



# SAICE 2017 INFRASTRUCTURE REPORT CARD FOR SOUTH AFRICA



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## I. MESSAGE FROM SAICE

The 2017 Infrastructure Report Card (IRC) is the third produced by the South African Institution of Civil Engineering (SAICE), following on the 2006 and 2011 editions. It reflects the expert view of the Institution and its members on the current condition of a broad range of public infrastructure.

SAICE is a not-for-profit learned society, a voluntary association of close to 11 000 graduates and professionals in the civil engineering sector. Its members are individuals from all three spheres of public sector service, state-owned companies (SOCs) and consultants, academia, contractors and suppliers from the private sector. In short, SAICE is the foremost body of professional expertise responsible for the conceptualisation,

design, construction and maintenance of the nation's public assets. It is entirely appropriate, then, that the Institution has prepared this assessment of the condition of public infrastructure as a public service.

This report is primarily the work of volunteers, and we owe them a debt of thanks. SAICE also thanks our principal research partner, the Council for Scientific and Industrial Research (CSIR), which provided the bulk of the baseline research reports. SAICE undertook further research of its own, consulted with its internal divisional structures and, for the first time, completed a broad-ranging survey of its members to supplement the research.

In addition to the assessment of the condition of ten sectors (comprising 29 sub-sectors) of infrastructure, the IRC provides comment on some of the reasons for the grades that it gives. The views expressed in this report, and the conclusions and grades provided, are those of SAICE alone.

SAICE will continue to expand the scope and detail with which it examines the condition of infrastructure. The public can look forward to bulletins and focused discussion documents before the next report card is issued.

We congratulate the IRC Team on the latest edition of the SAICE Infrastructure Report Card.



SAICE 2017 President  
Sundran Naicker Pr Eng



SAICE Chief Executive Officer  
Manglin Pillay Pr Eng



## 2. MESSAGE FROM THE IRC TEAM

“Infrastructure Reports” are published in many countries, but these mostly relate to commercial activity in the construction sector, or to the extent that the general availability of infrastructure supports commercial activity. Infrastructure report cards that actually grade the condition of infrastructure are published notably by the American Society of Civil Engineers (ASCE) in the United States, the Institution of Civil Engineers (ICE) in the United Kingdom and by Engineers Australia. These, of course, are all in developed economies.

In the developing world South Africa has been joined recently by Nigeria and Zambia, and there are indications that the concept of report cards is gaining traction in Africa. SAICE has been requested by the Southern African Federation of Engineering Organisations (SAFEEO) to prepare a template that could be used by other nations for this purpose. The project is at an advanced stage.

The value of these reports lies in their utility to inform and influence macro-level planning, to lobby for infra-

structure funding, to stimulate debate and to highlight the actions that civil engineers believe are necessary to improve the condition of the nation’s infrastructure. It should be noted that only infrastructure that is owned by the public sector is considered. This includes SOCs, e.g. Eskom, and concessions, e.g. toll-roads.

Although this condition assessment is a snapshot in time, it reflects the outcomes of past planning and decisions, both good and bad. Similarly, current approaches to public infrastructure will determine the future trends in infrastructure condition. In the commentary that follows, we discuss some of the key considerations that have led to the current situation and may affect the future condition.

The process undertaken by the IRC Team is rigorous. Desktop research reports are interrogated by the committee drafting the report card in conjunction with the SAICE specialist divisions for each sector. Thereafter, the draft report card is passed through a series of revisions culminating in the allocation of

grades for the condition of infrastructure in each sector and sub-sector. Finally these grades are moderated against previous grades for that sector and across sectors. An advisory group of eminent persons provides independent oversight.

The IRC Team has analysed data that is much more granular in nature than can be reflected in this brief document. As a report covering the entire country, the grades sometimes hide large variations between provinces or municipalities. This report also cannot cover all matters of importance relating to infrastructure – issues such as environmental concerns and the impact of increased urbanisation are critical to infrastructure, but are not discussed here directly. Important sectors, such as housing and ICT (Information and Communication Technology), are excluded from the current analysis largely because of unavailability of data for national assessment.

The IRC Team has added a further leg to its work this time around. During July of 2017, in a separate exercise and with the assistance of the CSIR, SAICE conducted a survey of its 10 929 members at the time to determine their perception of the condition of the nation’s infrastructure. The questions that were posed covered the same scope as this report, broken down further by province. The 669 responses received (a return rate of 6.1%) indicated substantial correlation with the more rigorous data-driven findings of the report card process. Further analysis of these results will be issued in due course.

The last SAICE Infrastructure Report Card, issued in 2011, noted that the heavy investments in new infrastructure preceding the 2010 Soccer World Cup had elevated the overall grade to C– from D+ in 2006. We cautioned that this apparent improvement was not cause for complacency. Sadly, it is evident that the poor attitude to maintenance continues and is reflected in the downturn in the current overall grade. The latest gradings suggest that one sub-sector shows improvement, 20 remain unchanged and five have deteriorated in the past six years. For three sub-sectors there are

no trends since they are new additions (namely higher education universities, TVET [Technical and Vocational Education and Training] colleges and the Gautrain).

**In 2017 we have awarded South Africa’s public infrastructure an overall grade of D+.**

Although this report card indicates a deterioration in the condition of our infrastructure, we are mindful of the great strides that have been taken in the first 23 years of democracy to provide infrastructure for the poorest citizens and for economic growth. Some of the challenges, if addressed immediately and with vigour, could yield positive results in the short term. Others will require more time and investment. But none are insurmountable.

The IRC Team thanks participants from the SAICE technical divisions for their intense debate and comment, the members of the advisory group for their guidance, and especially the core team who drafted the report and managed this process. All of them displayed admirable qualities of civic and professional duty as volunteers.



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Malcolm Pautz Pr Eng



Kevin Wall Pr Eng  
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## 3. THE SAICE INFRASTRUCTURE REPORT CARD

The overall grade of D+ indicates that South African infrastructure is generally at risk. This grade reflects an ongoing and unchanged norm of poor maintenance and insufficient engineering capacity in the public sector, as commented on in both the 2006 and the 2011 IRCs. In addition, this IRC will discuss some critical issues affecting infrastructure, particularly institutions and data management.

### 3.1 The meaning of the grades

A five-point scale, denoted A to E, has been used for the grading. At one extreme is infrastructure comparable to the best in the world and capable of enduring pressure from unusual events, e.g. an influx of visitors for an international event or the ability to withstand a lengthy drought, while at the other end is infrastructure in a state of disrepair or failure, exposing the public to possible health and safety hazards. The middle point, a C, represents a condition in which performance is satisfactory except during times of peak operating pressure.

In some instances, a + or – symbol is used to suggest that the grade lies at the upper or lower end of that scale. It is important to note that the gradings are generally applied to the infrastructure as it exists, and not on its ability to satisfy societal needs, e.g. a road that has high traffic volumes is not necessarily penalised, as the reason for it being so loaded could be that alternative transport modes are unavailable.

### 3.2 The meaning of the arrows

The current condition of infrastructure is indicated by its grade. Just as important is the longer-term trend in that condition. The arrows graphically represent the change in condition between reports, i.e. from 2006 to 2011, and from 2011 to date. In most instances there will be two arrows, but some sub-sectors were only introduced in 2011 or are new, in which case there will be a single arrow or none at all.

A	B	C	D	E
WORLD-CLASS	FIT FOR THE FUTURE	SATISFACTORY FOR NOW	AT RISK OF FAILURE	UNFIT FOR PURPOSE
Infrastructure is comparable to the best internationally in every respect. It is in excellent condition and well maintained, with capacity to endure pressure from unusual events.	Infrastructure is in good condition and properly maintained. It satisfies current demands and is sufficiently robust to deal with minor incidents.	Infrastructure condition is acceptable, although stressed at peak periods. It will need investment in the current Medium-Term Expenditure Framework (MTEF) period to avoid serious deficiencies.	Infrastructure is not coping with demand and is poorly maintained. It is likely that the public will be subjected to severe inconvenience and even danger without prompt action.	Infrastructure has failed or is on the verge of failure, exposing the public to health and safety hazards. Immediate action is required.

<b>WATER</b>		<b>D-</b> for bulk water resources	The unchanged low grade belies the further deterioration in the ageing bulk water infrastructure portfolio as a result of insufficient maintenance and neglect of renewal, partly due to funding shortfalls. A serious depletion of skilled personnel and officials at senior levels in the DWS (and generally in the water sector) hinders decisive planning and development to avoid shortages. Systems are in general operated too close to failure.
		<b>C+</b> supply in major urban areas	Major projects are critically behind schedule, notably Phase II of the Lesotho Highlands Water Project. In most major systems even small drought perturbations are already creating substantial service disruptions. Growing water shortages mean that alternative sources, such as water re-use, aquifer exploration and desalination, some of which are energy-intensive and expensive, must enter the water mix.
		<b>D-</b> supply for all other areas	The quality and the reliability of water supply has decreased in small towns and rural systems. Incentives resulting from 'Blue' and 'No Drop' quality monitoring have assisted in improving municipal management of drinking water quality and water loss control. Regrettably, the 'Blue Drop' report is no longer available in a format which allows comparison between water services authorities.
			Budgeting and spending on maintenance, rehabilitation and expansion remains inadequate for water supply in all areas. Damage caused by increased service delivery protests in urban and rural areas diverts funding from maintenance and expansion budgets. Consequently, given continually growing demands, communities face increasing risk of supply failures.
			Water leakage and other contributors to non-revenue water remain unacceptably high (losses of up to 40%). Demand management requires concerted attention to be effective.

<b>SANITATION (INCLUDING WASTEWATER)</b>		<b>C-</b> for major urban areas	The condition and functionality of sanitation infrastructure is of grave concern, especially outside the major urban areas. Although the unserved-households percentage has decreased significantly since 1994, due to growth in population and households, the actual number unserved remains at about 4 million.
		<b>E</b> for all other areas	'Green Drop' performance scores are generally in the "good" to "excellent" range around major urban areas. However, many urban facilities are unable to cope with increased demand. Many (up to 30% of all) WWTWs are in critical condition, discharging increasing quantities of untreated waste into streams.
			The skills required to operate and manage sophisticated sanitation and WWTW technologies are often scarce outside of major urban centres; consequently downstream users and ecosystems are subjected to high pathogen loads and eutrophication, and endure higher treatment costs to achieve potable water standards.
			Inhabitants in some rural areas still do not have access to safe sanitation. Pit toilets in rural and informal areas are frequently under-served, exposing residents to disease.
			<i>(Note: The grading for "all other areas" in 2011 ought to have been an E, and that grade remains.)</i>

<b>SOLID WASTE MANAGEMENT</b>		<b>C</b> for waste collection in the major urban areas	The first goal of the National Waste Management Strategy is to prioritise waste reduction, re-use, recycling and recovery (in that order) over disposal in landfill. It appears that at present less than 10% of waste is diverted from landfill sites. Tariffs that better reflect the cost of services might prompt users to reduce waste generation.
		<b>D</b> for waste collection in other areas	There has been some improvement in waste collection across major urban and other areas since the 2011 IRC. Overall, approximately 67% of households receive an adequate refuse removal service. In the major urban areas, the percentage is between 86% and 91%, while in the rural areas it is much lower at around 52%.
		<b>C+</b> for waste disposal in metros	Licensing of hazardous waste landfill sites, health care risk waste storage facilities, recycling facilities and transfer stations has improved, as has the compliance monitoring. Landfill sites in metros are generally licensed, but not all are well managed.
		<b>D-</b> for waste disposal in other areas	However, many municipalities, especially rural municipalities, have unlicensed landfill sites or licensed sites not operated according to accepted standards. Around 64% of these general waste disposal sites are currently unlicensed.
			Although recycling is legislated, there are few incentives for users to change their behaviour from a bias towards disposal. It is encouraging that industry recycling and recovery programmes are showing progress, notably waste vehicle tyres, through Industry Waste Management Plans.

<b>ROADS</b>		<b>B</b> for national roads	Of the nation's network of approximately 750 000 km of roads, SANRAL controls 21 403 km and maintains them to a high standard. The proportion in "poor" to "very poor" condition has crept slightly above the international benchmark of 10%, mainly due to the further acquisition of provincial roads in poorer condition. Constraints on funding due to revenue shortfalls in toll operations may affect operational and maintenance requirements. Despite this, the overall change in condition of the national roads has shown an increase in "good" and "very good" sections.
		<b>D</b> for paved provincial roads	A slight improvement in the paved provincial network score is due in part to the shifting from "fair-good" in 2011 to "good-very good" in Gauteng. Over 90% of sections in the Western Cape are either "fair", "good" or "very good", maintaining their standard. However, the condition in other provinces remains precarious or is deteriorating. There is a risk of further deterioration due to vehicle overloading, poor maintenance and the reduction of skilled personnel in provincial departments.
		<b>C-</b> for paved metropolitan roads	Regarding municipal roads, data on asset management is difficult to come by, even for municipalities that might have sound practices in place for their road systems. A particular issue is the difficulty in discovering to what extent monitoring is conducted and, if it is, to what extent this is used for effective asset management. Furthermore, the data (as for so much of the infrastructure in this report) is not readily available to the public, and it is not conveniently accessible in a form that permits comparison across municipalities or against good practice standards.
		<b>D-</b> for other paved municipal roads	
		<b>E</b> for provincial, metropolitan and municipal gravel roads	South African gravel roads constitute 75% of the road network. There has been some improvement in the Western Cape, contrasted with extraordinary deterioration in the North West Province.
			Due to neglect, gravel roads are generally in a very unhealthy condition, with between just 2% and 12% in the "good" to "very good" condition, depending on the province. By contrast the "poor" to "very poor" condition applies to 40% to 90% of the category.

<b>AIRPORTS</b>		<b>B+</b> for ACSA-owned facilities only	The three major international airports (OR Tambo in Johannesburg, Cape Town International, and King Shaka in Durban) account for nearly 90% of the 39 million annual ACSA passenger movements.
			ACSA has proven to be a world-class aviation infrastructure provider, strongly driven by the need to meet international compliance requirements and by its own high internal standards. A profitable company, with sufficient funding and systems for condition monitoring and maintenance, and with capable technical and managerial personnel, it consistently receives international accolades. Relatively high tariffs and possible capital over-investment could pose a problem for the sustainability of these standards.

