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SECTION A
THE MACRO TRENDS





2 The ‘thin oil of urbanisation’? Spatial change in Johannesburg and the Gauteng city-region

GRAEME GOTZ, CHRIS WRAY AND BRIAN MUBIWA

Johannesburg in its regional context

‘Delink from Johannesburg’: a regional view of spatial developments

EMM [Ekurhuleni Metropolitan Municipality] and its MSDF [Metropolitan Spatial Development Framework] acknowledge that it is part of the Gauteng city region. All the spatial and integral frameworks from the inception of the metro in 2000 have taken their cue from the Gauteng spatial planning framework and all the studies associated with it. Initially the core economic development triangle was developed directly from the GSDF [Gauteng Spatial Development Framework] of 2003, which identified Tshwane, Johannesburg and Kempton Park (including Germiston and Boksburg) as the development triangle of the province. The current MSDF evolved from the GSDF of 2010 which identifies Kempton Park as a development area emerging from the region developing around Johannesburg CBD as its core. However, since EMM is a metro in its own right, the concentric zone model adopted for Gauteng with EMM being part of CoJ [City of Johannesburg], it had been necessary to consciously delink EMM from CoJ and retain the core economic development triangle as part of the developmental agenda for EMM ...

It so happens that the airport is less than 10km from the metros boundary CoJ and hence the city is skewed towards Johannesburg. Most of the development activities in the city are based towards the west which is close to CoJ. Having noticed the skewed nature of developments in the city close to CoJ, the city adopted the core economic development triangle that would push the metro towards the east. The closeness of

the city to CoJ cannot be ignored but it should not be to the detriment of the desired development of the eastern areas of the city of Ekurhuleni. (EMM 2012: 16–17)

This extract, from the EMM's MSDF, is a remarkably frank statement of an underlying set of assumptions and attitudes about future urban development in the municipality. Decoded and pared to its essence, the passage signals a refusal to accept a new regional planning framework that sees Ekurhuleni in the orbit of Johannesburg. In turn, it states an intention to steer development away from the boundary shared by the two municipalities and therefore away from the current urban centre of gravity and towards the spatial periphery. The approach is justified with reference to the municipality being part of a larger urban formation – the Gauteng city-region – which older planning frameworks such as the GSDF of 2003 had envisaged evolving around a core development triangle to the north-east of Johannesburg.

There is much to contemplate in this extract, but in general terms it alerts us to the fact that in any sustained examination of spatial change in Johannesburg it would be an error to abstract the city from its regional context. The changes under way in the city need to be understood within a wider view of spatial developments – planned and unplanned – in a region of towns and cities of which Johannesburg is simply a part.

In this chapter we consider changes in the macro spatial structure of Johannesburg within the frame of the Gauteng city-region. We first provide a schematic overview of the city-region and Johannesburg's place in it, and then give a brief historical account of key spatial trends that have shaped both Johannesburg and the region over the last century. In the latter part of the chapter we use a depiction of urban expansion over the period 1991–2009, based on satellite imagery, to anchor an analysis of more recent aspects of the evolution in spatial forms. In this enquiry, our focus falls principally on whether there has been a continuation of past patterns of urban growth in and around Johannesburg, in particular what two scholars in the 1950s (Fair and Mallows 1959) termed the 'thin oil of urbanisation' – extensive sprawl with highly fragmented and discontinuous urban structures. We look specifically at the balance between changes on the edge of the built-up area, in effect extending the urban form, and those within it, leading to densification.

The Gauteng city-region: places and populations

Gauteng, the provincial area within which Johannesburg falls, is located in the central north-east of South Africa. It stretches some 200 km north to south and some 190 km east to west, giving it an area of 18 179 km². Johannesburg, South Africa's primary economic centre and the provincial capital, lies at the centre of the province. To its north is Pretoria, the national administrative capital, in the municipal area of Tshwane. A number of smaller urban centres – including Germiston, Alberton, Boksburg, Benoni, Springs, Nigel, Heidelberg, Vereeniging, Vanderbijlpark, Krugersdorp, Randfontein and Westonaria – spread out across the province (see [Plate 1](#) in the colour section of this book). Each of these centres has its own history and character, but together they work as a functionally connected, almost continuous urban agglomeration (South African Cities Network 2004).

In 1996 Gauteng had a population of 7.8 million people. By 2001 this had increased to just under 9.4 million. Census 2011, released in October 2012 (Stats SA 2012), estimated the province to have almost 12.3 million people. Statistics South Africa's mid-year population estimates for 2013 put the Gauteng population at just over 12.7 million, representing 24 per cent of the national total on about 1.4 per cent of its land area.

Within Gauteng, Johannesburg is the largest municipality by population size. In 1996 it had an estimated 2.6 million people. In 2001 this had grown to 3.2 million and Census 2011 estimated the city's population at 4.4 million. Statistics South Africa's mid-year population estimates for 2013 put the city at over 4.6 million, 36.5 per cent of the provincial total and almost 9 per cent of the national total. The next largest city in Gauteng is Ekurhuleni at just over 3.2 million, followed by Tshwane at almost 3.1 million on 2013 estimates.

A wider urban footprint of other towns and population concentrations extends beyond the borders of Gauteng. To the north-west is the town of Rustenburg, and the Rustenburg, Madibeng and Moretele local municipalities, all in the North West province. Rustenburg is a global centre of platinum mining. As the demand for platinum has increased over recent decades, mining activities have expanded and the area's growth has accelerated. According to the 2011 Census, Rustenburg has a population of 549 575. It grew 42 per cent between 2001 and 2011, compared to Johannesburg's growth of 37 per cent.

To the south-west of Gauteng, also in the North West province, is a patchwork of towns historically anchored on gold mining. Among them is Potchefstroom in the local municipality of Tlokwe and, to a greater extent, Klerksdorp in the City of Matlosana local municipality. Some of these centres have seen limited population growth over the last decades as their gold-mining economies have stagnated. Matlosana, for example, grew just 11 per cent over the period 2001–2011. Also to the south, just across the Gauteng border in the Free State province, is Sasolburg, a town centred on the production of oil from coal, situated within the local municipality of Metsimaholo.

