

URBANIZATION IN DEVELOPING COUNTRIES

RESIDENTIAL LAND UTILIZATION
Case Study: Nairobi, Kenya

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ABSTRACT

CONTENT:

This is a study on residential land utilization based upon the survey, evaluation and comparison of 12 localities selected from the metropolitan area of Nairobi, Kenya.

These localities represent the full range of residential developments of Nairobi's private, popular and public sectors, from the lowest to the highest densities and from the lowest to the highest incomes.

The physical environments of each of the localities are described in terms of land utilization at two scales: the locality itself, and a selected segment of the locality.

In order to facilitate comparative evaluation, a tentative 'model' for optimum efficiency of residential layouts is presented. The model also serves as an illustration to the guidelines derived in the study for physical planning of residential development.

A summary of information on Nairobi is included in the appendix for the benefit of the readers not familiar with the urban context.

OBJECTIVES:

- To emphasize the correlation between efficiency of settlements and their physical layout;
- To illustrate the relationships of the settlements in their urban context;
- To compare, contrast and evaluate the various physical layouts of residential developments within one city;
- To derive guidelines for more realistic and effective physical land utilization policies.

APPLICATION:

The study is intended as:

- A tool for reference and information for those concerned with the physical planning of residential developments;
- A tentative set of guidelines for those involved in the planning of residential developments;
- A source of 'feedback' for those involved in planning of future residential developments in Nairobi.

PREFACE

This study is part of a project on 'Development of Basic Performance Standards for Urbanization and Housing Technologies Through Testing of Models, in Nairobi, Kenya'. The project is being supported by the Massachusetts Institute of Technology and the Agency for International Development with the grant: 'Adaptation of Technology to the Conditions of Developing Countries'.

The study is based on a one month field trip to Nairobi in the summer of 1972 and was elaborated during the Spring semester of 1973 at M.I.T.

The authors gratefully acknowledge the support, guidance and advice received from Professor Horacio Caminos during the course of their studies at M.I.T., particularly in this study which owes a great deal to the research already carried out in his program: 'Urban Settlement Design in Developing Countries' at the School of Architecture and Planning, M.I.T.

The authors are indebted to Reinhard Goethert for his personal assistance and to Tari Chana for his participation in the study. Much appreciation goes also to Jann Gattoni for her moral support.

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INTRODUCTION



Panorama of Nairobi from the west

LAND AND URBANIZATION

This study is concerned with one of the most critical aspects of housing and urban development: LAND.

Land is the basic commodity for human settlements. It is the physical framework in which all living activities take place.

Coordinated and effective policies which affect land utilization, including land controls, taxation and public ownership of land, are necessary if optimum benefits are to result, especially during the period when rural land is converted to urban uses. Land utilization policies have an extremely important bearing upon the ability of a city to develop even to minimum functional living standards.

The role played by land becomes even more critical in cities of developing countries with their exponential rate of urbanization. African cities are still in early stages of urbanization and are not yet confronted with the overwhelming problems faced by Asian and Latin American cities.



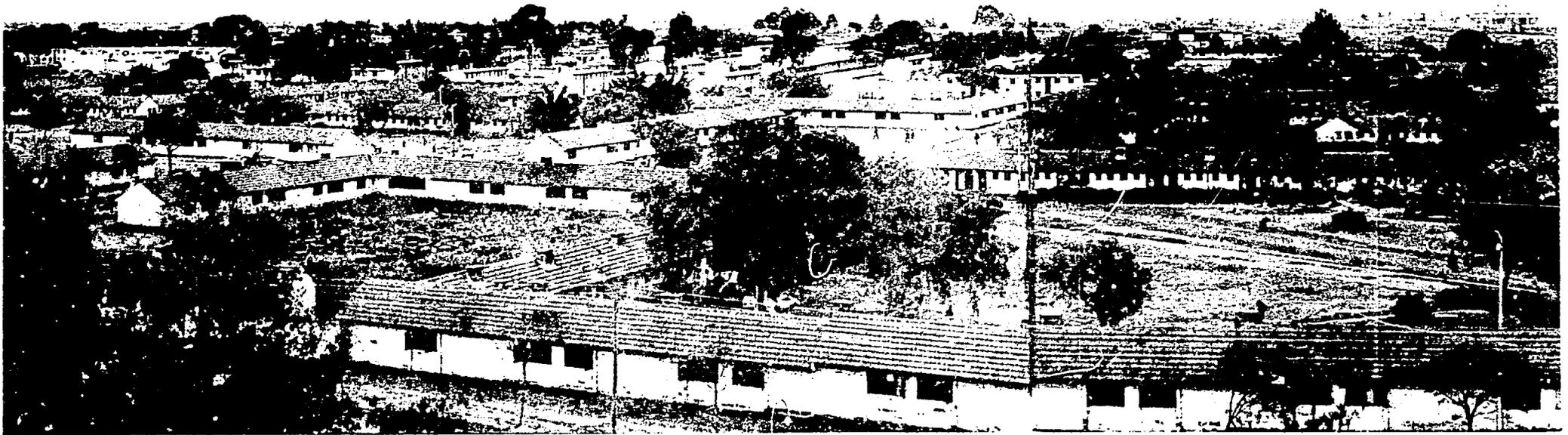
NAIROBI AS A CASE STUDY

This study focuses specifically on the physical layout/subdivision of land. This aspect of land is fundamental since the layout is not only critical from an efficiency and amenity standpoint, but also because it tends to be the most permanent feature of the city.

The city of Nairobi, Kenya, provides a typical example of a rapidly urbanizing African city. The city, only 74 years old and already the largest urban center in Eastern Africa, is in an incipient stage of accelerating urbanization. Its annual growth rate of between 7% and 9% has resulted in high unemployment, insufficient and inadequate shelter and potential urban sprawl. In 1971, 1/3 of the population was living in temporary, generally unserviced settlements.

The gap between housing demand and stock is increasing. It is invariably the low income sector that is most affected by this situation. This sector, which forms about 70% of the city's current population, will constitute an increasingly larger proportion of the future population. Any study on land must take this expanding sector into serious consideration.

The land requirements for the future metropolis that Nairobi is projected to become are immense. Its present population of 1/2 million is expected to explode to 4 1/2 million in the year 2000. Two means open for the



RESIDENTIAL DEVELOPMENT IN NAIROBI

city to contain this population are:
a) modify land use policies (for example higher density zoning);
b) add more land by extending the city boundary. It should be evident that the former is the more prudent option if only to avoid urban sprawl with its problems of extensive infrastructure costs, reliance on the automobile and boring landscape. Furthermore, Nairobi's existing boundaries are potentially capable of accommodating the population growth and still maintain acceptable densities and environmental standards.

Throughout the growth of Nairobi, from its inception as a railway depot in 1899 to the present, residential areas have occupied disproportionately larger areas of the city in relation to the size of the population at any particular time. The most prominent feature of the city's residential development has been its stratification on a racial basis. There are distinct African, Asian and European residential districts, each with its own supporting facilities, characteristic density, income groups and environmental quality.

This stratification is the result of a combination of official policies, cultural preferences and economic forces during the colonial administration.

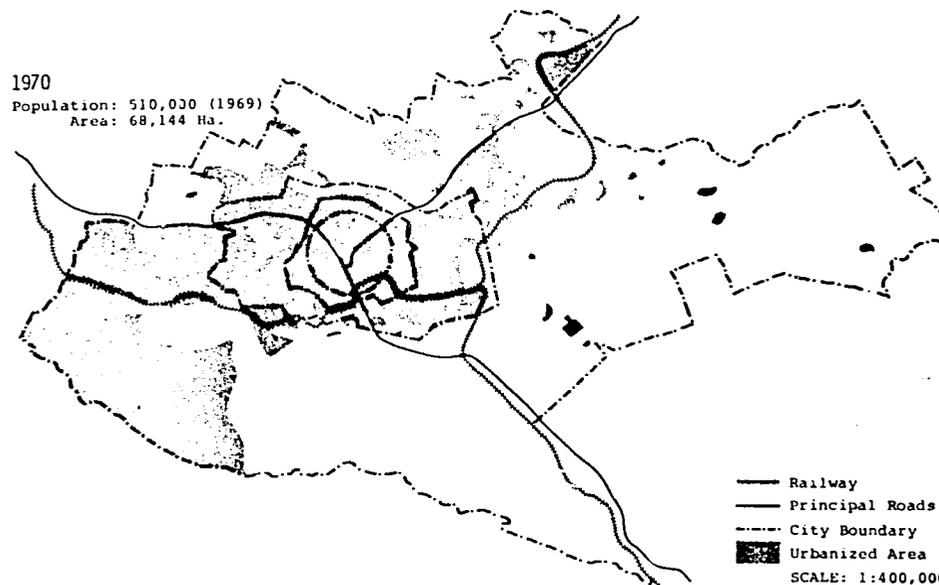
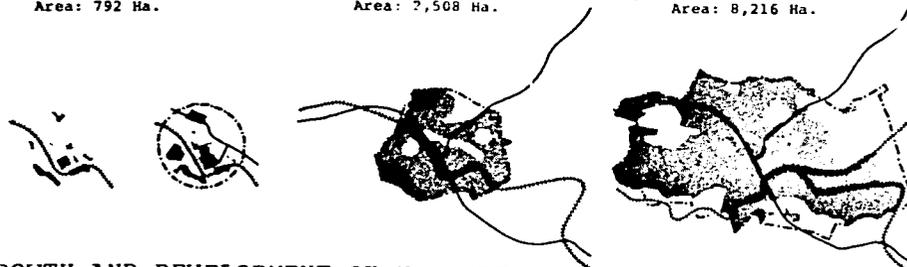


1900
Population: 11,500 (1906)
Area: 792 Ha.

1920
Population: 29,860 (1926)
Area: 2,508 Ha.

1940
Population: 108,900 (1944)
Area: 8,216 Ha.

1970
Population: 510,030 (1969)
Area: 68,144 Ha.



— Railway
— Principal Roads
--- City Boundary
■ Urbanized Area
SCALE: 1:400,000

GROWTH AND DEVELOPMENT OF NAIROBI

Nairobi was established with the railway encampment as its nucleus in 1899. In 1900 an arbitrary circular boundary of 1 1/2 mile radius was declared. The town consisted of the railway centre, the European business and administration center, the Indian bazaar, the Railway Quarters, the Dhoobie Quarters, the European residential suburb and the military barracks outside the town. Land around the town was being offered by authorities to new settlers at 4d to 6d an acre. By 1906 the population had reached 11,000 and definite land use zones appeared, by chance and choice of the inhabitants. In 1919 Nairobi became a municipality with a corporation and the initial circular boundary was changed to include some of the residential estates like Parklands. The first low income housing schemes were started in Eastlands during this period. Further boundary changes were made in 1926 to absorb most of the low density European residential areas like Muthaiga. However, this boundary encompassed the urban area only - 32 sq.m. extending about 6 miles east-west and 5 miles north-south. From 1928 to independence in 1963 the boundary remained substantially the same. Peri-urban low density residential areas developed and the lack of universal land use controls resulted in very low density residential developments. A Master Plan was prepared, for the first time, for a "Colonial Capital in Africa" by a team of South African planners in 1947. This plan perpetuated, in effect, segregation in residential areas with European, Asian and Official (for Africans) zones clearly defined. The 'Garden City' appearance of the city was initiated during this period. From 1948 to 1963 the city developed more or less along the lines prescribed by the Master Plan.

In 1963 the new independent administration of the city decided to expand the city boundaries with the intention of including adequate land for residential and commercial development, and to absorb the peri-urban and dormitory areas occupied by people depending on the city for their employment. The constraints to the expansion of the boundaries were recognized: NORTH: encroachment of good agricultural land; SOUTH: Nairobi Game Reserve; WEST: suburbs of varying densities already existing. Vacant or under utilized farmland in the east provided most of the area absorbed by the new boundary. Since independence the city has grown at a rate of 7% to 9% per annum.



Central business district of Nairobi

- The European residential areas occupy the best land in terms of natural features and amenities, and are characterized by low densities, detached one story houses with separate servants quarters and large lots.

They are situated to the west and northwest of the central business district: Upper Nairobi, Karen, Langata, Spring Valley and Muthaiga.

These areas constitute more than half of Nairobi's residential land but house less than 10% of its population.

- The Asian residential areas are characterized by medium/high densities, traditional multicolored, flat-topped houses, and small lots.

They are situated nearer to the central business district and the Industrial Area: Parklands, Eastleigh and Nairobi South.

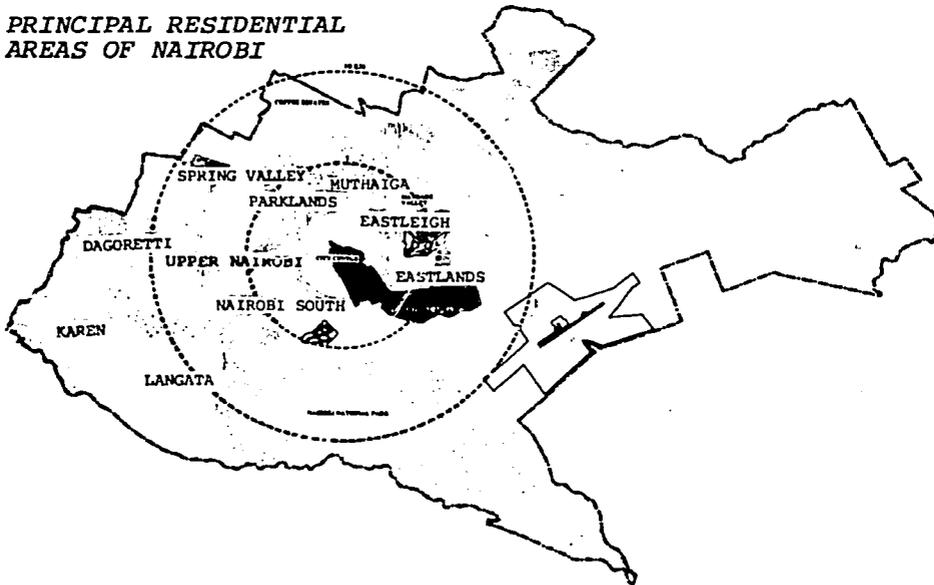
- The African residential areas sprawled eastward, occupying the poorest land, in an area called Eastlands, characterized by housing estates built principally by the Nairobi City Council and large employers for the working class.

This area, only 4 square miles, houses more than half the African population of Nairobi.

These rigid classifications are beginning to change, though Eastlands still remains predominantly African.



*PRINCIPAL RESIDENTIAL
AREAS OF NAIROBI*



The most significant consequences of previous land development practices are related with the density of development: a) Zoning of large minimum lot sizes in developments such as the European areas has resulted in excessively low densities. Therefore, more land is required per person while at the same time the city tends to grow at a rapid rate; b) High densities and overall restrictive policies in the remainder of the city created overcrowding and substandard environmental conditions. It is such areas that are growing the fastest; areas with larger lots are experiencing little strain.



Squatter development in Mathare Valley

The overall result of the policies of the colonial administration has been unbalanced land utilization and apparent land shortage.

At Independence, in 1963, the boundary of the city was extended from 30 square miles to 266 square miles, which, coupled with the immigration of job seekers effected a large increase in the city's population. Another significant post-independence development has been the growth of extra-legal residential development by the

popular sector (squatters and company tenements). Today this type of residential developments house more than 1/5 of the total population, having absorbed the majority of the in-migrants in the low income sector. Popular developments are characterized by high densities, traditional and tenement housing, and are concentrated in the Mathare Valley in the east of the central business district.

An examination of Nairobi's present physical form reveals a whole range of residential developments.

For the purposes of the residential land utilization survey, twelve localities were identified to cover the full spectrum of the types categorized in the following chart.



TYPES OF RESIDENTIAL DEVELOPMENT IN NAIROBI

TYPE	DEVELOPER	INTENSITY OF DEVELOPMENT	USERS INCOME LEVEL	% OF TOTAL POPULATION (V.Approx.)	% OF TOTAL RESIDENTIAL AREA (V.Approx.)	LOCALITIES SURVEYED
A SUBURBAN	Private	Low	High	20	80	Karen Parklands
B RURAL VILLAGE	Popular	Low	Low	10	10	Village Ngei I Kawangware Village
C TENEMENT	Private/ Popular	High	Low/Middle	70	10	Eastleigh Village I: Tenements
D SQUATTER	Popular	High	Low			Village I: Squatters
E MUNICIPAL HOUSING	Public	Medium/ High	Low/Middle			Kimathi Estate Kariobangi Mathare Redevelopment Makongeni Estate Kaloleni Estate

PHYSICAL RESIDENTIAL DEVELOPMENT



THE PHYSICAL LAYOUT

Residential development takes up more land than any of the other functions of the city. More than 50% of the built-up land in Nairobi is occupied by residential development; and most of the future land requirements to meet expansion are related with housing.

As a scarce resource, the use of land requires effective policies and goals if the optimum benefits for a maximum number of users at a minimum cost for the developer are to result.

The layout is a useful initial determinant of efficiency in terms of cost and functional viability of the development. An inefficient layout is a setback from the outset for any development.

Planning for all residential developments should emphasize the need for sound physical layout, BECAUSE: the physical layout is the primary determinant of subsequent commitment - cost of land, administration, maintenance, as well as the overall performance of the scheme. This is even more crucial in low income public housing, where the highest demands and needs are.

CRITERIA FOR EVALUATION OF PHYSICAL LAYOUTS

The criteria used in the evaluations of efficiency of physical layouts in the survey are:

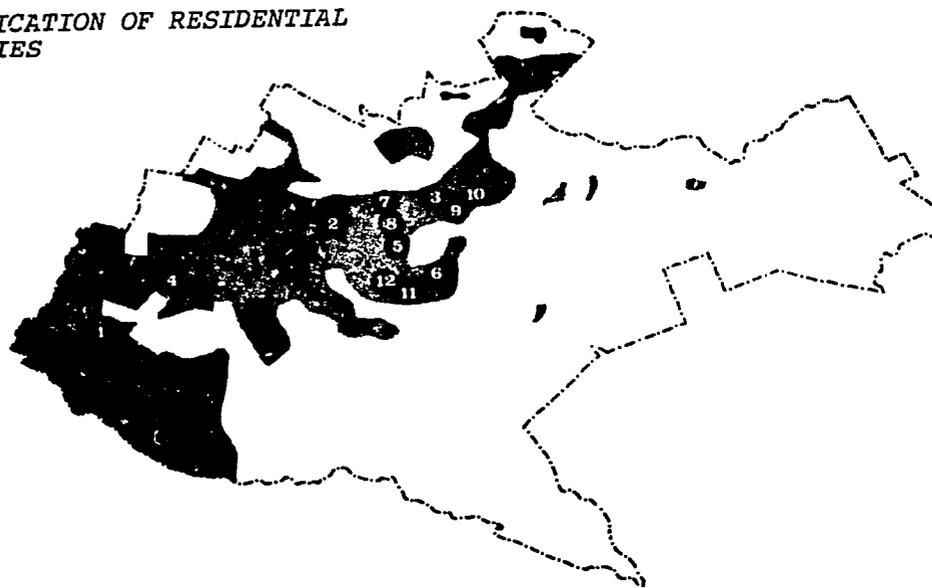
- **LAND UTILIZATION DISTRIBUTION:** Proportions of public, private and circulation areas within the layout. This determines maintenance responsibility, user control and functional efficiency.
e.g. A high percentage of circulation means higher cost per person, and therefore indicates an inefficient layout.
- **LAYOUT:** Lot configuration, blocks and circulation. This determines the infrastructure network.
e.g. Certain layouts result in complicated infrastructure networks requiring excessive lengths of networks and therefore higher cost per person.
- **DENSITY:** Number of persons and dwelling units per hectare. This determines the intensity of use.
e.g. Low density means a higher cost of development per person.
- **OTHER RELATED PHYSICAL DETERMINANTS.**

RESIDENTIAL LAYOUTS IN NAIROBI

The investigation of the basic types of residential layouts found in Nairobi was carried out in order to establish an understanding of residential land development issues and physical planning elements that constitute efficient, effective and beneficial development practices and layouts.

The survey examines and illustrates the evaluation of efficiency for twelve representative examples of residential layouts in Nairobi. Evaluations of 400m x 400m segments of each locality are described in terms of the criteria mentioned above.

IDENTIFICATION OF RESIDENTIAL LOCALITIES



The twelve residential localities can be identified as follows:

- 1 KAREN
Private sector, very low density, prestige suburb.
- 2 PARKLANDS
Private sector, low density, suburb.
- 3 VILLAGE NGEI I - Mathare Valley
Popular sector, low density, rural village.
- 4 KAWANGWARE VILLAGE - Dagoretti
Popular sector, medium density, rural village.
- 5 EASTLEIGH
Private sector, high density, tenements.
- 6 KIMATHI ESTATE - Eastlands
Public sector, medium density, new development.

- 7 VILLAGE I: SQUATTERS - Mathare
Popular sector, high density, uncontrolled settlement.
- 8 VILLAGE I: TENEMENTS - Mathare
Popular sector, very high density, tenements.
- 9 MATHARE REDEVELOPMENT
Public sector, medium density, site-and-service project.
- 10 KARIOBANGI
Public sector, high density, site-and-service project.
- 11 MAKONGENI ESTATE - Eastlands
Public sector, medium density, row housing.
- 12 KALOLENI ESTATE - Eastlands
Public sector, medium density, row housing.

This selection of layouts represents:

- RANGE OF POPULATION DENSITY: from very low (5 persons/Ha) to very high (1800 persons/Ha).
- MODES OF DEVELOPMENT: private, public, popular.
- RANGE OF USER INCOME GROUPS: from very high (over \$6000 p.a.) to very low (under \$300 p.a.)
- RANGE IN CONTROL OF OPEN SPACE: from entirely private to entirely public.
- RANGE OF DWELLING UNIT TYPES: room unit, house unit.

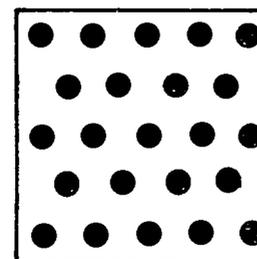
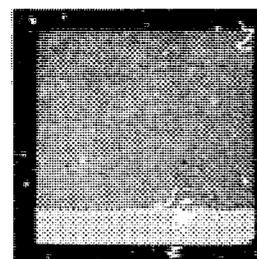
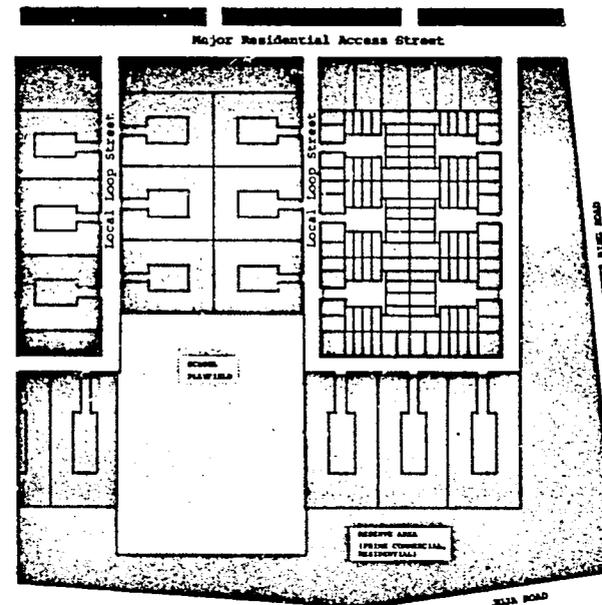
SURVEY SUMMARY

The following information is shown in the survey summary: layout type, land utilization and population density. The data for each locality is illustrated by means of three diagrams:

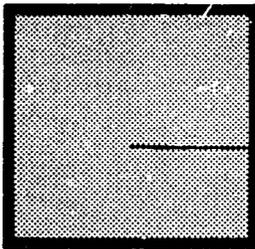
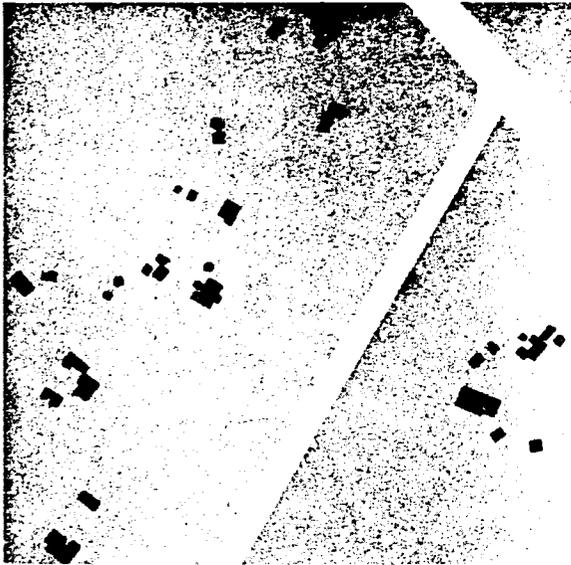
- **LOCALITY SEGMENT:**
A 400m x 400m segment selected from the locality for the calculation of evaluation data. The segment plan shows the layout of private land use areas, public and miscellaneous land use areas, public circulation areas, as well as the grouping of dwellings.

- **LAND UTILIZATION DIAGRAM:**
Illustrates the distribution of land use areas for each segment as follows:
 - % of circulation areas (PUBLIC) (in black);
 - % of miscellaneous PUBLIC areas (in light tone);
 - % of PRIVATE control areas (in dark tone)

- **DENSITY:**
Illustrates graphically the population density of each segment; each dot represents approximately 20 persons per hectare.

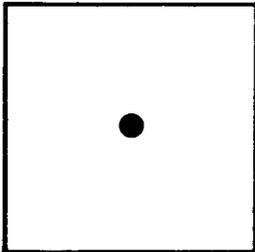


1 KAREN



LAND UTILIZATION DIAGRAM

Circulation: 8%
Private : 92%
Public : 0%



DENSITY DIAGRAM

● 20 persons

EFFICIENCY INDICATORS:

● DISTRIBUTION OF LAND UTILIZATION AREAS:

% Public - circulation : VERY LOW
% Public - miscellaneous: NONE
% Private : VERY HIGH

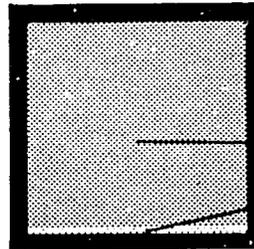
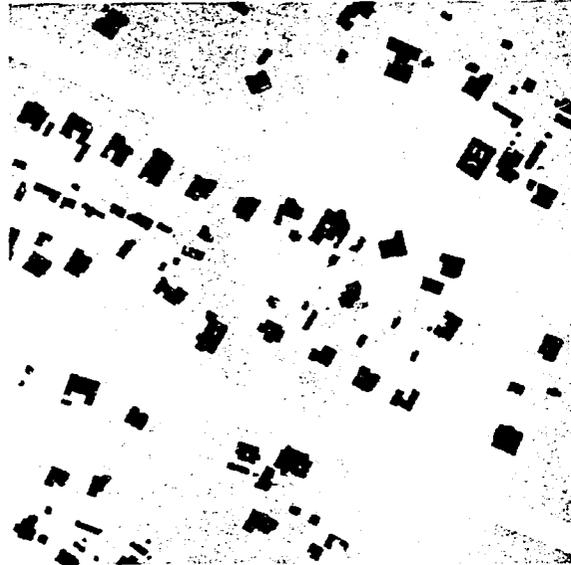
● INTENSITY OF USE:

Persons per Ha. : VERY LOW
Dwelling units per Ha. : VERY LOW
% Built-up coverage : VERY LOW

● LAYOUT:

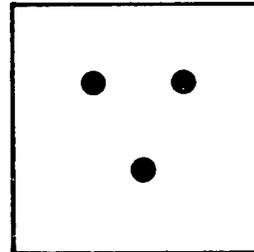
Lot areas : VERY LARGE
Length of circulation : VERY LOW
Ratio : VERY LOW

2 PARKLANDS



LAND UTILIZATION DIAGRAM

Circulation: 15%
Private : 84%
Public : 1%



DENSITY DIAGRAM

● 20 persons

EFFICIENCY INDICATORS:

● DISTRIBUTION OF LAND UTILIZATION AREAS:

% Public - circulation : VERY LOW
% Public - miscellaneous: VERY LOW
% Private : VERY HIGH

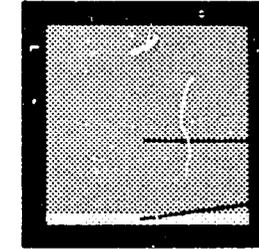
● INTENSITY OF USE:

Persons per Ha. : VERY LOW
Dwelling units per Ha. : VERY LOW
% Built-up coverage : LOW

● LAYOUT:

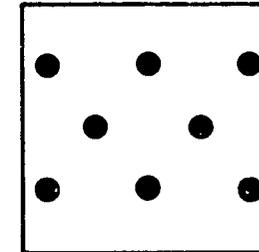
Lot areas : VERY LARGE
Length of circulation : LOW
Ratio : LOW

3 VILLAGE NGEI I



LAND UTILIZATION DIAGRAM

Circulation: 23%
Private : 72%
Public : 5%



DENSITY DIAGRAM

● 20 persons

EFFICIENCY INDICATORS:

● DISTRIBUTION OF LAND UTILIZATION AREAS:

% Public - circulation : LOW
% Public - miscellaneous: VERY LOW
% Private : HIGH

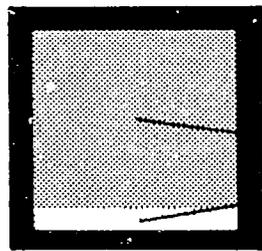
● INTENSITY OF USE:

Persons per Ha. : LOW
Dwelling units per Ha. : MEDIUM
% Built-up coverage : LOW

● LAYOUT:

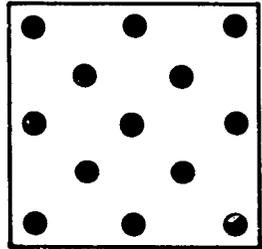
Lot areas : -
Length of circulation : -
Ratio : -

4 KAWANGWARE VILLAGE



LAND UTILIZATION DIAGRAM

Circulation: 19%
Private : 70%
Public : 11%



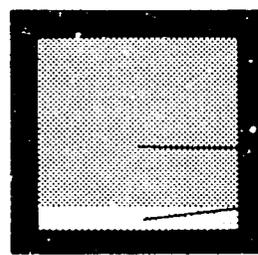
DENSITY DIAGRAM

● 20 persons

EFFICIENCY INDICATORS:

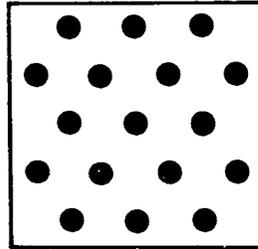
- DISTRIBUTION OF LAND UTILIZATION AREAS:
 - % Public - circulation : LOW
 - % Public - miscellaneous : LOW
 - % Private : HIGH
- INTENSITY OF USE:
 - Persons per Ha. : MEDIUM
 - Dwelling units per Ha. : MEDIUM
 - % Built-up coverage : MEDIUM
- LAYOUT:
 - Lot areas : LARGE
 - Length of circulation : HIGH
 - Ratio : MEDIUM

5 EASTLEIGH



LAND UTILIZATION DIAGRAM

Circulation: 29%
Private : 58%
Public : 13%



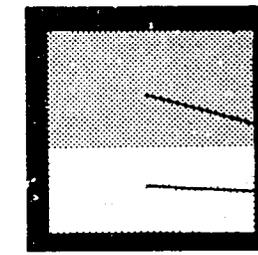
DENSITY DIAGRAM

● 20 persons

EFFICIENCY INDICATORS:

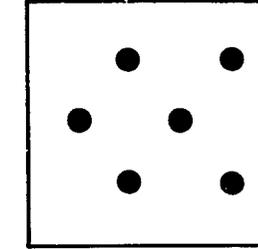
- DISTRIBUTION OF LAND UTILIZATION AREAS:
 - % Public - circulation : ACCEPTABLE
 - % Public - miscellaneous : ACCEPTABLE
 - % Private : ACCEPTABLE
- INTENSITY OF USE:
 - Persons per Ha. : MEDIUM
 - Dwelling units per Ha. : MEDIUM
 - % Built-up coverage : MEDIUM
- LAYOUT:
 - Lot areas : LARGE
 - Length of circulation : HIGH
 - Ratio : MEDIUM

6 KIMATHI ESTATE



LAND UTILIZATION DIAGRAM

Circulation: 27%
Private : 39%
Public : 34%



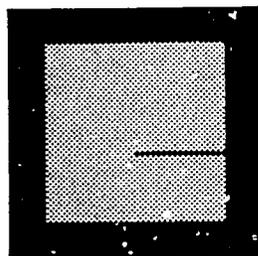
DENSITY DIAGRAM

● 20 persons

EFFICIENCY INDICATORS:

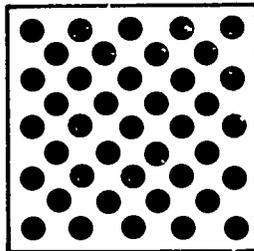
- DISTRIBUTION OF LAND UTILIZATION AREAS:
 - % Public - circulation : LOW
 - % Public - miscellaneous : HIGH
 - % Private : LOW
- INTENSITY OF USE:
 - Persons per Ha. : LOW
 - Dwelling units per Ha. : LOW
 - % Built-up coverage : LOW
- LAYOUT:
 - Lot areas : MEDIUM
 - Length of circulation : MEDIUM
 - Ratio : MEDIUM

7 VILLAGE I - SQUATTERS



LAND UTILIZATION DIAGRAM

Circulation: 48%
Private : 52%
Public : -



DENSITY DIAGRAM

● 20 persons

EFFICIENCY INDICATORS:

● DISTRIBUTION OF LAND UTILIZATION AREAS:

% Public - circulation : MEDIUM
% Public - miscellaneous: NONE
% Private : ACCEPTABLE

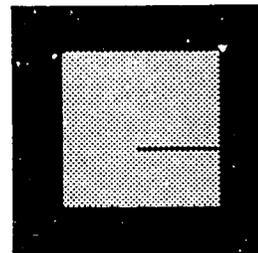
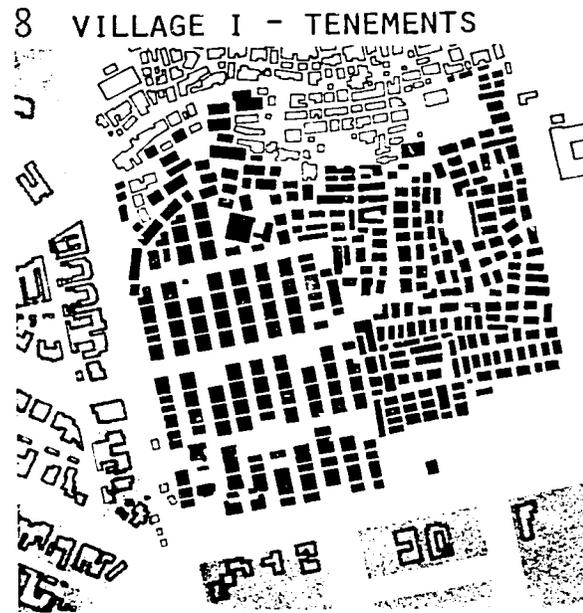
● INTENSITY OF USE:

Persons per Ha. : HIGH
Dwelling units per Ha. : VERY HIGH
% Built-up coverage : VERY HIGH

● LAYOUT:

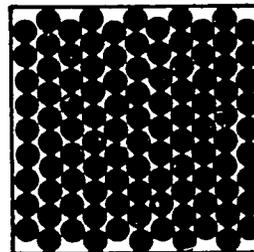
Lot areas : -
Length of circulation : -
Ratio : -

8 VILLAGE I - TENEMENTS



LAND UTILIZATION DIAGRAM

Circulation: 60%
Private : 40%
Public : -



DENSITY DIAGRAM

● 20 persons

EFFICIENCY INDICATORS:

● DISTRIBUTION OF LAND UTILIZATION AREAS:

% Public - circulation : HIGH
% Public - miscellaneous: NONE
% Private : ACCEPTABLE

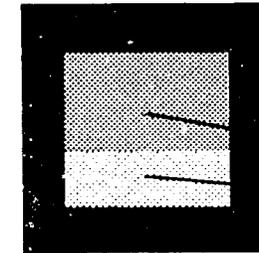
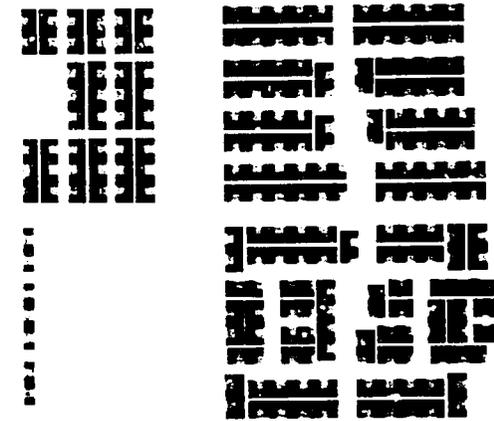
● INTENSITY OF USE:

Persons per Ha. : VERY HIGH
Dwelling units per Ha. : VERY HIGH
% Built-up coverage : VERY HIGH

● LAYOUT:

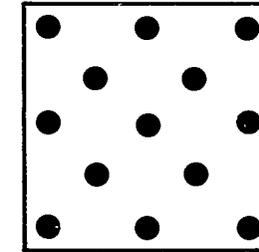
Lot areas : -
Length of circulation : -
Ratio : -

9 MATHARE REDEVELOPMENT



LAND UTILIZATION DIAGRAM

Circulation: 61%
Private : 25%
Public : 16%



DENSITY DIAGRAM

● 20 persons

EFFICIENCY INDICATORS:

● DISTRIBUTION OF LAND UTILIZATION AREAS:

% Public - circulation : VERY HIGH
% Public - miscellaneous: ACCEPTABLE
% Private : LOW

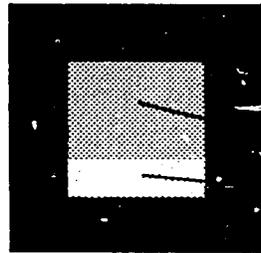
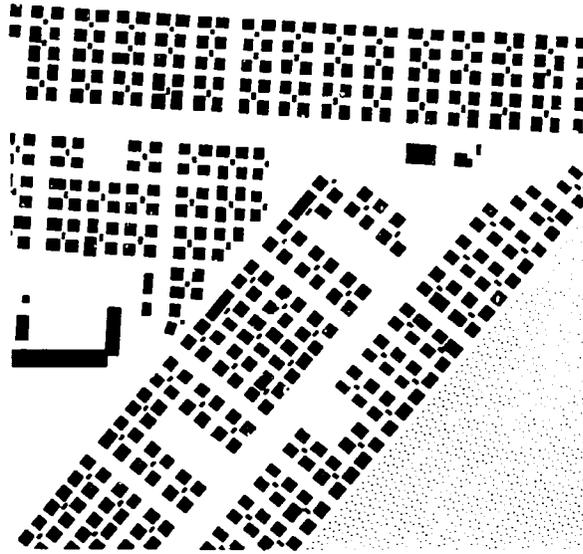
● INTENSITY OF USE:

Persons per Ha. : MEDIUM
Dwelling units per Ha. : HIGH
% Built-up coverage : LOW

● LAYOUT:

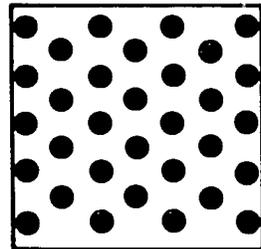
Lot areas : SMALL
Length of circulation : VERY HIGH
Ratio : VERY HIGH

10 KARIOBANGI



LAND UTILIZATION DIAGRAM

Circulation: 70%
Private : 21%
Public : 9%



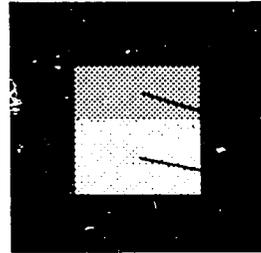
DENSITY DIAGRAM

● 20 persons

EFFICIENCY INDICATORS:

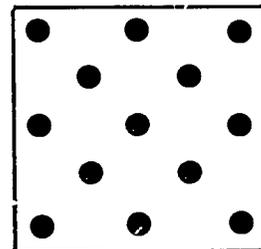
- DISTRIBUTION OF LAND UTILIZATION AREAS:
 - % Public - circulation : VERY HIGH
 - % Public - miscellaneous: LOW
 - % Private : LOW
- INTENSITY OF USE:
 - Persons per Ha. : HIGH
 - Dwelling units per Ha. : HIGH
 - % Built-up coverage : HIGH
- LAYOUT:
 - Lot areas : MEDIUM
 - Length of circulation : MEDIUM
 - Ratio : HIGH

11 MAKONGENI ESTATE



LAND UTILIZATION DIAGRAM

Circulation: 71%
Private : 14%
Public : 15%



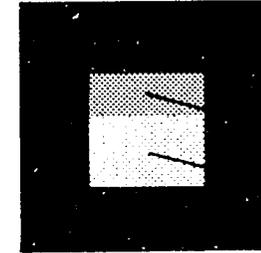
DENSITY DIAGRAM

● 20 persons

EFFICIENCY INDICATORS:

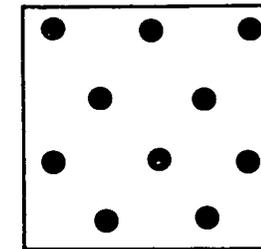
- DISTRIBUTION OF LAND UTILIZATION AREAS:
 - % Public - circulation : VERY HIGH
 - % Public - miscellaneous: ACCEPTABLE
 - % Private : VERY LOW
- INTENSITY OF USE:
 - Persons per Ha. : MEDIUM
 - Dwelling units per Ha. : MEDIUM
 - % Built-up coverage : LOW
- LAYOUT:
 - Lot areas : -
 - Length of circulation : VERY HIGH
 - Ratio : VERY HIGH

12 KALO LENI ESTATE



LAND UTILIZATION DIAGRAM

Circulation: 80%
Private : 6%
Public : 14%



DENSITY DIAGRAM

● 20 persons

EFFICIENCY INDICATORS:

- DISTRIBUTION OF LAND UTILIZATION AREAS:
 - % Public - circulation : VERY HIGH
 - % Public - miscellaneous: ACCEPTABLE
 - % Private : VERY LOW
- INTENSITY OF USE:
 - Persons per Ha. : LOW
 - Dwelling units per Ha. : MEDIUM
 - % Built-up coverage : LOW
- LAYOUT:
 - Lot areas : -
 - Length of circulation : VERY HIGH
 - Ratio : MEDIUM

EVALUATION OF RESIDENTIAL LAYOUTS

The four graphs represent an evaluation and comparison of the twelve survey localities in terms of gross POPULATION DENSITY and LAND USE PERCENTAGES of circulation, public and private areas and POPULATION DENSITY and LAND USE PERCENTAGE of LOT COVERAGE. All twelve cases are plotted on each graph. A model (M) has been prepared and is also plotted on the graphs for comparison.

HORIZONTAL SCALE:

GROSS RESIDENTIAL DENSITIES are represented logarithmically, from 0 to 2000 persons per hectare.

-The range of effective/accepted densities is 300 persons per hectare to 600 persons per hectare, based on the needs and limited resources of developing countries in providing housing for the lower income sector. Two to four story dwellings are recommended for urban subdivisions in order to maximize land utility, while minimizing public (municipal government) investment costs per unit provided.

-The range of densities in the survey cases is from 5 persons per hectare to 1865 persons per hectare. The majority are in the 150-250 persons per hectare range.

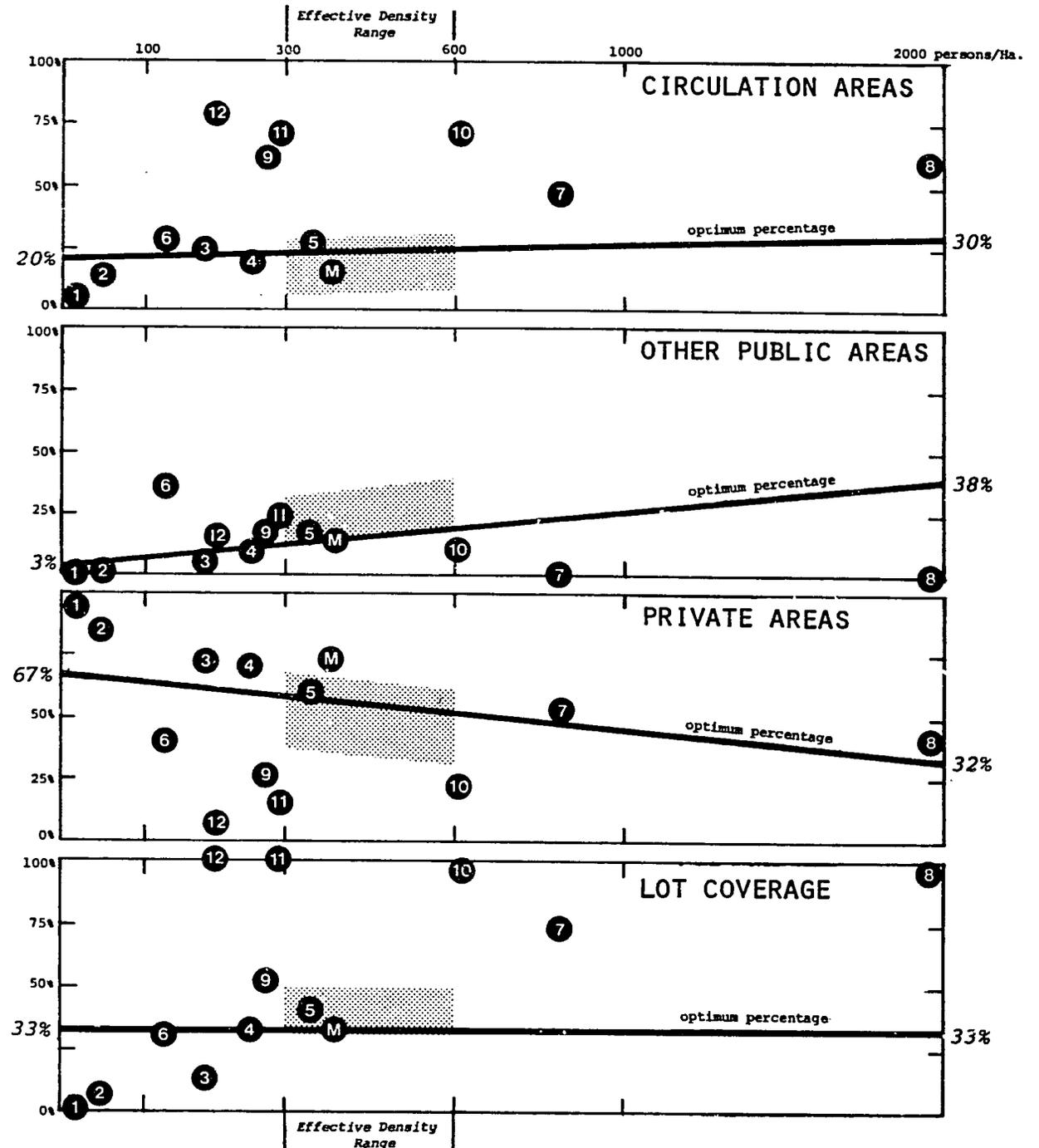
VERTICAL SCALE:

PERCENTAGES are represented from 0% to 100%.

-The range of optimum percentages is indicated by a line and is directly related to density.

SHADED BOX:

THE AREA OF OPTIMUM EFFICIENCY is represented by a shaded box. This zone is the intersection of the accepted density range and the line representing optimum percentage.



CIRCULATION AREAS (PUBLIC): areas that provide a pedestrian and vehicular road system and network for access, distribution and collection. The circulation area is usually considered to be under public ownership and therefore has a minimum of individual control and responsibility in initial cost of land, development, and maintenance.

The accepted range of circulation areas in a balanced layout is 20% at lower densities, to 30% at higher densities (the requirements of circulation area increase with intensity of use).

OTHER PUBLIC AREAS: areas within a residential layout for supporting facilities and services, including: schools, public markets, health facilities, playfields, parks, etc. The public areas are of limited individual control and responsibility and are essential to residential developments.

The accepted range of other public areas in a balanced layout is 3% at lower densities, to 38% at higher densities (the requirements of other public areas increase with intensity of use).

PRIVATE AREAS: areas defined by tenure and use to be of maximum individual control and responsibility. These areas are generally the economic support of the public land areas, and therefore it is important to maximize private land, and to minimize public land.

The accepted range of private areas in a balanced layout is 67% at lower densities, to 32% at higher densities (the percentage of private land decreases with intensity of use).

LOT COVERAGE: is the average built-up area of a lot. The percentage of lot coverage reflects the degree to which the private land (the individual residential lot) is used. It also indicates the relationship between open space and dwelling structure.

The accepted range of lot coverage is from 33% to 50%.

THE GRAPH indicates a line of optimum circulation area percentages (20%-30%).

- Layouts above the line: more than optimum percentage, therefore:
 - TO PUBLIC (municipal agencies), greater responsibility and costs.
 - TO USERS, increased access/service.
- Layouts below the line: less than optimum percentages, therefore:
 - TO PUBLIC (municipal agencies), less cost and responsibility.
 - TO USERS, less supporting costs.

THE GRAPH indicates a line of optimum private area percentages.

- Layouts above the line: greater than optimum percentage, therefore:
 - TO PUBLIC (municipal agencies), less responsibility and lower costs; more taxable land for support of public areas.
 - TO USERS, less direct costs, but at the expense of public facilities/services.
- Layouts below the line: less than optimum percentage, therefore:
 - TO PUBLIC (municipal agencies), more responsibility and costs.
 - TO USERS, less control, higher supporting costs.

THE GRAPH indicates a line of optimum public area percentages.

- Layouts above the line: greater than optimum percentages, therefore:
 - TO PUBLIC (municipal agencies), greater responsibility and costs, duplications.
 - TO USERS, increased services but at greater supporting costs.
- Layouts below the line: unacceptable percentages, therefore:
 - TO PUBLIC (municipal agencies), less direct costs detrimental for long term.
 - TO USERS, unacceptable, does not provide minimum requirements.

THE GRAPH represents the Nairobi City Council By-Law Standard of 33% lot coverage.

