 29% and 3%.

Table 5-23: Demographic details of the project area and study area

Sl No	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

5.13.2.2 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 5-24 below

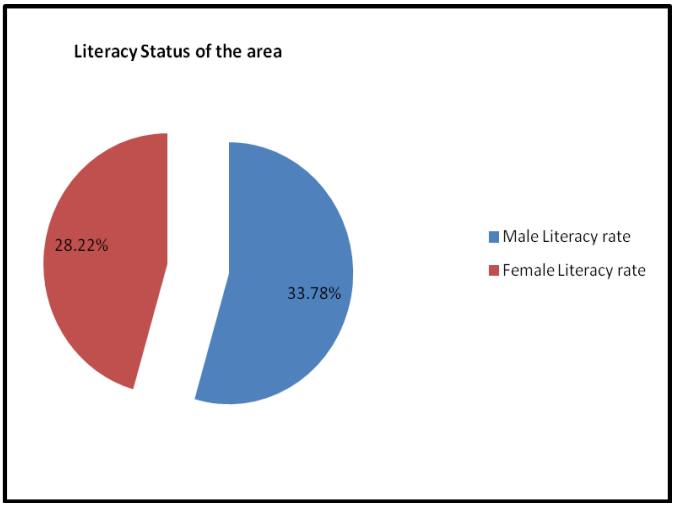


Figure 5-3: Literacy status of the area

Table 5-24: Literacy details of the area given in the below table

S. No	Literacy Level	Project Area	Study Area
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

5.13.2.3 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.

5.13.2.4 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- 4 and Table – 5-25.

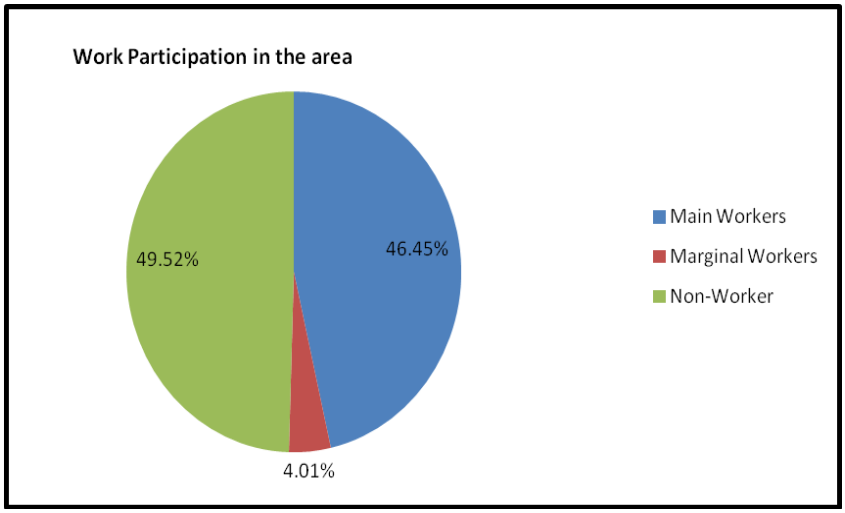


Figure 5-4: Work Participation in the Study Area

Table 5-25: Work participation in the study area

S. No	Work Participation	Project Area	Study Area
1	Total Worker	49145 (50.47%)	133864(50.93%)
2	Main Worker	45483 (46.45%)	120262(45.75%)
3	Cultivators	5840 (5.96%)	18776(7.14%)
4	Main AL	26276 (26.83%)	70585(26.85%)
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

Observations based on primary survey
Following are the observations based on the primary survey

5.13.2.5 Infrastructure & Facilities

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

5.13.2.6 Community Concern & Expectation

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 are 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 cheap curative care in the area. The surveys of the sample villages reveal that these villages didn't have access to the primary health centres (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 kilometres. However most of the roads in the area are only kaccha roads.

All the people in the study area are aware of the project activity and they have mostly positive opinion towards the project activity. The general social profile in the study area is as follows:

Table 5-26: Socio-economic Survey Findings

Sr. No.	Social Attributes	Details
1.	Language:	The main language spoken in the area is Telugu.
Social Infrastructure facilities		
2.	Availability of Water:	Majority of the villages face the problem of the 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. Few people use mineral water for drinking purpose procured from outside, which is expensive.
3.	Medical Facility:	Availability of medical facility in the area is poor, and the facilities are available at 4-5 Kms away from the villages.
4.	Education facility	Education facility is available only up to primary school level in most villages.
5.	Road facility	Approach roads to the villages are unpaved (kuccha) road. The transportation facility is poor. Minimum bus facility is available and the major mode of transportation is private auto- rickshaws and private motor vehicles.
6.	Electricity facility	Electricity is available and is on a satisfactory level and there is no problem of power outage in the area.
Objectives and Expectations		
7.	The opinions & the expectations of the people from the upcoming project activity are listed below	
8.	Land acquisition	Some villagers lost their land in the project. The compensation has been delivered to the people at the rate of new capital city policy and mostly people are satisfied with the compensation. However, some people in the area are not

Sr. No.	Social Attributes	Details
		satisfied with the compensation process and they claim that they were content with their agricultural activity.
9.	People awareness	People are aware regarding proposed project but they are not informed regarding the type of project activities. It was expressed during public consultations that project authority should create awareness regarding type of project activities.
10.	Needs and expectations	Villagers expressed their needs towards employment & expected employment & health facility from the upcoming project activity
11.	Positive opinion towards project	Majority of the people opined positively regarding the proposed project and satisfied with the compensation and land pooling process.
12.	Employment opportunity	There is large scale unemployment reported during the survey period and the proposed project will provide ample opportunities to the unemployed population.
13.	Demand for the employment	People have lost their land and don`t have employment, so they are expecting employment on priority basis.
14.	Expectations for the opportunities of the self-employment	Project effected villagers are expecting that authority should provide self-employment opportunities, so that villagers can use their compensation for self-employment purpose.
15.	Expectations for the infrastructure development	People of the project area are expecting development in infrastructure like roads, water, medical, drainage and transportation facility by the authority.
16.	Expectations regarding development	Villagers expect the project would bring development in their villages and would open up opportunity of employment and other business avenues.
17.	Mixed reactions towards project	Villagers in the project area have expressed mixed opinions regarding the pace and extent of the proposed development - the village sites (Gramakantham) development in particular.

CHAPTER 6: 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 Flood Mitigation works during construction and operation phases.

These impacts have been ascertained as part of the overall sub-project level designs with a view to minimize impacts through design interventions as much as possible. The residual impacts which could not be addressed as part of the design exercise have been clearly identified upfront such that necessary mitigation/management measures could be designed as part of the sub – project design documents (DPRs). The process of identification of impacts and integration of design measures have been iterative through relevant stakeholder consultations. The proposed flood mitigation works would lead to several positive impacts including overall aesthetic improvement of the city, significant employment generation, protection from potential floods, future opportunity for inland waterways and thereby contributing to reduction in road traffic, future tourism opportunities and associated economic opportunities.

The expected environmental impacts of concern due to flood mitigation measures could be mainly classified under two categories:

1) Impacts associated with Construction activities
   (a) Earthwork in excavation for deepening and widening of existing streams up to uniform bed level of +11m level and the proposed gravity canal;
   (b) Excavation and gabion lining for the proposed reservoirs
   (c) Construction facilities includes construction of camp sites, labour camps, and equipment
2) Commissioning
3) Operation and maintenance
   (a) Water intake in to the canals to maintain minimum water level of +14m
   (b) Maintaining of canals and reservoirs profile and operation of pumping stations

The impact analysis considering the above is presented in the following sections
Environmental Impacts - Construction activities.

6.1.1 Impacts due Earthwork and Embankments

1. *Spoil Disposal*: The construction of flood management works could lead to significant impacts relating to management earthwork involved in widening and deepening of existing canals, construction of gravity canals, and construction of flood retention reservoirs. The total quantity of earthwork (excavation) involved in all these works is 41,427,813 Cu.m. (About 41.5 Mil.Cu.m.). Out of this quantity, 444,800 Cu.m. is needed for earthwork in filling at reservoirs, and about 475,000 top soil need to be protected. Given this, about 38.20 Mil.Cu.m. need to be disposed. If necessary arrangements are not made, this could lead to serious impacts. In order to ensure safe disposal of spoil, ADC has identified areas within the city, which need to be filled up to achieve the ground level as per the Amaravati City Master Plan. These five sites would accommodate the 38.2 Mil.Cu.m spoil generated through excavation. Bore log data and soil quality details in the project area are placed at Annexure X, which, also provides a detailed location map showing the sites to be levelled, capacity of each site to

accommodate the spoil, and connectivity to sites. The map also depicts the nearby settlements, and water bodies which have been considered for assessing the impacts of spoil disposal. The associated impacts of spoil disposal, though temporary in nature but requiring specific mitigation measures include the following:

(a) *Potential air and noise quality impacts* due to fugitive dust emissions at settlements/villages which are within 500 meters radius from the disposal sites including: (i) Nidamarru; (ii) Sakhamuru; (iii) Rayapudi; and (iv) Lingayapalem. In addition, there could be marginal air quality impacts on other villages adjacent to the access roads. Specific environmental management measures would be required to address impacts on these villages.

(b) *Sludge on Natural Stream Bed:* The flows in the streams are intermittent and most part of the year remain dry in the current conditions. The irrigation authorities as part of the routine maintenance works, prior to monsoon, desilt the stream bed which is conventionally utilized by the farmers in the nearby fields. The sludge/silt mostly comprise of alluvial deposits during flash floods occurring during monsoon. However, in order to ascertain any requirement of treatment prior to spoil disposal, necessary measures such as sediment quality testing has been provisioned in the EMP.

(c) *Traffic Impacts*: Carting of excavated material will lead to significant increase in traffic on the access roads to the disposal sites for a temporary period of about 9 to 12 months. The relevant access roads include: E3, E8, E10, E14, N4, N9, N14, and N16. These roads have already been constructed as part of capital city's trunk infrastructure development as arterial and sub-arterial roads. No other village roads need to be used as all the disposal sites are next the above referred trunk roads. However, the settlements immediately next to the above referred roads would be subjected to potential road safety risks and fugitive dust and noise pollution. These impacts need to be addressed with relevant environmental management measures. The villages/settlements along these roads include: (i) Uddandarayapalem; (ii) Venkatapalem; (iii) Mandadam; (iv) Malkapuram; and (v) Velagapudi

(d) *Erosion of disposal sites*: This impact is not expected as the spoil is planned to be used for the filling the sites identified for levelling, which, will be utilized for different land uses as per the master plan. There are no ecologically or socially sensitive areas identified at/around these sites. Please refer Annexure –X for the location of the disposal sites.

(e) *Top Soil*: earthwork excavations would generate about 475,000 Cu.m. of top soil from all the sites. In order to prevent the loss of top soil, the design considerations have already factored to use this quantity within the 30m green buffer on either sides of the canal.

2. *Stone Aggregate for Reservoir Lining:* The reservoir embankment uses about 444,800 Cu.m. Soil for raising about 2m from ground level. In addition, about 114,260 Cu.m. of stone will be used for gabion lining. The potential quarries sites (refer Annexure – XI) approved by Mines and Geology Department, GoAP include Ananthavaram, Endroy, Lemalla and Karlapudi. Development of the quarry sites may lead to environment impacts. Given this, it is important to stipulate relevant construction contract provisions to ensure that the contractor prepares quarry management and rehabilitation plans.
3. *Dewatering*: In addition to the above impacts, earthwork excavation along the canal would require dewatering as some parts of the canal would encounter low ground water table. This aspect was analyzed in detail and it's observed that the ground water table is below 6 to 7 meters. However, the dewatering requirement cannot be ruled out as some of the sections encounter areas of shallow water table. To avoid construction related inconveniences, the design provisions have factored to start construction from upper reaches and the dewatering is proposed to be discharged

downstream. The water quality discharged would be of high turbidity in nature which could lead to pollution at the ultimate end of discharges in to Krishna River. This impact need to be addressed with relevant management measures.

4. *Drainage Pattern*: would not be affected with the proposed interventions as the discharges from different sub-streams and area flows will still drain in to the proposed canals. The enhanced capacity of the canals will further improve the overall drainage pattern for flood evacuation from the area. However, there is a possibility of blocking the natural drains with construction debris (especially during construction period) and thereby affecting local level drainage pattern. In order to prevent such events, it is necessary to enforce effective measures during construction phase as part of contractor's responsibility.
5. *Loss of Vegetation*: Out of the total canal length of 48 km., about 28 km. is in the barren area. Rest of the canal length has about 758 trees on either side. Out of these, about 529 will be affected and an estimated 106 trees can be transplanted in the green buffer zone. While Annex XXIV and XXV presents detailed vegetation survey, the summary of inventory is presented below. This impact has been addressed as part of designing the overall green corridor with 30m buffer on either side of the canal. The green buffer would provide about 45,000 trees all along the canal (The green buffer zone marked along the canals is placed at Annexure XIV). This measure also ensure that the compliance with compensatory plantation under WALTA Act.

Sr. No.	Canal	No. of Trees		Affected Trees	
		Right Bank	Left Bank	To be cut	To be re-located
1.	Kondaveeti Vagu	255	234	296	85
2.	Pala Vagu	117	152	127	21

6.1.2 Impacts due to Construction Facilities

The construction facilities and the activities could lead to range of impacts which could be significant although these impacts are temporary in nature. The key expected impacts include:

1. *Labor Influx*: The proposed construction activities at Amaravati is likely to lead to considerable influx of workers to the project site as the local labor is mostly related to agriculture workers with limited or no skill for construction works. While this could lead to some demand triggering local skill base development in the long term, there could be short term adverse social impacts on the local communities. Also, the labor influx could cause serious impacts relating to public health, socio-economic changes, competing demand for community resources, etc. These impacts need to be addressed with a comprehensive environmental management plans which necessarily includes (but not limited to): (a) management labor camps with all basic amenities and facilities including drinking water, sanitation, and clean living space; (b) camp site discipline including with specific protocols defined to ensure minimal impact on local communities; and (c) strict compliance with local laws and regulations.
2. *Occupational Health and Safety*: The construction activities could lead to occupational health and safety issues if necessary care is not taken to integrate the safety management systems in to the work protocols. These include: (a) provision of personal protective equipment; (b) site safety measures; (c) equipment safety measures; and (d) medical aid in case of emergency situations. These aspects need to be enforced through comprehensive environmental management plans
3. *Construction Related Pollution*: The construction phase would lead to significant air, noise and water pollution if necessary precautionary measures are not taken up. During construction phase, the major sources of air and noise pollution will be from heavy construction operations. The construction phase impacts will be associated with land

clearing, ground excavation, cut and fill operations (earth moving) and construction works and the major concern will be particulate matter (PM10 and PM2.5) and the noise pollution near the settlements and sensitive receptors like hospitals, schools, and religious places. The villages along the canal will be most impacted. These villages include: (a) Krishnayapalem; (b) Mandadam; (c) Malkapuram; (d) Velagapudi; (e) Sakhamuru; and (f) Neerukonda. The impacts on this villages need to be addressed with specific environmental management measures which will contain the construction related pollution and night time disturbances.

4. *Wastes*: The construction activities will include storage, handling and disposal of petroleum based products such as lubricants, hydraulic fluids, or fuels. Storage/usage and/or disposal could not only cause impacts but also lead to hazards/risks of potential leakage and contamination. Similarly, there would be several other waste which may not be hazardous but could lead to in-sanitary or disorderly conditions in and around construction sites. These include: solid and liquid wastes generated from construction camps, construction waste which is not systematically disposed causing cess pools and associated disease burden, etc.

6.1.3 Social Impacts

The total land requirement for flood mitigation works for a length of about 48.4 Kms and reservoirs (as per the Blue Network DPR) is 1998.86 acres comprising (LPS – 1131.30 acres; 75.46 acres under LA, 781.72 (5.3 acres of land is occupied by encroachers) under Government lands) and 10.38 acres under R1 Zone in Village Habitation). A total of 1913.02 acres of lands are already available with CRDA through LPS corresponding to 1754 landowners who gave lands under LPS and as lands covered in existing blue network (streams), 75.46 acres of land to be acquired under LARR, 10.38 acres within village habitation (R1 zone) to be acquired under Negotiated Settlement policy. LARR Act and Negotiated Settlement Policy are expected to impact [137] families. Among these, 27 families will be physically displaced. The land requirement details for the project, impacts present status of land assembly are detailed in RAP for flood mitigation works. The consultations relating to social impacts is presented in Chapter 7 of this report

6.1.4 Impact on Cultural and Heritage Sites

Three common property resources including, one temple in Mandadam, one burial ground in Sakhamuru and one burial ground in Mandadam will be affected. The specific details in this regard are detailed out in RAP for flood mitigation works. In addition, Undavalli Cave Temple, which is listed as a 'protected monument' by the Archeological Survey of India, is located near the project area. Nearest edge of the monument is at a distance of 300 meters from the existing canal. An existing road separates the monument and the canal. This being a sensitive location, necessary precautions need to be taken during construction phase to minimize the impacts, if any. Also provisions for managing chance finds need to be integrated as part of the EMP measures. Ancient monuments and archeological sites and remains rules 1959 is placed at **Annexure – XIII**.