To the east are a number of small to medium-sized towns, notably Witbank, Middelburg and Secunda, anchored respectively on coal mining, iron and steel production and energy generation. Some of these local municipalities are growing incredibly fast. For example Steve Tshwete, centred on Middleburg, grew 61 per cent between 2001 and 2011 to now stand at some 230 000 residents. Another area closely linked to Gauteng, situated to the north-east in the Mpumalanga municipalities of Thembisile and Dr JS Moroka, is a swathe of semi-urban settlements – a zone of displaced urbanisation – housing people once barred by apartheid from setting up home in South Africa's whites-only urban centre. This area of some 560 000 people, on 2011 estimates, has little economy of its own. It is functionally connected to the Gauteng economy by subsidised bus transport routes which have historically ferried thousands of workers into central Pretoria on a long-distance daily commute.

All of these centres are socially and economically linked with the cities and towns in Gauteng. Together they constitute an extended city-region. Since the region has no determinate boundary, it is difficult to estimate the total population of this wider formation.

However, if concentric circles are drawn around the inner city of Johannesburg – the putative ‘centre’ of the broader region – it can be estimated to have had 13.4 million people within a 100 km radius (Plate 3), and 16.8 million within 175 km, in 2011.

The ‘thin oil of urbanisation’: regional spatial development in historical perspective

While the dramatic expansion of urban forms and activities in what is today recognisable as the Gauteng city-region is singularly attributable to the discovery of gold in Johannesburg in 1886, this city was not the first urban formation in the area. As Mabin (2009: 5) notes, ‘the oldest surviving focus of urbanism in the region is Pretoria, founded as capital of a then-separate settler state in 1855.’¹ It took over from Potchefstroom in the far south-west corner of the city region.² Pretoria grew quickly in the years after it was established, and under ordinary circumstances urban expansion over the last century would probably have occurred in a monocentric form around this city. The discovery of gold some 50 km south of this emerging centre set up a bipolar arrangement of two linked but separate cities in close proximity, one with capital city functions, the other anchored on production, trade and finance.

The discovery of gold marked a dramatic adjustment in the fortunes of South Africa as a whole, and in turn a tectonic shift in the distribution of economic activity and population across the country. The gold rush led to massive international investment. The resulting accumulation of wealth attracted opportunity seekers from within South Africa and across the world. In turn this growth resulted in, and was enabled by, huge infrastructure and institutional developments,³ which set the basis for both the region’s emerging spatial structure and its articulation to the national space.

Writing in 1959, Fair and Mallows neatly describe this evolution:

In order to serve ‘the Reef’, as the gold mining zone of the Witwatersrand came to be called, and in particular to supply it with coal from these collieries, a railway was completed between Springs and Krugersdorp in 1891. Meanwhile, railways from the coastal ports of Cape Town, Lourenco Marques and Durban reached the Witwatersrand and Pretoria in 1892, 1894 and 1895 respectively. The junction of these routes on the Witwatersrand took place at the easiest crossing of the watershed at Germiston and so gave a permanent nodal significance to this centre. The railway crossing at, and its position on, the Vaal River, a future main source of water for the region, established Vereeniging also, then a small coal mining village, as a potentially important industrial nucleus in the pattern that was later to emerge ... Thus, as early as 1896 the broad framework of the present settlement pattern was clearly established. The polynuclear structure, the east-west mining axis and the north-south communications axis had emerged. The sum of these factors had produced the now clearly defined cruciform nature of the structure built around these two dominant axes. (Fair and Mallows 1959: 130)

There are three important points here. First, the bipolar presence of Pretoria and Johannesburg has dominated the structure of the Gauteng city-region. But further discoveries of gold all along the east-west reef, the growth of coal mining in the east, and the emergence of smaller industrial centres, such as Vereeniging-Vanderbijlpark and Nigel, all of which in one way or another connect into mining supply chains, have led to a metropolitan region with a polycentric spatial structure.

Second, over the last century the expansion of Johannesburg and its surrounding region has seen the reorientation of South Africa's space-economy so that the area now stands at the centre of a web of nationwide infrastructure networks. Today, national roads, passenger and freight rail, road freight routes, gas and oil pipelines, electricity transmission lines, water transfer schemes, national and international air corridors and so on all converge on, or radiate out from, the towns and cities that make up this region. Some of these networks not only connect the region to places elsewhere; they traverse the space and provide very significant internal structuring elements.

Third, the polycentric form of the region was itself structured in a cruciform pattern, with a predominant east-west arm known as the Witwatersrand, and a north-south axis with Pretoria at its head and the Vaal Triangle industrial complex (Vereeniging, Vanderbijlpark and Sasolburg) in the south. Initially referred to in the planning literature as the Southern Transvaal, the region eventually came to be known in everyday reference as the PWV (Pretoria-Witwatersrand-Vereeniging) (Beavon 1997). This form is clearly visible in [Plate 4](#), a 1956 land-use map from the report *A Planning Survey of the Southern Transvaal* (Fair et al. 1957).⁴ The same shape can be seen, here more consolidated, in the 1974 map ([Plate 5](#)), which is drawn in virtually identical colours.⁵

Within this overall polycentric structure, loosely organised along and around two major axes crossing in Johannesburg, the region's spatial development has produced a number of distinctive characteristics over time. While the historical literature points to considerable variety in spatial structures, some characteristics were common across the region. Four are highlighted briefly here.

Fractured forms

In the 1973 study 'The Witwatersrand – Regional Setting: Southern Transvaal' (often colloquially referred to as the Metrocom Report),⁶ the Urban and Regional Research Unit at the University of the Witwatersrand highlighted that component parts of the region had evolved quite varied macro structures.⁷ However, it refers repeatedly to the fact that a common feature across large parts of the region was the highly fractured nature of urban development. In relation to the Vaal Triangle it speaks of 'sparse and scattered pockets of white and non-white residential development'. On the near East Rand it sees a 'confused nucleus of mining, industrial and white residential development', and on the far East Rand a 'widely scattered pattern of land uses' (Urban and Regional Research Unit 1973: 13).