Layouts above the line: greater than optimum percentage, therefore:

- TO PUBLIC (municipal agencies), no direct effect.
- TO USERS, less desirable.

Layouts below the line: less than optimum percentage, therefore:

- TO PUBLIC (municipal agencies), no direct effect.
- TO USERS, more desirable, but higher supporting costs.

COMMENTS: Five cases (6, 3, 4, 5 and the model) are close to the line of circulation efficiency. Of these, case 5 (Eastleigh) and the model are also within the acceptable density range. Six cases above the efficiency line indicate an excessive percentage of land for circulation and reduced effectiveness in overall land utilization. The unbalanced land utilization distribution in these cases is the result of:

- Very high intensity of use in terms of population and land coverage in cases 7 (Mathare Squatters) and 8 (Mathare Tenements), where all open, unbuilt land is used entirely for circulation.
- Unclear definition of private areas (as in cases 9, 10, 11, 12; all public municipal housing schemes) results in very large public circulation areas (with minimum individual control).

COMMENTS: Most cases are within the accepted range of public areas. Only two cases (5, and the model) are also within the area of accepted density.

Three extreme cases (1, 7, 8) have no provision for public areas. Of these, 7 and 8 are also the cases with the highest densities and therefore the layouts which require the highest amount of public areas for the necessary supporting facilities and services (schools, clinics, etc.). These are also the cases of the highest intensity of coverage with no provision for open space or land for living activities other than the public circulation areas.

COMMENTS: Cases 5, 7, and 8 are close to the recommended line of optimum percentage. Case 5 (Eastleigh) and the model are within the area of acceptable density, and private land distribution.

All cases of public municipal housing are below the line of optimum private areas. In these cases, only the dwelling unit is the private area. Although cases 7 and 8 are close to the line of optimum percentage, in these cases the dwelling (room) unit itself is the only private area available.

COMMENTS: Three cases (6, 4, and the model) represent an acceptable percentage of the lot coverage. The graph illustrates the extremes in building type and density: large lot, suburban type layout with very low lot coverage; and very high density with complete lot coverage.

It can be seen that in the layouts housing the lower income groups (7, 8, 9, 10, 11 and 12) the dwelling unit type is minimized to a single, multi-purpose room per household of approximately 3-6 persons. Most activities (cooking, washing, play and socializing) take place outdoors, adjacent to the room unit. The adjacent open land becomes an extension of the private dwelling room unit.

It is important to provide a layout that permits more individual control of adjacent land.

MODEL FOR RESIDENTIAL DEVELOPMENT

The following model is presented as an illustration and explanation of basic residential planning elements and concepts that have been previously discussed.

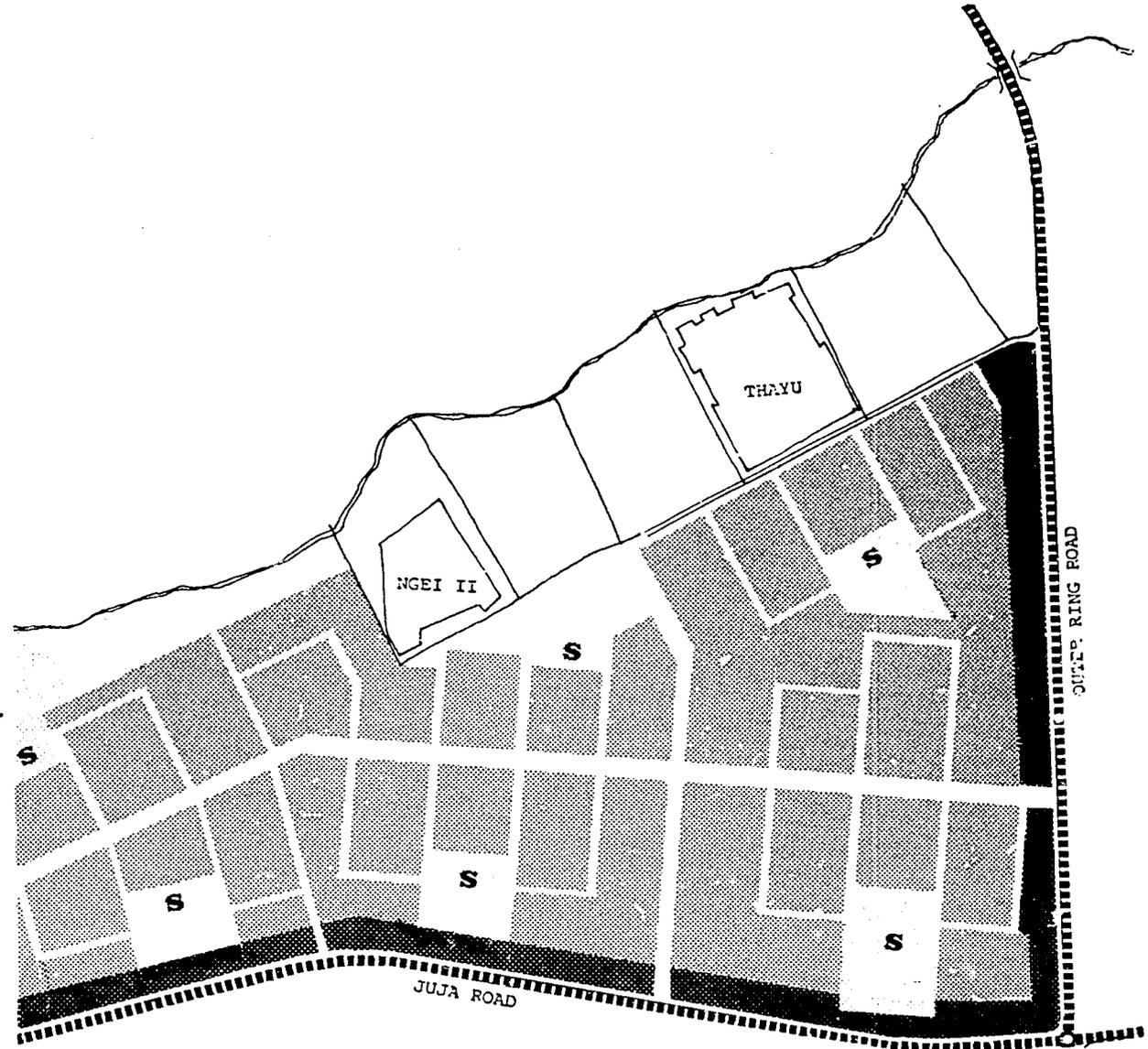
The model is intended as a reference source for design determinants of efficiency in the provision of housing and/or sites for very low, low and moderate low income groups.

The model complies with accepted and desirable ranges of population density, circulation, public and private, and lot coverage percentages.

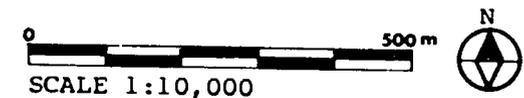
The model is described in the same format used in the survey and provides a frame of reference for comparison for the twelve surveys.

The site for the locality and locality segment of the model is the same as that of survey 9, Mathare Redevelopment.

- | | |
|---|---------------------|
| C Community Center | S School |
| H Health | R Recreation |
| P Police | RL Religious |
|  Residential | |
|  Commercial/ Reserve | |
|  Agricultural | |
|  Bus Route | |

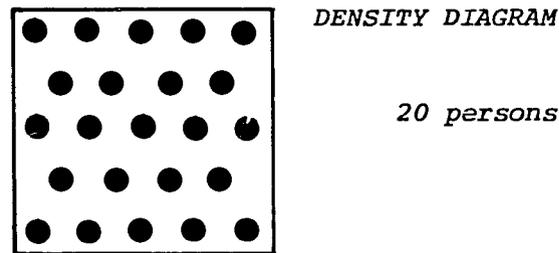
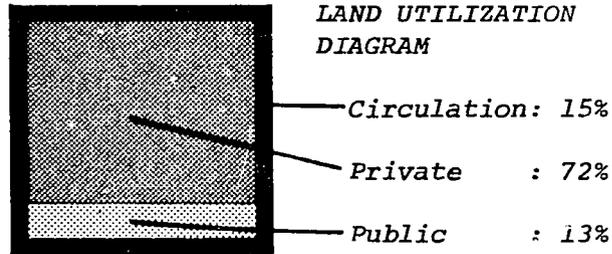


PROPOSED MODEL
LOCALITY LAND-USE PATTERN

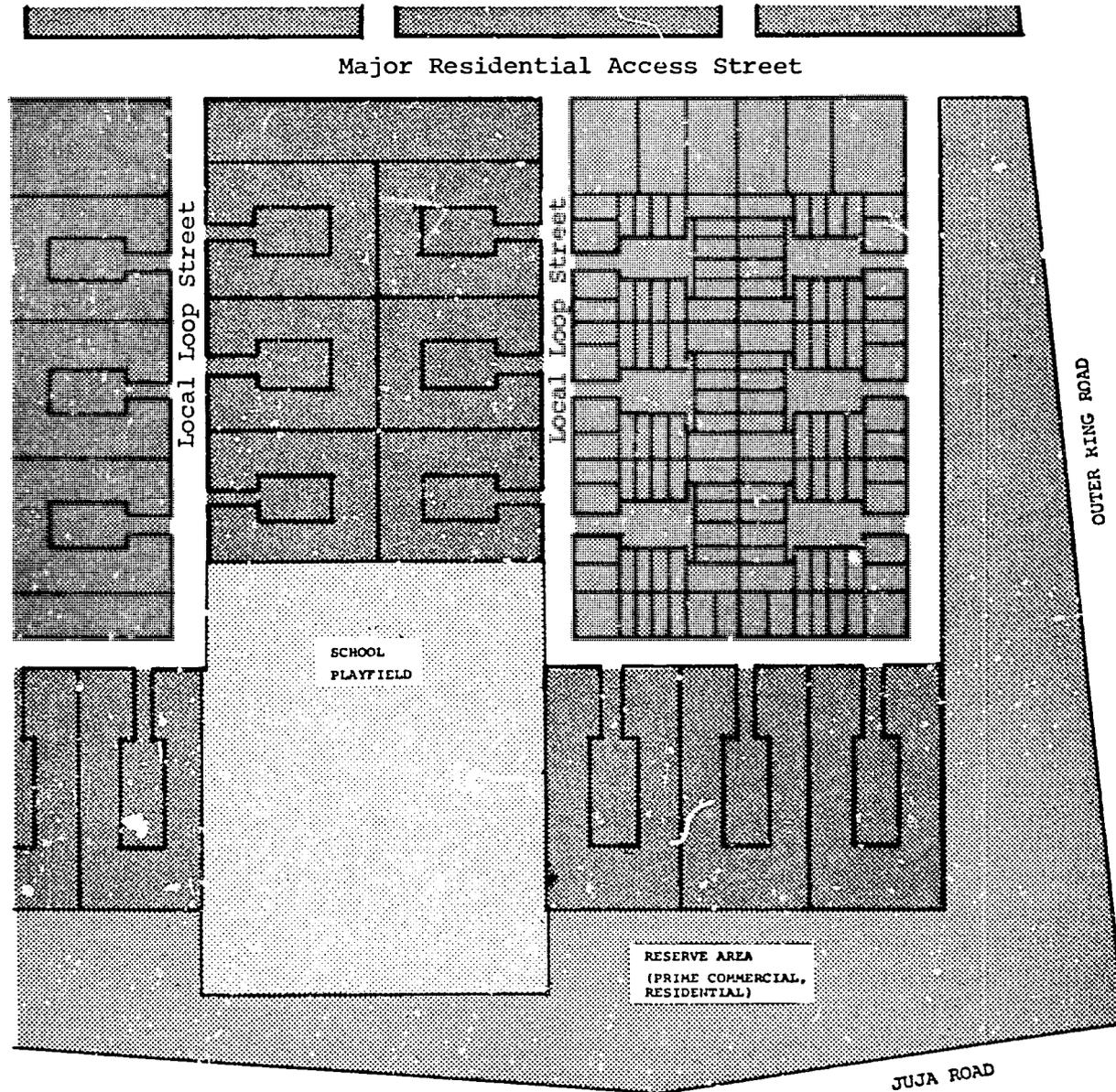


PROPOSED LAND UTILIZATION The distribution of segment land utilization areas is:

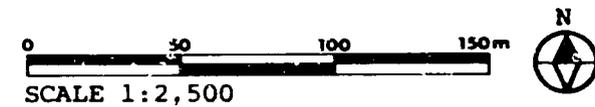
- % Public - circulation : ACCEPTABLE
- % Public - miscellaneous: ACCEPTABLE
- % Private : HIGH
- Population density : ACCEPTABLE
- Dwelling unit density : ACCEPTABLE
- % Built-up coverage : ACCEPTABLE



Density: 350-450 persons/Ha.
 Population: 6,000 persons
 No. of dwellings: ±400 dwellings
 Average Dw. Area: N.A.
 Built-up Area: N.A.
 No. of Dw. Units: ±1500 units
 (room units): ±1500 units
 (house units): -
 Unit Occupancy : 4 persons
 Unit Density: 312.5 units/Ha.
 Area of Segment: 16 Ha.
 Area used in Calculation: 16 Ha.



MODEL
 LOCALITY SEGMENT:
 PROPOSED LAND UTILIZATION



SURVEY



SURVEY LOCALITIES

- 1 KAREN
- 2 PARKLANDS
- 3 VILLAGE NGEI I - Mathare Valley
- 4 KAWANGWARE VILLAGE - Dagoretti
- 5 EASTLEIGH
- 6 KIMATHI ESTATE - Eastlands
- 7 VILLAGE I: SQUATTERS - Mathare
- 8 VILLAGE I: TENEMENTS - Mathare
- 9 MATHARE REDEVELOPMENT
- 10 KARIOBANGI
- 11 MAKONGENI ESTATE - Eastlands
- 12 KALO LENI ESTATE - Eastlands

*Air photograph of Nairobi showing
survey localities.
(Scale 1:200,000)*

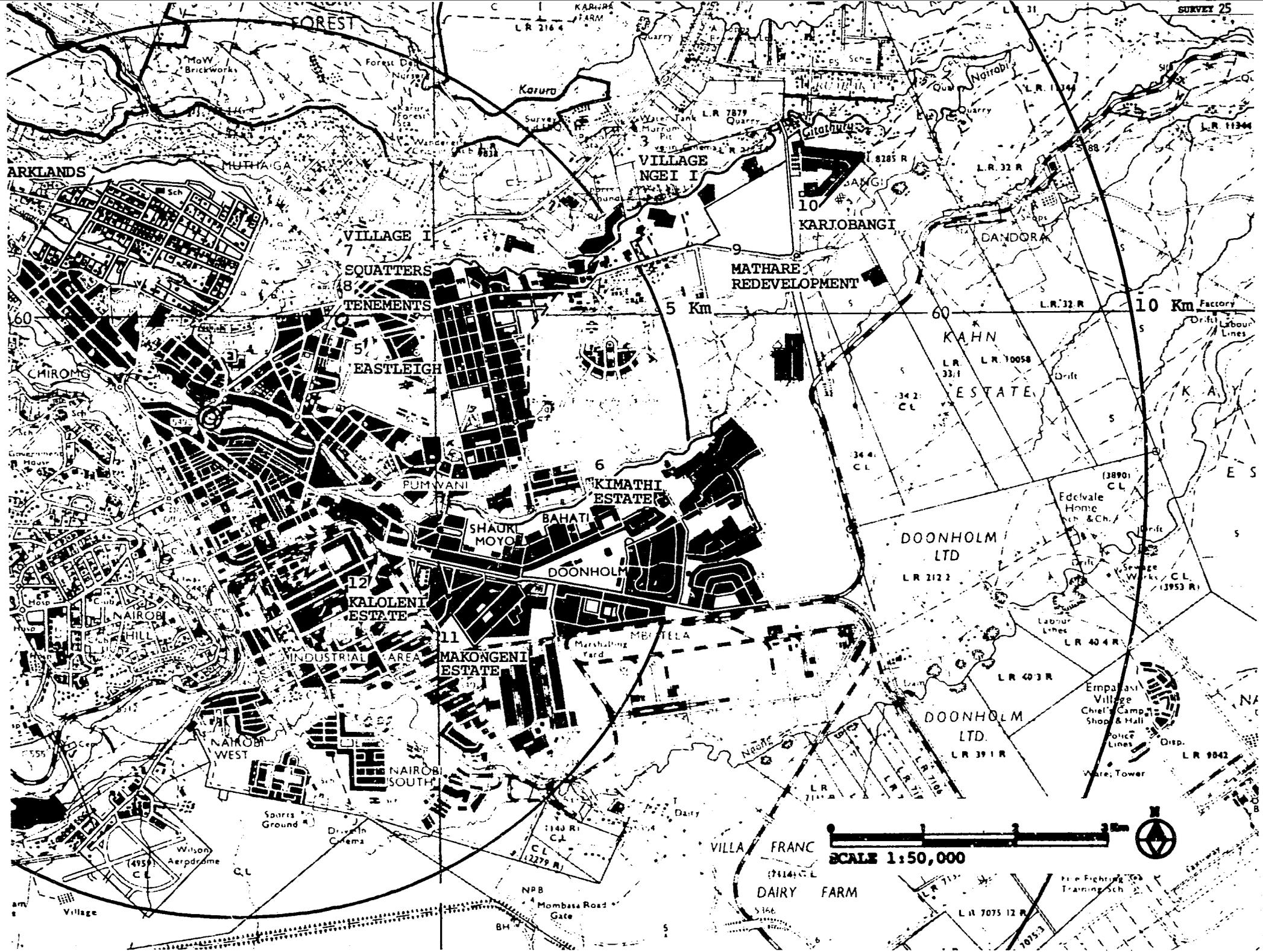
SURVEY EXPLANATION

Each Survey Locality is represented at three scales:

- LOCALITY: defined as a relatively self-contained residential area in Nairobi. In general it is contained within physical boundaries. Scale 1:10,000.
- LOCALITY SEGMENT: a 400m x 400m (approximately 1/4 mile x 1/4 mile) segment abstracted from each locality for purposes of evaluation and comparison. Scale 1:2,500.
- DWELLING UNIT: a typical dwelling in each locality segment. Scale 1:500.

Each Survey is organized as follows:

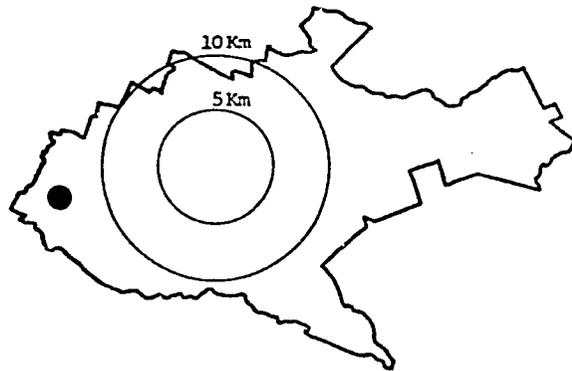
SCALE	DATA	PAGE SEQUENCE
LOCALITY	Air Photograph; Origins and Location.	1st page
	Plan Drawing; Layout Description; Population and Incomes.	2nd page
	Circulation Diagram; Circulation Description.	3rd page
	Land-use Pattern Diagram; Land-use Description	4th page
LOCALITY SEGMENT	Air Photograph; Typical Photograph.	5th page
	Lot Layout Drawing; Lot Layout Description; Figures for: No. of lots, Lot density, Average lot dimensions, Average lot area, Average lot coverage, Circulation length, Proportion of circulation length/area served.	6th page
	Actual Land Utilization Diagram; Assessment of actual land utilization in terms of accepted ranges: % Public - circulation (range 20%-30%), % Public - miscellaneous (range 3%-38%), % Private (range 67%-32%), Population density (range 300-600 persons/Ha.), Dwelling unit density (range 75-150 dwelling units/Ha.), % Built-up coverage (range 33%-50%); Land Utilization Diagram: % areas of circulation (in black), Private (in dark tone) and Public (in light tone); Density Diagram: Graphic representation of density of segment (each dot equals 20 persons/Ha.); Figures for: Density, Population, No. of dwellings, Average dwelling area, Built-up area, No. of dwelling units, Unit occupancy, Unit density.	7th page
DWELLING UNIT	Plan Drawing; Photographs of typical dwellings.	8th page



SCALE 1:50,000



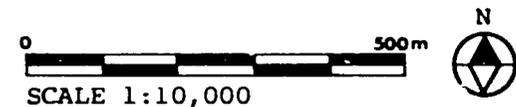
1 KAREN

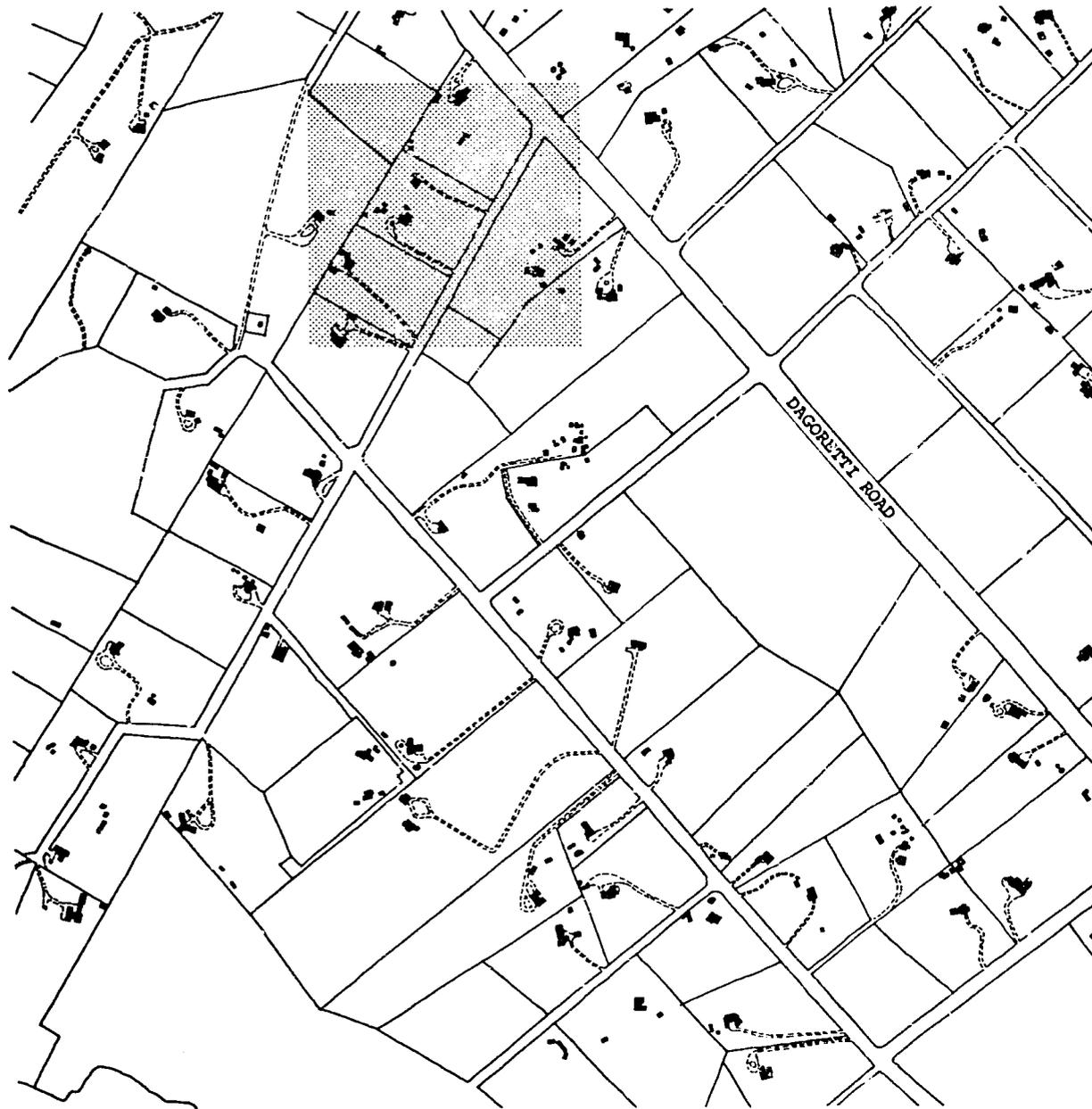


LOCATION AND ORIGIN Karen is located approximately 15 Km west of the city center. It is a low density prestige housing suburb of Nairobi connected to the central business district by the Ngong and Langata Roads. Karen developed in the 1930's as a peri-urban low density residential area. It was outside the 1927 municipal boundary and the lack of universal land use control enabled people to indulge their desire for a way of living in which the advantages of proximity to an urban center and the amenities of semi-rural life were combined, unencumbered by municipal regulations. Lower land prices were an added attraction. The suburb was exclusively for Europeans, and became part of Nairobi when the 1927 city boundary was extended to its present limits in 1963.



KAREN
LOCALITY AIR PHOTOGRAPH





LAYOUT Originally, Karen was laid out with 2, 4 and 8 Ha. plots; and the present minimum lot size required by zoning is 2 Ha. The scale in relation to residential use is directed by the automobile. The layout of residential properties is determined by topography and the irregular automobile network.

POPULATION / INCOME Predominantly European, the locality population in 1969 was 4,300 with high incomes.

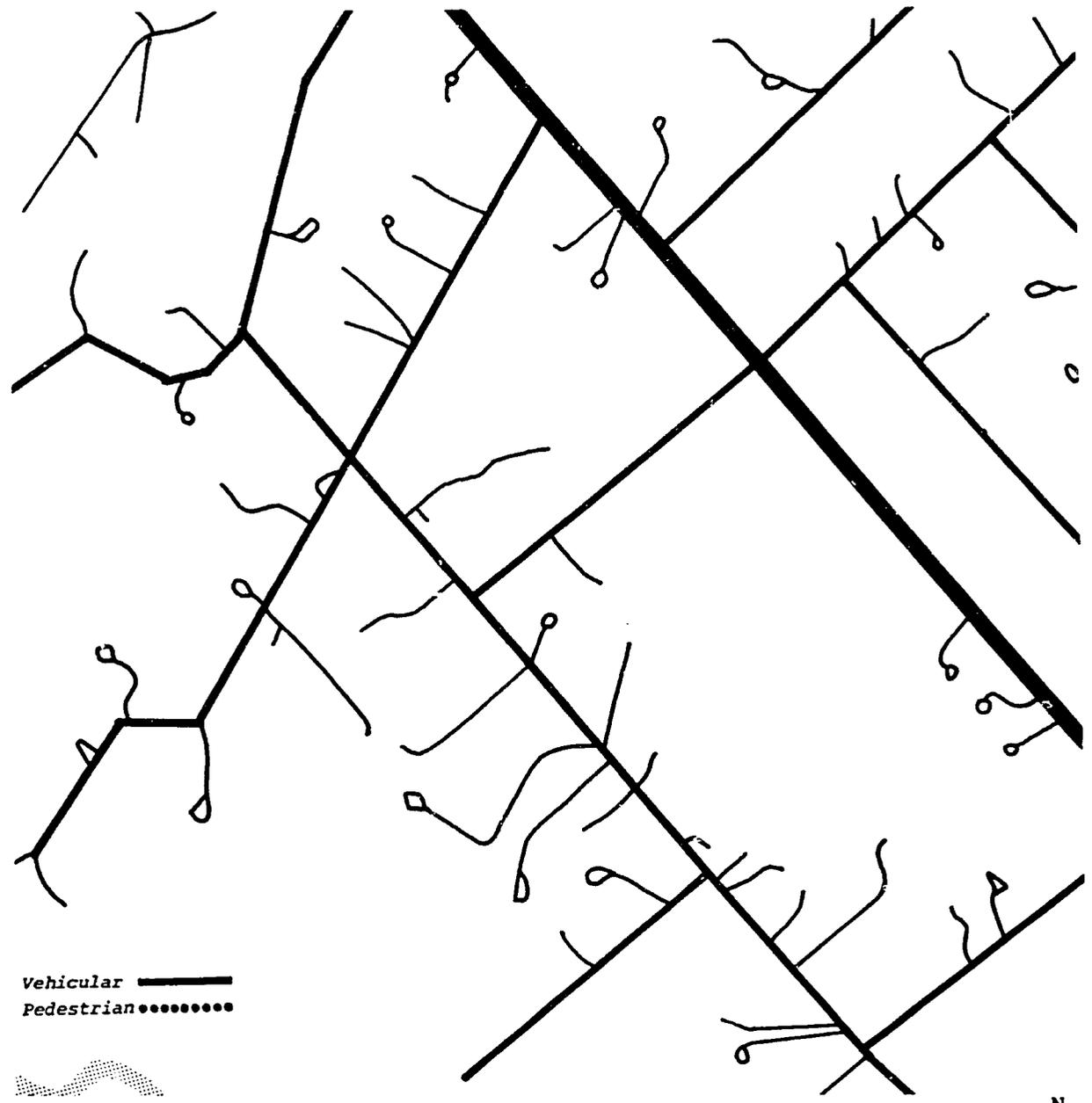
400m x 400m
Selected Segment

KAREN
LOCALITY PLAN

0 500m
SCALE 1:10,000

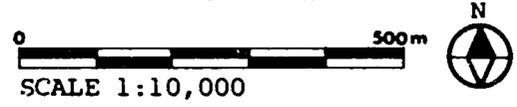


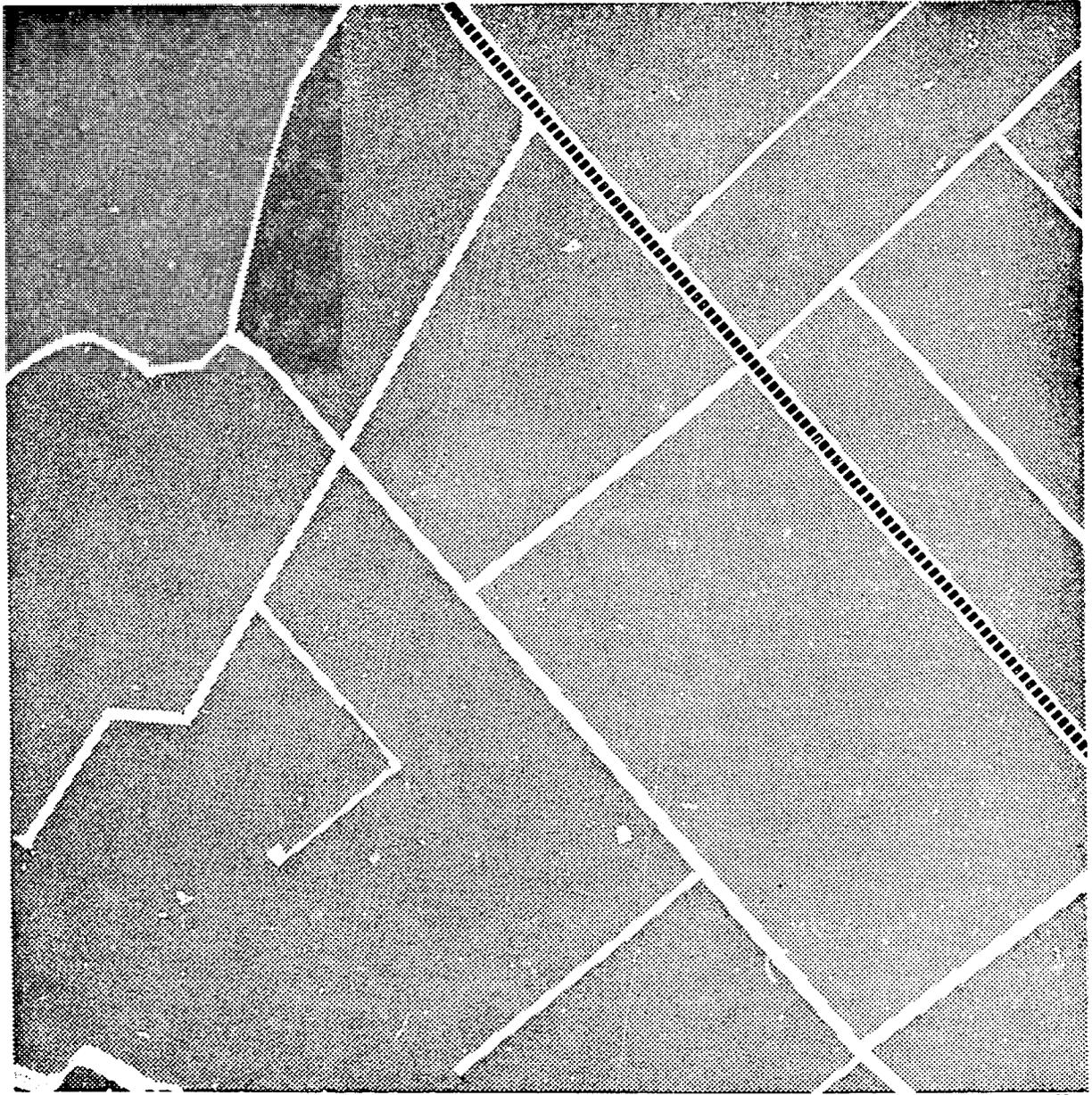
CIRCULATION The roads are used almost exclusively by automobiles; pedestrian circulation is negligible and is practiced, along with horse riding, more for recreation than for transportation. The bus route on Dagoretti Road serves the African domestic-servant population.



Vehicular —————
Pedestrian ·······

KAREN
LOCALITY CIRCULATION DIAGRAM





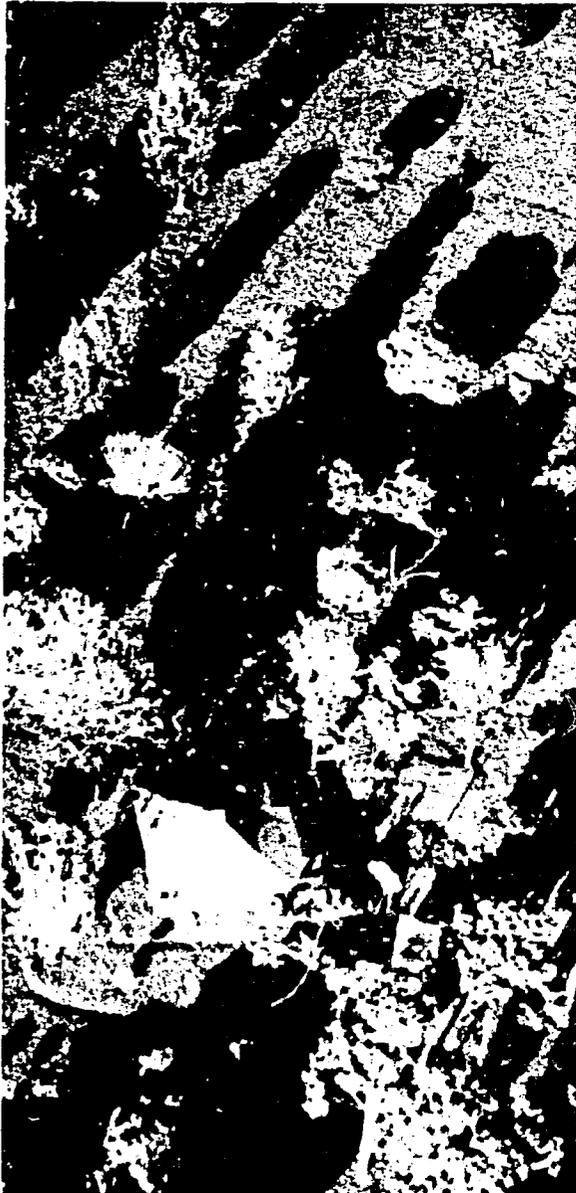
LAND USE The locality is primarily residential but at a very low density. It is said there are more horses than people in Karen. There has been little visible change in this area which is without public utilities.

- | | |
|---------------------------|---------------------|
| C Community Center | S School |
| H Health | R Recreation |
| P Police | RL Religious |

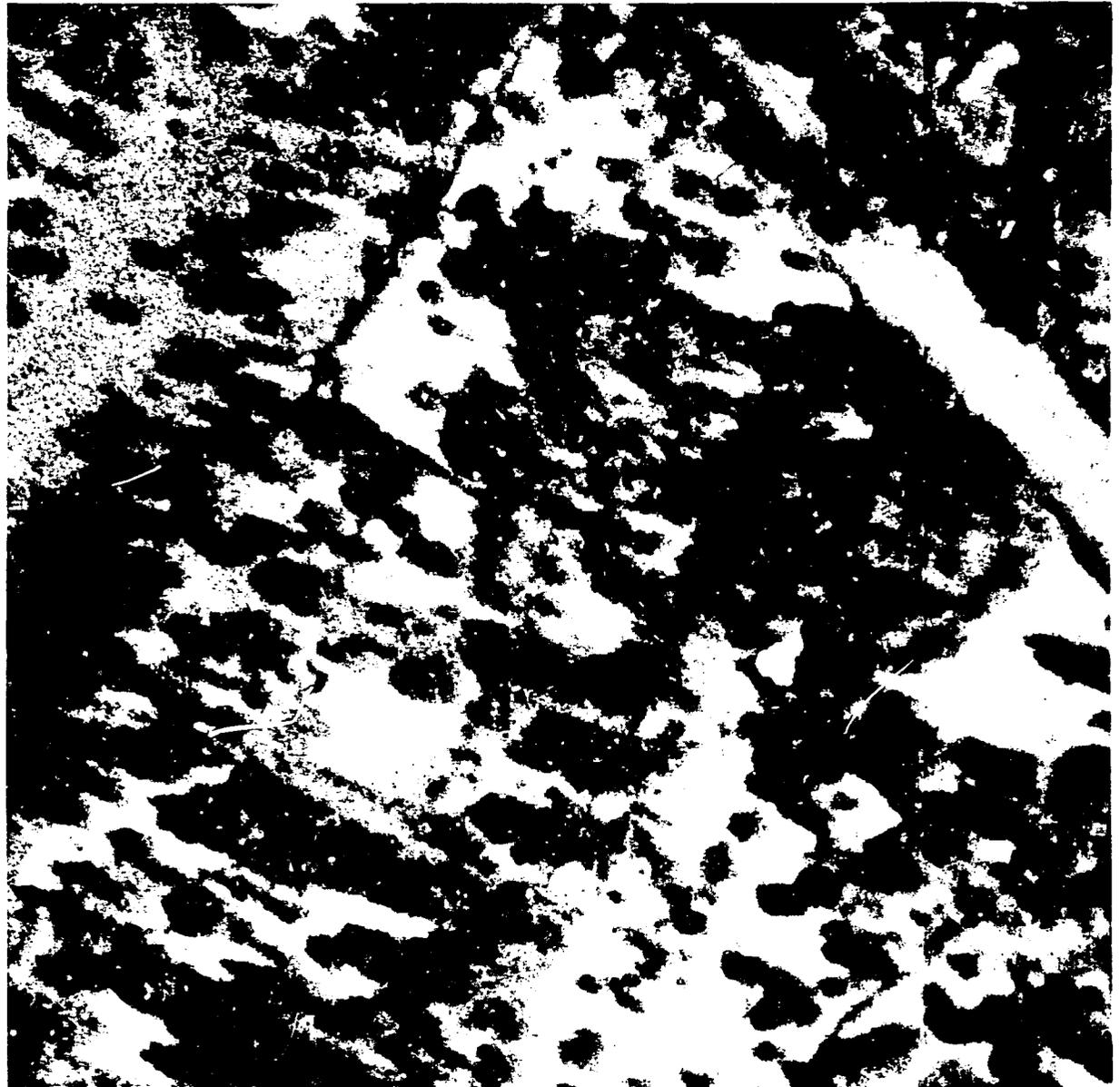
-  Residential
-  Commercial/Industrial
-  Agricultural
-  Bus Route

KAREN
LOCALITY LAND-USE PATTERN

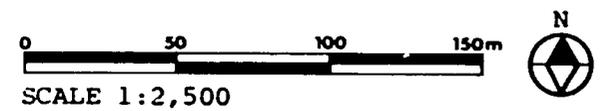


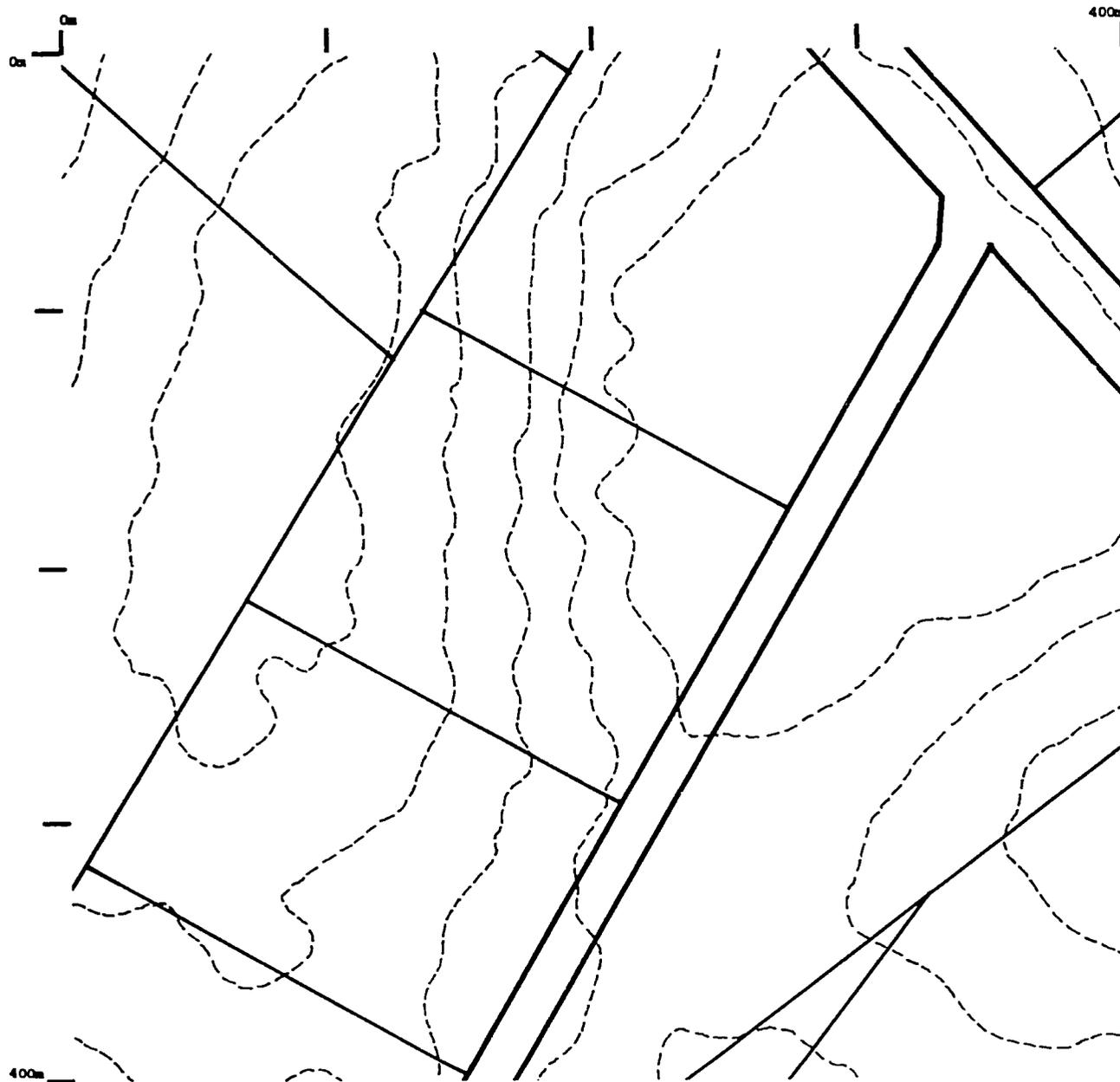


Individual dwelling with separate servants' quarters on typical five acre plot in Karen.



KAREN
LOCALITY SEGMENT:
AIR PHOTOGRAPH





KAREN
LOCALITY SEGMENT:
LOT LAYOUT



LOT LAYOUT Karen illustrates the typical, exclusive suburban, automobile dominated layout.

The very large lots account for:

- low circulation length and area;
- unbalanced distribution of land utilization;
- very low intensity of use.

The lots are serviced from 2 or 3 sides; the transverse road spacing of 600m to 1000m exceeds the accepted maximum for pedestrian circulation, indicating that the layout is based entirely on automobile access.

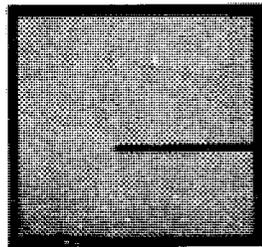
Individual dwellings are situated in the large lots and have no relationship to each other or to any recognizable grouping or neighborhood unit.

The ratio of circulation/area served is also very low but this is because of the very large lot size and it does not represent high efficiency of layout in this case.

No. of Lots: 7 lots
Lot Density: 0.4 lots/Ha.
Av. Lot Dimensions: 160m x 130m
Av. Lot Area: 20,800 sq.m.
Av. Lot Coverage: 1.2% of lot
Circulation Length: 550 m.
Circulation Length: 37.2 m/Ha.
Area Served

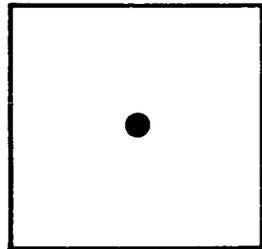
ACTUAL LAND UTILIZATION The distribution of segment land utilization areas is:

- % Public - circulation : VERY LOW
- % Public - miscellaneous: NONE
- % Private : VERY HIGH
- Population density : VERY LOW
- Dwelling unit density : VERY LOW
- % Built-up coverage : VERY LOW



LAND UTILIZATION DIAGRAM

Circulation: 8%
Private : 92%
Public : 0%

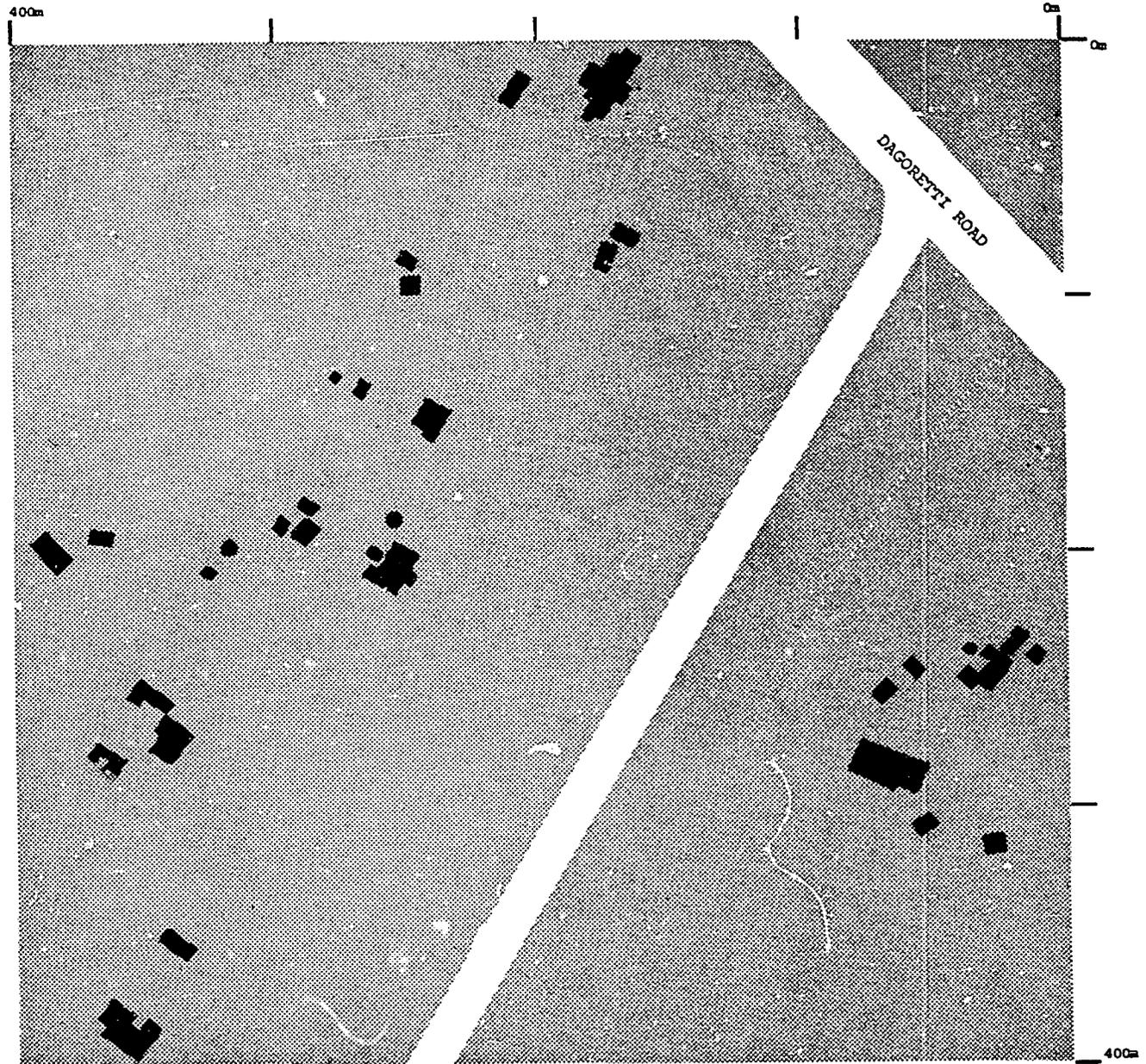


DENSITY DIAGRAM

● 20 persons

Density: 5 persons/Ha.
Population: 80 persons
No. of Dwellings: 22 dwellings
Average Dw. Area: 250 sq.m.
Built-up Area: 3.4%
No. of Dw. Units: 22 units
(Room Units): 15 units
(House Units): 7 units
Unit Occupancy: 5 persons
Unit Density: 1.4 units/Ha.

Area of Segment: 16 Ha.
Area used in Calculation: 16 Ha.