6.2 Environmental Impacts – Construction Phase

The proposed commissioning of Canals and Reservoirs is not expected to lead to any major impacts as these structures are not expected to hold significant volume of water above ground level. For example, the reservoirs will be less than 2m above the ground level with one third of this height will be free board. The rest of the 7m water column is below the ground level. Similarly, the canals will not have any embankment. While the risk of inundation due to breach of pondage is minimal, there could be impacts related to seepage leading to waterlogging in low lying areas. Such an impact could lead to secondary impacts on environment and health. These expected impacts have been minimized through design interventions which include: (a) lining of reservoirs with 1m impervious soil layer; (b) gradual filling of canals over a period of two years, covering

two year monsoons; (c) continuous seepage studies along the canal network to monitor seepage related issues during initial two years to ascertain the lining requirements at different sections of the canals. The environmental management plan covers the necessary management measures in this regard.

6.3 Environmental Impacts – Operation and Maintenance

6.3.1 Impacts due to Canal Network Operation

1. *Canal Water Level*: As mentioned in the above section, the canal water level will filled gradually to attain water column of about 3 meters (+11 to +14m). the canal water level could lead to the following impacts:
   a) Water Intake from Krishna River: will be to the tune of 0.35TMC (The proposed gravity inlet arrangement for drawing water from River Krishna to the Pala vagu canal is placed at Annexure VI; inlet and outlet details are placed at Annexure XXIII. The O&M aspects related to the project is placed at Annexure XXII). The impact of this quantity on downstream users. The Prakasam barrage at Vijayawada has a minimum quantity of 3TMC considering lean period flows. Given this, the water intake in to the canals is marginal quantity. Also, the water intake in to the canals will be released in to downstream irrigation purposes on bi-weekly basis. Thus, the flood mitigation canals will be only pass through arrangement with one time filing requirement. Such an arrangement will also ensure minimizing eutrophication conditions and eliminate the need for weed control measures.
   b) Increase in Ground Water Table: With the canals having natural (i.e., uncemented/ non-concretized) beds and banks, and having increased perennial water level due to widening and deepening, could result in natural groundwater recharge which intron could lead to secondary impacts. As referred above, it is proposed to observe the impact of canals on ground water and the subsidence of soil or water logging, if any for 2 years. After 2 year, the canals would be lined as per the requirement depending on the impacts on surface water bodies and ground water table.
2. *Canal maintenance* on regular basis could lead minor civil works and associated construction facilities. The maintenance works could lead to debris and marginal impacts. These impacts need to be managed with relevant environmental management measures.

6.3.2 Impacts due to Associated Facilities

1. *Green buffer along the canals:* The green buffer, if not managed as per the design standards, could lead to canal side degradation including encroachments, disposal of municipal waste, construction debris, etc. In order to avoid such impacts, the EMP lays basic minimum standards to be maintained along the canal network
2. *Discharge of untreated effluents*, silt & debris, and solid waste through natural storm water drains could occur. In such an event the aesthetics and the physical environment could be seriously affected. These impacts could be effectively managed since Amaravati City has an elaborate waste management strategies integrated in to city development plans. However, specific environmental management measures need to be followed to avoid such a scenario.
3. *Safety*: given open canal configuration, there is potential risk of safety. This aspect has been addressed as part of the design measures by providing access control and safety railing at all the settlement locations.

CHAPTER 7: PUBLIC CONSULTATION

7.1 Introduction:

Flood mitigation is identified[9] as one of the key proposals in the Amaravati Capital city master plan preparation process during 2015-16. Several consultations were held with stakeholders including public, land owners, village elders and land less laborers as part of the master plan consultation process during the preparation of draft master plan as well as the final master plan[10]. While consultations for implementation of flood mitigation works are documented in this chapter, a brief account of earlier consultations held for obtaining environmental clearance for the master plan is presented below. The public consultation attendees list is placed at Annexure XX.

7.2 Summary of consultations as part of capital city environmental clearance

The consultations were carried out by team of Social and Environmental experts in the month of June 2015. This consultation was based on the selected diverse groups of villagers within the Amravati Capital city. The summary of the stakeholder Consultation expectations are given in the following section.

7.2.1 Approach and Methodology

Approach and methodology 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. Socio-economic survey was carried out using pre-tested structured questionnaire[11]. Group Discussion at village level was also conducted.

The work plan includes the following tasks and activities

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

7.3 Summary of Stakeholder Consultation Process:

The details of the stakeholder consultations have been presented in detail as part of the report[12]. 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.

[9] Chapter 6.1.5, Concept Master Plan, July 2015
[10] Concept Master Plan published in July 2015; draft master plan published on December 2015 and the final master plan was notified on February 23, 2016. Documents consisting of comments and suggestions are available with APCRDA.
[11] Questionnaire format, filled in questionnaire and full details are available with APCRDA.
[12] Amaravati EIA report, available at crda.ap.gov.in, environment

Venue: Multiple villages (list in files), 2nd and 3rd week of June 2015
Participant: TCE: Mrs. Mamta Bavaskar (Social Expert), Dr. Jyoti Prabha (EIA Expert) & Mr. Babu Kiran **Sivala (Environment Expert)**
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

7.3.1 Socio - Economic Survey, findings:

All the people in the study area are aware of the project activity and they have mostly positive opinion towards the project activity. The general social 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 the 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. 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) road. 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.


Survey in the Kuragallu village


Survey in the Thullur Village

Discussion with the Female members in the village Nowluruu

Group discussion in the Bethapudi Village

Figure 7-1: Photographs of Social Survey (for EIA in 2015)

7.3.2 Awareness & Expectations:

The opinions & the expectations of the people from the Amaravati Capital City Development activity are listed below

- Some villagers lost their land in the project. The compensation has been delivered to the people at the rate of new capital city policy and mostly people are satisfied with the compensation.
- People are aware regarding proposed project but they are not informed regarding the type of project activities. It was expressed during public consultations that project authority should create awareness regarding type of project activities.
- Villagers expressed their needs towards employment & expected employment & health facility from the upcoming project activity
- Majority of the people opined positively regarding the proposed project and satisfied with the compensation and land pooling process.
- There is large scale unemployment reported during the survey period and the proposed project will provide ample opportunities to the unemployed population.
- People have lost their land and don`t have employment, so they are expecting employment on priority basis.
- Project effected villagers are expecting that authority should provide self-employment opportunities, so that villagers can use their compensation for self-employment purpose.
- People of the project area are expecting development in infrastructure like roads, water, medical, drainage and transportation facility by the authority.
- Villagers expect the project would bring development in their villages and would open up opportunity of employment and other business avenues.

7.3.3 Present status on opinions and expectations:

- The compensation in the form of annuity as per the scheme is being disbursed regularly. The 4th year annuity disbursed as well.
- Several awareness sessions conducted during 2015-2018 to appraise the people about master plan, infrastructure master plan, subprojects, infrastructure development works in returnable layouts, livelihood and employment opportunities13. In addition, the competent authority offices (CA offices) are provided with Project Information Centres to disseminate information about projects, progress and benefits. The CRDA online website provides latest updates through dashboard. Mana Amaravati App, downloaded by over 30000 users is also widely used to get updates, information about

[13] Public Consultations in detail are available in ESMF.

projects and progress of works and disbursement of benefits. The online as well as offline platforms are widely used by the people for accessing details of training programmes, skill upgradation works as well as livelihood opportunities. CRDA, through various campaigns is identifying most needy people that require additional support for providing targeted interventions.14 Separate studies are commissioned by Bank in respect of LPS and livelihoods and the outcomes are discussed in detail in the Resettlement Action Plan.

7.4 Stakeholder Consultation during EIA for the Flood Mitigation Works in 2017

Stakeholder consultation was carried out by the team of Social and Environmental experts in the month of July 2017. The details of the stakeholder consultation process and outcomes are given in the following sections.

Approach and Methodology

a) The lists of PAPs(Project Affected Persons) (losing land and/ or structures) were collected from the CRDA records. The survey was carried out among these PAPs. Many of these PAPs have opted for LPS (Land Pooling Scheme).
b) Prior appointment is taken and arranged through authorities such as CRDA , ADC, revenue dept. etc. to conduct surveys in the affected villages,
c) Information was gathered through Competent Authorities about PAPs,
d) Villages were surveyed by the team on scheduled date, and
e) Revisited the villages in case of respondents not present during first time.

The Competent Authorities (Officials from CRDA, ADC and Revenue Dept.) assigned their teams who are well versed with the landowners as well as geography to assist the survey. The survey was carried out among those losing land under LA&RR Act or through negotiated settlement (physical displacements). Some of the landowners did not participate in the LA & RR due to title issues of their land and therefore, they were not able to participate in LPS. [15]

7.4.1 Survey Findings

The proposed Flood Mitigation works involve 8.21 acres of private land in village areas and will displace 27 families in different locations along the alignment in 3 villages i.e., Mandadam, Rayapudi and Velagapudi. The total population to be displaced is 66 people based on enumeration of the affected families. The impacts to houses as well as buildings and any units is considered as full and whole unit to be acquired. Partial acquisition of units is avoided. All impacted households within village boundaries will be entitled for compensation to land and structures and resettlement assistance as per negotiated settlement policy[16]. The village-wise physical displacement is 24 families in Mandadam, 2 families in Rayapudi and 1 family in Velagapudi. The following are the key findings from the survey among the displaced families:

- About 26 of the PAP households are Female Headed Households
- About 21% of the PAPs are illiterates
- Most of the PAP household heads are farmers (34%) and 25% are working as Agricultural laborers. This corroborates with the fact that these are agrarian communities, dependent on agriculture.
- About 96% of the PAPs have own houses and among them 20% have pucca Houses.
- 100% of the PAP households have latrines.

[14] Ref RAP for flood mitigation works
[15] CRDA conducted special drives to sort out disputes. Some landowners are seeking legal recourse on their internal family disputes on title. In some cases, while the disputes are yet to be settled, landowners approached CRDA to offer lands under LPS with a condition that the benefit sharing and compensation will be as per outcome of legal outcome on title.
[16] Ref RPF and RAP for flood mitigation works.

- The average household income of the PAPs stands at Rs. 4,340/- per month.

7.4.2 Focus Group Discussions

Out of the 20 affected villages[17], 20 Focus Group Discussions were conducted in 14 villages at different locations. Around 165 people consisting of PAFs and landless pensioners, women's groups, SC / ST community, structure affected PDFs, PDFs affected on government lands, etc. The attendance sheets and the detailed pictures of these FGDs are available in the project files for reference. The summary of these FGDs is given below

- Many of the PAFs indicated that they are aware of the project and the impacts. However, they requested for additional inputs on entitlements. They requested that this information be given through community meetings, print and electronic media and other communication materials like pamphlets, FAQ booklets, etc. They would like this to be in easily understandable terms with examples.
- The PAFs want information on the implementation schedule with details such as a) when the acquisition will be done, b) when would they be notified to vacate their residences, c) how much time will be given for vacating the houses, d) when will be rehabilitation plots allotted to them, e) whether they would be relocated as a community as they are now, f) how much time will be given for building houses at the resettlement locations, g) can they take the salvageable material from the demolished residences, etc.
- Annuity is not being paid to the occupants who are on Govt. lands. It is requested to provide annuity to them on par with other assigned LPS land owners. They also knowingly or unknowingly depending upon Government lands for the past three generations and getting their livelihood.
- The eligibility or ineligibility of occupants needs clarity to know how they are given residential returnable plots 250 Sq. yds. per Acre. Majority of the occupants demand to provide at least 500 Sq. Yds. as their family size is increased.
- Minimum of INR 30,000/- not applied to one individual as he has his government land about 0.60 acres at four different places.[18]
- Providing infrastructural facility to all LPS returnable plots to be planned as soon as possible.
- Loss of Agricultural activity is a problem for the farmers.
- Seasonal employment to be provided to local labor or vehicles.
- NTR Sujala Sravanthi scheme is excellent in supplying drinking water to Sakhamuru village.
- Water for daily use is not available. Hence there will be much water trouble for daily use during ensuing summer and it is requested to plan for alternative source of water either from the pipe line arranged at **VIT** or from **SRM** or from Sakhamuru park where water pipes arranged.
- Returnable plots registration is somewhat slow.
- Flood water from Vykuntapuram must be diverted into the Krishna River.
- Vagu digging soil must be used for filling the low-lying areas where plots are in existing village nearer to Vagu.
- One individual who has gone to Singapore told that there is no private land which all the land resources are in the government control and also all individuals work hard and give more importance to cleanliness.
- It is informed that Lands under PWD control are not yet transferred to and all those types of land must come to CRDA custody and then all the land owners of Borupalem who surrendered their land under LPS will go to Registration.

[17] Total 20 revenue villages affected by the flood mitigation works but impacts are only in 15 villages.
[18] Base annuity of 30,000 is paid to landowner, even if the combined land extent is less than one acre.

- Jareebu lands are now treated as non-Jareebu which is a major problem related to 14 acres of Lemon Gardens.[19]
- Infrastructure as promised to be provided at the LPS layouts at the earliest.
- It is enquired about the Buffer Zone under flood mitigation Measures (where residential construction cannot take place) which is meant for the purpose of greenery and for strengthening of Bunds of the proposed channels.
- Revetment of Channels is necessary as it is the loose black soil which may be eroded during floods.
- In survey no.577 an extent of 0.51 acres which was surrendered to CRDA under LPS. Annuity of INR 15000/ for one year was paid and it was delayed the next two annuities.
- People demanded to solve the Gramakantham issue as soon as possible.[20]
- The Land owners of Jasmine gardens demands for higher compensation.
- 10 cents exemption is a demand from the people of Kuragallu.
- Poles for the plots to be placed to identify where one's own plot is. There are no poles to some plots.

Table 7-1: Common Property Resources affected

No	Village	Type of Impacts	Acres	Action plan
1	Mandadam	Temple	0.19	Consultations are initiated with the community
2		Burial Ground	0.73	As the remaining site is adequate, additional site is not proposed - accepted by the Community[21]
3.	Sakhamuru	Burial Ground	0.26	

Out of the 20 affected villages[22], 20 Focus Group Discussions were conducted in 14 villages at different locations. Displacements limited as the impacts are outside habitation area. The details of displacement are furnished in RAP for Flood Management Works. No adverse social impacts are identified as the works are meant to free the capital city from possible inundation and there are no physical displacement and resettlement requirements in these 6 villages. The habitations will benefit from these works as loss to livelihoods and assets are mitigated.

Around 165 people consisting of PAFs and landless pensioners, women's groups, SC / ST community, structure affected PDFs, PDFs affected on government lands, etc. The attendance sheets and the detailed pictures of these FGDs are available in the project files for reference. A detailed description of the key issues raised and how those issues are addressed is presented below.

Table 7-2: Details of focus group discussions

No	Key issues raised	How those addressed
Mandadam: 25-07-2017: FGD with marginal farmers, landless pensioners and PDFs due to structure loss - 15 attended		
1	Entitlements to the LA and LPS	The entitlements under LA, LPS and Negotiated Settlement Policy have been explained in detail.
Ainavolu: 25-07-2017: FGD with women pensioners and marginal farmers - 23 including 7 women		

[19] Classification as per expert team and process as per Got order, applicable to entire capital city.
[20] This issue is in 3 villages for 108 landowners only. CRDA is discussing with landowners to resolve.
[21] Ref RAP for flood mitigation works
[22] Total 20 revenue villages affected by the flood mitigation works but impacts are only in 15 villages.