<b>PORTS</b>		<b>B-</b> for commercial ports only	There are nine ports in the Transnet stable – seven major commercial ports: Saldanha Bay, Cape Town (Table Bay), Port Elizabeth, Ngqura (Coega), East London, Durban, Richards Bay, and two minor ports: Port Nolloth and Mossel Bay. Even though much of the infrastructure has been ageing, TNPA has made a concerted effort to repair and maintain its equipment and infrastructure, keeping it operationally serviceable. Demand and congestion have increased in most of these ports, but both the fixed and movable infrastructure still perform well in meeting the safety and operational standards. However, preventative maintenance will be required at the breakwaters.
			The ship repair dry-docks could be a greater revenue generator, but insufficient maintenance has led to deterioration of the assets.

RAIL	 <b>B +</b> for heavy-haul freight lines 	<p>The 22 500 route-km freight rail network is owned by Transnet, of which 1 500 km is for heavy haul (for export of coal and iron ore), about 11 300 km for general freight and the remainder branch lines. Increased investment has been made or committed to acquisition of locomotives, rolling stock and refurbishment of infrastructure, including signalling, depots and maintenance of the network.</p> <p>The overall condition of the heavy-haul network ranges from average to good. Bottlenecks exist on certain sections of the network. However, most infrastructure disciplines are performing adequately and, with some upgrading, large volumes can be accommodated to meet increased demands.</p>
	<b>C</b> for general freight lines 	<p>The existing general freight line network is generally in a fair condition. However, poor signalling and electrical-related infrastructure along certain sections are the main contributors to section failures, and require special attention. There has been a steady increase (per train km) in collisions, with some decrease in derailments.</p>
	<b>D-</b> for branch lines 	<p>The branch lines are in a very poor state, with only approximately 55% “operational” – and even parts of this portion are in disuse. The lack of provision of rail services, maintenance and investment in supporting infrastructure to the branch-line network has resulted in a significant and increasing maintenance backlog of track infrastructure, stations and yards, and even theft of sections of rail track.</p>
	<b>D+</b> for passenger lines – PRASA 	<p>The general condition of the PRASA passenger inter-city and commuter rail (2 228 track-km) network is fair. Signalling and building structures, in particular, are in a poor condition. Capital investment projects are under way to address the investment backlog. Operational issues, such as outdated equipment, theft, arson and vandalism, also need to be addressed in order to improve poor operational performance and an unreliable service. Mainline passenger services have dropped by more than half since 2010/11.</p>
	<b>A</b> for passenger lines – Gautrain <i>(new sub-sector)</i>	<p>The Gautrain network (80 km), a rapid rail link in Gauteng, commenced service in 2010 and the system is in an excellent condition overall. The high accountability measures in the form of performance-based funding encourage efficient operation and sound maintenance practices. No major incidents affecting the structural integrity of infrastructure have been reported.</p>

ELECTRICITY	 <b>C+</b> for Eskom's generating infrastructure 	<p>Eskom generates approximately 43 000 MW of electricity (95% of the country's total), and about 86% of this comes from coal. Demand for electricity supply has declined over the last decade. This, coupled with new generation capacity, has afforded Eskom the opportunity to improve planned maintenance and refurbishment, which were sorely neglected between 2007 and 2015. Major capital investment will bring further capacity on stream in the next five years, and there is now surplus capacity.</p> <p>With the reliance on coal for power generation, environmental obligations will require further investment to achieve acceptable emission standards, particularly from the older coal-fired power stations.</p>
	<b>B-</b> for Eskom's transmission network 	<p>Eskom's funding gap and governance pressures remain a major risk. As renewable energy generation becomes cheaper, the move towards cleaner technologies and possible independence from a national utility will increase the pressure on Eskom.</p> <p>The national grid, comprising Eskom's approximately 32 000 km of high-voltage lines and 427 transmission transformers, is in an acceptable condition, with a reasonable maintenance regime. It can meet current demand and deal with minor incidents across the network. As an aged asset, major capital investment is required to meet needs in the next five years, with a focus on increased plant replacement, continued maintenance and ongoing refurbishment.</p>
	<b>D</b> for local distribution 	<p>Eskom's distribution network, which distributes about 52% of grid electricity directly to consumers, is on average in a significantly better condition than the local distribution network managed by the 187 municipalities. Inadequate operation and maintenance capacity, and shortage of skilled personnel, make the ageing and overloaded local distribution network vulnerable. Policy uncertainty has led to periods of low investment in the municipal infrastructure. Theft, vandalism and poor debt collection are a burden on operation and maintenance budgets.</p>

HEALTH CARE	 <b>D+</b> for hospitals 	<p>There are 347 hospitals and 3 538 clinics and health care centres in the public service. Any condition grade of "C" and below in the context of healthcare facilities adversely affects patient care and safety, and places them and the staff at increased risk.</p> <p>Although data collection appears to have improved, its use appears unaligned to sustainable asset management practices, hampering proper prioritisation of spending. Furthermore, although investment in maintenance has increased, chronic underspending of budgets and neglect are continuing, causing rapid deterioration in hospital (especially tertiary and central) facilities, amidst a large maintenance backlog.</p>
	<b>D</b> for clinics 	<p>Intensive focus on selected clinics under the Ideal Clinic Realisation and Maintenance Programme has improved their condition from a severe state of disrepair. However, this often happens at the expense of other clinics, hospitals and specialised facilities, e.g. mental health, tuberculosis and malaria clinics. Much still has to be done to increase investment in specialised skills.</p>

EDUCATION	 <b>D+</b> for public ordinary schools 	<p>There are approximately 24 000 public ordinary schools. Significant progress has been made in addressing electricity, water and sanitation service backlogs. However, this focus has in some areas deprioritised general maintenance programmes, resulting in maintenance backlogs and reduced reliability of water and electricity supplies at some schools. There has been little progress on ancillary infrastructure, such as fencing, libraries, sports, and computer facilities and access to the internet.</p>
	<b>C+</b> for universities <i>(new sub-sector)</i>	<p>There are 26 public universities and 50 public TVET colleges. Dramatically increased student intakes have placed a severe burden on infrastructure. Although a majority of university buildings are on average in good condition, this is partly due to new build. Asset management plans are in place at many universities, although the accuracy of information and compliance varies. Maintenance capacity is often insufficient outside of the main centres and tends to be reactive.</p>
	<b>D+</b> for TVET colleges <i>(new sub-sector)</i>	<p>Infrastructure development and maintenance capacity is generally limited within the TVET sector. TVET colleges, especially in rural areas, generally lack sufficient funding and systems for maintenance, resulting in ad hoc repair. Their condition has generally deteriorated over the last ten years.</p> <p>Considerable damage is caused by vandalism and student protests at educational institutions. It is an unaffordable loss and diverts funding from maintenance and the construction of much needed new facilities.</p>

OVERALL GRADE	<b>D+</b> 	<p>Although much of South Africa's built environment infrastructure is of high quality, the below-average grade reflects the continuing low maintenance levels, and even neglect in many areas, that is taking a toll on its resilience. A lack of commitment to long-term planning, adequate dedicated funding, proper management systems, data collection and skill deployment and collaboration are major contributing factors.</p>
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## 4. THE PUBLIC ASSET

### 4.1 Introduction

In any country the most basic relationship that residents have with the state is through the use of public services and utilities like public roads, schools and clinics, or receiving water, sanitation or electricity services. All economic activity, and certainly sustainable growth, requires efficient systems of transport, energy, education and communication for production and trade. Such infrastructure forms the very foundation of well-being, progress and prosperity. Everyone has a direct interest in the condition of this infrastructure. It is a public asset created by and for the benefit of all residents. As such, it is a long-term investment deserving of protection and care, both by the State and the people who use it.

### 4.2 The purpose of infrastructure

A key pillar of the apartheid regime was unequal provision of and access to infrastructure. In response, the post-1994 government enshrined progressive socio-economic rights around access to infrastructure in the South African Constitution. At its most basic, this infrastructure serves to protect and enhance the

health and safety of users. Efficient water and sanitation systems, for example, underpin modern increases in life expectancy.

At the next level, infrastructure engenders social mobility and access to economic opportunities through access to good basic schooling, health facilities, electricity and transport. In this sense, infrastructure is key to inclusive growth, as it facilitates broader participation in the economy.

Finally, catalytic infrastructure is focused on generating economic growth and jobs – for example, TVET colleges, which are increasingly focused on bridging the gap between secondary education and jobs to increase sustainable employment opportunities. Another example might be a road or rail connection between economic centres. Infrastructure connects South Africa to the region and to the rest of the world. Growth-generating infrastructure enhances South Africa's trade and productive capacity and competitiveness.

In recent years weak economic growth, compounded by continuing challenges from poverty and inequality, has reduced the ability of the State, households and businesses to fund the needed infrastructure. Yet, for infrastructure to be effective it must address inherited backlogs aggravated by population growth, migration and increased urbanisation. The first step in responding to the challenge is to maximise the life of existing infrastructure.

### 4.3 The importance of maintenance

The total cost of a public infrastructure asset is far greater than the initial capital outlay once user costs and maintenance over its lifetime (and other costs such as decommissioning) are taken into account. Such a "life cycle cost" approach provides an integrated framework for selecting between different technical solutions at procurement stage, and proper management through the lifespan of the asset. Of course it is critical that the necessary maintenance is conducted. If the infrastructure is mismanaged, e.g. maintenance is neglected, then its functional life span will decline, or future operating or maintenance costs will increase – in either case the life cycle costs increase. This cost differential is often dramatic, e.g. road repair can cost up to six times as much as regular road maintenance.

The State is theoretically committed to a life cycle costing approach, as stated in the National Infrastructure Maintenance Strategy. Over the past two decades, the State has spent over R2.5 trillion on infrastructure, or an annual average of 6% of GDP<sup>1</sup>. Much of this money has been on capital expenditure for new infrastructure, although maintenance spending is prioritised in the National Budget to improve asset management. Since the 2011 IRC, however, economic growth has steadily declined, necessitating fiscal consolidation and a subsequent slowdown in infrastructure spending (as a percentage of GDP<sup>2</sup>). Efficient maintenance expenditure has thus become even more important to maximise the value of assets.

Yet in practise, neglect of maintenance is the most serious and persistent problem encountered in all three IRCs to date. There are multiple reasons for this, some of which are elaborated later in this IRC. Political leadership, planning capability and technical capacity are inconsistent, and frequently deficient, across depart-

ments and different spheres of government. Engineering capacity shortages are chronic at the municipal level, which is often where infrastructure is operated and maintained. There are also institutional problems, such as insufficient data to properly schedule maintenance and a lack of accountability for mismanagement of infrastructure. Often institutional failures and skills shortages allow corruption to thrive and thus create resistance to improving maintenance systems. In some cases, due to neglect, we may be overestimating the functionality of recently provided infrastructure (e.g. water supplies meet the definition for reliability in only about 69% of households).

It would be a fallacy to assume that any real saving is achieved by reducing, diverting or not spending maintenance budgets. The consequent reduction in asset values will far outweigh any notional "saving". In fact, there are other significant costs associated with inadequate maintenance, including economic loss, safety hazards and premature replacement. The "knock-on effect" compounds this damage. For example, the rolling blackouts of 2007 caused direct losses due to interrupted production and damage to equipment, but also additional costs to households and industry to create contingency arrangements, e.g. installing generators, altering schedules, etc. A similar trend is being observed due to an actual or perceived unreliable water supply, with consumers installing water tanks, filters, pumps, etc.

Proper use and consistent maintenance are therefore crucial to infrastructure longevity. The responsibility for this lies with the State and the users of infrastructure.

### 4.4 The role of users

Water shortages from South Africa's recent severe drought was a reminder of the urgent need for better demand-side management – much as rolling blackouts reminded us of the same problem a decade ago. The State must be held accountable for this. Yet it is just as important for users to hold themselves accountable and to take responsibility for changing their behaviour.

Civic disrespect – defined as theft, arson, vandalism, or wastage of resources – was highlighted in the 2011

*“Delivery” needs to be universally understood as embracing not just constructing the infrastructure, but the appropriate operation and maintenance thereafter, for the whole design life of the asset.*

(National Infrastructure Maintenance Strategy [NIMS]. Department of Public Works, CSIR, CIDB 2007.)

IRC and has worsened since then. It is now widespread in our society, reflecting the tense, conflict-ridden relationship many residents have with the State. Theft of metals like copper cables, aluminium guardrails and steel manhole covers, and illegal connections for water and electricity, are persistent, resulting in deprivation for legal users, possible safety hazards and associated disproportionate costs for replacement. Arson and vandalism have also increased since 2011, most notoriously in the education sector; e.g. Vuwani schools and the Fees Must Fall protests. The costs associated with these protests now stand at over R1 billion. These protests are reminiscent of similar service delivery protests around the country, which often result in unaffordable destruction to rail carriages, roadways, schools and other municipal infrastructure.

It is certainly true that inadequate maintenance contributes to wastage, massively so in the case of water resources (approximately a third of piped water is lost to leakages).<sup>3</sup> But another worrying manifestation of the culture of civic disrespect is wastage. Contrary to popular belief, wastage is far from unique to poorer users. South Africa's long history of under-pricing services (e.g. water and electricity) has resulted in insufficiently discriminatory pricing. For many middle-class and wealthy households, demand-side management could never succeed, because services are relatively cheap. This is extremely unreflective of South Africa's actual resource constraints.

There is a real lack of understanding of the true cost of the infrastructure and the value of basic services that are offered free of charge. Furthermore, in a number of provinces and municipalities it has become politically expedient to ignore the "basic" notion, and behave as though all services should be free. In many areas, the "free for all" approach overloads systems and leads to supply failures. In these locations, the reliability of services has also declined.<sup>4</sup>

The public sector institutions might own and operate valuable infrastructure, and be responsible for its maintenance, but other stakeholders, prominent among them civil society, also have a responsibility that goes beyond simple respect for the infrastructure. The reasons for civic disrespect are varied and complex, and will not be discussed here, but the impact on infrastructure is devastating for a resource-constrained economy. Users are at the very least duty-bound to protect infrastructure, operate it properly and economically, and report malfunctions to the appropriate authority. Far too often users fail in their duty.