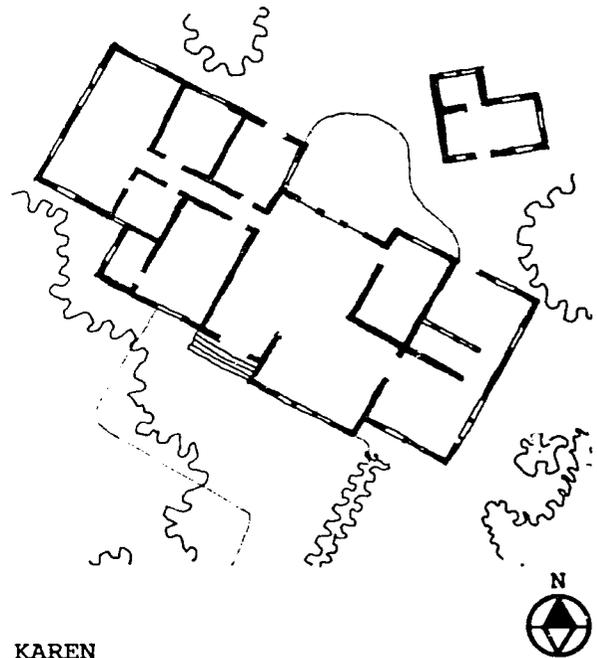


KAREN LOCALITY SEGMENT: ACTUAL LAND UTILIZATION





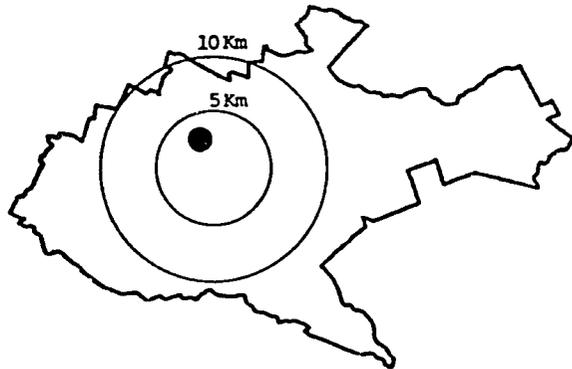
Typical residence in Karen with extensive, well-groomed gardens.



KAREN
TYPICAL DWELLING

SCALE 1:500

2 PARKLANDS



LOCATION AND ORIGIN Parklands falls within the 5 Km inner ring of the city at approximately 4 Km north of the central business district. The area is bound by the Limuru, Sclaters and Ring Roads and Mathare River in the north. The locality is well within the built-up area of Nairobi. Parklands was first developed as a second European suburb in the 1910's to compliment 'the Hill' which had the officers' quarters of the railway and government. The initial circular boundary of Nairobi was extended in 1919 to include Parklands. As better areas became available for European residential development, Parklands was left to the Asian community and today the great majority of them live there. Multi-colored, flat-topped houses are distinctive features of this suburb of Nairobi.



PARKLANDS
LOCALITY AIR PHOTOGRAPH

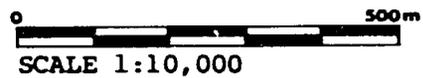




LAYOUT Parklands has a basic rectangular grid, somewhat modified by topography. It is a typical suburban subdivision for middle and upper income families. Minimum lot size is 0.2 Ha. with medium/high density development. The main 'avenues' run along the contours and are adequately connected by transverse streets.

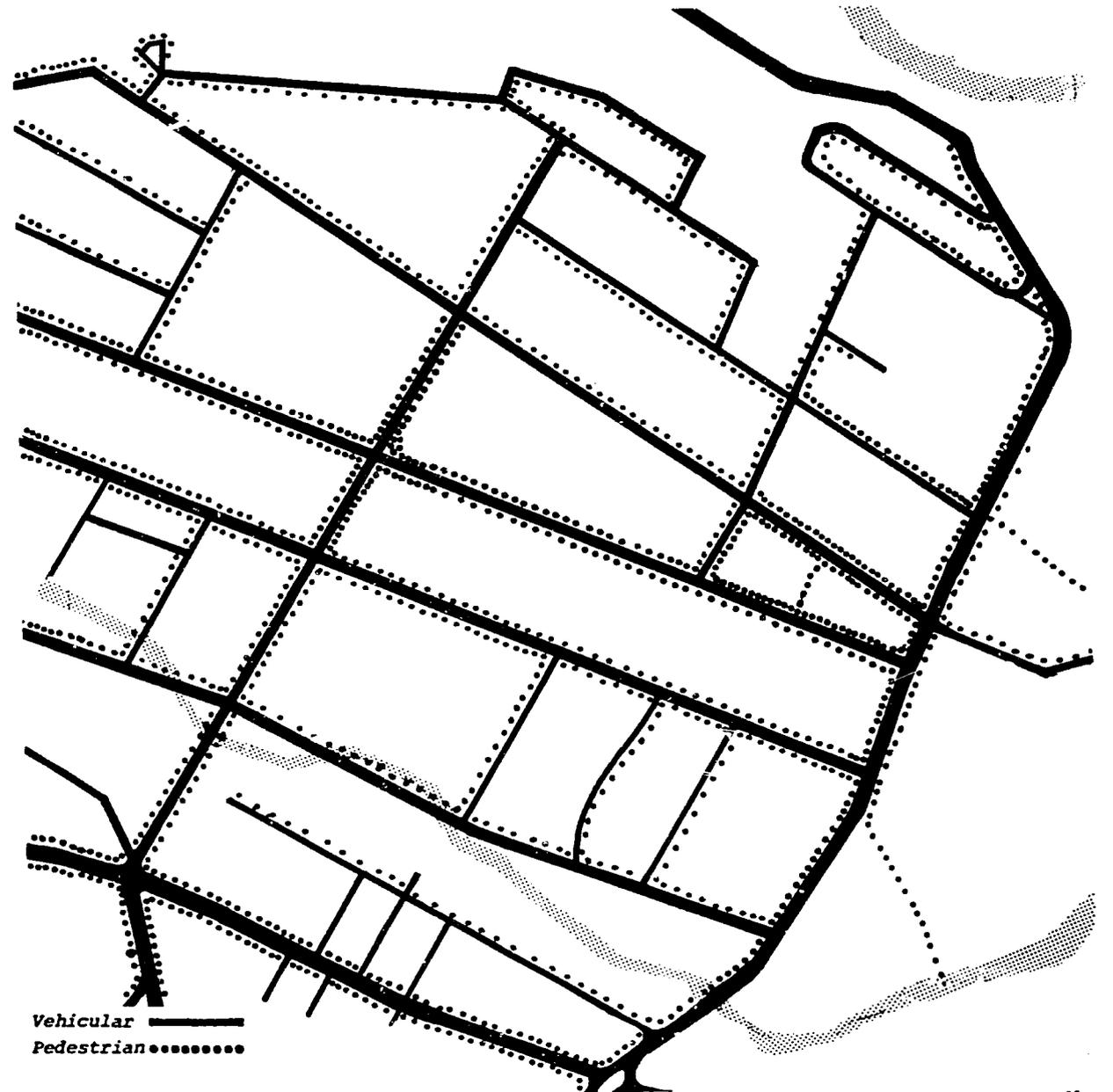
POPULATION/INCOMES Parklands has a population of 16,000 (1969) with an Asian majority. Incomes range from middle to high.

**PARKLANDS
LOCALITY PLAN**



400m x 400m
Selected Segment

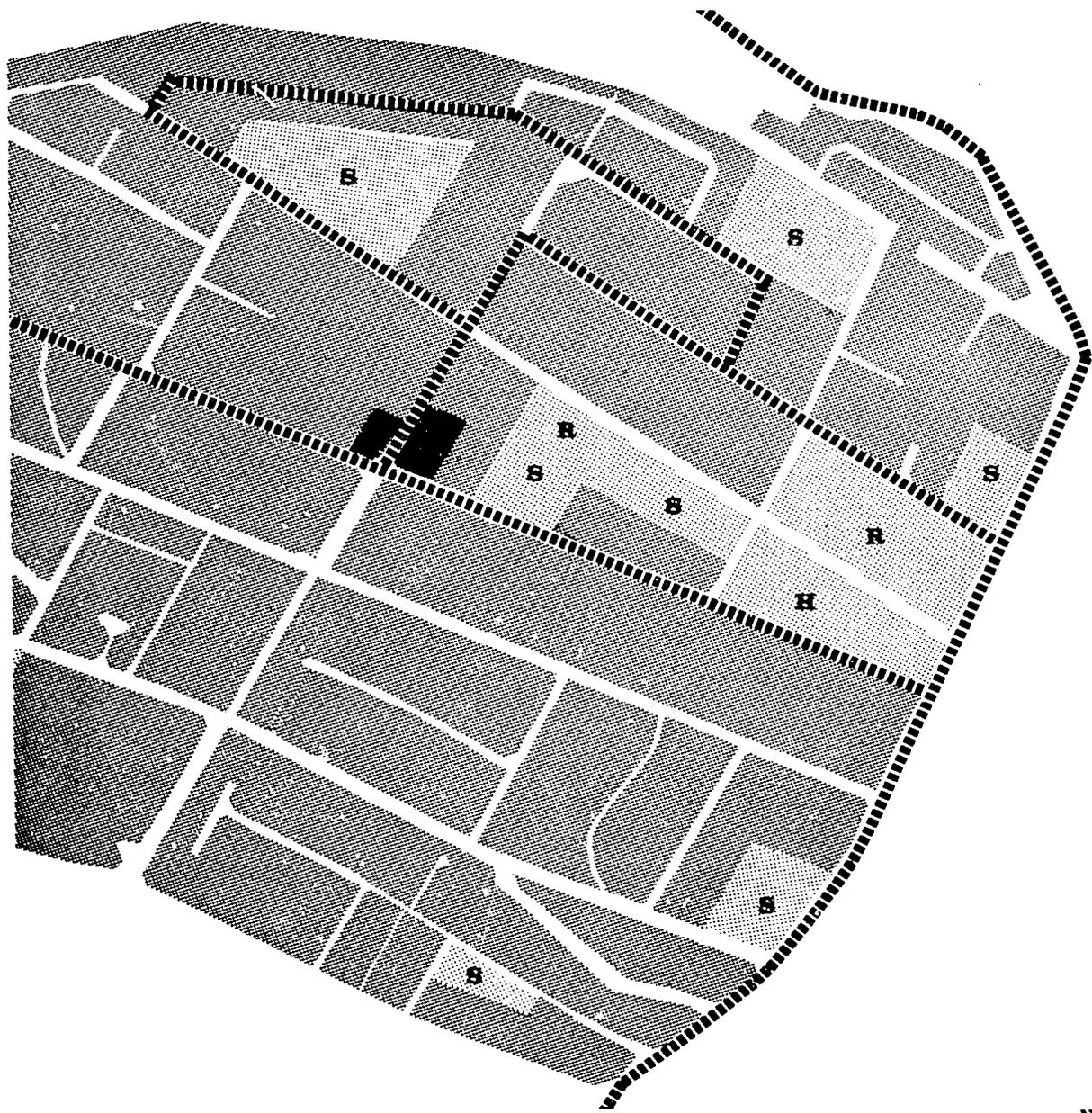
CIRCULATION All public access routes are open to both vehicular and pedestrian traffic. The longitudinal 'avenues' are the more heavily used streets; Limuru and Sclaters Roads are through traffic routes, forming the east and south boundaries of the locality. The locality is well served by public transport routes.



Vehicular —————
Pedestrian ·········

PARKLANDS
LOCALITY CIRCULATION DIAGRAM

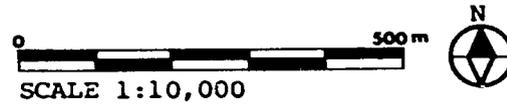




LAND USE The area is largely residential; there is no industry or significant commercial activity, except a shopping center and hotels along the main traffic arteries. The area is well provided with public utilities, services and open space, forming a self-sufficient suburb.

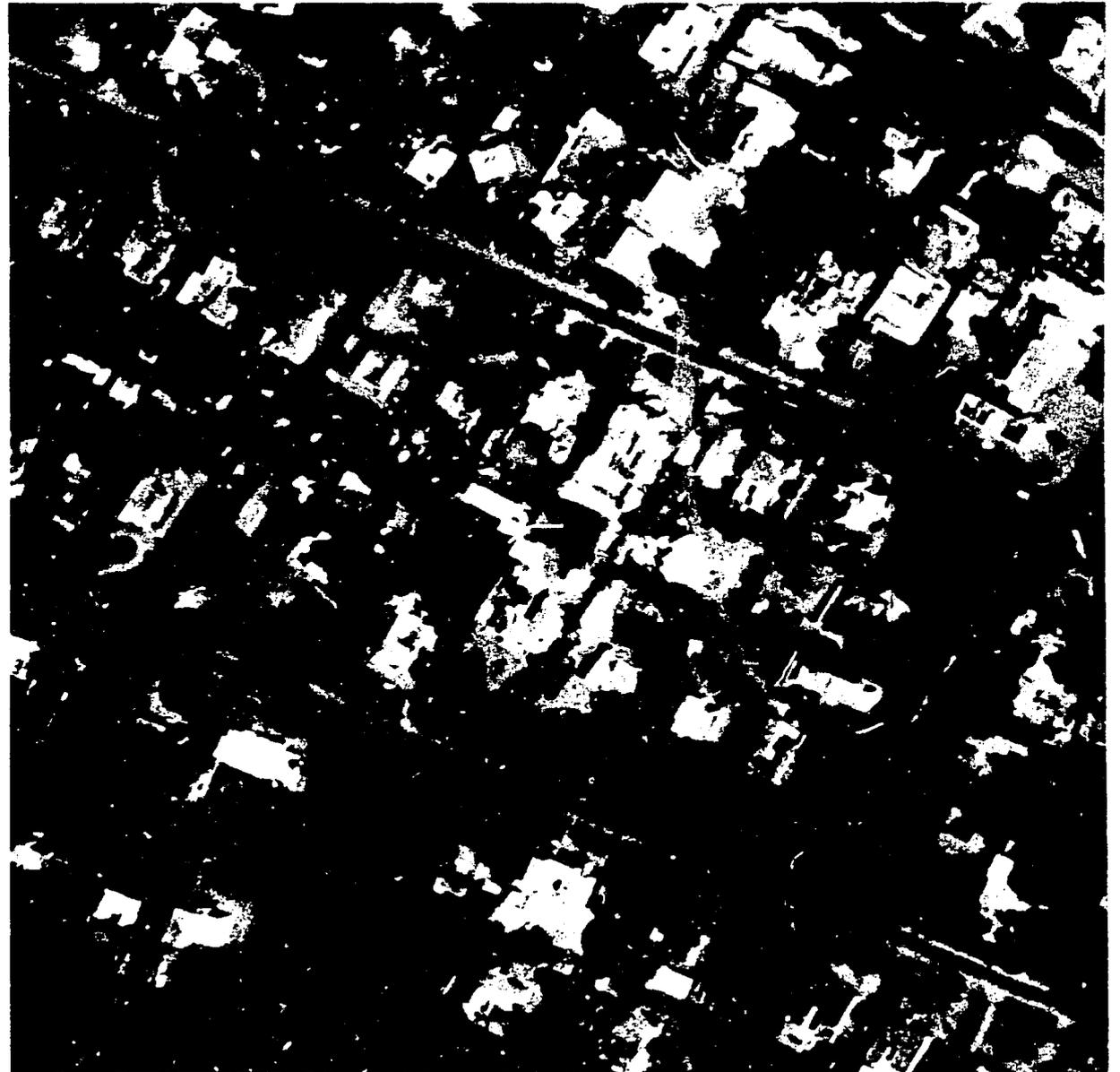
- | | |
|---|--------------|
| C Community Center | S School |
| H Health | R Recreation |
| P Police | RL Religious |
|  Residential | |
|  Commercial/Industrial | |
|  Agricultural | |
|  Bus Route | |

PARKLANDS
LOCALITY LAND-USE PATTERN





Large dwellings suited for extended families on half acre plots in Parklands.



**PARKLANDS
LOCALITY SEGMENT:
AIR PHOTOGRAPH**





LOT LAYOUT Parklands is a suburban gridiron layout. The lots, streets and blocks are larger than the average grid layout, more in scale with predominantly vehicular access and circulation although pedestrian use is prominent and sidewalks are generally provided.

Lots are regular, rectangular (1:2), generally serviced from the narrower frontage.

The ratio of circulation/area served is low because of larger lots.

- No. of Lots: 48 lots
- Lot Density: 3 lots/Ha.
- Av. Lot Dimensions: 48m x 80m
- Av. Lot Area: 3,840 sq.m.
- Av. Lot Coverage: 2.8% of lot
- Circulation Length: 1,210 m.
- Circulation Length: 88.0 m/Ha.
- Area Served

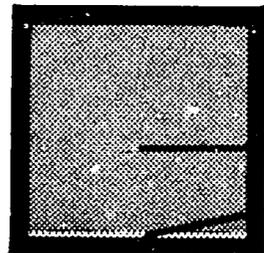
**PARKLANDS
LOCALITY SEGMENT:
LOT LAYOUT**



ACTUAL LAND UTILIZATION The distribution of segment land utilization areas is:

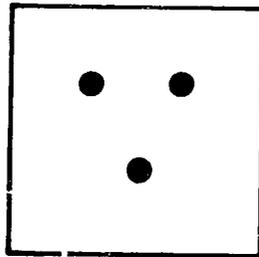
% Public - circulation : VERY LOW
 % Public - miscellaneous: VERY LOW
 % Private : VERY HIGH

Population density : VERY LOW
 Dwelling unit density : LOW
 % Built-up coverage : VERY LOW



LAND UTILIZATION DIAGRAM

Circulation: 15%
 Private : 84%
 Public : 1%

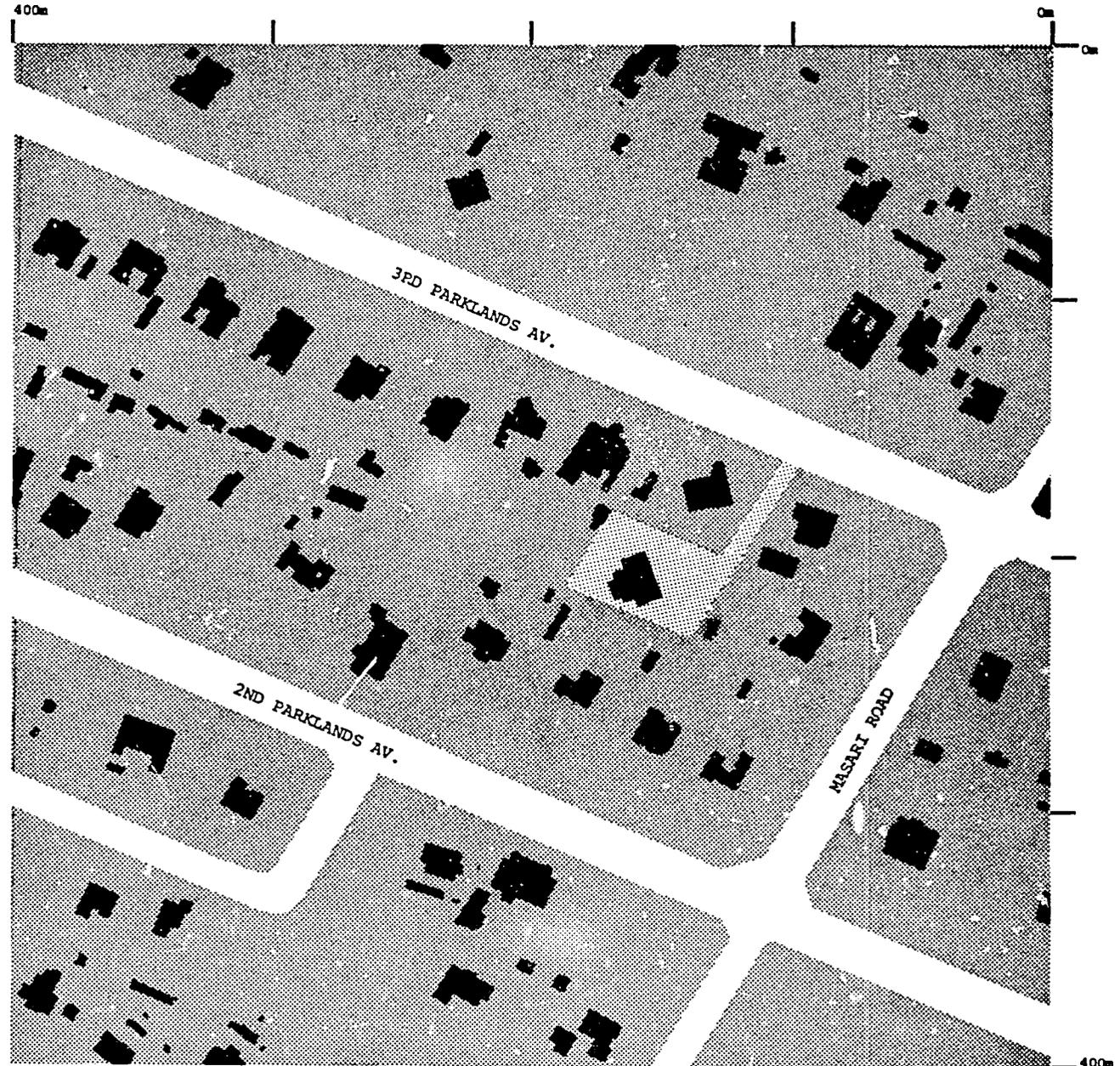


DENSITY DIAGRAM

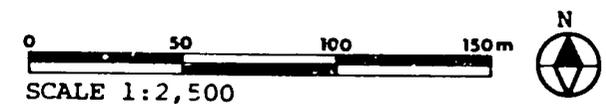
● 20 persons

Density: 54 persons/Ha.
 Population: 870 persons
 No. of Dwellings: 87 dwellings
 Average Dw. Area: 110 sq.m.
 Built-up Area: 5.9%
 No. of Dw. Units: 87 units
 (Room Units): 41 units
 (House Units): 46 units
 Unit Occupancy: 5 persons
 Unit Density: 5.4 units/Ha.

Area of Segment: 16 Ha.
 Area used in Calculation: 16 Ha.

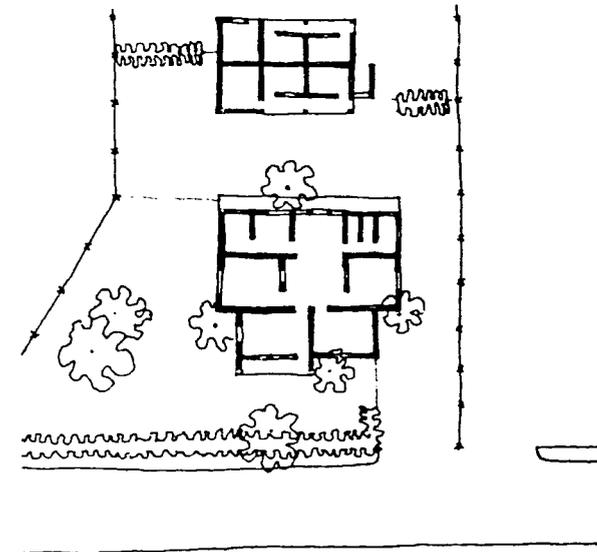


PARKLANDS LOCALITY SEGMENT: ACTUAL LAND UTILIZATION





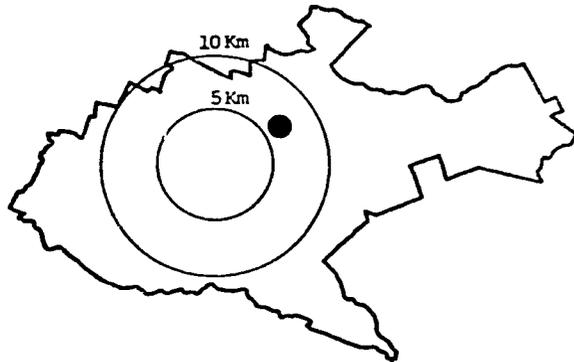
Typical street, well provided with sidewalks,
and dwellings in Parklands.



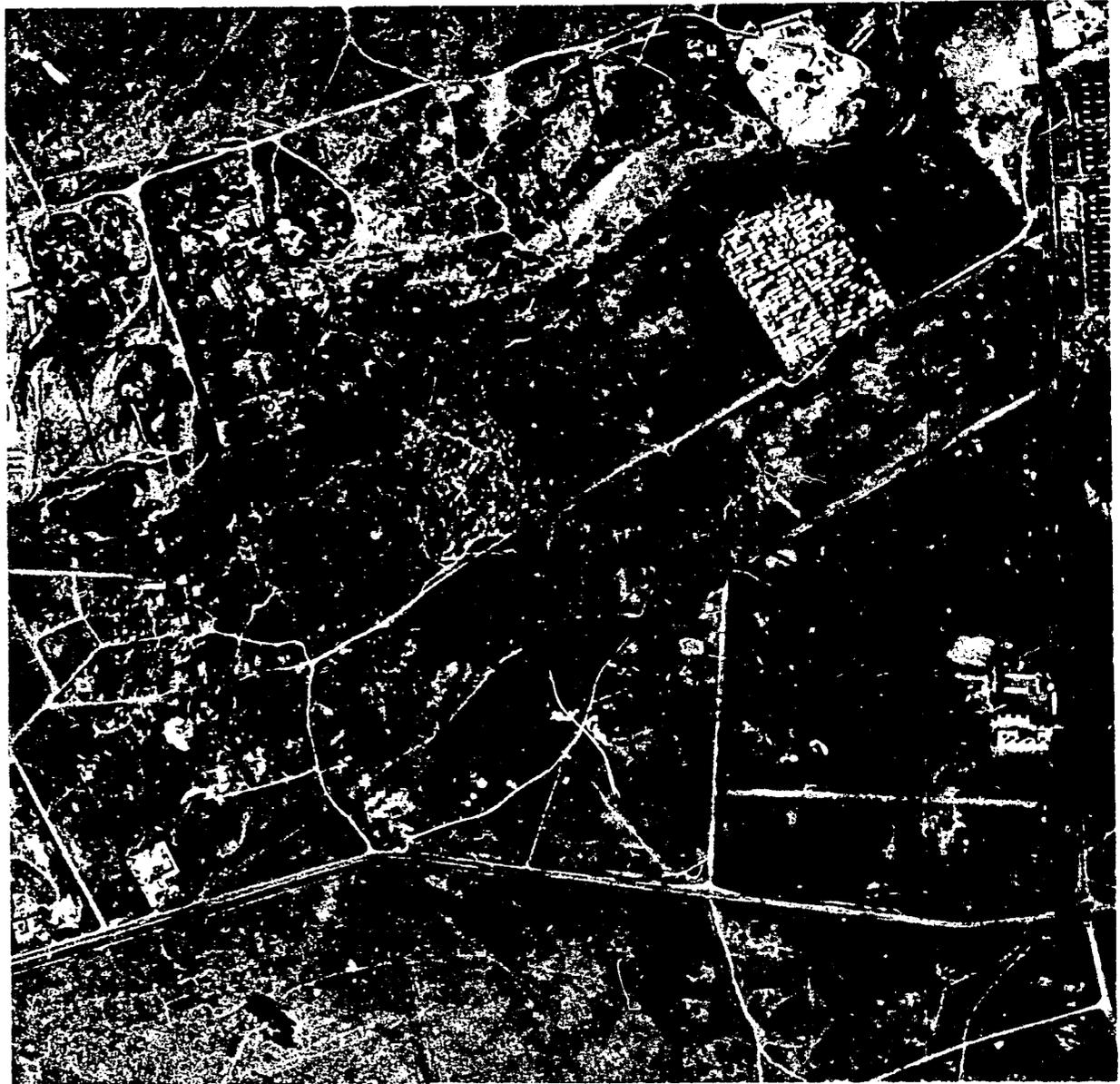
PARKLANDS
TYPICAL DWELLING

N
SCALE 1:500

3 VILLAGE NGEI I
MATHARE VALLEY



LOCATION AND ORIGIN Village Ngei I is one of the nine villages that make up the Mathare Valley Settlement and is located 6 Km northeast of the central business district. The village which is distinctively rural in character, began in 1962 and in 1964 there were 40 dwellings built by the squatters. Today there are about 90 structures on the site. The members of this village formed a committee to organize the buying of the site on which they had been squatting and subsequently their village has been chosen for Nairobi City Council improvements.

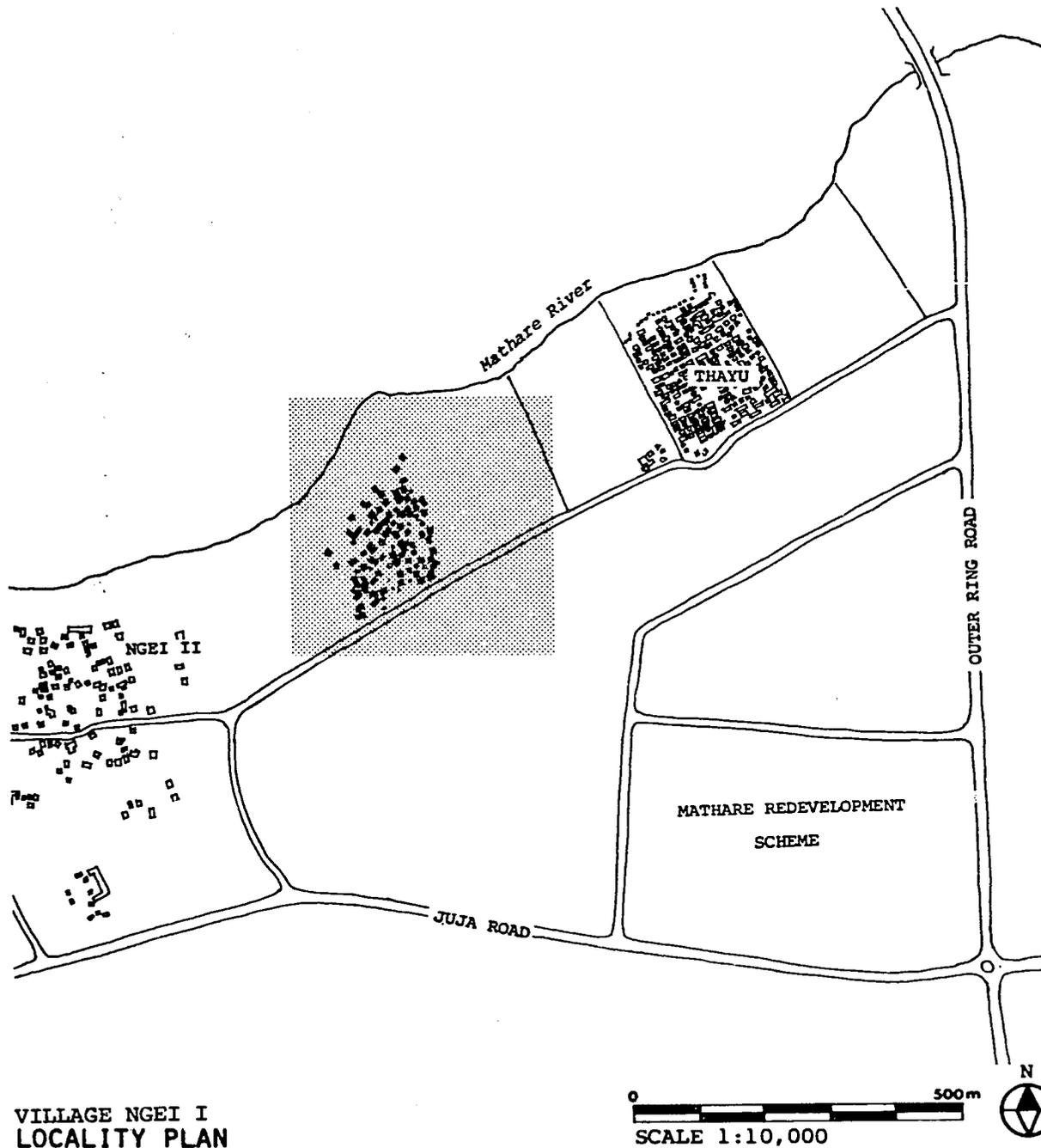


VILLAGE NGEI I
LOCALITY AIR PHOTOGRAPH



LAYOUT The village grew without any form of planning - squatters built structures haphazardly on the site, which has resulted in the irregular pattern of the village. The land within the village was not formally subdivided and as such there are no private lots.

POPULATION/INCOMES The village has a population of approximately 800 (1971), with low incomes.

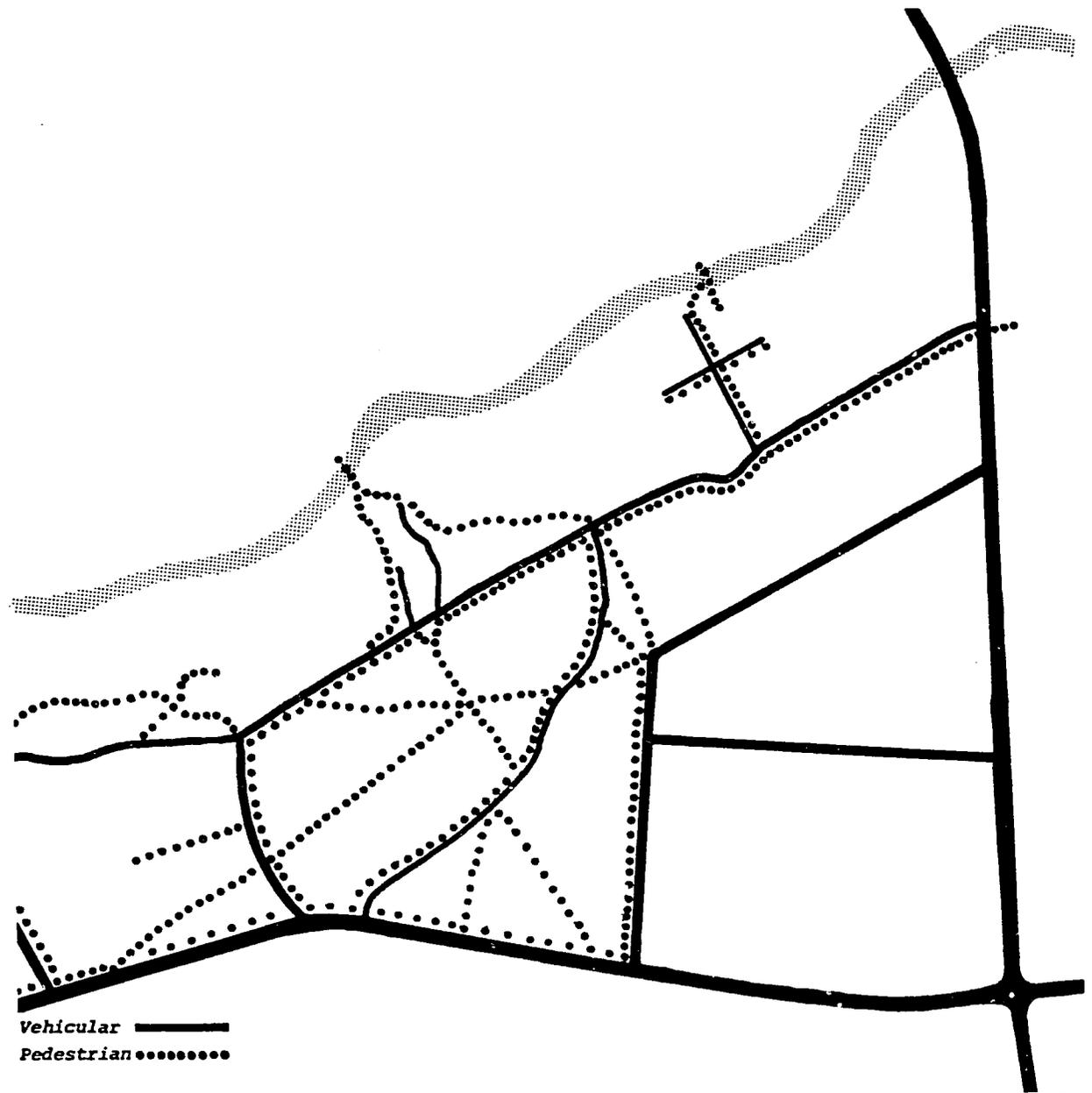


VILLAGE NGEI I
LOCALITY PLAN

0 500m
SCALE 1:10,000

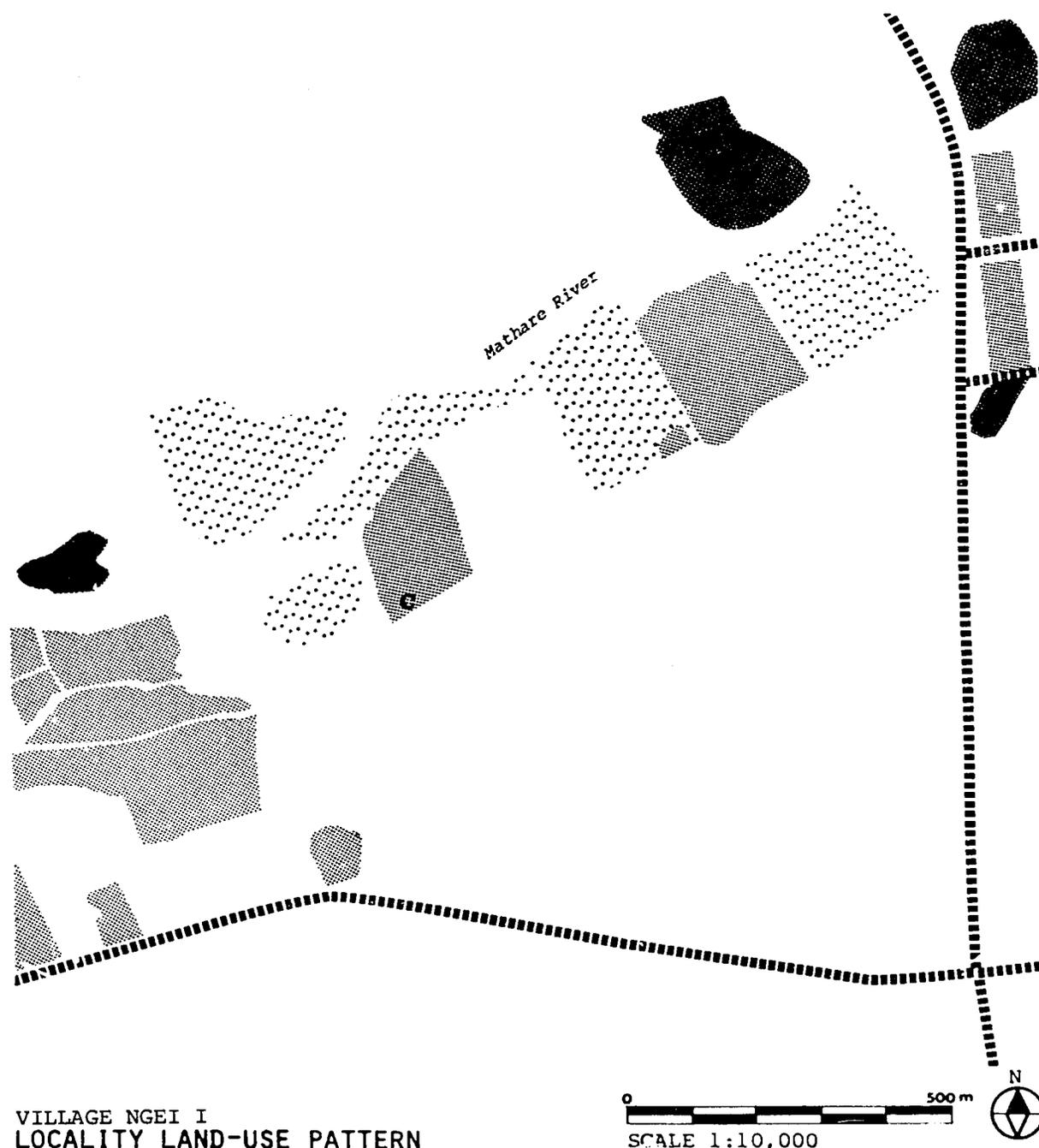
400m x 400m
Selected Segment

CIRCULATION A single track with two cul-de-sac branches provide the only vehicular access to the village. The rest of the circulation is pedestrian with footpaths leading to the dwellings. The nearest bus route is on Juja Road in the south.



VILLAGE NGEI I
LOCALITY CIRCULATION DIAGRAM

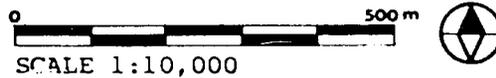




LAND USE The village is mostly residential with a small proportion of commercial activity in the form of stalls in front of the dwellings. There is one newly completed community hall but no schools or clinics. About a half of the open space is cultivated with 'shambas' of maize and sweet potato.

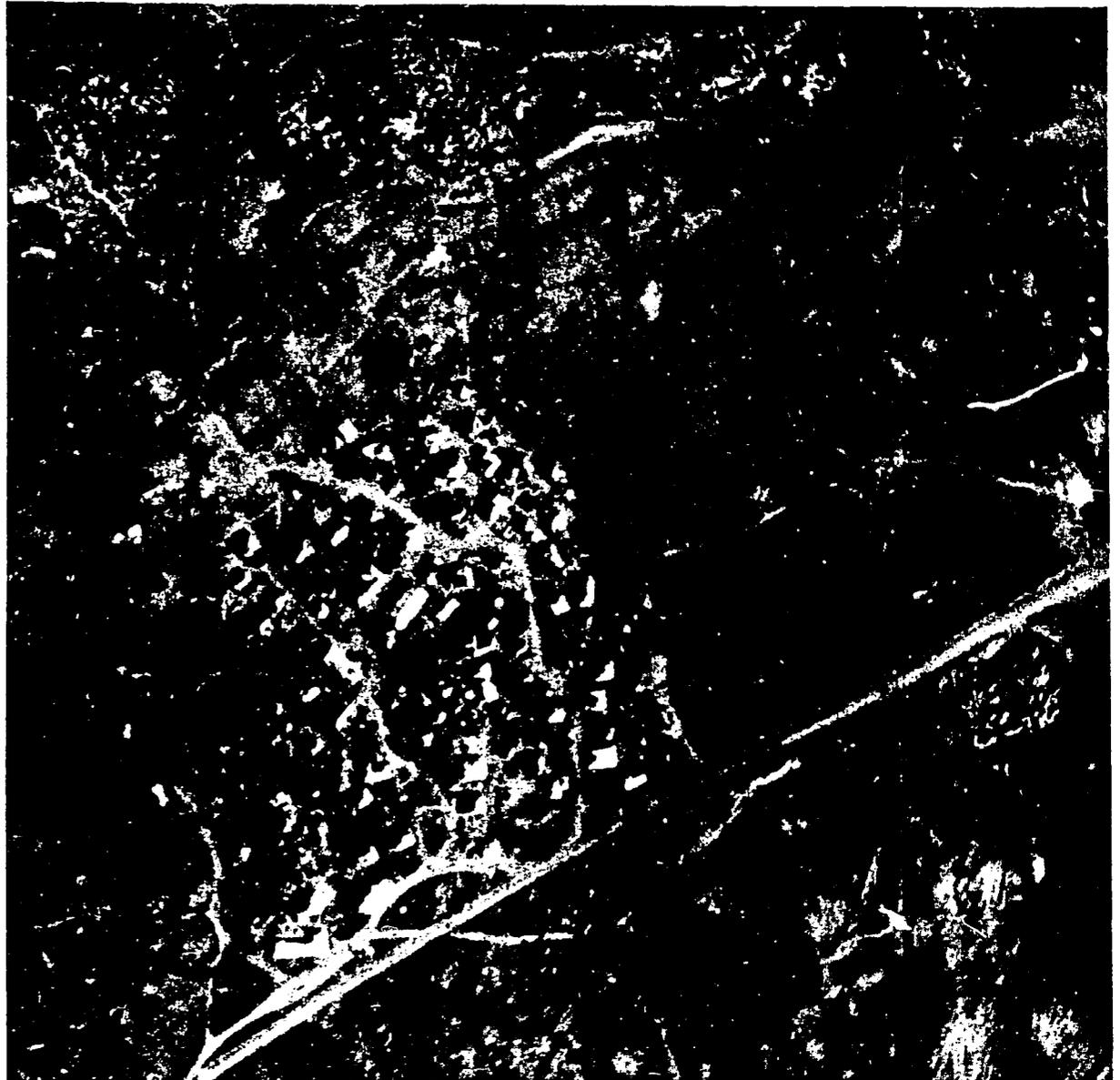
- | | |
|---|---------------------|
| C Community Center | S School |
| H Health | R Recreation |
| P Police | RL Religious |
|  Residential | |
|  Commercial/Industrial | |
|  Agricultural | |
|  Bus Route | |

VILLAGE NGEI I
LOCALITY LAND-USE PATTERN

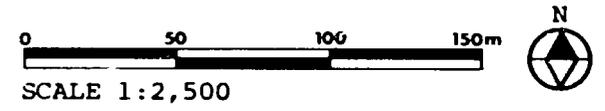




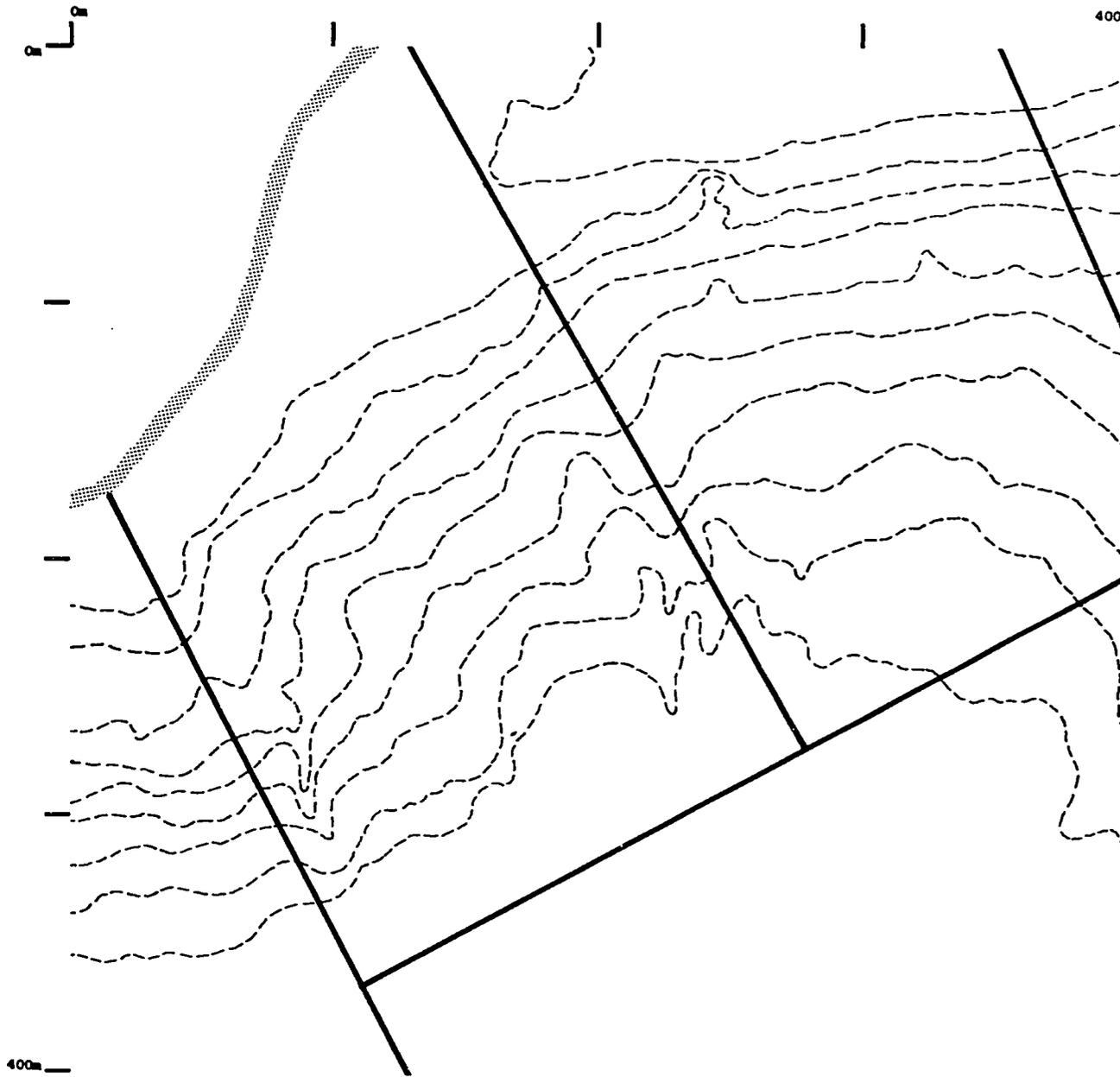
Traditional mud-and-wattle dwellings in Ngei I.



VILLAGE NGEI I
LOCALITY SEGMENT:
AIR PHOTOGRAPH



LOT LAYOUT Village Ngei I is an example of the traditional rural village layout. The land has not been legally or formally distributed and organized into lots. There does exist a certain definition of ownership/responsibility and personal control of land adjacent to the dwellings. Circulation is therefore minimized to footpaths and open spaces of a more communal nature.



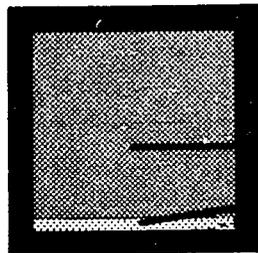
- No. of Lots:
- Lot Density:
- Av. Lot Dimensions:
- Av. Lot Area: Data for calculation of lot/circulation information not applicable.
- Av. Lot Coverage:
- Circulation Length:
- $\frac{\text{Circulation Length}}{\text{Area Served}}$

VILLAGE NGEI I
LOCALITY SEGMENT:
LOT LAYOUT



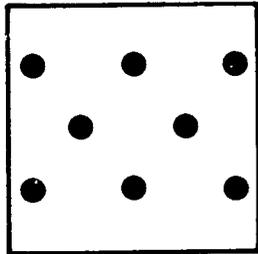
ACTUAL LAND UTILIZATION The distribution of segment land utilization areas is:

- % Public - circulation : LOW
- % Public - miscellaneous: VERY LOW
- % Private : HIGH
- Population density : LOW
- Dwelling unit density : MEDIUM
- % Built-up coverage : LOW



LAND UTILIZATION DIAGRAM

- Circulation: 23%
- Private : 72%
- Public : 5%



DENSITY DIAGRAM

● 20 persons

Density: 183 persons/Ha.
 Population: 784 persons
 No. of Dwellings: 85 dwellings
 Average Dw. Area: 42 sq.m.
 Built-up Area: 9.3%
 Vo. of Dw. Units: 224 units
 (Room Units): 224 units
 (House Units): -
 Unit Occupancy: 2 persons
 Unit Density: 52 units/Ha.
 Area of Segment: 16 Ha.
 Area used in Calculation: 4.3 Ha.

