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CITY OF JOHANNESBURG

CITY ENGINEER'S DEPARTMENT

FORWARD PLANNING : INTERIM REPORT NO. 2.

JOHANNESBURG : ITS RELATIONSHIP TO THE
PRETORIA-WITWATERSRAND-VEREENIGING REGION AND
ITS METROPOLITAN SPHERE OF INFLUENCE

B. L. LOFFELL.

CITY ENGINEER.

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The photograph on the cover is of the City Centre and
portion of the Metropolitan Region to the east, by
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1 : INTRODUCTION.

The primary object of this report is to highlight factors bearing on the formulation of plans for Johannesburg of the future. In due course comprehensive regional reports of extreme importance to Johannesburg and the region are expected from the Natural Resources Development Council, which is at present analysing information collected from a series of extensive studies of the Pretoria-Witwatersrand-Vereeniging Region.

In the late 1950's Dr. L.P. Green, then Research Officer in the Town Clerk's Department, studied and reported on Johannesburg in its regional and metropolitan setting in three interim reports:-

- 1st Interim Report : The Social Structure of the Witwatersrand Metropolitan Region,
- 2nd Interim Report : The Economic Structure of the Witwatersrand Metropolitan Region, and
- 3rd Interim Report : The Administrative Structure of the (Incomplete) Witwatersrand Metropolitan Region.

These reports have provided a sound source of reference. Additional information has been assembled from studies undertaken by officials of the Council on its own and on behalf of the Natural Resources Development Council.

The more detailed objects of the report are:-

- (i) to describe briefly Johannesburg in its National, Regional and Metropolitan setting;
- (ii) to describe in some detail the characteristics and structural elements of the region;
- (iii) to indicate growth factors and to compare statistical data;
- (iv) to attempt to define the boundaries of the inner metropolitan area;
- (v) to draw attention to factors linked with Government policy which can limit, control or inhibit development;
- (vi) to summarise the planning factors that should be considered in preparing the plan for Johannesburg of the future.

2 : JOHANNESBURG IN ITS GEOGRAPHICAL, NATIONAL,
REGIONAL AND METROPOLITAN SETTING.

2.1 GEOGRAPHICAL:

Physical Geography - the city of Johannesburg is situated in latitude 26 degrees 11 minutes South and longitude 28 degrees 4 minutes East, at a mean altitude of 5,850 feet above sea level. It is placed almost at the northern limit of the highveld area of the Transvaal Province and almost in the centre of the Witwatersrand Goldfields, which extend roughly eastwards and westwards over a total distance of approximately 88 miles.

The municipal area of the city and its suburbs is 94.46 square miles. The extreme length is $11\frac{1}{2}$ miles and extreme width $11\frac{1}{4}$ miles. In addition, the Council owns and controls Bantu townships 21.17 square miles in extent situated on the south-western boundary of the city but not within the defined area of the municipality. Other land owned and controlled by the Council outside its own boundaries covers a total area of 52.71 square miles and is used for various functional purposes such as sewage disposal works and farms, an electricity power station and parks.

The climate of Johannesburg is essentially temperate. Generally the days are bright and warm and the nights cool. The humidity is low in winter and there is a marked diurnal variation in temperature. The average daily period of sunshine is 8.7 hours, which is 72% of the possible amount of sunshine.

2.2 NATIONAL:

The principal sea ports serving Johannesburg are Durban, 400 miles away, Lourenco Marques in Portuguese East Africa, 380 miles away, and to lesser extents East London, Port Elizabeth and Cape Town - the last named being approximately 1,000 miles away.

Johannesburg is very much the focal point for the network of rail and road facilities linking the Republic's main activities.

Approximately 7% of the total South African population and 13% of the total White population is resident in Johannesburg. However, Johannesburg does approximately 40% of the country's wholesale business, 18% of the retail trade, 40% of the turnover of the municipal produce markets, 35% of the financial and banking business, and despite a lack of heavy industries, 20% of the national industrial income is produced by industries in Johannesburg.

2.3 REGIONAL

Johannesburg forms the core of the Southern Transvaal and the Pretoria-Witwatersrand-Vereeniging (P.W.V.) Region. The Southern Transvaal, with the addition of the gold mining and other activities in the northern portion of the Orange Free State, is the heartland of the Republic's greatest economic or human-use region which, founded on the extraction of gold, uranium, coal and iron from rich geological formations, extends in a wide arc from Witbank in the east, westwards through Pretoria to Klerksdorp, and thence southwards via Vereeniging to Welkom, Odendaarsrus, Virginia and the gold mines of the Orange Free State.

The P.W.V. Region contains the greatest urban concentration in the Republic. In the north is the metropolitan complex of Pretoria, the Administrative Capital, its steelworks and the border industrial complex. In the centre is the Witwatersrand metropolitan region stretching lineally from Springs in the east to Krugersdorp and Randfontein in the west, a distance of some 55 miles and an area of approximately 600 square miles.

To the south is the Vereeniging-Vanderbijl-Sasolburg metropolitan complex in which is to be found the main Iscor Steelworks, the Oil-from-Coal Works at Sasolburg, and other primary and secondary industrial activities. The region's water supply is collected in the Vaal Dam, which falls in this general region.

Figure 2.1 indicates the boundaries of the P.W.V. region and the main metropolitan regions.

2.4 THE WITWATERSRAND METROPOLITAN REGION

The Witwatersrand Metropolitan Region is dominated by the city of Johannesburg which, together with the city of Germiston, forms its nucleus or central core. The origins of the Witwatersrand Metropolitan Region lie in the discovery of gold and the proclamation of mining camps from 1886 onwards along the "banket" reef, that runs parallel to and south of the east-west ridges of the Witwatersrand; and its prosperity has been linked to that of gold mining ever since. Towns and cities developed from the mining camps perched on a watershed of rocky hills between 5,500 and 6,000 feet above sea level in an uncompromising and harsh natural landscape that had hitherto held out little promise of urban growth.

This metropolitan region will be dealt with in greater detail in the following chapter.

2.5 POPULATION:

L.P. Green's first interim report on the social structure of the Witwatersrand Metropolitan Region contains a detailed analysis of population trends in the Witwatersrand Metropolitan Region and comparisons of national, provincial and metropolitan population growth from 1911.

An additional reference providing a background to population growth and particularly population movements is contained in a study by Dr. Fair:

"The Core-Periphery Concept and Population Growth in South Africa 1911 - 1960"⁽¹⁾.

Some of the conclusions drawn by Green and Fair are relevant to this report and warrant highlighting.

Firstly, there is the population growth of the main nodal employment conurbations in the Republic and the movement of White and Bantu population from the rural areas to the urban conurbations. The dual process of urbanisation and depopulation of rural areas is thus reflected.

Secondly, the rapid increase of population in the Witwatersrand Metropolitan Complex was proportionately higher than the national increase in the decades prior to the war, later declining as other centres such as Durban and the coastal cities of the Cape have experienced strong development in the post-war period and attracted a strong movement of population.

Thirdly, that the outstanding regional growth of population has occurred in the Southern Transvaal and the immediate peripheral zone. Together these two areas accounted for 12.5% of all races in 1911 and 24.5% in 1960 and for 23.4% of Whites in 1911 and 41.7% in 1960 (Fair P.63). Fair goes on to state in respect of the Southern Transvaal Region: "Thus there is emerging an enlarged core consisting of a system of cities, a pattern which first characterised the United States about the turn of the century" (P.68).

Finally, the assessment is made by L.P. Green and substantiated by statistics of the past pattern of intensive residential development around the core (Johannesburg) of the Metropolitan Region and he forecasted that population of the magisterial districts of Johannesburg, Germiston and Roodepoort would form an ever-increasing percentage of the population of the Witwatersrand Metropolitan Region.

(1) Published in the South African Geographical Journal, Volume 47, December 1965.

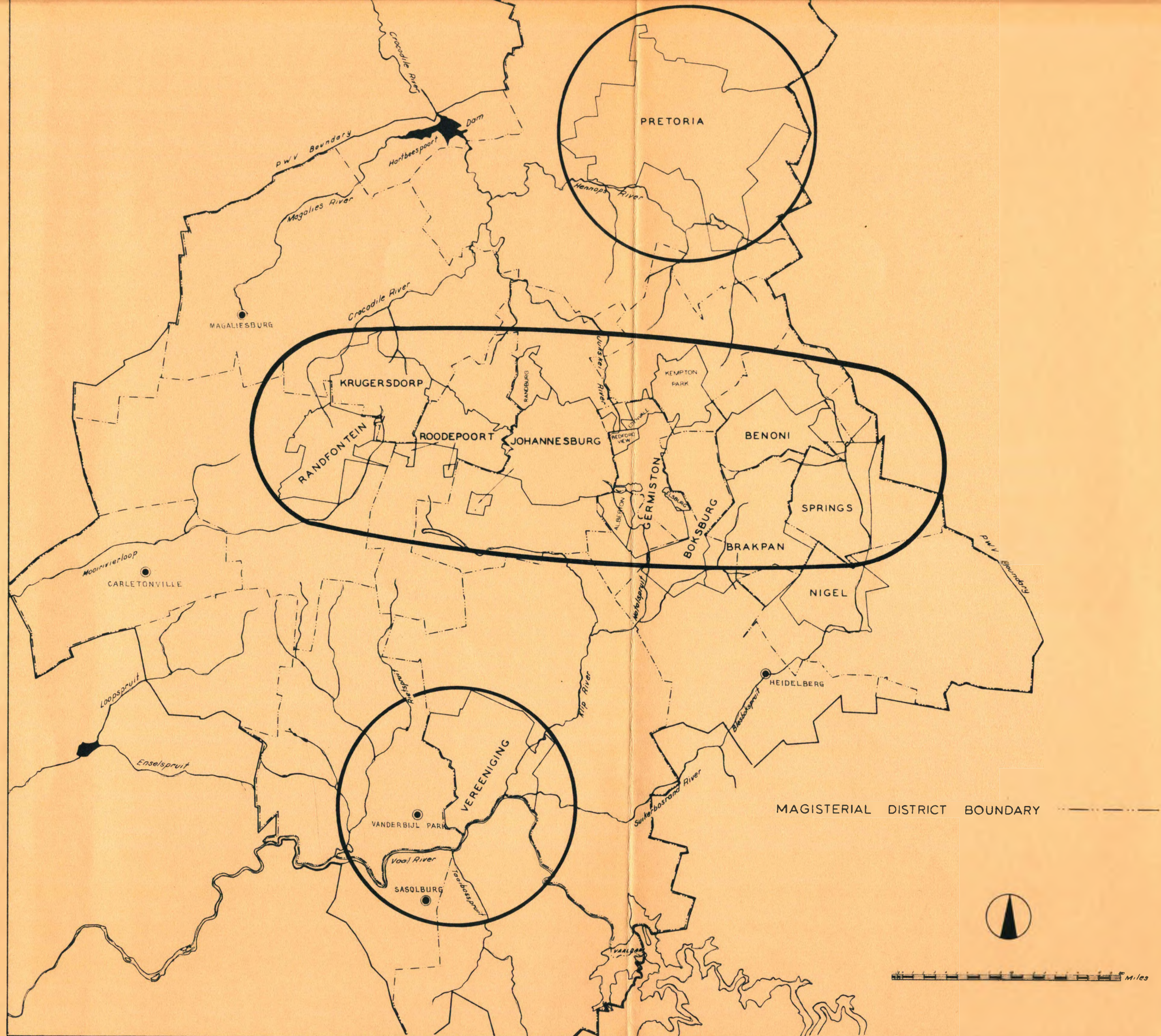


FIGURE 2.1

P.W.V. AREA AND THE THREE MAIN METROPOLITAN REGIONS

It is desirable to place on record the population figures since the beginning of the century in respect of the Republic, the Transvaal, the Witwatersrand, the Johannesburg Metropolitan Area, the Johannesburg Magisterial Area and the Johannesburg Municipal Area. Projections have been made to 1970, the year of the next census. In making these projections, difficulty has been experienced in assessing the weight carried by the immigration flow and it is probable that it will only be after the figures of the 1970 census are available that it will be possible to make reasonably accurate projections for the future.

The tables featuring the population figures referred to above will be found in Appendix A, which also contains a description of the census areas in question.

The following table summarises the average annual percentage increases actual, and projected, in the White population since 1936:-

***TABLE 2.1 : COMPARISON OF AVERAGE ANNUAL PERCENTAGE INCREASE IN WHITE POPULATION:**

Census Year	Republic	Transvaal	Witwatersrand	Johannesburg		
	%	%	%	Metro-politan %	Magis-terial %	Municipal %
1936 to 1946	1.6	2.7	3.0	-	-	-
1951	2.2	2.5	3.5	2.1	2.2	2.0
1960	1.7	2.2	1.8	1.4	1.2	0.9
1965	2.9	3.3	3.0	2.7	2.5	2.2
1970	5.3	5.6	5.4	5.1	4.9	4.7

An examination of Table 2.1 endorses Dr. Green's finding that prior to the war the rate of growth of the Witwatersrand was considerably higher than the national growth, evening out in the post-war period. The effect of immigration policies is very strongly reflected in this table. The large average annual percentage increase in the 1946 - 1951 period bolstered by immigration fell rapidly in the 1951 - 1960 period when immigration was a mere trickle and financial restrictions retarded the development of the country. The boom and the strong flow of immigrants since 1960 has sharply increased the annual rate and an assessment thereof has been made for 1965 and 1970. As has already been indicated, it will be only after the 1970 census figures are available that a realistic forecast can be made for the decades to follow.