## 5. MATTERS OF CRITICAL IMPORTANCE

### 5.1 Introduction

Previous IRCs discussed the severe impact of South Africa's poor application of systems, maintenance practices and the engineering skills shortage in government. Unfortunately, these problems remain as serious today. Within this context, this report will discuss three interrelated factors that critically affect the condition of infrastructure – the institutions that are tasked with their creation and care, the distribution and effectiveness of skills within these bodies, and the availability and appropriate use of data and information to influence decisions.

The message emerging from these discussions might appear gloomy. Data is the raw material for meaningful policy development, but, compared to international best practice, its availability and proper use is dismal in South Africa. Institutional knowledge, memory and leadership have the power to transition a developing nation into a winning one, yet we have more examples of failure than success in this regard. Innovative procurement and funding processes are possible, but these require even greater capacity embedded within the public sector to control, implement and manage.

Engineering and management skill, capability and collaboration are not efficiently leveraged to overcome the inherent shortages of capacity in our developing nation. These factors, separately and in combination, play a significant role in the condition of South African infrastructure, as described in the next sections and, by implication, the grades allocated.

Yet, even as the general picture is worrying, there are signs of positive change. South Africa is a developing country with limited resources, but the standards to which much infrastructure is built, and the level of formal commitment as reflected by our constitution, are certainly world-class. The engineering profession is finally seeing meaningful rates of gender and racial transformation – a welcome shift that should augment its ability to serve the nation. There are also institutions and data managers showing commitment to excellence, service and competence, which can serve as aspirations for others willing to improve. These factors should renew hope in the country's ability to manage the challenges discussed below – if leaders commit to doing so.

## 5.2 Institutions

Infrastructure is planned, funded, provided and managed by institutions that vary in quality, whether they are SOCs, metropolitan councils or local municipalities. Strong institutions are a bulwark against corruption, which is common in infrastructure because of the long project times and large amounts of money involved.<sup>5</sup> However, many of the institutions responsible for South African infrastructure are weak – poorly capacitated, ambiguously mandated and badly governed. It is not surprising then that there is declining public confidence in the strength of the institutions entrusted with infrastructure provision and maintenance.

Leaders develop the institutional culture by example. Unfortunately South Africa sees a high rate of change of senior personnel, including leaders, in infrastructure departments. Rapid turnover negatively impacts policy consistency and continuity. The capacity in all three spheres of government and in SOCs to plan, implement and sustain infrastructure has been deteriorating for some while. There is also too little accountability in cases where these changes are linked to corrupt practices. But there are other reasons, too, including a politicised ‘cadre deployment’ strategy that destabilises the civil service. The result is low morale, high levels of collusion and corruption, and a tendency towards protectionism and secrecy within some of these institutions.

Moreover, a culture of discretionary rather than evidence-based decision-making allows institutions to ignore inconvenient data and analysis. An example was the instruction to Eskom to “keep the lights on at all costs”<sup>6</sup> in the period leading up to and after the 2010 SoccerWorld Cup – at the cost of implementing Eskom’s own maintenance programme. The ultimate price was frequent outages in the ensuing years and a close shave with complete blackout.

Effective collaborations between the public and private sectors are threatened by rapid churn in positions and a general lack of capacity in the public sector. This is one reason for private sector reluctance to invest in infrastructure. A worse result is that corrupt private sector elements can (and do) exploit the void in public institutions to their benefit, and with massive associated costs for the country. Public-private partnerships (PPPs) offer a promising strategy for infrastructure procurement and management, but effective PPPs require both parties to be knowledgeable. Many municipalities, in particular, do not currently possess capacity to manage such a process.

All too often SOCs are examples of poor governance

at the national level, and are now frequently cited as barriers to economic growth and job creation in South Africa.<sup>7</sup> Improving governance and performance is becoming increasingly urgent given the extensive guarantees for SOCs underwritten by National Treasury. In addition, SOCs form the bulk of infrastructure spending by government – almost half of the total from 1998/99 to 2015/16 – and an expected 46% of capital expenditure during the current MTEF.<sup>8</sup> There is no easy fix to these problems. South Africa needs to protect its progressive commitments to free provision of basic services, while restructuring SOCs to increase competition within key sectors of the economy. On a positive note, in late 2016, Cabinet approved recommendations aimed at improving SOC governance in South Africa, although implementation has not yet begun.

At the local level, municipalities are often just as poorly governed as SOCs. Increased poor governance, lack of accountability, and capacity shortages as described in the 2011 IRC, continue to frustrate service delivery and effective asset management. The desperation that deprived communities feel is often evidenced by violence and destruction, such as with the municipal demarcation protests in Vuwani.

There are also successful institutions, some of which are burdened with increased responsibility due to their own accomplishments (e.g. SANRAL’s increasing responsibility for provincial roads). The examples of ACSA, SANRAL and Gautrain illustrate what has been achieved through appropriate procurement and funding models, application of best practices and an internal culture that aspires to excellence. Undoubtedly, regulation plays a role, e.g. ACSA has to comply with regulations of the International Civil Aviation Organisation to operate viably. However, even regulations would have limited effect if these institutions did not have the capacity (and will) to improve and maintain infrastructure as required.

## 5.3 Capacity and collaboration

South Africa faces a critical skills shortage in the engineering profession. Fundamentally, this results from a failing education system, which impedes the development of skilled professionals. Worse still, the shortage is aggravated by inefficient public sector utilisation of the available skilled engineering personnel. However, the improving supply and profile of engineering professionals bode well for the future.

Public sector recruitment and deployment of key engineering staff are frequently sub-optimal. In some cases the lack of clear and flexible career paths, with

associated training and retention strategies, causes job-hopping. In other cases racial and gender transformation of the public sector is prioritised over ability to perform the work – a strategy that is damaging to the development of both the infrastructure and the employees involved. The result is that the public sector becomes an unattractive employer for many competent professionals. Collaborative arrangements with the private sector could also make available many appropriately skilled professionals who are currently underemployed.

At the national level, although the size of Cabinet and government has increased significantly since the previous IRC, this has not been accompanied by an increase in engineering capability. There has also been no perceptible positive effect on asset management. In many cases, responsibility for infrastructure is shared across different departments and levels of government, which can dilute the expertise required, given the size of government. For example, the responsibility for public transport policy in Gauteng is shared between the national Department of Transport, the provincial departments of transport and education, transport agencies such as PRASA and Gautrain, and the local metropolitan government.<sup>9</sup> This sprawl complicates collaboration due to the number of stakeholders involved in any project. It also becomes more difficult to track data and benchmark projects.

SAICE has raised concerns over capacity shortages in municipalities, and worked with local government to improve the situation, for over a decade. The problem remains, in part because of population growth outstripping local government engineering capacity growth.<sup>10</sup> Although the situation has slightly improved in this reporting period, many municipalities still have no, or only a single junior engineering professional responsible for the operation and maintenance of tens of millions of Rand of investment in existing infrastructure, and also for the planning of new infrastructure.

Happily, there are some positive trends emerging regarding engineering capacity. Over the past ten years there has been a dramatic increase in (especially black and female) engineering graduates. The age profile of skilled persons in the civil engineering field was previously characterised by a ‘missing middle’ of professionals in the highly productive 35–50 year age group. In the near future, the number of senior and experienced engineering and management personnel in many departments will be severely reduced due to retirements. This could cause a technical (engineering and scientific) skills gap in top management, with serious negative effects for the country’s infrastructure.

Fortunately a wave of fresh graduates and professionals are approaching maturity, suggesting a brighter future, if only their development is properly managed. The tendency to place young graduates and registered professionals in challenging stations, e.g. a small municipality, can be a very effective developmental approach. When they are left without the wisdom and support of experienced professionals, however, it creates lasting damage to the individuals and their roles, which is not effective in addressing infrastructure or transformation challenges.

Figures 1–3 illustrate some aspects of capacity constraints and spread.

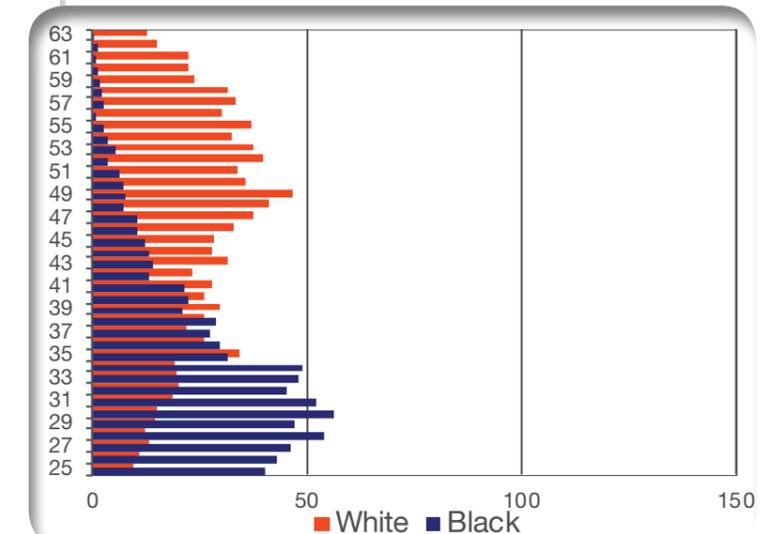


Figure 1: Population pyramid of civil engineering staff by race in 2005 (Lawless 2017)

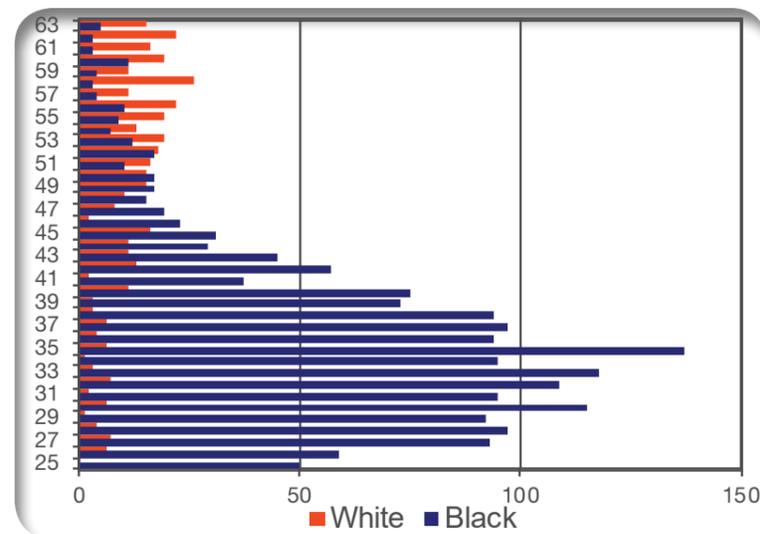


Figure 2: Population pyramid of civil engineering staff by race in 2015 (Lawless 2017)

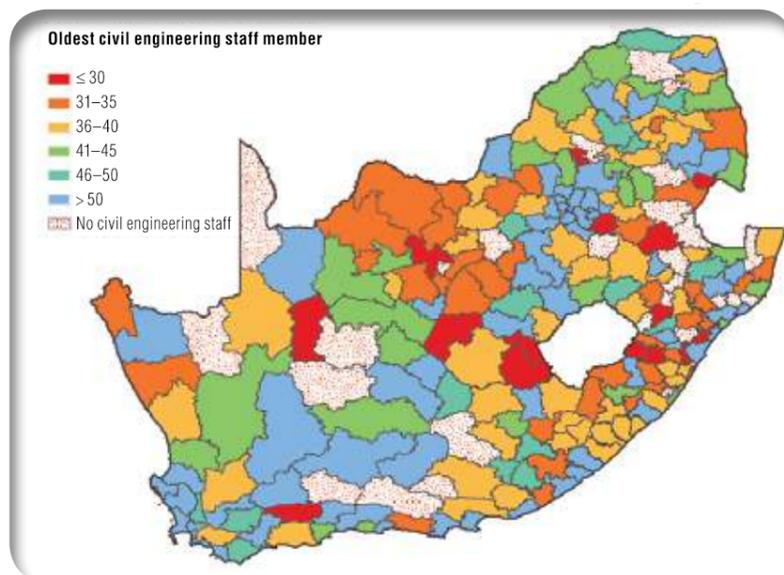


Figure 3: Age of the most senior civil engineering staff member per municipality in 2015 (Lawless 2017)

#### 5.4 Data management and infrastructure monitoring

Even the strongest institutions, staffed by the brightest professionals, cannot succeed without good information. Reliable, regular data collection and management is essential to the good governance and sustainability of infrastructure. Entrenching a data-driven culture is central to enabling evidence-based, accountable decision-making from infrastructure providers and operators. It also contributes to creating a sense of civic responsibility and awareness about infrastructure.

Infrastructure development involves long lead times, requiring advance planning, especially around funding. Thereafter it requires regular monitoring and performance evaluation. Collection of data is important at all stages of a project. Regularly assessing the project's full cost against its performance would increase transparency and shift towards evidence-based infrastructure policy in the future.<sup>11</sup> In the absence of such evidence, decisions are frequently driven by expedient political considerations. It would also enhance accountability for all involved in the planning, construction, operation and maintenance of the infrastructure.

Data should be collected and managed at the local level, but in a consistent way, allowing comparison across different parts of the country and with international peers. The Department of Water and Sanitation's Green Drop, Blue Drop and No Drop certification programmes, which have been instituted in municipalities since 2008, are excellent examples. Indeed, they can be credited for incentivising improved performance of a number of water services author-

ities. However, reporting on these programmes has become erratic in recent years.

There appears to be a general reluctance at political and official level to publish data that might be unfavourable, even when authorities are legally obliged to do so.<sup>12</sup> Those responsible for operating and maintaining infrastructure are also often resistant to sharing (or even collecting) data (e.g. Eskom has not presented asset replacement values to Parliament since 2009). It is unacceptable to allow a culture of failing to collect or ignoring data where decision-makers suspect it will support outcomes contrary to their preferences, or will expose them in mismanagement.

Internationally, infrastructure condition monitoring and management of the collected data have been transformed during the last few decades. The major reason for this is the emergence of smart methods to measure the condition of infrastructure – methods which do not depend on physical inspections. Condition monitoring can be done remotely and in real time, permitting greater discretion and frequency of measurement. There have been similar advances on techniques for collation and analysis of this data, transforming it into information which can be used by infrastructure managers and other stakeholders.

