GREEN DROP
National Report
2022

" Water is Life, Sanitation is Dignity "

water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

2030 NDP

green drop
CERTIFICATION
waste water service
REGULATION

FOREWORD by the HONOURABLE MINISTER

It gives me pleasure to present this 2022 Green Drop report. The President announced the relaunch of the Green Drop Certification programme in his State of the Nation Address, and we are pleased to have delivered on this commitment. We recognised that as a flagship project, this incentive-based regulation programme has the power to mobilise the wastewater sector on a path to improvement.

Wastewater management and sanitation are paramount to the dignity of our people and integrity of the environment and it is therefore important that we strive for excellence in these fields. Even though the Green Drop programme has been at the centre of much of the improvement in the sector over the years and has brought about change and reignited the passion amongst our wastewater specialists, the results of this report serves as a scientifically calculated indicator that there is still a mammoth task ahead of us.

It remains unacceptable that sewage spillages and failing wastewater treatment works are detrimentally impacting our environment as well as the livelihood and health of many of our communities on a daily basis in the year 2022. It is of great concern that there are so many systems with scores below 31%, indicating a dismal state of wastewater management, posing a risk to both environment and public health. I am therefore making the call to political, public and private leadership to declare their commitment to use this report as the turning point towards sustainable improvement, because everyone can make a difference within their sphere of influence. I need to make it clear that action will be taken against those municipalities that flagrantly put the lives of our people and environment at risk. As Minister of Water and Sanitation, I am engaging the Minister of Cooperative Governance to ensure that as National Government we take drastic intervention measures towards the improvement of water services.

We will use this report as the baseline for the Water Services Improvement Programme (10-point plan) from where we will measure the sustainable turn-around which we aspire to.

However, we are proud of those municipalities who have displayed their commitment towards effective wastewater management, even in the absence of the Green Drop programme over the past few years. The Green Drop scores achieved prove that excellence in the field of wastewater management is a realistic possibility and will remain the performance target for all to plan towards.

A special congratulations to the leadership, management and staff of those systems that attained the prestigious Green Drop status.

We move forward knowing that we do not accept 'being good' as the norm for the South African wastewater industry instead, we endeavour towards excellence.

Minister for Water and Sanitation: Mr Senzo Mchunu

FOREWORD by the DEPUTY MINISTERS

It is a privilege to be part of the release of this Green Drop 2022 report, and I am encouraged by the few pockets of excellence that exist in the wastewater space in our country. It speaks volumes of those women and men who proudly conducted the important work they do in the background over the audit period. I will encourage Municipal Management and Leadership to support them to continue on their path to higher levels of excellence.

I will also call upon on all municipal leadership to note the results of the wastewater systems in their areas of responsibility; to take keen interest in ensuring improvement.

The reality of sewer spillages demands decisive leadership from all of us in order to protect our communities and safeguard our environment. It is going to take a team effort to ensure that future Green Drop reports will present all round improvement in the management of wastewater services.

Deputy Minister for Water and Sanitation: Ms Dikeledi Magadzi

This report should trigger a passion and commitment in all of us to transform our thinking of wastewater treatment systems. These plants demands the merging of scientific and engineering skills to ensure that we have the capability to treat used water to acceptable water quality standards, which allows the reuse of our precious resource.

However, the results of this report indicate that too many of our systems are not being managed according to expectations, resulting into a detrimental impact on our water resources. We cannot allow this to continue. The Green Drop Standards serve as a clear guide towards excellent wastewater management and I would encourage all responsible to invest in upgrading your operational philosophies with a clear objectives, to prevent sewer spillages, to treat effluent to acceptable standards, and to ensure effective sludge management.

I salute those who displayed commendable discipline and commitment towards protecting our environment by managing their wastewater systems according to the standards set by the Green Drop Certification Programme.

Deputy Minister for Water and Sanitation: Mr David Mahlobo

MESSAGE by the DIRECTOR-GENERAL

The Green and Blue Drop Programmes lie at the heart of our vision to provide "safe water for all, forever" and our mission to "effectively manage the nation's water resources to ensure equitable and sustainable socio-economic development and universal access to water". These programmes not only support achievement of our strategic objectives but also align with our effort towards the United Nation's Sustainable Development Goals for clean water and sanitation, and climate action. It is therefore reassuring that the number of WSIs achieving Green Drop Certification has not materially fallen off, despite the lag since the 2013 GD process.

This year's results may not have shown the progressive improvements that we saw in previous cycles, but I am confident that we will get back on the right trajectory. This year's assessment has provided us with a baseline and the platform to launch the turnaround. As in previous years, the programme was widely embraced and the general euphoria around the process tends to spark improvements in subsequent cycles. Despite the process being compulsory, participation was driven more from deeper institutional commitment to progress and achieve excellence using the audit process as a barometer for change.

We have received international acclaim in the past and it will be important to re-establish the programme as the international benchmark for incentive-based regulation. We continued to innovate over the years through strengthening the scorecard and other regulatory tools. This year, we were able to introduce the "Very Rough Order of Measurement" (VROOM) model as part of the Green Drop Technical Site Assessments. At a high level, the VROOM provides insights on the state of the key elements of the wastewater treatment infrastructure and provides an order of magnitude estimate of cost to return the infrastructure to a functional condition. It is this kind of valuable insight gained from the GD process that can inform a coordinated response by DWS and other sector players.

As a department, we have continued to build internal regulatory capacity. We trained 96 of lead and assistant inspectors who were deployed as part of the 2021 GD Audits and hope to have influenced the 995 WWTWs (850 WSAs, 115 DPW & 30 privates) through our consultative audit process. We are committed to making the process as seamless and painless as possible for all Water Services Institutions and will incorporate the lessons learnt into the process for the subsequent cycles. We would like to see the GD process embedded and outcomes informing the planning, budgeting and professionalisation of the wastewater sector.

I would also like to express my appreciation to all the WSIs leaders and their officials who participated in the process. It is only through our combined efforts that we can improve the state of wastewater management in the country.

Director-General for Water and Sanitation: Dr Sean Douglas Phillips

The history of water will be measured not by its quantity but its quality...
Institute for Water Quality Management, 1970's.

GREEN DROP REPORT 2022 INDEX

1. EXECUTIVE SUMMARY

Green Drop Certification

Incentive based regulation is an innovative and uniquely South African response to challenges in the water sector. The Green Drop programme seeks to induce changes in behaviour of individuals and institutions to facilitate continuous improvement and adoption of best practice management of wastewater networks and treatment systems. Consequently, progressive improvement and excellent performance is recognised and rewarded. The Green Drop 2022 report provides comparative analyses and diagnostics to assist Water Services Institutions (WSIs) to focus on specific areas for improvement and restoring functionality of wastewater infrastructure. The publication of this regulatory report has the additional objective of ensuring that the responsible WSIs are held accountable.

The main outputs from the Green Drop 2022 audit cycle are:

- A Green Drop audit score for each wastewater system assessed, which is aggregated into an organisational (overall) score, expressed as a percentage (%)
- A Cumulative Risk Rating for each wastewater treatment works, expressed as a percentage (%)
- Technical Site Assessment (TSA) score for selected collector and treatment systems inspected, expressed as a percentage (%)
- A collective VROOM cost for all treatment systems within each WSI, expressed in Rand.

Green Drop Audit Process

The Green Drop Audits were conducted by 24 audit panels comprising of 2-3 qualified wastewater professionals. Inspectors qualified after achieving a threshold examination score. The audit scorecard was designed to consider evidence against 5 Key Performance Areas (KPAs): A: Capacity Management; B: Environmental Management; C: Financial Management; D: Technical Management; and E: Effluent and Sludge Compliance. Each KPA and sub-criteria carry a different weighting based on the regulatory priorities. The audit period under review was 1 July 2020 to 30 June 2021.

A wastewater system that achieves ≥90% Green Drop score, is regarded as excellent and is then allocated the prestigious Green Drop status. A system that achieved <31% is regarded as a dysfunctional system which would require appropriate interventions. [Note: The audit covers the sewer network, sewer pump-stations, and treatment systems. On-site sanitation is not part of the audit. A physical Site Inspection Assessment (TSA) is done at 1 to 2 systems to confirm the findings of the desktop audit. The TSA score (%) reflects the physical condition of the sewer collector network, pumping stations, treatment plant and point of discharge.)

Summary of Results

The Department of Water and Sanitation can report a 100% audit coverage of all identified Water Services Institutions for this audit period. The audit covered 144 Water Services Authorities (850 systems), 12 Department of Public Works (115 systems) and 5 private- and state-owned organisations (30 systems), totalling 995 wastewater networks and treatment works.

The Regulator determined that 23 wastewater systems scored a minimum of 90% when measured against the Green Drop standards and thus qualified for Green Drop Certification. This compares lower than the 60 systems awarded Green Drop Status in 2013 however it is recognised for its inherent value to establish an accurate, current baseline from where improvement can be driven, and excellence be incentivised. The Water Services Institutions that were Green Drop certified include the City of Ekurhuleni, Lesedi LM, iLembe DM, uMgungundlovu DM, Witzenberg LM, Bitou LM, Drakenstein LM, City of Cape Town, Saldanha Bay LM, Mosselbay LM, and Sasol Sasolburg. A further 30 Green Drop Contender systems were identified with audit scores of <90%, but with microbiological- and chemical effluent quality not meeting the Green Drop standard.

The results indicated that the vast majority of rural municipalities struggle to score more than 50%; only 5% of systems in Free State and Limpopo reached this threshold in comparison of 75% of systems in Gauteng. This coincides with the availability of specialist engineering and scientific skills being more prevalent in the urban municipalities.

Only 2 Department of Public Works (DPW) systems received Green Drop scores of >50% (EC Port Elizabeth Region), whilst 102 systems scored below 31% - this is of considerable concern which demands special attention.

Private- and state-owned systems had 25 of the 30 systems assessed (83%) scoring above 50%. These results are encouraging, and the Regulator urges the 17% to raise their performance above the 50% threshold during the next audit season.

The National Risk Ratio provides a risk perspective for treatment plants specifically. The results show an overall risk deteriorated from 2013 to 2021. Municipal plant regressed from 65.4% (medium risk) to 70.1% (high risk), and DPW plants regressed from 80% to 88% (critical risk).

