National Industrial Corridor Development Corporation (NICDC)

Stage-14

Preliminary Design Report Including Detailed Economic Analysis

October 2024

Preparation of Detailed Master Plan and Preliminary Design Report for Roads & Services/ Utilities for Kopparthy Industrial Area at Kadapa in Andhra Pradesh under VCIC Project

SUBMITTED By VOYANTS in Consortium with JLL :

Quality Control

PRELIMINARY DESIGN REPORT

Preparation of Detailed Master Plan and Preliminary Design Report for Roads & Services/ Utilities for Kopparthy Industrial Area at Kadapa in Andhra Pradesh under VCIC Project

Submitted to

National Industrial Corridor Development Corporation (NICDC)

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Abbreviations	Full Form
%	Percentage
AADT	Average Annual Daily Traffic
ADB	Asian Development Bank
AKIC	Amritsar Kolkata Industrial Corridor
APIIC	Andhra Pradesh Industrial Infrastructure Corporation
APMDC	Andhra Pradesh Mineral Development Corporation
APPCB	Andhra Pradesh Pollution Control Board
APSDPS	Andhra Pradesh State Development Planning Society
APSEZ	Andhra Pradesh Special Economic Zone
APSPDCL	Andhra Pradesh Southern Power Distribution Company Limited
BC	Backward Caste
bgl	Below Ground Level
BIM Model	Building information modelling
BIS	Bureau of Indian Standards
BIS	Bureau of Indian Standards
BMIC	Bengaluru Mumbai Industrial Corridor
BOQ	Bill of Quantity
BSNL	Bharat Sanchar Nigam Limited
C.C.I	Competition Commission of India
CBIC	Chennai Bengaluru Industrial Corridor
CBR	California Bearing Ratio
CL	Road Centreline
CPCB	Central Pollution Control Board
CW	Covered Well
CW	Carriageway
DEM	Digital Elevation Model
DFCCIL	Dedicated Freight Corridor Corporation of India Limited
DGCA	Directorate General of Civil Aviation
DIC	District Industrial Centre

DMADV	Design Measure Analyse Design Verify
DMAIC	Design Measure Analyse Improve Control
DMIC	Delhi Mumbai Industrial Corridor
DNIC	Delhi Nagpur Industrial Corridor
DPIIT	Department for Promotion of Industry and Internal Trade
DPR	Detailed Project Report
DSM	Digital Surface Model
DTCP	Directorate of Town and Country Planning
ECB	External Commercial Borrowings
ECEC	East Coast Economic Corridor
ECIC	East Coast Industrial Corridor
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EoDB	Ease of Doing Business
EPC	Engineering Procurement Construction
etc.	Et cetera
EXIM	Export Import
FCL	Full- Container-Load
FERA	Foreign Exchange Regulation Act
FY	Financial Year
FY15	Financial Year 15
g.	Grams
GAD	General Agreement Drawing
GCP	Ground Control Points
GDDP	Gross District Domestic Product
GDP	Gross Domestic Product
GFC	Good for Construction
GIS	Geographical Information System
GIS	Geographic Information System
GoAP	Government of Andhra Pradesh
GOI	Government of India
GPS	Global Positioning System
GSD	Ground Sampling distance

GSDP	Gross State Domestic Product
GSHAP	Global Seismic Hazard Assessment Program
GSR	Ground Storage Reservoir
GST	Goods and Service tax
Ha	Hectare
Ha	Hectare
HACCP	Hazard Analysis Critical Control Points
HBIC	Hyderabad Bengaluru Industrial Corridor
HNIC	Hyderabad Nagpur Industrial Corridor
HP	Hand Pump
HT Line	High Tension Line
HWIC	Hyderabad Warangal Industrial Corridor
ICT	Information and Communications Technology
INCAP	Infrastructure Corporation of AP
INR	Indian Rupee
IRC	Indian Road Congress
IRR	Internal Rate of Return
ISO	International Organization for Standardization
JICA	Japan International Cooperation Agency
kA	Kiloamps
KML	Keyhole Markup Language
kms, km	Kilometre
KV	Kilo Volt
kw	Kilo Watt
lps	Litre Per Second
m	Metre
MAA	Chennai International Airport
MDR	Major District Road
MoEF&CC	Ministry of Environment, Forest and Climate Change
MoRTH	Ministry of Road Transport and Highways
MRO	Mandal Revenue Officer
MRTP	Monopolistic and Restrictive Trade Practice

MSMEs	Medium and Small-scale Enterprise
MS-SQL	Microsoft SQL
Mt	Metre
MTPA	Million Tons Per Annum
MTs	Million Tones
MVA	Million Volt Amperes
MW	Mega watt
NH	National Highway
NHAI	National Highway Authority of India
NICDC	National Industrial Corridor Development Corporation Limited
NIMZ	National Investment and Manufacturing Zone
No	Number
NPV	Net Present Value
NREDCAP	Non-conventional Energy Development Corporation of Andhra Pradesh Limited
OEC	Odisha Economic Corridor
OH	Overhead
OHT	Over Head Tank
PBM	Permanent Benchmarks
PCPIR	Petroleum, Chemicals and Petrochemicals Investment Region
PDF	Portable Document Format
PPP	Public -Private Partnership
PSU	Public Sector Undertaking
QoL	Quality of Life
R&B	Road & Bridges
RDO	Revenue Divisional Office
RFP	Request for Proposal
RFQ	Request for Qualification
Row	Right of Way
RTK	Real-Time Kinematic
RWSS	Rural Water Supply and Sanitation Department
SBC	Safe Bearing capacity
SC	Scheduled Caste

SCADA	Supervisory control and data acquisition
SGST	State Goods and Services Tax
SH	State Highway
SIA	Social Impact Assessment
SOI	Survey of India
SOR	Schedule of Rates
SPV	Special Purpose Vehicle
Sq.km	Square Kilometre
ST	Scheduled Tribe
SCOT	Strength, Challenges, Opportunities & Threat
TADF	Technology Acquisition and Development Fund
TBP HLC	Tungabhadra Project High Level Canal
TEFR	Techno Economic Feasibility Report
TMC	One Thousand Million
TOR	Terms of Reference
TW	Tube Well/ Borehole
UG	Underground
USD	United States Dollar
UW	Un-covered Well
VAT	Value-Added Tax
VCIC	Vizag Chennai Industrial Corridor
VGF	Viability Gap Funding

1 Introduction

1.1 Project Brief

With a view to achieve sustainable economic transformation in Andhra Pradesh, a strong growth impetus on the manufacturing sector has been laid by National Industrial Corridor Development Corporation Ltd. (Henceforth referred to as 'NICDC'). As part of this strategic roadmap, NICDC is undertaking activities related to preparation of Master Planning and Preliminary Engineering for Kopparthy Industrial area at Kadapa in Andhra Pradesh. To fulfil this objective, NICDC has engaged Voyants Solutions Pvt. Ltd. in a JV with JLL India Ltd. (hereinafter referred to as the 'Consultant') for undertaking the Preparation of Detailed Master Plan and Preliminary Design Report for Roads & Services/ Utilities for Kopparthy Industrial Area at Kadapa in Andhra Pradesh under VCIC Project.

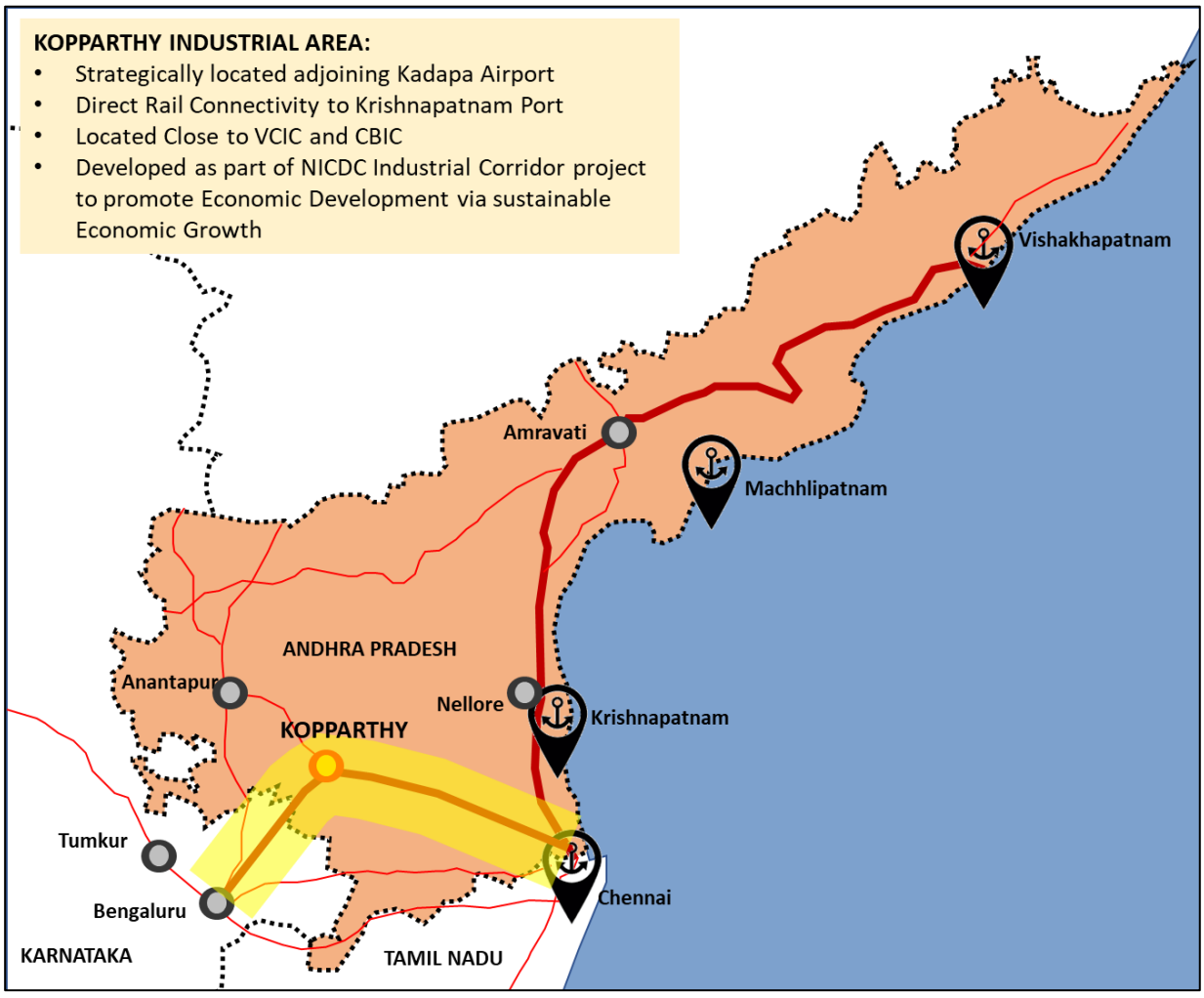


FIGURE 1-1 : INDUSTRIAL CORRIDORS: VCIC AND CBIC

Source: Voyants

NICDC envisions to create a strong economic base with a globally competitive environment and state-of-art infrastructure to activate local commerce, enhance foreign investments and attain sustainable development.' Based on this vision, 11 corridors identified by the government are being developed and 30 projects have been planned in 4 Phases up to 2024-25.

In Andhra Pradesh, the manufacturing sector contributes to 12% of the state's GDP as against the national average of 15%. Hence, tapping locational advantages along the industrial corridor and addressing challenges of industrial diversification and small labour-intensive manufacturing sectors shall be key to enhancing the competitive advantage of the state. The state ranks second in India in 'Ease of doing business' and leads in providing handholding support to new business units.

The Make in India initiative was launched in 2014 to support the country's industrialization efforts by encouraging global firms to set up manufacturing bases in India. The campaign identifies the Economic Corridor Development strategy as a policy instrument to increase manufacturing sector contribution to the country's GDP. In this background, the proposed Kopparthy Industrial Area at Kadapa district can help create an industrial growth multiplier and enhance the state's manufacturing share of GDP.

1.2 Task Purpose

The objectives of the assignment are:

- To review the perspective plan/concept master plan and other available reports and apprise themselves of the theme and concept for the proposed Node which takes into account the unique value proposition, the existing physical characteristics of the site and the current and future market demand as envisaged by the perspective plan
- To prepare a demand assessment to establish the industry mix, the range of economic activities, projected population and employment for the identified Economic Node and prepare a detailed financial analysis that together will form the basis for the development program for the detailed master plan.
- To prepare a detailed master plan including geo-referenced cadastral maps for the identified land area which will include urban design guidelines, plotting plan, landscape design strategy for the master plan, signage guidelines.

- To prepare a statutory plan for approval by the state town planning department or the relevant local authority as may be applicable
- To review the provision of roads and highway structures, structures and all utility services for example, drainage, electricity, gas, ICT, water, sewerage etc, including treatment plants, raw water transmission mains, sewage collection, industrial water and recycled water for flushing, as described in the notified/in principle approved maps, report and in other relevant documents. Develop strategies including sustainability (during and after construction) which will allow for phased construction in accordance with the Client's mandate
- To prepare a baseline and best practice assessment based on various benchmarking studies relevant for the project
- To prepare preliminary engineering design and drawings for roads, highway structures and utility services for the designated area within the identified Economic Node site incorporating strategies for sustainability, value addition and value engineering. To achieve the DMIC objective of development of world class economic nodes and clusters, it is essential that the planning and design for trunk level infrastructure should meet the best international practices, specifications and standards in terms of quality and sustainability.
    - The development of the Economic Node has been envisioned, conceptualised and planned to meet these quality standards and aspects of sustainability.
- Based on financial and technical assessment the consultant shall work out the appropriate implementation structure to be worked out in consultation with client.
- To prepare technical schedules of tender and bidding documents for issuing contracts for entire area in packages, if required.
- To assist the Client in the process of selection of contractors, and provide technical assistance to Client during Detailed Design by the contractors ensuring highest quality standards in implementation
- The consultant shall also provide necessary information and prepare documents as per the formats provided by NICDC for budgetary approvals and fund allocation for project implementation.

- Financial/Market Analysis: The consultant should undertake financial analysis for the project, which will also include estimation of financial internal rate of returns IRR etc. for the project.

1.3 Project Backdrop

The Government of India has planned the development of Vizag Chennai Industrial Corridor (VCIC) to achieve accelerated industrial development in the state of Andhra Pradesh through the "Make-In-India" program. This program aims to facilitate investment, foster innovation, enhance skill development, protect intellectual property, and build best-in-class manufacturing infrastructure. Considering that the manufacturing sector has huge potentials of employment generation, it is one of the key economic priorities of the Central and state government.

National Industrial Corridor Development Corporation Limited (NICDC), a special purpose company has appointed Voyants Private Limited and Jones Lang Lasalle Property Consultants (India) Pvt Ltd. for "Preparation of Detailed Master Plan and Preliminary Design Report for Roads & Services/ Utilities for Kopparthy Industrial Area at Kadapa in Andhra Pradesh under VCIC Project".

The Vizag Chennai Industrial Corridor proposes to address the infrastructure bottlenecks through a holistic approach while benefiting from the inherent strengths and competitiveness of each of the VCIC states. Accordingly, high impact/ market driven nodes are proposed to be developed, at strategic locations, within the corridor to provide transparent and investment friendly facility regimes.

1.3.1 Site Context

Kopparthy Node is located in Kadapa District, off to Kadapa Pulivendula Road. The total extent of Kopparthy Node is 2,595.74 acre (inclusive of ROW of 45.09 acre under ownership of Railways).

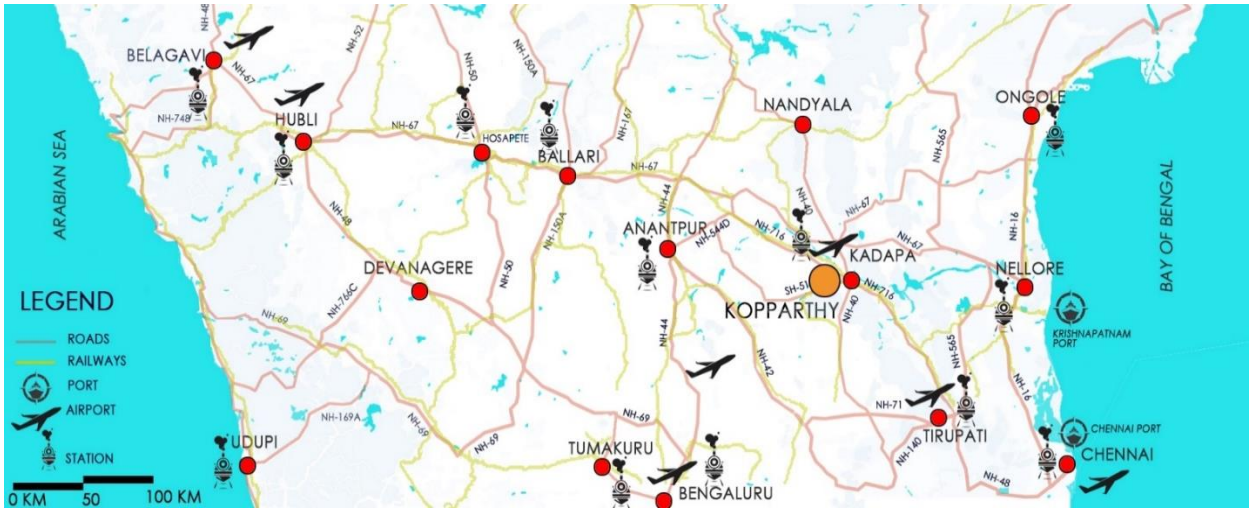


FIGURE 1-2 : REGIONAL CONNECTIVITY MAP

Source: Voyants

1.3.2 Salient Features of the site

i. The Region is well served through roads, rail, ports and airports. It is served by an expansive check railroad line running 195 kms and 830 kms of National Highways.
   a. National Highway 716 passes through the north of the study area and connects Anantapuram to Chennai via Kadapa.
   b. National Highway 40 connects Kurnool to Ranipet via Kadapa.
   c. MDR- 214 connects Kadapa to Ambavaram.
   d. SH 51 connects Pulivendula to Kadapa.
   e. Krishnapuram railway station is the nearest railway station located at a distance of around 2 kms from the study area.
   f. The study area is located adjoining to Kadapa Airport providing excellent locational advantages to Kopparthy Industrial Area.

ii. Literacy rate of the district is 67.3 % in the district. Male Literacy rate – 77.78% is higher than the state rate of 74.77%. Female Literacy rate is 56.77% which show availability of skilled labour

iii. The workforce participation rate in the district is 45.8%.

iv. Assessment of the district profile reveal that the social infrastructure facilities available is suited to sustain the existing district population, however, development of Kopparthy Industrial area shall attract additional working and floating population and hence social infrastructure provisions for the same should be considered in the plan.

v. Provision of power supply for the study area is proposed to be undertaken from a 220 KV power grid substation, Chinnakampalle, Kadapa, 22 kms distance from site to 132/33 KV SS in northern parcel of Kopparthy Industrial Area.

vi. Provision of water supply for Kopparthy Industrial Area is proposed to be pumped from Somasila reservoir as per AP GO 57 (please refer Annexure 1).

1.4 Location Profile

The study area falls under Kopparthy village, Tadigotla village of Chinthakommadinne mandal and T.G. Pally village, Yadavapuram village of Vallur mandal. The district has occupied a significant place in the Industrial map of Andhra Pradesh with its highly valued rich mineral resources. The total area demarcated for Kopparthy industrial development is 2,595.74 acre (inclusive of ROW of 45.09 acre under ownership of Railways) of land.

1.4.1 Road Connectivity

The study area comprises of 2,595.74 acre (inclusive of ROW of 45.09 acre under ownership of Railways). State Highway 51 provides access to the Koparthy Industrial Area on the northern side. The study area is well connected through a network of roads**.** **NH716** passes through the north of the industrial area and connects Anantapuram to Chennai via Kadapa. **NH40** connects Kurnool to Ranipet via Kadapa. NH 716 connects Krishnapatnam port via NH 67.

1.4.2 Rail Connectivity

Krishnapuram railway station is the nearest railway station located at a distance of around 9 kms from the study area. Two other railway stations, Kadapa railway station and Gangayapalle station is located at a distance of 13 km and 20 km from the study area respectively.

The Kadapa railway station connects the site to Hyderabad, Vijayawada, Odisha, Kerala, Tata Nagar and Chennai. The presence of nearby railway station shall facilitate development of Rail siding. Railway line along the Northern block boundary lies adjacent to the study area. The existing railway line passing through the site bisects the study area.

1.4.3 Nearest Airport

The study area is located at a distance of 11 kms from Kadapa Airport. Hence the proposed industrial park shall enjoy excellent locational advantages. Kadapa Airport was constructed on 669.5 acres in 1953. Presently, Kadapa Airport handles 100 passengers per hour. The existing flights connect the airport to Chennai, Belgaum, Hyderabad, Vijayawada.

1.4.4 Port Connectivity

The region has excellent port connectivity with the **Krishnapatnam port** located at a distance of **200 kms,** Chennai Port (270 kms), Kattupalli Port (270 kms). Visakhapatnam port, which is an important port of the region is located at a distance of 750 kms from the study area.

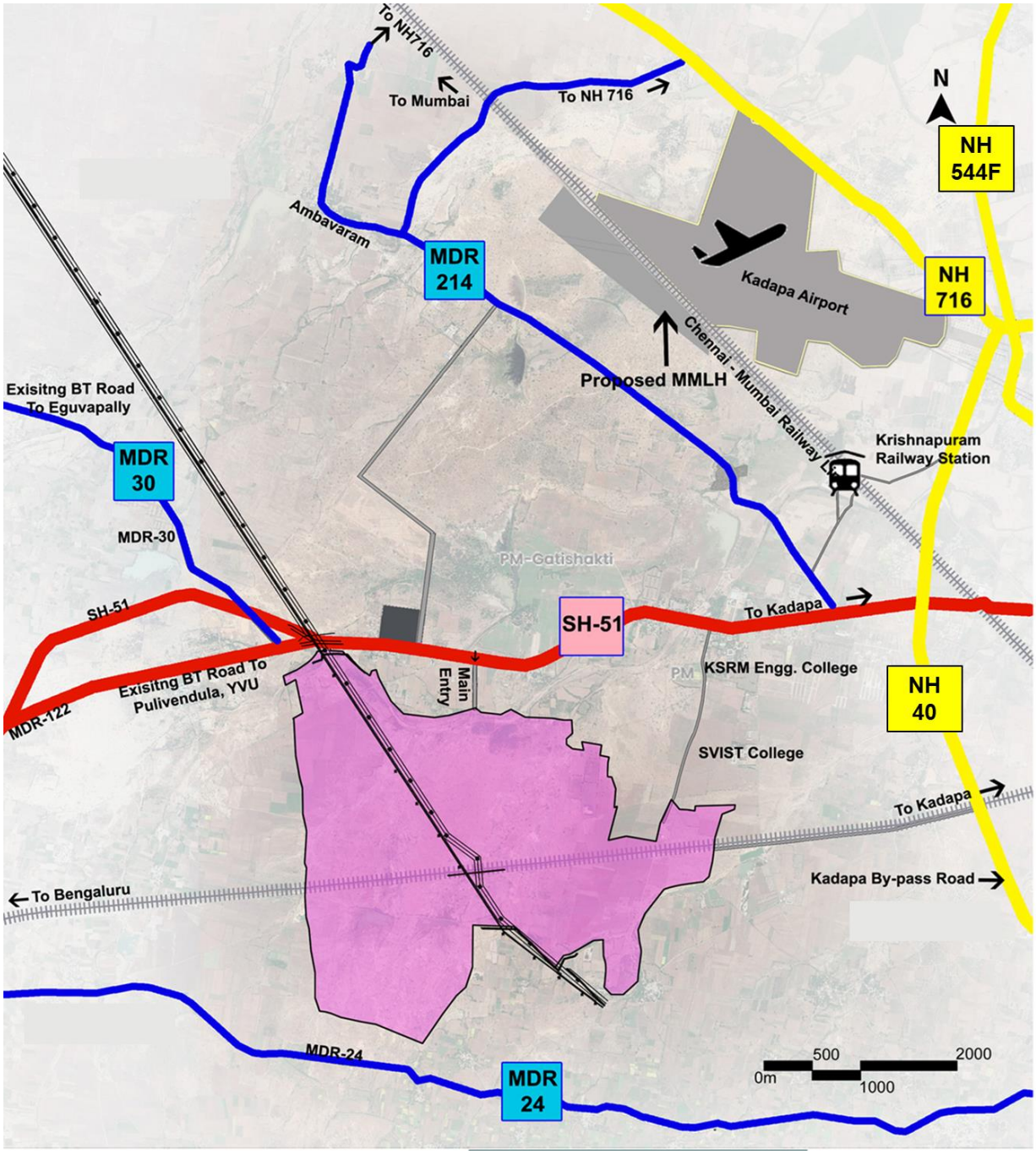


FIGURE 1-3 : KOPPARTHY INDUSTRIAL AREA LOCATION AND CONNECTIVITY

Source: Voyants

Direct rail Connectivity to Krishnapatnam port via Obluvaripalle provides excellent connectivity for freight as well as passenger traffic to and from Kopparthy Industrial Area.

1.5 Proposed Master Plan

This section presents the Final Master Plan approved by NICDC and APIIC post IEC review meeting held on 6th June 2022. A brief summary of the Land use plan has been outlined in this section.

Kopparthy Industrial area has a total area of about 2,595.74 acre (inclusive of ROW of 45.09 acre under ownership of Railways) and about 47% of the total area (1214 acres) is under Industrial use. Apart from this 5% area is under residential, 13% roads and 20% under green and open spaces.

The Non-processing area is inclusive of Logistics Park, Truck parking, General parking and Residential area. The area under buffers, organized greens, waterbodies, railway buffer and roads are provided separately.

The area under buffer greens includes 15m of buffer zone along the boundary. Also, in some parts, 15m of Organized greens along the boundary has been proposed to reduce the pollution load. The final area statement for the proposed development is as below.

LANDUSE SUMMARY		
Category	**Area (in Acres)**	**Percentage**
Industrial	1213.47	47.57%
Residential	136.25	5.34%
Commercial	53.78	2.11%
Utility	28.46	1.12%
Public Semi-public	26.87	1.05%
Parking	129.04	5.06%
Roads	337.24	13.22%
Greens/ Open	510.06	20.00%
Others (buffer etc.)	115.48*	4.53%
Total	**2550.65***	100%

*excluding ROW of 45.09 acre under ownership of Railways

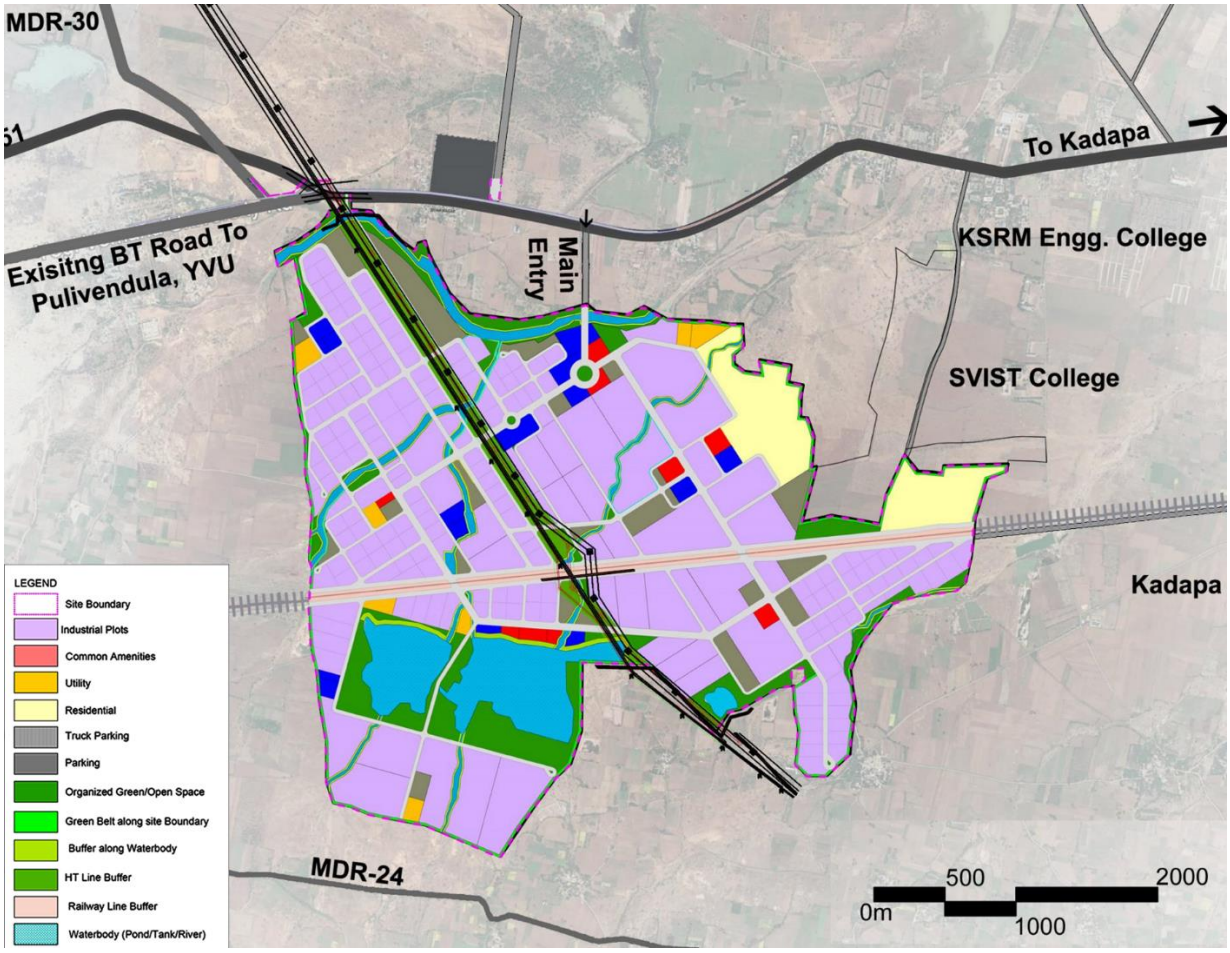


FIGURE 1-4: PROPOSED LAND USE FOR KIA

Source: Voyants

1.6 Key Considerations

Key consideration for physical planning of Kopparthy Industrial Park is:

a. To create a leading industrial precinct for manufacturing industries
b. Industrial hub: to create a hub which is globally competitive with access to excellent local, national and international transport links
c. Smart, efficient and sustainable utilities and infrastructure to support robust commercial, industrial and community activities
d. Employment: Be a contributor to employment and economic development within the state
e. Environment friendly and sustainable land use planning
f. Minimal intervention on the habitations within the Industrial Area
g. No development on Lakes falling within Kopparthy Industrial Area

h. Utilization of the existing the infrastructure such as road and utility lines to the extent possible and augmentation of capacity and system to cater to the future demand.
i. Provision of 20m green buffer along the Industrial Park boundary
j. Provision of Facility Hub in each of the manufacturing clusters comprising commercial areas, amenities, open recreational green spaces.
k. Provision of utilities based on the physical attributes of Kopparthy Industrial area

1.7 Market Assessment

Regression Analysis Method was adopted to determine the share of demand in the proposed Industrial Park at Kopparthy. Considering various scenarios such as Pessimistic Scenario (0% growth), Realistic Scenario (2% growth) witnessing Business as usual scenario, Optimistic Scenario (4% growth) that will be achieved through marketing and branding, promotions, exclusive incentives/ subsidies etc. As per trend of industries in Kadapa in year 2020-21, land requirement for MSME's and Large & Mega Industries were projected separately.

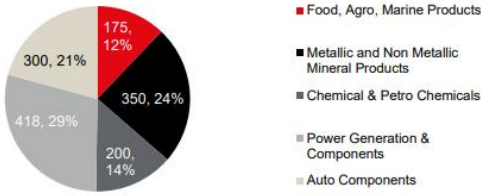
Demand for **MSME, large and mega Industries** for all type of industries is estimated for next 10 years under three scenarios.

Year/Scenarios	Realistic Scenario		Optimistic Scenario		Pessimistic Scenario	
	MSME	Large & Mega	MSME	Large & Mega	MSME	Large & Mega
No. of Industries (Projected)						
2021	84.0	-	142	0	42	0
2022	106.0	-	179	3	55	0
2023	128.0	3.0	214	3	65	0
2024	155.0	4.0	259	4	77	0
2025	189.0	5.0	316	6	93	2
2026	232.0	6.0	389	8	115	2
2027	288.0	7.0	484	10	144	2
2028	361.0	9.0	603	13	180	3
2029	455.0	10.0	762	16	227	4
2030	580.0	16.0	971	23	290	8
2031	747.0	21.0	1248	32	373	10
Total no. of industries	**3,325.0**	**81.0**	**5,567**	**118**	**1,661**	**31**
Land Area Requirement						
Total Land Area Required per industry (acres)*	**0.32**	**17.8**	**0.32**	**22.7**	**0.32**	**19.58**
Total Land Area Required for industries in proposed project (acres)	**1,064**	**1,443**	**1,781**	**2,681**	**532**	**607**
Total Allocation of land for industrial activities	**2,507 ~ 2,500 acres**		**4,462 ~ 4,460 acres**		**1,139 ~ 1,140 acres**	

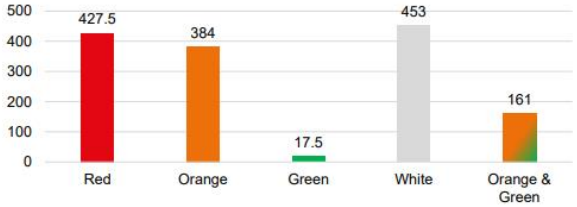
Note: *The land requirement for each type of industry is derived based on APIIC land allotment for MSME, large and mega industries and other private industries. Though there is a demand for ~70 acres for electronics industries as per JLL estimation, no land allocation has been suggested for electrical and electronics sector in subject site understanding there is an existing electronic manufacturing cluster already proposed in ~800 acres in North Mega Industrial Park. Hence, the derived demand can be accommodated in the same cluster

Though the demand for industries are derived on basis of various factors, the hazardous nature of industries as per the categorization stipulated by CPCB,2016 and site suitability, the demand is estimated.

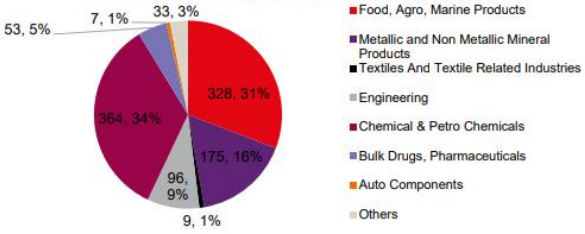
Land Allocation for Large & Mega Industries (in acres)



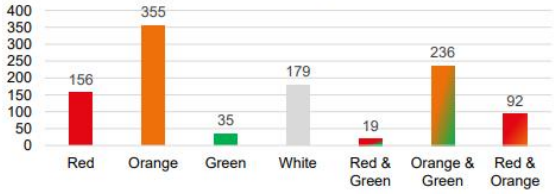
Land allocation for Large & Mega Industries in acres (as per CPCB,2016)



Land Allocation for MSME industries (in acres)



Land allocation for MSME Industries in acres (as per CPCB,2016)



Note: The sub categorization is considered as per the existing demand in the region and site suitability for various type of industries in terms of hazardous nature of industries.
Source: JLL Estimation, 2021

The below table summarizes the direct employment expected at the proposed project. The estimations are part of the Market Demand Assessment report and based on statistical data by Government of Andhra Pradesh.

Year/Scenarios	Realistic Scenario		Optimistic Scenario		Pessimistic Scenario	
	MSME	Large & Mega	MSME	Large & Mega	MSME	Large & Mega
No. of Industries (Projected)						
2021	84.0	-	142	0	42	0
2022	106.0	-	179	3	55	0
2023	128.0	3	214	3	65	0
2024	155.0	4	259	4	77	0
2025	189.0	5	316	6	93	2
2026	232.0	6	389	8	115	2
2027	288.0	7	484	10	144	2
2028	361.0	9	603	13	180	3
2029	455.0	10	762	16	227	4
2030	580.0	16	971	23	290	8
2031	747.0	21	1248	32	373	10
Total no. of industries	3,325.0	81	5,567	118	1,661	31
Employment						
Total Employment per industry (number)*	25	1,141	25	1,141	25	1,141
Total Employment to be generated (numbers)	83,125	92,400	139,175	134,638	41,675	35,371
Total Employment (numbers)	175,525		273,813		77,046	

*Note: *The employment industry data is derived as average employment data for overall industries approved in AP state as per the information available in AP industries portal*
*Source: *https://www.apindustries.gov.in/MoU_Tracker_New/*
Source: JLL Estimation, 2021

2 Road and Transportation Works

To achieve accelerated development of Kopparthy Industrial area, external connectivity to NH 716 and NH 40 has been proposed. The circulation plan for Kopparthy Industrial area has been proposed to connect the Kopparthy Industrial Area via SH 51 for integrated development.

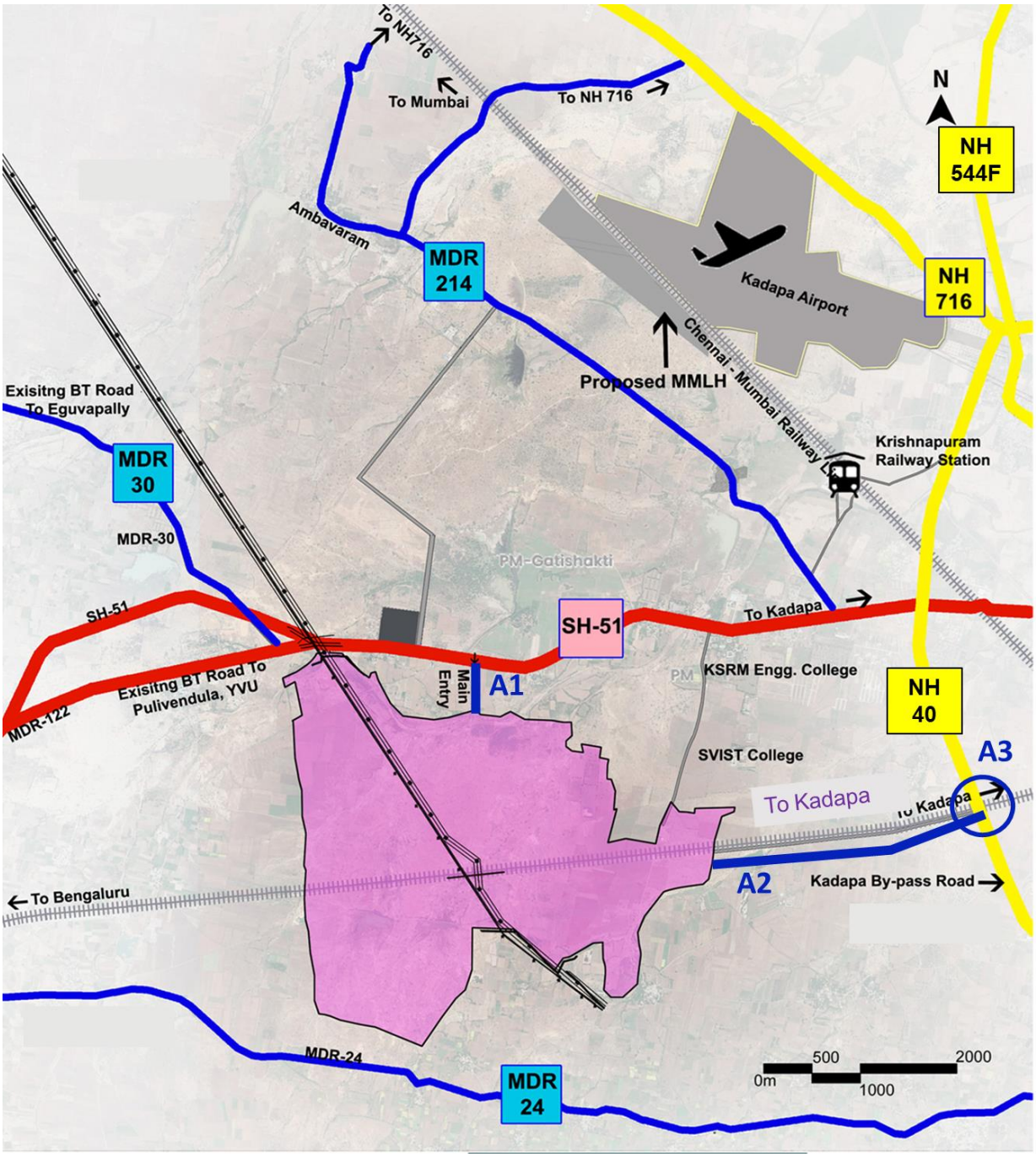


FIGURE 2-1 ROAD CONNECTIVITY

Connectivity	Status	Connectivity Project	Distance from Site (kms)
Road	Existing	4L- NH 544 F (Vijaywada- Ananthpur)	8
	Existing	4L-NH 716 (Kadapa-Chennai)	8
	Existing	4L- NH 40 (Kurnool - Ranipet) *(proposed to 6 lane Surat Chennai E'way)*	5
	Existing	SH 51 (Kadapa to Pulivendula) Existing 4 lane divided carriageway	Adjacent
Rail (SCR)	Existing	Krishnapuram Station	9
	Existing	Kadapa Junction	13
Airport	Existing	Kadapa Airport	11
	Existing	Tirupati International Airport	150
MMLP	Under Const.	Kadapa	9
	Proposed	Ananthapur	157
Ports	Existing	Krishnapatnam Port	200
	Existing	Chennai Port	270
ICD/CFS	Existing	Krishnapatnam	196
	Existing	Surareddy Palem, Ongole	235
	Exisiting	Bengaluru	240

2.1 Proposed System and Design Basis

Site levelling and grading works to be done considering balanced cut & fill up to possible extent to minimise the borrow earth from the outside of site.

Cutting and filling quantities to be finalised after adjustment of earthwork for roads, plot areas excavation. Filling quantities will be calculated on the total earth volume taking into consideration after deducting the earth scrubbing, vegetation and bulkage factor during compacted fill. The infrastructure demand calculations outlined in this chapter is based on

broad demand assessment. The final infrastructure demand shall be outlined in the following deliverable.

2.2 Traffic & Transportation

2.2.1 Introduction

With a view to achieve sustainable economic transformation in Andhra Pradesh, a strong growth impetus on the manufacturing sector has been laid by National Industrial Corridor Development Corporation Ltd. (Henceforth referred to as 'NICDC'). As part of this strategic roadmap, NICDC is undertaking activities related to preparation of Master Planning and Preliminary Engineering for Kopparthy Industrial area at Kadapa in Andhra Pradesh. To fulfil this objective, NICDC has engaged Voyants Solutions Pvt. Ltd. in a JV with JLL India Ltd. (hereinafter referred to as the 'Consultant') for undertaking the Preparation of Detailed Master Plan and Preliminary Design Report for Roads & Services/ Utilities for Kopparthy Industrial Area at Kadapa in Andhra Pradesh under VCIC Project.

The road network is the most important infrastructure development in any industrial area, as movement of all raw material to and finished goods from the plot is dependent on the road network. The alignment and design development of an industrial road network is a measure of and catalyst to an efficient construction and operations of an industrial area. Appropriate combination of various links both technically and economically generate industrial traffic infrastructure, and promote the objectives of accessibility and connectivity. Road network planning includes the fixing of right of way, geometric design of roads, design of typical cross- sections to ensure adequacy of carriageway widths and utility corridors, selection and design of pavement type, design of intersections, interchanges, location & provision of appropriate facilities. Design of road sections has been done according to design standards stipulated in IRC codes and improvements identified at the various stages of the project.

2.2.2 Classification of roads

The road has been classified mainly in four categories such as Arterial, sub-arterial, collector & local. The length wise details are attached in below mentioned Table 2-1.

TABLE 2-1: CLASSIFICATION OF ROAD

Sl. no.	Details	Kopparthy Industrial Area (Length of road in m)	
1	45 m	Arterial	7585
2	30 m	Sub Arterial	16119
3	24 m	Collector	7476
4	18 m	Local	20060
		Total (in m)	**51241**

2.2.3 Traffic Considerations

The transport demand is a function of Land use. The entire area is proposed to be developed in phases according to demand. The development area consists 2,595.74 acre (inclusive of ROW of 45.09 acre under ownership of Railways) land for the Kopparthy Industrial Area.

- Tonnage – On the basis of market analysis has been considered as mentioned in the table below:

TABLE 2-2: TONNAGE DISTRIBUTION

Sl No.	Zone	Tonnage
1	Kopparthy Industrial Area	9305038

- Modal Split & Occupancy – On the basis of similar projects, experience and market analysis has been considered as mentioned in the table below:

TABLE 2-3: MODAL SPLIT & OCCUPANCY

Modal Split of Population														
Land Use	**Walk**		**TW**		**Car**		**Taxi**		**Traveller/ HOV**		**Mini Bus**		**Bus**	
	WP	**FP**	**WP**	**FP**	**WP**	**FP**	**WP**	**FP**	**WP**	**FP**	**WP**	**FP**	**WP**	**FP**
Industries	10%	5%	5%	5%	5%	5%	5%	5%	5%	10%	10%	10%	60%	60%

- ❖ WP–Working Population, FP – Floating Population, HOV – High Occupancy Vehicles.
- ❖ Peak Hour Traffic – 50% passengers traffic. Considering that full traffic consumes in 2 office hours.

  In general, as per normal highways in urban area the peak hour traffic constitutes about 8-10 percent of the total daily traffic (Clause no. 6.1, IRC 106-1990). However, being this is the industrial project. Passenger traffic are expected to ply

maximum during the morning and evening hours, hence peak hour traffic has been considered 50%

- ❖ Load Sharing & General weight of commodity for Commercial Vehicles – As per market study.

- PCU Factor – The various vehicle types having different sizes and characteristics were converted into a single unit called passenger car unit. Passenger Car Unit (PCU) values are adopted from Indian Road Congress publication on "Capacity of Roads in Urban areas ", IRC- 106-1990 for Industrial project. The PCU values used are presented below.

TABLE 2-4: PCU FACTOR

Vehicles Type	TW	Car	Taxi	Mini Bus	Bus	2-Axle Trucks	3-Axle Trucks	Multi Axle Trucks
PCU Value	0.75	1	1	1.4	2.2	2.2	2.2	4

2.2.4 Commercial Traffic

TABLE 2-5: PCU COMPUTATION BASED ON TONNAGE

Zone	Tonnage	Truck Movement			Total Commercial Traffic in PCUs
		2 Axle	3 Axle	MAV	
Kopparthy Industrial Area	9305038	3102	2326	4512	9939

2.2.5 Passenger Traffic

TABLE 2-6: GENERATED PASSENGER VEHICLES PCUS BASED ON POPULATION

Zone	TW	Car	Taxi	Traveller/ HOV	Mini Bus	Bus	Total Passenger Traffic in PCUs
Kopparthy Industrial Area	3108	2072	4144	573	464	2735	13097

2.2.6 Total Traffic

On the basis of above assumptions phase wise and type of roads, traffic load has been calculated. However, summary of road wise traffic density has been mentioned in **Annexure- I**.

2.2.7 Access Gate

All commercial traffic and population traffic have been distributed among the various entries as marked in **Annexure- II.**

2.2.8 Conclusions and Recommendations

- Total Traffic volume for Kopparthy Industrial Area in PCUs per day = 13097
- Peak Hour of Total Traffic Volume for Kopparthy Industrial Area = 6549 PCUs
- Area has high potential of development which will have high pedestrian and vehicle flow once the development takes place.
- The plan proposes to have dedicated pedestrian infrastructure laid along with the vehicular traffic corridors.
- The pedestrian circulation is planned to be safe and secured which gives walkway connectivity to each building.
- The detailed design of Walkways shall be pedestrian friendly, especially for crossing the roads at junctions.
- The detailed design of road network shall segregate vehicles and pedestrian completely.
- Considering the Industry area to be a high activity area, vehicular parking demand will increase with development. Thus, appropriate parking spaces as per demand shall be provided in each phase with properly designed parking as per the standards and pedestrian facility shall be provided in each parking.
- Connectivity of parking areas to other major buildings will be properly design for pedestrian walk for normal and disable persons both.
- Landscaped plazas with designated spaces for hawkers along with parking lots for NMT, other IPT and service vehicles as well private vehicles shall also be provided in the detailed design.

2.3 Brief Design Standard

TABLE 2-7: BRIEF DESIGN STANDARD

Geometric parameters	Internal Roads		
	Generally followed	Exceptions	Remarks
Design speed (kmph)	60 kmph	20 kmph	Exceptional speed is applicable at junctions
	50 kmph		
	40 kmph		
	30 kmph		

Min. horizontal radius (m)	**Design Speed**	**Radius**		**Radius**	
	(kmph)	**(m)**		**(m)**	
	60	150		20m	Exceptional radius is applicable at junctions
	50	105			
	40	70			
	30	40			
	20	20			
Cross-fall / Camber (%)	2.50%			-	-
Super-elevation (%)	4.00%				-
Maximum Longitudinal gradient (%)	4%			-	-
Minimum Longitudinal gradient (%)	0.20%			-	-
Minimum "K" for vertical curve	**Design Speed**	**min k for stopping sight distance**		**-**	-
	(kmph)	**crest curve**	**sag curve**	**-**	**-**
	60	26.7	15	-	-
	50	15	10	-	-
	40	8.4	6.6	-	-
	30	3.8	3.5	-	-
Carriage way width (m)	3.5m (single Lane) 7.0m (2- Lane) 14.0m (4-Lane) 21.0m (6-Lane)			-	-
Extra Widening (m)	1.5m to 0.6m			-	-
Codes and Manual	IRC-86-2018, IRC-SP23, IRC-37:2018, IRC SP-84: 2019, IRC-2, AASHTO, IRC-106:1990				

2.4 Design Basis, Standards and Specifications:

TABLE 2-8: DESIGN CODES

Details	Code name
Geometric Design	IRC: SP: 84-2019 Manual of Specification & Standards for Four Laning of Highways.
	IRC: 86-2018 Geometric design standard for Urban roads and street
	IRC: 73-1973 Geometric design standard for rural highways
	IRC: 38 Guidelines for the design of horizontal curve
	IRC: 23 Vertical curves for highways
Pavement Design	Overlay & strengthening
	IRC 115-2014 for designing and strengthening requirements of existing pavement
	New Pavement
	IRC:58-2015 for design of rigid pavements
	IRC 37-2018 for design of flexible pavements
Traffic analysis	IRC: 64-1990 Guideline for capacity of roads in rural areas
	IRC:106-1990 Guideline for capacity of roads in urban areas
Drainage Design	IRC: 42 2014 Guidelines for road drainage
	IRC: 50-2013
Rotary design	IRC 65-1976
Road Delineator	IRC: 79-2019 Guidelines for road delineator
Interlocking block pavement	IRC: SP: 63-2018 Guidelines for the use of Interlocking block pavement
Cycle track	IRC: 11-2015 Recommended practice for design and layout of cycle track
	IRC: 67-2012 Code of Practice for Road Signs

Details	Code name
Road Furniture & Roadside Facilities	IRC: 35-2015: Code of Practice for Road Markings
	Related standards of IRC Manual of Specification & MoRTH publications

2.5 Finalization of Road levels

- Road levels at various cardinal points are fixed after reviewing the storm water drainage levels at various outlet points and finalised above the same.
- Efforts has been made to optimise cut fill earthwork quantities in accordance with land grading.

2.6 Carriageway Width

The primary purpose of a carriageway is vehicle mobility. As per clause 5.4 of IRC 86-2018 the width of carriageway of different types of roads is attached in below mentioned table:

TABLE 2-9: CARRIAGEWAY WIDTH FOR DIFFERENT ROAD TYPES

Sl no	Description	Width (m)
1	Single lane	3.5
2	2-Lane	7
3	4-Lane with raised kerbs	14
4	6-Lane with raised kerbs	21

Source: IRC 86-2018

Along with the carriageway width, minimum 0.25 m kerb shyness is also proposed on either side of road for Kopparthy Industrial Area. A paved shoulder of 1.5 m width is also proposed with few typical cross sections in North section.

2.7 Horizontal Alignment

The horizontal alignment is designed with design speed adopted in concept design for different category of roads. However, at few locations design speed corresponding to its respective type could not be maintained due to site constraints.

TABLE 2-10: DESIGNED HORIZONTAL ALIGNMENT (MINIMUM RADIUS)

Design Speed (kmph)	Radius (m)
60	150
50	105
40	70
30	40
20	20

Source: clause no 8.3 of IRC 86-2018

2.8 Vertical Alignment

The terrain is partly rolling and partly flat. Vertical alignment is designed with minimum road gradient required at flat surface, for storm water drainage. Min K value is adopted for design vertical curves corresponding to design speed.

