PLANNING FOR INTEGRATED DEVELOPMENT OF ROURKELA TOWN

DISSERTATION

Submitted in partial fulfilment of the

Requirements for the award of the degree

Of

MASTER OF URBAN AND RURAL PLANNING

Under the Guidance of

Prof. Dr. V.Devadas

By

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DEPARTMENT OF ARCHITECTURE AND PLANNING

INDIAN INSTITUTE OF TECHNOLOGY, ROORKEE

ROORKEE-247667 (INDIA)

JUNE, 2014

Dedicated to local workers of the Steel Town,

who built the town, brick by brick,

but still struggle to make their ends meet.

CERTIFICATE

Certified that report entitled **"PLANNING FOR INTEGRATED DEVELOPMENT OF ROURKELA TOWN"** which has been submitted by **Mr Debadutta Parida**, for partial fulfilment of the requirement for the award of the degree of **Master of Urban and Rural Planning**, in Department of Architecture and Planning, Indian Institute of Technology-Roorkee, is the student's own work under my supervision and guidance. The matter embodied in this dissertation has not been submitted by him for the award of any other degree of this or any other institute.

Date: ……..

Place: Roorkee

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CANDIDATE'S DECLARATION

I hereby declare that this report entitled **"PLANNING FOR INTEGRATED DEVELOPMENT OF ROURKELA TOWN"** which has been submitted for partial fulfilment of the requirement for the award of the degree of **Master of Urban and Rural Planning**,, in Department of Architecture and Planning, Indian Institute of Technology- Roorkee, is an authentic record of my own work carried out during the period from July 2013 to June 2014, under supervision and guidance of **PROF.DR.V.DEVADAS** , Department of Architecture and Planning, Indian Institute of Technology, Roorkee, India.

The matter embodied in this dissertation has not been submitted by me for the award of any other degree of this or any other institute.

Date: ……

Place: Roorkee (**DEBADUTTA PARIDA)**

This is to certify that the above statement made by the candidate is correct to the best of my knowledge and belief.

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ABSTRACT

The industrial towns in the Post-Colonial era in India were envisioned in order to achieve a modern town, which would look forward to the future that lies ahead of it, and which would be a message to the world that we are ready to stand shoulder to shoulder with others in this world. However, some things have gone horribly wrong in the past sixty years after planning of these few industrial towns in various parts of the country. One look around the towns today and you can easily see and comprehend that this was surely what our forefathers did not imagine out towns to be. Slums, informal settlement, high pollution levels, low sex ratio, the list is long. What is more worrying is that there is no updating of the master plans in many of these towns, so the authorities responsible for its development have no idea where the town is heading to.

This thesis was taken up surely due to the motivation of changing things in one such industrial town in India, Rourkela. It was necessary to collect a lot of data and then put it to paper to address each problem and then connect the dots, in order to achieve a better planned town in the future.

Over the course of this report, there has been a lot of secondary data analysis and primary survey analysis, based on which various spatial suggestions have been given using GIS tools. The solutions will reflect on how it is absolutely important to have a holistic approach to solving the issues in the town, rather than having short-sighted vision of bettering a road or rehabilitating a slum.

Key words: Industrial town, Post-Colonial, rehabilitating, slums

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ABBREVIATIONS

RDA – Rourkela Development Authority

RUA – Rourkela Urban Agglomeration

JUA – Jamshedpur Urban Agglomeration

JNNURM – Jawaharlal Nehru National Urban Renewal Mission

PWD – Public Works Department

CHAPTER 1: INTRODUCTION

This chapter gives a brief overview of the overall contents of the thesis. It focusses on the aims and objective set for the study as well as the methodology adopted in carrying out this investigation

1.1.Background

Development at all levels (macro and micro) in the Post Modern era is a major challenge for any government. The reason is that development is multi-sectoral as well as multi-dimensional. All sectors and dimensions have to be considered and mainstreamed into any planning process, thus making the process very complex.

When India obtained independence, one of the main priorities of the then Central government was the industrialization of the country. Various towns were identified for setting up large scale industries viz. Durgapur, Rourkela, Bokaro, Bhilai etc. Almost all of these towns looked forward to various planning theories and concepts adopted in Jamshedpur, India's first indigenous industrial town. Recent trends in urban planning in Indian cities has been categorically confined to metropolitan areas and other settlements involved in the creation of hybrid urban forms where the dominant discourse have always revolved around differences between colonial and indigenous settlements. This leaves the Urban Local Bodies (ULBs) in smaller towns in a dilemma of how to go about the process of planning their areas in the same progressive manner as the larger metropolitan areas. Needless to say these smaller, unnoticed industrial towns such as Rourkela have a significant impact on the economy of the states as well as the nation. It is therefore essential to focus attention on smaller towns like Rourkela to ensure that the growth and contribution to economy remains sustainable in the long run.

Rourkela was established nearly five decades after the establishment of the successful company town of Jamshedpur, and over the years it has evolved from a company town to an industrial town and gradually to an urban agglomeration. Tension between organised planned development and organic growth can be easily seen in the town today. In the last few decades, there has been an increase in setting up of industries of all sizes in and around the town which has resulted in continuous extension of the town as well as massive urbanization and slums. Currently, nearly 43 % of the population in the Municipal Township reside in slums (Census data, 2011), which is alarming. It is imperative that a holistic approach is

essential to tackle this uncontrolled growth, while at the same time not overlooking the ground realities at the local level (such as funding of ULBs, manpower, availability etc.). The only way to achieve it is through integrated development. Various planning efforts of different sectors of government and institutions need to be properly coordinated at a micro level, which in turn can result in structured changes at the macro level in the short, medium and long run. The role of the urban planner is to accommodate all these aspects in the approach to planning for the town. This thesis attempts to identify various factors responsible for the current scenario in the town and provide plausible solutions.

1.2 SWOT Analysis of Rourkela Town

1.2.1. Strengths

- Excellent location amidst rich mineral belt(availability of raw material)
- Plenty of water available to sustain the town in the long-run(surrounded by rivers Brahmani, Koel and Sankh)
- Cosmopolitan character of the town(enthusiastic work force)
- Good literacy rate(high citizen awareness)
- Not known for natural calamities

1.2.2. Weaknesses

- Poor connectivity over the rivers.
- Lack of intent among authorities
- Lack of proper SWM systems
- Increase in slums
- Lack of quality public transport
- Lack of quality healthcare
- Increasing tension between Steel Township areas and Municipal Town areas
- Obsolete Master Plan and Development Control rules and regulations not up to date.

1.2.3. Opportunity

- Scope of growth of small scale industries
- Scope of establishing mixed-use activities
- Scope of promotion of tourism
- Scope of development as educational hub of the state

1.2.4. Threats

- Declining quality of life of residents in Municipal areas
- Large scale deforestation
- Increasing water and atmospheric pollution

1.3 Aim

To evolve planning strategies to attain 'Integrated Development' of Rourkela Town (Municipal area)

1.4 Objectives

The following objectives have been framed in this investigation:

- To study the growth pattern of Rourkela Town.
- To study the existing conditions of the town and identify issues.
- To study planning strategies adopted by other industrial towns in India and Germany.
- To forecast the demand and supply of infrastructure in the town for the year 2031.
- To evolve physical plans and a set of policy guidelines to bring about Integrated Development in the study area.

1.5 Scope

The present investigation aims to identify issues, find solutions and evolve policy guidelines for development of Rourkela Municipal area. The solutions and policies will involve growth and development in the Municipal town. The author hopes that if the solutions and policies are implemented in time, then integrated development can be anticipated in the town.

1.6 Limitations

- The investigation aims to find solutions in the Municipal area comprising of thirty-three wards, which has been referred to as 'Rourkela Town' in this report.
- The solutions given are 'strategic' as well as 'specific'. Specific solutions have been given for certain areas after spatial analysis wherever applicable and necessary.

1.7 Methodology

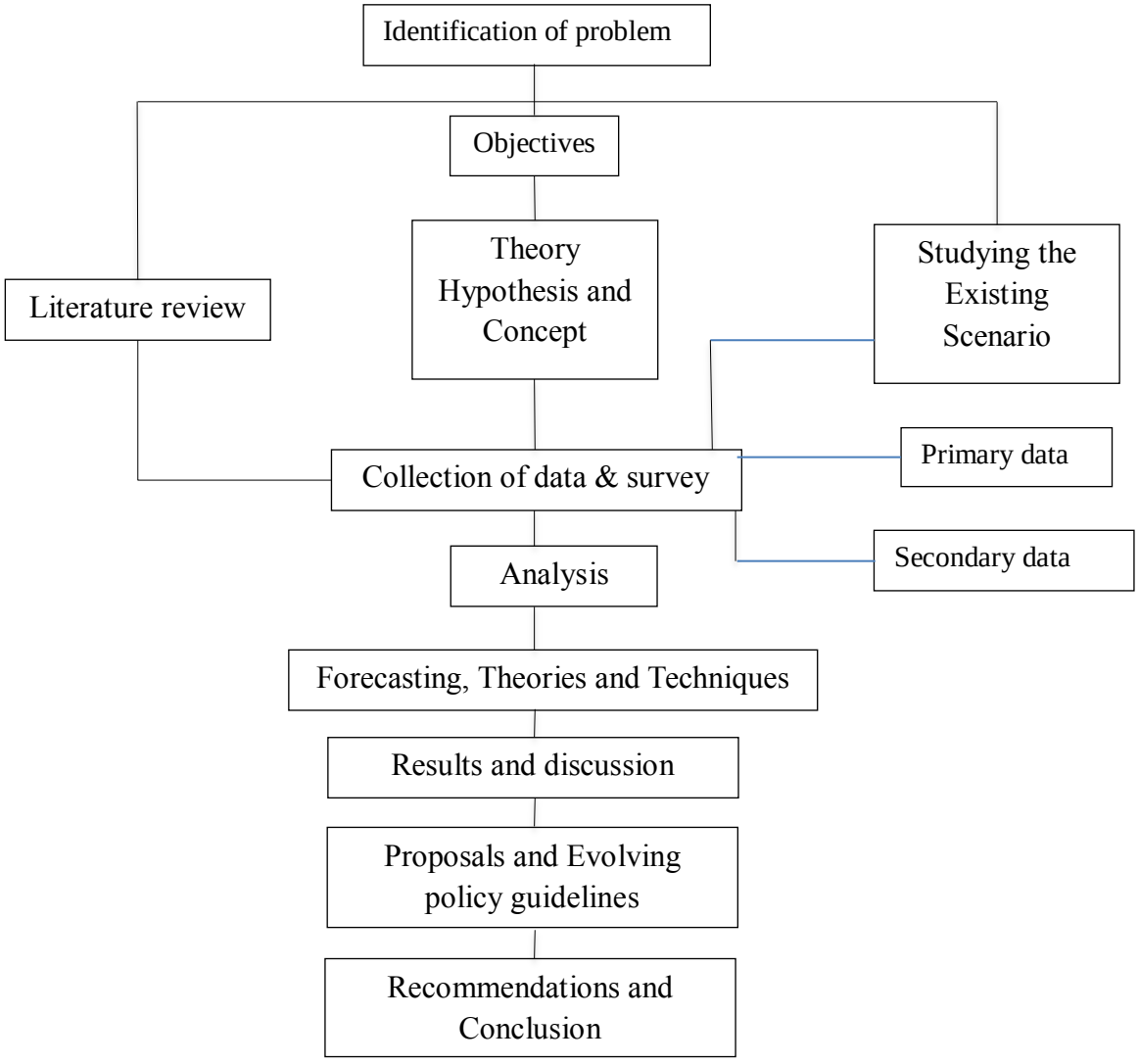


Chart 1 - Methodology chart

The chart above shows the methodology adopted for this investigation. It is explained in brief as follows:

Data: Involves data collection through Primary Sources (Household Survey, Online Questionnaire and Observations) and Secondary sources (Literature review, similar CDPs and case studies of industrial towns in India and Germany). An online questionnaire was framed for the survey and received 134 responses, while for household survey, 88 households were surveyed in the study area.

Tools and Techniques: The tools for data collection include interviews, schedules and observations including surveys and the techniques include calculation of land holding and

carrying capacity assessment using GIS as well as various statistical methods. Computer based analytical tools have been used such as MS Excel, AutoCAD, SPSS and GIS.

Analysis: Analysis will be done on the basis of data collected such as in survey results (summarization, classification and tabulation), maps etc. Most of the analysis in this report is GIS based spatial analysis.

Results and Discussion: Tangible results will be produced based on the analysis and inferences shall be drawn.

Solutions: The solutions that will be arrived at upon application of various tools and techniques will be of two types – spatial (in the form of thematic maps and area-specific solutions) and non-spatial (in the form of guidelines and policies). Based on all the above steps, recommendations and conclusion will be drawn. The investigation will end with a note on directions for further research in this area.

1.8 Sample Size Adequacy

One of the most significant steps in a survey research is to collect data which is representative of a population. Various scholars have put forward methods to calculate the adequate sample size required to generalize findings within the limits of a random error. It is imperative for this investigation that the sample size is considered judiciously.

According to Israel, the answer to the question of adequate sample size is influenced by a number of factors, including the purpose of the study, population size, the risk of selecting a 'bad' sample, and the allowable sampling error.

1.8.1. Sample Size Criteria

According to Miaonlis and Michener. "In addition to the purpose of the study and population size, three criteria usually will need to be specified to determine the appropriate sample size; the level of precision, the level of confidence or risk, and the degree of variability in the attributes being measured". Israel writes further regarding the three criteria as follows:

The level of Precision – The level of precision, also called sampling error, is the range in which the true value of the population is estimated. This range is often expressed in percentage points (e.g. ±5 per cent).

The Confidence Level – The Confidence Level is based on ideas under the Central Limit Theorem. The main idea encompassed in the Central Limit Theorem is that when a population is repeatedly sampled, the average value of the attribute obtained by those samples is equal to the true population value. The values obtained by the samples get distributed normally about the true value, with some samples having higher value and some obtaining a lower value than the true population value. In a normal distribution, approx. 95% of the sample values are within two standard deviations of the true value of population (e.g. mean).

Degree of Variability – The third criteria, the degree of variability in the attributes being measured, refers to distribution of attributes in a population. The more heterogeneous a population, larger is the sample size required to obtain a given level of precision. The less variable (more homogenous) a population, smaller is the sample size.

1.8.2 Strategies for determining Sample Size

There are four possible strategies for determining sample sizes : (Israel, 2013)

Using a census for small populations: When the population is small, it is advised to use the entire population as the sample. Costs are bound to be high, but the results are bound to be more accurate.

Using a sample size of a similar study: Consulting similar studies that were conducted and using the sample sizes prescribed in those studies or in the literature, prescribed for the same subject. More chances of being error prone if not checked in detail.

Using published tables: Relying on published tables which are set for particular criteria. The information given on the tables are prescribed for the selected criteria and if the survey research involves some other peculiar considerations, this method cannot be resorted to.

Using formulas to calculate a sample size: This study involves the determination of sample size for a research survey whose population size is quite large. The population looked at during the course of this study includes population in the Municipal Town of 2,73,040 comprising 33 wards. Thus the literature involves only those mathematical formulations which take into account large populations.

(Cochran, 1963) developed an equation to yield a representative sample for proportions, illustrated as below:

$$n_o = \frac{Z^2 pq}{e^2}$$

where n_o is the sample size, Z^2 is the abscissa of the normal curve that cuts an area α at the tails, e is the desired level of precision, p is the estimated proportion of an attribute that is present in the population and q is 1-p.

If the population is small then it is possible to reduce the sample size slightly. This is because a given sample size provides proportionately more information for a small population than for a large one. The correction formula below significantly reduces the necessary sample size for small populations.

$$n = \frac{N}{1 + N(e)^2}$$

where n is the sample size and N is the population size.

For the course of this research work and the dissertation, the formula employed for determining the sample size is that one proposed by (Yamane, 1967)

$$n = \frac{N}{1 + N(e)^2}$$

1.8.3. Sample Size Estimation

For this study, the sample size is determined as follows:

Confidence Interval = 95%

Degree of Variability = 0.5

The population size, according to Census 2011 of the Municipal Town is 2, 73,040, which is used for the study. Thus,

Population Size, N = 2, 73,040

The next criterion to be established is the required level of precision, e. The usual values of the level of precision range from 0.05 to 0.1 depending on the study concerned. For a research study at academic level, lower values of precision are generally tolerable, if it is difficult to obtain higher levels of precision(Bartlett, Kotrlik, & Higgins, 2001). For this study, the value of the level of precision is taken as 0.09, which is found to be within the specified ranges. Thus,

Level of Precision, e = 0.09

According to the formula designed by (Yamane, 1967), the optimal number of samples required for the study will be

$$n = \frac{N}{1 + N(e)^2}$$

Thus, n = 123 responses

The formulation above suggests that the optimum sample size necessary is 123 responses. The current survey conducted as part of the study for the dissertation obtained 134 responses, which is more than 123 as suggested.

Furthermore, for household survey, due to budget and time constraints, the household survey was carried out involving 88 households in various wards within the study area using random sampling technique.

1.8.4. Other Considerations

Budget, Time and other constraints

Often the researcher is faced with various constraints that may force them to use inadequate sample size because of practical versus statistical reasons. There constraints may include budget, time, personnel, and other resource limitations. In this case, researchers should report both the appropriate sample sizes along with the sample sizes actually used in the study, the reasons for using inadequate sample sizes, and a discussion of the effect the inadequate sample sizes may have on the results of the study(Bartlett et al., 2001).

CHAPTER 2: LITERATURE REVIEW

2.1 Integrated Development

In this age of globalization and information, any successful development must have a holistic approach. In other words, it should take into account multi-variate aspects such as social, cultural, economic, environmental and geographic realities that shape the lives of people involved. (De, 2003) says that "the idea of holistic development is not a new one. But the development efforts of the 1970s and 1980s was often hampered by a 'one-sized-fits-all' mentality, prescribing reforms from a centralized perspective, without regards for the territorially specific needs of a given population or community." An integrated approach recognises no such barriers. But the term itself is composed of two very different words, 'integrated' and 'development'. It is essential to understand what lies beneath both the words before having a perception of the concept of Integrated Development as a whole.

"Development is a concept which is contested both theoretically and politically, and is inherently both complex and ambiguous… … Recently it has taken on the limited meaning of the practice of development agencies, especially in aiming at reducing poverty".(Thomas, 2000). (Gore, 2000) says that "the vision of the liberation of people and peoples, which animated development practice in the 1950s and 1960s, has been replaced by a vision of a liberalization of economies".

The goal of structural transformation has been replaced with the goal of spatial integration. Long term transformations of economies and societies have slipped from view and attention was placed on short term growth and re-establishing financial balances. This thought is highly significant in the Indian context since there has been a major change in our cities especially after the economic liberalization and modernization of industries in the 1980s and 1990s in India. Though there has been a radical rise in the middle class in our cities, one has to admit that increase in opportunities in our cities has contributed to migration and hence rapid, unplanned urbanization and urban poverty. This is a 'wicked problem' for a planner and can in many ways be comparable to a 'social mess' that our cities are in presently. "Postmodern approaches see poverty and development as socially constructed and embedded within certain economic episteme which value some assets over others. By revealing the situated-ness of such interpretations of economy and poverty, postmodern approaches look

for alternative value systems so that the poor are not stigmatized and their spiritual and cultural 'assets' are recognised."(Hickey, S. and Mohan, 2003).

There is also this confusion regarding development being an 'immanent and unintentional process… … and an intentional activity'(Cowen, M. and Shenton, 1998) to bring about a change. If development means good change, questions arise about what is good and what sort of change matters. Perhaps the right course is for each of us to reflect, articulate and share our own ideas, accepting them as provisional and fallible(Chambers, 2004). But a common theme within a lot of these approaches is that development encompasses 'change', but the notion of good change is contested by (Kanbur, 2006) who states that there is no uniform or unique answer. Views that are perceived as development by one part of the community may not necessarily be shared by other parts of that community. This brings forward the necessity of integrating various sub groups and cultures within a development community to arrive at a consensus for a positive and 'good' change which is acceptable by all. It is imperative to understand that any single aspect of a town (cultural heritage, economy, infrastructure, environment etc.) cannot exist in isolation without being influenced by one another. An integrated approach is necessary at local levels which makes these aspects of the city 'interact' with each other and develop in tandem.

The concept of 'integrated' approach refers not only to its multi sectoral nature but also to the broad range of stakeholders involved in the complex. An integrated approach thinks globally while acting locally. Hence the local municipalities, communities, families and individuals have a role to play in the Integrated development efforts(De, 2003). This process is a real challenge, to coordinate various stakeholders so that they complement, and not contradict each other. At the same time it is necessary to concede that in practice, it is virtually impossible to satisfy every stakeholder at the local level. (De, 2003) further suggests that integrated development should be seen as a conceptual framework rather than as a policy constraint. Casting too wide a net may be counterproductive and discouraging.

The Integrated Development Plan of Johannesburg city defines Integrated Development Plan as " a participatory approach to integrate economic, sectoral, spatial, social, institutional, environmental and fiscal strategies in order to support the optimum allocation of scares resources between sectors and geographical areas and across the population in a manner that provides sustainable growth, equity and the empowerment of the poor and the marginalized"(Plan, 2012). An integrated approach helps the Municipality to focus itself and take pro-active steps and multi-directional and dimensional steps across all sectors at a local level. This can help in optimising opportunities as well as identifying the root cause of the

problems. At the same time, a Municipality can identify the problems and have a clear and pragmatic vision of possible approaches to solve them in a particular time frame.

The fundamental goal of integrated planning is to anticipate future opportunities and threats in all sectors of the development areas. It is an approach that not only combines various social, economic, infrastructural and environmental needs but at the same time gives a meaning to the lives of the individuals in a society(Koroneos & Rokos, 2012). Although there is a certain ambiguity and confusion on the perception of 'development', yet at the same time there exists a rich source of important experiences gained from efforts for development at micro as well as macro level. It is therefore essential to learn from these experiences and understand that integrated development is a responsibility of every individual involved in the development process, and hence has to be expressed simultaneously across all sectors.

2.2. Urban Planning Theories

2.2.1. Burgess Model

Also known as the Concentric Zone Model, it was one of the first models created by academics, developed in the 1920s by Ernest Burgess. Burgess attempted to model Chicago's spatial structure with respect to 'zones' around the city. These zones radiated from the centre of the city and moved concentrically outward. Burgess designated five different zones that had separate functions spatially (Ref. Fig. 1). The model is based on the idea that due to still competition and high land values in the centre of the city, high density development is seen near the CBD with sparse development on the edge of the city.

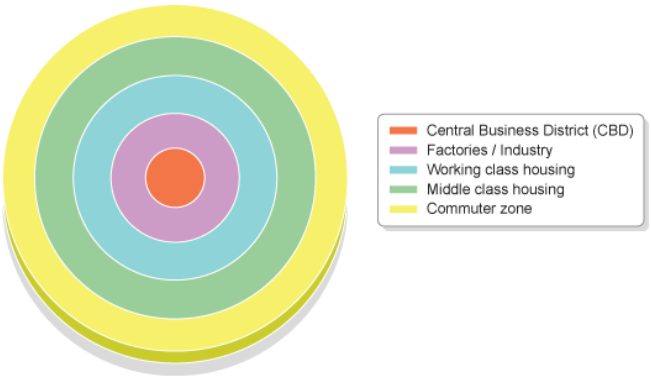


Figure 1 - Burgess Model schematic diagram

2.2.2. Hoyt Model

It is evident that the Concentric Zone Model may not be applicable to all cities, hence in 1939, Homer Hoyt attempted to further the earlier model. This model is based on Burgess Model, but additional sectors of similar land were concentrated in various parts of the city.

The factory/industry zone as well as certain working class housing radiate out from the CBD (for e.g. development along a main road or a railway). The model has a pie like look (Fig. 2 alongside)

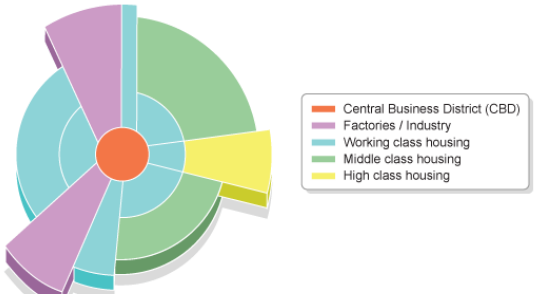


Figure 2 - Hoyt Model schematic diagram

2.2.3. Growth Pole Theory

In 1950, Francois Perroux defines a growth pole as 'centres (focal points) from which centrifugal forces emanate and to which forces are attracted. Each centre being a centre of attraction and repulsion has its proper field, which is set in the field of all other centres(Perroux, 1949). In simple terms, growth in an area does not appear everywhere and all at once. It appears as development poles and spreads along diverse channels (roads and commuting links etc.). This theory is based on two aspects: first of leading industries (growth in hinterland due to economic growth of industry) and polarization (hindrance to growth in hinterland due to attraction of industry.

2.2.4. Garden City Concept

Garden City concept is a method of urban planning initiated by E.Howard. In his book 'Garden Cities of Tomorrow' by Ebenezer Howard, he writes, "There are in reality not only, as is so constantly assumed, two alternatives – town life and country life – but a third alternative, in which all the advantages of the most energetic and active town life, with all the beauty and delight of the country, may be secured in perfect combination." He illustrated this by his famous diagram of "The Three Magnets" in which the major advantages of the town and the country are stated, while a third magnet of Town-Country was introduced which was free from the disadvantages of the other. The intention of a garden city was that it would be a planned, self-contained communities surrounded by greenbelts with proportionate areas of residence, industry and agriculture. A Garden City approach was an approach to deal with the increasing congestion and

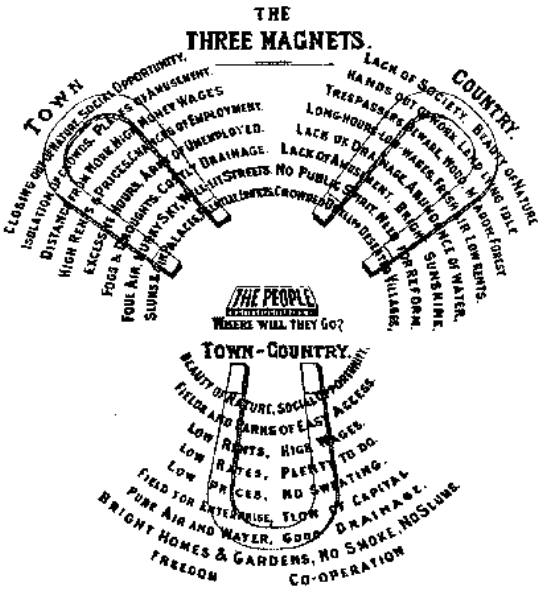


Figure 3 - Howard's Three Magnets Diagram

industrialization. The Garden City was planned graphically on a concentric pattern with open spaces, public parks and six radial boulevards, 120 ft. (37 metre) wide, extending from the centre. The Garden city would be self-sufficient and when it reached full population of 32,000, another Garden City would be developed nearly. The whole concept was envisaged by Howard as a cluster of several Garden Cities are satellites of a Central City of 50,000 people, linked by road and rail.

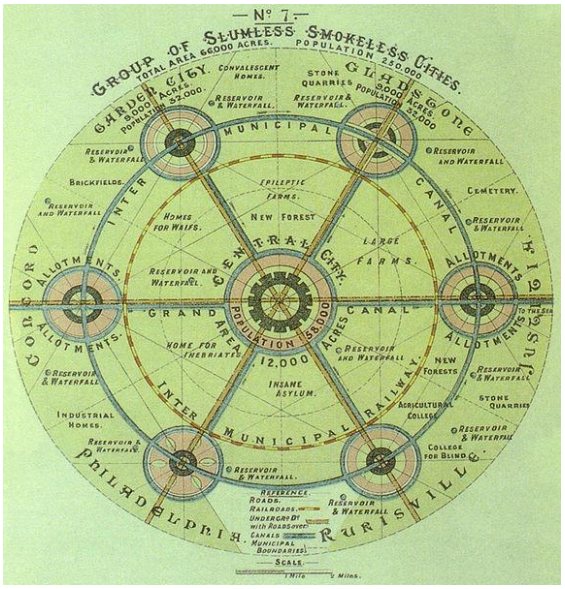


Figure 4 - Garden City Concept of Ebenezer Howard

2.2.5. Neighbourhood Unit Concept

The Neighbourhood Unit Concept, created by Clarence Perry in 1929 has been regarded as a model useful for practical application of the exercise of accommodation the population of a town in the residential area. Perry defines a neighbourhood with an elementary school which is at a walkable distance for the children of the community, adjacent to the school in a pack for all the residents to interact. His proposal is in the form of a square one-half mile on a side (160 acres) for a population of 5000. The core principles of the concept were around several physical design ideals:

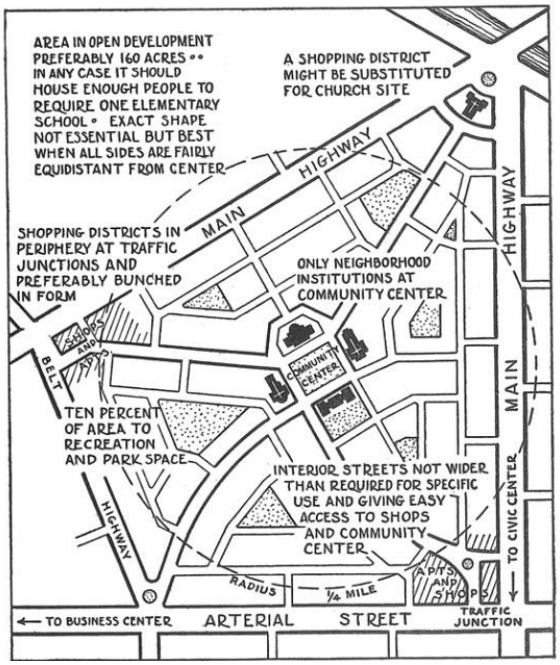


Figure 5 - Neighbourhood Concept diagram

- Centre the School
- Place arterial streets along the perimeter(to eliminate unwanted traffic)
- Design internal streets using a hierarchy to distinguish local and arterial streets
- Restrict local shopping areas to the perimeter (or main entrance)
- Dedicate at least ten per cent of the neighbourhood land area to parks and open space.

2.2.6 Inferences

On common ground, all the theories studied above have a common intent of providing a theoretical approach to planning through suggestive diagrams which could be altered depending upon the site selected. The Burgess model, although it developed during an industrial movement in American cities at the time, attempts at applying it in European cities failed, as in many European cities the upper class are located centrally rather than in the periphery in American cities. Also the theories talk of a 'typical city', there is no such thing as a typical city since every city is different. The Hoyt Model takes into consideration effect of transportation and communication on the growth of a city. This model works especially well in British cities as well as industrial city where the 'road' and 'rail' are of prime importance. This theory can be useful in analysing the spatial organization of industrial and residential areas in the town.

The Growth Pole theory has its applications in analysing the proposal of location of ancillary industries in the hinterland to avoid the effect of polarisation which is a normal phenomenon in industrial towns. At the same time, it can be helpful in understanding the positional importance of the major industrial area in the town.

The Garden City concept and Neighbourhood Unit Concept is an important aspect of this study since it has exceptional relevance to various planned towns in India in the Post-Colonial era. Examples of towns like Chandigarh, Bhubaneswar and Jamshedpur are based on these ideologies. It is also significant that the 1944 Koenigsberger Plan for the Steel City of Jamshedpur was an attempt to merge the concept of linear growth(band town planning) as well as many aspects of the Garden City(low density, plentiful greenery and well-designed bungalows(Sinha & Singh, 2011) with a reasonable amount of flexibility. Jamshedpur's planning provided a model for steel towns like Bhilai, Bokaro, Durgapur and Rourkela which was later built by the Central Government following independence. Rourkela, with its close proximity to Jamshedpur as well as its cultural similarity with Bhubaneswar, it is hence imperative to probe into the influence of the planning strategies adopted by Koenigsberger(garden city and neighbourhood unit concept) in the initial planning of the area. This aspect has been probed in detail in further chapters of this report.

2.3 Rourkela Development Authority (Planning and Building Standards)

2.3.1. Summary

The RDA Planning and Building Standards have been studied in order to understand the existing growth pattern the authorities are trying to achieve in the study area. The Standards are applicable to the areas within the jurisdiction of the Rourkela Development Authority. The document is divided into eleven parts; a brief of each section is described as follows.

Part I – This part deals with a brief introduction about the document and various definitions given later in the document.

Part II – This part deals with the administrative functions with relation to construction or demolition work done by the public in the areas under the jurisdiction of the Rourkela Development Authority.

Part III – This section deals with regulations on zoning throughout the region. It also shows the various land use types allowed or prohibited in various zones within the jurisdiction area.

Part IV – This section deals with general rules of construction in the area. Some of the salient features are given as follows:

- Minimum size of plots as well as minimum road width required for each category of land use and building type is shown in tabular form.
- The minimum set-backs according to plot sizes as well as maximum permissible FAR are given. The following table shows the maximum permissible FAR in the town:

Road width in m	FAR for residential/commercial	FAR for IT/ITES/Corporate
Up to 6m	1.0	--
6m and more & less than 9m	1.5	--
9m and more & less than 12m	1.75	--
12m and more & less than 15m	2.0	2.00
15m and more & less than 18m	2.25	2.25
18m and more & less than 30m	2.50	2.50
30m and more	2.75	2.75

Table 1 - FAR regulations as per RDA Standards

Part V – This part deals with special regulations applicable for Apartment buildings, mixed-use areas, Bastee areas and Group Housing Schemes.

Part VI – This part deals with permissible land uses in large scale integrated townships.

Part VII – This part deals with regulations for additional requirements in case of Apartment Buildings, Multi-Storeyed Apartments and Group Housing Schemes. It also contains information regarding the issue of occupancy certificate from the authority after completion of projects.

Part VIII – This part contains regulations regarding sub-division of land in the area. Table 2 below shows the regulations for minimum road width for sub division of land in the region.

Sl. No.	Area for development in Ha	Road width in m
1	Upto 1.0	9
2	1.0 – 4.0	12
3	4.0 – 10.0	18
4	Above 10.0	30

Table 2 - Minimum road width for development

Sl. No.	Length of road in m	Min. width of road
1	Upto 250	9
2	Above 250 up to 500	12
3	Above 500 up to 1000	15

Table 3 - Minimum road width according to length of road

Part IX, X and XI – The final three parts deal with compounding, roles of authorities in controlling development in the region as well as prohibition and regulations on industrial set ups and SEZ in the area.

2.3.2 Inferences

The Building Standards are not able to control the development of the town due to sudden upsurge in population in the last decade as well as constant urbanization and growth of slums. The maximum allowable FAR both any land use type is 2.75 for a road width of 30 ma dn more. However, it has to be noted that due to presence of narrow road widths throughout the town, it is hence impossible to efficiently utilize the allowable FAR in all places. This is a result of congested and organic development in a lot of wards in the town.

CHAPTER 3: CASE STUDIES

This chapter deals with documentation of case studies of two Indian Steel towns (Jamshedpur and Durgapur) and an industrial town in Germany (Mannheim). The aim of doing such a study was to get a holistic impression of developmental strategies adopted by urban bodies in industrial towns in India and Europe.

3.1. Jamshedpur, India

3.1.1. Introduction

Jamshedpur is one of the oldest as well as the largest 'existing' company town in the world. The present town is an Urban Agglomeration, spread over the villages of Sakchi, Susnigaria, Jugsalai and Beldih that lay in the Dhalbhum Pargana of East Singhbhum district of the state of Jharkhand in India. Jamshedpur is a remarkable success story in the face of the decline of company towns in other parts of the world. It started to grow even before the great experiments - New Delhi, Islamabad and Chandigarh – of the twentieth century in city planning in the Indian Subcontinent. Jamshedpur was an indigenous industrial development, initiated, financial and built by Indians, using local resources and labour albeit aided by foreign expertise(Sinha & Singh, 2011).

3.1.2. Planning Process

The planning of Jamshedpur can be broadly categorised into four scenarios wherein each was influenced by a particular ideology based on response to existing realities of the urban realm or the previous plan. They are discussed as follows:

Kennedy Plan, 1911: J. Kennedy of Pittsburgh (USA) prepared the first layout of the town. The plan was designed more or less on American lines with roads at right angles

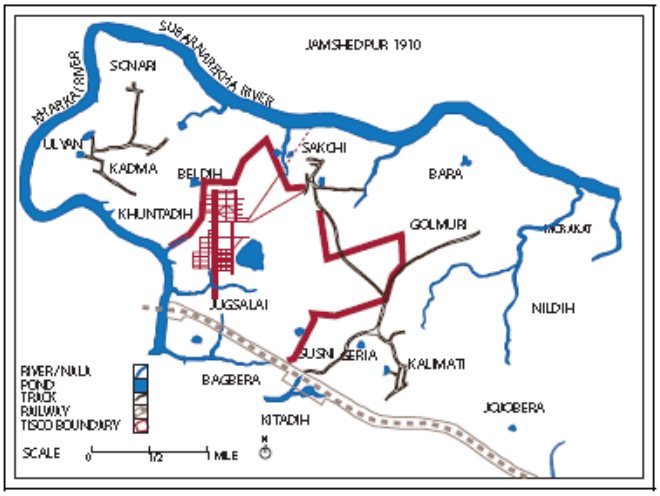


Figure 6 – 1911 Kennedy Plan, Jamshedpur

Temple Plan, 1920: From a small company town designed by Kennedy, Jamshedpur become an industrial township in a decade when it was planned by Charles Temple. Temple paid cloud attention to "landscape in planning the urban infrastructure went far beyond the conservancy approach practices by civic improvement trusts of nineteenth century colonial India(Sinha & Singh, 2011)

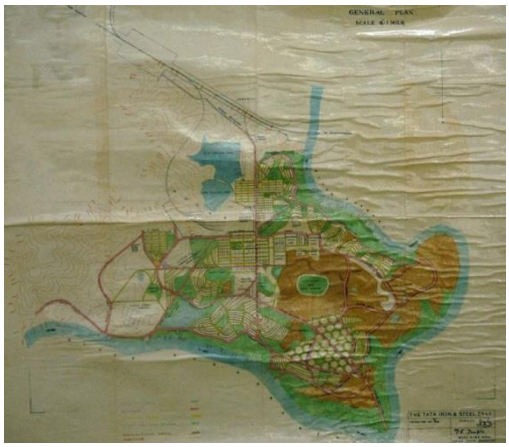


Figure 7 - 1920, Temple Plan, Jamshedpur

Stokes Plan, 1936 : The Stokes Plan was sort of extending the principles of Temple Plan and was a response to the housing crisis due to expansion of the town. His plan 'resembles the Homer Hoyt' wedge shaped urban model that stipulates segmented growth of housing along transportation arteries with those of similar incomes located in proximity to each other(Sinha & Singh, 2011)

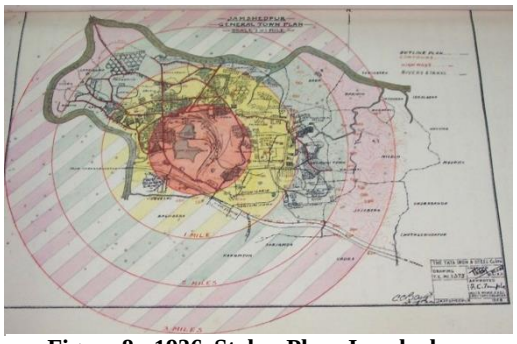


Figure 8 - 1936, Stokes Plan, Jamshedpur

Koenigsberger Plan, 1944: The Koenigsberger Plan is perhaps the most interesting as well as complex of all the plans discussed above, partly because he had to deal with the upsurge in population of the town to 1,50,000 and also since his plan had to respond to the ground realities which were mere outcome of three plans prior to his proposal. (Sinha & Singh, 2011) states further that "a close look at the Development Plan reveals Koenigsberger's effort to use the garden city precepts and the neighbourhood unit was only partially successfully thwarted by the fact that the city had grown substantially around the

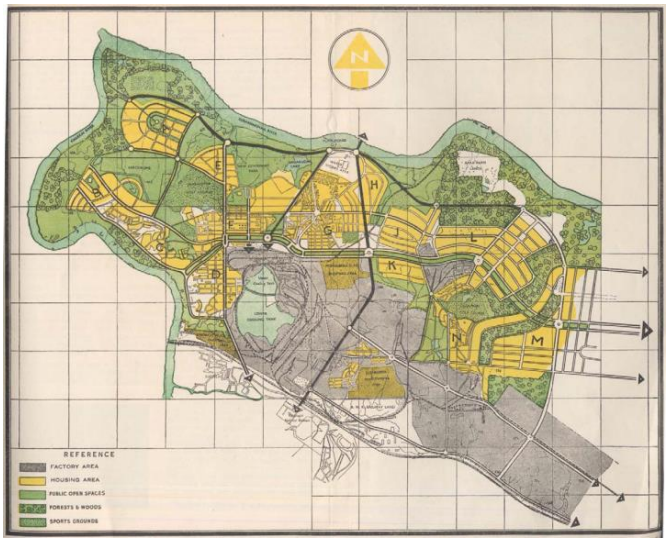


Figure 9 - 1944, Koenigsberger Plan, Jamshedpur

steel plant with interstitial pockets and peripheral existence of tribal villages transformed into bustees." So it is evident that Jamshedpur's plan at that time was not in accordance to the idealized layout of Howard for Garden City. Koenigsberger was able to identify spaces where planning could be done in the Garden City precepts and plan them accordingly. Some examples of this was division of the residential zone into twelve neighbourhood units and promoting linear growth(band towns) along transportation arteries as a response to concentric growth happening.

3.1.3. Recent Developments

The State Government plan for an industrial complex resulted in the birth of the satellite township of Adityapur in the 1960's across the river Kuakhai. Once the rivers were bridged, all barriers to extension were removed, wherein other extensions such as Mango on the not took place resulting in it being called as the JUA (Jamshedpur Urban Agglomeration). The Urban Agglomeration has seen a 36.4% growth in population between 1991 and 2001.

3.1.4. Issues

Some of the basic issues in the area are as follows:

- Unplanned growth in urban-rural fringe areas
- Increased congestion
- Lack of public sanitation
- Poor housing stock
- Multiplicity of agencies having multiple influences
- Nearly absent tax structure
- Urban Poverty and slums

3.1.5 JUA 2027 Master Plan

The JUA 2027 Master Plan was drawn by Superior Global Infrastructure of New Delhi in collaboration with the Philadelphia based firm, Wallace Roberts & Todd, with its scope covering Jamshedpur, Adityapur, Mango, Jugsalai and seven villages covering an area of 149.23 sq. km. The master plan was a result of the JNNURM launched by the Government of India in 2005-06. Some of the salient features of the plan were:

- Transit Oriented Development nodes to be promoted for distribution of services and amenities.

- Optimal utilization of vacant lands within JUA
- Specific proposals on traffic management, storm water and sewerage system
- Detailed SWM scheme within the framework of JNNURM scheme of the Indian Government.
- Proposal for BRTS(Bus Rapid Transit System)
- Street widening schemes for slow moving vehicles and pedestrians in the street.

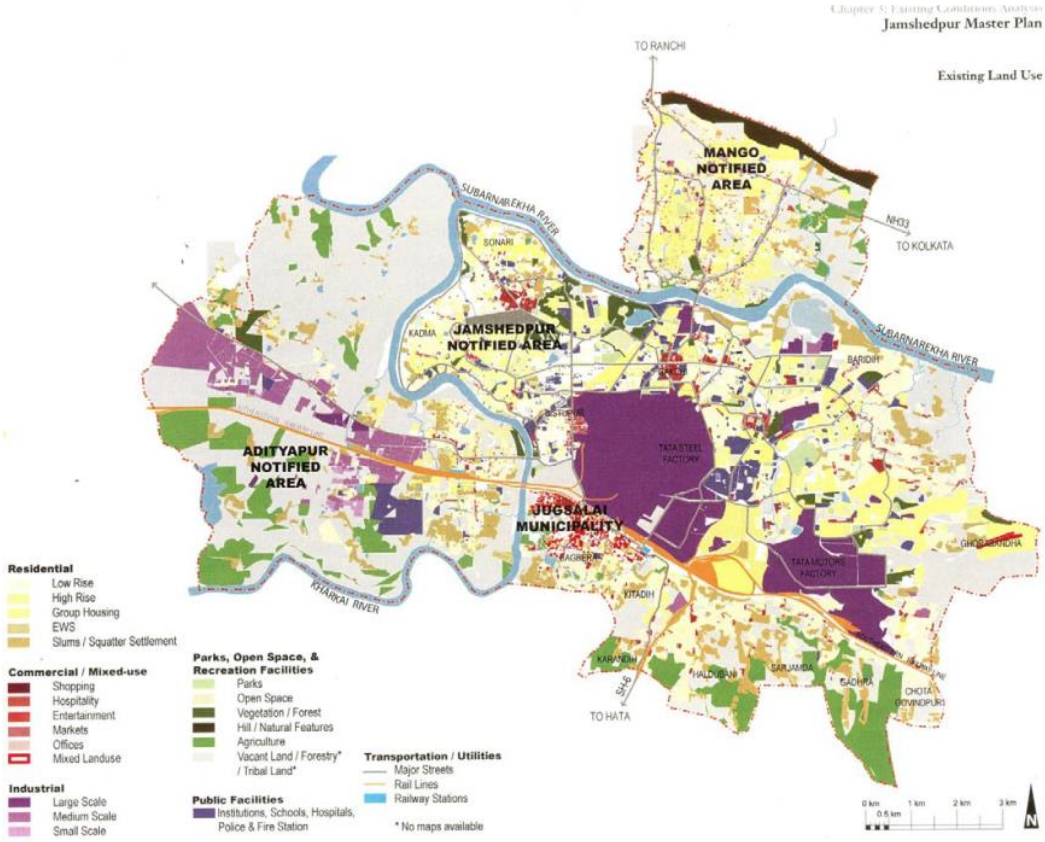


Figure 10 - JUA 2027 Proposed Land-Use Map

The Master plan can be comparable to the new urbanism model of concentrated, high density urban centres with mixed-use development in multiple nodes which are adjusted specifically to the Indian context.

3.1.6 Inferences

The planning of Jamshedpur has been a dynamic and at the same time truly dynamic approach given that it has changes much since its origin. The grid pattern and Hoyt's model as well as the Garden City and Neighbourhood Unit concepts, and the recent trends of new urbanism are all an attempt of reflectance of the thinking of that time. However, in the last five decades since the Koenigsberger Plan, there was a static phase in the town's history

which has brought forward numerous problems at micro as well as macro level. Although the strategies and recommendations of the Master Plan seem to be adequate, it has still not been tested on the ground. With increase in population and urbanization in the Urban Agglomeration, it is interesting to see how the latest master plan will be successful in its implementation

3.2. Durgapur, India

3.2.1. Background

Durgapur is an industrial town located in Bardhawan district in the state of West Bengal. It is part of the Asansol Urban Area which is one of West Bengal's major industrial as well as urban regions, and forms a part of Asansol Development Planning Area (ADPA).

Figure 11 - Location map of Durgapur city

3.2.2. Planning Process

The initial lay-out was designed by Modernist American architect Joseph Allen Stein and Benjamin Polk. The Durgapur barrage was constructed in 1955 followed by the Durgapur Thermal Power Station, after which massive follow up of industries was seen – Durgapur Steel Plant, Alloys Steel Plant, Durgapur Chemicals Ltd. Etc. The G.T.Road is a major road which passes through the town and acts as a physical barrier between the industrial area and the township area. A closer look at the plan of Durgapur reveals that areas like Benachity near the G.T.Road have undergone organic growth over the years, whereas the initial plans of the township area is based on grid pattern. But what is significant is that the Park is located in the centre of the residential township and

Figure 12 - Durgapur Plan, 1960

roads radiate out from all four corners from it. This shows the influence of Garden City concept and neighbourhood Unit aspects in the initial planning of the town.

3.2.3. Recent Developments

Much of the recent development in the town has been along the G.T.Road after it was widened around a decade ago. Areas like Bidhannagar and Bamunara see a lot of private builders constructing numerous housing complexes while the inner areas still grow in an organic manner. Yet, there are adequate green areas in the newly developed areas due to the area being a massive forest land. The recent problems in the city and the region has been addressed in the CDP- Asansol Urban Area prepared under JNNURM Scheme in 2006

3.2.4. CDP-Asansol Urban Area, 2006

A CDP was prepared in accordance to the JNNURM Programme, which is both a vision document as well as a Perspective Plan. The Planning Area is the Asansol Urban Area is spread over an area of 478.31 sq. km. with a population of 14.99 lac.

