Mapping of Electric Utilities in Roadways using GIS in Erode City

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Abstract

Urbanization has become a major phenomenon in India were lakhs are migrating every year increasing the traffic congestions. In many places over population has affected the local authorities even to provide basic transport services. Traffic problems in India are already an extensive task and will become much difficult due to urbanization and changing lifestyle of people. This analysis introduces a solution to the problem in transportation in erode city. In this project the electrical obstructions for transportation movement been identified and mapped by which they can be removed or altered in their routes.

An integrated approach to electric utility mapping is more than the sum of its parts. Location and mapping teams need to participate in a multi-phased process that includes lobbying and action on their part. They must be involved from start to finish. This project aims at mapping the electric utilities such as electric poles and transformers in major roadways of Erode City [Corporation limits] using GIS. These utilities have been mapped and differentiated based on their impact to the traffic flow operations in the roads. Initially, locating the utilities has been done through GPS (Global Positioning Systems) which will be very useful for finding the accurate latitude and longitude values. And then, mapping of utilities is carried out through GIS (Geographic Information Systems) which give better results in mapping. The software used for mapping is QGIS. The electric utilities which are obstructions to traffic movement are all to be identified and mapped which will be later altered in their alignment or removed.

1. Introduction

As India's economy and population grow at a rapid pace, more people are moving from the countryside to the city, increasing traffic congestion. Congestion is caused by the interaction between the number of cars and the amount of available road capacity along the routes they use. More people living in cities means more pressure on city infrastructure, but as technology becomes more widely used and advanced, it also creates vast quantities of data that can be studied and utilised to help alleviate this pressure. New techniques for processing and distilling data from mobile phones (spatiotemporal patterns) are constantly enhanced, and classic mobility models such as gravity, radiation, or activity-based models are updated in concert with the constant rise in volume and accuracy of new data sources [1]. The high expenses of getting the rare and tiny data have proved to be the barrier, despite the sound technique and precise implementation of these models. In this phenomena, understanding the intricate interaction of road structure and traffic patterns to simulate travel times and congestion in not just a single city, but many cities at once has been a special problem.

GPS and GIS technologies may be used to map utilities and detect impediments more effectively in management functions and decision support systems. When it comes to transportation planning, this is a critical consideration to keep in mind[2]. It is possible to apply IS in traffic control to produce the traffic control mechanism by recognising obstructions to traffic flow. GIS technology may be a powerful tool in the development of urbanisation, transportation information systems, and management. In order to locate and map the utilities, as well as to detect blockages, traffic control information is employed. Utility route design and planning automation using geographic information systems (GIS) has been researched by [3, 4]. Trench construction is the basis for this investigation. GIS digitization facilitates the creation of site geographies, which can then be used to map the obtained data. "Real-world representation of a road network for route planning in GIS" was the subject of three research. Methods for presenting road networks in GIS for network analysis are the focus of this research. Road tunnel deterioration is influenced by geological and operational factors, according to a recent study [5]. A research on "GIS for sustainable development" was carried out [6]. It is here that GIS will be described and its relevance addressed as an effective

instrument in the logical method of sustainable development because of its crucial function [7, 8]. A study of the technical elements of sustainable development and its consideration in the creation of projects is worth doing. The employment of national geographic data infrastructure should be in conformity with the additional superior scenario prescription and ruling at national and international levels. This chapter ends with a list of prerequisites for building a Spatial Data Infrastructure (SDI).The objective of this project is to locate the electric utilities using GPS followed by mapping the electric utilities using GIS(QGIS) and to improve traffic movement by identifying the utilities which obstruction to traffic movement[9, 10].By achieving the above target, we can provide efficient transport, reduce traffic congestion with less energy consumption and easy work with traffic problems during critical time.[11, 12].

2. Study Area

A total area of 109.52 square kilometres is split into 60 wards in Erode Corporation, which is located on the banks of the river Cauvery between latitudes 11^0 49.5" and 11^0 81.05" North and 77^0 42.5" and 77^0 44.5" East. Cotton is grown in the area around the city Fig. 1. In addition to cotton ginning and the manufacturing of transportation equipment, there are other industries. Textile power loom industry and the cultivation of turmeric are two of Erode's most notable businesses. Known across Tamil Nadu, Kangayam Bulls and Uthukuli Butter come from this area. The study area consists of the road networks within the Erode City Corporation. This consists of more than 1000 road segments in the network comprising about 806.70 km in distance. In these roads over 2000 electric utilities are placed nearer to the roads which may reduce the traffic flow in the city. In those utilities, some of them are obstructions to the traffic movement in the city. This study considers the obstructions to traffic movement in Erode municipal area, Tamil Nadu, India, in order to reduce the traffic congestions in future. The roads that are in disarray include Mettur Road (Urban Streets), Brough Road (Urban Streets), EVN Road (Urban Streets), Perundurai Road (SH 96), Sathy Road (SH 15), Chennimalai Road (Urban Streets),Kasipalayam Road (Urban Streets),Nasiyanur Road (MDR),Nethaji Road (Urban Streets),Sampath Nagar Road (Urban Streets). Recently in Erode town alone, there is a 300 percent increase in the number of vehicles. In this situation of lack of manpower and increased vehicle population, the traffic should be reduced only by increasing the capacity of roads. This capacity been increased by removing obstructions in roads.

3. Materials And Methodology

3.1 Locating the Utilities

Location of each utility was taken using GARMIN GPS and also by mobile phone GPS to locate the utilities for mapping and analysing. These utilities are located individually for all the roads and carried manually. The electrical utilities that been located are, Electric / Lamp Poles, Transformers. The width of each roads is measured using tape at regular intervals and then be averaged based on the span limit. This is the secondary stage of data collection. These widths are used at buffering stage of the utilities and to identify the utilities which are obstructions in the roads. These widths are calculated from the RoW (Right of Way) on both sides of the roads. This will also be useful in finding the encroachments. The stretch of mapping for individual roads varies. Each road been mapped within the city limits, so their stretches may vary accordingly. The length inside the city of each road varies because, the City Corporation limits varies in different roads Table 1.

Table 1
Road dimensions and their utilities

S.No	Name of the Road	No of utilities	No of Electric poles	No of transformers	Direction	No of Utilities in right side	No of Utilities in left side	Width of the road in m	Length of the road in m
1	Perundurai road	133	124	9	Towards East	84	49	16	5
2	Mettur road	51	50	1	Towards North	21	30	13	0.7
3	Sathy road	65	59	6	Towards East	223	422	15	1.2
4	Brough Road	95	86	9	Towards East	49	46	16	1.1
5	Nethaji Road	38	31	7	Towards North	20	18	13.2	0.8
6	Chennimalai Road	43	42	1	Towards East	9	34	14	2.4
7	Sampath Nagar Road	52	47	5	Towards North	22	30	12.8	3
8	EVN Road	89	84	5	Towards North	49	40	16.2	1.8
9	Nasiyanur Road	71	65	6	Towards East	36	355	13	1
10	Kasipalayam Road	127	113	14	Towards North	45	82	11	2.7
	Total	764	701	63		358	406		

4. Mapping The Utilities

After collecting (locating) the utilities, the GPS waypoints are all imported to the GIS software. The software used for mapping and buffering is QGIS. The points are separated according to their roads and renamed with their original locations. Each point has been marked with their roads[14]. This is to make sure that correct analysis done is flawless and also to avoid confusion in locating the points. The roads are traced using a tool in Google earth pro named Add Path in Add toolbar. Every inch of the road is traced using this tool and is saved with .kml file extension. The .kml file is then converted into shape file using QGIS to import the mapping process[15] Fig. 2. The following figure shows the road being marked using the tool in brown color. After tracing the roads in Google Earth Pro, they are all been verified. After verifying the roads covering the Erode City Municipal Corporation has been marked. All the points for roads are imported into the QGIS. This is because the file extensions are in .kml extensions which are easy to convert the points as shape file in QGIS. These uploaded points been mapped on the traced roads and been plotted on the Erode City Corporation map shape file. These points are mapped together in a single composition and then separated out for individual analysis.[17, 18]. All the points for roads are imported into the QGIS. This is because the file extensions are in .kml extensions which are easy to convert the points as shape file in QGIS. These

uploaded points been mapped on the traced roads and been plotted on the Erode City Corporation map shape file. These points are mapped together in a single composition and then separated out for individual analysis[19, 20]

5. Analysis

5.1 Buffering of points

After mapping all the points in the GIS, they are taken for individual analysis to find the number of utilities as obstruction in the roads. This been done through buffering of the points [21, 22].The buffering is takes place for individual roads separately. The value of buffering is given based on the width of roads, that been collected earlier. By this value, the obstructions and encroachments in the roads been identified, because these points inside the buffer layer all been indicated in a transparent layer[23, 24] The points that present outside the transparent layer (buffer layer) are not considered as obstructions, because those points do not affect the traffic to extent. And also, they are present away from the RoW of roads[25] Fig. 3 to 14.