TABLE 2-11: DESIGNED VERTICAL ALIGNMENT

Design Speed (kmph)	crest curve	sag curve
	min k for Intermediate sight distance	min k value
60	26.7	15
50	15	10
40	8.4	6.6
30	3.8	3.5

Source: clause no 5.7 of IRC 23

Vertical curves should be provided at all grade changes exceeding those indicated in below mentioned table. As per clause 9.3 of IRC 86-2018 The minimum lengths of vertical curves for satisfactory aberrance and maximum grade change without a vertical curve is also given in below mentioned table.

TABLE 2-12: MINIMUM LENGTH OF VERTICAL CURVES FOR SATISFACTORY ABERRANCE

Sl no	Design speed	Maximum grade change (%) not require da vertical curve	Minimum length of vertical curve (m)
1	20	1.5	15
2	30	1.5	15
3	40	1.2	20
4	50	1	30
5	60	0.8	40
6	70	0.6	50
7	80	0.6	50

Source: clause 9.3 of IRC 86-2018

Minimum longitudinal grades to be considered as 0.2% based on AASHTO provisions to keep cut-fill economical. Efforts have been made to keep the grade line smooth that matches with the character of the terrain.

2.9 Design Speed

Speed is used as a design criterion to influence the geometric design of an urban road. Embracing a proactive design approach on new and existing urban roads and streets with the goal of reducing speeds "may be the single most consequential intervention in reducing pedestrian injury and fatality." Higher design speeds often mandate larger curve radii, wider travel lane widths, on-street parking restrictions, guardrails, and clear zones. Lower design speeds reduce observed speeding behaviour, providing a safer road for people to walk, park and drive. Design speed is critical input for many geometric elements such as horizontal alignment, vertical alignment, and cross section elements.

As per clause 3.2 of IRC-86-2018 the proposed design speed is given in table 2.7.

TABLE 2-13: EXTRA WIDENING DETAILS LENGTHWISE

Sl. no.	Details		Length of Road (in m)
1	18 m	Sub Arterial	20060
2	24 m	Sub Arterial	7476
3	30 m	Sub Arterial	16119
4	45 m	Arterial-Sub Arterial	7585
		Total (in m)	**51241**

Source: clause 3.2 of IRC 86-2018

Exceptional speed (20kmph) is applicable at junctions

2.10 Extra widening

At sharp horizontal curve, it is necessary to widen the carriageway to provide for safe passage of vehicle. The widening required has to components: (i) mechanical widening to compensate for the extra width occupied by a vehicle on the curve due to tracking of the rare wheels(ii) psychological widening to permit easy crossing of vehicles in a lane tend to wander more on a curve than a straight reach. As per clause 8.6 of IRC 86-2018 the extra widening details is attached in below mentioned table:

TABLE 2-14: EXTRA WIDENING DETAILS

		Radius of curve (m)					
Sl no	**Carriageway width**	**upto 20**	**21-40**	**41-60**	**61-100**	**101-300**	**Above 300**
1	Two lane	1.5	1.5	1.2	0.9	0.6	Nil
2	Single lane	0.9	0.6	0.6	Nil	Nil	Nil

Source: 8.6 of IRC 86-2018

2.11 Camber/ Cross Fall

To facilitate efficient disposal of rainwater from the surface, suitable cross fall shall be provided as per IRC 86. The cross-fall details for various surface of roads are listed below in the following table.

TABLE 2-15: CROSS FALL

Surface Category	**Cross Fall (%)**
Bituminous	2.5%
Cement Concrete	2.0%
Granular/ Earthen Shoulder	2.5%/ 3.0%

2.12 Kerb Stones and Kerb Shyness

Kerbs are the boundary stones provided on both sides of the carriageway for providing the support to footpath and helps in draining the water from road surface to roadside storm water drains. As per IRC 86 – 2018, Clause-5, Roads in urban areas are required to develop with kerbs. Kerbs can be provided with or without drainage arrangement along the road. There are three types of kerbs are provided, barrier type, Semi Barrier type and Mountable type. the recommended kerb section for the proposed road alignment is of semi barrier type. The typical section of kerbs arrangement are as follows:

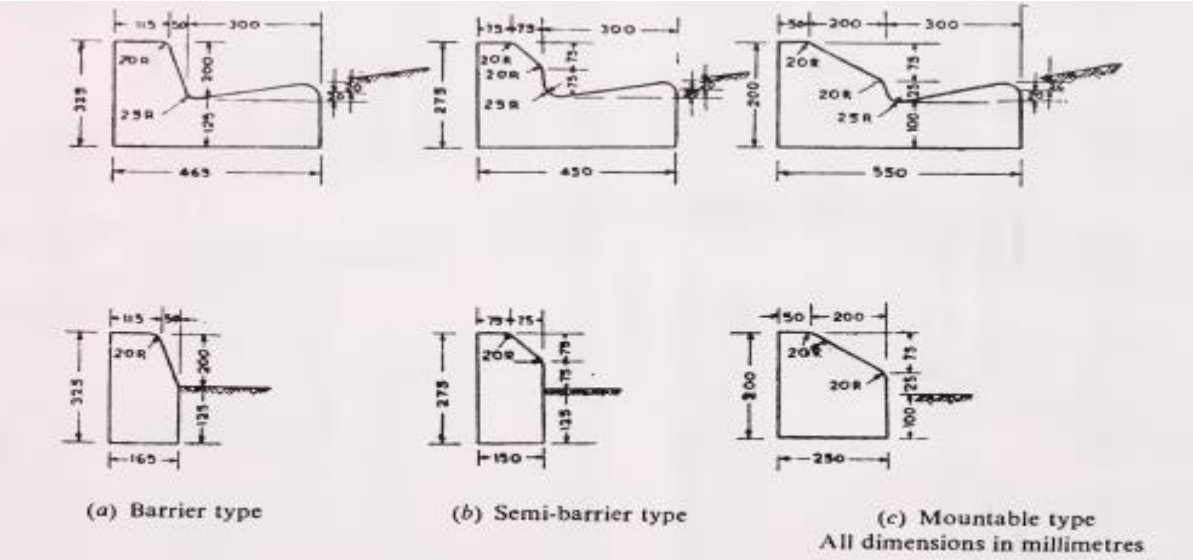


FIGURE 2-2 TYPICAL KERB SECTIONS

2.13 CBR of existing sub-grade soil

For the determination of CBR values of existing soil sub-grade, three different compaction energy levels were employed, using dynamic compaction by 10 blows, 30 blows and 65 blows with a rammer of 4.89-kg in weight, while remoulding the test specimen. OMC, whichever was higher, was maintained while remoulding the test specimens. Penetration test was conducted on test specimens, using CBR testing machine after completion of immersion in water for a period of 4 - days. Surcharge weight of 12.5 kg was kept throughout on the specimen during testing. CBR values were determined corresponding to 2.5 mm and 5.0-mm penetrations. A correlation between the dry densities (obtained corresponding to different levels of compaction) and 4-days soaked CBR value was established. CBR value against observed field dry density was thus determined for the sub-grade soil taken from test pits. The results of CBR values, Sieve Analysis, Atterberg limits and Modified Proctor including classification of the soils are shown in the table below. The computed CBR values are also included in the same table.

TABLE 2-16: SOIL PROPERTIES

Sl. No.	Trail Pits	Location	Grain Size Analysis (%)			Index Properties (%)			Free Swell Index	Modified Proctor Test Results		Classification of soil	Ill Energy Level CBR
			Gravel	Sand	Silt & Clay	LL	PL	PI		OMC (%)	MDD (g/cc)		
SOUTH PART													
4	TP-1	S09	1	45	54	52	24	28	110	12.40	1.88	SC-CH	6.65
5	TP-2	S03	3	24	73	46	23	23	30	13.89	1.77	CI	4.78
6	TP-3	S10	2	45	53	42	21	21	40	10.50	1.88	CI	6.50
7	TP-4	S02	64	9	27	38	16	22	40	9.00	2.05	GC	17.13
8	TP-5	S11	1	23	76	72	35	37	130	11.69	1.84	CH	5.98

2.14 Pavement Design

2.14.1 General

The proposed pavement on the project stretch is mainly flexible in nature. The general design Procedure for the flexible pavement for the proposed road as new construction of whole stretch as per the guidelines of IRC: 37-2018 – "Guidelines for the design of Flexible Pavements".

New pavement design is based on the design traffic (MSA) and the subgrade strength (soaked CBR).

2.14.2 Methodology of Pavement Design

Introduction

The flexible pavements are usually referred as a layered structure comprising generally bituminous surface like Bituminous Concrete (BC) and Dense Bituminous Macadam (DBM), Wet Mix Macadam (WMM) base and Granular Sub-Base (GSB) course of finite thickness, resting on subgrade of minimum thickness of 500 mm. The thickness design of these layers principally depends on the subgrade CBR and the traffic loads that the pavement has to carry during its design life. Ideally, the flexible pavement is built to such a depth that stresses on any given layer should not cause unwarranted rutting, fatigue, shoving, or other differential movements which may result in an uneven wearing surface. The chief function of the surfacing course is to provide a smooth wearing surface, resistant to traffic. However, the wearing course can provide some shearing resistance to the base structure and some added resistance to deformation.

Base courses are usually layers of aggregates that must possess high resistance to deformation in order to withstand the higher pressures imposed by wheel loads. High – quality processed aggregates are usually required, which also provide good internal drainage sub bases and generally made up of locally available aggregates, satisfying codal specification/requirements.

The design methodologies widely used for the flexible pavement design are Indian Road Congress (IRC) method, AASHTO methods and Asphalt Institute Method. For this project latest IRC (IRC:37-2018) method is used for designing the flexible pavement.

2.14.3 Design of New Flexible Pavement

IRC: 37-2018 method is adopted for the design which is based on the empirical – analytical approach, and provides catalogues for design of flexible pavements. The design inputs required for pavement design are explained as follows.

Design Theory

The pavement design method is based on elastic response of the pavement to traffic stresses (i.e. each of the materials in the pavement structure behaves in an elastic manner). The materials in the pavement are characterized by parameters whose values are determined from field and laboratory testing. The method assumes that failure will not occur as a result of permanent deformation of granular or bound materials (and this assumption will be valid as long as good construction procedures are followed, and the pavement is not subjected to very high wheel loads such as can be caused by a very heavily overloaded vehicle). The method also assumes that loss of pavement serviceability can occur due to:

- fatigue of bitumen bound or cemented layers due to repetitions of tensile strains at the bottom of such layers; and/or
- Permanent deformation of the sub-grade due to repeated vertical compressive strains induced in the sub-grade

The critical locations for pavement failure are therefore the bottom of bitumen bound layers (where tensile strains occur) and the top of the sub-grade (where compressive strains occur).

The base course and sub-grade are structural elements of the pavement. In conjunction with the overlying bituminous surface, their purpose is to distribute traffic wheel loads over

the whole foundation. To perform this function, we build the base course and sub-grade with the necessary internal strength properties.

Bituminous pavement layers have both tensile and compressive strength to resist internal stresses. Exhibit below shows how wheel load (W) slightly deflects the pavement structure, causing both tensile and compressive stresses within the pavement.

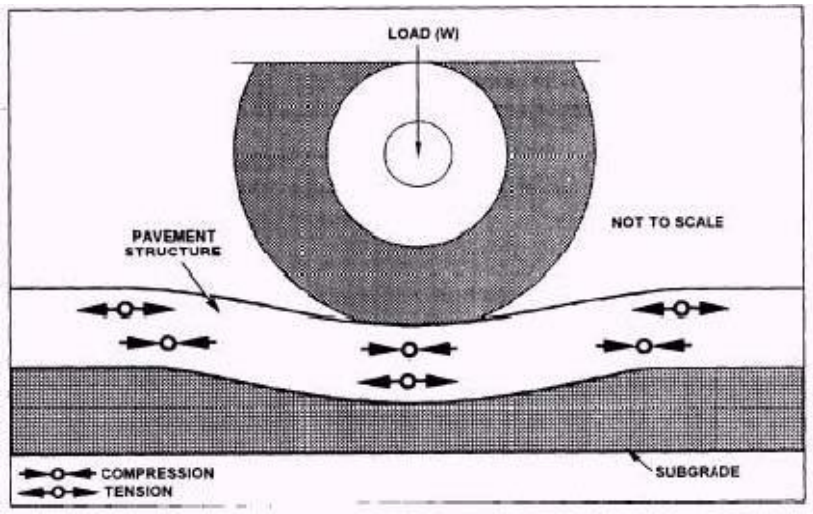


FIGURE 2-3 PAVEMENT DEFLECTION RESULTS IN TENSILE AND COMPRESSIVE STRESSES IN PAVEMENT STRUCTURE

Required total thickness of the pavement layers is determined by engineering design procedure. Factors considered in the procedure are as follows:

- Traffic to be served initially and over the design service life of the pavement
- Strength and other pertinent properties of the prepared sub-grade
- Strength and other influencing characteristics of the materials available or chosen for the layers (or courses) in the total pavement structure
- Special factors such free swelling property of existing soil

Design of New Flexible Pavement

Design of new pavement has been carried out based on IRC 37-2018 “Guidelines for the Design of Flexible Pavements” for design life of 20 years. Procedure for the same is given below:

Step 1: To find out initial traffic in the year of completion of construction in terms of the number of the number of commercial vehicles per day (CVPD)

Step 2: To determine traffic growth rate factor by studying the past trends of traffic growth

Step 3: Design life of Pavement

Step 4: To find out Vehicle Damage Factor to convert the number of commercial vehicles of different axle loads and axle configuration to the number of standard axle load repetition. It may be obtained by conducting axle load survey at site.

Step 5: To find out lane distribution factor of traffic over the carriageway

Step6: To determine design traffic in cumulative number of standard axles (msa) by the following formula mentioned below:

N= [365 x {(1+r)n-1]/r}] x A x D x F

Where,

N = Cumulative number of standard axles to be catered for in the design in terms of msa

A = Initial traffic in the year of completion of construction in terms of number of commercial vehicles per day in each direction

D = Lane Distribution Factor

n = Design life in years = 20 years

r = Annual growth rate of commercial vehicles

F = Vehicle damage factor

Design Period

Pavement design life is the period for which the initial design of pavement crust layers shall be designed. Design life should not be referred as terminal stage of crust beyond which crust becomes unusable. A design life of 20 years for flexible pavement has been considered for the design purposes.

Vehicle Damage Factors (VDF)

The VDF has been calculated from Axle load survey. The VDF value considered for different vehicle category is listed below in Table

TABLE 2-17: VDF SUMMARY

Vehicle category	Value
2-Axle Truck	4.5
3-Axle Truck	7.25

Vehicle category	Value
Multi Axle Truck	12.25
Bus	1.6

Lane Distribution Factor:

As per clause 4.5 of of IRC: 37-2018, Lane distribution factor is described below:

Two-lane two-way roads

The design should be based on 50 per cent of the total number of commercial vehicles in both the

Dual carriageway roads

The design of dual two-lane carriageway roads should be based on 75 per cent of the number of commercial vehicles in each direction. For dual three-lane carriageway and dual four-lane carriageway, the distribution factors shall be 60 per cent and 45 per cent respectively.

Traffic Growth Rate:

The Traffic Growth rates taken into consideration for the study is given in the Table below:

TABLE 2-18: TRAFFIC GROWTH RATES (%)

Vehicle Type	Growth rate
Bus	1.5
2-Axle	1.5
3-Axle	1.5
MAV	1.5

Step 7: To determine total pavement thickness and crust composition by charts/graphs with respect to CBR and cumulative number of standard axles.

The highest MSA calculated for 6Lane, 4 Lane and 2 Lane road is attached below:

TABLE 2-19: THE DESIGN MSA CALCULATED FOR THE 6-LANE ROAD

Year	Bus	2 Axle	3 Axle	MAV	Total yearly CVs (nos.)	Cumulative yearly CVs (nos.)	Yearly Design ESA	Cumulative Design ESA	MSA	Design year
VDF	1.60	4.50	7.25	12.25						
2023	669	259	194	207						
2024	679	262	197	210						
2025	689	266	200	213						
2026	699	270	203	216	5,06,819	5,06,819	7,06,735	7,06,735	0.71	1
2027	710	274	206	219	5,14,422	10,21,241	7,17,336	14,24,071	1.42	2
2028	720	278	209	223	5,22,138	15,43,379	7,28,096	21,52,168	2.15	3
2029	731	283	212	226	5,29,970	20,73,349	7,39,018	28,91,185	2.89	4
2030	742	287	215	230	5,37,920	26,11,269	7,50,103	36,41,288	3.64	5
2031	753	291	218	233	5,45,988	31,57,257	7,61,355	44,02,643	4.40	6
2032	765	296	222	236	5,54,178	37,11,436	7,72,775	51,75,418	5.18	7
2033	776	300	225	240	5,62,491	42,73,927	7,84,366	59,59,784	5.96	8
2034	788	305	228	244	5,70,928	48,44,855	7,96,132	67,55,916	6.76	9
2035	799	309	232	247	5,79,492	54,24,347	8,08,074	75,63,990	7.56	10
2036	811	314	235	251	5,88,185	60,12,532	8,20,195	83,84,185	8.38	11
2037	824	318	239	255	5,97,007	66,09,539	8,32,498	92,16,683	9.22	12
2038	836	323	242	259	6,05,963	72,15,502	8,44,985	1,00,61,669	10.06	13
2039	849	328	246	262	6,15,052	78,30,554	8,57,660	1,09,19,329	10.92	14
2040	861	333	250	266	6,24,278	84,54,832	8,70,525	1,17,89,854	11.79	15
2041	874	338	253	270	6,33,642	90,88,474	8,83,583	1,26,73,437	12.67	16
2042	887	343	257	274	6,43,147	97,31,620	8,96,837	1,35,70,274	13.57	17
2043	901	348	261	279	6,52,794	1,03,84,414	9,10,289	1,44,80,563	14.48	18
2044	914	353	265	283	6,62,586	1,10,47,000	9,23,944	1,54,04,507	15.40	19
2045	928	359	269	287	6,72,524	1,17,19,524	9,37,803	1,63,42,310	16.34	20
2046	942	364	273	291	6,82,612	1,24,02,136	9,51,870	1,72,94,179	17.29	21
2047	956	370	277	296	6,92,851	1,30,94,988	9,66,148	1,82,60,327	18.26	22
2048	970	375	281	300	7,03,244	1,37,98,232	9,80,640	1,92,40,967	19.24	23
2049	985	381	286	305	7,13,793	1,45,12,025	9,95,350	2,02,36,317	20.24	24

Year	Bus	2 Axle	3 Axle	MAV	Total yearly CVs (nos.)	Cumulative yearly CVs (nos.)	Yearly Design ESA	Cumulative Design ESA	MSA	Design year
VDF	1.60	4.50	7.25	12.25						
2050	1000	386	290	309	7,24,500	1,52,36,525	10,10,280	2,12,46,597	21.25	25
2051	1015	392	294	314	7,35,367	1,59,71,892	10,25,434	2,22,72,031	22.27	26
2052	1030	398	299	318	7,46,398	1,67,18,290	10,40,816	2,33,12,847	23.31	27

TABLE 2-20: THE DESIGN MSA CALCULATED FOR THE 4-LANE ROAD

Year	Bus	2 Axle	3 Axle	MAV	Total yearly CVs (nos.)	Cumulative yearly CVs (nos.)	Yearly Design ESA	Cumulative Design ESA	MSA	Design year
VDF	1.60	4.50	7.25	12.25						
2023	506	129	97	103						
2024	514	131	98	105						
2025	521	133	100	107						
2026	529	135	101	108	3,18,916	3,18,916	4,81,013	4,81,013	0.48	1
2027	537	137	103	110	3,23,700	6,42,616	4,88,229	9,69,242	0.97	2
2028	545	139	104	111	3,28,555	9,71,171	4,95,552	14,64,794	1.46	3
2029	553	141	106	113	3,33,484	13,04,655	5,02,985	19,67,779	1.97	4
2030	562	143	108	115	3,38,486	16,43,141	5,10,530	24,78,309	2.48	5
2031	570	146	109	116	3,43,563	19,86,704	5,18,188	29,96,497	3.00	6
2032	579	148	111	118	3,48,717	23,35,420	5,25,961	35,22,458	3.52	7
2033	587	150	113	120	3,53,947	26,89,368	5,33,850	40,56,308	4.06	8
2034	596	152	114	122	3,59,257	30,48,624	5,41,858	45,98,166	4.60	9
2035	605	155	116	124	3,64,645	34,13,270	5,49,986	51,48,152	5.15	10
2036	614	157	118	125	3,70,115	37,83,385	5,58,236	57,06,387	5.71	11
2037	623	159	119	127	3,75,667	41,59,052	5,66,609	62,72,996	6.27	12
2038	633	162	121	129	3,81,302	45,40,354	5,75,108	68,48,104	6.85	13
2039	642	164	123	131	3,87,021	49,27,375	5,83,735	74,31,839	7.43	14
2040	652	166	125	133	3,92,827	53,20,202	5,92,491	80,24,330	8.02	15
2041	661	169	127	135	3,98,719	57,18,921	6,01,378	86,25,708	8.63	16
2042	671	172	129	137	4,04,700	61,23,621	6,10,399	92,36,107	9.24	17

Year	Bus	2 Axle	3 Axle	MAV	Total yearly CVs (nos.)	Cumulative yearly CVs (nos.)	Yearly Design ESA	Cumulative Design ESA	MSA	Design year
VDF	1.60	4.50	7.25	12.25						
2043	681	174	131	139	4,10,770	65,34,391	6,19,555	98,55,662	9.86	18
2044	692	177	133	141	4,16,932	69,51,323	6,28,848	1,04,84,511	10.48	19
2045	702	179	135	143	4,23,186	73,74,509	6,38,281	1,11,22,792	11.12	20
2046	713	182	137	146	4,29,534	78,04,042	6,47,855	1,17,70,647	11.77	21
2047	723	185	139	148	4,35,977	82,40,019	6,57,573	1,24,28,220	12.43	22
2048	734	188	141	150	4,42,516	86,82,535	6,67,437	1,30,95,656	13.10	23
2049	745	190	143	152	4,49,154	91,31,690	6,77,448	1,37,73,104	13.77	24
2050	756	193	145	155	4,55,891	95,87,581	6,87,610	1,44,60,714	14.46	25
2051	768	196	147	157	4,62,730	1,00,50,311	6,97,924	1,51,58,638	15.16	26
2052	779	199	149	159	4,69,671	1,05,19,981	7,08,393	1,58,67,031	15.87	27

TABLE 2-21: THE DESIGN MSA CALCULATED FOR THE 2-LANE ROAD

Year	Bus	2 Axle	3 Axle	MAV	Total yearly CVs (nos.)	Cumulative yearly CVs (nos.)	Yearly Design ESA	Cumulative Design ESA	MSA	Design year
VDF	1.60	4.50	7.25	12.25						
2023	134	52	39	41						
2024	136	52	39	42						
2025	138	53	40	43						
2026	140	54	41	43	1,01,364	1,01,364	2,35,578	2,35,578	0.24	1
2027	142	55	41	44	1,02,884	2,04,248	2,39,112	4,74,690	0.47	2
2028	144	56	42	45	1,04,428	3,08,676	2,42,699	7,17,389	0.72	3
2029	146	57	42	45	1,05,994	4,14,670	2,46,339	9,63,728	0.96	4
2030	148	57	43	46	1,07,584	5,22,254	2,50,034	12,13,763	1.21	5
2031	151	58	44	47	1,09,198	6,31,451	2,53,785	14,67,548	1.47	6
2032	153	59	44	47	1,10,836	7,42,287	2,57,592	17,25,139	1.73	7
2033	155	60	45	48	1,12,498	8,54,785	2,61,455	19,86,595	1.99	8
2034	158	61	46	49	1,14,186	9,68,971	2,65,377	22,51,972	2.25	9

Year	Bus	2 Axle	3 Axle	MAV	Total yearly CVs (nos.)	Cumulative yearly CVs (nos.)	Yearly Design ESA	Cumulative Design ESA	MSA	Design year
VDF	1.60	4.50	7.25	12.25						
2035	160	62	46	49	1,15,898	10,84,869	2,69,358	25,21,330	2.52	10
2036	162	63	47	50	1,17,637	12,02,506	2,73,398	27,94,728	2.79	11
2037	165	64	48	51	1,19,401	13,21,908	2,77,499	30,72,228	3.07	12
2038	167	65	48	52	1,21,193	14,43,100	2,81,662	33,53,890	3.35	13
2039	170	66	49	52	1,23,010	15,66,111	2,85,887	36,39,776	3.64	14
2040	172	67	50	53	1,24,856	16,90,966	2,90,175	39,29,951	3.93	15
2041	175	68	51	54	1,26,728	18,17,695	2,94,528	42,24,479	4.22	16
2042	177	69	51	55	1,28,629	19,46,324	2,98,946	45,23,425	4.52	17
2043	180	70	52	56	1,30,559	20,76,883	3,03,430	48,26,854	4.83	18
2044	183	71	53	57	1,32,517	22,09,400	3,07,981	51,34,836	5.13	19
2045	186	72	54	57	1,34,505	23,43,905	3,12,601	54,47,437	5.45	20
2046	188	73	55	58	1,36,522	24,80,427	3,17,290	57,64,726	5.76	21
2047	191	74	55	59	1,38,570	26,18,998	3,22,049	60,86,776	6.09	22
2048	194	75	56	60	1,40,649	27,59,646	3,26,880	64,13,656	6.41	23
2049	197	76	57	61	1,42,759	29,02,405	3,31,783	67,45,439	6.75	24
2050	200	77	58	62	1,44,900	30,47,305	3,36,760	70,82,199	7.08	25
2051	203	78	59	63	1,47,073	31,94,378	3,41,811	74,24,010	7.42	26
2052	206	80	60	64	1,49,280	33,43,658	3,46,939	77,70,949	7.77	27

For 6 lane road, the msa comes out to be 16.34 for 20 years' design life. Hence, the Cumulative Number of Standard Axles considered for design is = 20 msa.

For 4 lane road, the msa comes out to be 11.12 for 20 years' design life. Hence, the Cumulative Number of Standard Axles considered for design is = 15 msa.

For 2 lane road, the msa comes out to be 5.45 for 20 years' design life. Hence, the Cumulative Number of Standard Axles considered for design is = 10 msa

Considering minimum 5% CBR value, the pavement composition as per Figure 12.1 (plate 1) of IRC 37-2018 is stated below:

TABLE 2-22: PAVEMENT COMPOSITION

Pavement Layers	Thickness(mm)		
	20 msa	15 msa	10 msa
BC	40	40	40
DBM	105	95	80
WMM	250	250	250
GSB	200	200	200
SUBGRADE	500	500	500

For overlay design BC layer of 40 mm is considered.

2.15 Intersections

Since, anticipated traffic volume is high in this kind of area development project the smooth traffic movement prevails over high speed, all the intersections are kept at grade only. Thus, the basic requirements for the design of intersections in this case was to cater to safe movements for the traffic and to provide them full traffic information by way of traffic signs, pavement markings and traffic signals, if required in future. Further, simplicity and uniformity has been considered as the guiding principles for intersection design and to ensure the safe passage of movements.

Though IRC-SP: 41-1994 give the monogram for warrants for the different types of at-grade or grade separated intersections, these warrants are based upon the traffic volumes on each of the two intersecting roads. The type of intersection to be provided shall be based on these IRC guidelines. Similarly warrants given in the “Type Designs for Intersections on National Highways” published by the MORT&H has also been taken into consideration for the design of intersections. However, looking at the very high level of traffic the at-grade intersections have been categorized in two types:

- Intersections within the sub-links
- Intersections of sub-links with the main link.

2.15.1 Type of intersections

The following types of junctions have been identified:

- 3-Arm Junctions
- 4-Arm Junctions

- Rotary intersection

2.15.2 Classification of intersections

The following features have been included in the junctions:

- Initially, all junctions shall be of non - signalized type. Later, they can be converted to signalized junctions in due course as traffic volumes grow without any major changes in the layout of the curves and islands.
- Pedestrian crossing (Zebra Crossing) will be marked.
- Turning arrows will be marked.
- Centre lines and lane lines will be demarcated.
- Traffic safety aids such as studs (cluster of red reflectors) shall be provided at nose of islands and rotary islands.
- Traffic signs shall be installed.
- For all junctions the turning radius is kept as 15 m.

2.15.3 Design of rotary intersection

The proposed rotary has been designed as per IRC 65-1976

The basic design parameters are given below:

Sl no.	Details	Value
1	Radius of central Island	1.33 time of radius of entry
2	Radius of the inscribed circle	Radius of central island +Weaving width
3	Rotary design speed (minimum)	30 kmph
4	Suggested value for Radius at entry	15-25 m
5	Width of entry	7.0 to 10.5 m
6	Width of exit	7.0 to 10.5 m
7	Minimum Width of Non weaving section (circulation width)	7.0m
8	Width of weaving section	One traffic lane wider than entry width
9	Minimum Length of weaving section	30 m (for 30 kmph design speed)
10	Capacity of rotary	<3,000 nos. per hour Justifying the provision of rotary as per Clause 3.3 (c) of IRC:65-1976

A typical drawing for rotary is attached below

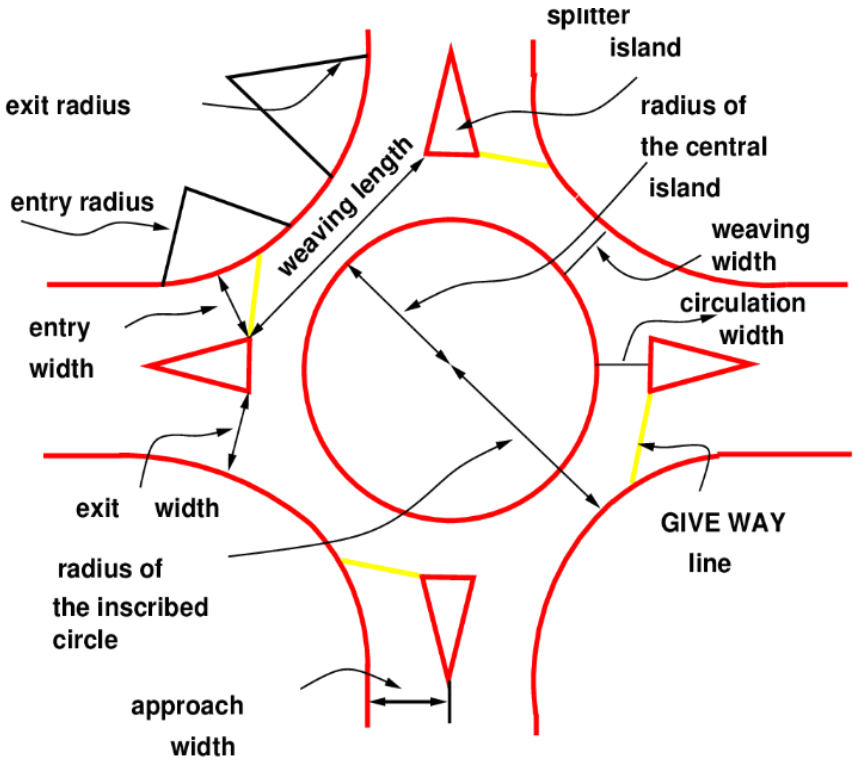


FIGURE 2-4 TYPICAL DRAWING OF ROTARY

Source: IRC 65-1976

2.16 Sight Distance

Sight distance is required for the safe movement of traffic on road and at intersections. The driver's ability to judge the hazard of entering intersection is very much enhanced as the visibility is increased by removal of obstructions falling in the line of sight.

Improvements to sight distance have been imparted by making the corners of the property lines circular parallel to the radius of the outer line of the carriageway or by giving green strip between carriage way and plot lines.

2.17 Drainage

Drainage is an essential component of road and intersections and therefore, the design should facilitate the removal of storm water from the junction expeditiously. Accordingly, suitable gradients and cross-slopes have been provided to ensure proper drainage of junctions. For storm water collection from the road surface, an arrangement of Storm water drain along with catch pits at every 10 intervals on the roadside edges shall be provided. considering the better handling of storm water and its safe disposal, Manhole connecting

to the Strom water drains at every 20m intervals shall be provided as per the IRC-42, 2014 and IRC-50, 2013. The section of manhole for every 20m interval is as follows:

2.17.1 Categories of Road

The circulation for the site has been planned according to the topography of the site. The right of way will also incorporate the special requirement of all proposed infrastructure services like water, sewage, power, telecom, gas etc. The proposed roads inside the park have been planned in hierarchy depending on the traffic volume expected.

Five categories of roads are provided as below:

TABLE 2-23: CATEGORIES OF ROAD

Sl. no.	Details	Kopparthy Industrial Area (Length of road in m)	
1	45 m	Arterial	20060
2	30 m	Sub Arterial	7476
3	24 m	Collector	16119
4	18 m	Local	7585
		Total (in m)	**51241**

*The above road length is inclusive of structure length

2.18 Structure Proposal

Project road is proposed to be constructed to 2/4-lane configuration. Special vehicle loading is considered in design of all bridges, culverts and structures.

All structures except where ever expansion joint have been provided, the pavement layers shall be continued over the structures for the smooth riding quality of the project road. These structures have been designed considering the dead load of the pavement layers.

Wherever Nallah Crossings are there, major & minor bridges are proposed. Culverts are proposed at cross drainage and near outlet points. The overall widths of the culverts shall be carriageway width of approach roads. Railway over bridge (ROB) has been provided in 2 locations in Kopparthy Industrial Area.

The structure details are provided below.

TABLE 2-24: BRIDGES OR CULVERTS

RUB LIST			
DETAILS	**ROAD NAME**	**SPAN ARRANGEMENT**	**WIDTH OF STRUCTURE**
RUB01	RS-45-05	40.81x1	2x8.5
RUB02	RS-45-08	40.81x1	2x8.5
RUB03	RS-18-14 & RS-24-09	40.81x1	2x8.5
MNB LIST			
DETAILS	**ROAD NAME**	**SPAN ARRANGEMENT**	**WIDTH OF STRUCTURE**
MNB01	RS-18-08	3x20	1x16
MNB02	RS-45-04	3x20	2x13.5
CULVERT			
CULVERT	TOTAL NOS.-151*		

**- Refer Culvert Drawing and Annexure XI for details*

Source: VSPL

2.19 Road Cross-sections

45 M Roads:

The 45 m roads would act as the spine for connecting internal roads as well as external road to project site. The right of way reserved for the spine road is 45m and has been proposed to have a dual carriageway separated with 3m wide median. Power trenches have been proposed in the Kopparthy Industrial Area on both sides of the carriageway with footpath, cycle tracks, plantations proposed over ground in line with the master plan.

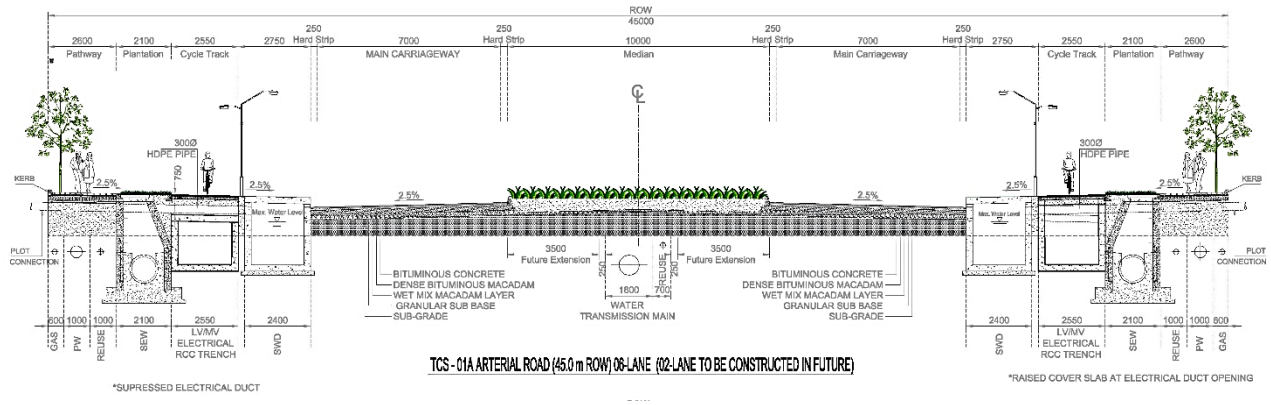


FIGURE 2-5 PROPOSED ROAD SECTION FOR KOPPARTHY INDUSTRIAL AREA -45M ROW (2 LANE TO BE CONSTRUCTED IN FUTURE)

Source: VSPL

30 M Roads:

These roads are proposed as Dual carriageway separated by a narrow median 1.2 m wide. Underground utilities have been proposed on both sides of the carriageway.

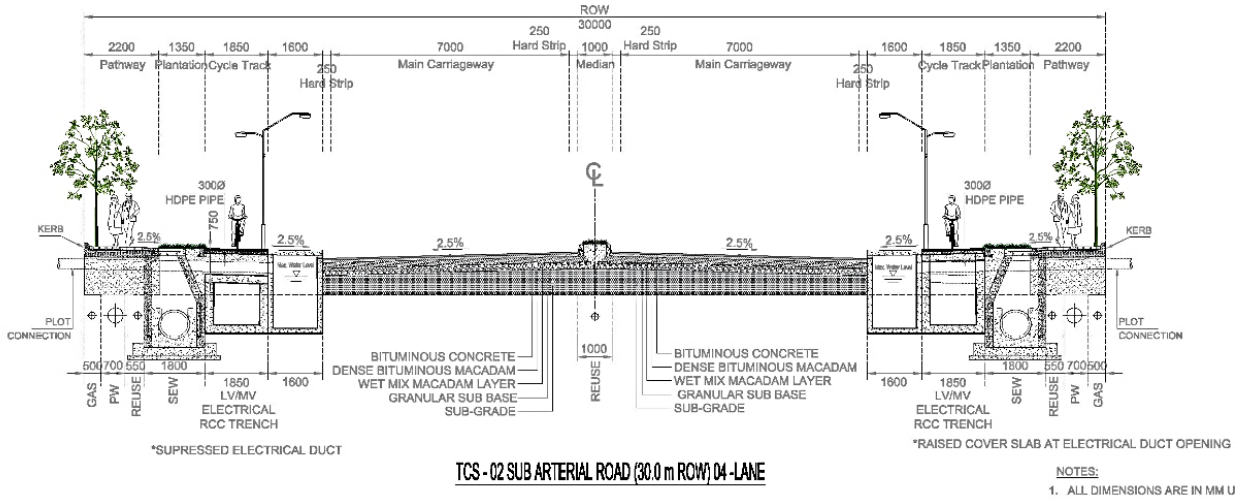


FIGURE 2-6 PROPOSED ROAD SECTION FOR KOPPARTHY INDUSTRIAL AREA -30M ROW

Source: VSPL

The 30m RoW roads abutting the railway line are proposed as Two-way single carriageway roads with underground utilities on side facing the industrial plots only.

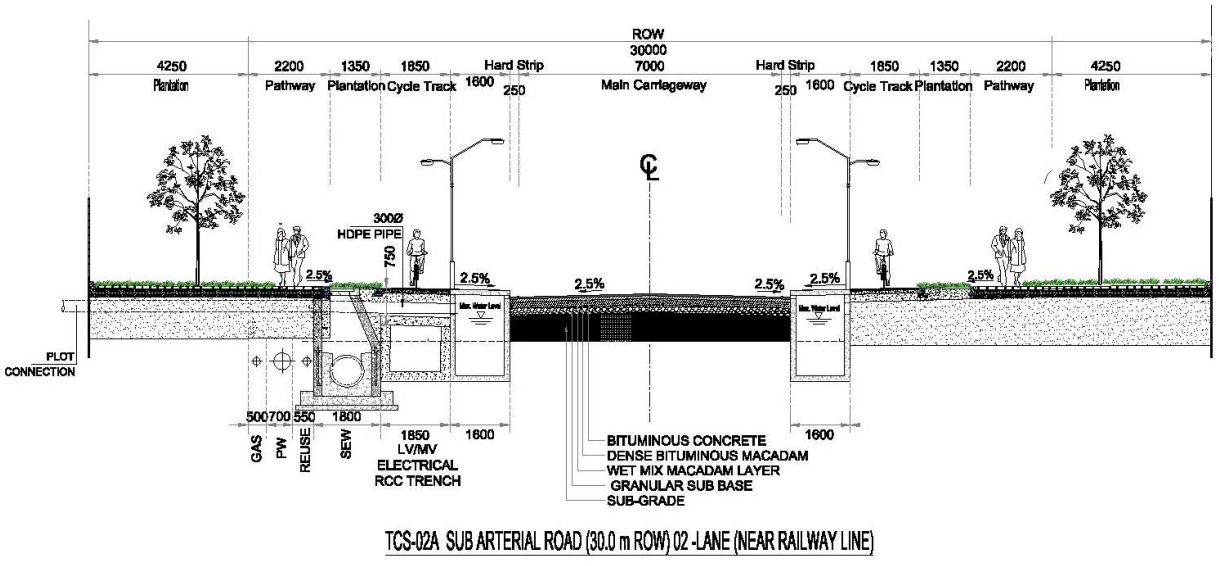


FIGURE 2-7 : PROPOSED ROAD SECTION FOR SOUTH BLOCK-30M ROW,

Source: VSPL

24 M Roads:

These roads are proposed as Dual carriageway separated by a narrow median 1.2 m wide. Underground utilities have been proposed on both sides of the carriageway.

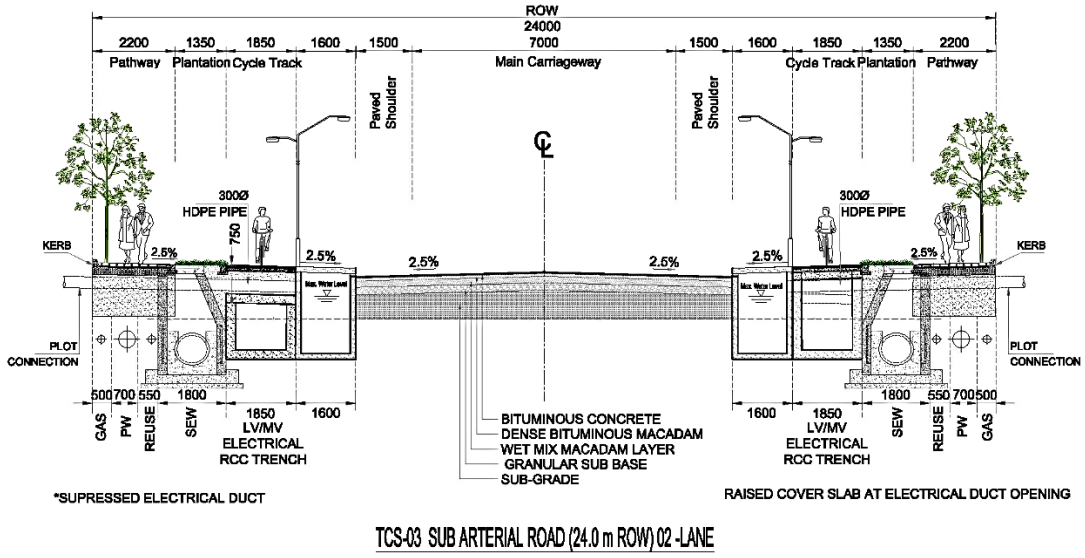


FIGURE 2-8 PROPOSED ROAD SECTION FOR KOPPARTHY INDUSTRIAL AREA -24M ROW

Source: VSPL

18 M Roads:

Two-way single carriageway is proposed for these roads. Footpaths and cycle tracks are proposed in this road with underground utilities on both sides of the carriageway.

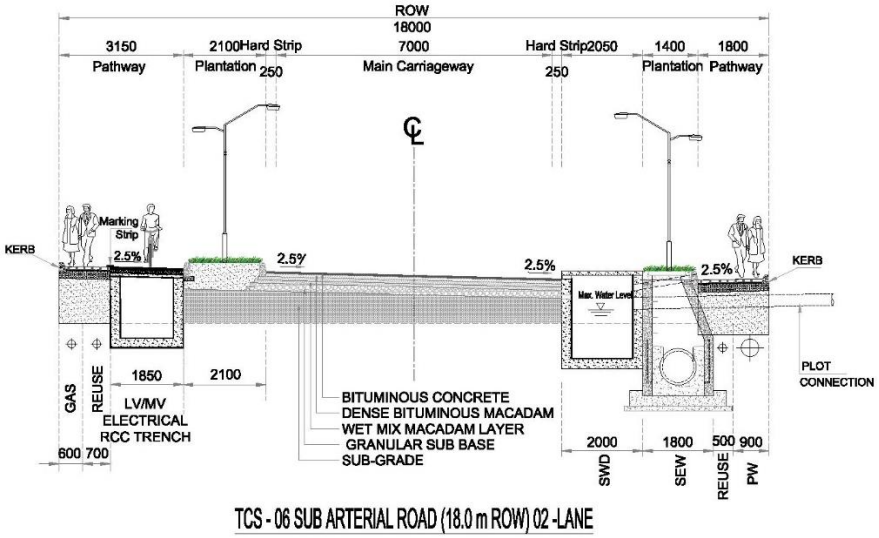


FIGURE 2-9 PROPOSED ROAD SECTION FOR KOPPARTHY INDUSTRIAL AREA 18M ROW

Source: VSPL

2.19.1 Pavement Composition

The proposed pavement composition for the proposed road cross-sections is as follow:

Sr. No.	Road Cross Section No.	Pavement Layer Thickness (mm)				
		Sub-Grade	GSB	WMM	DBM	BC
1	TCS-1A	500	200	250	95	40
2	TCS-2	500	200	250	95	40
3	TCS-2A	500	200	250	95	40
4	TCS-3	500	200	250	80	40
5	TCS-6	500	200	250	80	40

Source: VSPL

2.19.2 Clearance from HT Line

The minimum clearance from lowest conductor of overhead HT Lines to the finished road level as per the Schedule VIIIA of sub-regulation (1) of regulation (60) of Central Electricity Agency should be 18.80 for 765 kV. The same shall be adhered to at the time of execution of road works.

2.20 Traffic Control Devices and Road Safety Works

Traffic control devices and road safety works shall be provided in accordance with Section 9 of the IRC: SP:73-2018/IRC: SP:84-2019.

2.20.1 Traffic Signs

Traffic Signs include roadside signs, overhead signs and Kerb mounted signs etc. shall be provided along the entire Project roads and on all sides, roads joining the main carriageway/service road. A QR code shall be marked on back of each sign as per IRC 67.

All sign shall be of Micro Prismatic Grade Sheeting Corresponding to Class C sheeting as per ASTM D 4956 Type VIII, IX and XI.

All shoulder mounted signs shall be supported on GI Pipes. Overhead Signs shall be placed on a structurally sound gantry or cantilever structure made up of GI pipes. The placing of signs shall confirm to Table 4.1 and Fig 4.1 of IRC 67.

Road Markings:

Road markings shall be hot applied thermos plastic materials with reflectorized beads to achieve visibility confirming to clause 2.7.2 of IRC.

2.21 Bus shelter and Utility Ducts

Bus shelter details has been provided as per IRC SP 73-2018 & IRC SP 84-2019.

Utility Ducts across ROW in the form of 600mm dia. NP4 pipes shall be provided with inspection box/ chambers provide utility ducts for utility crossings as per site requirement.

Implementation Strategy:

The development of roads & bridges will be done in a phased manner. In 1st phase, the 45m ROW road will be developed with only 4-lanes and the 2 extra lanes will be developed in future. Similarly, in the 1st phase, only 1 Rail Under Bridge (RUB) will be developed and remaining 2 RUBs in the next phase.

3 Site Grading

Land levelling is the practice of creating requisite slope/s across study Area, plots to help easy drain off the water and avoid water logging.

3.1 Design Basis

Site levelling and grading works have been done considering balanced cut & fill up to possible extent to minimise the borrow earth from the outside of site. It has been also maintained 2:1 (H:V) slope in embankment at considerable level difference areas.

Cutting and filling quantities have been finalised after adjustment of earthwork for roads, plot areas. Filling quantities are based on the total earth volume taking into consideration after deducting the earth scrubbing, vegetation and bulkage factor during compacted fill.

3.2 Grading Strategy

3.2.1 Requirement

The utilization of land for development is impacted by the existing terrain and the road network design. The factors that necessitate grading on the given site are

1. Creating usable land parcels
2. It is better to grading the all-non-saleable plots, except road, green belt along site & nallah, existing settlement areas to avoid the huge cost. The owners of saleable plot, can grading their own plot based on the F.R.L.
3. Providing access to each plot / land parcel from the designed Finished Road levels.
4. Reducing the need for earth retaining structures such as retaining walls, embankments, bunds, pitched slopes etc. to stabilize areas closer to water channels
5. Prepare detailed design for most appropriate site grading considering existing and proposed road levels, plot levels, drainage, utilities and developments.
6. To facilitate gravitational storm water drainage and sewage flow as much as possible.

Therefore, to enhance the usability of land, the site needs to be graded to appropriate slopes and levels.

3.2.2 Strategy

The first step in grading is to complete the road level i.e. FRL, the grading quantity and grading cost to be kept at (+) or (-)150 mm. Further, ideally plot grading to be done in such a way that runoff is drained from the plot to the roadside. This strategy may not apply to large plots such as those above 5 acres i.e. 20,235 Sqm.

For bigger plots, the grading and levelling shall be governed by the layout of the respective plot. Thus, the Grading and levelling of the industrial and sellable plots is not considered in the cost calculations. 60% area of organized green is considered for grading works. Further, where ever necessary the retaining wall, embankment shall be used to stabilised the slope and filling.

Site levelling and grading works have been done based on the connectivity of proposed Road. General slope of 0.1 % has been considered towards the Road for drain out storm water from the site and minimum cut and fill. While proposing plot grading, two options can be opted.