Some South African infrastructure institutions, such as SANRAL, ACSA and the Gautrain Management Agency (GMA), have been quick to keep up with these changes, and rank with their good-practice peers elsewhere in the world. However, other institutions have been slow to adopt the changes or (a common problem) they collect the data, but make little use of it. In these institutions, infrastructure condition data seems to be thought of the same way as maintenance – as a secondary concern following infrastructure build.

The public availability of the resulting information and condition assessment would encourage infrastructure users to understand both the costs of criminality and to hold providers accountable for failures. In the absence of data and information there can be little meaningful civic engagement about planning processes and priorities. Entrenching a data-centred discourse would shift the perspective of users, and encourage them to take ownership of the infrastructure they use. Ultimately, such a culture would empower the professionals entrusted with designing and maintaining infrastructure, and the institutions that are charged with this crucial responsibility.



## 6. The Sector Condition Assessments

### 6.1 Water resources

South Africa's water is a precious resource. Rainfall is on average low and its distribution is uneven. The concept of a "water mix", i.e. assuring supply from a variety of sources including groundwater, re-use and desalination, is accepted. Surface and groundwater quality is slowly deteriorating because of factors including direct pollution, pollution from surface run-off, salination and acid mine drainage. Although the recent drought has once again emphasised the need for better conservation measures and changes in consumption behaviour, the public appears to take little heed of these warnings – for example targets for water demand management are very seldom met by municipalities. Funding is a major problem – funding for operations and maintenance, and for new capital works.

Growth in population has seen increased demand for fresh water resources, which has put a strain on available bulk supplies. This has been exacerbated by the recent drought in different parts of the country. Current water usage already exceeds the reliable yield of existing water infrastructure, and the marginal cost of future expansions is rising rapidly. As a consequence,

although South Africa uses less than 40% of the country's total renewable water resource, much of this is not available at the required assurance level, and thus economic and physical water scarcity is a reality. Growing water shortages mean that alternative sources will have to be considered. Chief amongst these are water re-use, aquifer water resource exploration and desalination, some of which are energy-intensive and expensive. There is little clarity on who will bear the costs, and whether the charging structures will adequately serve both resource conservation and equity goals.

Water infrastructure consists of bulk abstraction and conveyancing, as well as local treatment and distribution. The Department of Water and Sanitation (DWS) is responsible for the major water resources infrastructure, principally comprising the major dams, pipelines and canals. It controls 257 water schemes, of which 25% (65) are considered national schemes where raw water is collected and transferred from one catchment to another. The remainder are schemes where raw water is collected and delivered within a particular catchment.



Given the recent drought conditions, these systems have been under severe stress. A number of new schemes, to address future water problems, are in various stages of preparation. The largest of these, the second phase of the Lesotho Highlands Water Project (LHWP), is some five to seven years behind the planned timing, which will place the urban and industrial heartland of South Africa at risk in the event of drought. The augmentation of supplies to Cape Town has also been considerably delayed. Similar challenges are reported from the Umgeni system where the proposed bulk supply from a new uMkhomazi dam is likely to be late, not least because of the substantial bulk transmission requirements. In addition, supplies to Nelson Mandela Bay Metro have been limited due to the multi-year delay in completing the Nootgedacht pipeline which would provide additional supplies from the Orange River Scheme.

In these and other cases, responsibility is usually shared between the DWS and other authorities, such as the beneficiary municipalities. Funding, as noted above, is a major reason for delays. Implementation of new water resources infrastructure development is typically between 40% and 60% of targets, due largely to the difficulties which one or other party is having in securing funding – augmentation of supply to Nelson Mandela Bay Metro is a case in point.

The Department's asset register indicates a total pipe network of 1 070 km and canal systems of 8 100 km. Of the 5 248 registered dams in South Africa, the DWS only owns 6% (320), but they account for 86.4% of the retained water. The majority of the dams earmarked for rehabilitation were inherited from former homelands and do not meet the required acceptable safety standards. A number of these dams suffer from inadequate spillway capacities and some from structural instability.

In general, the major water resources infrastructure is not only ageing, but there has been further deterioration as a result of insufficient maintenance and inadequate ongoing capital renewal. Management failures have also been signalled in budgeting, operations and maintenance, as witnessed in the transmission and transfer systems in the Western Cape, the Vaal River Eastern Subsystem Augmentation Project (VRESAP), and the Thukela–Sterkfontein transfers. In other instances contracts have been awarded in excess of budgets or against the evidence of better cost-effective technical options. Many of the major water resource systems include a significant component of pumped transmission. The condition of the mechanical and electrical equipment, which has a shorter life and

is more maintenance-intensive, is a matter of concern, since equipment failures have resulted in service restrictions in some cases.

There has been significant improvement in the alignment of the DWS maintenance programme with its Asset Management Plan of 2010. However, there are some anomalies. For example, the DWS in its 2014/2015 annual report identified a vacancy rate of 17% in critical, technical and professional skills, whereas the 2015/2016 annual report states that it had been eliminated. This seems to contrast strongly with the views of personnel within the DWS, and indeed is not reflected in some divisional organograms, which still indicate more than 50% vacant engineering posts. In the past, the presence of experienced professional engineers in senior and top management was a key element in enabling strategic and day-to-day decision-making, and facilitating efficient operations. The rapid turnover of Directors General (DG) (eight, including Acting DGs, since 2009) and other senior staff further contributes to poor performance.

The water resources sector now faces a similar crisis to that of the electricity generation sector a decade ago – and as the IRC forewarned in 2006. It is important to recognise that it is also a crisis caused essentially by poor management at both national and local level – poor planning, unnecessary delays in implementation and a concerning decline in institutional competence. Other contributory issues include financial constraints at both national and local level, irresponsible consumption patterns, and wastage directly due to the poor condition of some infrastructure. The current widespread drought has exacerbated and exposed these weaknesses.

New investment sometimes diverts attention from the sustainable management of the existing infrastructure. Paradoxically, infrastructure failures might now be removing supply from more people than are served by new investment.

## 6.2 Water supply services

Water supply services, in the form of water treatment works, pump stations, reservoirs and reticulation, are the responsibility of the local government sphere, within the definition of which it is convenient for IRC purposes to include water boards and catchment management agencies. They are supported, and regulated, by national government departments, in particular the DWS.

South Africa met the 2015 Millennium Development Goal targets. However, the new challenge is to achieve

the Sustainable Development Goals which focus on the reliability and safety of water supplies, and the safe and effective management of human waste.

A wide range of legislation and frameworks governing water supply and sanitation, including the policy of free basic water and sanitation services, is in place.

A recurring theme that hampers achievement of service delivery goals is inadequate capability of service providers to fulfil their responsibilities. Delivering new infrastructure, operating and maintaining it, and eventually renewing or replacing it, are complex activities. Appropriately competent and skilled persons, however, are in short supply in the public sector, especially in rural areas. This is exacerbated in that infrastructure has been provided in settings where there is no financial capacity to hire the qualified staff needed, nor to provide the requisite levels of operation and maintenance spending. Many municipalities, including some district municipalities, require assistance, despite which there appears to be general reluctance to outsource any significant operation and maintenance tasks to the private sector. Nonetheless, in all of the metros, and in many other towns as well, the water supplied to households is of top quality – not many countries are able to boast that water can be drunk from the tap without treatment.

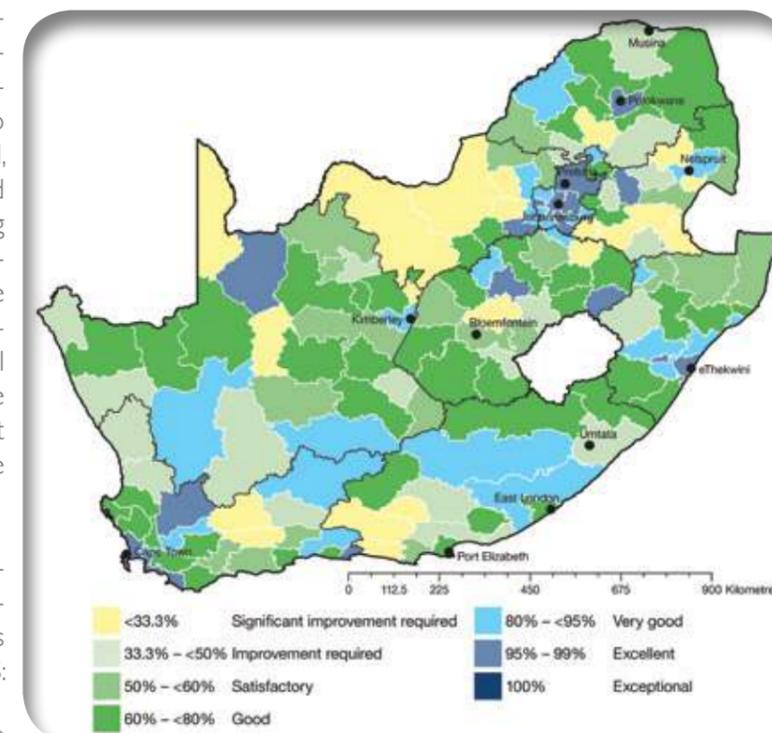
A consequence of inadequate capability is often inappropriate operational practices, together with neglect of maintenance. This without question reduces the functionality of infrastructure. To quote the DWS:

*“Initially water provision progress was measured by the supply of water infrastructure. In recent years, however, due mainly to poor maintenance practices, an increasing amount of infrastructure has become non-functional. By 2016, 86.51% of households had been provided with basic (RDP) level of water supply infrastructure. However, not all of the infrastructure was able to meet the level of assurance (reliability) of supply requirements, defined for a basic water supply as interruptions of <48 hrs at any one time, and a cumulative interruption time of <15 days over three months. If this reliability requirement is taken into consideration, then the 86.51% value is reduced to about 69% of the total number of households.”<sup>13</sup>*

The stark reality is that repairing dysfunctional infrastructure without addressing the factors that impact negatively on operations and maintenance is simply not a sustainable option in the medium to long term. Without basic maintenance, much of the more sophisticated and/or less robust infrastructure, such as treatment plants or pump stations, cannot be expected to deliver service indefinitely.

Some years ago, the DWS instituted the Blue Drop performance rating system for water services. This has clearly indicated where the challenges are greatest – which is particularly in the smaller towns and rural areas. It has also indicated which are the weakest aspects. Prominent among these are skills and budget issues, and also the lack of maintenance plans.

Figure 4 illustrates that the latest available (2014) Blue Drop scores are without exception higher around the major urban areas, and/or where water boards treat water in bulk and supply it to municipalities (to a great extent, the same areas).



**Figure 4: Blue Drop score 2014 (data supplied by the DWS in 2016)**

One of South Africa's main water management challenges is non-revenue water (NRW), which represents the water lost through physical leakage or commercial losses. About 31% of piped water does not reach consumers because of leaks in the network system. Although the relevant national data is incomplete, if commercial losses are included, then total loss is closer to 40%, much of it due to failed systems and political unwillingness to enforce cost recovery and debt collection. NRW represents a lost “resource” that cannot be afforded. In recognition of this, the DWS instituted the No Drop performance rating system of water supply institutions.

It is estimated that 35% to 45% of the water used by the agricultural sector is lost during irrigation, mostly



because schemes are in a state of disrepair or have exceeded their economic lifespan.

Addressing the capability limitations of much of local government is the greatest challenge facing local service delivery – not just in respect of water supply services. Key functions such as planning, budgeting, project management and the daily operation and maintenance functions are severely hampered. Widespread non-compliance with infrastructure asset management recommended practice results in funds that are allocated to new infrastructure investment being used for unplanned repairs and replacements. Repair and maintenance budgets are inadequate, which can sometimes be attributed to the ease with which these allocations may be deferred by municipalities in the expectation that the consequently deteriorated infrastructure will in due course be refurbished or replaced at the cost of national government. The DWS has on occasion rehabilitated selected infrastructure owned by municipalities, but has had no choice thereafter other than to hand it back to the same municipalities which had already proved themselves unable to adequately care for it.

The primary benefits of changing the current culture will be a drastic reduction in infrastructure life cycle costs, and a greatly improved ability to deliver a reliable, resilient and sustainable service.

### 6.3 Sanitation

Sanitation services comprise the provision of on-site or reticulated sanitation, and the conveyance and treatment of wastewater. The government's commitment to providing sustainable sanitation to its people is reflected in the country's constitution and in its policies. It also features in the widely accepted vision for the nation – the National Development Plan Vision 2030, which states that "... all South Africans will have access to sufficient ... hygienic sanitation to live healthy and dignified lives ..." Responsibility for this falls within the mandate of the DWS, and local government and/or water boards.

In 2014 the DWS took back responsibility for household sanitation provision from the Department of Human Settlements (DOHS). Currently an updated delivery status verification process is underway, but provisional figures for 2016 (see Table 1<sup>14</sup>) indicate

Table 1: Provisional DWS delivery status figures for 2016 (DWS 2017)

	1994	2016
Households (HH) (million)	8.7	16.9
HH below RDP (million)	4.5	4.0
% HH below RDP	52	23.8
HH equal to or above RDP (million)	4.2	12.9
% HH equal to or above RDP	48	76

that, although the percentage unserved is declining, due to population growth the absolute number of the unserved has remained relatively constant since 1994, at about 4 million households.

If the sanitation backlog is to be eradicated, then additional finances, combined with appropriate project management skills and effort, will be required. Political pressure to provide full waterborne sanitation as a basic level of sanitation is severely impacting the cost of service provision in parts of the country, as well as slowing down service delivery. Waterborne sanitation services cannot be provided effectively unless there is adequate and reliable water supply, so further investment in that dimension will often be wasted and the untreated wastewater crisis will simply get worse.

The DWS instituted the Green Drop performance rating system for wastewater systems. According to the latest available Green Drop findings, 30% of large WWTWs (Wastewater Treatment Works) are in a critical condition, implying that millions of litres of untreated or inadequately treated sewage are illegally discharged into rivers and streams each day. Water treatment and wastewater treatment works are generally in poor condition, thus increasing the environmental health risk, with 66% of all WWTWs requiring short to medium-term intervention, 35% requiring capacity upgrades and 56% requiring additional skilled operating and maintenance staff (DWS 2015, 2014 Green Drop Progress Report–Executive Summary).

