





# Exploration of Policy and Legislation for Managing Water Infrastructure Assets in the Rustenburg Local Municipality, South Africa


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## Abstract

The purpose of this paper is to explore the policy and legislative framework for managing water infrastructure assets in the Rustenburg Local Municipality. The lack of asset management policies and the implementation of legislation have left municipalities without asset information for planning. Although infrastructure assets improve quality of life and drive economies, if infrastructure asset management policies and legislation are not in place and adhered to, water provision cannot be realised. A qualitative research design, including

a desktop (document) review of policies and legislation on infrastructure asset management and a review of literature from 2011 to 2023, was employed. The findings of the reviews indicate that the Constitution of South Africa grants the right to access water through cooperation among the spheres of government in water infrastructure asset management. The Municipal Finance Management Act promotes the internal control of assets and financial affairs for the maintenance of infrastructure. The Local Government: Municipal Systems Act develops an Integrated Development Plan involving community participation for identifying challenges related to infrastructure assets. The Water Services Act establishes a Water Service Development Plan that provides population size information and addresses water infrastructure asset maintenance. The Rustenburg Local Municipality Integrated Development Plan promotes the use of information and communications technology in support of a smart city for the realisation of a technological water infrastructure asset management system. The Rustenburg Local Municipality Asset Management Policy encourages the development of an asset register for the compilation of infrastructure asset information. These policies complement one another for the realisation of infrastructure asset management and water services; however, they fail to address the concept of smart urban water management, which utilises smart sensors for real-time data collection to improve operations and communicate with citizens while monitoring water resources, storage, distribution, and wastewater treatment.

**Keywords:** Rustenburg Local Municipality, smart city theory, smart urban water management, service delivery, water infrastructure asset.

## **Introduction and Background**

South African municipalities cannot fulfil their constitutional mandate of delivering sustainable basic services due to their inability to manage their assets effectively (Jerome & Nel, 2021). As the population grows, the demand for water service delivery increases, which results in infrastructure assets becoming overloaded (Boshoff, 2009). It is estimated that the

demand for water in South Africa will exceed supply by 2025 if no action is taken regarding the implementation of a legislative framework and policies for water infrastructure assets (Koatla, 2011). Many South African municipalities are in a disastrous financial position, which has serious consequences, as they are unable to deliver essential services such as water (Brand, 2018). These service delivery challenges stem from the failure to maintain existing or new infrastructure (Mpehle, 2012; Tsheola, 2012). It is therefore crucial to manage infrastructure assets, as they are vital to the prosperity of life (Uddin et al., 2013) and have a positive impact on economic growth (Ruch & Geyer, 2017) through effective policy implementation. However, municipalities do not update their asset registers due to a failure to implement asset management policies (Boshoff & Pretorius, 2010), which results in their inability to predict infrastructure performance.

The implementation of policies and regulations in terms of water infrastructure assets has been emphasised in Agenda 2030's Sustainable Development Goals (SDGs). SDG 6 focuses on the provision of clean water and sanitation for all in a sustainable manner through the proper management of water infrastructure assets. However, inadequate water provision due to poor policy implementation regarding water infrastructure has led to community unrest and vandalism of municipal infrastructure (Majuru et al., 2012). To address the management of water infrastructure assets and water service provision, SDG 9 emphasises the utilisation of technology and innovation (Allen et al., 2018), while SDG 17 encourages collaboration, partnerships, and cooperation among communities and all levels of government to realise effective water service delivery. As such, inclusivity in managing water infrastructure assets is achieved. This approach has cascaded to the regions on the African continent through Africa Agenda 2063, which provides insight into regional perspectives on improving cities through sustainable development by focusing on governance and inclusive growth (Tshiyoyo, 2017). Nationally, the South African government introduced the National Development Plan: Vision 2030, which prioritises infrastructure programmes such as

information and communications technology (ICT) connectivity for the management of water infrastructure assets (National Planning Commission, 2012), while also addressing social issues such as poverty and inequality in a sustainable manner.

The legislature of the South African government consists of a democratic model with three spheres: national, provincial, and local government, as stated in Section 40 of the Constitution of South Africa, 1996 (Republic of South Africa [RSA], 1996). The mandate of this model is to strategise service delivery in order to bring government services closer to the people. The national government is responsible for developing the policy framework and providing support to local municipalities; for example, the Department of Cooperative Governance and Traditional Affairs acts as a custodian of local government (Department of Cooperative Governance and Traditional Affairs, 2019), while the Department of Water and Sanitation offers assistance regarding water infrastructure asset management and water service provision.