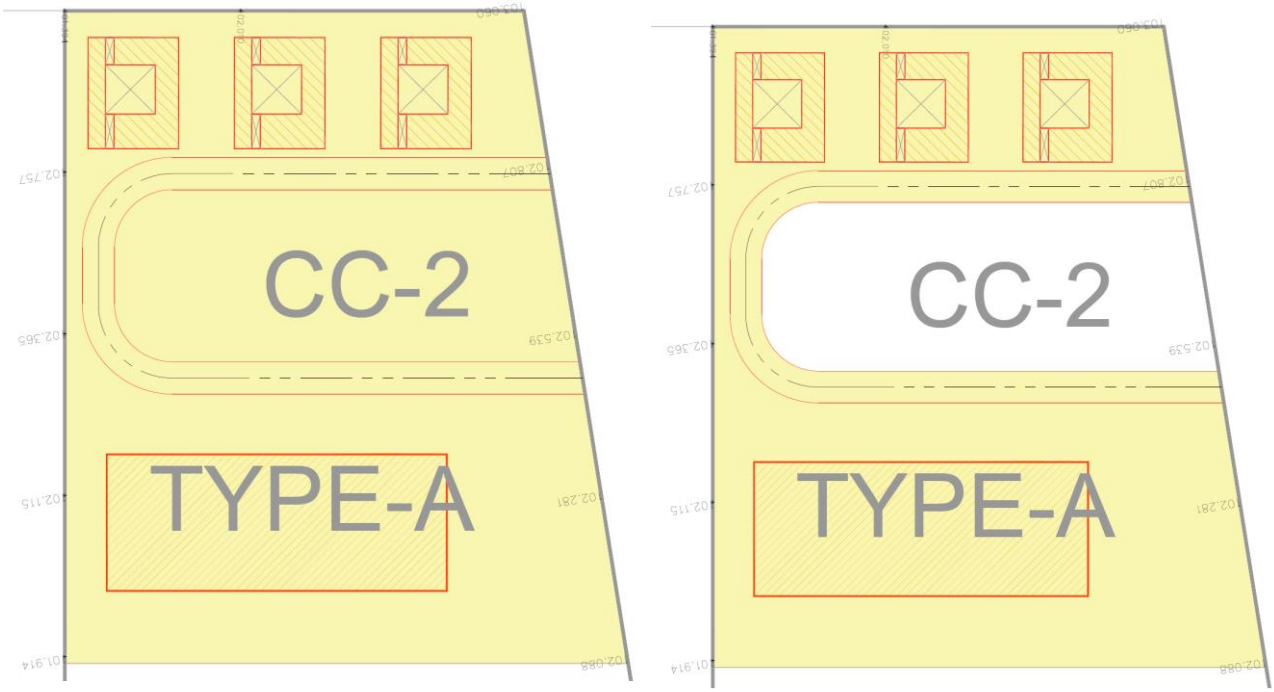


FIGURE 3-1 SCHEMATIC REPRESENTATION OF PLOT GRADING OPTIONS

Finished Road Level (FRL)	Road Network
± 0.15 m from ROW Edge Level	Plot Entry Level
Grading originating from road	Plot wise Grading
Retaining wall/embankment to stabilise slope	Stabiliztion of plot Edges

Table 3-1: Plot Distribution

Description	2D Area (Sqm)	Cut (Cu.M)	Fill (Cu.M)	Net (Cu.M) Cut-Fill	
Total for Grading KIA Plot areas:	***8936681.10***	***12201966.88***	***2990174.77***	***9211792.11***	***Cut***

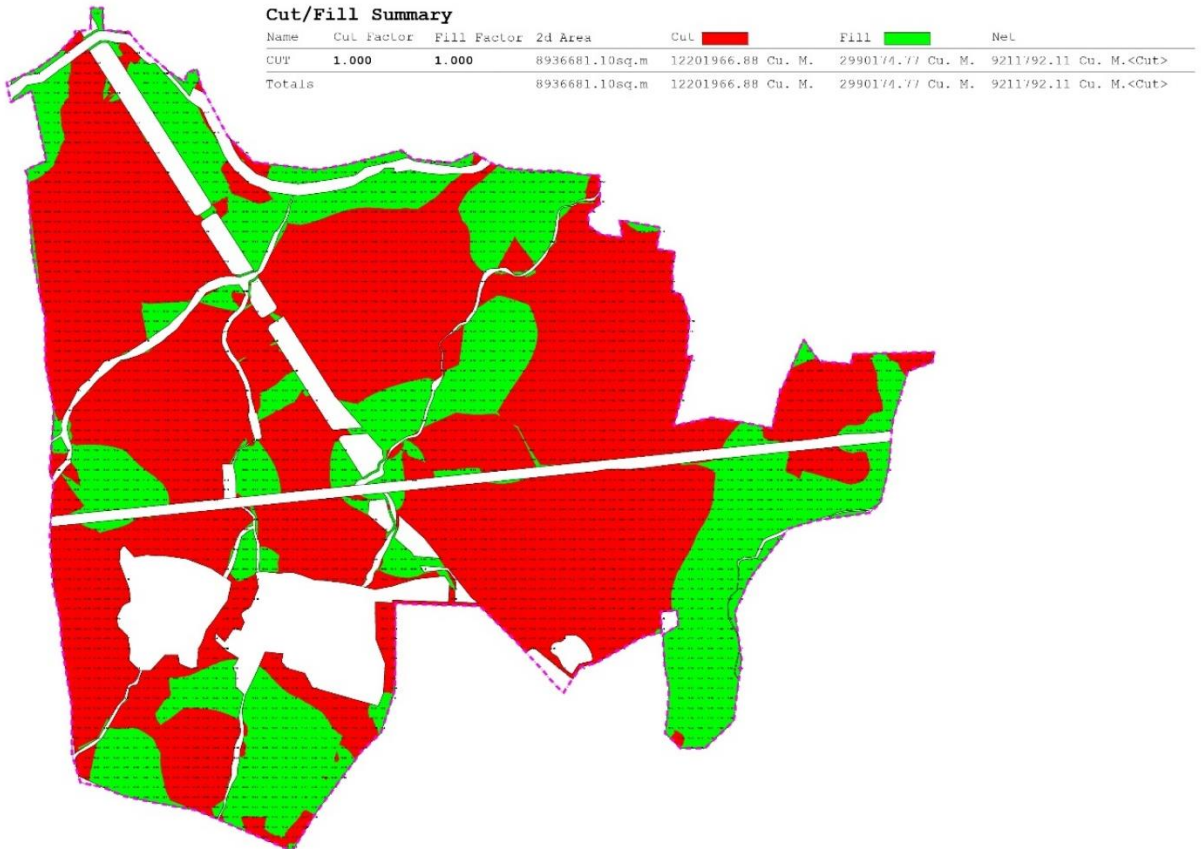


FIGURE 3-2 SITE GRADING PLAN OF KIA

The total area for development of the KIA is 8936681.10 sq.m. The total cutting volume is calculated to be 12201966.88 cu.m., whereas the total filling volume is found to be 2990174.77 cu.m. The overall cut-fill will be 9211792.11 cu.m. in cutting.

4 Water Supply, Wastewater and Storm Water Drainage System

4.1 Water Supply System

The section includes both Potable water and Recycled water (To be supplied from CETP and STP) system. Potable water Demand estimation for total area is based on proposed land use, built up area, the population proposed and process water demand.

The non-potable water demand includes horticulture demand, commercial cooling and Washing/ Cleaning which can be met from the recycled water. The water demand for the Non-Processing Area has been calculated separately due to variation in standards and requirements.

The horticulture demand and cooling demand will be fed through recycled water from proposed CETP and STP. The portion of horticulture demand and cooling demand will be fed through recycled water from proposed CETP and STP, additional quantity of water shall draw from potable water.

Basis of demand calculation for each type of plots/proposed land use is mentioned below:

TABLE 4-1: WATER DEMAND SUMMARY

Description	Demand
Process Water Demand	5.40
Potable Water Demand	8.26
Flushing Water Demand	4.05
Fire Water Demand Storage	1.40
Effluent Generation	3.24
Waste Water Generated	10.66
CETP	10.50
STP	4.00
Recycle Water Generated	12.52
AC Cooling Demand	6.64
Washing & Cleaning	1.48
Horticulture Demand	7.89
Deficit/ Surplus	- 3.50
Total Water Demand Requirement	**21.22**

A Water Treatment Plant of 15 MLD is proposed to carter to the process water demand of 5.40 MLD, potable water demand of 8.26 MLD and washing and cleaning water demand of 1.48 MLD.

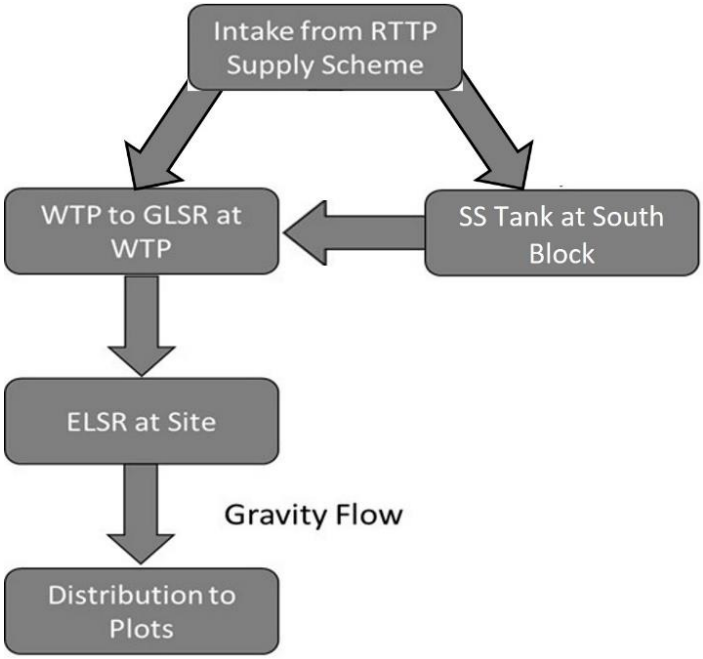


FIGURE 4-1 WATER DISTRIBUTION DIAGRAM

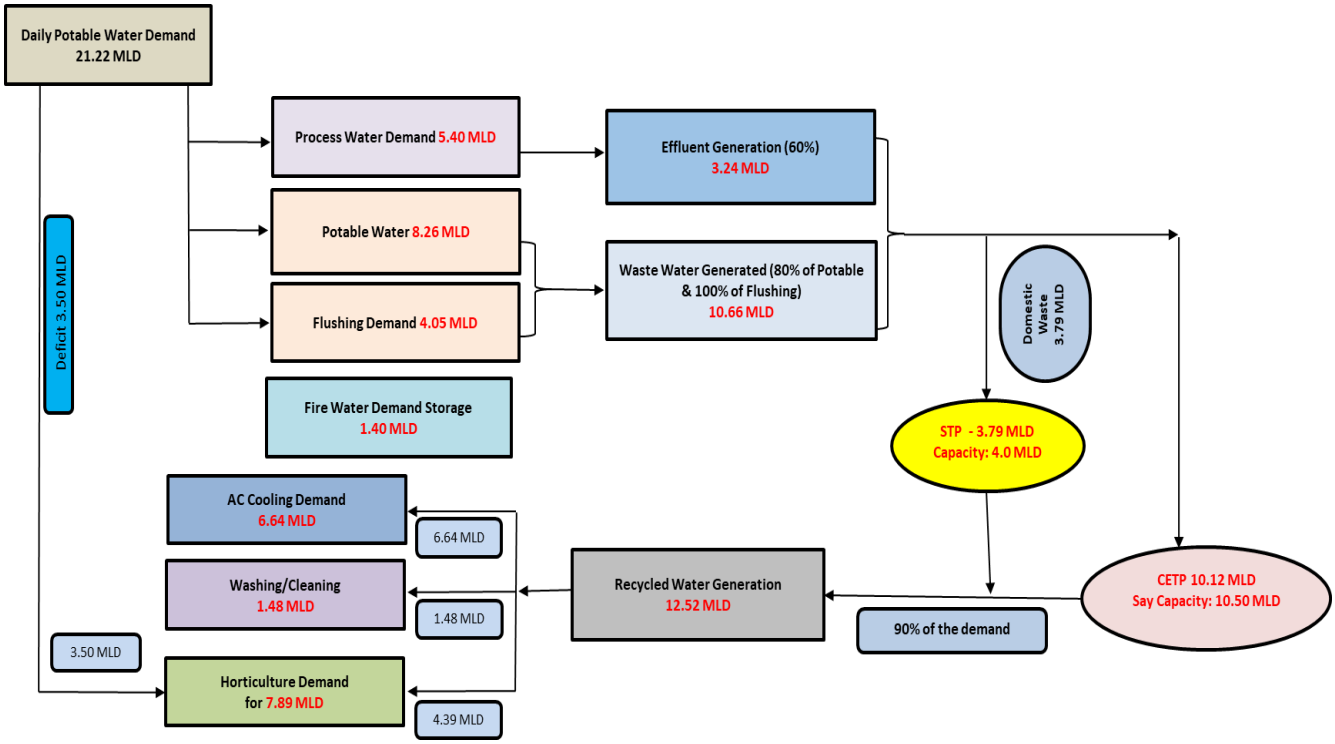


FIGURE 4-2: WATER BALANCE DIAGRAM

TABLE 4-2: PLOT WISE DEMAND CALCULATION

S. No.	Plot Type/ No.	Plot No	Area (Acre)	Area (Sq m)	Area (Ha)	BUA (sq.m.)	Working/ Residing Population	Floating population	Total Population	Potable (KLD)	Flushing (KLD)	Process Water (KLD)	Total Domestic Water (KLD)	AC Cooling	Washing/ Cleaning	Horticulture	Waste Water Generate	Effluent Generate
A	**PROCESSING AREA**																	
1	AUTO COMPONENTS - LARGE	10	2.67	10823.90	1.08	4329.56	43	4	48	1.34	0.67	12.99	15.00		1.73	6.49	1.74	7.79
2		11	2.71	10973.80	1.10	4389.52	44	4	48	1.36	0.68	13.17	15.21		1.76	6.58	1.77	7.90
3		12	2.73	11036.84	1.10	4414.73	44	4	49	1.37	0.68	13.24	15.30		1.77	6.62	1.78	7.95
4		13	2.71	10986.95	1.10	4394.78	44	4	48	1.36	0.68	13.18	15.23		1.76	6.59	1.77	7.91
5		14	2.72	11023.30	1.10	4409.32	44	4	49	1.37	0.68	13.23	15.28		1.76	6.61	1.78	7.94
6		15	2.76	11153.16	1.12	4461.26	45	4	49	1.38	0.69	13.38	15.46		1.78	6.69	1.80	8.03
7		16	2.77	11205.51	1.12	4482.20	45	4	49	1.39	0.69	13.45	15.53		1.79	6.72	1.81	8.07
8		17	2.76	11171.94	1.12	4468.77	45	4	49	1.39	0.69	13.41	15.48		1.79	6.70	1.80	8.04
9		18	3.13	12648.81	1.26	5059.52	51	5	56	1.57	0.78	15.18	17.53		2.02	7.59	2.04	9.11
10		19	3.17	12831.00	1.28	5132.40	51	5	56	1.59	0.80	15.40	17.78		2.05	7.70	2.07	9.24
11		20	3.17	12831.00	1.28	5132.40	51	5	56	1.59	0.80	15.40	17.78		2.05	7.70	2.07	9.24
12		21	3.17	12831.00	1.28	5132.40	51	5	56	1.59	0.80	15.40	17.78		2.05	7.70	2.07	9.24
13		22	3.17	12830.61	1.28	5132.24	51	5	56	1.59	0.80	15.40	17.78		2.05	7.70	2.07	9.24
14		23	3.13	12659.74	1.27	5063.90	51	5	56	1.57	0.78	15.19	17.55		2.03	7.60	2.04	9.12
15		24	2.25	9091.27	0.91	3636.51	36	4	40	1.13	0.56	10.91	12.60		1.45	5.45	1.47	6.55
16		25	2.30	9305.70	0.93	3722.28	37	4	41	1.15	0.58	11.17	12.90		1.49	5.58	1.50	6.70
17		26	2.30	9304.40	0.93	3721.76	37	4	41	1.15	0.58	11.17	12.90		1.49	5.58	1.50	6.70
18		27	2.07	8385.89	0.84	3354.36	34	3	37	1.04	0.52	10.06	11.62		1.34	5.03	1.35	6.04
19		28	3.11	12568.98	1.26	5027.59	50	5	55	1.56	0.78	15.08	17.42		2.01	7.54	2.03	9.05
20		29	2.30	9307.93	0.93	3723.17	37	4	41	1.15	0.58	11.17	12.90		1.49	5.58	1.50	6.70
21		30	2.30	9306.12	0.93	3722.45	37	4	41	1.15	0.58	11.17	12.90		1.49	5.58	1.50	6.70
22		31	2.25	9112.60	0.91	3645.04	36	4	40	1.13	0.56	10.94	12.63		1.46	5.47	1.47	6.56
23		37	2.41	9760.15	0.98	3904.06	39	4	43	1.21	0.61	11.71	13.53		1.56	5.86	1.57	7.03
24		38	1.36	5503.87	0.55	2201.55	22	2	24	0.68	0.34	6.60	7.63		0.88	3.30	0.89	3.96
25		39	2.20	8890.98	0.89	3556.39	36	4	39	1.10	0.55	10.67	12.32		1.42	5.33	1.43	6.40
26		40	2.52	10199.34	1.02	4079.74	41	4	45	1.26	0.63	12.24	14.14		1.63	6.12	1.64	7.34
27		41	2.50	10127.66	1.01	4051.07	41	4	45	1.26	0.63	12.15	14.04		1.62	6.08	1.63	7.29
28		42	2.83	11452.21	1.15	4580.89	46	5	50	1.42	0.71	13.74	15.87		1.83	6.87	1.85	8.25
29		43	2.86	11567.02	1.16	4626.81	46	5	51	1.43	0.72	13.88	16.03		1.85	6.94	1.86	8.33
30		44	2.86	11554.77	1.16	4621.91	46	5	51	1.43	0.72	13.87	16.01		1.85	6.93	1.86	8.32
31		45	2.82	11412.31	1.14	4564.92	46	5	50	1.42	0.71	13.69	15.82		1.83	6.85	1.84	8.22
32		46	2.86	11566.62	1.16	4626.65	46	5	51	1.43	0.72	13.88	16.03		1.85	6.94	1.86	8.33
33		47	2.85	11515.94	1.15	4606.38	46	5	51	1.43	0.71	13.82	15.96		1.84	6.91	1.86	8.29
34		48	3.23	13073.78	1.31	5229.51	52	5	58	1.62	0.81	15.69	18.12		2.09	7.84	2.11	9.41
35		49	2.50	10135.67	1.01	4054.27	41	4	45	1.26	0.63	12.16	14.05		1.62	6.08	1.63	7.30
36		50	2.51	10170.80	1.02	4068.32	41	4	45	1.26	0.63	12.20	14.10		1.63	6.10	1.64	7.32
37		51	2.50	10132.08	1.01	4052.83	41	4	45	1.26	0.63	12.16	14.04		1.62	6.08	1.63	7.30
38		52	6.10	24687.49	2.47	9875.00	99	10	109	3.06	1.53	29.62	34.22		3.95	14.81	3.98	17.77
39		53	6.18	25027.01	2.50	10010.80	100	10	110	3.10	1.55	30.03	34.69		4.00	15.02	4.03	18.02

S. No.	Plot Type/ No.	Area				BUA (sq.m.)	Working/ Residing Population	Floating population	Total Population	Potable (KLD)	Flushing (KLD)	Process Water (KLD)	Total Domestic Water (KLD)	AC Cooling	Washing/ Cleaning	Horticulture	Waste Water Generate	Effluent Generate
		Plot No	(Acre)	(Sq m)	(Ha)													
40		54	4.67	18892.61	1.89	7557.04	76	8	83	2.34	1.17	22.67	26.19		3.02	11.34	3.05	13.60
41		55	6.08	24594.59	2.46	9837.83	98	10	108	3.05	1.52	29.51	34.09		3.94	14.76	3.96	17.71
42		56	2.51	10143.64	1.01	4057.46	41	4	45	1.26	0.63	12.17	14.06		1.62	6.09	1.64	7.30
43		57	2.50	10135.07	1.01	4054.03	41	4	45	1.26	0.63	12.16	14.05		1.62	6.08	1.63	7.30
44		58	2.91	11774.82	1.18	4709.93	47	5	52	1.46	0.73	14.13	16.32		1.88	7.06	1.90	8.48
45		59	3.92	15867.44	1.59	6346.97	63	6	70	1.97	0.98	19.04	21.99		2.54	9.52	2.56	11.42
46		60	2.76	11159.21	1.12	4463.69	45	4	49	1.38	0.69	13.39	15.47		1.79	6.70	1.80	8.03
47		61	3.09	12500.63	1.25	5000.25	50	5	55	1.55	0.78	15.00	17.33		2.00	7.50	2.02	9.00
48		62	2.61	10565.91	1.06	4226.36	42	4	46	1.31	0.66	12.68	14.64		1.69	6.34	1.70	7.61
49		63	2.61	10558.61	1.06	4223.44	42	4	46	1.31	0.65	12.67	14.63		1.69	6.34	1.70	7.60
50		64	2.61	10566.05	1.06	4226.42	42	4	46	1.31	0.66	12.68	14.64		1.69	6.34	1.70	7.61
51		65	2.61	10558.69	1.06	4223.47	42	4	46	1.31	0.65	12.67	14.63		1.69	6.34	1.70	7.60
52		66	3.24	13116.35	1.31	5246.54	52	5	58	1.63	0.81	15.74	18.18		2.10	7.87	2.11	9.44
53		67	6.16	24931.82	2.49	9972.73	100	10	110	3.09	1.55	29.92	34.56		3.99	14.96	4.02	17.95
54		68	2.56	10375.95	1.04	4150.38	42	4	46	1.29	0.64	12.45	14.38		1.66	6.23	1.67	7.47
55		69	3.51	14208.42	1.42	5683.37	57	6	63	1.76	0.88	17.05	19.69		2.27	8.53	2.29	10.23
56		70	2.62	10614.00	1.06	4245.60	42	4	47	1.32	0.66	12.74	14.71		1.70	6.37	1.71	7.64
57		71	2.57	10405.69	1.04	4162.28	42	4	46	1.29	0.65	12.49	14.42		1.66	6.24	1.68	7.49
58		72	3.76	15220.57	1.52	6088.23	61	6	67	1.89	0.94	18.26	21.10		2.44	9.13	2.45	10.96
59		73	2.76	11166.98	1.12	4466.79	45	4	49	1.38	0.69	13.40	15.48		1.79	6.70	1.80	8.04
60		74	2.81	11356.91	1.14	4542.76	45	5	50	1.41	0.70	13.63	15.74		1.82	6.81	1.83	8.18
61		75	2.84	11484.84	1.15	4593.94	46	5	51	1.42	0.71	13.78	15.92		1.84	6.89	1.85	8.27
62		76	2.84	11501.18	1.15	4600.47	46	5	51	1.43	0.71	13.80	15.94		1.84	6.90	1.85	8.28
63		77	2.73	11053.30	1.11	4421.32	44	4	49	1.37	0.69	13.26	15.32		1.77	6.63	1.78	7.96
64		78	2.78	11248.52	1.12	4499.41	45	4	49	1.39	0.70	13.50	15.59		1.80	6.75	1.81	8.10
65		79	2.82	11396.31	1.14	4558.52	46	5	50	1.41	0.71	13.68	15.80		1.82	6.84	1.84	8.21
66		80	2.83	11449.14	1.14	4579.66	46	5	50	1.42	0.71	13.74	15.87		1.83	6.87	1.85	8.24
67		81	0.82	3325.81	0.33	1330.32	13	1	15	0.41	0.21	3.99	4.61		0.53	2.00	0.54	2.39
68		82	1.92	7758.04	0.78	3103.22	31	3	34	0.96	0.48	9.31	10.75		1.24	4.65	1.25	5.59
69		83	1.92	7761.60	0.78	3104.64	31	3	34	0.96	0.48	9.31	10.76		1.24	4.66	1.25	5.59
70		84	2.51	10141.50	1.01	4056.60	41	4	45	1.26	0.63	12.17	14.06		1.62	6.08	1.63	7.30
71		85	2.57	10390.06	1.04	4156.02	42	4	46	1.29	0.64	12.47	14.40		1.66	6.23	1.67	7.48
72		86	2.58	10455.07	1.05	4182.03	42	4	46	1.30	0.65	12.55	14.49		1.67	6.27	1.69	7.53
73		87	2.60	10519.64	1.05	4207.86	42	4	46	1.30	0.65	12.62	14.58		1.68	6.31	1.70	7.57
74		88	3.16	12770.75	1.28	5108.30	51	5	56	1.58	0.79	15.32	17.70		2.04	7.66	2.06	9.19
75	METALLIC NON METALLIC	104	3.01	12182.06	1.22	4872.82	49	5	54	1.51	0.76	6.02	8.29			7.31	1.96	3.61
76		105	3.05	12354.16	1.24	4941.66	49	5	54	1.53	0.77	6.11	8.40			7.41	1.99	3.66
77		106	3.11	12569.60	1.26	5027.84	50	5	55	1.56	0.78	6.21	8.55			7.54	2.03	3.73
78		107	3.14	12691.10	1.27	5076.44	51	5	56	1.57	0.79	6.27	8.63			7.61	2.05	3.76
79		108	3.06	12380.92	1.24	4952.37	50	5	54	1.54	0.77	6.12	8.42			7.43	2.00	3.67
80		109	2.37	9605.28	0.96	3842.11	38	4	42	1.19	0.60	4.75	6.53			5.76	1.55	2.85

S. No.	Plot Type/ No.	Area				BUA (sq.m.)	Working/ Residing Population	Floating population	Total Population	Potable (KLD)	Flushing (KLD)	Process Water (KLD)	Total Domestic Water (KLD)	AC Cooling	Washing/ Cleaning	Horticulture	Waste Water Generate	Effluent Generate
		Plot No	(Acre)	(Sq m)	(Ha)													
81		110	2.26	9140.70	0.91	3656.28	37	4	40	1.13	0.57	4.52	6.22			5.48	1.47	2.71
82		111	2.22	8969.02	0.90	3587.61	36	4	39	1.11	0.56	4.43	6.10			5.38	1.45	2.66
83		112	2.92	11826.80	1.18	4730.72	47	5	52	1.47	0.73	5.84	8.04			7.10	1.91	3.51
84		113	2.63	10628.32	1.06	4251.33	43	4	47	1.32	0.66	5.25	7.23			6.38	1.71	3.15
85		114	2.63	10628.32	1.06	4251.33	43	4	47	1.32	0.66	5.25	7.23			6.38	1.71	3.15
86		115	2.05	8297.69	0.83	3319.08	33	3	37	1.03	0.51	4.10	5.64			4.98	1.34	2.46
87		116	2.11	8520.59	0.85	3408.24	34	3	37	1.06	0.53	4.21	5.80			5.11	1.37	2.53
88		117	2.78	11270.31	1.13	4508.12	45	5	50	1.40	0.70	5.57	7.67			6.76	1.82	3.34
89		118	2.32	9403.89	0.94	3761.56	38	4	41	1.17	0.58	4.65	6.40			5.64	1.52	2.79
90		119	2.06	8335.13	0.83	3334.05	33	3	37	1.03	0.52	4.12	5.67			5.00	1.34	2.47
91		120	4.15	16779.82	1.68	6711.93	67	7	74	2.08	1.04	8.29	11.41			10.07	2.70	4.98
92		121	2.68	10845.68	1.08	4338.27	43	4	48	1.34	0.67	5.36	7.38			6.51	1.75	3.22
93		141	6.03	24387.07	2.44	9754.83	98	10	107	3.02	1.51	12.05	16.59			14.63	3.93	7.23
94		142	6.00	24295.92	2.43	9718.37	97	10	107	3.01	1.51	12.01	16.53			14.58	3.92	7.20
95		143	6.06	24518.63	2.45	9807.45	98	10	108	3.04	1.52	12.12	16.68			14.71	3.95	7.27
96		144	7.48	30253.35	3.03	12101.34	121	12	133	3.75	1.88	14.95	20.58			18.15	4.88	8.97
97		145	4.09	16558.37	1.66	6623.35	66	7	73	2.05	1.03	8.18	11.26			9.94	2.67	4.91
98		146	4.03	16319.80	1.63	6527.92	65	7	72	2.02	1.01	8.07	11.10			9.79	2.63	4.84
99		147	5.14	20785.06	2.08	8314.02	83	8	91	2.58	1.29	10.27	14.14			12.47	3.35	6.16
100		148	4.46	18044.88	1.80	7217.95	72	7	79	2.24	1.12	8.92	12.27			10.83	2.91	5.35
101		149	2.18	8842.21	0.88	3536.88	35	4	39	1.10	0.55	4.37	6.01			5.31	1.43	2.62
102		150	2.08	8424.54	0.84	3369.82	34	3	37	1.04	0.52	4.16	5.73			5.05	1.36	2.50
103		151	2.42	9795.01	0.98	3918.00	39	4	43	1.21	0.61	4.84	6.66			5.88	1.58	2.90
104		152	2.25	9102.00	0.91	3640.80	36	4	40	1.13	0.56	4.50	6.19			5.46	1.47	2.70
105		153	2.87	11595.68	1.16	4638.27	46	5	51	1.44	0.72	5.73	7.89			6.96	1.87	3.44
106		154	2.66	10746.38	1.07	4298.55	43	4	47	1.33	0.67	5.31	7.31			6.45	1.73	3.19
107		155	2.95	11935.48	1.19	4774.19	48	5	53	1.48	0.74	5.90	8.12			7.16	1.92	3.54
108		156	2.75	11118.14	1.11	4447.26	44	4	49	1.38	0.69	5.49	7.56			6.67	1.79	3.30
109		157	3.26	13187.56	1.32	5275.03	53	5	58	1.64	0.82	6.52	8.97			7.91	2.13	3.91
110		158	3.03	12263.66	1.23	4905.46	49	5	54	1.52	0.76	6.06	8.34			7.36	1.98	3.64
111		174	6.87	27811.09	2.78	11124.44	111	11	122	3.45	1.72	13.74	18.92			16.69	4.48	8.25
112		175	2.76	11168.99	1.12	4467.59	45	4	49	1.38	0.69	5.52	7.60			6.70	1.80	3.31
113		176	2.78	11256.21	1.13	4502.48	45	5	50	1.40	0.70	5.56	7.66			6.75	1.81	3.34
114		177	2.77	11197.51	1.12	4479.00	45	4	49	1.39	0.69	5.53	7.62			6.72	1.81	3.32
115		178	2.61	10548.02	1.05	4219.21	42	4	46	1.31	0.65	5.21	7.17			6.33	1.70	3.13
116		185	2.61	10557.35	1.06	4222.94	42	4	46	1.31	0.65	5.22	7.18			6.33	1.70	3.13
117		186	2.77	11208.47	1.12	4483.39	45	4	49	1.39	0.69	5.54	7.62			6.73	1.81	3.32
118		187	2.78	11267.07	1.13	4506.83	45	5	50	1.40	0.70	5.57	7.66			6.76	1.82	3.34
119		188	2.76	11179.33	1.12	4471.73	45	4	49	1.39	0.69	5.52	7.60			6.71	1.80	3.31
120		189	2.54	10264.37	1.03	4105.75	41	4	45	1.27	0.64	5.07	6.98			6.16	1.65	3.04
121		190	2.04	8235.45	0.82	3294.18	33	3	36	1.02	0.51	4.07	5.60			4.94	1.33	2.44

S. No.	Plot Type/ No.	Area				BUA (sq.m.)	Working/ Residing Population	Floating population	Total Population	Potable (KLD)	Flushing (KLD)	Process Water (KLD)	Total Domestic Water (KLD)	AC Cooling	Washing/ Cleaning	Horticulture	Waste Water Generate	Effluent Generate
		Plot No	(Acre)	(Sq m)	(Ha)													
122		191	2.05	8296.91	0.83	3318.77	33	3	37	1.03	0.51	4.10	5.64			4.98	1.34	2.46
123		192	2.04	8235.37	0.82	3294.15	33	3	36	1.02	0.51	4.07	5.60			4.94	1.33	2.44
124		193	2.51	10161.66	1.02	4064.67	41	4	45	1.26	0.63	5.02	6.91			6.10	1.64	3.01
125		194	2.51	10148.75	1.01	4059.50	41	4	45	1.26	0.63	5.02	6.90			6.09	1.64	3.01
126		205	2.04	8257.09	0.83	3302.84	33	3	36	1.02	0.51	4.08	5.62			4.95	1.33	2.45
127		206	2.05	8310.90	0.83	3324.36	33	3	37	1.03	0.52	4.11	5.65			4.99	1.34	2.46
128		207	2.04	8241.57	0.82	3296.63	33	3	36	1.02	0.51	4.07	5.61			4.94	1.33	2.44
129		208	2.67	10815.17	1.08	4326.07	43	4	48	1.34	0.67	5.34	7.36			6.49	1.74	3.21
130		209	4.66	18872.97	1.89	7549.19	75	8	83	2.34	1.17	9.33	12.84			11.32	3.04	5.60
131		210	6.27	25354.73	2.54	10141.89	101	10	112	3.14	1.57	12.53	17.25			15.21	4.09	7.52
132		211	3.07	12434.39	1.24	4973.76	50	5	55	1.54	0.77	6.15	8.46			7.46	2.00	3.69
133		212	3.50	14146.95	1.41	5658.78	57	6	62	1.75	0.88	6.99	9.62			8.49	2.28	4.19
134		213	3.37	13628.91	1.36	5451.56	55	5	60	1.69	0.84	6.74	9.27			8.18	2.20	4.04
135		221	2.88	11651.40	1.17	4660.56	47	5	51	1.44	0.72	5.76	7.93			6.99	1.88	3.45
136		222	3.10	12550.48	1.26	5020.19	50	5	55	1.56	0.78	6.20	8.54			7.53	2.02	3.72
137		223	3.84	15557.66	1.56	6223.07	62	6	68	1.93	0.96	7.69	10.58			9.33	2.51	4.61
138	TEXTILES	32	2.78	11261.14	1.13	10135.02	1014	101	1115	31.42	15.71	30.41	77.53		6.08	6.76	40.84	18.24
139		33	2.84	11490.20	1.15	10341.18	1034	103	1138	32.06	16.03	31.02	79.11		6.20	6.89	41.67	18.61
140		34	2.84	11487.50	1.15	10338.75	1034	103	1137	32.05	16.03	31.02	79.09		6.20	6.89	41.67	18.61
141		35	2.83	11460.65	1.15	10314.58	1031	103	1135	31.98	15.99	30.94	78.91		6.19	6.88	41.57	18.57
142		36	2.66	10762.67	1.08	9686.40	969	97	1066	30.03	15.01	29.06	74.10		5.81	6.46	39.04	17.44
143	ENGINEEIRING GOODS	1	2.96	11976.00	1.20	10778.40	1078	108	1186	33.41	16.71	13.32	63.44		6.47	7.19	43.44	7.99
144		2	2.25	9098.65	0.91	8188.78	819	82	901	25.39	12.69	10.12	48.20		4.91	5.46	33.00	6.07
145		3	2.42	9797.62	0.98	8817.86	882	88	970	27.34	13.67	10.89	51.90		5.29	5.88	35.54	6.54
146		4	2.43	9843.83	0.98	8859.45	886	89	975	27.46	13.73	10.95	52.14		5.32	5.91	35.70	6.57
147		5	2.45	9912.85	0.99	8921.57	892	89	981	27.66	13.83	11.02	52.51		5.35	5.95	35.95	6.61
148		6	2.56	10377.92	1.04	9340.13	934	93	1027	28.95	14.48	11.54	54.97		5.60	6.23	37.64	6.92
149		7	2.57	10393.17	1.04	9353.86	935	94	1029	29.00	14.50	11.56	55.05		5.61	6.24	37.70	6.93
150		8	2.58	10431.31	1.04	9388.18	939	94	1033	29.10	14.55	11.60	55.25		5.63	6.26	37.83	6.96
151		9	2.59	10476.57	1.05	9428.92	943	94	1037	29.23	14.61	11.65	55.49		5.66	6.29	38.00	6.99
152		135	8.43	34115.72	3.41	30704.15	3070	307	3377	95.18	47.59	37.94	180.71		18.42	20.47	123.74	22.76
153		179	2.21	8935.83	0.89	8042.24	804	80	885	24.93	12.47	9.94	47.33		4.83	5.36	32.41	5.96
154		180	1.38	5566.33	0.56	5009.70	501	50	551	15.53	7.77	6.19	29.48		3.01	3.34	20.19	3.71
155		181	2.17	8799.57	0.88	7919.61	792	79	871	24.55	12.28	9.78	46.61		4.75	5.28	31.92	5.87
156		182	2.56	10341.93	1.03	9307.74	931	93	1024	28.85	14.43	11.50	54.78		5.58	6.21	37.51	6.90
157		183	2.63	10626.08	1.06	9563.47	956	96	1052	29.65	14.82	11.82	56.29		5.74	6.38	38.54	7.09
158		184	2.63	10637.39	1.06	9573.65	957	96	1053	29.68	14.84	11.83	56.35		5.74	6.38	38.58	7.10
159		195	2.51	10148.51	1.01	9133.66	913	91	1005	28.31	14.16	11.28	53.76		5.48	6.09	36.81	6.77
160		196	2.51	10148.27	1.01	9133.44	913	91	1005	28.31	14.16	11.28	53.76		5.48	6.09	36.81	6.77
161		197	2.51	10148.04	1.01	9133.23	913	91	1005	28.31	14.16	11.28	53.75		5.48	6.09	36.81	6.77
162		198	2.48	10041.56	1.00	9037.40	904	90	994	28.02	14.01	11.17	53.19		5.42	6.02	36.42	6.70

S. No.	Plot Type/ No.	Plot No	Area (Acre)	Area (Sq m)	Area (Ha)	BUA (sq.m.)	Working/ Residing Population	Floating population	Total Population	Potable (KLD)	Flushing (KLD)	Process Water (KLD)	Total Domestic Water (KLD)	AC Cooling	Washing/ Cleaning	Horticulture	Waste Water Generate	Effluent Generate
163		199	4.08	16530.51	1.65	14877.46	1488	149	1637	46.12	23.06	18.38	87.56		8.93	9.92	59.96	11.03
164		200	4.27	17298.65	1.73	15568.78	1557	156	1713	48.26	24.13	19.24	91.63		9.34	10.38	62.74	11.54
165		201	4.23	17110.41	1.71	15399.37	1540	154	1694	47.74	23.87	19.03	90.63		9.24	10.27	62.06	11.42
166		202	3.51	14198.63	1.42	12778.76	1278	128	1406	39.61	19.81	15.79	75.21		7.67	8.52	51.50	9.47
167		203	1.91	7727.31	0.77	6954.58	695	70	765	21.56	10.78	8.59	40.93		4.17	4.64	28.03	5.16
168		204	1.89	7644.42	0.76	6879.98	688	69	757	21.33	10.66	8.50	40.49		4.13	4.59	27.73	5.10
169		214	3.07	12441.95	1.24	11197.76	1120	112	1232	34.71	17.36	13.84	65.90		6.72	7.47	45.13	8.30
170		215	3.01	12165.37	1.22	10948.83	1095	109	1204	33.94	16.97	13.53	64.44		6.57	7.30	44.12	8.12
171		216	3.14	12700.33	1.27	11430.30	1143	114	1257	35.43	17.72	14.12	67.27		6.86	7.62	46.06	8.47
172		217	4.17	16895.15	1.69	15205.63	1521	152	1673	47.14	23.57	18.79	89.49		9.12	10.14	61.28	11.27
173		218	2.85	11550.18	1.16	10395.17	1040	104	1143	32.23	16.11	12.84	61.18		6.24	6.93	41.89	7.71
174		219	2.72	11021.57	1.10	9919.41	992	99	1091	30.75	15.38	12.26	58.38		5.95	6.61	39.98	7.35
175		220	2.92	11816.68	1.18	10635.01	1064	106	1170	32.97	16.48	13.14	62.59		6.38	7.09	42.86	7.88
176	CHEMICAL AND PETRO CHEMICALS	89	12.32	49862.46	4.99	44876.21	4488	449	4936	139.12	69.56	134.63	343.30	269.26	26.93	29.92	180.85	80.78
177		90	12.58	50898.22	5.09	45808.40	4581	458	5039	142.01	71.00	137.43	350.43	274.85	27.49	30.54	184.61	82.46
178		91	11.90	48140.22	4.81	43326.20	4333	433	4766	134.31	67.16	129.98	331.45	259.96	26.00	28.88	174.60	77.99
179		92	13.82	55932.10	5.59	50338.89	5034	503	5537	156.05	78.03	151.02	385.09	302.03	30.20	33.56	202.87	90.61
180		93	3.15	12765.59	1.28	11489.03	1149	115	1264	35.62	17.81	34.47	87.89	68.93	6.89	7.66	46.30	20.68
181		94	2.08	8404.17	0.84	7563.76	756	76	832	23.45	11.72	22.69	57.86	45.38	4.54	5.04	30.48	13.61
182		95	2.51	10142.75	1.01	9128.47	913	91	1004	28.30	14.15	27.39	69.83	54.77	5.48	6.09	36.79	16.43
183		96	2.55	10331.30	1.03	9298.17	930	93	1023	28.82	14.41	27.89	71.13	55.79	5.58	6.20	37.47	16.74
184		97	2.55	10331.17	1.03	9298.05	930	93	1023	28.82	14.41	27.89	71.13	55.79	5.58	6.20	37.47	16.74
185		98	2.55	10331.14	1.03	9298.03	930	93	1023	28.82	14.41	27.89	71.13	55.79	5.58	6.20	37.47	16.74
186		99	2.55	10331.48	1.03	9298.33	930	93	1023	28.82	14.41	27.89	71.13	55.79	5.58	6.20	37.47	16.74
187		100	3.65	14763.63	1.48	13287.26	1329	133	1462	41.19	20.60	39.86	101.65	79.72	7.97	8.86	53.55	23.92
188		101	2.03	8229.14	0.82	7406.22	741	74	815	22.96	11.48	22.22	56.66	44.44	4.44	4.94	29.85	13.33
189		102	2.08	8409.44	0.84	7568.50	757	76	833	23.46	11.73	22.71	57.90	45.41	4.54	5.05	30.50	13.62
190		103	3.03	12247.44	1.22	11022.70	1102	110	1212	34.17	17.09	33.07	84.32	66.14	6.61	7.35	44.42	19.84
191		122	2.48	10045.33	1.00	9040.80	904	90	994	28.03	14.01	27.12	69.16	54.24	5.42	6.03	36.43	16.27
192		123	2.45	9929.81	0.99	8936.83	894	89	983	27.70	13.85	26.81	68.37	53.62	5.36	5.96	36.02	16.09
193		124	2.63	10628.98	1.06	9566.08	957	96	1052	29.65	14.83	28.70	73.18	57.40	5.74	6.38	38.55	17.22
194		125	6.23	25199.52	2.52	22679.57	2268	227	2495	70.31	35.15	68.04	173.50	136.08	13.61	15.12	91.40	40.82
195		126	11.18	45249.09	4.52	40724.18	4072	407	4480	126.24	63.12	122.17	311.54	244.35	24.43	27.15	164.12	73.30
196		127	11.94	48328.64	4.83	43495.78	4350	435	4785	134.84	67.42	130.49	332.74	260.97	26.10	29.00	175.29	78.29
197		128	12.44	50338.42	5.03	45304.58	4530	453	4984	140.44	70.22	135.91	346.58	271.83	27.18	30.20	182.58	81.55
198		129	12.73	51497.73	5.15	46347.96	4635	463	5098	143.68	71.84	139.04	354.56	278.09	27.81	30.90	186.78	83.43
199		130	8.86	35869.70	3.59	32282.73	3228	323	3551	100.08	50.04	96.85	246.96	193.70	19.37	21.52	130.10	58.11
200		165	9.56	38705.22	3.87	34834.70	3483	348	3832	107.99	53.99	104.50	266.49	209.01	20.90	23.22	140.38	62.70
201		166	16.19	65502.21	6.55	58951.99	5895	590	6485	182.75	91.38	176.86	450.98	353.71	35.37	39.30	237.58	106.11
202		167	22.45	90869.82	9.09	81782.83	8178	818	8996	253.53	126.76	245.35	625.64	490.70	49.07	54.52	329.58	147.21
203		168	9.37	37935.95	3.79	34142.36	3414	341	3756	105.84	52.92	102.43	261.19	204.85	20.49	22.76	137.59	61.46

S. No.	Plot Type/ No.	Plot No	Area (Acre)	Area (Sq m)	Area (Ha)	BUA (sq.m.)	Working/ Residing Population	Floating population	Total Population	Potable (KLD)	Flushing (KLD)	Process Water (KLD)	Total Domestic Water (KLD)	AC Cooling	Washing/ Cleaning	Horticulture	Waste Water Generate	Effluent Generate
204		169	13.46	54473.06	5.45	49025.76	4903	490	5393	151.98	75.99	147.08	375.05	294.15	29.42	32.68	197.57	88.25
205		170	11.49	46509.10	4.65	41858.19	4186	419	4604	129.76	64.88	125.57	320.22	251.15	25.11	27.91	168.69	75.34
206		171	11.46	46358.48	4.64	41722.63	4172	417	4589	129.34	64.67	125.17	319.18	250.34	25.03	27.82	168.14	75.10
207	RENEWABLE ENERGY	131	33.94	137334.61	13.73	137334.61	7	1	8	0.21	0.11		0.32			0.00	0.28	0.00
208		132	26.57	107538.96	10.75	107538.96	5	1	6	0.17	0.08		0.25			0.00	0.22	0.00
209		133	31.69	128253.11	12.83	128253.11	6	1	7	0.20	0.10		0.30			0.00	0.26	0.00
210		134	22.37	90530.67	9.05	90530.67	5	0	5	0.14	0.07		0.21			0.00	0.18	0.00
211		136	33.78	136721.45	13.67	136721.45	7	1	8	0.21	0.11		0.32			0.00	0.28	0.00
212		137	25.72	104086.03	10.41	104086.03	5	1	6	0.16	0.08		0.24			0.00	0.21	0.00
213		138	9.32	37720.06	3.77	37720.06	2	0	2	0.06	0.03		0.09			0.00	0.08	0.00
214		139	21.62	87485.07	8.75	87485.07	4	0	5	0.14	0.07		0.20			0.00	0.18	0.00
215		140	22.05	89242.27	8.92	89242.27	4	0	5	0.14	0.07		0.21			0.00	0.18	0.00
216		159	20.15	81564.39	8.16	81564.39	4	0	4	0.13	0.06		0.19			0.00	0.16	0.00
217		160	22.31	90293.83	9.03	90293.83	5	0	5	0.14	0.07		0.21			0.00	0.18	0.00
218		161	28.89	116928.07	11.69	116928.07	6	1	6	0.18	0.09		0.27			0.00	0.24	0.00
219		162	24.81	100403.95	10.04	100403.95	5	1	6	0.16	0.08		0.23			0.00	0.20	0.00
220		163	30.25	122424.64	12.24	122424.64	6	1	7	0.19	0.09		0.28			0.00	0.25	0.00
221		164	37.19	150505.81	15.05	150505.81	8	1	8	0.23	0.12		0.35			0.00	0.30	0.00
222		172	23.68	95835.47	9.58	95835.47	5	0	5	0.15	0.07		0.22			0.00	0.19	0.00
223		173	29.61	119822.87	11.98	119822.87	6	1	7	0.19	0.09		0.28			0.00	0.24	0.00
TOTAL (PROCESSING AREA)																		
B	**NON-PROCESSING AREA**																	
1	GENERAL PARKING	P-1	2.49	10078.02	1.01	7054.62	235	24	259	7.29	3.64		10.93		1.41	0.00	9.48	0.00
2		P-2	2.55	10338.60	1.03	7237.02	241	24	265	7.48	3.74		11.22		1.45	0.00	9.72	0.00
3		P-3	2.23	9037.49	0.90	6326.24	211	21	232	6.54	3.27		9.81		1.27	0.00	8.50	0.00
4		P-4	2.93	11844.94	1.18	8291.46	276	28	304	8.57	4.28		12.85		1.66	0.00	11.14	0.00
5		P-5	4.81	19473.12	1.95	13631.18	454	45	500	14.09	7.04		21.13		2.73	0.00	18.31	0.00
6		P-6	9.91	40086.78	4.01	28060.75	935	94	1029	29.00	14.50		43.49		5.61	0.00	37.69	0.00
7		P-7	27.44	111064.30	11.11	77745.01	2592	259	2851	80.34	40.17		120.50		15.55	0.00	104.44	0.00

S. No.	Plot Type/ No.	Plot No	Area (Acre)	Area (Sq m)	Area (Ha)	BUA (sq.m.)	Working/ Residing Population	Floating population	Total Population	Potable (KLD)	Flushing (KLD)	Process Water (KLD)	Total Domestic Water (KLD)	AC Cooling	Washing/ Cleaning	Horticulture	Waste Water Generate	Effluent Generate
8		P-8	6.53	26425.32	2.64	18497.72	617	62	678	19.11	9.56		28.67		3.70	0.00	24.85	0.00
9		P-9	2.72	11005.45	1.10	7703.81	257	26	282	7.96	3.98		11.94		1.54	0.00	10.35	0.00
10		P-10	3.37	13646.81	1.36	9552.77	318	32	350	9.87	4.94		14.81		1.91	0.00	12.83	0.00
11		P-11	1.99	8053.97	0.81	5637.78	188	19	207	5.83	2.91		8.74		1.13	0.00	7.57	0.00
12		P-12	10.47	42366.20	4.24	29656.34	989	99	1087	30.64	15.32		45.97		5.93	0.00	39.84	0.00
13		P-13	1.29	5228.31	0.52	3659.81	122	12	134	3.78	1.89		5.67		0.73	0.00	4.92	0.00
14		P-14	1.29	5210.30	0.52	3647.21	122	12	134	3.77	1.88		5.65		0.73	0.00	4.90	0.00
15		P-15	11.90	48137.76	4.81	33696.43	1123	112	1236	34.82	17.41		52.23		6.74	0.00	45.27	0.00
16		P-16	4.32	17481.74	1.75	12237.22	408	41	449	12.65	6.32		18.97		2.45	0.00	16.44	0.00
17		P-17	3.19	12892.34	1.29	9024.64	301	30	331	9.33	4.66		13.99		1.80	0.00	12.12	0.00
18		P-18	1.59	6450.39	0.65	4515.27	151	15	166	4.67	2.33		7.00		0.90	0.00	6.07	0.00
19		P-19	3.82	15445.73	1.54	10812.01	360	36	396	11.17	5.59		16.76		2.16	0.00	14.52	0.00
20		P-20	10.54	42664.51	4.27	29865.15	996	100	1095	30.86	15.43		46.29		5.97	0.00	40.12	0.00
21		P-21	6.91	27971.62	2.80	19580.14	653	65	718	20.23	10.12		30.35		3.92	0.00	26.30	0.00
22		P-22	6.75	27313.76	2.73	19119.63	637	64	701	19.76	9.88		29.64		3.82	0.00	25.68	0.00
23	COMMERCIAL	C-1	3.43	13899.36	1.39	5559.74	371	37	408	9.45	7.78		17.24	27.80	1.11	5.56	15.34	0.00
24		C-2	2.29	9255.13	0.93	3702.05	247	25	271	6.29	5.18		11.48	18.51	0.74	3.70	10.22	0.00
25		C-3	1.22	4923.26	0.49	1969.31	131	13	144	3.35	2.76		6.10	9.85	0.39	1.97	5.44	0.00
26		C-4	3.87	15672.20	1.57	6268.88	418	42	460	10.66	8.78		19.43	31.34	1.25	6.27	17.30	0.00
27		C-5	2.63	10625.91	1.06	4250.37	283	28	312	7.23	5.95		13.18	21.25	0.85	4.25	11.73	0.00
28		C-6	7.69	31111.85	3.11	12444.74	830	83	913	21.16	17.42		38.58	62.22	2.49	12.44	34.35	0.00
29		C-7	3.48	14102.42	1.41	5640.97	376	38	414	9.59	7.90		17.49	28.20	1.13	5.64	15.57	0.00
30		C-8	4.78	19336.15	1.93	7734.46	516	52	567	13.15	10.83		23.98	38.67	1.55	7.73	21.35	0.00
31		C-9	5.34	21612.03	2.16	8644.81	576	58	634	14.70	12.10		26.80	43.22	1.73	8.64	23.86	0.00
32		C-10	1.56	6310.34	0.63	2524.14	168	17	185	4.29	3.53		7.82	12.62	0.50	2.52	6.97	0.00
33		C-11	2.61	10564.60	1.06	4225.84	282	28	310	7.18	5.92		13.10	21.13	0.85	4.23	11.66	0.00
34		C-12	1.56	6304.19	0.63	2521.68	168	17	185	4.29	3.53		7.82	12.61	0.50	2.52	6.96	0.00
35		C-13	4.39	17780.25	1.78	7112.10	474	47	522	12.09	9.96		22.05	35.56	1.42	7.11	19.63	0.00
36		C-14	1.54	6213.50	0.62	2485.40	166	17	182	4.23	3.48		7.70	12.43	0.50	2.49	6.86	0.00
37		C-15	3.04	12316.85	1.23	4926.74	328	33	361	8.38	6.90		15.27	24.63	0.99	4.93	13.60	0.00
38		C-16	2.07	8393.28	0.84	3357.31	224	22	246	5.71	4.70		10.41	16.79	0.67	3.36	9.27	0.00
39		C-17	2.28	9215.18	0.92	3686.07	246	25	270	6.27	5.16		11.43	18.43	0.74	3.69	10.17	0.00
40	UTILITIES	UT-1	5.76	23315.62	2.33	2331.56	23	2	26	0.72	0.36		1.08			9.33	0.94	0.00
41		UT-2	3.60	14579.65	1.46	1457.96	15	1	16	0.45	0.23		0.68			5.83	0.59	0.00
42		UT-3	3.15	12753.80	1.28	1275.38	13	1	14	0.40	0.20		0.59			5.10	0.51	0.00
43		UT-4	5.80	23454.99	2.35	2345.50	23	2	26	0.73	0.36		1.09			9.38	0.95	0.00
44		UT-5	3.70	14976.32	1.50	1497.63	15	1	16	0.46	0.23		0.70			5.99	0.60	0.00
45		UT-6	2.72	11024.08	1.10	1102.41	11	1	12	0.34	0.17		0.51			4.41	0.44	0.00
46		UT-7	3.72	15067.26	1.51	1506.73	15	2	17	0.47	0.23		0.70			6.03	0.61	0.00
47	PUBLIC SEMIPUBLIC	PSP-1	1.53	6191.67	0.62	2476.67	165	17	182	5.12	2.56		7.68		0.50	2.48	6.65	0.00
48		PSP-2	3.55	14358.57	1.44	5743.43	383	38	421	11.87	5.93		17.80		1.15	5.74	15.43	0.00

S. No.	Plot Type/ No.	Plot No	Area (Acre)	Area (Sq m)	Area (Ha)	BUA (sq.m.)	Working/ Residing Population	Floating population	Total Population	Potable (KLD)	Flushing (KLD)	Process Water (KLD)	Total Domestic Water (KLD)	AC Cooling	Washing/ Cleaning	Horticulture	Waste Water Generate	Effluent Generate
49		PSP-3	2.49	10057.30	1.01	4022.92	268	27	295	8.31	4.16		12.47		0.80	4.02	10.81	0.00
50		PSP-4	4.17	16868.43	1.69	6747.37	450	45	495	13.94	6.97		20.92		1.35	6.75	18.13	0.00
51		PSP-5	4.37	17704.23	1.77	7081.69	472	47	519	14.64	7.32		21.95		1.42	7.08	19.03	0.00
52		PSP-6	1.70	6878.91	0.69	2751.56	183	18	202	5.69	2.84		8.53		0.55	2.75	7.39	0.00
53		PSP-7	3.47	14062.82	1.41	5625.13	375	38	413	11.63	5.81		17.44		1.13	5.63	15.11	0.00
54		PSP-8	1.78	7192.26	0.72	2876.90	192	19	211	5.95	2.97		8.92		0.58	2.88	7.73	0.00
55		PSP-9	3.82	15444.36	1.54	6177.74	412	41	453	12.77	6.38		19.15		1.24	6.18	16.60	0.00
56	HOUSING PLOTS/ RESIDENTIAL AREA		136.25	551391.62	55.14	275695.81	22056	2206	24261	2348.93	1058.67		3407.60			220.56	2937.81	0.00
TOTAL NON-PROCESSING AREA																		
C	**ROAD AND OPEN SPACES**																	
1	GREEN BELT -15M ALONG SITE (variable)*		48.71	197136.92	19.71											788.55		
2	WATERBODY BUFFER		12.29	49733.70	4.97											198.93		
3	Stream Buffer		45.41	183754.66	18.38											735.02		
4	ORGANIZED GREEN		186.99	756721.29	75.67											2875.54		
5	EXISTING WATERBODY		166.93	675558.82	67.56													
6	ROADS		337.24	1364771.29	136.48										272.95			
7	HT LINE AREA		79.32	321009.18	32.10													
8	Stream		76.81	310850.00	31.09													
9	Railway Buffer Line		54.16	219170.69	21.92													
TOTAL ROAD AND OPEN SPACES			**1007.87**	**4078706.55**	**407.87**	**0.00**	**0**	**0**	**0**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**272.95**	**4598.04**	**0.00**	**0.00**
TOTAL (A+B+C)			**2595.74**	**10504615.19**	**1050.46**	**4543601.97**	**179097**	**17910**	**197006**	**7185.28**	**3524.73**	**4698.31**	**15408.32**	**5773.50**	**1286.49**	**6863.65**	**9272.96**	**2818.99**

4.1.1 External Water supply (raw water)

The total required allocation of water (approximately) is 39.0 MLD. Based on discussions with State Nodal Agency, it was gathered that the Water Resources Department, GoAP has allocated 0.60 TMC (20 cusecs, or 46 MLD) of water to Kopparthy Mega Industrial Hub utilizing the existing infrastructure of RTTP Supply Scheme up to Mydukuru, instead of existing allocation from Somasila Reservoir to APIIC.