No	Key issues raised	How those addressed
2	Requested for extending Health cards coverage and acceptability in more number of hospitals for all kinds of ailments.	Government of Andhra Pradesh as part of the NTR Vaidya Seva issues Health cards to only BPL families / holders of white ration cards. In Amaravati, the Health cards are issued to all the residents of Capital City as on 8-12-2014. These health cards enable treatments to 1044 ailments at designated hospitals across Andhra Pradesh.
Pichikalapalem: 25-07-2017 : FGD with Marginal Farmers, pensioners and occupants in Government lands - 35 including 9 women		
3	Loans for small business, fees reimbursement	The policy is being prepared for issue of loans to initiate entrepreneurial activities.
Krishnayapalem: 19-03-2018 : FGD with occupants in Government lands: 8 participants including 1 woman		
4	• Annuity is not being paid to the occupants who are on Govt. lands. It is requested to provide annuity to them on par with other assigned LPS land owners. They also knowingly or unknowingly depending upon Government lands for the past three generations and getting their livelihood. • Pension amount of INR 2500 is also not given to some of the occupants who are not now living in that village. • 10% increase of Pension amount is required. • The eligibility or ineligibility of occupants needs clarity to know how they are given residential returnable plots 250 Sq. yds. per Acre. Majority of the occupants demand to provide at least 500 Sq. Yds. as their family size is increased. • Minimum of INR 30,000/- not applied to one individual as he has his government land about 0.60 acres at four different places.	▪ The compensation to occupants of Government lands was covered under G.O.Ms.No.153 dated 19-04-2017 and the compensation is being paid accordingly. ▪ With reference to payment of pensions to non-residents it is clarified that all the persons who are in Household survey will be provided with pensions as per their eligibility. If those eligible are missed out, they can apply to receive the pension amount. It is clarified that about 200 new pensions are sanctioned in the preceding weeks. ▪ Indexation of pension amount is considered. ▪ The allotment of residential plots to occupants is as per the guidelines under land pooling scheme. Specific grievances, if any, may be applied to concerned CA for examination. ▪ It is clarified that an individual can receive annuity equivalent to 1 acre even if he / she possesses combined extent of less than 1 acre. The request is not admissible as per the policy.
Nowluruu-2 (Yerrabalem): 19-03-2018 : FGD with LPS Landowners: 6 participants		

No	Key issues raised	How those addressed
5	• Drainage in existing village will be a problem for them. Before, this capital city project, there are vagus and Donkas through which the sewage water flows. But now all the vagu, vanka and Donkas were taken away by CRDA and developing them as returnable plots. Now they may face drainage problem. • An individual who is Dumb and local eligible person is not getting pension from CRDA or handicap pension under Social security scheme. • Providing infrastructural facility to all LPS returnable plots to be planned as soon as possible. • Loss of Agricultural activity is a problem for the farmers.	▪ The flood mitigation plan including storm water discharge is explained. The plan will ensure that there are no issues arising out of discharge of storm water. ▪ Indexation of pension amount is considered. ▪ With reference to development of Infrastructure, it is clarified that all steps are being taken in a phased manner to develop the infrastructure as per master plan.
Sakhamuru : 20-03-2018 : FGD with LPS landowners: 4 participants		
6	• Boundary stones at some returnable plots to be fixed. • Health Cards issue brought to the notice of the Commissioner. The Commissioner assured that there will be some particular individual on this job of health cards, and his Phone number will be written on the walls of every CRDA office to facilitate the Health card holders to contact the person at need times. • Seasonal employment to be provided to local labor or vehicles. • NTR sujala sravanthi scheme is excellent in supplying drinking water to Sakhamuru village. • Water for daily use is not available. Hence there will be much water trouble for daily use during ensuing summer and it is requested to plan for alternative	▪ Boundary stones as per standards are fixed for all the returnable plots with GPS coordinates. Any specific issue will be addressed by the CA. ▪ Project information center is designated to provide additional support regarding health cards. A qualified medical doctor is placed as coordinator to facilitate health card and treatment related issues for Amaravati health card holders. A sticker containing essential information will be affixed to each health cardholder's residence and communication material is handed over regarding treated ailments and designated hospitals. A common toll free number 104 will attend to resolving any queries ▪ Steps are being taken to position a person to look after health cards issues and specific instructions have been issued to all contractors by the ADC to engage local people in construction work.

No	Key issues raised	How those addressed
	source of water either from the pipe line arranged at VIT or from SRM or from Sakhamuru park where water pipes arranged.	▪ Suitable steps will be taken to redress water problems.
Velagapudi : 20-03-2018; FGD with LPS landowners: 9 participants		
7	• Discrimination in LPS package for the same individual for an extent of 0.19 acres of Jareebu it is INR 30,000 offered but for other parcel of land with the same extent of 0.19 under assignment is offered only INR 10,000. But the individual expects that a minimum of INR 30.000 for the assigned land also. • Returnable Plots registration is pending as their plots are located on the land of a person who is willing to give land to CRDA either under LPS or under LA or NSP. Requested to take steps for reallocation of plots. • Panchayat Secretary told that if Vagu is properly levelled to ensure free flow of rain water into Krishna River, it a good solution for inundation problems and requested to take steps accordingly as all land now is under the control of CRDA.	▪ It is clarified that compensation is being paid as per the approved guidelines and there is no discrimination in payment of annuity to any person. Specific cases may be brought to the notice of the concerned CA for redressal. Steps are being taken to relocate the plots in the undisputed area. Flood Mitigation Works will be done as per the drawings approved to avoid inundation.
Abbarajupalem: 21-03-2018: FGD with LPS landowners: 3 participants		
8	• Returnable plots for LPS land owners allotted on the land not surrendered by the private individual. And also there are only two boundary poles for the commercial plots which require planning for erection of another two poles. • It is complained that the authorities have denied payment of annuity to them treating their lands as non Jareebu now, though they were classified as Jareebu lands in the past and paid annuity accordingly for three years. It is	▪ Utmost care has been taken to allot plots in lands under possession of APCRDA. Specific grievances as to plot allotment may be brought to the notice of the concerned CA for redressal. ▪ A technical committee constituted by the District Administration has reviewed all cases regarding land classification and annuity is paid based on the decision of the Committee.

No	Key issues raised	How those addressed
	further complained that notices were issued to 11 land owners and the individuals went to the court also. But two individual have not yet received either notice or annuity but orally informed. Thus the farmers are not willing to get their lands registered.	
Borupalem: 21-03-2018 : FGD with LPS landowners: 11 participants		
9	• Returnable plots registration is somewhat slow. • Flood water from Vykuntapuram must be diverted into the Krishna River. • Vagu digging soil must be used for filling the low-lying areas where plots are in existing village nearer to Vagu. • One individual who has gone to Singapore told that there is no private land which all the land resources are in the government control and also all individuals work hard and give more importance to cleanliness. • It is informed that Lands under PWD control are not yet transferred to and all those types of land must come to CRDA custody and then all the land owners of Borupalem who surrendered their land under LPS will go to Registration. • Jareebu lands are now treated as non-Jareebu which is a major problem related to 14 acres of Lemon Gardens. • Infrastructure as promised to be provided at the LPS layouts at the earliest.	▪ New registration offices are set up in centralized places to ensure speedy registration of plots. It is informed that about 10000 registrations are already complete. Channelization of flood water will be attended as per the approved drawings to ensure safety of property and lives. Consultations are in its way for the transfer of PWD lands to APCRDA.
Venkatapalem: 21-03-2018 : FGD with LPS landowners and Marginal farmers: 15 participants		
10	• It is opined that it will take 20 years or so for getting the area developed as promised. So all the	▪ The matter of extending annuity to LPS landowners beyond 10 years, Kalyana Lakshmi, Medical facilities

No	Key issues raised	How those addressed
	LPS land owners request for enhancement of annuity period from 10 years to 15 years annuity. • **1325** health cards were issued at Venkatapalem village and all of them shall be provided with medical aid without any ceiling and without any charges for Medical tests. • Kalyana Lakshmi scheme shall be extended to poor people in upper castes also. • LA farmers land under valued as INR 22 lakh. But the land owners request to fix the value basing on the market value at INR 4 crore per acre. • Health card Desk is to be situated at Thullur.	are noted and passed on to appropriate authorities.
Kuragallu: 22-03-2018 : FGD with LPS landowners: 18 participants		
11	• It is enquired about the Buffer Zone under flood mitigation Measures (where no residential construction cannot take place) which is meant for the purpose of greenery and for strengthening of Bunds of the proposed channels. • Revetment of Channels is necessary as it is the loose black soil which may be eroded during floods. • In survey no.577 an extent of 0.51 acres which was surrendered to CRDA under LPS. Annuity of INR 15000/ for one year was paid and it was delayed the next two annuities. • People demanded to solve the Gramakantham burning issue as soon as possible.	▪ Buffer zone as provided under Flood Mitigation Works and as per the drawings will be adopted. Similarly revetment of channels will be taken up as per drawings and designs. ▪ The issue relating to Gramakantham's is considerably resolved already. ▪ The payment of annuity is being made to all the eligible LPS landowners. The third year annuity has already been released. Compensation to LPS farmers including jasmine gardens is being paid as per the provisions of LPS Rules. Specific demarcation of plots is being carried out by putting boundary stones.

No	Key issues raised	How those addressed
	• The Land owners of Jasmine gardens demands for higher compensation. • 10 cents exemption is a demand from the people of Kuragallu. • Poles for the plots to be placed to identify where one's own plot is. There are no poles to some plots.	
Ananthavaram & Nekkallu: 22-03-2018 : FGD with LPS landowners: 8 participants		
12	• There is some delay in payment of annuity • Gramakantham issue • Partial loan waiver.	▪ With regard to the partial loan waiver, the beneficiary is advised to submit representation for taking suitable steps.
Penumaka : 25-04-2018 FGD with LPS landowners: 4 participants including 1 woman		
13	• Allotment of returnable plots not yet done. The farmers requested to give the returnable plots as soon as possible. • Health cards were issued to everyone but in some hospitals these were not accepted, saying that, that particular hospital/disease is not listed on the health card. • The farmers who attended to the FGD felt happy for the rise in Land prices due to capital announcement / formation only. • People request capital gain tax exemption until the allotted plot(s) is sold. • Peg-marking is not yet done.	▪ The request for extending unlimited medical facilities, capital gains tax is passed on to appropriate authorities.

7.4.3 Consultation on draft EMP for Flood Mitigation Works

Stakeholder consultation was carried out by the team of Social and Environmental experts in the month of January 2018. This consultation was held with villagers residing along the alignment proposed for flood mitigation works within the Amravati Capital City. The summary of the stakeholder consultation expectations is given in the following section. Details of Public Consultations given in Table 7-3.

The public consultation was carried out in the four villages of the study area: Mandadam, Thullur, Neerukonda and Krishnayapalem.

The consultation team and discussion topics are given below:

Discussion Topics: Draft Resettlement Action Plan for Flood Management works and Draft Environmental Assessment and Environmental Management Plan for flood management works.

Organization/ Representaiton	Participants
Public Representatives	Local villagers
	Landowners
	Landless
	Women
	Labors
	Key decision makers in the village, informal representatives
Vasavya Mahila Mandali (Bank appointed NGO)	Dr. B Keerthi
	Mr. Ramanujaiah
	Mr. Dhanunjay Rao
	Mr. Sivayya
CRDA	Mr. Sastry
	Ms. Gayathri
	Mr. Bhavani Prasad
	Mr. Rambabu and others
ADCL	Mr. Ganesh Babu
	Mr. Venkata Ramana
	Mr. Ashraf
Blue Consultant	Mr. Babu Kiran Sivala
	Mrs. Mamta Bavaskar

7.4.4 The objectives of the public consultations are as follows:

- To identify issues that need to be resolved to minimize environmental impacts.
- To identify risks both anticipated and unanticipated to the project as a consequences of the construction activities
- To engage people in a regular and open dialogue to reduce conflicts and create a mutually beneficial environment for the people.

7.4.4.1 Mandadam village public consultation:

First public meeting was conducted at Mandadam village. During this meeting people were appraised about details of the project by means of hard copies of drawings and were informed that the World Bank financing is proposed for the development of the flood mitigation project.

One of the affected persons in the village informed that he was losing 0.08% of houses sites in Velagapudi, he asked same size at rehabilitation and resettlement colony. The same was discussed with the officers who is present for the public consultation meeting.

Some of the people raised their concerns at Mandadam on following the NGT judgment in implementation of proposed flood mitigation project related to Kondaveeti vagu. People expressed concern and asked if the NGT judgment was being implemented.

One of the affected persons in the Velagapudi Village was losing 0.06% of house and he asked same size of site at R& R colony. The same was discussed with CRDA officials.

Applications from farmers and residents of the villages were collected and submitted to CRDA.

7.4.4.2 Thullur village public consultation:

Second public meeting was conducted at Thullur village. During this meeting people were appraised about details of the project by means of hard copies of drawings and were informed that the World Bank financing is proposed for the development of the flood mitigation project.

At the time of the consultations clarifications were provided by CRDA Director, Strategy. The participants were given an overview of the proposed flood mitigation works. The participants expressed concern about expected flooding during the rainy season and enquired as to when the works would be completed.

7.4.4.3 Neerukonda village public consultation:

Third public meeting was conducted at Neerukonda village. During this meeting people were appraised about details of the project by means of hard copies of drawings and were informed that the World Bank financing is proposed for the development of the flood mitigation project. As at the Mandadam consultation, at Neerukonda as well, the participants expressed concern about implementation of the NGT issue At Neerukonda written petitions were given by attendees, and signed acknowledgement was provided by APCRDA.

7.4.4.4 Krishnayapalem village public consultation:

Fourth public meeting was conducted at Krishnayapalem village. During this meeting people were appraised about details of the project by means of hard copies of drawings and were informed that World Bank financing is proposed for the flood mitigation project.

Farmers raised concern about disaster preparedness in case of simultaneous flood to Krishna River and Kondaveeti Vagu. They also expressed concern that Neerukonda to Krishnayapalem is flood prone area that require additional protection measures.

7.4.5 Overall suggestions by the people in the public consultations meetings

- Minutes book to be maintained for all consultations by CRDA / government and take signatures from participants.
- One of the farmers from Thullur consultation suggested that people gave the lands in LPS for building capital city and taking the Annuity from CRDA from past three years, so as these lands belong to government, no need to consult for anything.
- Farmers raised concern of adequacy of disaster preparedness in case flood occurs in both Krishna river and Kondaveeti Vagu at the same time.They also expressed concerns that Neerukonda to Krishnayapalem is a flood prone area that requires additional protection.

Table 7-3: Details of Public Consultations

Sr. No.	Name of the village	Date /time	Participants	Major issues discussed	Clarification by the authority
1.	Mandadam	6th Jan 2018 (11.30 AM to 2.15 PM)	• More than 215 participants • Landowners from Undavalli & Penumaka • PAPs • Landless poor people	• Participants objected that CRDA gave two messages about the meetings; it caused ambiguity to attend the meetings.	APCRDA received requests from the public to conduct meetings in their villages also. Accordingly, two more meetings were announced in Thullur and Krishnayapalem, which are convenient for flood PAFs to participate. It is appraised to all that the participants are welcome in any / all of the meetings.
				• Participants said that CRDA taking signatures from the attendees and not mention any minutes on the paper, so they objected, mainly they suspected that the attendance sheet is used as confirmation paper of the meeting.	APCRDA clarified that the participants are required to record their participation as it is an important evidence of their participation, which will be kept in project files throughout the project period. It is further clarified that minutes will be included in the revised version of RAP and uploaded onto website of APCRDA for access by the public.
				• Farmers objected that CRDA did not follow the NGT guidelines, as per NGT flood ways are not to disturb existing ones, but in some areas Rayapudi, Lingayapalem it was filled.	The works undertaken by APCRDA are in accordance with the NGT directions. If any deviations observed due to miss-communication will be quickly addressed appropriately.
				• The public also expressed that the compensation being paid	No pending issues related to project footprint. Statements raised on adhoc

Sr. No.	Name of the village	Date /time	Participants	Major issues discussed	Clarification by the authority
				is not too genuine and also there are a few title related issues.	basis are forwarded to concerned authorities for initiating necessary action.
				• Farmers expressed whether reservoir's bunds are prepared pucca	It is clarified that the bunds will be made to withstand overflows, breaches, etc., and will be as per the relevant engineering / construction codes prescribed by IS. Also the designs are vetted by professional agencies and technical committees.
				• People expressed the concern that pensions are paid to landless is insufficient looking at the rising prices.	It is clarified in RPF and also in RAP that pension is an allowance and is not a replacement of livelihood income. Pension paid to landless is equivalent to the annuity of the landowner with an acre or less of land.
				• They also mentioned that they are not finding any work as all the agricultural activities are stopped in the capital city region	The skill development and livelihood development initiatives for promoting alternate livelihoods are explained. It is further clarified that targeted skill development programs will be conducted as desired by them.
				• People expressed concern about the flooding problem in the rainy season & Public enquired about the immediate mitigation measures:	The inundation mitigation measures through the project are explained in detail. The reservoirs, canals and the pumping systems are designed to fully mitigate 1 in 100 year flows. On an immediate basis, the existing channels

Sr. No.	Name of the village	Date /time	Participants	Major issues discussed	Clarification by the authority
					are being cleaned and pumping systems at Undavalli are being completed.
				• The public expressed that the earth material would be generated from widening and deepening of the canals: Mitigation measures has to be taken up and included in the EMP.	The EMP has already put in place mitigation measures regarding dug earth.
				• People expressed that as per the NGT guidelines, the flood banks should not be touched to take up the Flood Mitigation Works.	The proposed works will be as per the directions of Hon'ble NGT.
				• They expressed that the proposed alignment is not feasible	Alignments are finalized only after conducting required studies and after approval of the Competent Authorities.
				• People expressed that they faced the drinking water problem from the last 5 decades.	The Capital City Infrastructure Master Plan has addressed the water supply scheme for the entire capital city.
2.	Thullur	6th Jan 2018 (3.00 PM to 4.00 PM)	• Total 17 participants • 2 women • Landless poor & landowners and	• The public expressed their doubts about the alignment and the water storage capacity of the proposed reservoirs and the area / extent covered by these reservoirs. They also	It is clarified that the alignments are finalized after conducting required gravitational studies and with the approval of the Competent Authorities. Similarly, new reservoirs are proposed with a storage capacity of 0.4 TMC at Neerukonda, 0.1 TMC at Krishnayapalem

Sr. No.	Name of the village	Date /time	Participants	Major issues discussed	Clarification by the authority
				expressed that it becomes difficult for them to attend the frequent meetings, surveys, FGDs, etc. in view of their current work and requested not to create any disturbance unless the meeting / issue is really urgent.	and 0.03 TMC at Sakhamuru. The public are informed that unless and until there is a great need, meetings and surveys will not be scheduled as suggested.
3.	Neerukonda	6th Jan 2018 (5.00 PM to 6.45 PM)	• Total 120 participants • 28 women • No one signed the attendance sheet. • landowners of Undavalli & Penumaka • Landless labors	• The public expressed that they are not ready to give their lands. They also expressed that they are against the capital city construction and development. • Vagu lands are not to be used for Flood Mitigation Works. • They enquired whether ASCCDP is a registered body and ADC has a right to develop infrastructure facilities. • Some of the public expressed title related issues and gramakantha issues. • They said that the development works are not being done as per the applicable Acts and policies	It is clarified that required technical studies have been carried out as required to finalize the designs and drawings and there is no necessity for any apprehension as to the storage capacity of the reservoirs. Further, it is clarified that ASCCDP is a project designed by APCRDA which is constituted under the Act and the ADC is the executing agency of the works. Other issues as raised by the public as to Gramakantham, development works, etc., have been explained in a transparent manner. With regard to construction of Amaravati at alternative location is a policy matter to be decided by the Government.