Figure 5 illustrates that the Green Drop scores are without exception higher around the major urban areas, and also that two provinces have higher average scores than the others.

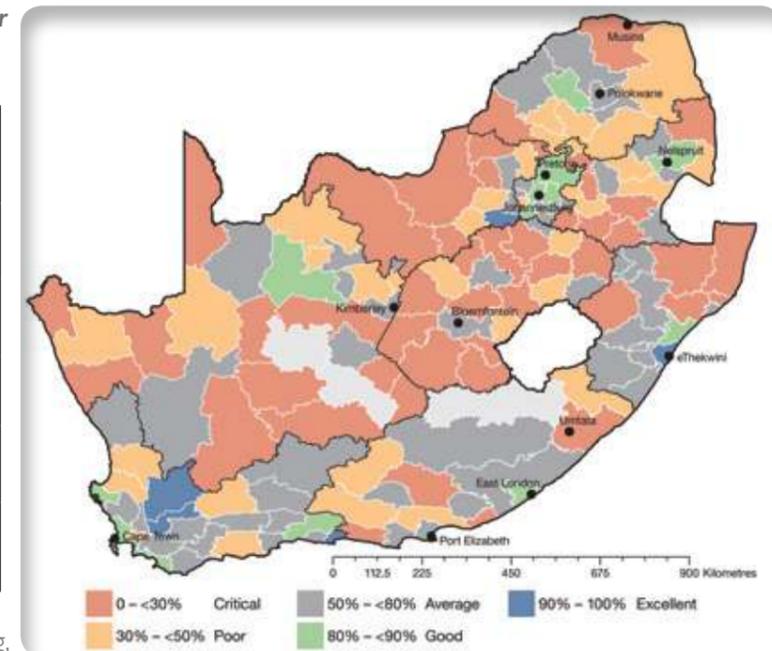


Figure 5: Green Drop score 2013 (data supplied by the DWS in 2016)

The most common problems experienced at WWTWs are poor design of treatment plant or individual processes, processes not operated according to design criteria, breakdown of equipment, inadequate technical back-up, change in raw water quality, poor planning of operations, and insufficient resources.

The skills required to operate and manage sophisticated technologies are often scarce outside of major urban centres. Downstream users and ecosystems subsequently bear the consequences in the form of high pathogen loads, eutrophication, and higher treatment costs to achieve potable water standards. Trickling systems and, where space permits, pond systems, may be a better option as they are more tolerant of power failures, have far lower energy costs, have more modest skills requirements and cost users less.

Municipal treatment facilities handle of the order of 6 000 Megalitres per day. Taking into account the demographic changes and the subsequent sanitation requirements, 22% available capacity remains for future demand – but this is an average figure nationally, whereas locally many WWTWs have no surplus capacity and are running at full demand. During the rainy season, because of infiltration into the sewers upstream, many receive more inflow than they can cope with, with the result that treatment processes are speeded up or simply bypassed. Electricity outages disrupt treatment processes and, if pumping is part of the process, can quickly cause temporary storage facilities at the WWTWs to be overwhelmed and/or require that the inflow bypass the works.



#### 6.4 Solid waste management

Solid waste management includes collection of waste from the population and appropriate quality of disposal mechanisms. The 2011 IRC highlighted important progress made since 2006 in waste management, and since then there have been further developments, with long-term implications in terms of legislation, policies and strategies. The National Waste Management Strategy (NWMS) was published in 2011 and is currently being updated by the Department of Environmental Affairs (DEA), in line with the requirement from the Waste Act for the NWMS to be updated every five years.

South Africa generated approximately 108 million tonnes of waste in 2011, of which 98 million tonnes were disposed of at landfills. In the order of 54.6% (59 million tonnes) is general waste, 44.4% (48 million tonnes) is currently unclassified waste and the remaining 1% (1 million tonnes) is hazardous waste.

The internationally accepted waste management hierarchy consists of options for waste management during the life cycle of waste, arranged in descending order of preference:

- Waste avoidance and reduction
- Re-use
- Recycling
- Recovery, and
- Treatment and disposal as the last resort.

If implemented correctly, this strategy has far-reaching cost-saving and sustainability implications. In the order of 10% of all waste generated in South Africa was recycled in 2011. Currently 54% of mainstream recyclables are recycled, with scrap metal at 80% doing the best and eWaste at 14% doing the worst.

Although recycling is legislated within South Africa, the actual recycling activities are largely driven by industry through the establishment of industry bodies, also known as Producer Responsibility Organisations (PROs). The first Industry Waste Management Plan (IndWMP) for tyres is a good example. Approximately 11 million tyres are currently sold per year locally and will eventually become waste. The estimated mass of the tyres sold is 275 000 tonnes. At the commencement of the plan in November 2012 only 4% of waste tyres were diverted from landfills, while by August 2016 over 60% were being diverted from landfills. However, in 2017 the contractor was placed under liquidation. It is nevertheless encouraging that such initiatives are on the increase, with impressive results also in the paper and packaging industry, where draft plans are undergoing a public consultation process.

Since 2011, households receiving an adequate refuse removal service have increased to approximately 67%. In major urban areas, the figure is between 86% and 91%, while in the rural areas it is around 52%. The rural figure must be taken in the context of low settlement densities, where on-site disposal or backyard burning of waste is sometimes appropriate.

Recent data on the number of waste disposal sites and the number that are licensed is not readily available. It is estimated that 64% of general waste landfill sites are not licensed. The situation with the licensing of hazardous waste landfill sites, health care risk waste storage facilities, recycling facilities and transfer stations has improved, with unverified data showing 100% of these facilities as licensed.

Municipalities generally charge users for waste disposal at less than cost. This practice encourages waste disposal rather than minimisation or recycling, and tends to subsidise the present generation at the expense of future generations – this must be corrected. The National Pricing Strategy for Waste Management (published in August 2016) aims to address the imbalance of under-pricing of waste services and cost-reflective tariffs, together with full cost accounting through appropriate financial systems.

#### 6.5 Roads

The South African road network is managed at three levels: (a) primary intercity, with economic roads mainly managed by SANRAL on behalf of the Department of Transport (DOT); (b) the secondary and tertiary intercity network, primary access and mobility roads largely managed by the nine provincial departments; and (c) the urban and rural municipal roads managed by local authorities.

The condition of South Africa's circa 750 000 km road network, which includes approximately 17.6% (132 000 km) of unproclaimed roads, remains very variable in nature, both between spheres of government and geographical areas. At one end of the spectrum, the condition of the primary (national) 21 403 km intercity road network is, and has for several decades been, very good. The sub-sector "national roads", however, does not achieve an "A" grading because of the additional 5 233 km of provincial roads incorporated into its network during the past few years. A large proportion of the national road network (76%) is older than the 20-year theoretical design life, which is a reflection of the quality of the roads built in the past, as well as the road maintenance operations carried out by SANRAL. Currently 11% (2 354 km) are in poor to very poor surface condition.

The status of sanitation infrastructure in the country is of grave concern. This is mainly related to communities served with waterborne sewerage systems where maintenance, refurbishment and upgrading of collection and treatment infrastructure have been neglected over the years. An increasing number of sewer failures are occurring within municipalities, which cause blockages in pipelines, overloading of manholes, flooding of community areas and leading to degradation of neighbouring services. Typical challenges include poor enforcement of policies (e.g. industrial effluent bylaws) and poor governance problems, lack of capacity to manage, corruption, inadequate sustainable financial models, vandalism, theft and illegal connections. The dominant challenges are related to insufficient technical capacity to manage, operate and maintain existing facilities and to plan for new facilities.

However, many on-site sanitation systems are no better off. For example, Ventilated Improved Pit (VIP) latrines work well, but, like any other form of infrastructure, need to be maintained from time to time. In

particular, they need to be emptied, but this is generally not being done. Schools and clinics and other government institutions in rural areas also make general use of on-site sanitation systems, and these, too, are often neglected to the point of being unusable.

And yet there are examples worthy of celebration. In May 2014 it was announced that eThekweni's Water and Sanitation Department won the Stockholm Industry Water Award "for its transformative and inclusive approach," calling it "one of the most progressive utilities in the world." The city has connected 1.3 million additional people to piped water and provided 700 000 people with access to toilets in 14 years. It also was South Africa's first municipality to put free basic water for the poor into practice. Furthermore, it has promoted rainwater harvesting and urine-diverting dry toilets.



SANRAL has, since its inception in 1998, managed to retain its high level of professional engineering expertise. On the other hand the nine provinces have suffered for two decades from a loss of experienced road professional expertise. Whilst some provinces have suffered more than others, the results of this have been reflected in the overall deterioration of provincial road networks. Metropolitan and municipal road authorities vary in performance, with the larger metropolitan authorities to a great extent retaining their levels of professional expertise, and consequently the condition of their road networks, whilst the municipal authorities in the main reflect the same pattern as some provincial authorities, namely a dearth of expertise.

The visual condition and riding quality of national and provincial roads were depicted in the 2013 State of Logistics Survey (CSIR 2013<sup>15</sup>). From Figure 6 it is apparent that, based on the proportions of “very poor” and “poor” roads, the condition of the SANRAL network and the networks of several other provinces

is satisfactory, but could nonetheless do with some improvement, while the networks of Mpumalanga, KwaZulu-Natal and the Free State are the most unsatisfactory, with the Free State network substantially deteriorating between 2009 and 2013.

The secondary and tertiary intercity road network, some 273 078 km in extent, is undergoing accelerated deterioration, so much so that both the efficiency and cost of moving freight on the network face severe challenges. In addition, road safety is compromised by the condition of the secondary road network.

The 83% (226 273 km) of this network which comprises gravel roads is in a very unhealthy condition, ranging between 40% and 90% being in a “poor” and “very poor” condition, depending on the province concerned. The percentage of these gravel roads which fall in the “good” and “very good” condition is between 2% and 12%, once again depending on the province concerned.

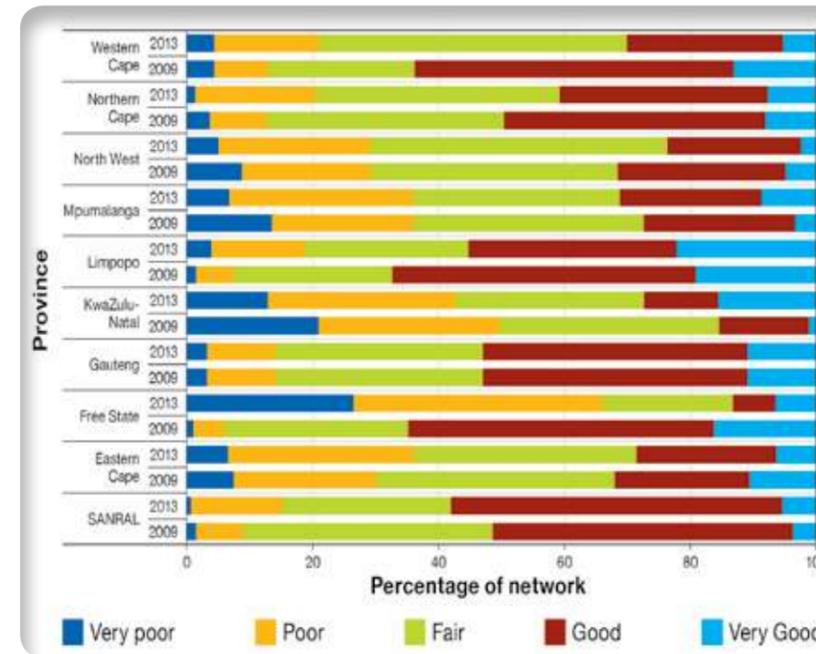


Figure 6: SANRAL and provincial roads condition data 2009 and 2013 (CSIR 2013)

The 17.1% (46 805 km) secondary surfaced roads fall into the different condition categories, depending on the province in which they are situated. The figures vary from a high of 58% to a low of 32% in a “good” and “very good” condition. For the classification of “poor” and “very poor” the range was from 13% to 33%, well above the accepted international norm of 10%.

The primary contributing factors leading to pavement deterioration in South Africa are capacity constraints, lack of maintenance, high traffic volumes, overloading and poor stormwater management. For example, poor drainage can be caused by poor (or no) stormwater system maintenance, or increases in surface runoff due to under-design because of gradual urban development.

For municipal and metropolitan paved and gravel roads, totalling 322 057 km, insufficient data has been provided by the authorities to be able to make an assessment on their condition. Hence this IRC has kept the rating as provided in 2011.

## 6.6 Airports

The SOC Airports Company of South Africa (ACSA) resides under the DOT. South Africa’s nine major airports which are owned and operated by ACSA include: (i) the three major international airports, namely, Oliver Tambo International, Cape Town International and King Shaka International, and (ii) the other six commercial airports in Kimberley, George, Upington, East London, Port Elizabeth and Bloemfontein.

The IRC grading does not take into account the secondary commercial airports, which include Rand Airport, Wonderboom Airport, Kruger Mpumalanga Airport, Pietermaritzburg Airport, Richards Bay Airport and Lanseria Airport. These secondary commercial airports are either owned and operated by the private sector (e.g. Lanseria, Rand Airport, Kruger Mpumalanga) or by provincial governments (e.g. Mthatha) or municipal governments (e.g. Richards Bay, Pietermaritzburg). There are also many smaller airports.

The three major international airports account for nearly 90% of the 39 million annual ACSA passenger movements. OR Tambo International had the highest number of passengers with 52.9% (20 million people), followed by Cape Town International at 26.5% (10 million) and Durban at 10.6% (4 million people). From years 2014 to 2016, the number of departing passengers increased by 11.5%, and aircraft landings increased by 8.8% (261 000 to 284 000).

ACSA is responsible for the property as a whole at all nine airports, in particular the runways, terminals and some of the hangars and technical areas. ACSA is not responsible for the navigational aids and air traffic control, which are the responsibility of the Air Traffic and Navigation Services (ATNS). ACSA invested more than R17 billion in capital infrastructure in the years preceding the 2010 FIFA World Cup. The total asset value<sup>16</sup> of all ACSA infrastructure exceeds R54 billion.