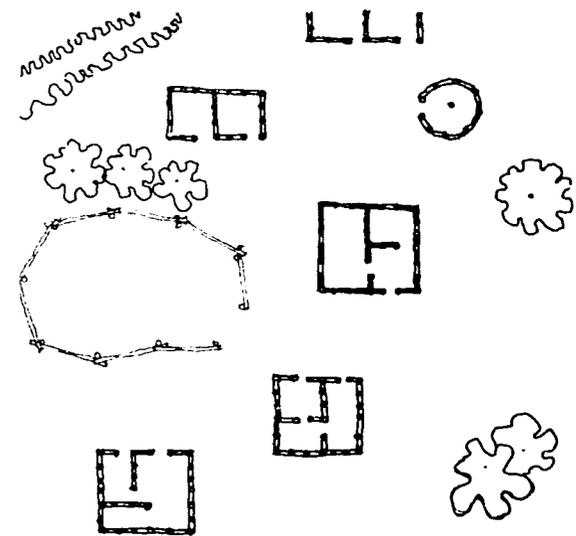


**VILLAGE NGEI I
 LOCALITY SEGMENT:
 ACTUAL LAND UTILIZATION**





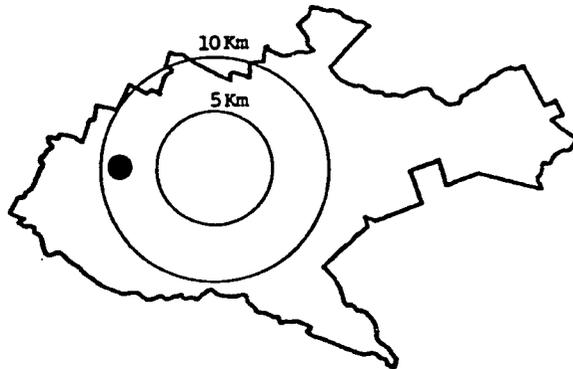
Typical rural homestead with dwellings and cattle enclosure. Cultivated 'shambas' of maize and sweet potato are along the river.



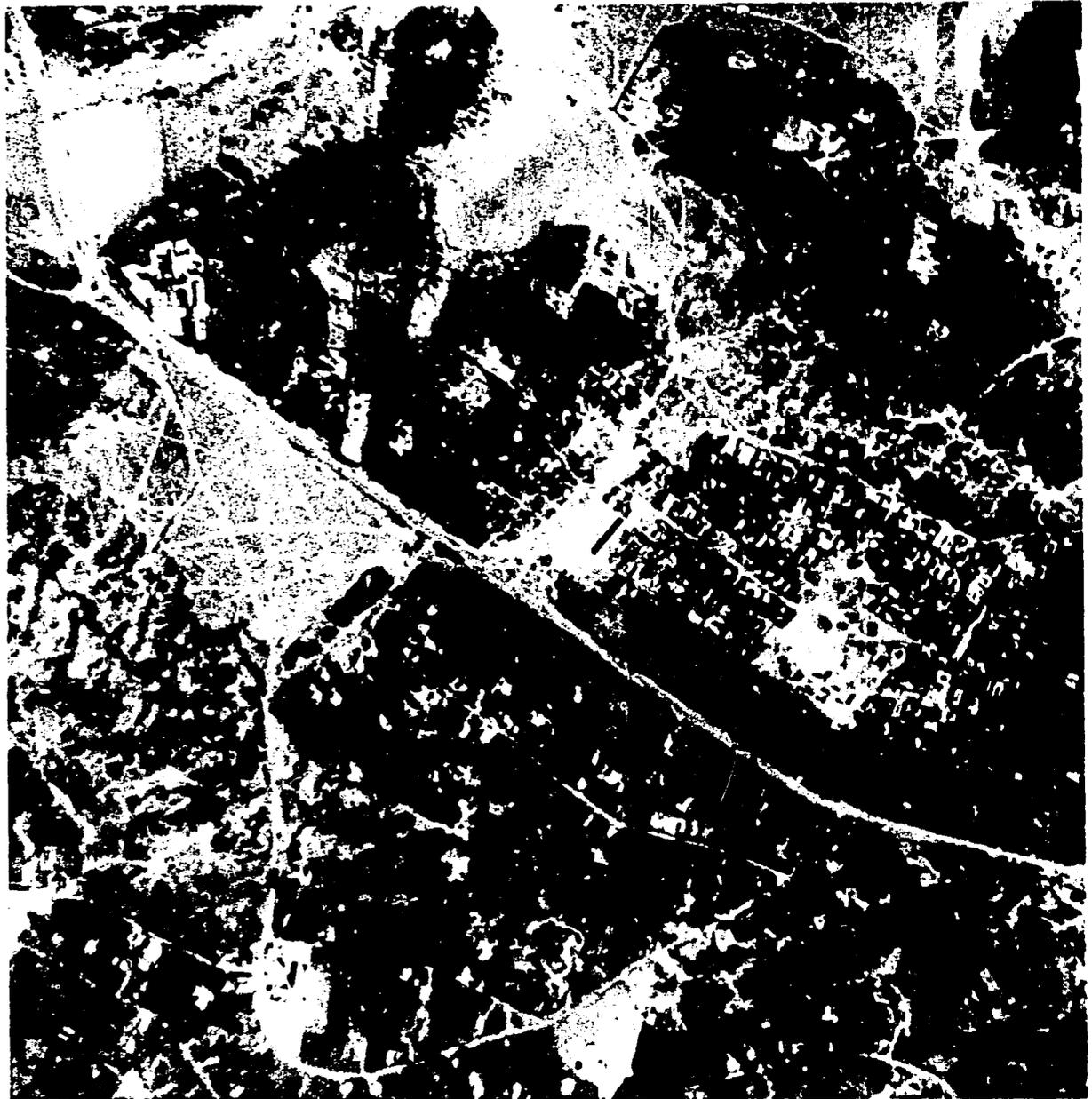
VILLAGE NGEI II
TYPICAL DWELLING

N
SCALE 1:500

4 KAWANGWARE VILLAGE DAGORETTI



LOCATION AND ORIGIN Kawangware is a village with an urban character in Dagoretti about 9 Km west of the central business district. Until 1963 Dagoretti was outside of the city boundaries. It was part of a major African tribal 'reserve' delineated by the colonial government. After the Emergency, in 1959, the villages in Dagoretti were consolidated as satellite labor pools for Nairobi. Since Independence, freehold land titles were issued to all people living in Dagoretti as a political reward. Today, Kawangware functions as a dormitory village, with its recently built stock of one-room tenements. Even after its inclusion by the 1963 city boundary it remained free of the city's building by-laws.



KAWANGWARE VILLAGE
LOCALITY AIR PHOTOGRAPH

0 300m
SCALE 1:10,000



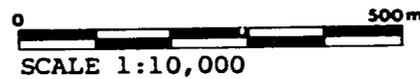


LAYOUT After the Emergency, the land in Kawangware and other villages in Dagoretti was subdivided into 0.1 Ha. and smaller lots. The layout was determined by the footpaths, small 'shambas' and existing structures. The tracks and footpaths were connected to Kawangware Road which forms the perimeter boundary of the locality.

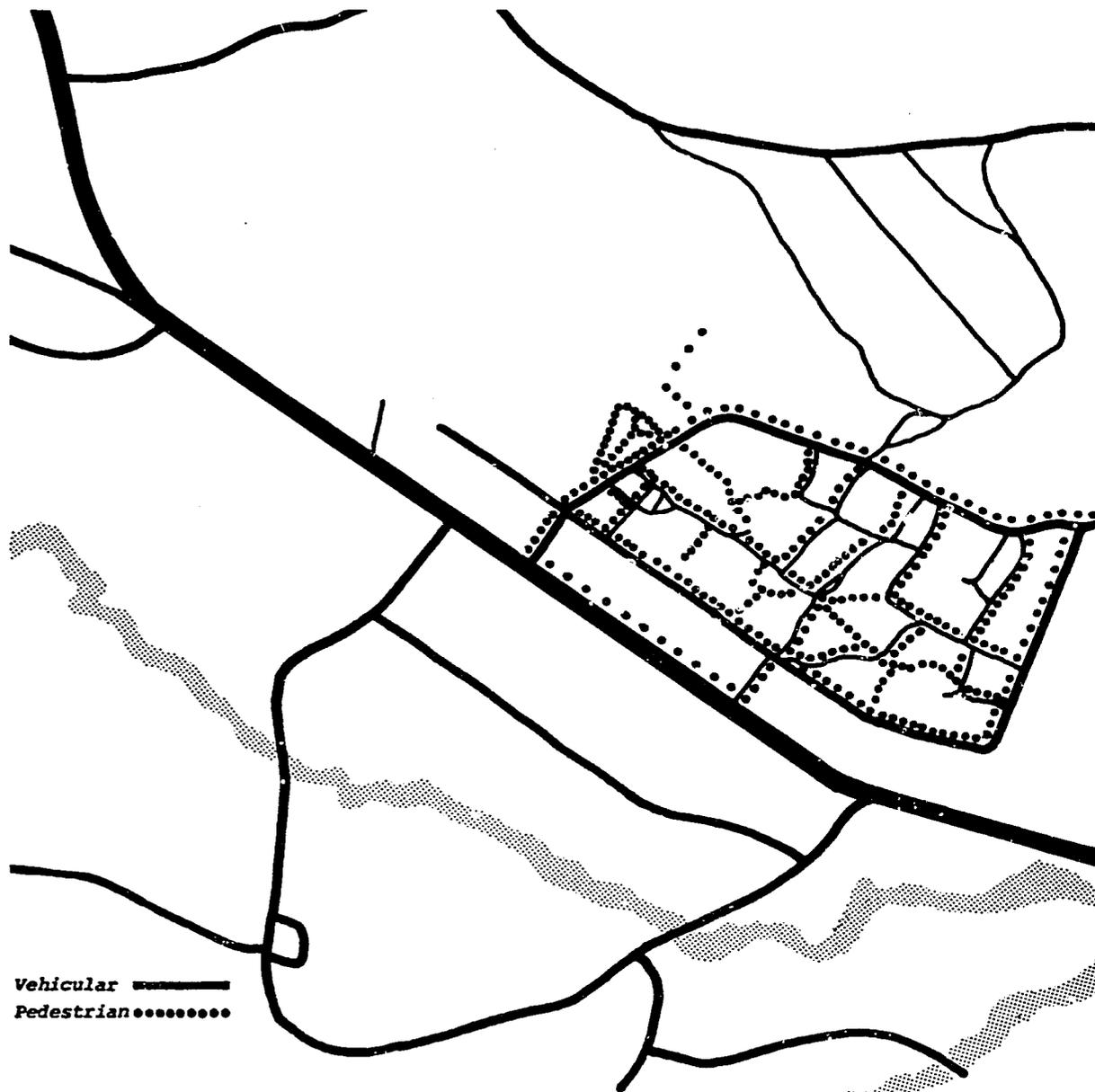
POPULATION/INCOMES The population of Kawangware is 4100 (1969), with incomes ranging from low to middle.

400m x 400m
Selected Segment

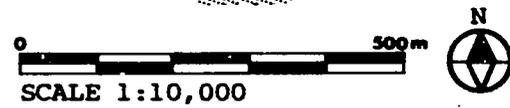
**KAWANGWARE VILLAGE
LOCALITY PLAN**

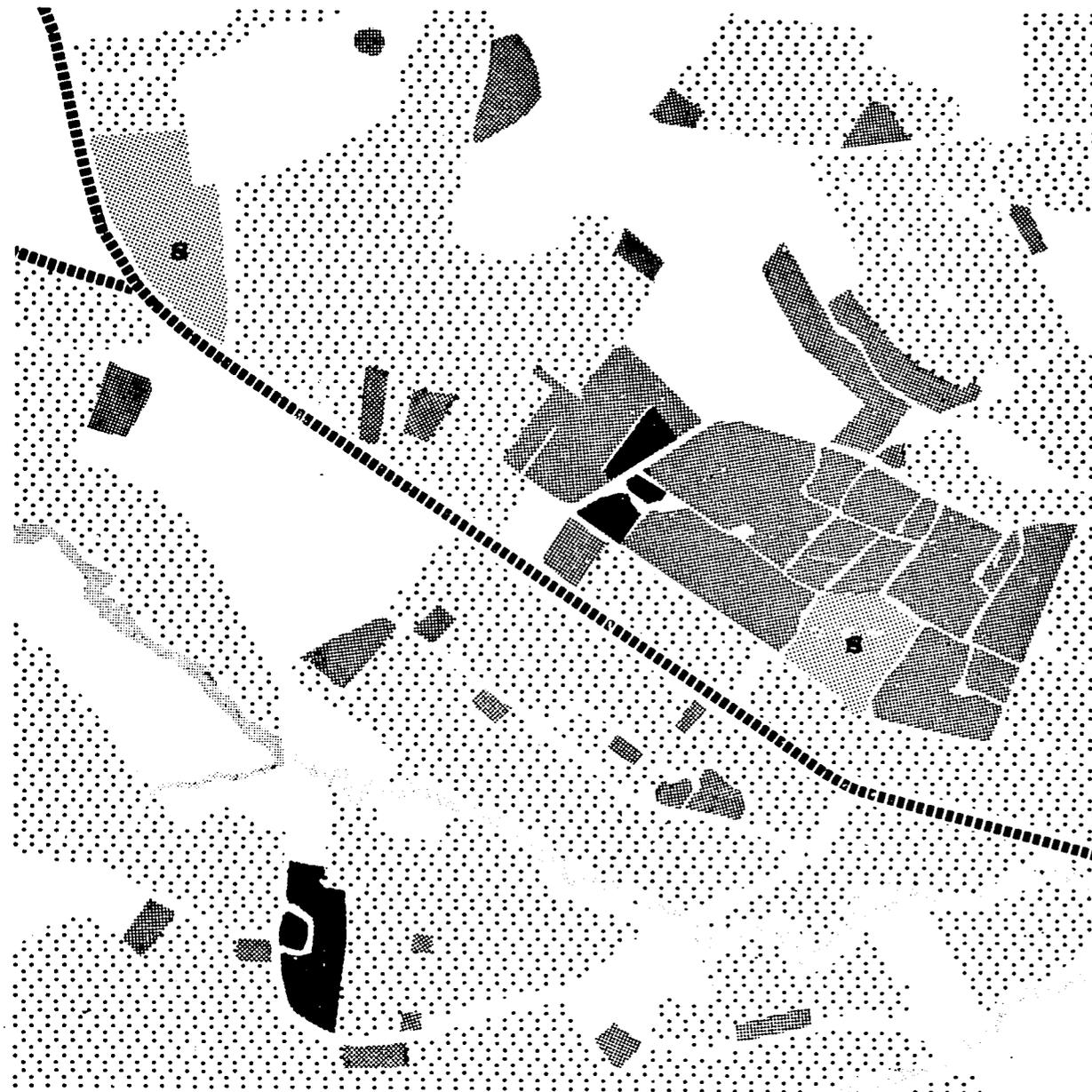


CIRCULATION A peripheral vehicular access road is connected with an internal network of tracks and foot-paths. Within the village the circulation is dominated by pedestrians. The village is served by the bus route on the adjoining Naivasha Road.



**KAWANGWARE VILLAGE
LOCALITY CIRCULATION DIAGRAM**





LAND USE Kawangware is predominantly residential, with some commercial activity at the western end and some scattered stalls. The only public space aside from the access tracks is a large open space in the south. There are no public utilities or services.

- | | |
|---|---------------------|
| C Community Center | S School |
| H Health | R Recreation |
| P Police | RL Religious |
|  Residential | |
|  Commercial/Industrial | |
|  Agricultural | |
|  Bus Route | |

**KAWANGWARE VILLAGE
LOCALITY LAND-USE PATTERN**

0 500 m
SCALE 1:10,000

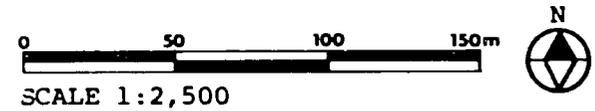


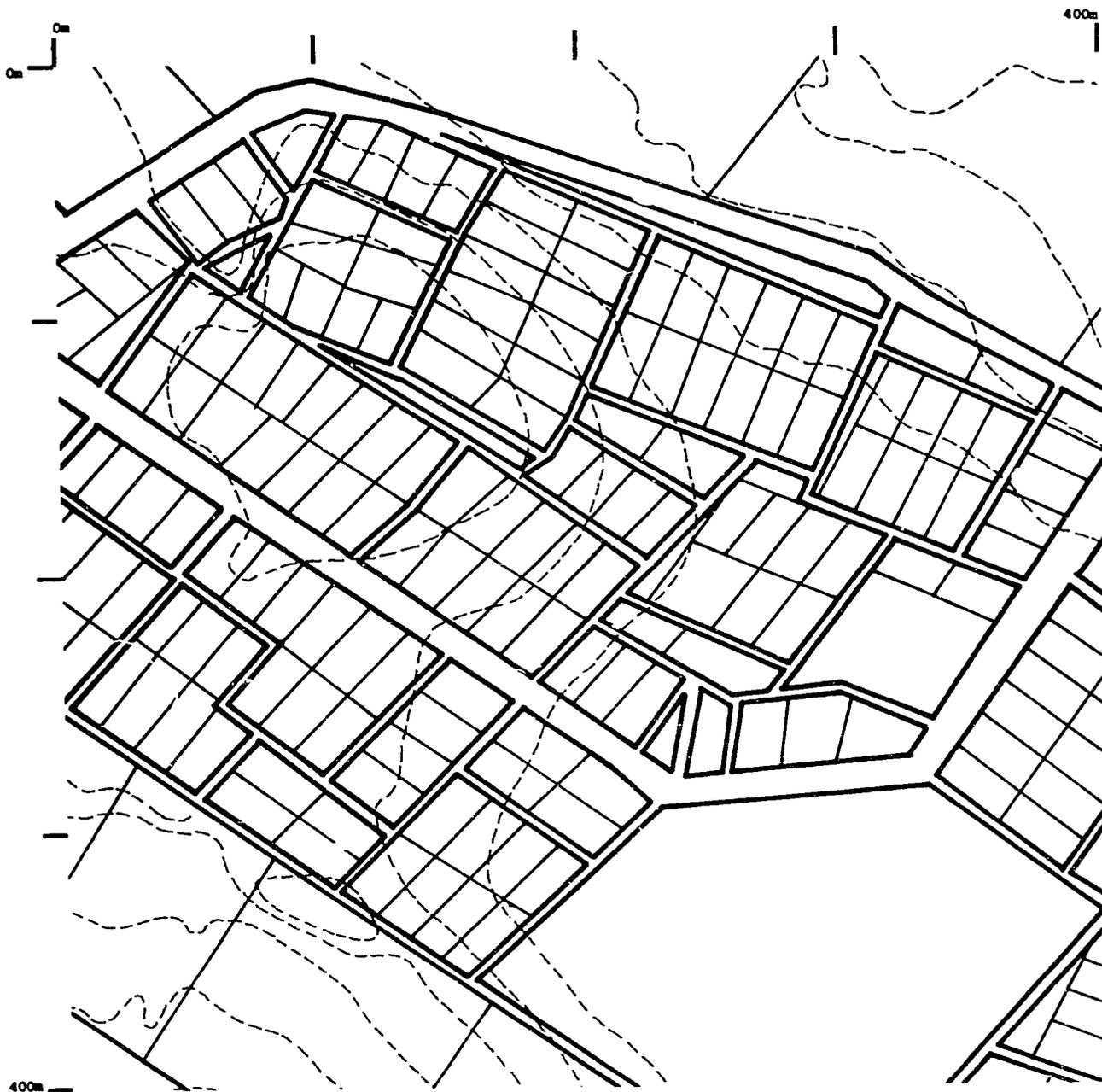


New development of single-room barracks (above) and typical rural homestead with 'shamba' (below).



KAWANGWARE VILLAGE
LOCALITY SEGMENT:
AIR PHOTOGRAPH





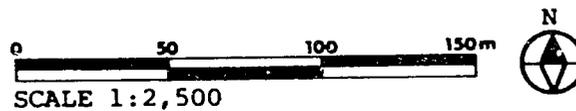
LOT LAYOUT Kawangware village is representative of a larger rural village layout that developed without control or organization of layout. It has recently been subdivided into lots; the resultant layout reflects the random positioning of streets and blocks.

Lots are large(1:2) and serviced from 2-3 sides.

The lots are clearly defined by fences; personal control of land adjacent to dwellings is high.

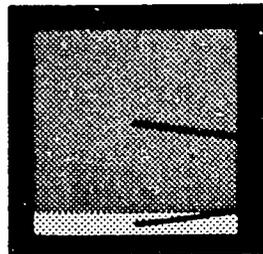
No. of Lots: 167 lots
 Lot Density: 10.4 lots/Ba.
 Av. Lot Dimensions: 14m x 30m
 Av. Lot Area: 420 sq.m.
 Av. Lot Coverage: 42.8% of lot
 Circulation Length: 2,905 m
Circulation Length / Area Served: 201 m/Ba.

**KAWANGWARE VILLAGE
 LOCALITY SEGMENT:
 LOT LAYOUT**



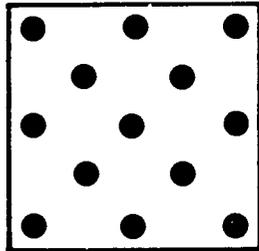
ACTUAL LAND UTILIZATION The distribution of segment land utilization areas is:

- % Public - circulation : LOW
- % Public - miscellaneous: LOW
- % Private : HIGH
- Population density : HIGH
- Dwelling unit density : HIGH
- % Built-up coverage : HIGH



LAND UTILIZATION DIAGRAM

- Circulation: 19%
- Private : 70%
- Public : 11%

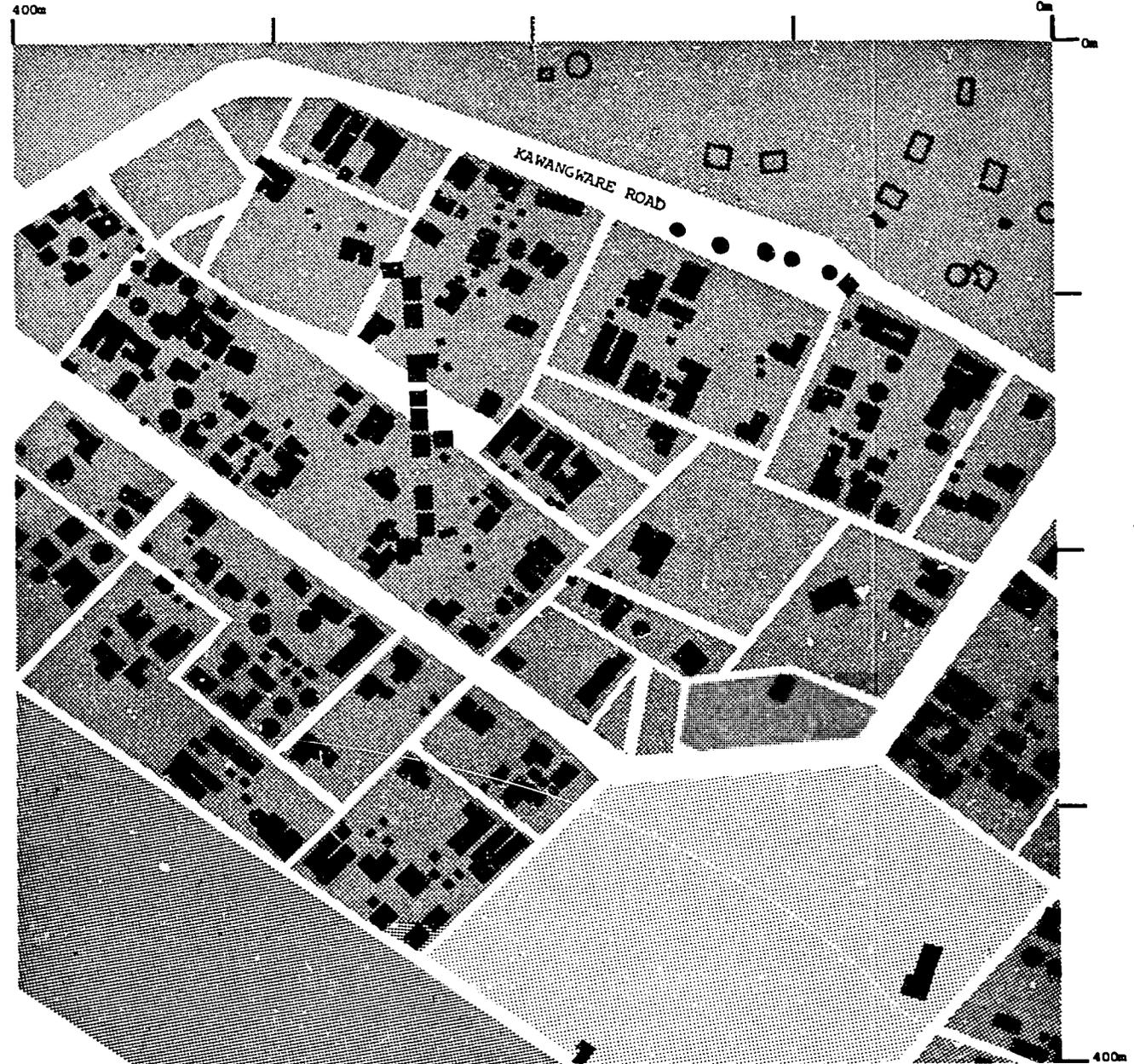


DENSITY DIAGRAM

- 20 persons

- Density: 255 persons/Ha.
- Population: 4,082 persons
- No. of Dwellings: 202 dwellings
- Average Dw. Area: 180 sq.m.
- Built-up Area: 22.7%
- No. of Dw. Units: 1750 units
- (Room Units): 1750 units
- (House Units): -
- Unit Occupancy: 4 persons
- Unit Density: 109.3 units/Ha.

- Area of Segment: 16 Ha.
- Area used in Calculation: 16 Ha

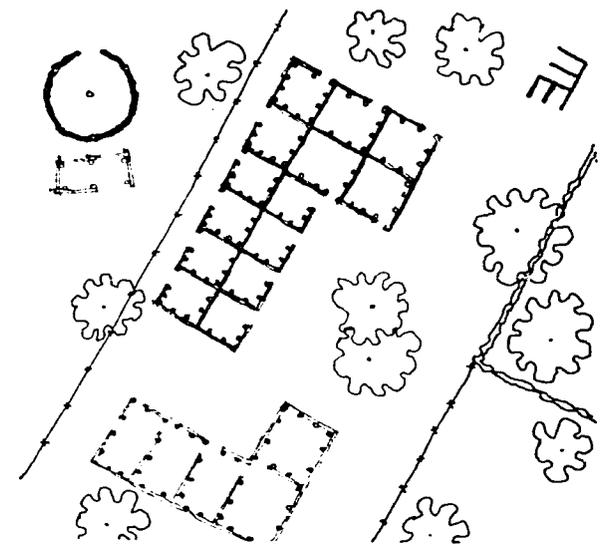


**KAWANGWARE VILLAGE
LOCALITY SEGMENT:
ACTUAL LAND UTILIZATION**





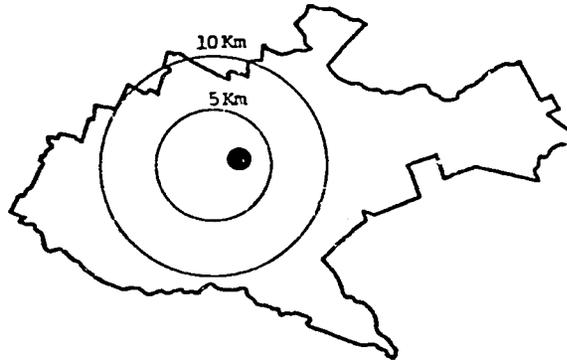
Photos illustrate the two most common types of dwellings in Kawangware: traditional huts and barracks of single-room units.



**KAWANGWARE VILLAGE
TYPICAL DWELLING**

SCALE 1:500

5 EASTLEIGH



LOCATION AND ORIGIN Eastleigh is located 3 Km east of the central business district. It is defined by Kenya Airforce Aerodrome in the east, Juja Road in the north, Ainsworth Road in the west and Pumwani residential area in the south. It was developed initially as a private low income residential district with traditional Asian courtyard type houses to cater for extended families and tenants. Until Independence, Eastleigh was occupied predominantly by Asian families in middle and low income groups. With the departure of many of these Asians at Independence, Africans have moved in and today Eastleigh is dominated by Africans.

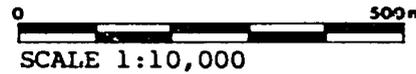




LAYOUT The layout of Eastleigh is a typical grid-iron street system with the main avenues running perpendicular to Juja Road. This layout is uniform and systematic with 0.04 Ha. lots. The blocks are subdivided by service alleys giving access to the backs of all lots.

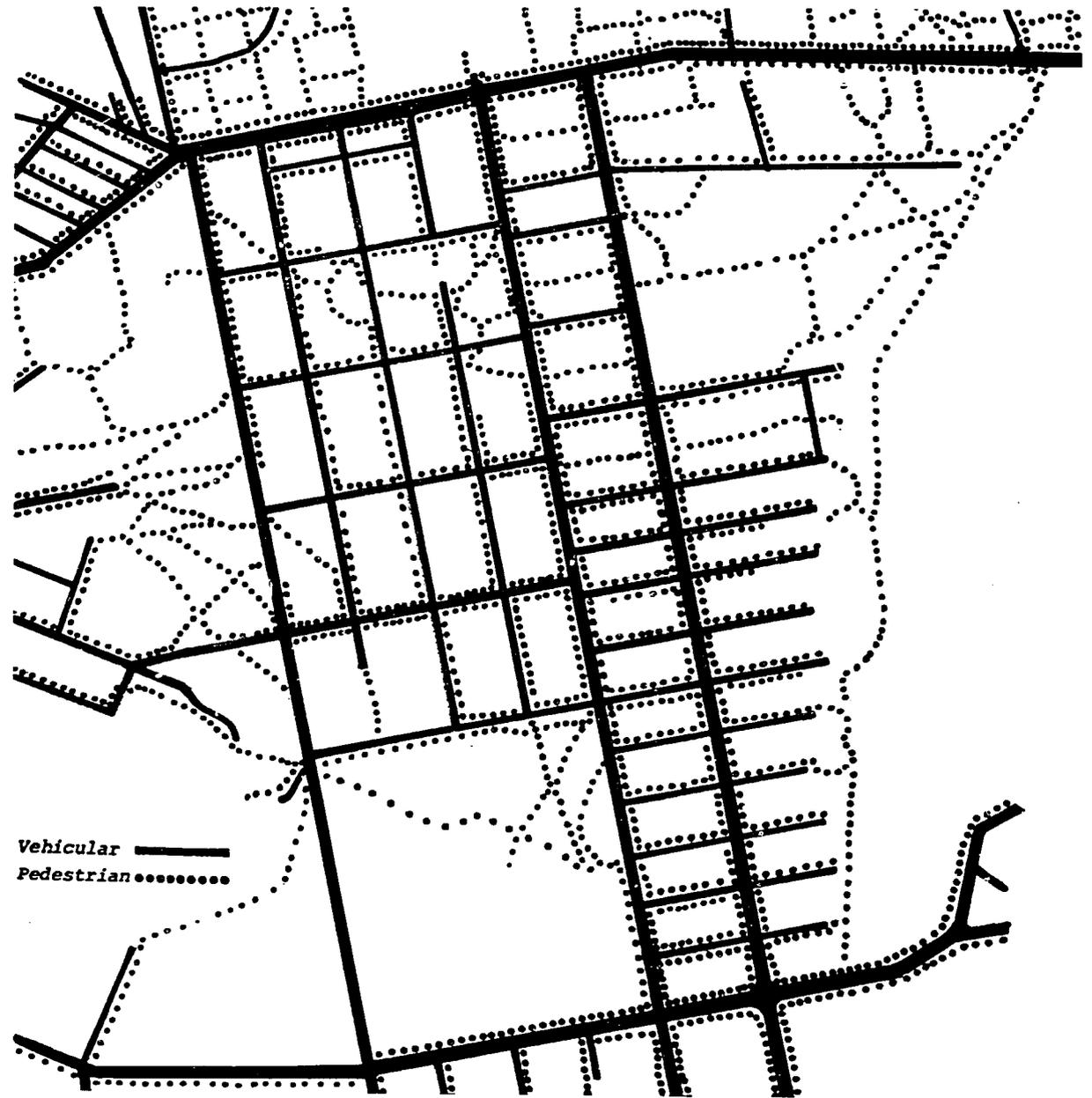
POPULATION/INCOMES The locality in 1969 recorded a population of 47,490 with incomes ranging from low to middle.

**EASTLEIGH
LOCALITY PLAN**

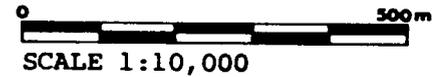


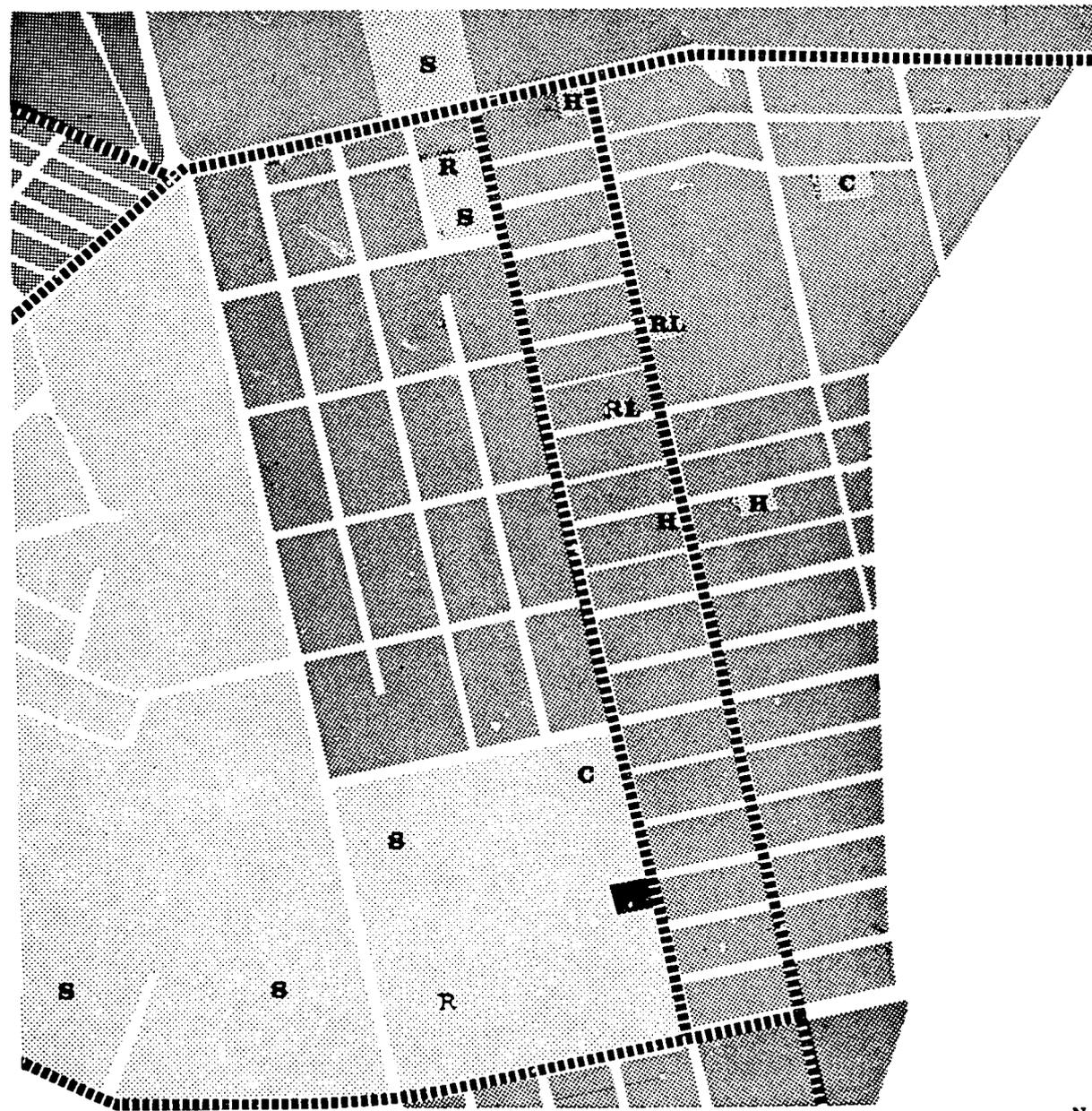
400m x 400m
Selected Segment

CIRCULATION Most streets are paved and accessible to vehicular traffic though pedestrians dominate. There are two regular bus routes passing through the locality, connecting it to the city center and principal work areas. There is also a pirate taxi service.



EASTLEIGH
LOCALITY CIRCULATION DIAGRAM





LAND USE A large proportion of the area is occupied by private dwelling lots, a small number of which are used for petty commerce and artisan workshops, mostly along the main traffic arteries. The area is well served with public utilities and services such as schools, clinics, and forms a relatively self-sufficient unit.

- | | |
|---|--------------|
| C Community Center | S School |
| H Health | R Recreation |
| P Police | RL Religious |
|  Residential | |
|  Commercial/Industrial | |
|  Agricultural | |
|  Bus Route | |

EASTLEIGH
LOCALITY LAND-USE PATTERN

0 500 m
SCALE 1:10,000



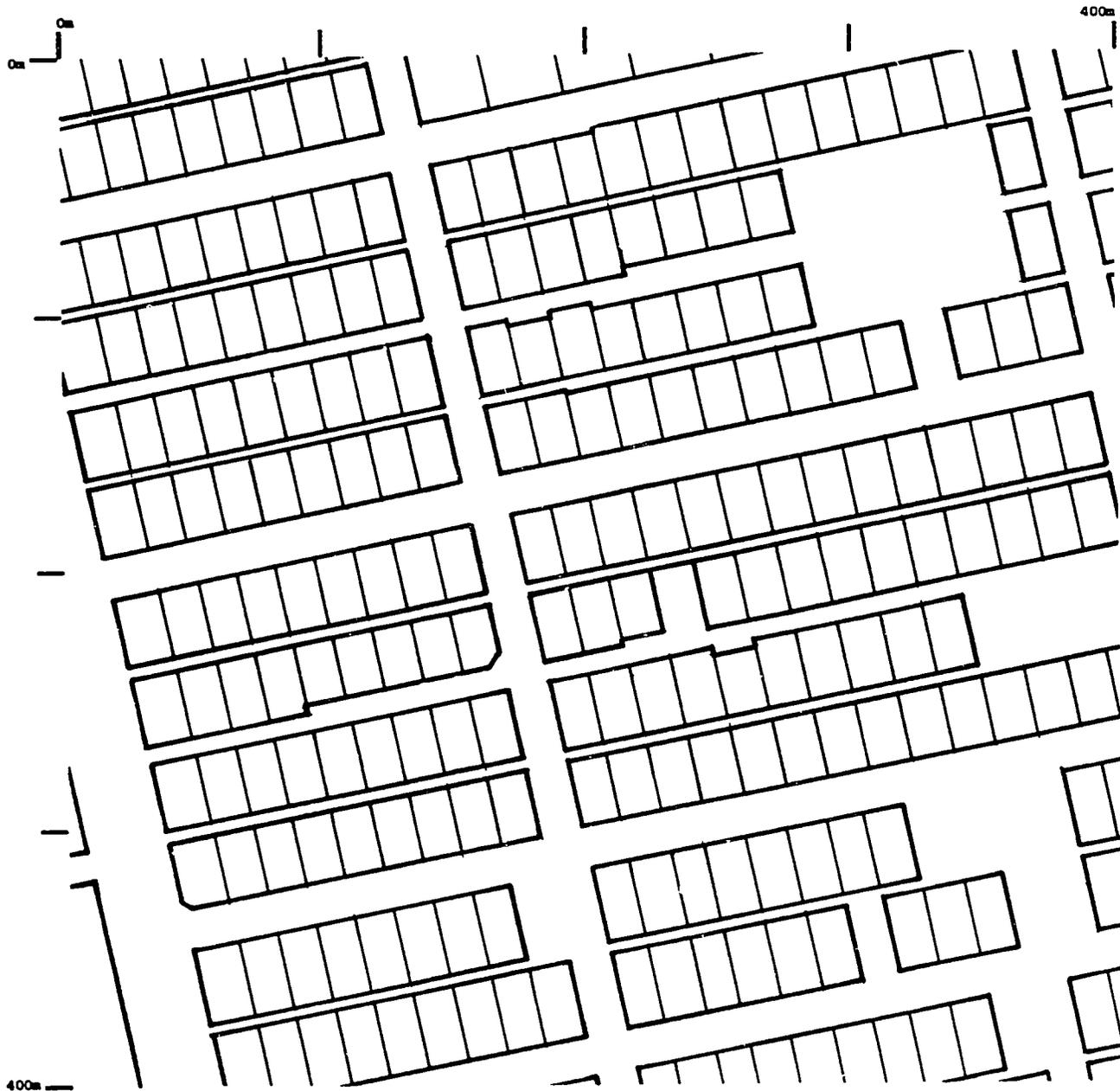


*Air view of a section of Eastleigh
with court-type tenements.*



**EASTLEIGH
LOCALITY SEGMENT:
AIR PHOTOGRAPH**





LOT LAYOUT Eastleigh is an application of the conventional gridiron layout. Regular rectangular lots (1:3) organized in rectangular blocks (60m x 210m) accommodate pedestrian and vehicular circulation.

Lots are serviced from 2 sides (service alley in rear of lot) which somewhat lessens the efficiency of circulation length. Nevertheless, the layout is one of the most efficient overall, allowing relatively balanced distributions of density, land utilization and circulation.

Lot coverage is almost 60% with a court-type dwelling that maximizes lot usage and personal control.

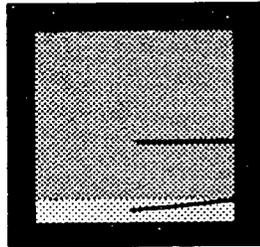
No. of Lots: 225 lots
 Lot Density: 14.1 lots/Ha.
 Av. Lot Dimensions: 16m x 26m
 Av. Lot Area: 416 sq.m.
 Av. Lot Coverage: 55.7% of lot
 Circulation Length: 2742 m.
 Circulation Length / Area Served: 240 m/Ha.

**EASTLEIGH
 LOCALITY SEGMENT:
 LOT LAYOUT**



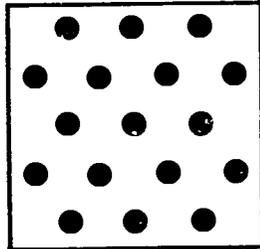
ACTUAL LAND UTILIZATION The distribution of segment land utilization areas is:

- % Public - circulation : ACCEPTABLE
- % Public - miscellaneous: ACCEPTABLE
- % Private : ACCEPTABLE
- Population density : MEDIUM
- Dwelling unit density : MEDIUM
- % Built-up coverage : MEDIUM



LAND UTILIZATION DIAGRAM

- Circulation: 29%
- Private : 58%
- Public : 13%



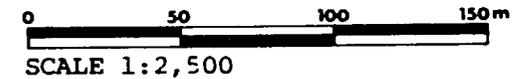
DENSITY DIAGRAM

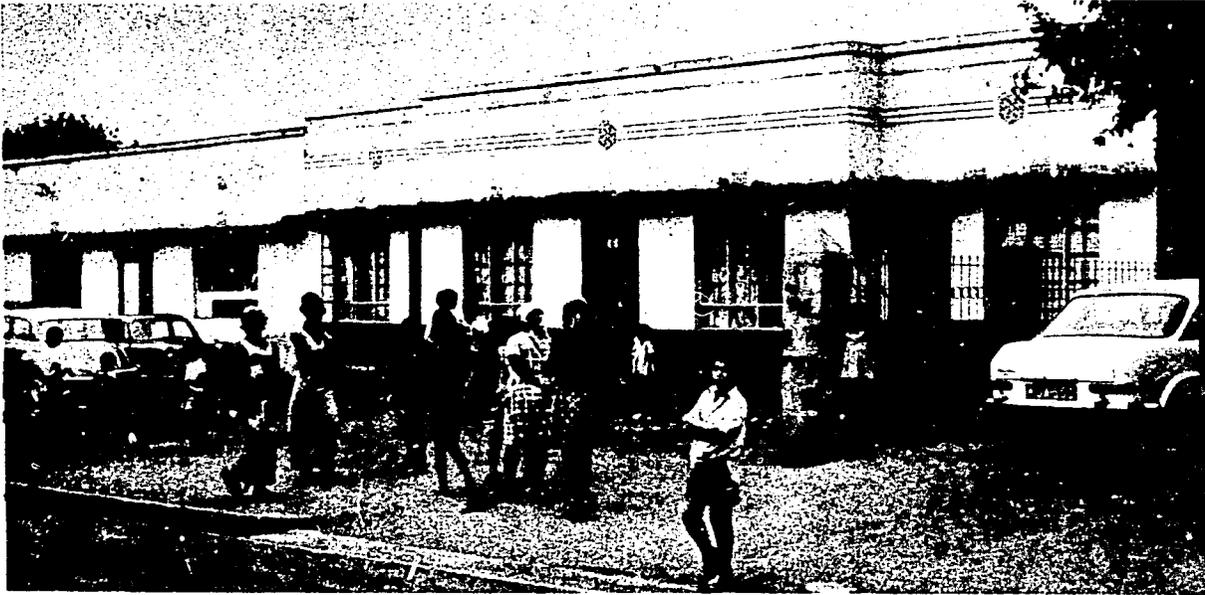
● 20 persons

- Density: 336 persons/Ha.
- Population: 5,376 persons
- No. of Dwellings: 168
- Average Dw. Area: 232 sq.m.
- Built-up Area: 24.3%
- No. of Dw. Units: 1,344 units
- (Room Units): 1,344 units
- (House Units): -
- Unit Occupancy: 4 persons
- Unit Density: 84 units/Ha.
- Area of Segment: 16 Ha.
- Area used in Calculation: 16 Ha.



EASTLEIGH LOCALITY SEGMENT: ACTUAL LAND UTILIZATION





Typical tenement in Eastleigh. Single-room dwelling units share a common court and communal services.

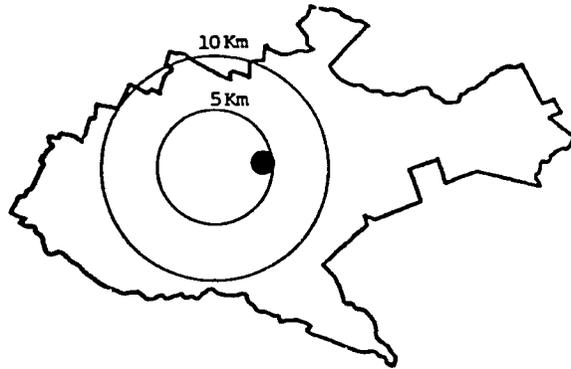


**EASTLEIGH
TYPICAL DWELLING**

SCALE 1:500



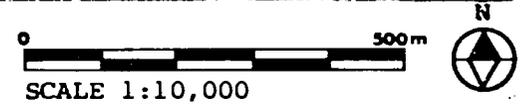
6 KIMATHI ESTATE EASTLANDS

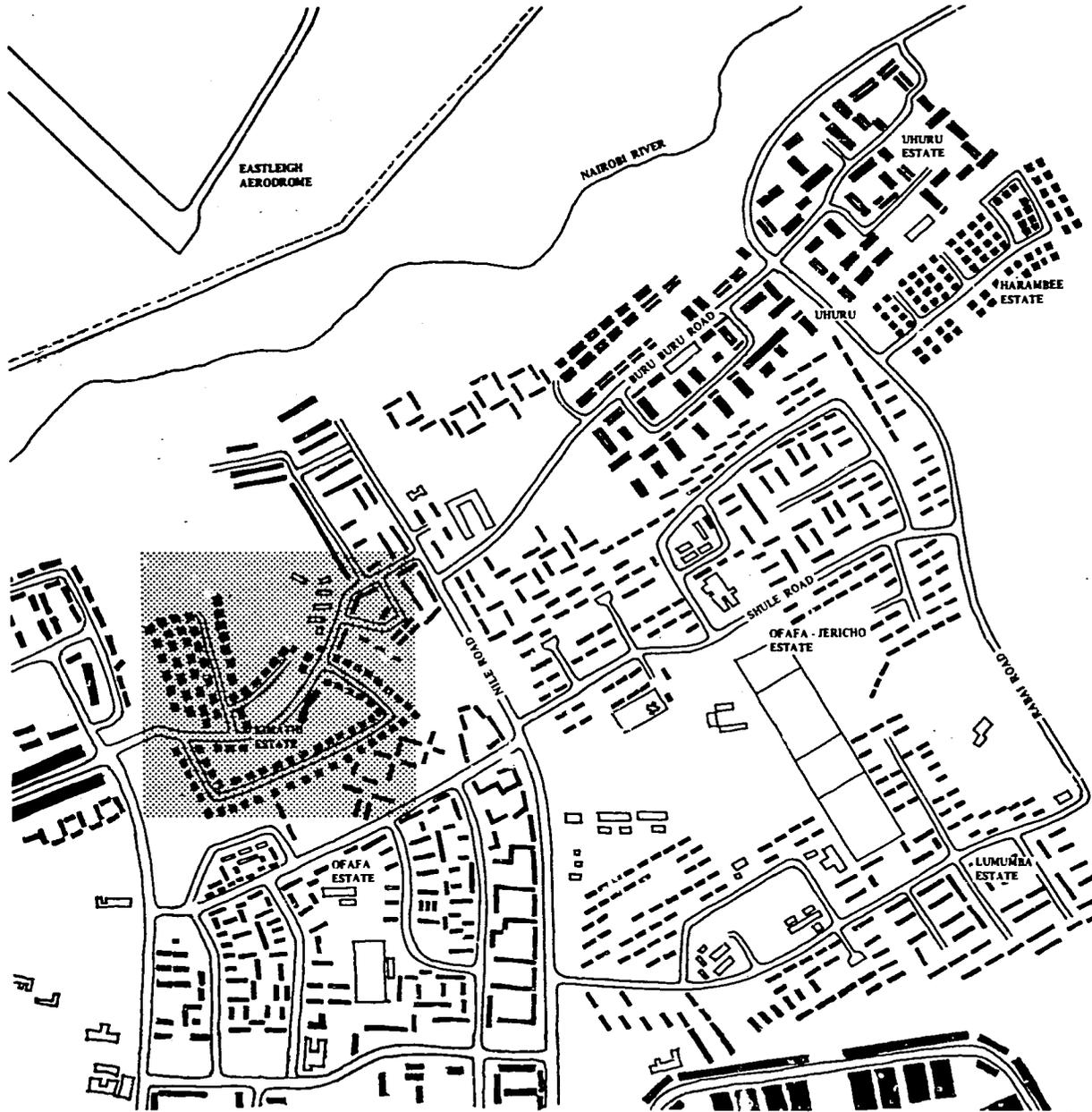


LOCATION AND ORIGIN Kimathi Estate is located 4 Km east of the central business district, in Eastlands. It is a public tenant-purchase housing scheme built with A.I.D. financing in 1970, and caters for middle/high income groups, like Harambee Estate which is a similar scheme in Eastlands.