This fractured development pattern is visible in [Plates 4](#) and [5](#). Both show white residential areas in dark pink and proposed white residential areas in light pink. The light

pink areas in the 1956 map have become dark by 1974, indicating significant consolidation in the northern Johannesburg part of the Witwatersrand, as also noted by the Urban and Regional Research Unit (1973). However, the eastern stretches of the Reef are very evidently made up of a series of residential fragments strewn across proclaimed mining land, shown in yellow on both maps. This pattern seems even more fragmentary by the early 1970s. A similar conclusion can be drawn for southern Pretoria, albeit to a lesser extent, and the Vaal Triangle, although here the light pink suggests a plan to cohere the area between the huge Iscor industrial works – in purple on both maps – and the Vaal River.

There were several reasons for this fracturing of urban development in the history of the Gauteng city-region. A very important factor on the central east-west axis was the nature of mining land itself. Undermining of southerly sloping gold reefs, together with extensive areas of mine tailings sterilised by the industrial chemicals used to extract gold from ore-bearing rock, meant that residential areas, even while they were essential in the vicinity of mine works to ensure a proximate labour supply, simply could not grow in more natural and efficient ways.

Of course, township planning under apartheid significantly exacerbated the fracturing of urban forms in the region. As [Plates 4 and 5](#) show for the critical 20-year period over which apartheid was most vigorously implemented, African, coloured and Indian/Asian areas were demarcated to be deliberately dislocated from the main urban cores. African areas are shown in dark grey on the 1974 map, coloured areas in dark blue and Indian/Asian areas in orange. To illustrate, consider the placement of Tembisa, shown as planned in 1956 and partly built in 1974, in what was then still open space between Pretoria and the Witwatersrand.

The mining belt of the Witwatersrand was also used deliberately in places as an apartheid ‘buffer zone’ separating racially defined settlements. Over time it became a physical marker of the spatial and wealth divides wrought by apartheid, and still today poses limitations on post-apartheid spatial reintegration. In Johannesburg in particular it continues to segment the city into a wealthier and greener north, and a much poorer and dustier south where townships such as Soweto and more informal settlements such as Orange Farm are located.

Another key reason for fragmentation has been that the region is encircled by an east-west-running collar of dolomitic land that renders development in some areas difficult or even impossible because of the danger of sinkholes (Urban and Regional Research Unit 1973). In one view, this ‘constraint’ on urban growth is also an asset. It ensures that a proportion of Gauteng’s land surface, in particular sections containing valuable agricultural land and unique unspoilt Bankenveld grassland, will be preserved from future development. But this land has prevented urban consolidation in certain areas, notably south of Soweto and south of Pretoria.

Sprawl and inverted densities

In their 1959 article, Fair and Mallows also identify the fragmented nature of urban space as a key characteristic, and tie this together with the issue of sprawl:

One interesting aspect of the historic development of the Reef and one affording a very sharp contrast to much of the older industrial growth, particularly in Europe, is

the relative lack of any restriction on horizontal expansion as far as the availability of land is concerned. The 'wide open spaces' of the Highveld are literally true; they have little agricultural value in the immediate neighbourhood of the Reef, as has already been pointed out, and the only limitations on urban sprawl are the internal technical limitations, mainly transport, water and power, of the urbanization itself. ... This thin 'oil' of urbanization has been spread out over the surface of the land ... This factor, added to the naturally haphazard surface patterns that any mining operation creates, has given an exceptionally loose and open texture to the urban areas. All trends indicate that urban dispersion is continuing at an un-checked rate, whether planned or un-planned; and it seems that planning will have to be done against the background of such a texture. (Fair and Mallows 1959: 137–138)

The fact that almost all of the growth in Gauteng occurred during the age of the automobile meant that very little white residential development occurred in and around dense, walkable city centres on the model of European cities. The rapid spreading of these areas is clearly shown in [Plates 4 and 5](#). The light pink areas in the 1956 map have all been built by 1974, and more has been developed besides, as evidenced in particular in northern Johannesburg and eastern Pretoria. And the 1974 map then shows the further planned extension of these areas. Most noticeable here is the proposed stretching of the residential edge in the south of Johannesburg – what would become the suburbs of Glenvista, Mulbarton, Bassonia, Meyersdal, Brackenhurst and Brackendowns – as well as along a corridor north of Roodepoort and Krugersdorp, and north and south of Pretoria.

In addition, apartheid policies of locating Africans in decentralised dormitory 'townships' did two things. First, on an overall level, it spread Gauteng's urban form more thinly than would have been the case if the cities' property markets had functioned normally, and people had been permitted to cluster naturally nearer to nodes of work opportunity. Fair and Mallows (1959: 137) compellingly, and not disapprovingly,⁸ describe the outcome of the 1953 Witwatersrand and Vereeniging Native Areas Zoning Committee's region-wide planning of African townships as follows:

The rate of this (African housing) development is such that the Director of Housing for Johannesburg was able to state that the ground was being consumed for African housing at the rate of two square miles per annum in the chief area of development south-west of Johannesburg.

This expansion is clear in the 1956 and 1974 maps. In 1956 a relatively small part of Soweto, just south of the mining belt, is shown as built (black on the map). The planned section is marked with a diagonal line pattern. By 1974 much of this had been built, as had Sebokeng north of Vereeniging, and Katlehong and Vosloosrus south of Alberton. Meanwhile, Sophiatown in central Johannesburg had been removed. Intriguingly, the two maps suggest that there was relatively slower development of African residential areas on the far East Rand, with Daveyton in particular showing no growth between 1956 and 1974.

Second, because apartheid policies forced large racially defined populations into ghettos

and prohibited free movement, this resulted in an aberration in the overall pattern of fast-spreading urban forms. Ordinarily the density curves of a city are highest at its centre, and drop off towards the periphery. In the Gauteng city-region the historical displacement of African, coloured and Indian/Asian populations was another dimension of sprawl, but it led to the unique signature of concentrations of high density on the edge of the city (Mabin 2009). Alain Bertaud shows that by 1990 Johannesburg had a density of some 40 persons per hectare (p/h) in its city centre, compared to about 300 in Paris and 100 in New York. Its densities then increased to between 140 and 150 persons p/h at a distance of around 25–30 km from the CBD along the central Witwatersrand zone, compared to less than 50 in Paris and around 25 in New York (Bertaud 2004).