Sr. No.	Name of the village	Date /time	Participants	Major issues discussed	Clarification by the authority
				• They mentioned that the records in government are misleading and hence requested for reinitiating the study about the lands, agriculture, Jareebu-dry classification, type of land use, etc. and then prepare the RAP for payment of compensation.	
				• The public opposed the storage capacity and extent of reservoir coverage in Neerukonda saying that the base estimates are incorrect.	
				• They expressed that the capital city should be built in an alternative location instead of Amravati.	
4.	**Krishnayapalem**	6th Jan 2018 (7.00 PM to 7.35 PM)	• Total – 25 • Women: 6	• The public expressed / enquired about the green belt development along the vagus (canals) and reservoirs: included in the EMP	The public are clarified that sufficient green belt development is being taken up along the Vagus (canals) and reservoirs as per the assurance given to NGT by APCRDA.
				Suggestions from the local people in the area • The public here expressed that the sub-project is a good	

Sr. No.	Name of the village	Date /time	Participants	Major issues discussed	Clarification by the authority
				initiative from the government side to preserve water and as a precautionary measure to avoid flooding in the capital city. • The public also mentioned that the R&R colonies are to be provided to PDFs with all the facilities on par with the LPS layouts. • They also expressed that the Karakatta Bridge has to be strengthened. Additional protection measures and safety measures to avoid disaster has to be taken up and included in the EMP.	

Krishnayapalam

Mandadam

Figure 7-2: Photo presentation for Public Consultations

CHAPTER 8: ENVIRONMENTAL MANAGEMENT PLAN

8.1 Introduction

Based on the assessment of potential negative impacts referred to as in Chapter 6 above, this chapter will present Environmental Management Plan (EMP) for the works of the amended and supplemented items for the sustainable development project of Flood Mitigation Works. Environmental Management Plan (EMP): An EMP is an instrument that details (a) the measures to be taken during the implementation and operation of a project to eliminate or offset adverse environmental impacts or to reduce them to acceptable levels; and (b) the actions needed to implement these measures. 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.

Objective of This EMP:

- To prepare a document which sets forth all the measures identified by the client
- To prevent, minimize, mitigate and compensate for the potential negative impacts derived from the flood mitigation works, as well as to strengthen the positive impacts.
- To define the parameters and variables to be used to assess the environmental quality in the influence area of the Project.
- To establish the mechanisms so that pertinent authorities can follow up on the Project environmental variables and implement the necessary controls.
- To design the mechanisms for accident prevention and response, and for contingencies which may arise during the execution and operation of the project

Design measures and Proposed EMP Content

The detailed designs for the proposed flood mitigation works has several built in measures to minimize environmental impacts. Summary of these include:

- Advanced Flood Early Warning System (FEWS) and city level disaster management plan (Please refer **Annexure XXI**)
- Multiple pumping options which not only minimizes flood risk but also optimizes pumping requirements as well as earthwork for establishing canal network
- Water circulation mechanism within the canal network which not only protects the downstream irrigation users but also minimizes chances of eutrophication and public health impacts thereby
- The overall city level grievance redressal mechanism involving citizens to minimise the impacts

In addition to the above, the EMP provided in the following sections cover:

- Environmental management for the Project's construction phase, as well as for the Project's operations phase.
- Guidance for the development of more detailed EMPs and relevant sub plans prepared by the Proponent (or its agent or contracted entity) prior to commencement of the Project's construction and operations phases.

The various EMP measures during pre-construction and infrastructure development phase are listed in Table 8-1 to 8 -3. EC conditions and compliance along with NGT conditions and compliance are placed to be followed while implementing and the same is placed at **Annexure XVIII** and **Annexure XIX.**

Table 8-1: Environmental Management Plan for Flood mitigation works – Kondaveetivagu, Palavagu & Gravity canal - Pre – construction Stage

Sr. No.	Project related Issues	Mitigation Measures to be taken	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
I.	Pre-Construction Stage			
i	Assure compliance with relevant construction field legislation	All clearances required from other departments and Environmental aspects shall be ensured and made available before start of work. Acquire construction permit, Provide Water management guidelines if subprojects are executed near surface watercourses. Kindly refer the table no: 2 -1.	Contractor	ADC
ii	Utility Relocation	As it is green field site, no such major utilities shall be envisaged. Since the proposed Canals / Vagus and Reservoirs are mainly surrounded by agricultural land, there are no utilities except overhead electric line and poles. • Identify the common utilities that would be affected such as: telephone cables, electric cables, electric poles, water pipelines etc. • Affected utilities shall be relocated with prior approval of the concerned agencies before construction starts. • Alternate temporary arrangement for crossing over shall be provided.	Planning - ADC Execution - Contractor	ADC
Iii	Tree Cutting	Trees will generally not be removed unless they are a safety hazard. Removal of trees shall be done only after the permissions / approvals are obtained. Disposal of cut trees is to be done immediately to ensure that the traffic movement is not disrupted. Proposed canal alignment mainly passes through agriculture field. • Permission for tree cutting as per WALTA, 2002 needs to be taken.	Contractor	ADC
iv.	Supply of Material	Procurement of construction material only from permitted sites and licensed/ authorized quarries.	Contractor	ADC

Sr. No.	Project related Issues	Mitigation Measures to be taken	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
v.	Water	The Contractor will be responsible for arranging adequate supply of water for the entire construction period. The contractor shall consult the local people before finalizing the locations. The contractor will preferentially source all water requirements from surface water bodies. The contractor will be allowed to pump only from the surface water bodies. Boring of any tube wells will be prohibited. The contractor will minimize wastage of water during construction.	Contractor	ADC
vi	Appointment of Environment & Safety Officer	The Contractor would prepare OHS plan and other required plans as per the WBs guidelines. The contractor will appoint qualified and experienced Environment & Safety Officer (ESO), who will dedicatedly work and ensure implementation of EMP including Occupational health and safety issues at the camp, construction work sites.	Contractor	ADC
vii	Other Construction Vehicles, Equipment and Machinery	• All vehicles, equipment and machinery to be procured for construction/ protection work will conform to the relevant Bureau of Indian Standard (BIS) norms/ CPCB standards. The discharge standards promulgated under the Environment Protection Act, 1986 and Motor Vehicles Act, 1988 will be strictly adhered to. • Soundproof DG set as per regulations will be used at the project site. • The contractor will maintain records of Pollution Under Control (PUC) certificates for all vehicles used during the contract period, which will be produced to Project Implementation Unit for verification whenever required.	Contractor	ADC
viii	Labour Requirement	The contractor preferably will use unskilled/ semiskilled labour from local area to give the maximum benefit to the local community. Planning of	Contractor	ADC

Sr. No.	Project related Issues	Mitigation Measures to be taken	Responsibilities	
			Planning and Execution	Supervision/ Monitoring
		labour camps, needs to be done to ensure adequate water supply, sanitation and drainage etc., in conformity with the Indian Labour Laws. Contractor will develop labour management plan along with campsite management plan		
ix	Design consideration for Flood control	There are many design considerations to be taken for the project such as: - Design of storm water drains considering the peak run-off and discharge capacity of drains. - Erosion control - Dyke and embankment to be designed as per Seismic activity of the area - Ground seepage and control - Using natural slope to the extent possible - Minimal intervention to the natural contour - Management of catchment area with plantation etc.	Design stage consultant	ADC

Table 8-2: Environmental Management Plan for Flood mitigation works - Construction Stage[23] and Operation Stage

Environmental Impact & Aspect	Mitigation Measures[24]	Time frame[25]	Implementation	Monitoring and Supervision	Reference
Construction Stage					
LAND					
Soil Erosion	Main reason for soil erosion could be due to excavation (~41.5 Mil.Cu.m). Contractor should plan the activities so that proper erosion control measures would be adopted. Following preventive measures to be taken such as • Excavation and backfilling to be avoided in the monsoons and shall be planned for dry season. • Vegetation growth along the banks to be maintained to the possible extent for soil stability and revegetation of disturbed areas and traps. • Proper drainage to be maintained for soil stability • Embankment slopes to be constructed within the right-of-way. Bio-turfing of embankments should be made enhance the slope stabilization. • Embankments and other areas of unsupported fill will not be constructed with steeper side slopes, or to greater widths than those shown in the design drawings.	Upon completion of construction activities at these sites. During construction	**Contractor**	**PMC & PIU**	Standard engineering practices and Contract Documents
Quarrying and Material Sources	The reservoir embankment would require 0.111 M. Cu.m of stone will be used lining of the reservoirs.	Beginning with & throughout construction	**Contractor**	**PMC & PIU**	The Environment

[23] The construction activities include site clearance, excavation, disposal of spoil, de-watering, construction of reservoir embankments and lining of reservoirs
[24] Some of the mitigation measures are preventive in nature while some others include additional measures in terms of environmental conservation and involve physical and construction work
[25] Timeframe refers to the duration or instant of time when the mitigation measures will be taken.

Environmental Impact & Aspect	Mitigation Measures[24]	Time frame[25]	Implementation	Monitoring and Supervision	Reference
	• Quarry material shall be sourced from approved and licensed aggregate and sand quarries identified by the Government. • For operating new quarries, the Contractor shall obtain materials from quarries only after consent of concerned authorities and only after development of a comprehensive quarry' redevelopment plan. • Adequate safety precautions shall be ensured during transportation of quarry material from quarries to the construction site. Vehicles transporting the material shall be covered to prevent spillage. Operations to be undertaken by the Contractor as per the direction and satisfaction of the PIU. • The contractor shall prepare query rehabilitation and management plan (environmental management plan) acceptable to ADC and the Bank.				(Protection) Act, 1986 The Air (Prevention and Control of Pollution) Act 1981 Contract Document
Loss of top soil	• Earthwork excavations would generate about 0.475 M. Cu.m of top sol from all the sites which would be stored in a stockpile and shall be covered. • Stockpiles to be designed in such a way that slope do not exceed 1:2 (vertical to horizontal). • Top soil will be safeguard from erosion and will be reused at the 30 meter buffer on either sides of the canal.	During Construction	**Contractor**	**PMC & PIU**	Contract Document
Contamination of Soil	Oil & fuel spills from construction equipment and improper management of construction site could result contamination of soil. The contract should	During Construction	**Contractor**	**PMC & PIU**	The Environment

Environmental Impact & Aspect	Mitigation Measures[24]	Time frame[25]	Implementation	Monitoring and Supervision	Reference
	strictly enforce the Guidelines of "Hazardous waste (management and handling) rules, 1989. • Plant to be setup 500m away from surface water body. • Oil interceptor will be installed at construction site. • Septic tank will be constructed for safe disposal of waste.				(Protection) Act, 1986 Contract Document
Generation of debris	• Any debris accumulated in the canals/vagus or generated due to construction activities should be stored at a designated place by the authority which need to be sufficiently away from waterbodies and habitats. • The generated debris shall be re-used efficiently if found suitable for using mainly as fill materials and stone pitching work without limiting to the project activities.	During Construction	**Contractor**	**PMC & PIU**	The Municipal Solid Wastes (Management and Handling) Rules, 2016 C&D Waste Rules 2016
Erosion of Disposal sites	Five disposal sites within the city has been identified considering the topographic profile and landfilling requirements. The impact is not expected as the disposal sites will be utilized for different land uses as per the master plan. However, the contractor has to spread the soil entire designated site to the possible extent to avoid any associated risks involved in disposal.	During Construction	**Contractor**	**PMC & PIU**	Contract Document
AIR					
Dust Generation	Vehicles are expected to pass through the major roads which are adjacent to the settlements namely (i) Uddandarayapalem; (ii) Venkatapalem; (iii) Mandadam; (iv) Malkapuram and (v) Velagapudi. Dust generation is expected from the excavation	Beginning with & throughout construction	**Contractor**	**PMC & PIU**	The Environment (Protection) Act, 1986

Environmental Impact & Aspect	Mitigation Measures[24]	Time frame[25]	Implementation	Monitoring and Supervision	Reference
	and disposal activities. Following preventive measures are suggested • Excavation activities at nearby settlements to be undertaken by sprinkling of the water. • Vehicles delivering materials should be covered to reduce spills and dust blowing off the load. • 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. • Clearing and grubbing to be done, just before the start of next activity on that site. In case of time gap, water should be sprinkled regularly till the start of next activity. • Unloading and disposal of spoil to be preferably undertaken in the night times. • Embankment slopes to be covered immediately after completion. • The contractor to develop and submit a dust control plan, an Air Quality Management Plan and Emissions Monitoring/Testing Plan.				The Air (Prevention and Control of Pollution) Act 1981 Contract Document
Emissions	• The contractor will submit PUC certificates for all vehicles/ equipment/machinery used for the project. Regular pollution check for construction vehicles shall be made. • DG set to be provided with vertical opening chimney of adequate height as per CPCB guidelines.	During Construction	**Contractor**	**PMC & PIU**	The Environment (Protection) Act, 1986 The Air (Prevention and

Environmental Impact & Aspect	Mitigation Measures[24]	Time frame[25]	Implementation	Monitoring and Supervision	Reference
	• LPG shall be used as fuel for cooking of food at construction labour camp instead of fuel wood. The unloading of all materials at construction sites will be limited to day time only to avoid accidents.				Control of Pollution) Act 1981 Contract Document
Equipment	Proposed activities require following equipment Excavation Equipment 1. Shovel of 0.85 Cum – 120/day 2. Tipper of 5 Cum – 850/Day Embankment Lining of Reservoirs 1. Angle Dozer of 90 H.P Capacity – 5/Day 2. Electrical Pump of 5 H.P – 6 3. Water tanker of 8000 liters – 6 4. Vibratory roller of 8 ton capacity - 6 The contractor will procure the construction plant and machinery, which will conform to the pollution control norms specified by the MoEF&CC/ CPCB/ APPCB. The contractor will ensure that all vehicles, equipment and machinery used for construction works are regularly maintained and confirm that pollution emission levels comply with the relevant requirements of CPCB and/Motor Vehicles Rules.	During Construction	**Contractor**	**PMC & PIU**	Contract Document
WATER					
Dewatering	Dewatering requirement may arise due to shallow water table at certain part of the canal sections to be excavated. Following preventive measures are to be undertaken to avoid any constructed related inconveniences	Throughout the Construction	**Contractor**	**PMC & PIU**	The Environment (Protection) Act, 1986. The Water (Prevention and

Environmental Impact & Aspect	Mitigation Measures[24]	Time frame[25]	Implementation	Monitoring and Supervision	Reference
	• Construction should start from upper reaches and the dewatering is proposed to be discharged downstream • To reduce the turbidity baffles would be provided before the discharge into the downstream • Maintenance of the baffles would be undertaken periodically by the contractor				Control of Pollution) Act 1974 Contract Document
Contamination of Surface and Ground Water	• 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 to prevent contamination from accidental spillage of oil. • All the debris resulting from construction activities shall be removed from the site on regular basis to prevent their runoff. Storage area shall be kept away from the water bodies to prevent any wash away into water bodies and ground water infiltration rates. • Adequate sanitation and waste management facility to be provided in construction camp as per Appendix 1.3 of EIA report and it is to be ensured that no liquid or solid waste get disposed into river during the construction period. • Labour camps are to be located away from water bodies • Construction labours should be restricted from polluting the source or misusing the source.	During construction	**Contractor**	**PMC & PIU**	The Environment (Protection) Act, 1986. The Water (Prevention and Control of Pollution) Act 1974 Contract Document

Environmental Impact & Aspect	Mitigation Measures[24]	Time frame[25]	Implementation	Monitoring and Supervision	Reference
	• With the envisaged canal lining after 2 years and reservoir lining in this project activity, there could be increase in the ground water level which may result secondary impacts on the structures. Necessary studies need to be conducted to understand the high ground water level by proponent.				
Alteration of Drainage	• Construction materials containing fine particles will be stored in an enclosure such that sediment-laden water does not drain into nearby watercourses. All discharge standards promulgated under Environmental Protection Act, 1986, will be adhered to. • All liquid wastes generated from the site shall be disposed of as acceptable to the Engineer. • Excavated soil shall be used/ transported at the earliest for filling low lying areas at the site for raising of level as planned. • Moreover, the washed soil to 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. Washing of trucks should only take place in paved or lined areas with appropriate wastewater collection measures. • Provision of a temporary or alternative pathway for storm-water drainage, avoiding the elimination or the temporary closure of the natural run-off pathways.	Whenever encountered during construction	**Contractor**	**PMC & PIU**	The Environment (Protection) Act, 1986. The Water (Prevention and Control of Pollution) Act 1974 Contract Document