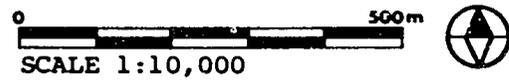


KIMATHI ESTATE
LOCALITY AIR PHOTOGRAPH





KIMATHI ESTATE
LOCALITY PLAN

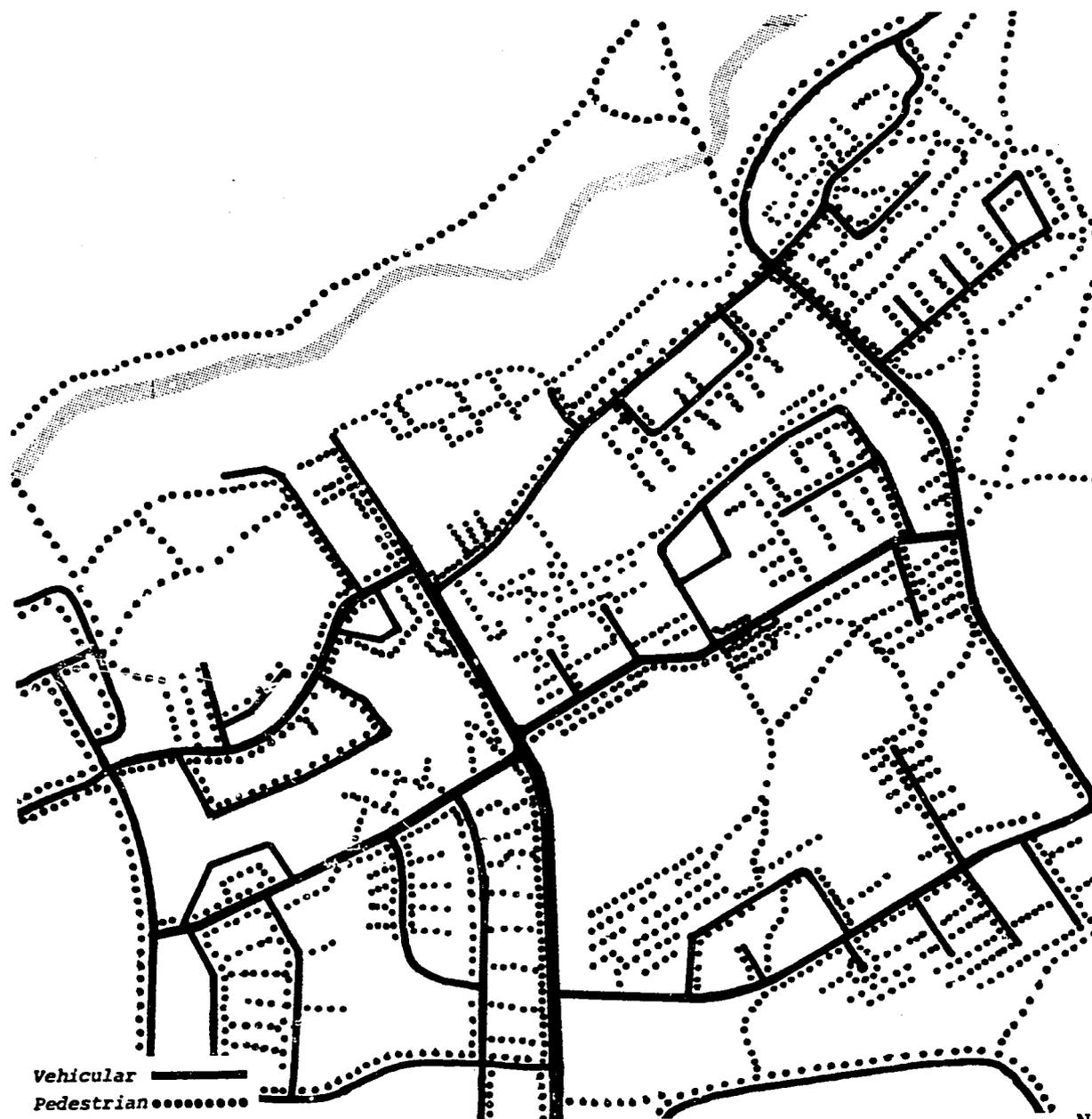


LAYOUT The estate was planned and built by the Nairobi City Council and the layout consists of 0.02 Ha. lots with individual vehicular accesses. The layout is designed for semi-detached and row single storey units.

POPULATION/INCOMES The estate had a population of about 1300 in 1969, with middle/high incomes.

400m x 400m
Selected Segment

CIRCULATION The main vehicular accesses in the estate are connected with the overall Eastlands circulation. A regular bus route makes a detour into the estate with a stop in it.

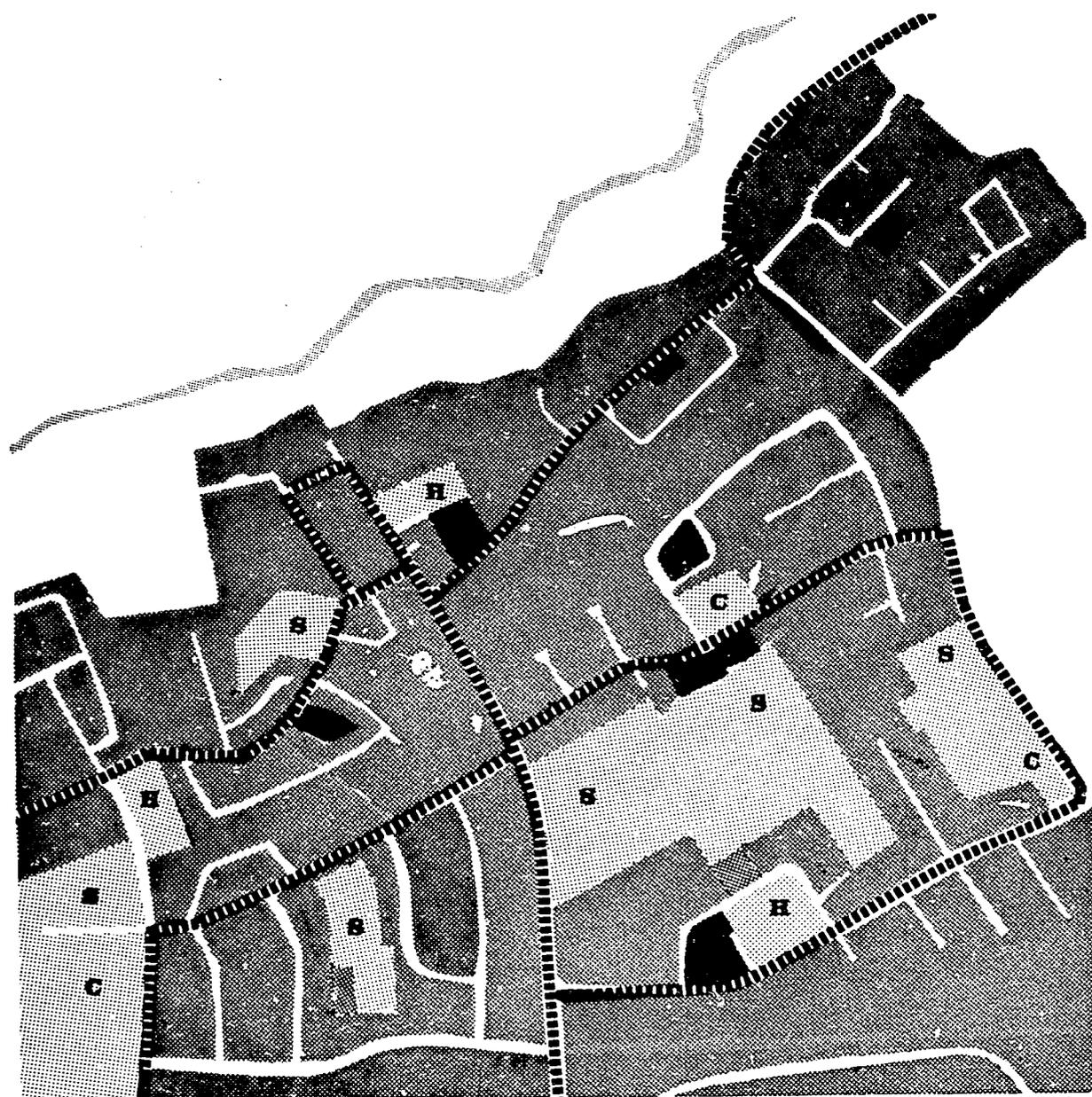


Vehicular ———
Pedestrian ·····

KIMATHI ESTATE
LOCALITY CIRCULATION DIAGRAM

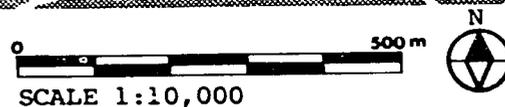


LAND USE Privately occupied dwellings cover almost a half of the locality, the rest is circulation and a school with playgrounds in the north. There is no commercial activity in the estate but it is well served with public utilities.



- | | | | |
|---------------------|-----------------------|----|------------|
| C | Community Center | S | School |
| H | Health | R | Recreation |
| P | Police | RL | Religious |
| [Stippled Box] | Residential | | |
| [Dark Box] | Commercial/Industrial | | |
| [Dotted Box] | Agricultural | | |
| [Thick Dashed Line] | Bus Route | | |

KIMATHI ESTATE
LOCALITY LAND-USE PATTERN

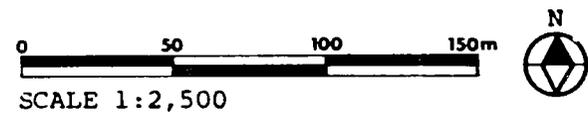




Semi-detached units on 1/20 acre plots in Kimathi.



KIMATHI ESTATE
LOCALITY SEGMENT:
AIR PHOTOGRAPH





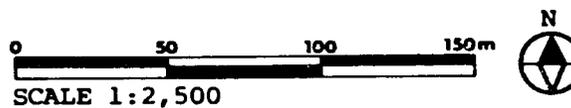
LOT LAYOUT Kimathi is a curvilinear, loop layout with attached and row type units. Lots are average size (1:3).

Excessive circulation and unassigned public land result in a relatively inefficient layout.

Private lots are fenced for maximum control.

No. of Lots: 225 lots
 Lot Density: 20 lots/Ha.
 Av. Lot Dimensions: 10m x 21m
 Av. Lot Area: 210 sq.m.
 Av. Lot Coverage: 30.5% of lot
 Circulation Length: 1,805 m.
Circulation Length / Area Served = 219 m/Ha.

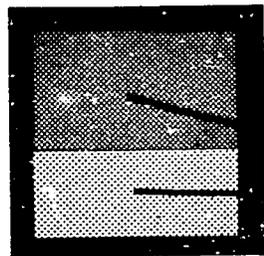
**KIMATHI ESTATE
 LOCALITY SEGMENT:
 LOT LAYOUT**



ACTUAL LAND UTILIZATION The distribution of segment land utilization areas is:

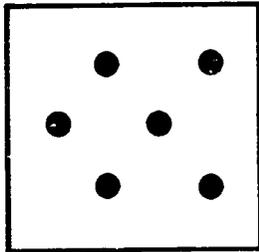
% Public - circulation : LOW
 % Public - miscellaneous: HIGH
 % Private : LOW

Population density : LOW
 Dwelling unit density : LOW
 % Built-up coverage : LOW



LAND UTILIZATION DIAGRAM

Circulation: 27%
 Private : 39%
 Public : 34%



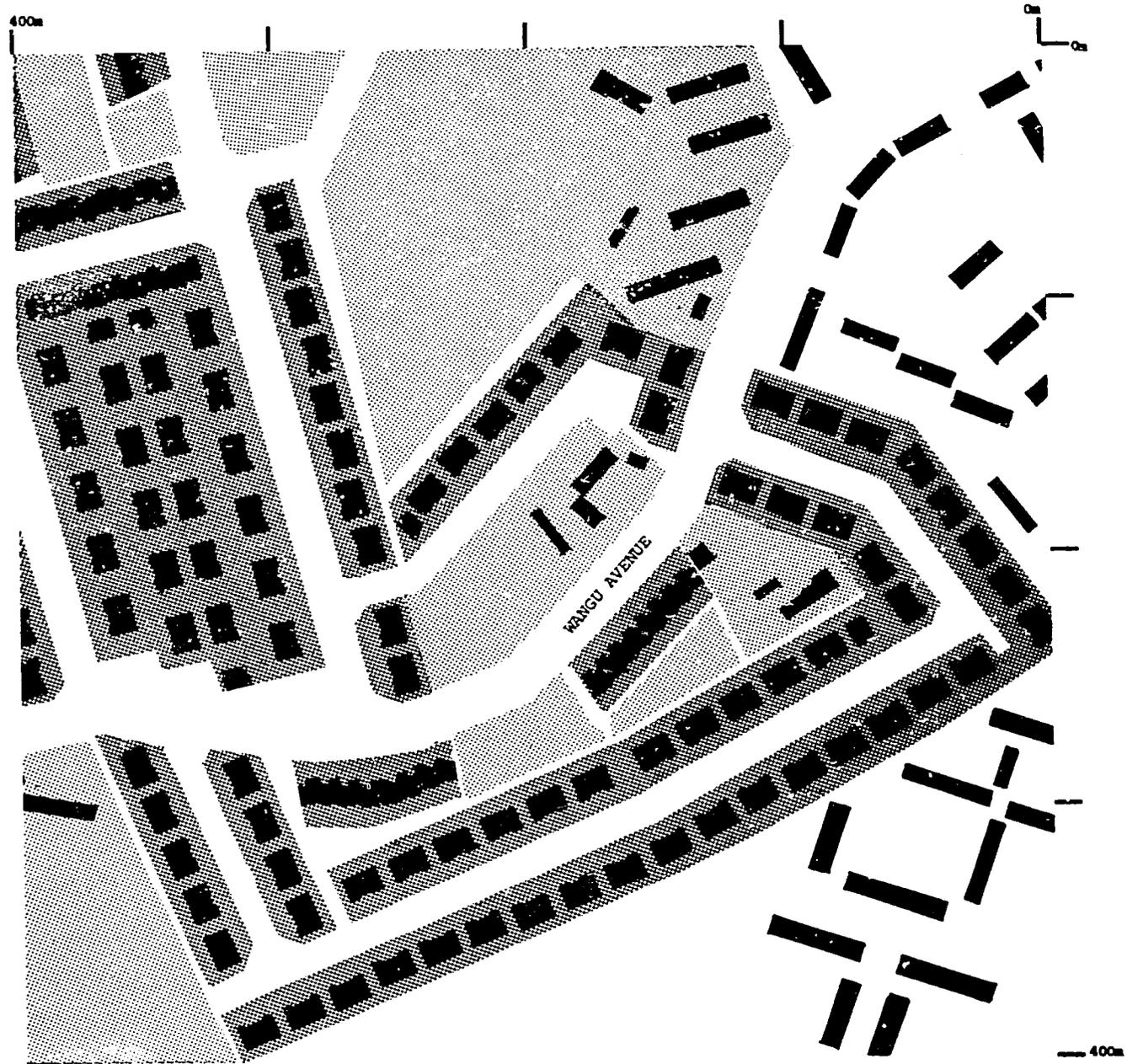
DENSITY DIAGRAM

● 20 persons

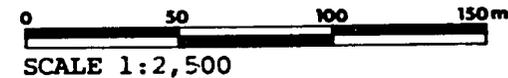
Density: 120 persons/Ha.
 Population: 1125 persons
 No. of Dwellings: 225 dwellings
 Average Dw. Area: 63 sq.m.
 Built-up Area: 12.6%
 No. of Dw. Units: 225 units
 (Room Units): -
 (House Units): 225 units
 Unit Occupancy: 5 persons
 Unit Density: 20 units/Ha.

Area of Segment: 16 Ha.

Area used in Calculation: 11.2 Ha.



**KIMATHI ESTATE
 LOCALITY SEGMENT:
 ACTUAL LAND UTILIZATION**

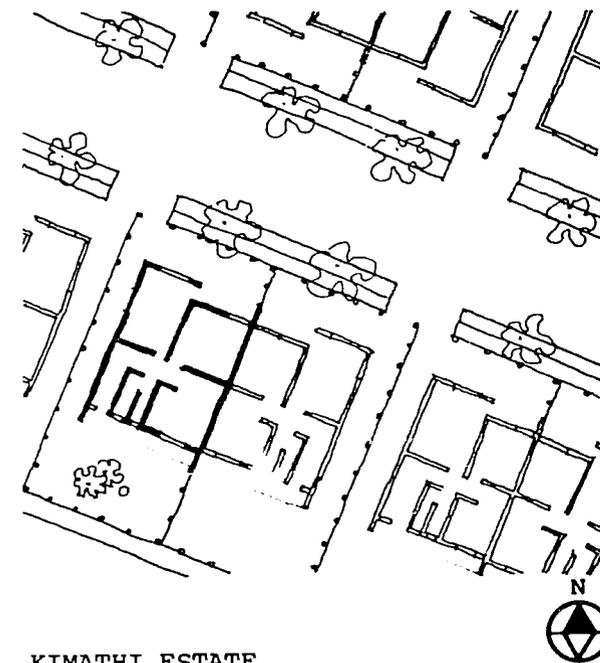


SCALE 1:2,500





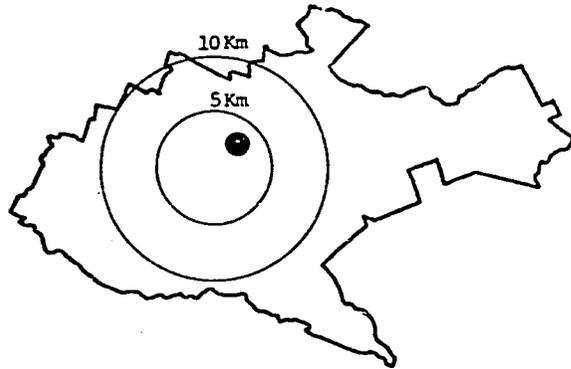
Typical dwelling in Kimathi Estate. Private spaces are fenced.



KIMATHI ESTATE
TYPICAL DWELLING

SCALE 1:500

7 VILLAGE I - SQUATTERS MATHARE VALLEY



LOCATION AND ORIGINS Village I is located 3 Km east of the central business district. It is bound by the Pangani residential district in the west, Mathare River in the north, St. Teresa's Girls School in the east and the company tenements in the south. The first record of squatters in Village I was made in 1921. The Mathare Valley had been subdivided in the 1910's and the owner of the site of Village I rented house lots to squatters. There were about 150 huts on the site when the colonial government in 1954 sent bulldozers to demolish them. After the Emergency, the squatters returned and in 1959 there were 9 structures in Village I. The new Independent Government attempted to eradicate the squatters without success. Today there are about 280 squatter dwellings in the village.



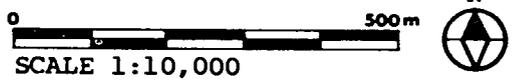
VILLAGE I - SQUATTERS
LOCALITY AIR PHOTOGRAPH

0 500m
SCALE 1:10,000





VILLAGE I - SQUATTERS
LOCALITY PLAN

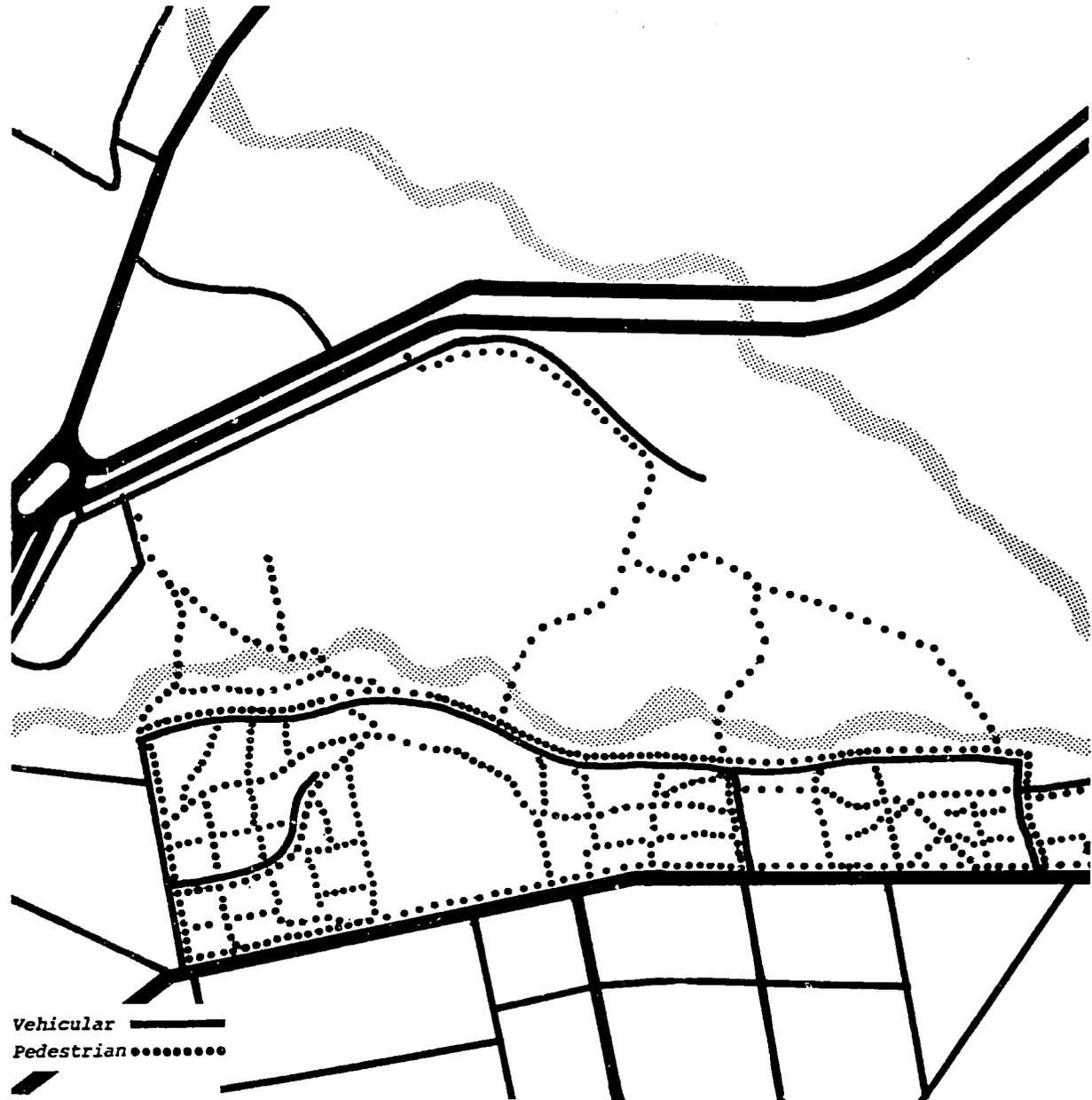


400m x 400m
Selected Segment

LAYOUT There is no planned layout. Dwellings were built close together in an irregular manner, though an access track cutting the village in half seems to have survived.

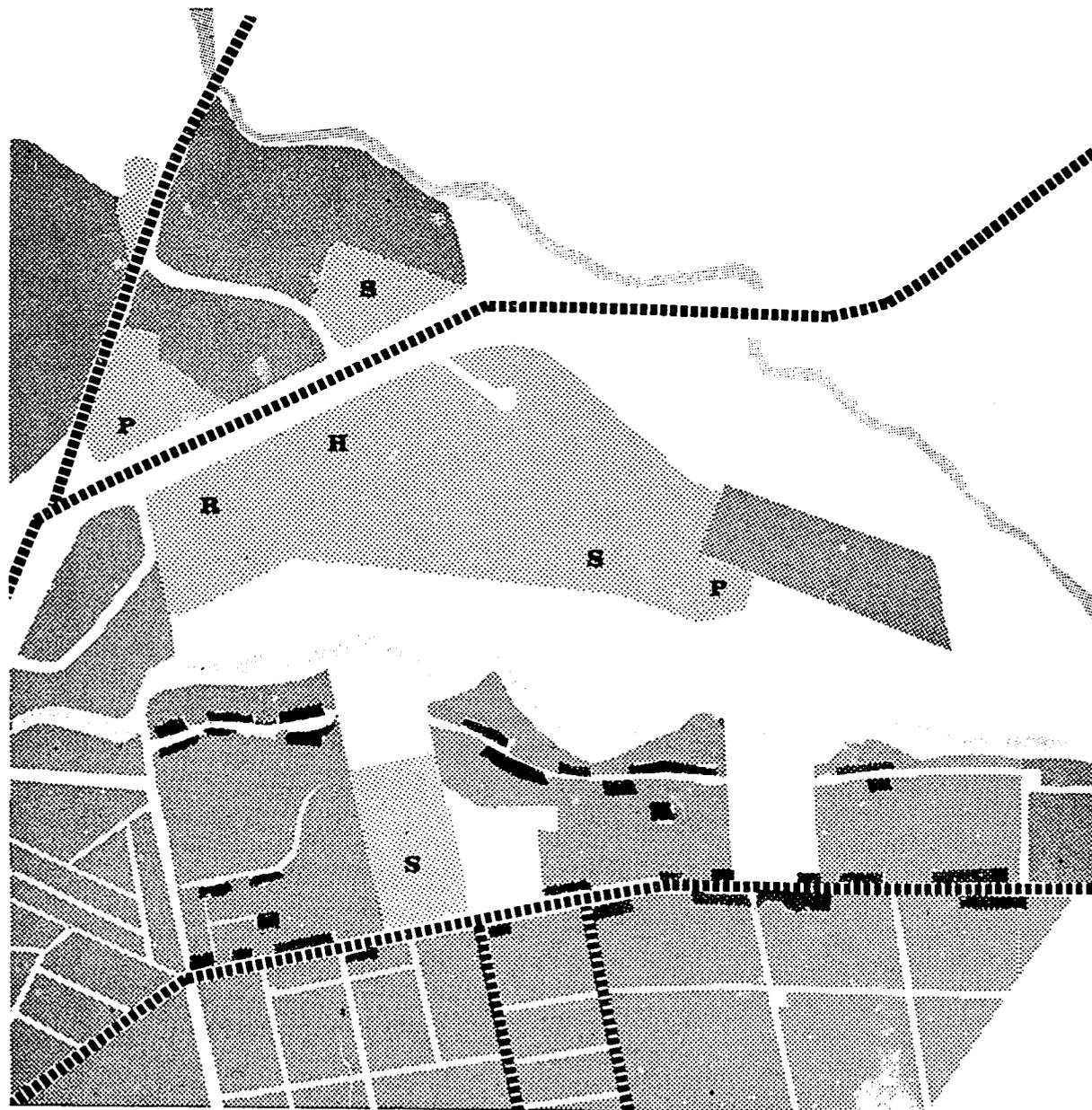
POPULATION/INCOMES The squatters in Village I numbered 4300 in 1970, mostly in the low income group.

CIRCULATION There is a surfaced road access through adjoining Pangani. The steep track from Juja Road can only be used in dry weather. Within the village a single street is suitable for vehicular traffic. The rest of the circulation is pedestrian. The bus route on Juja Road connects the village to the public transport network.



VILLAGE I - SQUATTERS
LOCALITY CIRCULATION DIAGRAM





LAND USE Predominantly residential with commercial stalls along the main street and a few scattered in other parts. There is also a school and a community hall, but no clinic or health facility. Cultivation takes place on the river bank and elsewhere outside the village.

- | | |
|---|--------------|
| C Community Center | S School |
| H Health | R Recreation |
| P Police | RL Religious |
|  Residential | |
|  Commercial/Industrial | |
|  Agricultural | |
|  Bus Route | |

VILLAGE I - SQUATTERS
LOCALITY LAND-USE PATTERN

0 500m
SCALE 1:10,000





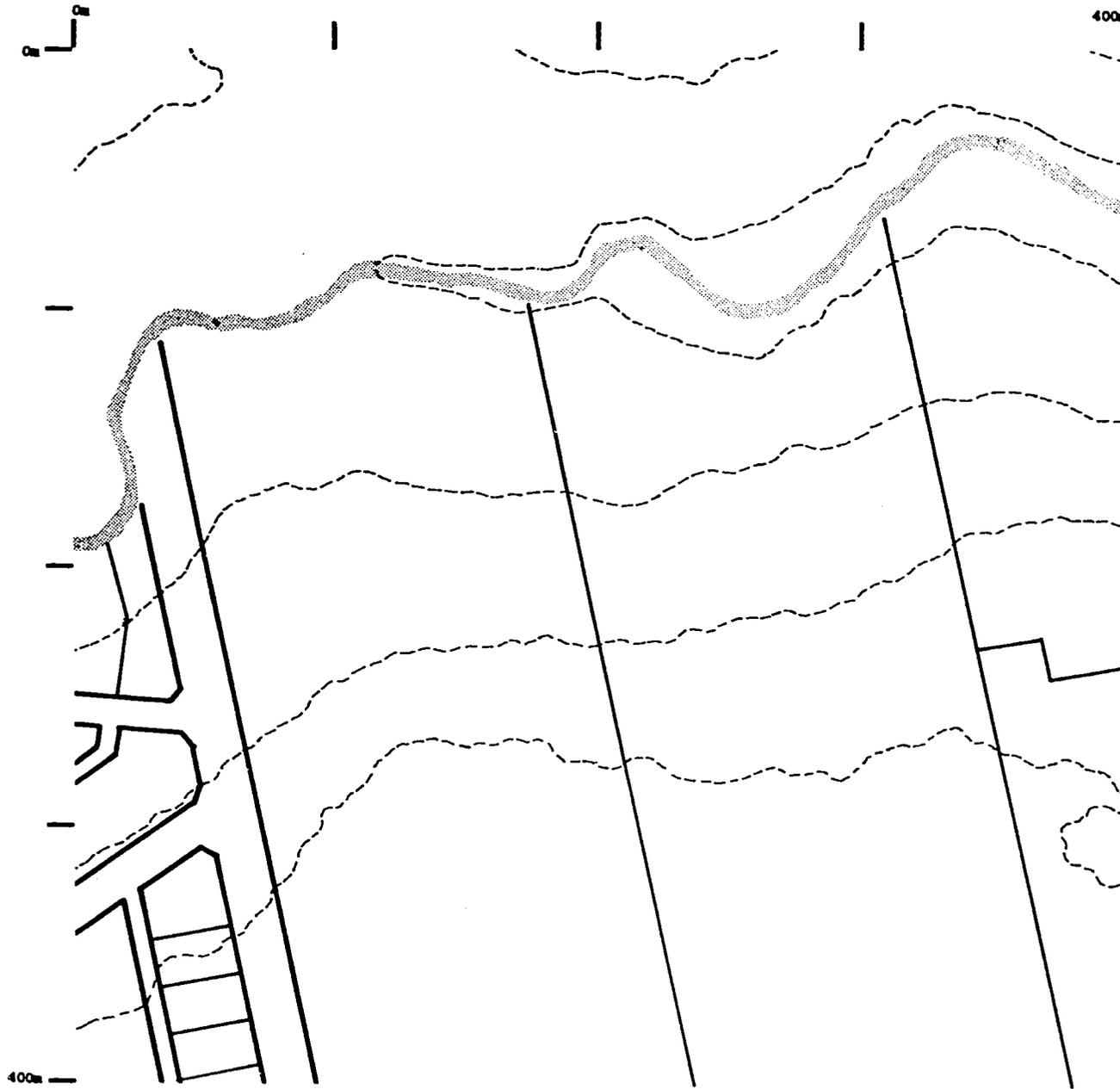
*Typical view of squatter dwellings
in Mathare Valley.*



VILLAGE I - SQUATTERS
LOCALITY SEGMENT:
AIR PHOTOGRAPH

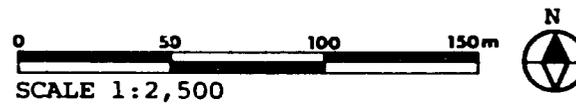
0 50 100 150m
SCALE 1:2,500





LOT LAYOUT Village I is an uncontrolled squatter settlement without a layout plan. Lots or recognized individual ownership of land are non-existent. The layout consists of private areas (the dwelling structures) and public/circulation areas (the open space). Circulation is random and entirely pedestrian dominated.

VILLAGE I - SQUATTERS
LOCALITY SEGMENT:
LOT LAYOUT

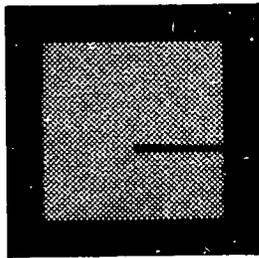


- No. of Lots: -
 - Lot Density: -
 - Av. Lot Dimensions: -
 - Av. Lot Area: -
 - Av. Lot Coverage: applicable.
 - Circulation Length: -
 - $\frac{\text{Circulation Length}}{\text{Area Served}}$: -
- Data for calculation of lot/circulation information not applicable.

ACTUAL LAND UTILIZATION The distribution of segment land utilization areas is:

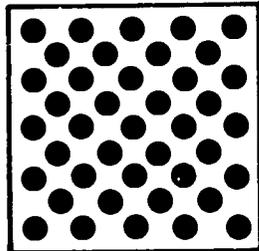
% Public - circulation : MEDIUM
 % Public - miscellaneous: NONE
 % Private : ACCEPTABLE

Population density : HIGH
 Dwelling unit density : VERY HIGH
 % Built-up coverage : VERY HIGH



LAND UTILIZATION DIAGRAM

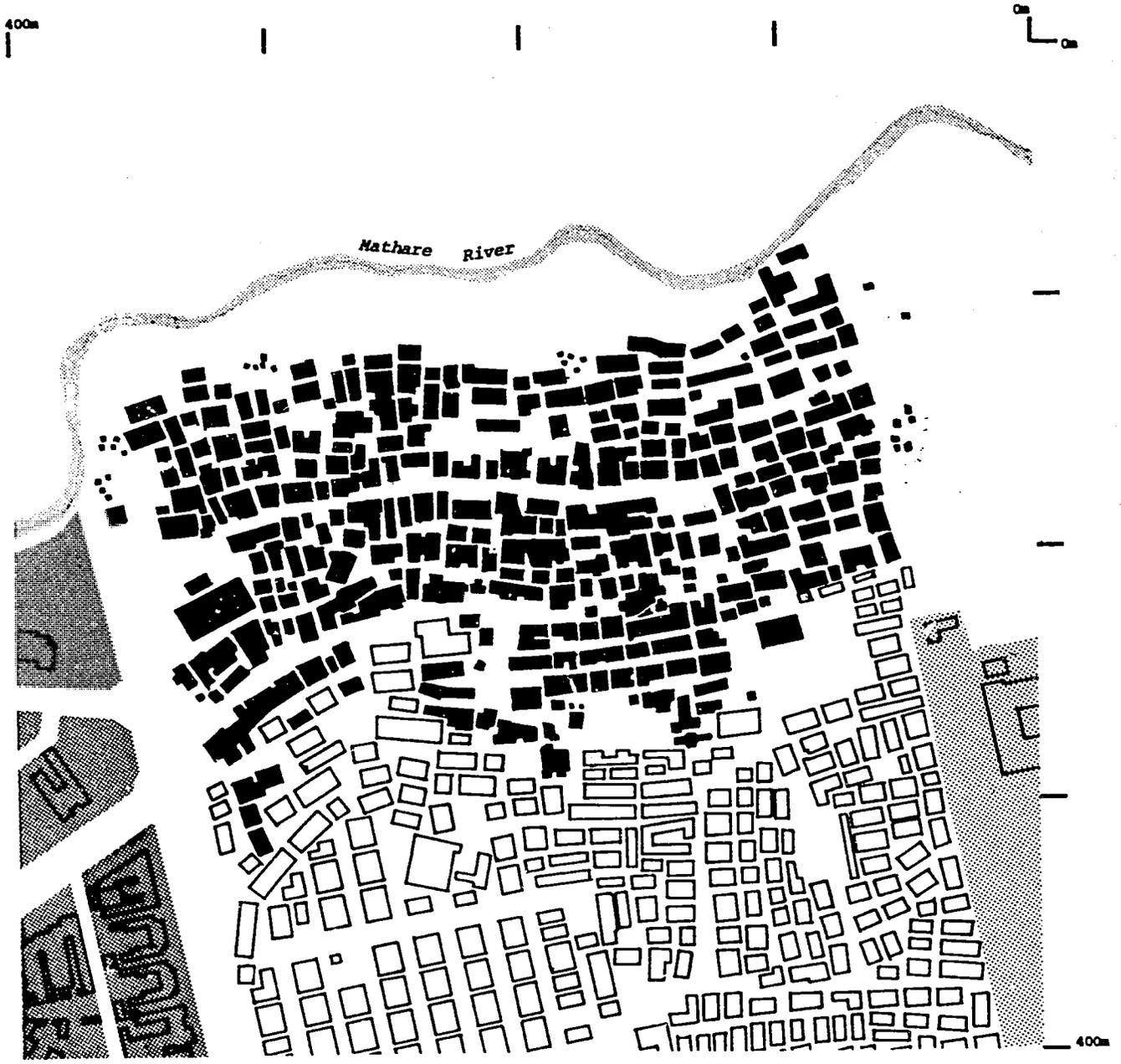
Circulation: 48%
 Private : 52%
 Public : -



DENSITY DIAGRAM

● 20 persons

Density: 819 persons/Ha.
 Population: 4,295 persons
 No. of Dwellings: 279 dwellings
 Average Dw. Area: 71.6 sq.m.
 Built-up Area: 38.1%
 No. of Dw. Units: 1227 units
 (Room Units): 1227 units
 (House Units): -
 Unit Occupancy: 3.8 persons
 Unit Density: 234.1 units/Ha.
 Area of Segment: 16 Ha.
 Area used in Calculation: 5.2 Ha.

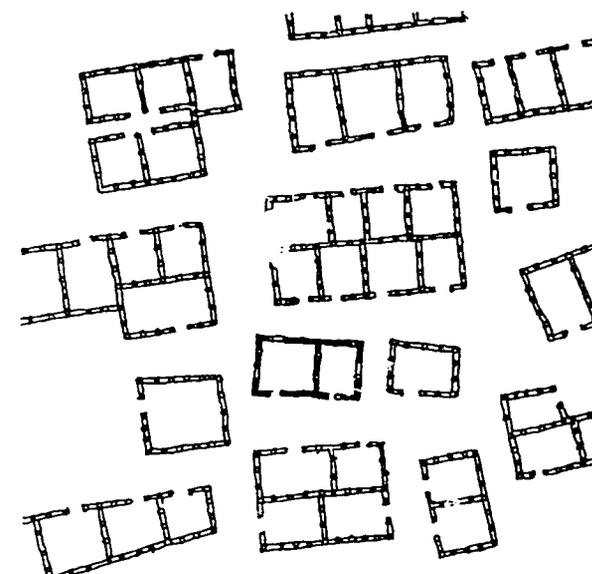


VILLAGE I - SQUATTERS
LOCALITY SEGMENT:
ACTUAL LAND UTILIZATION





Typical squatter dwellings, built close to each other. Construction is traditional with mud and wattle walls and hipped roofs made from discarded metal and cardboard.

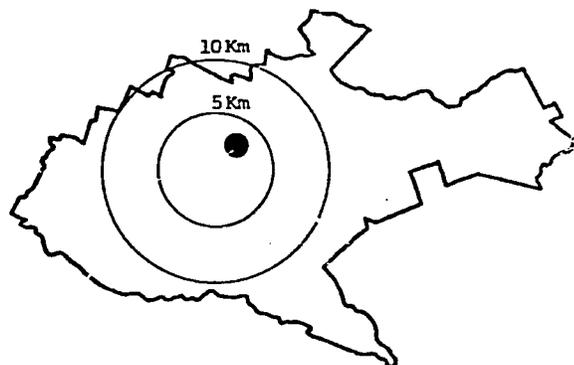


VILLAGE I - SQUATTERS
TYPICAL DWELLING



SCALE 1:500

8 VILLAGE I - TENEMENTS MATHARE VALLEY

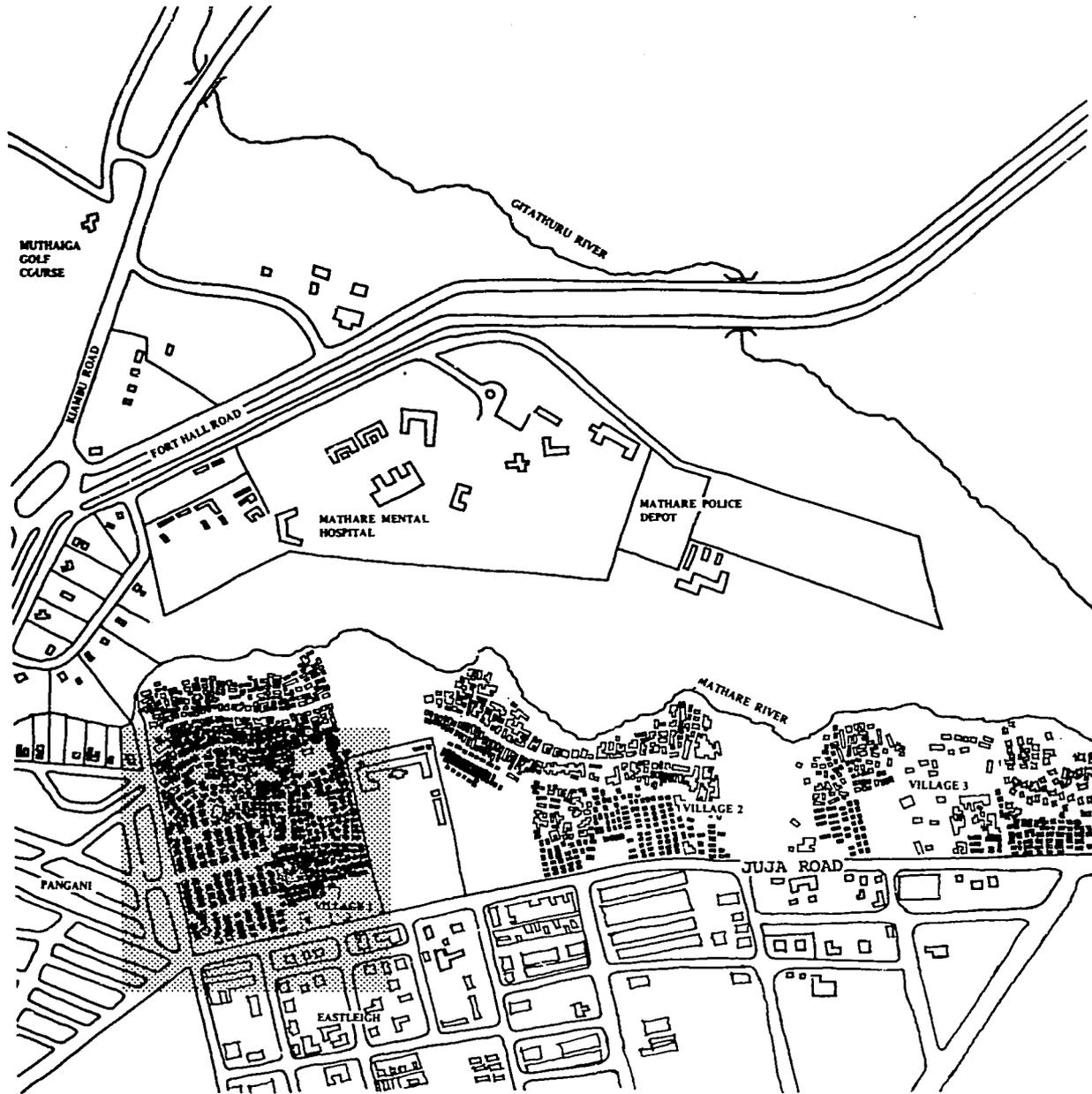


LOCATION AND ORIGIN Village I is located about 3 Km east of the central business district, along Juja Road at the western end of Mathare Valley. It is bound by the Pangani residential district in the west, by the squatters in the north, by St. Teresa's Girls School in the east and by Juja Road in the south. In 1965 local residents' associations or 'companies' began to form in Mathare to purchase land from the Asian owners and develop new houses. The two companies in Village I filled up the vacant land south of the squatters with timber 'barracks' between February 1970 and November 1970 when the government halted their activities. In 1972 the government decided to acquire all land with the intention of installing services and leasing back to the original companies.



VILLAGE I - TENEMENTS
LOCALITY AIR PHOTOGRAPH

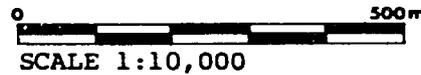




LAYOUT There was no formal subdivision into lots. The western half of the site has a housing layout consisting of three access roads and a constant distance between rows of buildings. The development in the eastern half is disorderly with no access provided for vehicles.

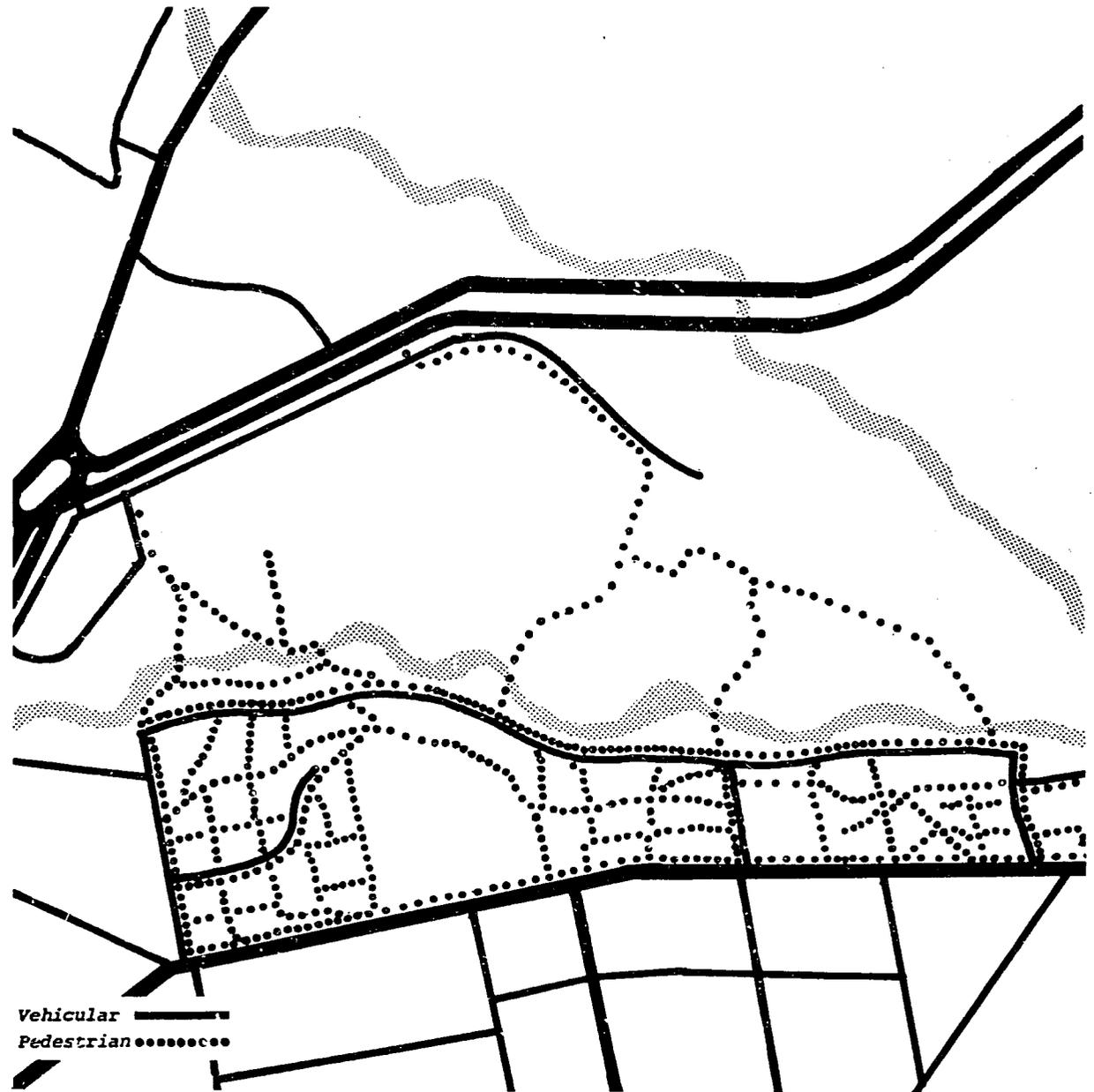
POPULATION/INCOMES The company tenement population in Village I numbered 13,200 in 1970, predominantly in the low income sector.