Deconcentration and displaced urbanisation

There is a recurring anxiety in the historical writings on the region over whether the urban fragments that had sprung up on the periphery would be viable in the long run. Fair and Mallows traced the shifting centres of gravity of gold mining and associated production. They highlighted the swing in economic weight from the West to the East Rand – in part due to the fact that the latter had a convergence of regional and national railways, proximity to the coalfields in what is now Mpumalanga, and flatter land for large industrial works – but also how gold production volumes in the Southern Transvaal were declining, while those in the new Free State goldfields were increasing. In their view, Johannesburg had already long since passed the point where it was ‘primarily dependent on mining’, and had consolidated a truly diverse metropolitan economy. But the ‘arms of the east-west axis’ were facing an ‘acute’ problem. They were showing a ‘growing degree of commuting’ to the ‘Johannesburg metropolitan core’ and had a ‘growing dormitory character in relation to Johannesburg’. To offset this decline, Fair and Mallows argue, outlying urban centres along the Reef were ‘encouraging the growth of industry’ to promote a more ‘balanced economy’ (Fair and Mallows 1959: 136).

Though in favour of this strategy in the late 1950s, Fair and his team at the Urban and Regional Research Unit seem more ambivalent about the likely success of industrial decentralisation in the 1973 Metrocom Report. Here they emphasise the special planning problems associated with urban areas on or near mining landscapes, which ‘may be shallowly undermined or replete with mine dumps, slime dams and derelict plant’, and which may also be affected by the ‘structural weaknesses’ of dolomitic land, and conclude pessimistically:

There is no geological reason for each of the formerly independent mining towns to become a manufacturing or service node within the modern metropolitan region that is so rapidly replacing the old mining complex, and there may be no particular economic or social reason either. (Urban and Regional Research Unit 1973: 9)

The challenge of how to ensure the sustainability and growth of peripheral areas, and ambivalence over the prospects for success of decentralisation measures, have been echoed at the larger regional scale through much of the last half-century. Geyer (1990) traces how

the 1956 Guide Plan for the PWV envisaged industrial development only in the region's core, while the 1974 Guide Plan had shifted policy to emphasise industrial development in the far eastern, far western and southern sections of the PWV. As early as the 1960s, but very explicitly by the early 1980s, decentralisation of industrial development was being tied to the patterns of urbanisation in bantustan areas in the far north-west and north-east of the city-region. Here, as mentioned earlier, swathes of semi-urban, semi-rural settlement make up a vast zone of displaced urbanisation. Late apartheid planning identified six industrial deconcentration points in this zone, to promote 'the development in these outer peripheral Bantustan areas and in the diversion of black urbanization away from the PWV' (Geyer 1990: 389).

Geyer is scathing in his critique of the deconcentration points selected, indicating that contrary to claims that they are geographically well located and economically supported by 'spontaneous natural growth tendencies', they would not work without costly and inefficient industrial subsidies. He also references academic arguments that the PWV was then still a small metropolitan region by world standards, and that diverting growth away from its core would hamper consolidation. But ironically, he concludes his article with his own vision for deconcentration, intriguingly in support of the ideals of a wider city-region:

If intermediate centres such as Potchefstroom-Klerksdorp-Witbank-Middleburg and Rustenburg are regarded as decentralization points in a system of cities with the PWV, a geographically more balanced distribution of deconcentration points ... some within the intermediate/outer core zone and some within the core fringe zone need to be designated to reinforce the system of cities. Centres such as Midrand and Meyerton within the intermediate/outer core zone, and Brits, Bronkhorstspuit, Secunda and Carletonville within the core fringe zone, all of which are centres with considerable growth potential, and all of which are located on primary communication axes inside the PWV and between the PWV and the intermediate cities should be considered. (Geyer 1990: 393)

Ribbon development

The historical scholarship is also ambivalent on a gradual process of infill development between the three poles of the city-region – Pretoria, the Witwatersrand and the Vaal Triangle – along key corridors. As noted, the region was connected to other key centres across South Africa by a national network of railway lines and later highways, but this infrastructure also traverses the space internally, providing a lattice along which growth can occur. While Geyer, in the extract above, sees the need to locate deconcentration points with explicit reference to these 'primary communication axes', others have worried about how the core urban areas seem to be sprawling outwards along these links. The 1973 Metrocom Report expresses great anxiety about this phenomenon, in fascinating terms *contrasting* it with a future spatial strategy that privileges development of peripheral areas:

Other probable sources of inter-metropolitan planning problems are ... in connection with ribbon-like industrial and residential thrusts taking place along the main highways

and railway lines, which from a regional standpoint appear to constitute urban sprawl. The questions arise as to (i) whether this apparent sprawl is inevitable; (ii) whether, if it is inevitable, it can and should be moulded into, for instance, corridors of satellite towns located in green interstices between the three metropolitan regions, or should be permitted to progressively join these regions together to form a planned but amorphous and coalesced megalopolis; (iii) whether, alternatively, such inter-metropolitan sprawl can and should be contained and limited in favour of planned development of outlying centres such as Bronkhorstspuit, Witbank, Brits, Kosmos, Rustenburg and Parys. (Urban and Regional Research Unit 1973: 14–15)

The Metrocom Report carefully weighs the options for various spatial strategies in its concluding sections, and comes down against the idea of the region’s cores gradually merging through development along the corridors. Instead it proposes a vision – based on option (iii) – of a ‘regional city’ with separate, ‘well defined, high-density urban clusters’ linked by rapid transport systems, but with cores kept apart by rural and agricultural land uses. Regardless of these preferences, however, the region continued to coalesce along the ribbons between its three major parts, a process facilitated by the ascendance in the mid 1970s of highway planning, and the construction of the so-called ‘PWV network’ of freeways in the following decades (Mabin 2009, 2013).

Urban expansion between 1991 and 2009

Land-cover mapping

How have these historical patterns in spatial development of the region continued, or changed, in the last two decades? Using data derived from satellite imagery, we have synthesised an overall picture of key structural developments in the more recent period since 1991.⁹ [Table 2.1](#) summarises this for Gauteng and Johannesburg, comparing 1991, 2001 and 2009.