All private- and state-owned works are in low- or medium risk positions. The most prominent risks were observed at treatment level, and pointed to works that exceeded their design capacity, dysfunctional processes, and equipment (especially disinfection), lack of flow monitoring, and effluent and sludge non-compliance. This reflects the increased demand placed on existing collection and treatment infrastructure due to expansion driven by population and economic growth.

Observations of significance from the Green Drop audits and technical site inspections are:

- Several institutions have invested in infrastructure upgrades, extensions, and refurbishments via capital funding. However, these systems were still found to fail the regulatory standards (mostly not meeting effluent quality limits), and/or fail accepted engineering and workmanship standards, and/or in certain cases, have not be commissioned in part or in full.
- Infrastructure is often being upgraded with the full system being taken out of commission, allowing untreated wastewater to bypass the plant directly to the water body.
- Non-payment of contractors, laboratories and other professional service providers is widely found, leading to services not being rendered, delayed, or discontinued.
- Vandalism and theft of electrical cables, equipment and civil structures results in system being inoperable for extended periods, with few WSIs having effective anti-vandalism strategies or contingency plans in place.
- The most vulnerable and concerning area is the overall sub-standard quality of final effluent and biosolids that is being discharged to their receiving environments.
- KPA A indicates that institutions have varying capacity and competency in terms of Plant Managers/Superintendents, Process Controllers, Engineers, Technicians, Technologists, and Scientists, whilst having reasonable access to contracted maintenance and laboratory services. Institutions with lower technical skills ratios were generally associated with lower Green Drop scores.
- Several wastewater systems are operating close to or beyond their hydraulic capacity, whilst a high number of WSIs do not know the design capacity or flow to their WWTWs. WSIs are thereby limited in their ability to plan to meet medium-term demand projections, or to confirm if spare capacity is available.
- Severe deficiencies were found in the monitoring of operational and compliance parameters.
- In general, a low level of awareness on energy efficiency and conservation exists at most WSIs. The majority of WSIs do not monitor their SPCs, and those who do monitor SPC, exceed the industry and technology benchmarks. This means that many opportunities are forfeited to improve energy efficiency, reduce cost, and mitigate CO_2 footprint.
- The Technical System Assessments (TSAs) show a highly variable result with respect of process and asset functionality for WWTs across the country. While some wastewater systems were excellent, others failed in all respects, with many plants being abandoned due to vandalism and other challenges.

Summary of Cases of Decline

Wastewater systems which failed to achieve the minimum Green Drop target of 31%, are placed under regulatory focus.

A total of 334 (39%) of *municipal* wastewater systems were identified to be in a critical state in 2021, compared to 248 (29%) in 2013. Municipal systems that are in critical positions are listed from high to low: Limpopo has 78% of its systems in critical state, followed by Northern Cape (76%), North West (69%), Free State (67%), Mpumalanga (43%), Eastern Cape (39%), Gauteng (15%), KwaZulu Natal (14), and Western Cape (11%).

A total of 102 (89%) out of the 115 *DPW systems* were identified in critical state, compared to 84% in 2013.

Of the *private systems*, 1 plant was identified in critical state.

The Way Forward

The Department of Water and Sanitation as Regulator of the water sector will use this Green Drop Report as the performance base-line for the municipal wastewater fraternity, to inform appropriate regulatory intervention with the objective to facilitate improvement. This will include the development of a Water Services Improvement Programme, which will include the 10-point plan towards informing sustainable intervention with the objective of ensuring a turnaround in the Municipal Water Services sector.

The results of this report demands that wastewater services be a primary focus area of the said programme in targeted areas. Green Drop Performance trends will be used to determine repetitive poor performance (which have led to significant environmental damage over a period of time), to inform a more drastic approach towards ensure turn around. This could include facilitating long term intervention by either a capacitated water board or any other suitable mode of sanitation services support.

National Government will ensure that grant funding allocated to the water sector will be allocated with the objective of restoring functionality of existing wastewater infrastructure according to the findings of this report. The determination of the 'very rough order of estimates' (VROOM) was done to give an estimation of the capital requirement for the functionality restoration drive. This will be effected with the support from National Treasury.

The Regulator will improve the implementation of Section 19 of the National Water Act (Act 36 of 1998) to ensure that directives are issued with timeframes for implementation. Failure to respond will trigger remedial action be taken at cost of the non-complying entity or municipality. The Department will take steps to improve its capacity to more effective in this duty. There are engagements with the Department of Cooperative Governance as well as National Treasury to explore ways of utilising conditional grants for the purpose of remedial intervention.

The Department welcomes the participation of ESKOM, SASOL and other private sector partners in the Green Drop Process and will take guide from this to ensure that a more inclusive regulatory process be explored for the next audit season. The Green Drop Certification programme will thus become mandatory for all wastewater treatment systems, including the private sector.

All Water Services Institutions are hereby encouraged to commence immediately with the preparation for the next Green Drop audit process.

2. INTRODUCTION

The history of water will be measured not by its quantity but its quality...

Lucas van Vuuren
Institute for Water Quality Management, 1970's

Purpose and Intent of Green Drop Certification

Since its inception in 2008, the Green Drop regulation programme sought to identify and develop the core competencies that, if strengthened, would gradually and sustainably improve the standard of wastewater management in South Africa. The intention was to align the minimum requirements and best practice as a new Green Drop standard to raise the bar for wastewater management. The programme is therefore not based on the results of a limited number of random samples but evaluates the entire wastewater management services over a one year audit period.

The Green Drop process is recognised as an international best practice and has received both local and international accolade. It is based on a consultative audit process that seeks to empower those responsible for wastewater management to deliver according to the set standards. It is also a transparent process, with clearly defined criteria that is geared to protect consumers from potentially unsustainable and unsafe services, as well as protecting the country's water resources.

The Green Drop audit criteria are designed to complement the efforts of other government and stakeholder programmes. They provide essential information to inform planning by sectoral partners, with the shared objective of achieving functional wastewater systems in the short term and excellence in wastewater management in the longer term.

The Green Drop audit process is intended to inspire a path that brings about sustainable compliant wastewater services through competent people, disciplined thought, and collective action which can be measured and reported to South African citizens every year.

Greatness is not a function of circumstance. Greatness, it turns out, is largely a matter of conscious choice, and discipline

Jim Collins

This report acknowledges those institutions that aim and plan for progress and greatness ...and rewards those that achieve it.

Incentive-based Regulation in South Africa

(Green Drop Certification)

Incentive-based regulation has gained significant momentum and support in the South African Water Sector, since its inception on 11 September 2008 (Minister of Water Affairs, National Municipal Indaba, Johannesburg). The concept was initially defined by two programmes: *Blue Drop Certification* for Drinking Water Quality Management Regulation; and *Green Drop Certification* for Wastewater Quality Management Regulation. *No Drop Certification* was added in 2014 that focused on water conservation and demand management in the municipal sector.

The Green Drop Wastewater Services Audit measures and compares the results of the performance of Water Service Institutions, and subsequently rewards (or penalises) the institution based on evidence of excellence (or failures) when measured against the defined standards. Benchmarks are used to help WSIs to identify gaps between their standard and industry norms. The report is designed to give comparative analysis and diagnostics to assist WSIs to focus on specific areas for improvement. Awareness of this performance is intended to hold WSIs to account, with pressure from consumers, media, politicians, business, and NGOs.

Each Green Drop audit cycle is marked by incremental change in the audit criteria, guided by the status and priorities of wastewater sector. It is therefore important for WSIs to note that merely maintaining the previous cycle's Green Drop evidence and performance will not warrant the same Green Drop score.

Risk-based Regulation in South Africa

(CRR profiles)

Whilst the *Green Drop assessment* focuses on the entire value chain (sewer collector, pumping, treatment, discharge) of the wastewater business within the municipalities (or other WSIs), the *Cumulative Risk assessment* focuses on the wastewater treatment function specifically. The latter approach allows the Regulator to have a database of the risk status and indicators for each treatment system in South Africa. As a 'sister' programme to Green Drop audits, risk-based regulation allows a WSI to identify and prioritise the critical risk areas within its wastewater treatment process and to take corrective measures to mitigate these. Risk analysis is done annually via the full Green Drop audit process, as well as in the alternate years via the Green Drop Progress Assessment (PAT) assessment. The results are published in the biennial Green Drop Report, as well as the Green Drop Progress (PAT) Report every alternate year.

The Department of Water and Sanitation integrates risk analysis as part of the audit process with the aim of quantifying, prioritising, and managing the risks to ensure targeted regulation of high-risk municipalities. The Wastewater Risk Abatement Plan (W_2RAP) is the tool whereby risks are identified and corrected, following a similar process of the reputed Water Safety Plan (WSP). A W_2RAP guideline is available to assist users (Water Research Commission, WRC TT 489/11).

Green Drop Scores

The main outputs from the Green Drop 2021 audit cycle are:

- A Green Drop audit score for each wastewater system assessed, which is aggregated into an organisational (overall) score, expressed as a percentage (%)
- A Cumulative Risk Rating for each wastewater treatment works, expressed as a percentage (%)
- Technical Site Assessment (TSA) score for selected collector and treatment systems inspected, expressed as a percentage (%)
- A collective VROOM cost for all treatment systems within each WSI, expressed in Rand.

Each indicator and its reference elements, can be described as follows:

- ***Green Drop Audit Score***: A Green Drop % is awarded to an individual wastewater system based on the results from the audit process which measures performance against 5 Key Performance Areas (KPA), plus a suite of bonuses and penalties. The individual audit scores aggregate as a single (weighted) institutional Green Drop audit score. The score is weighted against the design capacities of the individual treatment plants. This score serves as a Performance Indicator of the capacity, compliance, and good practice that the institution attains against the Green Drop Standards, which again have been derived from national and international standards. A wastewater system that achieves ≥90% Green Drop score, is regarded as excellent. A system that achieved <31% is regarded as a dysfunctional system which would require appropriate interventions. [**Note: The audit covers the sewer network and treatment systems. On-site sanitation is <u>not</u> part of the audit].**

Institutions that achieve ≥90%, are Green Drop Certified in acknowledgement of excellence

- ***Green Drop Certified and Green Drop Contenders***: A wastewater system that achieves an overall ≥90% Green Drop score and ≥90% for microbiological and chemical effluent qualities, is regarded as excellent and is thereby ''Green Drop Certified". A system that achieves an overall ≥90% Green Drop score but did not meet the ≥90% final effluent quality standards, is a ''Green Drop Contender". In such case, the Green Drop score is adjusted to 89%.