6. Results

These results show the number of obstructions and percentage of obstructions impact in the individual roads. These obstructions are predicted from the buffer value of the roads. And also, the overall impact by the electrical utilities to the whole Erode City Corporation has been given in these results Table 2.

Table 2
Results for the obstruction

S.No	Name of theRoad	No of Utilities	No of Obstructions	Percentage of Obstructions
1	Perundurai road	133	79	59.40%
2	Mettur road	51	39	76.50%
3	Sathy road	65	37	56.90%
4	Brough road	95	61	64.20%
5	Nethaji road	38	30	78.90%
6	Chennimalai road	43	22	51.10%
7	Sampath Nagarroad	52	27	51.90%
8	EVN road	89	58	65.20%
9	Nasiyanur road	71	64	90.10%
10	Kasipalayam road	127	88	69.30%
	Total	764	505	66.10%

From the results, it is clear that obstructions in the road network of Erode City Corporation are high. And also, the roads intersect at GH round about holds the maximum of obstructions Fig. 15.

7. Conclusion

GIS technology may be used to locate and map utilities, as shown by the QGIS study. Layering, projection, generalisation, and symbolization are all GIS concepts that are still widely used today and account for a significant percentage of the technology's capabilities. Maps and layers may be used in any way you choose, as shown by QGIS. The versatility of this study is shown by the use of many maps, which may be either vector or roaster. This is a critical tool for determining the locations of barriers on city streets. As a result, certain areas and resources will be less impacted. In this analysis, electric utilities on individual sides also been found out. For example, how many utilities on left side and how many on right side are all been found out. Adopting the GPS and GIS technology will result in better results which leads to differ the obstructions from the utilities.

Declarations

Ethical Approval

All data and works comes under ethical norms

Competing interests

There is no competing-of-interest for this research.

Authors' contributions

The authors confirm contribution to the paper as follows : Carried out field work for collection of electric utility location, Conceptualisation and Diagnosis of Output, Writing- review and editing, Image Clarification using GIS. All authors read and approved the final manuscript.