* Calculated from Tables in Annexure A.

3 : THE PRETORIA-WITWATERSRAND-VEREENIGING REGION.

3.1 COMMUNICATIONS:

Owing to the region's importance as an economic unit in the structure of the Republic and the fact that it contains the Administrative Capital, Pretoria, the region is a focal point for rail, road and air communications from the rest of the Republic and also from outside its borders. The dynamic nature of the region has also required a network of communications to be planned for movement within the region. Figure 3.1 indicates the main rail, road and air communication facilities.

3.1.1 Rail Communications:

Rail links form an important part in the structure of the region. Firstly, there is the main north-south line from Vereeniging via Germiston to Pretoria. South of Vereeniging this line continues to the Free State and to the Cape.

In both the Pretoria and Witwatersrand complexes there are the east-west railway lines; those to the east link the two complexes to the important port of Lourenco Marques and to the fruit and food producing farmlands of the Eastern Transvaal. The western and south-western lines link to places of valuable mineral exploitation and the main beef producing areas.

Germiston is a key railway transportation centre, as it also serves as the junction to the Natal line and consequently the port of Durban.

Other rail connections include the main line to the Cape via Kimberley, which runs in a south-westerly direction from Johannesburg.

The east-west route through the Witwatersrand complex provides a commuting service to Johannesburg from Springs on the east and Krugersdorp and Randfontein on the west.

3.1.2 Road Communications:

While railways form a most important communication system within the region and particularly to the rest of the country, the region is vitally dependent on highway traffic for its existence.

The region is served by a system of national, provincial, district and municipal roads forming a fairly close network over the whole area.

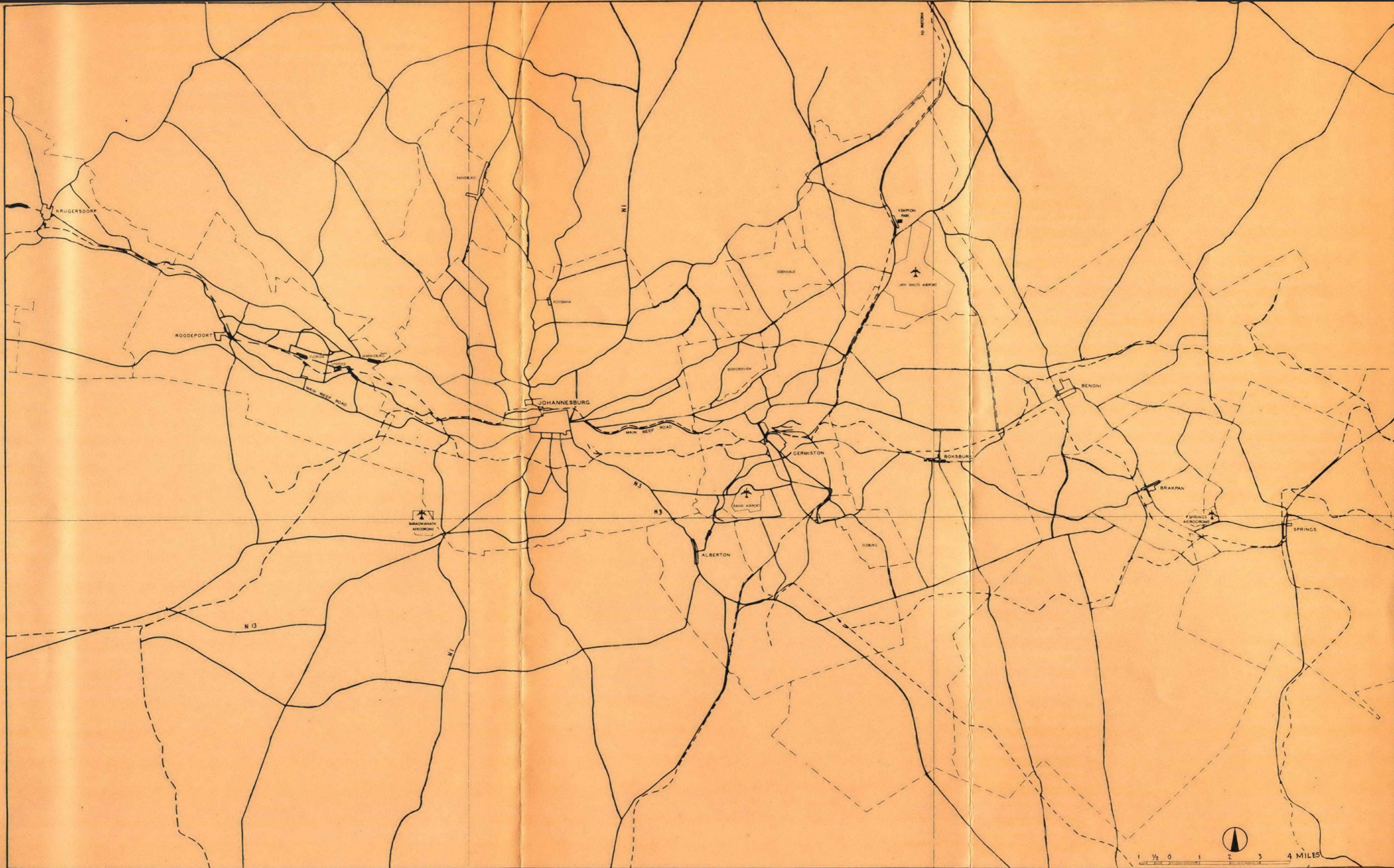


FIGURE 3-1

MAIN RAIL, ROAD AND AIR COMMUNICATIONS OF THE WITWATERSRAND

The national road system in the region consists of three roads. Firstly, there is the main north-south highway, N1, from Bloemfontein to Messina passing diagonally through Johannesburg from the south-west to the north-east and then through Pretoria. Secondly, there is the main highway to the south-west, N13, from Johannesburg to Kimberley and thirdly, the main highway to the south-east, N3, from Johannesburg to Durban. This primary system consists in the main of single two-lane carriageway roads in the rural areas between towns. On the approaches to Johannesburg they become dual carriageways and in the densely built up areas become indistinguishable from municipal main roads. None of the roads is to motorway standards.

The provincial road system provides a network of arterial roads between towns to supplement the national road system. This network provides direct connections between all towns and cities in the region as well as many radial and ring roads. The provincial road system, like the national road system, is in the main a single two-lane carriageway network. No provincial roads are to motorway standards.

The Main Reef Road, the most important arterial of the region, is a provincial road which runs the full length of the Witwatersrand in the vicinity of the outcrop of the gold-bearing reefs. The road is generally of low geometric standard, but carries an extremely heavy volume of traffic having a high proportion of industrial vehicles.

The district road system provides further arterial and collector facilities between areas which are mainly rural. Some of these roads carry fairly high volumes near the urban areas.

The majority of the routes within and through the towns and cities of the region are municipal roads and it is these roads that carry the heaviest traffic volumes. Again there are no roads of motorway standard in the urban areas.

Although at present there are no motorways in the P.W.V. region, the National Transport Commission, the Provincial Roads Department and the Johannesburg City Council are planning a network and portions of this network are at present under construction.

The proposed through road system for the P.W.V. region will consist essentially of a ring road surrounding the greater Johannesburg area with radial roads extending out from the ring road to Pretoria, Kempton Park, Benoni, Springs via Germiston, Heidelberg and Vereeniging. These through roads will be built to motorway standards.

Within the ring road there will be a north-south motorway running from the south-west to the north-east across Johannesburg and the peri-urban area in the north and an east-west motorway will cross Johannesburg just south of the outcrop of the gold-bearing reefs.

3.1.3 Air Communications:

There are a number of aerodromes in the P.W.V. Region. The chief of these is the Jan Smuts Airport handling international traffic and is the main entry and exit port of the Republic. It handles approximately 2,500 passengers a day, considerable freight, and employs approximately 1,000 people. It is consequently a heavy surface traffic generator. The proposed Provincial motorway network is designed to provide easy access from most of the region.

Surface traffic between the airport and Johannesburg is particularly heavy and has necessitated reconstruction of the link to Johannesburg with the ultimate objective of having a motorway standard to the Johannesburg municipal boundary. The route from the boundary to the centre, in terms of the present Traffic Plan, is to be improved, but will remain a non-motorway arterial only.

Jan Smuts Airport has, in addition, become a major recreational centre over the weekends, attracting crowds to watch the arrival and departure of aircraft.

Next in importance is the Rand Airport, which is owned and controlled by the City Council of Johannesburg. This aerodrome, which is practically surrounded by the municipality of Germiston, is connected to Johannesburg by a dual carriageway road. The Rand Airport is a commercial aerodrome providing extensive charter flight facilities and at present it handles approximately 24,000 flights a year.

Two other aerodromes offering commercial facilities and also facilities for training are the Grand Central Airport, midway between Pretoria and Johannesburg at Halfway House, and Baragwanath Aerodrome to the south of Johannesburg. Neither is a heavy surface traffic generator except when occasional air rallies take place.

There are military aerodromes at Swartkop and Lyttelton to the south of Pretoria and at Dunnottar to the south of Springs.

There are also commercial aerodromes at Pretoria North, Geduld and Brakpan on the East Rand, Krugersdorp on the West Rand, and to the south at Vanderbijl Park and Vereeniging.

3.2 PRETORIA METROPOLITAN REGION:

Pretoria, as the capital of the old Republics and now the Administrative Capital of South Africa, for many decades offered work opportunities almost solely confined to civil servants. The lack of work opportunities caused the establishment of many "poor" peripheral suburban areas, a legacy which still exists. The establishment of the Iscor Steel Works, together with the border industrial areas north of Pretoria and ancillary by-product activities has increased the work opportunities extensively.

With the growth of the nation, the civil service activities of Pretoria have expanded enormously and Pretoria over the past decade has experienced extraordinary boom development conditions.

Pretoria is a focal point for movements of people and goods from the rest of the region and the vehicular traffic on routes leading to it is consistently heavy.

3.3 THE VEREENIGING METROPOLITAN REGION:

The presence of large deposits of low grade coal suitable for industrial purposes and, formerly, an abundance of water, made the town of Vereeniging the centre of a large industrial and power complex. In addition, the Vaal River and tributaries provide aquatic recreational facilities for the region. Large power stations serving the region and the northern Free State have been erected. Vanderbijl Park is the centre of the steel and allied industries, whilst the Oil-from-Coal Works at Sasolburg plays a very important part in the national economy.

The situation of two complexes with similar activities at either end of the region has naturally resulted in desire lines of movement being created. These will undoubtedly be a feature of the analysis by the Natural Resources Development Council and any strong movements apparent between the north and the south of the region will undoubtedly be taken care of outside the main urban concentration of Johannesburg and its environs.

Substantial road and rail traffic exists between the Witwatersrand complex and Vereeniging, but as yet there has been no attraction or influence on the development of the Witwatersrand complex towards Vereeniging other than the lineal development following the railway line from Germiston and Alberton.

3.4 THE WITWATERSRAND METROPOLITAN REGION:

Historically this region is linked to the extraction of gold. In the post-war period, however, this structure has been changing and with industry and commerce rapidly advancing, the existence and structure of the metropolitan region is very largely becoming a function of communication. Gold mining is on the decline and while new gold mining ventures are being opened up to the east, west and south, the mines along the Witwatersrand are being successively closed.