- ***Green Drop PAT:*** The Green Drop Progress Assessment Tool is an instrument whereby the Department confirms and updates functional information and completes a risk assessment for each registered treatment works. The tool assesses risk via a weighted formula: CRR = (A x B) + C + D, whereby the four risk indicators are comprised of the treatment plant's design capacity, operational inflow, technical skills, and final effluent quality. The results are published in a biennial Green Drop Progress (PAT) Report in the alternate year to the full Green Drop Report and includes a historic comparison of the plants' risk movement since 2009 to the current PAT year.

- ***Cumulative Risk Rating:*** Risk is calculated for each system using a formula: **CRR = (A x B) + C + D**, w*here:*
  A = Hydraulic design capacity of the treatment plant in Ml/day
  B = Operational flow as % of the installed design capacity
  C = Number of non-compliant effluent quality parameters at point of discharge to receiving water body
  D = Number of technical skills gaps (supervision, operation, maintenance) in terms of Reg 2834 & Draft Reg 813.

Each risk element carries a different weight in proportion to the severity of the risk element (Annexure A).

CRR% deviation is calculated to show the variance between the baseline CRR and the maximum CRR value that could potentially be reached if all 4 risk indicators are in a critical state. *Example 1:* a 95% CRR %deviation value means the plant has only 5% space remaining before the system will reach its maximum critical state (100%) – this is an undesirable state. *Example 2:* a 25% CRR %deviation value means the plant holds a low and manageable risk position and that the 4 risk indicators are individually and collectively mitigated – this is a desirable state.

- ***Technical Site Inspection Score***: A physical inspection is done at 1 to 2 sites to confirm the findings of the desktop audit. These sites are chosen based on their size, technology, and audit findings to best represent the potential state of the remainder of the sewer networks and treatment works. The TSA percentage reflects the physical condition of the sewer collector network, pumping stations, treatment plant and point of discharge. The intention of the TSA is to verify the evidence presented and findings of the Green Drop audit by undertaking a physical inspection of the selected site/s. Such inspections consider the:
  - Appearance of the plant terrain and buildings
  - Condition of structures, equipment, and process units
  - Health and safety defects
  - Operational knowledge and monitoring
  - Workplace satisfaction.

  The scorecard (*right*) provides the scoring criteria used for each inspection point.

1	Ideal performance and fully functional
0.75	Fully functional, but with minor corrections to be made
0.5	Partially functional and average performance
0.25	Partial performance with major corrections to be made
0	Failure and poor performance
NA	In case of a process unit absent / not part of the plant design, assign NA = Not Applicable

- ***VROOM costing:*** The Very Rough Order of Measurement (VROOM) is an estimation of the funding required to restore existing infrastructure to its original design capacity and operations, by addressing civil, mechanical, and electrical defects. The cost is derived through an algorithm that uses the Green Drop Inspector's impression of the condition of the hardware, coupled with the system-specific design capacity and Green Drop score to derive an aggregated score for all treatment works within the organisation. The algorithm uses the refurbishment cost estimate of 1 to 2 systems and extrapolates it according to the other input values to arrive at an institutional cost, i.e. VROOM estimation. **NOTE: It does not constitute a specification, schedule of quantities or a definite refurbishment figure, but rather an indicative amount to inform a budget and hardware requirements.**

Further terminologies that support the above concepts are as follows:

- ***WSI:*** A Water Services Institution is defined as "...an entity, utility, or authority that provides water services to consumers or to another water services institution, and thereby is subject to compliance with the water laws of South Africa. WSI also means a water services authority, a water services provider, a water board, and a water services committee..."

- ***WSA*****:** A Water Services Authority is any District, Metropolitan or Local Municipality that is responsible for providing water services to end users.

- ***Wastewater System***: A wastewater system is defined as the pipes, sewers, pumping stations and treatment works that collect, reticulate, and treat wastewater from residents, businesses, and industries before releasing or reusing the final treated effluent and biosolids.

  Two different scorecards are used during the audit process, depending on the treatment technology employed:
  - Basic system: This is typically a treatment works with entry level technology, limited/no mechanical components, such as evaporation ponds, oxidation ponds, maturation ponds, sludge lagoons, wetlands, and reedbeds. Basic systems are less complex, have less stricter requirements, and generally hold lesser risk to the environment and customer
  - Advanced system: This is typically a works that employs more advanced forms of technology and comprise of several electrical, mechanical and instrumentation components, such as screening, de-gritting, biological filters, activated sludge systems, extended aeration, membranes, filters, belt presses, anaerobic digesters, UV disinfection, and pump stations. Advanced systems are generally more complex, hold potentially higher risk to the receiving environment, and are subject to stricter legal standards.

- ***IRIS***: The Integrated Regulatory Information System (IRIS) is a web-based application used by the Department of Water & Sanitation to facilitate the relationship between Regulation and Management of water supply and wastewater systems, while also keeping relevant stakeholders informed on compliance trends of registered supply systems. Information is uploaded by the Water Services Institution onto IRIS to allow the Inspector to assess evidence before, during and after the audit event. IRIS contains an inventory of information on all registered wastewater systems, tracks historic system performance, and provides the platform to register wastewater treatment works and operations staff.

- ***Diagnostic:*** A suite of key diagnostic themes covers a number of strategic areas of importance to the South African water industry. Diagnostics allows deeper examination of the data and a better understanding of the causes of behaviours and patterns, in answering pressing questions of "why did it happen? " and guide recommendations on "what correction or intervention is needed?".

Green Drop Reporting

This Green Drop Report 2022 upholds the Minister's commitment to provide the water sector and its stakeholders with **ongoing, current, accurate, verified,** and **relevant** information on the status of wastewater services in South Africa. It follows on a series of Green Drop Reports from 2009 to 2013, by providing feedback and progress pertaining to the current status of municipal, public, and selected private and state-owned wastewater facilities.

The Green Drop Report 2022 provides information on three different levels:

1. ***System specific*** data and information pertaining to the performance of each sewer network and treatment system at WSI level
2. ***Province specific*** data and information that highlight the strengths, weaknesses, and historic trends for the respective WSIs within a Province (WSA) or Region (DPW)
3. ***National overview*** that collates the findings from a provincial, regional and system levels to give an aggregated national perspective of wastewater service performance. Historic trends are provided to gain insight into the success of provincial and national strategies to improve wastewater management and to inform future strategies and interventions.

> ***The final proof of greatness lies in being able to endure criticism without resentment.***
> *Elbert Hubbard*

Assessment of the Bushkoppies activated sludge reactor for dead zones, functionality of the blowers, and quality of the mixed liquor. Process Controllers of Johannesburg Water explain the denitrification process across the various zones. Staff were well informed about the process and aim to improve on the shortfalls noted during the inspection.

Wastewater sludge.. agriculture.. energy – the perfect nexus. ERWAT & Ekurhuleni leading the way on energy efficiency and reuse of solids.

3. GREEN DROP STANDARDS 2021

The Stockdale paradox:
Confront the brutal truth of the situation, yet at the same time, never give up hope.

The Green Drop Audits were conducted by 24 audit panels comprising of qualified wastewater professionals. Each panel consisted of a Lead Inspector and 1-2 Inspectors. All inspectors underwent rigorous training and were required to achieve a threshold examination score to quality for involvement in the audit process.

WSIs were supported and capacitated through the audit process. Provincial symposia, attended by WSIs from that province, were held prior to the audit to share information on the audit process and criteria. Information was also shared on the role of IRIS and introduction to the IRIS Helpdesk. WSIs were also notified in advance of the audit date, audit criteria and the required portfolio of evidence (PoE) for the audit to assist with their preparation. The period under review for the 2021 audit cycle was: 1 July 2020 to 30 June 2021.

The audit scorecard was designed to consider evidence against 5 Key Performance Areas (A-E). The Green Drop KPAs, weights, and standards are summarised in the section below. Each KPA and sub-criteria carry a different weighting and are based on the relative regulatory priorities. Annexure B provides guidance on the format and interpretation of the Report Card.

Green Drop 2021 Audit Period : 1 July 2020 – 30 June 2021

Green Drop Standards

KPA A: Capacity Management (15%)

A1) Registration of Wastewater Treatment Plant	The wastewater treatment facility is registered as per the requirements of Regulation 2834 or as per Green Drop Standard (Draft Regulation 813)
A2) Registration of Process Controllers and Supervisor	Process controllers and supervisors are classified as per Regulation 2834 or Draft Regulation 813 (Green Drop Standard). These requirements will apply for all shifts of a specific wastewater system.
A3) Maintenance Capacity	The wastewater system must be served by a competent maintenance team (internal or outsourced), executing the maintenance work according to an acceptable maintenance plan/schedule.
A4) Engineering Management Capacity	The WSI must ensure that a competent engineering specialist oversee wastewater treatment operations, maintenance, and general asset management.
A5) *(Advanced Systems Only)* **Scientific Capacity (Sampling and Laboratory Information Management)**	The WSI must ensure that a suitably qualified professional scientist oversee the implementation of the operational and compliance monitoring programme (sampling and analyses).

KPA B: Environmental Management (15%)

B1) Wastewater Risk Management	The WSI shall conduct a detailed environmental risk assessment for the entire sewer collection system, wastewater treatment (both effluent liquid and sludge) and identify adequate control measures to implement for each risk identified. This process should be collated in form of an implemented system specific Wastewater Risk Abatement Plan (W_2RAP) as per the Water Research Commission (WRC) guideline.
B2) Operational Monitoring	Each WWTW shall have an operational monitoring programme in place which informs the operational efficacy (as per the required frequency) of the treatment facility as per the Authorisation.
B3) Compliance Monitoring (Effluent)	Each WWTW shall have a compliance monitoring programme in place (implemented) which informs on the compliance with the site-specific Authorisation requirements (as per the required frequency, determinands and sampling sites) of the treatment facility as per the Authorisation.
	Sludge management (including sludge monitoring) must be implemented as per the Authorisation requirements.