Environmental Impact & Aspect	Mitigation Measures[24]	Time frame[25]	Implementation	Monitoring and Supervision	Reference
	• The drainage system shall be cleaned from time to time, so it is always able to carry the volume of storm water for which it was designed.				
Sludge/silt	Currently the sludge/silt cleared by the irrigation authorities are used by the farmers in the adjoining fields. However, any deposits of sludge/silt observed while the proposed works following precautions to be undertaken • Slude/Silt to be tested before the disposal at the approved sites in accordance with the provisions. • Sludge/silt disposal has to be undertaken only on receipt of approval on the test report and quantity from the ADC. • Silt fencing will be provided around stockpiles at the construction sites close to water bodies. The fencing needs to be provided prior to commencement of earthworks and continue till the stabilization of the embankment slopes.	Throughout the Construction	**Contractor**	**PMC & PIU**	The Environment (Protection) Act, 1986. The Water (Prevention and Control of Pollution) Act 1974 Contract Document(BoQ)
Water requirement for project	• During construction only permitted quantity (permission taken) from approved sources should be used in construction activity. • Contractor to ensure optimum use of water; discourage labour from wastage of water. • Prior written permission from authorities for use of water for construction activity should be submitted to PIU. • It is prohibited to use of ground water for any purposes. Boring of any tube wells will be prohibited.	Throughout the Construction	**Contractor**	**PMC & PIU**	Contract Document

Environmental Impact & Aspect	Mitigation Measures[24]	Time frame[25]	Implementation	Monitoring and Supervision	Reference
NOISE					
Noise from vehicles, plants and equipment	• Construction operations should be undertaken primarily to day time, i.e. 6:00 am-10:00 pm only to minimize noise impacts. • The excavators should be equipped with the noise reduction/ masking equipment to reduce the noise generation inside and outside water. Noise from equipment can be reduced at source by isolation of exhaust system, by keeping engine room doors shut and by shielding. • Equipment's to be used for construction work shall be hand held tools with restricted use of pneumatic tools. • The equipment's used in construction shall strictly conform to the MoEF&CC/ CPCB noise standards and shall have latest noise suppression mountings. • All vehicles and equipment's used in construction will be fitted with exhaust silencers. • Only acoustic enclosures fitted DG sets will be allowed at the construction site and plant/ campsite.	Throughout the Construction	**Contractor**	**PMC & PIU**	Noise Pollution (Regulation and Control) Rules, 2000
FLORA AND FAUNA					
Loss of trees and Plantation works	Clearing and uprooting should be avoided beyond that which is directly required for construction activities. Buffer of minimum 30 meters to be developed either side of the canal and 50 meters around the	After completion of construction activities	**Contractor**	**PMC & PIU**	Forest (Conservation) Act, 1980, amended 1988 Andhra

Environmental Impact & Aspect	Mitigation Measures[24]	Time frame[25]	Implementation	Monitoring and Supervision	Reference
	waterbodies. Plantation as proposed below to be implemented on completion works[26]. 1. Pala vagu - Canal front (Approx. length of 16.7 Kms) – 118.6 Acre 2. Vykuntapuram Gravity Canal Front (Approx. length of 8kms with 23m wide section) – 39.5 Acre 3. Krishna Riverfront Development (25 km with 100m wide stretch greening) – 618 Acre 4. North bank canal front redevelopment – 60kms 5. Tree plantation shall be carried out as per the CPCB norms and Tree Authority directives following AP WALT ACT.				Pradesh Water, Land and Tree Act, 2002 Contract Document
Fauna	• Construction workers must protect natural resources • Hunting will be strictly prohibited	Throughout the Construction	**Contractor**	**PMC & PIU**	Contract Document
SOCIO-ECONOMIC ENVIRONMENT					
Accidents	The Contractor will provide, erect and maintain barricades, including signs marking flats, lights and flagmen as required by the PMC along the project works.	After Throughout the Construction	**Contractor**	**PMC & PIU**	Contract Document
Resettlement Action of People	Near 27 families are being affected due to the project. Affected people will be compensated as per the entitled framework detailed in RAP.	During Construction	**Contractor**	**PMC & PIU**	Contract Document and RAP

[26] Iindicative and subjected change as per the final green master plan

Environmental Impact & Aspect	Mitigation Measures[24]	Time frame[25]	Implementation	Monitoring and Supervision	Reference
Public Health and Safety	• No blasting activities near the existing settlements (especially near Neerukonda and Krishnayapalem) • Debris, so generated will be disposed to the satisfaction of Engineer. • Monitoring of air, water, noise and land during construction and operation phase.	Throughout the Construction	**Contractor**	**PMC & PIU**	Contract Document
Labor Camps	• Contractors should recruit the local people as laborers at least for unskilled and semi-skilled jobs. • Hygiene and basic facilities should be ensured at labor camp to prevent the spread of disease. • Labor Camp should be equipped with adequate number of Indian style of toilets with running water facility and connected to septic tanks; • No Asbestos Containing Materials should be used for construction. Construction material should preferably be certified green materials. • Provision must be made for Washing Areas. Soak pits & other measures to prevent stagnation of water must be made. • Adequate space, ventilation and privacy is mandatory. • Adequate waste management measures to be implemented • Cooking fuel must be LPG(fuelwood, kerosene or any such substance shouldn't be used) • Contractors should follow the guidelines for siting and layout of construction as per the Annexure – XII, Annexure XIIa and XIIb of EIA Report	Throughout the Construction	**Contractor**	**PMC & PIU**	Contract Document

Environmental Impact & Aspect	Mitigation Measures[24]	Time frame[25]	Implementation	Monitoring and Supervision	Reference
	• Campsite discipline including with specific protocols defined to ensure minimal impact on local communities. • Contractor should prepare Labor Management Plan and Camp site Management Plan. • Contractor should display the minimum wage and raise awareness on the labor rights.				
Operation Health and Safety	The Contractor would prepare OHS plan and other required plans as per the WBs guidelines. • All the laborers 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. Provision of infrastructure and amenities for migrant labor in construction camp to avoid dependence on limited local resources. • 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 program. • 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. • The contractor will appoint qualified and experienced Environment & Safety Officer (ESO), who will dedicatedly work and ensure implementation of EMP including Occupational	Throughout the Construction	**Contractor**	**PMC & PIU**	Relevant provisions of the Building and other construction workers (regulation of employment and conditions of services) Act 1996 are adhered to. Environmental, Health, and Safety (EHS) Guidelines-Water and Sanitation (2007) prepared by World Bank Group.

Environmental Impact & Aspect	Mitigation Measures[24]	Time frame[25]	Implementation	Monitoring and Supervision	Reference
	health and safety issues at the camp, construction work sites • The contractor will comply with all the precautions as required for ensuring the safety of the workmen as per the country' labor regulations and International Labor Organization (ILO) Convention No-62 as far as those are applicable to this contract				
Traffic Management	Carting of excavated material would require 845 vehicles per day. This would to increase in traffic on the access roads in the city including E3, E8, E10, E14, N4, N9, N14 and N16. The village settlements along these roads viz. (i) Uddandarayapalem; (ii) Venkatapalem; (iii) Mandadam; (iv) Malkapuram and (v) Velagapudi are expected to have problems due to envisaged additional traffic. In this regard, following preventive measures are suggested • Before start of the construction, proper traffic management plan will be prepared and submitted to ADC for approval. Secure assistance from local police for traffic control during the construction. • Necessary signage and barricading will be provided for safety of road users. • Contractor will ensure that no construction materials and debris are lying on the road. It will be collected and disposed of properly. • Wherever possible, rerouting of construction traffic to wider, less-restrictive road shall be preferred.	Throughout the Construction	**Contractor**	**PMC & PIU**	Contract Document

Environmental Impact & Aspect	Mitigation Measures[24]	Time frame[25]	Implementation	Monitoring and Supervision	Reference
	• The contractor shall provide training to the drivers regarding the traffic rules and management provisions. Training records shall be maintained by the contractor. • On possibility, the movement of heavy vehicles to be restricted to the night times • Unnecessary parking and sound pollution to be strictly avoided especially when vehicles are passing through the settlements and sensitive receptor such as schools, hospital and cultural centers.				
RISK AND SAFETY					
Risk and Safety from Construction activities	• Adequate precautions will be taken to prevent danger from electrical equipment. • No material or any of the sites will be so stacked or placed as to cause danger or inconvenience to any person or the public. • All necessary fencing and lights will be provided to protect the public.	Throughout the Construction	**Contractor**	**PMC & PIU**	EHS Guidelines of WB
Risk caused by Force' Majure	All reasonable precaution will be taken to prevent danger of the workers and the public from fire, flood, drowning, etc. All necessary steps will be taken for prompt first aid treatment of all injuries likely to be sustained during the course of work. Contractor has to prepare a response plan before start of construction works.	Throughout the Construction	**Contractor**	**PMC & PIU**	Contract Document
Safety measures during construction	The Contractor will make sure that during the construction work all The Contractor shall provide and ensure enforcement with zero tolerance on the following: • Protective footwear to be given to all workers.	Throughout the Construction	**Contractor**	**PMC & PIU**	Contract Document

Environmental Impact & Aspect	Mitigation Measures[24]	Time frame[25]	Implementation	Monitoring and Supervision	Reference
	• Ear plugs to workers exposed to high noise levels. • Helmets to all workers, supervising staff and inspecting official entering construction site, plant area, quarry and engaged in loading /unloading operations • Protective goggles and clothing to workers engaged in stone breaking activities. • Contractors has to ensure workers safety during construction activities as per the Annexure XXIX of EIA Report • Environmental and safety cell of the company shall also actively involved in imparting training and raising environmental awareness level of the construction staff.				
Hygiene	• At every workplace, good and sufficient water supply shall be maintained to avoid waterborne / water-related / water-based diseases to ensure the health and hygiene of workers. • Adequate drainage, mobile toilets shall be provided at workplace. • Preventive Medical care shall be provided to workers. • An action plan shall be prepared and implemented	Throughout the Construction	**Contractor**	**PMC & PIU**	Contract Document
HERITAGE AND CULTURE					
Heritage	• The Undavalli caves is at a distance of 300 meters from the existing canal which would not	During Construction	**Contractor**	**PMC & PIU**	Contract Document Ancient Monuments and

Environmental Impact & Aspect	Mitigation Measures[24]	Time frame[25]	Implementation	Monitoring and Supervision	Reference
	fall on either protected area[27] or regulated area[28] as per the Handbook of Conservation of Heritage Buildings published by CPWD. • However, specific measures to mitigate construction stage impacts include a. exclusion of any construction facilities (such as disposal sites, DG sets, batching plant, labor camps, etc.) within 1km radius; b. high level screen to prevent any air pollution from construction site and provision of water sprinkling; and c. exclusion of blasting activities within 1km radius				Archaeological Sites and Remains Rules 1959 Handbook of Conservation of Heritage Buildings published by CPWD.
Cultural Sites	Three common property resources including, one temple in Mandadam, one burial ground in Sakhamuru and one burial ground in Mandadam will be affected. The specific details are detailed out in RAP for flood mitigation works.	During Construction	**Contractor**	**PMC &PIU**	Contract Document & RAP
CONTRACTORS OBLIGATION					
Clean-up Operations, Restoration and Rehabilitation	• The contractor will prepare site restoration and demobilization plan, which will be approved by the Environmental Expert of Project Implementation Unit. The clean-up and restoration operation are to be implemented by the contractor prior to demobilization. The Contractor will clear all temporary structures;	On Completion	**Contractor**	**PMC & PIU**	Contract Document

[27] "Prohibited Area" means area of the protected monuments declared as of national importance and extending to a distance of 100 meters in all direction.

[26] "Regulated Area" means area in respect of every ancient monuments and archaeological sites and remains declared as of national importance and extending to a distance of 200 meters in all direction.

Environmental Impact & Aspect	Mitigation Measures[24]	Time frame[25]	Implementation	Monitoring and Supervision	Reference
	dispose all garbage, night soils and POL (Petroleum, Oil and Lubricants) wastes in environmental sound manner. • All disposal pits or trenches will be filled in and effectively sealed off. • All construction zones including camp, and any other area used/affected due to the project operations will be left clean and tidy at the contractor's expense to the entire satisfaction to the Environmental Expert of ADC				

Table 8-3: Environmental Management Plan for Flood mitigation works - Operation and Management Stage

Environmental Impact & Aspect	Mitigation Measures[29]	Time frame[30]	Implementation	Monitoring and Supervision	Reference
Drawl of Water from Krishna River	Water intake from Krishna river to the tune of 0.35 TMC out of the available 3 TMC (lean period) would be required to maintain minimum water levels on bi-weekly basis.	During Operation stage	ADC	ADC	EMP
Green buffer	The proposed green buffer either side of the canal and around the reservoirs, if not, managed as per the standards could lead to degradation including encroachments, disposal of wastes, construction debris etc. In order to avoid such impacts following measures to be adopted	During Operation stage	ADC	ADC	Forest (Conservation) Act, 1980, amended 1988 Andhra Pradesh Water, Land and Tree Act, 2002 Contract Document EMP
Maintenance of Canals	• The drainage system, canal will be periodically cleared so as to ensure water flow. The outlet structure should be inspected for evidence of clogging or outflow release velocities that are greater than design flow. • At least twice during the rainy season, accumulated trash and debris should be removed	During Operation stage	ADC	ADC	EMP

[29] Some of the mitigation measures are preventive in nature while some others include additional measures in terms of environmental conservation and involve physical and construction work

[30] Timeframe refers to the duration or instant of time when the mitigation measures will be taken.

Environmental Impact & Aspect	Mitigation Measures[29]	Time frame[30]	Implementation	Monitoring and Supervision	Reference
	from the side slopes, embankment, and spillway. All pond outlet devices should be protected from clogging. Sediment should be removed from the main ponds as necessary and at least once every two years. • Maintain oxygen levels for aquatic life and avoid generation of odors by following approved clearing mechanism.				
Maintenance of Reservoirs	• De-silting shall be carried out periodically. The outlet structure should be inspected for evidence of clogging or outflow release velocities that are greater than design flow. • At least twice during the rainy season, accumulated trash and debris should be removed. Sediment should be removed from the main ponds as necessary and at least once every two years. • Maintain oxygen levels for aquatic life and avoid generation of odors by following approved clearing mechanism	During Operation stage	ADC	ADC	EMP
Pollution Monitoring	The Project Implementation Unit will monitor the Ambient Air Quality, Water Quality, Soil Quality and Noise by engaging NABL approved Lab.	During Operation stage	ADC	ADC/APCRDA	EMP
Disposal of Waste and untreated effluents	In absence of strict mechanism towards maintenance of storm water, sewage and solid waste, the canals are prone for disposal of waste and untreated effluents. Proper disposal of waste oil, measures to control of oil spillage and etc., would be necessary during	During Operation stage	ADC/APCRDA	ADC/APCRDA	EMP

Environmental Impact & Aspect	Mitigation Measures[29]	Time frame[30]	Implementation	Monitoring and Supervision	Reference
	operation of the equipment involved in the flood mitigation works. In order to avoid any such implications the proponent has been implementing state of the art infrastructure in the capital city with operation and maintenance as part of the contractor of that facilities.				
Safety	Considering the open canal configuration, there is potential risk of safety. Following measures are proposed to avoid any such safety breach - 2.5 m long permanent type-IV barricade with 2.15 m high from road level conforming to IRC-SP 55-2014 including provision of LED strip lighting to MS barricades as safety measuring during night hours Workers safety measures such as use of PPE(Personal Protection Equipment) is necessary in case of operations involving in machinery.	During Operation stage	ADC	ADC/APCRDA	EMP

8.2 Organizational Framework

The proposed project will be implemented by ADC through its Project Implementation Unit (PIU). The PIU comprises of officers from Engineering Division, Procurement Division, Finance Division, Administrative Division, Social and Environmental Division of ADCL. The proposed Project Implementation Unit of ADCL is placed at Annexure XXVII of this report. In addition, Environmental management cell of APCRDA consisting Director (Environment), Director (Strategy), Chief Engineer, Superintendent Engineer, and Environment Engineer would be on board throughout implementation and monitoring of the project.