From Mydukuru water will be taken to the summer storage tanks of the site location through around 36 Kms of water supply pipeline system. For Kopparthy Industrial area(KIA), water supply pipe line of 8.18 kms is proposed from SS Tank located to the north of our site, connecting to SS Tank in the KIA by using 500 mm dia D.I. K9 gravity main. The schematic flow diagram is detailed below.

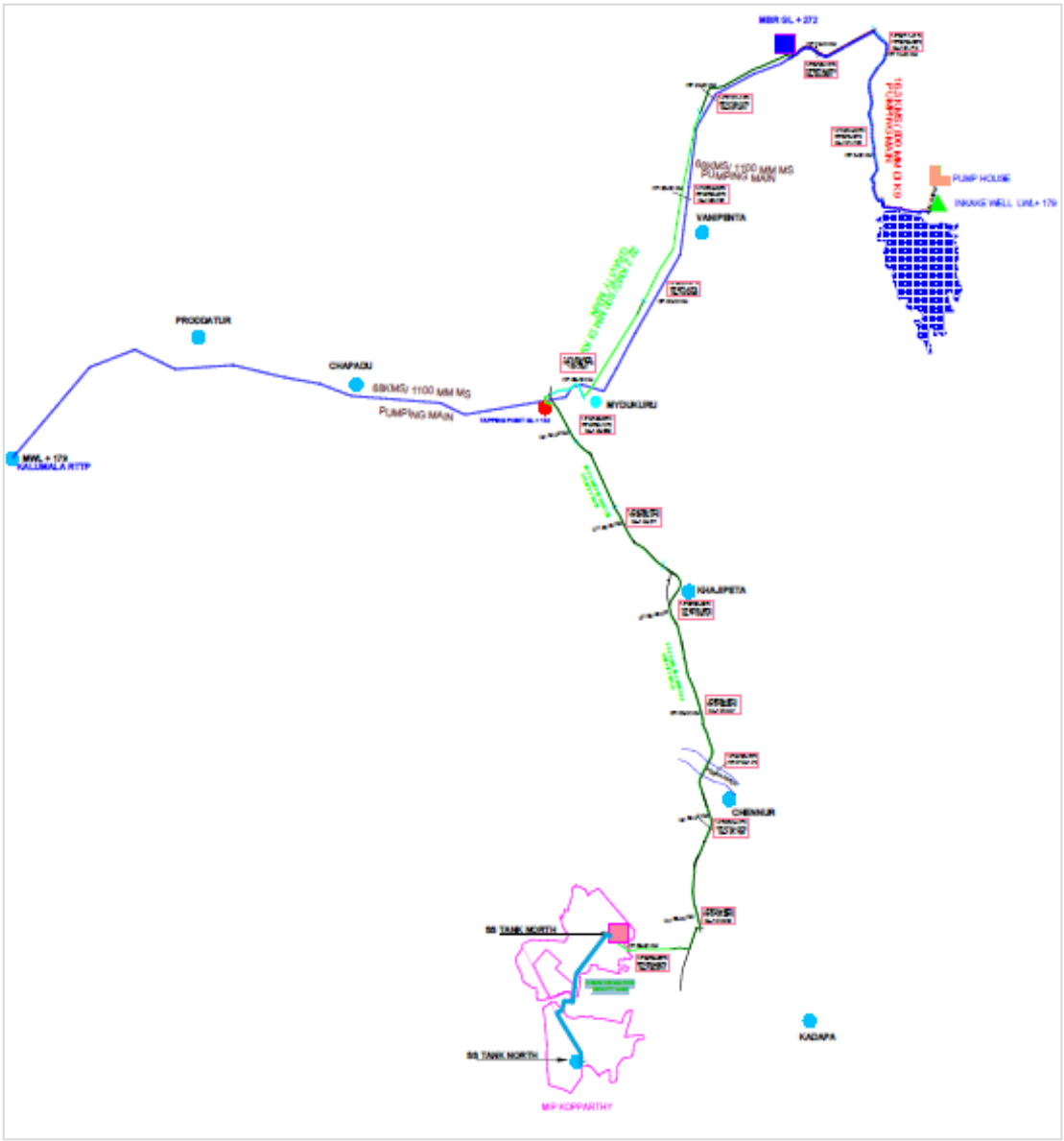


FIGURE 4-3 SCHEMATIC FLOW DIAGRAM OF INTAKE TO MIP KOPPARTHY SS TANK

4.1.2 Proposed Water Supply System

The proposed water supply system components follow:

- Intake well of 10.00 dia. is proposed at Summer Storage Tank (SST) to the WTP.
- Raw Water Pumping main is proposed to be connected to 15 MLD WTP and 1105 ML SST.
- 3 nos (2W + 1S) Vertical Turbine Pumps of 55 kw capacity each is proposed in intake well to pump raw water from intake well to WTP.
- A Rapid Gravity Filtration Water Treatment Plan of 15 MLD capacity is proposed.
- A Clear water sump of 3000 kl is proposed at WTP
- 3 nos (2W + 1S) HSC Pumps of 50 kw each capacity is proposed to pump clear water from clear water sump to 4 nos 1500 kl OHSRs.
- 4 Clear water OHSRs is proposed to supply to water to the entire distribution network.
- The proposed pipe materials are DI & HDPE pipe for the distribution system.

4.1.3 Proposed Water Treatment Plant

Water Treatment Plant of 15 MLD is proposed at Project premisses.

Proposed Water treatment plant consists of below mentioned units:

- Cascade aerator
- Chemical house
- Alum solution tank
- Flash mixer
- Clariflocculator
- Filter bed
- Back wash water storage tank
- Sludge collection tank
- Chlorine house, Chlorinators, Chlorine cylinders.
- Chlorine contact tank
- Clear water storage tank
- Transformer yard
- Laboratory
- Pump sets for wash water, used water recycling, sludge pumps, motors at chemical house, flash-mixer, clari- flocculates, and air compressors.

TABLE 4-3: DRINKING WATER QUALITY PARAMETERS

S. No.	Parameters	Acceptable*	Cause for Rejection**
1	Turbidity NTU	1	10
2	Color (units on Pt/Co scale)	5	25
3	Taste and odour	Unobjectionable	objectionable
4	pH	7-8.5	< 6.5 or >9.2
5	Total dissolved solids mg/l	500	2000
6	Total hardness (as CaCo3) mg/l	200	600
7	Chlorides (as Cl) mg/l	200	1000
8	Sulphate (as SO4) mg/l	200	400
9	Fluorides (as F) mg/l	1	1.5
10	Nitrates (as NO3) mg/l	45	45
11	Calcium (as Ca) mg/l	75	200
12	Magnesium (as Mg) mg/l	<=30	150
If there are 250 mg/l of sulphates, Mg content can be increased to a maximum of 125 mg/l with the reduction of sulphates at the rate of 1 unit per every 2.5 units of sulphates			
13	Iron (as Fe) mg/l	0.1	1
14	Manganese (as Mn) mg/l	0.05	0.5
15	Copper (as Cu) mg/l	0.05	1.5
16	Aluminum (as Al)	0.03	0.2
17	Alkalinity (as CaCo3) mg/l	200	600
18	Residual Chlorine (mg/l)	0.2	>1.0
19	Zinc (as Zn) mg/l	5	15
20	Phenolic compounds (as phenol) mg/l	0.001	0.002
21	Anionic Detergents (as MBAS) mg/l	0.2	1
22	Mineral oil mg/l	0.01	0.03
Toxic Materials			
23	Arsenic (as As) mg/l	0.01	0.05
24	Cadmium (as Cd) mg/l	0.01	0.01
25	Chromium (as hexavalent Cr) mg/l	0.05	0.05
26	Cyanide (as CN) mg/l	0.05	0.05
27	Lead (as Pb) mg/l	0.05	0.05
28	Selenium (as Se) mg/l	0.01	0.01
29	Mercury (total as Hg) mg/l	0.001	0.001

S. No.	Parameters	Acceptable*	Cause for Rejection**
30	Poly nuclear aromatic hydro carbons (PAH), µg/l	0.2	0.2
31	Pesticides (total, mg/l)	Absent	Refer WHO guidelines for drinking water quality Vol I- 1993
Radioactivity			
32	Gross Alpha activity (Bq/l)	0.1	0.1
33	Gross Beta activity (Bq/l)	1	1
**** The figures indicated under the column 'Acceptable' are the limits up to which water is generally acceptable to consumers***			
***** Figures in excess of those mentioned under 'Acceptable' render the water not acceptable , but still may be tolerated in the absence of an alternative and better source up to the limits indicated under column 'cause for rejection' above which source will have to be rejected***			
It is possible that some mine and spring waters may exceed these radio activity limits and in such cases it is necessary to analyse the individual radio-nuclides in order to assess the acceptability or otherwise for public consumption			
Source: CPHEEO Manual 1999			

4.1.4 Storage Requirement

Sump will have 2 hour's storage capacity. Elevated level service reservoir, will have 8 hour's storage capacity.

4.1.5 Pumping mains

Hazen - Williams's formula is used for the design of pumping mains. Most economical size of pumping main will be based on proper analysis of following factors:

a) Different pipe sizes
b) Duty, capacity and installed cost of the pump sets required against the corresponding pipe sizes considered
c) The recurring cost on energy charges, cost of repairs and renewables, cost of miscellaneous consumable stores, etc.,

Ductile Iron Pipe (DI-K9) pipes are recommended for pumping mains.

4.1.6 Design Brief

The collection system will be designed based on CPHEEO manual 1999 and using Water GEMS software.

4.1.7 Design formula

The Hazen – Williams's formula is expressed as

Q= 1.292 * 10-5 * C* d 2.63 S 0.54

Where,

Q = discharge in cubic meter per hour

d = diameter of pipe in mm

C= Hazen Williams coefficient

S = Slope of Hydraulic grade line

4.1.8 Minimum pipe size

Minimum pipe size of 75 mm is considered for design of distribution mains & 200 mm will be considered for pumping mains.

4.1.9 Velocity

For pumping mains, minimum velocity of 0.6 m/s and maximum velocity of 2.0 m/s is considered. Velocity with a maximum limit of 1.5 m/s is considered for design of gravity mains

4.1.10 Peak Factor

Peak factor as per the CPHEEO's guidelines is as follows:

TABLE 4-4: PEAK FACTOR

S. No.	Contributory population	Peak factor
1	Less than 50,000	3.0
2	50,000 to 200,000	2.5
3	Above 200,000	2.0

Hence, Peak Factor of 2.5 to be considered for design.

4.1.11 Residual Pressure

Distribution system is designed for minimum residual pressure at ferrule point. The minimum residual pressures at ferrule point as per CPHEEO manual 1999 is given below.

Table 4-5: Residual Pressure

S. No.	Type of building	Minimum Residual pressure at ferrule
1	Single Storey building	7m
2	Double Storey building	12m
3	Three Storey building	17m
4	Multi Storey building	Boosters to be provided for high pressures

Minimum Residual Pressure of 12m is considered for distribution network.

4.1.12 Pipe Material

The selection of pipe material depends on various technical factors such as internal pressures, coefficient of roughness, hydraulic and operating conditions, maximum permissible diameter, internal and external corrosion problem, laying and jointing, type of soil, special conditions etc.,

4.1.13 Hazen Williams Coefficient

The following values are adopted as per CPHEEO Manual 1999 on water supply.

TABLE 4-6: HAZEN WILLIAMS COEFFICIENT

S. No.	Material	Hazen-Williams C
1	Ductile Iron (DI)	130
2	High Density Polyethylene (HDPE)	140

Distribution System for Potable Water

The distribution system for potable water shall be planned based on CPHEEO recommendations for potable water. HDPE Pipe (PN-6) and Ductile Iron (D.I. K-9) pipes are recommended for distribution system. Up to 180 mm dia HDPE Pipes (PN-6) is Considered & Above 180 mm dia Ductile Iron Pipes (DI.K-9) has been considered and designed the system. The detailed pipe summary & Layout of the Water Supply network for the proposed system is furnished below.

TABLE 4-7: POTABLE WATER PIPE TABLE SUMMARY

Diameter	Material/Class	Length (m)
75	HDPE PN-6	32,783
90	HDPE PN-6	3,691
110	HDPE PN-6	4,730
125	HDPE PN-6	6,669
140	HDPE PN-6	4,360
160	HDPE PN-6	1,489
180	HDPE PN-6	1,107
200	D.I K-9	0
250	D.I K-9	0
300	D.I K-9	6,352
350	D.I K-9	907
400	D.I K-9	0
500	D.I K-9	0
600	D.I K-9	100
	Total Length (mts)	**63,169**

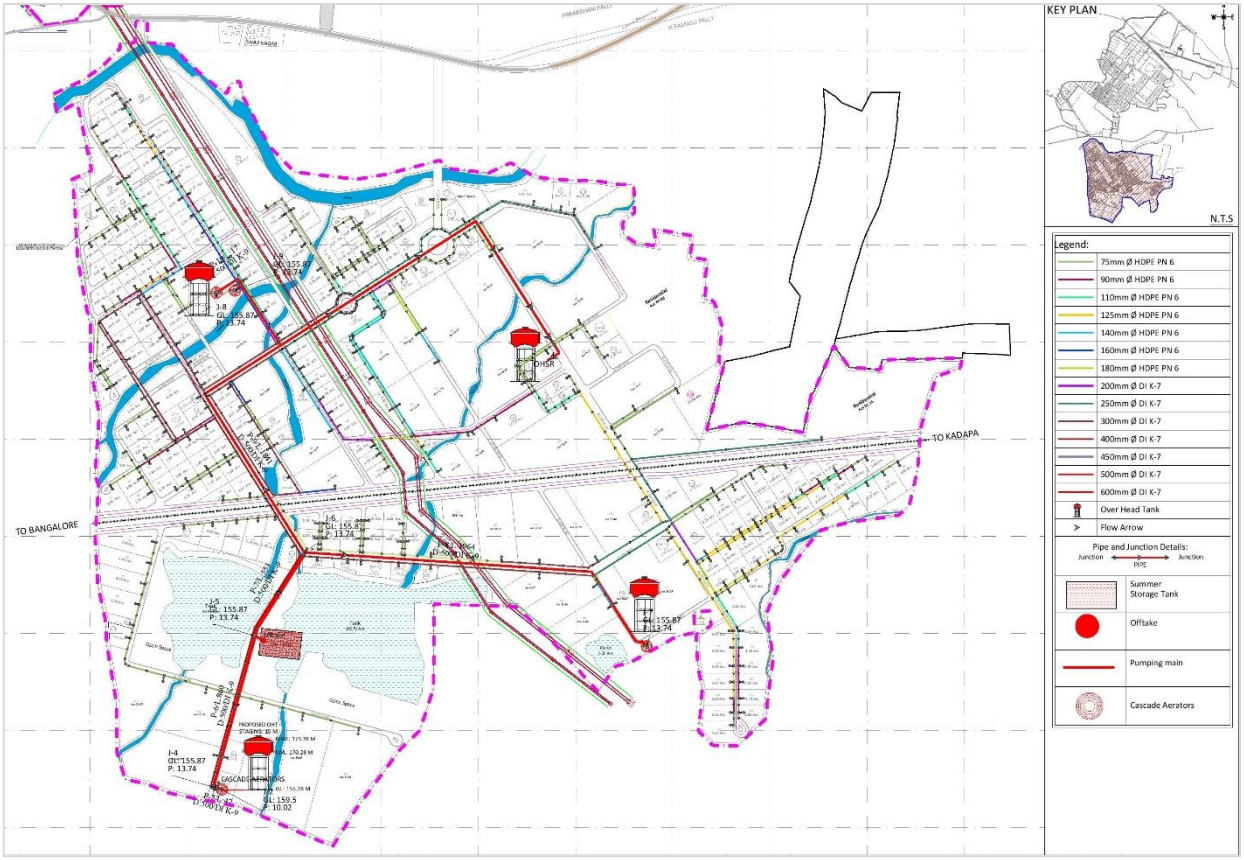


FIGURE 4-4 LAYOUT OF THE WATER SUPPLY NETWORK

4.2 Recycled Water System

Water Balance is achieved considering that Re-cycled water demand comprising cooling water demand, horticulture demand and Washing/ Cleaning will be met from the re-cycled water generated from Treatment Plant (CETP and STP). Waste water generation from various sources has been identified and estimated. Based on the treated water available from the CETP and STP the recycling water demand is calculated and furnished below.

TABLE 4-8: RECYCLED WATER DEMAND

Description	Demand	Units
Total		
Horticulture Demand	7.89	MLD
Washing Demand	1.48	MLD
AC cooling Demand	6.64	MLD
Available recycle water demand	12.52	MLD
Deficit	-3.50	**MLD**

The above water demand table outlines the gross water requirement for horticulture, washing cleaning and AC cooling services. The total available recycle water demand for the project area is 12.52 MLD.

4.2.1 Recycle Water Summary:

The total recycle water generation for KIA is 12.52 MLD. The effluent generation 3.24 MLD and the waste water generated is 10.66 MLD. A Layout of the Recycled treated water network for the proposed system is furnished below.

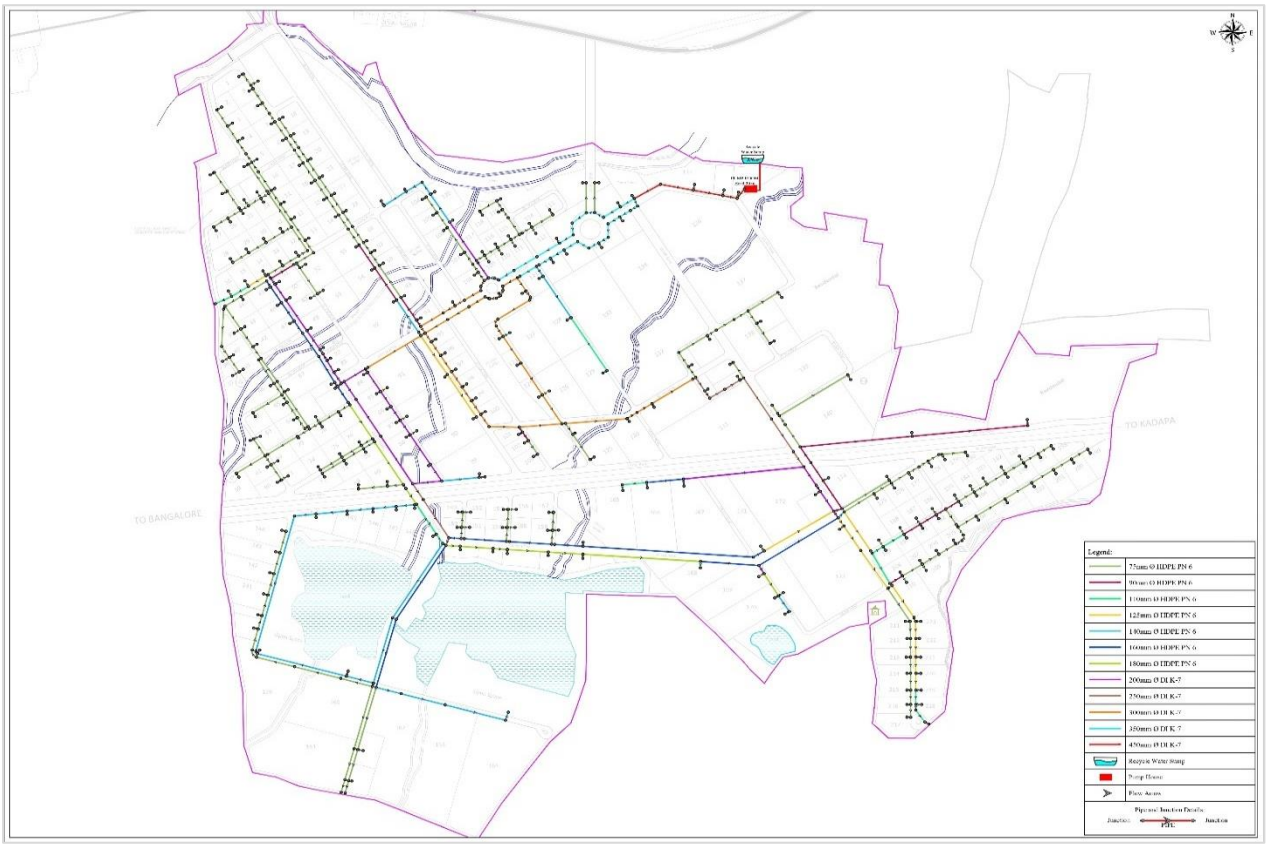


FIGURE 4-5: LAYOUT OF THE RECYCLED TREATED WATER NETWORK

4.2.2 Distribution System for Recycle Water

HDPE Pipe (PN-6) and Ductile Iron (DI.K-9) pipes are recommended for distribution system. Up to 180 mm dia HDPE Pipes (PN-6) is Considered & Above 180 mm dia Ductile Iron Pipes (DI.K-9) has been considered and designed the system. The detailed pipe summary & Layout of the Water Supply network for the proposed system is furnished below.

TABLE 4-9: RECYCLE WATER PIPE TABLE SUMMARY

Diameter	Material/Class	Length (m)
75	HDPE PN-6	24,256
90	HDPE PN-6	2,730
110	HDPE PN-6	1,843
125	HDPE PN-6	2,434
140	HDPE PN-6	4,812
160	HDPE PN-6	4,013

Diameter	Material/Class	Length (m)
180	HDPE PN-6	1,942
200	D.I K-9	3,480
250	D.I K-9	1,215
300	D.I K-9	3,894
350	D.I K-9	1,667
450	D.I K-9	575
	Total Length (mts)	**52,861**

4.3 Waste Water System

4.3.1 Introduction

Based on the topography of the site a comprehensive wastewater system is proposed. The wastewater generated from the plot shall be conveyed through a pipe to the main sewer line by gravity. The gravity system is mainly considered because it incurs less capital and operational costs. The total length of wastewater network proposed for the project area is 64.49 km. The total number of Lift stations proposed are 17 No's and One Number of Common Effluent Treatment Plant (CETP-1) and one number of Sewerage Treatment Plant (STP-1).

4.3.2 Waste Water Generation

The quantity of wastewater generation from the Project area is calculated based on the water demand and has been estimated to about 14 MLD. The sewage generations are taken as 80% of the per capita water consumption and effluent generation are taken as 60% of the Process water consumption.

4.3.3 Design Approach

The collection system will be designed based on CPHEEO manual, 2013 and using SewerGEMS software. Following various parameters will be considered for design.

4.3.3.1 Gravity Sewers

For design purposes, sewage flow in pipes is presumed to be steady and uniform. The sewer lines are aligned with positive slopes as much as possible and follow the gravity flow. As a design practice, the Manning's equation is used to model flows in sewers, which are assumed to be open channel flows.

4.3.4 Design formula

Manning's formula shall be adopted for the design of gravity sewers.

$$V = \frac{1}{n} R^{2/3} S^{1/2}$$

$$Q = A \times V$$

Where,

V = velocity in m/sec in partial flow conditions

N = Manning's roughness co-efficient

R = Hydraulic radius (m)

S = Hydraulic gradient

Q = Flow rate m^3/sec

A = Cross sectional area (m^2)

The values of Manning's Roughness Coefficient (n) for various pipeline materials are given in the table below.

Pipe Material	Roughness Coefficient, n
HDPE DWC	0.010
RCC NP3	0.011

4.3.4.1 Sewer Flow Generation

The waste water generation has been considered as 80% of the per capita water consumption for Non processing areas (residential, institutional areas) in accordance with the CPHEEO Manual,2013 and 60% as effluent generated for processing area (industries).

4.3.4.2 Minimum Diameter of Pipe

In order to ensure that the sewer possesses adequate capacity for peak flow, a minimum sewer size of 200 mm has been recommended.

4.3.4.3 Minimum Cover

The difference between the ground level and the crown of the sewer can be termed as cover. The minimum cover of 1 m considered in the entire network.

4.3.4.4 Velocity of Flow

To maintain self-cleaning velocities in the sewers, it is usual practice to maintain a minimum velocity of 0.6 m/sec at initial peak flow and 0.8 m/sec at design peak flow as recommended in paragraph 3.15.1 of the CPHEEO Manual 2013. However, in sewers with small initial peak flows, typically the upper reaches of the system, depths will be shallow and correspondingly velocities may be less than 0.6 m/sec. In these cases, a minimum velocity of 0.3 m/sec will be allowed which is sufficient to ensure minimum self-cleaning velocity. In those cases, where a 0.3 m/sec velocity cannot be maintained and periodic sewer flushing will be required. The pipe diameter and slope shall be selected to obtain the required velocities to minimize settling problems.

4.3.4.5 Erosion and Maximum Velocity

To avoid scouring and erosion of sewer pipes caused by sand and other gritty material the maximum velocity in gravity sewers is recommended not to exceed 3.0 m/sec, as per section 3.15.3 of the CPHEEO Manual 2013.

d/D	v/V	q/Q	N_0/N	v/V	q/Q
1.0	1.000	1.000	1.00	1.000	1.000
0.9	1.124	1.066	1.07	1.056	1.020
0.8	1.140	0.968	1.14	1.003	0.890
0.7	1.120	0.838	1.18	0.952	0.712
0.6	1.072	0.671	1.21	0.890	0.557
0.5	1.000	0.500	1.24	0.810	0.405
0.4	0.902	0.337	1.27	0.713	0.266
0.3	0.776	0.196	1.28	0.605	0.153
0.2	0.615	0.088	1.27	0.486	0.070
0.1	0.401	0.021	1.22	0.329	0.017

4.3.4.6 Manholes

Manholes are to be provided to facilitate cleaning and inspection of sewers. Below table gives the type and size of various manholes to be employed for different diameter of sewers and for different depths. The selection of types of manhole shall also be based on the economic and construction factors.

Types of Manholes	Description	Size of manholes
Circular Manholes	For depth up to 1.60m	900 mm diameter
Circular Manholes	For depth from 1.61m to 2.30m	1200 mm diameter
Circular Manholes	For depth from 2.31m to 4.50m	1500 mm diameter

4.3.4.7 House Connections and Sewer Connection Chambers

The basic criteria for design & installation of the service sewers are summarized below:

- The minimum diameter of the service sewer shall be 110 /160 mm
- The service sewer shall be laid up to the property line/Building, at slope not less than 1percent, i.e. 1 in 100.

4.3.5 Design Parameters

TABLE 4-10: DESIGN PARAMETERS

Sl. No	Description	Unit	Recommended parameters	Justification
A		**Wastewater Generation**		
1	% of Water Supply converted into waste water	%	80%	CPHEEO manual 2013 recommended upto 80%
B		**Hydraulic Design**		
1	Hydraulic Design		Manning's formula	As per CPHEEO manual 2013.
C		**Minimum Diameter in mm**		
1	Minimum diameter	mm	200	200mm dia is preferable
D		**Pipe Material**		
1	Material		HDPE DWC RCC NP3	As per the best practice
2	Manning's "η" For HDPE DWC		0.010 – HDPE DWC pipes 0.011 – RCC NP3	Considering the recommended pipe materials and the fact that the pipes will carry wastewater (which have sludge/solids), conservative value of 0.010 & 0.011 is recommended for HDPE DWC pipes & RCC NP3
E		**Limiting Velocities**		
1	Minimum	m/sec	0.6	It is understood that the self-cleansing Velocity may not be achieved for all the pipes, particularly in the initial reaches, due to small contributory population. In such cases self-cleaning velocity shall be ensured at least for full flow conditions of the pipe.
2	Maximum	m/sec	3.0	The waste water may carry some solids, such as grit. Therefore, it is desirable to restrict the maximum velocity to 3m/sec, to prevent the damage to the inner surface of the pipe.
F		**Bedding**		

Sl. No	Description	Unit	Recommended parameters	Justification
1	Type of Bedding		Granular / PCC / RCC with reinforcement based on CPHEEO 2013	The type of bedding is finalized based on diameter of the pipe and depth.
G		**Earth Cover**		
1	Minimum Cover		Minimum 1m cover is recommended for pipe design	Based on traffic load consideration minimum 1m cover is recommended and also recommended in CPHEEO manual 2013
H		**Limiting Depth of flow to Diameter**		
1	d/D ratio		0.80	As per CPHEEO manual 2013
I		**Manhole Construction**		
1	Material		RCC	To ensure strong and robust construction and its ability to maintain uniform & high construction quality. The high degree of water tightness reduces the potential of infiltration. Its corrosion resistance (after suitable lining) is important in the prevailing environment. RCC manholes are recommended.
J		**Spacing of Manholes – Maximum interval on straight reaches**		
1	Spacing	m	The maximum distance between manholes should be 30m as per CPHEEO 2013. Spacing of manholes shall be located at: I. change of direction II. change of slope III. change of pipe diameter IV. change of material V. Beginning of each line VI. at points of branches and in straight reaches.	Considering the operational problems for pipe cleaning during maintenance, it is preferable to provide the manhole Spacing as specified.
K		**Manhole sizes**		
1	Circular 0.90 to 1.60m > 1.61 to 2.30m >2.31 to 4.50m > 4.50m depth		0.90m 1.20m 1.50m 1.80m	Circular manholes are structurally more efficient to resist earth pressure. Suggested to avoid rectangular manholes. As per IS – 4111: 1986, Circular type manholes are much stronger than rectangular & arch type manholes.
L		**Drop Across Manhole – Sewer Transition**		

Sl. No	Description	Unit	Recommended parameters	Justification
1	Drop Manhole		Where difference between incoming and outgoing inverts exceeds 0.60m	When a pipe connects with another pipe and the difference in levels between both lines is more than 600mm, a drop connection is to be provided incorporating a vertical drop pipe from the higher pipe to lower one.
M		**Plot Service Connections**		
1	Diameter	mm	110/160	The minimum diameter is required to carry the heavy solids and other matter without choking and to facilitate the effective cleaning without damage to the pipe
2	Minimum gradient for plot service	%	1 in 100	The standard practice is to maintain the slope of 1 in 100 to ensure better hydraulic conditions.

4.3.6 Hydraulic Design of Sewer

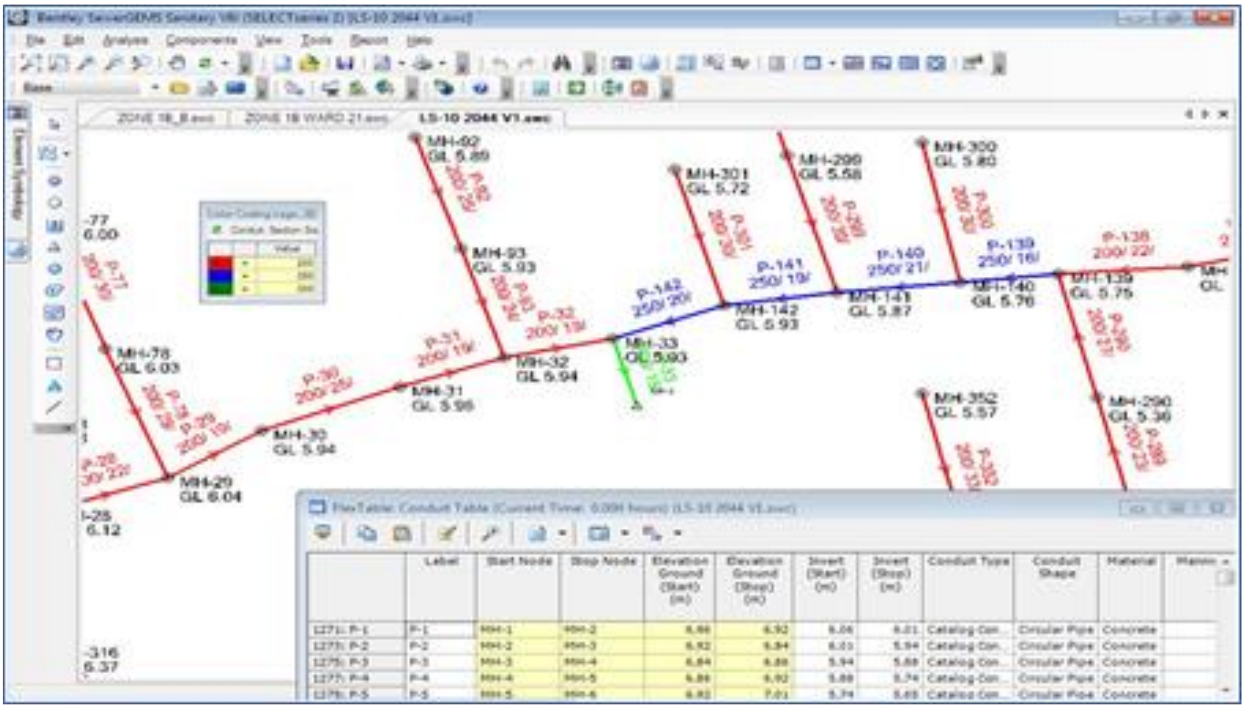
Sewer GEMS Modelling

The Sewer GEMS modelling is used for designing of sewers. The software is compatible with AutoCAD and GIS Software's and is easy to use. The Sewer GEMS model is used for design to determine the economic sizes of the sewer.

The sewer network has been designed using Bentley sewer GEMS. Sewer GEMS is powerful software for the design of gravity flow through sewer. The software can be run in Micro station and Auto Cad mode or in a Stand- Alone mode utilizing its own graphical interface.

Sewer GEMS allows the designer to create a graphical representation of a pipe network containing information on each pipe and manhole based on a set of design criteria such as population, flow, and hydraulics. It provides a choice of conveyance elements including circular pipes, arches, boxes and non-conventional shapes. The SewerGEMS model is used to analyze conditions under one flow condition at a time.

FIGURE -4-6 : SEWER GEMS MODEL



4.3.7 Sewerage Zoning

The project area is planned based on the topography and geographic features, ridge lines, alignment of drains, major roads. Based on topography, in the area, Lifting Section 17 are proposed MPS is ultimately discharging to CETP.

TABLE -4-11 : SEWER ZONING DETAILS

Sl.No	Zone No.	Peak Capacity in MLD	Discharges to
1	LS-1	1.683	MH-83
2	LS-2	8.25	LS-3
3	LS-3	0.539	MH-1538
4	LS-4	1.496	MH-967
5	LS-5	0.605	LS-13
6	LS-6	1.034	MH-1285
7	LS-7	5.874	MH-1950
8	LS-8 (MPS)	22.88	CETP
9	LS-9	1.518	MH-146
10	LS-10	2.123	MH-2027

Sl.No	Zone No.	Peak Capacity in MLD	Discharges to
11	LS-11	2.673	MH-2068
12	LS-12	0.44	MH-1725
13	LS-13	10.043	MH-1041
14	LS-14	1.551	MH-273
15	LS-15	5.258	MH-156
16	LS-16	0.825	MH-19
17	LS-17	0.385	MH-2082

4.3.8 Waste Water Pumping Stations

Type of strata and subsequent depth restriction on wastewater network will govern numbers and locations of pumping stations. The collection system design will also provide the peak flow and the level of the incoming pipe to the pumping station. A free board to be provided below the invert of the lowest incoming pipe. In General, wastewater Pumping Station comprises of the following units.

- Inlet Chamber
- Screen Chamber
- Wet Well
- Valve Chamber

4.3.9 Inlet Chamber

Flow from the upstream manhole will enter into the inlet chamber. Based on the incoming flow and size of the incoming sewer, suitable size for inlet chamber is arrived to cater peak flow.

4.3.10 Screen Chamber

Coarse Screen Channels are proposed in Sewage Pumping Stations. One Mechanical Coarse Screen (Working) and one Manual Coarse Screen (Standby) shall be provided in Coarse Screen Channels of Intermediate and Main Sewage Pumping Stations. Due to less capacity, only Manual Screen is proposed in Lifting Stations. Each Coarse Screen Channel shall be designed for 100% of Peak Flow.

The clear opening shall be 20 mm for Mechanical Coarse Screen and 20 mm for Manual Coarse Screen. The Mechanical and Manual Screens shall be made of SS 304 flats. Conveyor Belt and Chute arrangement shall be provided to take the screenings.

Screenings dropped from Chute shall be collected in a wheel Barrow. Manually operated CI Sluice Gates shall be provided at the upstream to regulate the flow.

Number of Units	:	1 Mechanical + 1 Manual
Approach Velocity at Average Flow	:	0.30 m/s
Velocity through Screen at Average Flow	:	0.60 m/s max.
Velocity through Screen at Peak Flow	:	1.20 m/s max.

Angle of Inclination for Mechanical Screen : 75 Degree

Angle of Inclination for Manual Screen : 45 Degree

4.3.11 Wet Well

Wastewater shall enter into Wet Well of the Pumping Station after screening. It will be circular in shape. The capacity of the Wet Well will be such that with any combination of inflow and pumping, the operating cycle for any Pump will not be less than 5 minutes.

The Pumps will be submersible Pumps, non-clog type design as per specification. The number of pumps chosen should be in multiple of DWF with 100% stand by capacity for peak flow.

4.3.12 Valve Chamber

Suitable size RCC valve chamber is provided to accommodate the delivery pipe valves and associated fittings.

4.3.13 Pumping Main

Generally, pumping main alignment depends on the disposal point (relay pumping station or treatment facility) and the shortest feasible alignment. The selected alignment will be used to determine:

- the static head experienced by the pump
- the length of the pumping main

4.3.14 Pumping Main Profile

Wherever possible, the pumping main configuration shall ensure that the main rises continuously from the pumping station to the discharge point. There will not be any abrupt changes in gradient which encourage the entrapment of air resulting in a reduced efficiency of pump operation.

Air valves on wastewater pumping mains are prone to malfunctioning and are also a source of odour nuisance. Consequently, high points on the pumping main will be avoided or special air valves suitable for wastewater applications shall be used.

4.3.15 Wastewater Pumping Stations and Pumping Mains Summary

The Wastewater pumping station are proposed with screen chamber, wet well and valve chamber. Also, a suitable pumping mechanism is arranged using non-clog, non-corrosive submersible pumps with necessary back-up as per guidelines. A pumping main of DI material is proposed to carry the wastewater by pumping to the destination manhole.

TABLE -4-12 : PIPE AND ITS LENGTH MPS AND PM SUMMARY FOR SOUTH AREA

Sl No	PS Name	Average Flow (MLD)	Pumping Main Discharge Location			
			Dia (mm)	Length (m)	Material	Discharge Location
1	LS-1	1.683	300	39.43	DI - K9	MH-83
2	LS-2	8.25	450	98.39	DI - K9	LS-3
3	LS-3	0.539	200	1587.20	DI - K9	MH-1538
4	LS-4	1.496	250	107.54	DI - K9	MH-967
5	LS-5	0.605	200	1126.39	DI - K9	LS-13
6	LS-6	1.034	250	116.56	DI - K9	MH-1285
7	LS-7	5.874	450	42.64	DI - K9	MH-1950
8	LS-8 (MPS)	22.88	600	20	DI - K9	CETP
9	LS-9	1.518	250	86.72	DI - K9	MH-146
10	LS-10	2.123	350	30.00	DI - K9	MH-2027
11	LS-11	2.673	350	60.00	DI - K9	MH-2068
12	LS-12	0.44	200	60.00	DI - K9	MH-1725
13	LS-13	10.043	500	60.00	DI - K9	MH-1041
14	LS-14	1.551	250	60.00	DI - K9	MH-273
15	LS-15	5.258	400	597.40	DI - K9	MH-156
16	LS-16	0.825	200	76.53	DI - K9	MH-19
17	LS-17	0.385	200	570.00	DI - K9	MH-2082

4.3.16 Pipe Summary

Sewer Network Quantity Summary is shown below.

TABLE -4-13 : PIPE AND ITS LENGTH SUMMARY

SI.NO	Diameter (mm)	Material	Length (m)
1	200	HDPE PE-100 6kg/cm^2	50923
2	250	HDPE PE-100 6kg/cm^2	4820
3	300	HDPE PE-100 6kg/cm^2	1489
4	350	HDPE PE-100 6kg/cm^2	2846
5	400	HDPE PE-100 6kg/cm^2	630
6	450	HDPE PE-100 6kg/cm^2	1606
7	500	HDPE PE-100 6kg/cm^2	2087
8	700	HDPE PE-100 6kg/cm^2	24
9	800	HDPE PE-100 6kg/cm^2	66
		Total Length (mts)	**64491**

4.3.17 Design Summary

An abstract of the proposed wastewater collection system for the project is tabulated below.

TABLE -4-14 : DETAILS OF THE DESIGN SUMMARY IN SOUTH AREA

Item	Value	Unit
Length of gravity collection system	64.491	km
Diameter range for gravity sewers	200 to 800	mm
No of Lifting Stations	17 (LS)	No's
Capacity of CETP	10.50	MLD
Capacity of STP	4.00	MLD

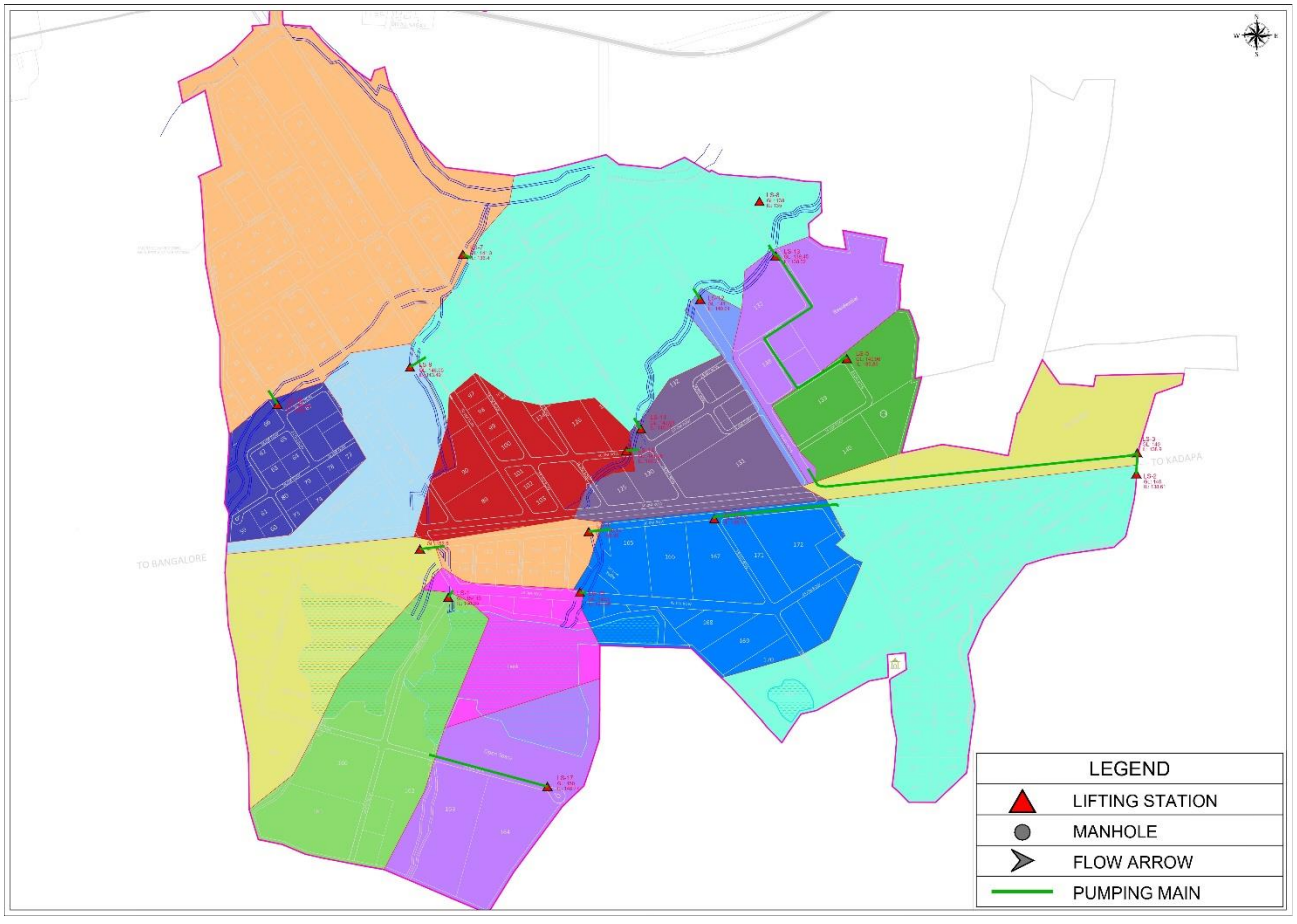


FIGURE -4-7 : SEWERAGE SYSTEM CONCEPT DIAGRAM

4.3.18 Common Effluent Treatment Plant

Common Effluent Treatment Plant is proposed with secondary treatment followed by tertiary treatment for reuse purpose. Secondary treatment of Sequential Batch Reactor

Technology is proposed. Tertiary treatment of Ultra Filtration followed by disinfection is proposed.

4.3.19 Process Flow of Common Effluent Treatment Plant

The treatment plant consist of three stage process in broadly as follows:

a) **Preliminary treatment units,** consist of Screen Chamber, Oil and Grease trap and Grit Chamber to remove the floating materials, oil, grease and settle able inorganic solids.

b) **Secondary treatment units,** to reduce BOD and TSS consists of aeration, floc formation and settling

c) **Tertiary treatment units,** consist of Pressure Sand Filter, Activated Carbon Filter and Ultraviolet Disinfection to remove suspended solids, colloidal matter, bacteria & viruses

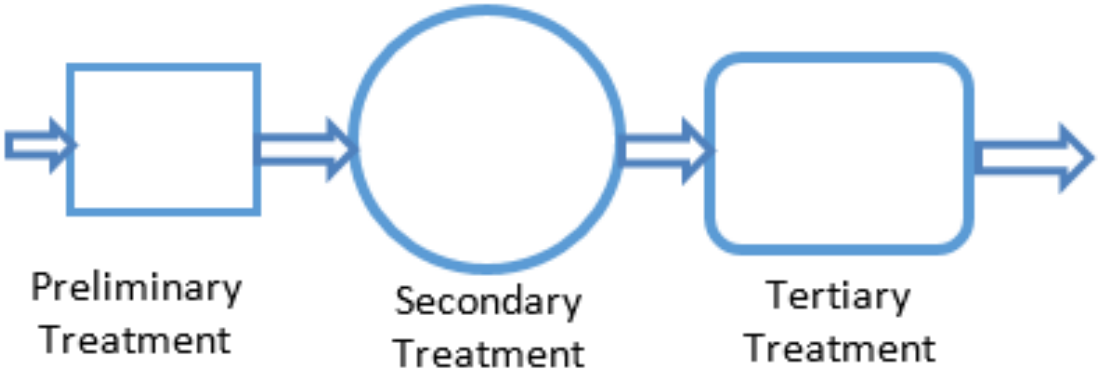


FIGURE -4-8 : PROCESS FLOW OF CETP TREATMENT

4.3.20 Wastewater Inlet and Treated Effluent Quality

Wastewater Inlet quality and treated Effluent quality has been considered as follows.

TABLE -4-15 : WASTEWATER AND TREATED EFFLUENT QUALITY

S.No	Parameters	Unit	Wastewater Inlet	After Secondary Treatment	After Tertiary Treatment
1	Design Temperature	^{o} C	20-35	20-35	20-35
2	pH @ 25^{o} C		6-8.0	6-8.5	6-8.5
3	COD	mg/l	5000	<50	<20
4	BOD @ 27^{o}c for 5 days	mg/l	200	<10	<5
5	Total Suspended Solids	mg/l	250	<20	<5
6	Oil & Grease	mg/l	10	10	5 - 10
7	Fecal Coliform	MPN/100ml	10^6	<230	<100

4.3.21 Moving Bed Biofilm Reactor Technology

The Moving Bed Bio-reactor (MBBR) is an aerobic process with attached growth which uses cylindrical shaped polyethylene carrier elements for biological growth. The moving media increases the contact time between the bacteria and the organics. Since the media has high porosity, it provides large surface area for bacteria to attach and grow. MBBR does not require any return activated sludge flow or backwashing. It has excellent characteristics for BOD/COD removal and nitrification in all types of wastewaters. It is compact and requires comparatively lesser space than the conventional system. Typical diagram of MBBR process is shown in Figure.

Salient Features of the MBBR

- Compact Footprint
- Expandable
- Durable non-clogging media
- Stable Process
- Lower sludge volume
- Ease of operation

Advantages of MBBR over Conventional System

- Consistently excellent effluent quality
- Compact and small foot print and about 40 to 50 % less land requirement
- Suitable for modular expansion and enhancement of capacity of existing plant.
- Simple to operate, requiring significantly less operator attention and time

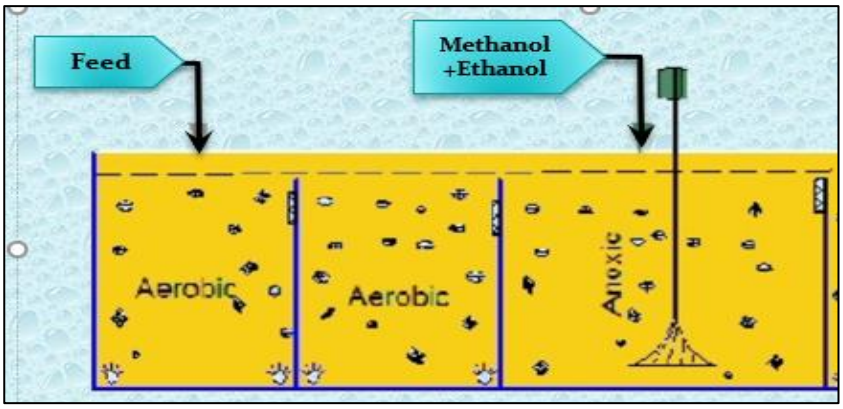


FIGURE -4-9 : SCHEMATIC OF MBBR PROCESS

Biomass Carriers

- Material: HDPE
- Size: 10- 14 mm
- Surface area: 500-800 m^2/m^3 of carriers
- Geometry: Highly open external surface

FIGURE -4-10 : BIOMASS CARRIERS IN MBBR PROCESS

4.3.22 Tertiary Treatment – Ultra Filtration

Ultra-filtration treatment is a conditioning treatment given to clarified water from aerobic treated sewage to remove the suspended solids, colloidal matter, bacteria & viruses. The UF treatment technology provides effluent of low TSS & Turbidity and can be used as pre-treatment for RO (Reverse Osmosis). The UF treatment facility can remove the turbidity up to less than 1.0 NTU. Ultra-filtration is a physical separation process using membranes with pore sizes in the range of 0.1 to 0.001 micron.

UF membranes are porous and allow only coarser solutes (macromolecules) to be rejected. All types of microorganisms as viruses and bacteria and all types of particles can be removed by this process. Since, the low molecular solutes are not retained by UF, osmotic back pressure can be neglected and operating pressure is kept low as 50- 500 KPa.

FIGURE -4-11 : ULTRA-FILTRATION

- Removes pollutants such as proteins and other macromolecular compounds and toxic non-degradable components
- Separates heavy metals after complexation or precipitation
- Separates components not readily degradable in sewage treatment effluents which are subsequently recycled to the biological stage
- It is a pre-treatment step prior to reverse osmosis
- Removes SS along with attached COD as a polishing step and avoiding secondary clarification

4.3.23 Common Effluent Treatment Facilities

The Proposed CETPs shall receive flow from industries which includes effluent and waste water.