B4) *(Advanced Systems Only)* **Sludge Classification and Monitoring**	
B5) Laboratory Credibility	All compliance monitoring samples must be analysed at a credible laboratory (either accredited according to SANAS requirements or participating in a Proficiency Testing scheme with acceptable z-scores) for the required determinands, with an acceptable turnaround time.

KPA C: Financial Management (20%)

C1) Wastewater Operations Cost Determination	The WSI must determine the actual operations and maintenance cost per wastewater scheme and express this in R/m^3. Specific cost drivers need to inform the budget, including energy.
C2) Energy Demand	WSI must have proof of Energy Efficiency Management by providing Specific Power Consumption (SPC), energy unit cost (R/kWh), and express energy treatment cost in (R/m^3)
C3) Operations & Maintenance Budget	WSI must provide an annual O&M budget per wastewater system (for sewer collection network and wastewater treatment system).
C4) Operations & Maintenance Expenditure	WSI must provide proof of the wastewater system O&M expenditure per annum (to be measured in relation to the original budget).
C5) *(Advanced Systems Only)* **Supply Chain Management of Services and Treatment Products**	There must be appropriate supply chain management processes in place to ensure continuous availability of treatment chemicals (and related consumables), maintenance and spares.

KPA D: Technical Management (20%)

D1) Wastewater Treatment Works Design Capacity Management	For each wastewater treatment works, there must be continuous monitoring of daily hydraulic and organic loading in terms of the Average Dry Weather Flow (ADWF) and Chemical Oxygen Demand (COD) and compared with the design capacity.
D2) Process Audit	A wastewater treatment facility must be subjected to an annual condition assessment and/or a Process Audit (conducted by a duly qualified professional person) to inform functionality of the infrastructure. Risk findings must be incorporated in the W_2RAP process.
D3) Sewer Main Inspection	The Sewer Collection System must be subjected to an annual asset condition assessment (conducted by a duly qualified professional person), which includes a sewer pump-station functionality assessment and wastewater flow balance. Risk findings must be incorporated in the W_2RAP process.
D4) Wastewater Asset Register	Wastewater Infrastructure must be included in the WSI Asset Register (as per AGSA requirements), detailing: a) relevant equipment and infrastructure b) asset description c) location d) condition e) remaining useful life f) replacement value.
D5) *(Advanced Systems Only)* **Bylaws and Enforcement (Local Regulation)**	Municipalities must have enforceable bylaws in place which will safeguard advanced wastewater treatment technologies from harmful influent which would pose a risk to biological treatment processes and receiving environment (where authorised decentralised systems are being used).

KPA E: Effluent and Sludge Compliance (30%)

E1) Monitoring Data Submission to DWS	A WSI must ensure that all Compliance Monitoring data is submitted on a monthly basis to the Department of Water and Sanitation on the required Regulatory System (IRIS).
E2) Water Use Authorisation	The Section 21 water use must be authorised in terms of the National Water Act (Act 36 of 1998)

E3) Effluent Quality Compliance	The effluent quality must comply to 90% (in total) with the authorised limits for the respective categories: a) 90% Microbiological Compliance b) 90% Chemical Compliance (c) 90% Physical Compliance
E4) *(Advanced Systems Only)* **Sludge Quality Compliance**	The solids/sludge must be classified as per WRC Sludge Guideline

Bonuses (Maximum of 15%)

F1) Process Control Training	Process controllers and supervisory staff must be subjected to relevant training over the past 24 months as from the date of audit. Cross-pollination and in-house training will be acknowledged as non-accredited capacity building.
F2) Stormwater Management	The WSI must have a Stormwater Ingress Management Plan detailing how stormwater (and other extraneous flow e.g. groundwater) entry is quantified, managed and monitored to prevent entry into sewer systems.
F3) Water Demand Management	WSI shall formulate and implement a Water Conservation and Water Demand Management Plan which provides a strategy and work plan that identify, quantify, monitor, and manage leakages and water losses of any kind that may create an artificial water demand due to higher hydraulic loading of wastewater collection and treatment infrastructure.
F4) Wastewater and Sewer Capital Projects planned for upgrades or refurbishment	An approved business plan for sewer and/or wastewater upgrades or refurbishment, with secured/confirmed funding.
F5) Sludge Reuse	Plant-specific initiatives that contribute to wastewater resource recovery and climate resilience objectives: energy efficiency, energy generation, beneficial use of sludge, effluent, nutrients, etc.
F6) Additional Impact Monitoring	Plant-specific monitoring of environmental or control sites/location, e.g. groundwater, up-stream / down stream impact monitoring, and soil analysis

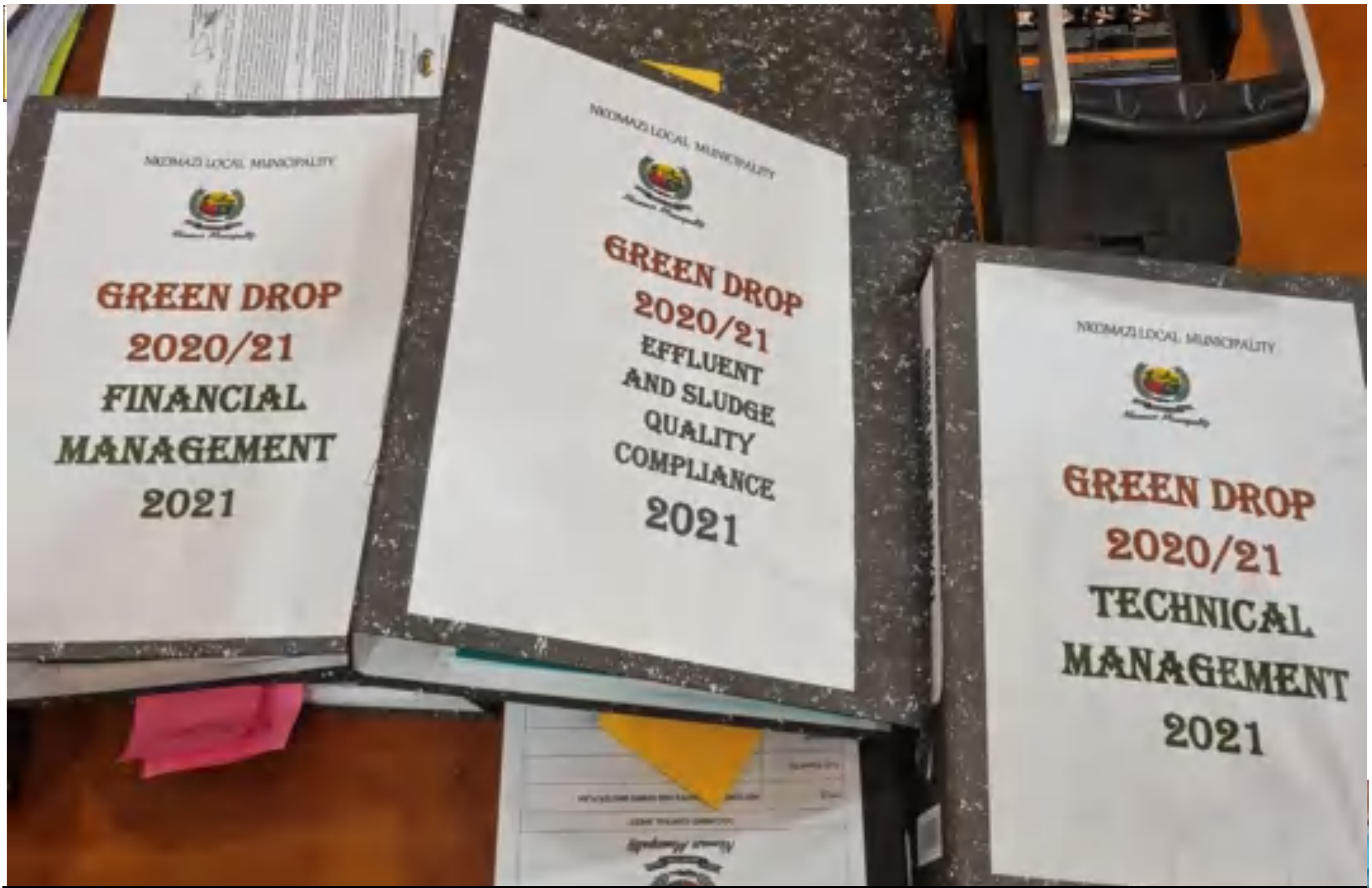
Penalties (Maximum of 15%)

G1) Wastewater Treatment Works operating beyond hydraulic design capacity	See D1. *Note: If the plant operates above its installed capacity, but the effluent quality complies on ALL 3 categories, only 50% of the penalty will be applied.*
G2) Any Sewer Collector & Pump-station dysfunctionality causing long term spillage	See D3. *Note: Should a WSI have proof of a response to a reported spillage as per its own Incident Management Protocol, within 7 days, then the penalty will not apply. If evidence of a long-term spill is observed during the TSA check of the network, a penalty will be applied, and possibly replicated to other systems in this WSI jurisdiction (Inspector discretion).*
Disqualifier	H1) Withholding or falsifying information H2) Directive Status (Non reaction to a Directive issued by the Department)

A final **effluent quality disqualifier** is applied during the 2021 audit. Wastewater systems qualify for Green Drop Certification status when achieving an audit score of ≥90%. However, if such system fails to achieve ≥90% in microbiological and/or chemical compliance, the system would be disqualified from Certification and the score adjusted to 89%. The system will then be acknowledged as a Green Drop Contender. The adjustment will transfer to the institutional Green Drop score as well. The purpose of the disqualifier is to ensure that the credibility of the programme stays intact **in pursuit of excellence**. A system is only regarded as excellent if final effluent quality meets the excellence standards.

- Microbiological quality is selected for its importance in safeguarding the health of the downstream user and the integrity of the water resource. The presence of pathogens and bacteriological indicators in the final effluent implies that disinfection and nutrient removal operations of a treatment works are not optimised or functional.
- Chemical quality is selected for its negative impact on the water quality of the receiving waterways into which treatment works release final effluent. The presence of nitrogen and phosphate causes enrichment of inland and coastal waters. This leads to low-oxygen waters and dominance of certain algae and organisms, which leads to biodiversity losses, loss of fishery resources, seagrass, corals, and other aquatic life.