8.2.1 Implementation of EMP

The implementation and monitoring of EMP would be through Environmental Management Cell under the Project Implementation Unit of ADCL. The roles and responsibilities of the officers are hereunder

Officer	Responsibility
Project Director (PIU)	• Overview of the project implementation • Ensure timely budget for the EMP. • Coordination with different state level committee, to obtain regulatory clearances. • Participate in state level meetings • Monthly review of the progress.
Deputy Project Director (PIU)	• Overall responsible for EMP implementation • Reporting to various stakeholders (World Bank, Regulatory bodies) on status of EMP implementation • Coordination with PIU Staff (EMC). • Responsible for obtaining regulatory Clearances • Review of the progress made by contractors • Ensure that BOQ items mentioned in EMP are executed as per Contract provisions.
Environmental Officer (PIU)	• Assisting Project Director in overall implementation of EMP • Review of periodic reports on EMP implementation and advising Project Director in taking corrective measure. • Conducting periodic field inspection of EMP implementation • Assisting Project Director to reporting various stakeholders (World Bank, Regulatory bodies) on status of EMP implementation • Preparing environmental training program and conducting the same for field officers and engineers of contractor.
Social Officer(PIU)	• Assisting Project Director in overall implementation of EMP/RAP • Review of periodic reports on EMP/RAP implementation and advising Project Director in taking corrective measure. • Conducting periodic field inspection of EMP/RAP implementation • Assisting Project Director to reporting various stakeholders (World Bank, Regulatory bodies) on status of RAP implementation in coordination with APCRDA • Preparing training program and conducting the same for field officers and engineers of contractor.
Engineer (PMC/Authority Engineer)	• Act as an "Engineer" for supervising EMP implementation • Responsible for maintaining quality of EMP envisioned in detail Project Report

Officer	Responsibility
	• Maintaining progress reports on EMP implementation • Periodic reporting to PIU-ADC about the status of EMP implementation • Work in close coordination with Executive Engineer (package unit) and contractor.
Executive Engineer (PIU)	• Conducting need-based site inspection and preparing compliance reports and forwarding the same to the Environmental Management Cell (EMC) • Programming necessary training program on environmental issues.
Deputy Executive Engineer (PIU)	• Working as site-representative of Executive Engineer • Conducting regular site inspection to all onsite and offsite works • Maintaining records of all necessary statutory compliance, to be obtained from contractor. • Maintaining records of EMP implementation including photographic records • Attending environmental and social training programs • Preparing periodic reports on EMP implementation and forwarding to EE
Manager - Environmental and Social Development	• As detailed below

For ensuring that EMP is implemented as per provision in the document, Contractor shall nominate a qualified and experienced as Manager - Environmental and Social development from the commencement to completion of the project.

The responsibilities of Manager - Environmental and Social development of Contractor will include but not limited to the following:

- Directly reporting to the Project Manager of the Contractor;
- Discussing various environmental/social issues and environmental/social mitigation, enhancement and monitoring actions;
- Prepare Contractor's Checklist, traffic management plan and safety plan as part of their Work Program;
- Ensure Contractor's compliance with the ESMF stipulations, code of conduct and conditions of statutory bodies;
- Assisting the project manager to ensure social and environmentally sound and safe construction practices;
- Conducting periodic environmental and safety training of engineers, supervisors and workers along with sensitization on social issues that may be arising during the construction stage of the project;
- Preparing a registers for material sources, labor, pollution monitoring results (if required by APPCB), public complaint/grievance redressal and as may be directed by the Engineer;

- Assisting the ADC on various environmental/social monitoring and control activities including pollution monitoring;
- Preparing and submitting monthly/bi-monthly reports or as specified in the contract documents to ADC on status of implementation safeguard measures.
- Will be responsible for getting and maintaining the approvals or clearance for various departments and Environmental officer.
- Will be responsible for all environmental and social safeguards of the project

8.3 Awareness and Training

ADC would take actions to augment the capacity of project management unit (PMU). A capacity building and training programme would be prepared which includes training of staff of Environmental and Social cell of PMU, contractor's staff (labours & engineers), PMC staff on environmental management, regulatory compliance and safety aspects. 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: Proponent will set up an Environmental Monitoring Cell (EMC) to review the effectiveness of environment management system during construction and operational phase. 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. Environmental training programs are presented in Table below

Table 8-4: Environmental Protection Training Table

S. No.	Training Program	Objective and Outline of Content	Participant profile	No of participants	Responsibility for Organizing	Frequency
1	Site Induction training	Site inductions for Collection, transport ,treatment and disposal of solid & hazardous waste	Staff and Contractors	25	Contractor	Once every six months to provide training, every time a new workers or new contractor should also provide training for admission
2	Environmental Awareness	Site environmental controls and an outline of the potential consequences of not meeting the environmental responsibilities	Staff and Contractors	20	Contractor	
3	DMP & Emergency Incidents	Understanding the requirements of Disaster Management Plan for emergency incidents	Staff and Contractors	20	Contractor	
4	Waste Minimization & Energy Conservation	Techniques for waste minimization,	Staff and Contractors	10	Contractor	

S. No.	Training Program	Objective and Outline of Content	Participant profile	No of participants	Responsibility for Organizing	Frequency
		water & energy conservation				
5	Environmental Health and Safety	Applicable environmental, health and safety regulations and compliance requirements for the same	Staff and Contractors	20	Contractor	
6	Social Issues	Gender issues, Non-discrimination, public consultation, labor influx	Staff and Contractor	20	Contractor/ADC	Once in Every Three Months

8.3.1 Workforce of Contractors

Through Training and Awareness robust measures shall be put in place to address the risk of gender-based violence. This can include:

(i) training and awareness raising among the workforce

(ii) informing workers about national laws that make sexual harassment and gender-based violence a punishable offence;

(iii) introducing a Worker Code of Conduct as part of the employment contract, and including sanctions for non-compliance; and

(iv) Contractors adopting a policy to cooperate with law enforcement agencies in investigating complaints about gender-based violence. Workforce of contractors training program is presented in Table below.

Table 8-5: Workforce of contractors training

Training Program	Objective and Outline of Content	Participant profile	No of participants	Responsibility for Organizing	Frequency
Labor safety & Environment Sanitation	Leaning on Labor safety and environmental sanitation	Contractor's workers and technical staff	All workers and staff on site	Contractor	Once every six months to provide training, every time a new workers or new contractor should also provide training for admission

8.4 Monitoring and Reporting procedures

The project's monitoring program included surface and groundwater quality impacts,

disturbance to important ecological habitats including riverside ecosystems, unscheduled environmental compliance inspections during construction, final inspection upon completion to ensure site condition is satisfactory, and assessment of sites prior to and after construction to ensure no loss of natural values.

Stipulated Air Quality Standards	
Total Particulates within 30 m of construction zone	- < 500 mcg/cum
PM_{10} (24 hrs. avg) in ambient air	- < 100 mcg/cum
$PM_{2.5}$ (24 hrs. avg) in ambient air	– < 60 mcg/cum
Noise Level Standards	
Work zone (8hrs. avg)	- < 85 dB(A)
Day time (Residential area)	- < 55 dB(A)
Night time (Residential area)	- < 45 dB(A)
Effluent Discharge Standards	
TSS	- < 100 mg/l
BOD_3 (27^0C)	- < 30 mg/l
TKN	- < 100 mg/l
Oil & grease	- < 10 mg/l

8.4.1 Reporting Requirements

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.

Contractor would be required to submit monthly and six monthly reports containing the status of environment, health & safety at site to PMC (Project management consultant) & PIU (Project Implementation Unit) of ADC. PMC will be responsible for construction supervision and ensuring effective implementation of EMP by the contractor. PMC should report to PMU monthly about the performance and effectiveness of the EMP implemented by contractor on site and coordinate with field units and PMU for necessary corrective actions as may be required.

Environmental Monitoring Indicators and Reporting System for the proposed development are summarized in Table 8-6 and 8-7.

Metrics for regular reporting for Contractors:

a. environmental incidents, including contamination, pollution or damage to ground or water supplies;

b. health and safety incidents, accidents, injuries and all fatalities that require treatment;

c. Incidents requiring immediate notification: The Contractor shall provide immediate notification to the Site Engineer of incidents in the following categories. Full details of

such incidents shall be provided to the Engineer within the timeframe agreed with the Engineer.

- Confirmed or likely violation of any law or international agreement;
- Any fatality or serious (lost time) injury;
- Significant adverse effects or damage to private property (e.g. vehicle accident, damage from fly rock, working beyond the boundary)
- Major pollution of drinking water aquifer or damage; or
- Any allegation of sexual harassment or sexual misbehavior, child abuse, defilement, or other
- Violations involving children.

d. interactions with regulators: agency, dates, subjects, outcomes

e. status of all permits and agreements:

   i. work permits: number required, number received, actions taken for those not received;

   ii. status of permits and consents: list areas/facilities with permits required (quarries, asphalt & batch plants), dates of application, dates issued (actions to follow up if not issued), dates submitted to site engineer (or equivalent), status of area (waiting for permits, working, abandoned without reclamation, decommissioning plan being implemented, etc.);

f. health and safety supervision:

   i. safety officer: number days worked, number of full inspections & partial inspections, reports to construction/project management;

   ii. number of workers, work hours, metric of PPE use (percentage of workers with full personal protection equipment (PPE), partial, etc.), worker violations observed (by type of violation, PPE or otherwise), warnings given, repeat warnings given, follow-up actions taken (if any);

g. worker accommodations:

   i. number of migrant labor housed in accommodations, number of locals;

   ii. date of last inspection, and highlights of inspection including status of accommodations' compliance with national and local law and good practice, including sanitation, space, etc.;

   iii. actions taken to recommend/require improved conditions, or to improve conditions.

h. HIV/AIDS: provider of health services, information and/or training, location of clinic, number of non-safety disease or illness treatments and diagnoses (no names to be provided);

i. gender (for migrant labor and locals separately): number of female workers, percentage of workforce, gender issues raised and dealt with (cross-reference grievances or other sections as needed);

j. training:

i. number of new workers, number receiving induction training, dates of induction training;

ii. number and dates of toolbox talks, number of workers receiving Occupational Health and Safety (OHS), environmental and social training;

iii. number and dates of HIV/AIDS sensitization and/or training, no. workers receiving training (in the reporting period and in the past); same questions for gender sensitization, flag person training.

iv. number and date of GBV /SEA sensitization and/or training, number of workers receiving training on code of conduct (in the reporting period and in the past), etc.

i. environmental and social supervision: days worked, areas inspected and numbers of inspections of each (road section, work camp, accommodations, quarries, borrow areas, spoil areas, clinic, HIV/AIDS center, community centers, days worked (hours community center open), number of people met, highlights of activities (issues raised), etc, highlights of activities/findings (including violations of environmental and/or social best practices, actions taken), reports to environmental and/or social specialist/construction/site management;

k. Grievances: list new grievances (e.g. allegations of GBV / SEA) received in the reporting period and unresolved past grievances by date received, complainant, how received, to whom referred to for action, resolution and date (if completed), data resolution reported to complainant, any required follow-up(Cross-reference other sections as needed):

i. Worker grievances;

ii. Community grievances

l. Traffic and vehicles/equipment:

i. traffic accidents involving project vehicles & equipment: provide date, location, damage, cause, follow-up;

ii. accidents involving non-project vehicles or property (also reported under immediate metrics): provide date, location, damage, cause, follow-up;

iii. overall condition of vehicles/equipment (subjective judgment by environmentalist); non-routine repairs and maintenance needed to improve safety and/or environmental performance (to control smoke, etc.).

m. Environmental mitigations and issues (what has been done):

i. dust: number of working bowsers, number of waterings/day, number of complaints, actions taken to resolve; highlights of quarry dust control (covers, sprays, operational status); % of rock/spoil lorries with covers, actions taken for uncovered vehicles;

ii. erosion control: controls implemented by location, status of water crossings, actions taken to resolve issues, emergency repairs needed to control erosion/sedimentation;

iii. quarries, borrow areas, spoil areas, asphalt plants, batch plants: identify major activities undertaken in the reporting period at each, and highlights of environmental and social protection: land clearing, boundary marking, topsoil salvage, traffic management, decommissioning planning, decommissioning implementation;

iv. blasting: number of blasts (and locations), status of implementation of blasting plan (including notices, evacuations, etc.), incidents of off-site damage or complaints (cross-reference other sections as needed);

v. spill cleanups, if any: material spilled, location, amount, actions taken, material disposal (report all spills that result in water or soil contamination;

vi. waste management: types and quantities generated and managed, including amount taken offsite (and by whom) or reused/recycled/disposed on-site;

vii. details of tree plantings and other mitigations required undertaken in the reporting period;

viii. details of water and swamp protection mitigations required undertaken in the reporting period

n. compliance:

i. compliance status for conditions of all relevant consents/permits, for the Work, including quarries, etc.): statement of compliance or listing of issues and actions taken (or to be taken) to reach compliance;

ii. compliance status of Contractors EMP requirements: statement of compliance or listing of issues and actions taken (or to be taken) to reach compliance

iii. compliance status of GBV/SEA prevention and response action plan: statement of compliance or listing of issues and actions taken (or to be taken) to reach compliance

iv. compliance status of Health and Safety Management Plan: statement of compliance or listing of issues and actions taken (or to be taken) to reach compliance

v. compliance with Air, Water, Noise and Soil quality/sediment standards as stipulated by CPCB based on Environmental Quality Monitoring protocols(Table 8-5 & Table 8-6)

vi. other unresolved issues from previous reporting periods related to environmental and social: continued violations, continued failure of equipment, continued lack of vehicle covers, spills not dealt with, continued compensation or blasting issues, etc. Cross-reference other sections as needed.

Metrics for regular reporting for PMC:

a. environmental incidents or non-compliances with contract requirements, including contamination, pollution or damage to ground or water supplies;

b. health and safety incidents, accidents, injuries and all fatalities that require treatment;

c. Incidents requiring immediate notification: The Contractor shall provide immediate notification to the Site Engineer of incidents in the following categories. Full details of such incidents shall be provided to the Engineer within the timeframe agreed with the Engineer.

- Confirmed or likely violation of any law or international agreement;
- Any fatality or serious (lost time) injury;
- Significant adverse effects or damage to private property (e.g. vehicle accident, damage from fly rock, working beyond the boundary)
- Major pollution of drinking water aquifer or damage; or

- Any allegation of sexual harassment or sexual misbehavior, child abuse, defilement, or other
- Violations involving children.

d. interactions with regulators: agency, dates, subjects, outcomes

e. status of all permits and agreements:

vii. work permits: number required, number received, actions taken for those not received;

viii. status of permits and consents: list areas/facilities with permits required (quarries, asphalt & batch plants), dates of application, dates issued (actions to follow up if not issued), dates submitted to site engineer (or equivalent), status of area (waiting for permits, working, abandoned without reclamation, decommissioning plan being implemented, etc.);

f. health and safety supervision:

i. safety officer: number days worked, number of full inspections & partial inspections, reports to construction/project management;

ii. number of workers, work hours, metric of PPE use (percentage of workers with full personal protection equipment (PPE), partial, etc.), worker violations observed (by type of violation, PPE or otherwise), warnings given, repeat warnings given, follow-up actions taken (if any);

g. worker accommodations:

i. number of migrant labor housed in accommodations, number of locals;

ii. date of last inspection, and highlights of inspection including status of accommodations' compliance with national and local law and good practice, including sanitation, space, etc.;

iii. actions taken to recommend/require improved conditions, or to improve conditions.

h. HIV/AIDS: provider of health services, information and/or training, location of clinic, number of non-safety disease or illness treatments and diagnoses (no names to be provided);

i. gender (for migrant labor and locals separately): number of female workers, percentage of workforce, gender issues raised and dealt with (cross-reference grievances or other sections as needed);

j. training:

i. number of new workers, number receiving induction training, dates of induction training;

ii. number and dates of toolbox talks, number of workers receiving Occupational Health and Safety (OHS), environmental and social training;

iii. number and dates of HIV/AIDS sensitization and/or training, no. workers receiving training (in the reporting period and in the past); same questions for gender sensitization, flag person training.

iv. number and date of GBV /SEA sensitization and/or training, number of workers receiving training on code of conduct (in the reporting period and in the past), etc.

v. environmental and social supervision: days worked, areas inspected and numbers of inspections of each (road section, work camp, accommodations, quarries, borrow areas, spoil areas, clinic, HIV/AIDS center, community centers, days worked (hours community center open), number of people met, highlights of activities (issues raised), etc, highlights of activities/findings (including violations of environmental and/or social best practices, actions taken), reports to environmental and/or social specialist/construction/site management;

k. Grievances: list new grievances (e.g. allegations of GBV / SEA) received in the reporting period and unresolved past grievances by date received, complainant, how received, to whom referred to for action, resolution and date (if completed), data resolution reported to complainant, any required follow-up(Cross-reference other sections as needed):

   i. Worker grievances;

   ii. Community grievances

l. Traffic and vehicles/equipment:

   i. traffic accidents involving project vehicles & equipment: provide date, location, damage, cause, follow-up;

   ii. accidents involving non-project vehicles or property (also reported under immediate metrics): provide date, location, damage, cause, follow-up;

   iii. overall condition of vehicles/equipment (subjective judgment by environmentalist); non-routine repairs and maintenance needed to improve safety and/or environmental performance (to control smoke, etc.).

m. Environmental mitigations and issues (what has been done):

   i. dust: number of working bowsers, number of waterings/day, number of complaints, actions taken to resolve; highlights of quarry dust control (covers, sprays, operational status); % of rock/spoil lorries with covers, actions taken for uncovered vehicles;

   ii. erosion control: controls implemented by location, status of water crossings, actions taken to resolve issues, emergency repairs needed to control erosion/sedimentation;

   iii. quarries, borrow areas, spoil areas, asphalt plants, batch plants: identify major activities undertaken in the reporting period at each, and highlights of environmental and social protection: land clearing, boundary marking, topsoil salvage, traffic management, decommissioning planning, decommissioning implementation;

   iv. blasting: number of blasts (and locations), status of implementation of blasting plan (including notices, evacuations, etc.), incidents of off-site damage or complaints (cross-reference other sections as needed);

   v. spill cleanups, if any: material spilled, location, amount, actions taken, material disposal (report all spills that result in water or soil contamination;

   vi. waste management: types and quantities generated and managed, including amount taken offsite (and by whom) or reused/recycled/disposed on-site;

   vii. details of tree plantings and other mitigations required undertaken in the reporting period;

   viii. details of water and swamp protection mitigations required undertaken in the reporting period

n. compliance:

   i. compliance status for conditions of all relevant consents/permits, for the Work, including quarries, etc.): statement of compliance or listing of issues and actions taken (or to be taken) to reach compliance;

   ii. compliance status of Contractors EMP requirements: statement of compliance or listing of issues and actions taken (or to be taken) to reach compliance

   iii. compliance status of GBV/SEA prevention and response action plan: statement of compliance or listing of issues and actions taken (or to be taken) to reach compliance

   iv. compliance status of Health and Safety Management Plan: statement of compliance or listing of issues and actions taken (or to be taken) to reach compliance

   v. compliance with Air, Water, Noise and Soil quality/sediment standards as stipulated by CPCB based on Environmental Quality Monitoring protocols(Table 8-5 & Table 8-6)

   vi. other unresolved issues from previous reporting periods related to environmental and social: continued violations, continued failure of equipment, continued lack of vehicle covers, spills not dealt with, continued compensation or blasting issues, etc. Cross-reference other sections as needed.