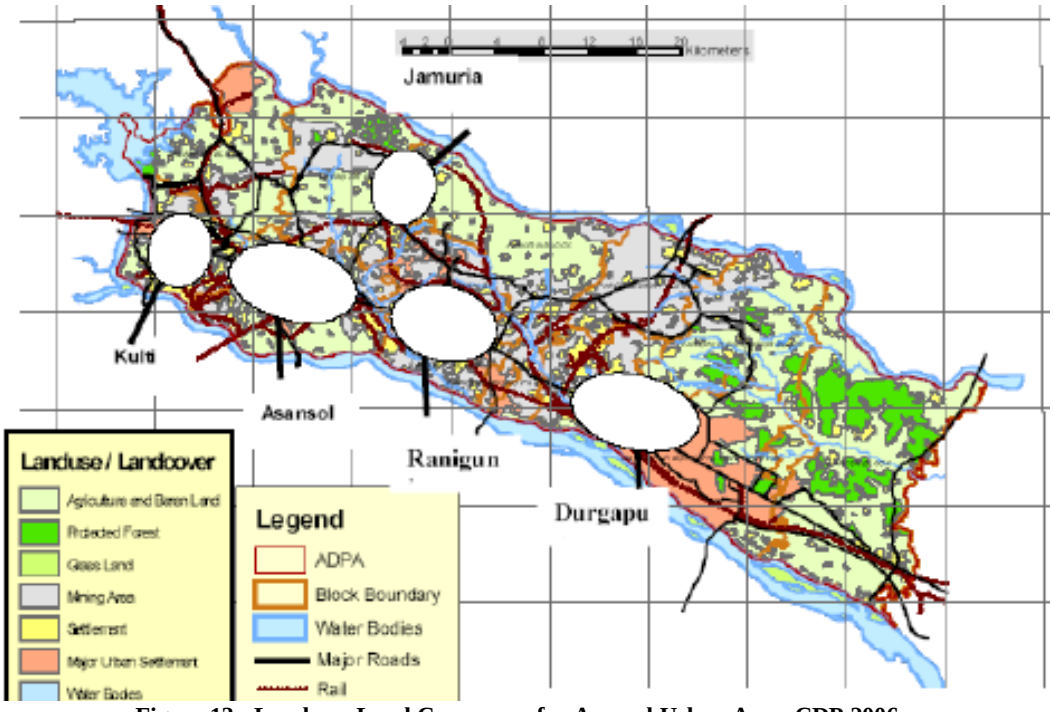


Figure 13 - Land use-Land Cover map for Asansol Urban Area, CDP 2006

Some focus areas of the CDP are stated as follows:

- Development of infrastructure(strategies to deal with issues affecting urban poor)
- Strengthening of municipal governments(financial accounting, budgeting systems and procedures, structures for more accountability and transparency and elimination of legal and other bottlenecks)
- Focus on sustainability
- Improvement of inter and intra-regional accessibility

Key issues in Durgapur town which have been identified in the CDP are as follows:

- Inadequate supply of drinking water(affects 37% of the population of the town)
- Poor Air quality(particulate pollutants is highest in the Asansol Urban Area)
- Neglected water bodies in the town
- Absence of a systematic drainage system(sewage from septic tanks goes directly into the open drain)
- Congestion in several links in south of NH-2 during peak time
- Lack of adequate maintenance of roads(especially near Benachity area)
- Inadequate parking facilities and encroachments on sidewalks.
- Poor rural connectivity
- Absence of landfill site for disposal of garbage
- Huge housing shortage(highest in Asansol Urban Area)
- Significant percentage of population in slums (12.7%)

In order to deal with the above issues, the solutions proposed in the CDP are:

- Development of program for RWH and Wastewater Treatment
- Organised discharge of industrial effluent
- Restoration of water bodies
- Construction of logistic hubs outside the city to counter congestion
- Construction of IMGD Sewerage Treatment Plant near Bidhannagar
- Proposal of parking lots implemented with PPP
- Focus on accessibility of pedestrians
- Revision of bye laws with respect to EWS/LIG housing, RWH, Water Management etc.
- Adoption of system of e-governance using IT applications
- Reform of property tax with GIS and make it a source of revenue

- Encouraging PPP
- Steps to increase awareness and public participation

3.2.5. Inferences

Durgapur is a classic example of development of typical industrial town. Unlike Jamshedpur, the town was planned in the 1950s and hence has many resemblances with its sister towns such as Rourkela, Bokaro and Bhilai. A brief study into its study reveals striking similarities between the planning ideology between Durgapur and Rourkela Town. Also, an in-depth analysis of the recently developed CDP reveals several issues which are similar in nature the issue in the study area. However, there is one criticism that can be made of the CDP: the population projection made for Durgapur for 2011 has proved to be inaccurate by the Census 2011 data (the CDP had predicted a steady growth in the area and forecasted the population of Durgapur area in 2011 to be 7, 00,794. However, the Census data 2011 reveals that population of Durgapur in 2011 was 5,66,937, thus a difference of 1,33,857 which is a deviation of 19.1% from the projected population, which is quite significant).Hence it is a lesson to pay adequate and careful attention to a more scientific approach to population forecasting in the study area.

3.3. Mannheim, Germany

3.3.1. Early History

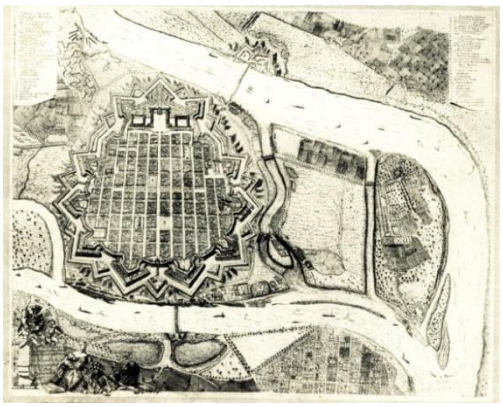


Figure 14 - Mannheim plan, 1758

Mannheim is an industrial city located on river Rhine in the south-western part of Germany. The city is the economic hub of the Rhine-Neckar metropolitan region and has a population of 3, 24,000 presently. The city started as a small company town in 1606, with the plan being in the form of a visible chequered ground plan with grid of streets and avenues, called "Mannheimer Quadrate". During the 17th and 18th century, the city developed as a cultural centre, while the physical plan remaining more or less same, with the city further developing across the river Rhine.

Majority of the industrial activity was in Ludwigshafen while the small scale industries as well as the workers' housing was in the Quadrate. Later on the city developed on the other

side of Neckar due to increase in population as well as shortage of housing for the new workers in the manufacturing sector.

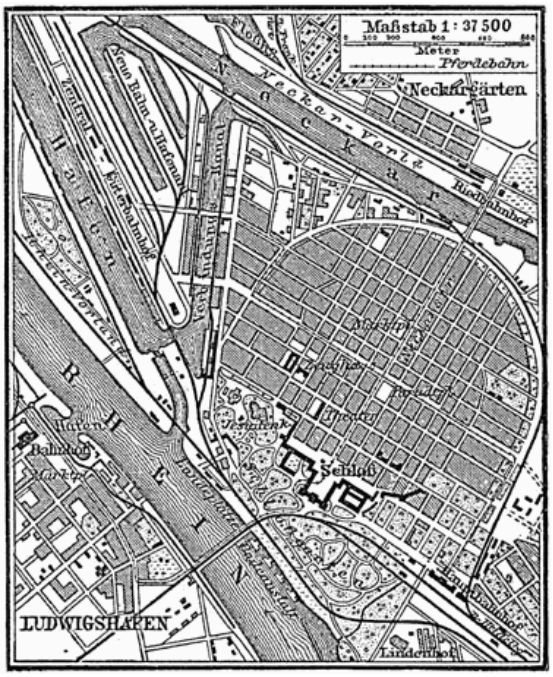


Figure 15 - Mannheim and Ludwigshafen, 1888(Source: Stadtarchiv Mannheim)

The city is separated from the nearby settlement of Ludwigshafen by the river Rhine. Ludwigshafen is a predominantly industrial area even till this data. The industrial plants were instrumental in promoting Germany's economy during the World Wars. Also, various industries manufactured ammunitions during the war. By 1930 the town along with Ludwigshafen had a population of 385,000. Air raids on Mannheim had destroyed the city during World War II. After the World War, the city core had to be completely re-built. Over the years, the economy of the city is gradually changing towards manufacturing based since opportunities in the industrial sector are on a decline in the city.

3.3.2. Recent Developments

Some of the recent developments in the city are as follows:

- Development of blue-green corridors in various parts of the city in order to connect the old and the new areas.
- Rehabilitation of the bike corridors and pedestrian zones in strategic locations in the city is being done by the Municipality.
- Development of new residential colonies due to shortage of housing in the city in recent times.
- Construction work in order to increase manufacturing sector in old core.

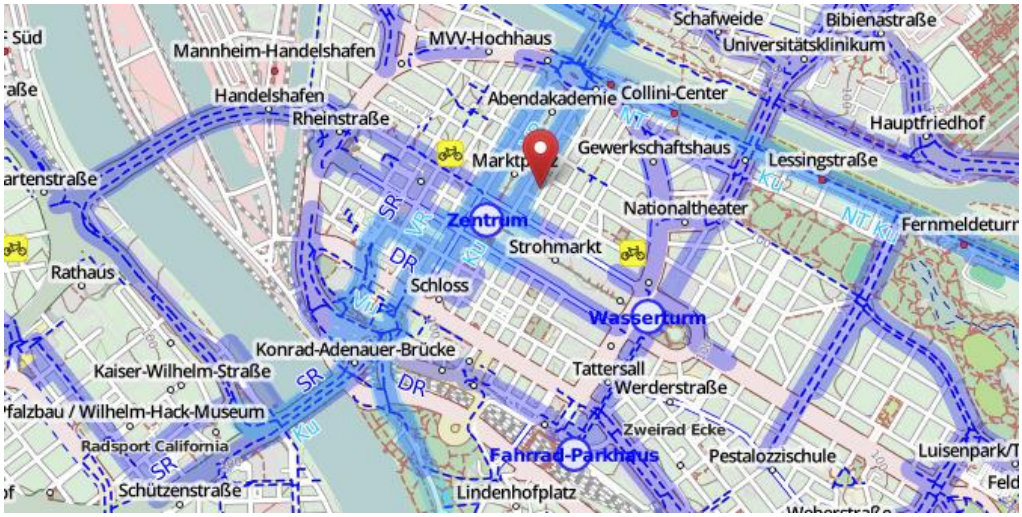


Figure 17 - Bike Corridor Plan, Mannheim 2013(Source: www.openstreetmaps.de)

- Expansion of physical and social infrastructure through development of new tram lines, development of eastern ring road, construction of second bridge over river Rhine etc. is being done recently.

Figure 16 - Narrow street in Mannheimer Quadrate

(Source : author)

- Good connectivity across the rivers has led to formation of a conurbation between Mannheim and Ludwigshafen in recent times. The second bridge along with creation of more infrastructure will help in re-densifying and de-densifying various parts of the city.

Figure 18 - Arial view of Ludwigshafen

- Significant development of breathing spaces along the river fronts which also doubles up as passive recreation space has been designed along the river Rhine and Neckar.
- Not much scope to increase green and open spaces within the old city center. Hence most of the urban space design and development work is taking place outside the 'Quadrate'.

3.3.3. Inferences

There can be seen a significant difference in quality of urban space between the old city center and new development outside it. The reason was that the old lay-out was based on narrower roads which have left limited scope to improve infrastructure levels in the core areas. This case study has significant relevance in relation to Rourkela due to multiple reasons. Firstly, the city has grown within the constraints of two rivers just like Rourkela Town. Secondly, there is relative tension existing within the city in terms of the infrastructure of the old Quadrate and the new settlements nearby. An attempt has been made to learn from the planning approaches by the Municipality in Mannheim and implementing similar ideas at policy level judiciously.

CHAPTER 4 – OVERVIEW OF STUDY AREA

In this chapter, a brief overview of the study area has been given. A SWOT Analysis has been done in order to identify the values of the town as a whole. Also, the chronological growth of the town between 1921 and 2013 has been mapped in GIS and shown briefly in this chapter.

4.1. Introduction

Rourkela is situated in the North Western part of Odisha State in the district of Sundergarh. The town is located in a mineral rich belt and is strategically located on the Kolkata-Mumbai rail route. The town is surrounded by the three rivers Brahmani and Sankh on the west and river Koel on the north. The general slope of the town is towards north and west while a hill range (Durgapur Hill Range) of about 300 m high cuts through the area.

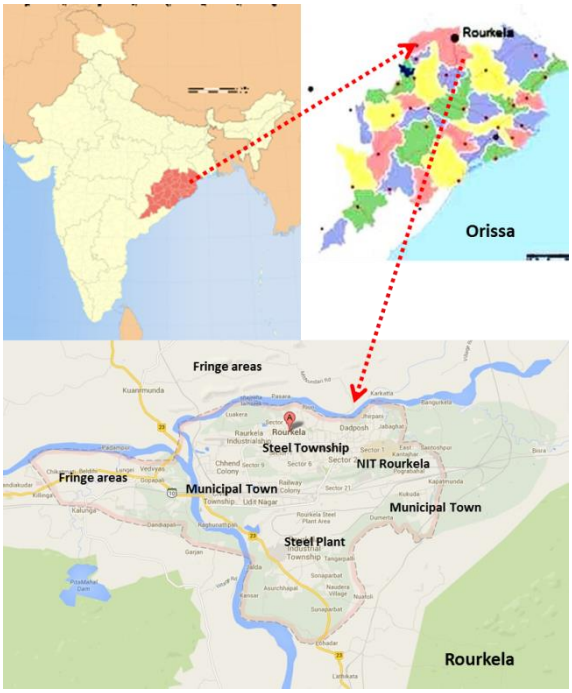


Figure 19 - Location map of Rourkela Town

The whole region is a Metropolitan Area, which comprises of the Steel Plant, Steel Township, Municipal Town and the Block Areas. The study area for this dissertation is the Municipal Township area which is mentioned in the report as Rourkela Town. As of now, the study area comprises of 33 wards with a total area of 31.6 sq. km. The population of the study area was 2, 73,040 in 2011.

4.2. Chronological Growth

A very significant step in this thesis is to understand the growth pattern of the area. It is significant to notice that not much research work has been done in this regard of documentation the growth of the town in the last 120 years of its history, and analysing it spatially. The overall growth of the area can be segmented into eight parts and analysed

spatially. Most of the sources are in the form of literature and books by various authors on their views of Rourkela before and after the Steel Plant.

Till 1921

During 1890s, the Bengal-Nagpur Railway Company constructed the Howrah Nagpur railway line, which ran through Rourkela. The Railway stations of Rourkela, Panposh (settlement near river Brahmani) and Bondamunda in the east were established in the same time. The then railway station of Rourkela was within the revenue village of Mahulpalli. The region was predominantly rural and under developed comprising of a few villages such as Durgapur(present day Uditnagar and Basanti Colony), Kuarmunda, Guruadihi, Urtum(Steel Plant area), Lanji Berana(IG Park), Ahirabandh, Bagdihi gaon, Jhirpani, Bhandu Tola, Tumkula, Dhatum Tola, Purunapani (Sector Area).

1921 to 1945

Rourkela was declared as an 'Urban Town' in 1931 after the merchants started to settle along the railway line in 1920s. At that time, the population was 492, while the population of Panposh was nearly five times (2252) that of Rourkela. Further railway line connecting Birmitrapur and Rourkela came up and was operational in 1926, and the railway station had the status of a junction. During this period, railway employees and merchants started to settle in the area. In 1945, a Sub-Divisional Court building was constructed at the village of Durgapur(present day Uditnagar).

1945 to 1960

After India achieved independence, steel plants at Bhilai, Durgapur and Rourkela were established as per the second five year plan (1956-1961) of the Central Government. But the surveys and land acquisition of 80 sq. miles started from 1952. German companies Siemens, Krupp & Demag stepped in for technical and financial advice. An additional 32 sq. km. was acquired out of 31 Revenue villages. Almost 13000 people (2424 families) were displaced in the process. Later, another 10,000 acres of land was acquired out of another 31 Revenue Villages for the construction of Mandira dam. Also, construction of Bondamunda Railway Station and railway lines to Hatia and Barsuan required further acquisition of land displacing another 20,000 persons.

By the year 1960, the Rourkela Steel Plant, Fertilizer Plant & Township and the Steel Township were constructed in the areas acquired by the then Govt. of Orissa. Also, a Marshalling yard was established at Bondamunda. The presence of the high Durgapur hill

range was used strategically in the early design of the town since it could serve as an excellent buffer to maintain the quiet character of the town from the noise of the steel plant, the State Highway and the main Calcutta-Bombay railway line.(Roy, 2007). Another significant observation is that most of the buildings in the industrial area (Rourkela Steel Plant) are aligned in South West-North East direction to ensure minimum exposure in the direction of wind and rain from SW monsoon.

The Steel Township was designed as twenty one sectors (in reality Sector 10, 11 and 12 do not exist). The sectors were planned with predominantly rectangular lay-out with plenty of open spaces. The Town and Country Planning estimated that 7500 workers would be employed in the pursuit of the target of one million tonnes of steel ingots, and an additional 2500 persons would be required as secondary workers to cater to the various needs of 7500 primary workers. The average family size taken was five, and the planners designed the township in the form of various self-sufficient neighbourhoods, with schools, hospitals, parks, playgrounds, police stations and social homes for a population of 50,000 initially. This reveals the influence of Koenigsberger's ideas of neighbourhood concept implemented in the cities of Bhubaneswar as well as the 1944 plan of Jamshedpur. In case of Jamshedpur, Koenigsberger had to deal with the designs implemented of his predecessors, and hence he had tried to implement the garden city concept and neighbourhood unit concept in all those areas where there was scope. While on the other hand, he could design self-sufficient neighbourhood units in the capital city of Bhubaneswar.

A broad look at the circulation map shows a 'ring road' along the main spine that would connect the township to the steel plant, the railway station, and the highways beyond. All other roads within the town would their way to this central avenue, the chief imperative being that each worker's house should be no more than a short walk away from the public transport vehicles of the plant. It is evident that the town planning was predominantly in relation to steel. Firstly, since the critical distance from the noise of the steel plant needed to be maintained while designing the neighbourhoods on the other side of the hills. Secondly, the planners relied on increase in steel production for projection of future growth of the town.

1961 to 1970

After the town was functioning, the resettlement process began, and the people who lost their homestead land and native places were resettled in resettlement localities in Jalda, Jhirpani etc. as well as beyond the river Koel in the north and in Bondamunda in the east. During this

time, there was a massive immigration of technical personnel from West Germany to extend technical assistance. Also, there was a huge rush of workers and business community migrating into the town in search of better opportunities from various parts of the state as well as the country. At the time when the steel plant started functioning, only 60 % of the workers in the town were allotted a household by the company. The rest of the population settled in areas close to the Steel Plant and mostly along the Howrah-Bombay railway line. Later, the government planned the Civil Township area which was on a rectangular grid pattern with individual plots on the lines of design of the sectors of the Steel Township designed earlier.

1970 to 1988

This was a period of marked urbanization in the area, wherein there was a growth of the town towards the North-East and Western areas. At the same time, there continued organic development along the railway station area. Planned townships like Chhend Colony (Phase – I), Basanti Colony and Koelnagar came up in order to cater to the increase in population. Yet, this period was significant since it marked rise in the informal labour sector and with it the proliferation of slums and other makeshift housing on the outskirts of the town as well as in areas near the Steel Plant. Hence, the quality of urban life that the town promised in its early years started to decline gradually.

1988 to 2000

In 1988, modernization of the Rourkela Steel Plant took place, after which it made a lot of profit by the early 1990s. The 1990s saw many people start to settle in high density planned colonies like Chhend Colony and Shaktinagar. On the other hand, more informal settlements also started to appear in and around the town. The housing need of the town had been increasing. At the same time, boundary of the town was difficult to maintain, since there was more growth along the river Brahmani in the west. Although the region beyond the river Brahmani was and still is not controlled by the Municipality, yet much of the makeshift housing settlements came up in the western areas.

2000 till date

Much of the development that has happened since 2000 has been a continuation of the development in the 1990s. Newer planned colonies in Chhend Colony (Phase – II), Balughat and Jagda has been habituated. Yet, in the absence of an updated master plan for the town, the unplanned growth of informal settlements has been growing, especially in the areas near

river Brahmani, Jagda and Bondamunda. Also the quality of urban spaces is on a constant decline in high density areas near the Rourkela Station, so much so that they have been

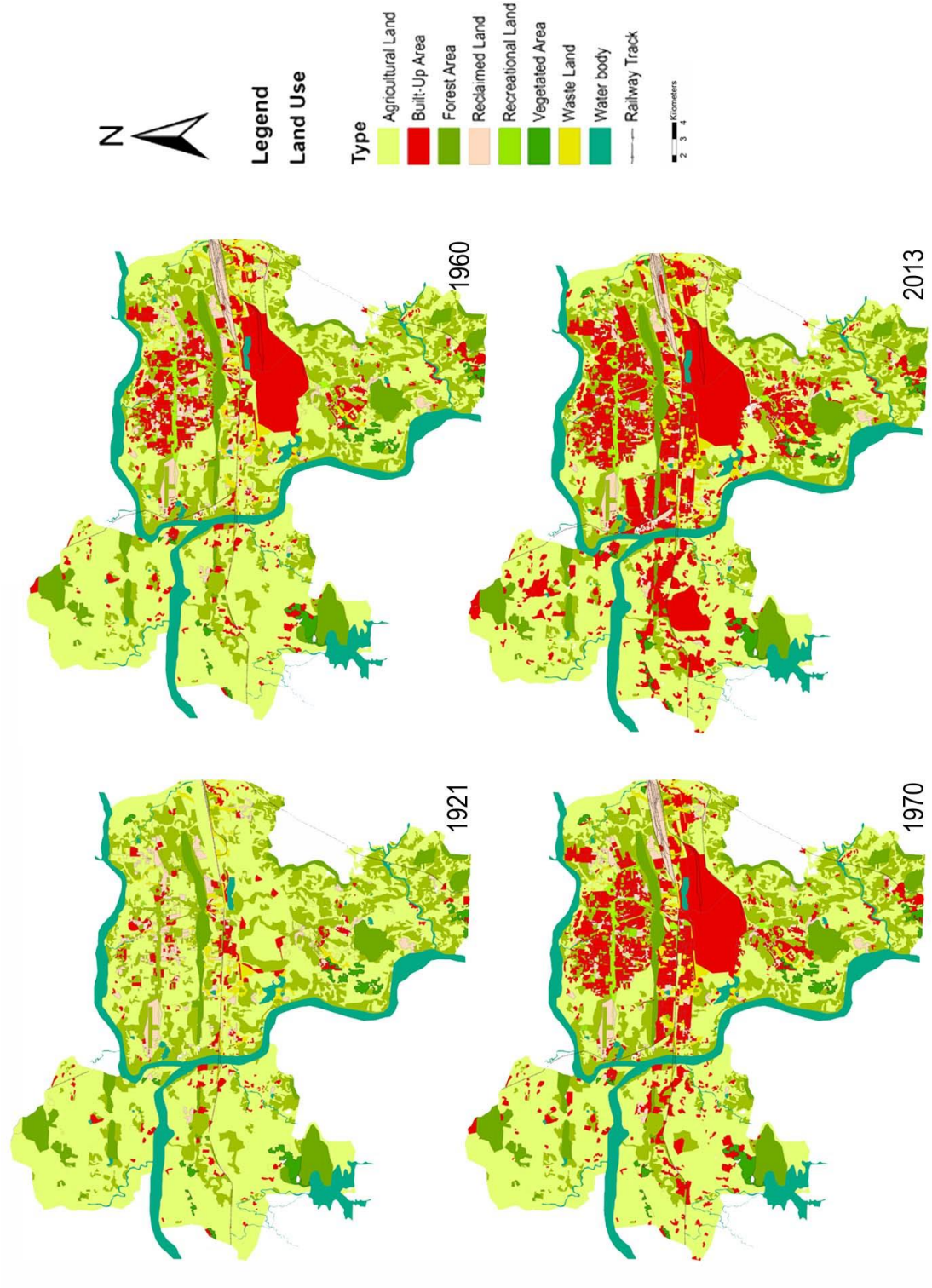


Figure 20 - Maps showing Chronological Growth of Rourkela Town between 1920 and 2013

classified as slums in the recent Census in 2011. There is clearly seen a marked tension between the planned colonies of the town in one hand and the unplanned organic spaces on the other. Majority of the unplanned colonies are in low lying areas and near the smaller water bodies in the town. Due to this reason, the qualities of the water bodies in the areas have declined to a large extent in the recent years.

4.3. Inference

It is important to understand that although the earlier planning approaches aimed at achieving dream of national unity and inclusive growth in underdeveloped areas, they have not been successful in achieving the same. For example, decisions like allocation of housing on the basis of workplace hierarchies resulted in economic polarization(Roy, 2007) and segregation. Also the early developments show a rather contradictory feature of various urban planning theories. While the planners simply adopted certain attributes of a concept implemented while they conveniently rejected certain other aspects necessary for the concept to be successful. All these factors, coupled with the absence of a collective and co-operative vision for the town has resulted in a social mess that the planners find themselves in. It is imperative that future planning measures and strategies have to integrate the needs of the inhabitants with the quality of the urban realm which connect them.

CHAPTER 5: EXISTING STATUS OF STUDY AREA

This chapter deals with documentation of the existing status of the study area of Rourkela Town. The area comprises of thirty-three wards with a total area of 31.6 sq.km. The existing status of the study area has been analysed statistically as well as spatially after identifying various parameters functioning in the town presently. The study is done in eight parts viz. Physical character, Demographic Study, Institutional Set-up, Socio-Economic Growth, Environment, Ecology, Traffic & Transportation and Infrastructure. Various parameters have been identified subject to availability of adequate data at local level and their inter-relationships have been further analysed spatially.

5.1. Physical Character

5.1.1. Soil

Most of the areas in the region are sandy loam soil of red colour. The forest blocks on the hill slopes have shallow and infertile soil, often sterile with quartz crystals, while in the valleys, red soil is found along with laterite soil which is rich in minerals. The whole region is rich in iron ore. Also, a lot of town area is characterized by the presence of alluvial soil which is good for vegetation.

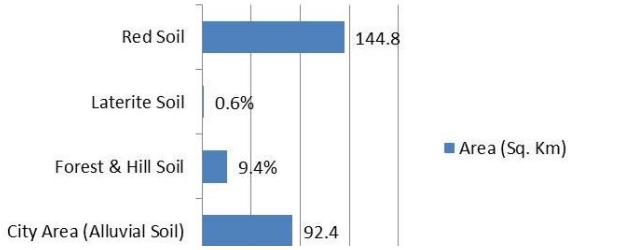


Figure 21 - Soil Area Distribution in Study area(Source : Rourkela Development Authority)

The soil in the region is predominantly acidic in nature, with the pH ranging from 6.3 to 6.8. The soil in the study area is fertile and has good agricultural and forestry potential. The soil area distribution data is available for the whole urban agglomeration. Nearly 55 % of the total area of the region is predominantly red soil, which is high in iron content. Other types of soils present in the region includes alluvial soil(35%), which is largely deposited by the rivers along their basins and comprises much of the town area. Forest and hill soil is present on the eastern and southern areas in the region, followed by laterite soil (0.6%) along the western and South West areas. Figure 22 shows the soil map of the region.

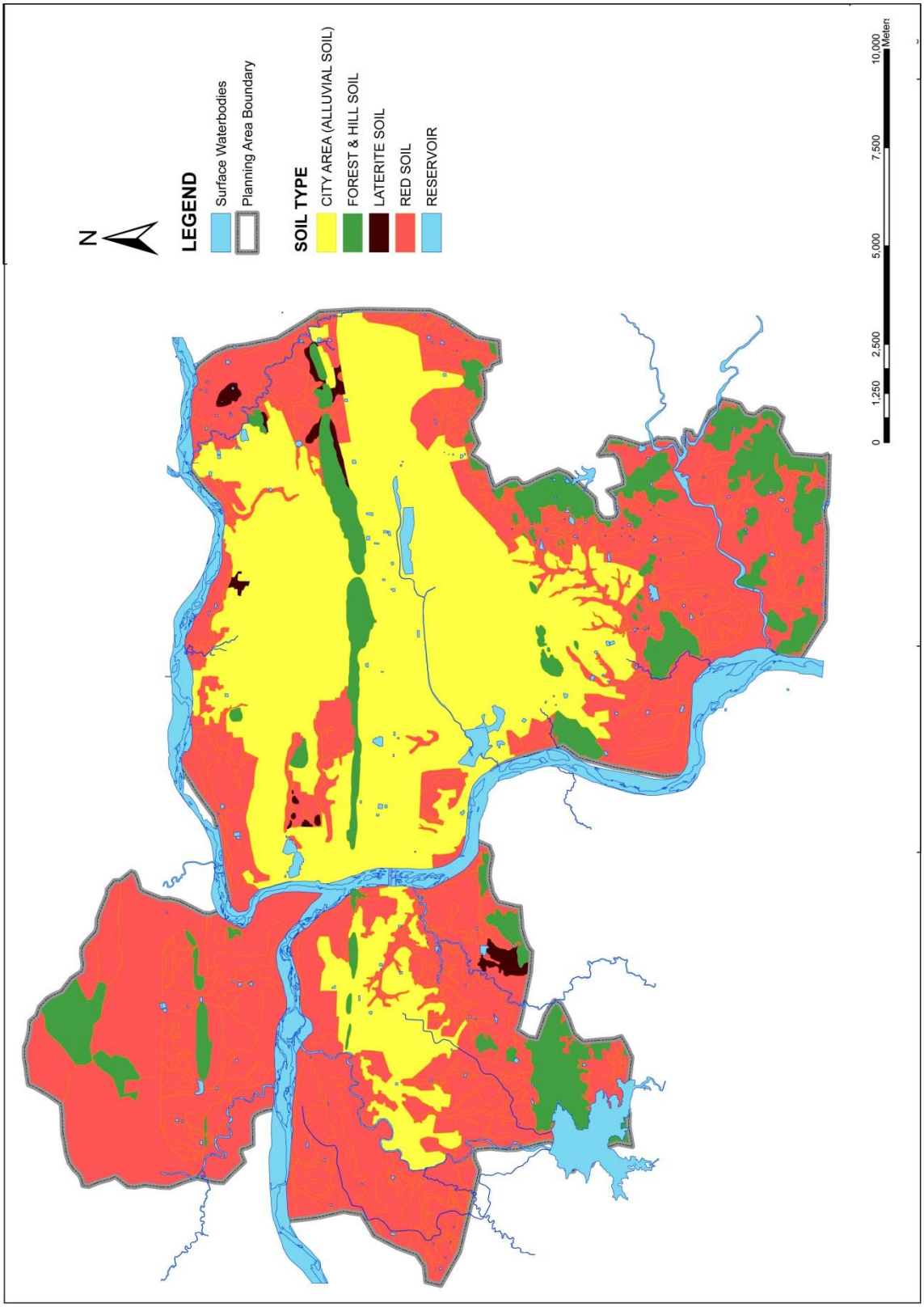


Figure 22 - Map showing soil types in Rourkela (Source: IIT Kharagpur Report)

5.1.2. Vegetation

Most of the data regarding the vegetation in the area is available at a district level. Nearly 36% of the area of Sundergarh district has semi-evergreen or tropical dry deciduous forests. There are three Reserve Forests in Hatibandha, Lathikatha and Sunaparbat viz. Kamarpahad R.F., the Chirobeda R.F. and Butukupiri R.F. Sal (Shorea robusta) is the main flora. Other top canopy mixed forest trees also exist in the study area such as Anogeissus *latifolia*, Terminalia *tomentosa*, Petrocarpus *marsupium*, Adina *cordifolia* etc.

5.1.3. Terrain and Geomorphology

The region is bounded by the rivers Brahmani and Sankh in the west and Koel in the north. The area has a natural slope towards the west and north. Major part of the town is a gradual slope towards north and west.. A linear ridge, Durgapur hill range runs from east to west throughout the town. The highest point in Durgapur hills is around 300 metres. Apart from this, there are numerous small water bodies (ponds, reservoirs, abandoned mining sites etc.) distributed throughout the town area. Fig. 25 shows the geomorphological map of the region.

5.1.4. Climate and Rainfall

Rourkela Town has a tropical climate and receives high rainfall during SW monsoon (June to September) and retreating NE Monsoon (December to January). The minimum and maximum temperatures are in the range of 7 ºC to 47 ºC, with a mean minimum and maximum temperature range of 9.8 ºC to 39.2 ºC. Average annual rainfall ranges between 1600 to 2000 mm. Fig. 23 and Fig. 24 below show the precipitation and temperature data of Rourkela Town for all months throughout the year.

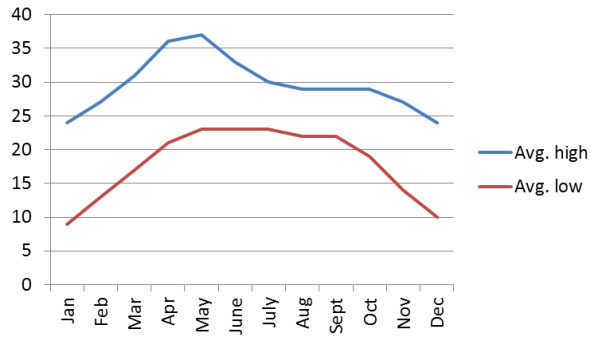


Figure 23 - Monthly average temperatures in Rourkela Town

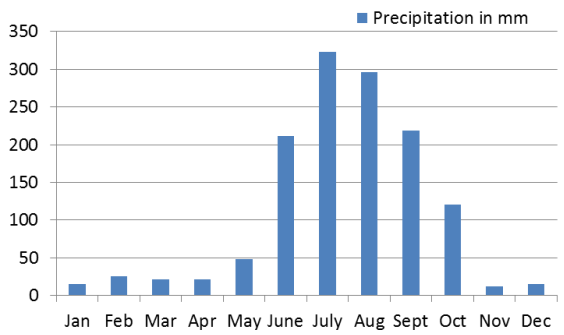


Figure 24 - Monthly Precipitation in Rourkela Town

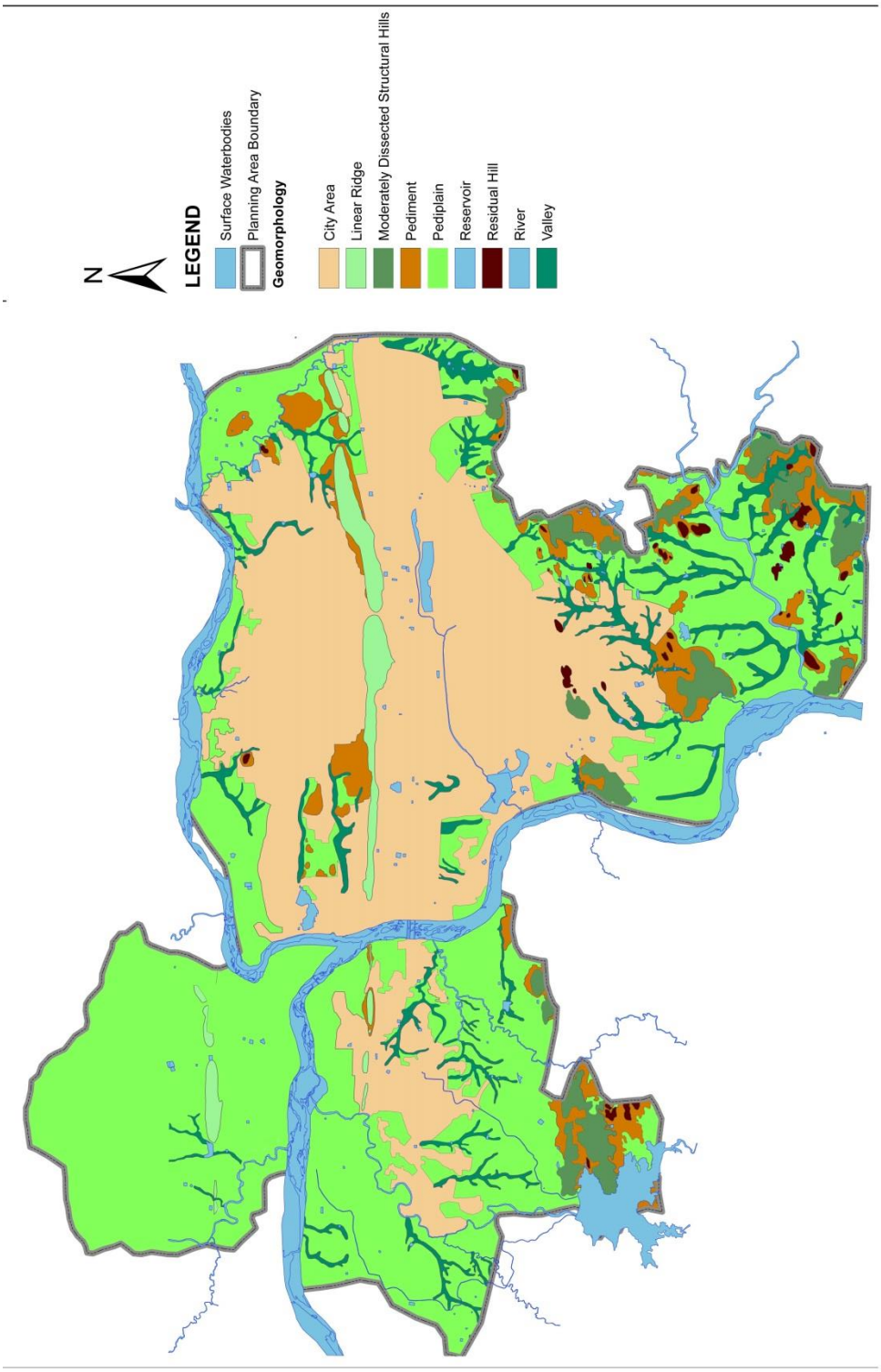


Figure 25 - Map showing Geomorphological features in Rourkela town

5.1.5. Land Use

These are broadly five major planning units in Rourkela. These are as follows

- Rourkela Municipality
- Steel Township
- Kuarmunda Block
- Lathikatha Block
- Bisra Block

Fig. 26 shows the land ownership pattern in the whole region. It is evident that most of the land is owned by private parties followed by a significant land owned by the Steel Plant and the Forest Department. It is primarily because of this that there are issues regarding unavailability of land in the study area.

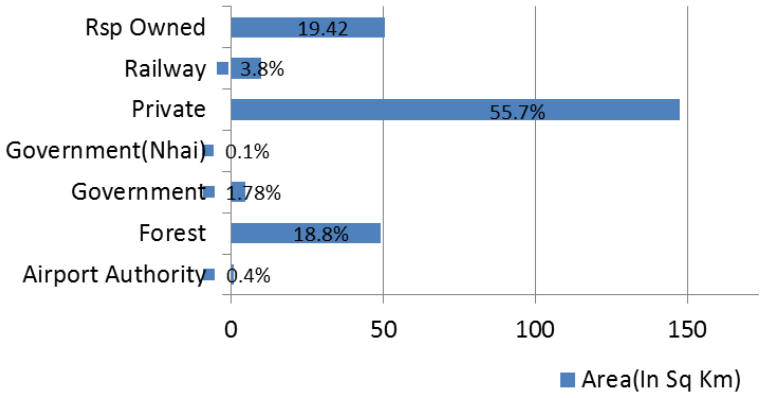


Figure 26 - Land use ownership pattern in Rourkela(Source : Rourkela Development Authority)

Land use	Area(In Sq. Km)	Area (In Percentage)
Built-up Rural	1.15	3.48
Residential	2.15	6.51
Industrial	0.32	0.97
Recreational Area	0.67	2.04
Public & Semi-public	4.39	13.28
Communication Area	0.003	0.01
Public Utilities &Facilities	0.06	0.20
Commercial Area	0.42	1.28
Reclaimed	2.92	8.82
Vegetated Area	0.44	1.35
Agriculture	7.66	24.64
Forest	2.53	10.67
Roads	3.98	12.03
Slums/Unauthorized Colonies	4.85	14.65
Total	31.60	100

Table 4 - Existing Land use pattern

The Municipal Area (Rourkela Town) has a total area of 31.6 sq. km. It is divided into 33 wards. It can be seen from the table alongside that a significant portion of the area is agricultural land (24%). Also, it is important to notice that the area occupied by slums/unauthorised colonies is 14.65 %, against the residential built up area of 6.51%. When the above information is analysed spatially, it can be seen that most of the agricultural areas are in the fringe areas and in the southern and eastern part of the town viz. in Jagda and Bondamunda. Also a significant

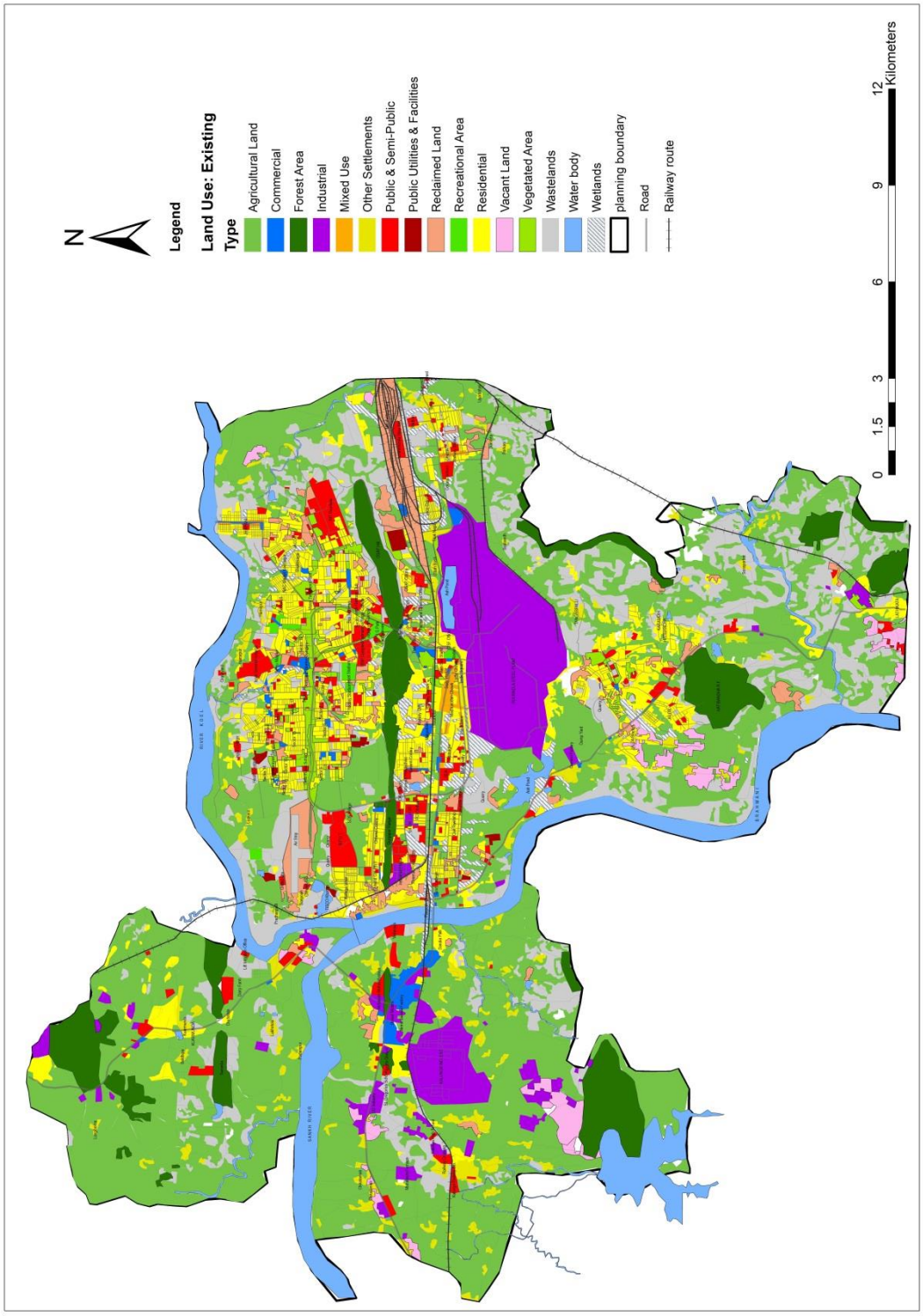


Figure 27 - Map showing Existing Land-use pattern in Rourkela

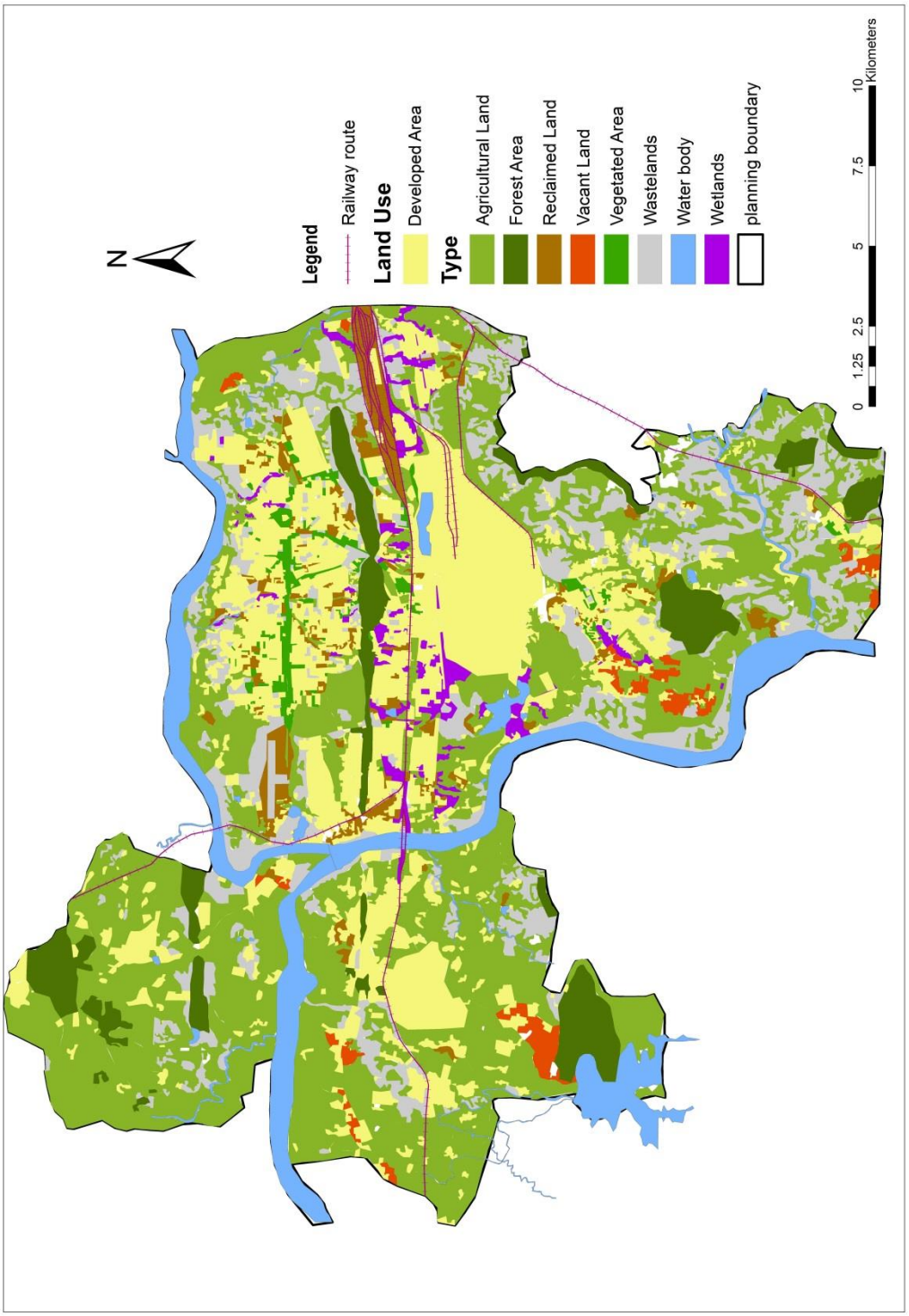


Figure 28 - Map showing Land Cover in Rourkela

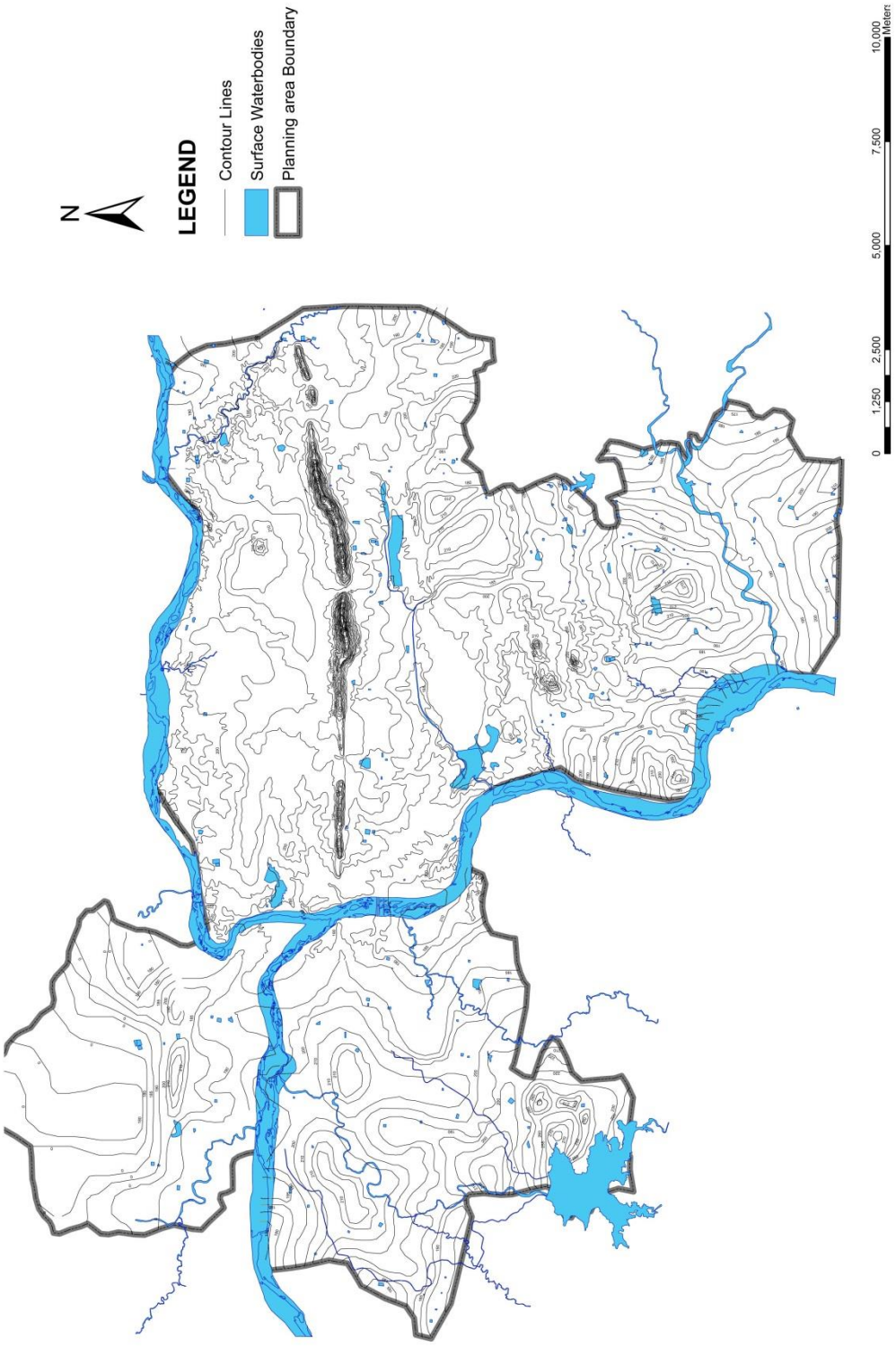


Figure 29 - Map showing contours in study area

part of the slums are located in the Railway Station area which has grown organically over the years. Apart from these, there are slums and other settlements in various other areas which have grown relatively recently, for e.g. the stretch near the newly developed fly over in Basanti Colony. There is scope for specific intervention in these areas after rehabilitation of the dwellers.