> ***"If you are going to achieve excellence in big things, you develop the habit in little matters. Excellence is not an exception, it is a prevailing attitude."***
>
> *Colin Powell*

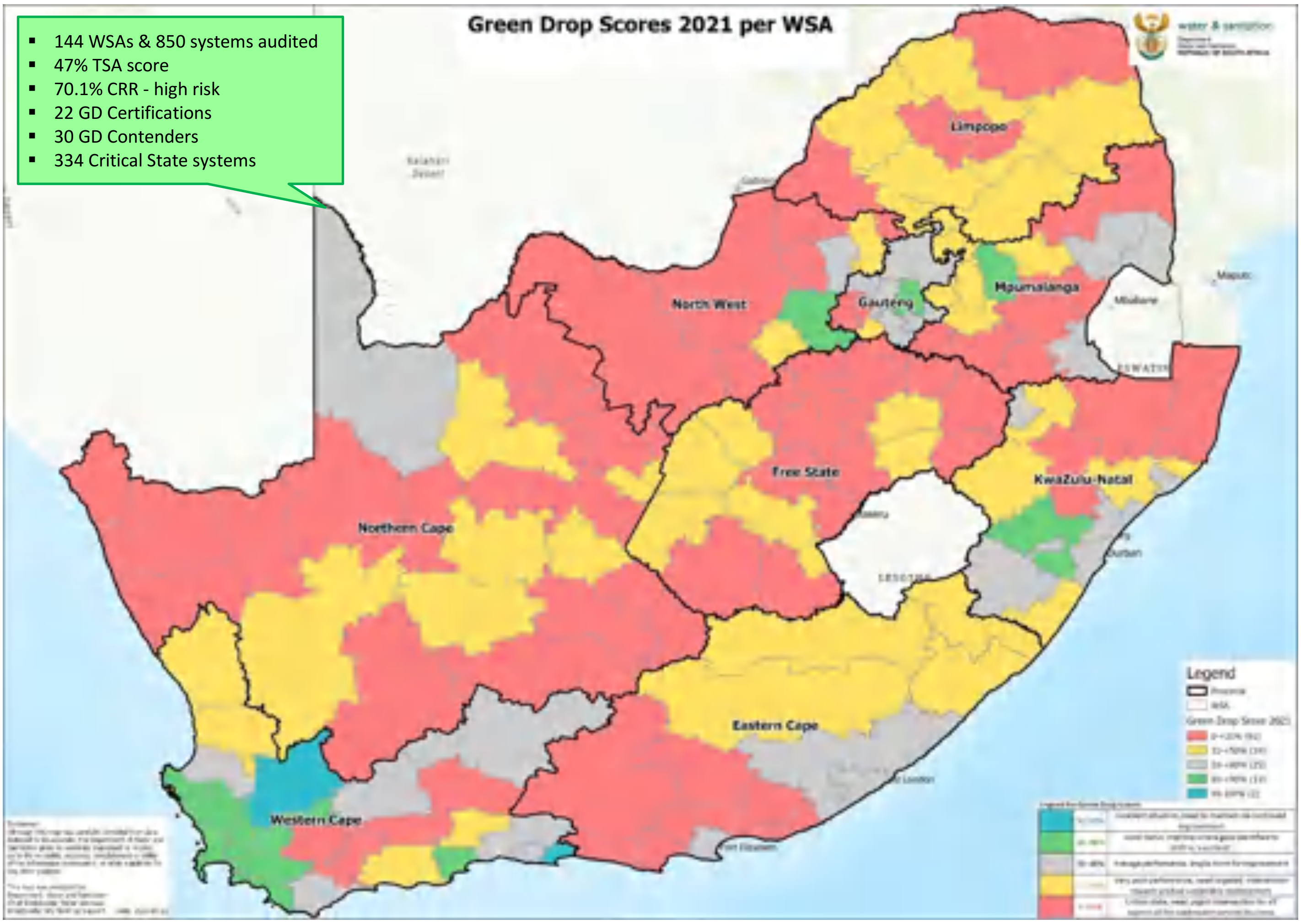


Excellent teams are seen by leadership attendance, by preparing well for their Green Drop audits, and by using the process to learn and enhance skills.

Excellent condition of sewer manholes and pipe condition, <45 minutes response time – well done to the Nkomazi team.

A convoy to inspect the sewer network and pump stations – maintaining these assets are important as maintenance are more economical than replacement.

4. NATIONAL PERFORMANCE OVERVIEW OF MUNICIPAL WASTEWATER MANAGEMENT



National Synopsis

An audit attendance record by 100% of municipalities affirms the commitment to the Green Drop national incentive-based regulation programme.

The Regulator determined that 22 wastewater systems scored a minimum of 90% when measured against the Green Drop standards for the audited period and thus qualified for the prestigious Green Drop Certification. This compares lower than the 60 systems awarded Green Drop Status in 2013 however it is recognised for its inherent value to establish an accurate, current baseline from where improvement can be driven, and excellence be incentivised.

In addition, 30 wastewater systems scored in the order of 89%, which identifies these as Green Drop Contenders in acknowledgment of excellent performance and being within reach of Green Drop status. There was no inclination towards lowering the bar but to the contrary, the “Contender” status serves as motivation to ensure that the responsible authorities invest in further improvement over the next audit period.

The Department of Water and Sanitation can report that all 144 Water Services Authorities were subjected to the Green Drop Audit which reflects a 100% audit coverage. It was also encouraging that all the authorities ensured attendance of responsible officials during audits, albeit that preparation for the audits ranged from being well-prepared to unprepared. The state of preparedness is generally a reflection of the extent to which wastewater management processes are entrenched in the WSIs daily operations.

Unfortunately, 334 (39%) of systems were identified to be in a critical score level. This compared to the 248 (29%) of the systems in 2013 indicates that there has been regress in the state of the wastewater systems. This decline is at both the treatment and sewer collection levels. The Green Drop audit process established that WSIs with low levels of investment in infrastructure, and low capacity in respect of skilled personnel, were more likely to have wastewater systems in a critical state.

Green Drop performance is characterised by pockets of strengths in technical capacity, especially at metropolitan level, even though smaller municipalities like Bitou and Witzenberg Local Municipalities serve as proof that excellence is possible in the smaller municipalities as well.

It would be the capacity and expertise, which leads the wastewater performance, especially in environments where efficient financial management is necessary due to a lack of funding. Results from KPA A suggest that municipalities have varying capacity and competency in terms of Plant Managers/Superintendents, Process Controllers, Engineers, Technicians, Technologists, and Scientists, whilst having reasonable access to contracted maintenance and laboratory services. Lower performing municipalities generally have lower technical skills ratios, with several shortfalls highlighted in this report.

The National Risk Ratio for treatment plants regressed from 65.4% (medium risk) in 2013 to 70.1% (high risk) in 2021. The most prominent risks were observed at treatment level, and pointed to works that exceeded their design capacity, dysfunctional processes, and equipment (especially disinfection), lack of flow monitoring, and effluent and sludge non-compliance. This reflects the increased demand placed on existing collection and treatment infrastructure due to expansion driven by population and economic growth. The latter poses an opportunity for Local Government and the industrial /commercial sector to jointly seek solutions to ensure a sustainable turnaround of the municipal wastewater business. Opportunities are presented in terms of reducing cost through process optimisation and improved energy efficiency, and beneficial use of sludge and other energy resources.

The Regulator is hopeful that the 2021 audits will set a baseline from where a positive trajectory for wastewater services and improved performance will follow. Municipalities are encouraged to start their preparation for the 2023 Green Drop audit. The Green Drop status are summarised in Table 1.

Table 1 - 2021 Green Drop Performance Highlights

Provinces	2013 GD Score (%)	2021 GD Score (%)	2021 GD Certified ≥90%	2021 GD Contenders (89%)	2021 Critical State (<31%)
Eastern Cape	65%	51%	0	0	48
Free State	51%	26%	0	0	64
Gauteng	83%	68%	7	5	9
KwaZulu Natal	82%	68%	3	1	20
Limpopo	45%	29%	0	0	50
Mpumalanga	44%	49%	0	3	33
North West	47%	30%	0	0	33
Northern Cape	44%	41%	0	0	59
Western Cape	85%	84%	12	21	18
Totals	-	-	**22**	**30**	**334**

The Department of Water and Sanitation acknowledges the excellence in wastewater management achieved for the Green Drop Audit year of 2021.

Green Drop Certificates are awarded and acknowledgement of Contender for Green Drop Certification to the following Provinces for the following systems

Provinces	Green Drop Certified Systems	Acknowledgement of Contender Systems for 2021 Green Drop Certification
Gauteng	**City of Ekurhuleni** ○ Rondebult ○ Herbert Bickley ○ JP Marais ○ Esther Park ○ Carl Grundling ○ Daveyton **Lesedi LM** ○ Ratanda	✓ **City of Ekurhuleni** ○ Tsakane ○ Hartebeesfontein ○ Welgedacht ○ Benoni ○ Rynfield
KwaZulu Natal	**iLembe DM** ○ Frasers ○ Shakaskraal **uMgungundlovu DM** ○ Cool Air	✓ **Harry Gwala DM** ○ Ixopo

Provinces	2021 Green Drop Certified Systems	Acknowledgement of 2021 Contender Systems for Green Drop Certification
Mpumalanga	-	✓ **Steve Tshwete LM** ○ KwaZamokuhle-Hendrina ○ Blinkpan-Mine village ○ Komati
Western Cape	**Witzenberg LM** ○ Ceres ○ Op die berg ○ Tulbach **Bitou LM** ○ Plettenberg-Bitou ○ Kurland **Drakenstein LM** ○ Hermon **City of Cape Town** ○ Green Point Outfall ○ Houtbay ○ Philadelphia ○ Wesfleur Domestic **Saldanha Bay LM** ○ Hopefield **Mossel Bay LM** ○ Herbertsdale	✓ **Drakenstein LM** ○ Paarl ○ Wellington ○ Saron ○ Gouda ○ Kliprug-Pearl Valley-Val de Vie ✓ **City of Cape Town** ○ Athlone ○ Macassar-Strand ○ Kraaifontein ○ Mitchells Plain ○ Borcherd's Quarry ○ Potsdam-Milnerton ○ Melkbosstrand ○ Fisentekraal ✓ **Mossel Bay LM** ○ Mossel Bay-Hartenbos ✓ **Overstrand LM** ○ Gansbaai ○ Stanford ○ Hermanus ○ Darling ✓ **Swartland LM** ○ Riebeeck Valley ○ Malmesbury-Abbotsdale ✓ **Breede Valley LM** ○ Worcester

Background to Municipal Wastewater Services

Incentive based regulation was an innovative and uniquely South African response to challenges in the water sector. The tragedies of Delmas (2005 and 2007) and Joe Gqabi (2007) showed that an alternative, proactive approach to regulation was required to improve the standards of drinking water and wastewater management. This was the genesis of the Blue Drop (Drinking Water) and Green Drop (Wastewater Quality) programmes in 2008.