Table 8-6: Environmental Monitoring Indicators & Reporting Frequency

Sr. No.	Indicator	Details	Frequency	Responsibility
1.	Regularity Permissions	Ensure necessary regulatory permissions	Before commencement of work	Engineer
2.	Insurance of workers	Ensure insurance of workers	Monthly	Contractor
3.	Gender Issues	Monitoring and documentation of deployment of women	Monthly	Contractor
4.	Grievances	Monitoring of grievances or complaints received during construction work	Weekly	PIU
5.	Air Quality	24 hourly Ambient Air Quality monitoring for $PM_{2.5}$, PM_{10}, SO_2 and NO_2 and CO	Once in each quarter (per year)	Contractor by engaging NABL accredited Environmental Lab
6.	Noise Levels	Noise levels(dB) for Day and Night	Once in each quarter (per year)	Contractor by engaging NABL accredited Environmental Lab
8.	Sediment Quality	Testing of dredged sediment for presence of heavy metals, toxins and other contaminants	Once prior to excavation	Contractor by engaging NABL accredited Environmental Lab
7.	Wastes and Debris	Monitoring of collection and disposal of debris at pre-identified site from construction sites	Daily	Contractor
8.	Traffic Safety	Monitoring traffic safety at worksites	Daily	Contractor
9.	Cleaning and Restoration	Camp and construction sites	On completion of work	Environment & Safety Officer of the Contractor

Table 8-7: Reporting System

Sr. No.	Item	Stage	Contractor	PMC/PIU
			Implementation& Reporting to PMC/PIU	Supervise/Field Compliance Monitoring
1.	Identification of disposal locations for debris	Construction	One Time	One Time
2.	Monthly EMP Implementation Report	Construction	Monthly	Monthly
3.	Environmental Quality Monitoring	Construction	Quarter	Quarter
4.	Cleaning and Restoration	After Completion of Construction	One Time	One Time
5.	Accident reporting	Construction	Monthly	Monthly

APCRDA/ADCL would report to the World Bank as per the project and World Bank reporting requirements

The contractor will take all reasonable steps to protect the environment on and off the construction site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of his operation.

8.5 Contract Clauses

- The Contractor shall be responsible for implementation of environmental provisions outlined in the EMP, in addition to adhering to all environmental provisions in the applicable specifications for the works as part of good engineering practice.
- All works undertaken towards protection of environmental resources as part of the EMP and as part of good engineering practices while adhering to relevant specifications shall be deemed to be incidental to works being carried out and no separate payment will be made unless otherwise specified explicitly. The costs towards environmental management as per EMP unless otherwise provided as a separate head, will be deemed to be part of the BOQ of the project. The scope of works of the Contractor towards the Implementation of the environmental provisions shall be as follows;
- Abide by all existing environmental regulations and requirements of the GoI/GoAP, during implementation.
- Compliance with all mitigation measures and monitoring requirements set out in the EMP
- Schedule of a method statement detailing how the subproject EMP will be complied with. This shall include methods and schedule of monitoring.
- Monitoring of project environmental performance and periodic submission of monitoring reports shall be done as per the EMP provisions.

- Compliance of all safety rules at work and provision of adequate health and safety measures such as water, food, sanitation, personal protective equipment, workers' insurance and medical facilities.

Code of Conduct of the Contractor

The Contractor will develop a Code of Conduct that will apply to Contractor's Personnel to ensure compliance with its Environmental, Social, Health and Safety (ESHS) obligations. The code of Conduct shall include the risks to be addressed by the Code in accordance with EMP including risks associated with: labor influx, spread of communicable diseases, sexual harassment, gender based violence, sexual exploitation and abuse, illicit behaviour and crime, and maintaining a safe environment etc.

In addition, the Contractor shall detail how this Code of Conduct will be implemented. This will include: how it will be introduced into conditions of employment/engagement, what training will be provided, how it will be monitored and how the Contractor proposes to deal with any breaches.

The Contractor shall be required to implement the agreed Code of Conduct

The Code of conduct will include the following

- *Environmental Management Plan*
- *consent/permit conditions* (Consent for establishment, consent for operation, explosive licence, Licence for quarrying, disposal of spoil or any other material and etc. as applicable)
- *required standards including World Bank Group EHS Guidelines*
- *relevant international conventions, standards or treaties, etc., national, legal and/or regulatory requirements and standards (where these represent higher standards than the WBG EHS Guidelines)*
- *relevant standards e.g. Workers' Accommodation: Process and Standards (IFC and EBRD)*
- *relevant sector standards e.g. workers' accommodation*
- *grievance redress mechanisms.*

A satisfactory code of conduct shall contain obligations on all Contractor's Personnel (including sub-contractors and day workers) that are suitable to address the following issues, as a minimum. Additional obligations may be added to respond to particular concerns of the region, the location and the project sector or to specific project requirements.

The Code of Conduct shall ensure

1. Compliance with applicable laws, rules, and regulations
2. Compliance with applicable health and safety requirements to protect the local community (including vulnerable and disadvantaged groups), the ADC's Personnel, and the Contractor's Personnel (including wearing prescribed personal protective equipment, preventing avoidable accidents and a duty to report conditions or practices that pose a safety hazard or threaten the environment)
3. No use of illegal substances

4. Non-Discrimination in dealing with the local community (including vulnerable and disadvantaged groups), the ADC's Personnel, and the Contractor's Personnel (for example on the basis of family status, ethnicity, race, gender, religion, language, marital status, age, disability (physical and mental), sexual orientation, gender identity, political conviction or social, civic, or health status)
5. Interactions with the local community(ies), members of the local community (ies), and any affected person(s) shall convey an attitude of respect, including to their culture and traditions
6. Prevention of Sexual harassment (for example to prohibit use of language or behavior, in particular towards women and/or children, that is inappropriate, harassing, abusive, sexually provocative, demeaning or culturally inappropriate)
7. Prevention of Violence, including sexual and/or gender based violence (for example acts that inflict physical, mental or sexual harm or suffering, threats of such acts, coercion, and deprivation of liberty
8. Prevention of Exploitation including sexual exploitation and abuse (for example the prohibition of the exchange of money, employment, goods, or services for sex, including sexual favors or other forms of humiliating, degrading behavior, exploitative behavior or abuse of power)
9. Protection of children(persons less than 18 years of age) (including prohibitions against sexual activity or abuse, or otherwise unacceptable behavior towards children, limiting interactions with children, and ensuring their safety in project areas)
10. Sanitation requirements (for example, to ensure workers use specified sanitary facilities provided by their employer and not open areas)
11. Avoidance of conflicts of interest (such that benefits, contracts, or employment, or any sort of preferential treatment or favors, are not provided to any person with whom there is a financial, family, or personal connection)
12. Respecting reasonable work instructions (including regarding environmental and social norms)
13. Protection and proper use of property (for example, to prohibit theft, carelessness or waste)
14. Duty to report violations of this Code
15. Non retaliation against workers who report violations of the Code, if that report is made in good faith.

The Code of Conduct should be written in plain language and signed by each worker to indicate that they have:

- received a copy of the code;
- had the code explained to them;
- acknowledged that adherence to this Code of Conduct is a condition of employment; and
- understood that violations of the Code can result in serious consequences, up to and including dismissal, or referral to legal authorities.

A copy of the code will be displayed in a location easily accessible to the community and project affected people. It shall be provided in languages comprehensible to the local community, Contractor's Personnel, ADC's Personnel, and affected persons.

Movement/ Circulation Plan during Construction

For all construction activities, the Contractor shall prior to initiation of construction activities, prepare and get approved by the Engineer, a construction plan including the staging, sequencing of construction activities, circulation plans to ensure smooth movement of public, including provision of alternative routes, etc.

Debris Disposal

The contractor will prior to start of construction and dismantling operations identify potential sites for disposal of hazardous construction debris, sites for general construction wastes and domestic wastes from construction camps. The contractor will obtain approval on identified sites from the Local Authority and disposal will be only after consent letter from the ADC.

Precautions for Protection of Environmental Resources

- The Contractor shall ensure that construction activities do not result in any contamination of land or water by polluting substances.
- Unless otherwise provided in the specifications, the Contractor shall ensure that no trees or shrubs or waterside vegetation are felled or harmed except those required to be cleared for execution of the works. The Contractor shall protect trees and vegetation from damage to the satisfaction of the Engineer.
- The Contractor shall consult with local residents and local government before locating project offices, sheds, and construction plant.
- The Contractor will maintain ecological balance by preventing felling of trees, water pollution and defacing of natural landscape. In respect of ecological balance, the Contractor will observe the following instructions.
- In the conduct of cleaning activities and operation of equipment, the Contractor will utilize such practicable methods and devices as are reasonably available to control, prevent and otherwise minimize air/noise pollution.
- The Contractor shall monitor the environmental parameters periodically as specified in the monitoring plan and report to the Engineer.

Occupational Health and Safety during Construction

The Contractor shall prepare Occupational Health and Safety Plan and other as per the World Bank regulations.

The Contractor shall, in accordance with the safety and health provisions specified in the EMP, provide workers with a safe and healthy working environment, in the work areas, through application of preventive and protective measures consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines. The borrower/ client will take steps to prevent accidents, injury, and disease arising from, associated with, or occurring during the course of work by

- Providing preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances;
- Providing appropriate equipment to minimize risks and requiring and enforcing its use;
- Training workers and providing them with appropriate incentives to use and comply with health and safety procedures and protective equipment;
- Documenting and reporting occupational accidents, diseases, and incidents; and
- Having emergency prevention, preparedness, and response arrangements in place.

8.6 Flood Mitigation Plan

Large number of urban locations are located on hazard prone land areas and a big majority of people are affected because of flooding. Irrespective of whether urban floods are part of larger riverine floods or result from inadequate drainage capacities, the damage potential of floods in cities is extraordinarily high. The main impacts of flooding on the population include, material damage and loss of life; the interruption of economic activity in the flooded areas; infection by water-borne diseases; and water pollution when toxic-waste dumps are flooded.

Given the high spatial concentration of people and values in cities, even small-scale floods may lead to considerable damage. In extreme cases urban floods can result in disasters that set back urban development by years or even decades. Recent statistics clearly indicate that economic damages caused by urban floods are rising.

In the context of Disaster Management (DM), awareness generation should have two objectives. First, it will prepare communities to deal with disasters in a manner that people's lives and properties are protected, and to ultimately become resilient.

Public awareness generation will serve to empower people with knowledge about the role and responsibilities of the state, leading to crystallisation of political and administrative will. This will manifest itself in better and timely strategies for disaster risk reduction.

As discussed in National Guidelines on Management of Floods, the most basic thing is that the community is to be aware of vulnerability which can vary from low to very high, but keeping the mobility of the people in the urban areas. They have to sensitise in all situations. Very often people are not aware of how individual actions can contribute to betterment or deterioration of vulnerability.

The urban flooding DM approach aims at institutionalising the implementation of initiatives and activities, covering all components of the DM cycle, including prevention, preparedness, mitigation, relief, rehabilitation and recovery, with a view to developing communities that are well-informed, resilient and prepared to face emergencies with minimal loss of life and property. Therefore, it will be the endeavour of the Central and State governments and the ULBs to ensure implementation of these Guidelines.

The initial activities of the DM response group comprising of State and Centre authorities, AP State Disaster Response Force, AP State Disaster Management Authority (APSDMA) and District Authorities. The Community Based Organizations (CBOs), with help of ULBs authorities and

Media can play major role in distare situation. The list of actions for in event of flood disaster is given in following Table.

Table 8-8: Action Plan for Flood Mitigation

Sr. No.	DM Stages	Activities/ Action
1.	Early Warning	Setting up Control Room/ Emergency Operation Centre round the clock
		Arrangement of vehicle and sound system for information dissemination
		Proper record keeping and transmission of information to all the level
		Ensure functioning of warning system & communication systems
		Create awareness with the target groups
2.	Evacuation	To warn people about the impending danger & to leave for safer places. Mobilize people to go to identified/ safer shelter
		Organize trained task force members
		To co-ordinate with civil defense-NGOs/ Secy. Rajya Sainik Board/ Police for support.
		Arrangement of boats/ vehicles etc. for evacuation. Deployment of Boats for evacuation
		Evacuate people of marooned areas and administer emergent relief
		Deployment of police for maintaining law & order & peace keeping during evacuation
3.	Search and Rescue	Deployment of Police/Fire Brigade for search and rescue
		Co-ordination with the NCC/ NSS/ Civil Defense/ Rajya Sainik Board etc. for rescue operation
		Ensure availability of the rescue materials
		Prepare inventory of shelter places and map indicating the shelter centers
		Provide & arrange Rescue kit at risk areas
4.	Medical aid	Deployment of Medical staff
		Stock piling of Life saving drugs/ORS packets/ Halogen tablets.
		Protocol on medical aid
		Treatment of the injured persons and Transportation of the injured to hospitals.
		Awareness message to stop the outbreak of epidemics
		Disease surveillance and transmission of reports to the higher authorities on a daily basis
		Vaccination
		Constitute mobile teams and visit the worst affected areas
		Disinfections of Drinking water sources.
		Identification of site operation camps.

Sr. No.	DM Stages	Activities/ Action
		To obtain/transmit information on natural calamities to District Control Room.
		Advance inoculation programme in the flood/Cyclone prone areas.
		Arrangement of fodder/medicines for the animals Vaccination, site operation camps, Carcasses disposal
5.	Shelter Management	Identification of Shelter/Temporary shelter at appropriate places and arrangement of tents etc.
		Arrangement of Food/Drinking water/Medicine in the shelter places.
		Arrangement of transportation
		Arrangement for safe shelter for animals
		Providing the lighting facilities for shelter places
		Deployment of Police Personnel
		Temporary supply of safe drinking water
6.	Emergent Relief/ Free Kitchen Operation	Deployment of vehicle
		Procurement and transportation of Relief materials to affected pockets/areas
		Provision of kitchen in the shelter camps & affected areas
		Assigning of free kitchen in the shelter camps & affected areas
		Assigning responsibilities to officials for distribution of emergent relief/running of free kitchen
		Coordinating with the NGOs/Other voluntary organization & PSUs / UNDP/ REDCROSS etc. for continuing Relief Operation
		Monitoring
7.	Water Supply and Sanitation	Ensuring supply of safe drinking water arrangement for supply of safe drinking water
		Disinfectant for purification of water
		Arrangement of mobile team and assigning specific operational area for supply of water
		Involvement of volunteers/village level workers inaccessible pockets health awareness campaign
8.	Infrastructure Restoration	Formation of task force with specific equipment's
		Assigning responsibilities for specific areas
		Emergency cleaning of debris to enable reconnaissance.
		Coordinate road-cleaning activities to assist relief work
		Begin clearing roads, assemble casual labor provide a work team carrying emergency tool kits
		Towing vehicles, Earth moving equipment's, cranes, construct temporary roads
		Keep National & other Highways clear from disaster effects.
		Damage assessment & Monitoring

8.7 Budgetary Provisions for Implementation of EMP

The EMP shall be integrated part of the bid/construction contract in the form of technical specifications and environmental performance requirements. The costs to be incurred on implementation of EMP items tabulated in Table 8-8 will be paid to the contractor as per items given in Bill of quantity. The contractor will ensure effective implementation of EMP during pre-construction, construction and demobilization phases.