VILLAGE I - TENEMENTS
LOCALITY PLAN

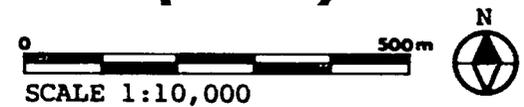


400m x 400m
Selected Segment

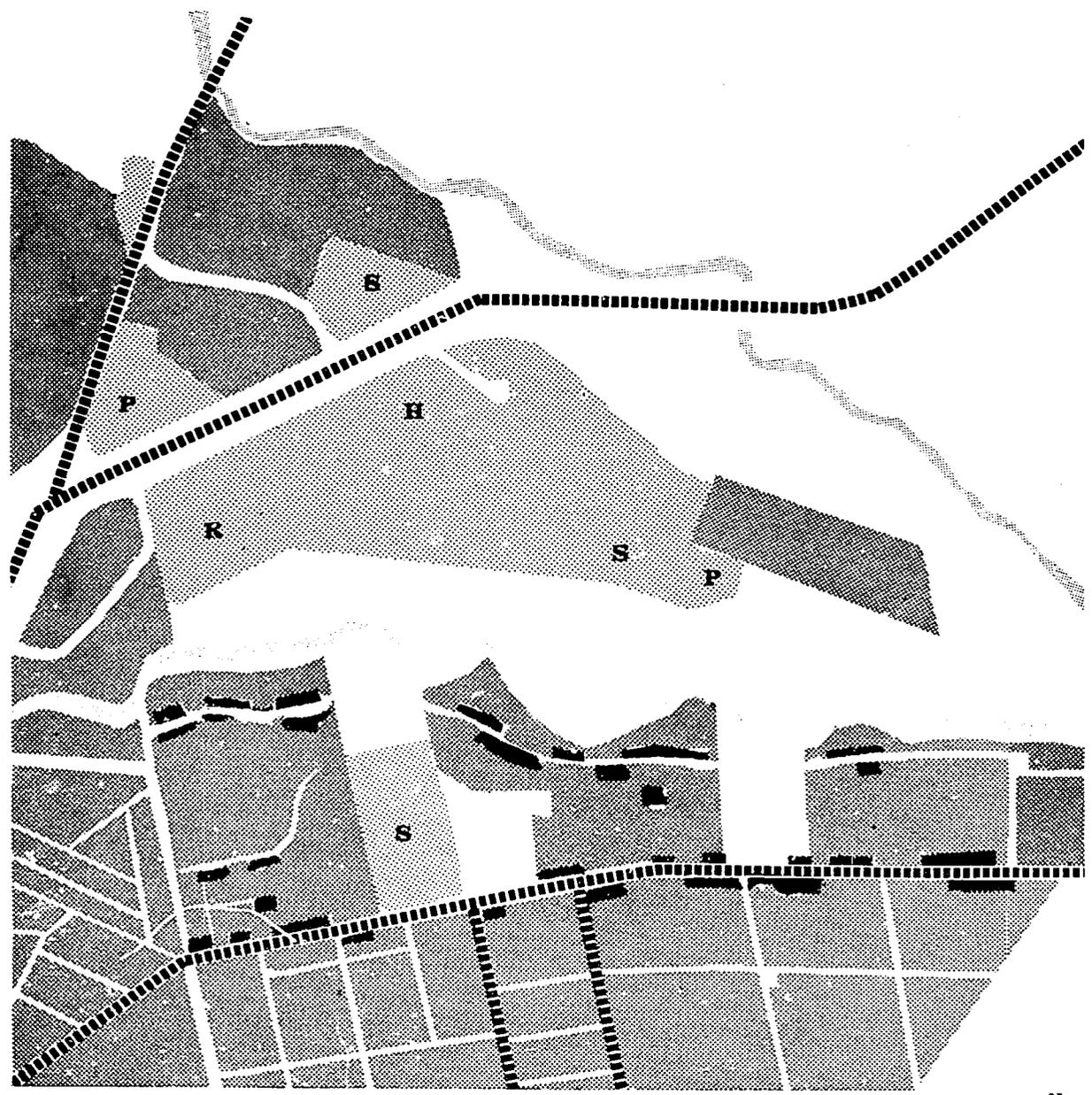
CIRCULATION There is only one usable cul-de-sac automobile access to the village. The rest of the area is served only by pedestrian paths. The bus route on adjoining Juja Road connects the village to the city public transport network.



VILLAGE I - TENEMENTS
LOCALITY CIRCULATION DIAGRAM



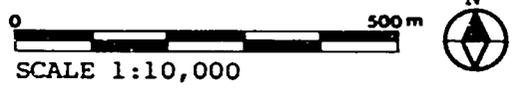
LAND USE Predominantly residential with commercial activity along Juja Road and the access track. There are no public utilities. The services provided by the companies are not adequate.



- C Community Center
- H Health
- P Police
- S School
- R Recreation
- RL Religious

-  Residential
-  Commercial/Industrial
-  Agricultural
-  Bus Route

VILLAGE I - TENEMENTS
LOCALITY LAND-USE PATTERN





Single-room tenements built by the recently established Mathare companies.



VILLAGE I - TENEMENTS
LOCALITY SEGMENT:
AIR PHOTOGRAPH

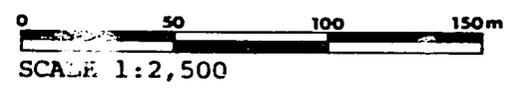
0 50 100 150m
SCALE 1:2,500





LOT LAYOUT The 'new tenement' development of Mathare Valley is basically dwelling structures built on a large parcel of land owned by a cooperative company. Units are rented. Therefore the area is not subdivided into lots. All open space is public and serves both as circulation as well as for the extension of living activities not performed in the small single room units. The arrangement of the dwelling structure determines the organization of the circulation layout.

VILLAGE I - TENEMENTS
LOCALITY SEGMENT:
LOT LAYOUT

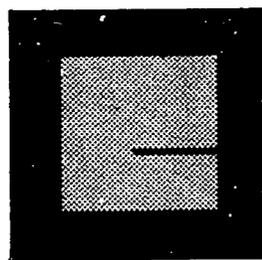


- No. of Lots:
- Lot Density:
- Av. Lot Dimensions:
- Av. Lot Area: Data for calculation of lot/ circulation information not applicable.
- Av. Lot Coverage:
- Circulation Length:
- Circulation Length / Area Served

ACTUAL LAND UTILIZATION The distribution of segment land utilization areas is:

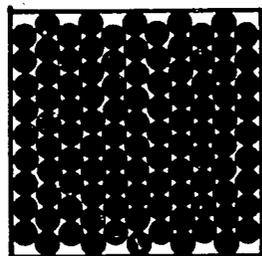
% Public - circulation : HIGH
 % Public - miscellaneous: NONE
 % Private : ACCEPTABLE

Population density : VERY HIGH
 Dwelling unit density : VERY HIGH
 % Built-up coverage : VERY HIGH



LAND UTILIZATION DIAGRAM

Circulation: 60%
 Private : 40%
 Public : -



DENSITY DIAGRAM

● 20 persons

Density: 1859 persons/Ha.
 Population: 13,200 persons
 No. of Dwellings: 389 dwellings
 Average Dw. Area: 72 sq. m.
 Built-up Area: 39.4%
 No. of Dw. Units: 3003 units
 (Room Units): 3003 units
 (House Units): -
 Unit Occupancy: 4.4 persons
 Unit Density: 422.9 units/Ha.

Area of Segment: 16 Ha.

Area used in
 Calculation: 7.1 Ha

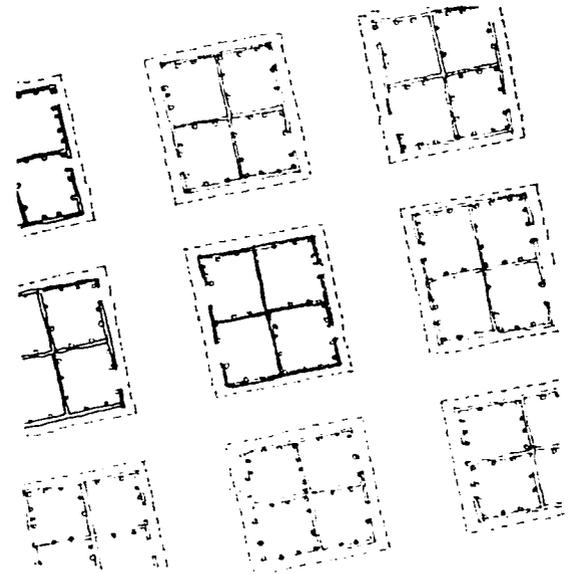


VILLAGE I - TENEMENTS
 LOCALITY SEGMENT:
 ACTUAL LAND UTILIZATION





Typical barracks of company tenements in Mathare. Construction is simple and cheap, with timber and corrugated iron sheeting.

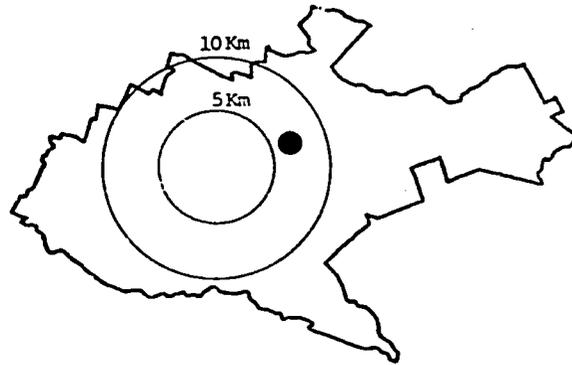


VILLAGE I - TENEMENTS
TYPICAL DWELLING



SCALE 1:500

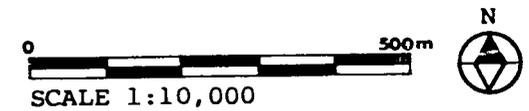
9 MATHARE REDEVELOPMENT



LOCATION AND ORIGIN The Mathare Redevelopment Scheme is located 7 Km east of the central business district, at the eastern end of Mathare Valley. The scheme was first proposed in 1969 as a way to deal with the Mathare squatter settlements. It is currently under construction.

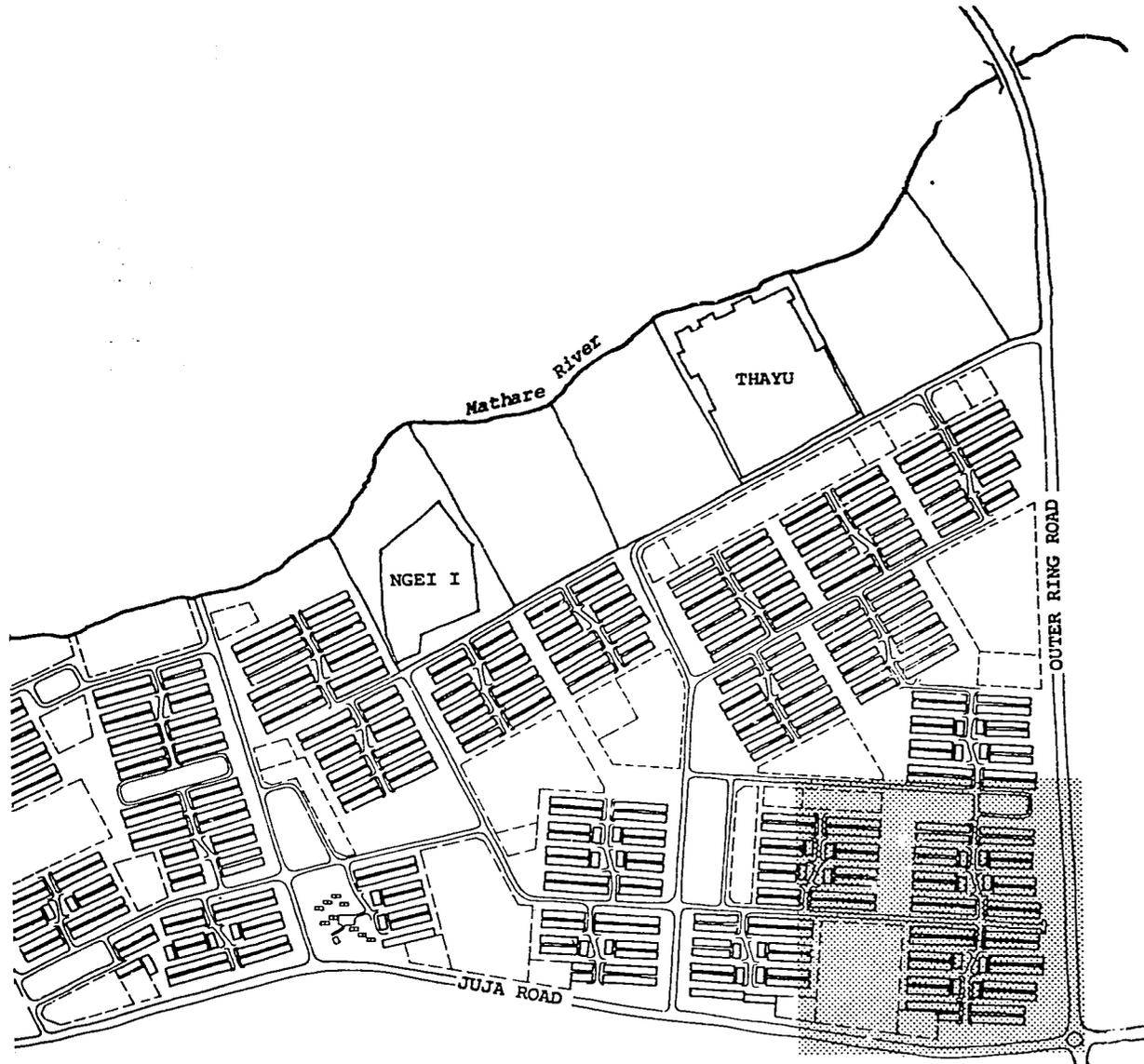


MATHARE REDEVELOPMENT
LOCALITY AIR PHOTOGRAPH



LAYOUT The layout was designed by the Nairobi City Council and has undergone several revisions. The plan called for the development of about 2500 site-and-service and core housing lots, of 126 sq.m. Rows of lots are laid out back to back, with service alleys and automobile access is proposed for every lot.

POPULATION/INCOME The proposed population for the scheme is 15,000, mainly in the low income sector.

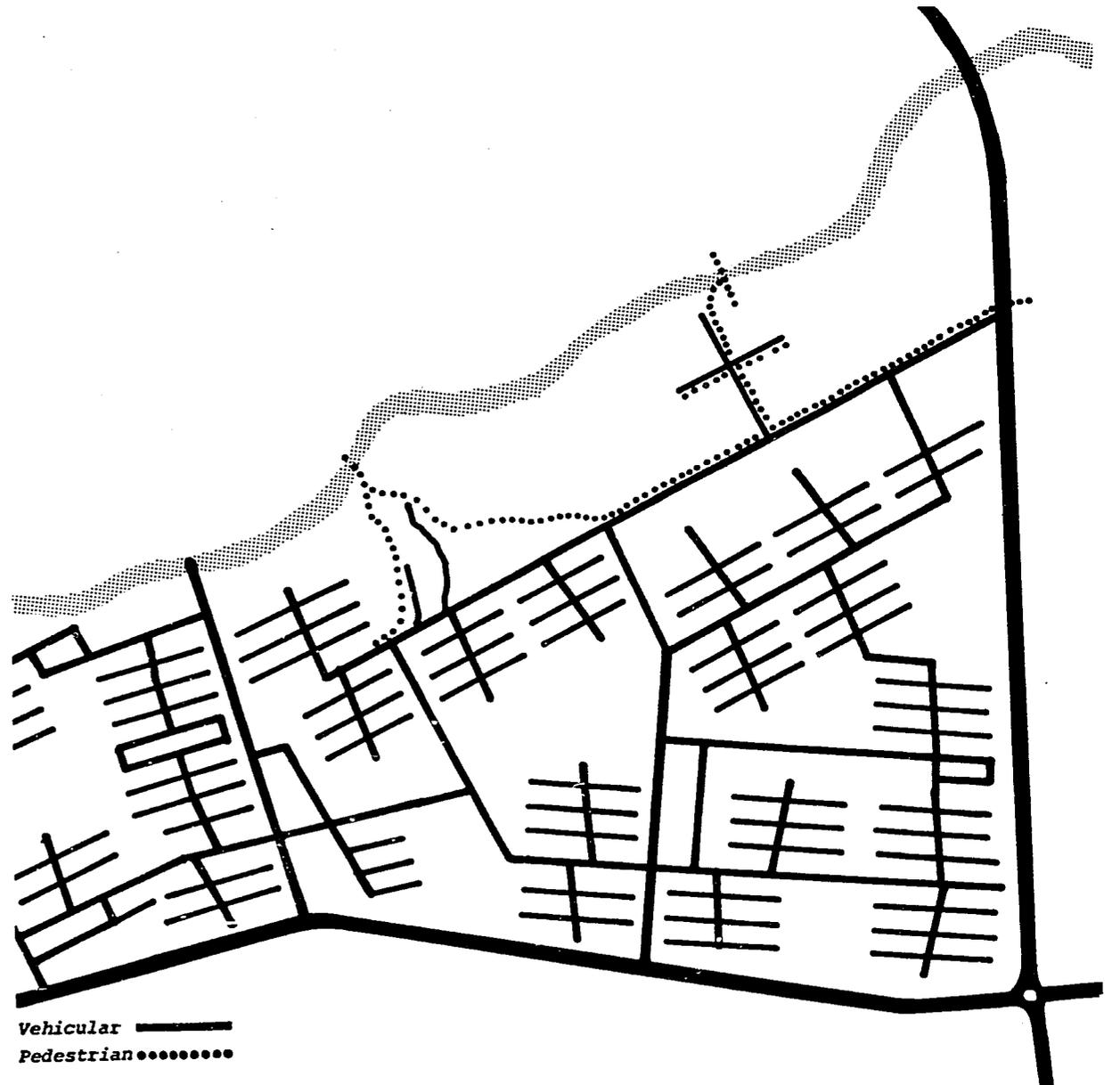


**MATHARE REDEVELOPMENT
LOCALITY PLAN**



400m x 400m
Selected Segment

CIRCULATION There are three categories of roads in the plan: main roads, lot-access roads, and service lanes. No specific walkways are indicated for pedestrians. There is a bus route on Ring Road and Juja Road which could serve the scheme.



MATHARE REDEVELOPMENT
LOCALITY CIRCULATION DIAGRAM



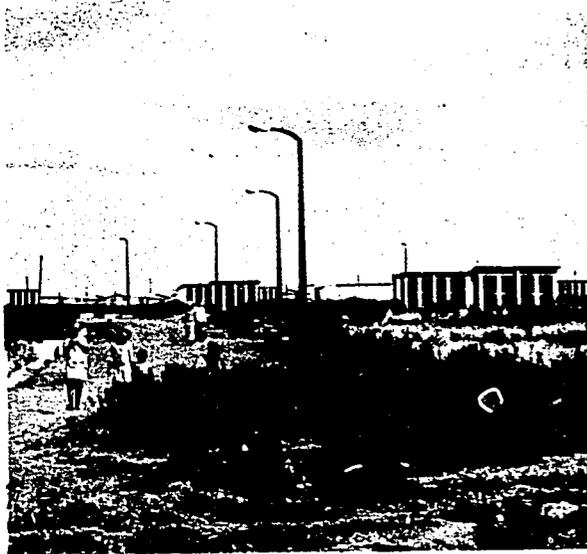
LAND USE According to the plan, about 25% of the area is residential; about 15% public - schools, clinics, markets; and the rest 60% is taken by circulation.



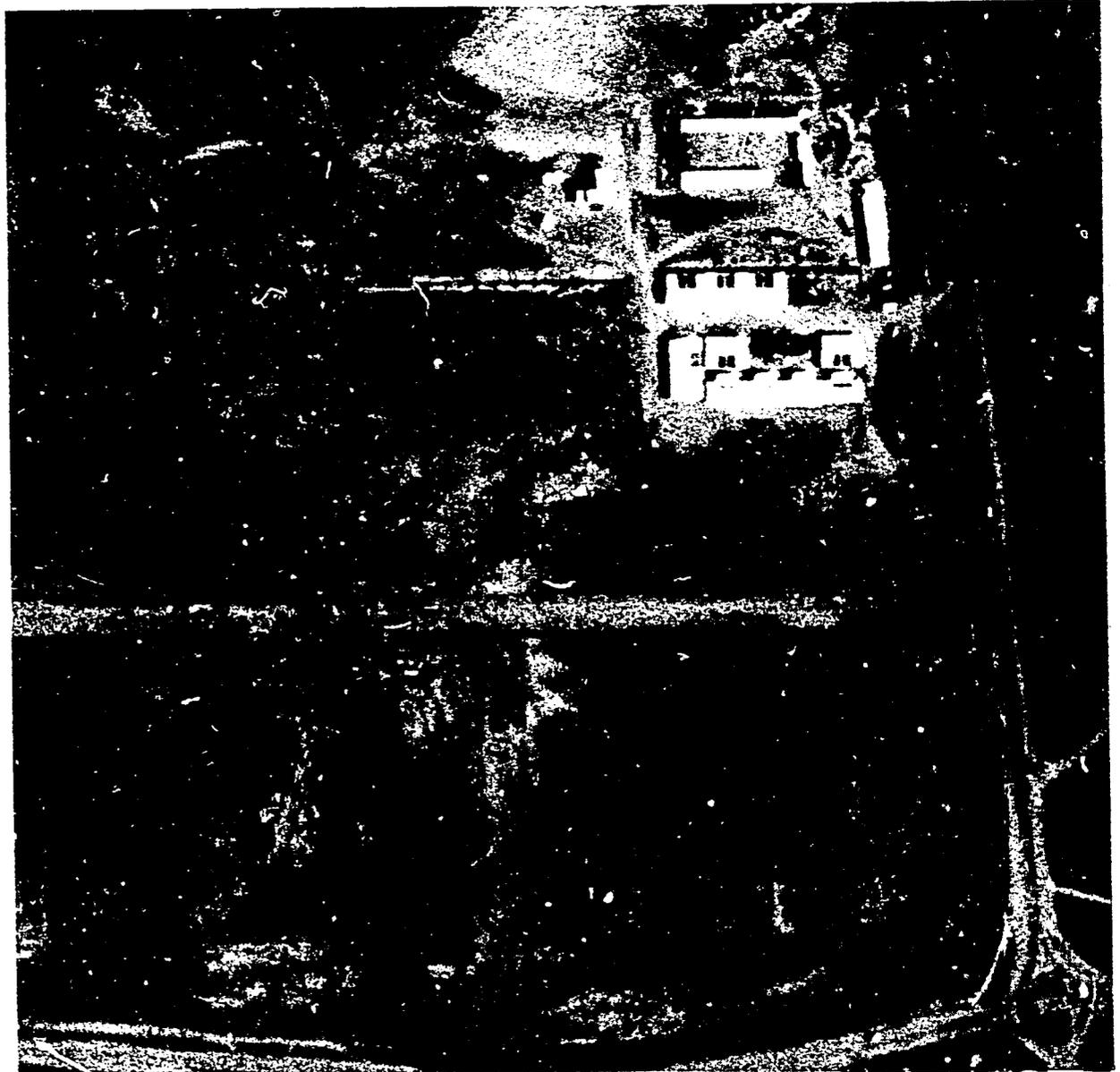
- | | |
|---|---------------------|
| C Community Center | S School |
| H Health | R Recreation |
| P Police | RL Religious |
|  Residential | |
|  Commercial/Industrial | |
|  Agricultural | |
|  Bus Route | |

**MATHARE REDEVELOPMENT
LOCALITY LAND-USE PATTERN**

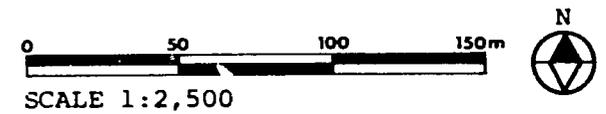
0 500 m
SCALE 1:10,000



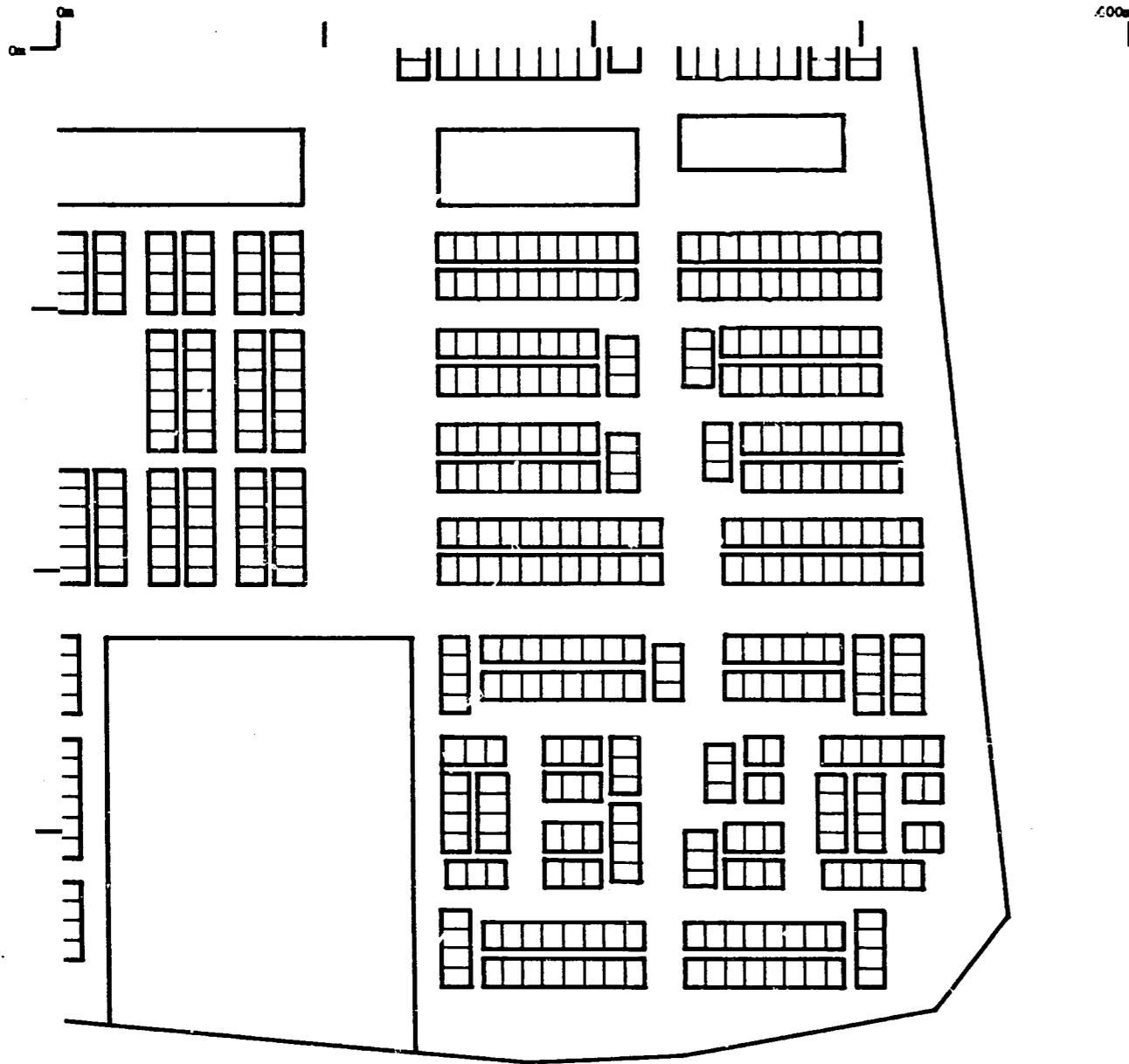
*Complete three-room core units
(above) and site-and-service lots
with the toilet/shower units (below)*



MATHARE REDEVELOPMENT
LOCALITY SEGMENT:
AIR PHOTOGRAPH



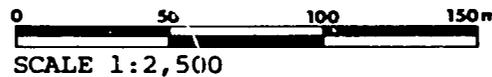
SCALE 1:2,500



LOT LAYOUT This layout is designed specifically to meet the needs of housing a large number of low income families in what is called 'site-and-service' and 'core/shell' plans. The layout concept is basically a modified gridiron (re: survey 5, Eastleigh). The lots are small (1:2) and serviced from 2-3 sides. The extremely high ratio of circulation length and area served accounts for minimal layout efficiency irrespective of the narrow (7.5m) lot frontage and acceptable density.

No. of Lots: 413 lots
 Lot Density: 29.5 lots/Ha.
 Av. Lot Dimensions: 7.5m x 11.5m
 Av. Lot Area: 86.3 sq.m.
 Av. Lot Coverage: 53% of lot
 Circulation Length: 3,593 m.
Circulation Length
Area Served: 470 m/Ha.

MATHARE REDEVELOPMENT
 LOCALITY SEGMENT:
 LOT LAYOUT



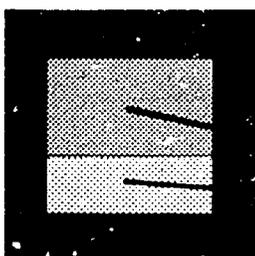
400m

400m

ACTUAL LAND UTILIZATION The distribution of segment land utilization areas is:

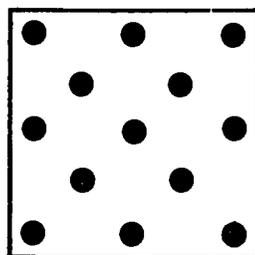
% Public - circulation : HIGH
 % Public - miscellaneous: VERY HIGH
 % Private : LOW

Population density : MEDIUM
 Dwelling unit density : HIGH
 % Built-up coverage : LOW



LAND UTILIZATION DIAGRAM

Circulation: 61%
 Private : 25%
 Public : 16%



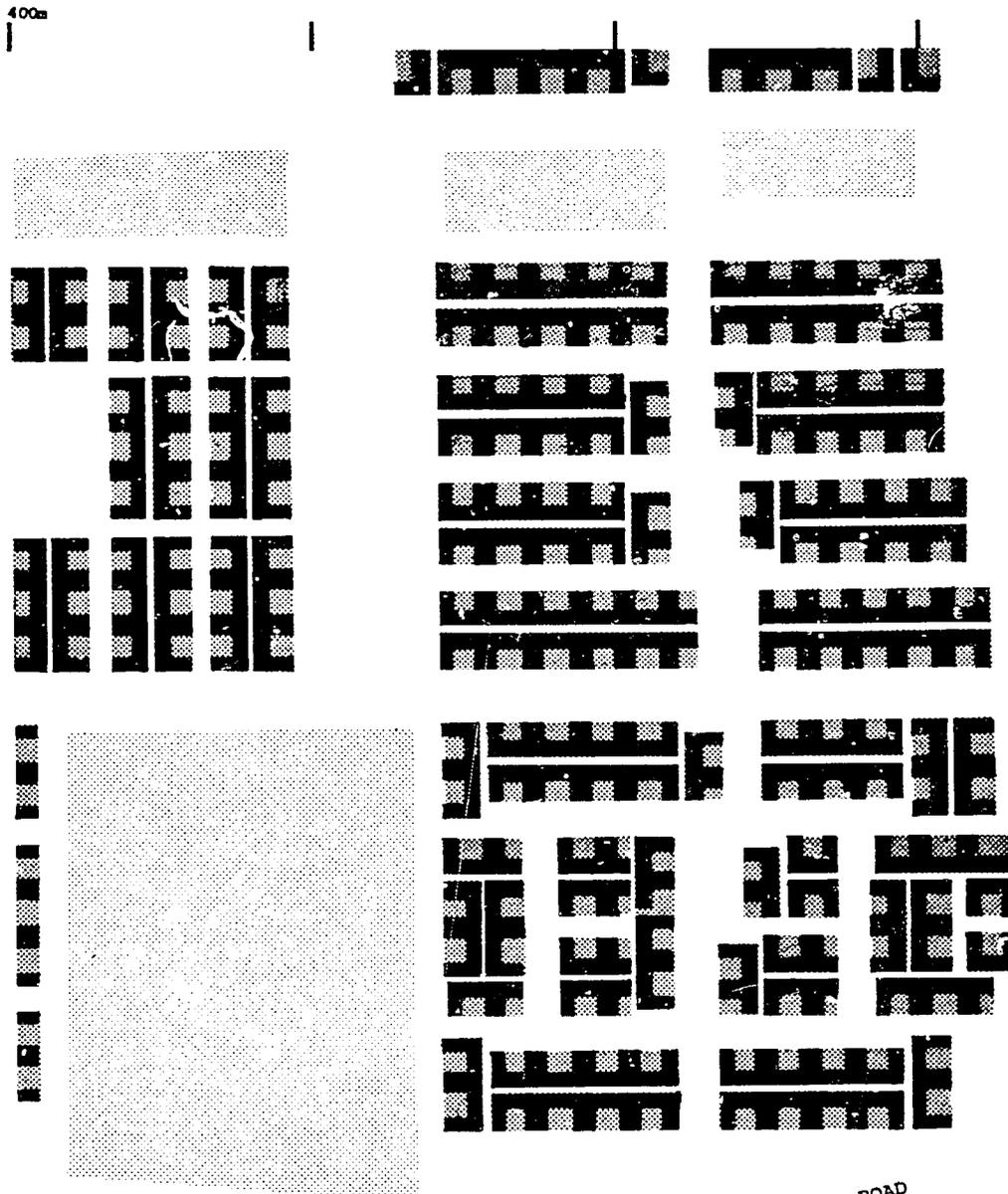
DENSITY DIAGRAM

● 20 persons

Density: 262 persons/Ha.
 Population: 3,717 persons
 No. of Dwellings: 413 dwellings
 Average Dw. Area: 45.8 sq.m.
 Built-up Area: 13%
 No. of Dw. Units: 1239 units
 (Room Units): 1239 units
 (House Units): -
 Unit Occupancy: 3 persons
 Unit Density: 87 units/Ha.

Area of Segment: 16 Ha.
 Area used in Calculation: 16 Ha.

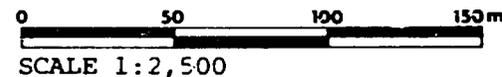
400m



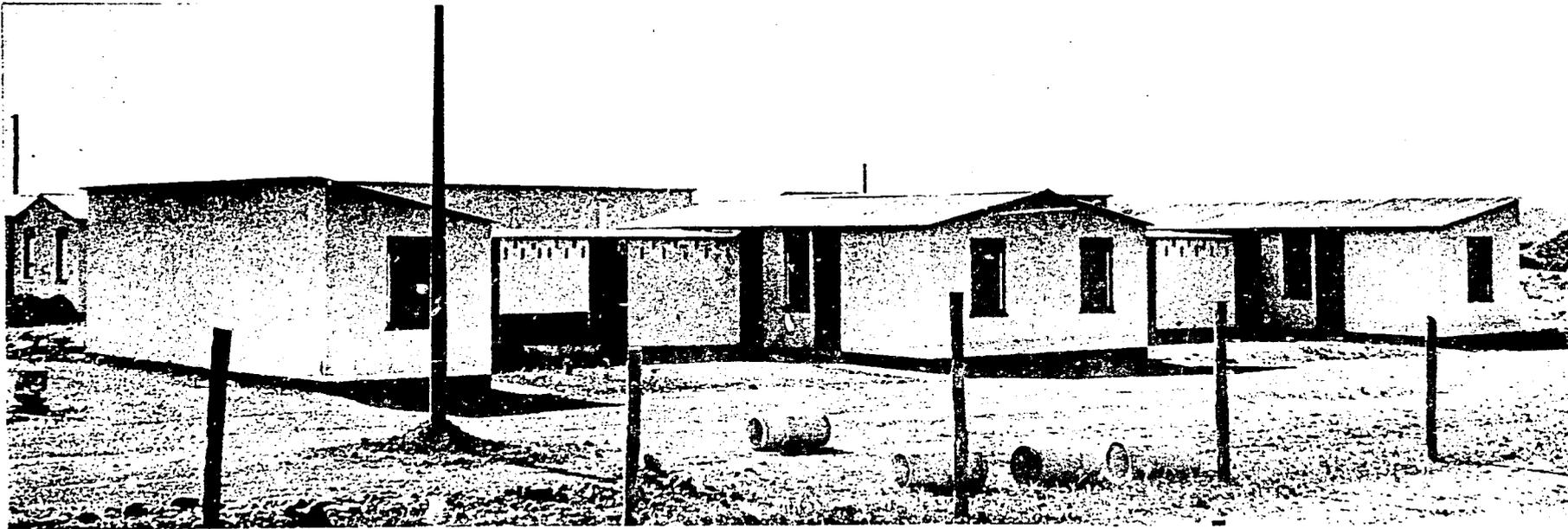
MATHARE REDEVELOPMENT
 LOCALITY SEGMENT:
 ACTUAL LAND UTILIZATION

JUJA ROAD

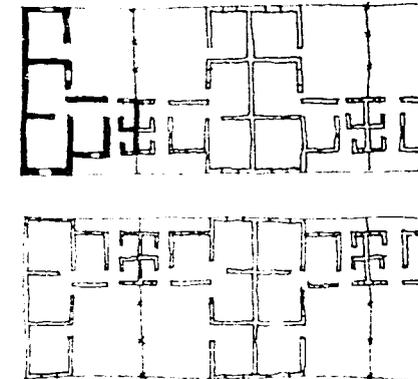
OUTER RING ROAD



400m



*Typical units in the Mathare Redevelopment Scheme.
Excessive circulation and utilities.*

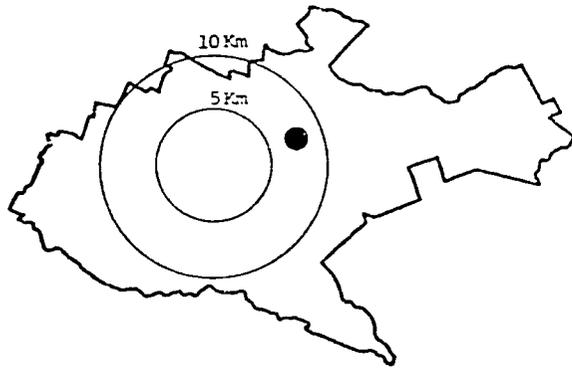


MATHARE REDEVELOPMENT
TYPICAL DWELLING



SCALE 1:500

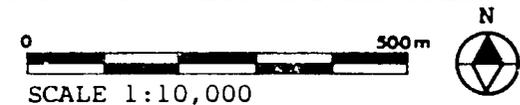
10 KARIOBANGI

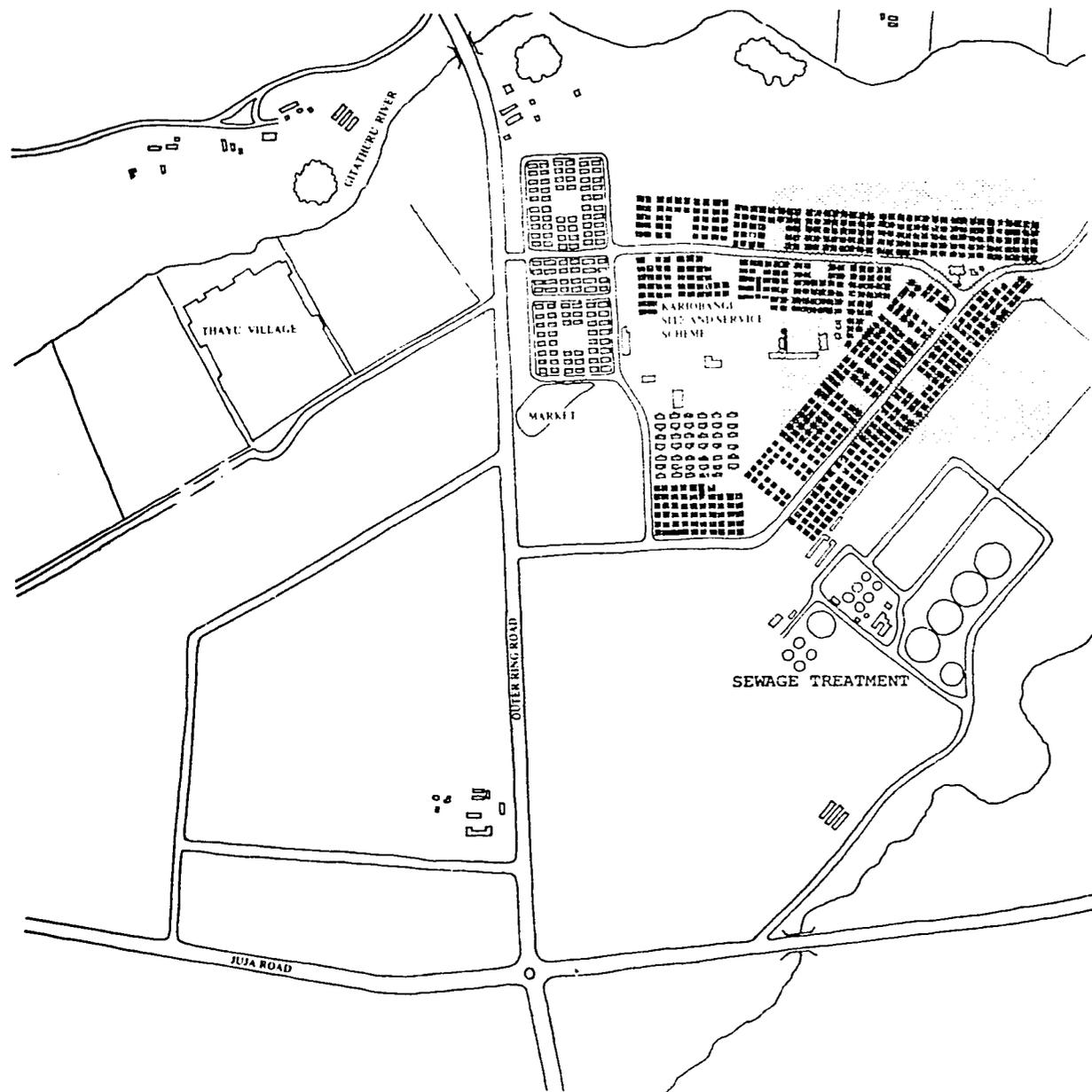


LOCATION AND ORIGINS Kariobangi is located about 7 Km east of the central business district. In 1954 Kariobangi was suggested as the site-and-service project to solve Nairobi's squatting problems (Working Party on Illegal Squatting). The project was begun in 1964 and completed in four stages, on land granted by the Government to the Nairobi City Council on a 99 year lease.



KARIOBANGI
LOCALITY AIR PHOTOGRAPH



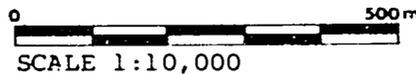


LAYOUT The site layout was designed by the Nairobi City Council's Engineer's Department and consists of 723 lots of 167 sq.m. allocated on 10 or 15 year leases. Groups of four lots share a service block with toilets, water points and wash slabs. Blocks of lots are laid out uniformly on both sides of the loop access road connecting with the Outer Ring Road. The layout was determined by the services network.

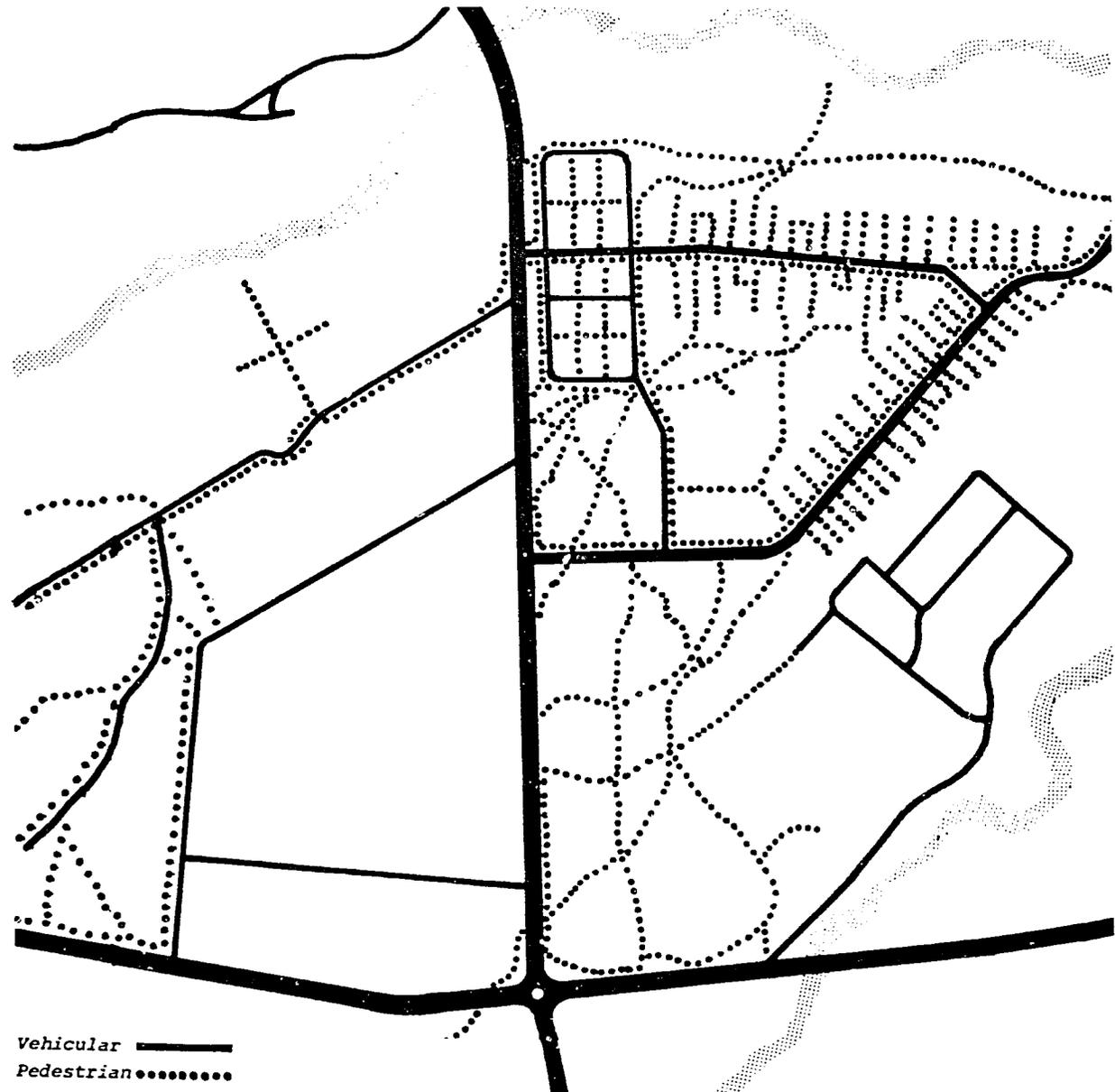
POPULATION/INCOMES The Kariobangi site-and-service scheme had a population of 12,000 in 1969, with predominantly low incomes.

400m x 400m
Selected Segment

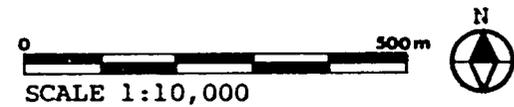
**KARIOBANGI
LOCALITY PLAN**



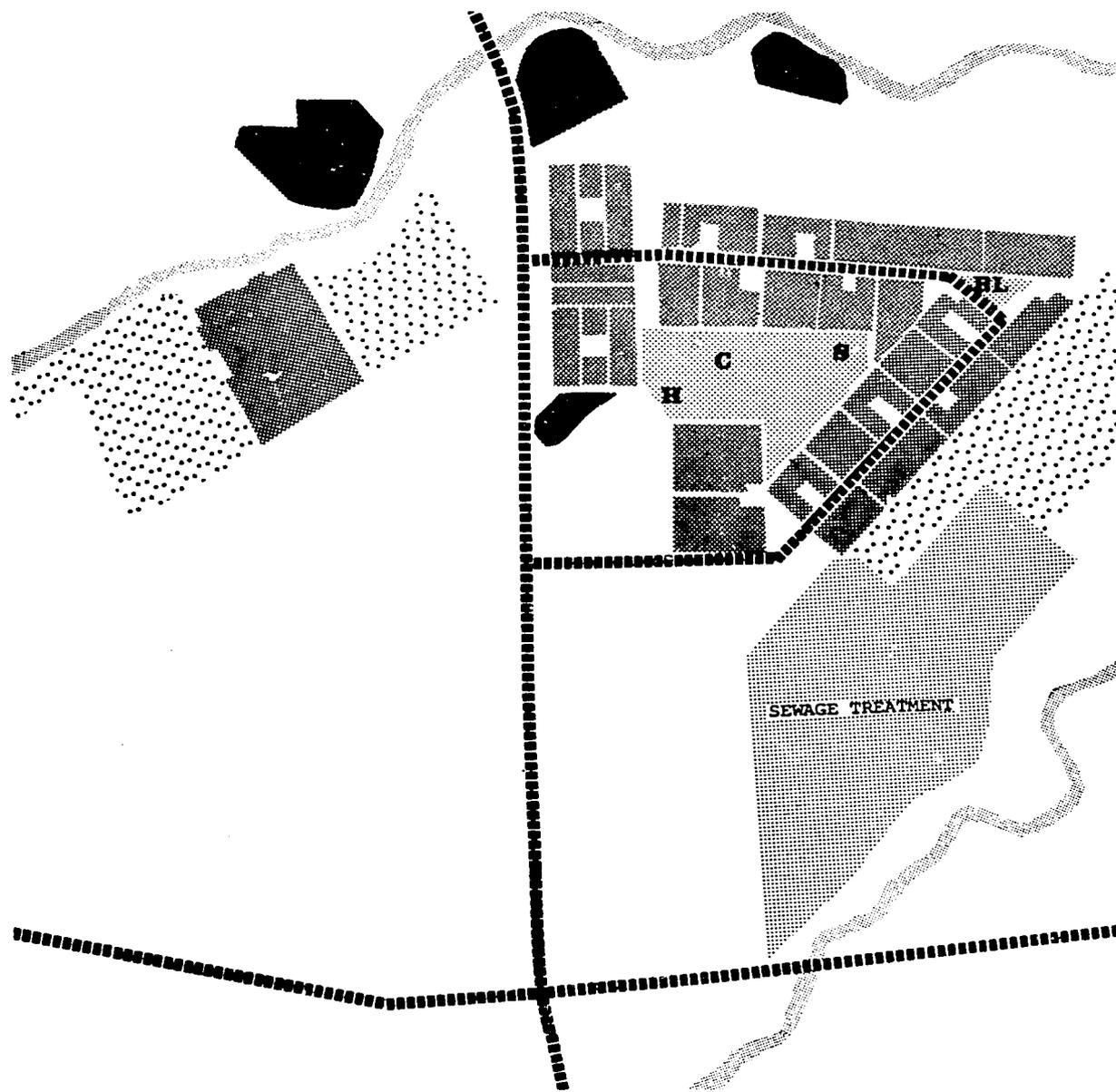
CIRCULATION There is a single loop street for vehicular traffic. All lots are served by pedestrian walkways, inaccessible to vehicles in most cases. The bus route on Outer Ring Road makes a detour into Kariobangi with several stops.



KARIOBANGI
LOCALITY CIRCULATION DIAGRAM



LAND USE Nearly 25% of the area is occupied by the dwellings; about 60% is taken by circulation which includes unbuilt portions of private lots; and the rest goes to public facilities and open space. The area is relatively well served by public utilities and services.