	1991		2001		2009	
	Ha	%	Ha	%	Ha	%
Gauteng urban (built-up)	228 792	12.6	289 781	16.0	333 458	18.4
Johannesburg urban (built-up)	68 534	41.7	82 515	50.2	92 746	56.4

TABLE 2.1: Percentage of Gauteng and Johannesburg that is urban (built-up), 1991, 2001 and 2009

Source: Mubiwa (2014); Mubiwa and Annegarn (2013)

Between 1991 and 2009 the urban extent of Gauteng increased by 104 666 hectares. Of this, 24 212 hectares were in Johannesburg and 80 454 in the remainder of the province. This equated to a percentage growth in urban land cover of 46 per cent across Gauteng – 35 per cent in Johannesburg and 50 per cent in areas outside this municipality. Growth was

faster between 1991 and 2001 (26.7 per cent for Gauteng) than between 2001 and 2009 (15.1 per cent), though this partly reflects the shorter second period. When viewed as a proportion of its own total area, urban land-cover growth was the fastest in Johannesburg between 1991 and 2009, rising nearly 15 per cent from 42 per cent to 56 per cent urban.¹⁰ By way of comparison, Ekurhuleni rose 12 per cent to end at 44 per cent urban in 2009. However, almost all municipal areas had faster percentage growth than Johannesburg over the two decades. Illustratively, the urban extent of Emfuleni (Vereeniging) grew 46 per cent, Mogale City (Krugersdorp) 56 per cent and Midvaal (Meyerton) 73 per cent.

Urban growth between 1991 and 2009 is mapped in [Plate 6](#) at the Gauteng-wide scale, and [Plate 7](#) for Johannesburg. The plates show the 1991 urban extent in green and the 2009 extent in red.

A close examination of the maps between 1991 and 2009 suggests that the regional structure of large urban blocks roughly arrayed in a cruciform pattern, with smaller but distinct urban centres around them, has remained intact, and that there has been considerable continuity in the historical growth patterns.

First, *fractured forms of development continue*, and in parts the process of fragmentation seems to have been exacerbated. In Johannesburg, consider Diepsloot and Cosmo City on the city's northern edge, a range of urban fragments in the south – with Poortjie in the far south-west corner being a particularly noteworthy example – and Vlakfontein north-west of Soweto in the old mining belt. ([Plates 1](#) and [2](#) provide a visual reference for many of the cities and suburbs mentioned in this chapter.) Vlakfontein and nearby Bram Fischerville notwithstanding, there has also been little development that has overcome the historical barrier of the east-west mining belt, and the separation it symbolises between the north and south of the city. The holes it leaves in the overall spatial pattern also remain. The same is clearly true for the East Rand segments of the Witwatersrand, in what is now Ekurhuleni – they show only slightly less fragmentation than in the 1956 and 1974 maps discussed earlier ([Plates 4](#) and [5](#)).

Second, and as suggested in the percentage calculations above, the maps indicate that *sprawl* has continued on the edges of both township areas and previously whites-only suburbs. Following Fair and Mallows' quoting of the then Johannesburg Director of Housing, 'African housing' still 'consumes ground' at a considerable rate on the edge of Soweto, and also every other large township laid out under apartheid. For example, Soweto has been extended dramatically south-west, west and north-east with new areas such as Protea South, Protea Glen, the beginnings of Lufhereng, and Braamfischerville. Urban growth was also significant in the Orange Farm, Lawley Estate, Ennerdale and Grasmere areas. However, by far the strongest growth seems to have been north-west of Tembisa, east of Halfway House, in Ivory and Ebony Park and related extensions.

In the north of Johannesburg, suburban sprawl characterised growth around the urban edge of the north-western suburbs, notably in Fourways, Sunninghill, Diepsloot and west of Midrand in new suburbs like Kyalami Estates and Vorna Valley. The extension of previously white residential areas is also pronounced in the south of Johannesburg.

While Johannesburg has seen much outward growth in certain areas, the province-wide map (Plate 6) makes it clear that other parts of the region have experienced even more significant expansion. Remarkable growth has occurred in the areas north-west of Pretoria around such settlements as Kekana, Babelegi, Hammanskraal, Temba and Ga-Mokone, together with north-east expansion of Mabopane and the south-west expansion of Soshanguve. Also in the Tshwane area, urban growth was seen on the edge of Atteridgeville, Mamelodi and Akasia. Bronkhorstspuit/Ekangala to the far north-east, and mining-related settlements such as Krugersdorp, Westonaria, Carletonville, Khutsong and Phomolong in the far west, also saw some growth.

The pace of expansion seemed slower on the East Rand than elsewhere between the late 1950s and early 1970s, but Ekurhuleni appears to have seen some of the most dramatic growth of townships in the 1991–2009 period. Areas such as Duduza and Geluksdale expanded southwards while Tsakane grew westwards. There has been a huge southward spread of the Katorus (Katlhong, Thokoza and Vosloosrus) complex of townships, as well as outward development on the north-eastern edge of Daveyton.

Not all areas have seen outward expansion. For example, the cores of Vereeniging and Vanderbijlpark, which certainly showed some expansion in the 1970–1990 period, have barely grown over the last two decades, except for the scattering of low-density development along the Vaal River to the west.¹¹ Further, notwithstanding evidence of spread, there has also been infill development in some places. Small portions of mining-to-urban conversion were experienced close to the Johannesburg CBD. This could be attributed to the reclamation of mine tailing facilities for wholesale and industrial development (see Chapter 29).

Third, the extraordinary development of the band of settlements in the north-western corner of the province speaks volumes to the residual effects of *displaced urbanisation*, and policies of diverting urbanisation through industrial *deconcentration*. While the monocentric character of the central part of Pretoria remains, the remarkable growth around Mabopane, Soshanguve and the Winterveld has bifurcated the space. Unfortunately our change-detection maps cover only Gauteng and so it is impossible to see whether there has been a similar trend in the areas previously covered by KwaNdebele, with the exception of that small portion – Ekangala – that was incorporated into Gauteng. This does seem to have shown similar growth over the period.

Fourth, all the evidence points towards the steady erosion of the Metrocom Report's vision of a 'regional city', built on the model of dense urban clusters kept separate by protected rural and agricultural green belts. Its fear that an amorphous region will coalesce from *sprawl along ribbons* between the three major cores is exactly what has come to pass, most notably with the developments along two corridors between Pretoria and Johannesburg/Ekurhuleni.