5.1.6. Road/Rail Network and Air Linkages

Bring an industrial hub; the role of the town in the development of the state of Odisha is undisputed. Also, due to increasing steel productions of the Steel Plant, it has a tremendous contribution to the GDP of the state as well as the nation. The town is the commercial and industrial capital of the state of Odisha. There are two important regional linkages:

- NH 23 towards Ranchi which runs from Chas-Ranchi-Rourkela-Talcher-Banspal Junction with NH 42. Nearly 30 km of this highway passes through in and around the town.
- SH 10 connecting Barbil-Sambalpur-Cuttack

The town is connected well to the other towns in the state; yet the internal transport network is unorganized and underdeveloped. Independent three wheeler auto taxis without meters are the most important mode of transportation, followed by public buses. Rourkela is situated at a distance of 413 km from Kolkata on the Howrah-Mumbai section. It is also 620 km away from Bhubaneswar, the capital of Odisha by rail. The Rourkela Railway Junction is under the SE Railway, and is directly connected with Delhi, Chennai, Bangalore, Ahmedabad, Ranchi, Dhanbad etc. Even though there is massive contribution to the South Eastern Junction from Rourkela Junction alone, yet the region still remains highly under developed in comparison to other areas of the state. There is still a lot of economic disparity in the district which is a reason for huge immigration in Rourkela town.

There is presence of an air strip in the North Western part of the town in the Rourkela Steel Township area, which was under the authority of the Airport Authority of India (AAI). At one time, Rourkela was connected with Kolkata by air. But after the airport was transferred to the authority of SAIL, flights were halted for several years. The authority has been passed over to AAI again since 2010, and DTDS has introduced a per seat charter service connecting the town to Jamshedpur, Bokaro, Patna, Ranchi, Bhubaneswar and Kolkata. But this service

has a lot of scope for augmentation since majority of the people still prefer to travel by trains and buses, showing lack of its impact on the market.

5.1.7. Built Environment

Majority of the built form in the town is individual plots owned by single family dwellings. Figure 30 shows the figure ground relationship between built form and open spaces in the town. The tension between planned and regular layout (in the Steel Township and planned colonies like Koelnagar, Basanti Colony, Civil Township and Chhend Colony) on one hand, and fragmented, organic development (near Brahmani and Koel rivers) on the other, can be easily figured out from the map. This seems to have a relationship with the overall quality of life of the residents in the town in both areas. Also, some of the waste lands near the rivers Brahmani and Koel are still not habituated, resulting in haphazard development and inadequate infrastructure in such areas due to low land prices.

Figure 31 - Well maintained Ring Road in Steel Township area

Another significant observation made is that there is a marked disparity between the quality of urban space in the Steel Township area and the Municipal Town areas, in terms of the size, quality and maintenance of open spaces, roads and relationship of the open spaces with the built form. There are definite reasons to this. Firstly, increasing population in the town and increased housing shortage in recent years has prompted the authorities to push for high density development in the new colonies which has resulted in a tremendous dichotomy in the quality of urban realm in the town. Secondly, keeping with the principles of planning of the settlements according to economic hierarchy even in the Municipal colonies has resulted in further economic polarization in the town. These factors, coupled with relatively low awareness levels in the Municipal areas as compared to the Steel Township areas has also resulted in this disparity.

Figure 30 - Encroachments near newly developed Fly over in Basanti Colony

Figure 32 - Map showing figure-ground relationship between built form and open space in Rourkela

5.2. Demography

5.2.1. Demography

The Rourkela Urban Agglomeration has a broad division of the Steel Township and Civil Township and has a variety of mix of population .from regions across the country, thus giving it a cosmopolitan character. Table alongside shows the population growth of the area between 1921 and 2011. Most of the rapid increase in population in the area took place between 1961 and 1981. This can be attributed due to increase in opportunities in work sector due to construction of the Rourkela Steel Plant. Between 1981 and 2011, there has been a rather constant growth in the population.

Year	Municipal Township	Rourkela UA	Growth rate
1921	-	382	-
1931	-	493	29.05%
1941	-	DNA	-
1951	-	DNA	-
1961	-	90287	-
1971	-	172502	91.05%
1981	-	322610	87.01%
1991	178329	398864	23.63%
2001	224987	484292	21.41%
2011	273040	552239	14.03%

Table 5 - Population growth in Rourkela

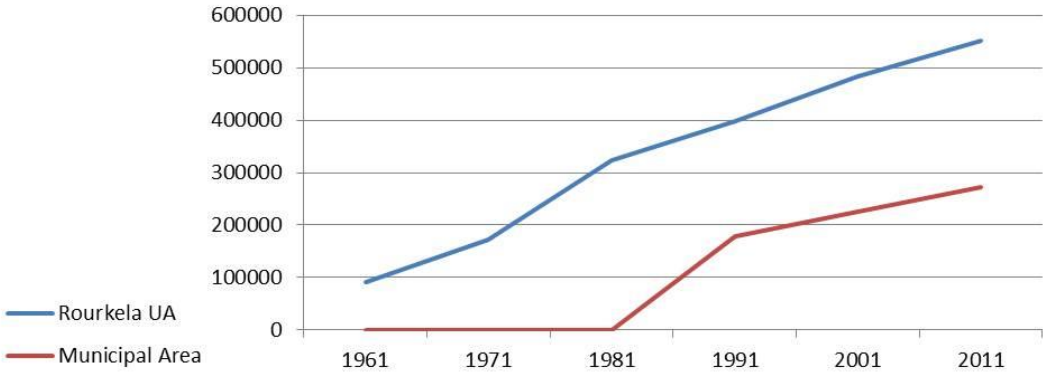


Figure 33- Population growth in Rourkela UA and Municipal Area

The figure below shows the ward wise population in the wards in Rourkela Town and their residential densities. The highest density is seen in the centrally located wards, most of which are full of unplanned settlements. Also proximity to the main station as well as the Steel Plant is a significant pull factor and a reason for high density in these areas. Ward No. 20 and Ward

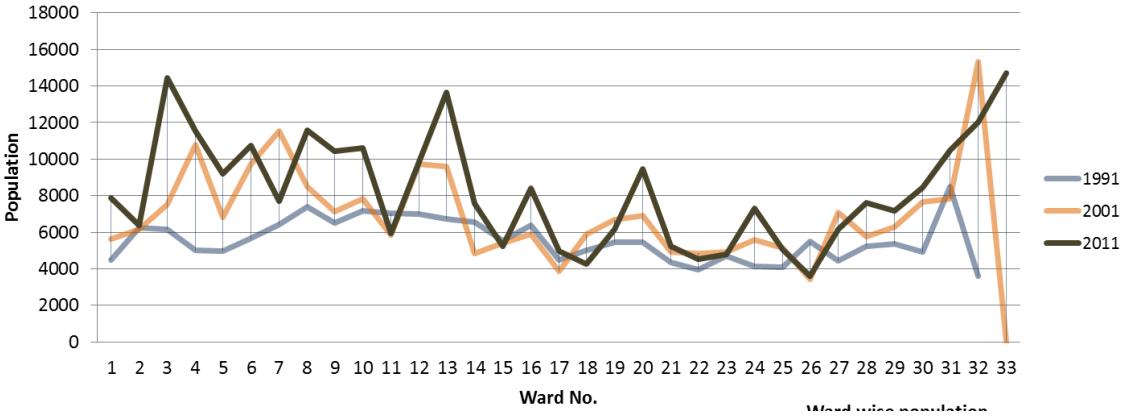


Figure 34 - Ward-wise population growth in Rourkela

No. 30 have the highest and lowest residential densities respectively. Newly developed areas like Jagda and certain areas near Bondamunda areas have low density due to greater distance from the industrial area as well as lack of proper public transportation. The density in Ward 30 is expected to increase in the next few years with increase in population.

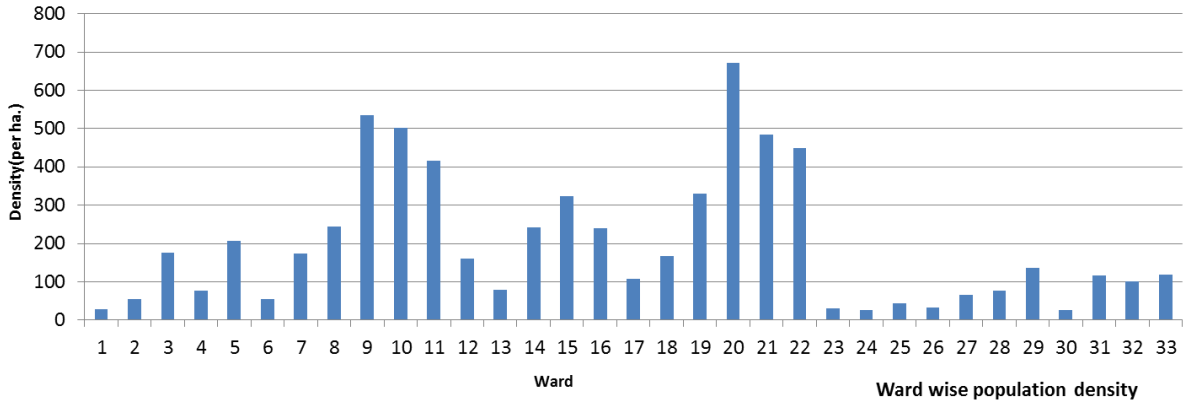


Figure 35 – Ward wise residential density in 2011

5.2.2. Sex Ratio

Fig. 36 below shows the ward wise sex ratio for the study area. The overall sex-ratio is 862.46. The sex-ratio for Ward No. 6 is the lowest (690), since it is a commercial and administrative area. On the other hand, the sex-ratio for Ward No. 24 is the highest (933) because it has residential colonies. If the overall sex ratio of the town is compared with that of the region, we find that the sex-ratio in the study area is considerably lower than the average sex ratio of Sundergarh district, Odisha state and India. This is because significant populations in the town are migrants from other parts of the state as well as from the country who arrive in the town in search of job opportunities. Due to issues of affordability as well as quality of housing available, most of these people settle in the town in unauthorized colonies without their families.

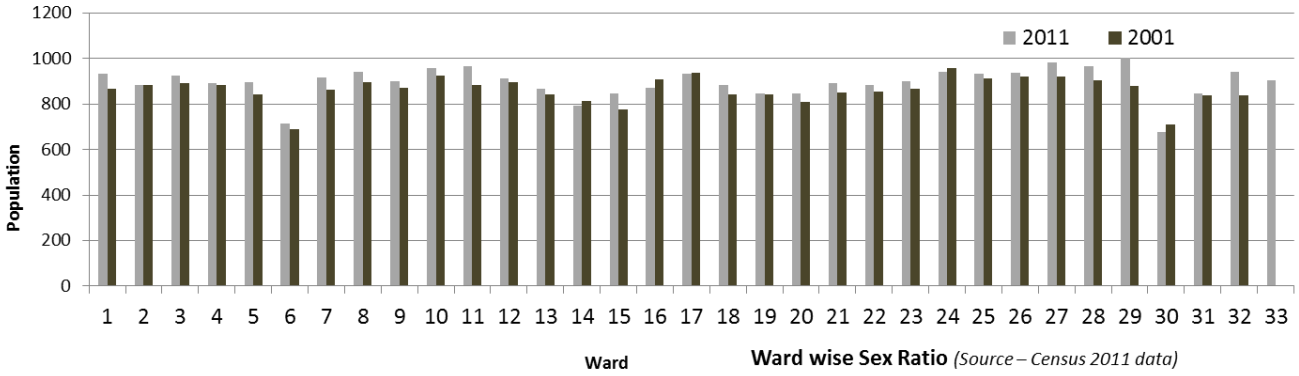


Figure 36 - Ward wise Sex-Ratio in Rourkela

5.2.3. Child Population

Figure 37 below shows the ward-wise child population for the study area. It can be seen that the child population (0-6 years) is highest in Ward No. 32 and lowest in Ward No. 26. Also, the child overall sex-ratio is 933 which is more than the overall sex-ratio of the whole population. Also, on having a closer look at the child sex-ratio of the overall population and comparing it with Sundergarh district, Odisha state and the national average, it is seen that the ratio of the town, district and state are higher than the national ratio. This is an indication

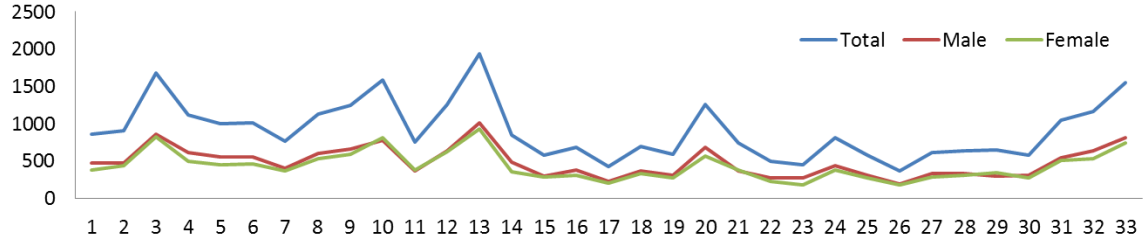


Figure 37 - Ward-wise Child Population (0-6yrs) in 2011

that there seems to be no discrimination among the female infants in the study area.

5.2.4. Birth Rate and Death Rate

Figure alongside shows the number of births and deaths in Rourkela Town between the years 2010 and 2012. The number of registered births and deaths show a trend towards natural growth, although there was a sudden upsurge in the death rate in 2011

Year	Birth Registered	Death Registered
2010	14140	3260
2011	15442	3487
2012	15904	3373

Figure 38 - Births and Deaths in the study area

5.2.5. Literacy Rate

The ward-wise literacy rate for the study area is shown in the figure alongside. The literacy rate is highest in Ward No. 28, with both male and female literacy being the highest, while it is lowest in Ward No. 10 among both males and females. This is because Ward No. 28 is a predominantly educational hub with many educational institutes functioning in the area, thus resulting in a significant population comprising students.

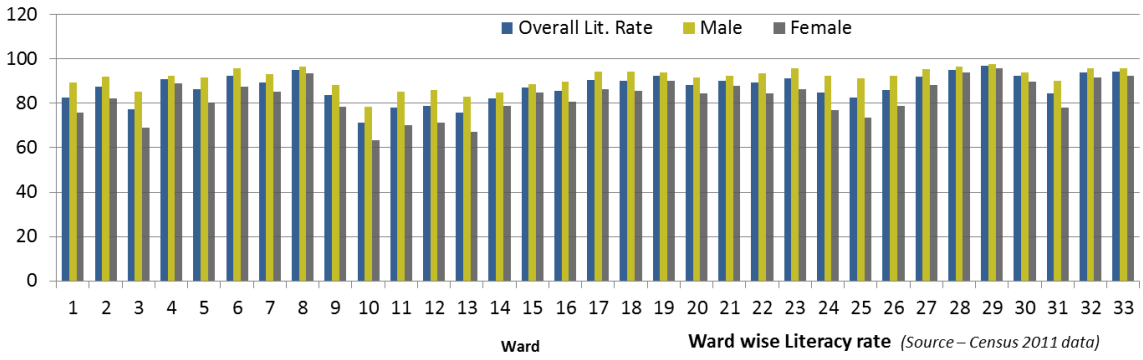


Figure 39 - Ward wise literacy rate in Rourkela

On observing the literacy rate in Sundergarh district, there can be seen a steady increase between 1961 to 2001, indicating increased awareness and increase in the number of educational institutes. Furthermore, a percentage split up of the male to female in the study area depict a higher percentage of literacy among male (57.5%) population than female population.

5.2.6. SC-ST Population

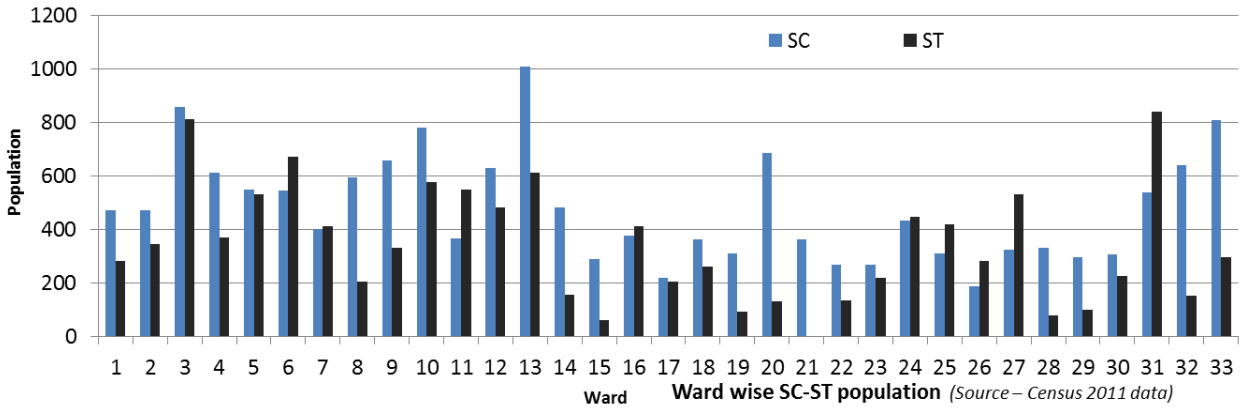


Figure 40 - Ward wise SC-ST Population in Rourkela

Figure above shows the ward wise SC-ST population in the study area. Ward No. 13 has the highest SC population while ward no. 17 has the lowest SC population. Ward No. 31 has the highest ST population while Ward No. 21 has the lowest ST population. Most of the tribal population in the region are in the rural fringes and beyond the two rivers Brahmani and Koel in resettlement colonies since 1960s. There are still social issues related to proper rehabilitation of the existing tribal settlements during the construction of the Steel Plant in 1950s.

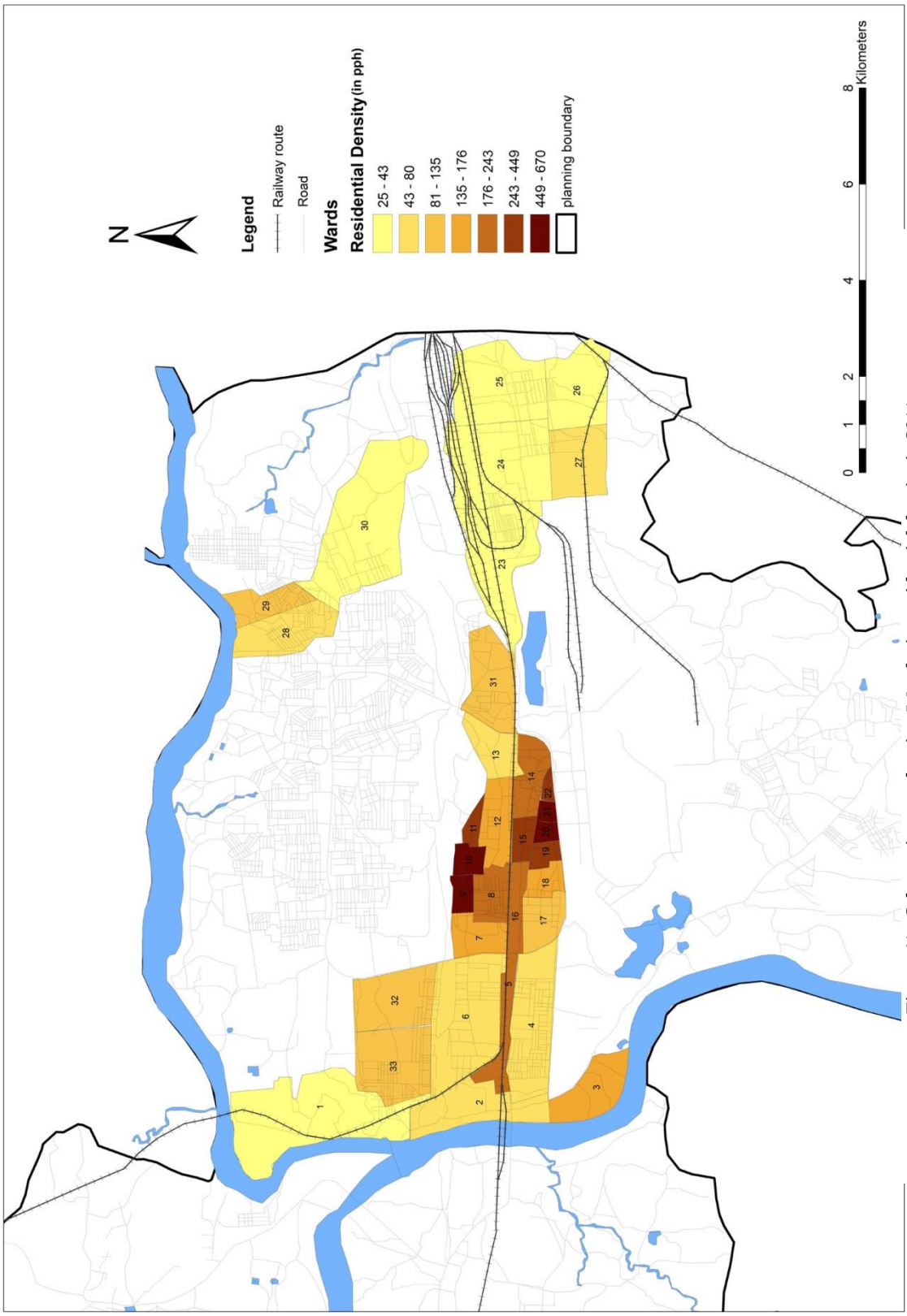


Figure 41 - Schematic map showing Ward wise residential density in 2011

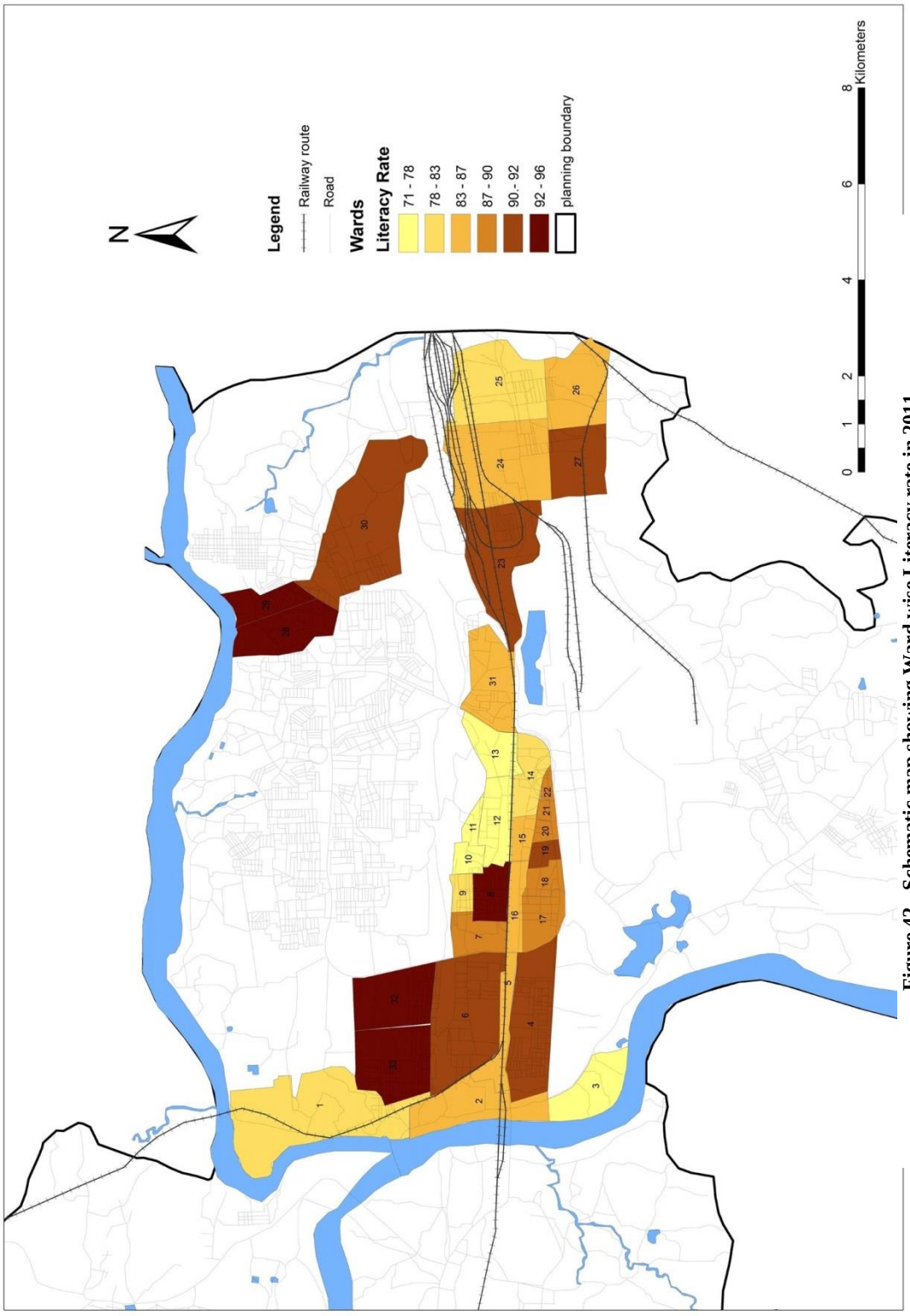


Figure 42 - Schematic map showing Ward wise Literacy rate in 2011

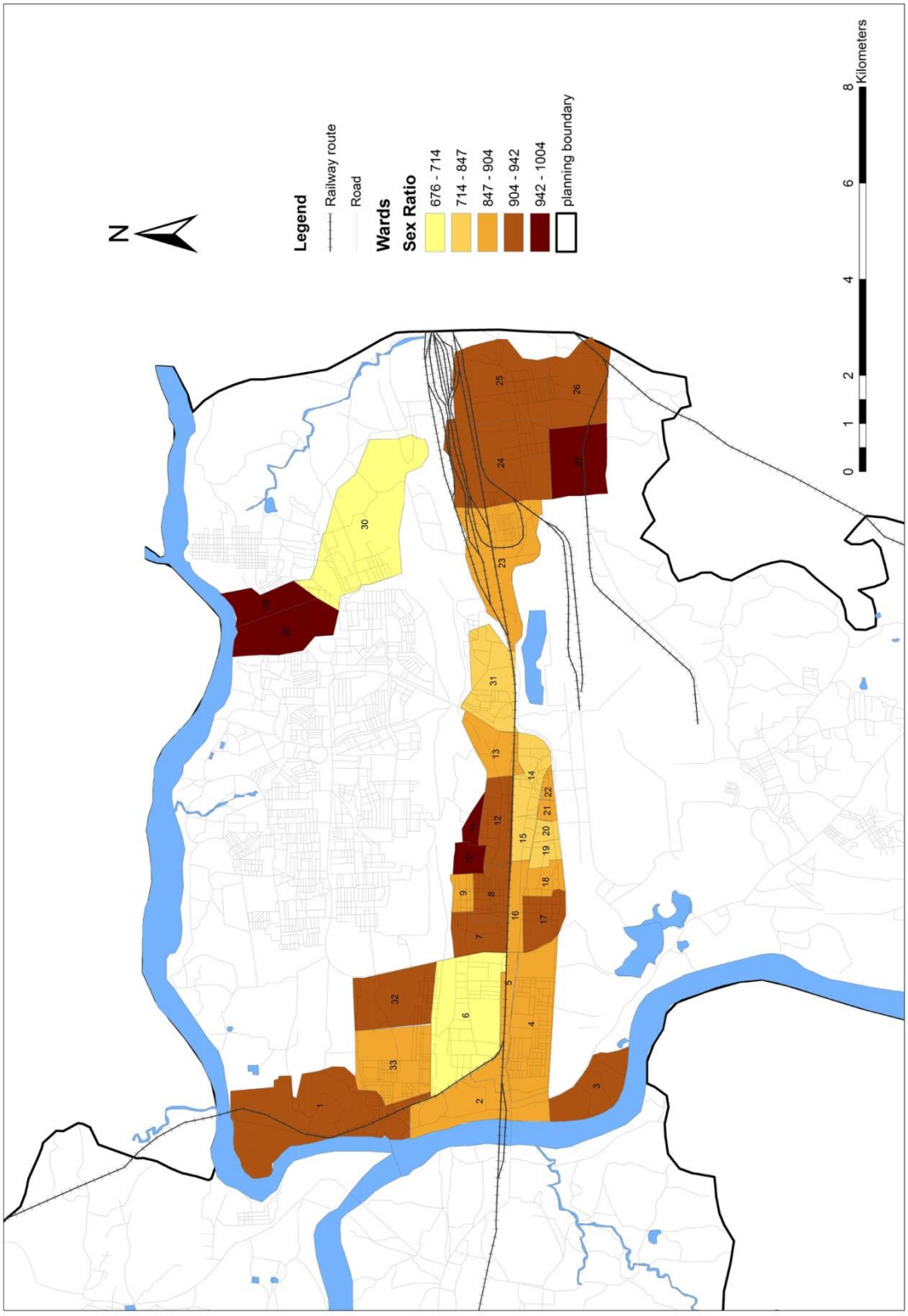


Figure 43 - Schematic map showing Ward wise Sex Ratio in 2011

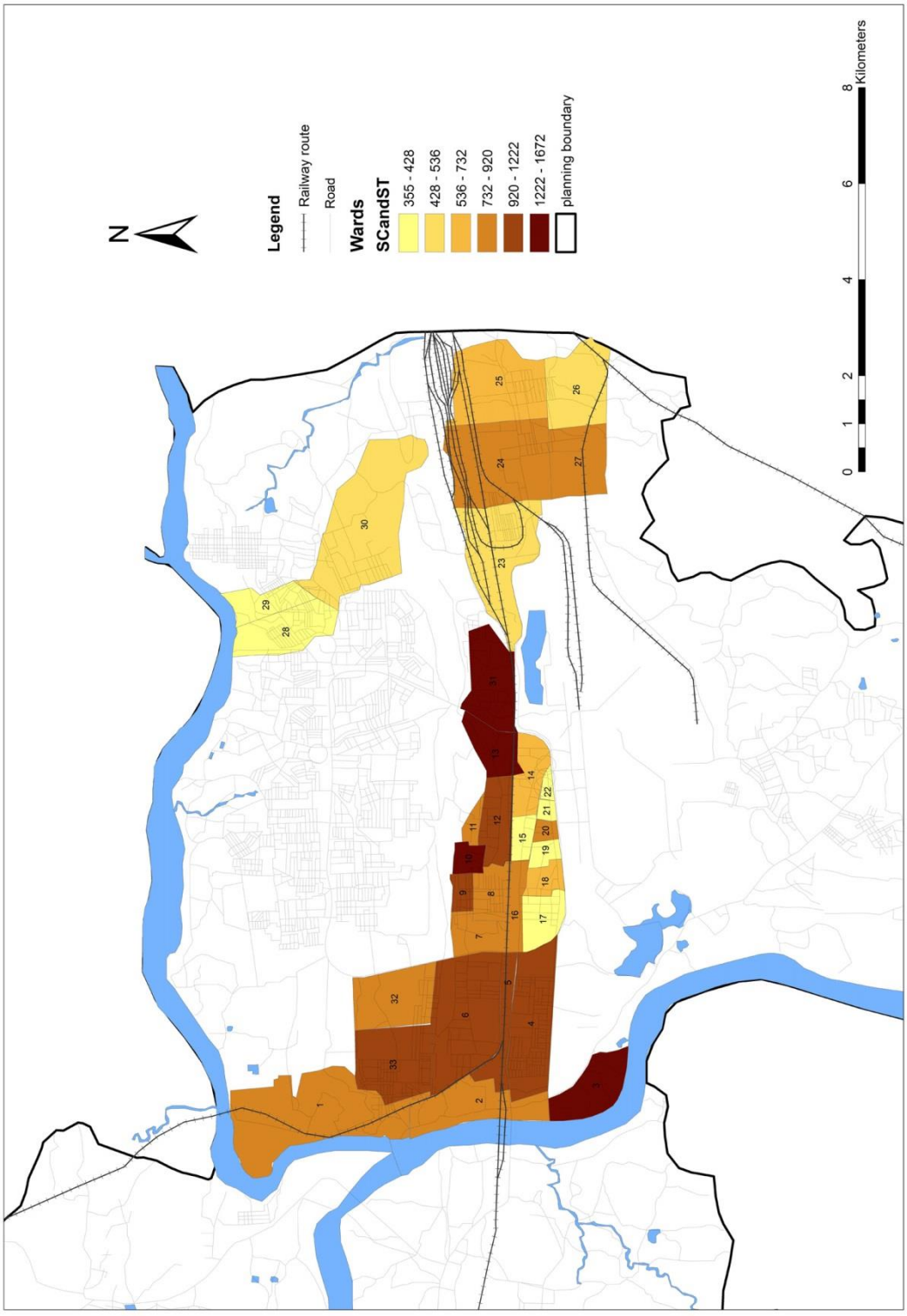


Figure 44 - Schematic map showing Ward wise SC & ST Population in 2011

5.3. Socio-Economic Condition

5.3.1. Slums

Figure below shows the ward wise area and population of slums in Rourkela Town. When it is further superimposed with the Ward map of the study area, it can be seen that Ward 1 has the highest population in slums. Since it is a fringe area, much improvement needs to be done in this ward in terms of providing basic amenities.

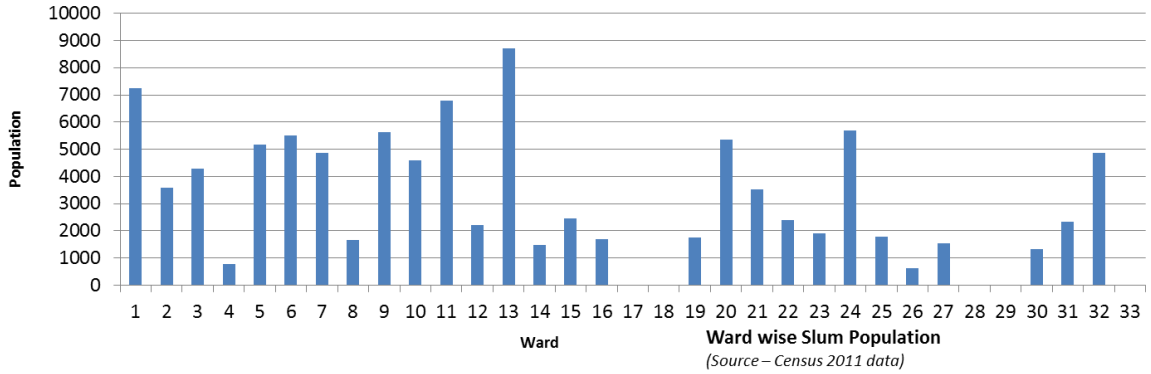
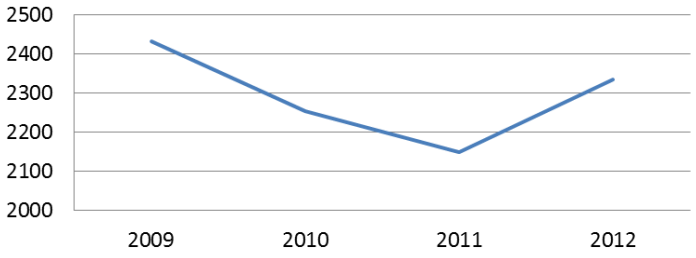


Figure 45 - Ward wise slum population in Rourkela

5.3.2. Crime Rate

Table alongside shows the number of criminal cases registered in Rourkela between 2009 and 2012. It can be seen that the number of crimes is relatively constant, even though the population is on the rise, thus indicating a decreasing crime rate per capita in the area. Some of the areas in the study area are prone to crimes due to non-existent or poor street lighting in the areas, thus making it dangerous for the public at night.



(Source: Office of Superintendent of Police, Rourkela)

Figure 46 - Number of crimes registered between 2009 and 2012

Rourkela is among the fastest growing towns in the country. It is the third largest town in the state of Odisha and also an important industrial hub. The town's economy is mainly driven by secondary sector and the industries contribute a lot to the revenue of the state. The economic base of Rourkela is based on the industrial estate grown there since 1958. Almost 75 to 80% of the population of the town is directly or indirectly dependent on the Rourkela Steel Plant

and its production for their livelihood. Besides the Rourkela Steel Plant, other industries of different scales have grown which are directly or indirectly dependent or related to the Rourkela Steel Plant.

5.3.3. Economic Sectors in Study Area

Primary Sector: The primary sector in the study area is limited to the agricultural areas in Bondamunda and Khadia Toli. Mining is the major primary sector activity in the region, but most of it lies outside the planning area.

Secondary Sector: The Secondary sector mainly includes industries (large, medium, small and micro scale industries of steel and iron) as well as household industries. Some other industries in the area are sponge iron, foundry products and machining and fabrication units.

Tertiary Sector: The tertiary sector mostly includes trade and commerce and other government and semi government institutions. The Tourism and Hospitality industry has a very good potential in the area and thus needs to be augmented.

5.3.4. Occupational Structure

Table below shows the distribution of workers during the year 2001 and 2011. There has been a marginal increase in the workforce participation rate which could be due to coming up of new industries like Adhunik Metalliks in the last decade.

Year	Total Population	Total Workers	Workforce Participation Rate	Main Workers	Marginal Workers	Non-Workers
2001	224987	64736	28.77 %	60198 (26.76%)	4538 (2.02%)	161786 (71.90%)
2011	273040	90666	33.20%	84028 (30.77%)	6638 (2.43%)	182055 (66.76%)

(Source – Census 2001 & 2011 data)

Table 6- Distribution of workers in Rourkela in 2001 and 2011

There was a gradual decline in the tertiary sector between 1961 and 2001 due to gradual saturation in the sector. The Secondary sector had shown a striking growth during 1971 and 1981 after a downfall between 1961 and 1971. The major economic activities still belong to secondary and tertiary sectors. However, significantly, the household industry is quite low

and hence needs to be developed to have a more positive effect on the economic base of the town in the long run.

5.3.5. Workforce Participation

Table below shows the ward wise distribution of main and marginal workers in the town. There is a very small population of marginal workers in the study area.

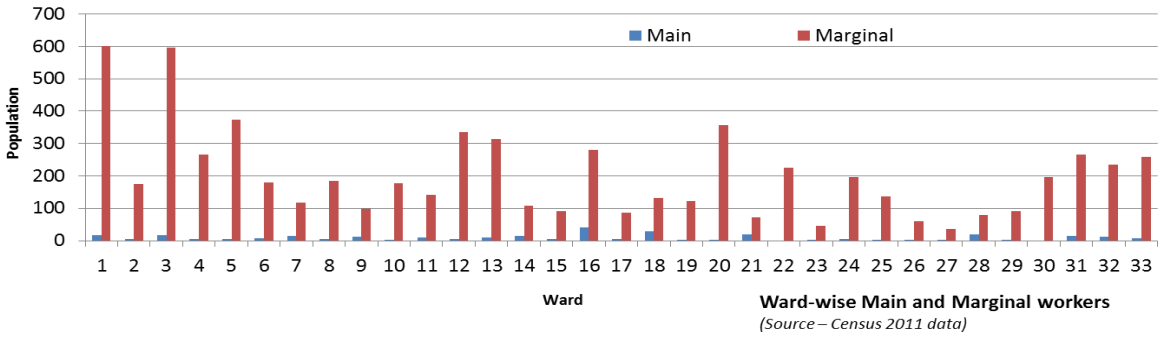


Figure 47 - Ward wise main and marginal workers in study area

The figure below shows the distribution of main and marginal workers in the study area. 84.29% of the workers in the area are male, which is the reason behind high unemployment rate in females. Also, it also shows that majority of the marginal workers are involved in the manufacturing sector.

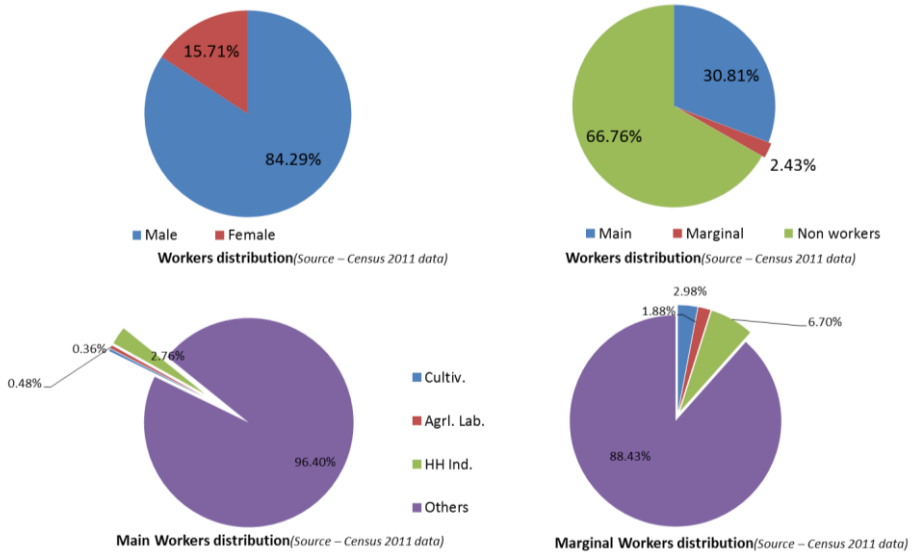


Figure 48 - Distribution of workers in 2011

5.3.6. Primary Sector

Agricultural activities in the study area are not very prominent. Mining is the major primary sector activity on which the industries in Rourkela are dependent. However, these activities lie mostly outside the Municipality or the Rourkela Development Authority area. Other primary sector activities like agriculture, livestock and forestry are mostly confined to the block areas in Bisra, Kuarmunda and Lathikata.

Minerals are the base of all industries in the region. Sundergarh is second among top six districts of Odisha state where mining activities are being undertaken. The major minerals found in Sundergarh district are limestone, dolomite, iron ore, coal, manganese and bauxite. There are a total of 63 mines around the study town at present.

5.3.7. Secondary Sector

Rourkela Metropolitan Area is also known as the industrial capital of Odisha state. Steel and allied sector are the predominant industries in Sundergarh district due to availability of the required minerals and coal in the district. The employment generated in small scale industries is almost two times that in Medium and Large Scale Industries together. On the contrary, the investment in small scale industries is just 5 % of that of the other two categories.

Large Scale Industries

Rourkela Steel Plant is the largest employer in Rourkela, and it contributes to almost 92% of employment generation by large industries in Rourkela Metropolitan Area. The migrant population in all large scale industries is around 11 % overall, and is 15 % in the Rourkela Steel Plant.

Medium Scale Industries

Majority of the medium scale industries in Rourkela are Iron and Steel industries. There are currently nine sponge iron industries out of which seven are functional. Also, other Medium Scale Industries include an Industrial Gases industry, one Iron-ore crusher and one transport industry. Majority of the medium scale industries are outside the study area yet have a great impact on the study area since they provide employment in the private sector.

Small Scale Industries

There are currently 1715 registered Small Scale Industries in Rourkela out of which 1235 are working. Majority of the small scale industries are Engineering and Metal based as well as Repairing and servicing industries followed by Miscellaneous Manufacturing, which is an indication of importance of steel and Rourkela Steel Plant's production levels on the overall economy of the town. Figure 49 shows the distribution of Small Scale Industries in the region.

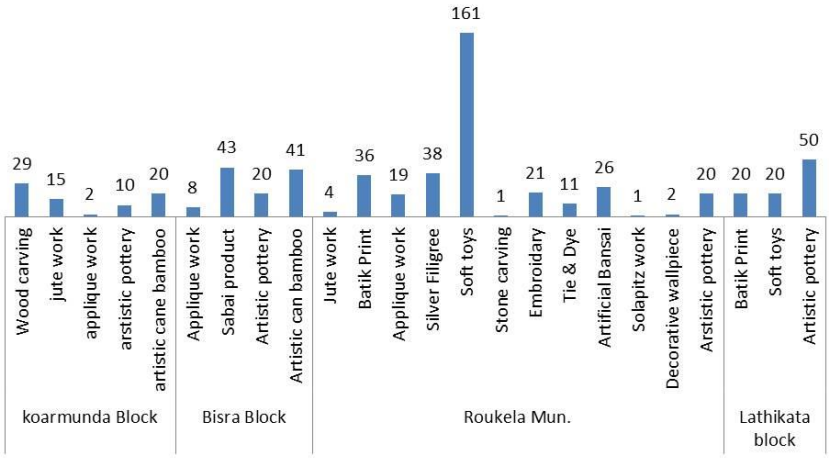


Figure 49 - Distribution of Small Scale Industries in Rourkela

In addition to the above, there are many Household Industries operational in the study area. Majority of them are soft toys followed by silver filigree. There is still a huge scope for development of Household Industries in Rourkela Town. It would lead to more employment opportunities in the semi-urban and rural areas in the town outskirts.

Future Growth

There is a proposed industrial corridor connecting Rourkela and Choudhwar industrial belts. It is expected to pass through the industrial hubs and coal mines along with new industrial areas and downstream industries in the region. The corridor would be 163 km of railway track length and 465 km on road. It is expected to solve the problem of inward and outward transportation of goods and minerals.

5.3.8. Trade and Commerce

Rourkela is a major urban center and commercial node in Sundergarh district. The major urban activities of trade and commerce in the entire town are mainly concentrated in Daily Market Stretch located at the heart of the town. Although there are other commercial markets in the Steel Township, but none possesses the same momentum and hierarchy as the Daily Market Area.

The map below shows the location of commercial nodes in Rourkela metropolitan Area. The Daily Market area and Ispat Market are the oldest as well as the two largest markets in the town. Most of the study area is covered adequately in terms of presence of commercial areas.

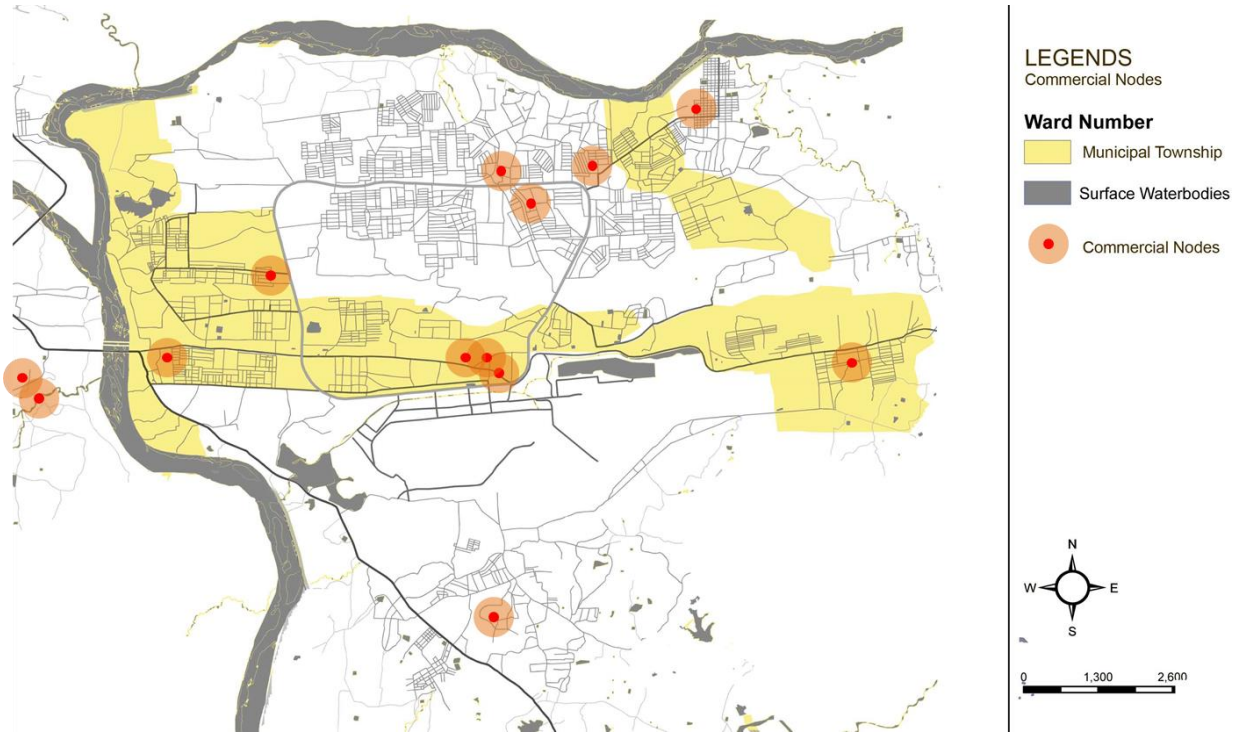


Figure 50 - Map showing major Commercial nodes in the region

It is observed that the ratio of shops and population served is higher than requirements as per UDPFI guidelines. There is an excess in number of shops which affects the market economy. At the same time, the maximum distance travelled for daily needs is quite low. This aspect can be kept in mind while developing road infrastructure in these areas where the roads can be made pedestrian and bicycle friendly in the long run.