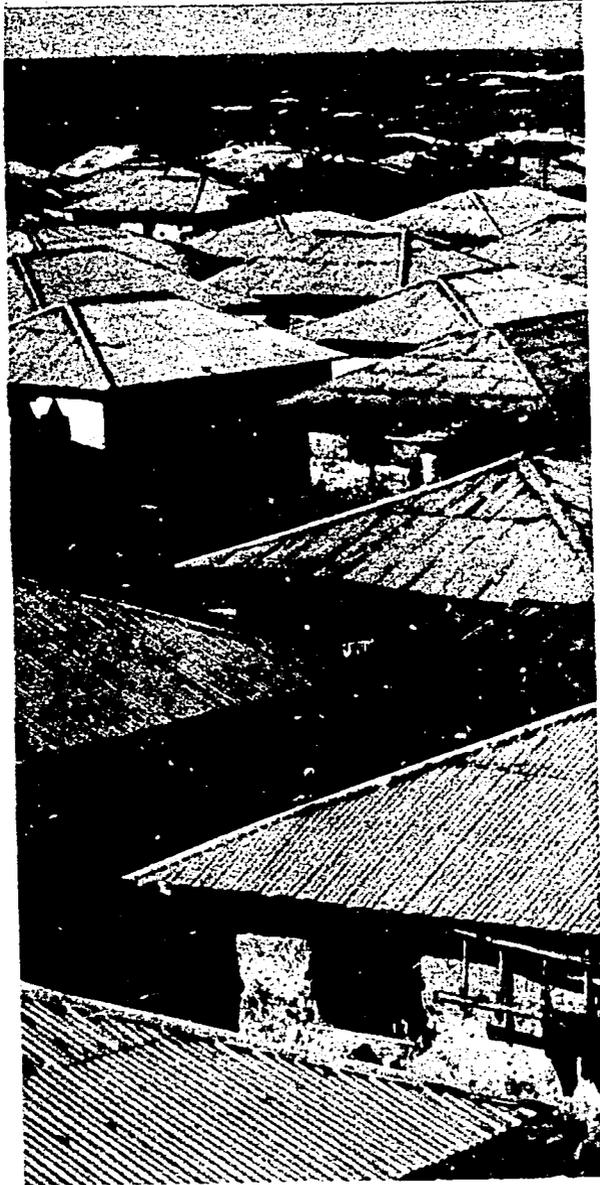


- | | |
|---|---------------------|
| C Community Center | S School |
| H Health | R Recreation |
| P Police | RL Religious |
|  Residential | |
|  Commercial/Industrial | |
|  Agricultural | |
|  Bus Route | |

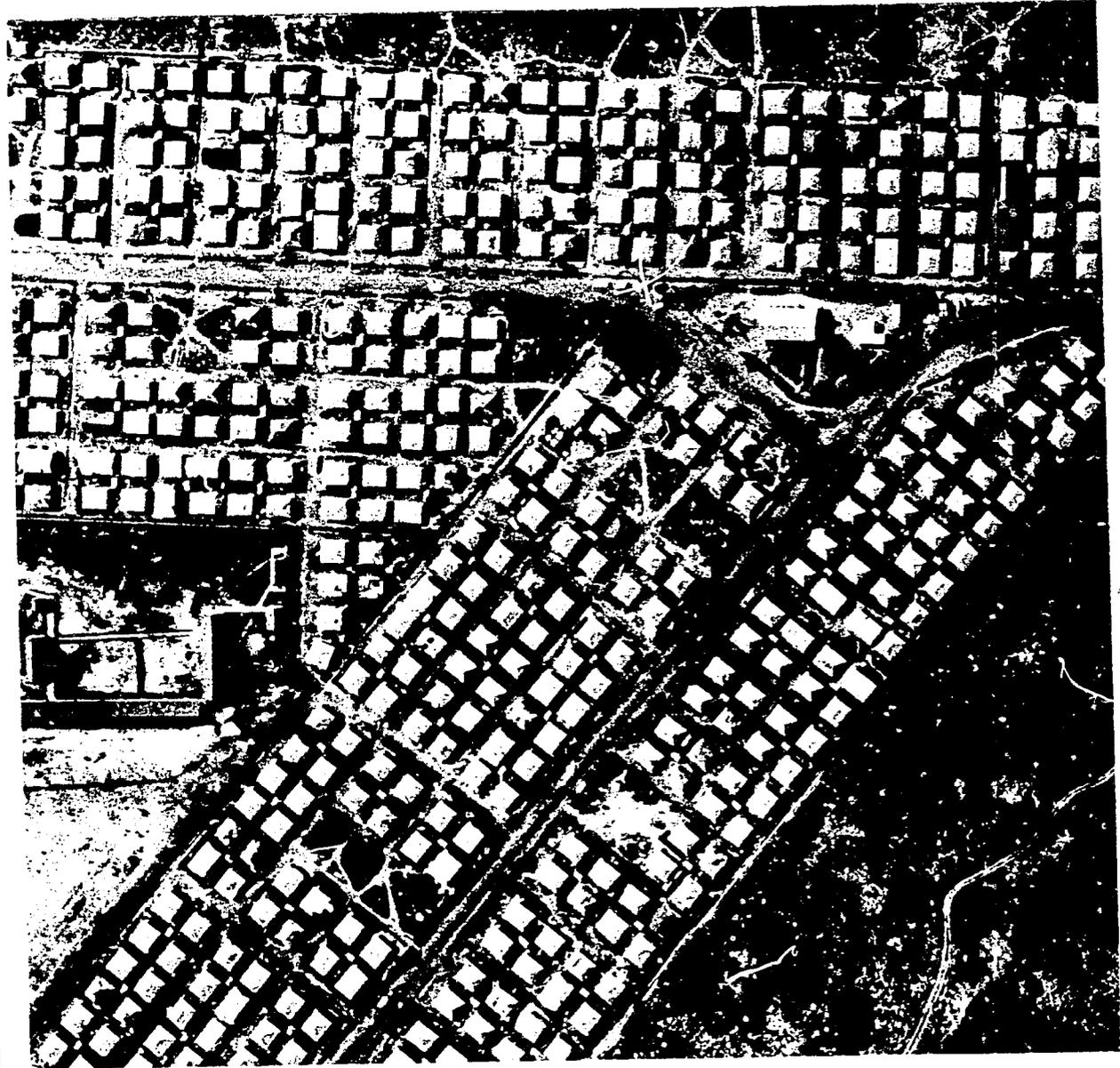
**KARIOBANGI
LOCALITY LAND-USE PATTERN**

0 500m
SCALE 1:10,000





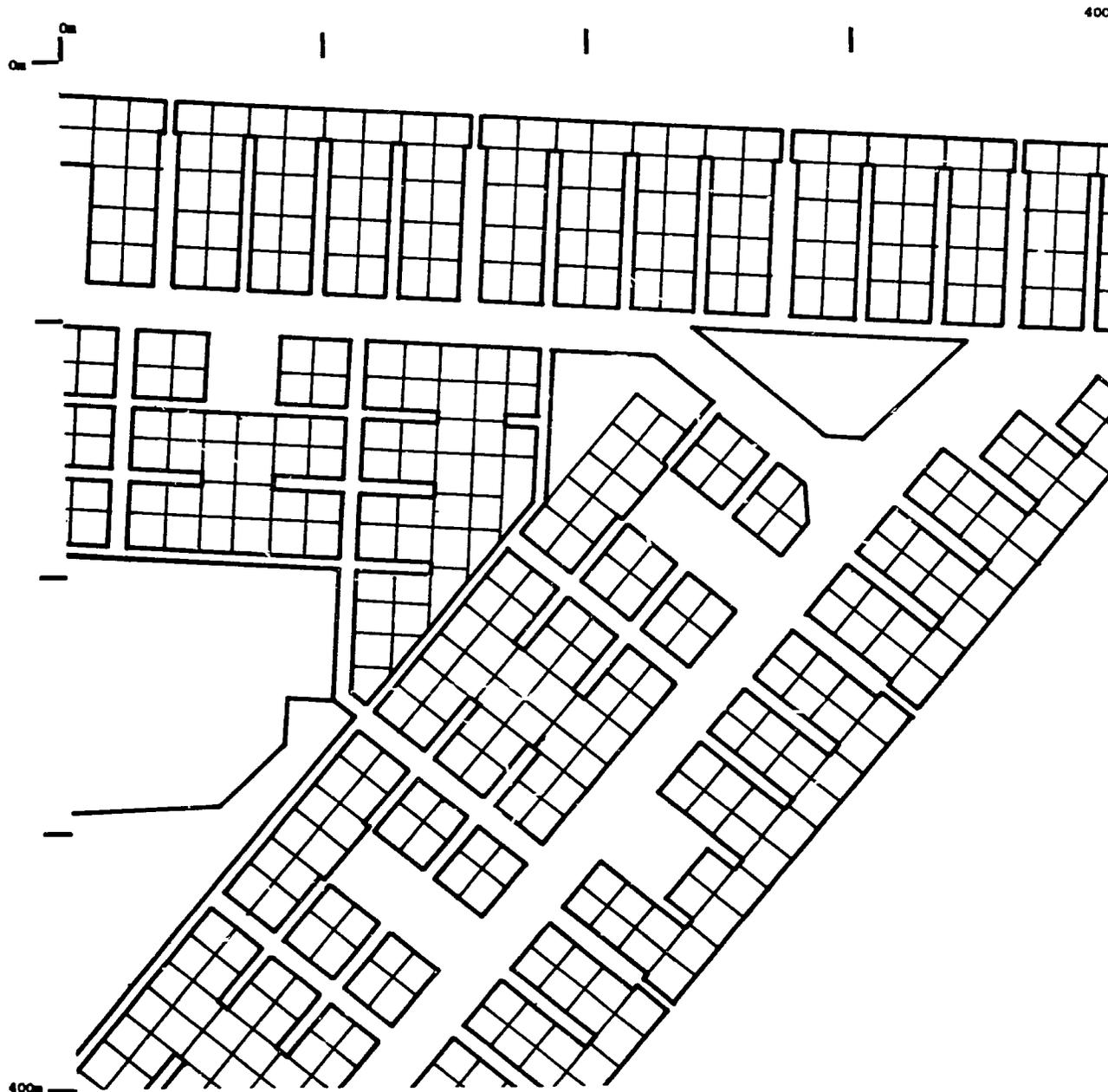
Air view of typical four-roomed dwellings of the Kariobangi site-and-service scheme.



**KARIOBANGI
LOCALITY SEGMENT:
AIR PHOTOGRAPH**

0 50 100 150m
SCALE 1:2,500





LOT LAYOUT Kariobangi is an example of an early site-and-service housing scheme. The layout was conceived to have an average size, square lot for each dwelling structure. In practice, the design of the dwelling units and their arrangement changes the nature of the open space to functions of circulation and minimal personal control. The single room dwelling units generate a dependence on the adjacent open spaces for functions and activities not performed indoors requiring personal control of these areas.

No. of Lots: 413 lots
 Lot Density: 36.8 lots/Ha.
 Av. Lot Dimensions: 12.2m x 13.7m
 Av. Lot Area: 167 sq.m.
 Av. Lot Coverage: 32.9% of lot
 Circulation Length: 1,012 m
 Circulation Length / Area Served: 336 m/Ha.

**KARIOBANGI
 LOCALITY SEGMENT:
 LOT LAYOUT**

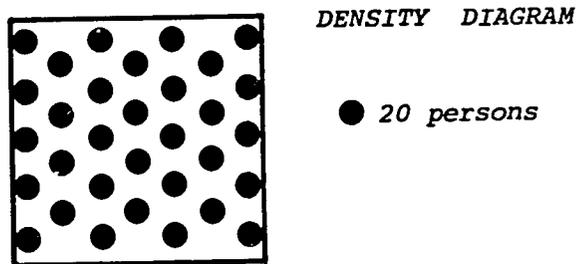
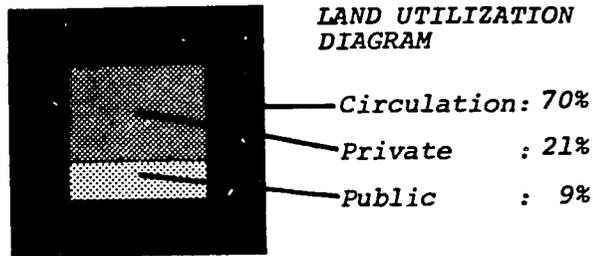
0 50 100 150m
 SCALE 1:2,500



ACTUAL LAND UTILIZATION The distribution of segment land utilization areas is:

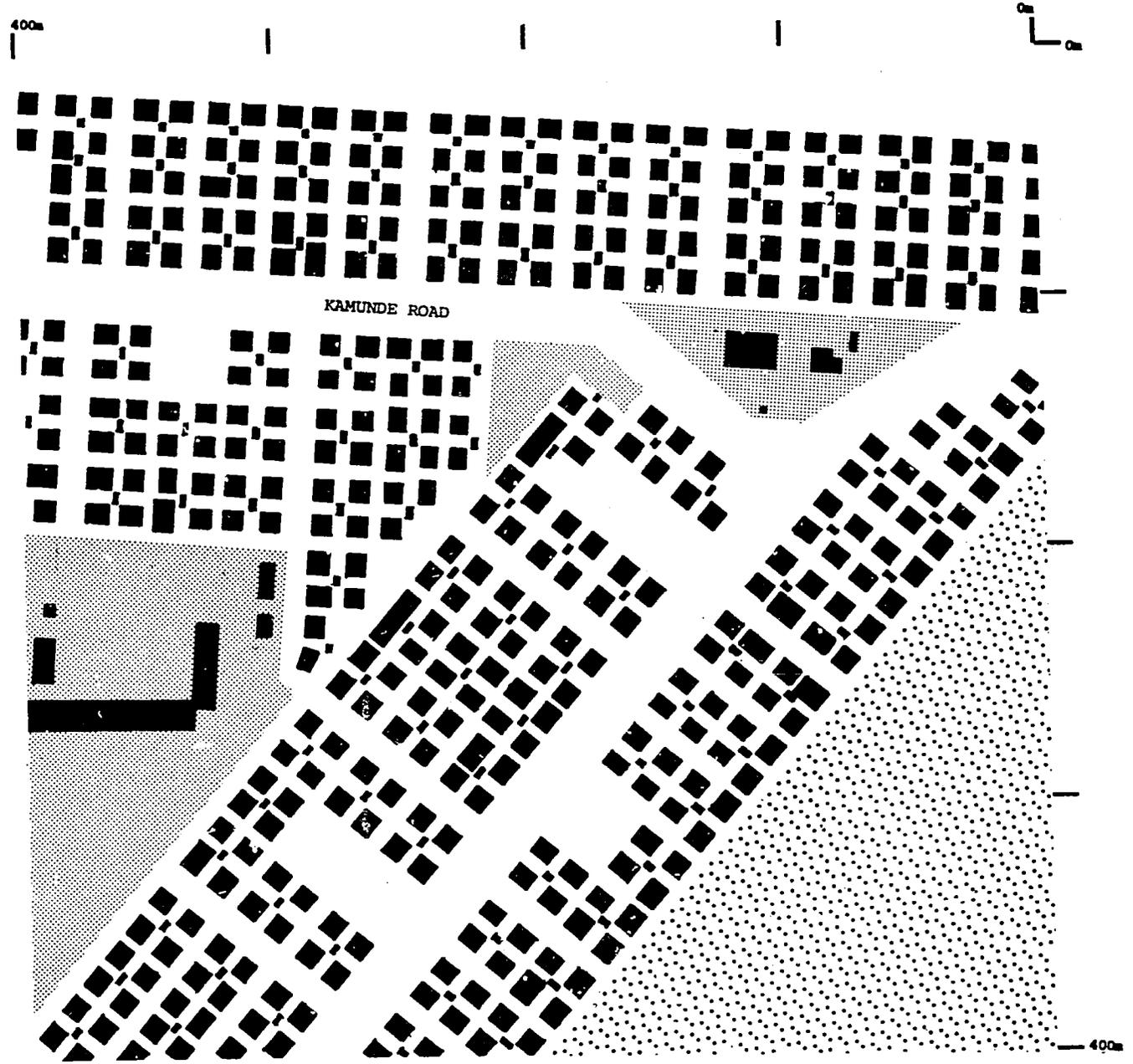
% Public - circulation : VERY HIGH
 % Public - miscellaneous: LOW
 % Private : LOW

Population density : HIGH
 Dwelling unit density : HIGH
 % Built-up coverage : HIGH



Density: 606 persons/Ha.
 Population: 6797 persons
 No. of Dwellings: 413 dwellings
 Average Dw. Area: 55 sq.m.
 Built-up Area: 20.5%
 No. of Dw. Units: 1652 units
 (Room Units): 1652 units
 (House Units):
 Unit Occupancy: 3.8 persons
 Unit Density: 147.5 units/Ha.

Area of Segment: 16 Ha.
 Area used in Calculation: 11.2 Ha.

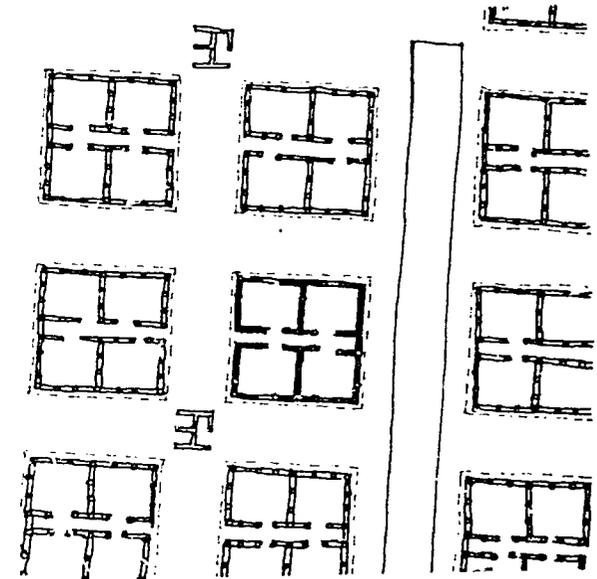
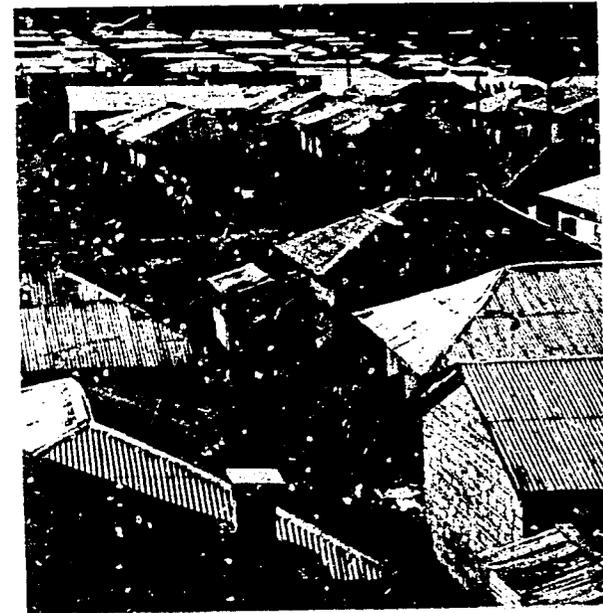


KARIOBANGI
 LOCALITY SEGMENT:
 ACTUAL LAND UTILIZATION





Groups of four dwellings share a common service block of showers, toilets and wash-slabs.

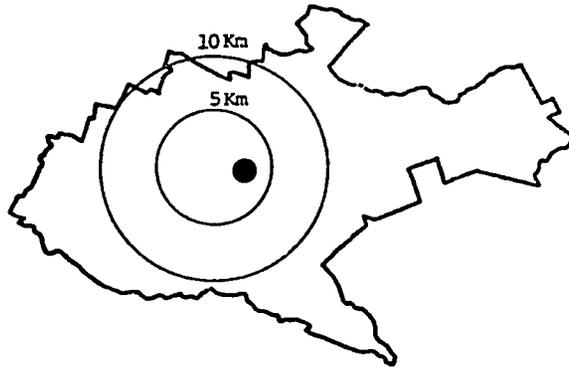


KARIOBANGI
TYPICAL DWELLING



SCALE 1:500

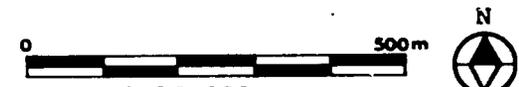
11 MAKONGENI ESTATE EASTLANDS



LOCATION AND ORIGIN Makongeni is located about 3 Km east of the central business district, in Eastlands. It is bound by Jogoo Road in the north, the railway in the south and by other public schemes in the east and west. In 1949, when the Master Plan for 'a Garden City in Africa' was prepared for the colonial government, an area was set aside in the east, called Eastlands, to accommodate all African workers of Nairobi. Makongeni was amongst the earlier public housing schemes to be built in Eastlands.



MAKONGENI ESTATE





**MAKONGENI ESTATE
LOCALITY PLAN**

0 500m
SCALE 1:10,000

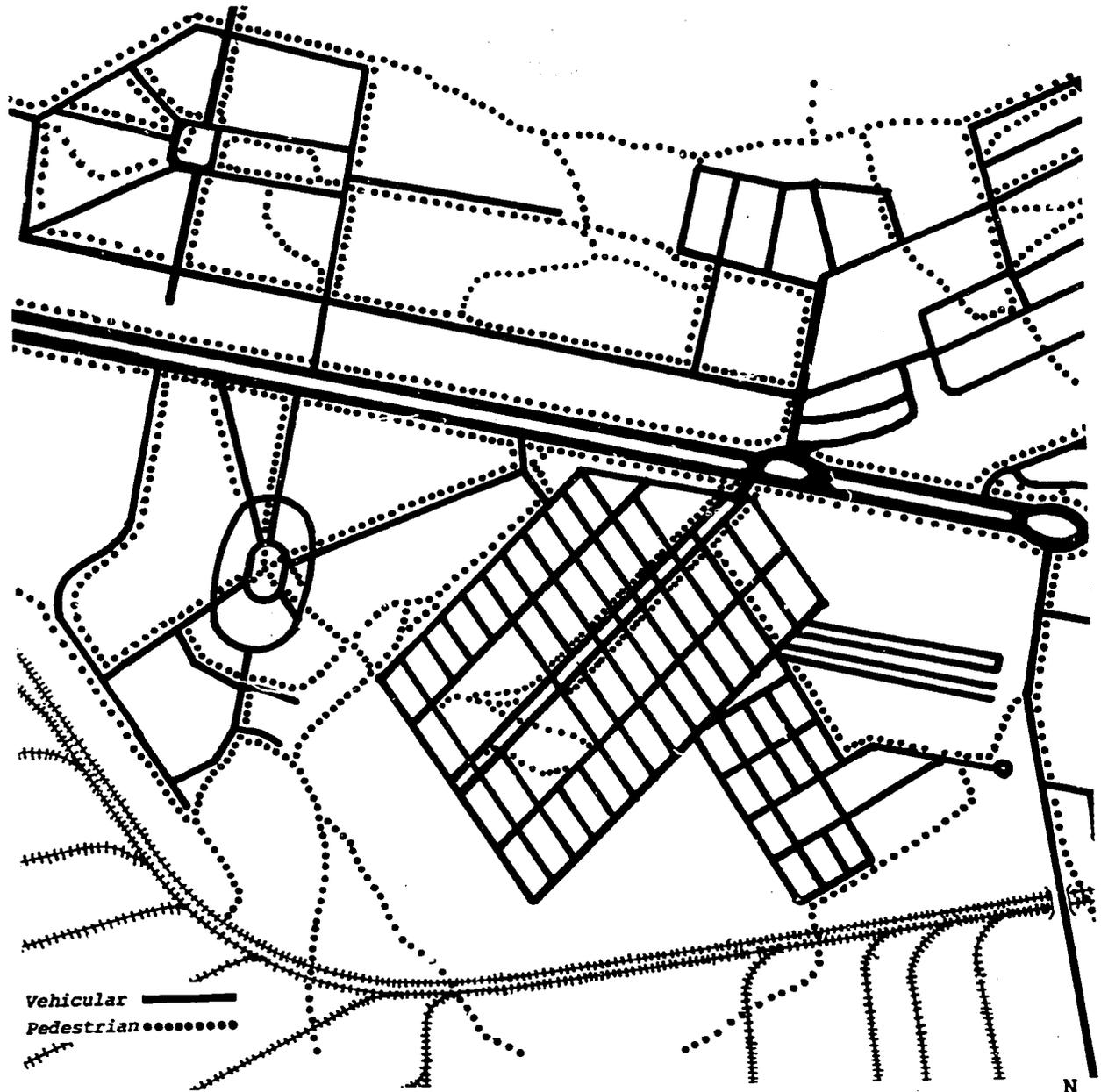


400m x 400m
Selected Segment

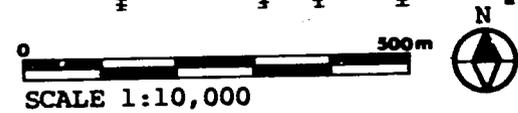
LAYOUT The layout of Makongeni was designed by the municipality and is a typical grid-iron layout with row housing.

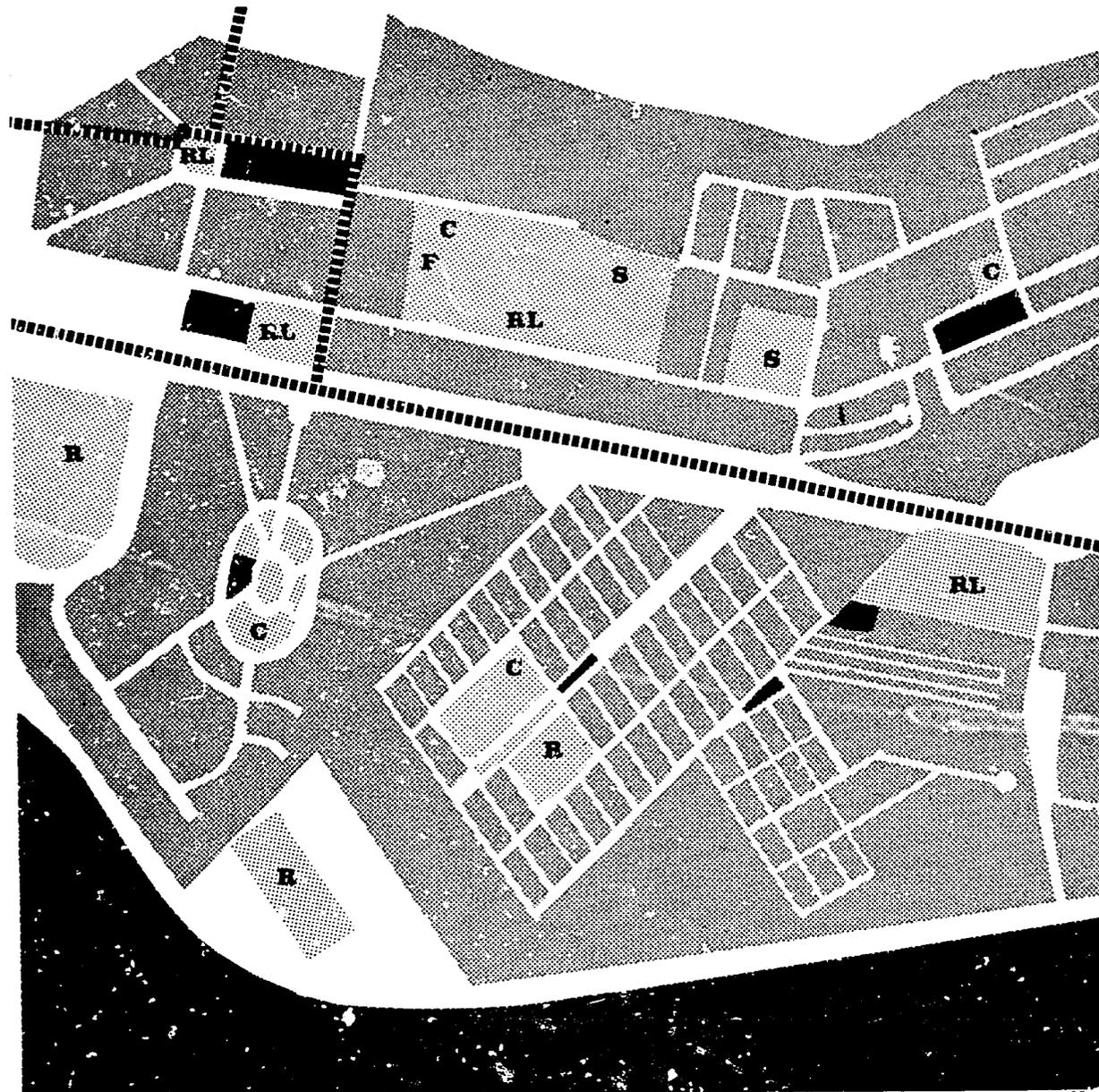
POPULATION/INCOMES Makongeni recorded a population of 7,750 in 1969, predominantly in the low income sector.

CIRCULATION A central street connects the internal grid-iron street system to Jogoo Road which is a major road in Eastlands. Every unit is served by vehicular access. Pedestrian circulation, which is dominant, is mainly along the central street and across open spaces. The bus route on Jogoo Road adequately serves the estate.



MAKONGENI ESTATE
LOCALITY CIRCULATION DIAGRAM





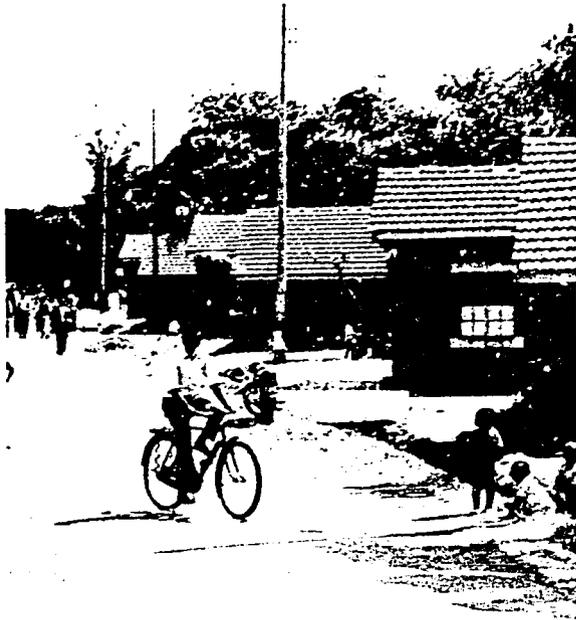
LAND USE Almost 70% of the area is taken by circulation, which includes open space around buildings; about 20% is residential and the rest is public and commercial. The area is adequately served with public utilities and facilities.

- | | |
|---------------------------|---------------------|
| C Community Center | S School |
| H Health | R Recreation |
| P Police | RL Religious |

-  Residential
-  Commercial/Industrial
-  Agricultural
-  Bus Route

MAKONGENI ESTATE
LOCALITY LAND-USE PATTERN

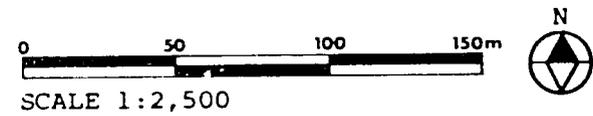


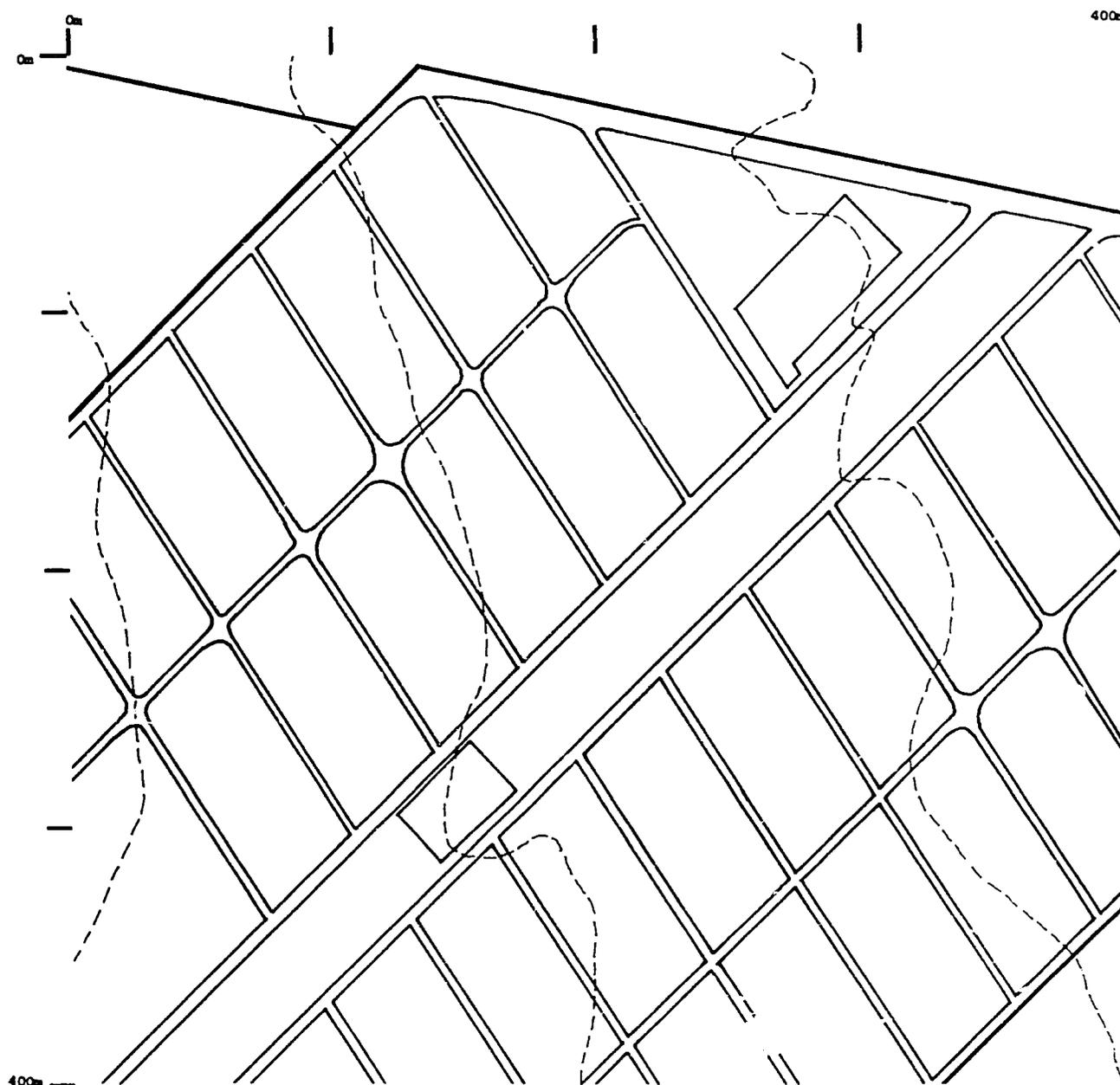


Typical units in Makongeni.



MAKONGENI ESTATE
LOCALITY SEGMENT:
AIR PHOTOGRAPH

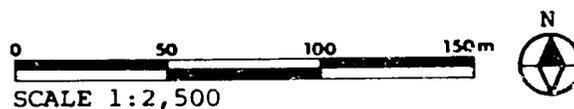




LOT LAYOUT Makongeni is an example of the basic gridiron layout adapted for row-type municipal housing. The area is not subdivided into lots. The circulation arrangement is a grid of 40m x 100m streets. The length of circulation is extremely high in proportion to the population and area served. The layout permits very little control of open spaces, which become public circulation areas.

- No. of Lots: -
- Lot Density: -
- Av. Lot Dimensions: -
- Av. Lot Area: -
- Av. Lot Coverage: -
- Circulation Length: 5,507 m
- Circulation Length
Area Served: 600 m/Ha.

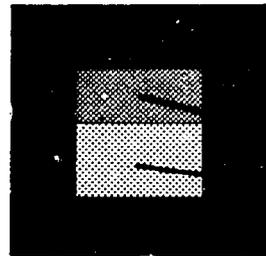
MAKONGENI ESTATE
LOCALITY SEGMENT:
LOT LAYOUT



ACTUAL LAND UTILIZATION The distribution of segment land utilization areas is:

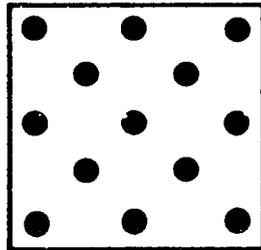
% Public - circulation : VERY HIGH
 % Public - miscellaneous: ACCEPTABLE
 % Private : VERY LOW

Population density : MEDIUM
 Dwelling unit density : MEDIUM
 % Built-up coverage : LOW



LAND UTILIZATION DIAGRAM

Circulation: 71%
 Private : 14%
 Public : 15%



DENSITY DIAGRAM

● 20 persons

Density: 283 persons/Ha.
 Population: 4520 persons
 No. of Dwellings: 113 dwellings
 Average Dw. Area: 192 sq.m.
 Built-up Area: 13.5%
 No. of Dw. Units: 1130 units
 (Room Units): 1130 units
 (House Units): -
 Unit Occupancy: 4 persons
 Unit Density: 70.6 units/Ha.

Area of Segment: 16 Ha.
 Area used in Calculation: 16 Ha.



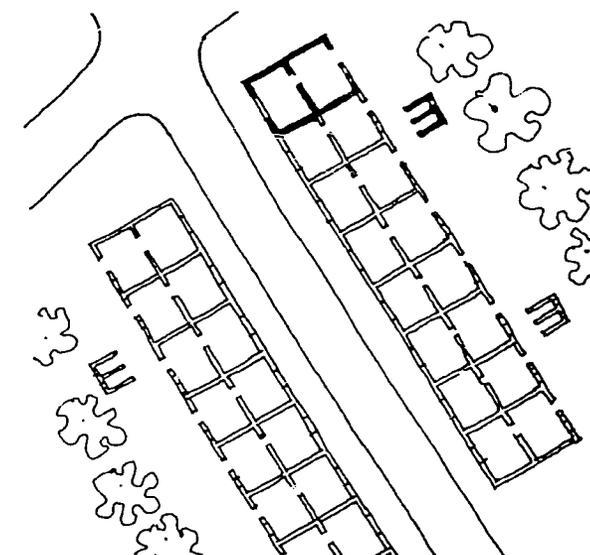
**MAKONGENI ESTATE
 LOCALITY SEGMENT:
 ACTUAL LAND UTILIZATION**



SCALE 1:2,500



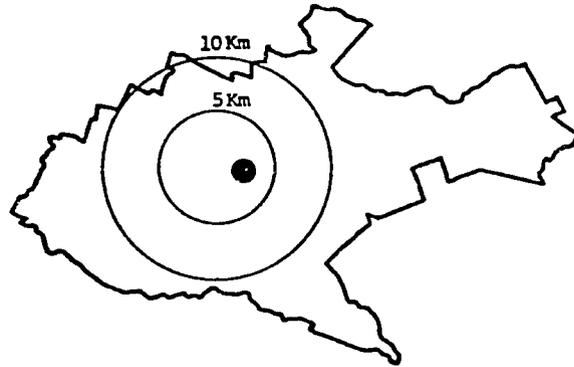
Typical row housing in Makongeni.



MAKONGENI ESTATE
TYPICAL DWELLING

N
SCALE 1:500

12 KALOLENI ESTATE
EASTLANDS



LOCATION AND ORIGIN Kaloleni is located about 3 Km east of the central business district, in Eastlands. Like the previous estate, Kaloleni was amongst the earlier public housing schemes for the low income sector built by the Nairobi City Council in Eastlands.



KALOLENI ESTATE
LOCALITY AIR PHOTOGRAPH





**KALOLENI ESTATE
LOCALITY PLAN**

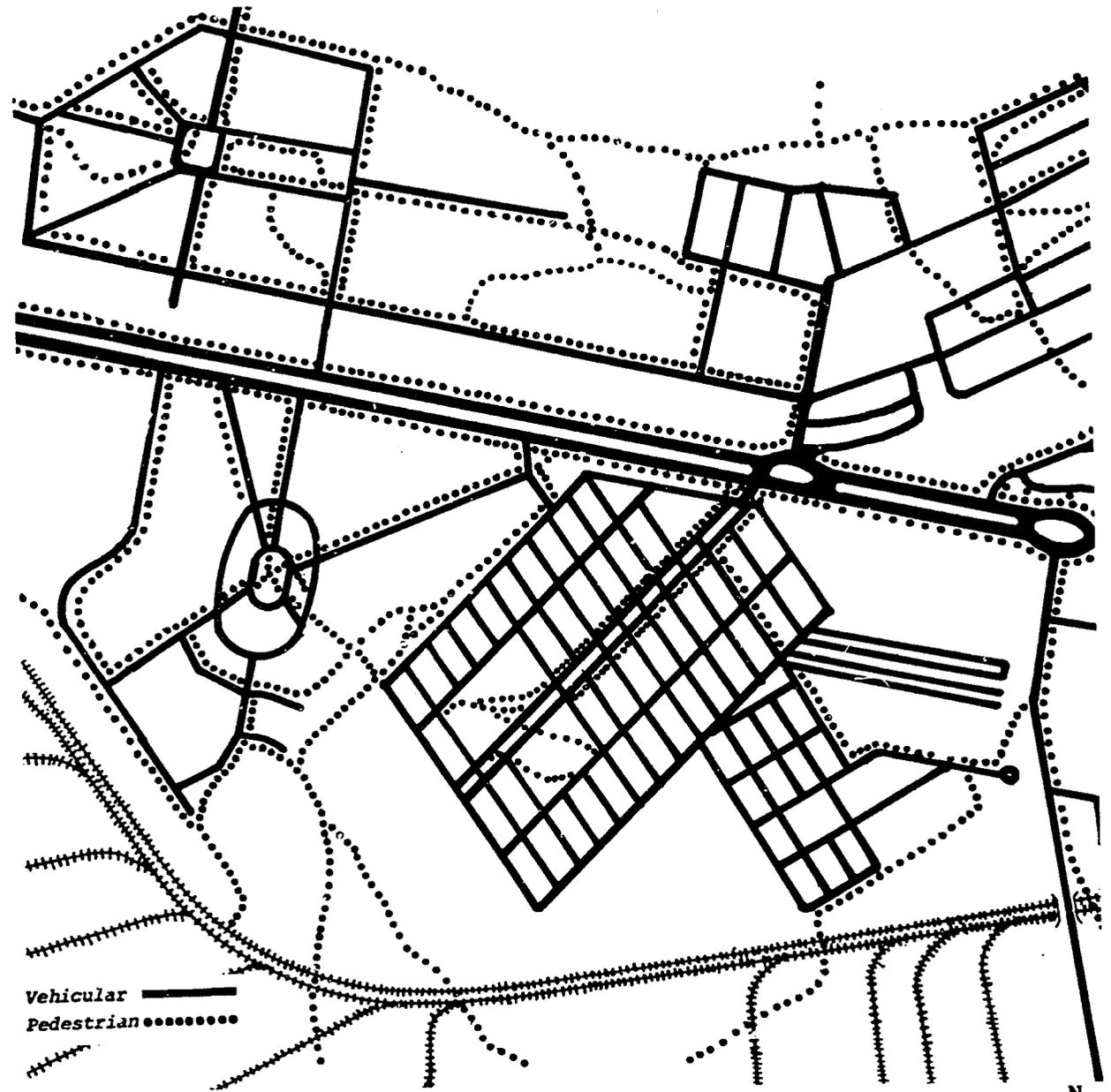
0 500m
SCALE 1:10,000

LAYOUT The layout of Kaloleni was designed by expatriates employed by the municipality. It is a typical radial layout, clearly influenced by the 'Garden City' concept prevalent at the time of its design. Rows of single-room blocks are grouped around service blocks.

POPULATION/INCOMES Kaloleni had a population of 4,800 in 1969, predominantly in the low income sector.

400m x 400m
Selected Segment

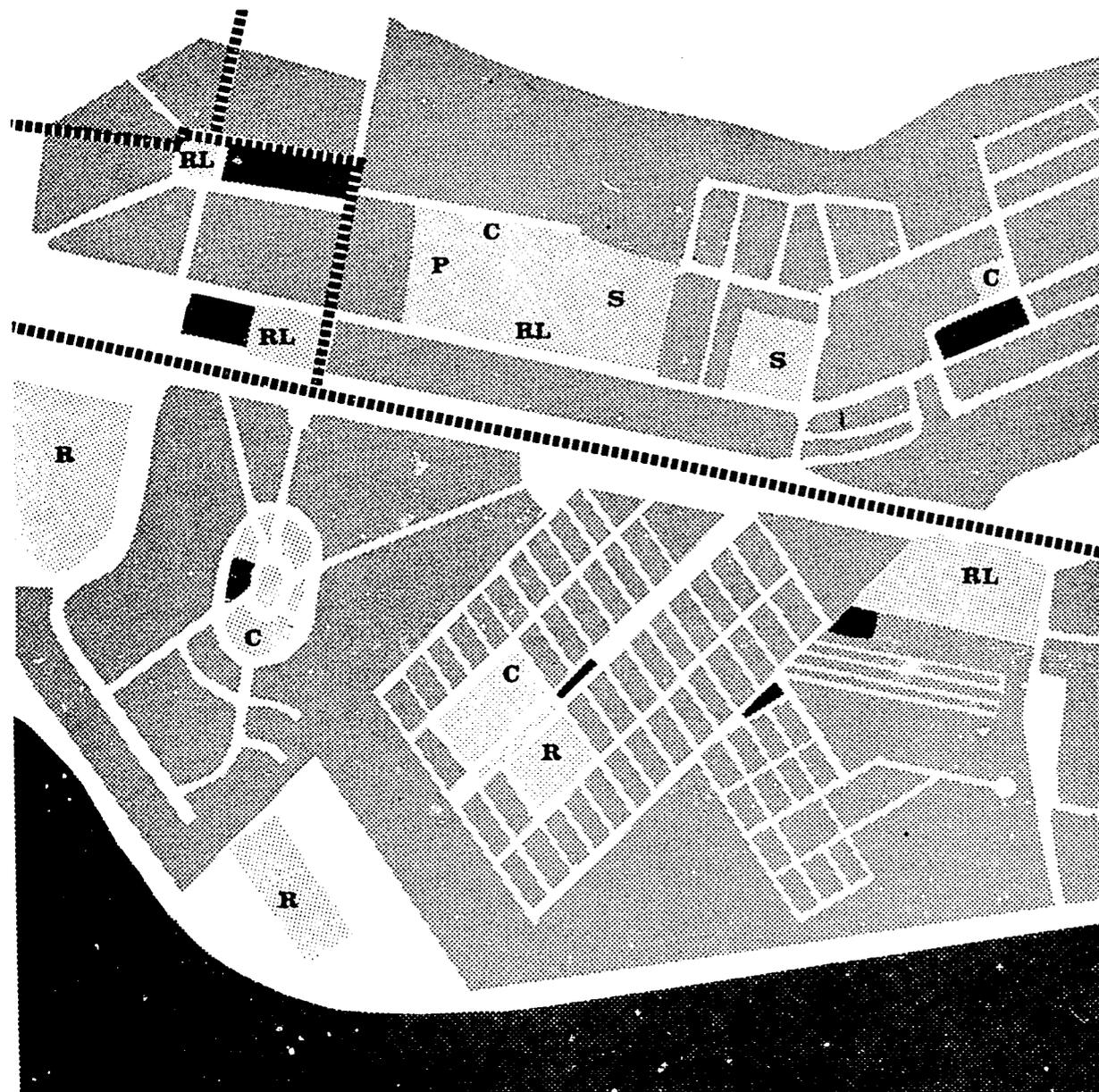
CIRCULATION The internal radial network of vehicular streets is connected to Jogoo Road by a central street which leads to the center of the layout. Pedestrian circulation dominates and is along the streets as well as across open spaces. The bus route on Jogoo Road adequately serves Kaloleni.



KALOLENI ESTATE
LOCALITY CIRCULATION DIAGRAM

0 500m
SCALE 1:10,000





LAND USE More than 3/4 of the area in Kaloleni is taken by circulation; a very small proportion by the residential structures; and the rest by public facilities and open space.

- | | |
|---------------------------|---------------------|
| C Community Center | S School |
| H Health | R Recreation |
| P Police | RL Religious |

- | | |
|---|-----------------------|
|  | Residential |
|  | Commercial/Industrial |
|  | Agricultural |
|  | Bus Route |

KALO LENI ESTATE
LOCALITY LAND-USE PATTERN





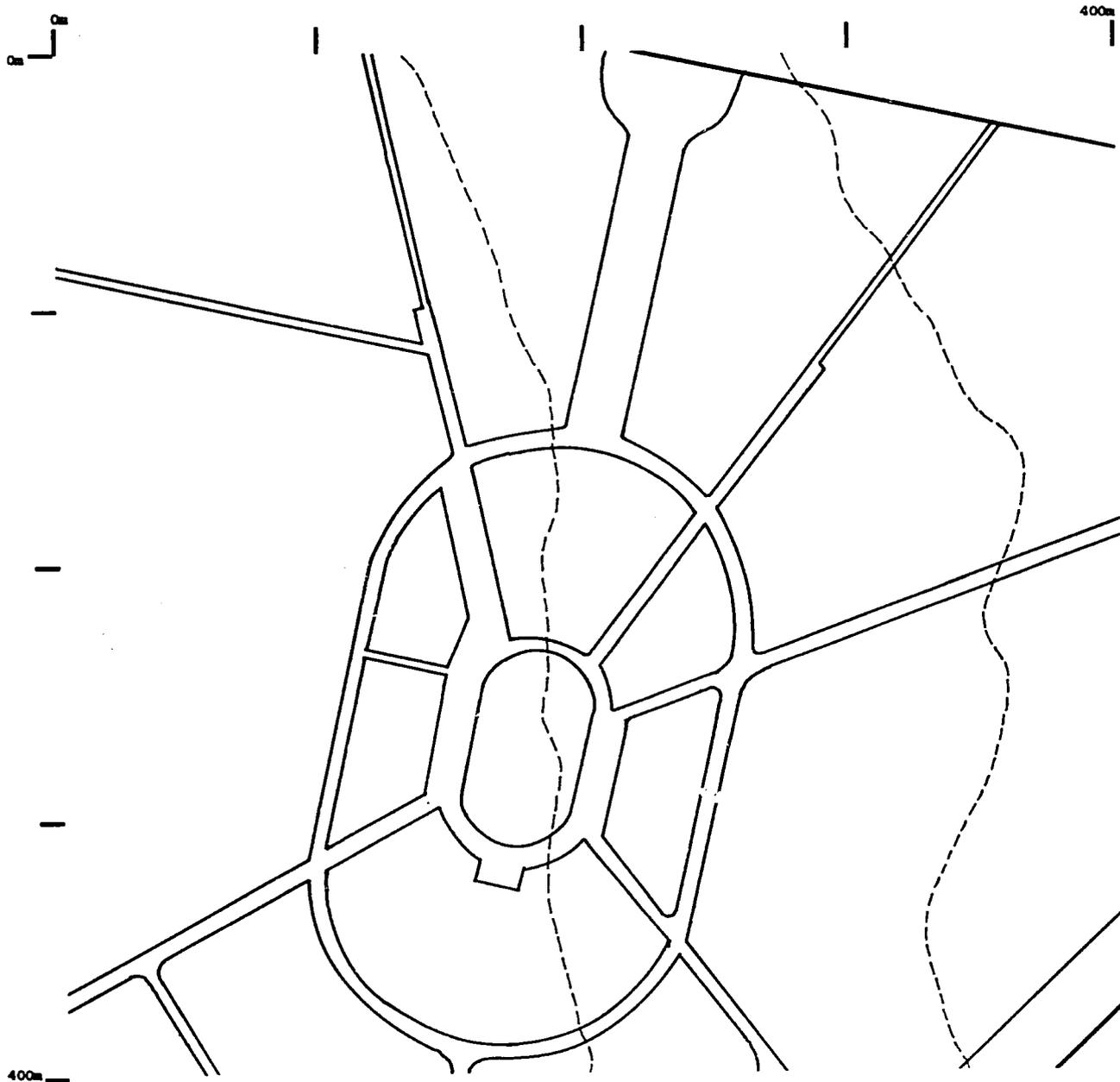
'Compound' type layout of Kaloleni.