Incentive-based regulation seeks to induce changes in behaviour of individuals and institutions to facilitate continuous improvement and adoption of best practice management of treatment systems. Consequently, progressive improvement and excellent performance is recognised and rewarded. It should however not be construed as a weaker form of regulation but rather an alternate approach, as it is underpinned by a strong legislative mandate in the Water Services Act.

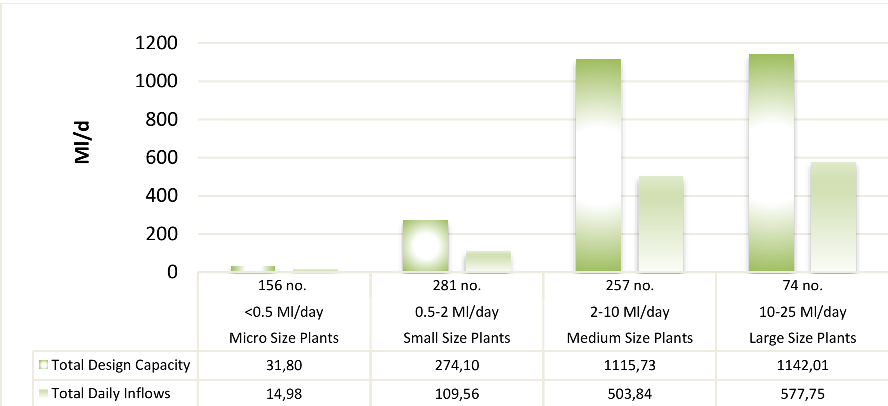
The Green Drop and Blue Drop incentive-based regulation promotes transparency and accountability and allows DWS to measure, monitor and publish information about the quality of water services, based on legislative standards or industry good practice. It seeks to identify risks and to ensure responsible authorities implement control measures to prevent failure.

South Africa has an extensive wastewater network. Wastewater services is delivered by 144 Water Services Authorities (municipalities) in the 9 Provinces of South Africa, through a network comprising of 850 WWTWs containing approximately 3,211 network pump stations and 47,449 km outfall and main sewer pipelines. The sewer network figure excludes pipeline data from 98 municipalities which were unable to provide this information. There is a total installed treatment capacity of 6,971 Ml/d, with the majority of this capacity residing in the medium to macro-sized treatment plants.

Table 2 - Summary of WWTW capacity and flow distribution according to plant sizes

	Micro Size Plants	Small Size Plants	Medium Size Plants	Large Size Plants	Macro Size Plants	Unknown (NI)*	Total
	<0.5 Ml/day	0.5-2 Ml/day	2-10 Ml/day	10-25 Ml/day	>25 Ml/day		
No. of WWTW	156 (18%)	281 (33%)	257 (30%)	74 (9%)	58 (7%)	24 (3%)	850
Total Design Capacity (Ml/day)	31.80	274.10	1115.73	1142.01	4408.10	24	6,971.74
Total Daily Inflow (Ml/day)	14.98	109.56	503.84	577.75	3623.86	341	4,829.98
Use of Design Capacity (%)	47%	40%	45%	51%	82%	-	69%

** "Unknown" means the number of WWTWs with NI (No Information) on design capacity or daily inflow*



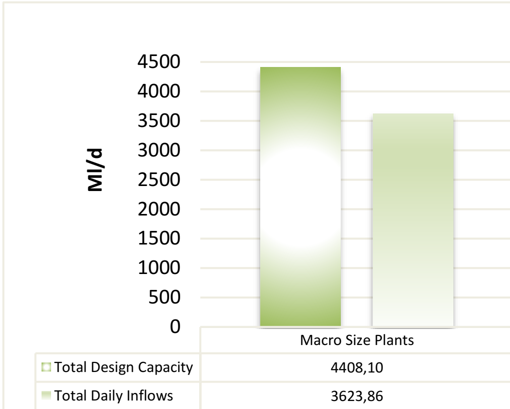


Figure 1 - Design capacities and operational inflow for a) micro-large sized WWTWs, b) macro sized WWTWs

Based on the current operational flow of 4,830 Ml/d, the treatment facilities are operating at 69% of their design capacity. The largest inflow contributors are the metropolitan municipalities, namely, City of Johannesburg with 943 Ml/d, City of Ekurhuleni with 819 Ml/d, City of Cape Town with 526 Ml/d, City of Tshwane with 507 Ml/d, eThekwini with 427 Ml/d, Nelson Mandela with 143 Ml/d, Mangaung with 140 Ml/d, and Buffalo City with 86 Ml/d.

Given the current capacity, this implies that there is 31% spare capacity to meet the medium-term demand. It must however be noted that inflow is not monitored in 341 systems (40%) and as a result the spare capacity could be substantially less than the 31% if these inflows are considered. Diagnostic #3 unpacks these statistics in more detail. This spare capacity would also be compromised at systems where some of the infrastructure or treatment modules are non-operational or dysfunctional. The VROOM Cost Diagnostic #7 provides more detail on the refurbishment requirements to restore such capacity and functionality.

The audit data shows that nationally, 82 systems are hydraulically overloaded. This figure could theoretically be higher, given that there are 341 systems where inflow monitoring is not taking place. The distribution of the hydraulically overloaded systems in each of the provinces, is as follows:

- Eastern Cape: 20 of 123 systems (41 systems with unknown inflows)
- Free State: 9 of 96 systems (62 systems)
- Gauteng: 13 of 60 systems (5 systems)
- KwaZulu Natal: 7 of 147 systems (47 systems)
- Limpopo: 6 of 64 systems (34 systems)
- Mpumalanga: 6 of 76 systems (35 systems)
- Northern Cape: 1 of 78 systems (57 systems)
- North-West: 3 of 48 systems (35 systems)
- Western Cape: 17 of 158 systems (18 systems).

The predominant treatment technologies comprise of ponds & lagoons, activated sludge (variations thereof), and biofilters for effluent treatment and solar drying beds, sludge lagoons/ponds, anaerobic digesters, and belt press dewatering for sludge treatment. The next audit will need to verify sludge treatment technologies, as insufficient information ("Other") is observed in this area.

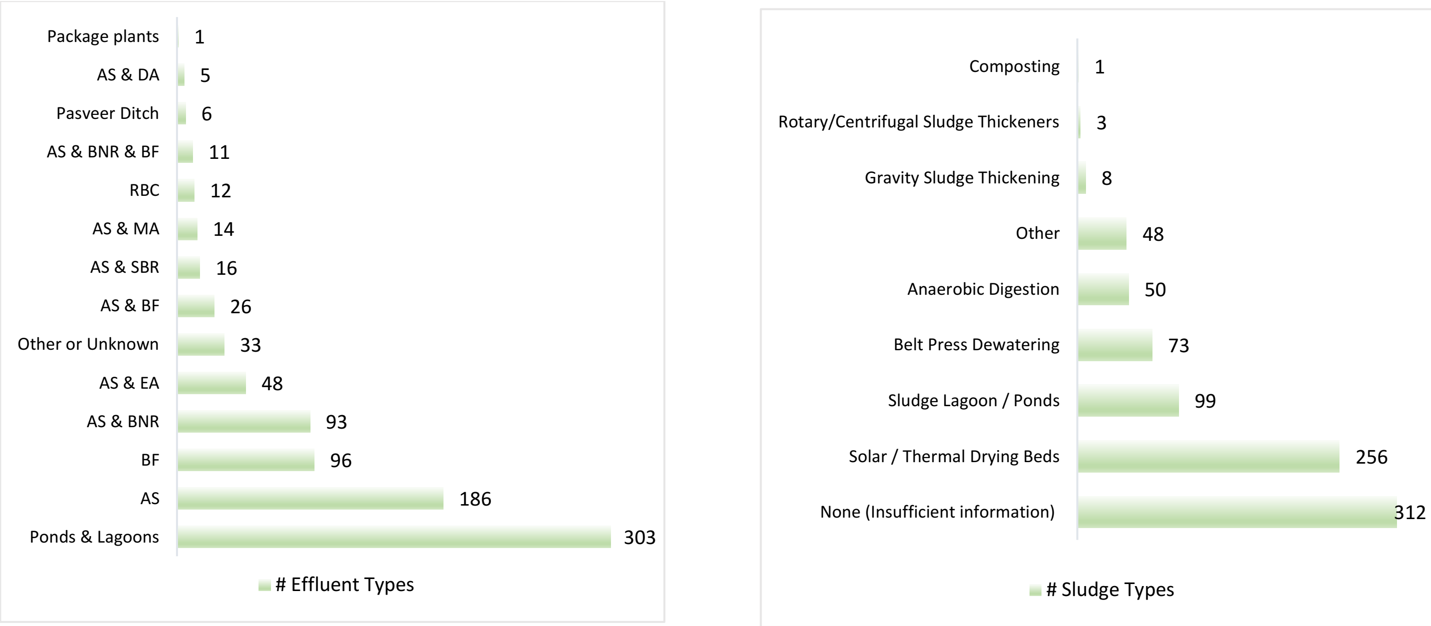


Figure 2 - Treatment technologies for wastewater effluent (a) and sludge (b)

Considering climate change objectives, municipalities are presented with opportunities to reduce energy demand through energy efficiency measures, or to generate electrical and heat energy, thereby reducing cost and reliance on external energy suppliers. Anaerobic digesters make up a significant part of sludge treatment technology in South Africa and are distributed across all 9 provinces. Most sludge digesters are located in Gauteng (56%), with 28 WWTWs having operational digesters. The cities of Ekurhuleni and Tshwane collectively have 197 anaerobic digesters, with a total design capacity of 353 Ml/d. All other provinces confirmed the use of anaerobic digestion for sludge treatment and are aware of the benefits associated with nutrient recovery and combined heat and power generation. However, statistics also confirmed that many anaerobic digesters are either fully committed or have limited spare capacity, while others face operational issues that restrict biogas (methane) production. Any limitations in sludge treatment capacity or operations will impact negatively on the overall wastewater treatment capability, as sludge and liquid treatment are inter-dependent.