Key developments stretching the urban form

Our calculations and mapping of urban growth between 1991 and 2009 show the extent to which the urban form of Johannesburg and the wider city-region has stretched over the

last two decades, and some of the main patterns. There have been three key driving forces behind this expansion: the provision of public housing, the dramatic growth of various sorts of gated communities and, to a lesser extent, the establishment of informal settlements. All three are discussed in detail in other chapters in this volume (Chapters 8, 9 and 11) but a broad overview is warranted here.

An indication of the extent and spatial location of new public housing developments and the expansion of gated communities can be drawn from GeoTerraImage's (GTI) building-based, land-use dataset. This captures a point per structure with associated attributes for various residential categories and thus can give a sense of residential growth patterns in Gauteng between 2001 and 2010.¹²

Plate 8 depicts the growth of formal freehold housing units – the deeper the shade of red the larger the number of new housing units per square kilometre between 2001 and 2010. It is clear that new housing has concentrated on the fringes of the cities, with the largest growth in Johannesburg occurring in Cosmo City in the north, around Soweto in the west and Orange Farm in the south. Much of this would have been government-provided housing.

On GTI's count there were 1 191 932 self-standing houses in Gauteng in 2001 (395 782 in Johannesburg) and by 2010 there were 1 550 905 (501 472 in Johannesburg). This was an increase of 30 per cent across Gauteng, and 27 per cent in Johannesburg.

Plate 8 also maps the growth of estates and security villages – the deeper the blue the greater the number of units per square kilometre between 2001 and 2010. GTI estimates that there was a 202 per cent increase in housing units – from 26 573 to 80 342 – in estates and security villages across the province. Johannesburg saw an increase of 114 per cent, from 13 757 to 29 410.

The location of townhouse clusters and estates, development of which is driven by the private sector, differs wildly from the sites of new housing, most of it in the form of publicly driven delivery. As shown in Plate 8, the latter are all in the poorer areas of the city-region, usually on the edges of municipalities and with a preponderance in southern and western Johannesburg, on an axis running between Johannesburg and Vereeniging (the Orange Farm, Evaton, Sharpeville complex of informal settlements and townships), as well as in the far northern parts of Tshwane. By contrast, the growth of estates is almost exclusively located in the wealthy core of the province, most on the edge of the existing built-up area, on a sweeping diagonal from the north-west of Johannesburg to the south-east of Tshwane.

Plate 9 confirms this picture, using a different dataset (AfriGIS) as at 2012. This captures gated communities in Gauteng, disaggregating between sectional schemes, residential estates, commercial estates/business parks and boomed-off residential areas. The background data show that in Johannesburg these various kinds of gated communities made up a total of 141.4 km² in 2012. This represents 8.6 per cent of the total land area of the city (1 644 km²) and a significant 19.0 per cent of its urban area (743 km²). In Gauteng as a whole, gated communities comprised 324.4 km², 1.9 per cent of Gauteng's total area and 11.7 per cent of its urban area. The extraordinary swathe of these gated communities across a wide sweep of

the central province, as mapped in [Plate 9](#), more viscerally captures the reality of how these forms of settlement have stretched the urban form than do the statistics.

The urban extent of the region has also been extended by informal settlements, but to a lesser degree. GTI informal housing data contain a point per informal housing structure, as well as another category, transitional, for informal dwellings in areas – such as those being formalised in situ with roads and stand layouts – where it is difficult to distinguish between temporary, informal housing and more permanent housing. On GTI's count, the number of informal settlement units across Gauteng increased from 395 449 in 2001 to 424 215 in 2010 (7.3 per cent growth) and the number of transitional units from 161 963 to 165 015, a mere 1.9 per cent increase. In Johannesburg, units in informal settlements declined from 105 868 to 99 166, while transitional structures rose by 50 per cent from 41 738 to 62 719.

There is consonance between these data and the results of the 2011 Census, if informal and transitional dwellings are counted together. According to the Census, there were 512 774 Gauteng households in informal and traditional dwellings in 2001. This declined by –12.7 per cent to 447 800 in 2011.¹³ One possible explanation for the miniscule growth (or decline in the case of the Census) in informal settlements may be the roll-out of government housing schemes across the province. The movement of informal settlement residents to backyard dwellings within formal stands may be another key factor. Regardless of the reason, it is clear that while informal settlements have certainly been part of the 'thin oil of urbanisation', spreading the region's urban form, their impact is declining relative to other settlement types.

Consolidation and densification within the urban extent

The section above traced key settlement developments extending the urban form of both Johannesburg and the wider region. However, this visible outward expansion is certainly not the only change under way. There are also trends that are having the opposite effect of driving up population densities.

As noted in the introduction to this volume, Angel et al. (2012) alert us to the fact that, contrary to almost all other major cities in the world, densities in Johannesburg increased between 1990 and 2000. There are various ways to test whether this trend continued.¹⁴

Using the concentric ring depiction of the Gauteng city-region discussed earlier, it is possible to show that the population beyond a 100 km radius of the centre of Johannesburg, *but within 175 km*, increased by 595 845 people (21.2 per cent) between 2001 and 2011. The population *within 100 km* increased by 3 143 625 (30.8 per cent), and the population within Johannesburg's boundaries grew by 1 211 136 (37.6 per cent) over the period. In overall terms, this is therefore a city-region that is growing fastest at its core, in effect consolidating.

On the basis of our land-cover change mapping we can also determine that the urban extent of Gauteng grew 15.1 per cent between 2001 and 2009, and that for Johannesburg it was 12.4 per cent. The population growth over the roughly corresponding period of 2001

		Inside 2000 urban built-up area	Outside 2000 urban built-up area
Johannesburg	Area km ²	547	1 097
2001	Population	2 478 627	747 186
	Density (per km ²)	4 534	681
2011	Population	3 140 097	1 294 646
	Density (per km ²)	5 744	1 180
2001–2011	Growth percentage	26.7	73.3
	Growth absolute	661 470	547 460
Gauteng	Area km ²	1 929	15 046
2001	Population	7 134 318	1 702 861
	Density (per km ²)	3 698	113
2011	Population	9 113 320	3 158 443
	Density (per km ²)	4 724	210
2001–2011	Growth percentage	27.7	85.5
	Growth absolute	1 979 002	1 455 582

TABLE 2.2: Density growth inside and outside the 2000 urban extent, Johannesburg and Gauteng, 2001–2011

Source: CSIR/ARC (2000); Stats SA (2011)

to 2011 was 30.7 per cent for Gauteng and 37.6 per cent for Johannesburg, suggesting significant densification.