ACSA’s success in operating and maintaining its airports is attributed to its strong financial state and its management, as well as the incentives of mandatory requirements for safety and reliability, coupled with regular and stringent inspections by regulatory authorities. ACSA budgets for infrastructure management are close to optimum. In addition it has secured adequate technical staff resources at all levels who are competent to manage and safeguard the sustainability



of its infrastructure. This has resulted in award-winning airport infrastructure.

The quality of airport infrastructure is driven more by local and international regulations than any other infrastructure sector. The most economical way to retain the value and extend the design lifespan of the infrastructure is by carrying out regular maintenance and by the optimisation of replacement periods. ACSA pays close attention to the condition of its runways and aprons. The sophisticated pavement management system is kept up to date with weekly visual inspections, record-keeping on all works undertaken and annual assessments on the remaining useful life of the infrastructure. Instrument landing systems, runway approach lights and runway ground lights are the highest priority and are maintained in such a way as to ensure statutory safety and reliability compliance with the International Civil Aviation Organisation (ICAO) requirements. All ACSA airports have standby generators with enough capacity to meet the power needs of these high-priority elements. The next priority level includes runways, baggage handling systems, fuel hy-

drant lines, security, emergency lighting within terminals and all “people movers” such as lifts, escalators, loading bridges, shuttles, etc.

Regular inspections from regulating authorities, such as the Civil Aviation Authority of South Africa (CAASA), have assisted in keeping the quality of the infrastructure on par with international standards. The CAASA inspects all infrastructure, including runway markings, lighting, electricity supply, fire engines, runway structures and surfaces. They also scrutinise airport officials’ qualifications and training standards.

One size does not fit all in respect of the different components of infrastructure. For example, runways: ACSA uses the number of movements as a base for calculating when maintenance is required. Once the appropriate number of movements for the runway design has been determined, the number of years between runway rehabilitation cycles can be established. The rehabilitation is undertaken at short-term (5-year) cycles and long-term (10-year) cycles. The data system captures all visual condition reports, and

all maintenance and repair works; it further captures information on use and is able to analyse this, comparing wear and tear (from the visual condition reports) with use, and employing past records of maintenance and repair to make predictions of useful life, thereby enabling recommendations on interventions to be made.

### 6.7 Commercial ports

The commercial ports are owned by Transnet (since 1989 a SOC, wholly owned by the South African government as represented by the Ministry of Public Enterprises) through its business units (divisions) – the Transnet National Ports Authority (TNPA), Transnet Port Terminals (TPT) and South African Port Operations (SAPO). The TNPA is responsible for the ports and their infrastructure, including berths, port buildings, tug and pilot services, navigable areas (therefore including services such as dredging) and aids to navigation. TPT is responsible for equipment such as straddle carriers, cranes and conveyor belts, and terminals (such as grain elevators) and their equipment. SAPO is responsible for vessel traffic and nautical services.

There are nine ports in the TNPA stable: seven major commercial ports – Saldanha Bay, Cape Town (Table Bay), Port Elizabeth, Ngqura (Coega), East London, Durban, Richards Bay – and two minor ports – Port Nolloth and Mossel Bay. The various ports cover a range of activities, some focusing on bulk commodities (iron ore export and petroleum import), servicing offshore oil industry, and single-cargo handling with collection facilities of different commodities, while others specialise in handling petroleum, dry bulk and mixed-use cargoes.

The financial state of Transnet has been highly material to the state of its infrastructure and that of its business units. Since Transnet’s return to profitability a dozen years ago, there has been significantly greater emphasis in the TNPA and SAPO (and indeed in all other Transnet business units) on infrastructure, both on capital investment to grow the business, and on repair and replacement of existing infrastructure. Even though much of the infrastructure, including port infrastructure, has been ageing, it is generally maintained in an operationally serviceable condition.

Regular condition monitoring of all infrastructure informs the work of the maintenance staff. This information is used to identify faults which need to be repaired, and to schedule planned maintenance interventions (the information is also utilised for audit and long-term planning). The seven port engineers are obliged to inspect their infrastructure annually, and report to the TNPA, which has laid down a maintenance policy. Each port puts together its own maintenance programme, unique to its environment, within the guidelines set out in the policy. SAPO has similar measures in place for its infrastructure.

The condition of the commercial ports infrastructure (defined, for present purposes, to comprise breakwaters, quay walls, terminal areas, lighting and navigation systems) can be said to be in an acceptable condition for port operations in all the ports. A wide variety of structural systems have been used for the working structures, the quays and jetties and the dry docks. Except for some steel sheet piling and, in the earliest portions of Cape Town harbour, some dressed stonework, all these structures are of concrete construction,



In the older ports – Cape Town, Port Elizabeth, East London and Durban – there is very little vacant land or water left for development. In the newer ports – Saldanha Bay, Ngqura and Richards Bay – there is still plenty of land or water available for development. This availability will lend itself to meet the 30-year demand forecasts as envisaged by Transnet for some of the ports; others may become congested and hinder logistical flows. Generally the terminals are operating close to their optimal capacity. To meet the anticipated forecast demands, further investments in capital and maintenance will be required.

Apart from its duties with respect to shipping – e.g. inspecting ships for seaworthiness – the South African Maritime Safety Authority (SAMSA) exercises certain regulatory functions over infrastructure at the harbours. These infrastructure responsibilities relate to navigation aids such as beacons and telecommunications – these and others are governed by international agreements.

Fishing harbours featured as a sub-sector in the 2011 IRC. Due to lack of data, it was not possible to update this report in 2017, and hence the sub-sector is not graded. The following brief note must suffice:

Deterioration of the proclaimed fishing harbours began with the winding up of the competently-staffed Technical Department of the Fisheries Development Corporation around 1991. Management of these harbours was then transferred to the Fisheries Branch of the Department of Agriculture, Water and Forestry, which proved to be not up to the task. For the last 15 years responsibility for the infrastructure component has been with the Department of Public Works (DPW).

In recent years at least one provincial government and a municipality or two have proposed that they take over the administration of those small harbours that fall within their jurisdiction, but it is doubtful that any of them has more capacity than the DPW. The issue

comes back to the shortfall in overall coastal engineering capacity to manage the coastline and its infrastructure.

### 6.8 Rail

South Africa's rail environment can be divided into two components – the freight rail network and the passenger rail networks.

Four main railway transportation bodies, namely Transnet, the Passenger Rail Agency of South Africa (PRASA), Gautrain Rapid Rail Link (Gautrain) and the Railway Safety Regulator (RSR), safeguard the rail sector in South Africa. The Gautrain, a new sub-sector to the IRC, is a mass rapid transit rail passenger line, which commenced operations in 2010 under a public-private partnership (PPP) framework.

There are three types of rail gauges (distance between the rails) in South Africa, with the majority being Cape gauge (92.7% of the total track owned by Transnet, i.e. 30 400 km of track, as opposed to the length of route) and PRASA (2 228 km); followed by narrow gauge (7.0% of isolated lines on the branch network); and international standard gauge (0.3% of the total track for the Gautrain passenger line).

Transnet, a SOC reporting to the Department of Public Enterprises (DPE), operating through its Transnet Freight Rail (TFR) division, is responsible for the management, maintenance and operations of the national freight rail network. TFR has the responsibility for an estimated 21 000 km route (12 800 km of core network, including 1 500 km of heavy-haul line, and 7 278 km of branch lines).

Transnet has allocated R201 billion over the period 2012/2013 to 2018/19 to increase rail carrying capacity and cargo volumes by refurbishment of existing infrastructure, namely rail, signalling, depots, locomotives and rolling stock, acquisition of new locomotives and rolling stock, and upgrading of other rail infrastructure.

mostly reinforced concrete. In general, the awareness of and good practice in the challenges of corrosion of reinforced concrete construction, despite, in the case of the older structures, the limitations of the understanding of the problem, has resulted in very durable structures. Doubtless, in the case of the older structures, incipient degradation is accumulating, but in general they still have significant operational life span left.

As much as the demand has increased in most of these ports, both the fixed and movable infrastructure still perform well in meeting the safety and operational standards.

The breakwaters at the entrances to all these ports are exposed to wave attack from storms. The design of these “rubble mound” breakwaters allows for a small percentage accumulating damage to the armour layer to the breakwaters. Repair and refurbishment intervention will usually be needed at intervals that vary from five to twenty years. It would appear from the breakwater inspections carried out periodically that such maintenance interventions are again becoming necessary at most of the breakwaters.

Roads and services within the port jurisdictions appear to be of reasonable condition.

In general Cape Town and Saldanha Bay, the ports on the west coast, are relatively free of littoral drift of sediment, and dredging is limited to routine maintenance. On the east coast there is a strong littoral drift, and hence the harbour entrances to the ports of Ngquru (Coega), East London, Durban and Richards Bay are designed with large sediment traps on the updrift side. Extensive dredging is needed to bypass this sediment flow that would otherwise block these entrances. The dredging programme keeps the harbour entrances clear and usable.

The ports, particularly Cape Town, Port Elizabeth and Durban, have facilities for drydocking of large ships. With this capacity, ship repair, properly supported and husbanded, could be a major industry and economic sector. However, on the TNPA books, the dry docks run at a loss. This has led to the facilities being run-down in both maintenance and manning.



Table 2: Export Ore System: Condition of Infrastructure (TFR Rail Development Plan 2015)

Section	Formation	Structures	Perway	Electrical	OHTE	Signals	Telecoms	Overall
Sishen–Saldanha	Green	Green	Yellow	Green	Green	Green	Yellow	Green
Hotazel–Kimberley	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Green	Yellow
Kimberley–De Aar	Green	Green	Yellow	Green	Green	Green	Yellow	Green
De Aar–Port Elizabeth	Yellow	Yellow	Red	Red	Green	Yellow	Green	Yellow

upgrading of buildings, stations, depots, staging yards and reliable overhauled rolling stock. Due to a reduction in subsidies, the condition of existing locomotives, and late arrivals caused by line shutdowns and derailments, patronage of the Mainline Passenger Services has declined by 57% (from 1 538 000 passengers in 2010/11 to 660 000 in 2015/16).

PRASA has embarked upon a R123 billion rolling stock acquisition programme over the next 20 years. This includes the establishment of a local manufacturing facility, and a spares and maintenance agreement has been entered into for the next 18 years, indicating the seriousness of ensuring continuous and proper maintenance. Of the first R5 billion to be spent, R0.9 billion (2016/17) will be used for the upgrading of rail infrastructure, such as signalling. Outdated and inadequate equipment is causing operational problems, with the signalling and building structures now in a critical condition.

With this planned expenditure staged over a period of years, it will still take some time to eradicate the serious backlog and observe significant improvements in service delivery based on the new and upgraded infrastructure. Temporary speed restrictions have been imposed in an attempt to prevent derailments and damage to the rail infrastructure. These speed restrictions have negatively affected service delivery levels, particularly the 'on-time' performance of trains. Operational performance was 80.5%, but this was negatively affected by challenges with train set availability, signal failure and security-related incidents, particularly in the Western Cape and KwaZulu-Natal. 'Mean time between failures' has increased, with an increase in derailment incidences by 68% (between 2012/13 and 2013/14).

Derailments and train fires peaked in 2010/11 and 2012/13 respectively, with a steady increase in collisions from 2011 to 2015, which is an indication of the condition of infrastructure and its poor operability. Increases in theft and vandalism have cost PRASA many millions over the years (see Figure 7). Train fires, particularly, lead to less availability of train sets at peak

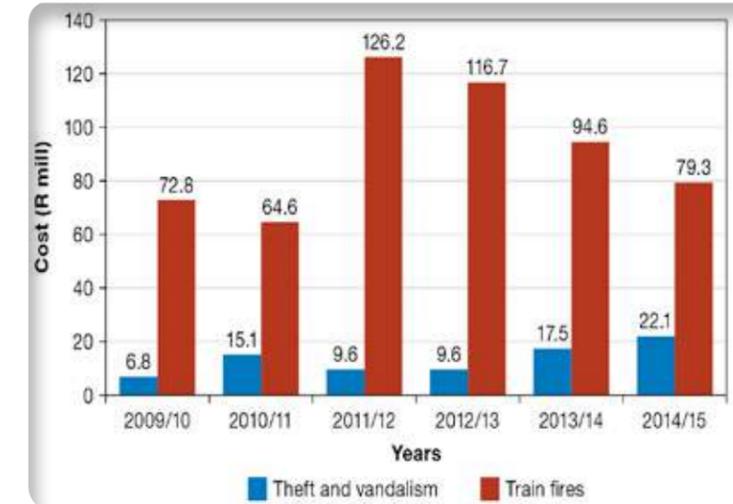


Figure 7: Cost of damage to PRASA rail infrastructure (Rail Safety Regulator "State of Safety Report 2014/15")

hours, causing more delays to trains and inconvenience to commuters.

The 80 km Gautrain rapid rail network, not reported on in earlier IRCs, was constructed and is operated and maintained by the Bombela Concession Company (BCC) under a public-private partnership. The Gautrain Management Agency (GMA), a Gauteng provincial entity, is tasked with the management, coordination and oversight of the Gautrain. At the end of the 19½-year concession period the rail asset will reside fully with the Gauteng Provincial Government.

The Gautrain started operation in 2010 and to date has completed about 80 million passenger trips. With a 99.6% availability rate (the norm is 94%) and 98.7% punctuality of its trains (the norm is 98.5%), the GMA has seen a growing ridership and demand for extension of the system. The BCC has strong incentives to keep the Gautrain at optimal service levels through adequate operating and maintenance procedures.

This large spend is an indication of a backlog in rail renewal and upgrading, and is needed to align with the anticipated 30-year demand forecasts for ports.

The increase in funding allocation for maintenance over the past five years (2011–2015) has seen increased volumes in freight rail – export coal up by 23% (from 62.2 million tonnes to 76.3 million tonnes), export iron ore up by 29% (from 46.2 million tonnes to 59.7 million tonnes) and general freight business (GFB) up 23%.

The condition of the coal, iron ore and manganese systems is acceptable, and the infrastructure appears to be functionally adequate, with the exception of poor electrical, signalling, perway or telecoms conditions on specific sections of route. Two areas of concern are the track-over-bridge structures on the Sishen–Saldanha line, and the inability to accommodate future traffic growth or increased axle loading resulting in high congestion and low performance on the Hotazel–Kimberley and Kimberley–De Aar lines. A further challenge is

on the operational bottleneck between Kimberley and De Aar due to the single line.