The provincial government's function is to support municipal capacity to strengthen and improve service delivery to communities (Asha & Makalela, 2020). Section 154 of the Constitution states that provincial governments should identify solutions to these challenges and provide support to municipalities (RSA, 1996). Local government operates the closest to the communities in terms of service delivery, such as water provision. Section 151(1) stipulates that developmental local government should be democratic and accountable to its citizens and should ensure service delivery to the people. For instance, water service provision is a constitutional right, as outlined in Section 27(1) of the Constitution (RSA, 1996).

However, there is a lack of water infrastructure asset management policies and implementation of legislation by municipalities. Furthermore, it has been noted that municipalities do not comply with various municipal policies that govern water infrastructure assets (Kang, 2019). This has resulted in unreliable management of infrastructure asset information that inhibits infrastructure asset managers from

conducting effective municipal planning, safeguarding, and maintenance of these assets (Chari et al., 2018).

### **Aim of the Study**

The broad aim of this study was to investigate the alignment of local government policies in managing infrastructure assets to improve water service delivery.

### **Significance of the Study**

Municipalities are obligated by the Constitution, Section 27(1) (b), to provide water, which is a basic need and right for everyone (RSA, 1996). However, several challenges hinder the provision of water to communities, such as inadequate infrastructure maintenance, ageing infrastructure, population growth, increasing infrastructure demands, poor data management, and mismanagement of resources (Singh & Ogra, 2016). As a result of these challenges, municipalities are increasingly experiencing pipe bursts and leaks, which lead to greater water losses and adversely affect service delivery (Love et al., 2018).

It is imperative to implement and adhere to policies and legislation on infrastructure asset management. Such implementation can provide control over and safeguard information regarding infrastructure assets, their condition, and how they can be maintained. This study contributes to the body of knowledge on urban geography, targeting researchers, practitioners, policymakers, engineers, and municipal managers. It aims to enhance understanding of the implementation of water infrastructure asset policies to manage governmental affairs, including the challenges and solutions facing water service provision to communities.

### **Theoretical Underpinnings of the Study**

The study focuses on the smart city theory and its frameworks, particularly the human smart city framework, which involves people and their participation in a city's governance (Kersting

et al., 2016); the institutional smart city framework, which encompasses the collaboration between state and civil society to improve service delivery (Belissent, 2011); and the technological smart city framework, which employs technologies to address societal problems (Bashynska & Dyskina, 2018). Sikora-Fernandez and Stawasz (2016, p. 86) define a smart city as a concept that is aimed at managing cities in a modern way using advanced technologies while conserving resources to achieve desired outcomes. The smart city theory was selected for this study due to its technological innovations, such as smart devices and sensors, which generate real-time data focusing on smart urban water management. This approach aims to enhance the connectivity of water infrastructure assets from the source (dams) through distribution (networks) to wastewater treatment plants.

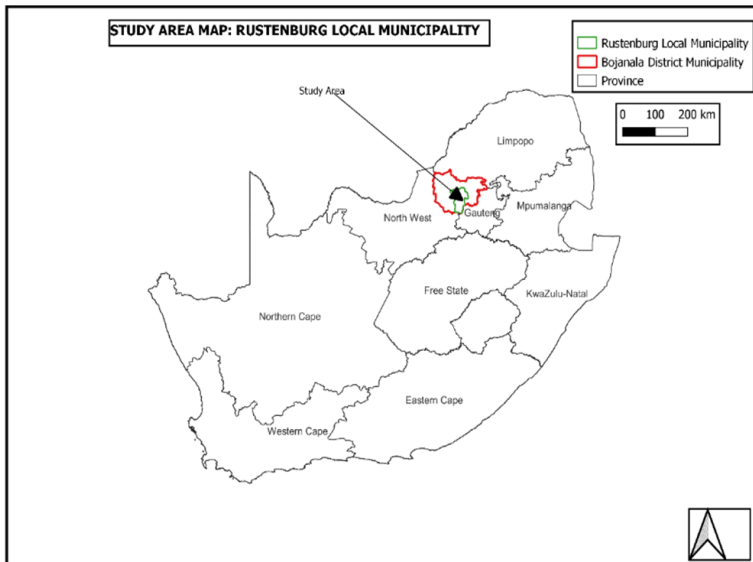
## **Methodology**

The study used a qualitative research approach, focusing on a review of literature from 2011 to 2023 and the legislative framework that guides the use of water infrastructure assets. The researchers utilised an interpretivist research paradigm, as it would facilitate the acquisition of in-depth knowledge of the phenomenon under investigation (Creswell, 2014). The research design adopted in this study was a qualitative research method, concentrating on secondary data collection through a document (desktop) review of municipal policies and legislation regarding water infrastructure assets. A document review study is defined as “the review by the researcher of written materials which can include personal and non-personal documents such as archives, annual reports, and policy documents” (Mohajan, 2018). The researchers undertook a document review to gain an understanding of the implementation of water infrastructure asset management policies and regulations in the Rustenburg Local Municipality. The study examined the following policies and legislation: the Constitution of the Republic of South Africa, 1996; the Municipal Finance Management Act, No. 56 of 2003; the Local Government: Municipal Systems Act, No. 32 of 2000; the Water Services Act, No. 108 of 1997; the Rustenburg Local

Municipality Integrated Development Plan (IDP); and the Rustenburg Local Municipality Asset Management Policy.