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Figures

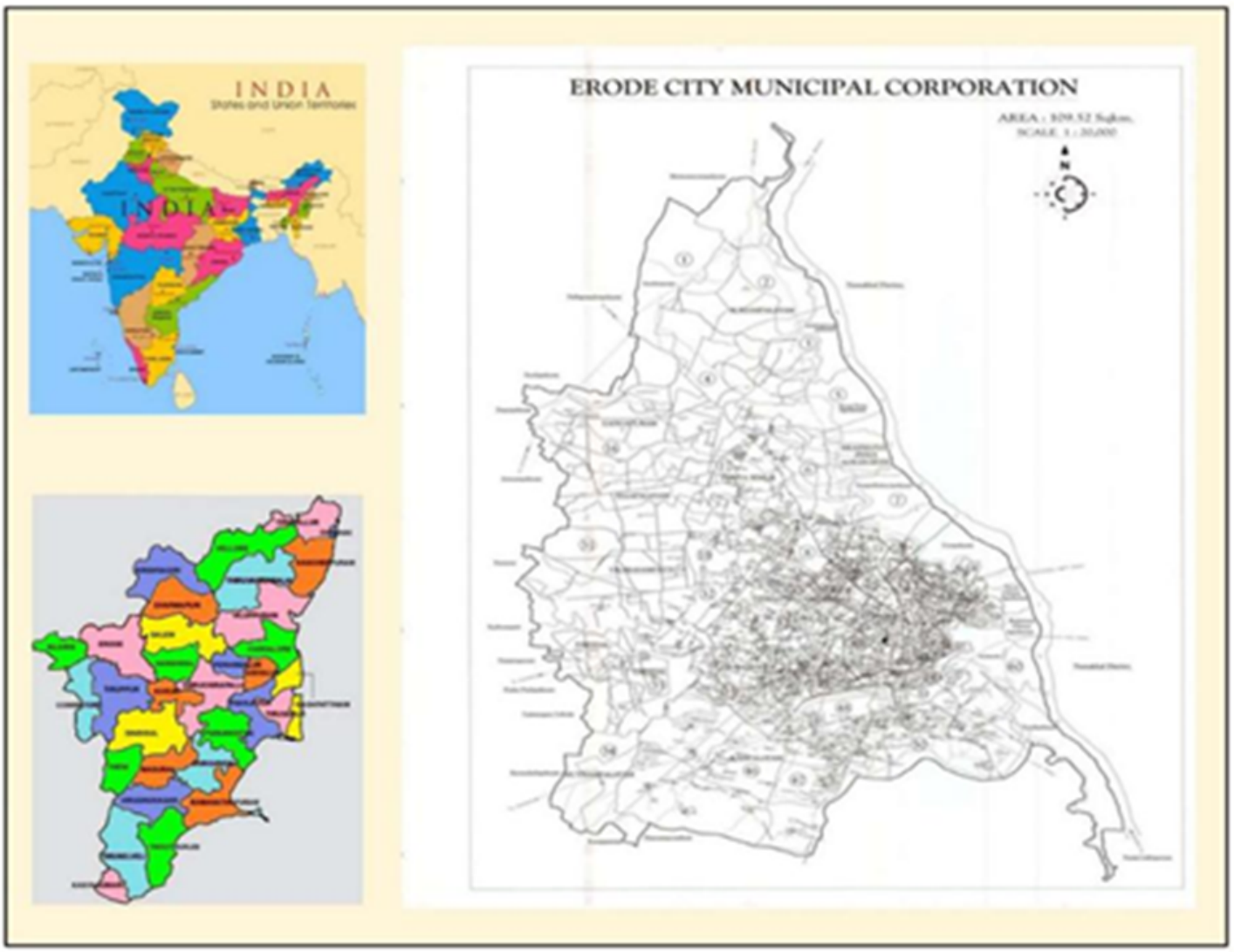

Figure 1

Erode City Map

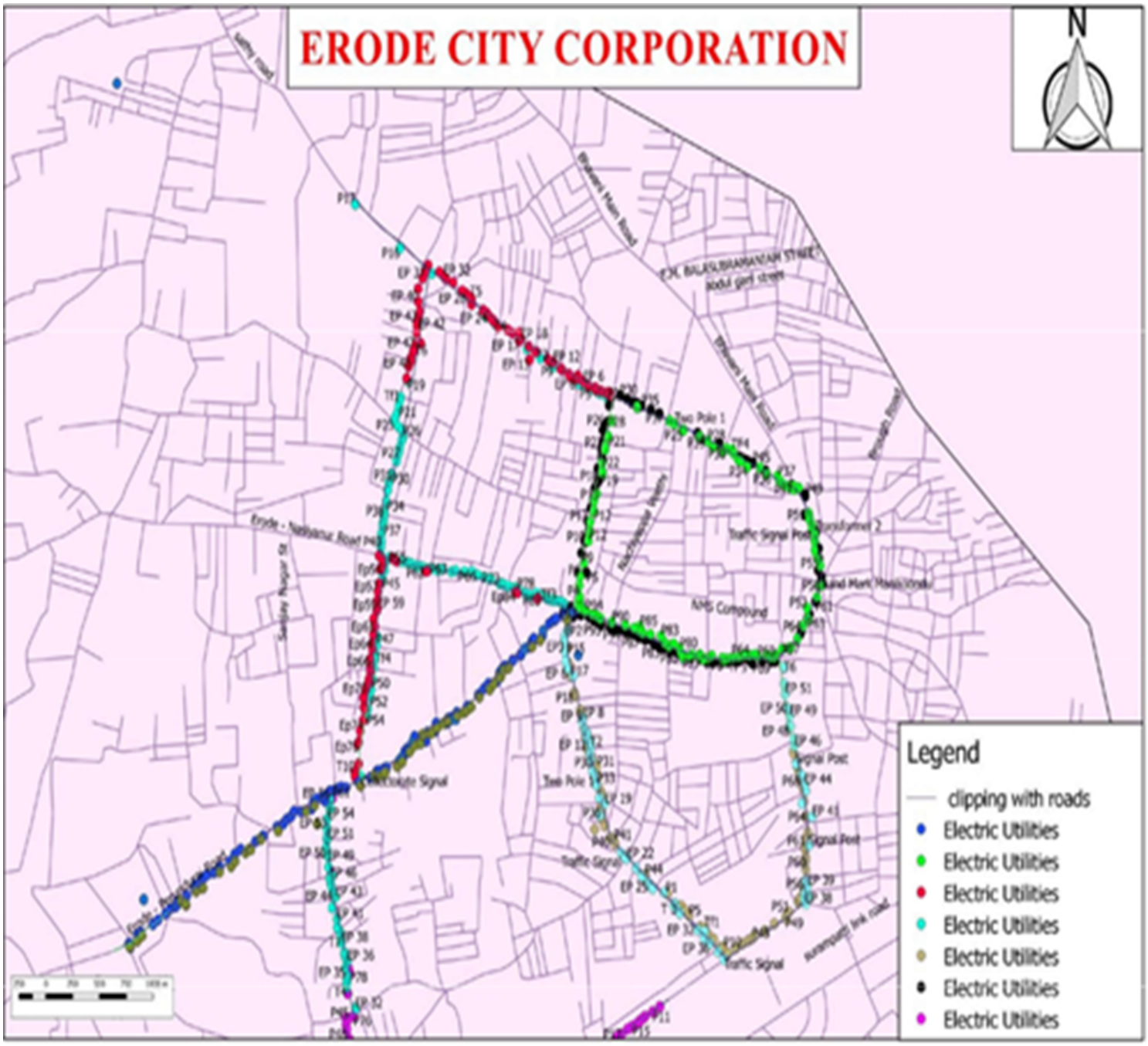

Figure 2

Mapped utilities in Erode City Corporation