L.P. Green observes: *

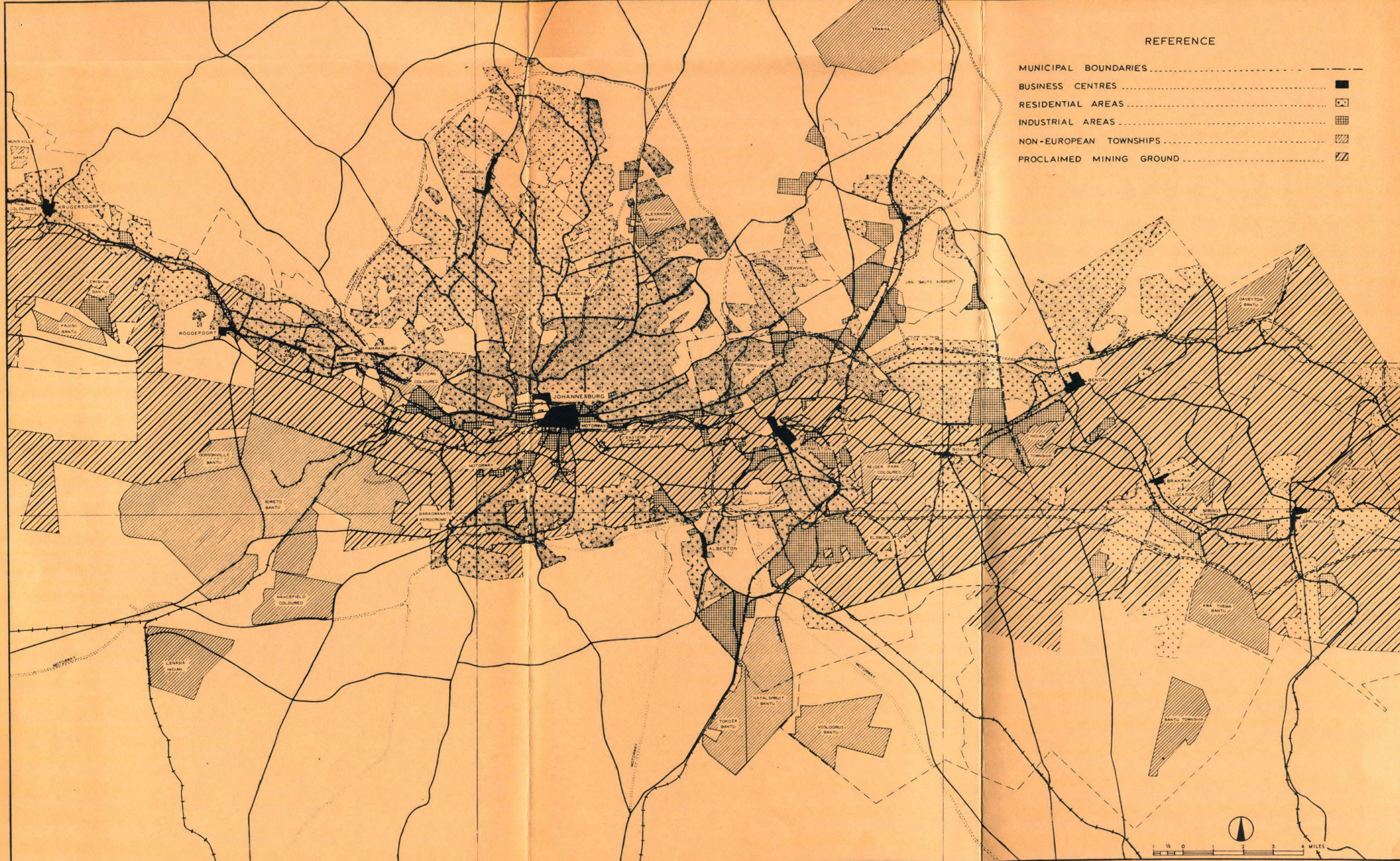
"..... most metropolitan regions appear to have two main physical boundaries. The first is an inner boundary some ten to fifteen miles distant from the city hub, which defines the metropolitan zone proper and embraces that population which is in daily contact with the hub for purposes of work or marketing. The second is an outer boundary that embraces more remote areas whose inhabitants, although not necessarily in daily contact with the hub, are economically dependent on it for many specialised functions and services.

As Figure 3.2 reveals, the physical pattern of the Witwatersrand is no exception to this general rule and immediately confirms the existence of a metropolitan region. The chief industrial areas are situated along an east-west corridor of mining and manufacturing which stretches with few significant gaps almost fifty-five miles from Springs to Krugersdorp and Randfontein. Thriving industrial off-shoots of this main corridor have grown in the directions of Kempton Park and Palmietfontein, to the north and south of Germiston along the north-south railway line, and a significant decentralisation is thus taking place presumably because of transport considerations and lack of space in the main corridor.

However, commerce and service activities⁽¹⁾ as a group normally engage the largest number of employees in metropolitan regions, and their particular influence on physical structure is therefore usually dominant.

* First Interim Report : The Social Structure of the Witwatersrand Metropolitan Region (Ps. 6 and 7).

(1) e.g., wholesale and retail trading of every kind; banking, insurance, accounting and other financial activities; estate, transport and travel agencies; the administrative headquarters of large industrial and commercial businesses.



REFERENCE

- MUNICIPAL BOUNDARIES - - - - -
- BUSINESS CENTRES ■
- RESIDENTIAL AREAS ▨
- INDUSTRIAL AREAS ▩
- NON-EUROPEAN TOWNSHIPS ▧
- PROCLAIMED MINING GROUND ▨

FIGURE 3.2

PHYSICAL DEVELOPMENT OF THE WITWATERSRAND

"Moreover, unlike industry, this group tends towards centralisation on the wholesale side, and the economies of large scale are often significant in the retail trade. Thus, quantitatively speaking, the most important work areas on the Witwatersrand are in fact the central business districts of its towns and cities. By far the greatest of these is Johannesburg's. The influence of this central business district, tempered by the influence of the smaller centres and the location of mining and major manufacturing industries, has increasingly dictated the pattern of residential development.

The main densely-populated zone stretches without a break for seventeen miles from Roodepoort in the west to Fisher's Hill in the east, and then jumps gold-mining land to link up with Germiston, Boksburg and, quite possibly, Kempton Park and Benoni - a total distance of some thirty miles. It reaches its maximum width to the north and south of Johannesburg's central business district, where it extends northwards to include Alexandra township, Craighall and Ferndale, and southwards to include Alberton, Natalspruit, Turffontein and Nancefield - a total distance of some fourteen miles. The main axis of this inner zone is the mining, industrial and commercial corridor running from east to west and separating the major European concentration on the north side of the axis from the major Non-European concentration on the south side, and particularly to the south-west of Johannesburg.

This densely-populated zone is the inner metropolitan zone surrounding the regional hub of Johannesburg's central business district. The outer metropolitan zone is naturally less clearly marked, but it embraces at least Randfontein, Krugersdorp, Brakpan and Springs, and it extends northwards towards Halfway House on the Pretoria Road and southwards to at least the vicinity of the east-west valley of the Klip River and Palmietfontein, but possibly even beyond this limit towards Ennerdale and Nigel. The metropolitan region as a whole thus approaches 1,000 square miles in area, its inner zone covers up to 340 square miles, and its outer zone extends over a further 500 to 600 square miles. It tends to coincide with the magisterial districts of Springs, Brakpan, Boksburg, Benoni, Germiston (including Kempton Park), Johannesburg and Roodepoort, and the

"municipal areas of Krugersdorp and Randfontein; and these districts and areas are therefore used for statistical purposes throughout the rest of this survey.

As shown in Figure 3.1, the various parts of this vast region are linked together by a network of communications whose main axis is complementary to the main economic axis, and thus runs from the eastern edge to the western edge of the region. This axis consists of the heavily-trafficked railway system threading together the towns and cities along the Reef, and the parallel Main Reef Road, which carries more industrial and commercial traffic than any other road in the Union. In contrast to this lineal pattern of regional communications, a radial system of national roads pivots on Johannesburg and connects to Pretoria, Potchefstroom, Vereeniging and Heidelberg; a radial system of national railways pivots on Germiston and connects to these same places; and a radial local road system has been developed within the inner metropolitan boundary, whose hub is Johannesburg's central business district and whose pattern is the result of the pull exerted by that district on the surrounding residential areas".

Green concluded that the Johannesburg inner metropolitan region extended from Benoni to Roodepoort and from south of Bryanston to the hills south of Johannesburg's municipal boundary.

Subsequent developments indicate that this boundary is too restrictive in a north-south direction. The strong industrial and residential development of Alberton in the Palmietfontein area requires the southern boundary to be extended further south, while the extension of the residential commuting population northwards also requires an adjustment of the boundary northwards.

The following chapter deals with this inner metropolitan region in greater detail with regard to the structural framework and the metropolitan population. Chapter 4, Section 7, attempts to define its boundaries more accurately.

3.5 SERVICES:

3.5.1 Water:

All Witwatersrand urban areas receive their water supplies from the Rand Water Board. The Board obtains its water from underground sources as well as the Vaal River. In terms of existing legislation the Board may

pump 10 million gallons of underground water a day from boreholes in the wells at Zuurbekom, about 17 miles south-west of Johannesburg, 20 million gallons of water a day from the Vaal River Barrage and 195 million gallons a day from the Vaal Dam. In terms of a permit, the Board may abstract an additional 72 million gallons of water a day from the Vaal River, making in all a daily total of 287 million gallons.

During 1965 the average daily quantity of water sold was 210.091 million gallons, and the maximum quantity extracted from the Vaal River was 264.3 million gallons on the 5th March 1965. The quantity extracted is very close to the permitted maximum.

The water obtained from Zuurbekom, usually between 5 and 6 million gallons a day, augments the supply of Vaal River water to the West Rand.

The increase in post-war water consumption on the Reef is indicated by the following table:-

TABLE 3.1 : DAILY WATER CONSUMPTION - MILLIONS OF GALLONS*

Year	East Rand	West Rand	Johannesburg	Gold Mines
1945-1946	6.540	1.744	23.524	27.860
1955-1956	15.188	4.622	36.767	41.303
1964-1965	28.820	8.525	63.393	40.847

The water consumption figures of the residential areas to the north of Johannesburg indicate the rapid development which has taken place. In 1964, consumption amounted to 13.415 million gallons, or more than double the amount consumed in 1959.

The recent drought conditions have emphasised the need to increase and maintain sources of supply to the Southern Transvaal Region.

The cost of bulk water supplies depends on the class of consumer and varies from 10.25 cents per 1,000 gallons to 13.75 cents per 1,000 gallons. The average charge for water has been reduced considerably over the past 60 years. In 1905, 1925, 1945 and 1951 the average cost of water per 1,000 gallons was 49.54 cents, 21.18 cents, 8.73 cents, and 8.00 cents respectively.

Since 1951 there has been a slight annual increase, the price of water being 10.51 cents per 1,000 gallons in 1965.

* Rand Water Board Annual Report 1965.

The Board supplies the water in bulk to local authorities who are then responsible for the reticulation of water in their areas of jurisdiction.

3.5.2 Electricity:

The Rand and Orange Free State Undertaking of Escom is the principal supplier of thermal power on the Witwatersrand.

New projects planned by Escom will supply high voltage current from large new pithead power stations located to the east of Johannesburg where coal is cheap but the 1966 drought gives rise to concern regarding the adequacy of water supplies. The Transvaal, and particularly the Witwatersrand, can be assured of adequate power supplies to meet the requirements of future growth.

The amount of electricity consumed by the mines and industry over the past 26 years gives an indication of the growth of the Witwatersrand, as well as the increasing importance of industry.

In 1939 Escom sold 3,500 million units of which the mines used 88% and in 1965 Escom sold 16,000 million units of which the mines used 59%.

A notable feature concerning power supply on the Rand is that the present cost of 0.4 cents per unit has remained practically unchanged since 1939 and is one of the cheapest areas of thermal power supply in the world.

Johannesburg generates its own power and interconnection with Escom is maintained for emergencies. All other urban areas on the Witwatersrand receive their power supplies from Escom.

In addition to supplying the 94 square miles of municipal area with electricity, Johannesburg also supplies the Bantu township in Soweto and some townships under the jurisdiction of the Peri-Urban Areas Health Board, which abut onto the municipality, a total area of supply of 147 square miles.

Johannesburg has continually extended its power generating facilities and in April 1966 recommended to the Administrator of the Transvaal Province that it be permitted to erect a new power station to the south-east of the city. Three of the main reasons why Johannesburg is able to continue producing cheap electricity are that sewage effluent is used for cooling purposes, the consumer zones are compact and coal which is unsuitable for industrial, commercial or household purposes, can be used for power generation. This duff coal is a marginal product of the coal mines comprising about 24% of output and was formerly considered waste, but because

modern power station furnaces consume pulverised coal, this coal can now be utilised. The Council is at present able to purchase this type of coal very cheaply and is supplied from several coalfields located within a radius of 100 miles of the city.

Johannesburg has increased the units of electricity sold to municipal consumers from 319 million units in 1939 to 1,802 million units in 1965. At present, power is generated at Orlando, Kelvin "A", Kelvin "B" and an emergency plant comprising two 22 M.W. gas turbines will be commissioned in April/May 1967 at the City Power Station adjoining the Central Area.

3.5.3 Sewerage:

It is a well known aspect of sewage purification economics that, up to certain limits, the greater the quantity of sewage treated, the lower the cost per gallon. For this reason it is desirable for local authorities located in the same drainage basin to embark upon joint sewerage schemes of a regional character rather than develop individual schemes.

Johannesburg's sewerage system is in fact a regional scheme serving the convenience and public health needs of a large part of the Central Witwatersrand urban complex, and it falls into four natural drainage basins which are briefly described.

(a) The northern drainage basin serves all areas lying to the north of the Witwatersrand Ridge, which includes the northern portion of Hillbrow and the northern suburbs. It also provides a sewerage service to Bedfordview, Edenvale, Randburg and part of Germiston and the Peri-Urban Areas Health Board. The sewage is treated at the Diepsloot Disposal Works which is situated 26 miles north of the city and serves a present population of approximately 385,000.