## Description of the Study Area

The Rustenburg Local Municipality is located in the Bojanala District Municipality in the North West province, as illustrated in Figure 1, and has a total population of 734 243. It is one of five local municipalities: Rustenburg, Madibeng, Moses Kotane, Moretele, and Kgetlengrivier. Rustenburg is a large town situated approximately 112 km north-west of Johannesburg and Pretoria, at the foot of the Magaliesberg mountain range. It is regarded as the fastest-growing municipality in South Africa due to the economic impact of the world's three largest platinum mines – Sibanye Stillwater, Anglo Platinum, and Impala Mine – which are located around the city (Mudau et al., 2014).



**Figure 1:** Study Area Map. Source: Own construction (2022)

## **Review of the Constitution of the Republic of South Africa, 1996**

The 1996 South African Constitution was promulgated on 18 December 1996 and came into effect on 4 February 1997. The Constitution outlines its purpose as healing the divisions of the past and establishing a society that is based on democratic values, social justice, and fundamental human rights (RSA, 1996). The Constitution in Section 27(1)(b) stipulates that everyone has the right to have access to water, while Section 152(1)(a-e)(2) emphasises that local government must ensure the provision of services to communities in a sustainable manner and involve communities in this process (RSA, 1996). Section 153 outlines that a municipality must structure its budget and planning processes to prioritise the basic needs of the community (RSA, 1996). Section 41(1)(c)(h)(i-vi) states that all spheres of government must provide effective, transparent, accountable, and coherent governance for the Republic to facilitate cooperation among one another in intergovernmental relations (RSA, 1996). The Constitution of South Africa was selected for this study in support of the study's aim, as it suggests that if infrastructure management is in place, including community participation, cooperation among spheres of government, and good budgeting and planning processes, water service provision will be effectively rendered to communities.

## **Review of Local Government Policies and Legislation on Asset Management**

South African municipalities are constitutionally mandated to provide services to communities. However, these services must be delivered through reliable infrastructure assets. Scholars have identified various challenges that affect service delivery in municipalities, such as a lack of an updated asset register, poor infrastructure data management, insufficient skills capacity, ageing infrastructure, and increasing infrastructure demand (Meehan, 2014; Oyedele, 2022). The South African government established the Municipal Infrastructure Support Agent (MISA)

to assist municipalities in addressing infrastructure challenges (MISA, 2016). MISA was created to provide technical and financial aid to municipalities to tackle these challenges. However, the responsibilities of MISA and those of the municipalities are not clearly defined (Bormann & Gulati, 2014). Nhleko and Inambao (2019) indicate that for municipalities to succeed in their functions, they must maintain well-performing, reliable infrastructure to prevent community protests.

### **Review of the Municipal Finance Management Act, No. 56 of 2003**

The Municipal Finance Management Act was administered and adopted in South Africa in 2003 (RSA, 2003). The objective of the Act is to ensure sound and sustainable management of the financial affairs of municipalities and other institutions in the local sphere of government (RSA, 2003). This Act was chosen for this study with consideration of the financial status of the municipality in relation to asset management for the provision of water services to the communities of Rustenburg Local Municipality. Maintenance of infrastructure assets requires a budget; the Act was therefore beneficial for this study regarding the management of infrastructure assets. The Municipal Finance Management Act, in Sections 63(1)(a)(b)(c), 63(2)(a)(b)(c), and 96(1)(a)(b) and (2)(a)(b), states that the accounting officer of the municipality is responsible for the management of assets, safeguarding, internal control (including the asset register), and providing an information system for asset accountability.

### **Review of the Local Government: Municipal Systems Act, No. 32 of 2000**

The Local Government: Municipal Systems Act was administered and adopted in 2000 (RSA, 2000). The objective of the Act is to provide the core principles, mechanisms, and processes necessary to enable municipalities to move progressively towards the social and economic upliftment of local communities (RSA, 2000). The Act promotes community participation in Sections 16(1)(i-v) and 42, as well as the drafting of an IDP as stipulated in Section 23(1)(a)(b)(c). Municipal councils adopt the IDP in accordance with Section

25(1)(a)(b)(c)(d)(e) of the Act (RSA, 2000). This Act plays a significant role in the study as it encourages community involvement in identifying challenges related to infrastructure assets, such as burst pipes that require maintenance. Section 4(2)(d) of the Local Government: Municipal Systems Act states that local government must ensure the provision of services to communities in a financially and environmentally sustainable manner (RSA, 2000). The Local Government: Municipal Systems Act encourages municipalities to apply sound asset management principles and systems to enable them to achieve sustainable financial provision for basic services (RSA, 2000). Section 73(2) (a)(b)(c)(d)(e) of the Local Government: Municipal Systems Act stipulates that the provision of basic municipal services should consider the need for prudent, efficient, and effective use of available resources, as well as the requirements for financial and environmental sustainability (RSA, 2000).