The national sewer network consists of sewer mains and pump stations as summarised in Table 3. All provinces show some level of deficiency in available/accurate sewer pipeline information from WSAs. Asset management information is critical given that it provides the quantum, condition, and age of assets that require maintenance and replacement over the asset lifespan. Sewer network inspections also revealed several cases where wastewater is discharged into the environment, often in close proximity to communities, before reaching the treatment works.

Table 3 - Summary of Collection Network Pump Stations and Sewer Pipelines

Provinces	# WWTWs	Pump Stations (#)	Sewer Pipelines (km)	National Summary
Eastern Cape	123	425	7,863	Nelson Mandela Bay and Buffalo City own and manage the bulk of the sewer collector infrastructure, approximately 3,900 km and 2,428 km respectively; and 86 sewer pump stations each. 8 municipalities could not provide information on sewer pipelines
Free State	96	287	1,995	Matjhabeng and Mangaung own and manage the bulk of the sewer collector infrastructure, approximately 1,463 km and 388 km; 61 and 26 sewer pump stations, respectively. 14 municipalities could not provide information on sewer pipelines
Gauteng	60	263	20,048	City of Ekurhuleni & City of Johannesburg own and manage the bulk of the sewer collector infrastructure, approximately 9,629 km & 9,145 km; and 113 & 40 sewer pump stations, respectively. 4 municipalities could not provide information on sewer pipelines
KwaZulu Natal	147	578	12,690	eThekwini, iLembe and Msunduzi own and manage the bulk of the sewer collector infrastructure, approximately 9,149 km, 1,501 km and 1,350 km; and 289, 36 and 18 sewer pump stations, respectively. Ugu has the 2nd highest number of pump stations at 81. 7 municipalities could not provide information on sewer pipelines
Limpopo	64	137	NI	The bulk of the pump stations are in Lephalale, Mopani and Vhembe. Information on the length of the sewer pipelines was not provided
Mpumalanga	76	195	1,635	Mbombela and Emalahleni own and manage the bulk of the sewer collector infrastructure, approximately 775 km and 825 km; and 61 and 15 sewer pump stations, respectively. 14 municipalities could not provide information on sewer pipelines
Northern Cape	78	207	1,040	Sol Plaatje manages the bulk of the sewer collector infrastructure, approximately 748 km and 35 sewer pump stations. 17 municipalities could not provide information on sewer pipelines

Provinces	# WWTWs	Pump Stations (#)	Sewer Pipelines (km)	National Summary
North West	48	174	2,163	JB Marks and Rustenburg own and manage the bulk of the sewer collector infrastructure, approximately 1,129 km and 1,003 km; and 56 and 3 sewer pump stations, respectively. 7 municipalities could not provide information on sewer pipelines
Western Cape	158	945	14.522	City of Cape Town own and manage the bulk of the sewer collector infrastructure, approximately 9,597 km and 346 sewer pump stations. 8 municipalities could not provide information on sewer pipelines
National Totals	**850**	**3,211**	**47,449**	

National Green Drop Analysis

The 100% response from the 144 municipalities (Water Services Authorities) audited during the 2021 Green Drop process demonstrates commitment to wastewater services in the country. Since the 2013 Green Drop audit, Local Government reforms resulted in the merging of many municipalities, combined with several name changes. As result, 152 municipalities (WSAs) were assessed in 2013 compared to 144 municipalities assessed in 2021. A total of 850 systems were assessed in 2021 compared to 824 in 2013. This increase is mostly as a result of new treatment works constructed since 2013, or existing systems registered on the Department's IRIS system.

Table 4 - Green Drop Comparative Analysis from 2009 to 2021

GREEN DROP COMPARATIVE ANALYSIS					
Performance Category	**2009**	**2011**	**2013**	**2021**	**Performance trend 2013 and 2021**
Incentive-based indicators					
Municipalities (WSAs) assessed (#)	98 (26%)	156 (100%)	152 (100%)	144 (100%)	→
Wastewater systems assessed (#)	444	821	824	850	↑
Average Green Drop score	37%	45%	46%	37%	↓
Green Drop scores ≥50% (#)	216 (49%)	361 (44%)	415 (51%)	309 (36%)	↓
Green Drop scores <50% (#)	228 (51%)	460 (56%)	409 (49%)	541 (64%)	↓
Green Drop Certifications (#)	33	40	60	22	↓
Technical Site Inspection Score (%)	NA	51%	58%	47%	↓

NA = Not Applied NI = No Information

↑= improvement, ↓= regress, →= no change

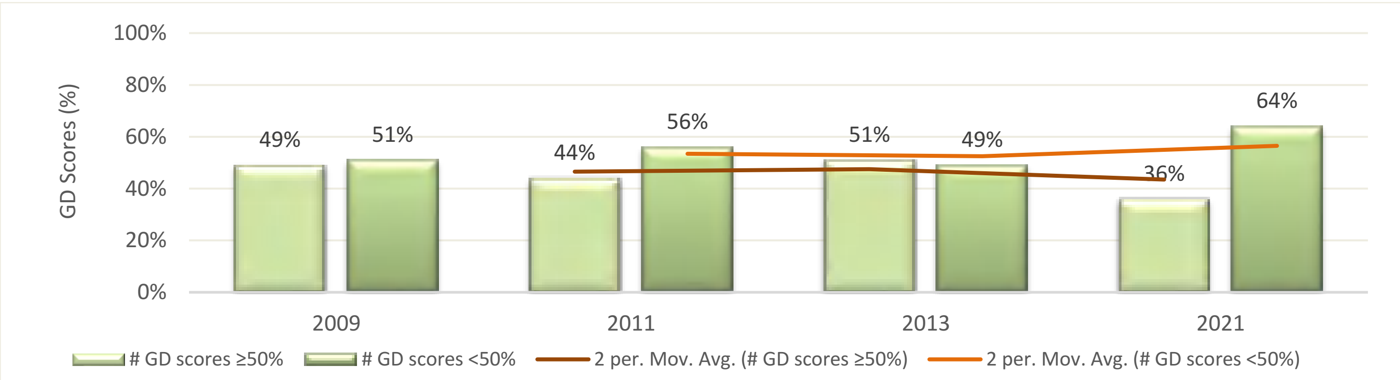


Figure 3 - Green Drop trend analysis over the period 2009 to 2021, indicating the percentage GD scores above and below 50%

The trend analysis indicates that:

- The number of systems audited has steadily increased from 444 in 2009 to 850 systems in 2021
- An upward trend in average GD scores were noted from 37% in 2009, 45% in 2011, and 46% in 2013, followed by a decrease to 37% in 2021
- A similar trend is observed for the number of systems with GD scores of ≥50%, which increased from 216 to 415 systems (44%) over the 2009 to 2013 period, but decreased to 309 (36%) in 2021
- This trend was mirrored by the number of systems with GD score of ≤50% decreasing from 460 (56%) in 2011 to 409 (49%) in 2013, followed by a regress to 541 (64%) in 2021
- The same 'upward-downward' trend is also reflected by the average TSA score, which had increased from 51% in 2011 to 58% in 2013, but decreased to 47% in 2021
- The Green Drop Certifications decreased from 60 awards in 2013 to 22 awards in 2021

- An overall performance trend from 2013 to 2021 signals the need for repeat/regular audits to ensure continued improvement. There are indications that performance has declined in the absence of the consistent regulatory engagement of the GD audits.

Figure 3 compares the Green Drop results over the periods 2011 to 2021. A significant proportion of the wastewater systems can be categorised as being in either a “Critical State”, or “Poor Performance” systems. It is of concern that 334 systems regressed to critical state in 2021, compared to 248 systems in this category in 2013.

Trends over the years 2013 and 2021 are summarised as follows:

- Systems in a ‘poor state’ increased from 161 systems in 2013 to 208 systems in 2021
- Systems in a ‘critical state’ increased from 248 systems in 2013 to 334 systems in 2021
- Systems in the ‘excellent and good state’ decreased from 134 systems in 2013 to 118 systems in 2021, especially the systems in the ‘excellent performance’ regressing from 60 in 2013 to 22 in 2021.