Table 2 is a summary, in this case for the export ore system, of the kind of information available on the TFR database.

Branch lines (comprising 7 278 km with only 3 928 km operational) have been prone to theft, vandalism and insufficient or no maintenance, resulting in a poor to very poor condition, with several lines not being operational. The rest of the TFR network appears to be in an adequate to poor condition.

PRASA provides commuter rail services in metropolitan areas, and long-distance (inter-city) rail and bus services within and to and from the borders of South Africa. PRASA rail operations are through Metrorail (400 million passengers per annum), Main Line Passenger Services, Shosholozha Meyl and Premier Class, with PRASA Corporate Real Estate Solutions (PRASA CRES) and PRASA Tech providing maintenance and



four gas turbine stations, one wind farm power station and one nuclear power station. Ingula, Medupi and Kusile will provide an additional 10 896 MW with original budget cost of R9 billion, R69 billion and R80 billion respectively. The capital expenditure for Medupi and Kusile is now R193 billion and R213 billion respectively, with Ingula allegedly coming in at R36 billion.

The 2006 IRC predicted that under-investment and poor forward planning with regard to electricity generation and distribution infrastructure would result in load-shedding. This became evident from 2007 onwards. Demand for electricity from Eskom started to decline in the same year, attributed to the appeal by Eskom that industry and the mining sector make use of less electricity, the steep increases in electricity tariffs which encouraged users to become more energy-conscious, and the general slowing down of the economy. The recent growth in IPPs has also contributed to the decrease in dependence on Eskom (see Figure 8).

Declining demand, together with the additional Eskom capacity coming online, will enable generation units to be taken out of service temporarily so that they can receive planned maintenance and midlife refurbishments. With the recapitalisation in generation capacity and Eskom's ability to leverage cross-border sales, Eskom can, governance permitting, once again achieve its competitive advantage as an SADC energy supplier. However, this will require diverting further investment in energy generation towards upgrading its transmission network.

Evidence is mounting that renewable energy will become the cheapest form of additional generation capacity (displacing fossil fuels), placing a greater focus on the IPPs, which already provide about 5% of the electricity. The role played by the IPPs is an important one and has helped South Africa towards a cleaner energy path. Research by the CSIR suggests that by 2020 a combination of solar, wind and gas energy would be as effective in meeting local baseload demand as a nuclear/coal energy mix.

The average age of Eskom's coal-fired power stations is 36 years, with Komati Power Station being the oldest at 52 years. Due to the costs involved in bringing older power stations to a level of compliance with minimum emission standards (in terms of the NEMA: Air Quality Act (Act 39 of 2004)) by the required 2020 cut-off, some may be decommissioned, the prime candidates being the Hendrina, Camden, Grootvlei and Komati power stations.

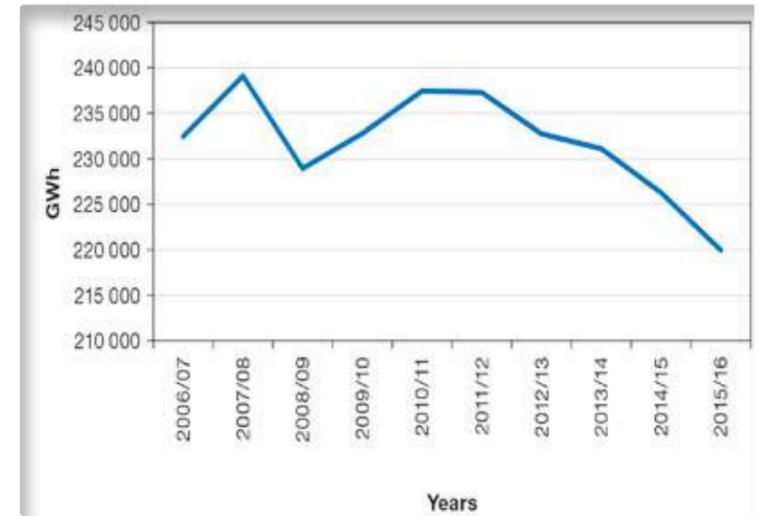


Figure 8: Power sent out by Eskom 2006–2016 (Eskom Integrated Report 2016)

Breakdowns of Eskom generation capacity were increasingly reported on in the press from about the end of 2010. Eskom was slow to advance plausible reasons for this, but it became increasingly apparent that Eskom had departed from its programme of planned maintenance. The problem was compounded by the outages – because of the consequent loss of generation capacity, infrastructure was often kept in service, even though its time for scheduled maintenance had arrived, further exacerbating the backlog in maintenance, and leading directly to breakdowns.

However, the extent of this neglect of maintenance was only revealed by Eskom from 2014. Early in 2015, the then Eskom CEO for the first time revealed the full scope – and consequences for generation capacity – of this neglect. The following extracts from his media presentation on 15 January 2015 refer:

- “Eskom has an elaborate maintenance regime that should maintain the health of our generation fleet ...
- Our philosophy of keeping the lights on at all costs superseded the maintenance philosophy and has put us into a very difficult position – Keeping the lights on program has avoided load shedding in the last seven years against all the odds, managing an extremely low operating margin – There is a severe maintenance backlog – Increasingly leading to unplanned outages (load losses) – Some of our running plants have partial load losses, because parts are worn out, and we do not have a time window to replace/fix – Keep the lights on philosophy has created a culture where proactive maintenance is less important ...

## 6.9 Electricity

### 6.9.1 Electricity generation and bulk transmission

The Department of Energy (DOE) has the legislative mandate, together with the Department of Public Enterprises (DPE), of ensuring energy security, oversight into the operations and running of the Electricity Supply Commission (Eskom – a SOC), and safeguarding access and regulation to the energy sector.

A sustainable sector comprises three elements: (i) economic growth, (ii) environmental sustainability and (iii) energy security.

Eskom's electricity supply activities include generation, transmission and distribution. Eskom generates approximately 95% of the electricity used in South Africa and 45% of the electricity used in Africa. Eskom is also the system operator of the interconnected power system, and it manages the supply and demand of electricity. This includes selling electricity abroad, buying electricity from independent power producers (IPPs), managing customer programmes to reduce consump-

tion, as well as demand-response programmes, such as the energy efficiency initiatives and the 5PM–9PM demand-reduction campaigns.

The electricity generation mix continues to be dominated by coal technology (86%), with nuclear technology at 6% and gas and hydro technology providing 4%. The DOE hopes to reduce the reliance on coal to 46%, and increase the role of renewable energy to 21% and nuclear energy to 13%, with both gas and hydro generation increasing to 11%. To realise the targets set out in this vision, government would need to interact more with IPPs to increase South Africa's clean energy and veer off the “dirty energy pathway”. It is estimated that Kusile will contribute 36.8 million tonnes of equivalent greenhouse gas emissions, increasing South Africa's energy sector emissions by 12.8%, and the country's total contribution to climate change by 9.7%.

Eskom dominates the production of electricity, with generation comprising 14 coal-fired power stations (including Kusile and Medupi, which are the largest), nine hydroelectric and pump storage power stations,

- We have arrived at a point that does not allow us to ignore the health of our plants ...”

A graph from the presentation further illustrates the point. This graph (Figure 9) shows the increasing unplanned capability loss factor (UCLF) percentages which Eskom experienced between 2005 and 2015.

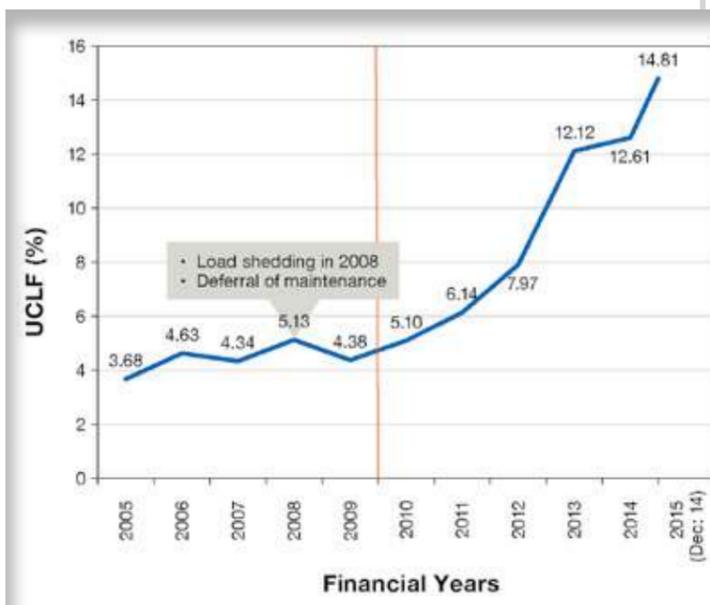


Figure 9: Eskom UCLF 2005–2015 (Matona 2015<sup>17</sup>)

A more telling example of the direct effects of maintenance neglect in any sector would be difficult to find.

It is understood that the availability of additional power from the new power stations, together with the decline in demand, has now enabled Eskom to return to its planned maintenance programme.

Eskom also operates, expands and maintains the national grid – 32 220 km of high-voltage transmission lines and over 427 transmission transformers. From this grid, power is distributed at a lower voltage through the distribution network operated and managed by Eskom and 187 municipalities around the country.

Thanks to the high level of maintenance of the Eskom transmission network, the only major incident during 2015/2016 was at a substation in Limpopo, resulting in power supply to Polokwane and the surrounding areas being disrupted by 100 minutes. However, given the age and vulnerability of the network, performance risks remain. The average age of the transmission network is 39 years, with the oldest substations and lines being 60 years old. This therefore requires a high level of network, plant and equipment maintenance, with continued refurbishment and replacement of plant.

### 6.9.2 Electricity local distribution

Electricity consumption in South Africa sees the bulk of the energy (60%) consumed by industries (manufacturing, mining, etc). Residential consumption is at 20%, commerce is at 15%, transport is at 2% and agriculture is at 3%. The lowest proportions of residential household connections are in KwaZulu-Natal and the Eastern Cape, due to their rural nature.

The electricity distribution network experiences significant challenges, as a result of factors such as under-investment in asset maintenance, an under-performing industry and a shortage of skills. As noted above, local distribution is by Eskom in certain areas, and by some of the municipalities within their jurisdiction. These municipalities buy the electricity from Eskom and sell it to consumers at a premium. Generally the maintenance by Eskom of its distribution network is good, but the maintenance – and hence the condition – of the municipal network varies greatly from municipality to municipality. Unfortunately there is no consolidated up-to-date municipal information – for example no statistics of the maintenance backlogs. However, it is understood that networks in many municipalities are in a poor condition.

Household electrification, especially rural electrification, remains a problem. In 2014 only 86% of houses had access to electricity for lighting purposes. Many of these houses were unmetered, or were the homes of those eligible for free basic electricity. With the DOE's electrification targets sitting at 97% by 2025, the development and formalisation of informal settlements is a priority. The idea of increasing the number of IPPs, especially for periurban and rural areas, and introducing distributed power generation and microgrids, needs revisiting.

### 6.10 Health care: hospitals and clinics

The public sector “health estate” is the responsibility of the Department of Health (DOH), together with the Department of Public Works (DPW), provincial health departments and, in some instances, municipalities.

There are over 6 000 healthcare facilities in South Africa, the vast majority (estimated at 3 885) being publicly owned and operated. There are 347 hospitals and 3 538 clinics, community health centres and community day centres. The CSIR estimates that the 2017 replacement value of public sector health buildings is in excess of R180 billion. Nearly seven in every ten households make use of public health facilities. The infrastructure is geographically dispersed, with 65% categorised as non-urban – for example, the two



provinces with the largest number of hospitals are Eastern Cape and KwaZulu-Natal. The public facilities differ in age by 150 years – the oldest being the Somerset Hospital (established in 1864) and the latest the Nelson Mandela Children's Hospital (opened in 2016).

Arrangements for budgeting and implementation of maintenance vary across provinces. In assessing life cycle costing for health facilities, it is important to differentiate between the movable and immovable assets. For example, medical equipment tends to have a short life cycle, with replacement on a five to ten-year cycle, with this lifespan growing shorter due to technology obsolescence and growing software sophistication. Chronic underspending is evident, resulting in a reactionary spend on maintenance, rather than prevention. A large backlog of maintenance has developed, contributing to increased service delivery failure. The Health Facility Revitalisation Grant – which funds a wide range of health infrastructure projects – was reduced by R200 million in 2016/17 and R365 million over the 2016 MTEF period, due to underspending. National Treasury has committed to invest R19.8 billion in health infrastructure over the 2017/18 to 2019/20 MTEF period.

Apartheid policies resulted in a legacy of inadequate and inequitable access, but despite the 23 years of democracy since then, there is still poor health infrastructure in the rural areas, with pockets of improvement under the Ideal Clinics Realisation and Maintenance Programme (primarily in the National Health Insurance (NHI) priority districts). Many urban hospitals – especially central or tertiary facilities – are entering into further decay and dilapidation. A baseline audit conducted by the DOH (2011/12) indicated that 80% of clinics were not fit for purpose, with weaknesses in infrastructure, staffing, availability of medicine,

cleanliness, security and waiting times. After an intervention in 2014 to get clinics to “ideal” status by March 2019, the DOH reported in June 2016 that a turnaround was evident, based upon eight work-streams through a systems approach. However, this appears only to be at the clinics and community health centres, whereas maintenance has been neglected at district, regional, tertiary and central hospitals.

The 2016 Auditor General's report observed a sustained and significant building deterioration at some health facilities in all provinces over a five-year period. AGSA (Auditor General South Africa) identified the following as the root causes: lack of skilled staff, poor financial management, inadequate supply chain management processes, lack of sufficient and capable project managers and poor coordination amongst different stakeholders. Coupled with this was the lack of consequences for contractors, implementing agents and provincial departments that performed poorly. Due to this, AGSA has stated that in the next audit it will be giving special attention to planning for maintenance and the quality of implementation.