### **Review of the Water Services Act, No. 108 of 1997**

The Water Services Act was administered and adopted in 1997 (RSA, 1997). The objectives of the Act are to provide for the right of access to basic water supply, to establish water services development plans, and to facilitate the gathering of information in a national information system (RSA, 1997). This Act was chosen for this study to guide the management of water infrastructure assets for water provision. Section 3(1)(2) of the Act stipulates that everyone has the right of access to basic water supply, and municipalities must ensure that this right is realised based on their water service development plans (RSA, 1997). Furthermore, Section 11(1) outlines that municipalities, as water service authorities, should provide access to water services. The Water Services Act, in Section 12(1)(a), highlights that municipalities must draft a Water Service Development Plan (RSA, 1997). This plan must detail all information pertaining to water service provision, including population size, water infrastructure assets, and maintenance, as stipulated in Section 13(a-h) of the Act (RSA, 1997). Additionally, Section 67(1) stipulates that the minister must ensure that there is a national information system on water services (RSA, 1997). This

system must record and provide data for the development and implementation of water services information, as outlined in Section 68(a)(b)(i-iii) of the Act (RSA, 1997).

### **Review of the Rustenburg Local Municipality Integrated Development Plan (IDP)**

The Rustenburg Local Municipality developed an IDP guided by the Municipal Systems Act of 2000. The plan emphasises the importance of intergovernmental relations, with the Rustenburg Local Municipality participating in the district IDP forum to align plans and implement projects (Rustenburg Local Municipality, 2022). It also elaborates on the use of ICT in support of the smart city initiative and the Fourth Industrial Revolution, aiming for the realisation of a technological water infrastructure asset management system (Rustenburg Local Municipality, 2022). This system will ensure effective planning that will lead to accurate reporting of assets and appropriate spending of the asset maintenance budget (Rustenburg Local Municipality, 2022). To ensure proper maintenance, the Rustenburg Local Municipality should develop an asset maintenance plan.

### **Review of the Rustenburg Local Municipality Asset Management Policy**

The Rustenburg Local Municipality adopted an asset management policy guided by the Municipal Finance Management Act of 2003. This policy empowers the municipal manager to regulate the acquisition, safeguarding, and maintenance of all municipal assets (Rustenburg Local Municipality, 2021). It also states that department heads procuring assets on behalf of the Rustenburg Local Municipality must ensure that only those assets necessary for the efficient, effective, and economical delivery of intended services are acquired (Rustenburg Local Municipality, 2021). Furthermore, the policy stipulates that assets that require periodic maintenance must be properly maintained to ensure that the intended benefits of the procured assets are realised (Rustenburg Local Municipality, 2021). Additionally, the policy encourages the development of an asset register in the

municipality for the planning and tracking of assets (Rustenburg Local Municipality, 2021).

## **Discussion**

The findings of the literature and document review of policies and legislation concerning water infrastructure asset management indicate that the Constitution of South Africa serves as the umbrella for all other policies and legislation. The review also revealed a need for municipalities to implement policies and legislation that support infrastructure asset management to improve water service delivery. For water to be provided to communities as a constitutional right, several processes must be followed, including community participation to identify areas that require water infrastructure assets. This should be included in the IDP, as guided by the Local Government: Municipal Systems Act. The budget for the acquisition and maintenance of infrastructure assets, as guided by the Municipal Finance Management Act, should be adhered to. Lastly, the management of water infrastructure asset information should utilise the Water Service Development Plan and asset register as a database in the municipality, as guided by the Water Services Act.

### **The Constitution of the Republic of South Africa, 1996**

The review of the South African Constitution emphasises the importance of providing access to water for everyone, as it is a human right stipulated in Section 27(1)(b) of the Constitution (RSA, 1996). However, water service provision can only be effective in a democratic developmental local government that is accountable to its citizens. The Constitution promotes cooperation in the form of stakeholder engagement among national, provincial, and local spheres of government to work together for the management of water infrastructure assets and to improve water service provision.

The Rustenburg Local Municipality, through its IDP, supports intergovernmental relations among all spheres of government to align plans and facilitate the implementation

of water infrastructure asset projects for the benefit of communities. This approach is also supported by the smart city theory, which served as the guiding framework for this study. This theory emphasises an institutional smart city framework where community involvement and input are valued, as well as collaboration among different departments, municipalities, and businesses for the management of water infrastructure assets (Albino et al., 2015). This collaboration will ultimately lead to the realisation of effective water service delivery through the exchange of ideas.