Figure 3

Buffered Map of Brough Road

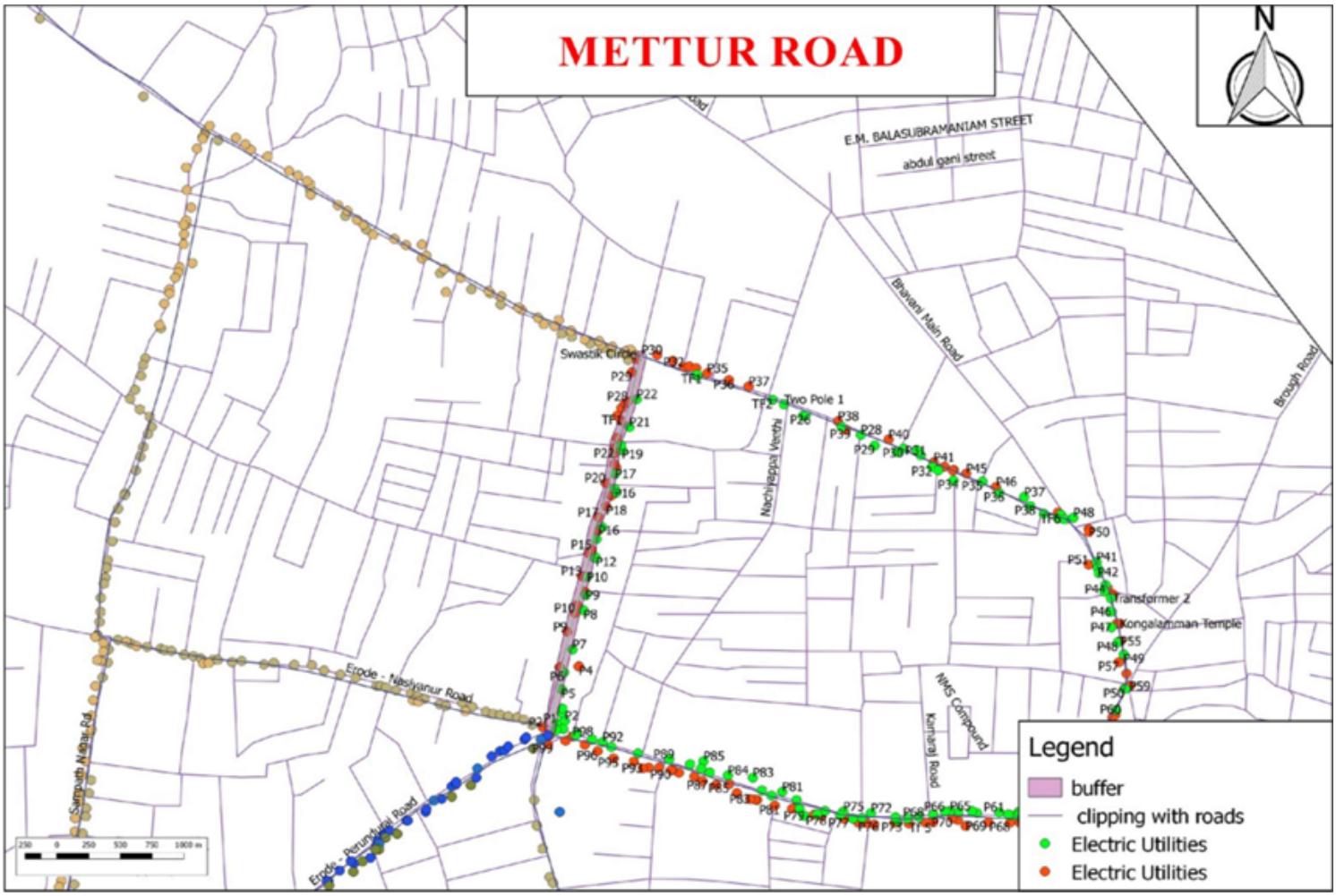

Figure 4

Buffered Map of Mettur Road

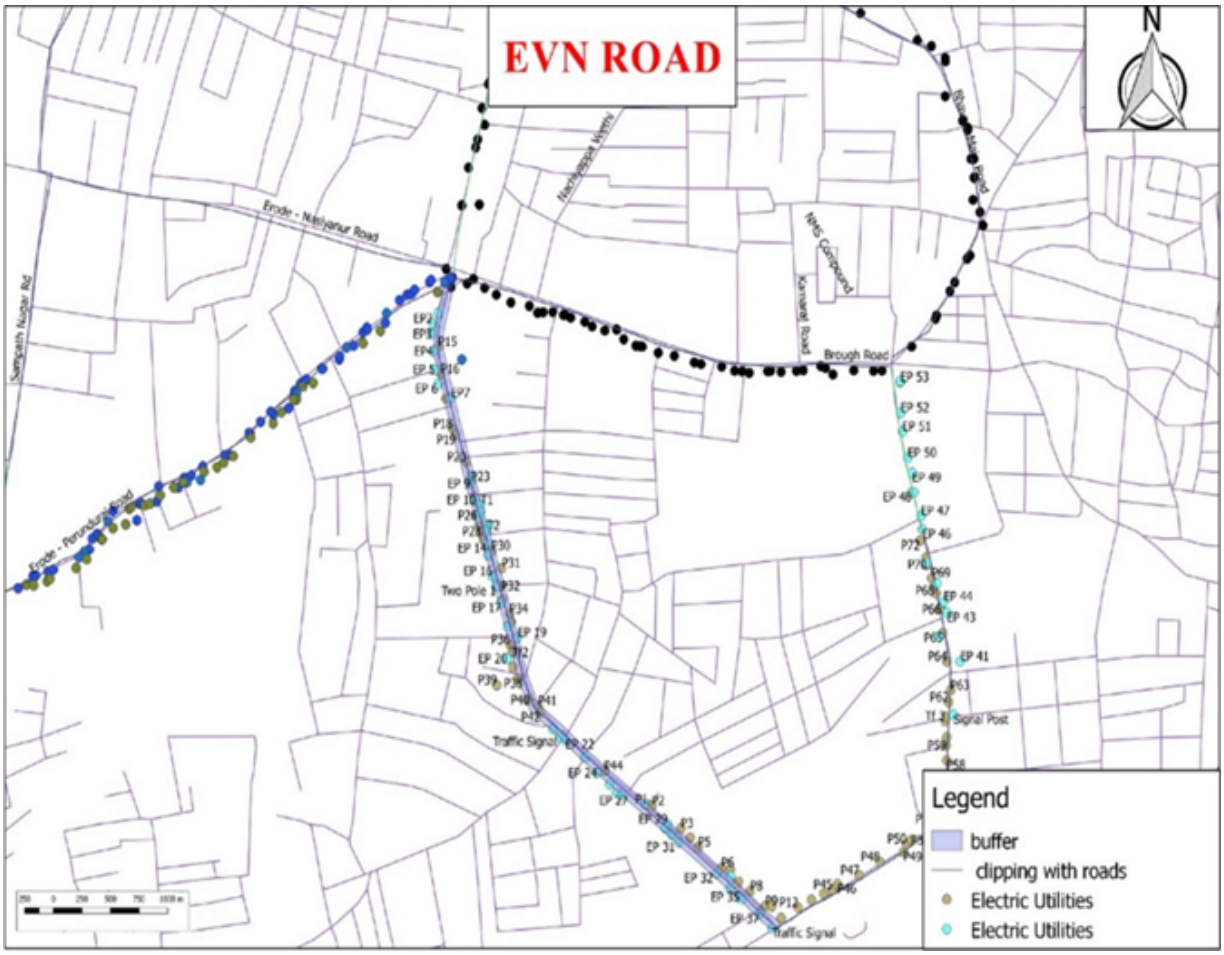

Figure 5

Buffered Map of EVN Road