- Capacity of CETP – 10.50 MLD wastewater (3.5 MLD Phase -1)

Treated effluent from CETP shall be reused for AC cooling and horticulture. In addition, excess treated water from CETP shall supply to the industries for process application. CETP consists of 3 Steps process which includes Preliminary, Secondary and Tertiary Treatment.

- Preliminary treatment consists of Mechanical Screening with Oil water separation, Grit Chamber, Equalization Tank, Fine Screen Channels, Oil and Grease Trap
- Secondary treatment consists of Moving Bed Biofilm Reactor and Clariflocculator
- Tertiary treatment consists of Ultra Filtration and Chlorination

4.3.24 Common Effluent Treatment Scheme: Wastewater

The Common Effluent Treatment Scheme and the salient features of the scheme are as presented below. The typical process flow diagram is as follows:

Typical Process flow diagram of Wastewater

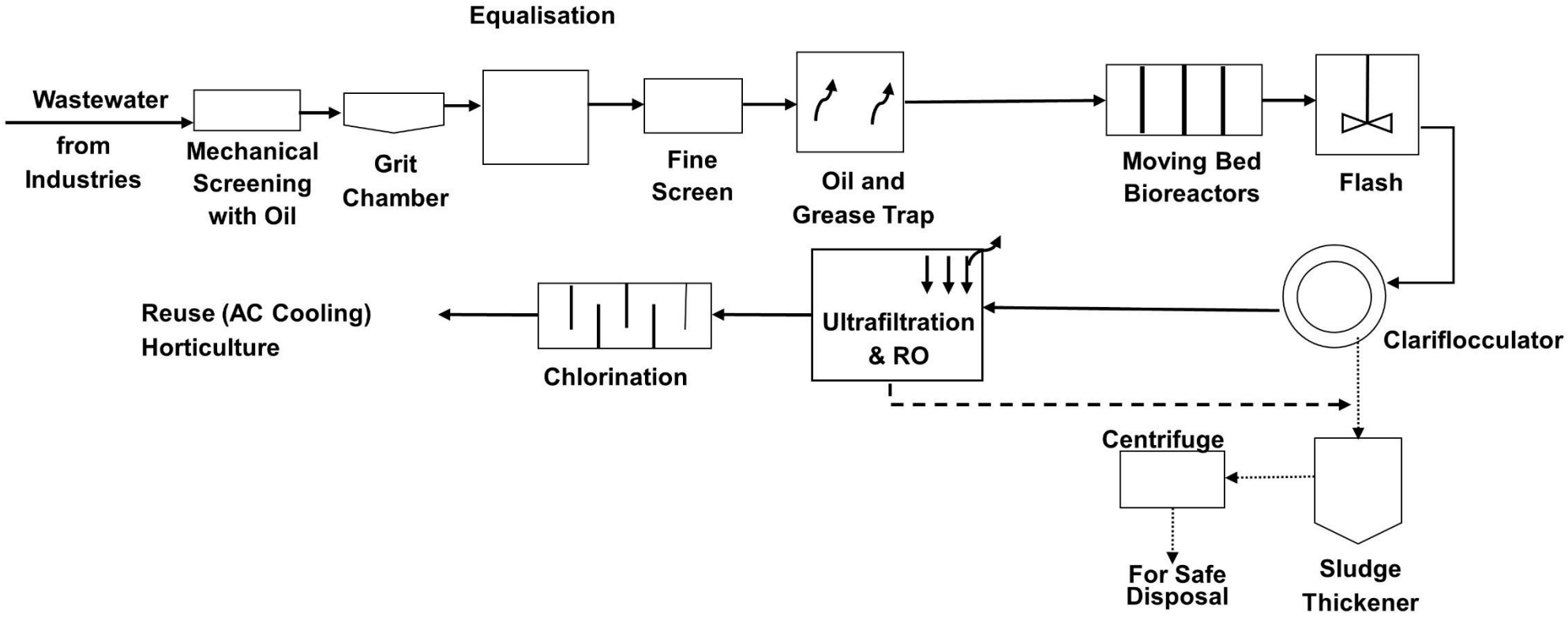


FIGURE 4-12: PROCESS FLOW DIAGRAM FOR CETP

4.4 Storm Water Drainage System

4.4.1 Strategy for Design

The site has been analysed in the context of pre and post development of land with respect to hydrological characteristics to achieve effective storm water management of rainwater. The aim of storm water management and all designed elements will be protection of the area from flooding during the monsoon period, conservation of the natural water courses and nallahs from erosion and pollution, reduction of pollutant loads and enhancement of the ecology and environment of the project area.

4.4.2 Catchment of Project Area

Figure 1 shows the location of the project area in the Google earth. The project area of 10.29 sq.km located at Kopparthy near Kadapa, Andhra Pradesh. Natural gradient in project area is South west to North East direction. Rainfall within the catchment boundary (23.25 sq.km) will contribute as runoff into the project area. Runoff flows towards east direction and mix into the nalla/ water bodies.

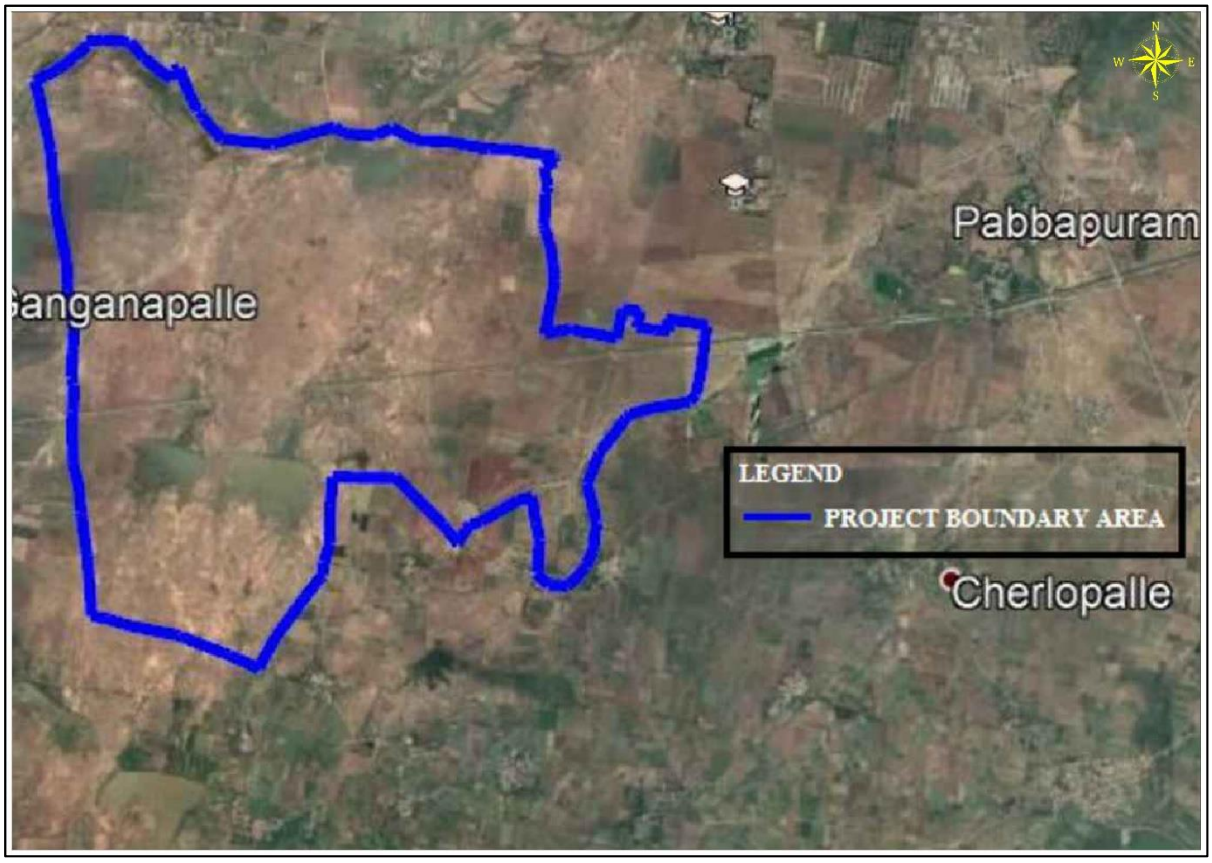


FIGURE 4-13 LOCATION OF THE PROJECT AREA IN GOOGLE EARTH

4.4.3 Design Basis

The drainage design has taken into consideration the following factors:

- Storm water drains are aligned to the carriageways following the proposed road gradients, draining into the water bodies.
- Proposed plot grading and direction of plot outfall has been considered in estimating the runoff generation in a particular road stretch.

The main criteria followed in the design of the drainage system is

- Safe disposal of storm water that is collected from the roads, pavements, medians, plots and other open/green areas.
- Maintaining self-cleansing velocity within the drains so that there is no stagnant water or silting.
- Maximum flow of water with minimum cross sections.

The below figure shows schematic diagram of the process of Storm Water network design followed.

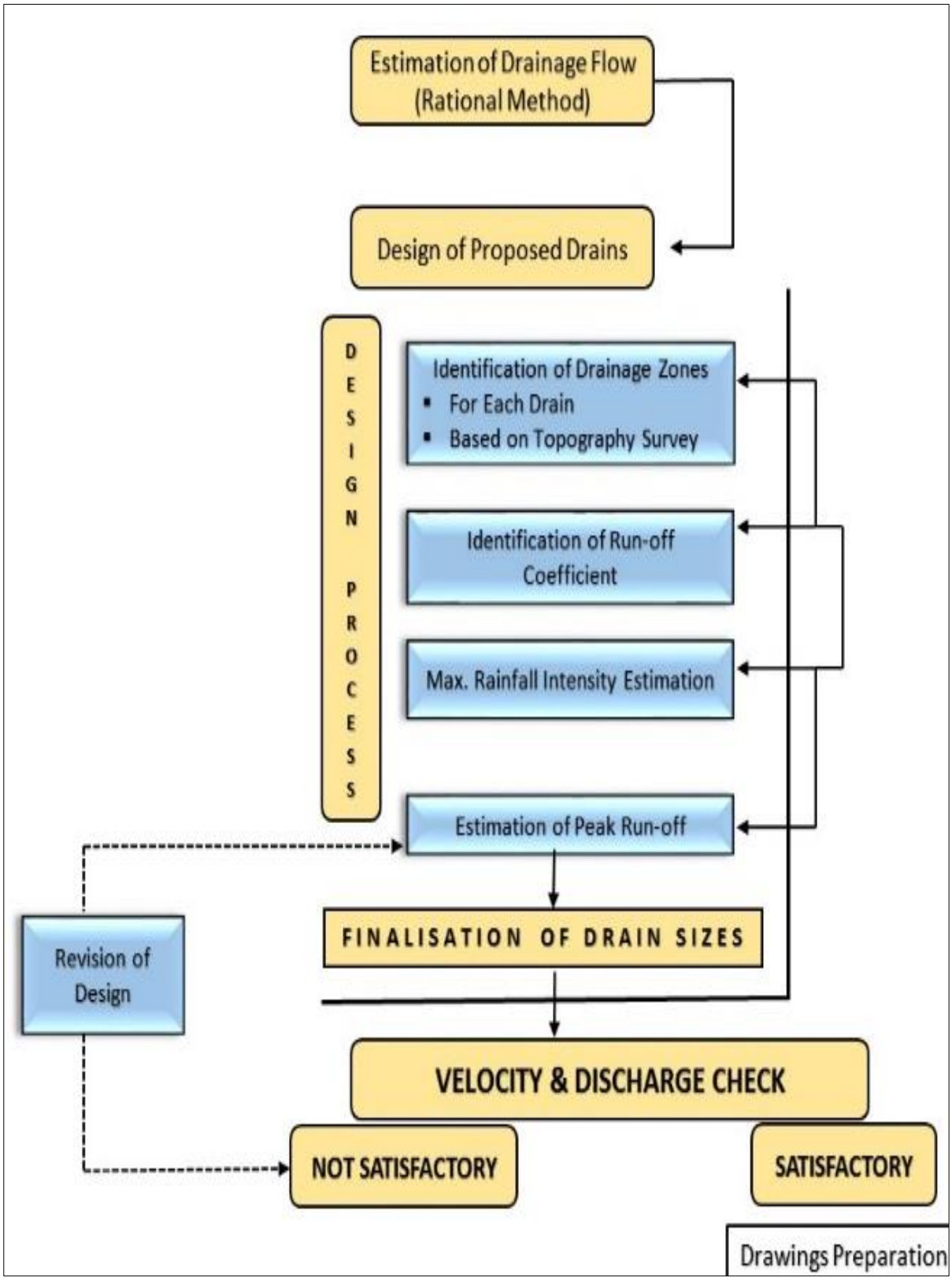


FIGURE 4-14 FLOW CHART – STORM WATER DRAIN DESIGN

4.4.4 Design Criteria

4.4.4.1 Rainfall and run-off

The intensity of rainfall for the design of the storm water drainage network has been determined considering the historical meteorological conditions. The design has been based on analysis of the rainfall pattern and its distribution with respect to time and intensity. The critical parameters that have been considered with respect to the rainfall include frequency distribution, depth and duration.

4.4.4.2 Co-efficient of Runoff

The co-efficient of runoff is the factor of different types of land use. Based on the permeability of the type of land use the value of C can be decided. So, higher the permeability of the land, lower the C value and vice versa.

4.4.4.3 Imperviousness

The percentage of drainage area can be obtained from the records of a particular drainage basin or City. In the absence of such data, standards can be followed.

Based on the land use, adopted coefficient of imperviousness for various land use of this project is given in the Table 1.

TABLE 4-16 COEFFICIENT OF IMPERVIOUSNESS

S. No.	Parameters	Coefficient of Imperviousness
1	Commercial and Industrial area	0.6-0.9
2	Residential area	0.6
3	Parks & Undeveloped areas including agricultural areas	0.2

Source: CPHEEO Manual 2019

4.4.4.4 Time of Concentration

Time of concentration is made up of inlet time, the period required to establish run-off and for water to flow from the most distant point in the drainage area to the drain, and time of flow in the drain. The latter is readily estimated by hydraulic computations. Inlet time is sometimes the most important factor in determining the probable run-off particularly in small districts or in fairly large districts with steep slopes.

Time of concentration (Tc) is computed for each catchment to calculate the intensity of rainfall for that catchment. The initial time of concentration calculated based on Kirpich formula.

Ti = 0.0078 (L)^0.77/s^0.385

Where, L= Flow length in feet and

s = Slope of catchment.

Ti = 0.01947 (L^3/H) ^0.385

Where, L = Flow length in m and

H = Elevation difference between catchment start point & drain inlet in m.

4.4.4.5 Storm Frequency

Considering status of the project area, Intensity of rainfall, availability of space for constructing the drains and cost benefit analysis, the return period is finalized as:

For Storm Water Drains: Once in 2 years

4.4.4.6 Storm Water Discharge (Q)

The storm water flow discharge has been determined by using the rational method.

Q = 10 C I A

Where	Q	=	storm runoff in m3/hr
	C	=	runoff co-efficient
	I	=	intensity of the rainfall in mm/hr
	A	=	area of the drainage district in hectares

Manning's formula is adopted for the design of Storm Water Drainage system.

$$V = \frac{1}{n} R^{2/3} S^{1/2}$$

Q = A x V

Where,	V	=	Velocity in m/sec at partial flow condition
	n	=	Manning's Roughness coefficient
	R	=	Hydraulic Radius (m)
	S	=	Slope of Hydraulic Gradient
	Q	=	Flow rate in cumecs
	A	=	Cross sectional Area of pipe in sq. m.

4.4.4.7 Rain fall Analysis

30 years (1991-2020) rainfall data of C.K.Dinne station at Kadapa District has been used for the analysis.

4.4.4.7.1 Analysis by Gumbels method

For many predictable rainfall regions, studies show that the Gumbel's Extreme Value distribution can be ideally used to represent the rainfall Intensity Duration Frequency (IDF) relation. However, for developing the model, one requires the maximum rainfall series for various durations. Table 2 shows intensities from this method.

TABLE 4-17 RAINFALL ANALYSIS – GUMBEL'S METHOD

Duration (Minutes)	Intensity (mm/hr)	
	2 Year	**5 Year**
5	247.03	307.68
10	155.58	193.78
15	118.72	147.86
20	97.99	122.05
25	84.44	105.17
30	74.77	93.13
35	67.46	84.03
40	61.71	76.87
45	57.05	71.06
50	53.18	66.24
55	49.90	62.16
60	47.09	58.65

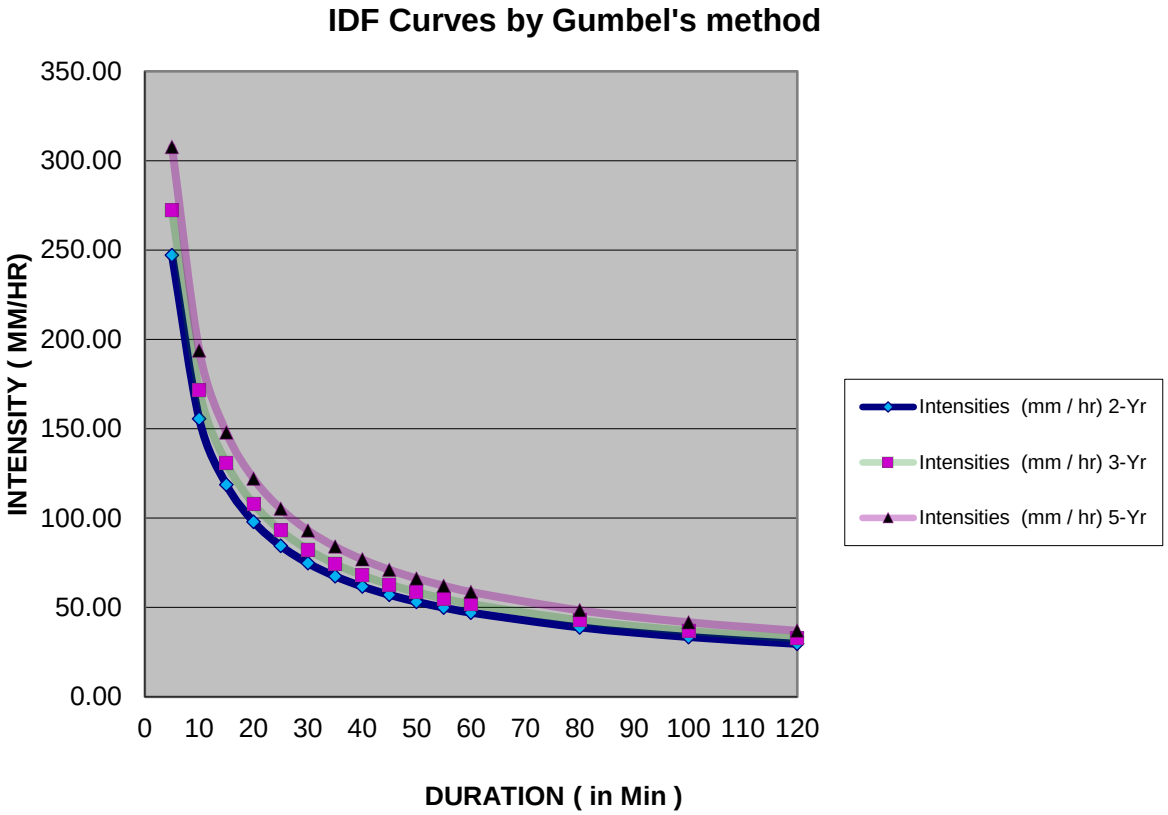


FIGURE 4-15 INTENSITY – DURATION – FREQUENCY VALUES FROM GUMBEL'S METHOD

Finally, rainfall intensity for 2-year return period of 47.09 mm/hr has been adopted for the design of storm water drainage system in the project area.

4.4.4.8 Free Board

The free board would vary from 0.1 m to 0.9 m depending on the size and type of drain as recommended by Table 5.3 of CPHEEO Manual 2019.

4.4.4.9 Coefficient of Roughness

Manning's coefficient of roughness plays an important role in offering resistance for the liquid to flow on its surface. "n" values for common materials used in Storm water drains as given in CPHEEO Manual 2019, which is tabulated at below table.

TABLE 4-18: COEFFICIENT OF ROUGHNESS

Type of Material	Manning's n
RCC Concrete	0.011

Source: CPHEEO Manual 2019

4.4.4.10 Longitudinal Bed Slope

Longitudinal bed slopes of drains would be fixed considering the natural slope of the area and nominal drops are provided to meet the permissible velocity criteria in case of steep slopes. The design would be based on Manning's formula.

4.4.5 Design of Drain section

Unlike the usage of conventional rectangular section, it is recommended to provide kerb channels within the carriage way for carrying the storm runoff due to the following reasons.

1) The length of the independent network is small resulting in lesser discharge
2) Optimisation of area within utility corridor

Therefore, the design of the storm water drain sections has been based on the discharge, catchment area and available width in RoW.

In the entire network, the sections have been used based on the extent of contributing catchment area. In order to design and determine the section type, each zone has been divided into number of catchment areas based on the respective outfalls. Considering the topography and discharge, such surface drains are feasible from the point of economy, construction, wear and tear and efficient maintenance and management.

For effective maintenance of the storm water network, inspection chambers are provided at 15m intervals all along the network.

Storm water from units/ plots shall be connected to adjacent drain by a pipe through catch basins, the detailed flow schematic sketch furnished in Figure 5.

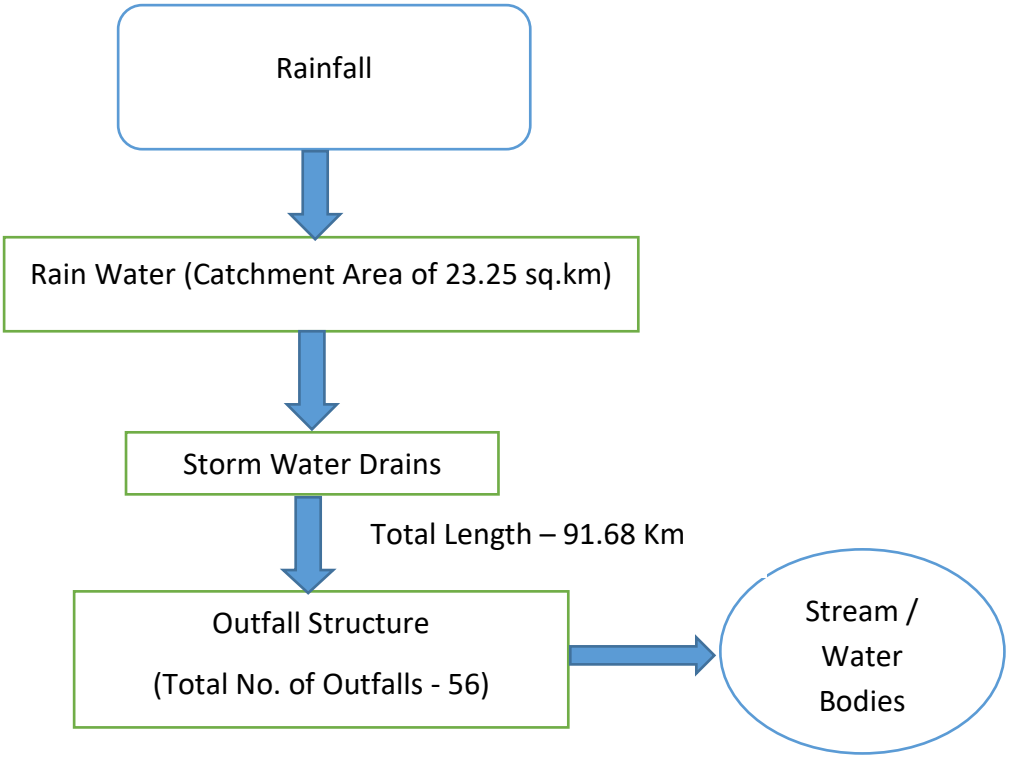


FIGURE 4-16 SCHEMATIC DIAGRAM FOR DESIGN OF STORM WATER DRAINS

4.4.6 Proposed Storm Water Drain Network

The total length of drainage network for entire network area is worked out to be 223.67 Km. Table 4 gives the details of the design outcomes /salient features of the entire storm water network.

TABLE 4-19 DRAIN NETWORK - SUMMARY

S.No	Drain size (m x m)	Length in m
1	0.60 x 1.00	44800.20
2	0.80 x 1.00	10754.00
3	0.90 x 1.00	10109.20
4	1.00 x 1.10	5988.40
5	1.20 x 1.10	3003.20
6	1.20 x 1.20	5406.50
7	1.50 x 1.20	2,524.60
8	1.50 x 1.50	3,710.90
9	1.80 x 1.50	1095.60
10	1.80 x 1.80	1020.80
11	2.00 x 1.80	240.2
12	2.00 x 2.00	3035.30
	TOTAL	**91688.90**

TABLE 4-20 SALIENT FEATURES OF PROPOSED STORM WATER NETWORK

Description	Value	Units
Total area of the catchment (project area)	23.25	Sq.km
Total Length of Storm Water Drainage system	91.688	Km
No. of Outfalls proposed	56	Nos

4.4.7 Outfall Structure

Outfall structures shall be placed at the end of Storm water drains that discharge runoff to nalla/ water bodies for disposal. Boundary conditions of outfalls to be confirmed during draft detailed project report. HFL of the river/ water body is required to finalize the outfall level, which will be collected during draft detailed design. The Outfall structure is proposed with RCC, apron and wing walls. A cut-off wall is proposed at the end of the outfall apron to prevent undermining of the structure.

TABLE 4-21 TYPE OF OUTLET

S. No.	Outfall	Type of Outlet
1	O-1	Surplus canal
2	O-2	Surplus canal
3	O-3	Surplus canal
4	O-4	Surplus canal
5	O-5	Surplus canal
6	O-6	Surplus canal
7	O-7	Surplus canal
8	O-8	Surplus canal
9	O-9	Surplus canal
10	O-10	Surplus canal
11	O-11	Surplus canal
12	O-12	Surplus canal
13	O-13	Surplus canal
14	O-14	Surplus canal
15	O-15	Surplus canal
16	O-16	Surplus canal
17	O-17	Surplus canal
18	O-18	Surplus canal
19	O-19	Surplus canal
20	O-20	Surplus canal

S. No.	Outfall	Type of Outlet
21	O-21	Surplus canal
22	O-22	Surplus canal
23	O-23	Surplus canal
24	O-24	Surplus canal
25	O-25	Surplus canal
26	O-26	Surplus canal
27	O-27	Surplus canal
28	O-28	Surplus canal
29	O-29	Surplus canal
30	O-30	Surplus canal
31	O-31	Surplus canal
32	O-32	Surplus canal
33	O-33	Surplus canal
34	O-34	Surplus canal
35	O-35	Surplus canal
36	O-36	Surplus canal
37	O-37	Surplus canal
38	O-38	Surplus canal
39	O-39	Surplus canal
40	O-40	Surplus canal
41	O-41	Surplus canal
42	O-42	Surplus canal
43	O-43	Surplus canal
44	O-44	Surplus canal
45	O-45	Surplus canal
46	O-46	Surplus canal
47	O-47	Surplus canal
48	O-48	Surplus canal
49	O-49	Surplus canal
50	O-50	Surplus canal
51	O-51	Surplus canal
52	O-52	Surplus canal
53	O-53	Surplus canal
54	O-54	Surplus canal
55	O-55	Surplus canal
56	O-56	Surplus canal

4.4.8 Restoration of Tanks in Project Area

There are 3 nos. of tanks located in the project area. Storm water drains are designed in such a way that tanks will receive storm water during rainy period and excess water shall be disposed at nalla/ water body outside the project area. Desilting the tank bed is proposed upto 3m depth to increase the storage capacity of the tank and ground water recharge. To recharge the ground water table in the project area, 4 nos. of recharge wells proposed in each tank. Earthen Bund shall be formed by utilizing the desilted earth within the tanks. Pathway proposed at the top of earthen bund for maintenance. Stone pitching proposed on inner side of the bund with stone blocks. Fencing proposed around the tanks to avoid littering of solid waste into the tanks. The costs of the desilting along with the stone pitching and fencing of the tanks has not been considered in the project costing which can be taken up in a separate project as it would serve the area in good stead. The details of the tanks are given in Table 4-8.

TABLE 4-22 DETAILS OF TANKS IN PROJECT AREA

S.No.	Tank ID	Name of the Block	Total Area (sq.m)	Storage Area (sq.m)	Storage Capacity ml (Live storage)
1	Tank-E	South	4,11,055	3,16,873	1105
2	Tank-F	South	2,42,468	2,27,474	-
3	Tank-G	South	26,910	22,615	-

Of the three tanks, Tank E is proposed to utilised as Summer Storage Tank which shall be curated in a regular shape and depth. The tank will have stone pitching inside and a pathway on the edge of length approx. 2500m. The perimeter of the SST will have a pathway of length 2500m. The upstream side of SST, stormwater may be diverted to downstream by construction of SWD or construction of Structure for tank inflow and outflow may be decided as per site conditions.

Implementation Strategies:

The overall water network will be developed at the starting of the project, whereas the development of CETP and STP will be done in a phased manner. In the 1st phase, 3.5MLD of CETP will be developed which will be further developed in subsequent

phases. STP will be developed once residential area gets developed fully. Initially, the CETP will cater to the needs of the residential population also till the time 4.00 MLD STP is developed.

5 Solid Waste Management

5.1.1 Strategy of Design

The Textile and chemical industries, household, commercial establishments etc., generate solid waste on day-to-day basis. The waste should normally be stored at the source of waste generation till collection for disposal. The primary objective of solid waste management is minimization of waste to be sent to the disposal. This is achieved by a system of efficient segregation starting at consumer level, utilization of bio-degradable waste for composting or energy generation, and recycling of the non-biodegradable and industrial waste.

5.1.2 Waste Management

Composition of waste is very important aspect and determines to a large extent of handling, treatment and disposal options. The solid waste to be collected daily basis and transported to the treatment facilities for further treatment. The waste generated from the plots can be categorised as follows:

a. Hazardous Waste
b. E Waste
c. Organic Waste
d. Recyclables

5.1.3 Quantity of Waste

The total solid waste quantity generated from the plots of the proposed project area is as follows:

TABLE 5-1 QUANTITY OF WASTE

Category	Sub Category	MSW (TPD)
Processing Area (Industrial Area)	Textiles	1.04
	Auto Components	0.71
	Engineering	7.21
	Chemical	18.24
	Metallic Non-Metallic	0.66
	Renewable Energy Large - Power Generation	0.02
	Total Processing Area (Industrial Area)	**27.89**

Category	Sub Category	MSW (TPD)
Non-Processing Area	Utility	0.02
	Commercial	1.19
	Public And Semi Public	0.59
	General Parking	2.50
	Residential Area	4.52
	Total Non - Processing Area (Industrial Area)	**8.83**

- Solid waste generation in Project Area (27.89+8.83) = 36.71 TPD

5.1.4 Waste Segregation, Collection and Transportation

Waste should be stored at the source of waste generation until it is collected for disposal. It is essential to segregate waste into different fractions, commonly referred to as primary segregation. Segregation of Waste needs to be linked to primary collection of waste from the doorstep.

Waste should be segregated by waste generators into three fractions: wet (green container), dry (white container), and industrial hazardous waste. This is referred to as the three-bin system. Apart from these wastes horticulture waste and construction and demolition should be stored and collected separately. The wet fraction should preferably be used for composting; and the dry waste should be sent for recycling. Also, hazardous and E waste should be collected separately and deposited at the designated collection centres.

FIGURE -5-1 :BINS FOR COLLECTION OF DRY, WET AND HAZARDOUS WASTE

5.1.4.1 SEGREGATION OF WASTES

Generated Solid waste can be categorized as Organic Waste, Reuse Waste (Metal, Card Boards, Plastics and Glass etc.,), E Waste and Hazardous Waste (textile MSME and chemical MSME).

Kopparthy industrial Area generates 14% organic waste, 3.5% of reuse waste, 0.5% of E Waste and 82% of Hazardous waste.

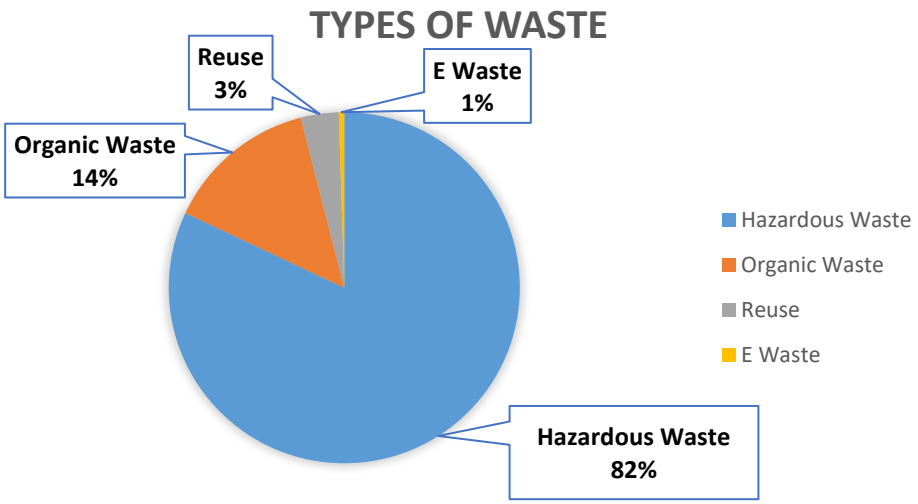


FIGURE -5-2 : PIE CHART - TYPE OF WASTE FOR SOUTH AREA

TABLE -5-2 : SEGREGATION OF WASTE IN PROJECT AREA

Sl No.	Description	Qty of Waste (Kg)	Remarks
	Total Solid Waste		
	Processing & Non-Processing Area	36.71	
A	**Hazardous Waste**		
e1	Facilities within Processing Area	30.11	82% of Total Waste
B	**Total Organic Waste**		
b1	Facilities within Processing & Non-Processing Area	5.14	14% of Total Waste
C	**Reuse - Card Boards, Plastics, Glass**		
c1	Facilities within Processing & Non-Processing Area	1.29	3.5% of Total Waste
D	**E-Waste**		
d1	Facilities within Processing & Non-Processing Area	0.18	0.5% of Total Waste
F	**Grand Total**	**36.71**	

5.1.5 Waste Management Treatment & Disposal

The waste management treatment and disposal facility shall comprise the following:

1) Vermiculture – Organic Waste – 5.14 TPD
2) Recycling Facility – Reuse (Metal, Card Boards, Plastics, Glass) – 1.29 TPD
3) Disposal of Hazardous Waste to designated hazardous waste disposal location – 30.11 TPD
4) Disposal of E Waste to designated E waste disposal location – 0.18 TPD

Upon receipt of waste at the facility, the same shall be weighed, logged and the waste shall take the pathway based on the color coding viz. the green containers shall be transported to the organic waste processing of vermiculture, the white containers shall be transferred to the recycling facility and the black containers shall be transferred to the designated hazardous waste disposal location.

5.1.6 Vermiculture

Vermiculture is a technique based on utilizing some species of earthworms to convert organic waste into vermi compost which is again, the product of decomposition by various worms. It is a practice of harvesting worms that take part in decomposing organic waste and turning it into nutrient rich fertilizer. The worms consume the decomposing organic material and flush it out of their system which is referred to as worm manure.

FIGURE -5-3 :VERMICULTURE

5.1.7 Recycling Facility

Segregation of wastes is the key to the success of a solid waste management program, and is the most complex part of the problem. Separation of materials into recyclables (Paper, Plastic, Ferrous and Non-Ferrous Metals, Glass). As indicated

there are different kinds of materials in the SW, which have different potential in terms of its value which needs to be restored.

FIGURE -5-4 :TYPES OF WASTE COLLECTION BINS

The proposed facility shall comprise of waste segregation facilities to separate waste materials into paper, plastic, metal, glass and other recyclables. Firstly, metal shall be separated from the waste by magnetic separation. Glass and other non-ferrous metals shall then be separated by gravity separation. Mechanical separation of Paper and Plastic is complex and would be adopted if the quantities are significant, however, with the present situation of low quantities of these materials, they shall be separated manually following occupational safety measures.

The segregated materials shall be bailed using mechanical bailers, compacted and sold to authorized recyclers of these materials. While the rejects and non-recyclables form this unit shall be sent to sanitary landfill.

5.1.8 Hazardous Facility

Common hazardous waste incineration facilities are those facilities, which handle hazardous waste from more than one industry either installed as an integral part or located elsewhere. Various concerned components of common incineration facility include proper transportation, storage, analytical laboratory facilities, feeding mechanism, incineration system (rotary kiln & post combustion chamber), gas cleaning system, tail gas monitoring facilities with automatic on-line monitoring & control facilities, ash/slag management, bleed/scrubber liquor management and measures for health protection of workers.

The hazardous waste generated in each industry needs to be transported to the designated area of Existing hazardous waste management within the city. It is the

responsibility of each industry to collect, store and transport safely to the disposal location. Each industry should bear the hazardous waste disposal cost.

5.1.9 E-Waste

The E waste generated in each industry needs to be transported to the designated area of Existing e-waste management within the city. It is the responsibility of each industry to collect, store and transport safely to the disposal location. Each industry should bear the e-waste disposal cost.

6 Power Supply System

6.1 General

Electrical system and supply is one of the most important infra services which plays an important role in attracting the prime developers. This document deals with the requirements of electrical power transmission, distribution, and illumination / Road Lighting within the Kopparthy Industrial Area.

6.2 Study of the Existing Power System around the Project Area

Two existing EHV lines of 765 KV and 220 KV are passing through the Kopparthy Industrial Area.There is one existing 220 KV grid substation established in Chinnakampalle, Kadapa which is 22 kms away from the site location.

6.3 Power Requirement during Construction Stage

Nearest MV power line shall be considered to provide the temporary power supply to the construction site and other activities at the stage of construction. Provision of DG set shall be considered for power supply during construction stage in case of power failure.

6.4 Design Assumptions

The following design assumptions / parameters have been adopted:

- The design and related documents are based on the submitted concept master plan of 2595.74 acres area. To calculate the total electrical load of the project area or capacity of Main Receiving Substation (MRSS) and Zonal Substation (ZSS) is to be finalized based on sanctioned load of individual plot holder. However, in present scenario, the sanctioned load of individual plot holder is not available and therefore plot wise load has been derived according to their land-use/ production for Industries Facility, Utility etc to arrive at total load of the Kopparthy Industrial Area.
- The capacity of transformer has designed at 80% loading of its rated capacity.
- Voltage Regulation has considered as +6% for LV network, - 9% to +6% for 33kV network
- Fault level MVA at 11kV side has considered as 350 MVA & 750 MVA for 33kV side.

The designs assumptions for different types of industrial units are tabulated in brief hereunder:

TABLE 6-1 :DESIGN ASSUMPTIONS FOR INDUSTRIAL SECTORS

Sl. No.	Description	Power requirement
A	**Manufacturing Industries**	
1	Food, Agro, Marine Products	135 kVA/Acre
2	Auto Components	150 kVA/Acre
3	Bulk Drug	200 kVA/Acre
4	Textiles – MSME	160 kVA/Acre
5	Engineering	150 kVA/Acre
6	Chemical And Petro	330 kVA/Acre
7	Renewable Energy Equipment	255 kVA/Acre

Source: As per industry standards/ study of industries in operation/ DHBVN Planning Manual

For other Development Area, the following load norms are considered to get the total power demand of the development area.

TABLE 6-2 : DESIGN ASSUMPTIONS FOR OTHER DEVELOPMENTS

Sl. No.	Description	Power Requirement
1	Utility	50kVA/Acre
2	Commercial	120 kVA/Acre
3	Amenities & Facility	120 kVA/Acre
4	Logistic Park	50kVA/Acre
5	Residential	225 kVA/Acre
6	CETP/WTP	80 kVA/Acre
7	ROAD	1.15 kVA/Acre
8	Truck Parking	40 kVA/Acre
9	Green/ Open Space	0.5 kVA/Acre

Source: As per industry standards/ study of industries in operation/ DHBVN Planning Manual

- Maximum Power Demand for Kopparthy Industrial Area of 2595.74 Acre Area is 185.22 MVA with over all diversity @ 0.7.
- The power demand, i.e. 185.22 MVA, will be fed from proposed 220/33/11kV Main receiving substation, which will be constructed in site area
- Construction of RCC cable trench have considered for laying of the power cable and optic fiber cable for better operation and maintenance.
- All industrial plots will be fed by the 33kV, 11kV & LV Underground Distribution network.
- Stepping down to L.T supply for Utility pockets/commercial/facility/Road Lighting use will be made available by 11/0.415kV Distribution Transformer near the load centers of suitable ratings as required.
- Amorphous core transformers, instead of conventional transformers, at all locations which operate at near 100% efficiency have been considered.
- Energy efficient smart street LED lighting have been considered for entire park and all outdoor lighting system shall be connected to automatic controls. Automatic controls can be either time based or photo sensor based.
- **Solar Power Generation:** Provision for Solar power has considered as India is blessed with abundant sunshine and solar power is expected to play a critical role in meeting the energy needs of the country in the long run. Solar power projects can be setup in a much shorter timeframe when compared to conventional power projects and the cost of solar power has become more

economical today. Solar power can also help meet energy requirements for both grid connected as well as off-grid applications.

Andhra Pradesh is poised for rapid industrial growth driven by infrastructure investments and has also been selected by Ministry of Power as one of the pilot states for implementation of the 24X7 – Power for All (PFA) scheme. Solar energy can become an important source in meeting the growing power requirements of the State. The State government is keen to tap the immense solar potential and promote this clean source of energy to meet the rising energy requirements of the State.

Therefore, Government of Andhra Pradesh has issued "**Andhra Pradesh Solar Power Policy -2018**" vide **G.O.MS. No. 1 dated: 03-01-2019** to meet the twin objectives of energy security and clean energy considerations. Many fiscal incentives for large scale promotion of the projects has been announced under the policy. Andhra Pradesh Solar Power Policy -2018 is is attached herewith as Annexure-I for ready reference of NICDC.

The Government will promote solar rooftop systems on public buildings, domestic, commercial, and industrial establishments on gross and or net meter basis. The consumer(s) are free to choose either net or gross meter option for sale of power to Discom under this policy.

All the plots available within the site is being considered for installation of Solar panels on the roof area to offset the electric load from conventional sources. The available roof area assumed is based on the ground coverage of each plot and only 30 % considered for installation of Solar Panels.

TABLE 6-3 : ROOFTOP SOLAR POWER GENERATION

Sl. No.	Zone	Total Area	BUA (In Sq m.)	Actual Roof top area (In sq. m) for installation of solar panels	Solar Generation (12 Sq.m for 1KW)	Solar Generation (MW)
a	b	c	d	e=d*30%	f=e/12	g=f/1000
1	South	2595.75	3937242	1181172.6	98431.05	98.43

Source: General norms being adopted in any utility

It is clearly visible that with the help of rooftop solar power generation, sufficient power can be generated which may cater the entire load of the industrial area. Therefore, rooftop solar power generation is the best solution for sustainable power in long terms.

Modalities (Guidelines) for implementing the Solar Roof Top (SRT):

Modalities for implementing the Solar Rood Top shall be as per the Solar Roof Top (SRT) policy 2018 submitted by Eastern Power Distribution Company of Andhra Pradesh Limited (APEPDCL) vide its Lr. No. CGM/EC/ EPDCL/ VSP/ GM/ Solar/ E-266947/ D. No. 1/ 207578/ 19 dated 04-01-2019[1].

EV Charging Stations

The transition to electric mobility is a promising global strategy for decarbonizing the transport sector. India is among a handful of countries that support the global EV30@30 campaign, which targets to have at least 30% new vehicle sales be electric by 2030. An accessible and robust network of electric vehicle (EV) charging infrastructure is an essential pre-requisite to achieving this ambitious transition. The Government of India has instituted various enabling policies to promote the development of the charging infrastructure network.

Site Planning for EV Charging

Site planning is an important aspect of integrating EV charging in parking areas. When planning for EV charging integration at a given site, the following planning guidelines should be kept in mind:

- Allocate space that is easily accessible and clearly visible from the site entrance.
- Select the charging location to minimize civil work and wiring requirements, where possible.
- Follow all safety provisions for EV charging planning as defined by the CEA (Measures relating to Safety and Electric Supply) (Amendment) Regulations, 2019.
- Clearly demarcate the parking spaces reserved for EV charging with appropriate signage and markings.
- Provide ample space for vehicle circulation i.e. to enter and exit the charging bays.
- Ensure that the charging area is secured against theft and vandalism.

[1] Document available at www.aperc.gov.in;

TABLE 6-4 : SPACE REQUIREMENTS FOR UPSTREAM ELECTRICAL INFRASTRUCTURE

Estimated load	Recommended DT set-up	Minimum area requirement
100 kW to 300 kW	Installation of one 11 kV pole or plinth mounted DT	4mx4m (pole) 8 m x 5 m (plinth)
300 kW to 700 kW	Installation of one 11 kV plinth mounted DT	9 m x 5 m
700 kW to 1,500 kW	Installation of two 11 kV plinth mounted DTs	10 m x 8 m

Source: Handbook of EV charging infrastructure implementation version1; NITI AYOG

TABLE 6-5 : CHARGING DEMAND BY VEHICLE SEGMENT

VEHICLE SEGMENTS	Daily kms driven	Battery capacity in kWh	Driving range in km/ full charge	Daily charging demand in kWh	Total daily charging demand in kWh - 2025	Total daily charging demand in kWh - 2030
E-2W	40	2.5	80	1.25	125596	765442
E-3W (passenger / cargo)	120	7	100	8.4	255162	972757
E-car (personal)	40	30.2	312	4	17498	164786
E-car (commercial)	100	21.2	181	12	55931	491838

Source: Handbook of EV charging infrastructure implementation version1; NITI AYOG

6.5 Load Estimation and Identification of Power Source

6.5.1 Power demand

This segment outlines the power demand assumptions and the load calculations undertaken for initiation of the final power network design. On the basis of the load norms, the plot wise load is calculated and the connected and maximum load demand has worked out for substation.

The design development of electrical network to reach its technical and economical potentials should meet the criteria of reliability, security, interoperability, re-configurability, controllability, maintainability, flexibility, reduced cost and environmental impact. The four major criteria commonly emphasized by network designers are reliability, cost, operational flexibility and environment including social impact.

The summary of load calculations and the resultant maximum demand of entire project area are detailed below:

6.5.2 Assumptions of Power requirement

A. Food, Agro, Marine Products Industry

1	Food Processing Industry (Coconut, Dairy & Spices)				
Sl. No.	**Description**	**Load**	**Area**	**Load Norm**	**Source of Information/ Reference**
i)	Dairy Industry	100kW	2 Acre	50kW/Acre	Industry standard
ii)	Dairy product	162kW	1 Acre	162kW/Acre	Industry standard
iii)	Spices Industry	125kW	1 Acre	125kW/Acre	Case Study By KINFRA (Project for pure Spices Powders)
iv)	Milling- Grain Foods Industry	162kW	1 Acre	162kW/Acre	Industry standard
Average load				**124.75kW/Acre**	
Load Norms adopted for calculation				**135 KVA/Acre**	

B. Auto Component Industry

2	AUTO COMPONENT					
S. NO	**INDUSTRY NAME**	**LOAD REQUIREMENT (kVA)**	**AREA (in Acre)**	**LOAD NORMS (KVA/Acre)**	**Detail of product**	**Source of Information / References**
1	Aravalli Infra Power	1000	10.03	99.7	Auto components	Industry in operation
2	Bosch Chassis	600	2.44	246	Auto components	Industry in operation
3	Uttaranchal Auto	300	1	300	Auto Parts	Industry in operation
Average load				215		
Load Norms adopted for calculation				***215 KVA/Acre***		

C. Auto Component Industry

3.	Industrial Load (FOR METALLIC & NON METALLIC MINERALS)					
S. NO	**INDUSTRY NAME/TYPE**	**LOAD REQUIREMENT (KW)**	**AREA (in Acre)**	**LOAD NORMS (KVA/Acre)**	**Detail of product**	**Source of Information / Reference**
1	GLASS			218	glass	Industry standards
2	Orvi Design Studio LLP	180	1.3	153.8		Mahindra World City (Industry in operation)
3.	Report by MSME Development Institute Raipur Chhattisgarh	22	0.1	244.4		Industry in operation
Average load				205		
Load Norms adopted for calculation				***200 KVA/Acre***		

D. Bulk Drug Industry

4.	Industrial Load (FOR BULK DRUG)				
S. NO	**INDUSTRY NAME/TYPE**	**LOAD REQUIREMENT (KW)**	**AREA (in Acre)**	**LOAD NORMS(KVA/ Acre)**	**Source of Information / References**
1	Moracea Pharmaceuticals	79.0	0.25	351.1	Industry in operation
2	Reckitt Bec kiser	630	21	33.3	Industry in operation
Average load				192	
Load Norms adopted for calculation				***200 KVA/Acre***	

E. Garment & Fabric Industry

5.	Industrial Load (For GARMENTS & FABRIC)					
S. NO	**INDUSTRY NAME**	**LOAD REQUIREMENT (KW)**	**AREA (in Acre)**	**LOAD NORMS(KVA/ Acre)**	**Detail of product**	**Source of Information / References**
1	Innovative Textiles Plot No B-8 ESIP, Sitarganj	2700.0	15	200.00	Textiles	Industry in operation
2	Jaipur craft pvt ltd	240	3.9	68.38		Industry standard
3.	Ratan Textiles	400	2.1	211.64		Industry in operation
Average load				160		
Load Norms adopted for calculation				***160 KVA/Acre***		

F. Engineering Industry:

6.	Industrial Load (For ENGINEERING GOODS)				
S. NO	**INDUSTRY TYPE**	**LOAD REQUIREMENT (KW)**	**AREA(In Acre)**	**LOAD NORMS (KVA/Acre)**	**Source of Information / References**
1	Dynamic Power tech Pvt Ltd	500.0	2.9	191.57	Industry in operation
2	Engineering Industry	120	1	133.33	Past Designing Project (KHED SEZ)
2	Knitpro Designs LLP	225	2.1	119.05	Industry in operation
Average load				148	
Load Norms adopted for calculation				***150 KVA/Acre***	

G. Intermediate Chemicals Industry

7.	Intermediate Chemicals					
S. NO	**INDUSTRY TYPE**	**LOAD REQUIREMENT (kVA)**	**AREA (in Acre)**	**LOAD NORMS (KVA/Acre)**	**Detail of product**	**Source of Information / References**
1	BPCL Refinery, kochi	41012.5	150	273.42	Refinery	Industry in operation

7.	Intermediate Chemicals					
S. NO	**INDUSTRY TYPE**	**LOAD REQUIREMENT (kVA)**	**AREA (in Acre)**	**LOAD NORMS (KVA/Acre)**	**Detail of product**	**Source of Information / References**
2	Indian Oil Corporation	21600	54	400.0	Haldia Refinery	Industry in operation
3	Indian Oil Corporation	42		350	Baruni Refinery	Industry in operation
4	J.K. Pharmaceuticals Ltd.	350	1.15	304	R&D Unit and Chemical Industry	Industry in operation
Average load				332		
Load Norms adopted for calculation				***330 KVA/Acre***		

H. Intermediate Chemicals Industry

8	Renewable Energy				
S. NO	**INDUSTRY TYPE**	**LOAD REQUIREMENT (kVA)**	**AREA(in Acre)**	**LOAD NORMS (KVA/Acre)**	**Source of Information / References**
1	Stork Phobos	220	1	220	Industry in operation
2	Geep Batteries Pvt Ltd	556	1.5	370.4	Industry in operation
3	CTS Infrastructure	180	1.08	166.7	
Average load				252	
Load Norms adopted for calculation				***255 KVA/Acre***	

I. Residential

9	Residential				
Sl. No.	**Description**	**Load**	**area**	**Load Norm**	**Source of Information / References**
i)	4Marla	6KW	101.17 sq.mt.	59.3 Watt/ sqmt.	Approved norms between HUDA &DHBVNL/UHBVNL(Ref. appended)
ii)	10Marla	12KW	252.928 sq.mt.	47.5 Watt/ sqmt.	
iii)	1Kanal	20KW	505.86 sq.mt.	40 Watt/ sqmt.	
Average load				48.9Watt/ sq.mt.	
Load Norms adopted for calculation				50 watt/ Sqmt.	
Say				*225 KVA/ Acre*	

6.5.3 Electrical Load Calculation:

Based on the power assumption and land use, Electrical Load Calculation for Kopparthy Industrial Area are tabulated below. The entire project area of 2595.74 has been considered for load calculation however, please note that net development area is 2550.65 acres.