### **The Municipal Finance Management Act, No. 56 of 2003**

The review of the Municipal Finance Management Act emphasises the responsibility of the accounting officer for the management of assets, internal control, sustainable management of financial affairs, budgets, and the use of the asset register, as stated in Sections 63(1)(a)(b)(c) and 63(2)(a)(b)(c) of the Act (RSA, 2003). This is also noted by Boshoff and Pretorius (2010), who indicate that the chief financial officer is ultimately responsible for activities associated with asset usage. The Rustenburg Local Municipality Asset Management Policy adheres to the stipulations of the Municipal Finance Management Act regarding the accounting officer being the custodian of municipal funds and assets, who regulates the acquisition, safeguarding, and maintenance of all assets. Municipalities lack an updated asset register where water infrastructure asset information is stored, which results in inadequate tracking records of water infrastructure assets for planning, which affects the maintenance schedule for these assets. Nsanganzeli and Nelson (2011) opine that water infrastructure assets should be safeguarded in a robust manner by implementing internal control systems.

Municipalities are under serious pressure to provide water services to communities within their municipal infrastructure budget allocation for operations and maintenance. They are encouraged to allocate and invest funds to improve infrastructure conditions and performance by adopting efficient and sustainable infrastructure management strategies

(Abusharar, 2012). It must be noted that municipalities generate income through revenue enhancement in the form of billing customers via smart metering. However, if municipal water infrastructure asset information is not up to standard, it compromises the municipality's ability to generate income. The lack of implementation of policies regarding water infrastructure assets leaves municipalities with inadequate funding, which subsequently affects the maintenance of municipal assets. Bikam and Chakwizira (2021) opine that inadequate funding results in neglected maintenance of municipal assets, which impacts water infrastructure. The IDP of the Rustenburg Local Municipality concurs with the issues of inadequate funding and lack of expenditure on the asset maintenance budget due to insufficient planning. This ultimately leads to poor water service delivery to communities.

### **The Local Government: Municipal Systems Act. No. 32 of 2000**

The Local Government: Municipal Systems Act elaborates more on community participation and drafting of municipalities' IDPs, as stated in Section 16(1)(a) of the Act (RSA, 2000). Water infrastructure asset management in municipalities can be achieved if citizens are involved in the affairs of the municipality. The Rustenburg Local Municipality should prioritise public participation wherein communities can participate in water resource management and water infrastructure asset management, to communicate asset management plans, and seek feedback so that water service delivery can be achieved. Bryson et al. (2013) mention that community participation is vital in local government because municipalities can plan projects based on what the community needs. This provides municipalities with information regarding any service delivery concerns about infrastructure assets. Such community participation can enable municipalities to identify the poorest communities and marginalised sectors of society to participate in local governance (Cloete, 2012).

When citizens participate in water infrastructure asset management in a municipality, it improves the chances of avoiding vandalism and community unrest. This is because,

when communities understand the importance of water infrastructure asset management, they are more likely to conserve water and its infrastructure assets sustainably. The involvement of citizens in municipal affairs regarding the implementation of water infrastructure asset management policies and community participation is elaborated on in the human smart city framework, which served as a guideline for this study. This framework emphasises the significance of human (citizen or community) participation in governmental affairs. Consequently, a city is considered smart when investments in human and social capital are achieved through participatory governance to improve living conditions (Kourtit et al., 2012).

### **The Water Services Act, No. 108 of 1997**

The review of the Water Services Act indicates the importance of establishing a Water Services Development Plan, which serves as a compilation of water infrastructure asset information as stipulated in Sections 67(1) to (4) and 68(a)(b)(i-iii) of the Act (RSA, 1997). The Rustenburg Local Municipality Asset Management Policy, as guided by the Water Services Act, encourages the development of an asset register to track asset information for planning purposes. The water infrastructure asset information in a municipality is gathered for the purpose of municipal development. Makhari (2016) opines that water service delivery can be made easier by maintaining and monitoring water service management records. These records enable municipalities to track services provided to the communities (Ngumbela, 2021).

The Rustenburg Local Municipality should implement the Water Services Act to support the management of infrastructure assets and water service delivery to communities. Municipalities often fail to implement the Water Services Act due to a lack of skilled personnel to develop a Water Services Development Plan (Makaya et al., 2020). This hampers water provision to communities, which makes it difficult to pinpoint where there is a need for infrastructure asset maintenance due to insufficient information in the plan. The Water Services Act, in

Section 12(1)(a)(b)(i-ii), outlines that each municipality should prepare a Water Services Development Plan. Hove et al. (2019) indicate that the Water Services Act supports participatory water governance; however, authorities lack the means to effectively consult communities and the capacity to use community-generated data for service delivery. A lack of skills and relevant personnel in a municipality leads to inaccuracies in asset information, which affects the overall planning of water service provision.