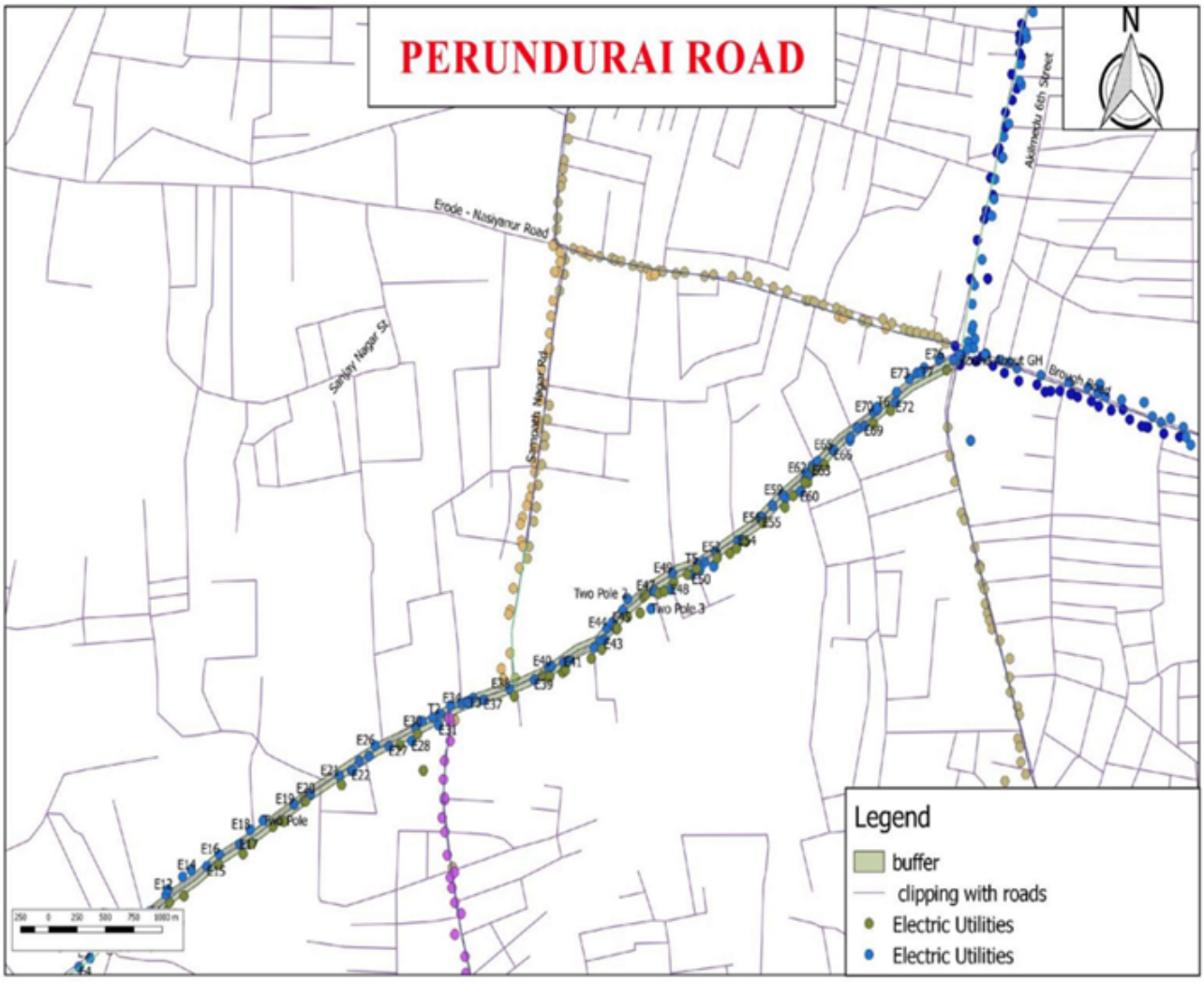

Figure 6

Buffered Map of Perundurai Road

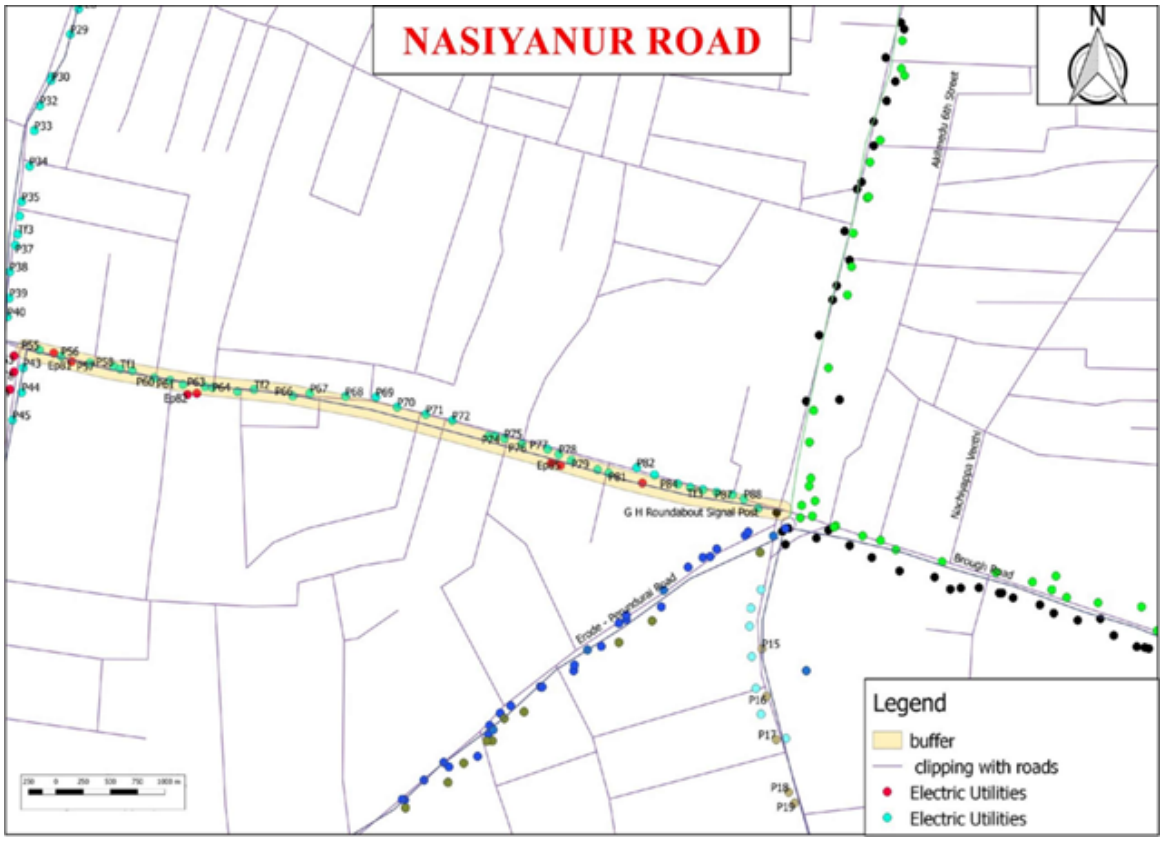

Figure 7

Buffered Map of Nasiyanur Road

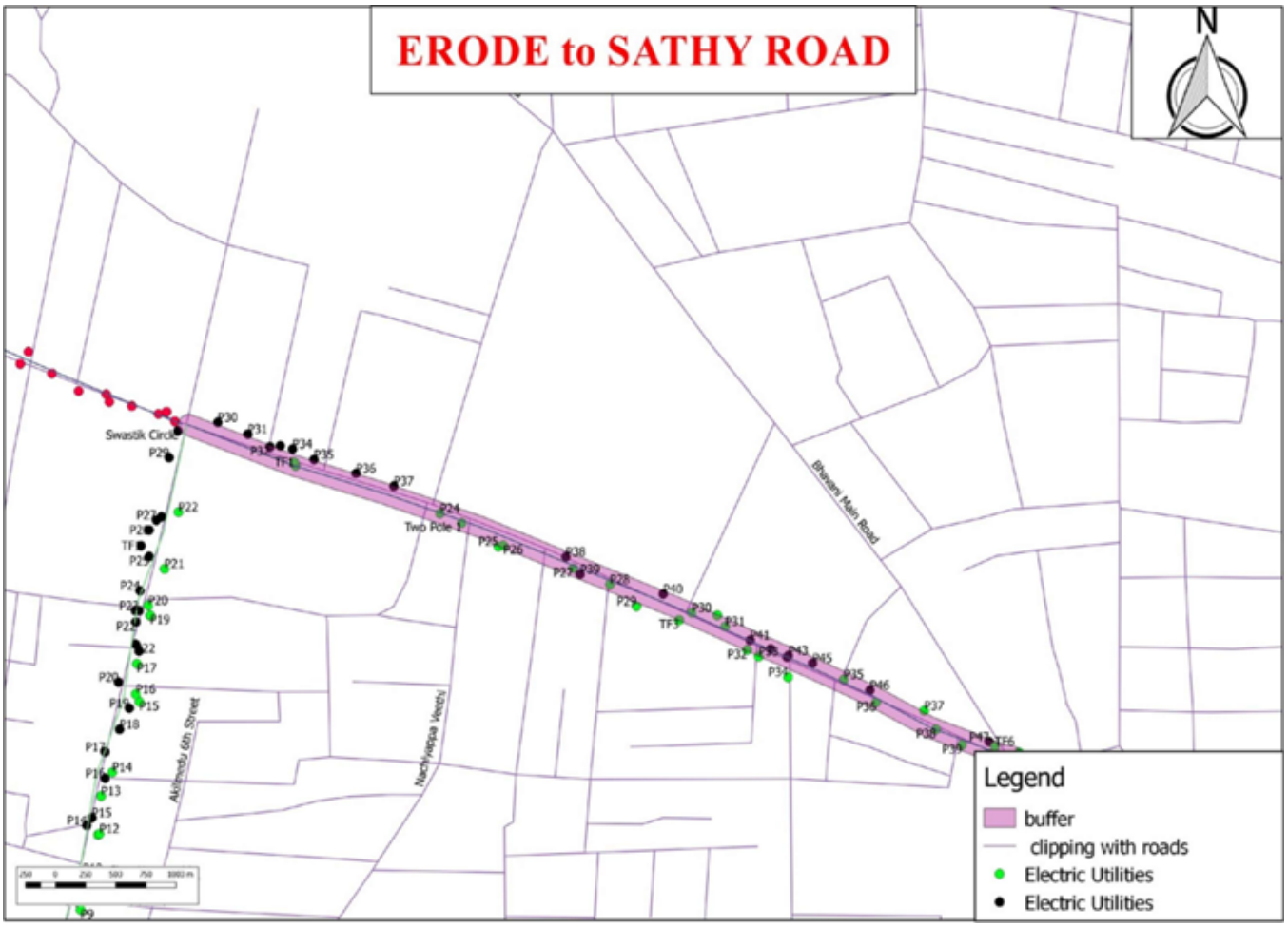

Figure 8