TABLE 6-6 : ELECTRICAL LOAD CALCULATIONS

SOUTH ZONE LOAD CLACULATION OF NIDC KOPPARTHY										
Sl.No	CATEGORY	Sector	SUB CATEGORY	AREAS (in SQM)	AREAS (in Acs)	Load Noams	Connected load	Demand factor	Max Demand (KVA)	Max Demand (MVA)
a	b	c	d	e	f=e/ 4046.86	g	h=e*f	i	j=h*i	k=j/1000
1	PROCESSING AREA (Industrial area)	South Block	TEXTILES	56462.1545	13.95	160.00	2232.33	0.70	1562.63	1.56
2			AUTO COMPONENTS	868137.8613	214.52	150.00	32178.20	0.70	22524.74	22.52
3			ENGINEERING	390918.3005	96.60	150.00	14489.69	0.70	10142.78	10.14
4			CHEMICAL	988560.9265	244.28	330.00	80611.91	0.70	56428.34	56.43
5			METALIC AND NON MET	809961.9024	200.15	200.00	40029.15	0.70	28020.41	28.02
6			RENEWABLE ENERGY LARGE - POWER GENERATION	1796691.251	443.97	255.00	113212.78	1.00	113212.78	113.21
7	NON PROCESSING AREA	South Block	UTILITY	115171.7167	28.46	50.00	1422.98	0.60	853.79	0.85
8			COMMERCIAL	217636.5136	53.78	120.00	6453.49	0.60	3872.10	3.87
9			PUBLIC AND SEMI PUBLIC	108758.5557	26.87	120.00	3224.98	0.60	1934.99	1.93
10			GENERAL PARKING	522217.4544	129.04	50.00	6452.13	0.60	3871.28	3.87
11			RESIDENTIAL AREA	551391.6179	136.25	225.00	30656.64	0.70	21459.65	21.46
12	ROAD AND OPEN SPACES	South Block	WATERBODY	675558.8227	166.93	0.50	83.47	1.00	83.47	0.08
13			BUFFER ALONG WATERBODY	49733.6957	12.29	0.50	6.14	1.00	6.14	0.01
14			Streams	310850.0008	76.81	0.50	38.41	1.00	38.41	0.04
15			Stream Buffer	183754.6598	45.41	0.50	22.70	1.00	22.70	0.02
16			ORGANIZED GREENS/OPEN SPACES	756721.2881	186.99	0.50	93.49	1.00	93.49	0.09
17			HT LINE AREA	321009.1795	79.32	0.50	39.66	1.00	39.66	0.04
18			GREEN BELT ALONG SITE	197136.9247	48.71	0.50	24.36	1.00	24.36	0.02
19			RAILWAY BUFFER LINE	219170.6909	54.16	0.50	27.08	1.00	27.08	0.03
20			ROADS	1364771.292	337.24	1.15	387.83	1.00	387.83	0.39
			TOTAL	10504614.81	2595.74				264606.61	264.61
	Demand Load (MVA) after overall Diversity @ 0.7									185.22

6.5.4 Source of power

Andhra Pradesh Electricity Regularity Commission (APERC) and Transmission Corporation of Andhra Pradesh (APTRANSCO) are the authorities to provide the incoming power supply to the project area. Andhra Pradesh Southern Power Distribution Company shall be responsible for supply of power for 33 KV & below voltage levels.

Following officials have been consulted to arrive at the source of power for Kopparthy Industrial Area project area:

Sl. No	Name of the Official	Designation	Department	Phone Number
1	Mr. Manohar Reddy	ADE	O&M (APTRANSCO)	8712613246
2	Mr. Subbarayudu	AE (Chinnakampalle SS)	Maintenance (APTRANSCO)	9491043217
3	Mr. Subba Reddy	ADE (Chinnakampalle SS)	O&M (APTRANSCO)	9490154200
4	Mr. Achyut Reddy	ADE	Construction (APTRANSCO)	9490154260
5	Mr. K. Narahari Rao	EE	Construction (APTRANSCO)	9440811138
6	Mr. Subba Rao	DE	Commercial (APSPDCL)	9491052938
7	Mr. Sudharshan	Electrical Project Coordinator	APIIC (Zonal Office Kadapa)	9666009321
8	Mr. Surender Reddy	IT Associate	APIIC (Zonal Office Kadapa)	9966220781
9	Mr. Dorababu	DGM	APIIC (Guntur)	7729983120 & 7780396558
10	Mr. Ramana	SE	Operations (APSPDCL)	9443811751

Following four sources for supply of power has been identified and discussed so far:

Sr. No.	Source of power supply
1	220/132 KV grid substation Chinnakampalle, Kadapa
2	Substation at Chakrapetha
3	Substation at Animal House
4	220 KV lines passing through Kopparthy Industrial South Extension Area (Tapping point RTTP 3 & 4 and Tapping point RTTP 1 &2)

Source 1: 220/132 KV grid substation Chinnakampalle, Kadapa

Earlier it was proposed that power may be brought to the project site from 220/132 KV grid substation Chinnakampalle, Kadapa which is at the distance of 22 kms from the project site. It was proposed that an additional bay at Chinnakampalle Substation site was available to feed the project area.

But post discussion with APTRANSCO it has found that the corridor between Chinnakampalle Substation to Kopparthy Industrial Area (South area) is heavily crowded with 765kV , 400kV , 220kV lines passing through. It has found that Right Of Way (ROW) is very difficult to get the permission.

Figure 6-1 : Site visit photographs of Chinnakampalle substation

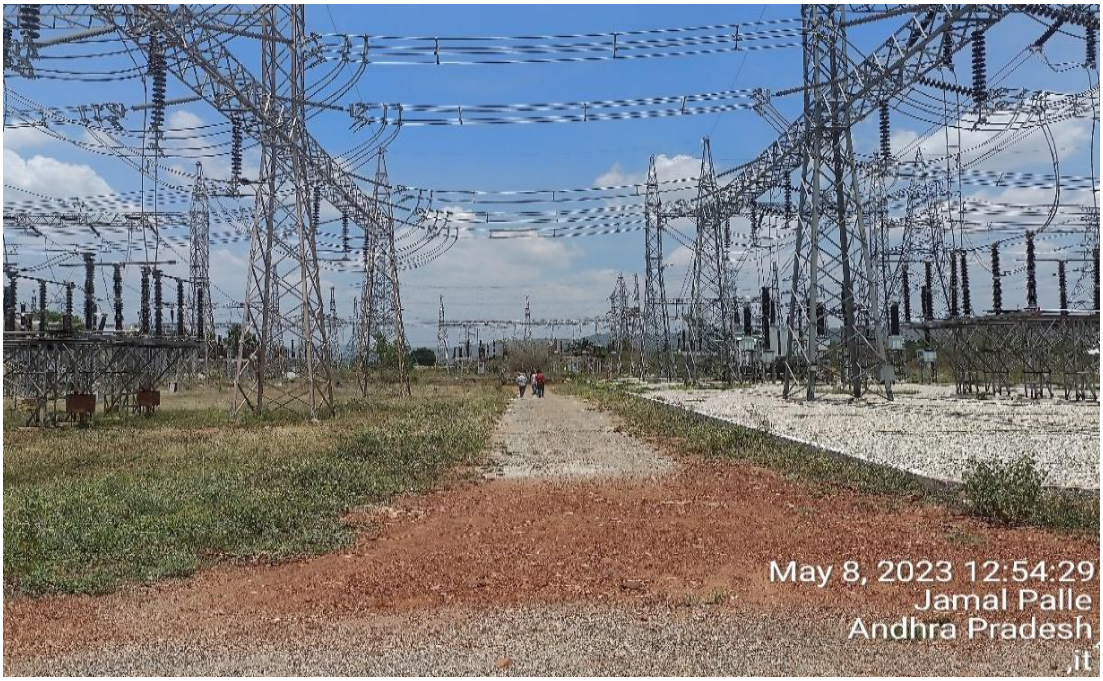


FIGURE 6-2 : EXISTING LINES GOING THROUGH CORRIDOR OUTSIDE CHINNAKAMPALLE SUBSTATION

Source 2: Chakrapetha or Animal House Substations:

These substations are approx. 45 & 50 km from the site location which is not a good option and again these lines may pass through the forest area where sufficient clearance will not be possible for the Right of Way (ROW).

Source 3: 220 KV lines passing through Kopparthy Industrial South Extension Area:

Two 220 kV Lines which are emanating from Rayalaseema Thermal Power Plant (RTPP) are passing through Kopparthy Industrial South extension area. One of the 220 KV line passing near to the proposed 220/33kV Main Receiving Substation (MRSS) in Kopparthy Industrial South extension area can be tapped to meet the power requirement of project site.

This will avoid Right of Way (ROW) and required power can be drawn. The distance between the tapping point of RTPP 1 & 2 220 kV line and the proposed MRSS is less than 1 km. Three (3) number of towers required between the tapping point of 220kV line and the proposed MRSS. **The Single Line Drawing (SLD) is placed below as**

drawing (C) Single Line Drawing (SLD) of proposal Tapping from RTPP 1 & 2 220 kV Line.

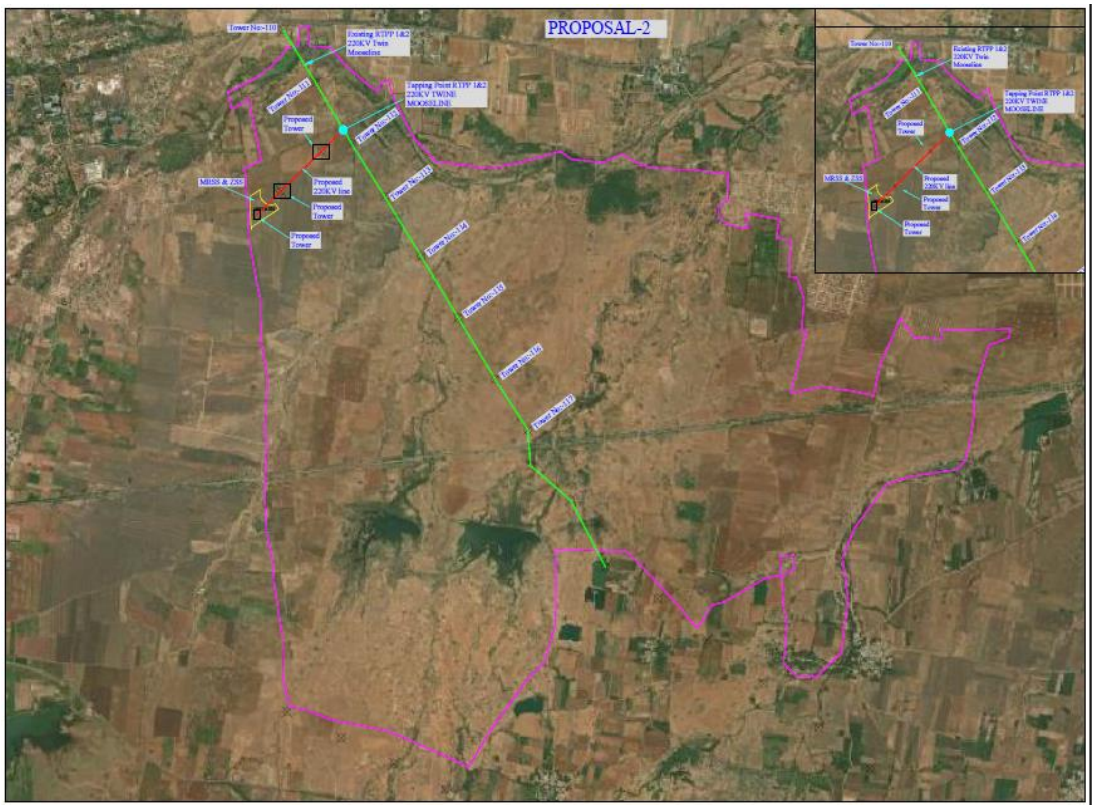


FIGURE 6-3 : SINGLE LINE DRAWING OF PROPOSAL TAPPING FROM RTTP 1&2, 220 KV LINE

Third option i.e. 220kV line emanating from Rayalaseema Thermal Power Plant (RTPP) is found to be a feasible solution. Any line can be tapped with 3/7 number of towers and arrange 220/33kV Main Receiving Substation (MRSS) in Kopparthy Industrial South extension area.

6.5.5 Codes and Standards

The following standards and codes (latest editions/ revisions) shall be used to govern the detail design of the electrical system:

- BIS: Bureau of Indian Standard;
- IEC: International Electro technical commission;
- IEEE: Institute of Electrical & Electronic Engineers
- NEC: National Electrical Code.

- NEMA: National Electrical Manufacturing Association.
- Practices being followed by APERC, APEPDCL & APSPDCL;
- Regulations laid down by Central Electricity Authority (CEA);
- BS: British Standard;
- IS: Indian Standard
- Regulations laid by chief controller of explosives;
- Any other regulations laid down by the local authorities;
- Regulations laid down by tariff advisory committee / Fire insurance regulations;

6.5.6 System Voltage Level

400kV, 220kV, 132kV, 33 kV, 11kV and 415 volts are the established system voltages in the area.

Power Supply prevailing norms of Andhra Pradesh Electricity Regulatory Commission is mentioned below:

H.T consumers seeking to avail supply through independent feeder (Dedicated) feeder from the substations where transformation to required voltage takes place shall be:

For total contracted demand with the licensees and all other sources:

Capacity	Supply Voltage
Up to 3000 kVA	11kVor 33kV
3001 kVA to 5000 kVA	33 kV
5001 kVA to 20000 kVA	33 kV 132 kV
Above 20,000 kVA	132 kV or 220 kV

Source *- Prevailing Norms of AP Electricity Regulatory Commission (APERC)*

6.5.7 Major Electrical Equipment

The proposed electrical system is decided to be underground system. The following is the list of major electrical equipment:

- Power Transformers.
- SCADA enable VCB Panels
- Power Cables
- Ring Main Units
- Feeder Remote Terminal unit (FRTU)

- Distribution Transformer
- Package Substations
- Feeder Pillar
- Earthing

6.5.8 Recommendations

Load demand of 185.22 MVA for the Kopparthy Industrial Area site can be meet by construction of 220/33/11 kV Main Receiving Substation (MRSS) .

6.5.9 Proposed Concept Design

While designing electrical system, it is every designer's job to build a reliable, efficient, effective and secure system. To cater the power demand of Kopparthy Industrial Area. 1 no. 220/33/11kV GIS Main Receiving Substation (MRSS) with 4 nos. of 33/11kV substation has proposed.

The evacuation of power from the 33/11kV ZSS to the plot holders will be done by 11kV and LV Underground distribution network.

After completion/commissioning of electrical distribution part of the project, it shall be handed over to the electricity board for operation and maintenance, the whole network shall be designed/commissioned as per the AP Electricity Board guidelines. The detailed design documents/drawings will have to be approved from AP Electricity Board before execution to avoid any challenges at time of commissioning & handing over etc.

6.6 Selection of Cable

Selection of Power Cable is based on the on maximum demand of consumers for creation of robust system under Kopparthy Industrial area for better redundancy and quality power supply.

The proposed standardization of various sizes of cables with respect to range of load is elaborated as under:

S.N.	Voltage level	Size of Power Cable	Current Carrying Capacity in Amp. (Duct / Pipe)	Load in MVA
1	33 KV	3Cx400 Sq.mm.	355	20.29
2.	11 KV	3Cx240 Sq.mm.	275	5.24

Source: APERC transmission tariff, FY 2023-2024

6.6.1 SELECTION OF 33kv CABLE BASED ON SHORT CIRCUIT CURRENT

Fault Level at 33kV (ZSS) = 1500 MVA

Short Circuit Current Isc = $\frac{\text{Fault MVA X 1000}}{\sqrt{3}\text{ X KV at Fault Point Root}}$

= $\frac{1500 \text{ X } 1000}{\sqrt{3} \text{ X } 33}$

= 26.24 KA (rms)

Now, by using formula Isc = K X A/ √T, cable size can be calculated when,

Isc = Short circuit current in KA (RMS)

T = Duration of short circuit current in sec = 1 SEC

A = Area of Aluminium conductor in sq.mm.
K = Constant = 0.094 (for aluminium)

A = Isc X √ T/K
= 26.24 X 1/0.094 = 279.19 SQ MM

As per the above calculation, the required cable size is 279.19 Sq.mm but as per standard manufacturing process confirming to IEC 60502-2 & IS:7098-2, no such size is available.

400sq.mm is the next cable size after 300 sq.mm., Therefore, considering A. P Industrial area load, maximum size of the cable shall be of 400 sq.mm cable size.

6.7 Substation Criteria for Short Circuit

The maximum short-circuit level on any new substation bus should not exceed 80% of the rated short circuit capacity of the substation. The 20% margin is intended to take care of the increase in short-circuit levels as the system grows. The rated breaking current capability of switchgear at different voltage levels may be taken as given below:

Voltage level	Rated breaking Capacity
765 kV	40 kA / 50 kA / 63 kA
400 kV	50 kA / 63 kA / 80 kA
220 kV	40 kA / 50 kA / 63 kA
132 kV	25 kA / 31.5 kA / 40 kA

Source: APERC transmission tariff, FY 2023-2024

6.8 Implementation of SCADA and smart metering in Electrical Network

Implementation of Supervisory Control and Data Acquisition (SCADA) for automation of distribution network shall be considered. SCADA is one of the solutions available for data acquisition, monitor and control systems through Ring Main Unit (RMU) with self-healing system, IEDs, Fault Passage Indicators (FPI) and FRTUs. SCADA compatible equipment is to be consider for power distribution system.

Grid automation has helped distribution utilities across the world in increasing their reliability, improving quality of power and optimum utilization of their assets, resulting in higher customer satisfaction. Automation decreases human intervention and helps utilities restore the faulty equipment in minimum duration. Smart Grid Pilot Project is an initiative of Ministry of Power with following objectives:

- Increase in power availability.
- Reduction of AT&C losses.
- Optimal utilization of resources for sustainable growth.
- Reduction in Blackouts.
- Managing load during peak hours.

6.8.1 SCADA Automation in Distribution Network

Supervisory Control and Data Acquisition or simply SCADA is one of the solutions available for data acquisition, monitor and control systems covering large geographical areas. It refers to the combination of data acquisition and telemetry.

SCADA systems are mainly used for the implementation of monitoring and control system of an equipment or a plant & distribution network, etc.

This system displays the received data on number of operator screens and conveys back the necessary control actions to the remote terminal units.

6.8.2 Component of SCADA Automation

Grid Automation has following components:

- Software Modules installed in the control room
- Hardware installed in the control room
- Communication system like GPRS, CDMA, RF Mesh, OFC etc.
- Communication equipment i.e. RTU & FRTU
- Motorized Switches for remote operation of grid
- Sensors such as MFTs, Weather Transducers etc.

6.8.3 Illustration of automated fault restoration by SCADA

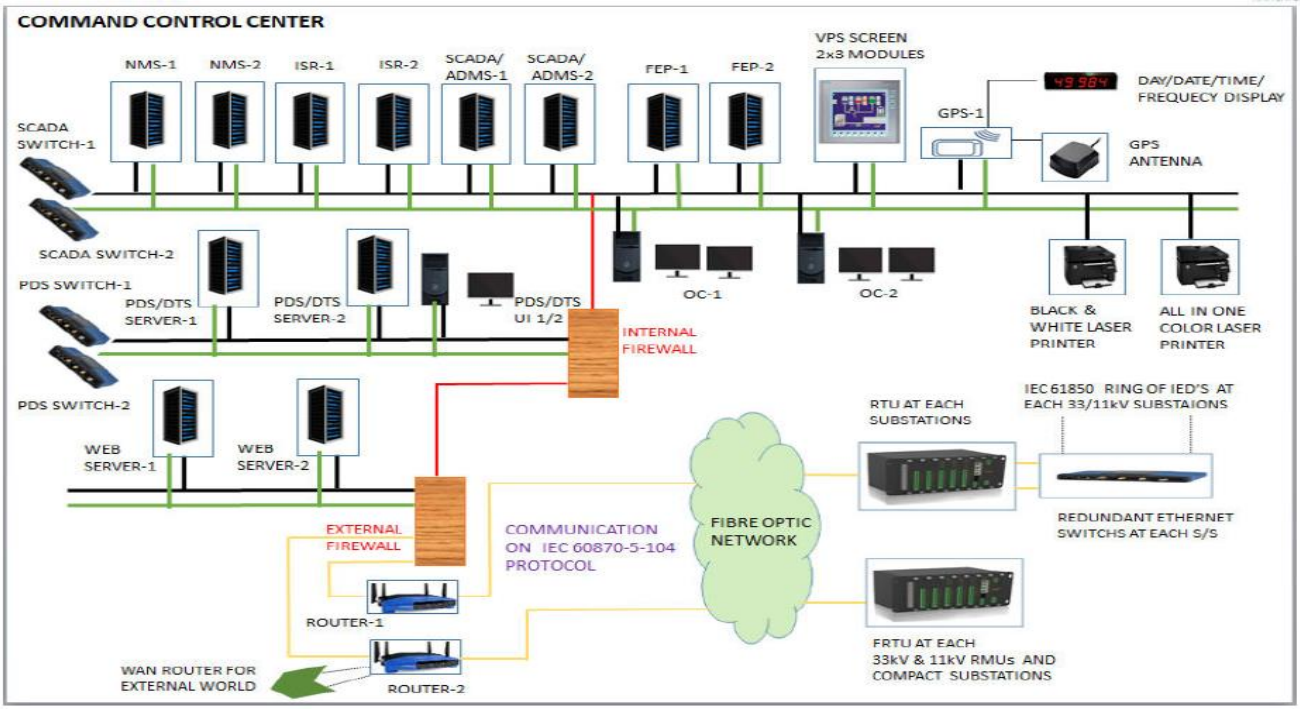
Electrical system has designed in a ring and if a fault occurs in any part, the faulty portion is isolated and power is fed through alternate path. If the closing and opening of load break switches is done manually, it takes time and requires man power. However, the same can be done remotely sitting in the control room through grid automation system. In grid automation system motorized load break switch/circuit breakers are installed which can be controlled remotely through communication system and communication equipment. Communication equipment are Remote Terminal Unit which are microprocessor-controlled electronic device that interfaces objects in the physical world to SCADA system by transmitting telemetry data to a master system, and by using messages from the master supervisory system to control connected objects.

Communication system being used is optical fibre as it is most reliable and has the potential to cater to future needs in terms of bandwidth. Moreover, laying optical fibre cable is very convenient, being laid over and above the power cable, no separate digging or boring is required to lay optical fibre. Sensors like MFTs, Weather transducers are used to collect information like voltage, current, temperature, wind direction etc. and feed these to communication equipment's as mentioned above so that the same information can be taken to control room over communication system like optical fibre cable. This information is received by the front end server of SCADA system which in

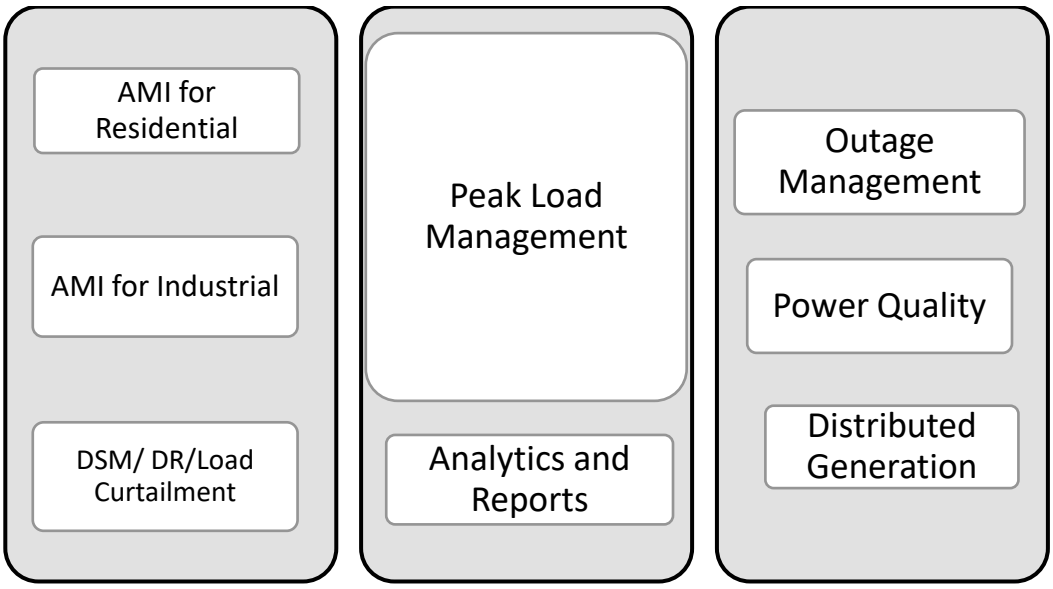
turn shares it with various application servers like SCADA, DMS, OMS, EMS servers etc. for their processing and storing relevant information in database.

6.8.4 SCADA Architecture & Elements

FIGURE 6-4 :TYPICAL SCADA ARCHITECTURE FOR ELECTRICAL DISTRIBUTION NETWORK



6.8.5 Smart Grid module details



6.8.6 AMI for Residential/Industrial

Advanced Metering infrastructure (AMI) is the combination of the electronic meters with two-way communications technology for information and real time control. The Meter in this system is called Smart Meter. Here the meter has both Consumer in-home appliance / other meter centric (HAN / NAN) & Network centric (WAN) communication facilities. These systems include hardware, software, communications, Meter Data Management (MDM) software, and supplier business systems. AMI differs from traditional automatic meter reading (AMR) as AMI enables two-way communication with the meter.

Previous systems, which used to utilized one-way communications to collect meter data only were referred to as AMR (Automated Meter Reading) Systems. The system had Network centric communication only.

AMI has following advantages for utility as well consumers

FOR UTILITY	FOR CONSUMER
Elimination of non-technical losses	Knowledgeable energy consumption
Minimization of operational costs	Fair prices for electricity
Automation of electricity supply and metering	Accurate electricity bills based on real consumption
Improvement of electricity supply quality and decrease of power outages	Improved and non-interrupted electricity supply

6.8.7 Construction of Main Receiving Substation- MRSS (220/33/11kV)

Estimate load of Kopparthy Industrial Area is 185.22 MVA. One 220/33kV Substation has considered as Main Receiving Substation to cater this load.

6.8.8 Construction of Zonal Substation-ZSS (GIS-33/11kV, 2X10MVA, Indoor Type)

33/11KV GIS substation has planned for the entire project. Power will be brought to the site from the 33kV HT line near the project area. The location of ZSS is available in the Master Plan. The identification of ZSS plots at its central location has made easy to balance the load density of the development. The ZSS comprise of two number 33kV incomer through underground sub-transmission line from the proposed 220kV GSS. The proposed system inside ZSS, consists 33kV C&R panel with LI-LO facility and 11kV VCB Panel with suitable capacitor bank. Two numbers Power Transformers with NGR will be located outside the control building room on foundation. U.G M. V. Power Cable

is proposed to cater power to individual industrial through Ring Main Units (RMU . The Ring Main Units interconnected with each other to build system redundancy.

6.8.9 MV Reticulation

19/33 kV (E) will be 3-core Aluminum Armored TR-XLPE type in accordance with IEC 60502-2. The MV cable will be installed underground at a minimum depth of 1050 mm below ground level. The cable will terminate at GSS & ZSS. The cables will be run through the RCC Masonry Cable Trenches.

6.35/11kV (E) will be 3-core Aluminum Armored XLPE type in accordance with IEC 60502-2. The MV cable will be installed underground at a minimum depth of 900 mm below ground level. The cable will terminate at each Ring main unit. The Ring main unit is proposed with 3/4nos. outgoings as required with SF6/Vacuum circuit breaker arrangement for Tee-Off. The cable will be laid underground at a minimum level of 900 mm below ground level in tier formation according to the voltage level. The cables will be run through the RCC Masonry Cable Trenches.

6.8.10 LV Reticulation

LV cable will be buried at a minimum depth of 750mm below ground and will connect the distribution transformer as per the L.T Load requirement. LV cables shall be installed a minimum of 300 mm apart from other 11kV cables.

6.8.11 Smart Metering:

Smart metering in the Indian power sector have recently attracted much attention to improve the performance and quality of power supply. Considering the smart technology implementation in the entire industrial area, Smart metering is also proposed at consumer end.

Smart metering is an advanced metering technology involving placing intelligent meters to read, process and feedback the data to customers. It measures energy consumption, remotely switches the supply to customers and remotely controls the maximum electricity consumption.

6.8.12 Reticulation of Emergency Power Supply

An emergency power system is an independent source of electrical power that supports important electrical systems on loss of normal power supply. Individual Plot/unit holder can use Generators with the prime mover are the most prevalent source of power for

emergency and standby power system. There will be also the attempt to design non-conventional energy either by wind or solar etc. This is one of the green building efforts. Climate conditions are favorable for solar power plant and thus plot holders can also install roof top Solar Panels for an emergency supply and to connect with feeder with the financial benefits under Govt./MNRE schemes.

6.8.13 Cable Laying details and Design Standards

Detailed Network Survey:

Before taking up the line construction work the contractor shall verify the proposed line route by jointly surveying with the representative of the concerned Engineer in charge.

The exact spotting of the single and multiple 33KV Cable network have to be finalized by the contractor in consultation with the concern Engineer In-charge.

The final schedule indicating routes of UG Cabling, angle of deviation, road crossing and other details shall be submitted for the approval to the concerned Engineer in charge.

The second process is to verify and create the GIS data base of electrical network.

The third process will be to create a proposed underground cable network with cable trench /cable ways in cable trench.

After approval the contractor shall submit four more sets of the approved reports along with one set of reproducible of final profile drawing to the Engineer of the Contract for record purpose.

Right of Way:

Right of way and necessary way leave clearance shall be arranged by the contractor on behalf of respective utility in accordance with the work schedule. The contractor will arrange to secure way leave and Right of way in the restricted area with the help of RESPECTIVE utility.

Tentative cable route plans will be furnished to the contractors, indicating the roads, position of substations and road crossings. The exact route survey and alignment will be decided on evaluating the findings by excavating trial holes by the contractor / subcontractor. The work should be taken upon only after approval the final route. The utility reserves the right to change, alter deviate the route on technical reasons. It is the

responsibility of the contractor to conduct necessary detailed route survey and submit of proposals to the owner for approval.

Road Crossing:

Proposed network design is planned with due consideration to avoid the number of road crossing and railway crossing. As per proposed electrical network.

The trenchless technology shall be used with HDPE casing for the portion of the cable route such as road, railway, nallah crossing and without HDPE casing for major portion of the cable route. The outer diameter of the HDPE pipe shall be suitable for insertion in an 8” diameter horizontally drilled bore. The HDPE pipe shall be of PE 80 grade with pressure rating PN4 conforming to IS 4984/1995 and shall have wall thickness of 6.20 to 7.10 mm. The HDPE pipes shall be joined by using Butt welding and a 7/20 G.I wire shall be provided along the entire length of each pipe duct.

The Depth of horizontal drilling shall be between 2 to 3 meters or as required. The drilling shall be with a Directional drilling unit equipped with automated pipe handling system and all necessary accessories. Reinstatement of road surface over trench at Crossing (Road/Nalah/River)

Railways Crossing

At the time of route survey, the railway crossings shall be finalized as per the regulation laid down by the Railway Authorities. The following are the important features of the prevailing regulations (revised in 1987):

The crossing shall normally be at right angle to the railway track. No crossing shall be located over a booster transformer, traction switching station, traction sub- station or a track cabin location in an electrified area.

The approval for crossing railway track shall be obtained by the Contractor from the Railway Authority on behalf of respective utility. The letter to this regard shall be obtained by the Contractor from officer concerned of respective utility. All the works related to the above proposal shall be deemed to be included in the scope of the contract except in case, if modifications are required in the line below or above, the line being crossed. In such cases, work shall be done on the conditions agreed upon.

The angle of crossing shall be as near to 90 degrees as possible. However, deviation to the extent of 30 degrees may be permitted under exceptionally difficult situations.

Also, in the crossing span, power line support will be as near the telecommunications lines as possible, to obtain increased vertical clearance between the wires.

The power cable should not be laid above the telecommunication cable, to avoid danger to the life of the person, digging to attend to the fault in telecommunication cable. For identification of power cables, the cable protective cover, such as bricks or RCC slabs shall be marked as “utility name”. The likely interference to the existing telecommunication cables should be avoided by referring to and coordinating with the appropriate telecommunication authorities.

When the angle of crossing has to the below 60 degrees the matter will referred to the authority in charge of the telecommunication system. The contractor shall obtain the letter from of respective DISCOM and permission of telecommunication authority shall be obtained by the contractor on behalf of respective DISCOM.

Methods ensuring that normal services may not be interrupted nor damage caused to property shall be used during UG operations, where roads, channels, telecommunication lines and railway lines must be crossed.

At Railway Crossing and road crossing etc the cable should be laid primarily through trenchless boring and HDPE Pipes. In some circumstances the lying of cable direct in ground for road crossing may be allowed for which the approval may be sought from the respective circle authorities.

Statutory Regulations and Standards

The contractor is required to follow local statutory regulations stipulated in Electricity (Supply) Act 1948, Indian Electricity Rules 1956, or as amended and other local rules and regulations referred in this specification.

The codes and/ or standard referred to in the specifications shall govern. Such codes and/ or standard, referred to shall mean the interest revisions, amendments, changes adopted and published by the relevant agencies unless otherwise indicated.

Other internationally accepted standards which ensure equal or better performances than those specified shall also be accepted, subject to prior approval by the Engineer In charge, respective DISCOM/Utility.

General Specification/Guidelines for laying of 33KV UG Network:

The scope shall cover complete installation of all equipment and accessories covered under this contract.

Installation work pertaining to equipment, cabling etc. should be in accordance with the applicable standards, safety codes etc.

Installation shall be carried out strictly in accordance with the approved drawings modifications, if any, required to suit site conditions, shall be carried out only with the prior approval of the Engineer. All such changes shall be incorporated in “As built” drawings to be furnished by the contractor.

Laying of 33 KV Cables

- It is proposed to lay underground XLPE cable(s) conforming to IS: 692 or 1S.7098 (Part-2) and any amendment thereof as per bill of quantity in various lengths on different routes within the project area.
- The quantity as given in the bill of quantity are approx. and may vary on either side as per actual requirement at site. Work should be done as per actual distances along the route of the cable and shall be paid accordingly.
- The scope of this specification covers loading transportation, unloading of cable drums, digging of trenches, laying in underground trenches, jointing terminations back filling of earth and testing & commissioning of sizes

mentioned in schedule of work conforming to relevant ISS/technical particulars enclosed herewith.

- The following technical particulars for laying of cable shall be followed as per IS: 1255/1983 or latest amendment thereof.

Sr. No	Item	For 33 KV	For 11 KV
1	Depth of trench	1050 mm	900 mm
2	Width of trench	750 mm	500 mm (For single cable)
3	Size of stone slab	450x600 x50 mm	
4	No. of stone slab per meter	1.67	1.67
5	No. of bricks per meter	9 x 2	9x2 for 3x185 mm2 or
6	Local sand per meter	0.563 cubic meter	0.375 cubic meter
7	D.C voltage to which cable shall withstand for 5 minutes after completion of laying/ jointing/ termination (in kms) between any conductor and metallic sheath/screen/armor	60 KV	18 KV
8	(HDD method)	Asper specification given	
9	Clearances- The desired minimum Clearances are as follows.	Clearance not necessary, however larger the clearance better would be current carrying capacity.	Clearance not necessary, however larger the clearance better would be current carrying capacity.
	a) Power cable to power cable	0.2 meter	0.2 meter
	b) Power cable to control cable	0.3 meter	0.3 meter
	c) Power cable to communication cable d) Power cable to water line	0.3 meter	0.3 meter

Source: Indian Standards: 1255/1983

Note: 1- High voltage test to be conducted by contractor.

Note:2 - In case of any damage of material/ equipment of 3rd party, all charges would be borne by the contractor.

Cable Trench:

The trenches for the cable laying shall be done as per standard practice The trenches shall be dug in such a manner so that soil etc. once excavated does not fall back in the trench.

a) The cables entry and exit in pipes etc. should be according to relevant IS.
b) When power cables laid through directly buried method for more than one cable shall be laid in the same trench, a horizontal inter axial spacing for 0.25 to 0.40 meters for 33KV and 0.15 to 0.25 meter for 11 KV in order to reduce the effect of mutual heating effect and also to ensure the fault occurring on one cable shall not damage to other cable.

A 45 km RCC trench is proposed in the utility corridor of the RoW. The typical section of the cable trench is provided in the figure below:-

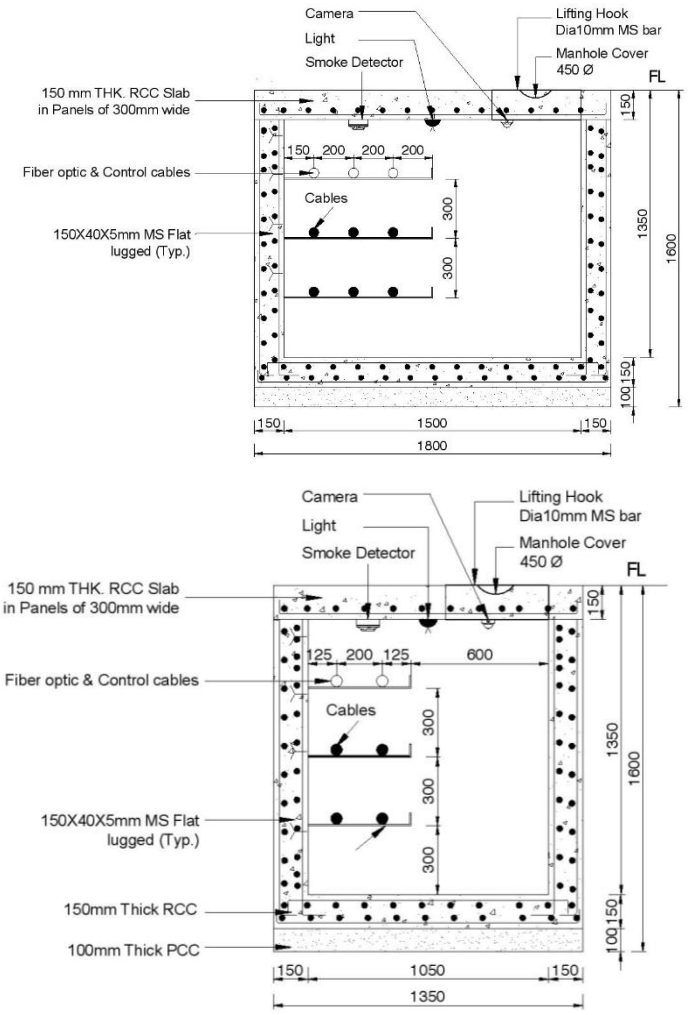


FIGURE 6-5 : TYPICAL SECTION FOR CABLE TRENCH

Trial Holes:

The Contractor shall excavate trial holes, for alignment purpose at appropriate distance apart as warranted by the local conditions, keep a record of the findings and close the trial holes properly to avoid hindrance / accidents to pedestrian traffic. The final route / alignment of the cable shall be decided based on the finding of the trial holes.

It is the responsibility of the contractor to maintain as far as possible the required statutory clearances from other utility services.

Any damage caused, inadvertently to any utility services shall be set right & it is the sole responsibility of the contractor to do the same to the satisfaction of the concerned utility.

Handling of cable: -

The contractor shall have made adequate arrangement (particularly sufficient man power & equipment) for proper handling of cables and putting the same direct on rollers and ensure that no twists etc. are made in the cable and cables are not damaged in any way whatsoever. Contractor shall also ensure that during entire working at site Up to commissioning stage their responsible engineers/supervisor with trained crew shall be continuously available.

Road cutting and restoration: -

Necessary permissions to lay the cable in ground after cutting the road(s) (Kachha). Brick-pitched & Pukka. Crossing bridges railway tracks etc. will be obtained by the contractor over the request from the engineer in charge of the work and necessary payment/charges of above shall be borne by the contractor.

The contractor should take notice of the fact that in case of cutting of roads etc. is required for laying cable; the contractor shall have to take prior permission from local authorities'/ Development authorities etc. or another owner of the road.

The road cutting charges payable to such agencies may be substantial and shall be borne by the contractor. The contractor shall take care of such charges while quoting his rate for laying of cables as no extra payment shall be made to the contractor on this account. All necessary clearance for such work from the respective agencies shall be responsibility of the contractor.

Warning / notices - While the execution of work is in progress, the contractor shall have to provide necessary lighting arrangement/signboard/ road stoppers and other precautionary warnings/notices so that accidents/ damages/losses to the public/manpower/ material etc. are avoided.

Technical Details for laying of UG Network:

Paving Out of The Cable:

The pulling shall be done by hand and in such a manner as to provide good bedding for the protective cable covers like tiles or bricks. The maximum permissible pulling force on XLPE armoured cables shall not exceed $P= 9 D^2$ Newton where P is the pulling force in Newton and D is the outer diameter of the cables in mm. However, the normal values of pulling force shall be around 15 to 20 percent of this force when laid in trenches, 20 to 40 percent with one or two 90-degree bends in trenches,50 to 60 percent when the bends are 3 or more. The cables shall have a minimum of 0.3-m clearance from the communication cables or water supply mains whenever they are encountered.

The excavated cable trench shall be drained of all water and bed surface shall be smooth, uniform and fairly hard before laying out the cable. The cable shall be pulled in the trench only on cable rollers spaced out at uniform intervals to prevent damage to cable.

The laying out process shall be smooth and steady, without subjecting the cable to abnormal tension. The cable laid out shall be smoothly and evenly transferred to the ground after providing sand cushion and shall never be dropped. All snake bends in the cable shall be straightened out.

Flaking:

Wherever it is not possible to lay off the entire cable drum length, the cable should be cut and properly sealed and if it is necessary to remove the cable from the drum, it should be properly flaked, in the form of figure 8. Such cable lengths should be properly stored at site.

Installation Procedure: -

While laying direct in the ground. the Gable should be laid on a bedding of minimum 75 mm riddled soil or sand & then covering it with additional riddled soil or sand of minimum 75 mm & protecting it by means of RCC slabs, as per the approved drawing.

The minimum depth of laying from the ground surface to the top of the Cable is as follows, however the drawings stipulated in the specification.

- 11 KV cable - 0.9 meter
- 33 KV Cable - 1.05 meter
- LT cable and control cables- 0.75 meter
- Cables at road crossings - 1.00 meter
- Cables at railway level crossings (measured from the bottom of sleepers to the top of pipe)- 1.00 meter.

The depth may vary as per the site conditions for which the contractor will seek approval from the Engineer in charge.

a) The minimum clearances are as follow: -
   - Power cable to control cable- 0.2 meter.
   - Power cable to communication cable - 0 3 meter.
   - Power cable to Gas/water - 0. 3 meter
   - Power Cable to Power cable – clearance not necessary however, larger the clearance better would be carrying capacity.

b) The Diameter of the cable conduit or pipe or duct shall be at least 1.5 times the outer diameter of the cable. Spare ducts for further extensions should be provided. The spare duct runs should be sealed off.

c) For identification of the route of U/G Cable and safety of others/human being the word “Power cable” should be marked on the protective covering of RCC slabs, as per the drawings stipulated in the specification.

d) All the other materials liked coarse and fine aggregate sand, joint markers, sealing. identification strips/ tags of metal or plastics, route markers. cable support clamps, terminals and inline connectors. sealing compounds etc. whether specifically mentioned or not in these specifications are deemed to have been included in the scope of supply

and installation. These shall have to be got approved by the contractor from the Engineer-in-charge before use.

e) Identification strips/ tags of metal or plastics should be attached to the cables. particularly if several cables are laid in parallel, 8 to 10m apart. Identification tags should also be attached at every entry point into the buildings and at the cable end terminations.

f) A bedding of riddled earth or river Sand should be provided and protective cable warning tapes should be used. Instruction to back fill the trench should not be given until the entire length is protected by cable cover and checked.

g) The precautions to be taken while laying cables in ducts by taking care against abrasions during pulling, proper alignment of duct, precautions against damage. to cable at duct entry positions etc.

h) In case of jointing of lengths of Various cables, provision of RCC jointing inspection pit/window should be kept in case the same is to be kept underground. However, overhead jointing of cable may be done through RMUs.

i) For tapping power from underground HT XLPE cable. a Ring Main Unit (RMU) depending upon the voltage level i.e. 33KV or Switching Stations shall be installed at every load centre i.e. HT connection/distribution transformer/tapping point between the cable. A standard 3 way RMU having 2 no. isolator's (for incoming and outgoing) and one no. circuit breaker unit (for local load control e.g. DT/ HT connection) will be installed. For the 11KV system, outdoor type RMUs can be used with proper fencing of the area.

j) However, for the 33KV system, Indoor type RMUs shall be used for which a room of 10 ' X 10' size is required. The RMU shall be having SF6 quenching media with both sides extendable and motorized with the provision of self-powered supply as per Nigam specification /IS/IEC. However, the provision of FRTU shall be available in the RMU for compatibility with future SCADA.

Cables Over Bridges:

k) Wherever the cable route crosses bridge the cable shall be laid in the ducts, if provided, by removing and replacing the R.C.C. covers and filled with sand cushion.

l) In the absence of the cable ducts over bridges, the cable shall be laid in suitable size RCC/steel/G.I. pipes or as directed by the engineer In-charge and the pipe covered by cement concrete if necessary to protect from direct sunrays and Masonry/RCC supports at suitable intervals, wherever required as decided by the Engineer in charge and/or stipulations of concerned Highway/Railway/local authorities.

Cable Crossing open Drains with Long Span:

m) Wherever the cable has to cross open drains, with a long span, the cable shall be laid in suitable size RCC closed duct/GI pipe/ hume pipe properly jointed with suitable collars. The GI pipe/hume pipe shall be firmly supported on pillars, columns, or suitable support of R.C.C. foundation & walls in CC 1:1½: 3 to the required depth & width as required at site and directions & drawings as per technical specifications & procedures of PWD.

n) Wherever the U.G. cable has to cross the sewerage or water supply line the U.G. cable has to be taken below them maintaining adequate clearance. Further wherever the U.G. cable runs parallel to the telephone cable a separation distance of at least 300-mm shall be maintained. The cable should be taken inside Hume Pipes wherever required.

o) The cables shall be laid in Hume pipes/stoneware pipe wherever the cable and trench crosses private roads, gates, etc. In order to avoid inconvenience, the stoneware pipe should be laid first after excavation and excavated trench shall be back filled, compacted and surface properly redone to restore that original condition.

Footpath Cutting:

p) The pavement slabs shall be removed, neatly stacked on side before starting excavation.

6.8.15 Design Criteria of Smart Road Lighting

Roads should allow users of the road at night to travel in the safest and comfortable manner possible so that the road's traffic capacity at night is as close to the daytime capacity as possible. The driver should be able to see clearly without the use of dipped or driving headlights and locate all significant details with certainty and in time, particularly the alignment of the road (its direction and surroundings), any traffic signs, and potential obstacles; additionally, he should be made aware of any dangerous situation without the use of his headlight beams, whether driving or passing.

FIGURE 6-6 : THEMATIC VIEW OF ROAD LIGHTING

The pedestrian should be able to see the edges of the footways, vehicles, and obstacles clearly; there should be no dark patches. The above goal should be met while keeping the aesthetic appearance of the lighted road in mind, and within reasonable installation and maintenance costs. The economy and aesthetics of the installations are determined by the road's character, which includes its location as well as the nature and intensity of traffic.

The entire road and its details should be visible at all times. Among the details that must be perceived are the surrounds of the carriageway and the formation way, the entry of side roads, and traffic signs, whether at the side or painted on the carriageway surface.

The various types of pole arrangements are as follows:

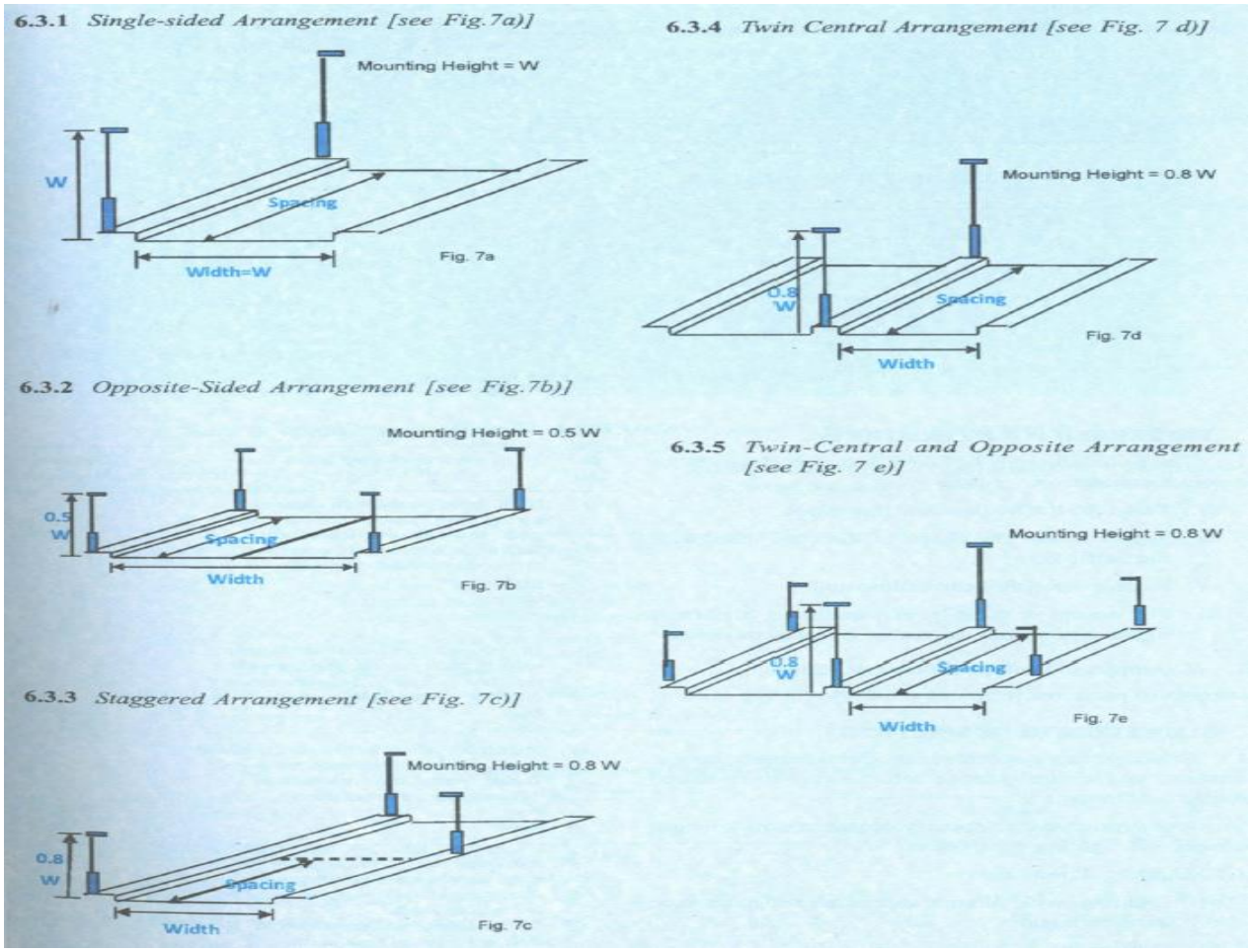


FIGURE 6-8 : TYPE OF POLE ARRANGEMENTS

Source: IS, SP 72, 2010

Any object that is or may be dangerous must be seen and recognized clearly and quickly. Such an obstacle should be visible from a sufficient distance to allow the driver enough time to execute any manoeuvre required by the presence of the obstacle without endangering himself or others. This time should be enough to perceive the obstacle, identify it, assess its direction of movement, distance, and speed, and decide which manoeuvres to perform, taking into account the vehicle's speed, the driver's reaction time, and braking time. This perception should obviously be provided throughout the driver's visual field, that is, in both foveal and peripheral vision zones.

The street lighting should be continuous and uniform. Special lighting, which does not interfere with the overall appearance of the road's lighting, should be provided at critical

points and areas such as bends, crossroads, Junctions etc. The carriageway luminance is determined by the distribution of luminaire luminous intensities, the geometry of the installation, that is, the siting with respect to the carriageway plan, and the reflection characteristics of the carriageway surface.

The choice of source for public lighting is guided by the following considerations are:

1 Luminous Flux

2 Economy (Determined by Lumens/watt and life)

3 Dimensions of the lighting sources

4 Colour Characteristics

5 Type of Luminaires: Cut-off Luminaires, Semi-cut-off luminaires, Non –cut-off luminaires.

Important Terms relating to Street lighting arrangement are:

- **Luminaire:** A housing for one or more lamps, comprising a body and any refractor, reflector, diffuser or enclosure associated with the lamp.
- **Outreach:** The distance measured horizontally between the centre of the column or wall face and the centre of a luminaire.
- **Overhang:** The distance measured horizontally between the centre of a luminaire mounted on the bracket and the adjacent edge of the carriageway.
- **Mounting Height:** The vertical distance between the centre of the luminaire and the surface of the carriageway.
- **Spacing:** The distance measured along the centre line of the carriageway, between successive luminaires in an installation.
- **Lighting System:** An array of luminaires with a specific light distribution that are positioned in accordance with that distribution.
- **Lighting Installation:** The entire highway lighting system, including lamps, luminaires, support structures, and electrical and other auxiliary equipment.