A more nuanced picture was derived by determining the urban/built-up area of Gauteng and Johannesburg in 2000 from the National Land Cover (CSIR/ARC 2000) dataset, and estimating the population growth inside and outside this extent between 2001 and 2011 using the Census small area layer.

Table 2.2 summarises the results, showing that while percentage growth outside the 2000 urban extent was considerable for both Gauteng and Johannesburg, absolute growth and increases in density inside the urban form were marked.

Urban edges

There are a number of factors driving increasing densities in the region. One has been the delineation of urban boundaries, or edges, by both provincial and local government. In essence, an urban edge is a threshold beyond which urban development will not be permitted. Gauteng instituted an urban edge in 2002 as a policy flowing from its 2000 GSDF (Horn 2009). Motivations given for the edge included the need to encourage densification in a way that supports, and is supported by, public transport; to encourage the

acquisition of well-located land for housing which would consequently not be on the edge of the city; to promote a compact and sustainable city; and to direct development towards sites in the core where bulk infrastructure already exists, relieving pressure for the extension of stretched infrastructure networks (Horn 2009).

By all accounts, the delineation of the edge started well with the establishment of an urban edge task team, consisting of key provincial government departments and all affected municipalities, and the definition of a logically ordered process to define and approve the boundary. However, intergovernmental challenges arose when municipalities contended that they had not been consulted enough in the initial design work on the urban edge, and proposed a different set of boundaries through their own integrated development planning processes.¹⁵ This led to a conundrum: on the one hand the provincial government's version of the edge had no legal standing because it needed to be authorised in terms of legislation that was only concluded later in 2003, with key regulations still to be drafted thereafter; on the other, a different set of boundaries was formally adopted as part of spatial development frameworks in municipal integrated development plans, and began to govern local planning decisions immediately (Horn 2009). While efforts to resolve the matter over the years met with some success in some places, differences of opinion and divergences in application of urban edges continued through much of the 2000s (see [Chapter 20](#)), until in February 2011 the Gauteng edge was rescinded with the approval of a new GSDF.

These difficulties aside, urban boundaries did have some impact in limiting expansion. [Plates 10](#) and [11](#) show the changing Gauteng urban edge, overlaid with a new view of our change-detection mapping between 1991 and 2009. In these maps the extent of change to urban land cover in each square kilometre block across the province is shown through a colour ramp, with 100 per cent being complete change in the block, as marked in red on the maps. This version of the change mapping illuminates that urban expansion in the 1991–2001 period seemed to be over a much wider area in virtually all parts of the province than over the 2001–2009 period. In the latter period, growth was also considerable, but much more concentrated in specific locations. [Plate 10](#) shows the first provincial urban edge drawn in 2002. Municipal urban edges would have roughly followed this line, though there were certainly divergences. [Plate 11](#) shows both the 2002 edge in grey, and how this line shifted over the decade with the 2010 adjustment in blue.

Four things stand out. First, it is notable that the urban edge was drawn to start with in a way that permits the ongoing 'ribbon development' connecting Pretoria and the Witwatersrand, a choice that recognises the inevitability of the trend the 1973 Metrocom Report feared. Second, it seems clear that the 2002 line was drawn to contain areas of extensive sprawl such as the fast-expanding north-western belt and growing southern suburbs in Johannesburg. The 2001–2009 map ([Plate 11](#)) suggests that, by and large, the edge succeeded in accomplishing exactly this. The pattern of growth has altered significantly in the second map, and sprawl has not continued across the 2002 line except in a few places. Third, it is clear that some areas of concentrated expansion were in fact already anticipated and allowed for in the 2002 edge. Consider, for example, how the southerly

expansion of the Katorus townships in Ekurhuleni, while dramatic, occurs within the 2002 line. Fourth, these positive conclusions notwithstanding, there has been development over the boundary between 2001 and 2009 and an accompanying trend of moving the edge to accommodate this. For example, the edge has been moved to allow for new large-scale housing developments such as Lufhereng west of Soweto, and for more lifestyle estates, especially where this brings greater property rates revenue to smaller municipalities such as the previous Kungwini. However, as the second map (Plate 11) shows, the shift is not always outwards, allowing free reign to sprawl; in some instances the edge has actually been tightened over time.

While there is considerable nuance in the story, and while we cannot be conclusive, it is likely that the urban edge approach contributed to the slowing of urban expansion in the 2001–2009 period over that seen in the previous decade. Further, the slower pace of outward growth in *some areas* may be attributable to the more rigorous application of urban boundaries there than elsewhere. For example, Johannesburg's urban growth of 12 per cent between 2001 and 2009 compares to 16 per cent in Tshwane, a municipality that did not adopt an urban edge.

Inner-city developments and backyard dwellings

A number of other trends are driving densification. We noted earlier that Alain Bertaud (2004), while highlighting the generally low densities in the region, had identified the odd phenomenon of inverted densities, with a very low population concentration at Johannesburg's core increasing dramatically some 25–30 km from the centre. However, Bertaud reproduced his analysis later in the decade, using 2001 instead of 1991 Census data, and looking at Gauteng as a whole. Here he found that densities in the inner city of Johannesburg had increased to over 140 p/h. Along the density curve they also slope downwards in line with international norms to about 25 p/h within 30 km of the city centre. He specifies here that his 1991 analysis was along the Witwatersrand only (Bertaud 2008).