(b) The south-western basin drains the central area of the city, southern Hillbrow, most of the Southern Suburbs as well as Roodepoort-Maraisburg to the Klipspruit Sewage Purification Works.

(c) In the Olifantsvlei Basin is located the Olifantsvlei Sewage Purification Plant which serves the Bantu townships of Soweto housing approximately 600,000 people.

(d) The south-east quadrant of the city between the Main Reef Road and the southern and eastern boundaries of the municipality drains into the south-eastern basin. The sewer serving this basin has been partially

constructed and when complete it will be approximately 32 miles long. The sewage flowing from this basin will be purified at the Olifantsvlei Sewage Works. This sewer will also drain the townships in the Peri-Urban Areas on the south of the city and will no doubt accelerate the development of this area. It is also suitable for the development of a regional scheme to accept sewage from Alberton, Germiston and Boksburg, all of which lie in this valley.

To the east of Johannesburg there is an eastern basin in which the towns of Benoni, Brakpan, Springs, Dunnottar and Nigel are located. Germiston has established the Rondebult and Dakema sewage purification works serving both Germiston and Boksburg. The positions of the main sewage disposal works are shown on Figure 3.3.

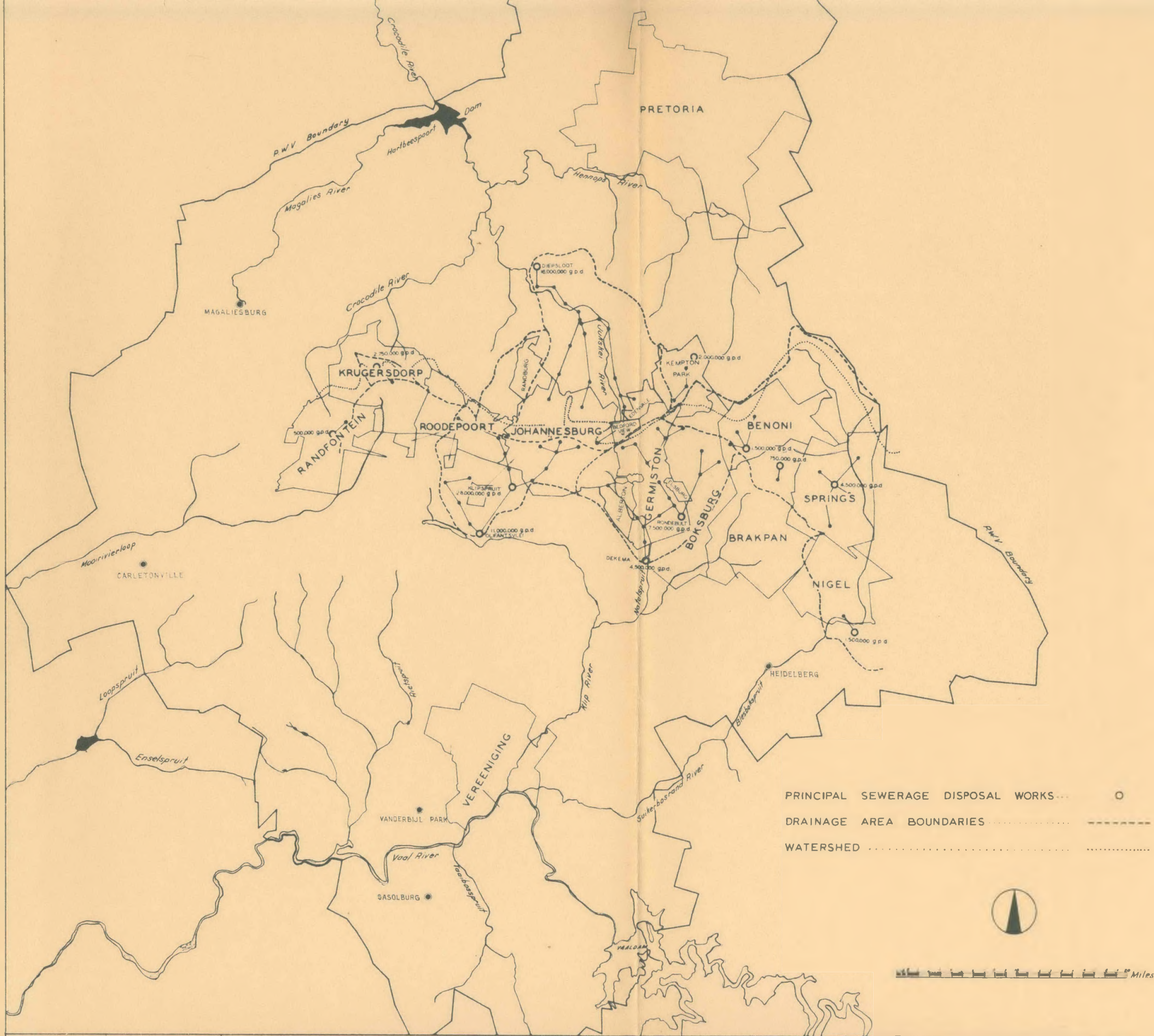


FIGURE 3.3

MAIN DRAINAGE AREAS OF THE WITWATERSRAND

4 : DEVELOPMENT AND GROWTH FACTORS
STATISTICAL COMPARISONS : INNER
WITWATERSRAND METROPOLITAN REGION.

4.1 POPULATION:

The principal towns, cities and urbanised areas which fall in the Inner Witwatersrand Metropolitan Region are Johannesburg, as the core, with Randburg and Greater Sandown* immediately to its north. To the east are Edenvale, Bedfordview, Germiston and Alberton with Kempton Park slightly further to the east and Boksburg and Benoni further afield. To the west is Roodepoort and the urban area known as the Johannesburg North-Western Area. Linked with Johannesburg is its dormitory Bantu city of Soweto.

The sizes of the municipal areas, together with population figures in terms of the 1960 census and the percentage increase in population since 1951, are contained in the following table:-

TABLE 4.1 : POPULATION OF CITIES AND TOWNS - CENSUS 1960.

City or Town	Area Square Miles	Population 1960			% Increase White Population since 1951
		White	Non-White	Total	
Johannesburg	94.46	368,987	226,096	595,083	8.1
Soweto Complex	26.90	-	440,521	440,521	-
Roodepoort	45.10	40,908	54,303	95,211	38.9
North-Western Area	9.70	3,882	1,546	5,428	125.7
Randburg	12.10	8,707	3,153	11,860	45.9
Greater Sandown	46.40	18,992	13,201	32,193	118.9.
Edenvale	6.50	10,865	19,669	30,534	94.3
Bedfordview	5.00	3,264	2,024	5,288	30.1
Germiston	52.00	56,954	91,148	148,102	22.3
Alberton	13.61	11,539	13,621	25,160	31.8
Kempton Park	29.82	10,698	7,065	17,763	95.4
Boksburg	76.24	27,596	43,433	71,029	12.1
Benoni	47.97	33,386	89,116	122,502	17.9

In order to obtain an assessment of White population trends since 1960, development figures for new dwelling units have been extracted from the records of the Bureau of Statistics for the period 1961 - 1965. Figures in respect of Randburg and the Greater Sandown Area were obtained from the Randburg Municipality and the Peri-Urban Areas Health Board. These figures are reflected in Table 4.2, together with an estimate of the increase of population.

*The areas of Bryanston, Sandown and North-Eastern Local Area Committees of the Peri-Urban Areas Health Board.

TABLE 4.2 : DWELLING UNITS ERECTED PERIOD 1961 - 1965 INCLUSIVE.

City or Town	Dwellings	Flats	Total	Rooms	Estimated Increase in Population (White)	% Increase on 1960 Population
Johannesburg	1,925	3,776	5,701	987	19,298	5.2
Roodepoort	1,312	438	1,750		6,789	16.5
North-Western Area	526	181	707		2,734	70.4
Randburg	2,844	558	3,402		13,796	158.4
Greater Sandown	3,209	322	3,531		14,844	78.1
Edenvale	850	46	896		3,840	35.3
Bedfordview	144	28	172		698	21.3
Germiston	1,232	463	1,695	28	6,502	11.4
Alberton	604	280	884		3,309	28.6
Kempton Park	1,553	604	2,157		8,237	77.0
Boksburg	518	124	642		2,565	9.3
Benoni	751	585	1,336		4,671	13.9
TOTAL:	15,468	7,405	22,873	1,015	87,283	-

*NOTE: Family size for houses has been taken at 4.39 and for flats at 2.35.

The major residential development has occurred in Randburg and Greater Sandown, where in the 5 year period more dwelling units were erected than in Johannesburg itself - 6,933 as against 5,701. Other figures are Roodepoort 1,750 units, Germiston 1,723 units, Alberton 884 units and Edenvale 896 units. Significant figures further afield are Kempton Park with 2,157 units and Benoni with 1,336 units. The percentage increases of population as reflected in Tables 4.1 and 4.2 indicate the rapid growth that has occurred to the north of Johannesburg and in Kempton Park. This pattern of residential growth confirms Dr. Green's initial assumption in this connection.

In order to appreciate the significance of these residential growth factors insofar as they affect Johannesburg, it is necessary to relate the pattern to the work base applicable to each area and to the movements to and from Johannesburg. This will be highlighted in the subsequent sections of this chapter.

4.2 INDUSTRIES:

The pattern of the main industrial development has followed the line of the mines from the east to the west and the north-south railway line from Vereeniging via Germiston to Pretoria. Heavy industries in the metropolitan complex have concentrated in the East Rand. In Alberton,

* Bureau of Statistics News Release 1st July 1966, Page 11, Houses and Flats Occupied by Whites, Coloureds and Asiatics.

Germiston and Kempton Park strong and relatively new industrial complexes have developed. In Johannesburg, whilst there are strong industrial complexes developed to the east, south and west of the central area, a great deal of the industrial employment is offered in the "flatted" multi-storey industrial development in and around the central area. In comparison with the East Rand, the industrial development on the West Rand is relatively small.

With the heavy concentration of industries in the Vereeniging-Vanderbijl Park area and the growing industrial development at Pretoria, the picture of the regional industrial pattern is completed.

To summarise, there is the strong east-west development along the Reef, and the strong north-south development along the railway line. Figure 3.2 illustrates the development.

L.P. Green indicated the following position as in 1957:--*

"Secondary industry is developing as gold-mining begins to decline. While the value of gold produced in the Union as a whole increased by 25% between 1940 and 1953, private industrial undertakings expanded the value of their gross output by 458%. In the case of gold, the Witwatersrand contributed virtually nothing to this percentage increase, and the output and employment of its mines dropped by 30% and 33% respectively. In the case of secondary industry, however, the Witwatersrand was a key factor in the Union's rapid expansion, and accounted for over 30% of the increase in national employment.

The distribution of this industrial growth today, by metropolitan zones, is sketched on Figure 3.2. The overwhelming importance of the inner metropolitan zone is immediately apparent. In fact, 89% of the region's industrial workers are employed in this zone as against only 11% in the outer zone (1945-50 census). Of this 11%, the eastern portion of the outer metropolitan zone, i.e., Springs and Brakpan, accounts for over 7%. From west to east, the main types of industrial employment in each magisterial district are as follows: Randfontein, metal and engineering; Krugersdorp, metal and engineering, building and contracting; Roodepoort, metal and engineering, and stone and clay processing; Johannesburg, metal and engineering, textiles, building and contracting, and food processing; Germiston, metal

* Second Interim Report: The Economic Structure of the Witwatersrand Metropolitan Region (Ps. 5 and 6).

"and engineering, building and contracting, chemicals and textiles; Boksburg, metal and engineering, and stone and clay processing; Benoni, metal and engineering, and textiles; Brakpan, metal and engineering; Springs, metal and engineering, stone and clay processing and printing.

Thus, throughout the metropolitan region, industrial development is very much dependent on metal and engineering and this group accounts for roughly 33% of the total employment in secondary industry. However, its importance varies greatly between the outer and inner metropolitan zones, employing only 31% of the total industrial workers in the inner zone, but as much as 56% in the outer zone. In the inner zone, the remaining 69% of the industrial employees are engaged in all classes of work, especially in the Johannesburg magisterial district. The main employing groups are building and contracting (14%), clothing and textiles (13%), food processing (6%) and chemicals and paints (5%)."

The industrial growth pattern since 1960 has been gauged from figures extracted from the Bureau of Statistics. These are in terms of the returns submitted to that department by the various local authorities. The returns feature the values of new buildings and also the values of additions and alterations to existing buildings of all descriptions. An attempt has been made to apportion the additions in respect of industrial buildings and these latter figures should, therefore, be treated with reserve. An assessment has also been made to determine the square footage and the employment capacity:-

TABLE 4.3 : NEW INDUSTRIAL BUILDINGS AND ADDITIONS:
PERIOD 1961 - 1965.