The road lighting configuration are represented as follows:

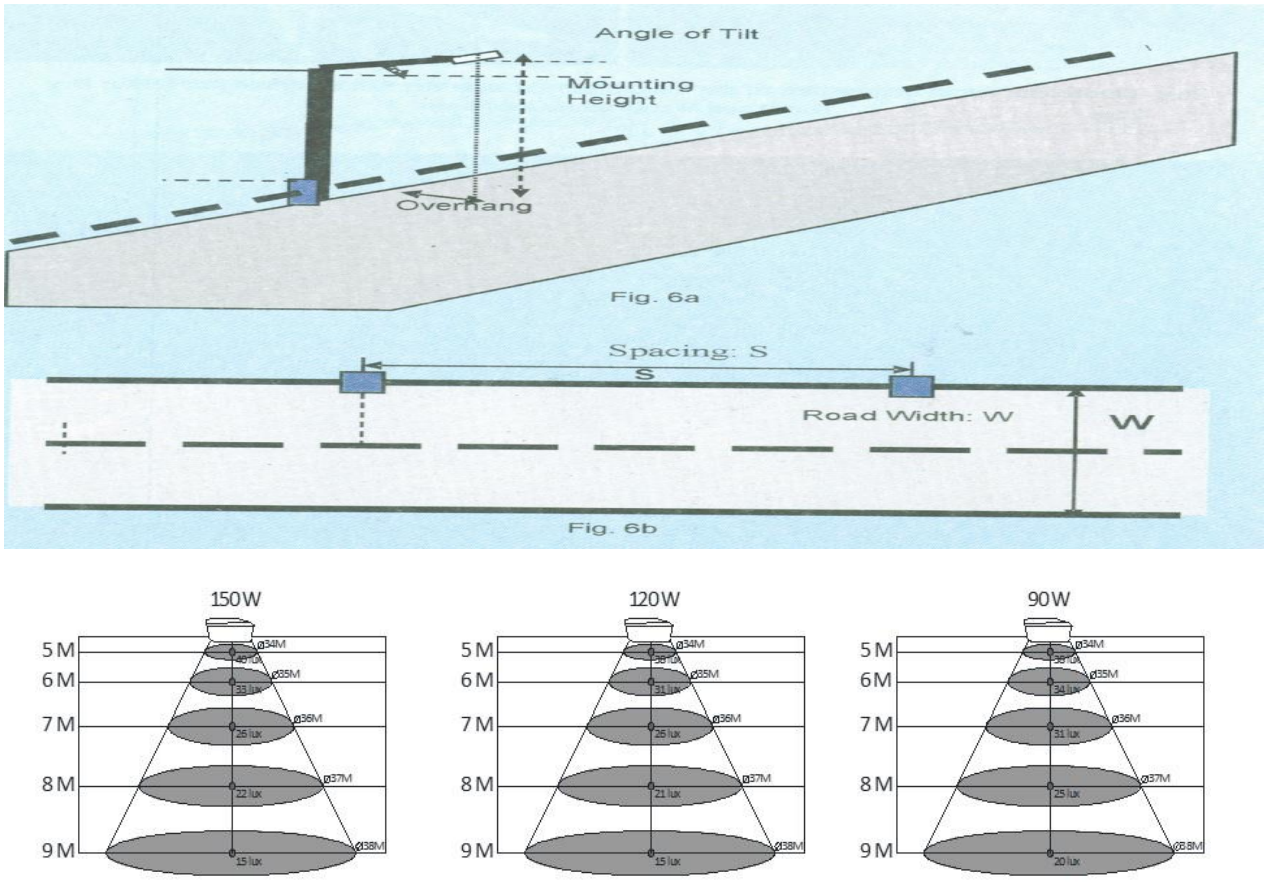


FIGURE 6-9 : ROAD LIGHTING CONFIGURATIONS AND LUX DISTRIBUTION DRAWING

Source: IS, SP 72, 2010

A properly maintained Street lighting installation is critical to its proper operation. Certain maintenance activities aimed at keeping the installation's effectiveness at the highest possible level are economically justified,

(a) The large investment in public lighting installations continues to provide a good return.

(b) Because of the far from negligible power consumption that is wasted in a poorly maintained installation.

A lighting installation's maintenance should include:

- Replacement of defective and missing lamps Accessories
- Systematic replacement of lamps having a reduced efficiency, that is, those lamps have to the end of their useful service life.

- Cleaning of luminaires and lamps

Inspection of the mains, earthing arrangements, gaskets, the tracing of defects and broken lamps, and control of the switching equipment.

Basic requirement of road, green area and periphery lighting proposed be as follows:

- Adequate level of illuminations for heavy vehicles/light vehicles/cyclist
- Uniform illumination level over carriage way with minimum glare
- Safety of movement
- Minimum disturbance during fog/dust conditions
- Use of high efficiency lighting fixtures with high lumen output and low power consumption
- Beautification and pleasing view

6.8.16 Technical Details of Smart Street Lighting System

The technical parameters of the smart Street lighting for various types of roads are adopted as per approved National/International guidelines and perform the lux level calculation with help of software for the selection of pole, luminaire and lights. Technical Detail for Smart Street Lighting System given in the below table:

TABLE 6-7: TECHNICAL DETAILS OF ROAD LIGHTING SYSTEM

S. NO.	DESCRIPTION	45M WIDE ROAD	30 M WIDE ROAD	24 M WIDE ROAD	18 M WIDE ROAD
1	**Area of Installation**	Industrial	Industrial	Industrial/ Residential	Industrial/ Residential
2	**Pole Mounting pole detail**	Double arm pole, on both side of carriageway	Double arm pole, on both side of carriageway	Double arm pole, on both side of carriageway and staggered	Double arm pole, on both side of carriageway and staggered
3	**Lighting Fixture**	150W, LED lamp	120W, LED lamp	90W, LED lamp	90W, LED lamp
4	**Angle of tilt**	25°	25°	25°	25°
5	**Average Lux Level**	15	15	12	12
6	**Uniformity Factor**	0.53	0.63	0.43	0.43
7	**Mounting height**	9Mtrs.	9Mtrs.	9Mtrs.	9Mtrs.
8	**Spacing**	25M	25M	25M	25M

Source: - Indian standard -1944

6.8.17 Design Criteria of Smart Street Lighting

Junctions of main roads and larger areas are proposed to be illuminated by providing smart High- Mast system of illumination. The HIGH-MASTs will be selected based upon TERRAIN CATEGORY of TC-2 & Wind pressure 50 m/s as per IS: 875. The mounting height of High-masts & number of luminaries will be based upon the following data:

TABLE 6-8: HIGH MAST DATA (SHAFT DIMENSION, FOUNDATION BOLTS/ ACCESSORIES)

S.NO.	DESCRIPTION	16M				20M					
1	TYPE OF MAST	16M0	16M1	16M2	16M3	20M0	20M1	20M2	20M3	20M4	20M5
2	TOP DIAMETER	166	166	220	220	166	166	206	208	208	210
3	BASE DIAMETER	356	415	485	485	404	419	489	489	489	518
4	P.C.D.	460	530	630	630	500	530	630	630	630	630
5	BASE O.D. FLANGE	540	630	730	730	580	630	730	730	730	730
6	BASE FLANGE THICKNESS	32	32	32	32	32	32	32	32	32	32
7	NUMBER OF SECTIONS	2	2	2	2	2	2	2	2	2	2
8	SECTIONAL THICKNESS	3.3	3.4	3.4	3.4	3.4	3.4	3.4	4.4	4.5	5.6
9	NO. OF BOLTS	8	8	12	12	8	12	16	16	16	20
10	BOLT DIA. (INCH)	1	1	1	1	1	1	1	1	1	1
11	BOLT LENGTH	750	1200	1200	1200	750	1200	1200	1200	1200	1200
Steel Grade : BSEN100025, All Dimensions are in mm											
YIELD STRESS: 355 MPA											
TENSILE STRESS: 490-630 MPA											
ELONGATION: 22%											

Source: - Indian standard -1944

6.8.18 Power Supply

Power supply to Conventional smart street lighting pole be fed through underground 1.1 kV XLPE insulated, armoured, aluminium conductor cables. Distribution of power be through 415V, 3phase, 4 wire system.

Cables for street lighting system shall be sized based on protection device rating, the capacity of cable, permissible voltage drop and in general, according to IEC. All cable shall be armoured, aluminium conductor cable and to be installed direct buried. Voltage drop is an important consideration in long runs associated with street/road lighting. Cable shall be sized in a way to maintain a minimum voltage drop between feeder pillars to the last pole on the circuit. Power supply for road lighting be made available from the proposed distribution transformer / LV Feeder Pillar in the entire project area depending

upon the site conditions. To obtain optimized power consumption of street lighting in the Kopparthy Industrial Park development, we have considered 90 Watt LED bulbs for 18M and 24M road of total length 26.494 kilometres , 120 watt bulb for 30 M roads of total length 16.366 kilometres and 150 watt bulb for 45 M roads of total length 7.340 kilometres. Total load of the street lightning for total road length of 50.202 kilometres is 0.436 MW (Approx 0.45 MW) of power required for street lightning.

TABLE 6-9: OPTIMIZED POWER CONSUMPTION STREET LIGHTING

(A) For 18M & 24M road load calculation		
Sl. No	**Details**	**Qty**
1	Total Road Length	26.494
2	Number of LED bulbs	2120
3	Total load Watts (90 Watt bulb)	190800
4	Total load (KW)	190.80
5	Total load (MW)	0.190

(B) For 30M road load calculation		
Sl. No	**Details**	**Qty**
1	Total Road Length	16.366
2	Number of LED bulbs	1310
3	Total load Watts (120 Watt bulb)	157200
4	Total load (KW)	157.2
5	Total load (MW)	0.157

(C) For 45M road load calculation		
Sl. No	**Details**	**Qty**
1	Total Road Length	7.34
2	Number of LED bulbs	588
3	Total load Watts (150 Watt bulb)	88200
4	Total load (KW)	88.2
5	Total load (MW)	0.088

Total load calculation (A+B+C)		
Sl. No	**Details**	**Qty**
1	Total Road Length	50.200
2	Total number of LED bulbs	4018
3	Total load Watts	436200
4	Total load (KW)	436.20
5	Total load (MW)	0.436

6.8.19 Control System

In order to have an energy efficient system, smart LED luminaries of various ratings are proposed for the street lighting. Smart LED are significantly energy efficient; offer good quality of light and have a longer life than others of around 40000 – 90000 hrs depending upon the quality of LED, design and operating environment. The lux level has been considered as per IS1944.The smart street lights shall be controlled from outdoor street light Panel with 4Pole MCCB incomer, Energy meter, power contactor for switching ON/ OFF the lights and MCB outgoings for distribution.

Below are the Operational Charges and Maintenance Charges of Street Lightning based on the references taken from some previous contracts of sub contractors as per Andhra Padesh government released tenders.

TABLE 6-10: OPERATIONAL CHARGES OF STREET LIGHTNING

Operational Charges of Street Lightning										
Description	**Load of Each Point (W)**	**Working Hours**	**Total Load in KWH / Point/Month**	**Fixed Charges (Per Point / Month)**	**Energy Charges (Rs / KWH)**	**Total Charges (Per Point / Month)**	**Total Charges (Per Point / Year)**	**Total Points**	**Total Charges / Month**	**Total Charges / Year**
Load (In Watt)	90	10	27.00	80	3.05	162.35	1,948.20	2120	3,44,182.00	41,30,184.00
Load (In Watt)	120	10	36.00	100	5.05	281.80	3,381.60	1310	3,69,158.00	44,29,896.00
Load (In Watt)	150	10	45.00	100	5.05	327.25	3,927.00	588	1,92,423.00	23,09,076.00
Operational Charges Total Amount									**9,05,763.00**	**1,08,69,156.00**

TABLE 6-11: MAINTENANCE CHARGES OF STREET LIGHTNING

Maintenance Charges of Street Lightning					
S.No	**Description**	**Rate/ Km**	**Total Length (Km)**	**Total Rate/ Month**	**Per Year**
1	Maintenance of 90 W street lights per month	60000	26.494	1589640	19075680
2	Maintenance of 120 W street lights per month	100000	16.366	1636600	19639200
3	Maintenance of 150 W street lights per month	125000	7.34	917500	11010000
Total Amount				**41,43,740.00**	**4,97,24,880.00**

TABLE 6-12: OPERATIONAL CHARGES AND MAINTENANCE CHARGES OF STREET LIGHTNING

Operational Charges and Maintenance Charges of Street Lightning			
S. No	**Street Light Watt**	**Monthly Charges**	**Yearly Charges**
1	90	3,44,182.00	41,30,184.00
2	120	3,69,158.00	44,29,896.00
3	150	1,92,423.00	23,09,076.00
Operational Charges (A)		**9,05,763.00**	**1,08,69,156.00**
1	90	1589640	19075680
2	120	1636600	19639200
3	150	917500	11010000
Maintenance Charges (B)		**41,43,740.00**	**4,97,24,880.00**
Total Charges (A+B)		**50,49,503.00**	**6,05,94,036.00**

7 Information and Communication Technology

Information & Communications Technology (ICT) as the key enabler to integrate various functions of the mega industrial park development and operations, provide advanced and affordable services to the citizens along with efficient governance and management of the Industrial Park operations. ICT will enable creation of a sustainable eco-system of the government, industries/businesses, social infrastructure with an overall citizen-centric development.

7.1 Telecommunication System

The implementation of Telecommunication system is very important for any development and its usage has become a necessity these days. As such telecommunication network is proposed to be provided in a manner so as to have connectivity by different service providers. The telecom operators in the Andhra Pradesh circle are as follows enabling users to select the services of service provider of their liking.

TABLE 7-1: TELE SERVICES

S. No.	SERVICES	OPERATOR
1	Wireless	Vodafone IDEA Ltd
		BSNL
2	Unified	Reliance Infocomm
		Tata Teleservices (TTML)
		Bharti Airtel Ltd
3	Wireline	BSNL

Source: Voyants Analysis

Telecom Services today are of the following types:

Landline operations requiring a telecom cable & junction box space in utility corridor

- # Wireless services on GSM / CDMA platform requiring tower at stipulated radii
- # Broad band Services requiring a cable corridor and distribution chambers
- # Short Coverage Wi-Fi networks

To achieve it, Optical fibers are used to provide and connect various service providers for telecom as well as broadband services to the users through the optical fiber network. To run the cabling, the provision for laying the conduit & chamber in front of all the plots has been proposed in ROW planning.

7.2 Data Communication System

A high-speed communication facility through earth station is available for Information Technology units/companies. Earth station functions as international gateway and provides worldwide reliable high-speed data communication (HSDC) services at internationally competitive rates. In India, the facility of internet as well as international private leased line is available from earth station owned by software technology park of India or VSNL and some other prominent players in this field.

The telecommunication and broadband connectivity network Overhead Conductors can be provided within the project site by either project authority or provision can be made in service corridor by project authority for laying of Overhead Conductors by any of the prominent service providers e.g. Airtel, BSNL, and Reliance etc. Provision in service corridors should be sufficient to accommodate 3-4 service providers to ensure competition and hence better service.

Further, while reserving space in service corridors, provision for laying the conduits & chambers in front of all the plots is to be kept in mind and location of these shall be finalized along with Master Planners and landscape consultant.

7.2.1 ICT System

The paradigm shift towards modern cities includes a strong need to have integrated and connected infrastructure with a focus on citizen-centric services.

The overall vision of Kopparthy Industrial Area (KIA) includes positioning of Information & Communications Technology (ICT) as the key enabler to integrate various functions of the mega industrial park development and operations, provide advanced and

affordable services to the citizens along with efficient governance and management of the Industrial Park operations.

ICT will enable creation of a sustainable eco-system of the government, industries/businesses, social infrastructure with an overall citizen-centric development. It will enable Special Purpose Vehicle (SPV) to be an efficient and tech-savvy organization that will truly leverage ICT for its operations and decision making.

ICT will cultivate the development of a digital and connected industrial park which ultimately helps in promoting and sustaining economic growth and development.

7.2.2 Project Components

As one of the key initiatives for realizing this vision, Kopparthy Industrial Area SPV plans to implement a state-of-the-art ICT infrastructure along with various components as part of this Project.

At the centre of the Project is the Kopparthy Industrial Area Integrated Command and Control Centre (KIA-ICCC) which will be the nerve centre for the industrial park. All applications will be installed in this ICCC.

The KIA-ICCC will interface with all end-devices and applications including at field level and at the user level. It will be the only location from where the industrial park will be operated and managed in terms of the infrastructure, critical systems, and operations.

All components that will be integrated at the KIA-ICCC will communicate to the KIA-ICCC using either wired or wireless communications. The wired communications i.e., for the field devices and sensors will be over a purposeful-built fibre optic-based infrastructure which will be deployed throughout the Project area. The fibre optic infrastructure will be used to meet both SPV needs and non-SPV needs i.e., tenants of KIA. It is desired that with this Project, an overall Fibre-to-the-X (FTTX) architecture is implemented for all field device connectivity and for connectivity to every plot. The wireless communications on the other hand will include purposeful built wireless network such as LoRA (Long Range wireless), M2M communications for some field applications like utilities or will be realized using the industrial park Wi-Fi network. The

Wi-Fi network will be deployed throughout the public areas of Kopparthy and will be used to enable broadband to be accessible, affordable, and available for the citizens.

For applications such as e-governance, the citizen will use either the public Wi-Fi service or KIA's multi-services digital kiosks or may use the respective connectivity from the respective Internet service provider. Multiple e- governance services are being planned and KIA aims to provide 100% of resident and tenant services online. The backend of the e-governance system and the backbone for KIA operations will be an Enterprise Resource Planning (ERP) system that will be primarily used by KIA for operating and managing the industrial park. It is envisaged that the ERP system will be the one common system used by KIA for all activities required as part of the operations and management of KIA.

An intelligent smart industrial park also includes the concept of a safe industrial park. KIA also plans to implement proactive CCTV surveillance system that will be used to monitor the industrial park and its assets. In addition, automatic traffic counters and classifiers will be implemented at all entry and exit points of Kopparthy to monitor traffic flows and other parameters. Environmental sensors will also be implemented at strategic locations for monitoring various parameters such as pollutant levels which will enable KIA to continuously track the environmental impact of the industrial park. An integrated vehicle tracking system for KIA vehicles will be implemented for automatically tracking locations of all KIA vehicle assets at the command-and-control centre. Specifically for solid waste management, in addition to tracking, it is also desired to automatically dispatch the waste collection vehicles based on various parameters and inputs including bin level sensors.

KIA as an organization is expected to be lean. In addition, there may be outsourced services being managed by a Mega Industrial Park Manager who may operate some of the functions on behalf of KIA.

7.2.3 Summary of Project Components

A Summary of the Project Components are as follows:

1. E-Governance and ERP: will comprise of implementation of various citizen engaging e- governance initiatives with a target of 100% of KIA's services being available online. This also includes a robust state-of-the-art ERP system for planning and managing KIA's operations more efficiently. The ERP system shall enable KIA to have efficient business processes that can be managed in an integrated manner.
2. Kopparthy Industrial Area Integrated Command and Control Centre (KIA-ICCC): which will be the 'nerve-centre' of KIA for real-time monitoring and control of the connected infrastructure and industrial park services.
3. IT Infrastructure - This includes implementation of complete IT Infrastructure to be provided such as Operator Workstations, Communication Cabinets with Racks, Servers, UPS, Data Security Solutions and Databases.
4. Fibre Optics Infrastructure: End-to-end fibre optic infrastructure (passive and active) to meet all the current and future needs of the industrial park with an overall architecture of Fibre-to-the-X (FTTX) for a connected mega industrial park using various Points-of- Presence (PoP) facilities.
5. Pan Industrial Park Wi-Fi: Public Wi-Fi to make broadband services more accessible, affordable, and available for citizens and workforce
6. CCTV surveillance system for proactive monitoring of strategic areas and infrastructure across the industrial park.
7. Automatic Traffic Counters and Classifiers (ATCC), Automatic Number Plate Recognition (ANPR) for monitoring flow and type of traffic at all entry/exit points of the industrial park.
8. Multiservice Digital Kiosk and Emergency Operation Systems: Integrated and interactive multi-services digital kiosks for citizen services and emergency communications with Wi-Fi and CCTV across various public areas.
9. ICT interface for Smart Solid Waste Management: ICT interface infrastructure required for integrating solid waste bins, collection trucks and operations along with dispatch for solid waste collection.

10. Environmental Sensors: Implementation of environmental sensors at strategic locations in KIA for monitoring of various parameters such as temperature, humidity, wind speed, rainfall, and pollutants.
11. Automatic Vehicle Location (AVL) System: Real-time tracking and monitoring of key KIA/non-KIA vehicles including police, fire, solid waste trucks, ambulance, and water tankers.
12. Other In-Facility Services: This includes Building Management System and Access Control System. Building management system for monitoring, control, and automation of critical infrastructure at KIA-ICCC and Point-of-Presence (POP) Rooms. Access control system for controlled access with integrated biometric functionality for both KIA-ICCC and POP rooms.

7.2.4 Architecture

1. The solution architecture should be open, interoperable, and scalable.
2. Adherence to the model framework of cyber security requirements set for Smart City (K-15016/61/2016-SC-1, Government of India, and Ministry of Urban Development).
3. All the components of the Technical Architecture should:
   a) at least comply with the published eGovernance standards, frameworks, policies, and guidelines available on http://egovstandards.gov.in (updated from time-to- time); and
   b) In reference to the leading industry standards and as per indicative standards mentioned at Appendix B.
4. The overall architecture shall support:
   a) Expandability: Open ended; allows upgrading to take advantage of continued evolution in transportation information and control systems.
   b) Interoperability: Machine independent; allows the largest-possible markets for deployment.
   c) Compatibility: Non-interference; various devices within the same system must be able to operate without interfering with the operation of other devices.

d) Interchangeability: Vendor independent; devices from different vendors that perform the same functions may be interchanged.

e) Open: Non-proprietary; promotes rapid development of new technologies and acceptance by consumers.

f) Scalable: Flexible; standards recognize local conditions with a wide range of ICT devices and communication channel capabilities. Legacy systems are accommodated to the extent possible.

g) State-of-the-art: Use of the best available standards to avoid locking in obsolescent technologies

5. Minimize the infrastructure such as poles, by co-locating various equipment (CCTV, Wi-fi, Sensors, switches etc.) on streetlight poles..

7.2.5 Integration Requirements

1. Along with the implementation of the above-mentioned components, the ICT Solution shall also be responsible for end-to-end coordination and integration with the following components (provided by Other Services).
2. Triple Play Voice, Video and Data Services: KIA may to lease out dedicated backbone and distribution fibre optic infrastructure to the Telecom Service Providers (TSPs) as part of this Project. This fibre optic infrastructure will be implemented by the ICT MSI and will be used by the TSPs. KIA will essentially provide ‘dark fibre’ to the TSPs and will provide TSPs dedicated space for co-locating their respective equipment at POP rooms. ICT MSI shall coordinate with various TSPs to incorporate their requirements in terms of dark fibre infrastructure.
3. Passive Infrastructure for Cellular Services: A tower company may be appointed by KIA for the installation, operations, and maintenance of passive infrastructure for cellular services including cell phone towers and integrated smart poles. KIA will also provide dedicated space to the tower company for installation of towers and co-location of equipment (provided by cellular service providers). The ICT MSI shall coordinate with the tower company and incorporate their requirements in terms of passive infrastructure.

4. ICT interface with Power, Water and Street Lighting Infrastructure for Internet of Things (IoT): The EPC Contractor is to implement the civil and utilities trunk infrastructure. The water, power and street lighting infrastructure being provided by the EPC Contractor will be SCADA based and will be integrated at the KIA-ICCC for the purposes of monitoring and control of critical parameters. The integration of these SCADA enabled utilities at the KIA-ICCC and complete coordination with the EPC Contractor shall be the responsibility of the ICT MSI.
5. Hosting Services: KIA will appoint a cloud service provider for meeting the hosting needs of the Project. Part of the Project IT infrastructure in the form of servers will be used via Infrastructure-as-a-Services (IaaS) provided by the cloud service provider. This will be used by the ICT-MSI for hosting services.
6. Solid Waste Management: ICT-MSI shall coordinate with the designated solid waste management agency for the ICT infrastructure and components being provided as part of the ICT Project.

7.2.6 System features: e-Governance and ERP

As part of the KIA e-Governance and ERP systems, multiple applications will be provided for both citizens facing and KIA specific requirements. The e-governance system broadly includes citizen facing applications that will become the point of interface for the citizens with KIA. The applications will be made available over different mediums including citizen application, portal, and website. Further, the ERP system will effectively be the backbone for KIA that will enable efficient and integrated operations and maintenance of the industrial park. The ERP system will be closely integrated with the e-governance system and will become the main system used by KIA for industrial park governance and operations.

ERP system shall be required to be implemented to automate the internal business functions at KIA. The goal of AEE is to create one holistic system which allows KIA to be lean and efficient in their business processes and functions and provide 100% online services to the citizens. Since KIA is a greenfield mega industrial park, most of the key functionalities available in standard software shall be configured meeting the business requirements in key

functions of KIA. Besides the standard state-of-the-art ERP system, functionalities like Document Management System, Portal for customer communication (Service requests/ Complaints), Bespoke solutions for E-Government functions as listed in this document, web enablement of GIS foundation layer, and SOA based integration framework for integrating various application systems etc. are required to be developed/customized.

Main System components are:

1. KIA Corporate Website – Design, Development and Launch of the same.

2. Customer Facing Systems: Comprising of:
   a) Multi-Channel Communication Centre for citizens,
   b) Portal,
   c) E- governance functions,
   d) M-Governance Functions,
   e) Social Governance,
   f) Web based GIS layer,
   g) Digital Locker,
   h) Citizen smart card,
   i) Kiosk and Mobile Applications,
   j) Management Information System along with KPI and Dashboards.

3. Back-office Systems i.e., ERP: Comprising of:
   a) Finance and Accounts,
   b) Purchasing,
   c) budgeting,
   d) contract management system,
   e) Asset Management,
   f) Electricity and water connection,
   g) Billing,
   h) Maintenance,

i) Projects,
j) Stores,
k) HR and Payroll.

4. Framework for integrating various applications.
5. Foundation Layer: A SOA based integration solution, document management system, will be an integral part of the overall solution.

The vision of KIA is to use IT towards establishment of people centred, responsive, well governed functions and to provide a single, easy, secure, and reliable means of access to municipal information and services to the citizens of this area. A Citizen Facilitation centre, multi-services digital kiosk, mobile application and website backed with an integrated portal is the front end of these applications.

At the core of the stakeholder's service experience will be KIA portal which will be a gateway to various stakeholders including citizens. The Portal will have an intuitive user interface for rendering various services and providing role-based access to various systems in use at KIA. Through the Portal, any user can seek service, status check on service request, lodge an incident/complaint, get information, and provide suggestions. It is envisaged that the citizen shall interact with KIA via the portal which shall direct the query / grievance to the relevant department using workflows.

The Face-to-face contact point for the citizens will be a Citizen Facilitation Centre (CFC). The Citizen Facilitation centre would be manned by trained employees of KIA. These employees shall assist the citizens with information, application, or complaints. The employees shall also take care of e-mail, postal service letters and phone calls. The employees shall log into the portal and conduct the business required for the citizen. The CFC may be used to verify and upload documents to the digital locker.

7.2.6.1 Benefits to the Lessee/ Consumers:

1. The Lessee benefits because there is transparency, efficiency, and integrity in his dealings with KIA, furthermore, there is ease in information access.
2. Convergence of services and delivery mechanism and extending outreach.
3. The service delivery is faster to the citizens.

4. Online visibility on water and electricity consumption with a one-day time lag.
5. Payment of Land related maintenance charges, Water bills, Power bills is online.
6. Reducing the cost of citizen like travel cost, wages cost etc.
7. Reducing the time in availing the services like travelling, waiting time.
8. Online status of application Redressing citizen Grievance within a stipulated time frame.
9. Access to all Citizen and Business-related services at Kopparthy.
10. Access to information easily with service delivery counters within reach.
11. High Level of Convenience.
12. Facility of payment at convenient points and extended hours.
13. Negligible Queuing.
14. Minimizing the number of customer visits.

7.2.7 E-Governance Modules

KIA recognizes the importance of Information Technology (IT) to enhance the efficiency and effectiveness of service delivery to citizens and stakeholders. Due to this, KIA has set up a vision to develop a fully digital organization by comprehensive deployment of IT across its departments of conduct business.

As part of the vision, it has been envisaged to implement electronic delivery of KIA services to citizens for greater efficiency, transparency, and accountability. Intent is to allow citizens and stakeholders to access and use KIA services online to provide ease of use and promote paperless and digital platforms. Following modules shall be implemented as part of envisaged e-Governance solution of the KIA:

1. Corporate Website: to provide useful information to citizen and stakeholders.
2. KIA Portal and Mobile Applications: It shall provide a gateway to all stakeholder experience including citizens.

3. Citizen Facilitation Centre (CFC): It shall provide in person contact point for all citizens.
4. Birth and Death Certificate Module: It shall provide the capability for online registration of birth and death certificates.
5. Trade Licenses: It shall be an online module for periodic review and approval of licenses.
6. Right to Information (RTI): It shall provide information to accept applications, register requests, disposal to relevant department, track status, maintain an appeal register and status of appeals.
7. Legal – Related to Land only: It shall assist the legal cell of KIA to monitor and analyse all land related cases and expenditures.
8. Citizen Grievance Redressal: It shall be an online module for citizens through KIA portal and mobile application to register and track all public grievances associated with KIA functions.
9. GIS Platform with Web GIS: It shall consist of implementation of GIS Map of Kopparthy which shall be a common platform across all KIA solutions. It shall also include web enabled version of the GIS map shall be implemented for citizens and KIA employees.
10. Management Information System (KPI Dashboard): Performance management framework shall be implemented to demonstrate 'Open Data' initiatives.
11. Digital Locker: It shall be an online file storage facility for citizens and businesses.
12. Smart Card System: it shall be used by citizens, workers, and businesses as a digital identity.
13. Automated Building Plan Approval System: Online solution to KIA for building layout plans scrutiny.

All the above-mentioned modules shall be closely integrated with the back-end ERP system to perform as one cohesive and holistic system which shall play a vital role in electronic and automated service delivery to citizens.

Considerable encouragement shall be provided to citizens and businesses to adopt digital and online services

7.2.7.1 Corporate Website

The KIA corporate website needs to be the face of KIA and shall present KIA to various stakeholders. It will be accessed by citizens, investors, and corporates alike and shall provide factual and attractive information to investors. The corporate web site should clearly communicate a sense of 'identity' at first glance.

KIA's website should serve as a cutting-edge communication tool that clearly conveys its mission, vision, offerings, and purpose. The site shall help prospects and citizens to better understand and engage with the KIA's mission. The website shall be a useful tool for the target audience, while being visually appealing, user-friendly, and state-of-the-art. It must allow easy navigation. The site must have an attractive mix of text, images, audio, and video. The website should:

1. Increase traffic and visitor engagement through architecture, design, and other features such as social media integration.
2. Help visitors easily understand the KIA's mission and obtain information about KIA's offerings.
3. Deliver content concisely and clearly. This content includes dynamic information.

The Corporate web site should have links to log-in for visitors, residents, and employees. This logs in shall redirect the user to the portal with rights to view or transact as per user status.

The home page shall be clean and visually compelling that quickly conveys to the visitor, the KIA's mission and what the KIA does. This shall include dynamic 'Call-Outs' which highlight what's new on the website as well as information sliders.

7.2.7.2 Customer Facing Systems: Portal, Kiosks and Mobile Application

KIA is developing KIA as a mixed-use industrial area and will have municipal powers and functions in this area. The municipal functions envisaged are:

1. Local level governance.
2. Primary Collection of Solid Waste.
3. Maintenance of Storm Water Drains.
4. Maintenance of Municipal Roads.
5. Maintenance of parks, gardens, and playgrounds.
6. Primary education and medical needs.
7. Governance of markets, cremation grounds and slaughterhouses as applicable.
8. Regulating advertisements.
9. Allotment of Trade Licenses directly or indirectly.
10. O&M of internal sewers and community toilets as applicable.
11. Street lighting.
12. Operation and Maintenance of Important points in the industrial park.
13. Assessment Land maintenance charges.
14. Utility Payment: Payments relating to electricity and water bills.
15. Interaction with Fire Service and Police

In line with the National e-Governance Plan (NeGP), the aim of KIA is to "Make all citizen services accessible to the common man in Kopparthy, through common service delivery outlets, and ensure efficiency, transparency, and reliability of such services at affordable costs to realise the basic needs of the resident or common man".

Kopparthy, being a mega industrial park, is expected to have a high internet penetration with industrial park Wi-Fi and fibre backbone. In addition, mobiles would

also enable anytime, anywhere access to and delivery of services which would be ideal for delivery Govt. services, financial inclusion, micro credit, location (GPS) based services, etc. KIA, is fully geared up to exploit the huge potential for empowerment through mobile governance.

At the core of the stakeholders' service experience will be KIA portal which will be a gateway to various stakeholders including citizens. The Portal will have an intuitive user interface for rendering various services and providing role-based access to various systems in use at KIA. Through the Portal, any user can seek service, status check on service request, lodge an incident/complaint, get information, and provide suggestions. It is envisaged that the citizen shall interact with KIA via the portal which shall direct the query / grievance to the relevant department using industry standard workflows. Similarly, for KIA, the portal shall act as a gateway for single sign on services to check all sorts of services and requests related to m- governance.

The in-person contact point for the citizens will be a Citizen Facilitation Centre (CFC). The Citizen Facilitation centre would be manned by trained employees of KIA. These employees shall assist the citizens with information, application, or complaints. The employees shall also take care of e-mail, postal service letters and phone calls. The employees shall log into the portal and conduct the business required for the citizens. The CFC may be used to verify and upload documents to the digital locker.

The citizen can also access services at multi-services digital kiosks that will be set up in Kopparthy at strategic locations. Kiosks will be put up at suitable location across the industrial park thereby giving industrial park stakeholders a free access to various services at convenient locations.

The heart of the industrial park is a mobile application i.e., the citizen app which will be used by citizens for accessing all industrial park services. Another version of the app will be for m-governance which will be used by KIA for their day-to-day operations and functions.

The citizen may log in by their smart card at either the facilitation centre or a kiosk or from their personal devices integrated with website, portal, and mobile app.

The key objective of the Portal, Facilitation centre, Mobile App and the kiosk will be to:

a) Provide Single Window services to citizens on anytime, anywhere basis.

b) Provide a single and integrated view of KIA information system.

c) Provide a single application form for all services as required.

7.2.7.3 Birth and Death Certificate Module

The registration of births and deaths is one of the functions of a Municipality. Registrar of the Municipality is the authorized person for issue of birth and death certificates. Hospitals are responsible for the registration of births & deaths within the municipality. The births and deaths, which take place in the hospital are recorded and reported to the municipalities. For non-hospital events, the concerned parties can make necessary applications to the Municipalities.

The Birth and death module primarily deals with recording of birth and death details taking place within Kopparthy Residential Area and Hospitals. The process includes recording/registration of the primary data in relation to birth/death, informabtion on the fee collected including the penalties and issue of the certificates.

The main activities of birth and death process are:

a) Birth & death registration.

b) Validation of data.

c) Application Registration.

d) Issue of birth and death certificates.

e) Corrections in the registration details.

f) Updating of registration details (Inclusion of child's name).

7.2.7.4 Trade Licenses

KIA has provisioned for commercial establishments in Kopparthy area. These establishments must be issued trade licenses and governed. The licenses shall be periodically reviewed, renewed, or rejected. The envisaged system shall have the provision of:

a) Online application of licenses (includes portal, mobile & facilitation centre).

b) Evaluation of applications through document management system.

c) Online approvals.

Licensing Department issues licenses to the shops, trader, and market within the jurisdiction of KIA. KIA may give these licenses directly or in coordination with another authorized municipality (if applicable).

Note: The licensee will be required to submit periodic (to be decided by KIA) data on turnover, tax paid, number of employees, and other KPIs which will be updated on the KIA dashboard.

7.2.7.5 Right to Information (RTI)

The module for RTI should have the ability to accept applications, register requests, disposal to relevant department, track status, maintain an appeal register and status of appeals.

7.2.7.6 Legal – Related to Land Only

This module will assist the legal cell of KIA in monitoring and analyzing all their land related cases and expenditures.

7.2.7.7 Lessee Grievances Redressal

KIA will provide various public utility services due to which, it might receive few complaints/suggestions/feedbacks pertaining to its services. To address all these complaints, it is necessary to have an efficient and effective grievance redressal mechanism. The objective of public grievance monitoring system is to provide multiple channels of grievance recording, to make it more citizens friendly and to provide

linkages to different sections for increased transparency, citizen participation and performance accountability.

The system should have the ability to maintain different types of grievances caused to the citizens, department or section that needs to address the grievance, number of days within which the grievance needs to be addressed and nature of grievance whether it is financial or non-financial.

The main activities as part of Public Grievance Monitoring Management process include:

a) Registration of the complaint/suggestion.

b) Issuance of acknowledgment.

c) Trigger an event in the ERP system.

d) Capturing of status of the complaint till it is resolved.

e) Generation of necessary reports for proper monitoring.

7.2.7.8 GIS Platform with Web GIS

GIS Map

GIS map of Kopparthy which shall be a common platform across all the solutions including Public Wi-Fi Access Points, industrial park Surveillance System, Environmental Sensors, ICT based Solid Waste Management, AVL, etc along with other GIS layers being provided by other contractors will be required as part of this Project.

Note that the base map of Kopparthy in GIS that has land related properties which will be used to build the actual GIS map and platform will be provided to the successful MSI.

1. GIS maps shall be comprehensive and detailed up to roads, houses and building level.
2. GIS Map shall provide complete details of the industrial park in various digital vector layers and allows for zoom in/out, searching, and retrieving information

capabilities.

3. GIS details procured shall include the following data with attributes:
   - Road Network:
     - industrial park Arterial Roads.
     - Streets.
   - Administrative boundaries:
     - industrial park Boundaries.
   - Building footprints and names.
   - Points of Interest data to include:
     - Health services (Hospitals, Bl.ood Banks, and Diagnostics centre, Ambulance Services, Other Medical Services, etc.).
     - Community services (fire stations, police stations, banks, ATMs, post offices, educational facilities, KIA Buildings etc.).
     - Business Centres (shopping malls, markets, commercial complexes etc.).
     - Residential areas (Apartments, housing societies etc.).
     - Transportation (bus stops/Terminus, parking areas, petrol bunks, railway stations, etc.).
     - Recreation facilities (Restaurants, theatres, auditoriums etc.).
     - Other utilities such as travel and tourism facilities, religious places, burial grounds, solid waste locations.
     - Local landmarks with locally called names.
   - Land-Cover:
     - Green areas.
     - Open areas.
     - Water bodies.

- Address layers (Pin code, Locality, Sub-locality, House numbers/names).
- Geo referencing of all the assets pertaining to the solutions as required.
- All data procured shall be imported into a central database.
- System Functionalities:
  - The system shall have capability to perform attribute or spatial queries on data from selected sources.
  - The system shall support Mobile platform, iOS, Android, and Windows.
  - The system shall support clipping and/or downloading of raster and vector data by authorised users.
  - The system shall support server-side Geo-processing.
  - The application shall have standard and modern map navigation tools of pan and zoom.
  - The application shall support client requests to print the spatial data.
  - The system shall be able to support industry-standard data types, industry- standard data formats, unlimited file size or database size, unlimited number of files or tables, and unlimited number of users.
  - The system shall support geocoding and reverse geocoding.
  - The system shall allow the users to perform advanced spatial analysis like geocoding, routing, buffering and attribute-based analysis.
  - The application shall have standard and modern map navigation tools of pan and zoom.
  - The system shall have the facility wherein the user can opt to view in 2D or 3D environment.
  - The system shall be compatible with Google Maps, Bing™ Maps, Micro Station, AutoCAD, MGE, FRAMME, G/Technology, ODBC source.
  - The System shall support hierarchical legends, and watermarks.

- The application shall allow users to view the data with different symbology styles like differentiating feature records based on attributes or types, dynamic label generation with conflict detection, and translucency of all raster data and area colour fill.
- The system shall allow the user to find Address.
- The system shall be able to consume real-time enterprise published spatial data. It shall be able to consume the third-party published OGC (Open Geo- Spatial) web-services.

- Application shall be OGC compliant for database and shall provision conversion to other database formats.
- GIS base maps shall be installed on workstations at KIA-ICCC. GIS maps and data replication shall happen from central system remotely.

7.2.7.9 Management Information System: KPI Dashboard

Performance management, monitoring and evaluation are critical elements utilized by the industrial park to improve organisational and individual performance and to enhance service delivery. The establishment and development of the performance management framework ensures integration between strategic planning and performance management by linking the solutions/services to indicators and targets that can be used to measure performance.

The proposed performance management framework is developed based on global city performance framework like ISO: 37120 and others. Performance Management Framework shall demonstrate ‘Open Data’ initiatives.

7.2.7.10 Digital Locker

The digital locker facility is based on the concept of DigiLocker, a national Digital Locker System launched by the Govt. of India.

Digital Locker is an online storage facility provided by KIA to store important documents. Citizens can upload documents like Voter Id card, PAN card, BPL card, Driving license, education certificates etc. These documents will be linked to the

property id number and can be treated as citizen documents. So, the citizen may not need to carry physical documents while applying for utilities or jobs or government certificates or educational institutions etc. It will address the challenges faced by citizens and government to submit and verify the authenticity of the document's multiple times.

The digital locker will enable anytime and anywhere access to the documents. Dedicated personal storage space will be allotted per allottee. The citizen can store authenticated and unauthenticated documents in the locker. The citizen can upload documents from the portal to the unauthenticated section. On producing originals at the citizen facilitation centre, and as per KIA work flow they can be verified and moved to the authenticated section.

7.2.7.11 Smart Card System

It is envisaged that the Industrial units and citizens shall have a smart card code as an identity. This shall be based on his credentials as supplied to the LMS or at the Lessee facilitation Centre or through mobile application/website/portal. The credentials shall be submitted once and validated and kept in a secure digital locker. The smart card shall be the front and access to this locker. This will be the citizen's or company's unique identity. The holder of the smart card can use it for accessing information on the portal, pay bills, use Wi-Fi services while in the industrial park. The citizen may also use this id to submit any complaints / requests. This id must further be authenticated with a one-time password to the registered mobile number or a pin number for security purposes.

The lessee / company may use this id to apply for utilities, pay the bills and use other services on the portal. Guest users may also visit the portal and will have access to selective options.

7.2.7.12 Automated Building Plan Approval System

Automated Building Plan Approval System should be able to provide online solution to KIA for building layout plans movement process monitoring for automatic development control regulations.

7.2.8 Enterprise Resource Planning (ERP) System

The ERP at KIA is envisaged to be the system of record, and a core component of a majority

of the business processes. All the master data like Customers, Properties, Vendors, Equipment, Service Tax Rates, Electric and Water supply rates, Employees & Associates, Materials, Spares, G/L accounts, Banks, Cost Centres etc. would be maintained in this system.

ERP solution shall logically represent all assets as mentioned above to ensure that preventive, reactive and breakdown maintenance activities are efficiently processed.

ERP system shall be the backbone component of the envisaged solution. As a part of the backbone of the systems, it is planned to have an ERP system comprising of modules to address the following business functions:

- Revenue Management: E-Auction of plots, Land Sales (integration with Land Management System), Land related maintenance charges and other applicable taxes, Customer Chargeable Work, Rental for KIA facilities, etc.
- Finance and Management Accounting: General Ledger, Accounts Payable, Accounts Receivable, Asset Management, Depreciation Calculation, Over Head Costing, Work Order Costing, Investment Planning, Funds and Grants Management.
- Purchasing and Inventory Management: E-Procurement, Purchase Requisitions, Purchase Orders and Contracts, Receipt of Goods and Services, Invoice Receipt, Inventory and Spares Management, Vendor Master, Approval Hierarchies and MIS.
- Contract Management: Contract Lifecycle from Contract drafting, review from multiple perspective, and creating a final Contract document.
- Operations, Maintenance & Asset Life Cycle Management: Properties, Roads, Pipeline, Fibre Network Records, Asset/Equipment Master, Resource Master, Preventive, Predictive and Breakdown Maintenance, Notifications, Work Orders, Maintenance History Management and MIS.

- Project and Works Management: Capital Investment Planning, Managing Project Schedules and Costs, Project Execution, Project Accounting.
- HR and Payroll: HR Management, Payroll Management, Payroll Processing, Employee Self Service, Time, and Attendance Management.
- Water Utility Management and Billing: Customer Service Management, New Connections, Temporary Water Connections, Automated Meter Reading, Service Management, Water Billing.
- Electric Utility Management and Billing: Customer Service Management, New Connections, Temporary Electricity Connections, Automated Meter Reading, Service Management, Electricity Billing.
- Integration and Interfaces: Creating Service Oriented Architecture (SOA) based enterprise framework to enable online integration for the various AEE
- Access Channel: Integrated Portal services to be accessed via several end user devices.
- Enterprise Content Management System: For storing, scanning, uploading, sharing of KIA documents.

The ERP modules would provide out of the box integration amongst themselves and further the ERP would be integrated with Document Management System, Land Management System, Payment Systems, Banks (payment gateway), GIS, Portal, SCADA systems, Customer Facilitation Centre, Kiosks and E- Gov system.

The ERP system shall have the following requirements for the OEM and the solution:

1. The multicurrency ERP package shall be based on globally used, proven, and fully integrated but modular commercially-off-the-shelf ERP product. The ERP system shall be fully integrated across all modules including finance, vendor accounting, customer receivables accounting, management accounting, maintenance work orders, inventory, asset management, projects, investment management, utility billing. Master data like for Vendors, Properties, Customer, Materials, Assets should be stored only at one place (without duplication).
2. The ERP software application should be readily deployable with or without

configuration to suit the customer's specific process requirements and shall not involve developing the application and/or modules from scratch.

3. ERP software shall be certified on various operating systems like Windows, Linux, and Unix. Additionally, certified backend databases are Sybase ASE, DB2, MS SQL, ORACLE.
4. The ERP software shall be implementable or deployable and maintainable by any other competent agency other than the manufacturer or agency which has developed the COTS software. The ERP software provider have a published method of appointment of implementation partners.
5. The ERP Solution must have multiple implementation partners who have implement experience of implementing the proposed ERP solution.
6. ERP supports localization features for India taxes and provides the legal changes for these taxes as a support package from time to time.
7. ERP is completely scalable and supports large enterprise implementation. It shall be built for corporate operations.
8. ERP shall support security features required for enterprise application.
9. ERP OEM shall offer 24X7, SLA based support which is being separately signed with the customers/ implementation partners as part of licensing agreements.
10. ERP OEM shall have a development centre in India with more than 1000 Developers.
11. Proposed COTS solution shall also be available with complete transparency including operation manuals, help documents and source code as a standard from the ERP OEM.
12. The ERP Solution provider should have its own offices in India for service and support. Liaison offices, partner organization offices will not be treated as vendors own office.

7.2.9 Kopparthy Industrial Area Integrated Command and Control Centre

KIA Integrated Command and Control Centre (KIA-ICCC) will be the 'nerve-centre' of Kopparthy Industrial park that will assist in enhancing efficiencies of industrial park operations and management.

KIA-ICCC will help in making the industrial park operations intelligent, integrated, and efficient.

KIA-ICCC leverages information provided by multiple systems, which further helps in providing an integrated, seamless, proactive, and comprehensive response mechanism for day-to-day industrial park operations and challenges

It includes the centralized command and control centre with the necessary hardware and software to support industrial park operations. An essential feature of the KIA-ICCC is a smart industrial park platform which is a combination of system layers that when combined make use of Big Data, ICT and other infrastructure, advanced computing, analytics, and visualization to enhance industrial park's intelligence while normalizing the data. In addition, it provides a tool for the industrial park to better manage the services it provides to its citizens.

Note that the OEM of the smart industrial park platform shall comply with the following requirements:

a) OEM shall be a publicly listed company with a registered office in India.
b) OEM should have minimum 500 employees on company payroll.
c) OEM should have ISO-9001 quality certification.
d) OEM should have 24x7 technical assistance support in India. Support should be through online website and phone number for registering service request.
e) OEM should provide online developer program tools that help industrial park produce new applications and/or use solution APIs to enhance or manage existing solution.
f) OEM proposed solution shall be implemented across at least 3 places globally.

There are several functions and systems that will be managed out of the KIA-ICCC.

Depending on the type of system and the respective functions, they may be monitored and/or controlled from the KIA-ICCC and will have the option of sharing a feed to another agency as required via the KIA-ICCC.

Note that the electrical, street lighting, water and wastewater systems will be provided by Others and have been explained as part of other sections of this RFQ cum RFP.

These systems will be SCADA based using their respective individual system deployments and will only be integrated at the KIA-ICCC for critical alarms and functionality.

It is not expected that there is an entire duplication of these systems for the purposes of monitor and control at the KIA-ICCC.

System	Monitor	Control	Feed sharing (External)
Electrical system including metering	✓	✓	
Street lighting			
Water (including metering) and Wastewater			
Solid Waste Management			
Environmental Sensors			
CCTV Surveillance			
Emergency Communications			
Fire			
Police (CCTV)			
Ambulance and other Vehicles			
e-Governance			
ICT infrastructure – Wired & Wireless	✓	✓	
Facilities management – KIA building			
Facilities management – Non-KIA buildings			
Transit & Traffic Management			
Education			
Healthcare			
Kiosks			

Components of the KIA - ICCC:

a) Applications and Web Browsers – Multiple software applications shall be a content input into the KIA-ICCC Systems.
b) Audio System and Speakers – A system of audio components to provide annunciations in the operations and boardroom spaces within the KIA-ICCC.
c) Boardroom Display – Large format LED monitor shall be provided in the boardroom.
d) Call Centre – A 24 x 7 call centre shall be setup to support industrial park operations. The call centre shall have the capability of expansion as required to support industrial park Services
e) CATV – Cable TV shall be an input source into the KIA-ICCC Systems. This content source shall be managed by the DCMS and be available anywhere in the KIA-ICCC. Inputs such as weather, news, etc can be obtained via this CATV feed.
f) CCTV Cameras and ATCC – These are the primary video inputs into the Video Systems.
g) Industrial Park Managed Systems – Content for several industrial park systems to be managed and monitored at the KIA-ICCC.
h) Cloud and Disaster Recovery Site – Are external to the industrial park limits and used for system applications and data storage for some of the systems.
i) DCMS – The Display Content Management System shall manage all networked visual content throughout the facility, including the video display wall and the boardroom display. This system will manage a dashboard for industrial park Management Systems to be displayed and monitored on the video wall.
j) Monitors – Consist of operator monitors, cabin monitor, and other displays that are connected to the KIA-ICCC network.
k) Network Video Recorder (NVR) – Network video recorders shall be dedicated for recording and archiving of camera video.
l) Operator Workstations – These workstations shall be dedicated for KIA-

ICCC System

m) use at the operator consoles. They are the point of control for the various systems at the KIA-ICCC.

n) Smart Industrial park Platform – Various smart industrial park dashboards, Key Performance Indicators (KPI's), and analytics that are available as display visuals to aid industrial park operations and better manage the Industrial Park. This platform will also input and output feeds from other systems and agencies such as fire, education, healthcare, etc.

o) Video Display Wall – The Video Display Wall shall be in the Operations Room and shall be the primary visual display for operators at the KIA-ICCC.

p) Video Management System – The Video Management System shall manage CCTV streaming video, PTZ control, and video archiving.

The Smart Industrial Park Platform

The smart industrial park platform shall take feeds/inputs from various sensors, citizens, real-time systems, processed data, and legacy data to enable proactive monitoring, analytical prediction, and cross-system communications for making an intelligent Industrial Park.

In terms of analysis, using this platform, the industrial park shall achieve statistical and predictive analytics, big data analytics, business intelligence and real-time event processing. Through this platform, various 'mined' information shall be shared with industrial park officials and citizens in the form of reports, dashboards, standard APIs, and open data.