Daily Market Stretch

The Daily Market Stretch supplies goods to almost all major markets in the town. The area is very important for the economy of the town as a whole. The stretch has predominantly mixed land use on both sides of the road with commercial activities in the ground and first floor throughout. Total employment generation of the 789 meters stretch is approximately calculated as 2500, and the total monthly turn over (including Sabzi Mandi) is around INR 39 crore. The entire market area is maintained by the Rourkela Development Authority.

Major issues in the Daily Market Stretch are as follows:

- Encroachment on sidewalks by informal shops
- Improper drainage
- Insufficient parking space(problem of on-street parking which is leading to congestion)
- Unavailability of loading-unloading area
- No separate freight corridor
- Inadequate sanitation facilities
- Lack of proper water supply facilities

Traffic Chowk Market

The Traffic Chowk Market is one of the busiest areas in the study area. Due to its proximity to the Ring Road and entrance located on the Traffic Chowk, it causes huge traffic jams on the Ring Road especially during peak hours. Although it is one of many significant locations commercially, yet it is plagued by various issues over the last two decades.

Major issues in Traffic Chowk Market are as follows:

- Unavailability of parking spaces
- Traffic Chaos during peak hours
- Huge number of informal shops which are not properly maintained
- Absence of proper drainage and sanitation facilities
- Inadequate water supply facilities

A comparative analysis of markets in the Steel Township and Municipal Town under ten parameters shows that the conditions of Ispat Market and Sector-5 Market in terms of infrastructure and parking availability is better than in the study area. It is essential to take adequate measures to improve infrastructure in the markets in the study area and at the same time take necessary steps to reduce congestion.

5.3.9. Tourism

Apart from being an industrial hub, the town is also full of religious and natural scenic beauty. The district of Sundergarh, by virtue of having thirty-six percent of land as forest land is rich in many tourist sports. Some of the important and most visited tourist destinations in

and around the study area are shown in the map below. Table below shows the number of tourists identified in the tourist centers in Sundergarh district between 2008 and 2010. It shows that most of the tourists in the town are local people, while only a minority is foreign tourists. One of the main issues is lack of adequate accommodation facilities available in the town for tourists from outside the town and state. Although the number of tourists has nearly doubled between 2008 and 2010, yet it is essential to upgrade the facilities available to ensure more inflow of foreign tourists in order to improve the tourism industry.

S. no	Name of the tourist centre	Distance from Rourkela	2008			2009			2010		
			Domestic	Foreign	Total	Domestic	Foreign	Total	Domestic	Foreign	Total
1	Rourkela	0	336824	583	337407	543012	625	543637	553872	601	554473
2	Vedavyas	9	432420	0	432420	445392	0	445392	454299	0	454299
3	Khandadhar	104	197480	0	197480	203404	0	203404	209510	0	209510
4	Ghogar	27	186900	0	186900	192507	0	192507	198764	0	198764
5	Mandira dam	32	121600	0	121600	125248	0	125248	127753	0	127753
6	Darjeeing	58	72440	0	72440	74613	0	74613	76105	0	76105
7	Deodhara	56	58300	0	58300	60049	0	60049	61250	0	61250
8	Sundargarh	107	53223	0	53223	54819	0	54819	55915	0	55915
9	Junagarh	173	41735	0	41735	42987	0	42987	43846	0	43846
10	Miriglotah	111	40315	0	40315	41524	0	41524	42394	0	42394
11	Ushakothi	154	21221	0	21221	21857	0	21857	22294	0	22294
12	Chhatri hill	92	20680	0	20680	21300	0	21300	21726	0	21726

Table 7 - Number of tourists between 2008 and 2010

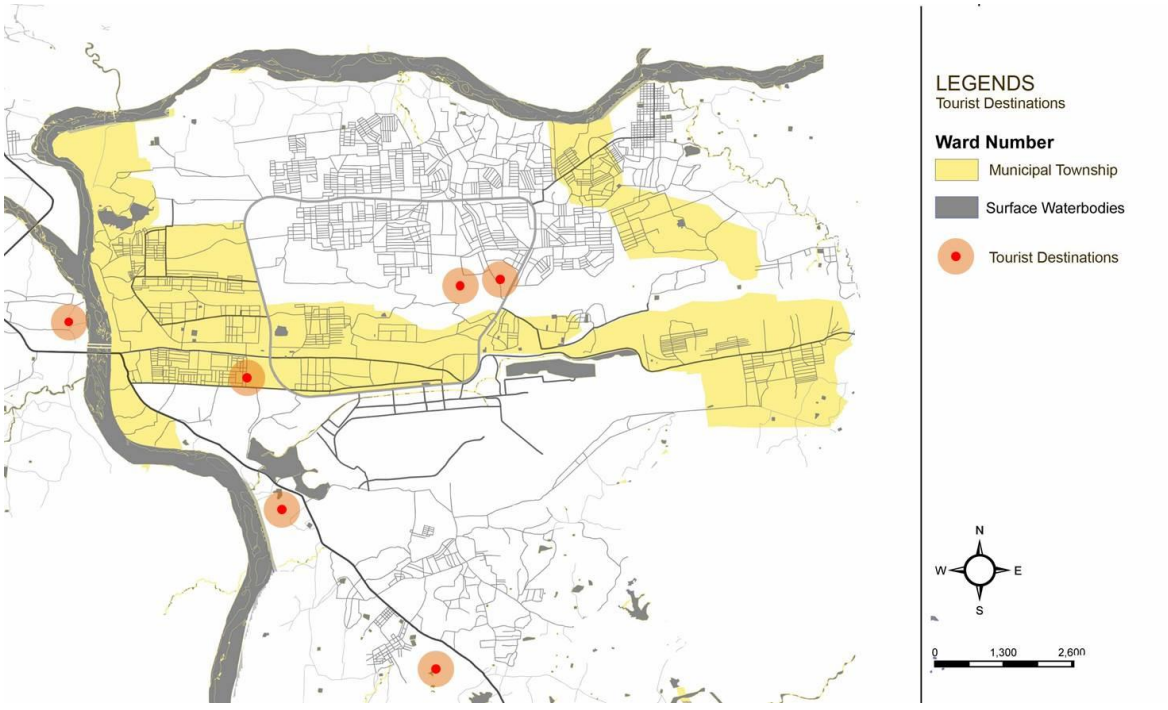


Figure 51 - Map showing major tourist attractions in the region

Accommodation Units

Table below shows the number of hostels and number of beds in the town between 2009 and 2011. It can be seen that the number has not changed while the number of tourists has increased rapidly in this period. Also, the average occupancy level has been steady in this period. It is really necessary to increase the number of rooms in the town.

	2010			2011			2012		
	No. Of Hotels	No. Of Rooms	No. Of Beds	No. Of Hotels	No. Of Hotels	No. Of Beds	No. Of Hotels	No. Of Hotels	No. Of Beds
Rourkela	47	1283	2302	47	1283	2302	47	1283	2302

Table 9 - Number of beds in the town between 2010 to 2012

It was observed that majority of the tourists in hotels are families. A satisfaction level analysis was done during the household survey regarding the most preferable destination in the town as well as level of service for tourists in the town. It shows that Hanuman Vatika is the most preferred visiting location of the residents. Also, only 37% of the visitors are satisfied with the quality of service at tourist centers, which is an obvious cause for concern and needs augmentation. The table alongside shows a SWOT Analysis of three major tourist destinations in and around the town.

	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Hanuman Vatika	1. Spiritual Value 2. Frequently visited by residents 3. Locational advantage	1. Lack of parking space 2. Congestion 3.Cleanliness issues	1. Lot of economy generation 2. Existing area has scope for improvement	1. Lack of vision 2. Increased congestion
Vedavyas	1. Spiritual Value 2. Frequently visited by residents 3.Locational advantage	1. Absence of food stalls 2. Discomfort due to proximity to cremation facility	1. Riverfront development as town grows beyond river Brahmani	1. Congestion during festival season 2. Safety issues at night
Vaishno Devi Temple	1. Well maintained 2. Good view of Rourkela town from hill top(good location)	1. Lack of public transport connecting to the site 2. No defined parking space 3.No public amenities	1. More eateries 2. Better landscaping	1. Safety(lack of railings) 2. Overcrowding during specific worshipping days

Table 8 - SWOT Analysis of major tourist locations

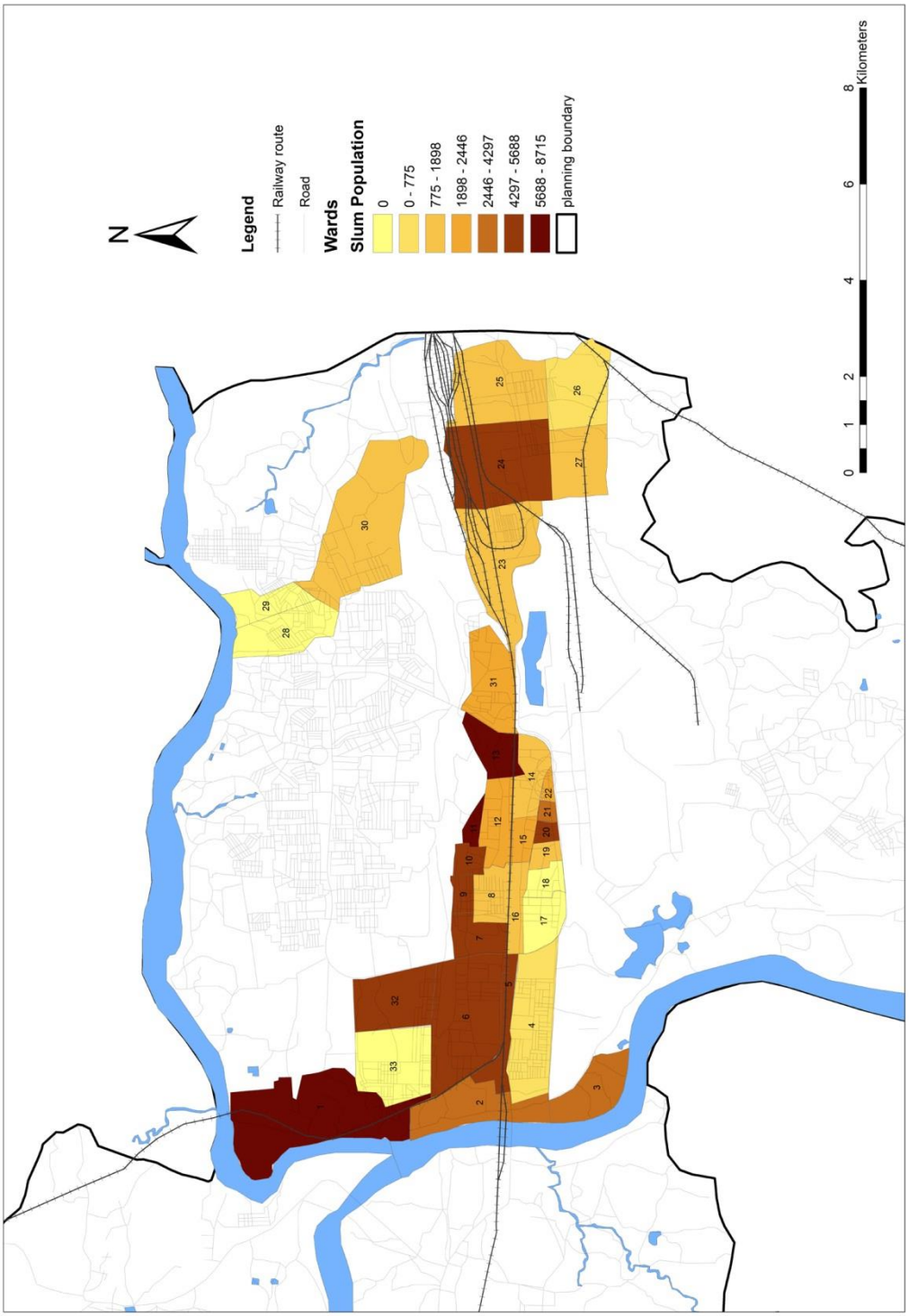


Figure 52 - Map showing ward wise slum population in study area

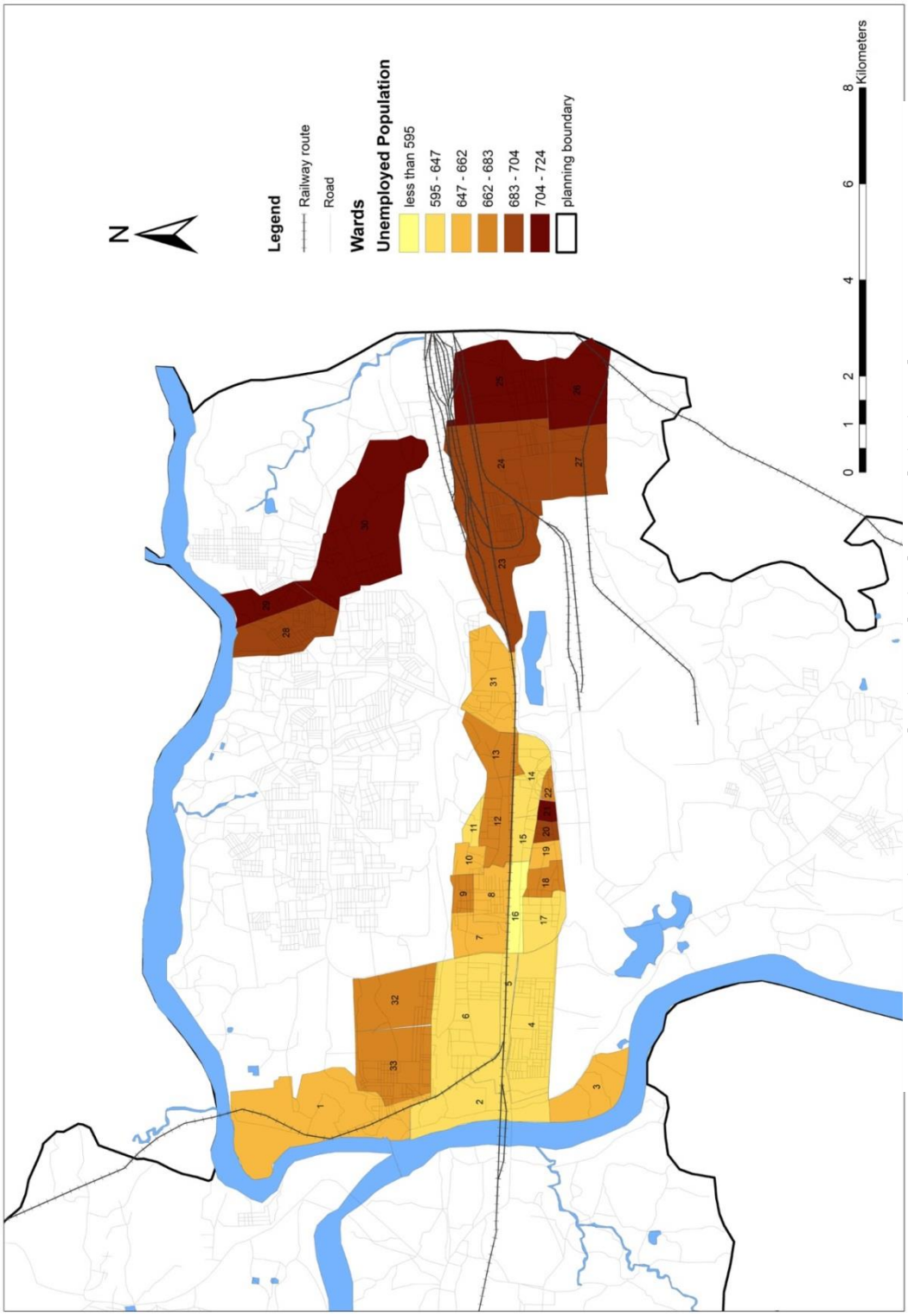


Figure 53 - Map showing ward wise slum population in study area

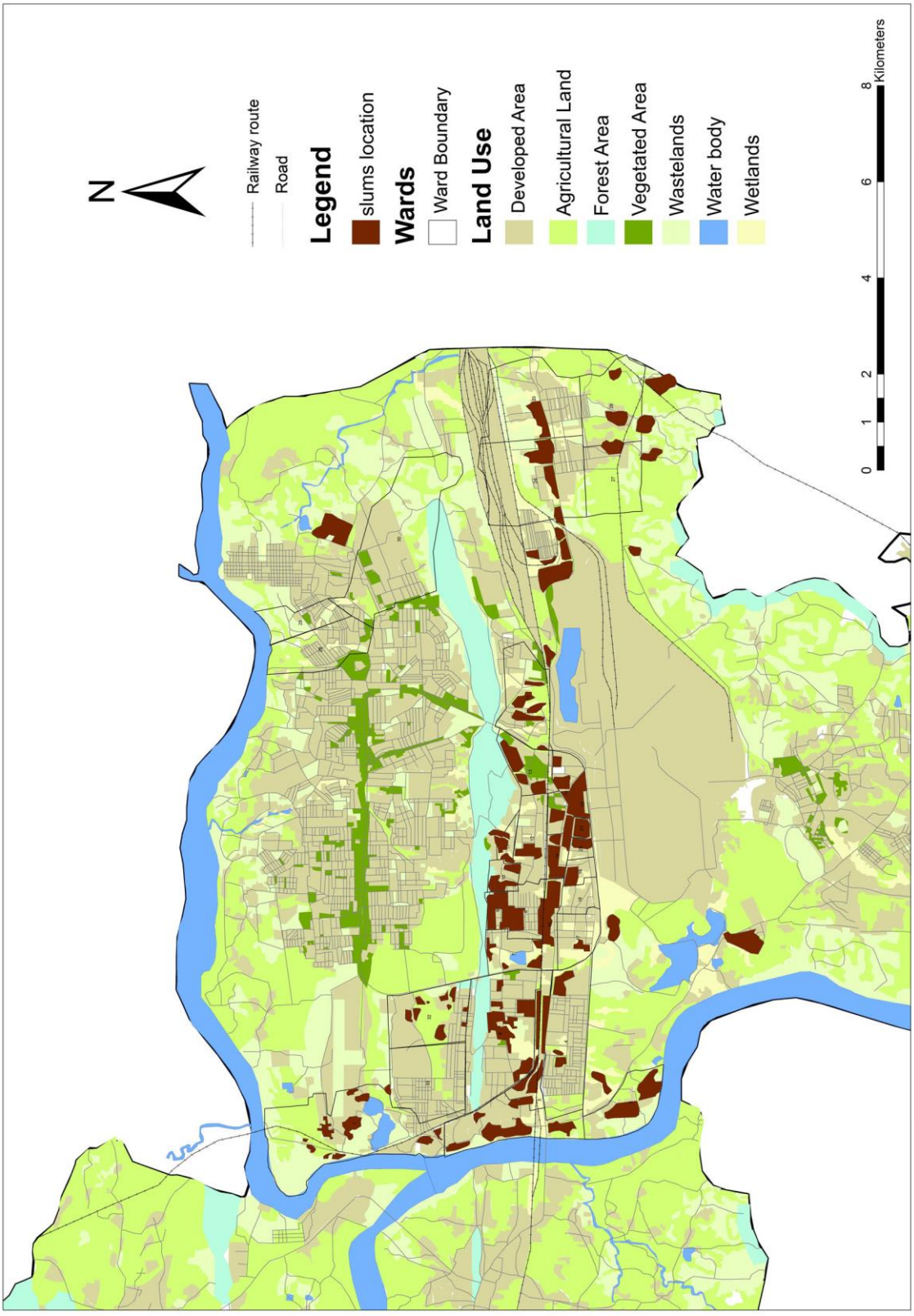


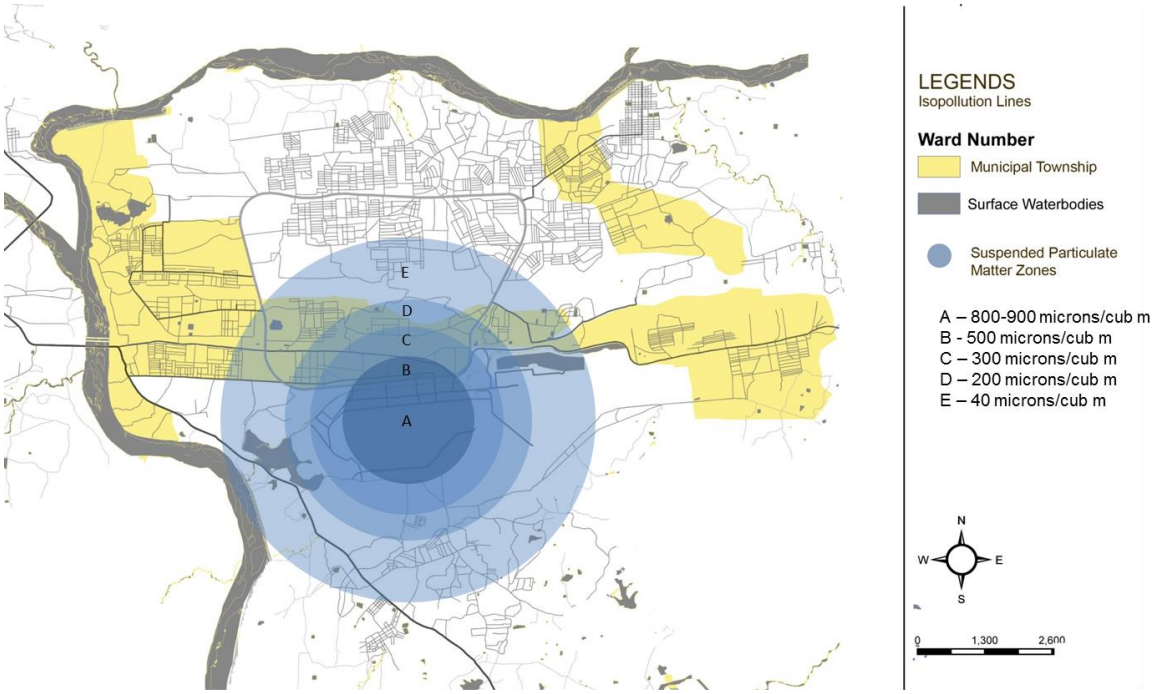
Figure 54 - Map showing location of slums in study area

5.4. Environment

This section focuses on the impact of pollution in various forms on the environmental functions of the town. One of many imperatives of industrialization is contamination of soil, water, air as well as noise which is obviously a major source of concern in the long run for the benefit of the population. In the study area, rapid urbanization in the areas which are prone to multiple forms of pollution (due to proximity to the Rourkela Steel Plant) in the recent years has resulted in deterioration in the "quality, beauty as well as healing capacity of the environment" in the town(Dara, P.K, Singh, D.K., & Rout, 1997).

5.4.1. Air Quality

The major contributor to air pollution in the town is the Rourkela Steel Plant. In the Rourkela Steel Plant, some of the pollutants in general are dust particles such as CO_2, SO_2, NH_3, NO, H_2S, HCN, noxious gases, fumes, anthracene vapours, mercury from instruments, heat

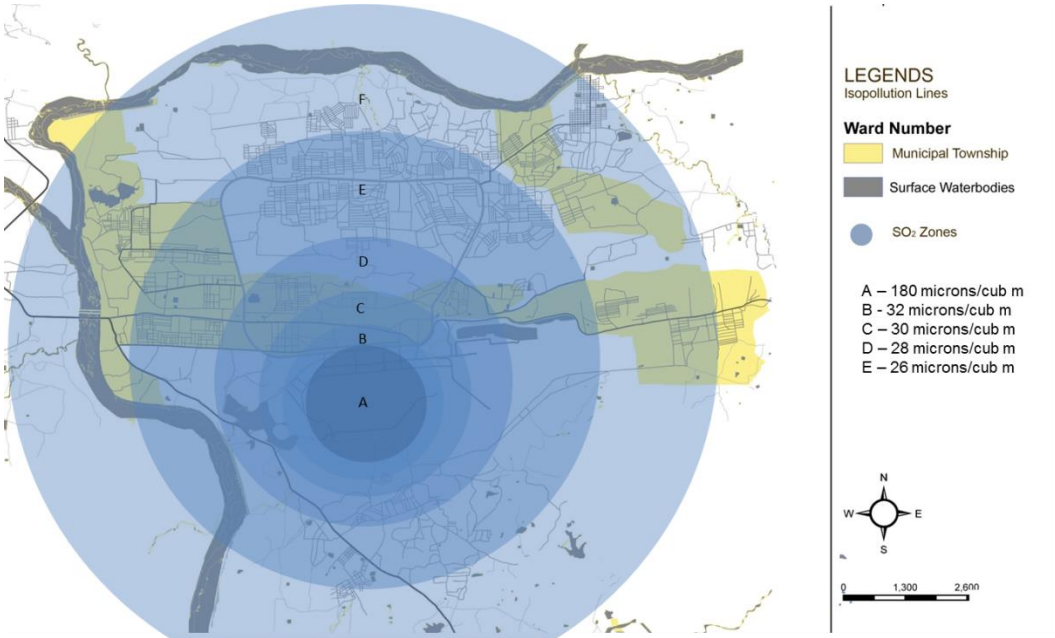


Particulate Matter Isopollution lines in Rourkela(redrawn by author)
.(Source : Kara, Singh & Rout, 1997)

Figure 55 - Particulate Matter Isopollution lines in Rourkela (Source :Dara et al, 1997)

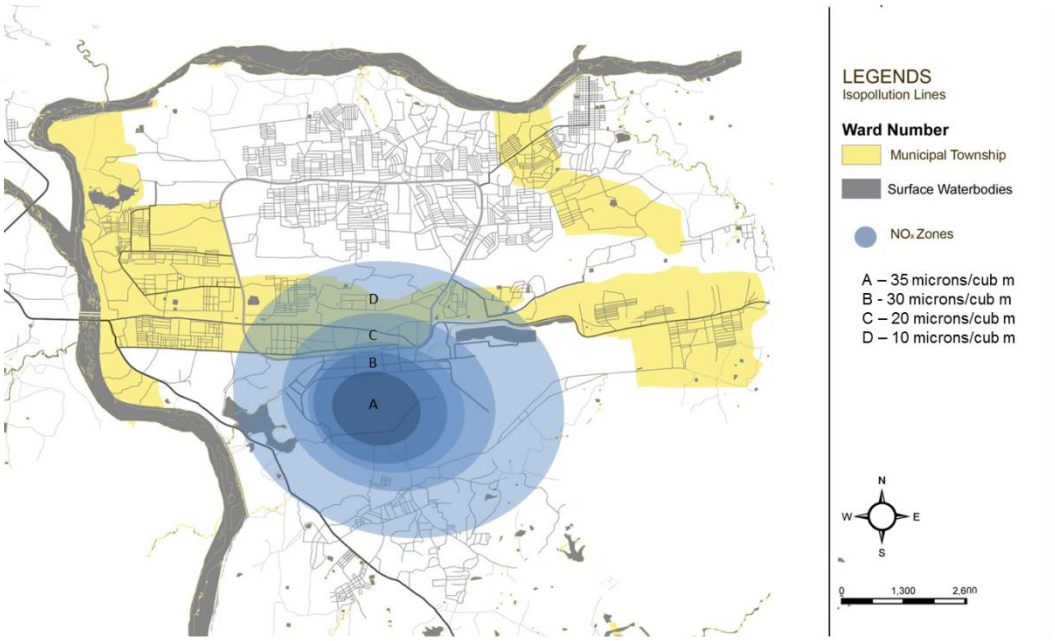
radiation, noise etc., A detailed chemical analysis of the skyline over the Rourkela Metropolitan Area suggests that "the natural atmospheric condition over the town has

undergone various changes just after the physical setting was distorted for installation of the giant steel plant… … The skyline has become multi-colored due to the emissions of various



SO_2 Isopollution lines in Rourkela(redrawn by author)
.(Source : Kara, Singh & Rout, 1997)

Figure 56 - SO2 Isopollution lines in Rourkela



NO_x Isopollution lines in Rourkela(redrawn by author)
.(Source : Kara, Singh & Rout, 1997)

Figure 57 - NOx Isopollution lines in Rourkela

coloured smokes and suspended particles hanging over Rourkela Town. The thicker troposphere has again been divided by another distinct denser layer at the bottom of it because of these heavier floating materials which are unevenly distributed over this area."(Dara, P.K, Singh, D.K., & Rout, 1997). The study reveals that the SPM, NO_x and SO_x are not found distributed in equal proportions to the distance from the center taken from study. Figure 55 shows various isopollution lines drawn on the map in the form of concentric rings showing the distribution of SPM ranging from 40 to 500 microns/m^3. The suspended particles are found in very low intensity in the north of Durgapur hills, indicating that the hills have been protective of the Steel Township as well as many other residential colonies in the study area.

Fig. 56 shows isopollution lines drawn showing distribution of SO_2 over the town. The map clearly shows that the existence of the Durgapur hills gives very little protection to the residential areas from the invisible SO_2. The study also reveals that there is an abrupt fall in the intensity as one moves away from the Steel Plant. Yet this is a strong case of concern that the health hazards are still of a great degree which have a potential to cause bronchial diseases. Fig. 57 shows the isopollution lines drawn showing distribution of NO_2 over the town. The map shows a different pattern of zoning which is quite different from the other two. It shows that the emissions of NO_x is found in higher quantity in the Steel Plant Area(especially in Fertilizer Plant and Coke Oven Plant located in the South East sector of the Plant Area). But the effect is not seen having much effect over 5 km. from the core i.e. in the residential areas.

A joint report of WHO and UNEP, "Air Pollution in Megacities of Asia, 2002", studied air pollution levels in many large, medium and small Asian cities including Rourkela, and suggests that since 1990 the pollution levels in Rourkela has been increasing

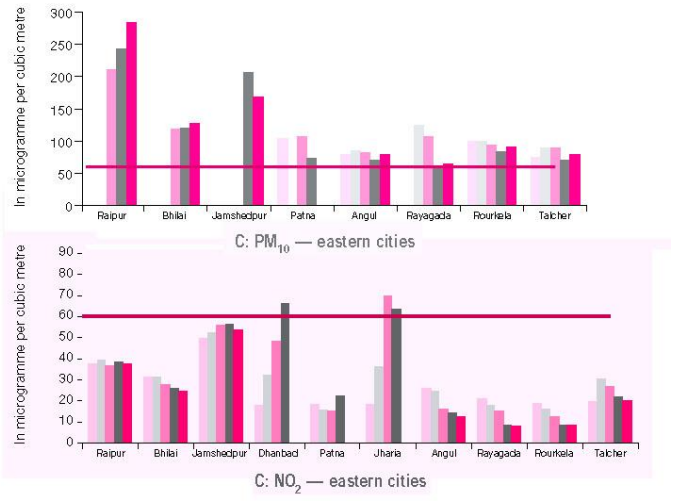


Figure 58 - Air pollution in various Indian cities(Source: WHO and UNEP Report, 2002

rapidly(Chatterton, 2006).

Figure 59 show that the PM levels in Rourkela was well above standards prescribed by Central Pollution Control Board, New Delhi, while the NO2 levels was well within the standards.(Chatterton, 2006)

5.4.2. Noise

Due to rapid industrial growth of Rourkela Metropolitan area, the transportation sector has grown rapidly in the last decade. "The number of vehicles on roads is increasing at a faster rate from 14,226 registered in 2007 to 18,269 in 2011(Goswami, Swain, & Panda, 2013).Due to rapid urbanization, the road traffic noise causes annoyance, damage hearing and pose a wide range of negative effects on the health in urban areas(Goswami et al., 2013).Traffic noise has been recently quite an immidiate concern in the study area. Three noise indicators, TNI(Traffic Noise Index), NPL(Noise Pollution Level) and NC(Noise Climate) data calculated in twelve different squares of the town during specified timings(7-10am, 11am-2pm, 3-6pm, 7-10pm, 10pm-midnight and 4-6 am)is shown below. The results show that "the average noise levels ranged from 68.5 dB to 120.3 dB at day time and 45.5 to 102.8 dB at night time. Even the minimum TNI value was 103 dB." This shows that the values of NPL and TNI clearly exceed the permissible limit of traffic noise of WHO of 70 dB for day time

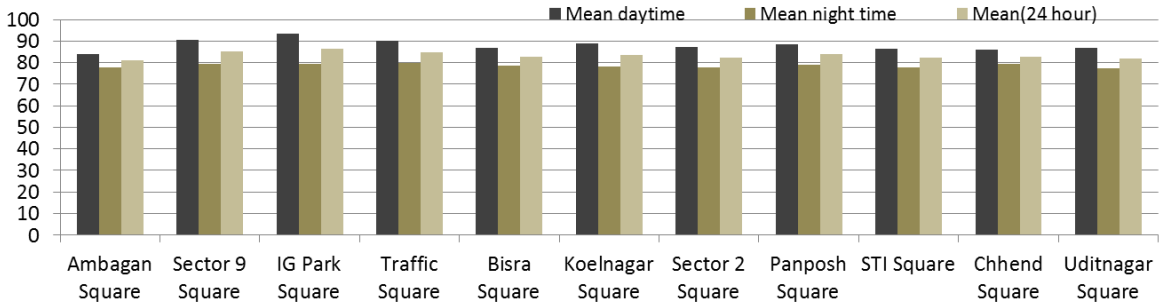


Figure 59 - Noise levels(in dB) in various squares in Rourkela(Source: Goswami et al, 2013)

and 55 dB for night time. The noise levels at various squares do not differ significantly during the peak hours(7-10pm) which suggests that there is high noise pollution throughout day and night in and around the study area.(Goswami et al., 2013)

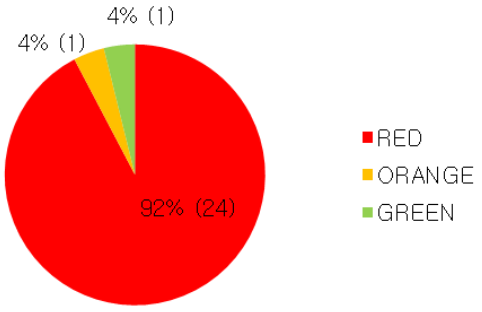
Some of the reasons for the present alarming state of high noise levels could be:

1. Absence of a proper public transport system, which forces increase in vehicular growth in the town.

2. Lack of synchronised traffic signals, which is currently leading to unnecessary honking by vehicles on road.
3. Traffic congestion in commercial areas which can be linked with inadequate road infrastructure.

It is obvious that with further increase in population in Rourkela Town coupled with industrial and vehicular growth, the noise levels would increase faster making it a potential threat in the future. It is essential that significant and timely steps are taken to control the noise levels in the town.

5.4.3. Water Pollution



Polluting industries distribution
(Source : Forest and environment department order, 2007)

Figure 60 - Polluting industries distribution in Rourkela(Source : Forest and Environment Department order, 2007)

As per a report by the Forest Department of Odisha State in 2007, Rourkela Steel Plant, IDL Chemicals in Sonaparbat, Fertilizer Plant of SAIL as well as the Steel Township are under the category of grossly polluting bodies.The Guragini Nullah is the main effluent carrying drainage of the steelplant which discharges the same to Brahmani river. The natural gullies and nullahs of the Brahmani basin have been diverted and converted into the drainage carrying the effluents and wastes of the town along with the discharge of rainwater to river Brahmani.

A study by Forest and Environment Department, Odisha reveals that 92% of large and medium scale industried fall in the red or highly polluting category. Figure 60 shows that majority of the small scale industries are in the green category. After the development of RSP within a relatively short period of time, there existed forty quarrying pits in and around the town which after being left unused in recent years have been filled with water and hence pose environmental threat to the increasing residential colonies around them. Some of these are dangerous sites prone to accidents since they have been abandoned without any fences for safety. Figure below shows location of such abandoned mines and quarries.

Although the quality of water of Koel River is mildly polluted(Pradhan, 2010), yet it is observed that due to increase in coal-based industries in the area, urgent attention is needed

for treatment of liquid effluents from these industries before they are discharged into the fresh water streams as well as the rivers Koel and Brahmani.

The Steel Township has its own sewage network and a treatment plant, while the Municipal Township does not have a proper sewage network presently. Discharges from septik tanks are mostly into open drains which are carried into open lands and water bodies in the study area. This is turn affects the water bodies and the urban environment. It is seen that majority of the slum pockets are close to water bodies in the study area. If this practice of water pollution is continued in the water bodies, it can have an adverse impact on the health and quality of life of the slum dwellers as well as residents close to such area.

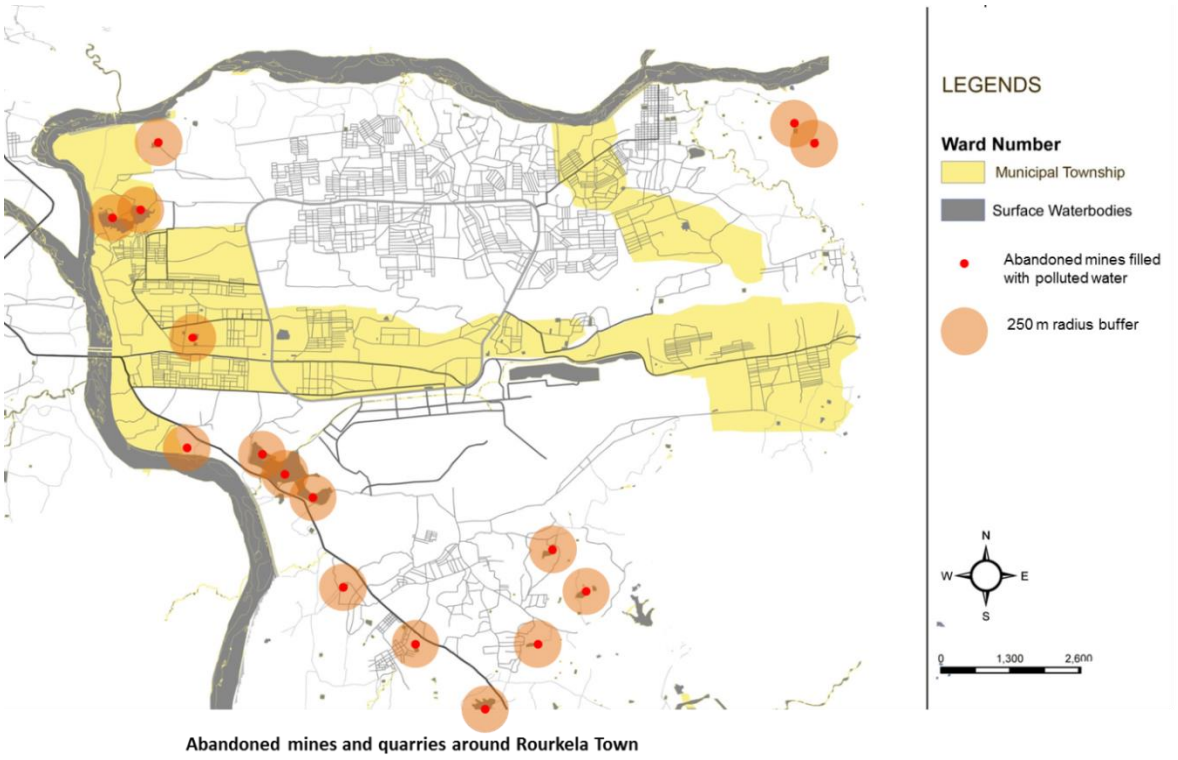


Figure 61 - Location of abandoned mines and quarries in and around study area

5.4.4. Urban Environment

The pollution of the environment in air, water and noise have contributed much to the degradation of the urban environment in the town. In addition to all these, the dumping of slag deposits from the steel plant has created an artificial elevated land which rises amongst the green fields. The whole dumping yard site looks like a dark and grey coloured hillock

which spreads over quite a large area. This affects the visual appearance of the urban environment as well as can be a matter of concern in the long run.

There needs a great deal left to be done in proper management of Solid Waste in the study area. Although some wards have a proper management in place, this attribute is missing in other wards. At the same time, waste from households is sometimes dumped into open plots or sometimes on road sides, thus affecting the environment.

- Some of the issues with respect to the study area are:
- Dumping of waste on road sides
- Lack of maintained green areas(although open spaces are earmarked in areas like Chhend Colony, Basanti Colony etc. yet the quality of open spaces has immense scope for maintainance and augmentation.
- Lack of proper sewage management scheme
- Decision making without public involvement(recently the Municipaliaty earmarked an open area near river Brahmani and started to dump the Municipal waste there, but it had to stop after the residents of nearby areas like Balughat complained against it. This shows that the decision making in the Municipality did not take into consideration the view of the residents.

5.5. Ecology

After the establishment of the industries in the town, the region has undergone several changes with respect to topography, environmental quality, drainage system and skyline. When the steel plant was constructed, the "undulating rugged land was bulldozed and made artificial plain area to allow the installation of the heavy German machines"(Dara, P.K, Singh, D.K., & Rout, 1997). Since the area was rich in minerals, forty number of mines and another forty quarries were opened to exploit the available rsources as well as to accommodate building materials for construction purposes. Huge forest lands were cut off which caused irrepairable damage to the biosphere(Dara, P.K, Singh, D.K., & Rout, 1997). As a result of this, the hills in the region bore only open scrub vegetation instead of dense jungles. Over the years with increase in population and establishment of residential areas near these quarrying and mining sites, they have now been abandoned. Yet, they have left behind deep gorges which have been filled with water over the years. The previously mining site at Raghunathpalli has been abandoned due to residential development near it. It is now used as a dumping site for municipal waste.

There have been very studies regarding the ecological impacts of industrialization and urbanization in Rourkela Town. This is alarming considering heavy impact of industrial areas on the physical, socio-economic and environmental aspects in the town in the last few decades. This section explores new opportunities for ecological studies in the town through qualitative assessment of urban-rural gradients.

5.5.1. Urban-Rural Gradients Approach

The gradient paradigm provides a useful tool for ecological studies in an urban system.(McDonnell, M.J.&Pickett, 1990). Urbanization in the town has been characterized by "increase in human habitation, coupled with increased per capita energy consumption and extensive modification of the landscape, creating a system that does not depend principally on local natural resources to persist."(McDonnell, M.J.&Pickett, 1990). From an ecological point of view, these aspects are related to formation of urban-rural gradients in the town. As an ecological concept, an urban-rural gradient is "an ordering of sites based on the predominance of building and infrastructure, coupled with dense human populationm in contrast with sites having sparse infrastructure and low human population density. Other criteria, such as some physical or biological environmental measurement, such as pollution,

or social contrasts such as dependence on agriculture or management of natural resources, can be used to contrast urban and rural sites"(BES, 2012)

The gradient paradigm offers a useful framework to test hypothesis on the impacts of urban development on ecological processes. These studies, however tend to simplify the actual urban structure into monocentric agglomerations characterized by concentric rings of development surrounding a dense core. The assumption of gradient analysis is that the overall urban exposure changes predictably with distance from the urban core.(Alberti, M, Eric, B & Cohen, 2001).

The qualitative assessment involves various parameters such as population growth, increased pollution levels, high infrastructure etc deciding the urban-rural gradients in the study area. Other significant factors like species abundance and richness, carbon emissions per capita etc have not been considered due to unavailability of adequate data at local level. Fig. 62 further shows a spatial analysis of the above data showing the urban-rural gradients in the town. There is a significant relationship between pollution levels and green spaces in the area(areas with trees having higher canopies show lower levels of pollution and vice-versa), although further detailed studies need to be done in this regard.

5.5.2. Inferences

Although various authors have established a relationship between industrialization and urbanization trends in the town and environmental degradation and ecosystem imbalance, there have been very few studies which have tried to quantify the same. The various factors of urbanization and industrialization and "their biotic and environmental effects are each divisible into these realms – physical structure, biotic components and human culture(institutions)"(McDonnell, M.J.&Pickett, 1990). The conceptual qualitative study adopted above can serve as a framework for study considering the town as an ecosystem to create specific models to quantatively describe interactions between various variables in the ecosystem.

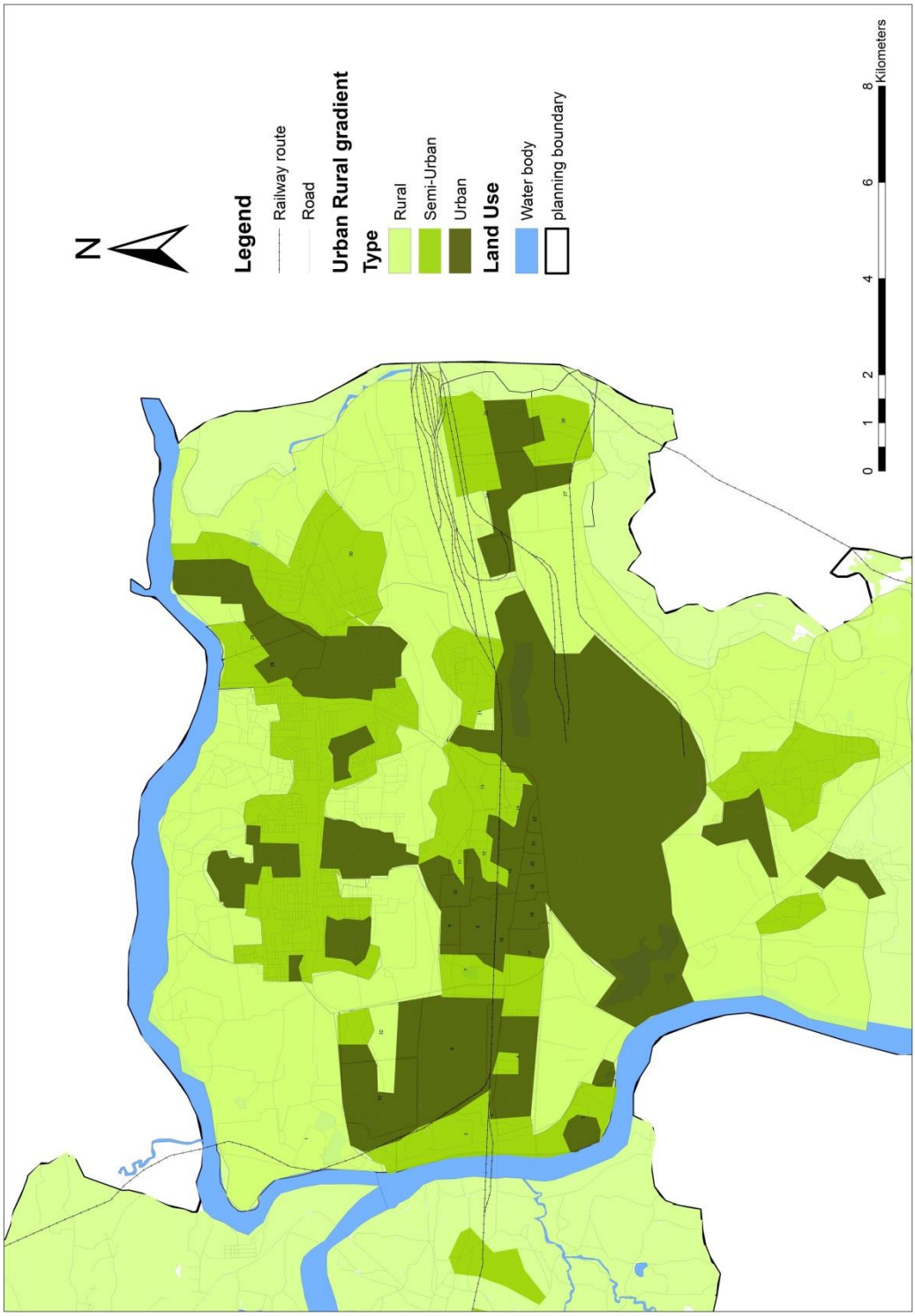


Figure 62 - Urban-Rural Gradient Map for Rourkela

5.6. Infrastructure

This section deals with documentation of the existing status of infrastructure in the study area. Also, it aims to analyse the gap between required levels of infrastructure as per UDPFI Guidelines and the current scenario.

5.6.1. Physical Infrastructure

The Rourkela Metropolitan area is the third largest town in the state of Odisha in terms of population and the second largest in terms of area. It is an industrial and educational hub, and has the highest per capita income in the state. Its role in the development of the state as well as contribution to national economy is undisputed. However there is a sharp distinction between the physical infrastructure levels in the Steel Township and the Municipal Area. A thorough investigation reveals that the Steel Township has proper mechanisms in place with respect to road infrastructure, water supply, sewerage treatment etc, while it is not so efficient in case of Municipal Town. With a steady increase in urbanization, especially in the Municipal Town, this could have adverse implications in the long run.

5.6.1.1.Water Supply

The water supply system in the town is primarily dependent on the rivers Koel and Brahmani. The Public Health Engineering Organization provides service to the town with respect to water supply. The town recieves two hours and forty five minutes water supply per day.Table alongside various indicators and benchmarks with respect to water supply service in the study area. There exists a huge gap between the benchmark set and the achieved levels of the Municipality in terms of coverage, continuity of supply, quality of water and extent of metering, although in terms of per capita supply of water(lpcd) and redressal of consumer complaints, the performance is much better. A mojor concern is that the physcial coverage of water supply is quite low(as against 630 km road length, the water network is available in about 220 km only, which is around 35 %). Also,

Performance Indicator	Benchmark	2009-10	2010-11	Target for 2011-12
Coverage (%)	100%	34.1	35.0	40
Per Capita Supply of Water (lcpd)	135	293	275	250
Extent of Metering (%)	100%	0	0	2
Extent of Non-Revenue Water (%)	15%	74.2	33.2	30
Continuity of Water Supply	24 X 7	2.9	2.8	2.8
Eff. In Redressal of Consumer Complaints (%)	80%	76.4	78.3	80
Quality of Water Supplied (%)	100%	23	21.5	30
Cost Recovery (%)	100%	23	21.5	30
Eff. In Collection of Water Charges (%)	90%	65,5	66.5	80

Table 10 - Indicators for water supply in study area

since there are no meters and users are charged at a flat rate, there is concern of wastage of water.