Town	New Buildings R	Additions R	Total R million	Floor Space (million sq.ft.)	Increase in Employment	
					Whites	Non-Whites
Johannesburg	14,904,150	2,240,000	17.14	6.86	4,800	15,780
Roodepoort	405,000	320,000	0.72	0.29	200	670
Germiston	2,806,050	2,720,000	5.52	2.21	1,550	5,080
Alberton	2,493,750	1,289,000	3.77	1.51	1,060	3,470
Kempton Park	6,545,835	3,280,000	9.83	3.93	2,750	9,040
Boksburg	834,050	1,970,000	2.80	1.12	780	2,580
Benoni	3,863,375	240,000	4.10	1.64	1,150	3,770

NOTE: In the calculation of the floor space, a cost of R2-50 per sq.ft. has been used and, from preliminary figures obtained for Johannesburg industrial areas, 0.7 White and 2.3 Non-White workers per 1,000 sq.ft. of industrial building have been used.

These figures confirm that Roodepoort has no strong expanding industrial base and that its function is primarily that of a dormitory to Johannesburg.

They also reveal the strength of the industrial development along the Pretoria-Vereeniging railway line in the municipal areas of Kempton Park (R9.83m), Germiston (R5.52m) and Alberton (R5.77m). The extent of the industrial boom at Kempton Park is visibly noticeable to all who use the Airport Road and is matched by a significant increase in new dwelling units. It thus appears that Kempton Park is well established as a town with a sound industrial economic base with no great need for its inhabitants to look to Johannesburg as a place of work. Its ties with Johannesburg in terms of the presence of the Jan Smuts Airport, the main national airport, and the movement of industrial vehicles to and from the Isando industrial complex are, however, strong and it must still be considered as part of the Inner Metropolitan Area.

The development in Benoni is also significant. Whilst in the 1950's Johannesburg provided the major source of employment, it is apparent that Benoni is losing such ties and is building up its own industrial economic base with links directed towards Springs and the Eastern Transvaal.

4.3 CENTRAL AREA DEVELOPMENT : REEF TOWNS:

In 1963 a study was conducted on behalf of the Natural Resources Development Council of the central areas of all the Reef towns.

With the exception of Springs, where there is considerable multi-storey development, and excluding Johannesburg, the pattern of development was predominantly one storey buildings, many of which are outdated in quality. In nearly all the centres and particularly Benoni, business activities connected with the motor trade are prominent.

As regards shopping, Springs was the best in quality and had the appearance of becoming a nodal centre for the surrounding districts. Benoni, in area, possesses more shops, but a large number is of poor quality. On the West Rand, Krugersdorp has the strongest shopping centre and also possesses the qualities of becoming a nodal centre for the surrounding districts. Both Springs and Krugersdorp have reasonably strong office development.

Benoni and Krugersdorp appear to have the strongest concentration of Governmental buildings.

Figures were extracted from the Bureau of Census in respect of new buildings, financial and commercial, in the central areas. The values of new buildings, together with an assessment of the value of additions and the employment opportunities created, are features in the following table:-

**TABLE 4.4 : NEW FINANCIAL AND COMMERCIAL BUILDINGS
AND ADDITIONS : PERIOD 1961 - 1965.**

City or Town	New Buildings R millions	Additions R millions	Total R millions	Floor Space (millions sq.ft.)	Increase in Employment	
					Whites	Non-Whites
Johannesburg	22.2	3.4	25.6	5.12	13,360	5,430
Roodepoort	0.8	0.5	1.3	0.26	680	280
Germiston	3.7	3.7	7.4	1.48	3,860	1,570
Alberton	0.5	0.2	0.7	0.14	360	150
Kempton Park	0.7	0.3	1.0	0.20	520	210
Boksburg	0.4	0.1	0.5	0.10	260	110
Benoni	1.4	0.7	2.1	0.42	1,100	450

The factors to determine the employment figures are based on figures obtained for Johannesburg in the Central Area Study which is not yet complete and they may be subject to amendment later. The figures used are 2.61 Whites and 1.06 Non-Whites per 1,000 square feet of floor space and the costs at R5 per sq.ft. of floor space.

It is noteworthy that while Germiston shows a relatively low increase in industrial development, it shows here an increase in its financial and commercial development, which is something that can be expected in view of its close ties with Johannesburg. It is expected that this trend will continue. There are no signs, however, that this growth is related at all to decentralisation from Johannesburg.

The development in Benoni is also significant and there have been new buildings erected there for financial institutions and also additions to existing buildings for office purposes. These developments are strengthening the work base of Benoni and further indicate the loosening of its dependence on Johannesburg.

There are no signs of any strong movements to decentralise office and financial activities from Johannesburg.

4.4 EMPLOYMENT:

The Bureau of Statistics in its analysis of the 1960 census has published employment statistics for Johannesburg Metropolitan Area (Vol. 2, No. 9), Germiston Metropolitan Area (Vol. 2, No. 8), the East Rand (Vol. 2, No. 7) and the West Rand (Vol. 2, No. 12).

These statistics have been summarised in the following table to indicate the numbers of Whites economically active in the groups which have

been termed for the purposes of this report "White Collar", i.e. financial and commercial, and "Blue Collar", i.e. industrial, trades, etc.

TABLE 4.5 : RELATIONSHIP OF WHITE COLLAR AND BLUE COLLAR EMPLOYMENT.

Metropolitan Area	White Collar	Blue Collar	Ratio
Johannesburg	113,728	62,871	1.8 : 1
Germiston	16,142	16,849	1.0 : 1
East Rand	26,519	32,009	0.8 : 1
West Rand	18,392	20,030	0.9 : 1

These employment figures reveal clearly the economic base of the Metropolitan Areas. Johannesburg is very strongly a financial and commercial centre but with a strong secondary industrial base; Germiston has industry just exceeding commerce as an employment factor. The dominance of industry on the East Rand and to a lesser extent on the West Rand is noticeable.

Trends in terms of new development since 1960 as shown in Tables 4.3 and 4.4 emphasise that the core of Johannesburg and Germiston is strengthening its financial and commercial base whilst industrial development in Kempton Park, Alberton and the East Rand is dominant.

The following table compares the number of new dwellings erected and employment opportunities offered in the areas of the different local authorities for the period December 1960 - December 1965:-

TABLE 4.6 : RELATIONSHIP OF NEW DWELLING UNITS TO NEW PLACES OF EMPLOYMENT.

City or Town	New Dwelling Units 1	Commercial Employment 2	Industrial Employment 3	Total Employment 4	Excess Employment over new Dwelling Units
Johannesburg	5701 + 987 rooms	13,360	4,800	18,160	+ 11,472
Roodepoort	1,750	680	200	880	- 870
Germiston	1,723	3,860	1,550	5,410	+ 3,687
Alberton	884	360	1,060	1,420	+ 536
Kempton Park	2,157	520	2,750	3,270	+ 1,113
Boksburg	642	260	780	1,040	+ 398
Benoni	1,336	1,100	1,150	2,250	+ 914

The employment opportunities in Johannesburg cater also for the residents in Randburg, Greater Sandown and the North-Western Areas (7,640 new dwelling units), other Peri-Urban Areas, Bedfordview and Roodepoort. The negative sign for Roodepoort once again indicates its dormitory status

to Johannesburg. Kempton Park affords work opportunities to Edenvale (896 new units). Germiston, like Johannesburg, offers employment facilities to the surrounding local authorities, including Johannesburg, and Benoni is strengthening its work base in relation to population increase.

Finally, it is desirable to compare the white collar with the blue collar opportunities of employment as are feature in columns 2 and 3 of the above table, and these are:-

Johannesburg	2.8 : 1
Roodepoort	3.4 : 1
Germiston	2.5 : 1
Alberton	0.3 : 1
Kempton Park	0.2 : 1
Boksburg	0.3 : 1
Benoni	1.0 : 1

Once again these figures confirm deductions already made on the economic base of the component municipalities of the area.

4.5 MOVEMENT:

4.5.1 Road:

The Inner Witwatersrand Metropolitan Region cannot exist without the daily movement of people and goods by car, truck, bus and train throughout the region. As far as Johannesburg is concerned, this movement consists of trips within the magisterial area by residents of this area; trips out of the magisterial area to surrounding towns and cities by residents of the area, and trips into the magisterial area from residents of the surrounding towns and cities.

Residents of the Johannesburg and Randburg vehicle licensing district make about 845,000 person trips daily by car or public transport. Of this number, about 54,000 person trips have origins or destinations in the towns and cities of the Witwatersrand. The majority of the latter trips are to Germiston, with Roodepoort, Kempton Park and Alberton being the next most important. The trips to Roodepoort being the next most important. The trips to Roodepoort being less than 40% and those of the other two towns being about one-third and one-quarter respectively of those to Germiston. Of the approximately 27,000 trips with destinations in towns on the Witwatersrand, about 12,000 are work trips and of these over 40% are to Germiston.

A fairly high number of trips are to Pretoria (about the same number as to Roodepoort) but the number of work trips is comparatively small.

Trucks registered in the Johannesburg and Randburg vehicle licensing area make about 92,000 trips daily, of which about 10,000 trips have origins or destinations in the towns and cities to the east and west. The majority of the trips are to Germiston, with Roodepoort, Alberton and Kempton Park (including Isando) next in importance. The trips to Roodepoort are about one-half the number to Germiston and those of the other two towns being about one-third of those to Germiston. Truck trips to Pretoria are relatively high.

Residents and firms of the areas surrounding the Johannesburg and Randburg licensing district make about 76,000 vehicle trips in and out of this district in a 13 hour period. Of these, 61,000 are car trips. Towns and cities to the east and west produce about 62,000 vehicle trips into or out of the above districts. 35,000 vehicle trips have origins in the towns and cities to the east and west and 14,000 of these vehicle trips are work trips made by car.

29,000 cars enter the Johannesburg - Randburg licensing district carrying nearly 48,000 people from the towns and cities to the east and west.

The majority of the vehicle trips come about equally from Roodepoort and Germiston, but the car work trips from Roodepoort are about 40% greater than those from Germiston, whereas the truck trips from Germiston are about 100% greater than those from Roodepoort. This indicates the importance of Germiston as an industrial and commercial centre and of Roodepoort as a residential centre.

Edenvale, Alberton and Krugersdorp each produce about the same number of car work trips to Johannesburg, each being about one-fifth of those from Roodepoort. Of this group of towns, Alberton produces the greatest number of truck trips to Johannesburg, being about two-thirds those of Roodepoort and twice those of Edenvale and Krugersdorp. Kempton Park, including Isando, produces about the same number of truck trips to Johannesburg as Alberton does.

Pretoria also produces an important number of trips to Johannesburg, about equal to those from Krugersdorp and Edenvale, but there are rather few work trips.

Details of the vehicle movements in the Region, as well as to the north and south, are set out in Table 4.7. These figures were derived from tabulations extracted from the Home Interview, Truck and External Cordon Origin-Destination Surveys carried out in 1965.

TABLE 4.7 : VEHICLE MOVEMENTS BETWEEN JOHANNESBURG AND THE TOWNS TO THE EAST AND WEST.

Town or City	External Vehicles ¹		Internal Residents ²	Internal Trucks ³
	Vehicle Trips to Johannesburg		Car Trips from Johannesburg	Vehicle Trips from Johannesburg
	No. of Vehicles	Car Work Trips ⁴	No. of Cars	No. of Vehicles
WEST				
Randfontein	580	150	170	90
Krugersdorp	2,190	950	560	320
Rooдеpoort	8,630	5,150	1,970	770
EAST				
Bedfordview	1,440	470	700	170
Alberton	2,770	1,070	1,570	550
Germiston	8,560	3,630	5,270	1,460
Edenvale	2,130	1,020	660	220
Kempton Park	1,940	530	1,670	420
Boksburg	1,460	450	780	230
Benoni	1,550	440	910	240
Brakpan	520	170	170	80
Springs	930	150	500	230
NORTH				
Pretoria	2,250	350	2,100	550
SOUTH				
Vereeniging	530	80	360	250
Vanderbijl	240	20	210	90
Sasolburg	130	10	80	50

1. External Vehicles: Vehicles not registered in the Johannesburg or Randburg licensing district.
2. Internal Residents: Persons living in licensing districts of Johannesburg and Randburg.
3. Internal Trucks: Trucks registered in licensing districts of Johannesburg and Randburg.
4. Number of Cars.

TABLE 4.8 : PERSON TRIPS BETWEEN JOHANNESBURG
AND THE TOWNS TO THE EAST AND WEST.