The literature review indicates that municipalities face significant challenges related to the management of infrastructure; South Africa therefore requires innovative solutions to issues relating to water service delivery (Steyn, 2020). The implementation of water infrastructure asset management policies and water service delivery needs to integrate technological innovation based on a smart city framework to achieve smart urban water management. Policy and regulation reviews on water infrastructure asset management primarily focus on governance regarding community participation, stakeholder engagement, sustainable use of municipal finances, and the recording of infrastructure information for implementation in a municipality. These policies fail to address the concept of smart urban water development, which uses computer control to collect information, utilise data to improve operations, and communicate with citizens regarding the city's development (Grigg, 2022). Information about water infrastructure assets can be gathered using smart sensors to provide real-time data that identify actual failures, thereby enhancing water infrastructure assets (Du Toit & Stimie, 2023). This includes the monitoring and control of water resources, storage, distribution, and wastewater treatment.

## **Conclusion**

The Constitution of South Africa established a government that has produced numerous policies and pieces of legislation for the implementation of water infrastructure asset management and water services since 1994. These policies were developed to rectify the imbalances of the past, where only the minority

had access to infrastructure assets and water service provision. This study reviewed the following policies: the Constitution of South Africa, the Municipal Finance Management Act, the Local Government: Municipal Systems Act, the Water Services Act, and the Rustenburg Local Municipality IDP and Asset Management Policy for the management of water infrastructure assets in the Rustenburg Local Municipality. The findings of this review emphasise the importance of government cooperation, wherein national, provincial, and local spheres of government must work together to provide water services while involving communities in governmental affairs and valuing their ideas.

These policies also emphasise promoting financial sustainability in municipalities to ensure that there is sufficient budget for the maintenance of water infrastructure assets, thereby enabling effective water provision. However, all the information pertaining to water infrastructure assets obtained from the communities is included in the IDP of the municipality. These policies further emphasise the development of a Water Service Development Plan and an asset register, wherein all the information on water infrastructure assets can be stored and utilised for municipal planning. The literature review elaborates on how the inability to manage water infrastructure assets and the lack of an asset register adversely affect service delivery. Additionally, the mismanagement of infrastructure assets has placed municipalities in disastrous financial positions due to their failure to implement and adhere to policies and legislation regarding the management of water infrastructure assets.

This study emphasises the use of smart urban water management, guided by the smart city theory, which served as a framework for this research. It aims to facilitate technological innovation for collecting and monitoring real-time data through smart sensors, from the source to the distribution networks. Although there is a knowledge gap in the policies regarding smart urban water management, this approach will assist municipalities in coordinating and controlling their water infrastructure assets, thus improving water service delivery to communities. As a recommendation, the Rustenburg Local Municipality should prioritise the implementation of all these

policies and Acts to ensure proper water infrastructure asset management. The smart urban water management concept should be incorporated into all these policies to achieve an integrated water supply.

## References

- Abusharar, S. (2012). Municipal infrastructure systems: Performance and prioritisation. Class 4 presentation: Infrastructure planning and management. The Islamic University of Gaza Civil Engineering Department.
- Albino, V., Berardi, U., & Dangelico, R. M. (2015). Smart cities: Definitions, dimensions, performance, initiatives. *Journal of Urban Technology*, 22(1), 3–21. <https://doi.org/10.1080/10630732.2014.942092>
- Allen, C., Metternicht, G., & Wiedmann, T. (2018). Prioritising SDG targets: Assessing baselines, gaps and interlinkages. *Sustainability Science*, 14, 421–438. <https://doi.org/10.1007/s11625-018-0596-8>
- Asha, A. A., & Makalela, K. I. (2020). Challenges in the implementation of Integrated Development Plan and service delivery in Lepelle-Nkumphi Municipality, Limpopo province. *International Journal of Economics and Finance Studies*, 12, 1–15. <https://doi.org/10.34109/ijefs.202012101>
- Bashynska, I., & Dyskina, A. (2018). The overview analytical document of the international experience of building smart city. *Business: Theory and Practice*, 19, 228–241. <https://doi.org/10.3846/btp.2018.23>
- Bellisent, J. (2011). The core of a smart city must be smart governance. Forrester Research.
- Bikam, P., & Chakwizira, J. (2021). Municipal asset operations and maintenance performance in metropolitan and rural municipalities in Gauteng province and Vhembe District municipalities, South Africa. *Cogent Engineering*, 8(1), 1935409. <https://doi.org/10.1080/23311916.2021.1935409>