Functional Layers of Smart Industrial Park Platform

The Functional Layers of the Smart Industrial Park Platform includes:

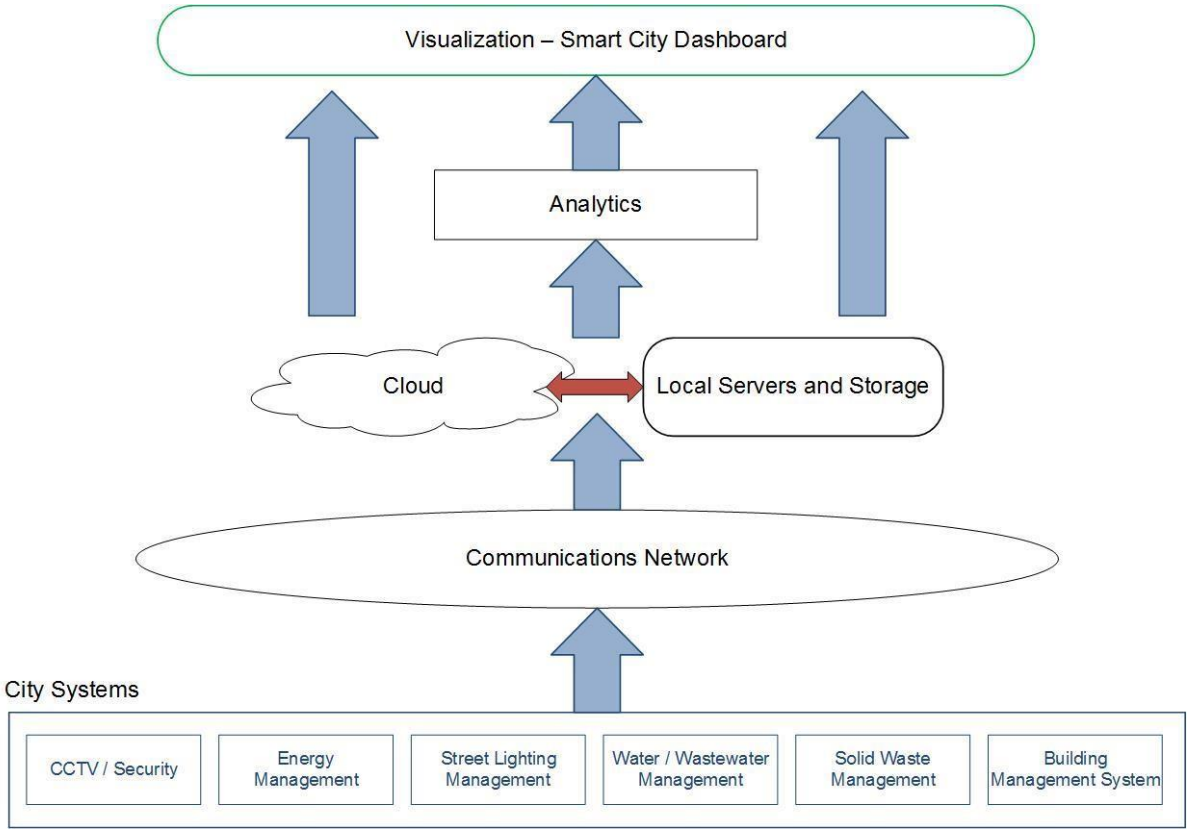
a) Industrial Park Systems: These are independent systems for managing and/or monitoring a specific set of equipment, sensors, etc. (e.g., Water IoT, CCTV cameras, Wi-Fi, Streetlighting, BMS, etc.).

b) Communications Network: This primarily consists of network hardware such as fibre communications backbone, network switches, Wi-Fi Access Points, etc.

c) Data Centre and Disaster Recovery Centre: Central hardware where system applications and big data are stored and retrieved. This includes a combination of data hosted on cloud and some on-site data processing and storage as per the requirements of this RFQ cum RFP.

d) Analytics: This layer provides the real intelligence for an Industrial Park. Analytics correlate data across two or more independent systems (cross-system intelligence) and supports both predictive and prescriptive analytics.

e) Visualization: Visual information that is typically displayed and monitored at a central location. Visual outputs for a smart industrial park platform originate both directly from industrial park (city) systems and the analytics layer. For KIA, visualization will primarily be at the ACC along with visualization using web portals, and applications.



Database

Any commercially available database like Oracle/Informix/MS SQL /DB2 shall be provided along with license and support and upgrade costs.

Data Security

The smart industrial park network architecture shall adopt an end-to-end security model that protects data and infrastructure from malicious attacks, thefts, natural disasters, etc. The architecture shall be implemented in such a way that the system is protected from hackers and other threats.

The data security system shall address security policies, hardware, and software, along with the connectivity between the field device and the respective application.

Note that the client at its discretion may have the authority to carry a security audit of the entire system during the Project or post implementation at regular intervals.

Hosting – On Premises and Cloud

The hosting requirements of the project shall be met via a hybrid architecture that includes:

- On-premises; and
- On-Cloud.

Overall, the objective of this architecture is to optimize the number of on-site servers without compromising the overall performance of the system.

KIA through a cloud service provider shall provide the hosting infrastructure i.e., servers with OS for hosting all applications and services that will be implemented on-cloud. The following indicative systems are envisaged to be hosted on-cloud:

- ERP.
- E-Governance.
- Smart Industrial Park Platform.
- Solid waste management, CAD and all AVL systems.
- Environmental Sensors.

Apart from the above-mentioned systems, all other systems are expected to be hosted on-site. It is expected that all applications for on-cloud hosting shall support cloud ready architecture.

Application	High Availability/ Clustering	Single sign on	Back up	DR (minimum production capacity)	RTO	RPO	Expected Response Time in Seconds
ERP	Yes	Yes	Yes	Yes (Min 50%)	60 Mins	15	3
E-Governance	Yes	Yes	Yes	Yes (Min 50%)	60 Mins	15 Mins	3
Portal	Yes	Yes	Yes	Yes (Min 50%)	60 Mins	15	2
Websit	Yes	Yes	Yes	Yes (Min 50%)	60 Mins	15	2
DMS	Yes	Yes	Yes	Yes (Min 50%)	60 Mins	15	3
Kiosk	No	No	Yes	Yes (Min 50%)	60 Mins	15	2
Mobile	No	No	Yes	No	60 Mins	15	3
Smart Industri	Yes	Yes	Yes	Yes (Min 50%)	60 Mins	15 Mins	2
CAD and	No	No	Yes	Yes (Min 50%)	60 Mins	15 Mins	3
Smart Industri	Yes	Yes	Yes	Yes (Min 50%)	60 Mins	15 Mins	3
CCTV Surveill	Yes	Yes	Yes	Yes (Min 50%)	60 Mins	15 Mins	3
Any other Applicat	Yes	No	Yes	Yes (Min 50%)	60 Mins	15 Mins	3

IT Infrastructure - The operator workstations

The Operator Workstations shall be specifically installed for the operators at the command-and-control centre. Other than this, there will also be a need to provide regular workstations. The specification for all the workstations (including operator

workstation) shall be common. The only difference between an operator workstation and a workstation shall be that for an operator workstation, the workstation unit will be installed at the rack room.

IT Infrastructure – Uninterrupted Power Supply

The UPS unit shall be provided at each POP rooms and ICCC rooms (Command and Control Centre and Rack Room) to backup entire KIA devices & switches, emergency lights and Fire detections system. UPS system shall provide a redundant power supply to the following needs:

- Servers and important network and storage equipment.
- Access control, Fire Detection & suppression system, and surveillance system.

7.2.10 Fibre Optic Infrastructure

An underlying enabler of a industrial park is a highly reliable and available fibre optic infrastructure.

Kopparthy Industrial park to have an end-to-end fibre optic infrastructure with an overall FTT-X architecture for all its services. This infrastructure will be used for both KIA and non-KIA services including KIA tenants.

It is expected that overall, fibre optic infrastructure will be used for connectivity to all 'things' being implemented as part of Kopparthy Industrial Park and will be the underlying enabler for connectivity.

The end-to-end fibre optic infrastructure shall be provided as per the following:

a) A total of Three (3) POPs shall be in the Kopparthy.
b) A dedicated fibre optic infrastructure shall be provided in a partial-mesh architecture. This fibre optic infrastructure shall be dedicated for backbone communications of the Project.
c) From each of these POP facilities, there will be a dedicated fibre optic infrastructure required for distribution communications of the Project. This distribution communications will be used to provide connectivity to the field

devices and for connectivity to plots. This shall be provided in a dual ring configuration.

d) The last layer for communications will be the access layer i.e., connectivity to every plot and field device that will be provided from the distribution network. This is further divided into three (3) scenarios:

I. For KIA plots – access communications include connectivity from the distribution communications trench until the Main Telecom Room (MTR) of the building. This includes fibre optic civil infrastructure and network cabling.

II. For non-KIA plots – access communications also include connectivity from the distribution communications trench until the MTR of the building. However, in this case, the MSI will only provide fibre optic civil infrastructure (ducts) from the nearest manhole just until outside the property line of the respective plot.

III. For field device – access communications to all field devices.

The KIA network is envisaged to have the following key attributes:

a) Reliability, Availability and Resiliency: The OFC network shall have a high degree of reliability, availability, and resiliency, even in the event of failed links, equipment failure, and overloaded conditions with a self-healing architecture. In addition, the failure of a single link or piece of equipment should not impact the overall network performance.

b) Scalability: The network shall be scalable that can grow to include new user groups and can support new applications without impacting the level of service delivered to existing users.

c) Manageability and Sustainability: Once designed and developed, the KIA available network staff must be able to manage and support the network. In order that it functions effectively and efficiently.

d) Affordable and accessible: The services utilizing the KIA network (TSP) will be affordable and within reach of the target consumers.

e) Publicly Available: The OFC network shall be publicly available to encourage Digital India and Internet penetration.

f) Generate Revenue: The OFC network shall be able to generate revenue for KIA so that it is sustainable and profitable.

7.2.10.1 Backbone Architecture

The backbone will be designed between Primary POP and all the two (2) secondary POPs. KIA-ICCC, the location of the KIA will form an additional node on this backbone network and will also be connected using the backbone network.

The backbone architecture for Kopparthy is being proposed as partial mesh where all the data that is transmitted between the POPs will take the shortest path (or least costly path) between POPs with high reliability, resilience, and survivability. In the case of a failure or break in one of the links, the data takes an alternative path to the destination. Each POP shall be connected to the other two POPs for high availability, reliability, and survivability of the overall backbone network.

The overall backbone network connectivity will be such that each link shall be able to meet its individual zone requirement plus account for redundant network switching capacity required in case of any link failure along with provision for future growth in terms of bandwidth requirements of the network. It is expected that the backbone network is continuous i.e., there is no field splicing of the backbone network, and all terminations of the backbone network happens only at the POP facilities and KIA-ICCC.

7.2.10.2 Distribution Architecture

The distribution architecture will be Layer 2 based is designed for a ring configuration for the fibre optic network. This ring will be created using both redundant POPs and geographically redundant paths wherever available. The distribution fibre will be used to connect a particular ‘zone’ from a respective POP. This zone will include distribution connectivity to both plots and end-devices.

7.2.10.3 Access Distribution for Industrial Park -wide KIA Services

Using the distribution network, the access network will provide end-to-end connectivity to the field devices and plots. The access network will be divided into the following parts:

a) For KIA field devices.

b) For KIA plots.

c) For non-KIA plots.

7.2.10.4 Active Electronics for Fibre Optic Network

It is expected that all network switches at access level (field) shall be Layer 2 based and shall be industrial grade, suited to perform as per on-site conditions.

All network switches at distribution level (POP) shall also be Layer 2 based but may not be industrial grade. Further, all network switches for backbone (POP) shall be Layer 3 based.

7.2.10.5 Point of Presence

Point-of-Presence (POP) rooms are where all telecom services (KIA and non-KIA) will originate/terminate. This space will be shared between KIA services and tenants including telecom service providers and cellular among others. There is one (1) primary POP, which will be in the KIA-ICCC of the Industrial Park and two (2) secondary POPs proposed at geographically distributed locations across Kopparthy. The POPs shall have dedicated space for each of the tenant and KIA services. They will also have the main cellular towers co-located in the same plot location with dedicated space for cellular services.

Note that it is expected that the POP will not just cater to Kopparthy's needs today but also future growth in terms of space requirements and support tenant co-locations.

Based on the building size of 1,800 sq.ft. and tower, and in compliance with all relevant development guidelines the entire plot area needs to be developed into the required POP.

7.2.11 Public wide Wi-Fi

Public Wi-Fi is one of the key service offerings by KIA to its citizens; an initiative aimed to enable mobile broadband to be affordable, accessible, and available for citizens. The Wi-Fi infrastructure includes a combination of Wi-Fi Access Points (APs), mounting infrastructure, and associated active and passive infrastructure including fibre/copper-based network.

Since KIA will be a greenfield smart industrial park which will have a considerable number of workforce and population, there is a requirement to provide pan Industrial Park Wi-Fi services across all public spaces and other strategic locations for enabling the mobile broadband to be affordable, accessible, and available for its citizens. Through this approach, KIA will be able to offer Wi- Fi as a service to its citizens across Kopparthy.

In addition to citizen benefits, the presence of a public Wi-Fi network creates many benefits for the KIA workforce. KIA employees will also utilize the benefits of mobile connectivity for m- governance applications throughout the Industrial Park, allowing efficient access to mobile applications that support their individual work processes, from building inspections to solid waste removal, and municipal services. Any municipal function that requires employees to be mobile will benefit from the Wi-Fi connectivity. Financially, this will reduce the costs for cellular data (3G/ LTE) that KIA will be paying as almost all mobile data will flow across the public Wi-Fi network. Moreover, Wi-Fi will be used for offering e-governance services for the citizens.

For the implementation of a public Wi-Fi network, the following are the two (2) types of infrastructure being proposed for Wi-Fi Access Points:

1. Outdoor Rated Access Point (AP) co-located on Street Light Poles: This setup will be used across all public right-of-way areas.
2. Integrated with Multi-Services Digital Kiosk: Wi-Fi access points will be integrated at the Multi-Services Digital Kiosk that will be installed at the strategic locations within the plots such as KIA, parks, etc.

Architecture

The approach for Wi-Fi is that KIA will invest in building the Wi-Fi infrastructure including access points and associated hardware and software and will provide fibre to each of the access points for backhaul purposes.

The Master System Integrator (MSI) needs to be onboarded will have a neutral operator responsible for operating the Wi-Fi network and will also be responsible for providing the raw bandwidth for the Wi-Fi network. This neutral operator will act as an operator of operators i.e., tenant-based model who in-turn will offer Wi-Fi services from various telecom service providers. The MSI can offer additional value-add services such as music, videos, games etc over this Wi-Fi LAN network and can also use this network for 3G/4G offloading.

The Wi-Fi APs and Multi-Services Digital Kiosk will be connected using dedicated fibre optic infrastructure. Each of the Wi-Fi APs will have dedicated fibre counts that will connect back to the POP. For redundancy, the AP shall use wireless frequency for creating a mesh to ensure continuous communications in case of a fibre link not being available.

Wi-Fi network shall also include a Wi-Fi management software and application with a secure login procedure. The public Wi-Fi network shall also support mobility i.e., people driving or walking within KIA will be able to access the Wi-Fi network on the move for within the coverage area as per the project requirements.

The overall concept of operations for public Wi-Fi is such that KIA will provide Wi-Fi as a service to its citizens. It will allow citizens to use Wi-Fi for various e-governance applications, use Wi- Fi with a one-time login, coupon-based login, or premium plan.

The summary of the overall concept of operations in terms of different services being offered via the public Wi-Fi network are:

1. One-time login – each session will last for 30 minutes or 100MB (whichever happens first) post which the user will have to go through the login process again.
2. KIA industrial park services i.e., e-governance and m-governance – all e-

governance and m- governance services to be offered to citizens and KIA employees using the Wi-Fi LAN at no cost to the citizens for any amount of time.

3. Plans – various coupons will be available for using the public Wi-Fi services. These coupons will be made available at strategic locations across Kopparthy including Multi- Services Digital Kiosk. Further, they can also be available via SMS service. In addition, there will be premium plans available to the citizens for:

    a. Purchasing a premium plan session at one time that lasts more than 30 minutes or 100 MB and/or at a faster speed.

    b. Extended dwelling plan – It is expected that the Wi-Fi operator is neutral and allows multiple Internet Service Providers (ISPs) to offer their services using this Wi-Fi network. As part of the Project, it is expected that there will be some ISPs who also offer wired broadband services in Kopparthy. Therefore, there will be an option for the user to extend the wired broadband service plan at the dwelling to public Wi-Fi service by paying a premium over the base plan that is being used by the user.

7.2.12 CCTV Surveillance System with Integrated Traffic Management System (ITMS), including Automatic Traffic Counters & Classifiers (ATCC) and Automatic Number Plate Recognition (ANPR).

As part of the project, an all-IP based video surveillance system shall be deployed across strategic areas of the Kopparthy. Objective of the surveillance system is to provide an integrated platform for enabling real-time communication between multiple departments responsible for safety and security across the industrial park while creating an interactive response management system.

Surveillance cameras shall be installed at all strategic locations including roads, intersections, public spaces/buildings, and other critical/sensitive facilities like KIA-ICCC Building, and POP Rooms. All video captured from these locations shall be transmitted back to the KIA-ICCC for live viewing and performing pro- active

monitoring and response management activities as part of industrial park administration.

The primary purpose of the CCTV surveillance system shall be to provide proactive security as opposed to reactive security. This means that for every CCTV camera that will be installed as part of the project, there will be a certain objective. This objective may include – monitor, recognize, or detect. The CCTV surveillance system shall leverage Industrial Park's fibre optic network for communication. All recording of the CCTV surveillance system shall be in such a way that there is no single point of failure. CCTV surveillance system shall support both edge analytics and central video analytics. The cameras implemented as part of this project shall be rated for operations in outdoor environment (for outdoor installations) and depending on the objective/application, shall be of different configurations i.e., PTZ, fixed cameras.

Throughout KIA i.e., along industrial park roads, intersections and at the entry/exit points of the Industrial Park, CCTVs shall be co-located with the street light poles and Wi-Fi access points.

Along with CCTV Cameras, Automatic Traffic Counter and Classifier (ATCC) sensors shall also be installed at all entry/exit points of KIA. ATCC shall be capable of automatically counting and classifying all types of vehicles under all lighting conditions.

As the CCTVs shall be co-located at the street light poles, same switch (as used for Wi-Fi) shall be used to backhaul to the KIA-ICCC via dedicated fibre optic infrastructure. For connectivity, CCTVs will be connected to the nearest Point of Presence (POP) through a dedicated switch and fibre optic infrastructure. At the POP, there will be dedicated infrastructure like Network Video Recorder (NVR) that will be connected to the CCTV surveillance system for real-time recording purposes. Further, using the fibre optic infrastructure, real-time monitoring of CCTV surveillance videos shall be enabled at KIA-ICCC video wall and workstations.

7.2.13 Multiservice Digital Kiosk and Emergency Communication System

Multi-Services Digital Kiosks will be deployed across Kopparthy to give the citizens access to various services via one integrated platform.

This will be a dedicated and fixed structure which will include:

a) Wi-Fi access point,
b) emergency call button,
c) charging points,
d) solar panels,
e) access to citizen services including capabilities to make payments for citizen services and bills using touch screen,
f) static advertising around three (3) faces,
g) Smart Card Reader and CCTV.

Multi Services Digital Kiosks shall be installed at strategic locations such as KIA-ICCC building, public parks, Exhibition Pavilion, etc.

Multi-Services Digital Kiosk shall relate to the KIA-ICCC using the fibre optic infrastructure. A switch shall be housed inside each multi-service's digital kiosk from where the data will be backhauled to the nearest POP over the fibre optic infrastructure.

7.2.14 Environmental Sensing and Monitoring

Environmental parameters, specifically air and noise pollution, are a major concern for the citizens and administrators of any Industrial Park.

As Kopparthy aspires to also be an environmentally sustainable smart Industrial Park, integrated environmental monitoring stations comprising of various sensors shall be implemented in KIA.

The objectives of the system include:

- Integrated ambient air and noise pollution monitoring stations comprising of various environmental sensors for monitoring and trending of various ambient air and noise parameters.
- Tracking of Kopparthy's contribution to environment with respect to these parameters and adjusting any framework for the Industrial Park.
- Environmental sensors shall be integrated with KIA-ICCC for central monitoring and analysis.

- Environmental sensor parameters shall be available through Industrial park Portal and Applications for citizens as part of 'open data' initiative and to create citizen awareness.

7.2.15 ICT Interface for Smart Solid Waste Management with CAD/AVL

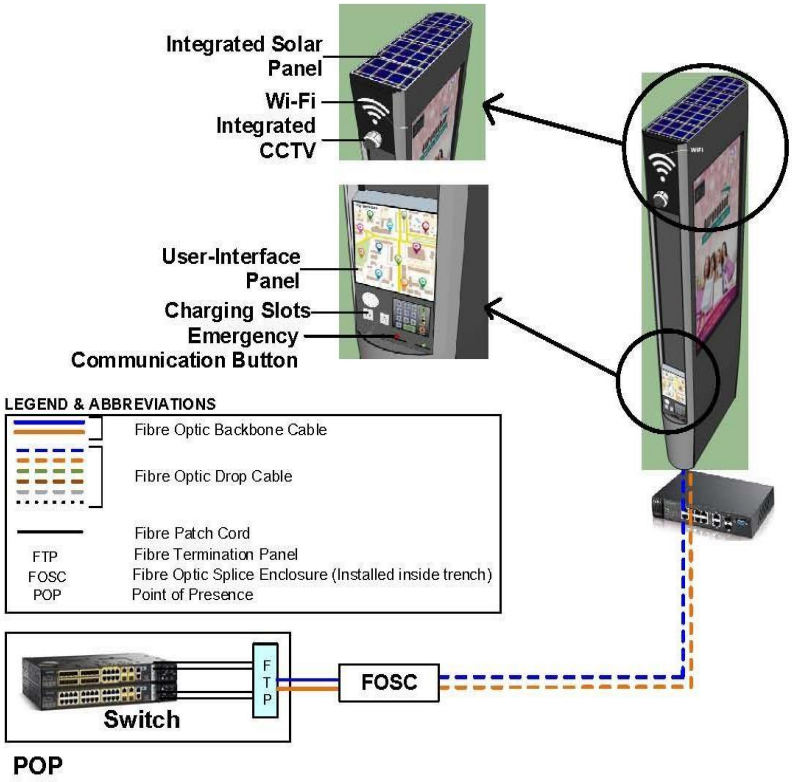
The Smart Solid Waste Management System for KIA shall consist of the following components:

a) Automatic vehicle tracking and computer aided dispatch for waste collection vehicles.
b) RFID based system for bin tracking.
c) Wireless bin sensors for bins.
d) Static Weigh Bridge, Barrier Gate and CCTV Surveillance System at Solid Waste Management Site; and
e) Central application among other components.

Waste bins will be placed at strategic locations throughout the Project area.

Ultrasonic sensors shall be installed in some of these waste bins, which will then optimize the Industrial Park 's waste collection operations by real-time monitoring of bin fill-level.

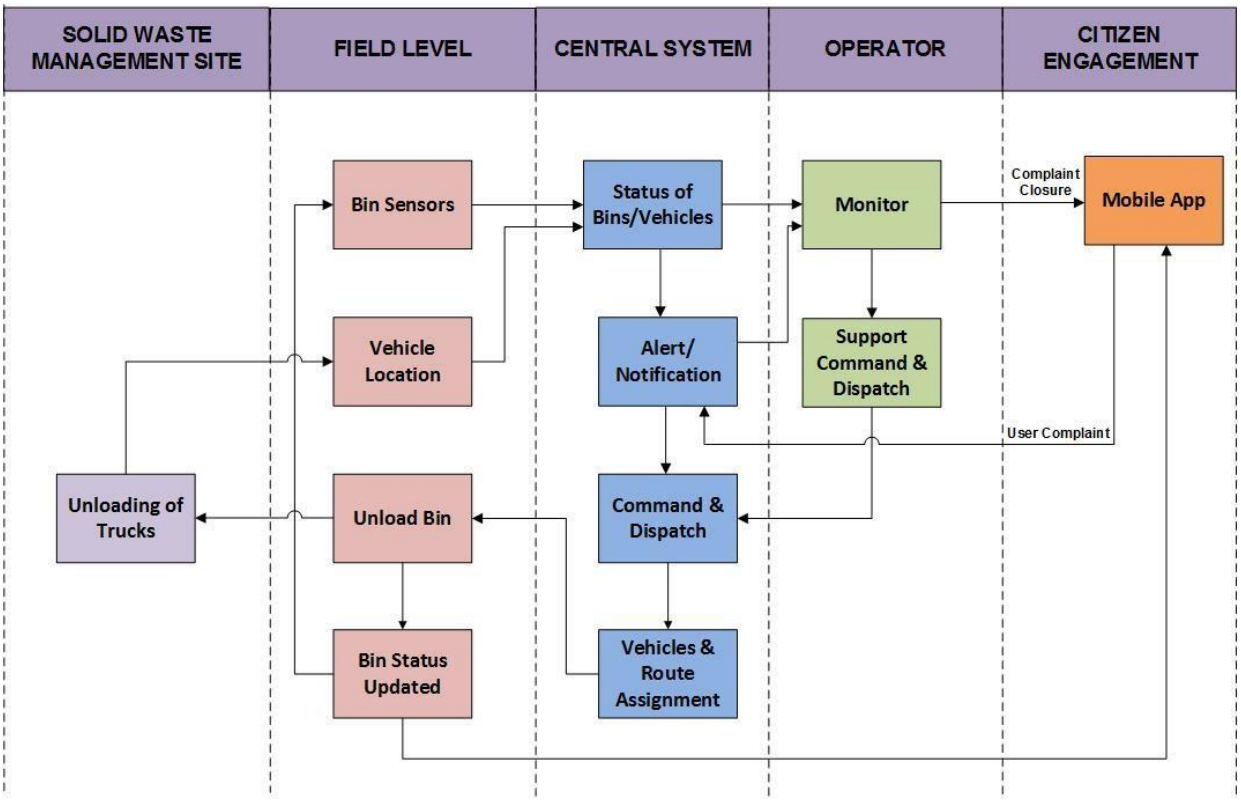
Using a CAD/AVL system installed as part of the waste collection trucks, optimization of bin collection vehicle routes and vehicle scheduling along with the assignment of vehicles will be undertaken via this system.



When the waste fill-level of any bin crosses the pre-defined threshold level, the sensor shall automatically send signal to the respective gateway via M2M network and from the gateway the data shall be backhauled at the KIA-ICCC. Through the aid of sensors installed inside the bins, the operator at the KIA-ICC shall be able to monitor the fill level of the bin in real time which is then connected to the central system for dispatch of collection vehicle.

In addition, there will be RFID tags installed on bins and RFID Readers installed on waste collection trucks/ waste collection personnel for tracking of waste collection from the bins.

Solid waste management disposal site shall be equipped with the Static Weigh Bridge, Barrier.



The overall concept of operations and architecture for deploying smart solid waste management system has been described below:

- The bin sensor installed at the waste collection bin shall transmit the real-time M2M signal to the KIA-ICCC through the Gateway.
- As the defined bin threshold level is reached, the waste collection truck shall be directed towards the bin via optimized route through Computer Aided Dispatch (CAD) System.
- Real time monitoring of the truck's location and route shall be done through Automatic Vehicle Locator (AVL) system.
- As the truck collects the waste from the bins, same shall be notified to the KIA-ICCC via RFID system.
- After the waste collection, the truck shall be routed to the solid waste management site via optimized route through CAD.
- As the truck enters the solid waste management site, the truck shall be weighed

through static weigh bridge system. The information of the truck (i.e., weight of the waste, vehicle details like vehicle class and registration number, truck entrance time, etc.) shall be recorded and transferred to ACC on real-time basis. Once this process is successfully completed, the barrier gate shall be opened, and the truck shall proceed to unload the waste. This process shall be monitored through the CCTV surveillance system.

- As the truck unloads itself at the solid waste management site, this shall be notified to the KIA-ICCC, and the new route shall be directed to truck for collection of waste.
- At KIA-ICCC, all the collection processes shall be supervised on real-time basis through GIS dashboard/smart waste management software platform at the control centre. The information collected at KIA-ICCC can be monitored and analysed to optimize the collection, transportation, processing, and disposal processes.
- Citizen shall be able to file a complaint regarding the waste accumulation in the Industrial Park. As soon as the complaint will be filed by the citizen, the operator at the KIA-ICCC shall be notified with the same and the required action shall be taken.
- KIA shall have the access to this system. KIA shall be able to monitor and track the status of solid waste collection, review trends and average scenarios for various areas, review the status of citizen complaints, etc

7.3 ICT -cum- Admin Building

The Integrated Command and Control Centre will be set-up in the Admin Building of the Industrial Area. The minimum area of the Admin building shall be 4500 sq.m. including required infrastructure work of compound wall, internal roads and gate.

8 Landscape Plan:

The goal of the landscape strategy is to create a green backdrop for enhanced liveability and workability within the context of maximum efficiency in the Kopparthy industrial area. A visual appeal will be created which will impress visitors and create a sense of belonging among the employees.

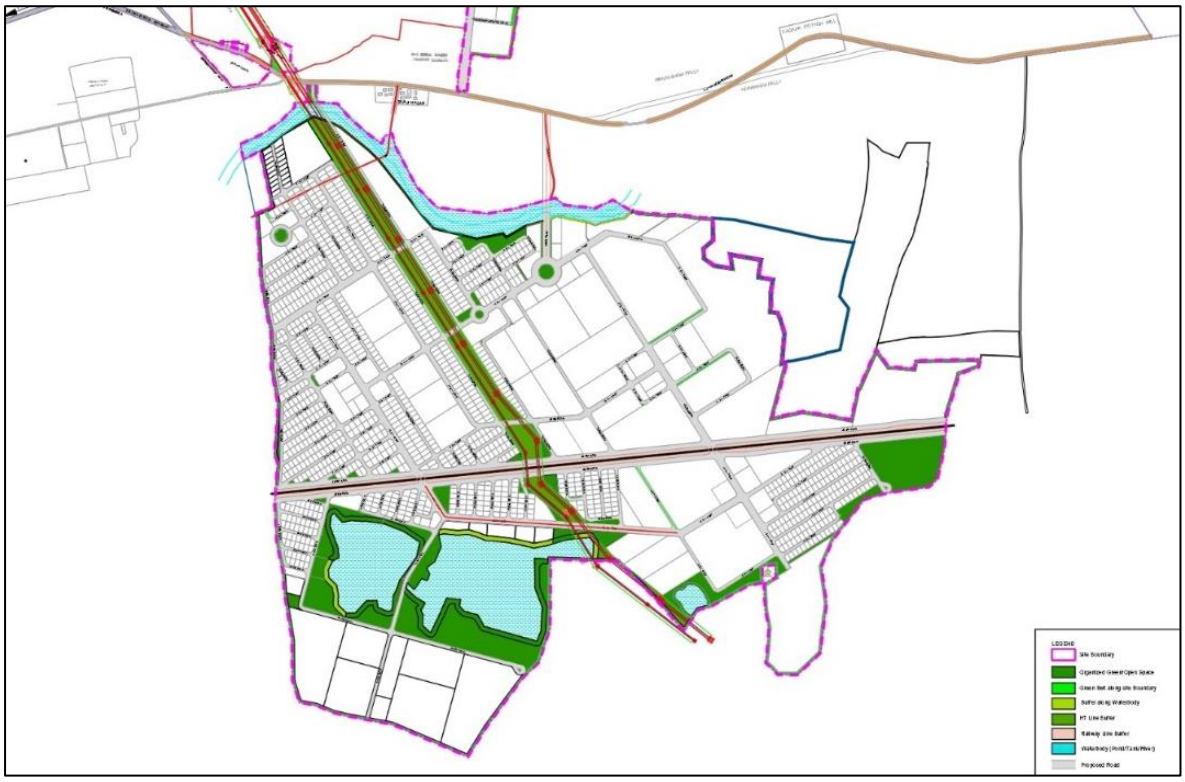


FIGURE 8-1 ORGANISED GREENS AND OPEN SPACES

Source: VSPL

The major green areas in the site are shown in the adjoining illustration. The recommendations on Landscape plan is depicted below:

- Creation of Pocket Parks
- Use of Indigenous Flora
- Breathing Space Creation
- Miyawaki Forest

Recommended Landscapes:

Xeriscaping
The practice of designing landscapes to reduce or eliminate the need for irrigation as part of Water Smart Landscaping

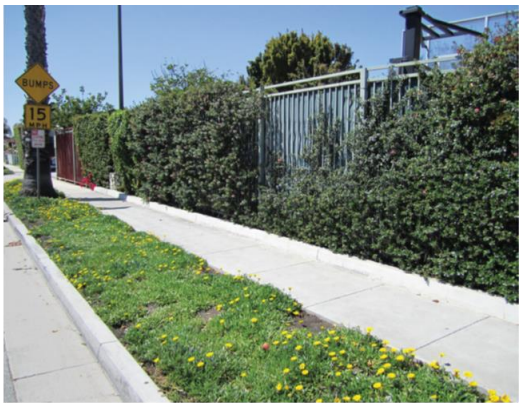
Strong Street Edge

Landscape used to create Breathing spaces

Recreational Spaces for Development. The proposed pocket parks shall act as punctures within the industrial park and act as recreational spaces for the development

FIGURE 8-2: ILLUSTRATIVE EXAMPLES OF RECOMMENDED LANDSCAPES

Recommended Fence Design



Climbing Vegetation Break the monotony of a long fence

Source: Google Compilation of illustrative images

8.1.1 Walls and Fences

Long walls and fences are recommended to be broken up by landscaping, pilasters, offsets in the alignment of the wall or fence, and/or changes in material, colour, or texture.

8.1.2 Indigenous Flora:

Red Sanders (*Pterocarpus santalinus*)

The most significant tree in the region *is Pterocarpiis santalinus* (Red sanders). It is a very pretty, moderate-sized tree. The wood is dark red in colour. It is 'Near Threatened'.

Date Palm (*Phoenix Sp.*)

Date trees typically reach about 21–23 metres (69–75 ft) in height, growing singly or forming a clump with several stems

Arjun (*Terminalia arjuna*)

The Arjuna grows to about 20–25 metres tall and forms a wide canopy at the crown, from which branches drop downwards.

Anjan (*Hardwickia binata*)

Hardwickia binata is a moderate-sized to large tree with drooping branches. The bark of the tree is greyish-brown in colour, rough with deep cracks.

Jamun (*Syzygium cumini*)

Jamun is an evergreen tropical tree favored for its fruit, timber, and ornamental value.

Harad (*Terminalia chebula*)

This is a medium to large deciduous tree growing to 30 m (98 ft) tall. The fruit is edible and is used in traditional medicine.

Dhaora (*Anogeissus latifolia*)

It is one of the most useful trees in India. Its leaves contain large amounts of gallotannins, and are used in India for tanning and firewood.

Wild Mango (*Mangifera indica*)

It is a large fruit-tree, capable of growing to a height and crown width of about 30 metres (100 ft)

FIGURE 8-3 : INDIGENOUS FLORA SPECIES PROPOSED

Source: VSPL

8.1.3 Schematic Landscape Layout

Schematic landscape layouts have been shown for the two recreational parks in the KIA.

FIGURE 8-4 : SCHEMATIC LANDSCAPE LAYOUT

This is for reference purposes only

Lake Park 1: Park for Business Meets Including Pavilions

This park has been developed with two pavilions to hold lake-side meetings, exhibitions etc. This is meant to be a space for official purposes.

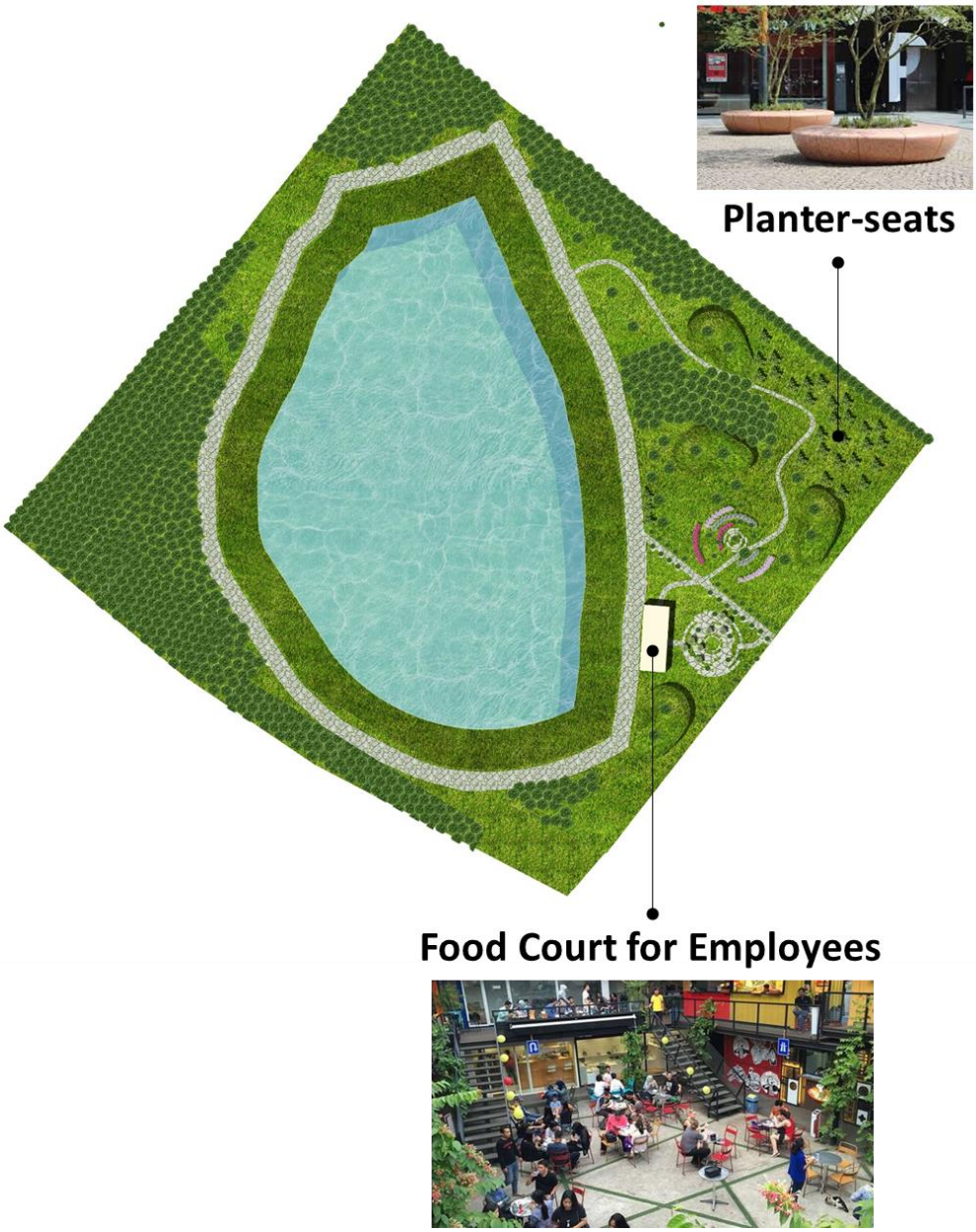


FIGURE 8-5 : SCHEMATIC LANDSCAPE LAYOUT FOR KIA

This is for reference purposes only

Lake Park 2: Park for Recreation of Employees and Visitors

The other lake in the Northern area is proposed to be designed as a recreational park for employees and visitors, including truck drivers. It is going to have a food-pavilion, indoor and outdoor seating, and trees with planter-seats

8.1.4 Landscape Elements:

Planter-seats

Planter seats are provided in various parts of the industrial park, especially in the parks, to create resting spaces at intervals.

Bioswales

Bioswales will be crucial in absorbing the accumulated rainwater and recharging the groundwater.

Grass pavers in parking

Grass pavers are provided in the parking area to absorb rainwater and replenish the underground aquifers.

Shaded Parking

Tree-shaded parking spaces offer shade to the parked cars as well as providing a place for greening.

Segregated Cycle Path

Segregated cycle paths make encourage bicycle ridership, fostering sustainability.

Deck on Lake

Decks provide an interface between the land and water, also providing a context for various events.

FIGURE 8-6 : PROPOSED LANDSCAPE ELEMENTS

A landscaped area of 47.11 acres is proposed to be developed in the Phase-1 including organized open green spaces.

8.2 Guidance for Detailing

8.2.1 Character of Entry Point:

Features of the initial central entry will include the following:

- A landscape design that has a distinct character with which the community can identify.
- Integrated public art reflecting the natural environment and/or the local cultural heritage.
- Primary signage signifying the entry to the estate
- Clusters of low native shrubs within a sweep of irrigated turf leading up to the above signs.
- Kerbing and formal street tree planting down each verge of an entry avenue, and a median strip planted to tall trees and groundcover to add form and colour.
- Street lighting in the median.

8.2.2 Lighting Standards

Guidelines for proper lighting are provided below:

- Avoid poorly sighted lights on the boundary of the estate.
- Positioning lights appropriately to avoid poorly directed lighting.
- Use appropriate shields to avoid light spilling upwards.
- Low level bollard lights can provide an alternative to taller columns along pedestrian routes within industrial allotments.
- Restriction of running hours by limiting usage to an as-needed basis.
- Where practicable, switch off lights when not required for safety, security
- Limiting roads directly facing any existing nearby residential properties.
- Signage should be carefully illuminated in order to minimize glare.
- Landscape buffers to further reduce the impact of vehicle headlights.

8.3 Guidance for development of street and information signage

Uniform fencing and signage standards are proposed to ensure consistency and high standards of presentation throughout the estate.

8.3.1 Signage Guidelines:

The signage policy within the estate should ensure that all public signs have a consistent design in order to provide clear direction for people to navigate their way around the estate. This policy should guard against overuse or untidy clusters of signs that can become visually intrusive.

The same signage design might also be adapted for the entry to each business or plant site, with an estate logo and an industry name plate as the basis. There should be some flexibility to permit individual businesses to install signage to their own corporate design, although this should still be compatible with the immediate landscaped surrounds in respect of size, colour and design, and should meet the approval of estate management. Within the above context, the following general criteria might apply to signs on private allotments:

- Sign location should be considered in the site and building design process, rather than installing signs arbitrarily on a finished site or building.

- Signs should be of constant form, lettering, type and colour on any one site.
- Signs at site entries should be located within the vegetation setbacks proposed for plant entries.
- No flags, banners, bunting or similar temporary displays or signs should be permitted on road frontages

9 Project Cost Estimates

The block cost estimates for the development of the Kopparthy Industrial Area are given in this chapter. The estimates have been prepared using the Common Schedule of Rates as per the Andhra Pradesh Revised Standard Data for the year 2023-24.

The total cost for the project including land is framed at Rs. 2,136.51 crores, where the cost for the internal trunk infrastructure development for Rs. 1,264.44 crores. The calculations for the block costs constitutes of external infrastructure development works, internal infrastructure development works and amenities and facility building development works.

9.1 Cost Estimates for External Infrastructure

The external infrastructure consists of roads, rail connectivity, along with the water and power supply. As per discussion, all external connectivity costs are to be borne by the state govt.

9.2 Cost Estimates for Internal Infrastructure

The internal infrastructure consists of site levelling & grading works, internal roads, internal power supply & distribution, street lighting and telecommunication, potable water supply system, recycled treated water system, fire-fighting system, sewerage system, storm water drainage system, solid waste management, gas piping network, landscaping works, boundary wall with barbed wire fencing, misc. works including wifi hotspot, and software for smart infrastructure and railway siding. The various costs for the internal infrastructure of the Kopparthy Industrial Area are provided in Table 9-1. The total costs amount to Rs. 1,264.44 crores for the Kopparthy Industrial area.

TABLE 9-1 COST OF INTERNAL INFRASTRUCTURE DEVELOPMENT WORKS

S. No	Particulars	Amount (INR Cr)
1	Roads	244.35
2	Stormwater, CD structures, Recharge pits	146.46
3	Potable water	29.99

S. No	Particulars	Amount (INR Cr)
4	Recycled water networks and storage	12.92
5	Power and Street Lighting	326.91
6	ICT & SCADA	65.36
7	Solid Waste Management, Sewer network, WTP, CETP	77.67
8	Landscape	5.04
9	**Seigniorage Charges**	**22.28**
A	**Sub Total A**	**930.98**
	GST @ 18% on Project Construction Cost	167.58
B	**Project Construction Cost including GST (Sub Total B)**	**1098.56**
C	**Other Costs and Provisions**	
1	O&M Cost for 4 years - 1.5 % for each year on Sub Total B	65.91
2	Contingencies @ 2.5% on Sub Total B	27.46
3	Price Escalation @ 2.5% on Sub Total B	27.46
4	PMC charges @ 2% on Sub Total B	21.97
5	Administration charges@ 1.5% on Sub Total B	16.48
6	Quality control @ 0.25% on Sub Total B	2.75
7	Construction safety cost of 0.25% on Sub Total B	2.75
8	Provision for NAC @ 0.1%	1.10
C	**Total Other Cost including Provisions (Sub Total C)**	**99.97**
	Total Project Cost (B+C)	**1264.44**

Note:

The above costing refers to the development of the initial phases only. However, the requirement of the balanced trunk infrastructure works will be developed by the Special Purpose Vehicle (SPV) at a later stage.

9.3 Total Cost Estimates

The total cost estimates are presented in the table below, inclusive of the three components outlines in the sections above (Table 9-2).

TABLE 9-2 TOTAL PROJECT COST

Sl. No.	Item	Amount (In Cr)
A	Total Land Cost	872.07
B	Total Cost for Development Works	1,264.44
A+B	Total Cost for Development Works Including Land Cost	2,136.51

10 Financial Analysis

The total project area of 2,595.74 Acres is connected via State Highway 51. For the purpose of this report, the Site / Region specific assumptions like area statement, construction cost, Funding Pattern etc. are explained initially followed by the common assumptions including Upfront Lease Premium Value, Maintenance cost, Depreciation and Tax workings. Later, the Key Financial Outcomes and Performance Indicators are further summarised in this chapter.

10.1 Kopparthy Industrial Area

The Kopparthy Industrial Area has an extent of 2,595.74 Acres and is located on the southern part of SH 51. The proposed development in this region is Auto Components, Chemical & Petrochemical Industry, Engineering Goods, Renewable Energy, Pharma Industry / Bulk Drug, Residential and Commercial facilities.

10.1.1 Infrastructure Development Cost

The infrastructure cost / cost of development is prepared based on APSOR. The cost of development includes 1. External Infrastructure, 2. Internal Infrastructure and 3. Facilities / Amenities and this includes development of Road, Rail Network, Power Distribution Network, Water Supply System, Fire Fighting System, Solid Waste Management & Recycled Treated Water System, Gas Piping System etc. The overall summary of same is as below

TABLE 10-1 : INFRASTRUCTURE DEVELOPMENT COST

S.No	Particulars	Amount (INR Cr)
1	Roads	244.35
2	Stormwater, CD structures, Recharge pits	146.46
3	Potable water	29.99
4	Recycled water networks and storage	12.92
5	Power and Street Lighting & Fire Fighting	326.91
6	ICT & SCADA	65.36

S.No	Particulars	Amount (INR Cr)
7	Solid Waste Management, Sewer network, WTP, CETP	77.67
8	Landscape	5.04
9	**Seigniorage Charges**	**22.28**
A	**Sub Total A**	**930.98**
	GST @ 18% on Project Construction Cost	167.58
B	**Project Construction Cost including GST (Sub Total B)**	**1098.56**
	Other Costs and Provisions	
1	O&M Cost for 4 years - 1.5 % for each year on Sub Total B	65.91
2	Contingencies @ 2.5% on Sub Total B	27.46
3	Price Escalation @ 2.5% on Sub Total B	27.46
4	PMC charges @ 2% on Sub Total B	21.97
5	Administration charges@ 1.5% on Sub Total B	16.48
6	Quality control @ 0.25% on Sub Total B	2.75
7	Construction safety cost of 0.25% on Sub Total B	2.75
8	Provision for NAC @ 0.1%	1.10
C	**Total Other Cost including Provisions (Sub Total C)**	**99.97**
	Total Project Cost (B+C)	**1264.44**

10.1.2 Project Implementation Schedule

The overall project shall be implemented for a period of 8 Years - 10 Years. However, the total development is expected to be completed in 3 Years and with an maintenance period of 4 Years post completion of construction activity. Initial assessment of the implementation schedule is prepared based on the extent of development of infrastructure networks along with the support facilities that needs to be developed initially as detailed below.

TABLE 10-2 : PROJECT IMPLEMENTATION SCHEDULE

10.1.3 Capital Structure

The capital structure for the project is proposed based on the discussion with the authority and with the preliminary viability assessment of the project, this includes funding from NICDC / APIIC for procurement of land as well as for development of Infrastructure facility. Further depending on the revenue, other financial parameters and limitation on various project development criteria below capital structure is proposed.

TABLE 10-3 : CAPITAL STRUCTURE

S.No	Particulars	Amount
1	Equity – NICDC	872.07
2	Equity – APIIC	872.07
3	Debt	200.00
4	Project Internal Cash Flow	192.37
	Total	2,136.51

Source: Financial Analysis, JLL

10.2 Common Revenue & Cost Assumptions

This chapter explains the common assumptions like land value assessment methodology, Maintenance Charges collected from the Industrial Units, Operational Cost incurred for maintenance of the proposed infrastructure facility, Depreciation Rates, Income Tax Workings etc.

10.2.1 Land Valuation Methodology

Two approaches are followed for arriving at the right value for the proposed development. One approach is Market approach where value of recent transaction for the Industrial land parcels in the vicinity is being assessed along with other transaction in and around Kadapa. Thus, the sale value / price of the land is arrived based on market price / transaction history, stakeholders' discussions, Industrial Performance in the district etc. The other approach that is considered is Cost plus approach where the actual cost of land and infrastructure development cost along with the margin is considered for arriving at the sale value of the land parcels. Upon deliberations and discussions with the authority, it was advised to follow cost plus approach since this project envisages infrastructure development that will be of international standards and thus would demand huge investment for development of same. Further, it was also deliberated that the project shall be benchmarked with the other large industrial development across the country. Thus, the prices are fixed for every land use i.e. Industrial, Commercial, Residential etc. as detailed below.

TABLE 10-4 : SITE ATTRIBUTES ASSESSMENT MATRIX

S.No	Particulars	Unit	Amount
1	Industrial Plots	INR Cr	1.40
2	Commercial Plots	INR Cr	2.80
3	Residential Plots	INR Cr	2.10

Source: Financial Analysis, JLL

10.2.2 Maintenance Fee

Assumptions related to operation & management of the Kopparthy node have been provided below:

- The SPV shall be responsible for the routine as well as the periodic

maintenance needed for assuring seamless services to manufacturing tenants.

- The O&M for the first 4 years is to be provided by contractor. It is assumed at 1.5% p.a. of the initial project construction cost.
- The O&M charges to be recovered from plot owners are estimated at Rs 0.025 Crore per acre per year (the value has been considered based on experiences of similar industrial developments in India). This value includes salaries of staff involved in O&M, cleaning and maintenance of roads and ancillary infrastructure, firefighting systems, sewerage network, ICT network and other utilities.
- The O&M expenditures are expected to be Rs. 0.02 Crore per acre per year (the value has been considered based on experiences of similar industrial developments in India).
- A periodic maintenance cost equivalent to 1% of the total infrastructure cost has been levied every 12 years post-handover by EPC contractor in 2043-44 and 2055-56. This shall be recovered from the O&M corpus that will be created from the O&M surplus collected annually.
- The recovery and cost rates are assumed to increase by 5% per year.

10.2.3 Other Assumptions

The financial appraisal also assumes the following:

- Inflation per annum - 5%
- Depreciation in Straight Line Method -
- Depreciation period of administration building/ property is considered over 30 years from the year 2028-29 at the rate of 3.3%
- ICT Assets to depreciate in 6 years from the year 2028-29 at the rate of 16.67%
- Taxes assumptions are
    - The corporate tax rate has been assumed to be 29.12% (25% base rate + 12% surcharge + 4% health cess)

- GST has been considered in cost estimation on all utility components wherever applicable.

- In accordance with APIIC guidelines, the sale of industrial land is exempt from GST, and this exemption has been considered in the estimations.
- Land value at end of calculation period has been ignored.
- In accordance with APIIC guidelines, lease rental has not been considered.
- Advance payment as 5% of the total cost has been considered to be awarded to the contractor in FY25.
- Depreciation has been considered only on those utilities, which will remain under the ownership of the SPV.
- Surplus fund available shall be reinvested at 5.5% interest rate annually.
- Interest on accruals has been calculated based on the closing balance of the previous year.

10.3 Key Financial Outcome

This section consists of CAPEX summary, Capital Structure, total revenue & total operational cost summary of the North Region & South regions respectively.

TABLE 10-5 : KEY FINANCIAL PARAMETERS (36 YEARS)

S.No	Particulars	Unit	Amount
1	Total Land Extent	Acre	2,550.65
2	Total Project Cost #	INR Cr	2,136.51
3	Cost of Development/ Acre incl Land Cost *	INR Cr	0.83
4	Revenue - Lease Premium	INR Cr	2,850.36
5	Upfront Lease Premium / Acre *	INR Cr	1.10
6	Total Maintenance Revenue	INR Cr	3,123.70
7	Total Maintenance Cost	INR Cr	2,498.96
8	Project IRR – 36 Years	%	10.57 %

S.No	Particulars	Unit	Amount
9	Equity Project IRR – 36 Years	%	10.63 %

Note

Project Cost is including land cost

* Unit Cost of Development / Upfront Lease Premium is calculated based on overall land area of 2,550.65 Acres

Source: Financial Analysis, JLL