Town or City	External Residents ¹		Internal Residents ²	
	Person Trips to Johannesburg by Car		Person Trips from Johannesburg	
	All Purposes	Work Trips ³	All Purposes	Work Trips
<u>WEST</u>				
Randfontein	810	300	330	80
Krugersdorp	3,320	1,700	1,190	330
Roodepoort	13,420	8,800	3,830	1,480
<u>EAST</u>				
Bedfordview	1,860	800	1,040	290
Alberton	3,750	1,700	2,570	1,580
Germiston	11,080	5,800	9,720	5,280
Edenvale	2,680	1,600	1,140	350
Kempton Park	2,200	900	2,950	1,190
Boksburg	1,890	800	1,290	890
Benoni	2,120	800	1,710	510
Brakpan	810	300	260	100
Springs	1,170	300	670	310
<u>NORTH</u>				
Pretoria	3,730	650	3,620	890
<u>SOUTH</u>				
Vereeniging	780	150	600	140
Vanderbijl	400	40	260	100
Sasolburg	240	20	120	50

1. External Residents : Persons living outside the licensing districts of Johannesburg and Randburg.
2. Internal Residents : Persons living in the licensing districts of Johannesburg and Randburg.
3. Derived by multiplying number of car work trips by the average car occupancy for cars entering Johannesburg from each town (correct to nearest 100).

It will be noted from Table 4.8 that great numbers of residents outside the Johannesburg district make daily trips to Johannesburg and also large numbers of Johannesburg district residents make daily trips to the towns to the east and west. Generally the trips to Johannesburg by residents of a nearby town are greater than the trips by Johannesburg residents to that town, except in the case of Kempton Park.

Work trips to Johannesburg from residents of east-west towns generally balance those from Johannesburg district residents to these towns, except in the case of Randfontein, Krugersdorp, Roodepoort, Bedfordview, Edenvale, Benoni and Brakpan when the flow to Johannesburg is much greater and Kempton Park where the flow from Johannesburg is greater.

In an attempt to define the Inner Witwatersrand Metropolitan Region on a persons and goods movement basis, the estimated 1965 White population of each of the east and west towns was expressed as a factor of the total external vehicle movements from the town to Johannesburg. Also these populations were expressed as factors of person movements of Johannesburg district residents and truck movements of Johannesburg district trucks to these towns. The factor represents the number of persons in the town required to support one trip to, or attract one trip from, Johannesburg. In this form the smaller the factor the more dependent Johannesburg and the town under consideration are on each other. These factors, plotted in bar chart form, are shown on Figure 4.1 from which it will be noted that between Roodepoort and Kempton Park the factors are reasonably similar, but on either side they increase considerably. This would tend to indicate that from a movement point of view the Inner Witwatersrand Metropolitan Region consists of Roodepoort, Johannesburg district, Alberton, Germiston, Edenvale and Kempton Park. However, the movement picture for the whole area is not known, e.g., the movement between Boksburg and Germiston or Benoni and Germiston, so this deduction may not be entirely valid.

4.5.2 Bus and Train Travel by Non-Residents of the Johannesburg Area:

Long distance bus travel by Whites from the surrounding towns to the Johannesburg area is not particularly significant compared with other modes of travel. Work trips by bus from Germiston are by far the most important and in fact exceed those by train although they are only about a third of those by car.

Five bus services bring passengers into the Johannesburg area from all directions. The numbers of passengers carried are shown in Table 4.9.

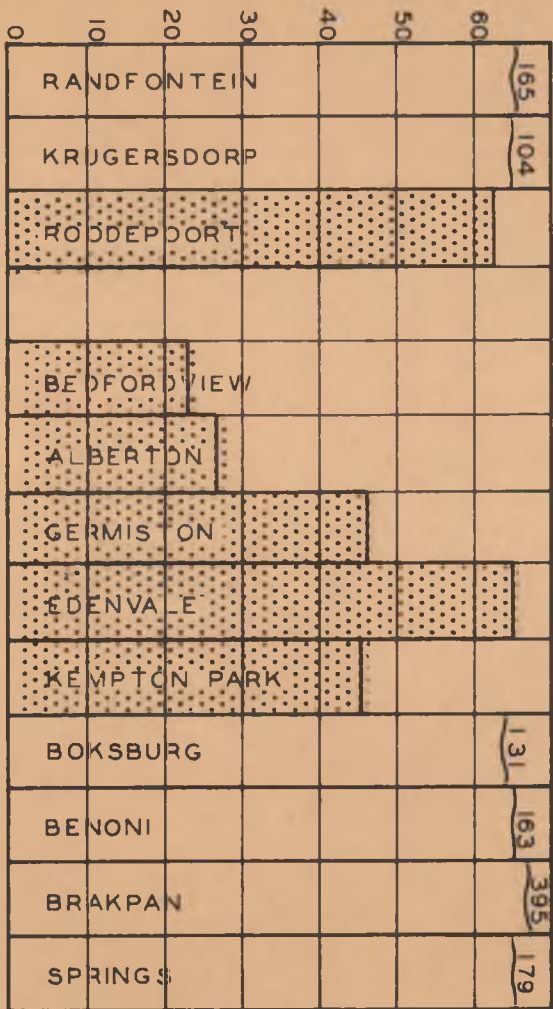
TABLE 4.9 : PASSENGERS CARRIED BY BUS INTO JOHANNESBURG.

B u s S e r v i c e	Passengers to Johannesburg	
	All Day	Morning Peak Period
Roodepoort	900	570
Alberton	600	340
Greyhound ¹	500	250
PUTCO ⁴ Operating and Technical ²	2,500	2,000
South African Railways ³	3,800	2,850

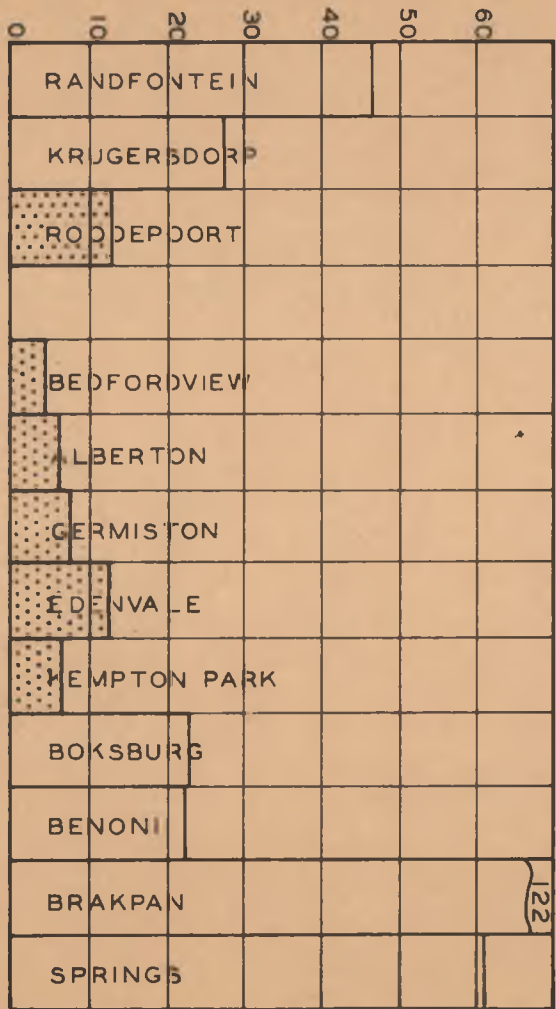
1. Passengers from Potchefstroom, Klerksdorp, Vereeniging, Vanderbijl Park.
2. Passengers from Pretoria and Edenvale.
3. Passengers from Germiston, Roodepoort and Vereeniging.
4. Public Utility Transport Corporation.

NUMBER OF WHITE PERSONS IN TOWN REQUIRED TO SUPPORT ONE TRIP TO OR FROM JOHANNESBURG

C) TRUCK SURVEY: TRIPS FROM JOHANNESBURG



B) HOME INTERVIEW SURVEY: TRIPS FROM JOHANNESBURG



A) EXTERNAL SURVEY: TRIPS TO JOHANNESBURG

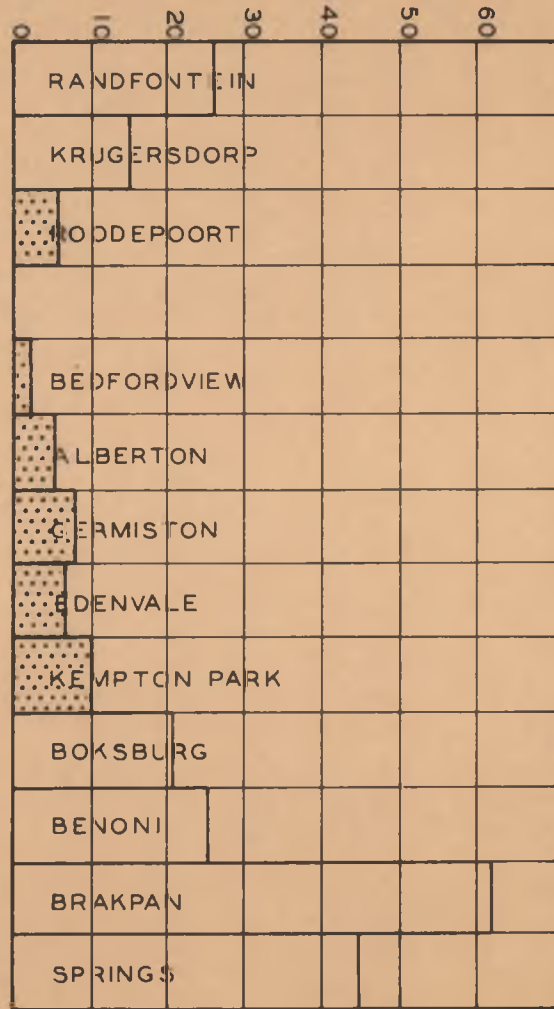


FIGURE 4.1 INTERDEPENDENCE OF JOHANNESBURG & REEF TOWNS

Details of the peak period passengers carried are given in Table 4.10. Trip details of bus passengers are not as well recorded as for train passengers so certain assumptions have been made to allocate passengers to certain towns. These assumptions are explained in a footnote to the Table.

TABLE 4.10 : PEAK PERIOD PASSENGERS CARRIED BY BUS:

Origin Town	Bus Service	Passengers to Johannesburg in Morning Peak Period
Roodepoort	Roodepoort and S.A.R.	920
Bedfordview	PUTCO	300 ¹
Alberton	Alberton	340
Germiston	S.A.R.	2,000
Edenvale	PUTCO	700 ¹

1. PUTCO brings in 2,000 passengers from Pretoria, Edenvale and Bedfordview. The Corporation estimates that 1,000 come from the Edenvale direction. This 1,000 has been split between Edenvale and Bedfordview in proportion to the car trips from the two towns.

Complete figures are not yet available of travel by trains to the Johannesburg area from the surrounding towns. Table 4.11 shows the number of people, holding season tickets, who travel by train from the east and west towns to stations in the Johannesburg area up to and including Johannesburg Station.

TABLE 4.11 : SEASON TICKET PASSENGERS TO JOHANNESBURG.

Origin Station	Number of Passengers
<u>WEST RAND</u>	
Randfontein ¹	640 ⁶
Krugersdorp ²	1,420 ⁶
Roodepoort ³	4,940 ⁶
<u>EAST RAND</u>	
Germiston ⁴	1,680 ⁷
Boksburg ⁵	1,750 ⁷
Benoni	1,330 ⁷
Brakpan	890 ⁷
Springs	740 ⁷

1. Includes Robinson.
2. Includes West Rand and Luipaardsvlei.
3. Includes Hamburg, Florida, Unified and Maraisburg.
4. Includes President, Driehoek and Geldenhuys.
5. Includes Dunswart, Boksburg East, East Rand, Angelo and Delmore.
6. Number of passengers with destination between Newclare and Johannesburg Stations inclusive.
7. Number of passengers with destination between Cleveland and Johannesburg Stations inclusive.

The figures given in this Table could be somewhat higher because the number of passengers with destinations in the Johannesburg area beyond Johannesburg Station is not known.

Assuming that these season ticket trips are all work trips and combining them with the work trips of external residents by car from Table 4.8 the following Table 4.12 gives the number of workers in each town for one work trip to the Johannesburg area:-

TABLE 4.12 : WORK TRIPS TO THE JOHANNESBURG AREA.

Origin Town	Estimated 1965 Workers	Work Trips by:			Trips Total	Workers per Trip	% of Working Popula- tion
		Car	Train	Bus			
WEST							
Randfontein	5,940	300	640	-	940	6.4	16
Krugersdorp	13,500	1,730	1,420	-	3,150	4.3	23
Roo-depoort	19,800	8,820	4,940	920	14,680	1.4	74
EAST							
Bedfordview	1,800	760	-	300	1,060	1.7	59
Alberton	6,800	1,750	(1)	340	2,090	3.3	31
Germiston	32,500	5,770	1,680	2,000	9,450	3.4	29
Edenvale	6,800	1,550	-	700	2,250	3.0	33
Kempton Park	8,600	900	(2)	-	-	-	-
Boksburg	12,380	760	1,750	-	2,510	4.9	20
Benoni	18,320	750	1,330	-	2,080	8.8	11
Brakpan	12,540	320	890	-	1,210	10.4	9
Springs	18,150	260	740	-	1,000	18.2	5

- (1) Train travel from Alberton to Johannesburg area not known; assumed to be negligible because of good direct bus service.
- (2) Not available.