- Bormann, T., & Gulati, M. (2014). The food energy water nexus: Understanding South Africa's most urgent sustainability challenge. WWF-SA.
- Boshoff, L. (2009). Municipal infrastructure asset care in South Africa: A reality check. [https://www.iatconsulting.co.za/published/Municipal%20Asset%20Care%20in%20South%20Africa\\_\\_A%20Reality%20Check.pdf](https://www.iatconsulting.co.za/published/Municipal%20Asset%20Care%20in%20South%20Africa__A%20Reality%20Check.pdf)
- Boshoff, L. & Pretorius, W. (2010). Asset registers and asset management: What are the demands on the municipal engineer? <https://www.iatconsulting.co.za/published/Asset%20Registers%20and%20Asset%20Management%20.What%20are%20the%20Demands%20on%20the%20Municipal%20Engineer.pdf>
- Brand, D. (2018, May 29). Local government in South Africa is in crisis. How it can be fixed. *The Conversation*. <https://theconversation.com/local-government-in-south-africa-is-in-crisis-how-it-can-be-fixed-97331>
- Bryson, J. M., Quick, K. S., Slotterback, C. S., & Crosby, B. C. (2013). Designing public participation processes. *Public Administration Review*, 73(1), 23-24. <https://doi.org/10.1111/j.1540-6210.2012.02678.x>
- Chari, M. M., Hamandawana, H., & Zhou, L. (2018). Using geostatistical techniques to map adaptive capacities of resource-poor communities to climate change: A case study of Nkonkobe Local Municipality, Eastern Cape province, South Africa. *International Journal of Climate Change Strategies and Management*, 10(5), 670-688. <https://doi.org/10.1108/IJCCSM-03-2017-0071>
- Cloete, F. (2012). Government lessons from South Africa: Institutions, state of progress and measurement. Van Schaik.
- Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage Publications.
- Department of Cooperative Governance and Traditional Affairs. (2019). *Local government in South Africa: Challenges and recommendations*. Government Printer.

- Du Toit, B. R., & Stimie, J. E. (2023). Towards smart cities in South Africa: Evolution, definitions and future cities. *South African Journal of Industrial Engineering*, 34(1), 85–96. <https://doi.org/10.7166/34-1-2839>
- Grigg, N. (2022). Economic framework of smart and integrated urban water systems. *Smart Cities*, 5, 241–250. <https://doi.org/10.3390/smartcities5010015>
- Hove, J., D'Ambruso, L., Mabetha, D., Van der Merwe, M., Byass, P., Kahn, K., Khosa, S., Witter, S., & Twine, R. (2019). Water is life: Developing community participation for clean water in rural South Africa. *BMJ Global Health*, 4, e001377. <https://doi.org/10.1136/bmjgh-2018-001377>
- Jerome, J. P., & Nel, D. (2021). Municipal infrastructure management and its impact on service delivery in the city of Ekurhuleni. *Africa's Public Service Delivery and Performance Review*, 9(1), a508. <https://doi.org/10.4102/apsdpr.v9i1.508>
- Kang, H. (2019). Challenges for water infrastructure asset management in South Korea. *Water Policy*, 21(1), 1–11. <https://doi.org/10.2166/wp.2019.005>
- Kersting, N., Gasparikova, J., Iglesias, A., & Krenjora, J. (2016). Local democratic renewal by deliberative participatory instruments: Participatory budgeting in comparative study. In S. Kuhlmann & G. Bouckaert (Eds.), *Local public sector reforms in times of crisis: National trajectories and international comparisons* (pp. 317–331). Springer. [https://doi.org/10.1057/978-1-137-52548-2\\_18](https://doi.org/10.1057/978-1-137-52548-2_18)
- Koatla, T. A. B. (2011). Analysis of institutional arrangement and variables that affect sustainable small water infrastructure operations, management and maintenance in Lambani, Limpopo province (South Africa). Agricultural Research Council: Institute of Soil, Climate and Water.
- Kourtit, K., Nijkamp, P., & Arribas, D. (2012). Smart cities in perspectives: A comparative European study by means of self-organising maps. *Innovation: The European Journal of Social Science Research*, 25(2), 229–246. <https://doi.org/10.1080/13511610.2012.660330>