Buffered Map of Erode to Sathy Road

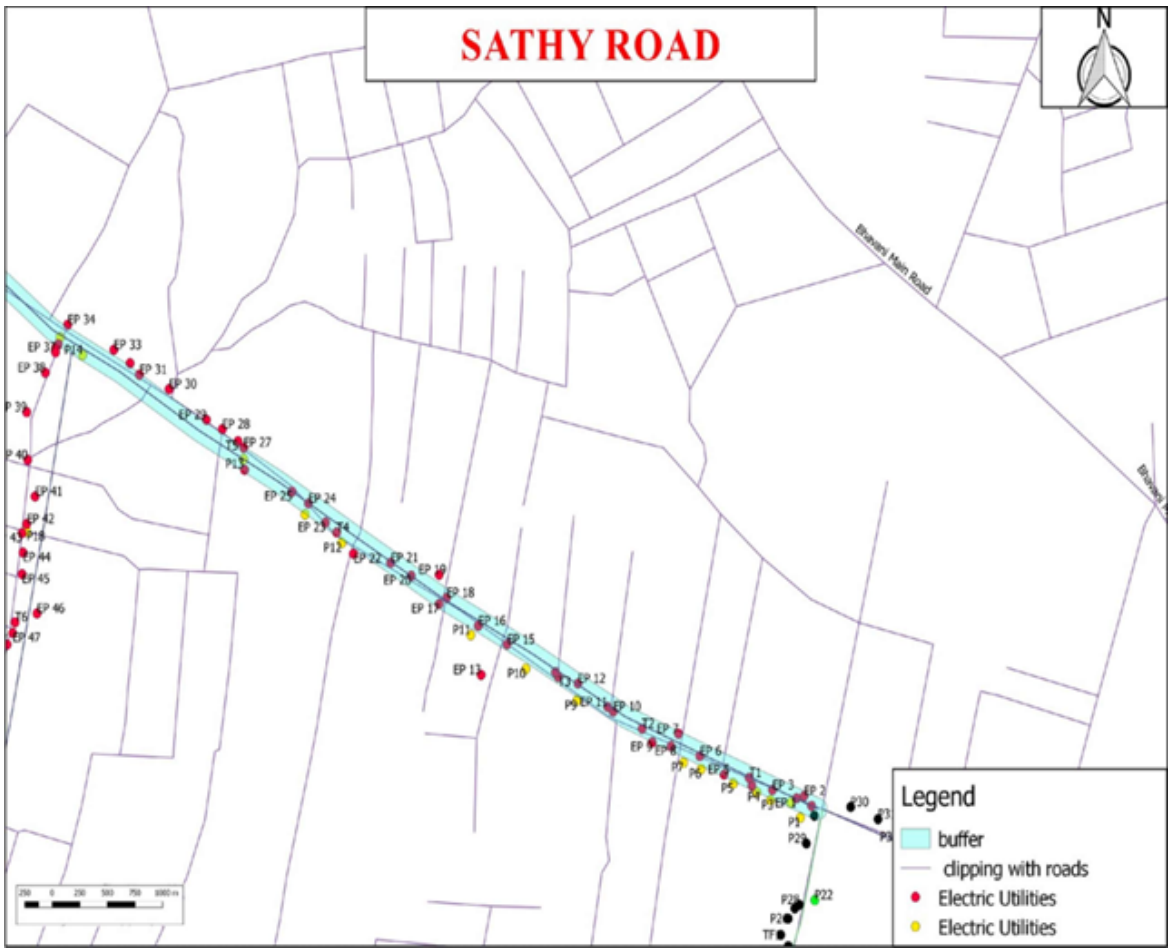

Figure 9

Buffered Map of Sathy Road

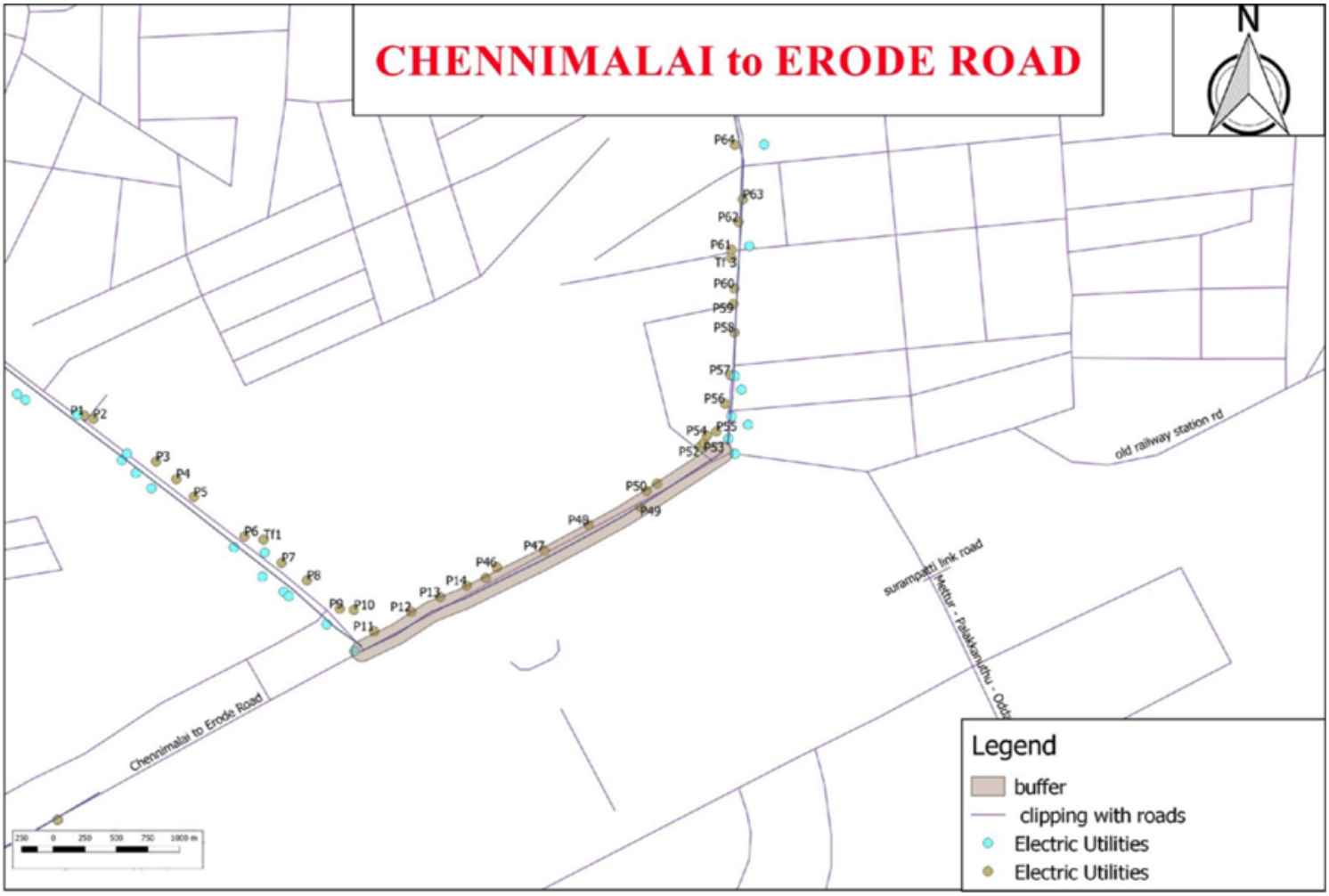

Figure 10

Buffered Map of Chennimalai to Erode Road