It will be noted that more person work trips are made by car than by public transport from Germiston and that the same applies to Roo-depoort. For Krugersdorp slightly more people travel by car than by public transport but in all other cases where towns are served by the Railway more people travel by public transport.

By far the greatest number of person work trips come from Roo-depoort - nearly 14,700 - equivalent to one work trip to Johannesburg for every 1.4 workers in the town.

The consideration of train passengers has extended the area of influence of Johannesburg as compared with that determined by road traffic. In considering all work trips by car and public transport both Boksburg and Krugersdorp are dependent on Johannesburg for employment of approximately 20% of their working population. From Table 4.12 it will be seen that the ratio of working population to work trips to Johannesburg for each town from Krugersdorp to Boksburg (except Kempton Park for which complete figures are not available), is under 5 but on either side of this group of towns the ratio immediately becomes higher.

As pointed out earlier the movement picture for the whole area is not known but railway season ticket figures are known for destination in Germiston and Boksburg for origins to the east. Table 4.13 shows the influence of Germiston and Boksburg and the Germiston - Johannesburg complex on the work trips from the east.

From the ratios in this table it will be noticed that Boksburg is far more dependent on Germiston and on the Germiston - Johannesburg complex than either Benoni, Brakpan or Springs. Also that Springs, Brakpan and Benoni are not greatly dependent on Boksburg. From a movement aspect only Boksburg could possibly form part of the Inner Witwatersrand Metropolitan Region.

TABLE 4.13 : WORK TRIPS TO GERMISTON AND BOKSBURG
FROM EAST BY RAIL.

Origin Town	Estimated 1965 Workers	To Germiston		To Boksburg		To Johannesburg - ¹ Germiston	
		Tickets	Ratio ²	Tickets	Ratio ²	Tickets	Ratio ²
Springs	18,150	160	115	80	222	890	20
Brakpan	12,540	230	55	120	105	1,110	11
Benoni	18,320	300	62	80	223	1,630	11
Boksburg	12,380	420	29	-	-	2,170	6

1. Johannesburg - Germiston complex.
2. Ratio worker population to tickets.

TABLE 4.14 : WORK TRIPS TO ROODEPOORT AND JOHANNESBURG
FROM WEST BY RAIL.

Origin Town	Estimated 1965 Workers	To Roodepoort		To Johannesburg - ¹ Roodepoort	
		Tickets	Ratio ²	Tickets	Ratio ²
Randfontein	5,940	40	156	680	9
Krugersdorp	13,500	200	69	1,620	8

1. Johannesburg - Roodepoort complex.
2. Ratio worker population to tickets.

Considering the West Rand Table 4.14 shows that as far as rail travel is concerned Krugersdorp is far more dependent on Roodepoort and on the Johannesburg - Roodepoort complex than Randfontein and that this dependence is very similar to that of Benoni on Germiston and on the Johannesburg - Germiston complex. See Table 4.13. On this basis Krugersdorp has weaker ties with the core than Boksburg, but when road and rail trips to Johannesburg are considered the relationship is equal to that of Boksburg.

4.6 NON-WHITE RACE GROUPS:

No attempt has been made to analyse or assess the growth trends of the Non-Whites and their functions in the Metropolitan Complex. Full reports will be prepared separately in respect of the Non-White populations of Johannesburg.

A study of Figure 3.2 reveals that the areas allocated to the Non-White race groups, numerically larger than the White, are restricted in size. Planning to house the natural increase of this section of the population is a matter for urgent action.

The group areas defined for the various race groups are primarily as follows:-

4.6.1 Bantu Race Group:

Tembisa to the north-east of the Germiston - Pretoria railway line is administered by Germiston and serves the local authorities of Kempton Park, Edenvale, Peri-Urban Areas, Modderfontein and Randburg. Daveyton serves Benoni and Boksburg; Natalspruit serves Germiston and Alberton and an extension serves Boksburg; Soweto serves Johannesburg; Dobsonville serves Roodepoort, and Alexandra, the character of which is to be changed, serves the northern areas and Johannesburg.

Most of these areas are restricted by the group area boundary, by proximity to existing development, or by great distance from possible future development. Insofar as Johannesburg is concerned, more land for an expanding Bantu population is becoming an urgent necessity and it is not unlikely that a similar state of affairs exists in respect of the remainder of the Inner Metropolitan Region. The housing of the Bantu race group is fast becoming a regional matter of extreme urgency.

4.6.2 Coloured Race Group:

Present government policy in regard to Coloured group areas on the Witwatersrand is being directed to the establishment of three main areas for ownership and occupation by this racial group. These areas are:-

Boksburg for Coloureds resident and normally working on the East Rand. This is presently being implemented by the removal of Coloureds from adjoining towns such as Benoni, Brakpan, Germiston and Springs.

Randfontein for Coloureds normally working and resident at Carletonville, Westonaria and Krugersdorp.

Johannesburg for the accommodation of Coloureds resident or working in areas around Johannesburg and not necessarily catering for Coloureds only within the Johannesburg municipal area. In this regard two main group area complexes have been proclaimed as a first step in this direction, viz.:-

- (a) The complex of Coloured townships of Western, Coronationville, Newclare, Bosmont, Riverlea within the Johannesburg municipal area, and
- (b) The Nancefield, Klipriviersoog, Munshiville complex situated in the peri-urban area to the south-west of Johannesburg.

The Johannesburg area has a Coloured population estimated at approximately 72,000. Present group areas within Johannesburg proper are inadequate to cater for existing housing needs of this racial group and an extension of Coloured group areas is essential.

4.6.3 Asiatic Race Group:

Group areas for the Asiatic race group have been proclaimed in Benoni on the East Rand and at Lenasia to the south of Johannesburg. The requirements of this race group will be the subject of a separate report and will undoubtedly have to be considered on a metropolitan basis.

4.7 DEFINITION OF THE INNER METROPOLITAN REGION:

At the outset it is advisable to establish the purpose for attempting to define the boundaries of the inner metropolitan region. The purpose is specifically one of defining an entity, the component portions of which are so strongly linked economically and by movement of people and goods that it is desirable, if not essential that an overall plan should be drawn up to direct future development to the mutual benefit of such component portions.

While it is not considered to be the purpose of this report to recommend how the planning of the inner metropolitan region should be coordinated, it would appear that at an early stage an approach should be made to the local and other authorities concerned to discuss this matter.

It is clear that Benoni, Brakpan and Springs on the East Rand and Randfontein on the West Rand do not fall into the inner metropolitan region and based on the road trips illustrated in the bar charts, Figure 4.1, it would appear that both Krugersdorp and Boksburg also fall outside the inner

metropolitan region. The fact that 23% and 20% respectively of the working populations of these towns work in Johannesburg, however, does indicate that strong ties exist. There are no known criteria which can be used to make a full decision. The development in these towns and the rise or decline of their relationship with Johannesburg in the future alone will determine their position.

It is considered, therefore, that they should be excluded in the first instance, but that future studies should embrace these two towns in respect of movement and employment in order that trends are established to arrive at a firm decision.

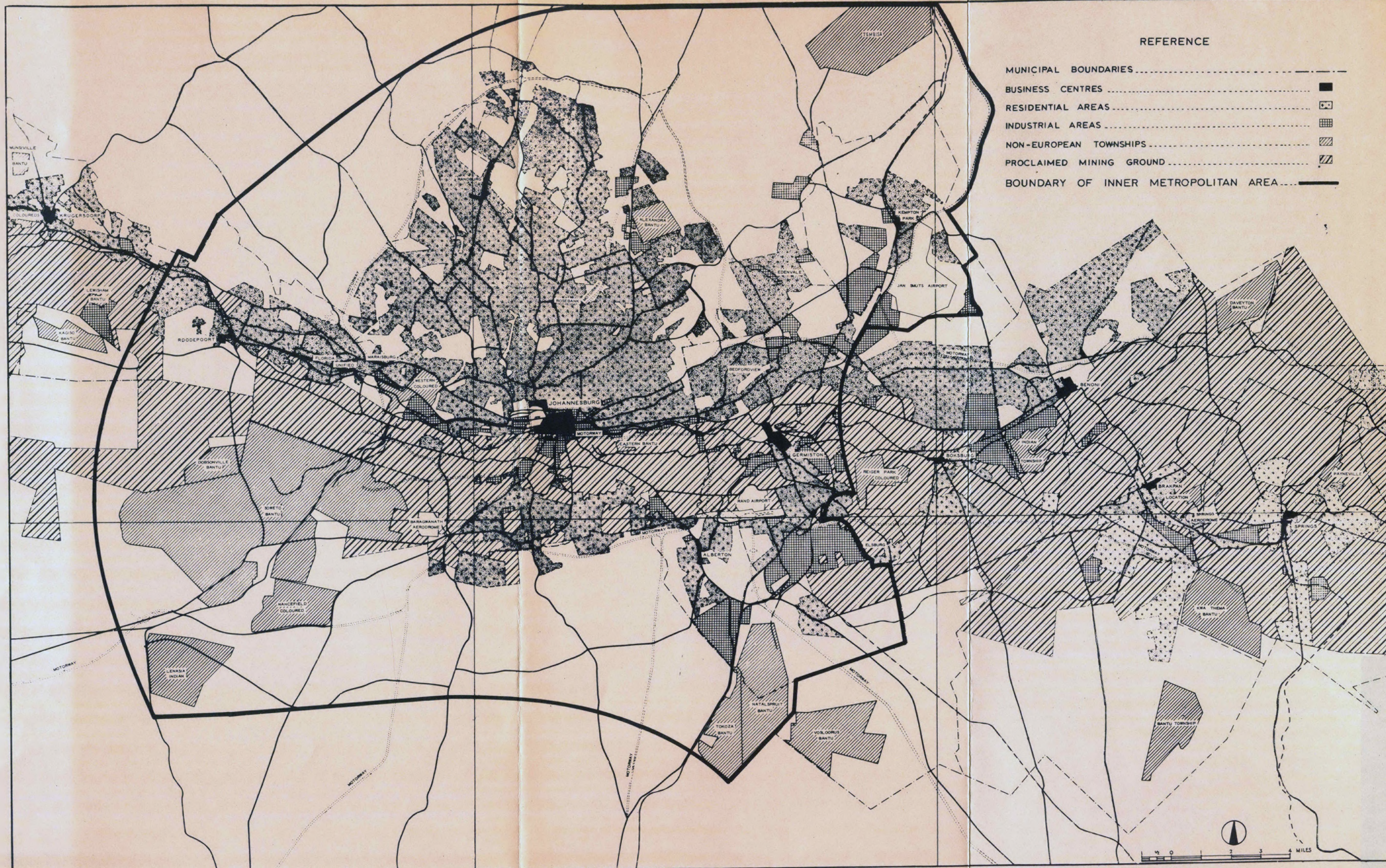
Subject to this proviso, the inner metropolitan area can be defined as the municipal areas of Kempton Park, Germiston, Alberton, Edenvale, Bedfordview, Roodepoort-Maraisburg and Randburg; the areas known as the north-western areas, Greater Sandown, Modderfontein, together with relevant peri-urban areas to complete the Metropolitan area as an entity. Included in the boundary are also the Non-White residential complexes serving the main urban areas.

The suggested boundary of the inner metropolitan area is illustrated on the map, Figure 4.2.

4.8 MINING GROUND:

The future use of mining ground is one that is inextricably linked with Central Government policies on the location of industry and race groups and the supply of water. In general, the land is well related to the hubs of commercial, financial and industrial activities of the Reef. Large pockets of mining land are unsuitable in their present condition for any use other than industrial, but this is not possible in terms of present policy. Certain sections should be developed and used for park and recreational purposes and in time could provide an interesting landscape of man-made hills throughout the complex.

The closing of the mines along the Reef has not brought the economic depression that was feared. Figures applicable to the Robinson Deep Mine indicate that from 1950 to 1966 when the mine closed the numbers employed, both White and Bantu, have steadily decreased over the years. Similarly, the value of stores purchased from Johannesburg has progressively decreased. The impact, consequently, is not sudden and does not involve the nearest cities in a sudden financial crisis. Most Reef towns have been able to adjust their economy by the establishment of industrial areas.



REFERENCE

MUNICIPAL BOUNDARIES	-----	
BUSINESS CENTRES	-----	■
RESIDENTIAL AREAS	-----	▨
INDUSTRIAL AREAS	-----	▧
NON-EUROPEAN TOWNSHIPS	-----	▩
PROCLAIMED MINING GROUND	-----	▪
BOUNDARY OF INNER METROPOLITAN AREA	-----	—



FIGURE 4.2

THE INNER METROPOLITAN AREA OF THE WITWATERSRAND

The percentage of the total economically active population of Whites and Bantu employed in the gold mining industry along the reef is contained in the following table:-

TABLE 4.15 : PERCENTAGE OF WHITES AND BANTU EMPLOYED IN GOLD MINING INDUSTRY*

Metropolitan Area	Gold Mining	
	% Whites	% Bantu
Johannesburg	2.55	9.54
Germiston	4.38	19.20
East Rand	19.04	47.62
West Rand	29.68	70.32

The percentages indicate the negligible employment opportunities offered to Whites in the Johannesburg metropolitan areas where most of the mines have now closed down. On the East Rand, the employment opportunities are strong and on the West Rand very strong. Most of the Bantu are non-resident and will be moved as the mines close down.