Treatment of Water

Figure 63 and Table 11show the locations and capacity of six treatment plants in the study area respectively. The total capacity of all plants conbined is 80.05 MLD. The Orissa Water Supply and Sewerage Board executes the water supply projects and hands over to the Public Health Engineering Organization after completion for operation and maintainance. The

Sr. No	Treatment Plants	Capacity (In MLD)
1	Panposh	4.5
2	Panposh	13.5
3	Panposh	55
4	Koelnagar	3.4
5	Koelnagar	1.4
6	Jhirpani	2.25
	Total	80.05

Table 11- Capacities of Treatment Plant in Study area

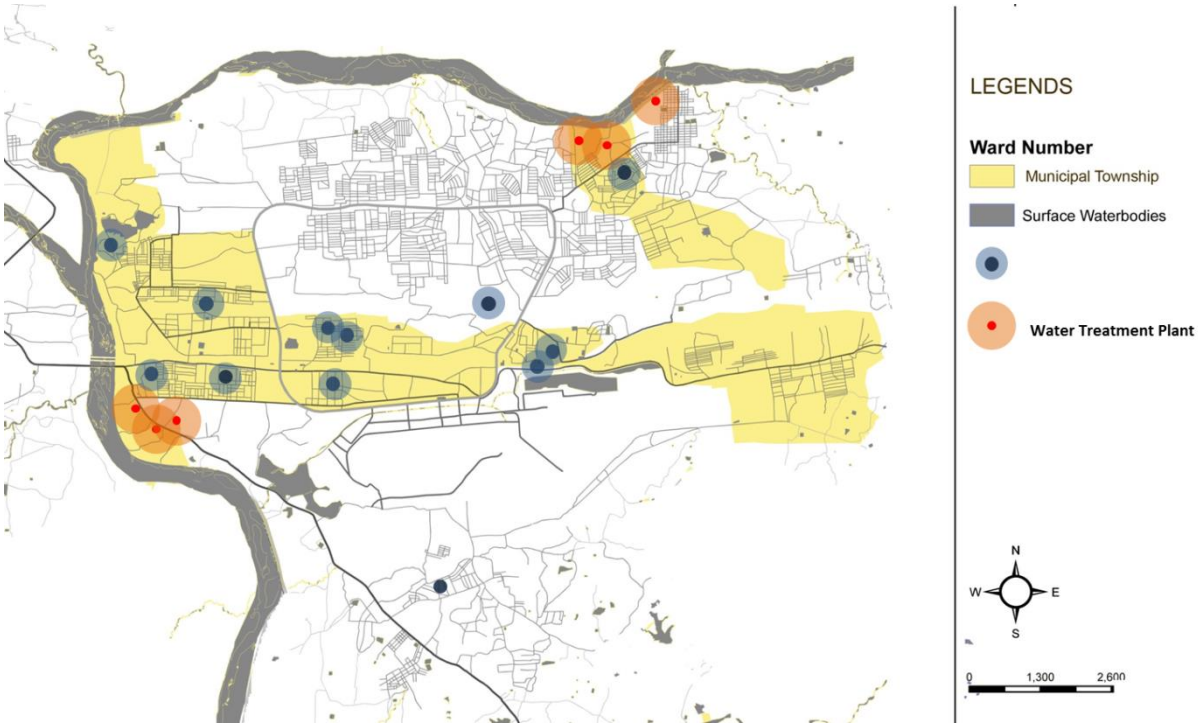


Figure 63- Location of water treatment plants and Overhead Supply tanks in study area

purification stages being followed in the treatment plants are aeration, coagulation, sedimentation, filtration(Rapid Gravity Filter) and disinfection with liquid chlorine and bleaching powder.(Municipality, 2011).

Access to Water Supply

Figure 64 shows the various water sources in the slum and non slum huseholds in the study area. Majority of households in the non-slum areas(70%) have access to PHD pipe supply or

bore-wells, while the majority in slum areas(72%) have access to public taps and tube wells which dry up during the peak summer time. Also, the PHD pipe supply reaches only 10 % households in the slum areas, which shows contrast between the planned neighbourhoods and unplanned slums in Rourkela Town.

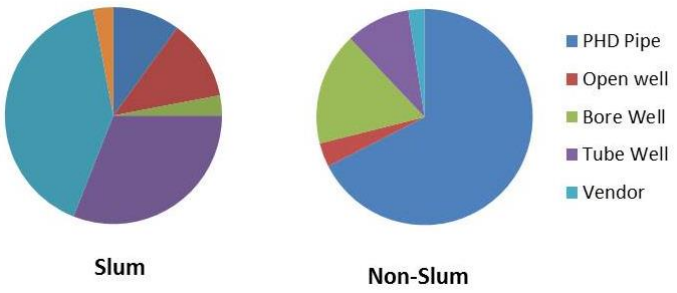


Figure 64- Source of water in slum and non-slum households (Source: Draft CSP Report, Rourkela, 2011)

The slum areas are most affected during summer when the water table falls as low as 20 m against 6-7 m(below ground level) at normal times, thus resulting in scarcity of water. Recent urbanization trends have resulted in the ground water levels go as low as 190 feet in Madhusudhanpalli from 30 feet in 1981, and beyond 150 feet in Balughat which is located close to the river Brahmani.

Some of the major issues related to water supply are:

- There is inequality in distribution of water in all areas.
- The coverage area is quite low leading to inadequate distribution network.
- There exists no metering of water usage which leads to wastage of water in the study area.
- The growth of the slums near the rivers Koel and Brahmani and other water bodies has resulted in open defecation in these areas as a result of which there is decreasing quality of water bodies in the study area.
- Inadequate maintenance of existing infrastructure.

5.6.1.2. Sanitation

Access to Toilets

Figure 65 shows the access to toilet in slum and non-slum areas in the study area. It is evident that almost all households in non-slum areas have access to toilets where as 25 % of the slum households resort to

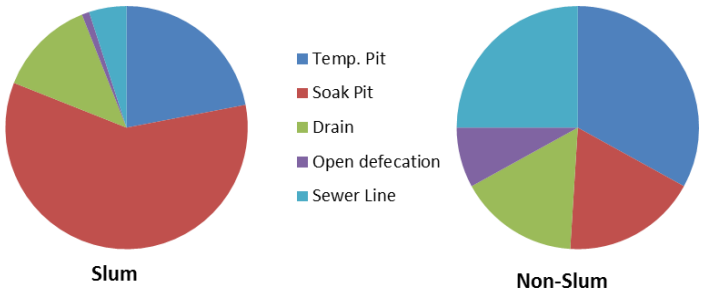


Figure 65 - Access to toilet in slum and non-slum households

(Source: Draft CSP Report, Rourkela, 2011)

open defecation. This has many negative implications on other aspects such as health, environmental quality etc. and needs immidiate attention. Only two wards(Ward No. 28 and 29) in Koelnagar area have non-slums with a proper dewerage collection network functioning properly, which has a decentralized septik tank, the effluents of which are discharged into river Koel.

Community/Public Toilets

There are six public toilets with 64 seats used extensively by the slum dwellers. Three of these are maintained by the Municipality, one by Rourkela Development Authority and remaining two by Sulabh International, an NGO. All these toilets charge fees in the range of Rs. 2 to Rs. 4 with an average number of users in the range of 200 to 250 everyday. The source of water used is either from PHD or bore well and disposal of waste is into individual soak-pits.

Waste Water Management

The treatment of waste water is again limited to one colony(Koelnagar) with septik tank treatment which accounts to only 5 % of non-slum households. Although it has been observed that a large number of households have access to toilets and water, yet 95 % of the area are without a proper sewerage system. Further, about 86% of non-slum households and 61% of slum households have on site sanitation facilities and the remaining households discharge the waste water into water bodies. This poses a great threat to the public health, especially in the slum areas who are already facing unbearable unhygeinic conditions.

5.6.1.3 Solid Waste Management

The Health Department of Municipality is responsible for the collection and transportation of solid waste generated in Rourkela Municipal Area. For operational purposes, sanitary officers are in charge of Solid Waste Management in 33 wards in the study area. Fig.66 shows that the primary collection in the study area is carried out through door-to-door collection, while nearly 42% of the households also resort to road-side

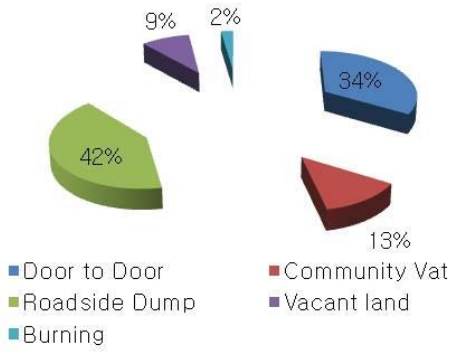


Figure 66 - Collection methods of Solid Waste in Rourkela(Source : Draft CSP Report, Rourkela, 2011)

dumping and 34% resort to burning the waste. The present mechanism is highly inefficient. Door-to-door collection of garbage is currently operational in 15 wards out of which eleven are outsourced to private agencies. The Rourkela Municipality is planning to extend the private management to all the wards.

The total solid waste generated per month amounts to 4980 tons of which 4410 tonnes are collected and disposed at different low lying areas within and outside the town. The Municipality uses the same dumping yard used by the steel township. The waste collected by street sweeping is about 1710 tonnes per month, which is nearly 35 % of the total waste generated, further indicating the fact that a significant proportion of domestic waste is thrown on the road.

The Municipality has currently five tippers/trucks, seven tractor trolleys, two excavators and nine auto tippers with funding from the 12th FC Grant. They have 88 dust bins and 66 garbage nins placed within the town. Apart from this, a private agency has its own equipments for Solid Waste Management in the 15 wards under its control.(Municipality, 2011)

Mechanism of Solid Waste Management

The Solid Waste Management is done in three stages viz. waste generation, collection and seggregation and waste disposal. The process of door-to-door collection and equipments available for Municipality and the Private agencies and NGOs. is given below in Table 12.

	MUNICIPALITY	PRIVATE AGENCY
Total no. of Tippers/Trucks	6	2
Total no. of Tractors	3	5
Total no. of Wheel Barrow	250	32
Total no. of Tri-cycle	132	26
Total no of auto rickshaw(SWM)	9	-
250 ltr capacity dust bin (SWM)	112	-
3mt capacity Dust Bin (SWM)	30	-
JCB	1	-
Bin attachment	2	-

Table 12 - Availability of equipments for Solid Waste Disposal

Seggregation is not practiced from the household level except Wards 28 and 29. However, construction waste and recyclable waste are seggregated before the transfer stations. Table 13 shows the disposal sites in the study area and the composition of waste in the town. It is observed that majority of the waste is organic waste which is sent to the landfill site followed

by construction waste. Recently, the Municipality earmarked 9.37 acres area near balughat area with 100 ton anaerobic compost plant. However due to protests by the residents of Balughat area, the project has been halted. Most of the disposal is hence done near Tarkera area jointly by the Rourkela Steel Plant and the Rourkela Municipality, while a new disposal site is proposed by the Municipality in Deogaon.

Sl..No	Existing / Currently used landfill sites			
	Place	**Area**	**Ownership**	**Status**
1	Balughat- With an 100 ton anaerobic compost plant	9.37 acres	Government	Opposed by people and currently closed/ inaccessible
2	Tarkera under unit-44,Khata No.21 of Deogaon	85 acres	RSP	Joint land fill where the municipality also dumps its waste
3	Tangarpali	26.63 acres	Government	15 km away from Rourkela Town, Scientific land fill development, yet to be handed over to the municipality
4	Deogaon	50 acre	Government	Proposed

Table 13 - Existing/Currently used landfill sites in Rourkela

Some of the major issues with regard to SWM area as follows:

- Increased roadside dumping on road sides.
- River banks are widely used to dump garbage without proper scientific treatment which can lead to hygiene issues in the long run.
- Lack of communication between the Municipality and citizens which is evident from closure of the disposal site near Balughat.
- Lack of awareness among residents regarding waste seggregation at source.

5.6.1.4. Storm Water Management

There are four major natural drains viz. Bondamunda nullah, PF nullah, Main drain nullah and kalinga Vihar nullah flowing into the Koel river. The town has a natural slope towards north which helps in quick drainage of storm water. The total length of drains

Sl No.	Indicator	Benchmark	March 2011	Target 2011-12
1	Coverage of Storm Water Drainage Network (%)	100	21	25
2	Incidence of Water Logging/Flooding	0	05	03

Table 14 - Storm water drainage indicators in study area

are 488 km, most of which are kutcha. Table 14 shows the drainage indicators in the study area.

Due to littering and dumping of waste on road sides throughout the study area, the drains in the area are often clogged, which is a concern. Some of the major issues related to Storm Water Management in the study area are as follows:

- Most of the drains in the study area are open drains acting presently as conveyance channels for untreated sewage into the river. This accompanied by clogging of solid waste have a negative effect on health and environmental parameters of the neighbourhoods.
- Ill maintained drains throughout the residential colonies
- Encroachment by residents in commercial areas resulting in obstruction of free flow of streams especially during monsoon.

5.6.1.5 Energy

Currently the power distribution and supply of Rourkela Town is divided into two large zones – the Steel Plant and Steel Township on one hand and the Municipal Township and adjacent Block areas on the other. The main source of energy in the Rourkela Steel Plant area is from a 120MW power plant with a 50:50 venture between NTPC-SAIL Power Company situated within the Plant area from which power to the Steel Plant and Steel Township is supplied. In additional, there is also a 1 MW Solar Power Plant in the Rourkela Steel Plant which is expandable to upto 6 MW in the future.

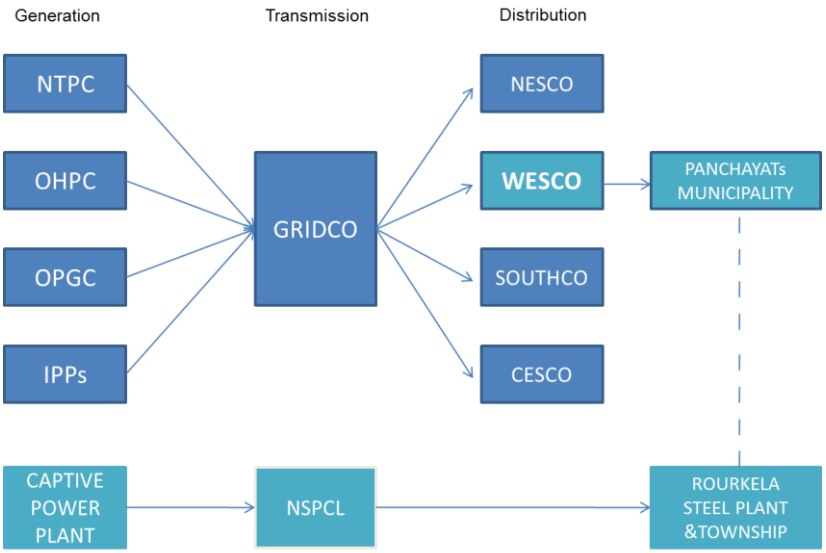


Chart 2 - Schematic flow diagram of energy supply in the region

The main power supplier in the Municipal Town is GRIDCO(Grid Corporation of India). Chart 2 shows the schematic flow diagram of power supply in the Rourkela Metropolitan

Area. GRIDCO purchases power from various independent generators like NTPC, OHPC etc. and provides bulk of supply to independent distribution companies(WESCO, NESCO etc.) which are then responsible for further distribution of power in the study area.

WESCO was incorporated as a Public Ltd. Company in 1997 to carry out the distribution and retail supply business of electricity in the Western Odisha region, including Rourkela Town along with the Block areas. Some of the responsibilities of WESCO are:

- Purchasing bulk power from GRIDCO and selling it directly to all categories of consumers.
- Construction, maintainence and repair of all lines and 33kV & below Sub stations.
- Installation and replacement of new and defunct meters respectively.
- Billing and collection of revenue from consumers.

Apart from this, the Steel Plant takes power from WESCO at times when its power plant goes under maintenance.In the study area, the power distribution is taken through the Tarkera Grid 220kV/132kV and further distributed to two 133kV/33kV substations viz. Rourkela Grid and Chhend Grid, as shown in Chart 3.

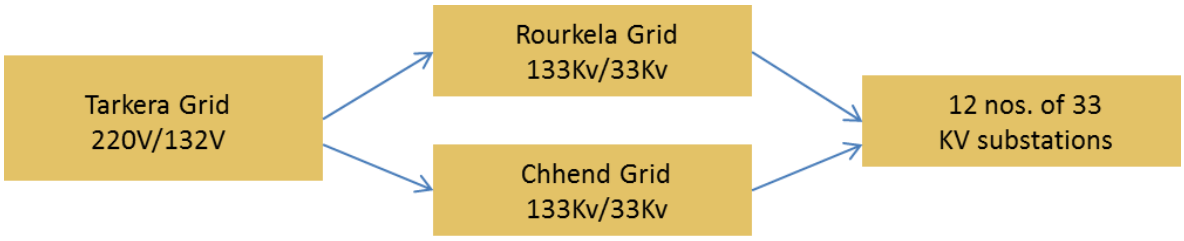


Chart 3 - Distribution of power in Rourkela

Further distribution is done through twelve number of 33kV/11kV substations distributed throughout the Municipal Town. The total length of 33 kV lines is 263.4 km, 11kV lines is 1075.4 km and LT lines is 1012.8 km which has remained unchanged since 2009. Following is the supply and consumption figures for Rourkela(Source : WESCO):

Consumers

Residential : 55000 Approx.

Commercial : 8000 Approx.

Demand in RDA Area

Residential : 80 MW Approx.

Commercial : 30 MW Approx.

Power Losses

Theft : 55-60%

Transmission : 15-20 %

Present Consumption

Domestic : 0.8 million units/day

Industries : 1.3 million units/day

Commercial : 0.2 million units/day

Existing Situation

Figure 67 shows the duration of power cuts in the study area. Power cuts are a regular occurance in the area. Majority of the households face power cuts ranging between 2-4 hours per day. Almost all the households are electified and majority of the households have single meter connections.

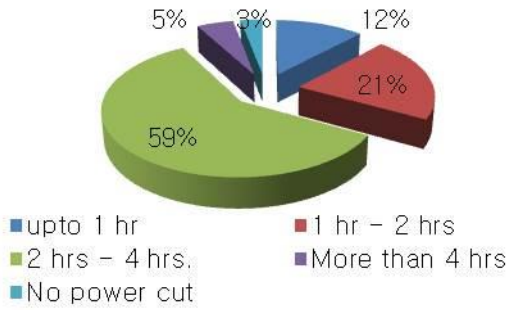


Figure 67 - Duration of power cuts in study area(Source : IIT Kharagpur Report)

Streetlighting

Although there is currently moderate quality of street lighting system throughout the Metropolitan area, the spacing of the lights is an issue to be looked at. The spacing of street lights in certain wards is quite high, which can result in negative effects on social issues like crime rate. Although the coverage of streetlighting of roads is 86%, yet a significant portion of the streets are not adequately illuminated at night time.

Some of the issues with respect to energy supply in the study area are as follows:

- Huge amount of power theft at the LT level(55%) is seen in the study area, which is resulting in power shortage and hence power cuts.
- Nearly 10% of the households in the study area are non-metered.
- High spacing of streetlights and uncovered streets in terms of streetlighting.
- Outdated manual operation of streetlighting still continues since decades.

5.6.2. Social Infrastructure

5.6.2.1. Educational facilities

Figure 68 shows the ward wise distribution of various educational facilities in Rourkela Metropolitan Area. One of the main reasons for this joint study is that, due to the relative short distances between neighbourhoods and wards between the Steel Township and Municipal Township area, there is intermix of students between neighbourhoods. It can be observed that majority of the wards in the study area do not have access to educational facilities, and hence have to travel longer distances to reach educational institutes in other wards and in the Steel Township area.

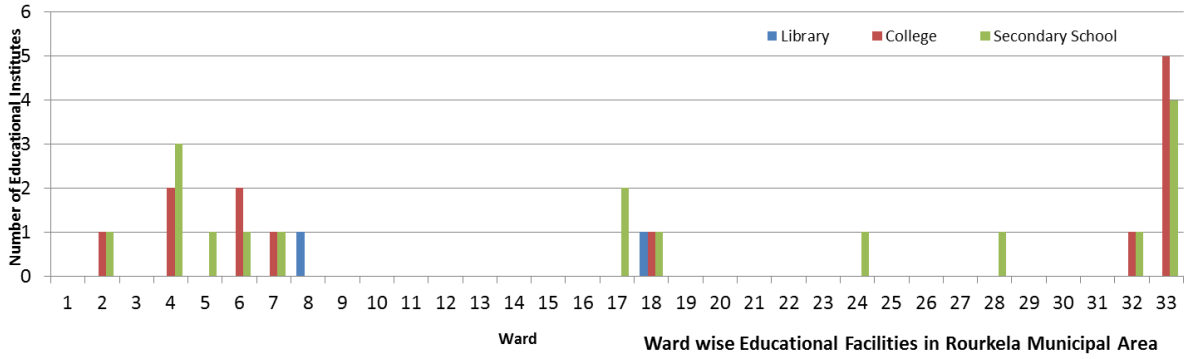


Figure 68 - Ward wise distribution of educational facilities in the study area

This fact is further supplemented by Figure 69 which shows the average minimum distance travelled to the nearest educational facility. The average minimum distance travelled to the nearest primary school is significantly high(1.5 to 2kms) in Ward No. 1,6,12,13,23 and 33. But it is also seen that the wards have proper access to high schools within 2 km and Senior

Secondary schools within 3 kms. Table 15 shows the required and existing number of educational institutes of various kinds in Rourkela Metropolitan Area.

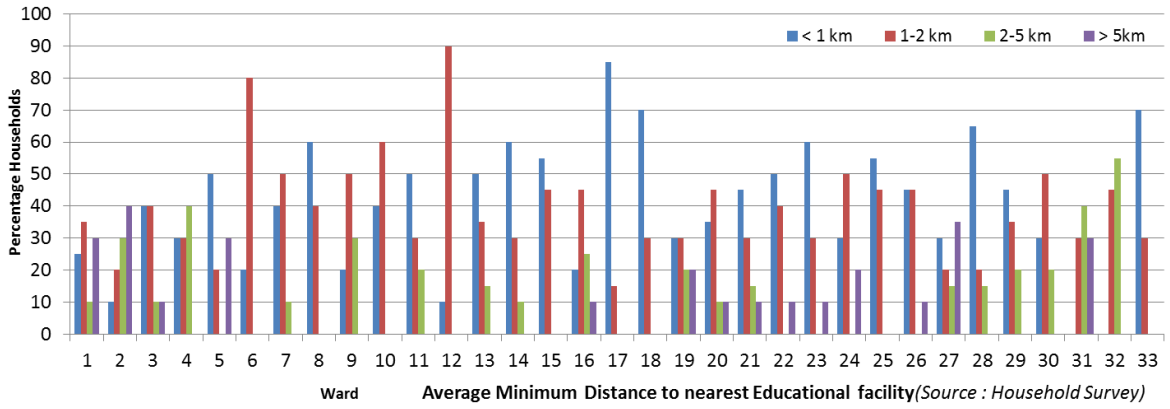


Figure 69 - Average minimum distance to nearest educational facility

It is observed that there is accute shortage of nursery schools and Senior Secondary Schools which is leading to high travel distance between home and school in the study area. Also, there is only one institute for the differently abled in the study area against the requirement of six as per UDPFI guidelines.

	Required		Actual	
	R.U.A.	Mun. Town	R.U.A.	Mun. Town
Nursery School	221	110	286	70
Sr.Sec	110	55	98	70
College	74	37	71	14
Tech. Univ.	01	01	02	01
Engg. Coll.	02	-	02	-
Medical College	02	-	-	03
Inst. For Diff. abled	06	-	-	01

Table 15- Existing demand and supply of educational facilities(as per UDPFI Guidelines)

Figure 70 shows the map showing the distribution of schools in Rourkela Metropolitan Area. Apart from Ward No. 1 and 3 have very low coverage of schools and need immidiate attention. This could be because of low population density in Ward No. 1 and relatively new developments in Ward No. 3. New areas need to be earmarked for opening schools in these two wards.

Figure 71 shows map showing distribution of colleges and other training institutes in the Rourkela Metropolitan Area. The number of colleges is sufficient as per the requirement of UDPFI guidelines. Due to presence of National Institute of Technology, Rourkela and few other quality educational institutions, the town is known as the educational hub of the state.

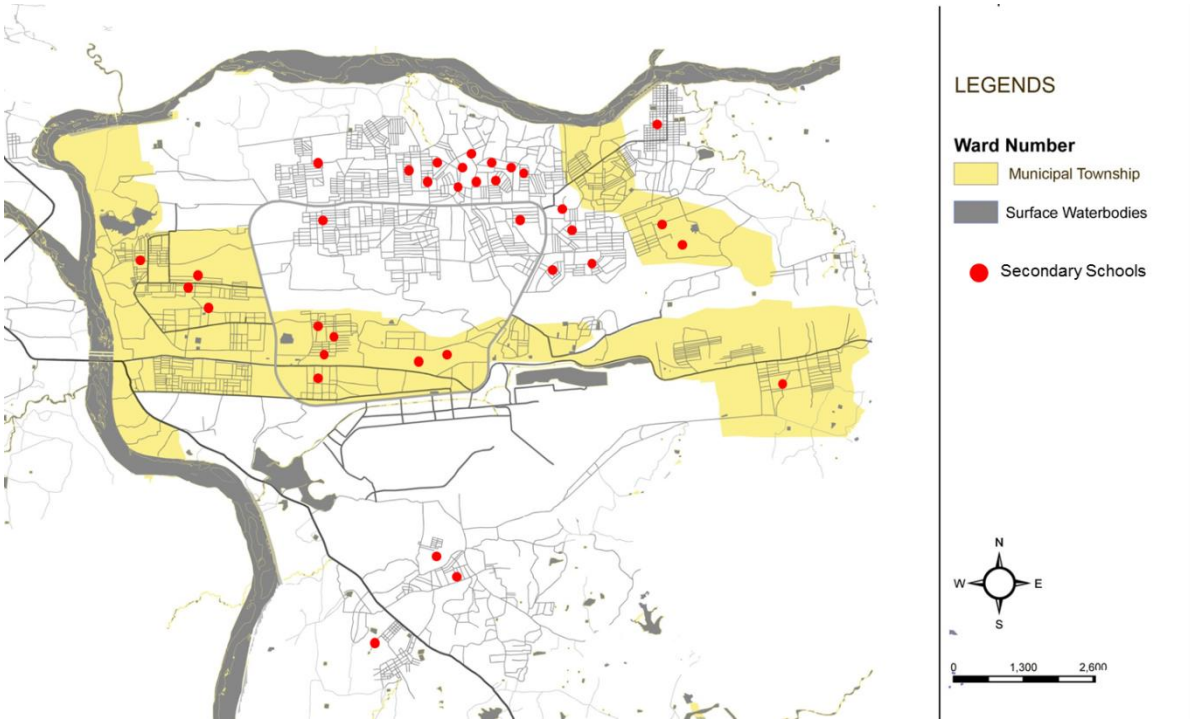


Figure 70 - Locations of Secondary Schools in Rourkela

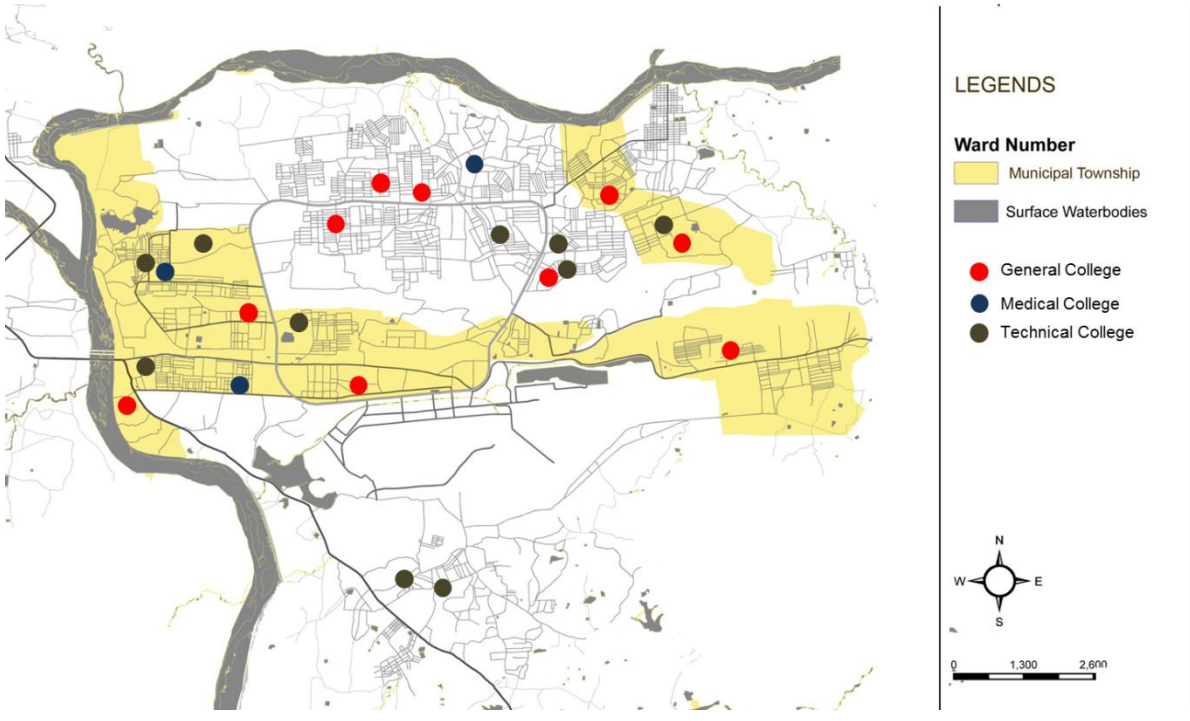


Figure 71 - Location of Colleges in Rourkela

Student Enrolment

Table 16 shows the classroom enrolment list in 2011-2012 from Class I to Class VII in the town. It can be clearly seen that there is a steady decrease in the enrolment numbers each year. The number of dropouts is uniform in case of ST category students but not so in SC Category students.

CLASS	ALL COMMUNITY			SC			ST		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
I	9761	9726	19487	1350	1409	2759	5511	5336	10847
II	8755	8477	17232	1207	1107	2314	4870	4619	9489
III	8348	7892	16240	1131	1071	2202	4533	4314	8847
IV	7831	7155	14986	1106	1038	2144	4118	3903	8021
V	7553	7416	14969	1064	1042	2106	4002	3785	7787
VI	6708	6460	13168	1049	847	1896	3588	3349	6937
VII	6766	6845	13611	1005	966	1971	3668	3405	7073
Total	**55722**	**53971**	**109693**	**7912**	**7480**	**15392**	**30290**	**28711**	**59001**

Table 16- Class wise Student Enrolment in 2011-12(Source :Department of School & Mass Education)

5.6.2.2. Healthcare facilities

Health service in the Urban Agglomeration is quite well organised. However, there are numerous private hospitals and clinics which charge higher prices for treatment. Hence a huge proportion of the population receive treatment for lower prices in two larger hospitals i.e. Rourkela General Hospital(R.G.H.) run by the State and Ispat General Hospital(I>G.H.) under the Steel Plant. Table alongside shows the required facilties as per UDPFI guidelines and existing facilities.

	Required		Actual	
	Nos.	Beds	Nos.	Beds
General Hospital	03	900-1500	03	1294
Int. Hospital(Cat – A)	07	700-1400	01	120
Int. Hospital(Cat – B)	01	50-80	26	371
Polyclinic	07	07	23	DNA
Nursing Home	07-14	175-350	03	68
Dispensary	43	-	DNA	DNA

Table 17 - Existing demand and supply of healthcare facilities (as per UDPFI Guidelines

Figure 73 below shows the locations of existing healthcare facilities in the town. It is seen that majority of the healthcare facilities are located in the central areas in Civil Township and Uditnagar. Yet, certain wards such as Ward No. 23 to 26(Bondamunda area) and Ward No. 1,

32 and 33(Chhend Colony and Gudia Toli areas) have limited access to healthcare units. This is further analyzed through Figure 72 showing the average minimum distance to the nearest healthcare facility in the study area, which confirms that the distances are relatively higher

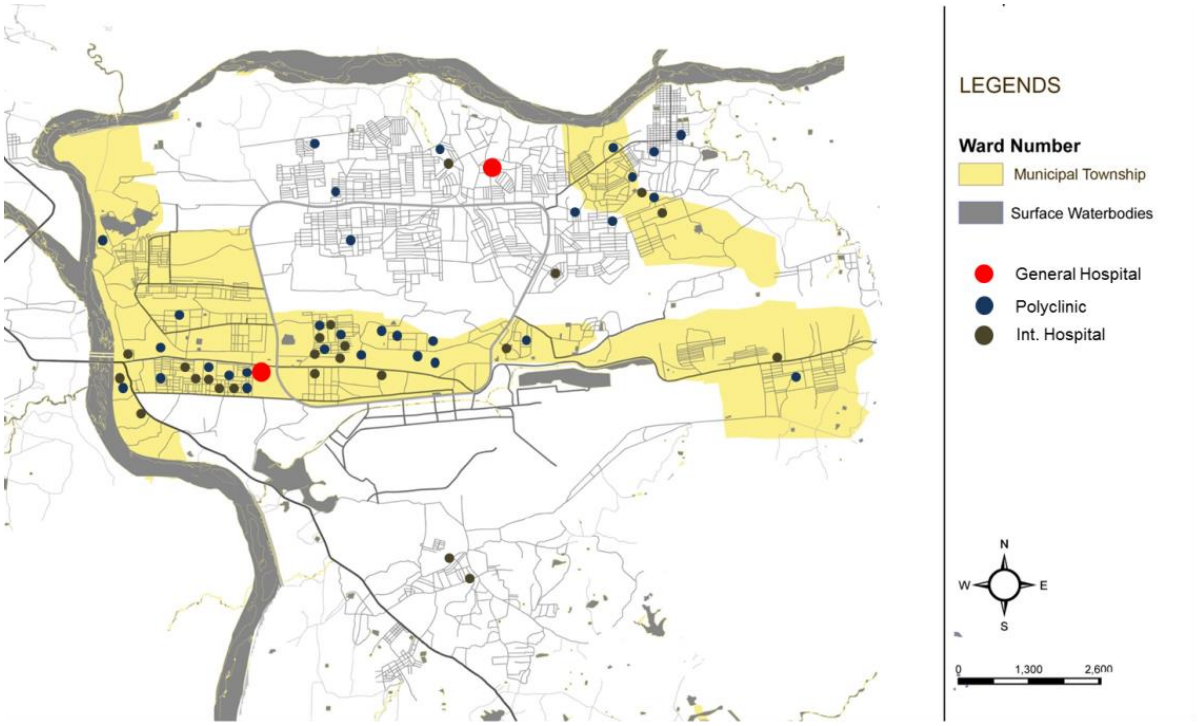


Figure 72 - Location of healthcare units in Rourkela

for these wards and hence there is need for augmentation of facilities in Bondamunda region as well as Chhend Colony area.

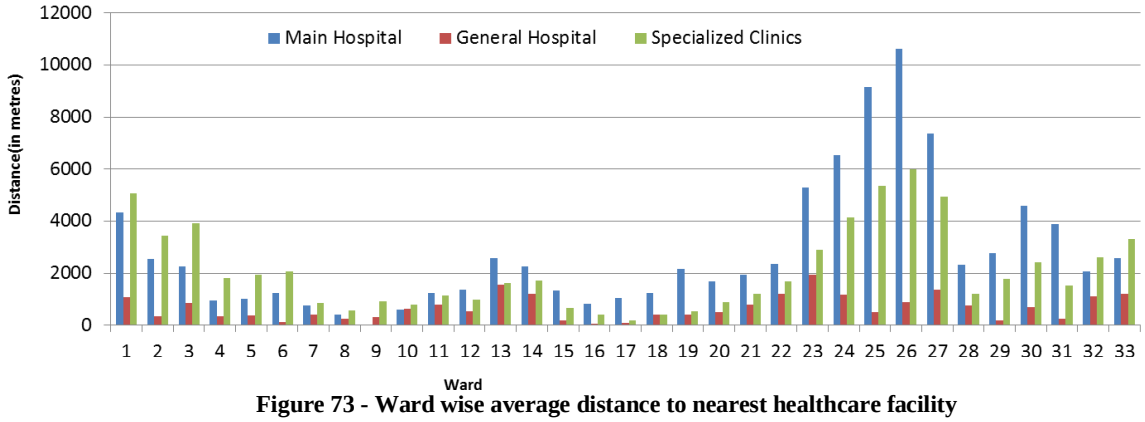


Figure 73 - Ward wise average distance to nearest healthcare facility

Diseases Occurred

Figure 74 shows the main source of diseases spread in the town in the last decade. In spite to the presence of large scale industries, the town is doing well since there are limited water-borne and air-borne diseases in the town. Primary household survey also confirms this, since 30% of the households had a family member diagnosed with some serious disease in the last five years.

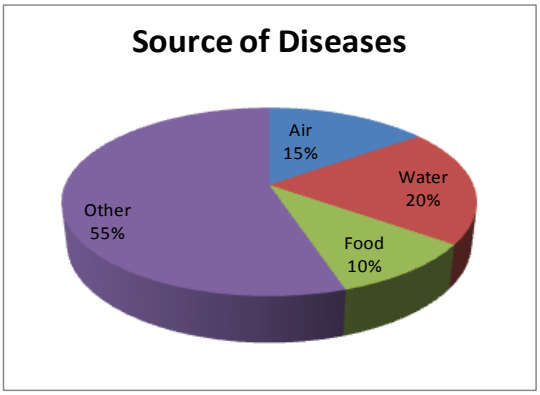


Figure 74 - Source of diseases in Rourkela town

5.6.2.3. Safety and Security

Police Stations

There are presently 24 Police Stations in the Rourkela Police jurisdiction area. Data from the Police Department suggests a decreasing trend of crime incidents between 2009 to 2012 .

	Required		Actual		Proposed	
	R.U.A.	Mun. Town	R.U.A.	Mun. Town	R.U.A.	Mun. Town
Fire Station	04	02	04	02	06	-

Table 18- Existing and Required number of police stations (as per UDPFI Guidelines

There has been a concern of increase in the number of murder and thefts in the town between 2011 and 2012 even with the number of Police Station in the town being sufficient.

There was considerable naxalite influence in many of the fringe areas of the town until few years ago. In order to cater to this issue, the State Government has provided extra force and advanced equipment to 5 Police Stations(Bisra P.S., Koida P.S., Bolang P.S., Lathikata P.S. and Kalta P.S.). The last naxalite attack wa recorded in 2011 in Kuarmunda and in 2012 in Bisra, while there has been no naxalite movement since the last three years in the region.

Fire Stations

There are presently four fire stations in the Rourkela Metropolitan Area, two in the study area and two others in the Steel Plant Area. Fire Stations in the Steel Plant Area is primarily to

deal with industrial incidents. Apart from these, six more fire stations have been proposed in the Rourkela Jurisdiction mostly in the peri-urban areas distributed in Bisra, Kuarmunda and Lathikata blocks. Table 19 shows the details of incidents occurred in the town between 2008 and 2012. It is observed that the number of fire calls(with people involved) have been steady in this period.

Year	No of fire calls	Calls (people involved)	Life lost	Life saved	Property lost
2008	77	53	7	3	2,30,00,000
2009	75	44	6	10	31,00,000
2010	202	38	1	12	46,74,000
2011	74	38	5	5	95,00,000
2012	84	43	6	6	71,00,000

Table 19 - Details of incidents and fire calls in Rourkela between 2008 and 2012

Figure 75 shows the spatial distribution of the various Police Stations and existing and proposed fire stations in the town. Ward No. 24 to 28(Bondamunda area) and Ward No. 1 are not very well covered by the Police Stations.

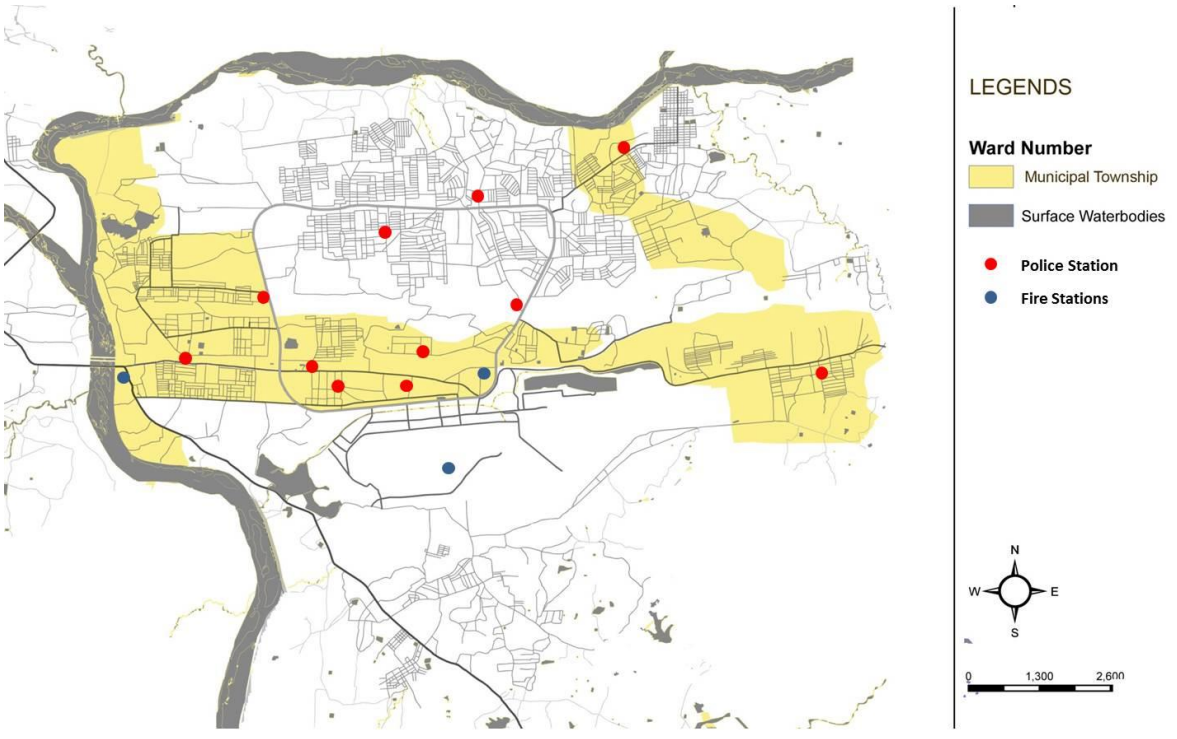


Figure 75 - Location of Police Station and Fire Stations in Rourkela

Some of the issues pertaining to safety and security in the town are as follows:

- There is a steady crime rate despite sufficient number of Police Stations.
- Absence of fire hydrants in congested commercial areas near Old Rourkela area to deal with sudden occurance of fire.
- Encroachments of roads in commercial areas makes it difficult for free movement of fire vehicle.
- Poor maintenance of fire stations due to non-allocation of maintenance funds.
- Lack of coordination between Municipal and Rourkela Steel Plant fire stations.

5.6.2.4.Postal Services

Table 20 shows the existing and proposed post offices in Rourkela. Currently, there are 25 number of branches in the Rourkela Metropolitan Area, out of which 8 branches are located in the study area against requirement of 18 according to UDPFI Guidelines. An additional six number of Post Offices have been proposed. However they are mostly proposed in the block areas which are relatively underdeveloped. Figure 76 shows the distribution of Post Offices in the town. There is only one Post Office in the combined area comprising Ward No. 23 to 26, also Ward No. 1,2,32 and 33 have service from a single Post Office. These areas need to be looked into and new post offices need to be set up..

	Required		**Actual**		**Proposed**	
	R.U.A.	Mun. Town	R.U.A.	Mun. Town	R.U.A.	Mun. Town
Post Offices	43	18	25	11	06	00

Table 20- Existing and required postal service(as per UDPFI Guidelines)

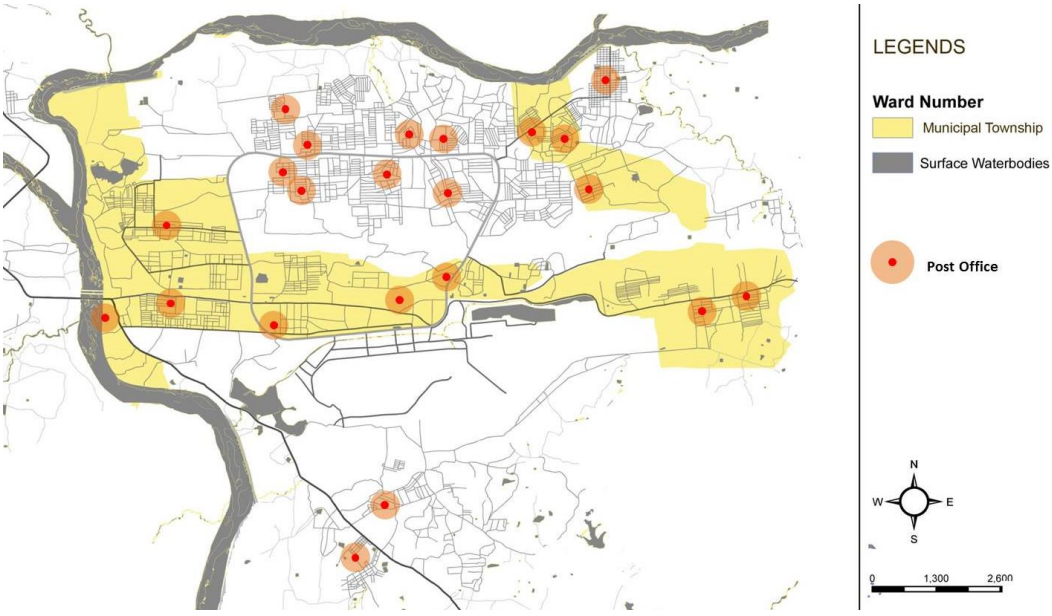


Figure 76 - Location of post offices in Rourkela

5.6.2.5. Socio-Cultural facilities

Table 21 shows the required and actual distribution of socio-cultural facilities in the town. It is observed that most of these facilities are not upto the mark and also are present mostly in the Steel Township area. Most of these facilities were built when the town was newly constructed while the progress has been considerably slow as compared to rapid rise in the population.

	Required		Actual	
	R.U.A.	Mun. Town	R.U.A.	Mun. Town
Community Hall	43	18	12	03
Library	43	18	08	03
Club	07	03	05	01
Music/Dance School	07	03	01	01
Socio-Cultural Center	07	03	02	-
Theatre	-	-	03	03
Spiritual Center	07	03	01	00

Table 21 - Existing and Required Socio-Cultural Facilities in Rourkela(as per UDPFI Guidelines)

Figure 77 shows the distribution of various socio-cultural facilities in the town. Bondamunda area has been in neglect in most of the cases discussed till now. One of the reasons is due to its location away from the main ring road which is the main element of connection spatially as well as culturally in the town. Community halls and libraries need to be established in phases in order to bring about upliftment in education and socio-cultural facilities in the town in the long run.

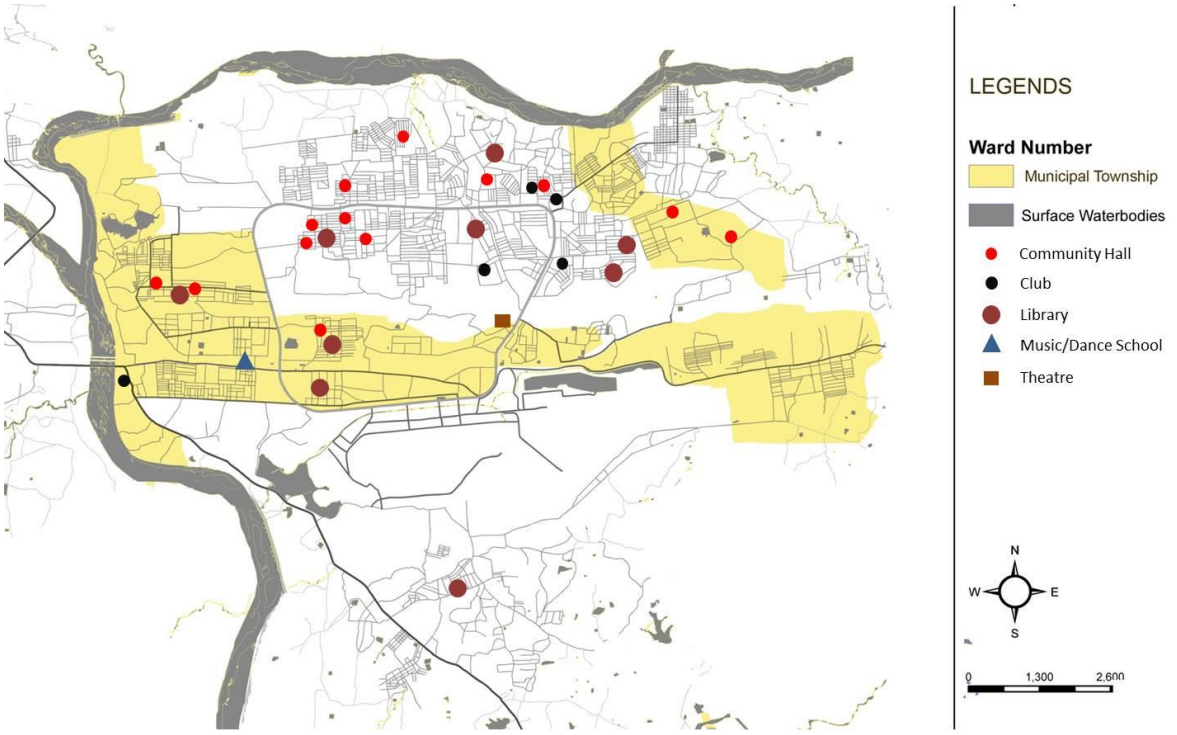


Figure 77 - Location of Socio-Cultural facilities in Rourkela

5.6.2.6 Religious Places

The religious places are well distributed in all wards with each neighbourhood having access to at least one place of worship. Results of an online questionnaire conducted online as part of this investigation shows that religious places are the most preferred visited places by nearly 75 % residents in the town.