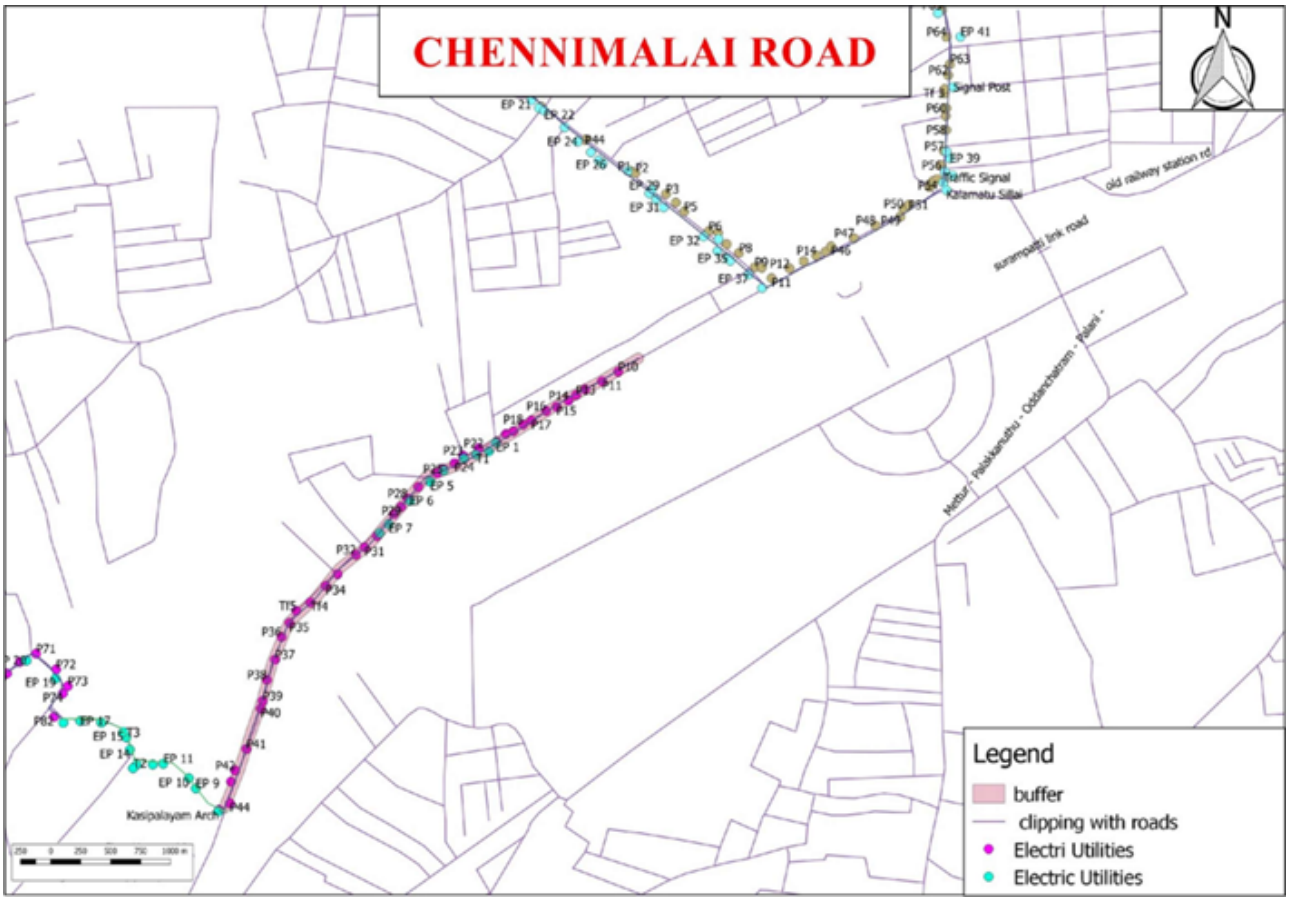

Figure 11

Buffered Map of Chennimalai Road

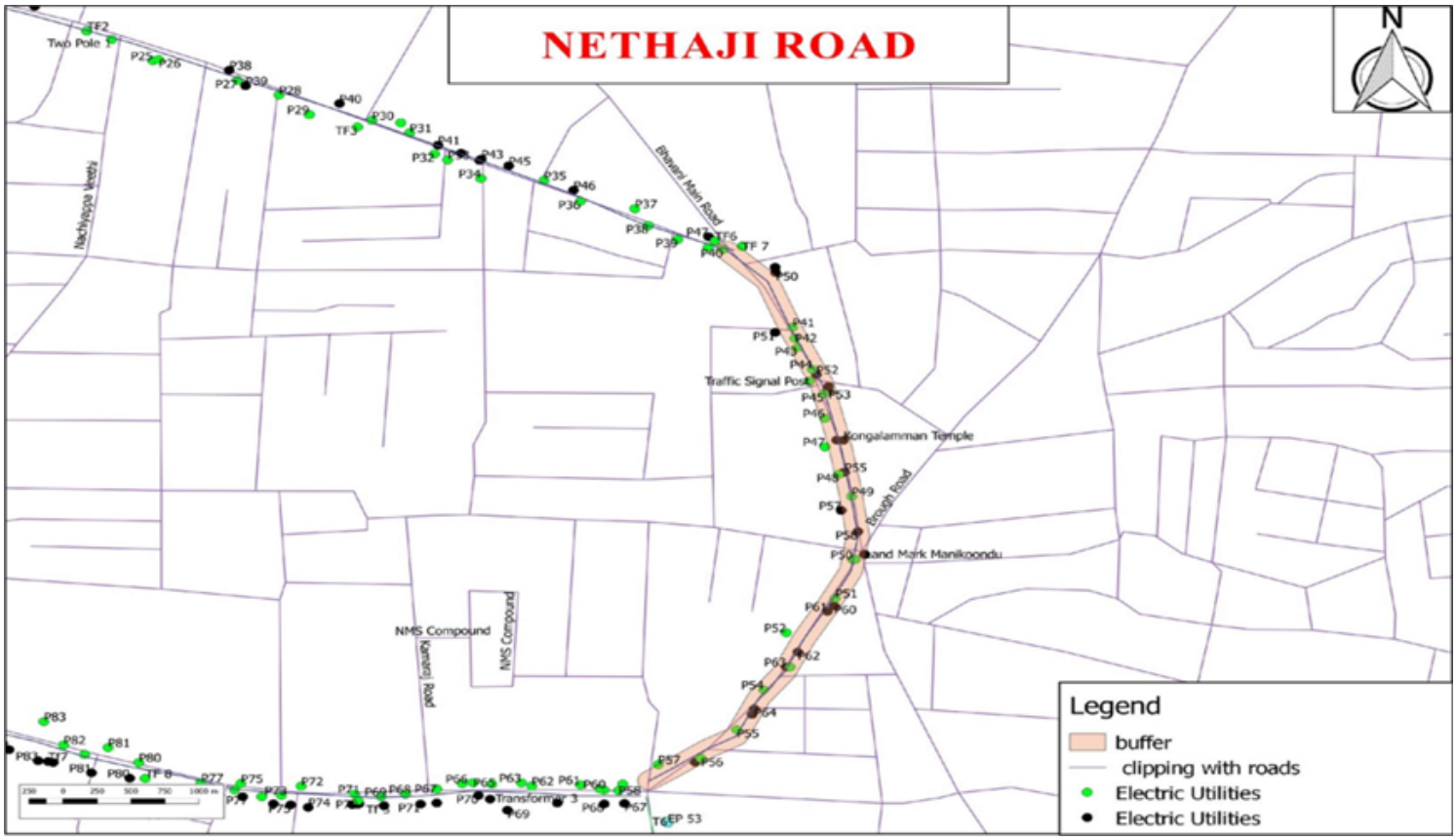

Figure 12

Buffered Map of Nethaji Road

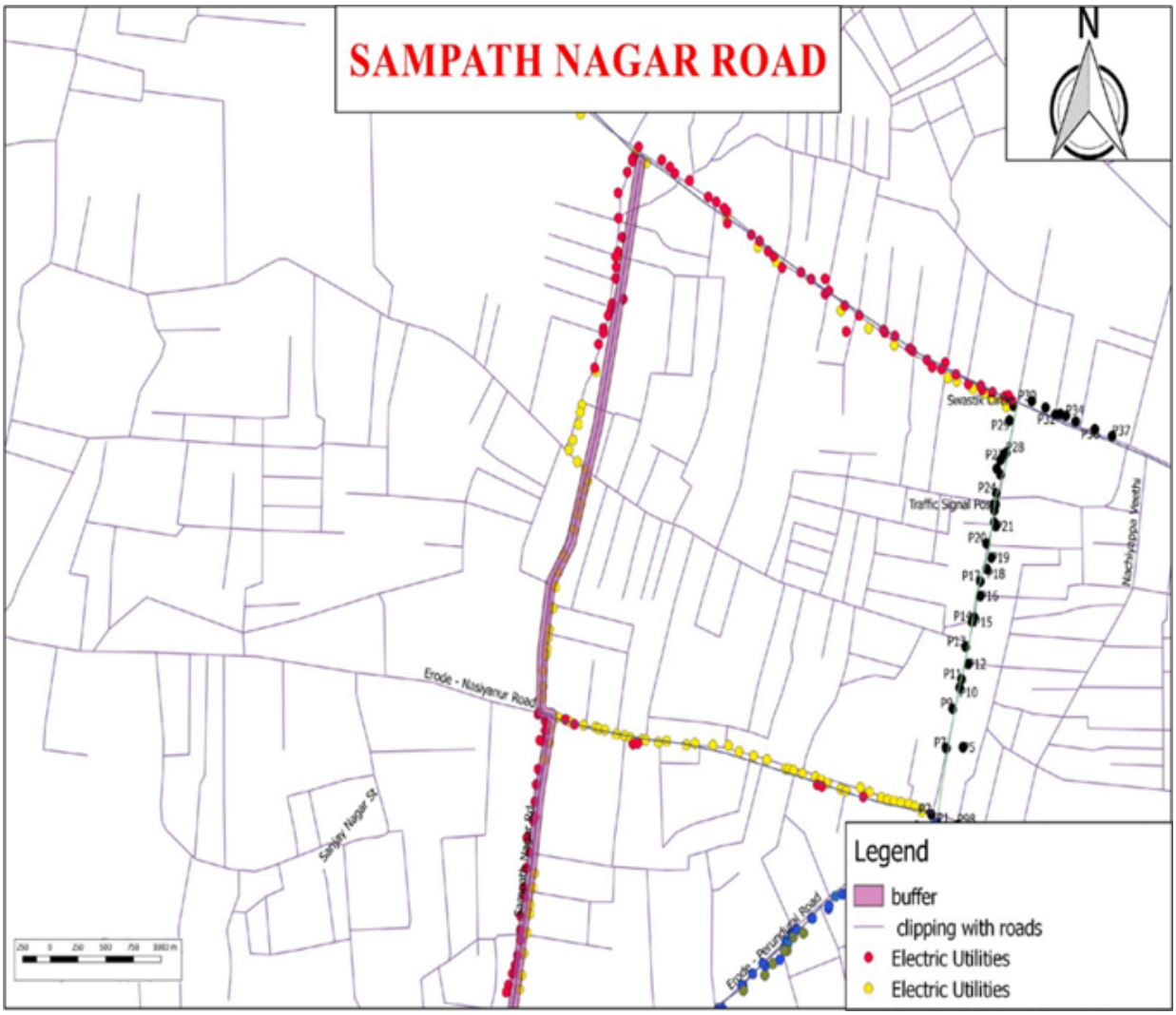

Figure 13