No matter what use is made of mining ground in the future, it would appear that a primary consideration should be that of planning strong communications systems throughout the Reef. This is an issue which will undoubtedly be covered by the Regional Plan.

4.9 GOVERNMENT POLICY:

The problem facing planners in the fields of regional, metropolitan and local planning is to forecast how and when policy decisions of the Government are to be implemented. There are three inter-related basic matters in regard to which policies have been stated, but for which a workable solution is still to be found.

The first is in respect of the only natural resource which the rich Southern Transvaal Region is lacking, namely, water. Recent droughts have brought this to a head and a Commission has been appointed by the Government to tackle the problem of augmenting the meagre supplies at present available from the Vaal Dam. The availability of water affects the future of the region in all forms of development. The quantity of water that will become available will determine its size and could prove a vital factor in influencing the early decentralisation of activities on a national scale.

* Bureau of Statistics Volume 2 Reports on the Metropolitan Areas of Johannesburg, Germiston, East Rand and West Rand, 1960.

The second factor is the future of the urban Bantu. Johannesburg has the largest urban Bantu population in the country. Natural increase within the next two decades will require the present group areas to be increased by approximately 50%. The reality of Bantu returning to their Bantustans may have its complications. Bantu manpower is becoming increasingly integrated into the economy of industrial, commercial and service activities of the region. Policy decisions on further areas for the Bantu is a matter of extreme urgency.

The third factor is that of industrial expansion. It must be accepted that an industrial region cannot be completely circumscribed in its need to expand without its economy being harmfully affected. Inevitably there must be conflict between the need to strengthen the national wealth and restrictive governmental policy. Only the Government can reconcile the two. Under present circumstances therefore it is impossible to forecast the future in respect of possible industrial expansion outside of the areas already zoned for that purpose.

The future of the region therefore depends on Government decisions and actions and at present no forecast can be made.

5 : PLANNING CONSIDERATIONS AS THEY
AFFECT JOHANNESBURG.

5.1 METROPOLITAN STRUCTURE : CHANGES
AND TRENDS PINPOINTED:

Perhaps the most significant change in the metropolitan structure is the trend for the towns east of Johannesburg to become more independent of Johannesburg as a source of employment. While ties with Johannesburg remain relatively firm from an industrial, commercial and financial point of view, the percentage of commuters to and from work in Johannesburg should become proportionately less with the growth of population in these towns.

In contrast, development of places of work to the west, and particularly in respect of Roodepoort, has been far less and it can be assumed that Roodepoort, together with the areas to the north and north-west of Johannesburg, will be required to carry the full burden of the expansion of a population which will look to Johannesburg for its source of employment.

It would appear that the Witwatersrand Metropolitan Region in fact is subdivisible into three metropolitan areas. The Central Metropolitan Area stretching from Roodepoort on the west to Kempton Park on the east, the Jukskei River to the north and the Klip River on the south, is dominant. There is also the possibility of an increasingly strong metropolitan area on the east centred on Springs and incorporating Boksburg, Benoni, Brakpan and stretching to Nigel. On the west the picture of a closely knit metropolitan area is still not clear, but developments there should be studied with interest as time progresses.

The area to the south of Johannesburg still remains an enigma. Development for residential purposes is minimal, but it can be expected that with the ever-increasing value of land to the north, a move to live in the south by people in middle income groups must come about.

5.2 GROWTH PROJECTION ASSUMPTION:

On the assumption that lack of water will be overcome and Government policies will not limit new industries and Bantu labour, industrial development on the East Rand is likely to increase, particularly in the vicinity of the railway line from Vereeniging - Germiston - Pretoria. In this latter case residential areas to the East and West would provide the sources of labour.

The growth of population of the Non-White race groups would require further areas to be established and this could possibly lead to more intensive development of industries on the West Rand emphasising more strongly the existing strong movement of industrial traffic on the east-west arterial routes.

Unfortunately Johannesburg's group areas are completely circumscribed. Its White population is spreading increasingly northwards and decentralised financial and commercial activities are bound to follow. This trend indicates the need to establish group areas for other race groups to the north-west of Johannesburg and the vicinity of the new Northern Disposal Works appears to be the logical area. If this were to come about, an industrial complex or complexes serving as a buffer would be a natural corollary. This, in turn, could revive the possibility of a railway from Pretoria via Krugersdorp to Vanderbijl Park and Vereeniging.

This pressure of population expanding northwards could well lead to the need to establish a "New Town" at Halfway House within the next decade or two and it is expected that the Regional Plan will cover this contingency.

All development trends indicate that Johannesburg's centre will remain the strong and vital core of the Metropolitan Region and properly planned decentralisation must come about in order to maintain its virility.

5.3 METROPOLITAN FACTORS TO BE CONSIDERED IN JOHANNESBURG'S PLANNING:

The appreciation that has been made in this report is circumscribed by what will emerge from the plan at present being prepared by the Natural Resources Development Council and by Government policies that have to be made effective, but as matters stand it would appear that the following factors will have to be considered by Johannesburg in the preparation of its plans for the future:-

- (i) Heavier movement of industrial and commercial vehicles from the east will develop.
- (ii) The trend of increasing work opportunities to the east will stabilise the rate of increase of movement of workers to Johannesburg.
- (iii) A heavier movement of vehicles on the Jan Smuts Airport Road can be expected as Kempton Park expands its industrial complex.

- (iv) The residential development to the north and north-west of Johannesburg is of extreme concern and the control of development must be integrated into an overall plan.
- (v) An increase in commuting movement from the west and particularly Roodepoort can be expected.
- (vi) Residential development to the south will become necessary and the Council should secure land there at an early stage for housing and recreational purposes.
- (vii) The need to establish further group areas for Non-White race groups on a metropolitan basis is of paramount importance otherwise development by private enterprise will make the task one of extreme difficulty in the future.
- (viii) The desirability of co-ordinating planning in the Inner Metropolitan Area is a matter requiring attention at all levels of government.

In conclusion, it must be stated that subsequent reports will deal in detail with numerous issues which have been referred to only briefly in this report.

POPULATION FIGURES.

DESCRIPTION OF CENSUS AREAS.

Republic of South Africa comprises the provinces of the Cape, Natal, Orange Free State and the Transvaal.

Transvaal: The province of the Transvaal.

Witwatersrand comprises the magisterial districts of Randfontein, Krugersdorp, Roodepoort, Johannesburg (including Randburg), Germiston (including Edenvale and Alberton), Kempton Park, Boksburg, Benoni, Brakpan and Springs.

Johannesburg Magisterial District comprises the City of Johannesburg (excluding the Rand Airport), Randburg Municipality, the Soweto complex and the Peri-Urban Areas to the north and south of Johannesburg, including farmland.

Johannesburg Metropolitan Area comprises the Johannesburg Magisterial District as defined above, to which is added the townships of North-cliff Extensions, Blackheath, Fairlands and Berario on the west and Glenhazel and Extensions, Senderwood, Essexwold, Viewcrest, Lombardy East and the farms Bergvallei, Klipfontein and Lombardy on the east.

Johannesburg Municipal Area: The proclaimed municipal area of Johannesburg, excluding the Rand Airport, but including Pinville.

POPULATION FIGURES

TABLE A.1:

P O P U L A T I O N - R E P U B L I C							
Year	Total All Races	Whites	Coloureds	Asiatics	Bantu	Total Non-Whites	Ratio White : Non-White
1904	5,174,827	1,117,234	444,991	122,311	3,490,291	4,057,593	1 : 3.46
1911	5,972,757	1,276,319	525,466	152,094	4,018,878	4,696,438	1 : 3.68
1921	6,927,403	1,521,343	545,181	163,594	4,697,285	5,406,060	1 : 3.55
1936	9,587,863	2,003,334	769,241	219,691	6,595,597	7,584,529	1 : 3.79
1946	11,415,925	2,372,044	928,062	285,260	7,830,559	9,043,881	1 : 3.81
1951	12,671,452	2,641,689	1,103,016	366,664	8,560,083	10,029,763	1 : 3.79
1960	16,002,797	3,088,492	1,509,258	477,125	10,927,922	12,914,305	1 : 4.18
1965	17,952,000	3,407,000	1,736,000	540,000	12,269,000	14,545,000	1 : 4.27
1970	20,066,000	3,815,000	1,962,000	609,000	13,680,000	16,251,000	1 : 4.26

TABLE A.2:

P O P U L A T I O N - T R A N S V A A L							
Year	Total All Races	Whites	Coloureds	Asiatics	Bantu	Total Non-Whites	Ratio White : Non-White
1904	1,269,951	297,717	24,159	10,948	937,127	972,234	1 : 3.27
1911	1,686,212	420,570	34,793	11,004	1,219,845	1,265,642	1 : 3.01
1921	2,087,636	544,973	32,291	14,503	1,495,869	1,542,663	1 : 2.83
1936	3,341,470	820,756	50,841	25,493	2,444,380	2,520,714	1 : 3.01
1946	4,283,038	1,063,121	59,986	37,758	3,122,173	3,219,917	1 : 3.02
1951	4,812,838	1,204,712	75,014	49,342	3,483,770	3,608,126	1 : 3.00
1960	6,273,477	1,468,305	108,007	63,787	4,633,378	4,805,172	1 : 3.27
1965	7,041,000	1,617,000	126,000	71,000	5,227,000	5,424,000	1 : 3.36
1970	7,839,000	1,811,000	147,000	76,000	5,805,000	6,028,000	1 : 3.33

TABLE A.3:

P O P U L A T I O N - W I T W A T E R S R A N D							
Year	Total All Races	Whites	Coloureds	Asiatics	Bantu	Total Non-Whites	Ratio White : Non-White
1904							
1911							
1921	537,055	233,194	16,027	8,895	278,939	303,861	1 : 1.30
1936	1,024,564	406,251	30,820	14,270	573,223	618,313	1 : 1.52
1946	1,438,475	547,836	40,398	21,147	829,094	890,639	1 : 1.63
1951	1,741,318	650,221	52,888	29,906	1,008,303	1,091,097	1 : 1.68
1960	2,180,914	766,379	78,134	39,915	1,296,486	1,414,535	1 : 1.85
1965	2,442,000	845,000	92,000	46,000	1,459,000	1,597,000	1 : 1.89
1970	2,736,000	947,000	106,000	52,000	1,631,000	1,789,000	1 : 1.89

TABLE A.4:

P O P U L A T I O N - J O H A N N E S B U R G - M E T R O P O L I T A N							
Year	Total All Races	Whites	Coloureds	Asiatics	Bantu	Total Non-Whites	Ratio White : Non-White
1921	304,827	158,937	12,382	6,314	127,194	145,890	1 : .92
1936	570,200	269,358	24,772	10,522	265,548	300,842	1 : 1.12
1946	-	-	-	-	-	-	-
1951	918,700	365,657	38,930	22,295	491,818	553,043	1 : 1.51
1960	1,152,525	413,153	59,467	28,993	650,912	739,372	1 : 1.79
1965	1,233,000	456,000	71,000	33,000	673,000	777,000	1 : 1.81
1970	1,334,000	511,000	82,000	38,000	703,000	823,000	1 : 1.61

TABLE A.5:

P O P U L A T I O N - J O H A N N E S B U R G - M A G I S T E R I A L							
Year	Total All Races	Whites	Coloureds	Asiatics	Bantu	Total Non-Whites	Ratio White : Non-White
1921	299,691	155,338	12,215	6,286	125,852	144,353	1 : .93
1936	537,217	262,434	23,722	10,256	240,805	274,783	1 : 1.05
1951	915,334	363,567	38,908	22,295	490,564	551,767	1 : 1.52
1960	1,137,806	404,143	59,368	28,983	645,312	733,663	1 : 1.82
1965	1,223,000	446,000	71,000	33,000	673,000	777,000	1 : 1.74
1970	1,322,000	500,000	82,000	37,000	703,000	822,000	1 : 1.65

TABLE A.6:

P O P U L A T I O N - J O H A N N E S B U R G - M U N I C I P A L							
Year	Total All Races	Whites	Coloureds	Asiatics	Bantu	Total Non-Whites	Ratio White : Non-White
1921	285,057	151,955	11,393	6,215	115,494	133,102	1 : .88
1936	479,619	256,276	21,436	9,934	191,973	223,343	1 : .87
1946	-	-	-	-	-	-	-
1951	631,911	341,218	26,153	19,811	244,729	290,693	1 : .85
1960	595,083	368,987	35,084	23,639	167,373	226,096	1 : .61
1965	596,000	407,000	40,000	26,000	123,000	189,000	1 : .46

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