5.6.2.7 Cremation/Burial grounds

Table 22 shows the required and present cremation/burial grounds in the town. Vedavyas ghat near the confluence of the three rivers brahmani, Koel and Sankh is considered a holy place among the Hindus, which is why most of the Hindu population uses Vedavyas Burning Ghat for cremation purpose. There is no electric crematorium in the town which is a necessary requirement as per UDPFI Guidelines. The number of graveyards and cemeteries are sufficient for the Muslim and Christian population in the town. Figure 78 shows the location of various cremation/burial grounds in the town.

	Required	Actual
Cremation Ground	03	01
Cemetaries		06
Electric Crematorium	01	00
Graveyard		02

Table 22 - Existing and required Cremation Grounds/Graveyards etc.(as per UDPFI Guidelines)

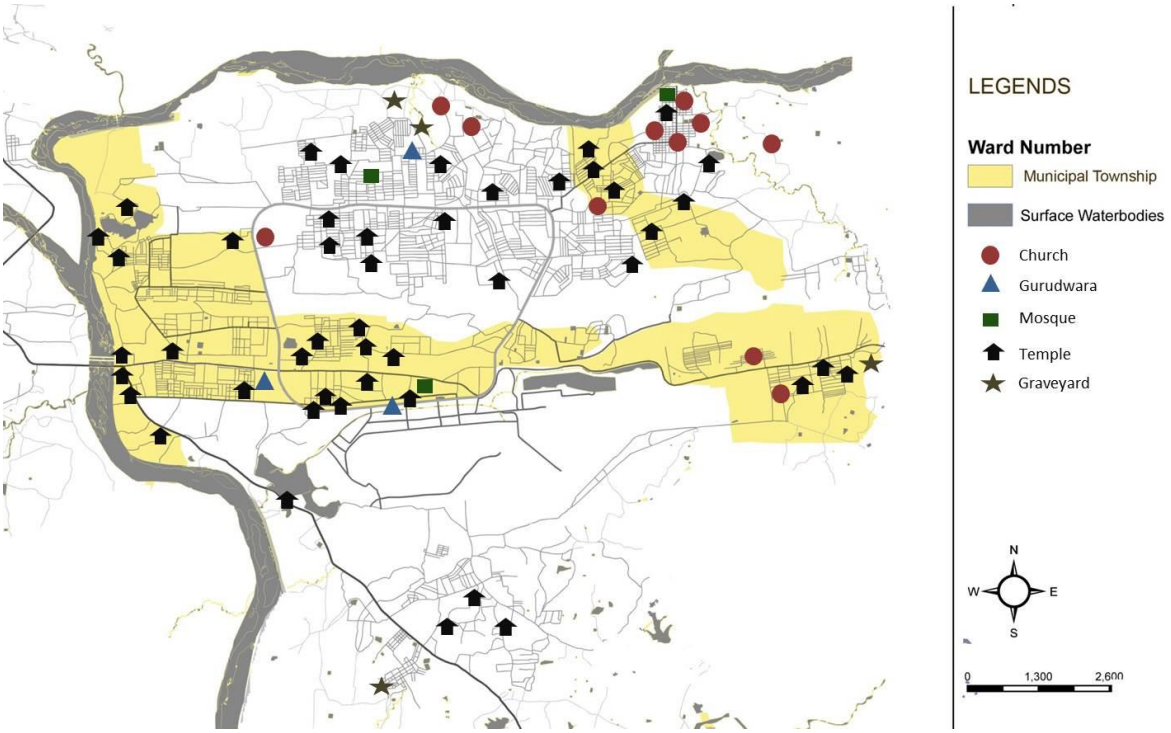


Figure 78 - Location of religious places and burial/cremation grounds in Rourkela

The following issues with respect to cremation/burial grounds in the town are noted below:

There of only one cremation ground for the whole Hindu population in Vedavyas. There is need of having another cremation ground with an electric crematorium.

- Absence of graveyards in Wards 28, 29 and 30(Koelnagar and Jagda) as well as Ward No. 4(Civil Township Area).
- Lack of electric crematoriums in major hospitals(R.G.H. and I.G.H.) which is really needed to deal with deaths caused by a serious disease.

5.6.2.8. Sports facilities

Rourkela has a historical background of producing Olympians in Hockey and also some members in the national Cricket team. The sports facilities available in the town are rather well developed, with existing number of stadiums being 9 as compared to requirement of one in a district. Apart from these, there are plenty of open spaces and playgrounds provided in the residential areas. Table 23 shows a list of spots complexes in Rourkela Metropolitan Area. The Ispat stadium is the largest stadium in the town, which is used for multi purpose events(sports and culture) throughout the year. Apart from this, two atroturf hockey stadiums have been constructed in the study area(Panposh and Chhend Colony). Figure 80 shows the locations of various sports complexes in the town.

Figure 79 - Aerial view of Ispat Stadum and Biju Patnaik Stadium in Rourkela

Sr. No.	Name	Location
1	ISPAT Stadium	Sector 6
2	Jalda Mini Stadium	National Highway 23
3	SERSA Stadium	Bondamunda
4	Biju Patnaik Hockey Stadium	Sector -6
5	Dilip Tirkey Stadium	Sector 1
6	Kalta Sports Stadium	NH 215
7	IEC Softwares	Sector 6
8	Indoor Stadium	Sector 5
9	Sports Hostel	Chhend
10	Sports Hostel	Panposh
11	ISPAT Mini Stadium	Sector 22

Table 23 - List of sports complexes in Rourkela

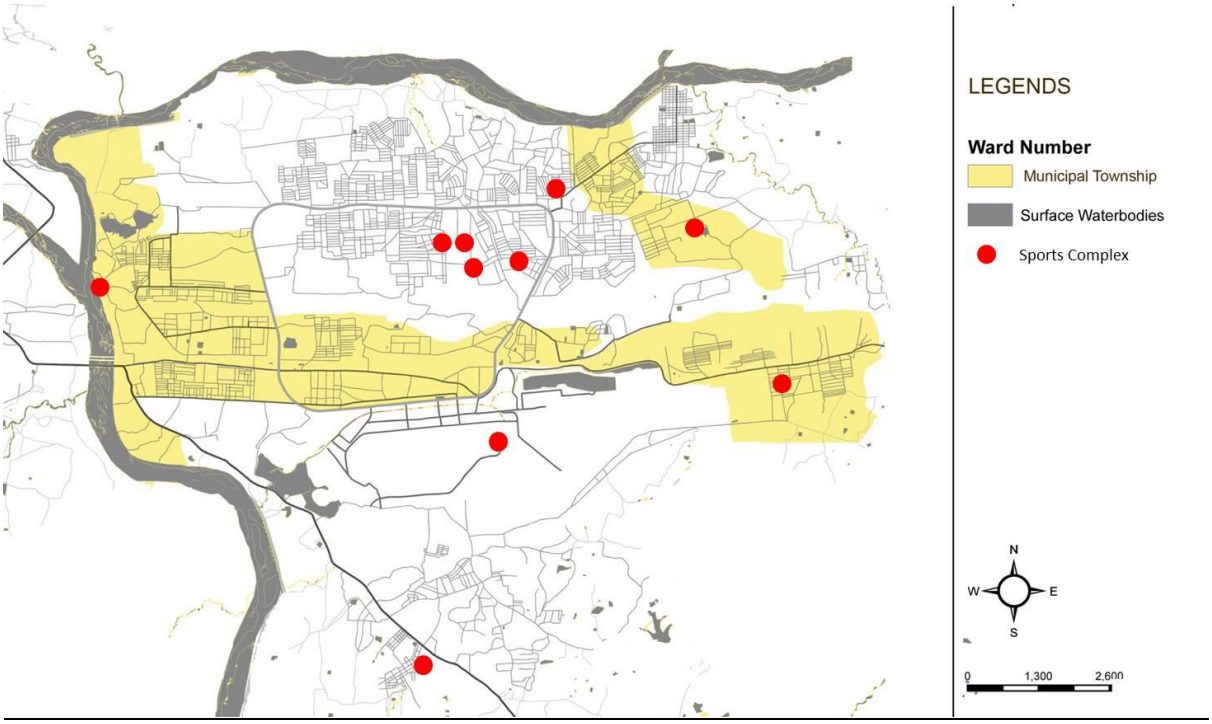


Figure 80 - Location of Sports Complex in Rourkela

5.6.2.9. Open Spaces(Parks and Playgrounds)

Presently, 14 wards out of a total of 33 wards in the study area do not have proper playground or parks. Also, most of the playgrounds or parks earmarked during initial development of the neighbourhoods are ill-maintained and hence not being utilized properly. It is observed that there is a sharp contrast between the quality of open spaces in the Steel Township and the Municipal Town area.

There are numerous potential green areas in the study areas which are currently unutilized or under-utilized. These areas can be developed in phases in order to provide breathing spaces especially in the high density residential colonies in the study area. A green corridor map has been evolved in this study which addresses the issue of open spaces in the town.

5.6.3. Economic Infrastructure

Presently there are nine nationalized banks distributed in Rourkela with forty-eight branches as listed in Table 24. Figure 81 shows the distribution of various banks in the town. It is observed that most of the wards have sufficient access to banking services. However, the coverage is much lower in Bondamunda, Chhend Colony and Panposh areas. Most of the banks are concentrated in the high density commercial areas along the Kachery Road. All the banks provide loan facilities based on the income level and source of the person concerned.

Name of bank	Location	No. of branches
Uco Bank	Sector-19	6
Axis Bank	Panposh	3
Andhar Bank	Civil Township	2
Canara Bank	Uditnagar	2
Bank Of India	Sector-19	5
Bank Of Baroda	Ambagan	3
State Bank Of India	Jalda Rangila Chowk	18
United Bank Of India	Sector-19	2
Agricultural Development Bank	Vedvyas Chowk	1

Table 24 - List of banks and their branches in Rourkela

Figure 81 - Location of banks in Rourkela

5.7 Traffic and Transportation

5.7.1. Road Network

Rourkela Town has a total of 629.57 km of roads which are under the control of the Municipality. The roads within the study area are constructed and maintained by three agencies :

1. Rourkela Development Authority(RDA)
2. Rourkela Municipality
3. R&B Division, Public Works Department(PWD)

The PWD is also involved in construction of bridges and new roads, while also involved in maintenance and widening of roads with the Rourkela Municipality. Figure 82 shows the pattern of road distribution and the road width in the study area. The strategically important roads are located in the stretch between Panposh Chowk and Bisra Chowk. Most of the roads in this area are in good to average condition, although there are encroachments in commercial stretches leading to congestion and slow traffic movement.Currently, the PWD and Municipality are working on widening of main stretches of Katchery Road from 12m to 18m width with addition of a pedestrian pathway. Also, a fly over is currently functional between Uditnagar and Basanti Colony to divert the traffic entering into the Uditnagar stretch. There is presence of lesser number of major roads in the western areas near river Koel and hence the area has limited connecctivity. The bridge over river Brahmani is the only connecting feature between the town and the fringe areas. Hence, the area near Panposh Chowk is frequently choked with heavy vehicles entering or leaving the town. Also, illegal parking of

Heavy vehicles is seen on roads near Vedavyas Chowk which increases the possibility of occurance of accidents.

Steel Township Road Network

The major road in the town is the Ring road which provides connectivity between the steel township and the steel plant. It was built in the 1950s alongwith the steel plant and is maintained by the Rourkela Steel Plant. Although the primary function of a ring road is to relieve the town centre from cross traffic by redistributing in bound and out bound traffic of town centre, yet the Rourkela Ring Road has entirely different functions since there is absence of a particular geographical town center of the town. Hence the ring road is a circular

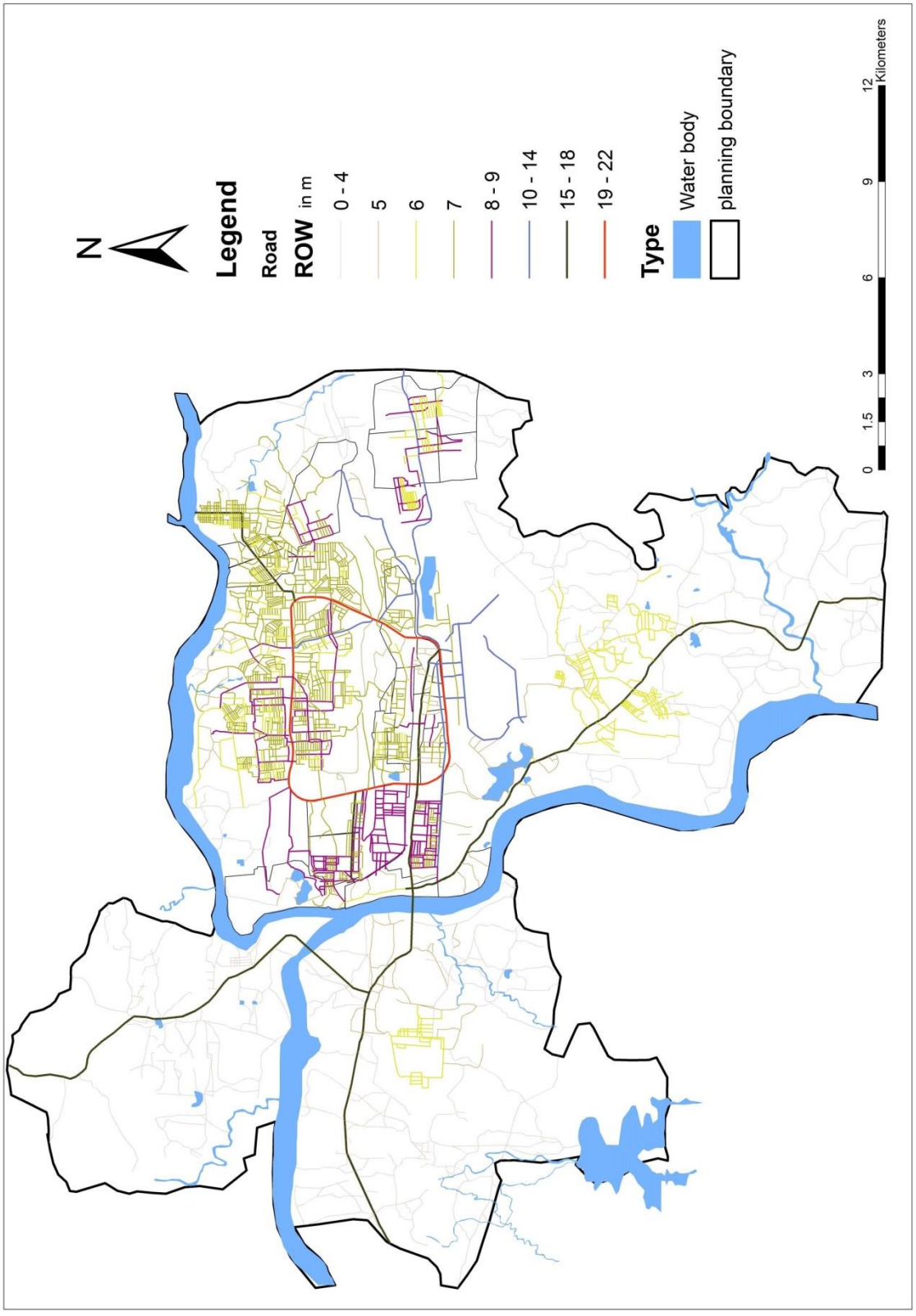


Figure 82 - Map showing Existing Road Network with road widths in Rourkela

road linking various parts of the town. Although the road is a visual pleasure to drive due to green open spaces all around and well landscaped, yet due to over speeding and negligent driving, there have been recent concerns of it being accident prone.

The major issues in road infratructure in the study area are as follows:

- High level of encroachments in major roads in parking areas, thus increasing congestion.
- Narrow road width in newly developed residential colonies leaves no scope for improvement in future.
- Absence of proper infrastructure for pedestrians.
- Over speeding in certain roads leads to frequent accidents.
- Small rotaries in certain intersections(DAV Chowk) making it difficult to control the traffic.
- Illegal parking of heavy vehicles near Vedavyas due to lack of earmarked truck parking area.

5.7.2. Rail network

The Rourkela Railway Division comprises of Sundergarh, Jharsuguda and Kendujhargarh districts of Odisha and is under the SE Railway Zone. Of 2495 km length of railway route in the state, 337 km passes through Sundergarh district which is also the highest in the state. Also, Sundergarh district generates nearly Rs. 800 cr. Annually which is around 40% of the total revenue generated by Chakradharpur Divisio. Yet, the region remains neglected in comparison to rail connectivity and facilities are compared to other regions. The Railways are a major carrier of freight since the region is predominantly industrial.

5.7.3. Freight Movement

Rourkela is a major destination and origin point for freight carriage through Railways. Table 25 shows the annual quantity of freight carried by Railways in the town. The Container Corporation of India, a subsidiary of Indian Railways was the monopoly operator of container trains in India till 2006. After the Ministry of Railways allowed entry of private sector operators to obtain license to run container trains in the Indian Rail Network, a private operator, Inlogistics, has acquired 18 acres of land in Rourkela to start a container terminal with two rail lines. Table 26 shows the monthly/annual quantity of freight carried by trucks

Sl. no	Freight	Quantity(annual)
1	Cooking coal	2.3 MT
2	Iron ore	1.8 MT
3	Boiler coal	1.5 MT
4	Tin ,zinc ,aluminum ferro alloys	1.6 MT
5	Sponge iron	N.A.
6	cement	0.5MT

Table 25 - Freight carried by Railways(Source : Station Master, Rourkela Railway Station)

Material (major)	No. Of trucks / month	Quantity tones / month	No. of trucks/day	Source
Iron Ore (Lump)	625	10000	21	Rourkela truck owners association
Iron Ore (Fine)	625	10000	21	
Bauxite	389	3500	13	
cement	110		4	
Limestone	156	2500	5	
goods for markets	400	3000	13	Primary survey
trucks passing by Rourkela on NH 23	7274	NA	242	NIC
TOTAL	9579		319	

Table 26 - Freight carried by trucks(Source : IIT Kharagpur Report)

in the town. Out of the total trucks passing through Rourkela, around 75 to 80% of the trucks make a stop over in and around the town. Most of the trucks are restricted from entering the town during daytime to avoid traffic congestion in the major roads. Yet, since most trucks ply on NH 23 and SH 10 which are also main entry points into the town, mixing of passenger traffic with freight traffic is an issue especially in Panposh Chowk and Hockey Chowk. A rough analysis of the parking space of trucks is done as follows:

- Total number of trucks passing through Rourkela each day = 319 nos.
- Number of trucks stopping in Rourkela per day = 80% of 319 = 255 nos.
- Required parking space = 10,200 sq. m(assuming parking bay3.5m x 7.5m as per UDPFI guidelines)
- Adding 40% additional space(loading/unloading/other ancillary services etc.) = 6075 sq.m.
- Current space available for parking = 6075 sq.m.
- Additional parking space required = 8205 sq.mt.

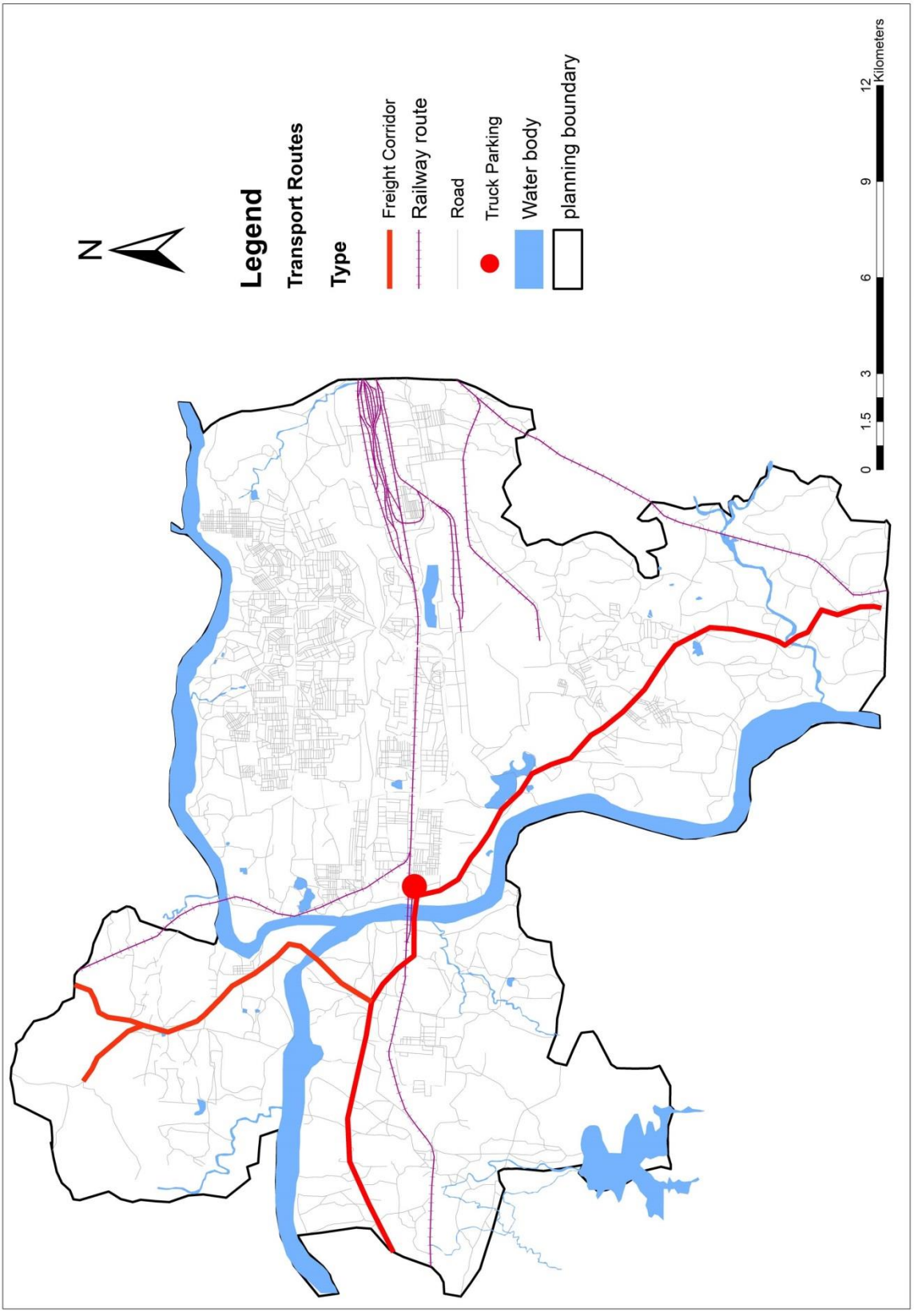


Figure 83 - Map showing freight corridor in Rourkela

5.7.4. Public Transport System

The Public Transport network in the town is not so well developed. The major mode of transportation in the town are in the form of buses and autorickshaws. The bus service can be categorized as Inter-city buses and Intra-city buses.

Regional Bus Service

Rourkela is one of the 14 depots in Odisha state. Currently, the depot runs 14 buses to various locations in the state. Only the buses plying along Aska, Kiribur and Nayagarh are profitable whereas the rest are in loss, since passengers prefer private buses because they provide better comfort as well as more competitive fares. The average number of passengers in a day is around 850.

Intra-town bus service

Currently around 60 buses run from the Main bus stands in order to cater to the intra town demand of traffic. There are two main bus stands – the Old Bus Stand, in front of DTM Office and the New Bus Stand at Gandhi Road. The Old Bus Stand is improperly designed for ingress and egress of buses which is causing localized congestion in the area. The New Bus Stand, built by the Municipality caters to the regional traffic demand. An average of 300 buses operate from the New Bus Stand daily running in 13 different routes, within and outside the state. In addition, there have been certain new proposals as follows:

- 17 number of buses for BRT under the JNNURM grant has been requested by the Municipality to run within the Municipal Town.
- New bus services for 37 educational institutes in Rourkela Metropolitan Area and peripheral block areas is proposed.

Para-transit system

Since the service provided by the buses in the town are inadequate, autorickshaws are the major mode of para-transit in the town. There are nearly 800 autos running in the Rourkela Metropolitan Area. The average number of trips are almost 2400 per day, with average occupancy of 5 persons. The peak hours are 8am to 12pm and 4pm to 7pm on normal working days. The major route in the town for auto service is the route between Railway Station to Sectors(Steel Township) via Chhend Colony.

Table 27 shows the main auto stands in the town along with their capacity. The major issue is that there are no earmarked auto stands in the town. As a result, most of these auto stands are located on encroached area and on road sides.

Sl.no	Auto stands	No. of autos
1	Station Road	140
2	Panposh	130
3	IG hospital	45
4	Jhirpani	30
5	Koel Nagar	60
6	Chhend Colony	65
7	Kalinga vihar	40

Table 27 - List of auto rickshaw stands in Rourkela

5.7.5. Traffic Character

The major traffic intersections in the town are in the Ring road and Panposh Road. Figure 84 shows the seven major intersections – Bisra Chowk, Panposh Chowk, Traffic Chowk, Madhusudhan Chowk, DAV Chowk and Hanuman Chowk. Fig.84 shows the morning and evening peak(8-9am and 5-6pm) traffic count at the intersections in the town. It is observed that there is considerable increase in traffic count in the evening peak compared to the morning peak. The maximum increase is seen in bisra Chowk(198%) which is why there is maximum congestion in that area. The most important factor responsible for congestion in these areas is that more than 50% of the traffic is on bicycles and pedestrians which create an intermixing of slow moving and fast moving traffic.

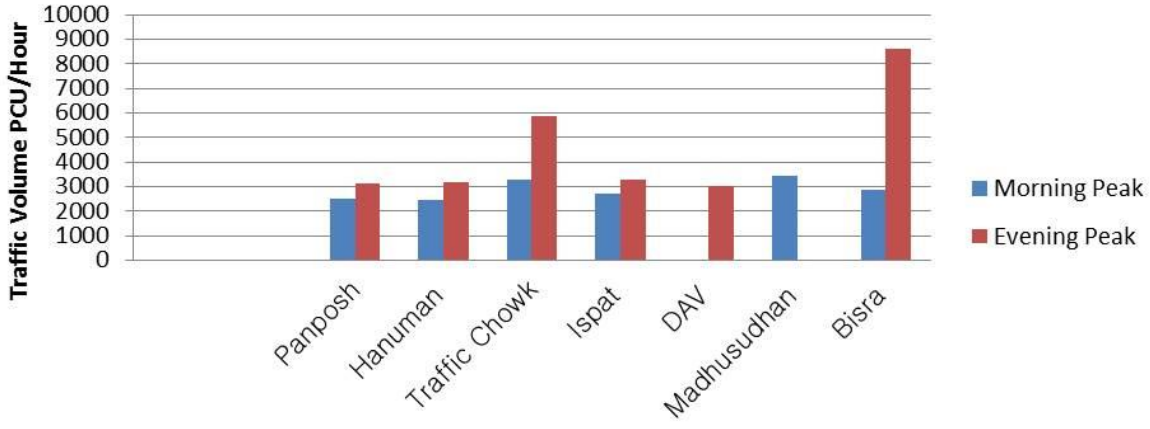


Figure 84 - Morning and Evening traffic count(Source : IIT Kharagpur Report)

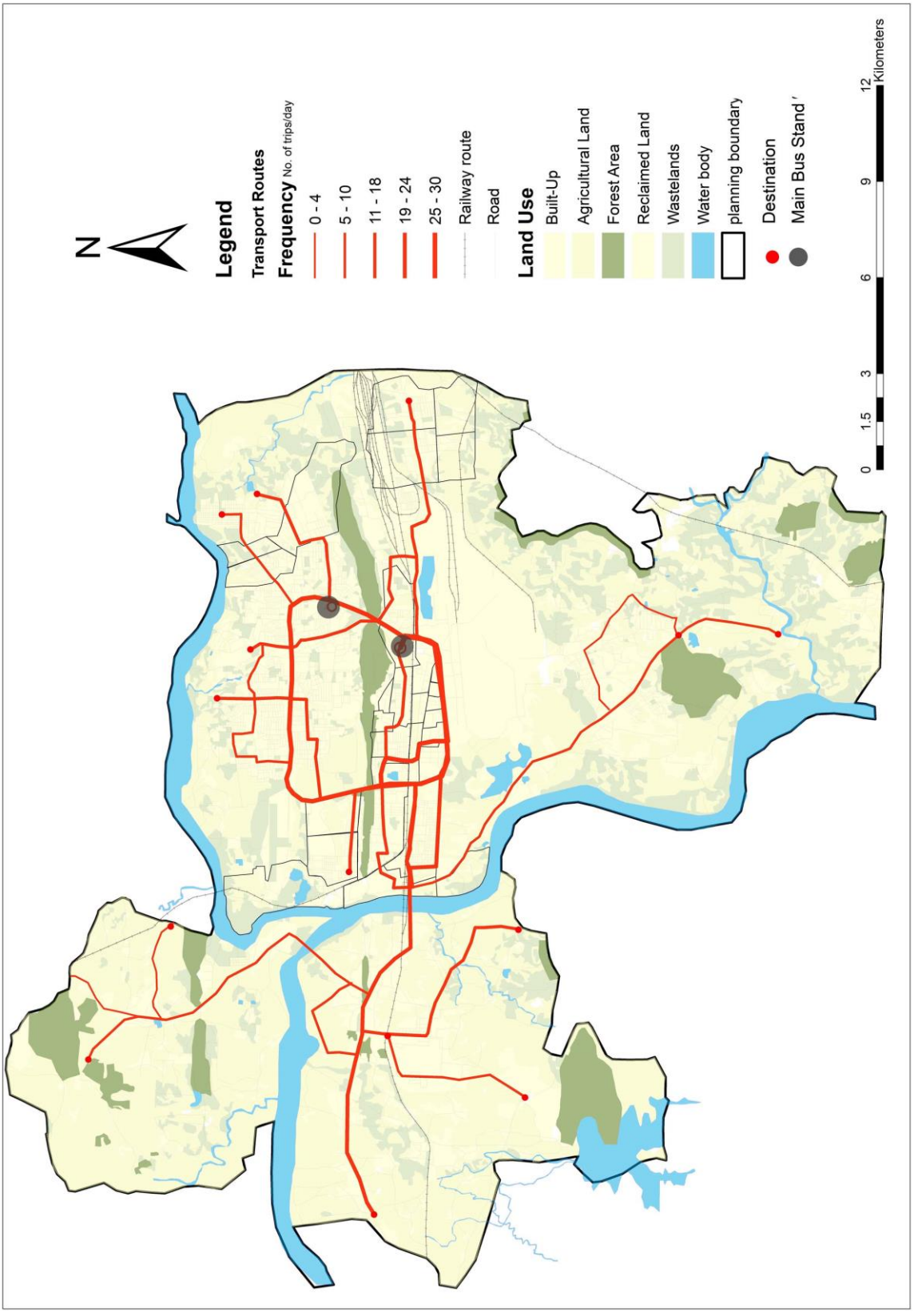


Figure 85 - Existing Public Transport routes in Rourkela

5.7.6. Non-Motorized Traffic Movement

Walk trips comprise nearly 38% of the total trips undertaken by people in Rourkela Town. Although there is quite high pedestrian volume in Bisra Chowk, Madhusudhan Chowk and Traffic Chowk, yet there is seen high traffic speed in these areas which is a cause of concern. Also, in Hanuman Chowk, the roads approaching it have pedestrian pavements, yet due to encroachments and high traffic speeds, there is low pedestrian count in the roads. Also, lack of detailing of kerbs on the pedestrian pavements and absence of zebra crossings poses a great threat to lives of pedestrins while crossing the road. Recently, a foot-over-bridge has been constructed near IG Park for convenient tourism movement in the area, bus there is lack of accessibility in areas like Bisra Chowk where the traffic count is significantly high.

In terms of road infrastructure with respect to seggregation of traffic, the same road is used by high speed vehicles(cars, trucks), two wheelers, animal driven carts, cyclists, pedestrians and sometimes even by animals. This creates traffic chaos by increasing traffic time and induces congestion even when the Volume/Capacity ratio is under acceptable limits. Considerable shorter distances(within 5km) in the town are travelled preferably by bicycle. Due to high average traffic speeds observed in the major main roads in the study area, it is essential to seggregate the traffic between motorized and non-motorized transport and also introduce traffic calming measures in main roads.

5.7.7. Vehicular Growth Pattern

Figure 86 shows the vehicular growth trend of various types of vehicles registered in the town from 2002 to 2012. It indicates an uniform registration of vehicles over this perios of time for all vehicles types except Heavy Goods Vehicle, In case of Heavy Goods Vehicles, there can be seen a sharp decrease between 2007 and 2009. This was mainly due to closure of various sponge iron factories in the region, as well as entry of private parties in the freight movement market.

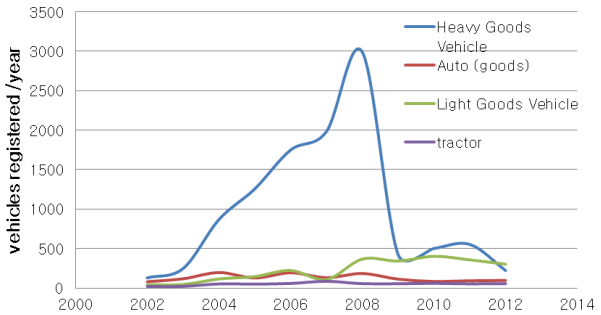


Figure 86 - Vehicles Registered: Goods Transport(Source : RDA)

Figure 87 and 88 show the growth trends of various vehicles registered under the Passenger Transport and Non- Transport categories. The trend of growth in case of private autos has

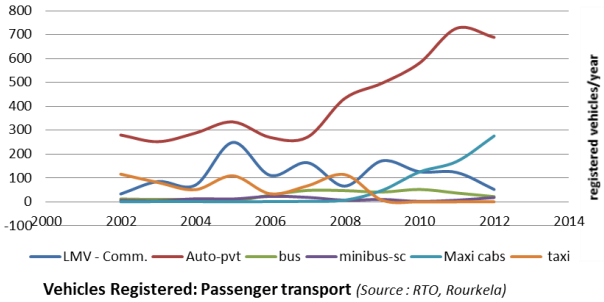


Figure 88 - Vehicles Registered- Passenger Transport(Source : RDA

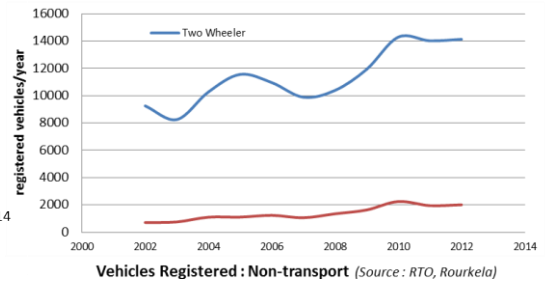


Figure 87 - Vehicles Registered -Non=Transport(Source: RDA)

been growing steadily since 2007, while other public transport like buses and taxis have stayed constant. This can be attributed to two basic factors, increase in per capita income of people in this period has made autos more affordable. Secondly, autos are considered more convenient since they can provide more accurate service and save time. Hence autorickshaws are the most preferred mode of public transport in the town. Apart from this, in case of private transport vehicles, it can be see that while there is a steady increase in two-wheelers, the registration for cars have been constant. While the situation is not so alarming, the public transport have to be augmented in order to cater to the needs of the economically weaker section of the population since they cannot afford autorickshaws throughout the month. They have to resort to Non Motorized Transportaton systems, but the current road infrastructure is simply inadequate to support proper movement of Non Motorized Transport vehicles.

5.7.8. Modal Split

Figure 89 alongside shows the modal split for work trip, educational trip and market trip obtained through household survey in the study area. It is observed that most of the trips to workplace are by two-wheelers, while in case of education trips, the modes are rather well distributed. In case of market trips, it is seen that people prefer to walk to the shopping facilities, which suggests that the market places in the neighbourhood satisfy theneeds of the residents.

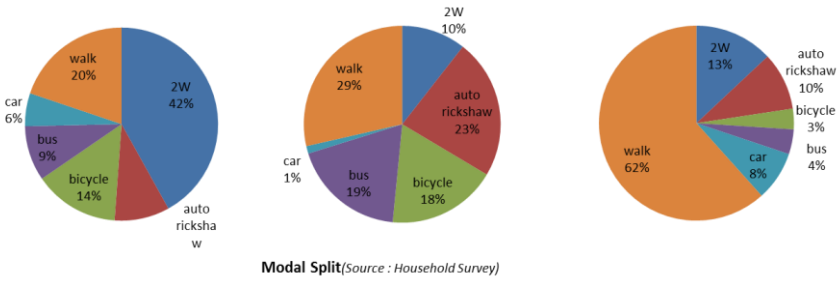


Figure 89 - Modal Split(Source: Household Survey)

Some observations are given below;

- The use of public transport is very low among the residents in case of work trips and market trips.
- Percentage share of Non Motorised Transport vehicles in all these cases is significantly higher, hence there is need to enhance road infrastructure according to the Non Motorised Transport vehicles' needs.

5.7.9. Parking

In order to cater to the increasing demand in the town especially in the Panposh Road which is without proper parking lots, the Municipality has proposed parking lots at five locations along the entire stretch. The proposed Parking lots by the Municipality are at:

- Powerhouse road
- Plant side road
- Anand bhawan lane
- Station road
- Old Station road

Apart from this, on-street parking is a regular phenomenon throughout the study area, especially in the commercial areas. Also, there is a high possibility of rejection in the existing market places and transportation hubs like Railway Station and Bus Stand, especially in peak hours. New parking lots need to be proposed near commercial spaces to reduce on-street parking

5.7.10. Accident data

Figure 90 shows the number of accidents between 2010 to 2012 in the town. The rate of accidents has been observed to gradually decline in this period.

Some of the most accident prone areas in the study area are as follows:

- NH 143 or NH 23: Jalda-Chandiposh- Deogaon route
- Road towards Sambalpur, near Vedavyas, specially near Nuangaon Tollgate
- 7-17 Chowk on ring road
- Chhend Colony Chowk on ring road

- DAV Chowk
- Hanuman Vatika chowk

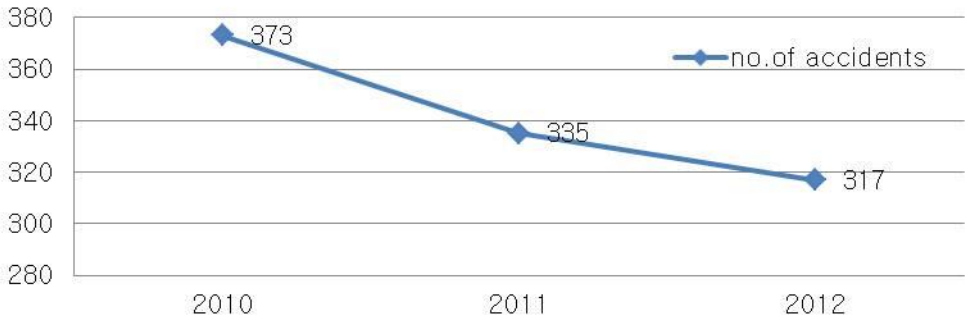


Figure 90 - Number of accidents between 2010 and 2012(Source : SP Office, Rourkela)

Some of the strategies in place in the current Trafic Management System are:

- Restriction on entry of goods vehicle into the town between 10am and 8pm
- One way traffic movement in Traffic Gate, Madhusudhan Chowk and Ambedkar Chowk
- Deployment of 16 patrol vehicles, out of which one is solely for traffic issues.
- Awareness drives for public in schools and Nehru Stadium in the past year to prevent under age driving.

5.8. Institutions

Chart 4 below shows the various stakeholders involved in development work in the town. Rourkela was declared as Notified Area Council as per Notification No. 6400 dtd. 28.07.1955 of the Health Department in 1955. Thereafter, the NAC was bifurcated into two NACs i.e. Rourkela Civil Township and Rourkela Steel Township in Notification No. 6211 dtd. 17.06.1963 of the Housing and Urban Development Department. In 1998, the NAC Civil Township was declared as Municipality and started functioning w.e.f. 19.09.1998 with an area of 19.78 sq. km comprising of thirteen revenue villages. The population of the Municipality prior to the amalgamation of the smaller urban area of the defunct NAC(ST) as per 1991 Census was 1,40,992. The Government declared major portion of the erstwhile NAC(ST) as Industrial Town and the remaining area to be amalgamated with Rourkela

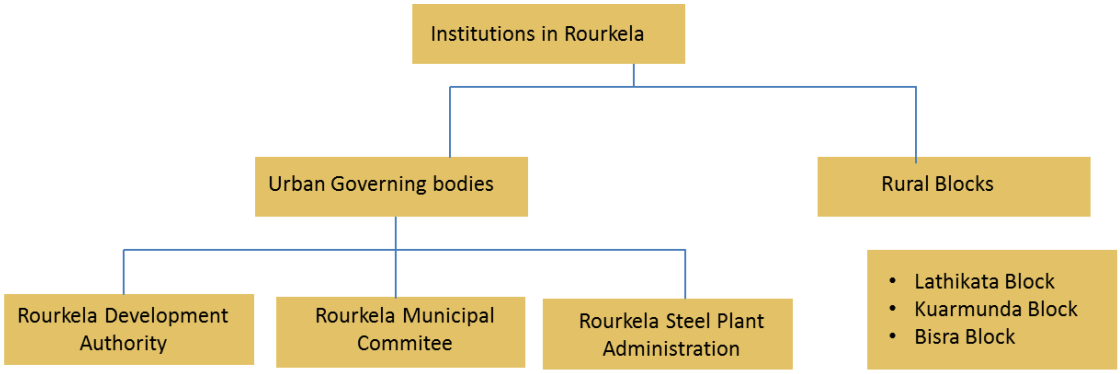


Chart 4 - Various Stakeholders in Rourkela

Municipality. After amalgamation, the population of the Municipal Town was 2,24,987(2001 Census) and an area of 31.6 sq. km. Presently, the Rourkela Municipality has a population of 2,73,040(as per 2011 Census) consisting of 33 wards and 13 Revenue Villages. The names of the thirteen Revenue Villages are stated as follows:

- Pradhanpalli
- Chhend
- Tarkera
- Udtam
- Dumerta
- Bankia
- Panposh Town
- Durgapur
- Barkani
- Bandhposh
- Raghunathpalli
- Mahulpalli
- Bondhamunda

5.8.1. Rourkela Municipality

Municipality started functioning from 1998 with an area of 19.78 sq.km comprising of 13 Revenue Villages. Currently, the population of the MunicipalTown is 2,73,040 consisting of 33 wards.

Aims and Objectives of Municipality

To look after the health, sanitation, water supply, roads, safety and public convenience of the citizens of the urban inhabitants. This includes improvement and upgradation of the socio-economical status of the urban poor.

Functional Structure

Some of the basic Responsibilities of the Municipality are:

- Basic services within the town such as Solid Waste Management, improvement of roads, drainage, street lighting.
- Preventive health care and sanitation
- Implementation of slum development
- Birth and Death Registration
- Development and maintenance of parking, plantation of green spaces as well as commercial markets

Issues

- There is lack of co-ordination among various authorities in Rourkela town viz. Rourkela Municipality, Rourkela Steel Plant and Rourkela Development Authority.
- After amalgamation of the major portion of the N.A.C.(S.T.) with Rourkela Municipality, the N.A.C. Office is still functioning as N.A.C.(S.T.), which is causing administrative inconvenience and which is not audited till date.

Financial Structure

Figure 91 shows the budget estimates for consecutive financial years 2010-11, 2011-12 and 2012-13. The income receipt and expenditure has increased in the last three years, and also there is nominal increase in the opening and closing balance.

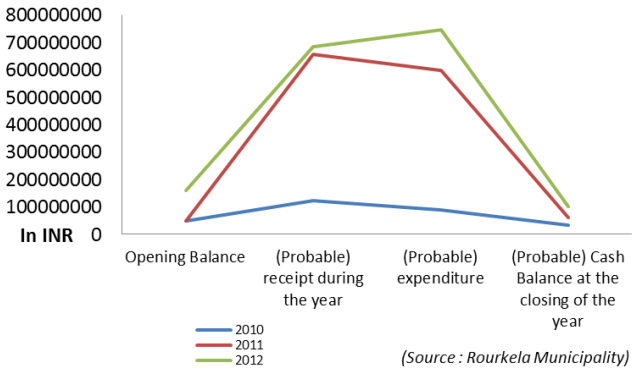


Figure 91- Budget estimates of Municipality

Taxation

As per the Orissa Municipal Act, 1950, the Municipality has got powers to levy the tax on the following:

- Property tax
- Profession tax
- Tax on Animals and Vessels
- Show Tax
- Advertisement tax
- Tax on woods which are brought to the sales with ULB.
- Special charges in transfer of properties

Figure 92 shows the various sources of revenue of Rourkela Municipality

- Holding tax
- Light tax
- Water tax
- Advertisement tax
- Fees from bus stand
- License fee

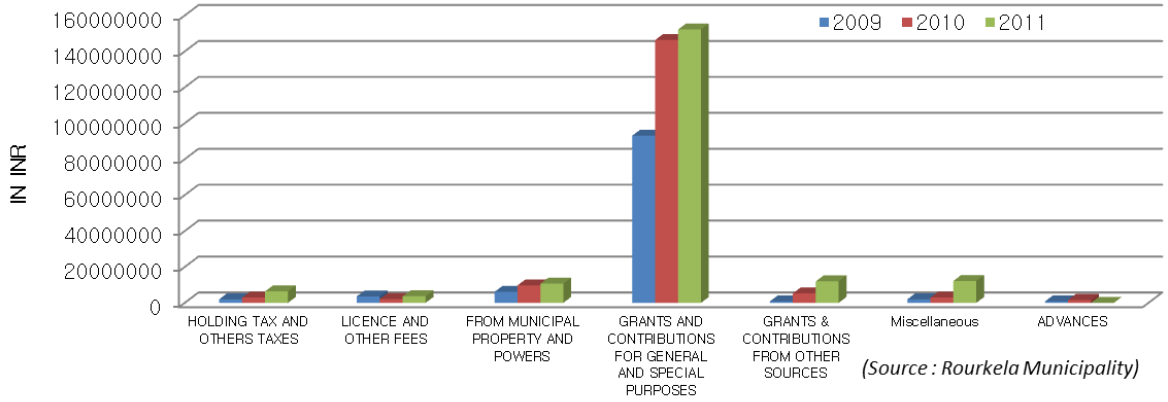


Figure 92 - Sources of Revenue of Municipality

Table below shows the list of various Government Aids under various schemes under the Central and State Government

SL. NO	NAME OF SCHEME	Amount balance as on 21.04.11
1	P.L.ACCOUNT (Profit Loss Account)	Rs7,17,63,121.00
2	B.R.G.F (Backward Regions Grant Fund)	Rs1,83,02,772.00
3	I.H.S.D.P(Integrated Housing and Slum Development Programme)	Rs56,81,400.00
4	W.O.D.C. (Western Odisha Development Council)	Rs1,06,45,629.00
5	ACA TOURISM (Accessible Culture for All, International Project)	Rs1,24,82,473.00
6	MPLAD (Member of Parliament Local Area Development Scheme)	Rs65,61,575.00
7	MLALAD (Members of Legislative Assembly Local Area Development)	Rs11,60,000.00
8	12th finance	Rs3,48,99,113.00
9	13th finance	Rs16,75,701.00
10	Road development	Rs1,32,82,087.00
11	Rajiv Awas Yojana	Rs23,00,000.00
12	TOTAL	Rs17,87,53,871.00

Table 28 - List of Government aids in Rourkela

Tax Collection Efficiency

Table 29 below shows the tax demand and collection in the years 2010-11 and 2011-12.

		Collection upto March 2011			Collection up to March-2012		
		Arrear	Arrear	Arrear	Arrear	Current	Total
1	Holding	1404131	1917522	1917522	1917522	2215174	3619305
2	Light	1404131	213058	213058	213058	2215174	3619305
3	Water	334368				756569	1090937
4	Drainage	209785	0.00	0.00	0.00	491933	701718
	Total	3352415	2130580	2130580	2130580	5678850	9031265

Table 29 - Tax collection by Municipality for 2011 and 2012

The Collection Efficiency is calsulated using the formula below:

$$\text{Collection Efficiency(CE)} = \frac{\sum \text{Actual Collection}}{\sum \text{Total Target Collection}} = 33.54\%$$

The revenue from holding tax and Light Tax have increased sharply between 2010 and 2012, yet there is still plenty of scope for increase in revenue from other sources. The tax collection

efficiency currently is very low, which indicates lack of proper management of tax administration.

Expenditure

Figure 93 show the various areas of expenditure by the Municipality between the years 2009 and 2011. It is seen that there has been an increase in expenditure in 2011 in Conservancy and Public Works, where as there has been very low investment in the Health Sector by the Municipality. Also, there has been a sharp rise in the expenditure towards Extraordinary and Debt in the year 2010-11. Expenses on debts in one financial year seems to be very high and hence need careful planning.