For much of its early years, Johannesburg's inner city was a dense mixture of both formal and informal dwellings crowded together around the original mine works to the south. From these early beginnings residential development spread outwards, first to the east and south, and then over the Braamfontein ridge to the north. It did so in part because city planning regulations restricted the height of buildings in the central city area. These height restrictions were removed in the 1950s, leading to a building boom of high-rise residential apartments in Hillbrow and Berea. Since then densities have increased in waves, although the 1980s saw a dip in the overall trend, with white residents beginning to abandon the area in favour of the suburbs. More recently, densities have climbed as underutilised office blocks have been converted to residential quarters, both legally and illegally. Flats, houses in the near-inner-city suburbs and industrial spaces have also been subdivided to accommodate multiple families. Within the urban development zone boundary conventionally used to define the Johannesburg inner city,¹⁶ the population increased 35 per cent from 158 142 in 1996 to 213 650 in 2001. It increased a further 21 per cent to 259 268 between 2001 and

2011. Similar marked growth has been seen in other central city areas across the region, such as the Pretoria CBD.

Another instance of multiple families occupying a property is the phenomenon of backyard dwellings. This occurs when the yards of formal self-standing houses are made available for the construction of secondary structures, formal or informal. GTI data indicate that while there was limited growth of structures in informal settlements between 2001 and 2010, the number of backyard structures across Gauteng increased by 178 per cent from 266 929 to 743 052. In Johannesburg, the increase was a massive 213 per cent from 86 422 to 270 285, a significant impetus behind densification.

Conclusion

This chapter started from the premise that spatial change in Johannesburg can only be fully understood if one contextualises it within the trends and dynamics shaping space in the wider urban form of which this city is a part. At no point in the history of modern settlement in the area did the boundaries of the current City of Johannesburg contain the full extent of urban development. Johannesburg has *always* been one part of a wider region of towns and cities and spatial change in the city, whether planned or unplanned, has always occurred in dynamic interaction with changes in the surrounding parts of the city-region, and vice versa. With reference to spatial features and processes that are explored in more detail in other chapters of this volume, we have tried to give both a historical perspective and a more contemporary view. We show that while some dimensions of region-wide change continue to stretch the urban form, the ongoing ‘thin oil’ of sprawl and fragmentation is also strongly counterbalanced by structural changes leading to densification and consolidation within the urban fabric.

Acknowledgements

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Notes

- 1 This section of the chapter is informed by Alan Mabin’s considerable work tracing the history of the region, notably: Mabin (2008, 2009 and 2013) as well as his contribution to the case study commissioned by the GCRO in 2009 on The Gauteng City Region for Metropolis’s Commission 2 on Urban Growth Management, see <http://www.gcro.ac.za/project/metropolis>.
- 2 Potchefstroom was founded in 1838 and became the capital of the Zuid Afrikaanse Republiek in 1841. See <http://www.potchefstroom.info/history/town-timeline>. The oldest European-settled town in the broader region is Klerksdorp, founded in 1837.
- 3 An example was Rand Water, established in 1903, which today still supplies much of the extended region with bulk water (Rand Water 2004).

- 4 Note that the map is recorded in the report as dated 1956, while the report was published in 1957.
- 5 We cropped the map to a size equivalent to the 1956 map to enable comparison.
- 6 The report's preface explains that Metrocom was a grouping of city councils whose members were Johannesburg and Germiston, Alberton, Edenvale, Kempton Park, Krugersdorp, Randburg, Roodepoort, Sandton, as well as the Village Council of Bedfordview and the Modderfontein Health Committee (Urban and Regional Research Unit 1973). It is worth noting that TJD Fair was also involved in the development of this report, as the director of the Urban and Regional Research Unit, and as one of the authors.
- 7 The report indicates that metropolitan Pretoria had developed an 'essentially mononuclear character' compared to the 'dualistic character' of the Vaal Triangle, with Sasolburg located across the Vaal River from the extensive industrial and residential areas around Vereeniging-Vanderbijlpark. By contrast, the Witwatersrand had its own 'multi-centred character'. Within this variegation the Metrocom Report disaggregates further to different parts of the Witwatersrand. Its central sections around Johannesburg – despite the east-west mining and industrial belt – had consolidated and were in a process of becoming denser and more connected. The eastern parts, by contrast, had a more fragmented structure across a 'vast expanse of mining land' (Urban and Regional Research Unit 1973: 13).
- 8 In this 1959 article their primary reference point seems to be that the post-Second World War industrial development of the region has led to a rapid increase in the flow of African workers to the region. Existing African township areas could not accommodate this increase, leading in turn to 'undesirable shanty towns (arising) in an unplanned fashion around all the main urban areas' (Fair and Mallows 1959: 137).
- 9 A method that combines land-cover mapping using Landsat5 Thematic Mapper (TM) and Landsat7 Enhanced Thematic Mapper Plus (ETM+) data, together with classification and post-classification analysis, was employed to detect and analyse urban growth in Gauteng over the time spans 1991 to 2001 and 2001 to 2009. The classification procedure generally performed well in extracting land-use/cover information. Some spectrally separable classes were easily identified and classified. However, spectral-signature-based classification did not amply discriminate between some spectrally similar classes (e.g. grasslands and vegetated mine tailing storage facilities; barren, bare-cultivated lands; unvegetated mine tailing storage facilities and some partially built-up areas), resulting in classification confusions. Apparent errors were detected by comparing classification results/maps with true and false colour composites of the source images and resolved by way of on-screen editing (a process known as heads-up digitising). Further checking against other high-resolution imagery, Google Earth images and other mapping was also done. Using the confusion matrix tool in ENVI™, the overall accuracy of the land-use/cover change detection was calculated to be 90 per cent and the Kappa Index was 0.89, both very satisfactory results.
- 10 On this analysis urban growth across the region was mostly at the expense of woodlands. In 1991 woodlands made up 9.6 per cent of Gauteng and 6.9 per cent of Johannesburg; by 2009 this land-cover class had declined to 3.4 per cent of Gauteng and 0.8 per cent of Johannesburg. Counter-intuitively, grasslands increased slightly and agricultural land remained static over the period.
- 11 This is while urban land cover in Emfuleni as a whole grew 46 per cent between 1991 and 2009.

- 12 Satellite imagery for some parts of the province was for 2002 and 2009, but for ease of reference the base dates of 2001 and 2010 are used in the text.
- 13 Differences in the numbers are attributable to the fact that the Census counts households, not structures, and previous studies have found a high incidence of 'locked structures' – dwellings which no household seems to use on a regular basis – in informal settlements.
- 14 The method discussed in the introduction is not repeated here.
- 15 Not all Gauteng municipalities incorporated the idea of the urban edge into their own spatial development frameworks. Tshwane in particular regarded it as a blunt instrument, and preferred instead to emphasise other growth management tools (Horn 2009).
- 16 This analysis is based on the 27 Census sub-places that overlay the urban development zone boundary.

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