Buffered Map of Sampath Nagar Road

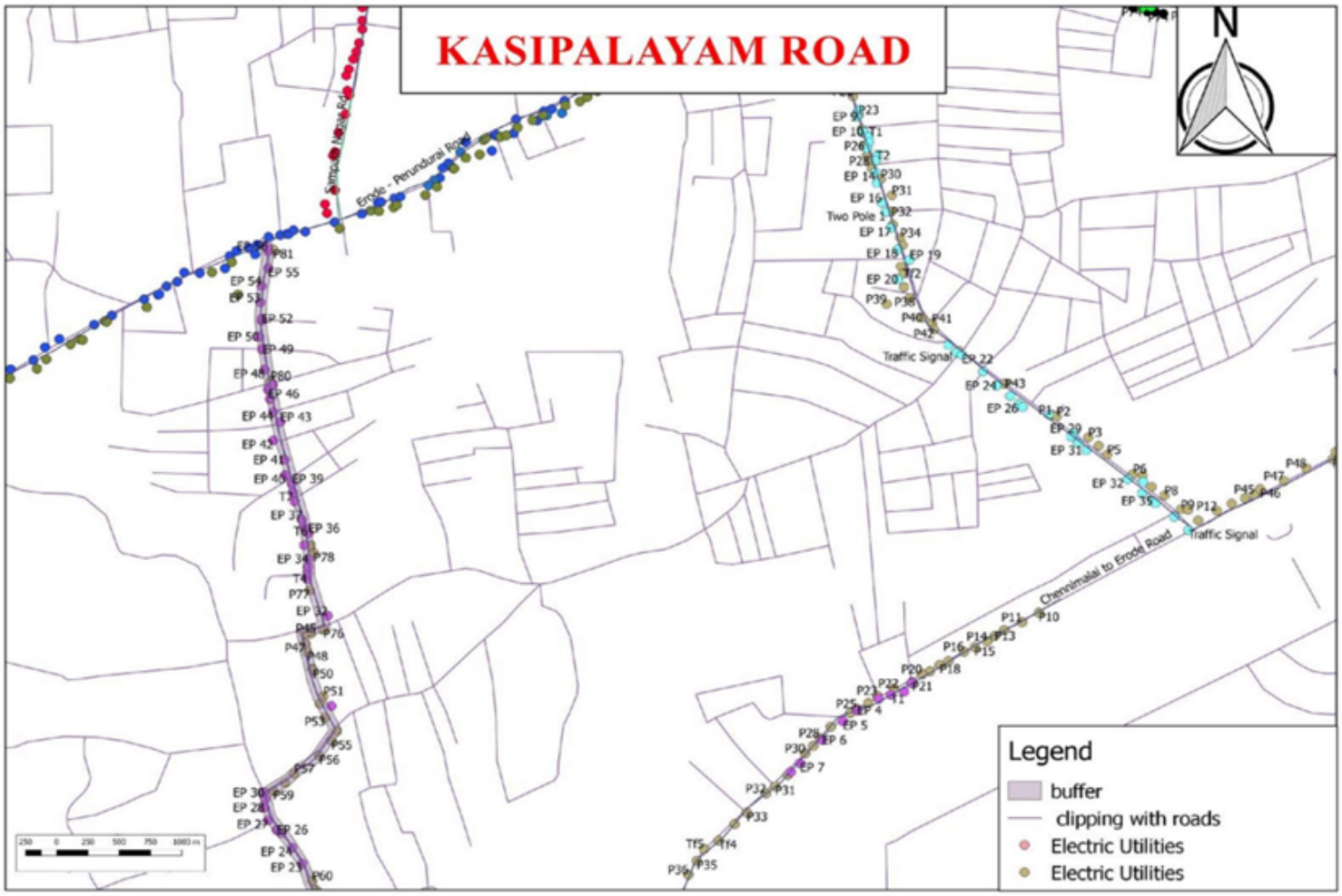

Figure 14

Buffered Map of Kasipalayam Road

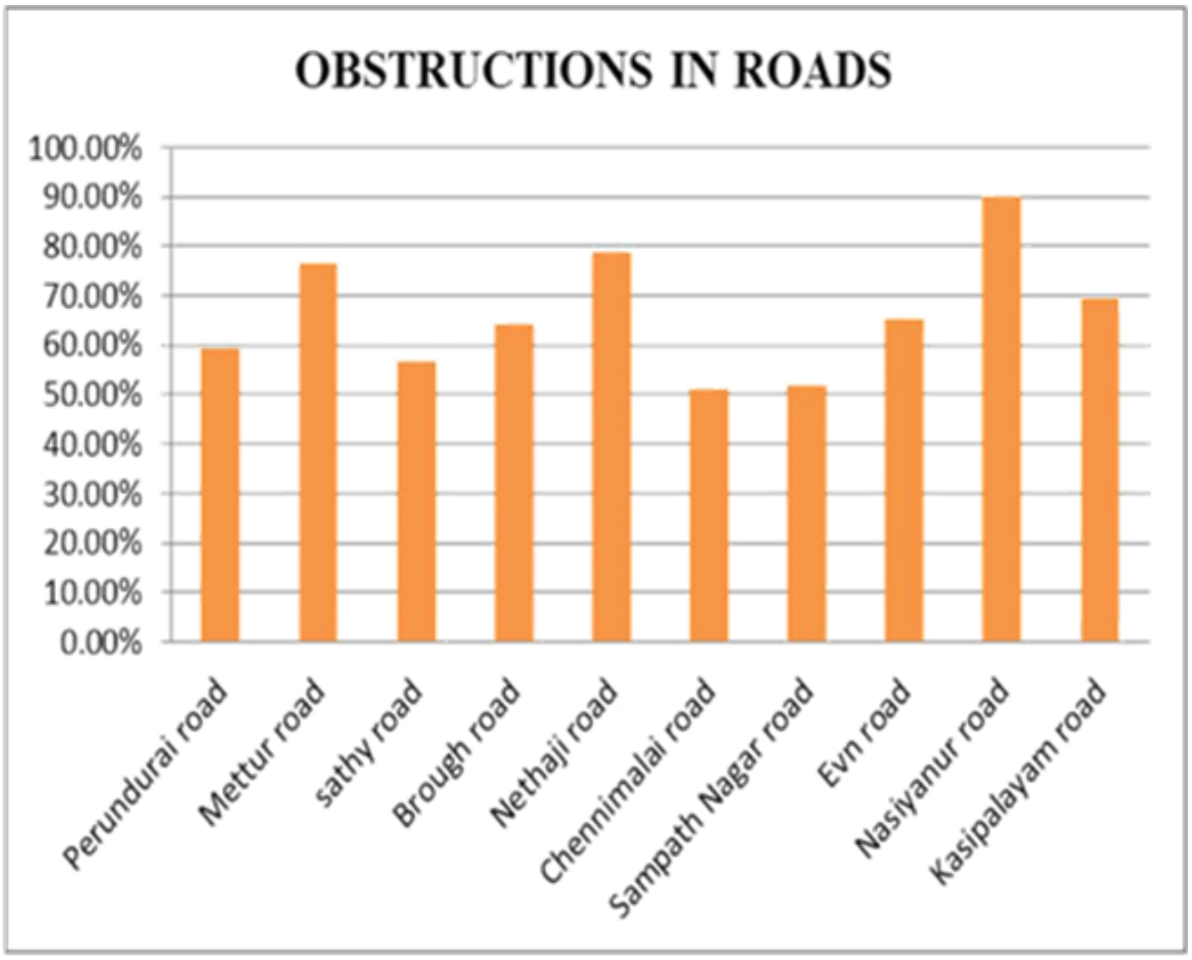

Figure 15

Comparison of Obstructions in Roads