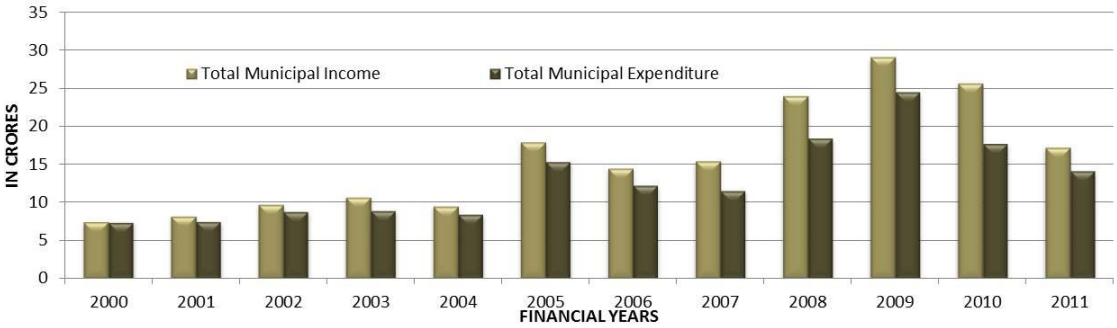


Figure 93 - Expenditure pattern of Municipality

5.8.2. Rourkela Development Authority

The Rourkela Development Authority(RDA) was constituted with effect from 02.10.1995 with its jurisdiction over developed areas of Rourkela Civil Township, Rourkela Industrial Complex, Rajgangpur, Biramitrapur and Sundergarh. Current master plan boundary has subsequently included Jagda, Jalda, Lathikata, Kalunga, Chikatamati and Kuarmunda and has been named as Rourkela Industrial Complex. The master plan prepared in 1966 is obsolete. Currently a C.D.P. for Rourkela Industrial Complex is under progress. RDA Building Bye laws have been prepared by the RDA and is effective in the study area.

Financial Structure

Figure 94 shows the actual budgets and estimate for the year 2009-12 and 2012-13 respectively. It shows increase in revenue receipt between 2010 and 2012. There has been introduction of expenditure for construction of parks and greenery in 2012-13. There has been an increase in expenditure for investment in bus terminal.

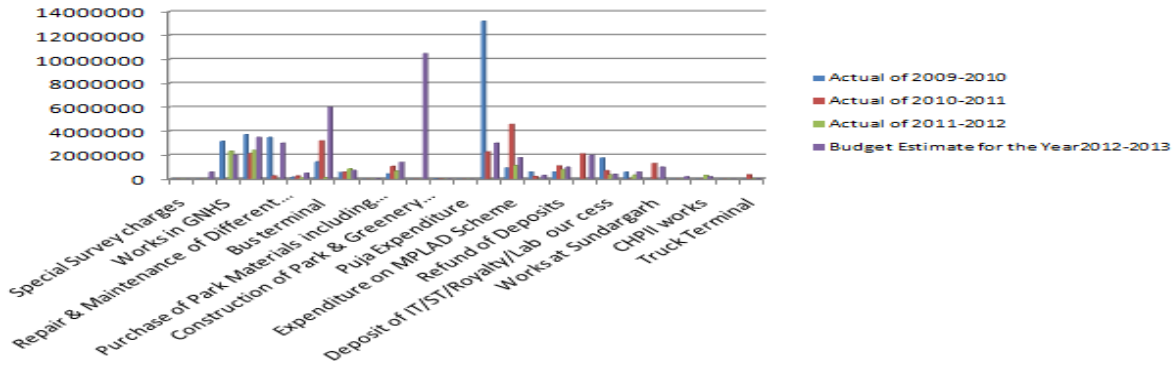


Figure 94 - Budget and estimate of RDA

Building Regulations

The Building Regulations and Standards have been proposed by the Rourkela Development Authority and is effective in the study area. The Regulations are based on zoning as per the old master plan and also control the F.A.R. , height of buildings and set backs in plots as per the abutting road width and size of plot. However, there is serious lapse in implementation process due to which deviations and encroachments can be seen in many residential and commercial areas throughout the study area. Hence, the regulations need to be local area based based on the type of built form desired in various parts of the town.

Apart from this, additional regulations related to urban design guidelines such as pedestrian pathway, cycle tracks, green spaces etc. should be added in the regulations in case of large housing projects to ensure more controlled development in the future.

Issues

- There is mismatch between functions and finances of Municipality and RDA
- Current Master Plan for the Planning area is obsolete, and the decision making is hence unscientific and not systematic
- Under spending of certain funds is a cause of concern and shows lack of vision and clarity of the authorities

5.8.3. Schemes under Rourkela Municipality

a) Urban Poverty Alleviation

- This is a Centrally sponsored scheme with financial burden shared by the Central government of India and Govt. of Odisha in the proportion of 75% and 25% respectively.The following observations are made:
- There is underspending in USEP, STEP-UP Training, UWSP and UCDN projects under this scheme.
- Huge gap exists between amount granted and the expenditure

b) Integrated Housing and Slum Development Programme(IHSDP)

- The IHSDP project was sanctioned in order to provide infrastructure facilities in four slums viz. Khariabahal(21 d.u.), Kisantola(34 d.u.), Chhend basti(31 d.u.) and Bandhposh(38 d.u.). The project was technically sanctioned for Rs. 251.14 lacs. The following observations are made:
- The tender process could not be finalized due to non-participation and non-competition of bidders, wh ile on another occasion, the bidders quoted higher rates than the sanctioned amount
- Execution of the project started with the cost of contract Rs.272.39 with hope that additional differential cost will be borne by the Government.
- 19 beneficiaries have been substituted due to land disputes and new benificiaries have been approved by the Municipality. The project is currently under progress.

c) Rajiv Awas Yojana

There has not been any progress in terms of execution in the study area under this Scheme. Recent developments include initiation of a slum profile, households profile and livelihood profile survey work taken up by ‘Shraddha’, an NGO.

d) Proposals under PPP Model

There are currently many proposals to develop three Integrated Commercial-cum-Residential complexes in PPP mode in Rourkela. The activities are to be carried out by the company Ernst & Young which will provide assistance in selection of a private developer for the construction work.

5.8.4. Projects under RDA

The following projects have been proposed under RDA in its jurisdiction area;

i. Housing Scheme on Government land at Post Mortem House
   - Area = 8 acres
   - Present Status : RDA has applied for transfer of this land to its name, but project has not been initiated yet.

ii. Housing Scheme at Chhend Colony
   - Area = 108 acres
   - Present Status : Currently approximately 30 acres of the concerned land is partially encroached. RDA has applied for lease of 60 acres of land to the Land Acquisition Committee but it has not got approval yet

iii. Central Park Development at BSNL Square, Chhend Colony

Government has released Rs. 1.25 cr. For utilization in construction of compound wall of Government land and also partly for the development of parks in various parts of the town. Later, it was proposed to club all the funds and invest in one project i.e. Central Park at BSNL Square. After transfer of land to RDA by the Revenue Department, work has commenced in the area in 2014.

iv. Development of Truck Parking Area
   - Area = 2.20 acres
   - Current Status: Presently, an area near Panposh Chowk has been earmarked by RDA to avoid on-street parking of trucks. A detailed concept has been prepared by the Planning Section and is currently pending approval from the VC, RDA. RDA has already deposited Rs. 20 lacs with the Revenue Department in 2011 and is under the possession of the land. The land is currently utilized as a Truck Parking but lacks other facilities.

CHAPTER 6: ANALYSIS

This chapter deals with analysis of primary data as well as calculation of carrying capacity of the thirty-three wards in the study area. Based on the figures after calculation as well as spatial analysis done in GIS, a land use map has been proposed for the region for the year 2031.

6.1. Primary Survey data analysis

As discussed in Section 1.8 of this report regarding the sample size adequacy, the required number of responses was 123. Apart from household survey done in 88 households in the survey area(results have been discussed in Chapter 5 earlier), an online questionnaire was prepared and mailed to 150 respondents between November 2013 and March 2014. The total number of valid responses received was 134, which is more than the required number of responses discussed earlier. In order to get to know about the public opinion regarding the existing conditions in the town as well as performance of the Municipality and other authorities, respondents were asked to rate on a scale of 1 to 5 various attributes according to their satisfaction levels and personal opinions. For analysis, weightage was given to each response(5 to most satisfied and 1 to very poor), and a cumulative weighted mean was calculated for each attribute using the formula as below:

$$\text{Z Score} = \frac{\sum(N \times W)}{S},$$

Where, Z = weighted mean

N = Number of responses for a category

W = Weight assigned to each category

S = Total number of responses

After calculation, the mean of the dataset was calculated as 3.189, while the standard deviation was 0.38. Based on this the grading scheme was prepared linking the Z scores with Level of Service(LOS) for qualitative analysis of the data. Table 30 shows the grading scheme adopted for this analysis.

Range	Level of Service(LOS)	
> 3.95	A	Highly Satisfactory
3.58 to 3.95	B	Satisfactory
3.20 to 3.57	C	Average
2.81 to 3.19	D	Not satisfactory
< 2.81	E	Poor

Table 30 - Grading Scheme adopted for the study

The results of the analysis are shown below in Table 31.

Existing Situation(Peoples' opinion)

Attribute	Z Score	LOS
Road Condition and Safety	3.00	D
Access to pedestrians and cyclists	2.88	D
Street Lighting	3.52	C
Parks/Playgrounds conditions	2.63	E
Cleanliness	3.11	D
Healthcare facilities	3.11	D
Educational facilities	3.81	B
Shopping facilities	3.51	C
Conditions of drains	2.81	D
Traffic and Congestion	3.51	C

Performance of Municipality(Peoples' opinion)

Attribute	Z Score
Road Condition and Safety	3.89
Access to pedestrians and cyclists	3.55
Street Lighting	4.10
Parks/Playgrounds conditions	3.55
Cleanliness	3.78
Healthcare facilities	3.88
Educational facilities	4.48
Shopping facilities	4.04
Conditions of drains	3.41
Traffic and Congestion	3.92

Table 31 - Z-Score values for existing situation(a) and performance(b)

The results show that peoples' opinion regarding existing conditions of most of the attributes are fairly poor, especially in case of Parks and playgrounds which was assigned LOS E which is really poor. At the same time, the public opinion regarding performance of the Municipality in tackling these issues currently is fairly better, with opinion showing better performance levels especially in terms of Educational facilities, Street lighting and Shopping

Future Priority(Peoples' opinion)

Attribute	Z Score
Improving Road Infrastructure	4.63
Improving Healthcare facilities	4.67
Improving Educational facilities	4.63
Cleanliness	4.29
Slum upgradation	4.89
Development of parks and green spaces	4.67
Improving Road Safety	4.59
Developing Tourism	4.29

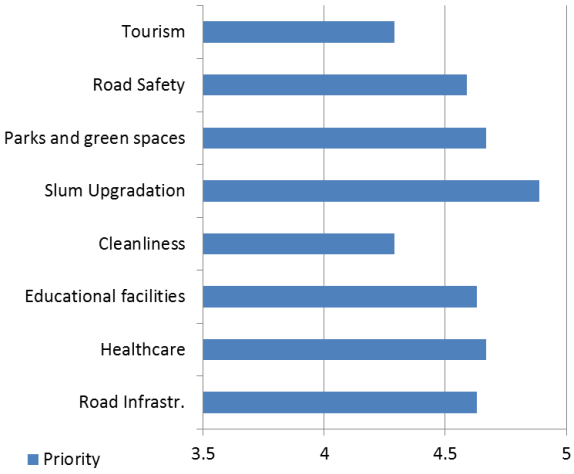


Table 32 - Z Scores for peoples' opinion for future priority

facilities. Also, the respondents were queried about what should be the priority of the Municipality in the future works undertaken by it, in which the highest Z score was shown in slum upgradation follwed by fairly equal scores for road infrastructure and safety, health and parks and playgrounds. These findings match those of the secondary data analysed before in which there could be seen quite a gap between expenditure in these areas by the authorities.

Some of the findings of this analysis are:

- Need for better schemes for slum upgradation works in the study area to tackle the problem of such a high slum population.
- There is need to improve the conditions of existing parks and playgrounds in the residential areas like Chhend Colony, Basanti Colony, Bondamunda etc where these are lying in neglect since a decade.
- There is an increased awareness regarding lack of green and open areas in the study area, hence there needs to be a proposal for a green corridor to balance the high density development in the Municipal colonies.
- The access to pedestrians and cyclists is 'not satisfactory', and hence needs to be augmented in the future.

6.2. Carrying Capacity Assessment

Ward wise analysis was done by calculating the carrying capacity as per the existing infrastructural levels. The approach is similar to the approach of finding the population holding capacity of an area. The approach aims to find how much population each ward can carry according to its present state of infrastructure and amenities. Once, the carrying capacity of the ward is known, we can then identify all those wards which have already exceeded their carrying capacities. Based on the identification, strategic interventions have been proposed later in the report.

The following framework for calculation of carrying capacity was implemented:

1. Delineation of the study area
2. Demarcation of developable and non-developable area using GIS (non-developable areas include areas with high slope, forest areas, wetlands, drainage channels, water bodies, depressions etc.)
3. Determination of area used for development of infrastructure and facilities.
4. Calculation of available residential area.
5. Calculation of Carrying capacity using the following formula.

$$\mathbf{CC = A_u - (A_{nd} + A_{if}) \times FAR/S}$$

Where CC = Carrying Capacity

A_u = *Total urban area*

A_{nd} = *Area non-developable*

A_{nd} = *Area for infrastructure*

FAR = Floor Area Ratio

S = Floor Area Requirement per head

Based on the above formula, the carrying capacity of each ward was calculated. A_{nd} *and* A_{nd} were calculated from spatial analysis using GIS tools. The existing maximum FAR and predominant building height in all wards has been shown in Figure 95 and Figure 96 respectively.

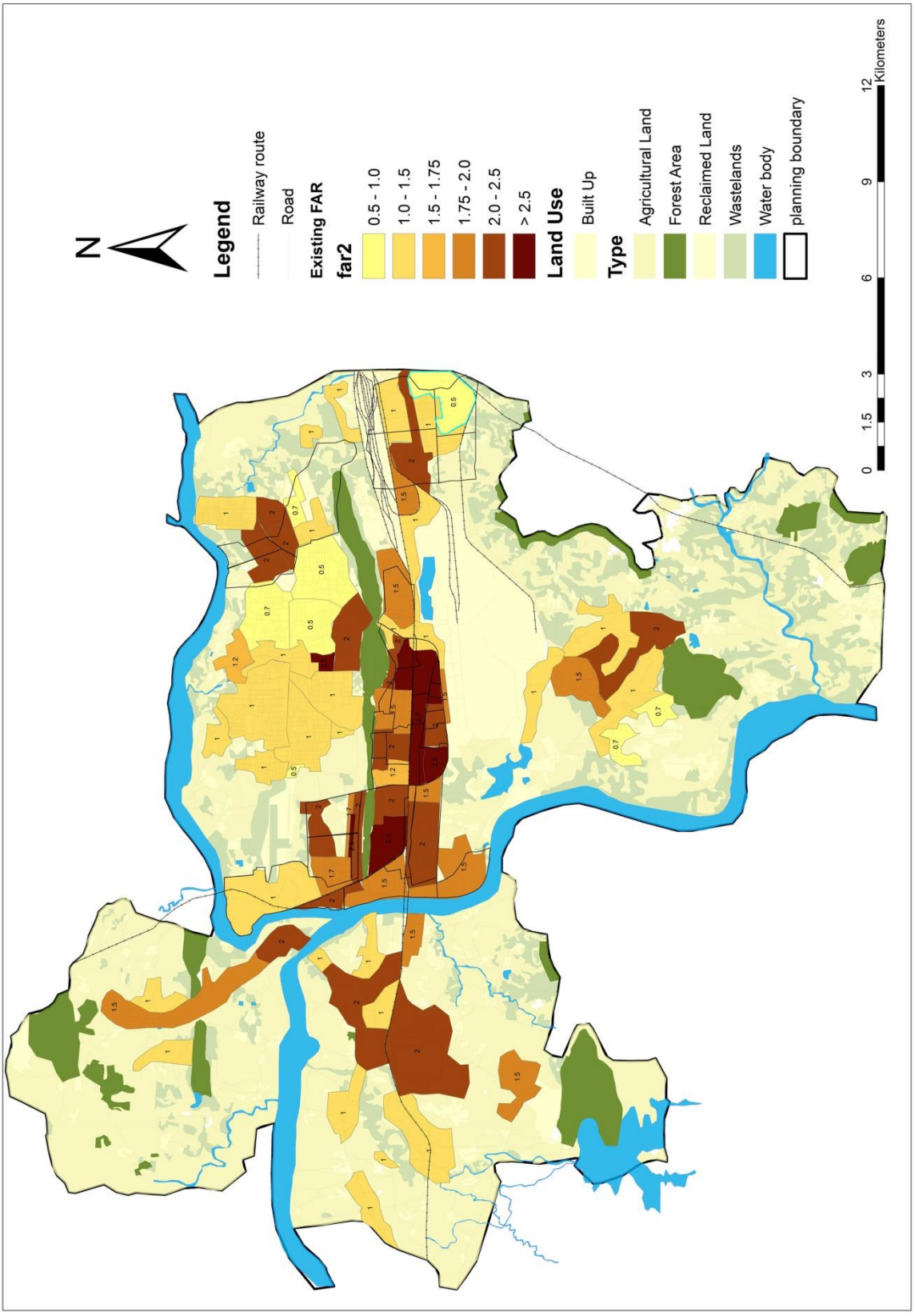


Figure 95 - Map showing existing FAR in the region

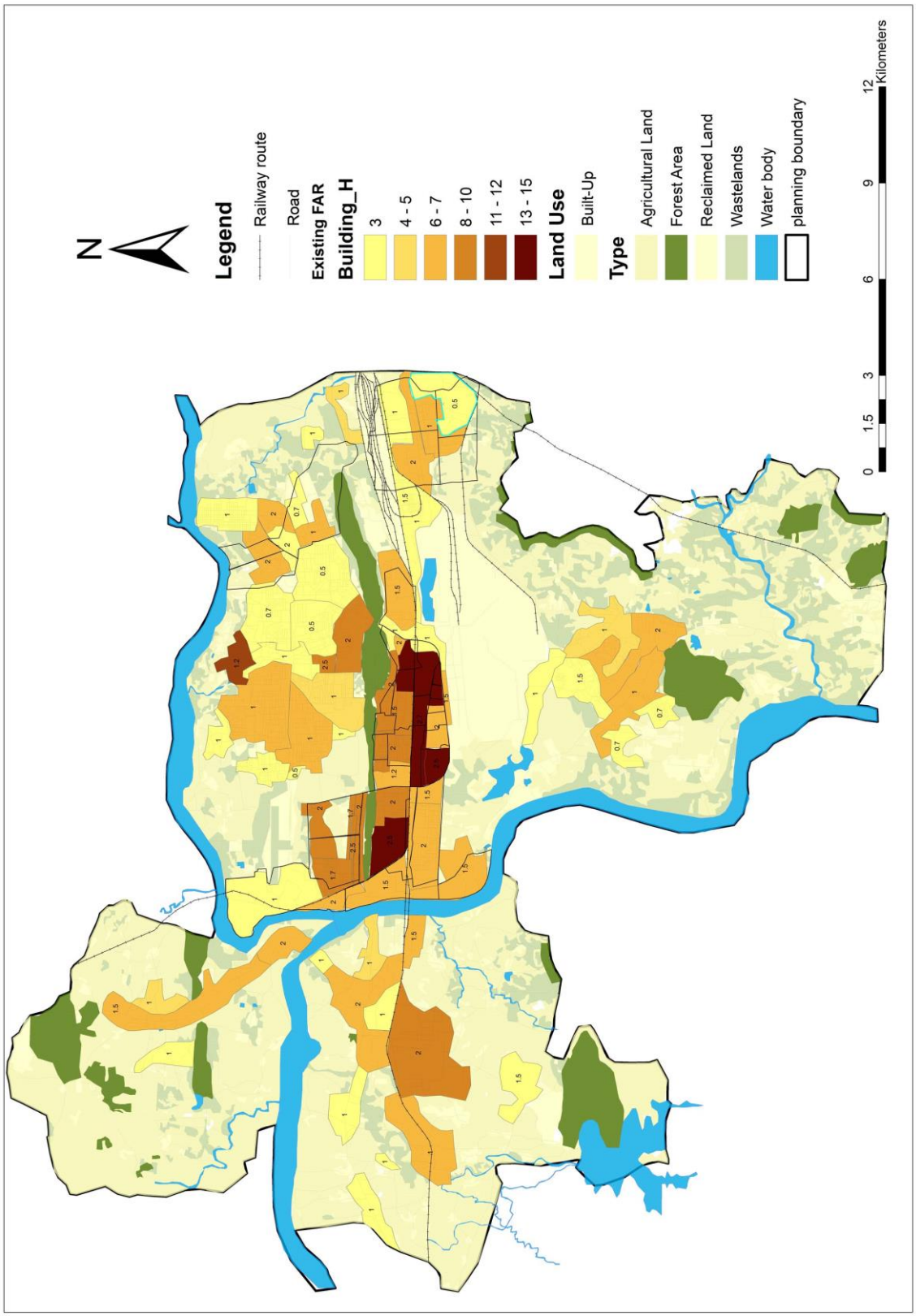


Figure 96 - Map showing existing height of built form in study area

Table 33 below shows the existing carrying of the thrity three wards along with a comparison with the existing population in each ward after calculation by using the formula given earlier.

Sl..No.	Ward	Area(Au)	Carrying Capacity	Population in 2011
01	1	3.1951	11289	7876
02	2	1.2825	2182	6356
03	3	0.8205	9460	14443
04	4	1.6191	30531	11518
05	5	0.4445	4340	9213
06	6	1.9637	10915	10716
07	7	0.4409	8410	7682
08	8	0.4753	12800	11582
09	9	0.1949	6998	10435
10	10	0.211	4117	10590
11	11	0.1426	3351	5917
12	12	0.6168	17733	9852
13	13	1.7494	14354	13659
14	14	0.314	13905	7586
15	15	0.1614	5031	5212
16	16	0.3578	4188	8382
17	17	0.4619	1979	4968
18	18	0.2655	8489	4281
19	19	0.1898	8654	6136
20	20	0.1411	6015	9462
21	21	0.1089	5451	5247
22	22	0.1013	5243	4530
23	23	1.6585	8090	4803
24	24	2.7934	18622	7316
25	25	1.1531	6040	5053
26	26	1.1577	3265	3590
27	27	0.9423	3575	6174
28	28	0.993	8846	7611
29	29	0.53	6568	7185
30	30	3.7514	10718	8467
31	31	0.9124	7038	10453
32	32	1.193	16776	12034
33	33	1.2637	45318	14711
		31.6065	310318	273040

Table 33 - Carrying capacity of wards

In the above table, the wards marked in red are the ones in which have exceeded the calculated carrying capacities. Some of the reasons in these wards are low infrastructure levels, increased urbanization and informal settlements specifically in these wards, low building heights and low FAR coverage. On the contrary, there are other wards which are relatively lesser population and can sustain population growth in the future. Strategies in the Development Guidelines can be changed in order to increase the quality of existing infrastructure levels in specific wards where the problem of increased population exists. Also, there is need to re-densify and de-densify certain areas in order to normalize the population densities while the new development approach is implemented.

CHAPTER 7 : FORECASTING

7.1. Population Forecasting

The forecasting has been done for the study area for the year 2021 and 2031 using the average of the calculation results from the four methods viz. Arithmetic Increase, Geometric Increase, Incremental Increase and Regression Method.

The results found from each of these methods are elucidated as follows:

Arithmetical Increase

The following expression has been used to calculate population by Arithmetic Increase method,

Population after n_{th} decade will be $P_n = P + n.C$

Where, P_n is the population after n decade and P is present population.

Thus, P_{2021} = 3,20,396

and P_{2031} = 3,67,752

Geometrical Progression

The following expression has been used for calculation by Geometrical Progression Method

The population at the end of nth decade 'P_n' can be estimated as:

$P_n = P (1+ I_G/100) n$

Where, I_G = geometric mean (%)

P = Present population

N = no. of decades

Thus, P_{2021} = 3,36,658

and P_{2031} = 4,15,099

Incremental Increase

The following expression has been used for calculation by Incremental Increase Method

Population after nth decade is $Pn = P+ n.X + \{n (n+1)/2\}.Y$

Where, Pn = Population after nth decade

X = Average increase

Y = Incremental increase

Thus, P_{2021} = 3, 21,791

and P_{2031} = 3,71,937

Regression

A linear regression model was made by assuming the population P in 2021 as dependant variable(y) and Area(A) & population in 2001(P_0) as independent variable.

Thus, $P = a_1 * A + b_1 * P_0 + c_1$

Where, P = Population in 2011

A = Area

P_0 = Population in 2001

a and b are coefficients of A and P_0 respectively, while c is constant for the linear equation.

From the model, the values of a, b and c generated were as follows:

a_1 =205.188

b_1= 0.8

c_1 = 2251.484

In doing the progressions for the years 2021 and 2031 respectively, it is assumed that the rate of change of population will follow the same equation till 2021. In case of calculation of $P_{2031,}$ further regression is done considering P_{2031} as the dependent variable while P_{2021} replaces the value of $P_{0.}$ Thus the new equation is

$P_{2031} = a_2 * A + b_2 * P_{2021} + c_2$

From the model, the values of a, b and c generated were as follows:

a_2 =219.108

b_2= 0.854

c_2 = 2404.226

Thus, P_{2021} = 2, 99,216

and P_{2031} = 3,59,130

Thus, the final average values of populations projected are as follows:

P_{2021} = 3, 19,515

P_{2031} = 3, 71,937

The final projected population for the study area as well as the Rourkela Metropolitan area was calculated by extending the same method for them. Table 34 shows the final population projections for the town.

Year	Population
	Municipal Town
1961	-
1971	-
1981	-
1991	1,78,329
2001	2,24,987
2011	2,73,040
2021(Projected)	3,19515
2031(Projected)	3,78,479

Table 34 - Projected Population of study area

The same methodology was adopted for all the wards. Table 35 shows the existing and projected ward-wise population in the study area.

	Population			Projected Population	
Ward	**1991**	**2001**	**2011**	**2021**	**2031**
1	4491	**5622**	7876	9832	12120
2	6249	**6174**	6356	8114	10133
3	6172	**7529**	14443	14922	16153
4	5024	**10790**	11518	12598	14246
5	4980	**6835**	9213	10372	11971
6	5654	**9720**	10716	11988	13777
7	6416	**11535**	7682	9063	10792
8	7368	**8493**	11582	12402	13805
9	6492	**7114**	10435	11361	12804
10	7159	**7846**	10590	11497	12930
11	7028	**5842**	5917	7490	9307
12	6986	**9745**	9852	10955	12536
13	6730	**9611**	13659	14456	15948
14	6533	**4841**	7586	8953	10664
15	5541	**5391**	5212	6892	8773

16	6355	**5911**	8382	9643	11295
17	4478	**3849**	4968	6749	8715
18	5015	**5905**	4281	6119	8102
19	5432	**6667**	6136	7687	9496
20	5467	**6888**	9462	10518	12032
21	4349	**4911**	5247	6910	8778
22	3957	**4827**	4530	6296	8223
23	4721	**4906**	4803	6870	9100
24	4115	**5572**	7316	9266	11518
25	4078	**5123**	5053	6973	9076
26	5495	**3439**	3590	5724	7953
27	4454	**7064**	6174	7884	9847
28	5219	**5754**	7611	9123	10974
29	5341	**6278**	7185	8658	10448
30	4925	**7636**	8467	10459	12813
31	8495	**7828**	10453	11533	13125
32	3610	**15341**	12034	12945	14460
33	-	**-**	14711	15248	16549
	178329	224987	273040	**319515**	**378479**

Table 35 - Ward-wise projection for study area

7.2. Forecasting of Demand of Infrastructure

The demand for the forecasted year 2021 and 2031 has been done after referring to the UDPFI Guidelines applicable as of today. Given below is the requirement of infrastructure for the forecasted years.

7.2.1. Water Supply

Current requirement of water supply @135lpcd = 36.86 MLD

Current Supply is 34 % of the requirement = 12.53MLD

Requirement of water supply for the forecasted years:

For 2021 = 43.13 MLD

For 2031 = 51.09 MLD

The benchmark set as per the Draft Sanitation Plan for Rourkela Town in 2011 is to achieve 40% coverage by 2012, which is 14.74MLD. Assuming an increase of 1 MLD every year, the

forecasted supply of water would be 23.7 MLD and 33.74 MLD respectively for the year 2021 and 2031 respectively. These figures are too low for the population projected earlier. Hence it is essential to formulate strategies to ensure that the town does not enter into a crisis in terms of water supply.

7.2.2. Solid Waste Management

The following is the calculation at three stages namely, waste generation, collection and segregation and finally the waste disposal.

Stage 1: Waste Generation (2010 Status)

- Domestic population generation (per capita) = 0.35 Kg (for slums: 0.20 Kg per capita per day)
- Domestic Population=224987x 350gm = 78.74mt
- Floating population (approx.) = 10.00mt
- Commercial units- = 30.50mt
- Total = 119.24mt

Stage 2: Waste Collection and Segregation (2010 Status)

Transported garbage:-

i. By Municipality -

Vehicle	Trips /day	Total Volume
Tipper-	5x4= 20trip	20x2.50=50.00 cum (mini tipper)
	1x4 -4trips	4x5.00 = 20.00cum (tipper)
Auto Rickshaw	9x6=54	54x0.50= 27.00cum
Tractor-	3X6=18 trip	18x1.50=27.00cum
		Total Volume 124.00cum
Density	@ 0.450Mt / Cum	Total Weight 55.80 Mt.

ii. Through privatization-

Tipper-	2x4= 8trip	8x5.00= 40.00 cum
Tractor-3	5X6=30 trip	30x1.50=45.00cum
	Total volume	85.00 cum
		Or 85.00x 0.450 = 38.25mt

iii. Total waste collected and transported— 55.80MT+38.25MT= 94.05MT

iv. Balance Waste to be collected and transported-- 24.95MT

Segregation is not practiced from the household level. However Construction waste is separated and recyclables are segregated before the transfer stations

- Waste collected & transported = 94 MT
- Waste sent to Transfer stations = 62.13Cum i.e. 27.95 MT = 28MT app (excluding construction waste)

10% reduction of waste after segregation = 0.1x 28=2.8 MT

Waste sent to Land fill site= 28-2.8=25.2MT per day

RSP area Waste:

- Waste sent to Landfill=60MT per day (majorly bio degradable and inert materials. Recyclables are separated off)
- **Total waste sent to landfill site=25.2+60=85.3 MT/day**
- Compacted waste density = 0.80 MT/Cum
- Final waste volume= 106.6 Cum
- Volume of Daily Soil Cover=0.33 x 106.6 = 35.54 Cum (Waste to soil ratio of 3:1)

Total volume of filling per day = 106.6 + 35.54 = 44.8 Cum/day

Tarkera Dam Site Area = 85 acres = 0.344 Sq. km= 3,44,000 Sq.m

Assuming a depth of 4m for the landfill site

Total Volume of Land Fill Site=1,720,000 cum = 1.376 x 10^6 Cum

Approximate years the site can be used = 1.376 x 10^6 Cum /(365 x 44.8) =84 years

This shows that the present land filling site size is adequate. However strategies need to be thought of in order to make sure that the environmental degradation does not take place in the nearly areas.

7.2.3. Educational facilities

Table 36 below shows the existing as well as forecasted requirements of Educational facilities as per the UDPFI Guidelines.

	Existing Requirements		Existing		Required 2021	Required 2031
	R.U.A.	Mun. Town	R.U.A.	Municipal Town	Municipal Town	Municipal Town
Nursery School	221	110	286	70	128	152
Sr.Sec	110	55	98	70	64	76
College	74	37	71	14	43	51
Tech. Univ.	01	01	02	01	01	01
Engg. Coll.	02	-	02	-	02	02
Medical College	02	-	-	03	02	02
Inst. For Diff. abled	06	-	-	01	07	09

Table 36 - Forecasting requirement of educational facilities in study area

It is seen that the educational facilities in the area are upto the standards, except from the Institute for Differently Abled. Hence, such institutes need to be proposed in the near future in the town.

7.2.4. Healthcare Facilities

Table 37 below shows the existing as well as forecasted requirements of Educational facilities as per the UDPFI Guidelines.

	Required		Actual		2021	2031
	Nos.	Beds	Nos.	Beds	Beds	Beds
General Hospital	03	900-1500	03	1294	1200	1500
Int. Hospital(Cat – A)	07	700-1400	01	120	700	700
Int. Hospital(Cat – B)	01	50-80	26	371	06	06
Polyclinic	07	07	23	DNA	07	07
Nursing Home	07-14	175-350	03	68	14	14
Dispensary	43	-	DNA	DNA	43	51

Table 37 - Forecasted requirements of Healthcare facilities

7.2.5. Social Infrastructure

Table 38 and 39 below shows the existing as well as forecasted requirements of Social Infrastructure facilities as per the UDPFI Guidelines.

	Required		Actual		2021	2031
	R.P.J	**Mun. Town**	**R.P.J.**	**Mun. Town**	**Mun. Town**	**Mun. Town**
Police Station	08	03	24	08	04	05
Police Post	13	06	-	-	-	-

Table 38 - Forecasted Requirements of Police Stations

	Required		**Actual**		**2021**	**2031**
	R.U.A.	Mun. Town	R.U.A.	Mun. Town	Mun. Town	Mun. Town
Fire Stations	04	02	04	02		
Community Hall	43	18	12	03	64	76
Library	43	18	08	03	21	25
Club	07	03	05	01	04	04
Music/Dance School	07	03	01	01	04	04
Socio-Cultural Center	07	03	02	-	-	-
Theatre	-	-	03	03	-	-
Spiritual Center	07	03	01	-	-	-
Cremation Ground	03	-	01	-	02	02

Table 39 - Forecasted requirements of socio-cultural facilities

Based on the requirements, various proposals and strategies have been formulated in the report which are discussed in the next chapter.

CHAPTER 8 : PROPOSAL

In this chapter, various proposals for the study area as well as for the region have been given in the form of spatial maps as well as broad strategies and policy guidelines. In certain wards where it is possible to further re-densify the area, proposal to amend the existing building regulations has been proposed. The study area is shown in five different zones – Zone A, B, C, D and E to give clear and detailed spatial solutions.

8.1. Proposed Zones

It is proposed that the solutions should be implemented as per five different zones in the study area. This will help deal with the existing local level problems of each zone with specific spatial as well as strategy that fits to a particular area while it may not for another. Figure below shows the five zones to be proposed in the area.

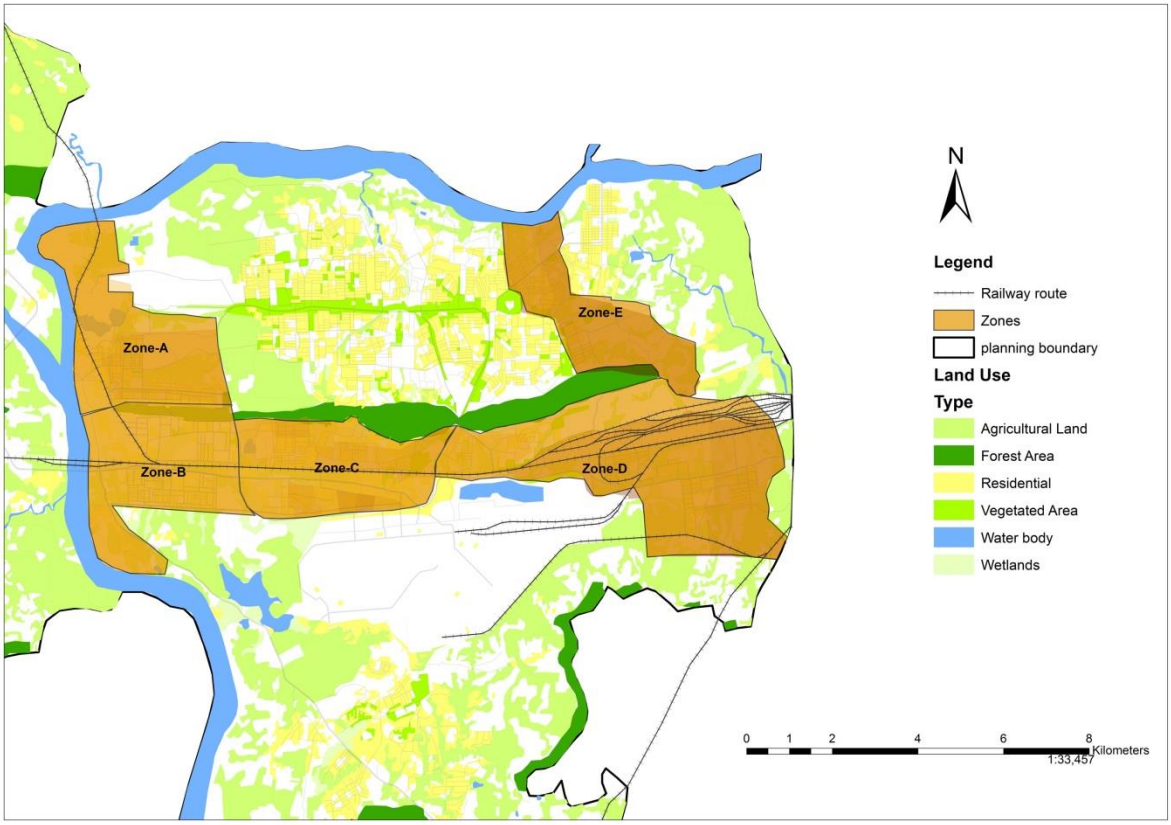


Figure 97 - Proposed Zones in study area

The proposals given in this report are for all five zones separately. It is essential that the zones have different building regulations and zoning . Following are the zones:

Zone A - area comprising of Chhend Colony area and area behind TISCO Khadan. This is predominantly a residential area with planned development on one side of the railway line and organic growth beyond the railway track. The density and population of both the wards of Chhend Colony are quite high. Hence infrastructure levels should be increased in the remaining areas beyond the railway line to attract the population in those places.

Zone B – area comprising Panposh, Civil Township area and Industrial Estate. This area is full of industrial activity with many small and medium scale industries functioning currently. Currently, new development is taking place since the last decade in areas beyond Panposh and along the river Brahmani.

Zone C – area comprising Basanti Colony, Uditnagar, Railway Colony, Daily Market etc. This is the busiest part of the town and is full of commercial activities. The Railway Station and the Main Bus Stand are located in this zone.

Zone D – relatively less developed area comprising of Bondamunda area and wastelands near OSAP hill.

Zone E – area containing planned areas of Koelnagar, Shakti nagar and National Institute of Technology area.

8.2. Land Use

Fig. 98 shows the proposed land use map for the study area for the year 2031. It is assumed that the Rourkela Steel Plant will develop a master plan for all the areas under its control for the same forecasted year. Hence strategic interventions have been proposed only in the study area specifically.

An attempt has been made to develop more residential and mixed use colonies near the river Brahmani. The future growth of the town is towards the river and hence it needs to be controlled from now. The environmental aspects of the area near the river after increase in population form the basis of this proposal. Although the present state of pollution levels in river Brahmani are within limits, this is expected to increase in the future. It is proposed that river Brahmani should be the main functional element of the town in the forecasted year. This approach will help in developing the river front in the future while normalizing the increasing densities near the Railway Station area. The idea is to not play catch up in terms of providing

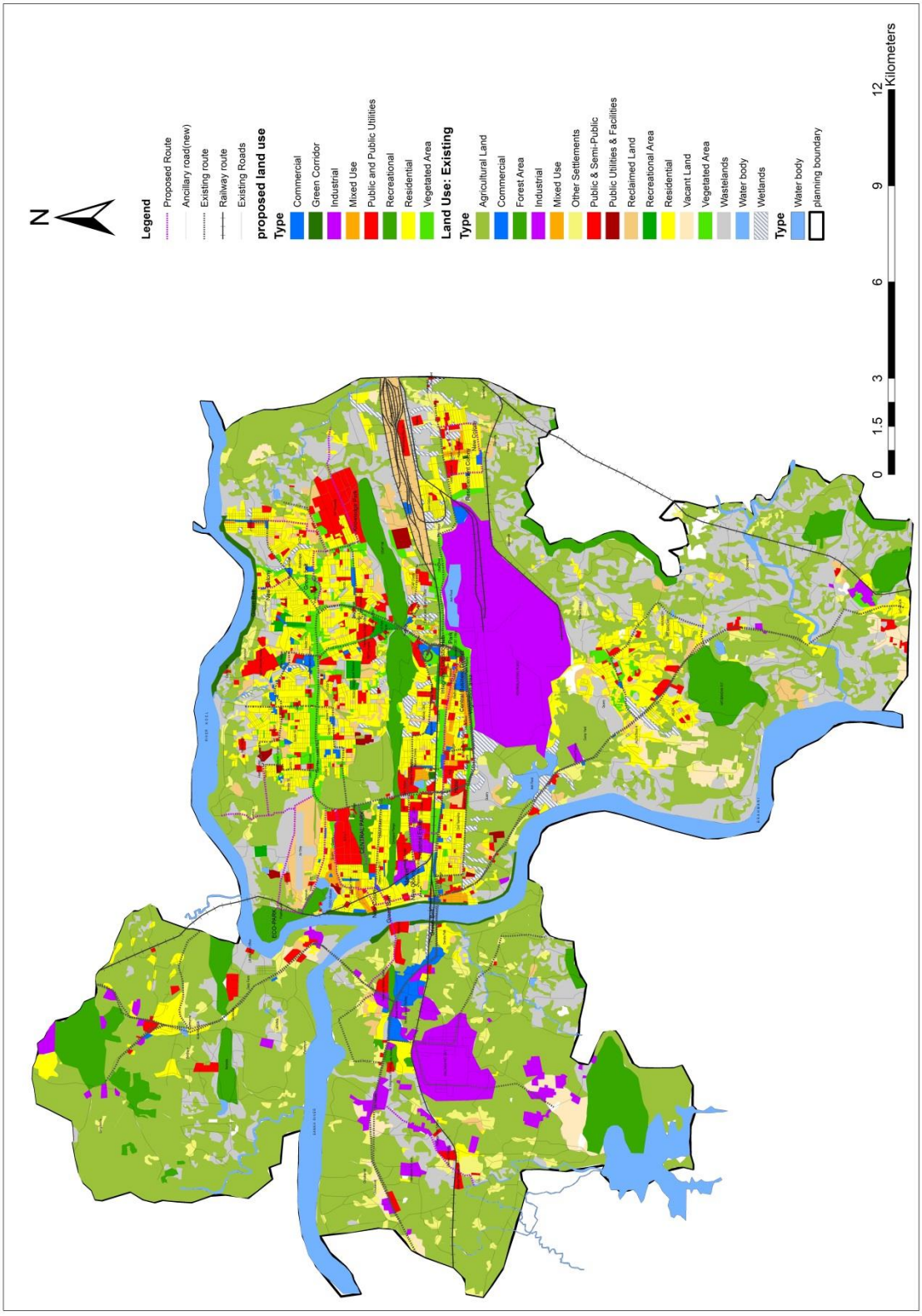


Figure 98 - Proposed Land Use Map for 2031

infastructure in existing areas but to develop new functional elements capable of attracting the population. Details of strategies proposed with land use map in each zone is given as follows:

Zone A

1. A Central Park should be developed in the area earmarked in the map. This area should be declared as a "no development zone". The area of the open space is nearly 86 hectares. Due to lack of breathing spaces in the recently developed colonies in Ward No. 32 and 33, coupled with haphazard development commencing in this area, it would render the whole zone cramped in a few years. Hence such development has to be stopped. With Central funding and with PPPs, a Central Park should be designed in the area.
2. Physical infrastructure to be provided for areas on the other side of the railway colony.
3. The main road of Chhend Colony to be extended across the river Brahmani through a bridge and eventually to meet the National Highway in Kuarmunda block. This will ensure more development along the transportation channel as well as reduce congestion on the lone bridge near Panposh.
4. The area beyond the TISCO Khadan is currenly lying waste although it is under the Municipality. An Eco-Park with an Ecological Museum to be developed in the area after feasibility report and due environmental clearances. This will result in generation of revenue for the authority in the long run as well as promote research in ecology in the region.

Zone B

1. The 7.5 km stretch of river Brahmani to be declared as a "no development zone" and a green corridor to be developed on 100 m on either side. This area will be developed for tourist activities while also checking the human intervention in the river once new colonies start to settle in the zone.
2. An industrial estate to be developed in this zone with focus on manufacturing sector and promotion of small scale industries. This is to be supplemented by a vocational training centre in the estate.

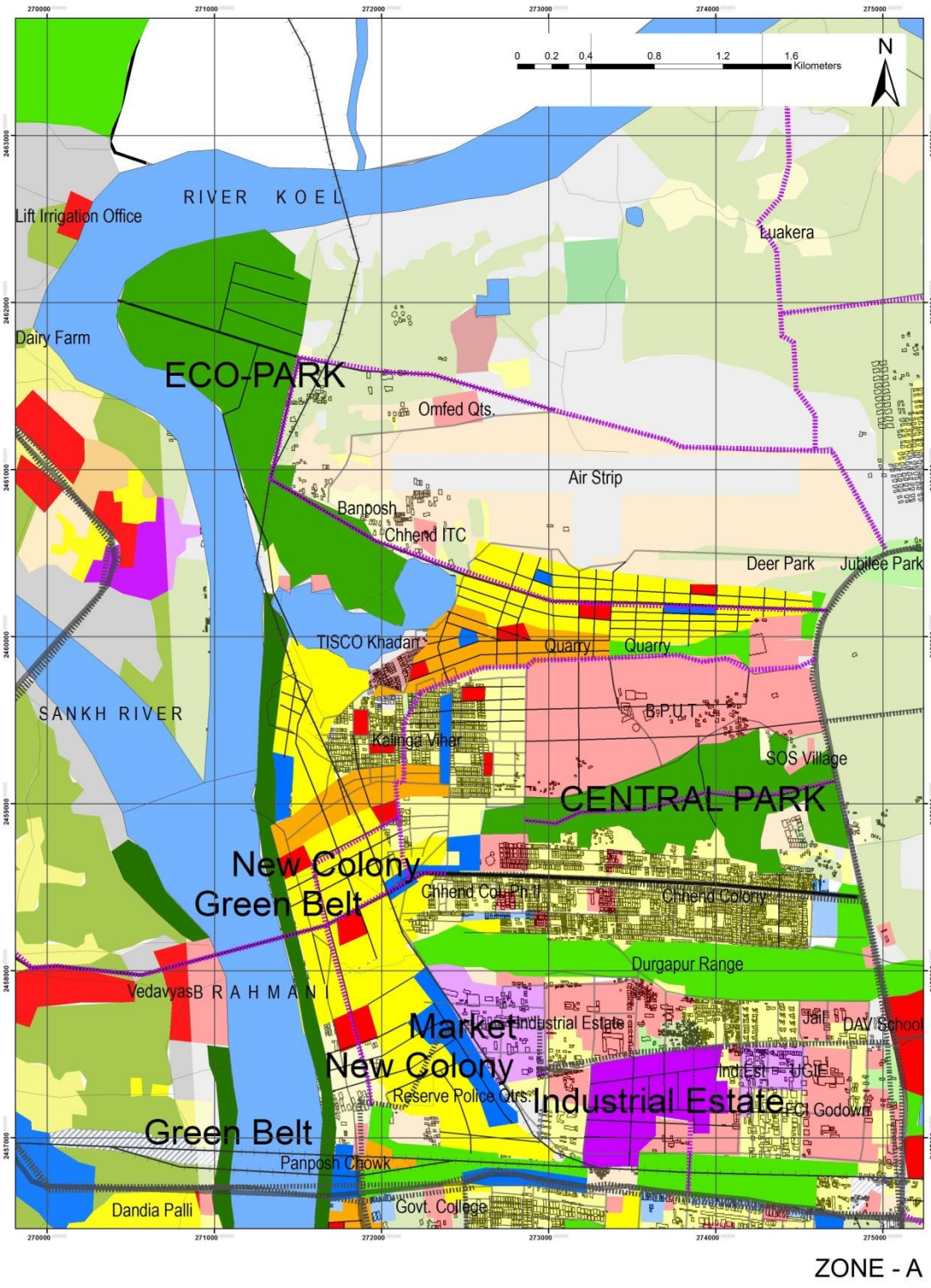


Figure 99 - Proposed Land Use map for Zone A

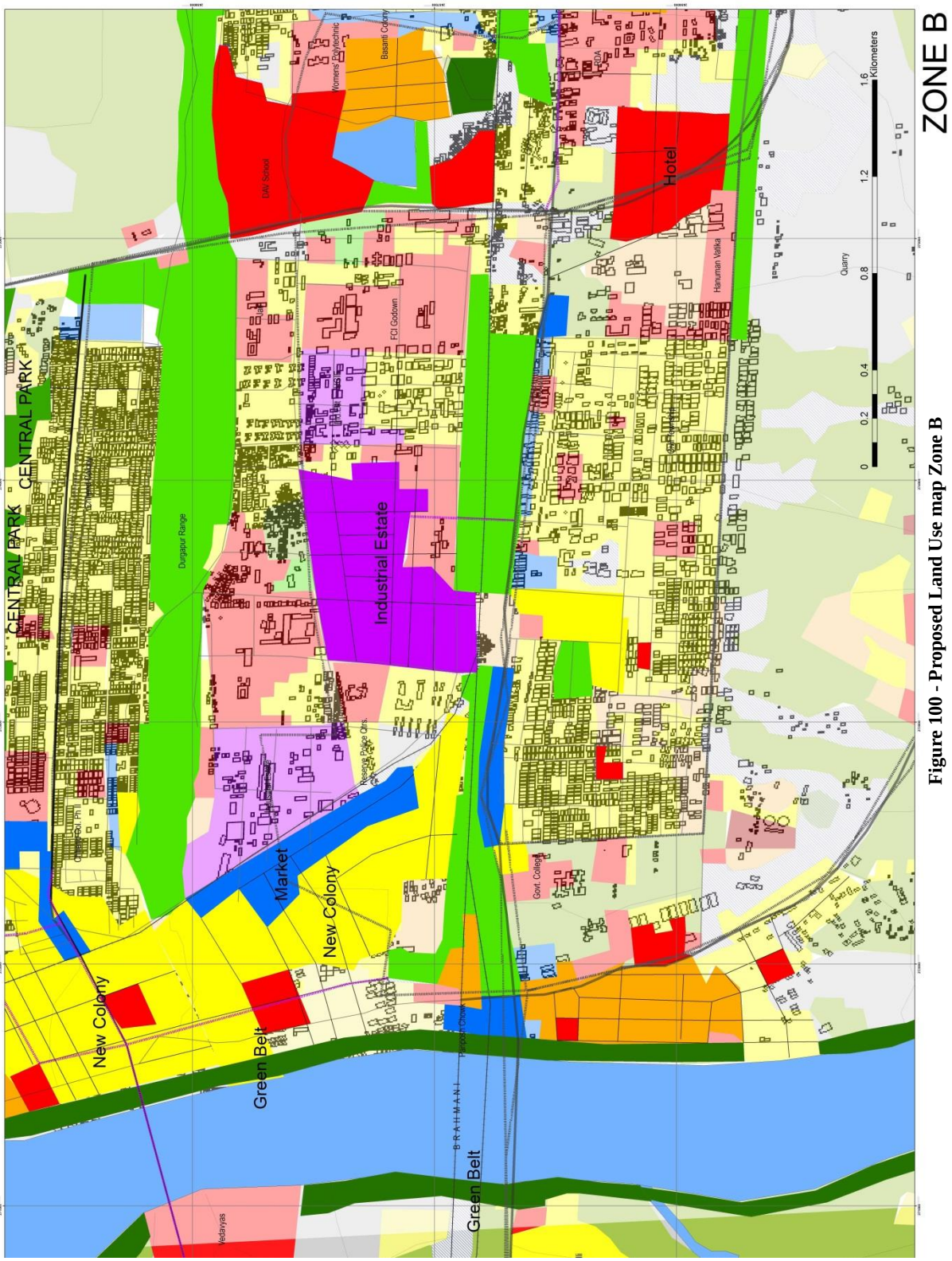


Figure 100 - Proposed Land Use map Zone B

3. New market to be developed in the Industrial Est. area to deal with the new residential development in the zone.

Zone C

1. The existing slums to be rehabilitated near Bondamunda area which is close to the RSP. More mixed use development to be initiated in the area in order to revitalize the area.
2. The wards 20 and 21 to be gradually developed into a Central Business district of the area.
3. A logistic hub to be created by integrating the services near the Railway Station and Main Bus Stand.
4. Guest houses and hotels to be developed near Hanuman Vatika area in PPP mode in order to promote tourism sector.