Whilst international research suggests a link between health facility design and management, and health service delivery, there is very little South African evidence of the impact of facility condition on health outcomes. This is mostly attributable to a scarcity of comparable information, and a lack of proper ongoing monitoring and evaluation, healthcare infrastructure information systems and/or coordinated data collection and sharing. Nonetheless, it is widely understood that poorly maintained facilities do not only impede health service delivery, but also increase the level of risk to patients, staff and service costs, besides reducing the service life of equipment and facilities. The inadequate facilities make it challenging for health care professionals to



carry out their work, and incentivise them to relocate from rural areas, despite this being where their services are most needed.

Public health sector infrastructure is highly variable. The best maintained examples are comparable with private sector and international facilities, whilst the worst maintained are condemnable, uninhabitable and not fit for service. There is a dire need to shift from a pure maintenance regime to life cycle approaches with a view to delivering better value for money.

In South Africa, where there is a high burden of disease and immune-suppressed patients and staff, there is a direct link between design, operation and maintenance, and infection control. For example, the risk of transmission of airborne diseases, such as tuberculosis, is high, especially due to poorly maintained heating, ventilation and air conditioning systems. A shortage of skilled and experienced staff, and lack of supervision present risks and bring the public health service into disrepute. For example, insufficient bulk water supply

led to the closure of a Mpumalanga hospital, failure to purchase fuel for back-up generators led to the death of a number of ICU patients at Letaba hospitals, and failure to clean plumbing equipment led to nosocomial infection at the Chris Hani Baragwanath Hospital, resulting in a number of deaths.

## 6.11 Education

### 6.11.1 Public ordinary schools

Basic education, including primary and secondary schooling, is the responsibility of the Department of Basic Education (DBE). There is a great deal of variation across and within provinces in terms of access to education and the condition of schools. The focus for schooling infrastructure has been on addressing backlogs, particularly those preventing learners from accessing schools and those endangering their health and safety, e.g. replacing schools built from inappropriate materials such as asbestos.

In 2016 there were 23 577 public ordinary schools, compared to approximately 24 460 schools reported

in the 2011 IRC. The decrease is due to programmes such as the Rationalisation Programme, which closes schools with enrolments of under 135 learners (considered the minimum number of learners for effective utilisation of physical and human resources). Most of these schools were in the Eastern Cape, Mpumalanga and the Free State. Gauteng and the Western Cape were the only provinces to have increased the number of public schools.

Damage, theft and vandalism to public schooling infrastructure have evolved as key themes to the infrastructure assessment of public schools. A recent example is the damage to 28 schools in Vuwani, Limpopo, in 2016, with a repair cost of around R720 million. The protests kept learners away from school for several weeks, and the loss of critical infrastructure resulted in the quality of education being compromised. Criminality, such as destruction during service delivery protests or theft of electricity equipment (which the Northern Cape provincial education department cited as a reason for slow electrification of schools), threatens schooling infrastructure. Yet, even well-intentioned efforts may have adverse infrastructure consequences if paired with misinformation, e.g. civil activism around schools that may demand flush toilets rather than VIPs – where the latter are realistic to provide and maintain, given water resources, and are adequately safe for learner health. In this case there is perhaps need for greater communication across stakeholders in the education environment.

The DBE has made a lot of progress in building new schools since the 2011 IRC. Programmes such as the Accelerated School Infrastructure Development Initiative (ASIDI) have reduced the numbers of schools built out of inappropriate materials, and increased provision of water, electricity and sanitation. However, this focus on new schools has deprioritised maintenance. As a result, the reliability of infrastructure has decreased sharply due to a lack of maintenance programmes, skilled staff managing the public school infrastructure, and a diversion of maintenance funds. The maintenance of water and sanitation facilities, particularly, at many schools, leaves much to be desired. Although the DBE claims that less than 1% of schools are without water and toilets, in some provinces these facilities at the majority of rural schools are out of order for much of the time. More than 10% of schools have unreliable electricity infrastructure, 20% of schools were found to have unreliable water supply, and 30% of schools have neglected the maintenance of toilets and toilet systems. In provinces such as the Eastern Cape, North West, Limpopo and KwaZulu-Natal, the increase in

schools provided with water and electricity is exceeded by the decrease in reliability of these services since 2013.

Bad sanitation facilities impact especially on female learners – no more so than at the time of menstruation, when privacy, frustrated by inadequate toilets, is denied. The 2011 IRC highlighted that female learners miss school during menstruation because of inadequate sanitation. A closely related issue, namely the unavailability and unaffordability of sanitary pads, has since received considerable media and public attention, resulting in multiple efforts to donate sanitary pads, and a notable commitment by KwaZulu-Natal authorities to provide sanitary pads for learners. Unfortunately, the issue of inadequate sanitation facilities (including handwashing) remains a problem, speaking to the urgent need for further improvements in schooling infrastructure, one of the measures needed to help address South Africa's crisis in basic education outcomes.

These problems require urgent attention. If existing infrastructure is allowed to become completely non-functional, it will require replacement at much higher cost than allocated for maintenance. Planning seems to have improved across most provinces, but technical and planning capacity is still insufficient in places like Mpumalanga. Maintenance budgets are often too low and should be ring-fenced. An additional problem is that valuation of school infrastructure is not based on consistent practices across provinces, which complicates estimation of maintenance budgets.

School infrastructure also includes the provision of secure fencing, libraries, classrooms, laboratories, sports facilities, computer facilities and internet access. There has been little progress in addressing these lower-priority backlogs – in fact, access to sports facilities has worsened, 86.2% of schools are without laboratories, 77% have no libraries, 42% have no sports facilities and 67.5% have no computer facilities. Only 19.7% of schools have access to the internet.



### 6.11.2 Public higher education

The public higher education sector and all its infrastructure is the responsibility of the Department of Higher Education and Training (DHET) and the DPW. The sector, not featured in previous IRCs, consists of 4 048 educational institutions, which include public and private universities, TVET colleges, adult education centres, SETAs (Sector Education and Training Authorities) and formal post-school institutions such as prison schools.

As with schools, the quality and quantity of higher education infrastructure vary significantly around the country, particularly on a rural/urban divide. And, as with schools, the quality and quantity of higher education infrastructure will affect learning outcomes and graduation rates.

There are 26 public universities and 50 public TVET colleges, with more than 1.6 million students utilising the infrastructure at the various campuses and/or learning online. The sector has experienced rapid

growth in a short space of time, as universities in particular have been instructed to accept and graduate as many students as possible. This has put great strain on infrastructure, staff and other resources. The biggest challenge at the moment is developing new and larger infrastructure that is capable of handling the student influx, whilst ensuring the existing infrastructure (some of which is decades old) is maintained and upgraded. A further challenge is providing residential facilities for students, as the demand far exceeds the current supply, even when private residential accommodation is taken into account.

Two additional universities have been constructed in Mpumalanga (University of Mpumalanga) and the Northern Cape (Sol Plaatje University) to provide additional capacity. Sixteen new or renovated TVET college campuses are also currently in advanced stages of development or construction. The location of these new campuses is evidence of increased efforts by government to improve access to education, as the geographical locations are not all concentrated in

city centres, but spread across remote areas of South Africa, including the Waterberg Campus in Thabazimbi, Limpopo, the Nkandla Campus in KwaZulu-Natal, and the Ingwe Campus in Nqgunqushu Lusikisiki, Eastern Cape.

The most recent (2014) reliable collation of infrastructure condition information for public universities stated that, of the 5 206 buildings, 13% were in a poor condition and 54% were in a good condition. Compared to the previous collation in 2011, this indicated an overall improvement in condition. However, most of this improvement was a result of new buildings rather than better maintenance practices. Most universities have insufficient institutional capacity for planning and maintaining infrastructure, which forces them to rely on external consultants. This can, and sometimes does, lead to ad hoc interventions, weak systems and limited institutional memory, to the detriment of long-term planning.

The latest reliable collation of infrastructure condition information for TVETs was in 2005.<sup>18</sup> However, the limited assessment which the CSIR engaged in for the

purposes of the current IRC showed that the condition of their infrastructure has deteriorated over the past ten years. Budget allocations for maintenance have been well below the levels required for acceptable levels of maintenance. Limited maintenance seems to have occurred across the 50 campuses. The problems are exacerbated at rural TVETs, where it is very difficult to find and retain skilled capacity for maintenance of infrastructure.

Significant attention was brought to the higher education sector during the Fees Must Fall campaign, which saw damage to higher education infrastructure costing more than R600 million in 2016. The damage was worst at the North-West University Mafikeng Campus, where numerous buildings were burnt, as well as at the University of Johannesburg and the University of the Witwatersrand, but there was also widespread damage at several TVET campuses. Without doubt, this damage has impacted on the quality of higher education and training, and the funding needed to repair the damage will undoubtedly impact on maintenance budgets.



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*SAICE (established in 1903) represents the foremost body of professional expertise in the built environment, with approximately 11 000 members who enhance the interest of civil society by advancing the science and profession of civil engineering.*

## 8. End Notes

1. This spending includes maintenance, upgrades and capital expenditure across all three levels of government. See "Budget Review 2017: Annexure D" 2017. Available at: <http://www.treasury.gov.za/documents/national%20budget/2017/budgetReview.aspx>
2. Op. cit.
3. ActionAid 2016. Running on Empty: What Business, Government and Citizens must do to confront South Africa's water crisis. Available at: <https://www.moneyweb.co.za/wp-content/uploads/2016/04/Running-on-Empty-Water-efficiency-report.pdf>
4. As reported by StatsSA.
5. OECD (Organisation for Economic Cooperation and Development) 2017. Getting Infrastructure Right: A framework for better governance. OECD Publishing: Paris. Available at: <http://dx.doi.org/10.1787/9789264272453-en>
6. Matona, Tshedisi 2015. Media presentation, Tshediso Matona, Chief Executive, 15 January 2015. Available at: [https://www.linkedin.com/pulse/media-presentation-tshediso-matona-chief-executive-15-van-der-rheede?trk=pulse-det-nav\\_art](https://www.linkedin.com/pulse/media-presentation-tshediso-matona-chief-executive-15-van-der-rheede?trk=pulse-det-nav_art)
7. IMF (International Monetary Fund) 2017. Staff Report for the 2017 Article IV Consultation. Available at: <https://www.imf.org/en/Publications/CR/Issues/2017/07/06/South-Africa-2017-Article-IV-Consultation-Press-Release-Staff-Report-and-Statement-by-the-45044>
8. National Treasury 2017. Budget Review 2017. Available at: <http://www.treasury.gov.za/documents/national%20budget/2017/review/FullBR.pdf>
9. Walters, J 2014. Public transport policy implementation in South Africa: Quo Vadis? *Journal of Transport and Supply Chain Management*, 8(1). Available at <http://www.jtscm.co.za/index.php/jtscm/article/view/134/219>
10. Lawless, A 2017. Numbers and Needs in Local Government – where are we now? *Civil Engineering*, 25(1): 15–26.
11. OECD (Organisation for Economic Cooperation and Development) 2017. Getting Infrastructure Right: A framework for better governance. OECD Publishing: Paris. Available at: <http://dx.doi.org/10.1787/9789264272453-en>
12. As for example in compliance with the Water Services Act (Act 108 of 1997).
13. DWS (Department of Water and Sanitation) 2017. Strategic Overview of the Water Sector in South Africa: 2017.
14. Op. cit.
15. CSIR (Council for Scientific and Industrial Research) 2013. 10th Annual State of Logistics Survey for South Africa. Pretoria.
16. It is understood that by "total asset value" is meant the current replacement cost, as in 2016.
17. Matona, Tshedisi 2015. Media presentation, Tshediso Matona, Chief Executive, 15 January 2015. Available at: [https://www.linkedin.com/pulse/media-presentation-tshediso-matona-chief-executive-15-van-der-rheede?trk=pulse-det-nav\\_art](https://www.linkedin.com/pulse/media-presentation-tshediso-matona-chief-executive-15-van-der-rheede?trk=pulse-det-nav_art)
18. They were then known as Colleges for Further Education and Training (FET Colleges).

## 9. References

A comprehensive list of references is contained in the SAICE IRC 2017 webpage, which can be accessed at:

<http://saice.org.za/saice-publications/>

# 10. List of Acronyms

ACSA	Airports Company South Africa
AGSA	Auditor General South Africa
ASCE	American Society of Civil Engineers
ASIDI	Accelerated School Infrastructure Development Initiative
ATNS	Air Traffic and Navigation Services
BCC	Bombela Concession Company
CAASA	Civil Aviation Authority of South Africa
CSIR	Council for Scientific and Industrial Research
DBE	Department of Basic Education
DEA	Department of Environmental Affairs
DHET	Department of Higher Education and Training
DOE	Department of Energy
DOH	Department of Health
DOHS	Department of Human Settlements
DOT	Department of Transport
DPE	Department of Public Enterprises
DPW	Department of Public Works
DWS	Department of Water and Sanitation
ESKOM	Electricity Supply Commission
GFB	General Freight Business
GMA	Gautrain Management Agency
ICAO	International Civil Aviation Organisation
ICE	Institution of Civil Engineers
ICT	Information and Communication Technology
IndWMP	Industry Waste Management Plan
IPP	Independent Power Producer
IRC	Infrastructure Report Card
LHWP	Lesotho Highlands Water Project
MTEF	Medium-Term Expenditure Framework
NHI	National Health Insurance
NIMS	National Infrastructure Maintenance Strategy
NRW	Non-Revenue Water
NWMS	National Waste Management Strategy
OHTE	Overhead Track Equipment
PPP	Public-Private Partnership
PRASA CRES	PRASA Corporate Real Estate Solutions
PRASA	Passenger Rail Agency of South Africa
PRO	Producer Responsibility Organisation
RDP	Reconstruction and Development Programme
RSR	Railway Safety Regulator
SAFE0	Southern African Federation of Engineering Organisations
SAICE	South African Institution of Civil Engineering
SAMSA	South African Maritime Safety Authority
SANRAL	South African National Roads Agency Limited
SAPO	South African Port Operations
SETA	Sector Education and Training Authority
SOC	State-Owned Company
TFR	Transnet Freight Rail
TNPA	Transnet National Ports Authority
TPT	Transnet Port Terminals
TVET	Technical and Vocational Education and Training (College)
UCLF	Unplanned Capability Loss Factor
VIP	Ventilated Improved Pit
VRESAP	Vaal River Eastern Subsystem Augmentation Project
WWTW	Wastewater Treatment Works



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