- Love, P. E., Zhou, J., Matthews, J., Lavender, M., & Morse, T. (2018). Managing rail infrastructure for a digital future: Future proofing of asset information. *Transport Research Part A: Policy and Practice*, 110, 161-176. <https://doi.org/10.1016/j.tra.2018.02.014>
- Majuru, B., Jagals, P., & Hunter, P. R. (2012). Assessing rural small community water supply in Limpopo, South Africa: Water service benchmarks and reliability. *Science of the Total Environment*, 435-436, 479-486. <https://doi.org/10.1016/j.scitotenv.2012.07.024>
- Makaya, E., Rohse, M., Day, R., Vogel, C., Mehta, L., McEven, L., Rangelcroft, S., & Van Loon, A. F. (2020). Water governance challenges in rural South Africa: Exploring institution coordination in drought management. *Water Policy*, 22(2020), 519-540. <https://doi.org/10.2166/wp.2020.234>
- Makhari, C. L. (2016). Assessment of water service delivery in the municipalities of city of Tshwane, City of Cape Town and eThekweni (Master's dissertation). University of the Western Cape.
- Meehan, K. M. (2014). Tool-power: Water infrastructure as well springs of state power. *Geoforum*, 57, 215-224. <https://doi.org/10.1016/j.geoforum.2013.08.005>
- Mohajan, H. K. (2018). Qualitative research methodology in social science and related subjects. *Journal of Economic Development, Environment and People*, 7(1), 23-48. <https://doi.org/10.26458/jedep.v7i1.571>
- Mpehle, Z. (2012). Are service delivery protests justifiable in the democratic South Africa? *Journal of Public Administration*, 47(1). <https://journals.co.za/doi/abs/10.10520/EJC121945>
- Mudau, N., Mhangara, P., & Gebreslasie, M. (2014). Monitoring urban growth around Rustenburg, South Africa using SPOT 5. *South African Journal of Geomatics*, 3(2), 185-196. <https://doi.org/10.4314/sajg.v3i2.5>
- Municipal Infrastructure Support Agent (MISA). (2016). Introduction to the municipal infrastructure performance management information system. <http://www.mipmis.gov.za/>

- National Planning Commission (NPC). (2012). National Development Plan 2030: Our future – make it work. NPC.
- Ngumbela, X. G. (2021). Troubled municipalities, municipality troubles: An implementation of back to basics programme in the Eastern Cape province, South Africa. *Africa's Public Service Delivery and Performance Review*, 9(1), 9405. <https://doi.org/10.4102/apsdpr.v9i1.405>
- Nhleko, M., & Inambo, F. L. (2019). Impact of municipal infrastructure conditions and maintenance programs in determining municipal service delivery effectiveness, cost effectiveness and energy efficiency. *International Journal of Mechanical Engineering and Technology*, 10(12), 642–659.
- Nsanganzeli, A. J., & Nelson, J. (2011). The levels of factors that contribute towards efficiency, effectiveness and strength of the internal control system with regard to no-current assets safeguard and management in public institutions in Tanzania. *International Journal of Academics Research in Business and Social Sciences*, 1(3), 109–117. <https://doi.org/10.6007/ijarbss.v1i2.25>
- Oyedele, O. A. (2012). The challenge of infrastructure development in democratic governance. Paper presented at FIG Working Week 2012: Knowing to manage the territory, protect the environment, evaluate the cultural heritage, Rome, Italy, 6–10 May 2012.
- Republic of South Africa. (1996). Constitution of South Africa Act, 1996. Government Printer.
- Republic of South Africa. (1997). Water Services Act, No. 108 of 1997. Government Printer.
- Republic of South Africa. (2000). Local Government: Municipal Systems Act, No. 32 of 2000. Government Printers.
- Republic of South Africa. (2003). Municipal Finance Management Act, No. 56 of 2003. Pretoria. Government Printers.
- Ruch, W., & Geyer, S. (2017). Public capital investment economic growth and poverty reduction in South African municipalities. *Regional Science Policy and Practice*, 9(4), 269–285. <https://doi.org/10.1111/rsp3.12104>

- Rustenburg Local Municipality. (2021). Asset management policy. Rustenburg Local Municipality.
- Rustenburg Local Municipality. (2022). Integrated development plan 2021/2022. Rustenburg Local Municipality.
- Sikora-Fernandez, D., & Stawasz, D. (2016). The concept of smart city in the theory and practice of urban development management. *Romanian Journal of Regional Science*, 10(1), 86–99.
- Singh, K., & Ogra, A. (2016). Assessment of municipal infrastructure life cycle: Case study of Johannesburg. In *Conference Proceedings of the 7<sup>th</sup> Planning Africa Conference 2016: Making sense of the future, Disruption and reinvention*, Sandton Convention Centre, Johannesburg, South Africa, 4–6 July 2016.
- Steyn, N. R. (2020). The realisation of the constitutional water right in South African cities through intelligent water management technologies (Doctoral thesis). North-West University.
- Tsheola, J. P. (2012). Theorising a democratic developmental state: Issues of public service delivery planning and violet protests in South Africa. *Journal of Public Administration*, 47(1), 161–179.
- Tshiyoyo, M. (2017). Assessing the catalytic role of the African Charter and the African Peer Review Mechanism in the realisation of the objectives set out in Africa Agenda 2063 and the SDGs. *African Journal of Public Affairs*, 9(8), 173–185.
- Uddin, W., Hudson, W. R., & Haas, R. (2013). *Public infrastructure asset management* (2nd ed.). McGraw-Hill Education.