Zone D

1. A resettlement colony of area 92 ha. to be developed near Bondamunda which is at the same distance from the Steel Plant as earlier. Proper infrastructure to be developed in the area first.
2. A "Knowledge Park" to be developed in 52 ha. Area near NIT Rourkela to develop Rourkela into an educational hub in the region.
3. The slum areas previously to be converted into dense foliage vegetation of large canopy and resistant plant species like Acacia *mangium* and Swietenia *mahagoni*.

Zone E

1. A green belt to be developed along river Koel for 100m after declaring it as a "No Development Zone"
2. A new colony to be developed near Koelnagar with adequate infrastructure.

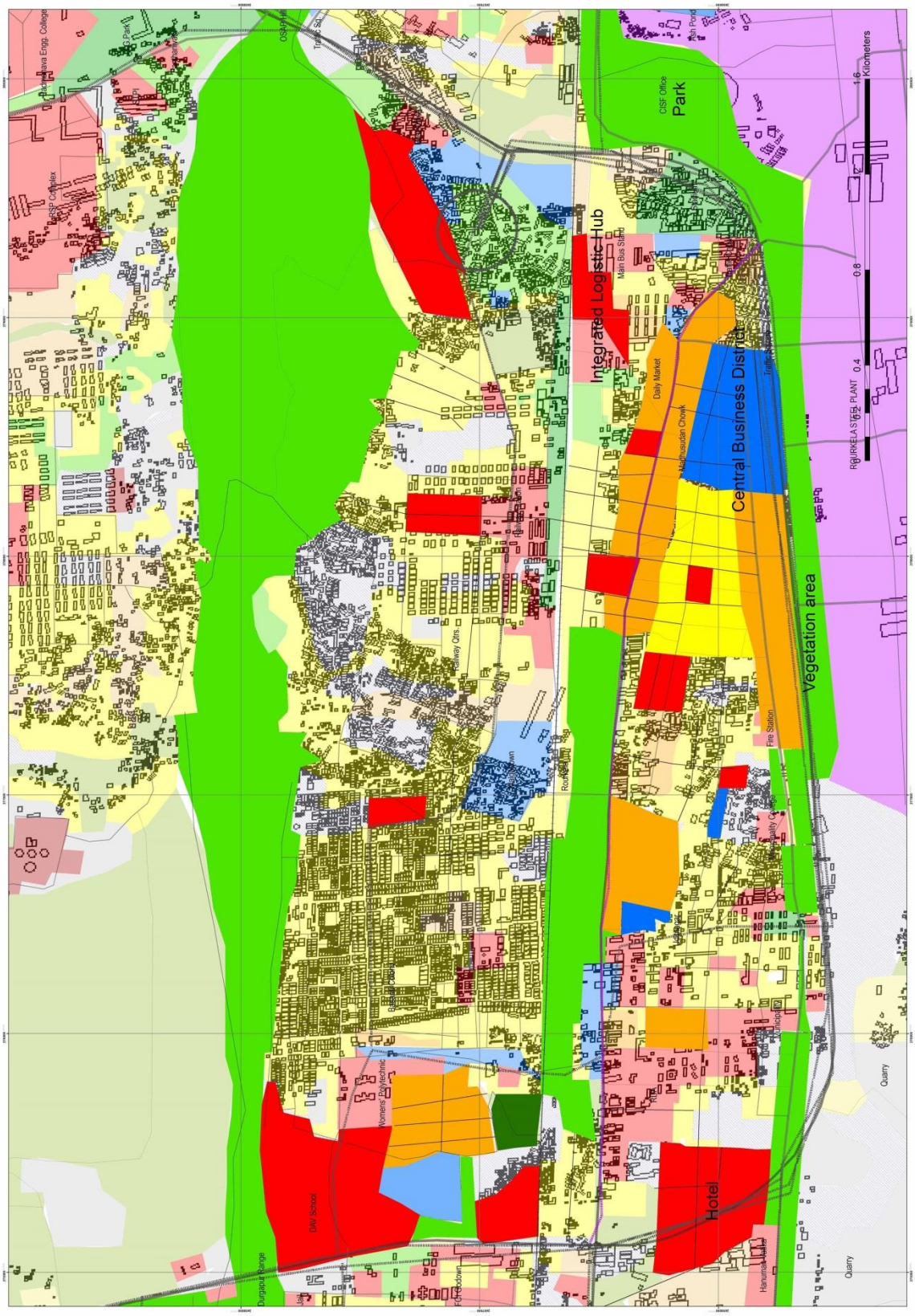


Figure 101 - Proposed land Use Zone C

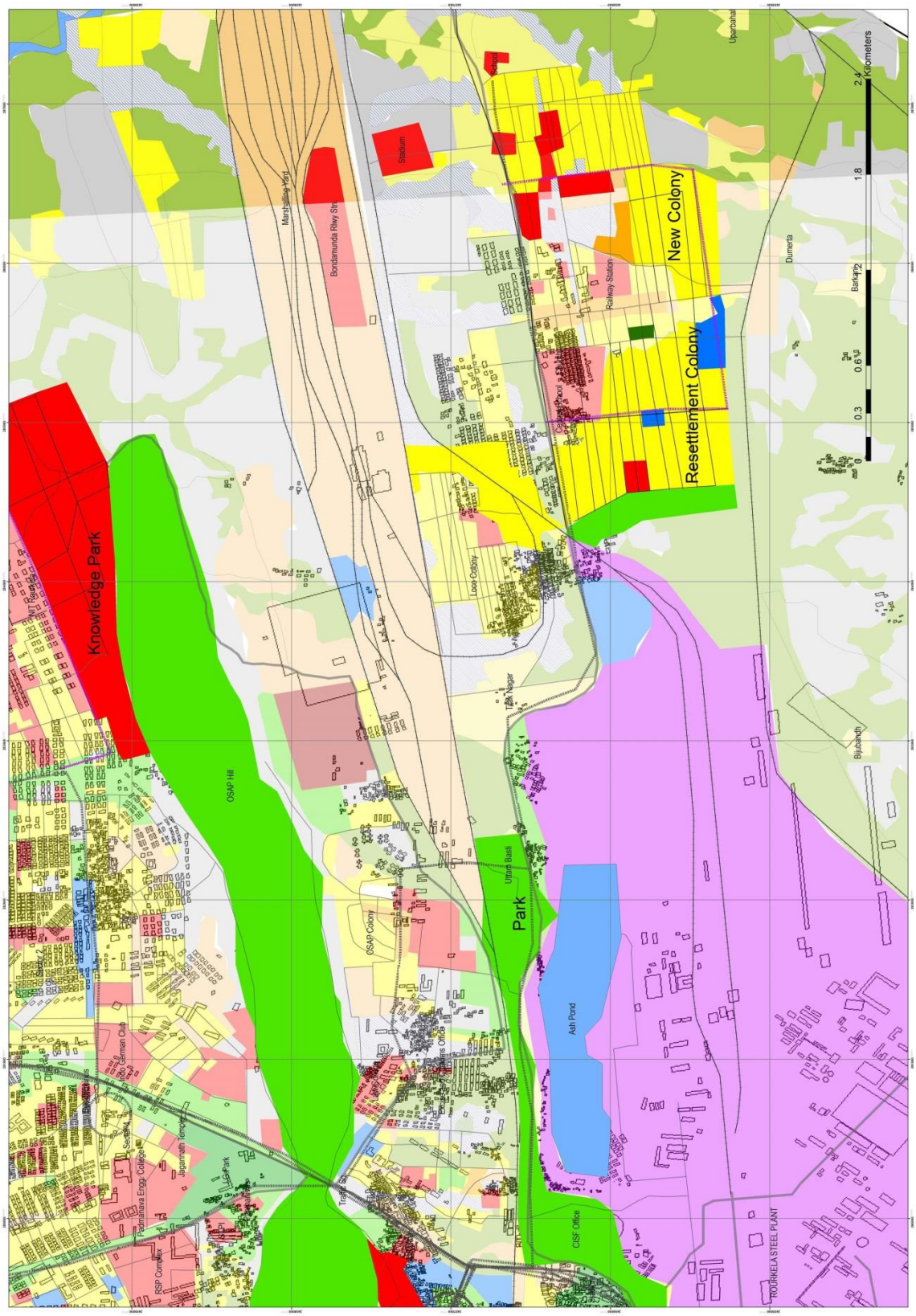


Figure 102 - Proposal for Land Use Zone D

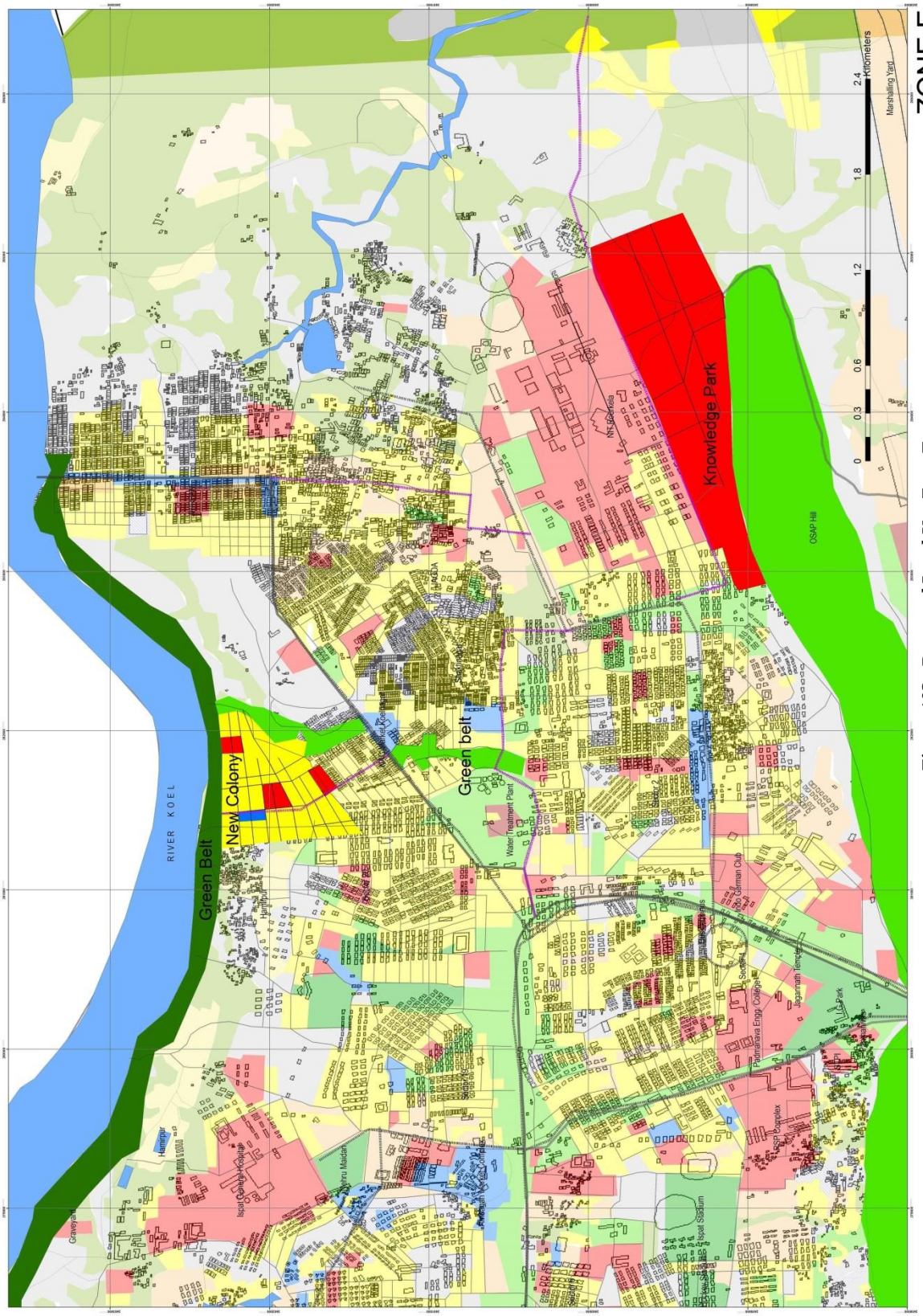


Figure 103 - Proposed Land Use Zone E

8.3. Blue-Green Corridors

Due to increase in urbanization and slums in recent years, there is shortage of breathing spaces in the town. While there is adequate green areas in the Rourkela Steel Township, the study area completely lacks the same. Effort has been made to integrate green areas as well as to maintain and improve the water bodies in the area. The following strategies are to be implemented:

1. 100 m wide "No Development Zone" to be developed along both the rivers Brahmani and Koel.
2. Central Park to be developed near Chhend Colony area.
3. Eco park to be developed to conserve the TISCO Khadan area.
4. Plantation to be done around DAV Pond area after cleaning it to develop it into a tourist attraction. Adequate buffer plantation needs to be done to act as a buffer from the noise from the Ring road as well as privacy of the tourists.
5. Vegetation area to be developed along stretches of Mahatab Road as well as near Traffic Chowk after resettlement of slum dwellers.

8.4. Road network network and Public Transport

Some strategies for augmentation of existing road network are as follows:

1. Wherever road widening process has already started, next phase of adding pedestrian pathways(sidewalks) to be developed.
2. Congested road like Kachery road to be widened.
3. New roads need to be minimum width of 10 m while main road to be at least 16m wide. UDPFI Guidelines to be followed to develop sidewalks and road side parking etc.
4. New bus routes to be introduced especially in the new proposed colonies as well as connecting the existing routes through alternate routes
5. Frequency of buses in each route to be increased so as to reduce congestion in buses.
6. New parking lots to be developed for para transit transport near the bus stands in order to integrate both the services in the long run.

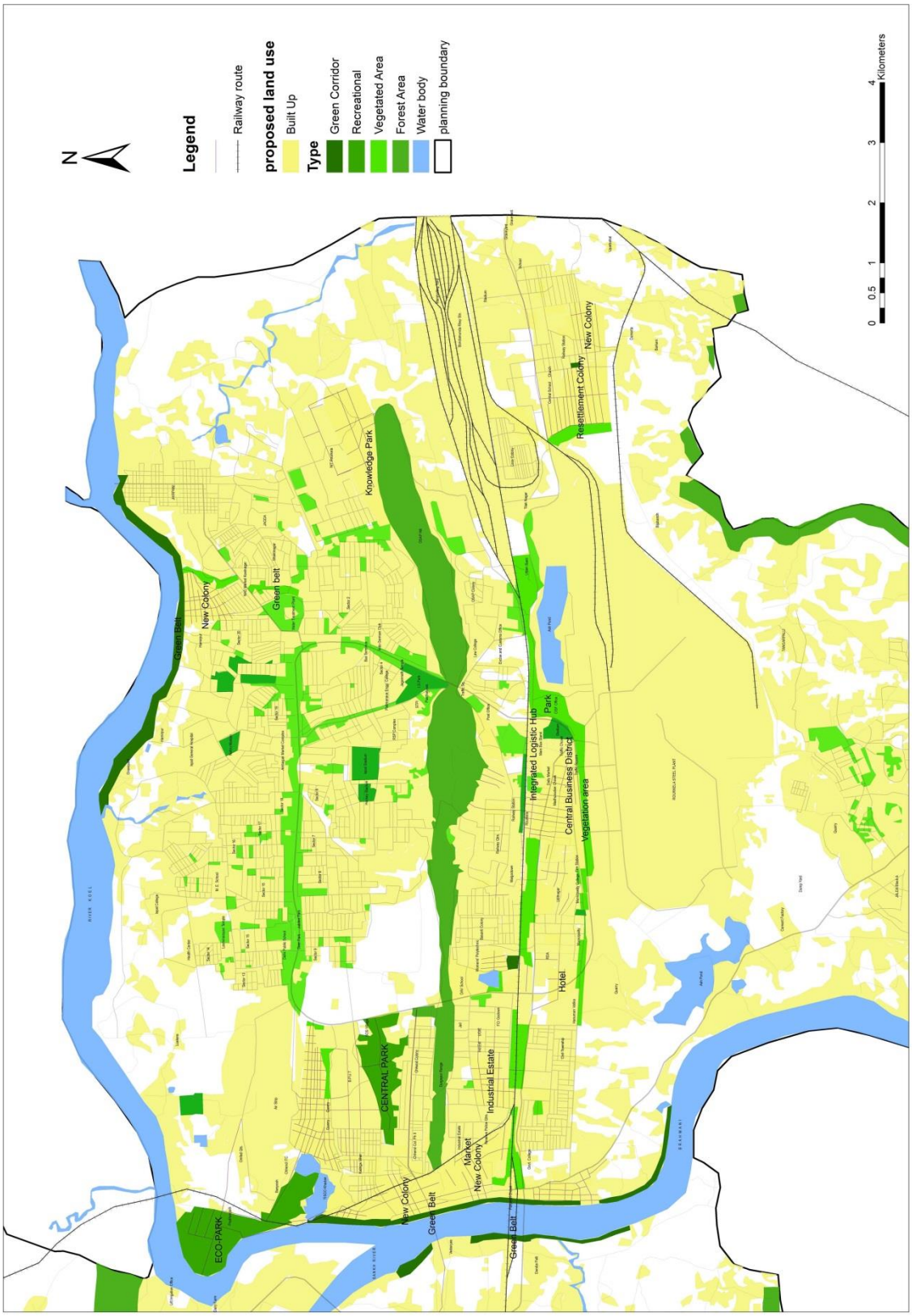


Figure 104 - Proposed Green Areas

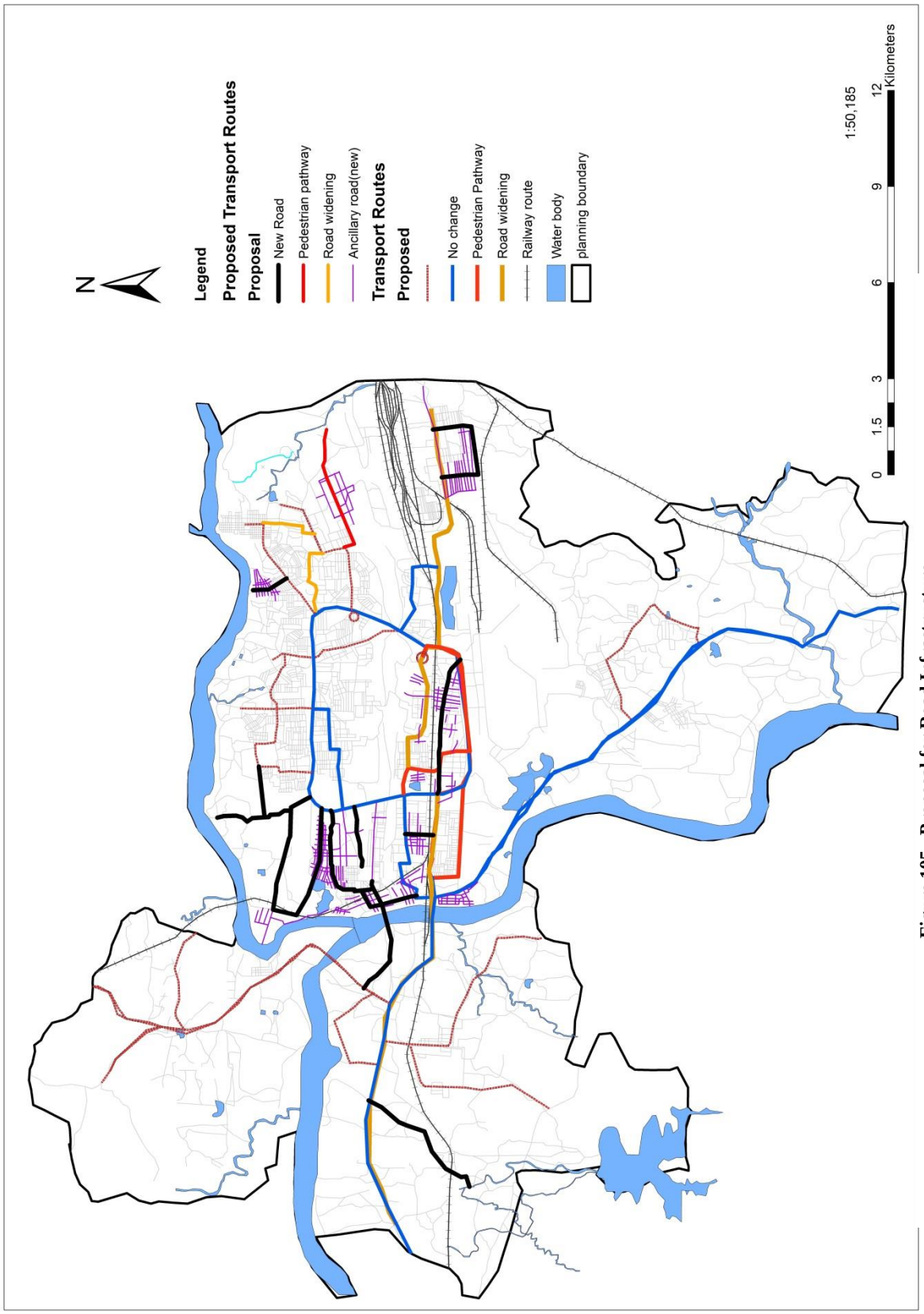


Figure 105 - Proposal for Road Infrastructure

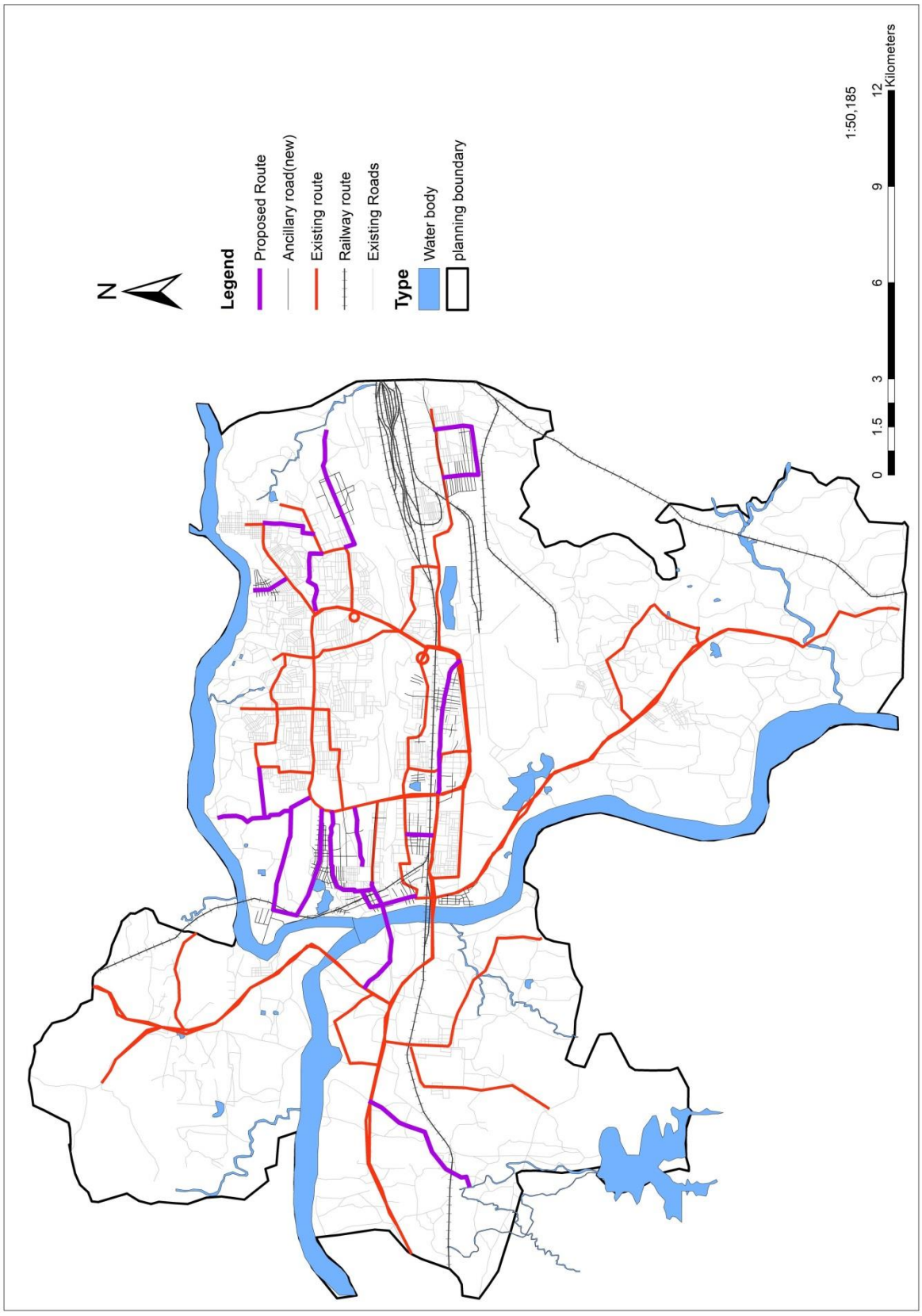


Figure 106 - Proposed bus routes

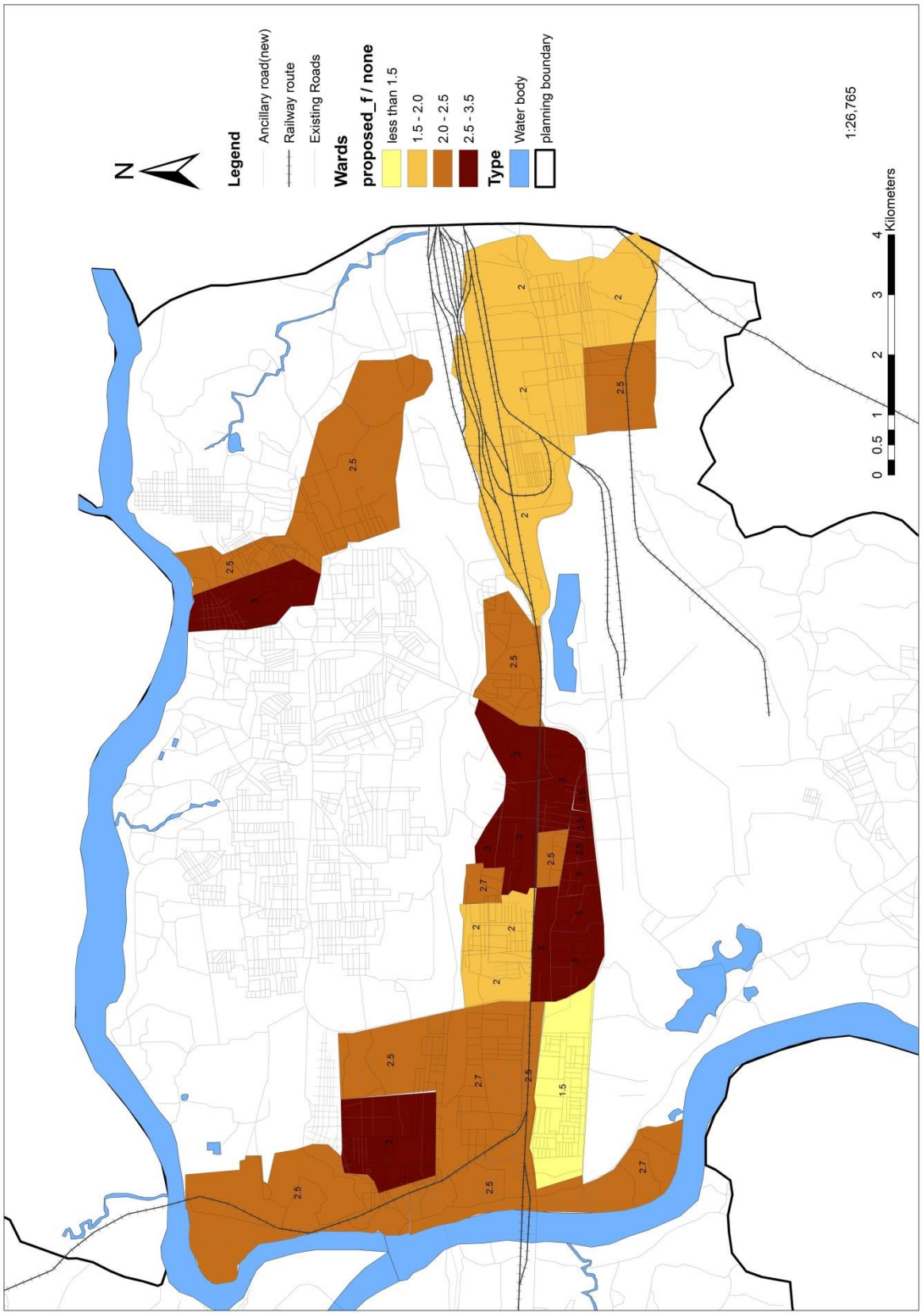


Figure 107 - Proposed FAR

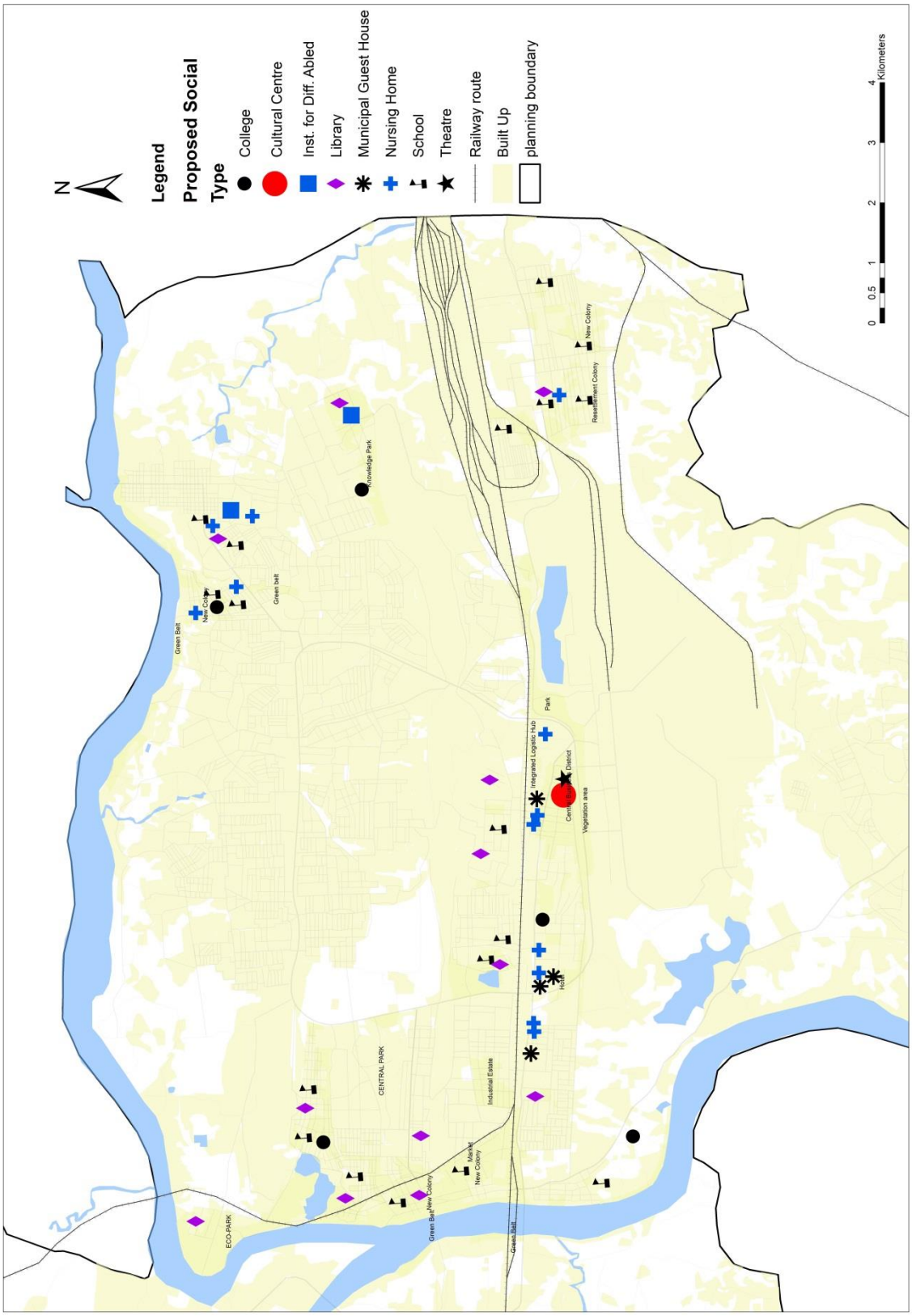


Figure 108 - Proposed Social Infrastucture

8.5. Phased Development

The development proposed shall be implemented in three phases:

Phase I(2014 to 2020)

Some strategies to be implemented in this phase are as follows:

- Road widening in all major roads to be completed by the year 2017.
- Slum Resettlement process to commence from 2016 and a new colony near Bondamunda to be habitated by 2020.
- Land pooling to start by the Municipality in 2017 in areas where new colonies can be developed.
- Revised Building Regulations to be published by 2016.
- Earmarking and development of parking lot for trucks and auto rickshaws by 2015.

Phase II(2021 to 2025)

Some strategies to be implemented in this phase are as follows:

- Construction of second bridge over river Brahmani.
- Infrastructure to be developed for new residential colonies.
- Plantation drives to initiate by the end of year 2024.
- Central Business District development to begin.
- New bus routes to commence.
- Social infrastructure to be developed to address the existing gap.
- Development of industrial estate in Zone B

Phase III(2025 to 2031)

Some strategies to be implemented in this phase are as follows:

- Mixed use compact high density development in Chhend Colony, Basanti Colony etc.
- High rise high density development in higher FAR areas with larger road widths.
- Knowledge Park and Eco-Park development.
- Further development of social infrastructure.

8.6. Policies and Guildelines

The following planning guidelines have been proposed for development of Rourkela Town:

Development Control and Land-Use

i. The 7.5 km stretch of river Brahmani to be declared as a "no development zone" with a green belt to be constructed on 300 m on either side of it.
ii. The current bye-laws for FAR and building height to be revised, after increase of road width in main roads. The new FAR for roads wider than 9m and plot sizes more than 200 smt. shall have proposed FAR of 3 to 3.5(depending on land-use type).
iii. Mixed land use type to be initiated in main road stretches in Chhend Colony, Basanti Colony and Katchery road.
iv. A Central Business District to be developed in the Station Area after rehabilitation of the slum colonies during Phase III of this project.
v. Green Corridors to be developed near Chhend Colony as well as between the RSP and Bondamunda area.

Institutional set-up

i. A new Joint Urban Planning Committee to be formed to address specifically the issues in the town and its peri-urban areas. The stakeholders shall be the Rourkela Municipality, Rourkela Development Authority, Rourkela Steel Plant and PWD.
ii. PPP shall be encouraged in development of new infrastructure as well as rehabilitation of the existing slums after earmarking areas near Bondamunda and Jagda.
iii. A GIS based database to be evolved by the Committee in order to update land-use pattern from time to time, for efficient tax assessment, to check FAR/Bye-Laws violation, land ownership transfers, approvals by RDA etc.

Infrastructure

i. Development in future to be promoted along the main transportation channels
ii. Drinking water supply and Sanitation facilities to be provided to the slum dwellers by 2016.
iii. Areas to be earmarked for development of auto rickshaw stands.

iv. New schools to be developed in Ward No. 1, 23, 24, 25, 26 as well as the new colonies.
v. Land pooling mechanism to be carried out in Bondamunda and Jagda in order to attract population from congested wards. The focus should be on dispersing growth throughout the town rather than on redevelopment of core.
vi. Development work for a 200-bedded hospital to be initiated from the year 2026.

Transportation guidelines

i. New routes of public transport to be developed after increasing the number of buses running in the town as well as their frequency in proportion to increase in population.
ii. Special bus-service for tourists to be introduced in the town.
iii. Road widening schemes initiated to be completed by 2018 and revised bye-laws to be made applicable therein.
iv. Connectivity to be increased over rivers Brahmani and Koel through development of a bridge across it (proposed in the land-use map).
v. Pedestrianisation schemes to be implemented by the Municipality in new developed colonies, colonies where land use is re-organised as well as after road widening of important roads.

Tourism guidelines

i. To explore the feasibility of developing eco-parks over wetlands and wastelands in the town through feasibility studies.
ii. River front development work to be carried out across the 7.5 km stretch of river Brahmani. Delineation of the area to be done in Phase – II and design and implementation to be carried out in Phase III.

8.7. Funding

Since the project at hand is enormous, it will of course involve a large scale funding by various authorities at State level as well as the Centre. The major funding currently is from the State Government. In order to address the issues in the town as well as to implement the policies, various stakeholders have to be involved for funding the projects. Some of the main

funding agencies in the town are Rourkela Municipality, Rourkela Development Authority and Public Works Department.

PPP Mode: Public Private Partnership should be implemented for implementation of projects as per the guidelines in order to ensure funding adequate.

Central Government: Recently, the Central Government sanctioned funding for augmentation of the number of buses in the town. As a result, 60 new buses are to start service very soon. 75% funding for the Knowledge Park as well as 25 % for slum rehabilitation programmes should be from the Central Government funding.

Urban Local Bodies: The local authorities need to improve their tax collection in order to improve revenues considerably in the future. This funding is to be used to implement various slum resettlement projects, improvement of road infrastructure as well as introducing vegetated areas.

Depending on the size and nature of the project, one or more among these authorities can be involved. Care must be taken to procure for adequate funding on schedule.

CHAPTER 9 : RECOMMENDATIONS

Physical

1. Tree plantation drives should be promoted by special policies at city level in the industrial and mining areas in order to maintain the vegetation area intact.
2. Road network along the industrial corridor needs to be augmented
3. There should be better maintenance of the Rourkela Airstrip, and infrastructure should be improved in phases to commence low cost airlines to nearby areas like Kolkata, Ranchi and Hyderabad.
4. Locations where new colonies are proposed need to have revised local level bye laws with wider roads during layout process to accommodate infrastructure for pedestrian and cycle track facilities. The area can be compensated by higher FAR in such areas.
5. The building bye laws need to be revised so as to push for construction of more multi-family dwellings in new colonies.

Socio-Economic

1. The low sex ratio is a very complicated situation and cannot be solved within a few years. Long term strategies need to be developed for empowerment of females in the study area by increasing opportunities for them.
2. Phased renovation work needs to be initiated in areas near the Railway Station(Kachery Road area) in order to improve the quality of life of the dwellers
3. There should be more schemes promoted by the authorities to increase the number of small scale industries to increase share of women in workforce.
4. Infrastructure and parking should be developed in major commercial nodes in the town.
5. There should be construction of more government aided guest houses as well as encouragement to build new hotels to increase the accomodation facilities in the town for tourists.

Environment

1. Trees with high canopy should be planted along the Ring road to reduce the increased noise pollution.
2. Resistant species of plants should be planted near the industrial area

3. More research should be done will collaboration with government institutes to quantify various parameters related to pollution levels
4. A green corridor should be built in the highly dense wards of 32 and 33.

Ecology

1. Computerised database should be created regarding pollution levels at various locations as well as flora and fauna throughout the town
2. Research needs to be done to quantify the carbon emissions per capita of the town which will be a significant factor in a few years

Infrastructure

1. The Sanitation Plan prepared by the Municipality aims at 100 per cent efficiency which is difficult to achieve given the financial structure of the Municipality, hence the objectives should be revised to have more pragmatic solutions.
2. Streetlights should have total coverage with adequate spacing.
3. Steps must be taken to check power theft in the Municipal as well as industrial areas.
4. The road infrastructure needs to be developed to reach the same standard as in Steel Township area to avoid the dichotomy between spaces.
5. Public Transport System needs to be started with more number and efficient bus service by 2021.
6. Road infrastructure should be developed for non motorised transport, especially in the main roads.
7. More connectivity needs to be achieved across the river Brahmani and Koel, hence there should be construction of bridges at strategic location on the two rivers.
8. There is need to construct more libraries throughout the town with internet facilities

Institutions

1. There needs to be more funding from the State as well as the Centre in order to make the authorities implement proper schemes to reduce the housing shortage
2. The Master Plan process for the Urban Agglomeration should be speeded up since the current master plan is obsolete
3. There should be more coordination between the Municipality, Rourkela Development Authority and the Rourkela Steel Plant in taking important decisions related to planning issues of the town.
4. More awareness campaigns should be started by the authorities to ensure proper implementation of building bye laws.

CHAPTER 10: CONCLUSION

This thesis has focussed on identifying present issues and finding solutions for them through physical planning and broad strategies. The morphology of Rourkela Town has evolved over the years just like other similar industrial towns built in India in the Post-Colonial era. Through the thesis, it has evolved that the issues predominant in Rourkela are similar in nature to similar industrial towns in the country.

It is significant that Indian towns have many things to learn from the developmental approach of the west, although this has to be done carefully and intelligently due to the vast difference in climate, history, culture and methodologies adopted. An honest attempt has been made in this thesis to do the same and propose feasible solutions in the study area in terms of specific short-term projects as well as strategic solutions in terms of policies and guidelines. It is imperative that towns in India have to deal with the issue of increase in population as well as housing shortage and unavailability of developable area. Hence an attempt has been made to revise the existing development regulations in order to bring about more controlled development in the future.

There is immense potential in Rourkela Town to transform itself into a vibrant economic hub in the region as well as in the state through proper compact development supported by infrastructure growth in time. In order for this to happen, the authorities have to cooperate among themselves and ensure that the policies and guidelines are followed and implemented on schedule.

Directions for further research

This thesis has focussed on identifying issues, studying the existing scenario and proposing spatial solutions in the study area comprising of the Municipal town. Further research could be taken up by analysing the whole region and proposing solutions at a regional level. Also, the sample size taken for household survey for this thesis is eighty-eight households. Further survey can be done in all the wards in the town through stratified random sampling to arrive at more accurate survey results. Further work can also be done in the field of transportation in the town to develop a Rapid Transit System.

CHAPTER 11 : APPENDIX

11.1. Appendix 1: Household Survey Schedule

Date.....

1. IDENTIFICATION

a) Name of Head of family ……..

b) Location(Colony) ……..

c) Religion(please tick) [ ] Hindu [ ] Muslim [ ] Christian [ ] Other

d) Caste(please tick) [ ] Gen [ ] SC [ ] ST [ ] OBC

2. MIGRATORY STATUS

[ ] Migrated [ ] Local (please tick)

(If migrated, mention the details)

Migrated from where [ ] Within Sundergarh dist. [ ] Within Odisha [ ] Other state

Year of Migration ……

Reasons for Migration

[ ] In search of employment [ ] To start new business/shop etc

[ ] Came for education or training [ ] Did not like living in previous residence

[ ] Any other

3. COMPOSITION OF HOUSEHOLD(Please write about members in family)

Sl. No.	Sex (M/F)	Age (Years)	Marital Status (A)	General Education (B)	Activity / Occupation (C)	Monthly Income
1						
2						
3						
4						

5						
6						

A) Marital Status UM –Unmarried M – Married
W – Widowed

B) Education I – Illiterate NF – Literate with no formal Education
PS – Primary School G – Graduate
PG – Post Graduate T – Technical / Professional

C) Occupation W – Worker/Businessman HW – Housewife
R – Retired U – Unemployed
S – Student

4. HOUSING

a) Tenure Status [ ]Owned [ ]Tenant [ ]Sub-tenant [ ] Other

(If on Rent), Monthly House Rent ……

b) Area of House Plot (in sq. ft.) ……

c) Covered Area (in sq. ft.) ……

d) Year of the Construction of the House …….

e) Number of floors …….

5. What is the source of water supply in your household?

[ ] Municipal supply [ ] Borewell/Tube well

[ ] Open well [ ] Water body(pond, lake etc.)

[ ] Other

6. What is the duration of water supply?

[ ] less than 30 min [ ] 30min to 1 hour

[ ] 1-2 hour [ ] more than 2 hours

7. Is there an electric meter in the house? [ ] Yes [ ] No

8. What is the duration of power cut each day?

[ ] less than 30 min [ ] 30min to 1 hour

[ ] 1-2 hour [ ] more than 2 hours

9. Which of the following do you have at home?

[ ] Computer [ ] Television

[ ] Refrigerator [ ] Washing Machine

10. Mode of transport

a) No. of bicycles in the household ……

b) No. of 2-wheelers in the household ……

c) No. of 4 wheelers in the household ……

11. What is the mode of sewage disposal in your household?

[ ] Soak Pit [ ] Municipal Sewer line

[ ] Open drainage [ ] Other

12. What do you do to the garbage daily?

[ ] Burn it [ ] Dump it in an open plot nearby

[ ] Dump it on road side [ ] Collected by Municipality

Thank you

11.2. Appendix 2:Online Questionnaire

Edit this form

Rourkela: Planning an ideal Steel city in India

Hello!!...I am a final year Master of Urban and Rural Planning student of IIT Roorkee, Uttarakhand and a DAAD-IIT Master Scholar at Kaiserslautern Institute of Technology, Kaiserslautern, Germany. This is a survey conducted as a part of my research on Rourkela Municipal Area for my Master thesis. Rourkela today, as per the Census 2011, has around 40 % of its population in slums, which is an obvious case of concern. This fact is the basic motivation behind doing this research which aims to find out solutions to solve multiple problems in our town. Please spare a few minutes to answer the following questions so we can make our town a better place to live in.

Your Name

Your locality(e.g. Chhend Colony, Basanti Colony etc.)

Your age

- less than 6 years
- between 7 and 26 years
- between 27 and 60 years
- above 60 years

Sex

- Male
- Female

What is your Marital Status?

- Married
- Unmarried

- Widowed

What is your educational qualification?

- Illiterate
- Primary School
- High School
- 10+2
- Graduation and above

What is your occupation?

- Student
- Worker/Businessman
- Housewife
- Retired
- Unemployed

What is your monthly income ?

- less than Rs. 2500
- between Rs 2501 to 7500
- between Rs 7501 to 15000
- more than Rs. 15000
- No income

Is there anyone in your family(including you) who was diagnosed with a disease in the last five years(tuberculosis, malaria etc.)?

- YES
- NO

How would you rate the following in your locality?

	Excellent	Very Good	Average	Poor	VeryPoor
Road condition and safety					
Access for Pedestrians and					

cyclists					
Street Lighting					
Condition of parks /playgrounds					
Cleanliness					
Healthcare facilities					
Educational facilities (access to schools etc.)					
Shopping Facilities (access to markets and shops)					
Condition of drains					
Traffic and congestion					

How satisfied are you by the initiatives by Municipality and local authority with respect to the followings?

	Highly satisfied	Moderately satisfied	Not satisfied	No idea
Road condition and safety				
Access for Pedestrians and cyclists				
Street Lighting				
Condition of				

parks /playgrounds				
Cleanliness				
Healthcare facilities				
Educational facilities (access to schools etc.)				
Shopping Facilities (access to markets and shops)				
Condition for drains				
Traffic and congestion				

What do you think should be the priority of the Municipality in the town?

	Most important	Moderately important	Not so important	Least important
Developing Road Infrastructure				
Improving Healthcare facilities				
Improving Educational facilities				
Cleanliness				
Slum				

upgradation				
Development of parks and green spaces				
Improving Roadsafety				
Developing Tourism				

What is your most preferred mode of transport to go to

	Bicycle	Two wheeler	Four wheeler	Public transport(Auto/Bus/other)	Walk
School/Office					
Shopping					

Would you prefer to walk/cycle to go to places within 2 km from your home if there is a separate pedestrian path and cycle track on the road?

- Yes
- No

What is your most preferred visited place in town?

- Hanuman Vatika
- Vedvyas
- Local temples

IG Park

Vaishno devi temple

Other

Are you willing to pay more for improvement of infrastructure in your locality?

Yes

No

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