KALOLENI ESTATE
LOCALITY SEGMENT:
AIR PHOTOGRAPH

0 50 100 150m
SCALE 1:2,500





LOT LAYOUT Kaloleni is an example of a radial layout plan adapted for a 'compound' type municipal housing. The area is not subdivided into lots. The large open spaces around the dwelling units lack personal control and function as public circulation.

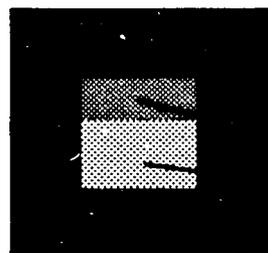
No. of Lots: -
 Lot Density: -
 Av. Lot Dimensions: -
 Av. Lot Area: -
 Av. Lot Coverage: -
 Circulation Length: 2,296 m
 $\frac{\text{Circulation Length}}{\text{Area Served}} : 164 \text{ m/Ha.}$

**KALOLENI ESTATE
 LOCALITY SEGMENT:
 LOT LAYOUT**



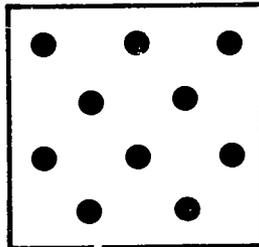
ACTUAL LAND UTILIZATION The distribution of segment land utilization areas is:

% Public - circulation : VERY HIGH
 % Public - miscellaneous: ACCEPTABLE
 % Private : VERY LOW
 Population density : LOW
 Dwelling unit density : MEDIUM
 % Built-up coverage : LOW



LAND UTILIZATION DIAGRAM

Circulation: 80%
 Private : 6%
 Public : 14%



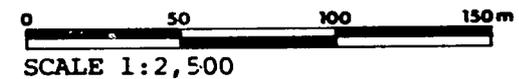
DENSITY DIAGRAM

● 20 persons

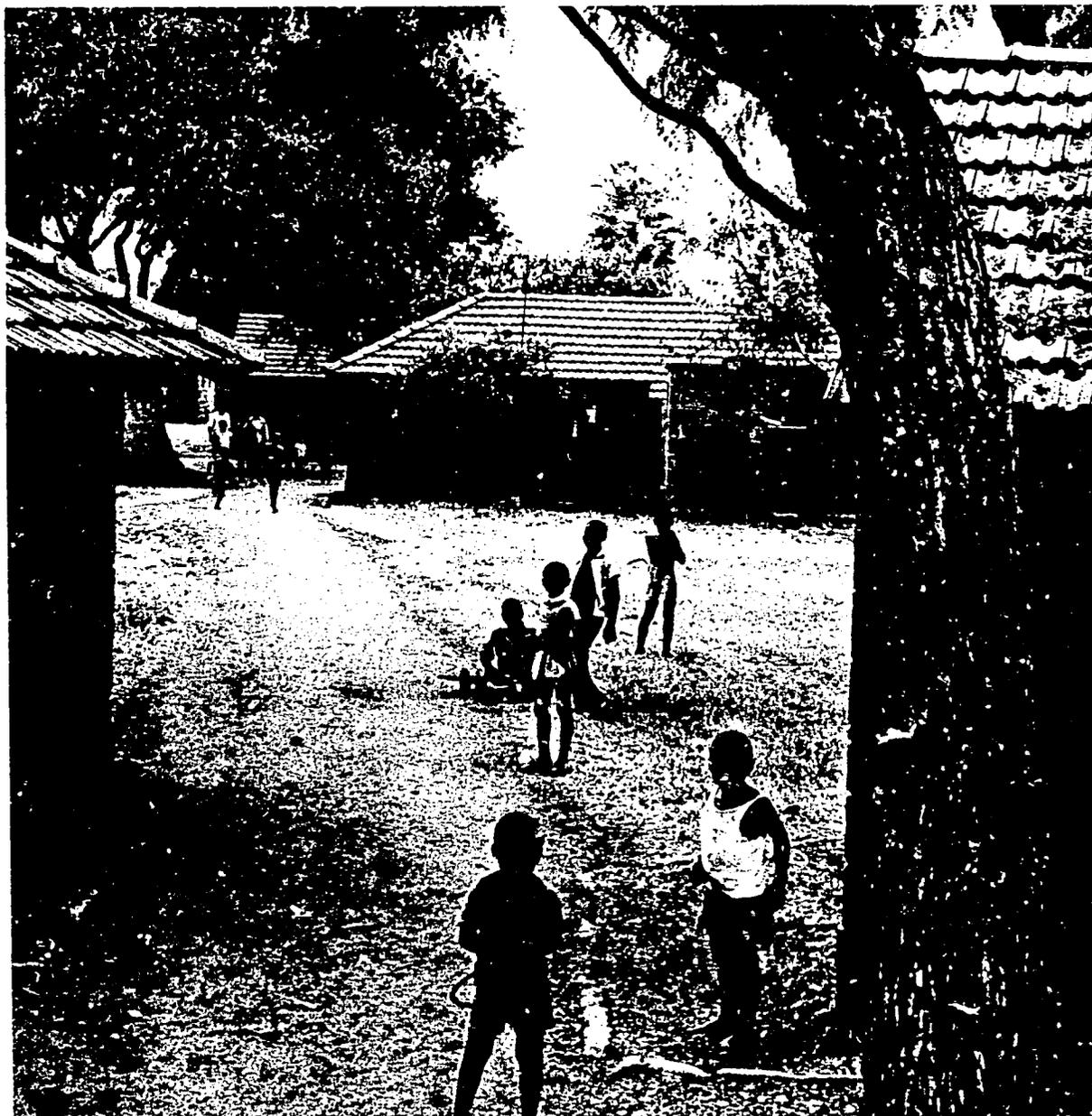
Density: 200 persons/Ha.
 Population: 4620 persons
 No. of Dwellings: 165 dwellings
 Average Dw. Area: 166 sq.m.
 Built-up Area: 6.2%
 No. of Dw. Units: 1155 units
 (Room Units): 1155 units
 (House Units): -
 Unit Occupancy: 4 persons
 Unit Density: 72.1 units/Ha.
 Area of Segment: 16 Ha.
 Area used in Calculation: 16 Ha.



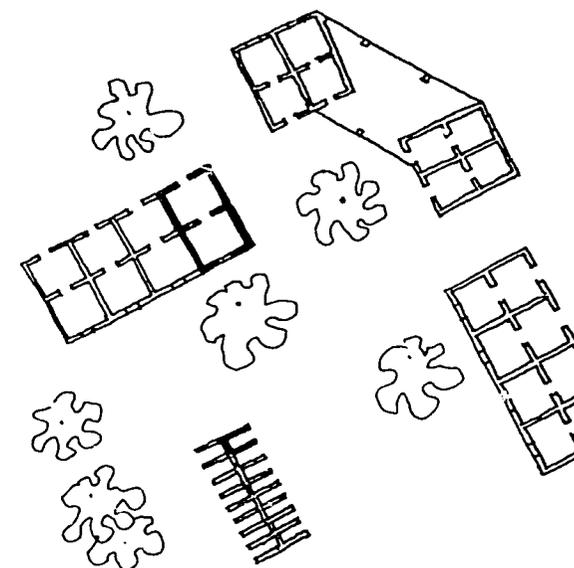
**KALO LENI ESTATE
 LOCALITY SEGMENT:
 ACTUAL LAND UTILIZATION**



SCALE 1:2,500

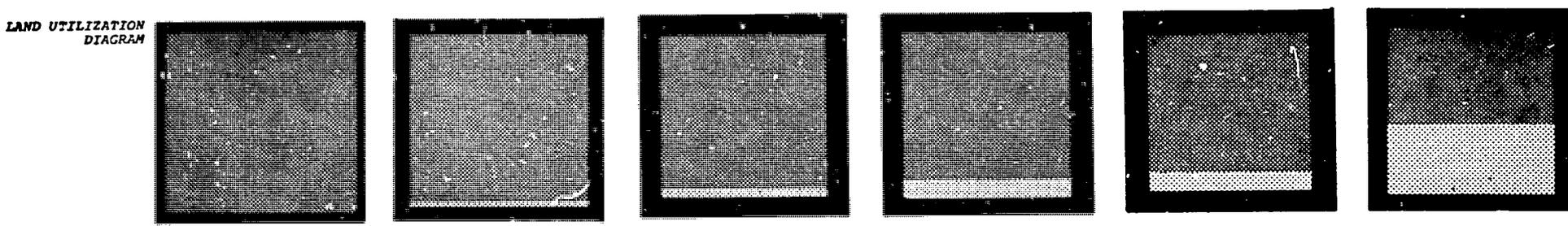
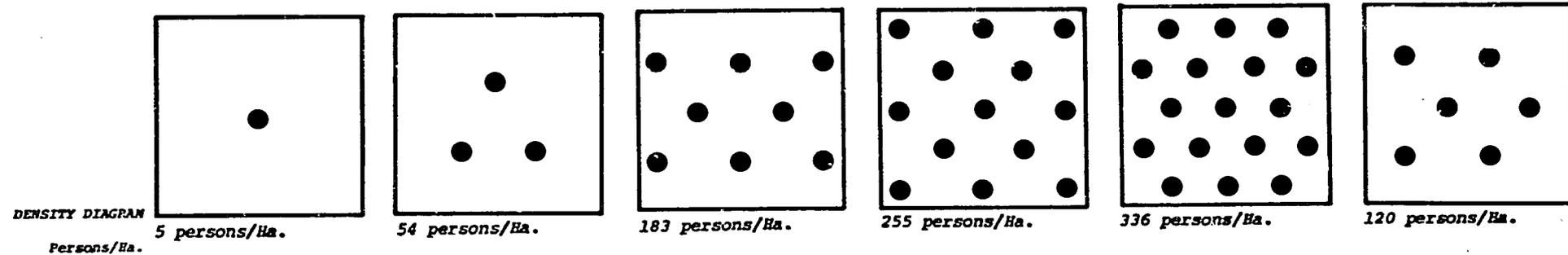
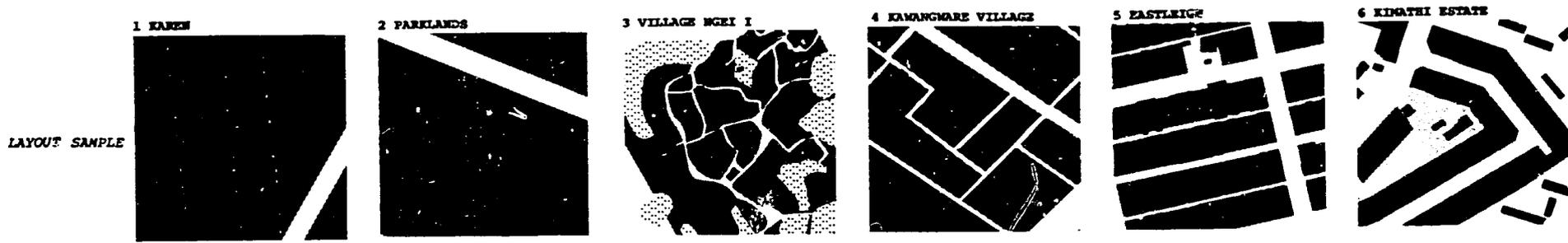


Typical dwellings in Kaloleni.



KALO LENI ESTATE
TYPICAL DWELLING

SCALE 1:500

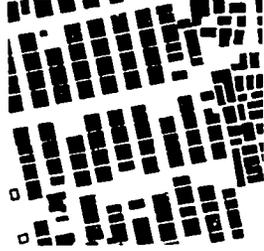


Circulation (%):	8	15	23	19	29	27
Public (%):	0	1	5	11	13	34
Private (%):	92	84	72	70	58	39
Length (m):	550	1410	-	2905	2742	1805
Ratio (m/Ha):	37.2	89.0	-	201.0	240.0	219.0
No. of lots:	7	48	-	167	225	225
Lots/Ha.:	0.4	3.0	-	10.4	14.1	20.1
Lot coverage (%):	1.4	5.3	32.0	42.8	55.7	30.5
Segment coverage (%):	1.2	5.9	9.3	22.7	24.3	12.6
No. of room units:	7	41	224	1750	1344	-
No. of house units:	15	46	-	-	-	225
Units/Ha.:	1.4	5.4	32.0	42.8	84.0	30.5
Unit occupancy:	5	5	2	4	4	4
Users' income level:	H	M/H	L	L	L M	M
Land cost (\$/Ha):	90	3000	300	900	1500	6450
Area used in calculation (Ha):	16.0	16.0	4.3	16.0	16.0	11.2

7 VILLAGE I: SQUATTERS



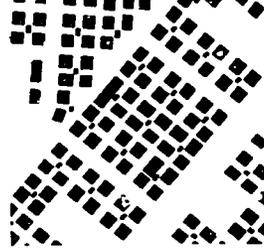
8 VILLAGE I: TENEMENTS



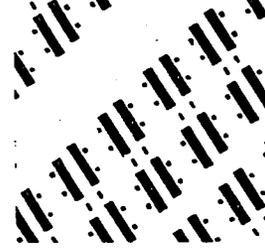
9 MATHARE REDEVELOPMENT



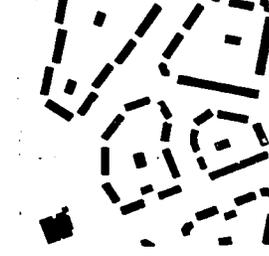
10 KARIOBANGI



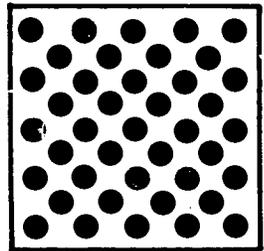
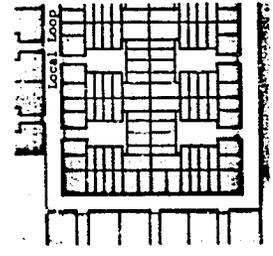
11 MAKONGENI ESTATE



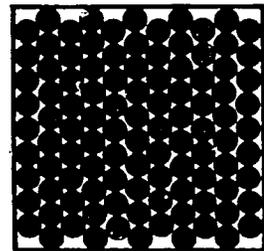
12 KALOLENI ESTATE



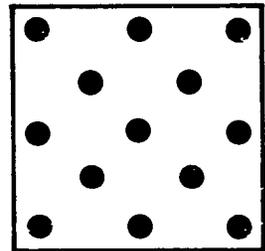
MODEL



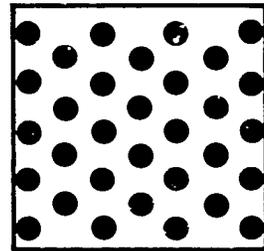
819 persons/Ha.



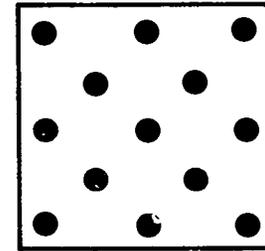
1859 persons/Ha.



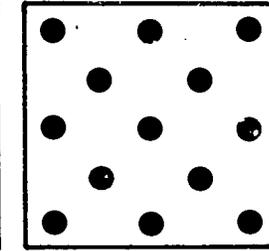
262 persons/Ha.



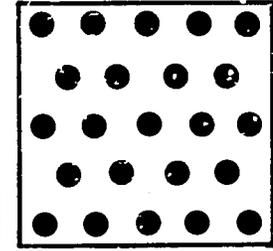
606 persons/Ha.



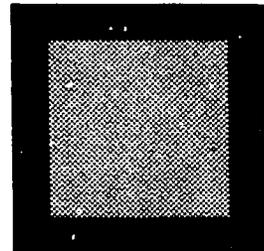
283 persons/Ha.



200 persons/Ha.

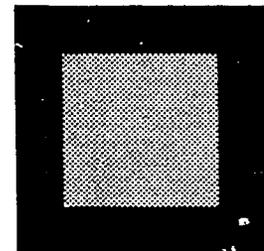


466 persons/Ha.



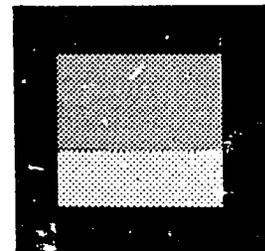
48
0
52
-
-
-
-
38.1
1227
-
234.1
4
L
900

5.3



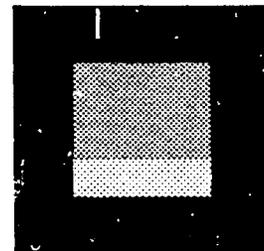
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40
-
-
-
-
39.4
300.3
-
422.9
4
L
900

7.1



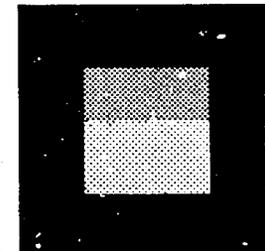
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14
25
3593
470.0
-
464
29.0
53.0
-
13.0
1392
-
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16.0



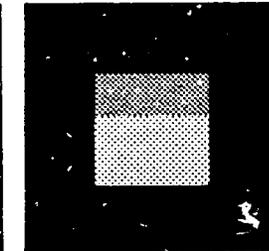
70
9
21
1012
336.0
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413
36.8
32.9
-
20.5
1652
-
147.5
3.8
L
300

11.2



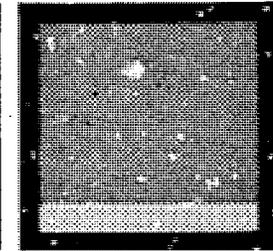
71
15
14
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600.0
-
-
-
13.5
1130
-
70.6
4
L
1500

16.0



80
14
6
2296
164.0
-
-
-
6.2
1155
-
72.2
4
L
1500

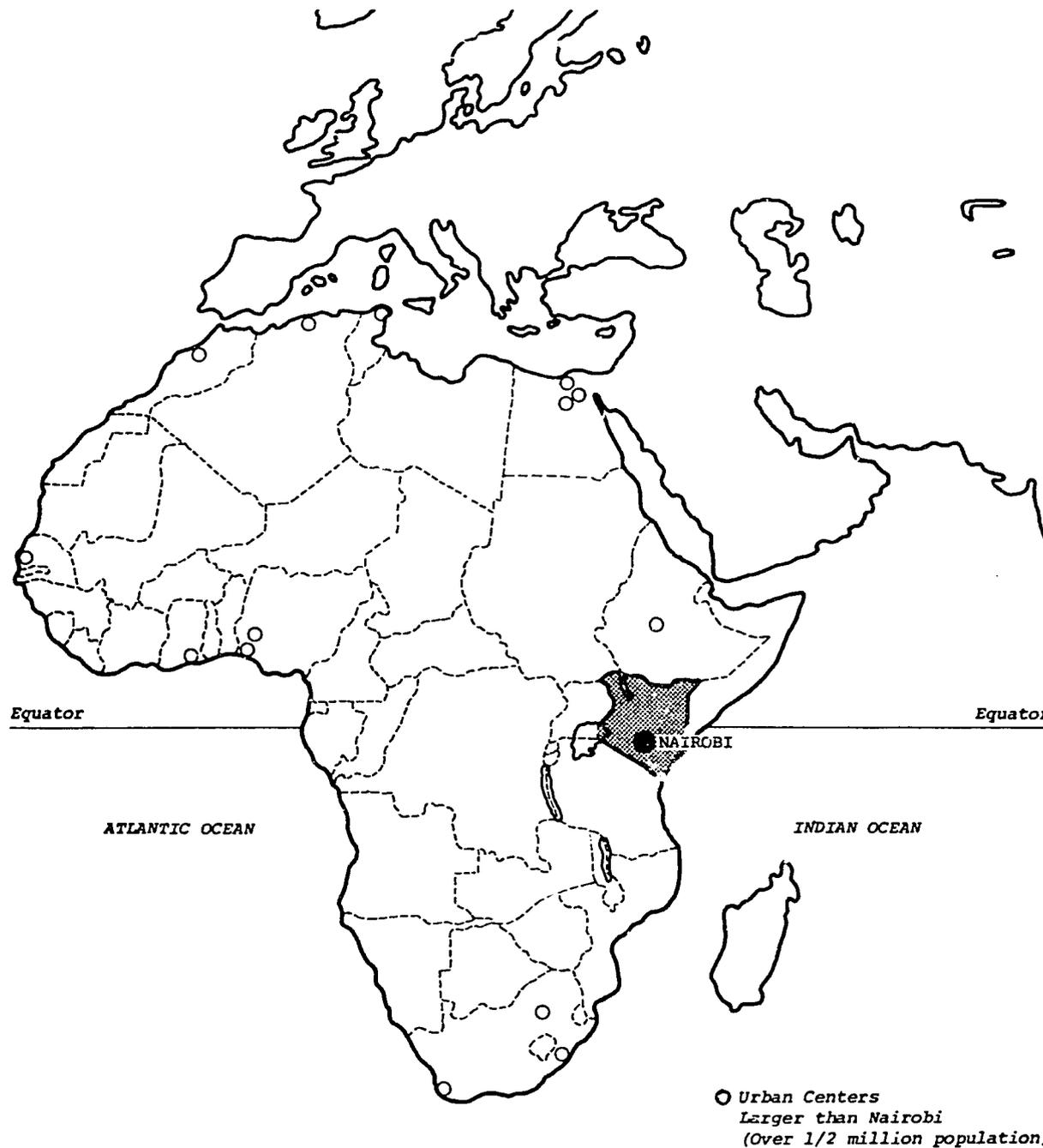
16.0



15
13
72
1220
70.0
-
398
35
34
-
1500
-
92
4
L
300

16.0

APPENDIX



BASIC DATA: KENYA

Kenya, an independent state in East Africa and a member of the Commonwealth of Nations, is bounded east by the Indian Ocean and the Somali Republic, north by Ethiopia and the Republic of the Sudan, west by Uganda and south by Tanzania.

Area: 582,647 sq.kms. including 14,792 sq.kms. of water.

Population: (1969) 10,940,000; 97% African.

Languages: Swahili, English (official).

Religion: Pagan, Christian, Moslem.

Economy: Agriculture, Tourism, Light Industry. The economy has developed largely on the basis of production of agricultural and livestock commodities from the land.

Monetary Unit: Kenya Shilling with a par value of KShs. 7.14 to US \$1.

Government and Administration: A republic with a parliamentary type of Government. It has a strong centralized system with a president who is popularly elected every four years. The ruling Kenya African National Union (KANU) is the only political party. The country is divided into seven provinces; and the Nairobi Area forms a separate entity outside the provincial system.

Education: Responsibility in relation to all aspects of education rests with the government but the administration of primary schools is largely delegated to county councils and municipalities. English is the medium of instruction. (1968-1969): Primary Pupils, 1,209,680; Teachers 37,923; Secondary Pupils, 101,361; Teachers, 4,644.

Health: There are about 160 health centers, bringing integrated health services to rural areas. Government and local authority hospitals provide free treatment for all outpatients and children. Approximate mortality statistics: Infant mortality rate, 170 deaths per 1000 live births; life expectancy, 36 years; death rate, 25 per 1000.

Largest Cities: (1969) Nairobi, 509,286 persons; Mombasa, 247,003 persons; Nakuru, 47,151 persons; Kisumu, 32,431 persons.

BASIC DATA: NAIROBI

Nairobi, the capital city of Kenya, lies at the head of the Athi plains, where the Kikuyu escarpment begins about 450 kms. northwest of the Indian Ocean port of Mombasa. With an altitude of 1800 meters above sea level, the city has a pleasant climate. The temperatures rarely exceed 27°C at midday and the average annual rainfall is about 840 mm of which half falls during March-May.

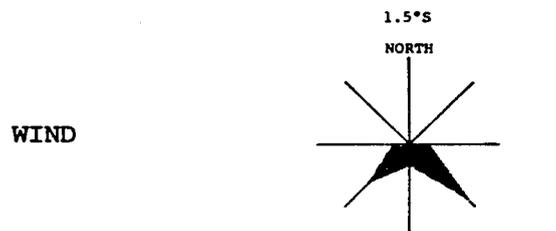
Area: 689 sq.km.

Population: (1969) 509,286; 83% African; Growth rate 7%-9% per annum.

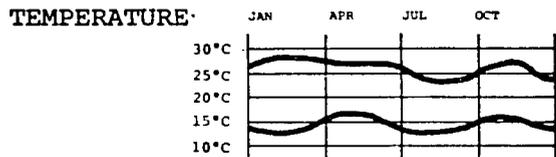
Administration: The Nairobi Metropolitan Area is an independent administrative unit. The Nairobi City Council comprising 40 elected councillors including a mayor, is responsible for the government of the area as a municipality.

Industry: Industrial activity in Nairobi is based largely on Kenya's predominantly agricultural economy and includes the manufacture of foods and tobacco products, building and furnishing materials, the curing of hides and skins, brewing, railway and light engineering. Nairobi is the main importing and distributing center for manufacture from overseas.

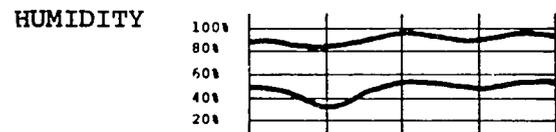
Education: Primary, secondary and higher education facilities are conducted through the Government, Nairobi City Council and private institutions.



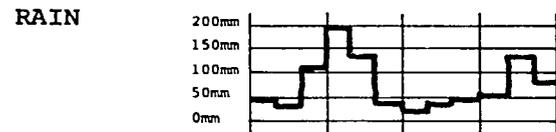
WIND



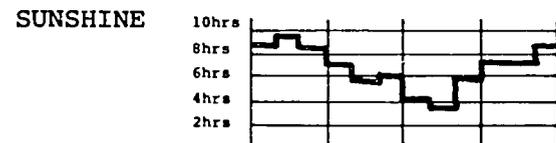
TEMPERATURE



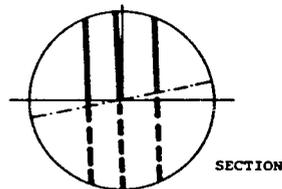
HUMIDITY



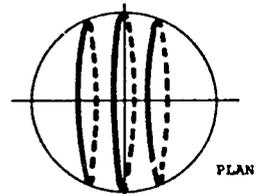
RAIN



SUNSHINE

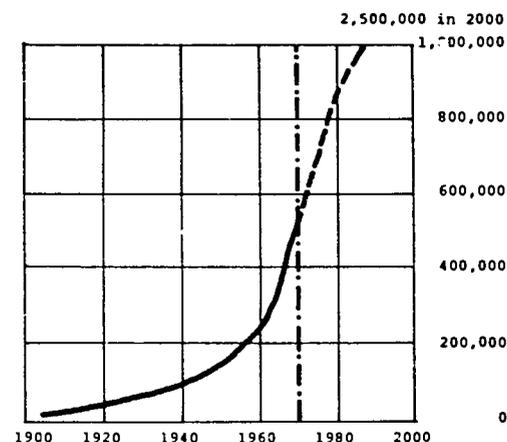


SECTION



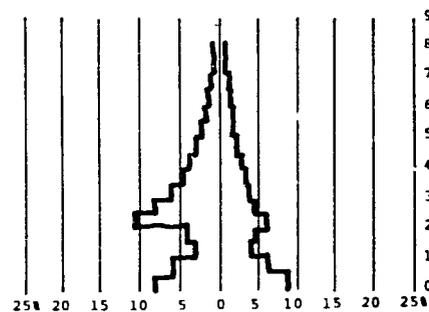
PLAN

SUN



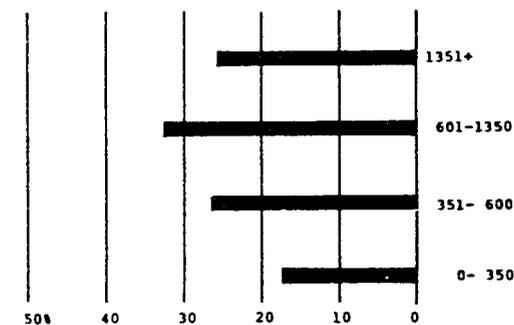
URBAN POPULATION GROWTH

horizontal: dates; vertical: population



URBAN POPULATION DISTRIBUTION

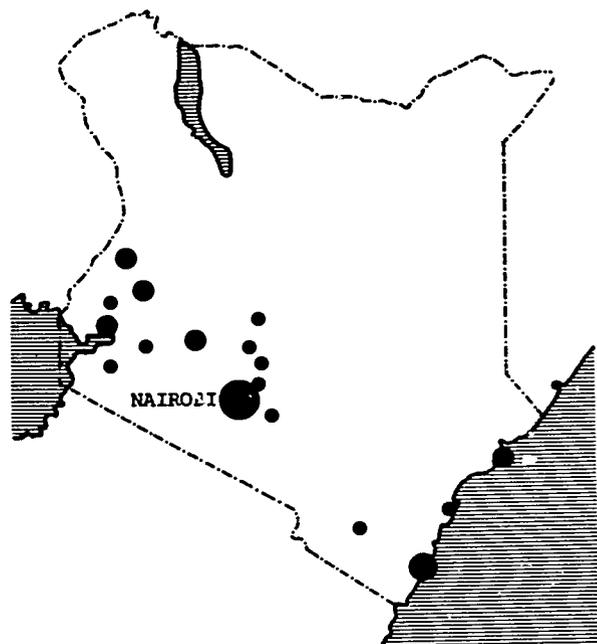
Census, 1969; population, 509,000
males: M. 303,000; females: F. 206,000
horizontal: percentages; vertical: ages



URBAN ANNUAL INCOME

Approximate 1969; population, 509,000
horizontal: percentages; vertical: dollars

GROWTH OF URBAN CENTERS IN KENYA
1948-1969

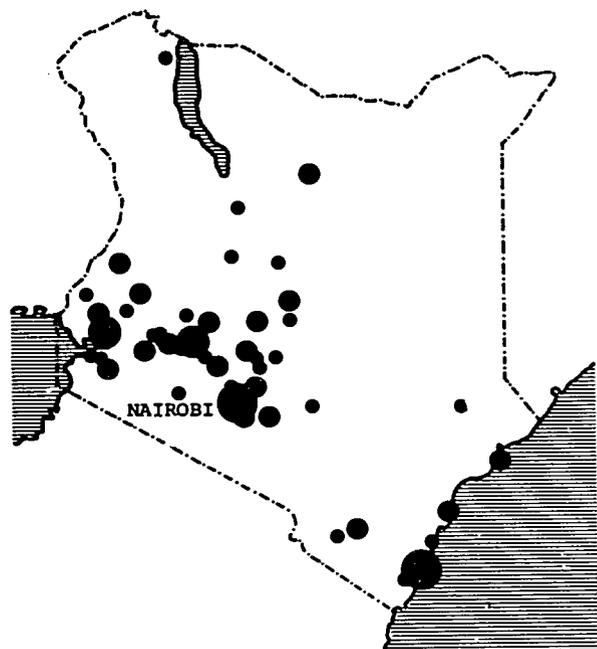


1948 Census

Urban Population: 276,240 5.1%
 Rural Population: 5,129,786 94.9%
 Total Population: 5,405,926 100.0%

Nairobi: 118,976 2.2%

Number of Urban Centers
with over 2000 inhabitants: 17



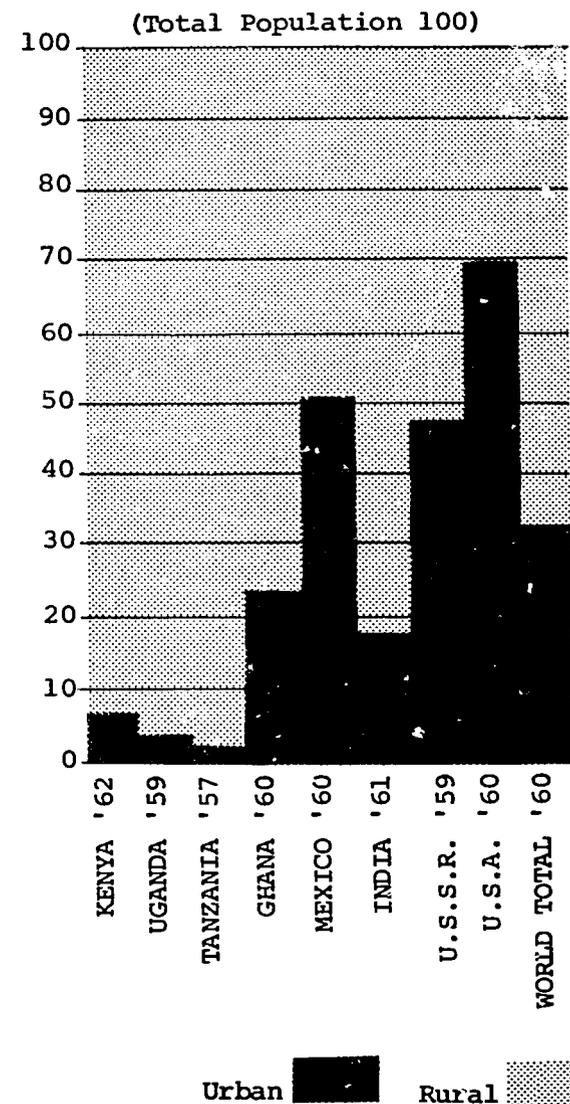
1969 Census

Urban Population: 1,082,437 9.9%
 Rural Population: 9,860,268 90.1%
 Total Population: 10,942,705 100.0%

Nairobi: 509,286 4.9%

Number of Urban Centers
with over 2000 inhabitants: 48

KENYA'S URBAN POPULATION COMPARED
TO SOME OTHER COUNTRIES AND THE
WORLD AVERAGE:

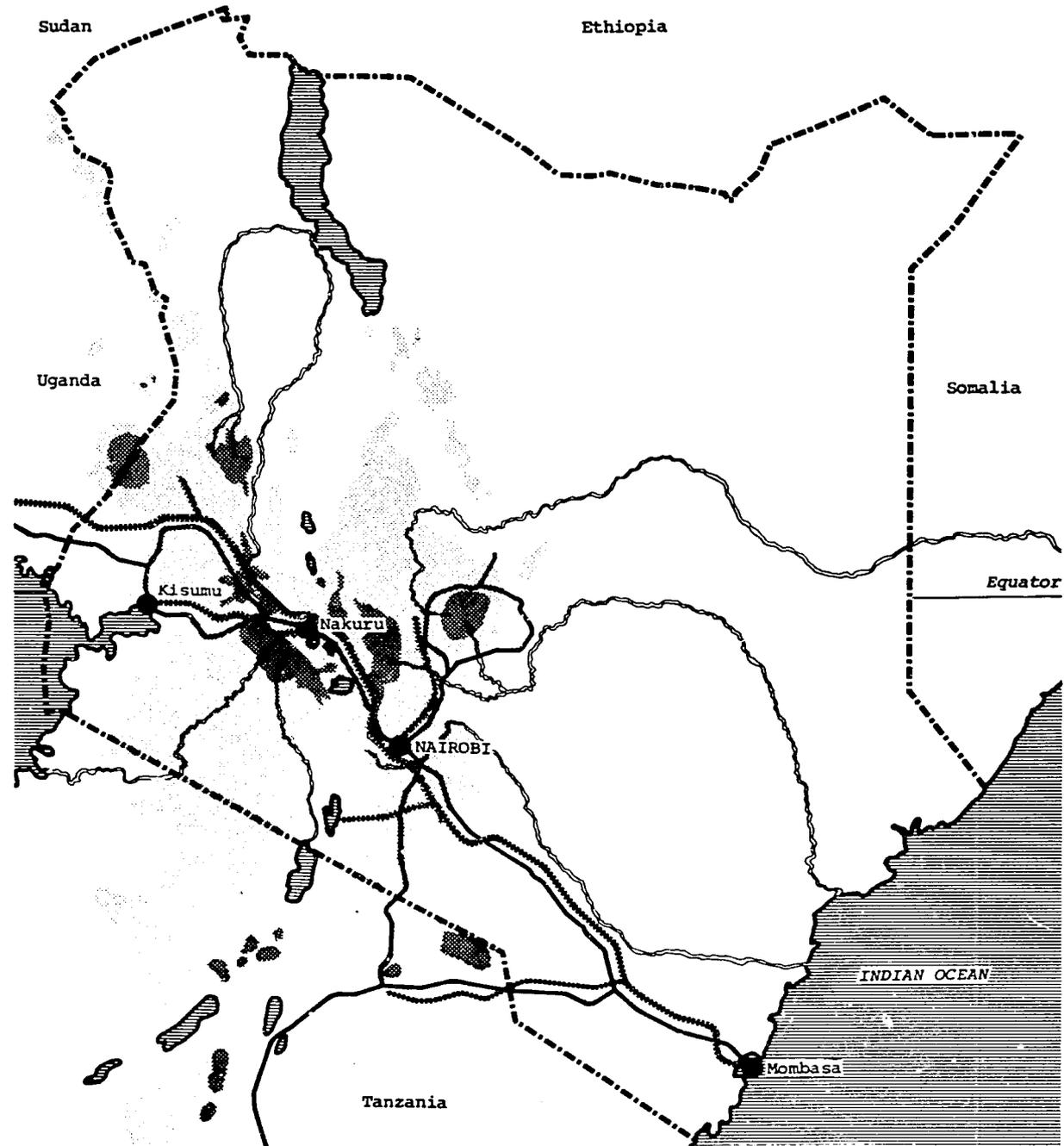
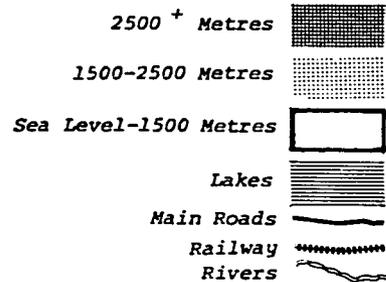


URBANIZATION IN KENYA

Urbanization as a major development in Kenya is a recent phenomenon. Prior to the establishment of European administration towards the beginning of this century, the only urban centers existing in East Africa were the Arab trading centers along the coast. Urban centers inland are a European creation, evolved by imported notions and planning practices. Ninety per cent of the inland urban centers began as railway centers during the construction of the Uganda Railway, and grew as bases for administrative and commercial activities along the route from the coast to Lake Victoria.

At present the number of urban centers with a population of 2000 or more inhabitants is relatively low, and the urban centers are small in size compared to those in many other parts of the world. However, the growth of urban centers in Kenya during the last two decades has been very rapid and follows urbanization trends in other developing countries. The latest census carried out in 1969 showed an urban population of about 1,000,000 distributed over 48 urban centers, though more than half of this population is accounted for by Nairobi alone.

Current trends indicate that by the year 1980 the total population of Kenya will have grown from its present 10,940,000 to 16,000,000. A continued urban population growth rate of 7.1% per annum will result in an urban population of 2,200,000 by 1980 or 15.1% of Kenya's total population at that time. By the year 2000 urban centers throughout Kenya will have to accommodate 26%-32% of the country's population. Nairobi will remain the biggest and most important urban center in Kenya; it is projected to grow five-fold from its present 509,000 to 2,500,000 during the period 1970-2000.



NAIROBI METROPOLITAN AREA

Topography: Nairobi lies on the border of two topographically different areas. To the south there are the wide expanses of the Athi and Kapiti Plains. To the north the land rises to form dissected 'stream valleys'.

Circulation: Nairobi is well served by roads and railways. The main routes are southeast and south to Mombasa and Tanzania, and northwest via the highlands to Lake Victoria and Uganda. There are regular train and bus services to many centers, and the city has an extensive public transport network. Nairobi airport at Embakasi, about 14 km southwest of the city is equipped to deal with the largest aircraft in international service.

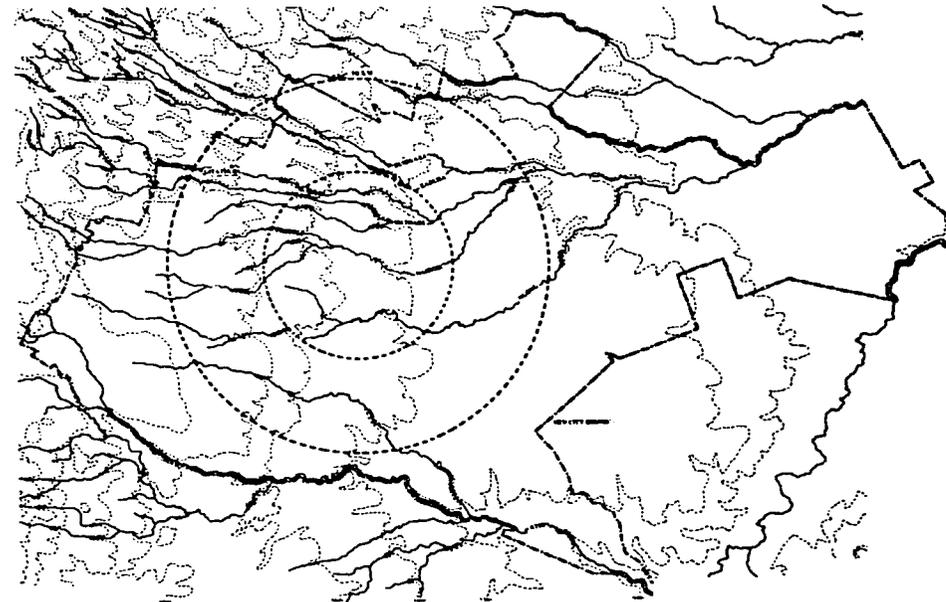
Residential Densities: The higher density residential districts such as Eastlands, Eastleigh, Pangani and Mathare Valley are concentrated in the east and northeast of the central business district. The medium density districts like Parklands are in the north and northwest while the low density districts extend westward. A comparatively low overall density figure of 28 persons per gross hectare tends to mask the wide variations that exist between different parts of the city. At one extreme there are areas in the east with a net density of 465 persons per hectare and at the other a figure of less than one for Karen in the west.

Income Distribution: The residential densities map also reflects the income distribution pattern in the city, with the majority of the people with lower income levels occupying the high density residential areas. The medium and higher income level groups are in the medium and low density areas respectively.

Land Use: The city has a clearly differentiated central commercial core accommodating business offices and commercial facilities, Government and Nairobi City Council offices. Industrial activities are accommodated in the level area extending southwest from the railway station. Residential areas are primarily located to the northwest, west and east of the central business district. The city boundary includes two forests, the Ngong Forest and the Karura Forest in the west and north of the city center respectively; and a comparatively large game reserve, the Nairobi National Park in the south.



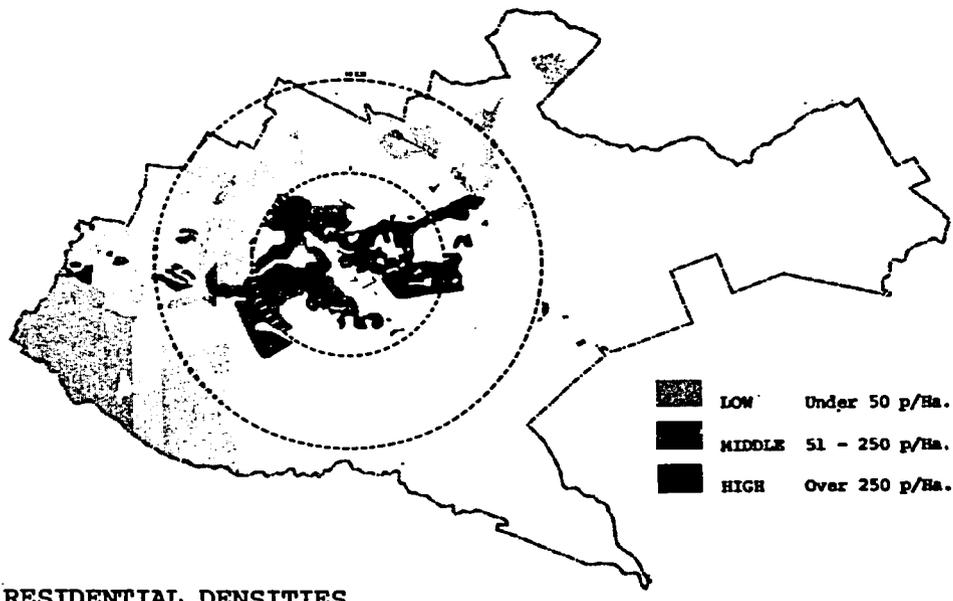
AIR PHOTO



TOPOGRAPHY

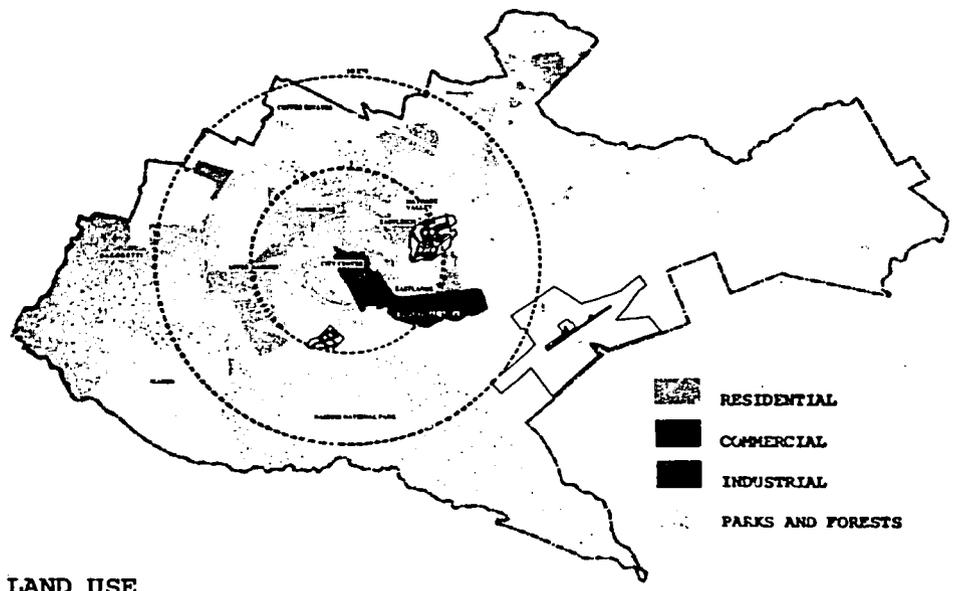


CIRCULATION



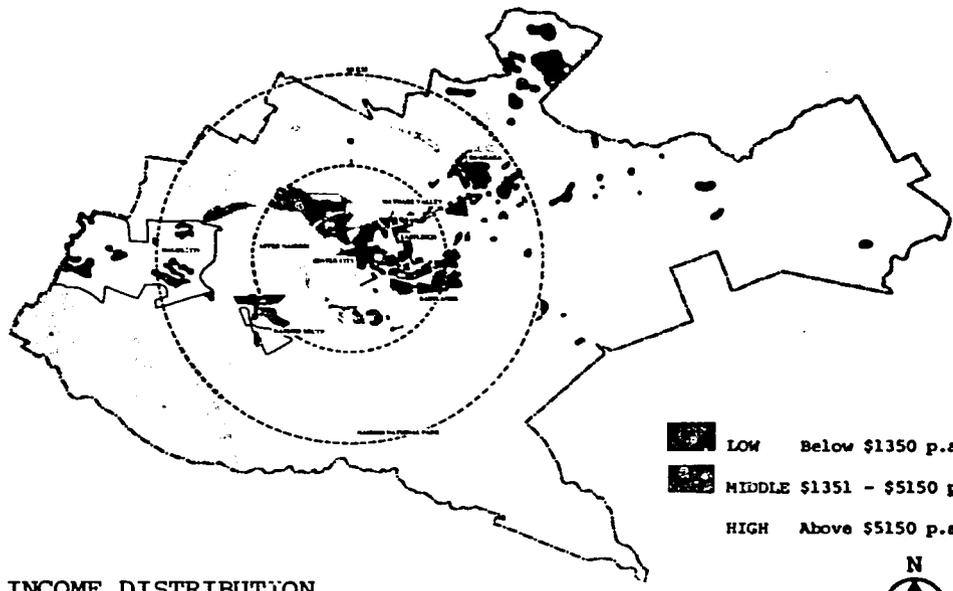
-  LOW Under 50 p/Ba.
-  MIDDLE 51 - 250 p/Ba.
-  HIGH Over 250 p/Ba.

RESIDENTIAL DENSITIES



-  RESIDENTIAL
-  COMMERCIAL
-  INDUSTRIAL
-  PARKS AND FORESTS

LAND USE



-  LOW Below \$1350 p.a.
-  MIDDLE \$1351 - \$5150 p.a.
-  HIGH Above \$5150 p.a.

INCOME DISTRIBUTION

SCALE 1:400,000 

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It is regretted that references have not been noted in the text. The following articles and publications have provided background information:

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