8.8 Project & EMP Implementation Schedule for Flood Mitigations Works

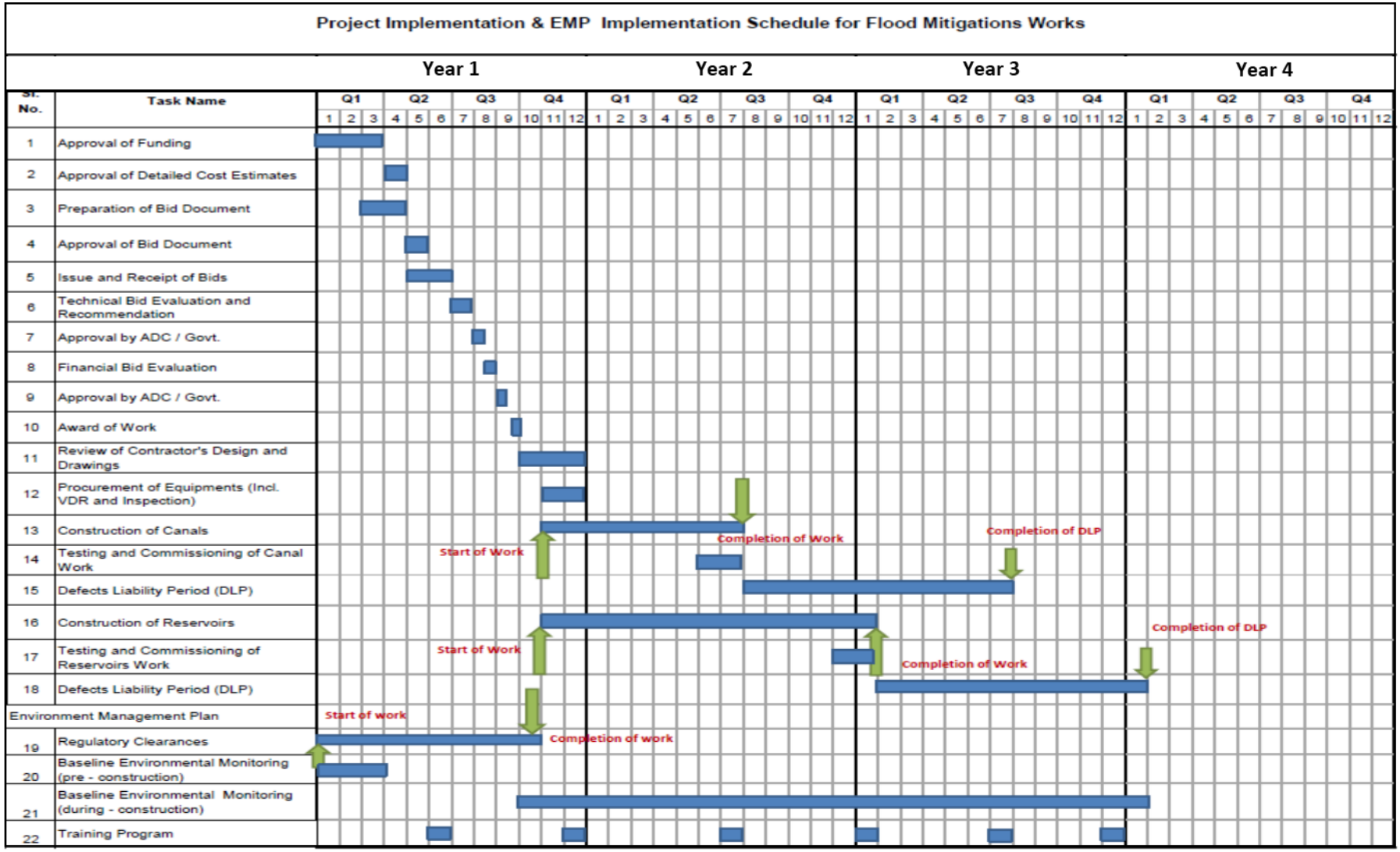


Table 8-9: Cost Estimate for EMP Implementation

Sr. No.	EMP Item Particulars	Basis of Estimation	Quantity and Cost per unit	Total Amount (in lacs, INR) (Approx.)
1.	Providing and Installing 2.5m long permanent type-IV barricade with 2.15m high from road level conforming to IRC-SP 55-2014 including Provision of LED Strip lighting to MS barricades as a safety measure during night hours	Considering 6 operational areas at any given point of time & 100m length per operational area, Total length of Barricading required - Total length of barricading required - (100 mts. x 6 sites/work fronts)	600 meters	46.0
		Cost per running meter	Rs.7600	
		Total Cost of barricades	600xRs. 7600	
2.	Installation of caution/sign/diversion boards on both upstream and downstream sides of operational area as per requirement of specific stretch (including cost of boards and other materials required for fixing, shifting	No. of boards required per operational area/ segment (considering 5 nos. on each side of the work front)	10	2.86
		Total boards required for 6 operational areas at any given point of time	60	

Sr. No.	EMP Item Particulars	Basis of Estimation	Quantity and Cost per unit	Total Amount (in lacs, INR) (Approx.)
	charges from one place to another with all incidental charges leads & lifts)	Cost of each board as per IRC Specifications	3 different type of signs are there, Cautionary/ Mandatory sign- Triangular (90cm side of equilateral) No. of Boards-25: (Rs.4562.55) Mandatory/regulatory sign – Octagonal (90cm side) No. of Boards-:10 (Rs.7180.57) Mandatory/ regulatory sign -Circualr (60cm dia) No. of Boards-: 25 (Rs.4017.8)	
		Total cost of boards	(25xRs.4562.55)+(10xRs.7180.57)+(25xRs.4017.8)	
3.	Provision of 2 seater mobile toilet (1 seat for man and 1 seat for woman) with separate entrances), fitted with 2000 litres overhead water storage tank and sludge tank of capacity 1000L, and stationed at a suitable place within 100 metres from operational area, with lighting and ventilation arrangement, including all material, labor, consumables,	Total no. of operational areas at any point in time	6	3.0
		Considering 1 mobile toilet/operational area, total mobile toilets required	6	
		Cost of one mobile toilet two seater (1 man & 1 women with separate entry) with labor	Rs 50000	
		Total cost of mobile toilets	Rs. 50000x6	

Sr. No.	EMP Item Particulars	Basis of Estimation	Quantity and Cost per unit	Total Amount (in lacs, INR) (Approx.)
	tools & plant, including disposal of waste, etc.			
4.	Provision of mobile drinking water counter /kiosk, fabricated from stainless steel with 300 liter capacity, with at least two taps, with bottom tank to collect waste water and stationed at a suitable place	Nos of Drinking water counter/kiosk required / operational area	1	1.5
		Total number of water counter/kiosks -	6	
		Total Cost for Drinking water counter/kiosk	6x25000	
5.	Solid Waste Management: Providing and installing HDPE bin (wheel base) as per specification including loading, unloading and conveyance upto work site, including all taxes, duties etc.*	Total Cost	LS	10
6.	Deploying an on-site crew group, comprising of mason, plumber, electrician and fabricator (with	Total cost of deploying skilled workers (mason, plumber, electrician and fabricator) with		6.85

Sr. No.	EMP Item Particulars	Basis of Estimation	Quantity and Cost per unit	Total Amount (in lacs, INR) (Approx.)
	assistant/s) at the work zones for the construction period including cost of providing one multi utility pick-up van and provision for keeping tools and equipment including driver and fuel, for all leads and lifts, including all materials, consumables, tools, etc. (Mobile pick up van also shall have one operational mobile number with dedicated vehicle)	vehicle and repair equipment/tools per month	Rs. 57100	
		Total Cost	12 months x Rs. 57100	
7.	Desilting by any means including removal of silt, sludge, sediments, soil, garbage, floating debris, boulders stones, etc., including	Total estimated quantity of garbage/ sludge collection and disposal	LS	10
		Cost of collection and disposal per cum		
	carriage of desilted material to disposal sites within and upto lead at approved/ designated sites including sprinkling of	Total collection and disposal of garbage and sludge from seven drains		

Sr. No.	EMP Item Particulars	Basis of Estimation	Quantity and Cost per unit	Total Amount (in lacs, INR) (Approx.)
	approved disinfectants, loading, unloading and transport			
8.	Positioning of agile flagman with an orange vest and a helmet and a red flag 600 x 600 mm securely fastened to a staff 1 m in length for guiding/managing the traffic	No. of Flagmen	LS	12
		Cost of hiring services of one flagman		
		Total Cost		
9.	Personnel Protective Equipment	Personnel Protective Equipment's such as Full Body Protective Suit, hard hat or helmet, protective footwear, goggles, hand gloves, masks while handling raw sewage/waste water/solid waste from drains	200	15.0
		Cost of Full Body Protective Suit, gloves, mask etc. while handling Raw Sewage/ Waste	Rs.7500	

Sr. No.	EMP Item Particulars	Basis of Estimation	Quantity and Cost per unit	Total Amount (in lacs, INR) (Approx.)
		Water/Solid Waste for one worker		
		Total Cost	200xRs. 7500	
10.	Provision for Orientation/Training for Contractors	Lump sum Cost	INR 50,000 x 14 rounds	7.0
11.	Environmental monitoring of operational areas and work campsites under the project through a NABL/MOEFCC accredited laboratory a)The parameters to be monitored under AAQ are :PM_{10} , $PM_{2.5}$, ,SO_2, , NO_2, CO as per CPCB guidelines	No. of locations	16 Locations	10.64
		Frequency & duration of monitoring	Once in month (per year)	
		Total no. of samples	12x16 = 152	
		Cost of Ambient Air Quality Monitoring and Noise Measurements @ Rs. 7000 per sample	7000 x 152	
12.	Water Sampling and Analysis for TSS, BOD,COD, pH, Turbidity, Oil	Numbers of Locations (Ground – 7, Surface – 5)	18	

Sr. No.	EMP Item Particulars	Basis of Estimation	Quantity and Cost per unit	Total Amount (in lacs, INR) (Approx.)
	& Grease and Coliforms with Frequency & duration of monitoring as once in quarter and as per CPCB guidelines, etc. complete as per direction of Engineer	Frequency & duration of monitoring	Once in month (per year)	
		Total no. of samples	18 x12=216	
		Cost of Sampling and Analysis of waste water @ Rs.4000/sample	4000 x 216	8.64
13.	Soil Sampling and Analysis for PH, EC, Porosity, Sodium as Na, Potassium as K, SAR, Permeability, Moisture Content, Copper as Cu, Iron as Fe as per CPCB guidelines, etc. complete as per direction of Engineer	Numbers of Locations	12	5.76
		Frequency & duration of monitoring	Once in each quarter (per year)	
		Total no. of samples	12 x12=144	
		Cost of Sampling and Analysis of waste water @ Rs.4000/sample	4000 x 144	
14	The ambient noise levels measured and analyzed for equivalent noise levels viz. Leq (24hrly), Lday, and Lnight at all the noise monitoring locations.	Numbers of Locations	16	1.92
		Frequency & duration of monitoring	Once in each quarter (per year)	
		Total no. of samples	16 x12=192	

Sr. No.	EMP Item Particulars	Basis of Estimation	Quantity and Cost per unit	Total Amount (in lacs, INR) (Approx.)
		Cost of Sampling and Analysis of waste water @ Rs.1000/sample	1000 x 192	
15	Cost of Labor Camp which includes living unit for labors, common kitchen, common bio-toilets etc. (each block can accommodate 32 persons) – **(Drawing is presented in Annexure – XII & XXIX)**		Cost per block (8 room, 1 kitchen & 3 bio-toilets) is Rs. 11 lacs. For two (2) blocks 22 lacs	22
	Total Cost of EMP Implementation And Monitoring			**163.24**

Penalty for Non-Compliance:

(a) The contractor shall follow all environmental mitigation measures as defined in the Environmental Management Plan. A damage shall be levied at the rate of Rs 10000/- per day for per location for non-conformity of Environmental Management Plan measures.

(b) The contractor shall ensure that sufficient numbers and good quality personnel protective equipment (PPE) are provided to the staff and labour defined in the labour codes and/or regulatory requirements referred in the Environmental Management Plan (EMP). In addition, the contractor shall enforce safety discipline amongst works to use PPE. A damage shall be levied at the rate of Rs 2000/- per day per staff/labour for non-conformity in part or full.

(c) The Contractor shall prepare traffic diversion plans, obtain necessary diversion permissions, and provide adequate safety measures including barricading of all the construction sites, provision of access to private properties, etc. as defined in the Environmental Management Plan. A damage shall be levied at the rate of Rs 25000/- per day per location, in the event of non-conformity in part or full to such measures.

CHAPTER 9: CONCLUSIONS AND RECOMMENDATIONS

9.1 Summary of Impacts

The process described in this document has assessed the environmental impacts of all elements of the infrastructure proposed under the flood mitigation project. Potential negative impacts were identified in relation to both construction and operation of the improved infrastructure. The impacts are summarised as follows:

- Soil resources: The project requires excavation and re-filling in certain areas, which may have impact on Top soil. There could also be impact due to soil spillage from fuelling area for vehicles and equipment.
- Impact on water resources: Some minor impact is envisaged during construction phase of the project due to soil erosion, spillage of oil and lubricants and other construction work. The activities may lead to contamination of surface and ground water.
- Impact on air quality: Movement of vehicles and equipment during construction phase may have negative impact on air quality of the area.
- Impacts on Ecology and Biodiversity: Due loss of trees coming on the project alignment may impact the ecology of the area. Changes in land use may also have impact on ecology and biodiversity.
- Community Health and Safety: Due to air pollution and noise, the community health and safety may get impacted.

9.2 Summary of mitigation works

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

All the clearances required for Environmental aspects during construction shall be ensured and made available prior to start of construction activity. The excavations shall conform to the lines, grades, side slopes and levels shown in the drawings or as directed by the engineer. Topsoil will be removed prior to commencement of bulk earthwork and preserved for reuse in landscape within the project area. Tree plantation shall be carried out as per the CPCB norms, Tree Authority directives and AP WALTA Act 2002, Andhra Pradesh. Environmental and safety cell of the project shall also actively involved in imparting training and raising environmental awareness level of the construction staff.

9.3 Integration of EMP in the Project

All works undertaken towards protection of environmental resources as part of the EMP while adhering to relevant specifications shall be deemed to be incidental for the works being carried out and no separate payment will be made unless otherwise specified explicitly. The costs towards environmental management as per EMP unless otherwise provided as a separate head, will be deemed to be part of the BOQ of the project. The scope of works of the Contractor towards the Implementation of the environmental provisions shall be as follows:

- Abide by all existing environmental regulations and requirements of the GoI, during implementation.

- Compliance with all mitigation measures and monitoring requirements set out in the EMP
- Schedule of a method statement detailing how the subproject EMP will be complied with. This shall include methods and schedule of monitoring.
- Monitoring of project environmental performance and periodic submission of monitoring reports shall be done at least once during the construction phase.
- Compliance of all safety rules at work and provision of adequate health and safety measures such as water, food, sanitation, personal protective equipment, workers' insurance and medical facilities.

9.4 Potential for residual Impacts

On the basis of the assessment of potential impacts and the recommended mitigation measures in this EIA, overall, the Proposed Development is not likely to impose many significant adverse effects on the environment. As summarized in EMP Section, the majority of impacts on the environmental are either negligible in nature (and therefore significance) or of minor adverse significance.

The EIA has, however, identified some potentially moderate/ major adversely significant effects, largely surrounding the landscape and visual impacts of the proposed development during operation. Impacts on landscape character and potentially sensitive receptor points in the surrounding area are considered to be potentially major adverse.

9.5 Strategy for future review and revision of the EMP

The Amravati Sustainable Capital City Development Project (ASCCDP), supported by the World Bank, involves green-field development of selected urban infrastructure (roads, flood mitigation) and is categorized as Category A. Considering the fact that some of the sub-projects under the ASCCDP are to be designed during the course of its implementation, an Environmental and Social Management Framework (ESMF) was developed.

As specified in the ESMF, the flood mitigation sub-project requires an EIA to be undertaken and an EMP to be developed and implemented. The EIA and EMP will go through an independent technical review by a third party agency who are engaged by ADC as per the World Bank/Government of A.P requirements.

9.6 Chance find procedures

Archaeological sites are protected by The Ancient Monument and Archeological Sites and Remains Rules 1958 and The Ancient Monument and Archeological Sites and Remains Rules 1959. They are non-renewable, very susceptible to disturbance and are finite in number. Archaeological sites are an important resource that is protected for their historical, cultural, scientific and educational value to the general public and local communities. Impacts to archaeological sites must be avoided or managed by development proponents.

The objectives of the 'Archaeological Chance Find Procedure' are to promote preservation of archaeological data while minimizing disruption of construction scheduling.

9.6.1 Potential Impacts to Archaeological Sites

Developments that involve excavation, movement, or disturbance of soils have the potential to impact archaeological materials, if present. Activities such as road construction, land clearing, and excavation are all examples of activities that may adversely affect archaeological deposits.

9.6.2 Archaeological Chance Find Procedure

Following procedures to be adopted in case of finding any archaeological materials:

- All construction activity in the vicinity of the remains is to cease immediately.
- The find location will be recorded, and all remains will be left in place.
- The project archaeologist and Archaeology Branch will be contacted.
- Potential significance of the remains will be assessed and mitigative options will be identified.
- If the significance of the remains is judged sufficient to warrant further action and they cannot be avoided, then the project archaeologist in consultation with the Archaeology Branch and representatives of local archaeological department will determine the appropriate course of action.
- In the case of human remains, if the remains are assessed to be archaeological, then the Archaeology Branch will be consulted to determine how to handle them. Options could include avoidance or respectful removal and reburial.

***** End of the Report ******