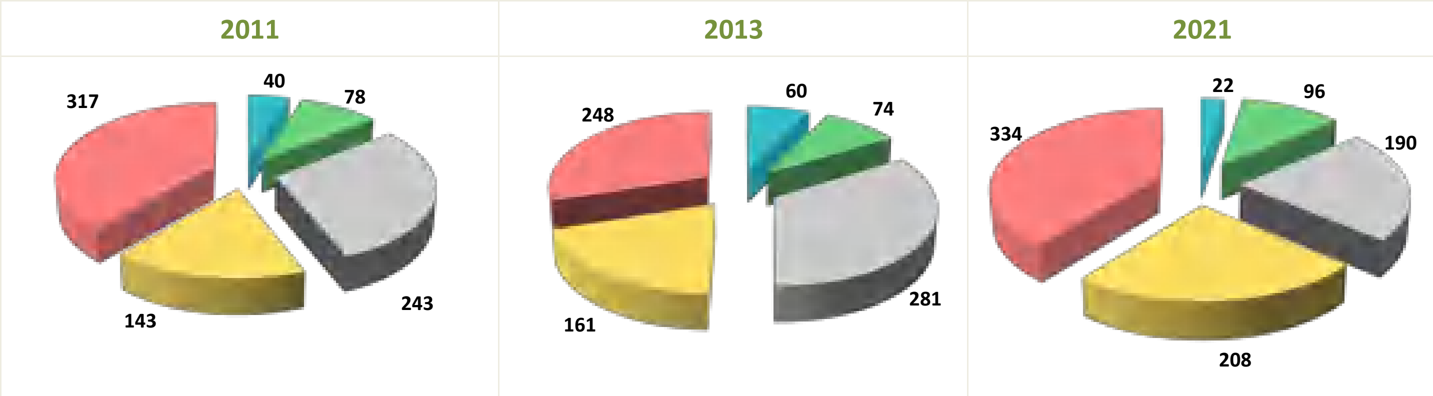


Figure 4 - No. WWTWs in the Green Drop score categories over the period 2011 to 2021 (graph legend to right)

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
31-<50% Poor	
0-<31% Critical state	

The above trend analysis points to an overall regress in wastewater performance over the 2013 to 2021 timeline, which will decline further if the root causes are not addressed. The inherent value of the 2021 audit results is that it establishes a much needed and updated baseline from where appropriate turnaround strategies can be developed, implemented, and monitored, as outlined by the National Water and Sanitation Master Plan of 2018.

National Risk Analysis

The Green Drop risk analysis (CRR) focuses specifically on the wastewater treatment function. It considers 4 core risk indicators, i.e. design capacity, operational flow, technical capacity and effluent quality. The CRR values do not factor risks associated with sanitation or wastewater network and collector systems.

Table 5 - Cumulative Risk Comparative Analysis from 2009 to 2021

CUMULATIVE RISK COMPARATIVE ANALYSIS					
Performance Category	**2009**	**2011**	**2013**	**2021**	**Performance Trend 2013 to 2021**
Highest CRR	29	32	30	32	-
Average CRR	13.3	13.6	12.2	13.2	↓
Lowest CRR	4	3	4	3	-
Design Rating (A)	1.4	1.4	1.4	1.4	→
Capacity Exceedance Rating (B)	3.7	4.1	3.6	3.7	↓
Effluent Failure Rating (C)	5.7	5.7	4.9	5.7	↓
Technical Skills Rating (D)	2.4	2.6	2.5	2.4	↑
CRR% Deviation	**67.0**	**69.2**	**65.4**	**70.1**	↓

↑= improvement, ↓= regress, →= no change

Table 5 indicates a national relapse in CRR% from 2013 to 2021, in that treatment plants have generally moved into a more vulnerable risk space over the past 8 years. This regress is mostly associated with increased effluent quality failures (C), and design capacity being exceeded (B). Marginal movement was seen in terms of the design capacity rating (A) and technical skills rating (D).

Individual systems, however, shows a more pronounced movement in risk and risk causes, as discussed in the Provincial Green Drop Reports (refer to municipal "***Regulator's Comment***").

The CRR analysis, in context of the Green Drop results, suggests that future improvements and interventions should focus on: 1) capacity exceedance at plants which are hydraulically overloaded or approaching its design lifespan; 2) effluent quality failures, especially for microbiological compliance; and 3) strengthening of technical skills and operational competency, especially related to sludge management.

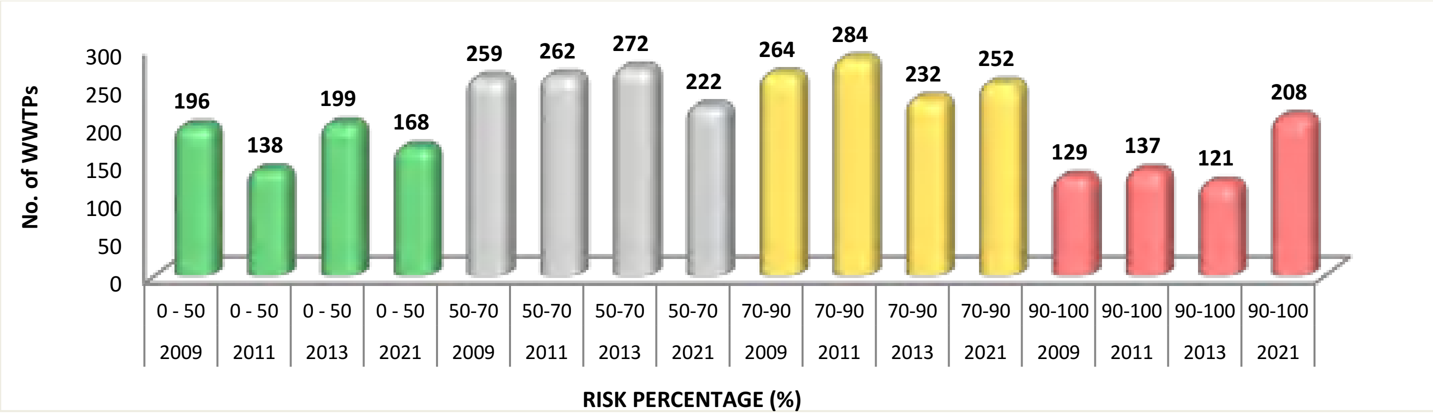
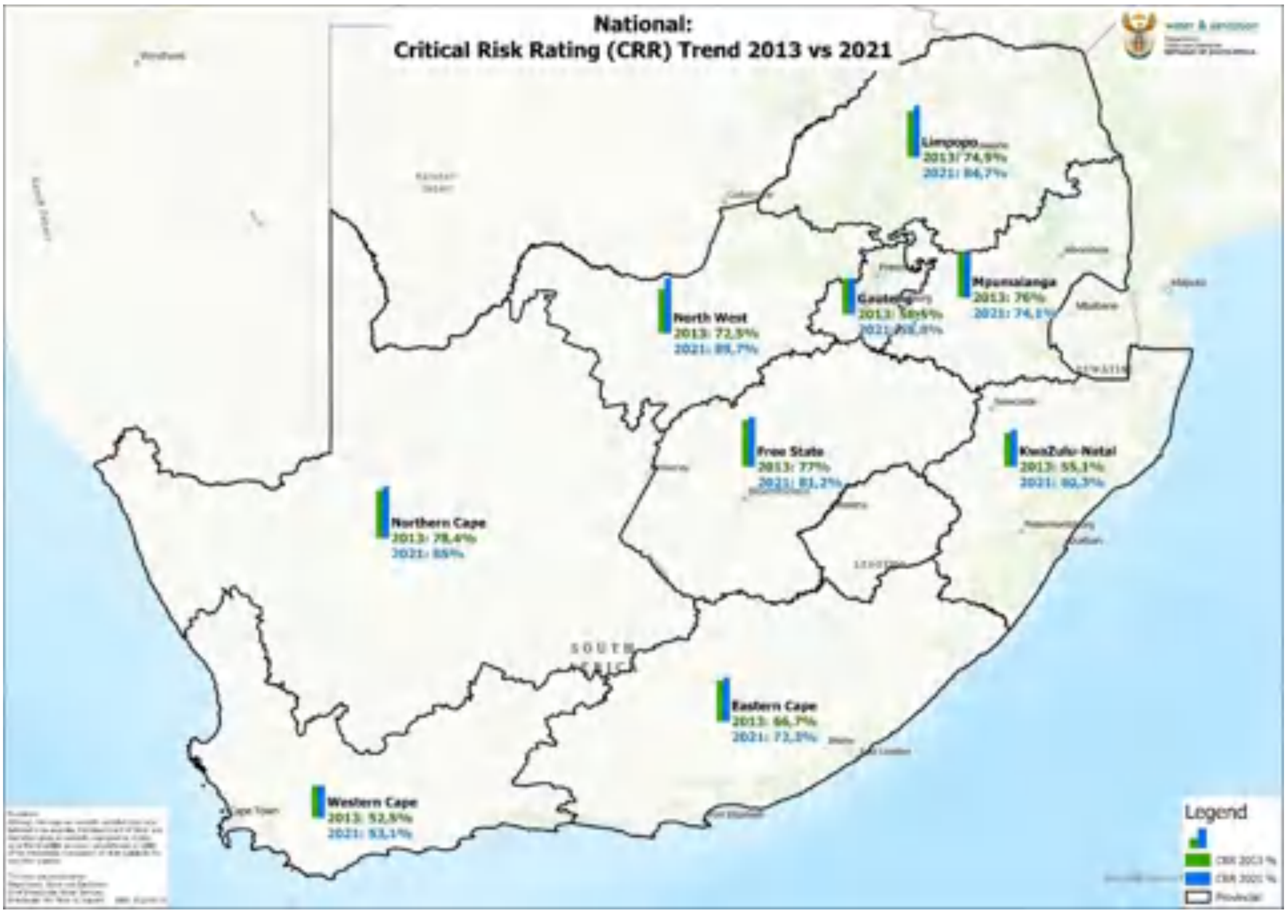


Figure 5 - WWTW Risk distribution and trends from 2009 to 2021; Colour legend

90 – 100% Critical risk WWTPs	
70 - <90% High risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low risk WWTPs	

Analysis of the CRR ratings for the period 2009 to 2021 reveals that:

- The CRR% improved from 2011 to 2013, at a time when W_2RAPs and risk-averse strategies and plans were being entrenched in local government, however, these gains have been lost between 2013 to 2021.
- The 2021 assessment cycle highlighted regressive shifts versus 2013, with a decrease in the number of low-risk WWTWs (199 to 168), a decrease in the medium risk WWTWs (272 to 222), and an increase in high (232 to 252) and critical risk WWTWs (121 to 208).



Regulatory Enforcement

Wastewater systems which failed to achieve the minimum Green Drop target of 31%, are placed under regulatory focus. A total of 334 (39%) of wastewater systems received Green Drop scores below 31% and are placed under **regulatory surveillance** in accordance with the Water Services Act (108 0f 1997) and National Water Act (36 of 1998). The Regulator requires the identified municipalities in their respective Provinces, to submit a detailed corrective action plan within 60 days from publishing of this report. In addition, the municipalities will be compelled to ringfence water services grant allocation to rectify/restore wastewater collection and treatment infrastructure shortcomings identified in this report.

Table 6 - Number of wastewater systems that failed the minimum Green Drop target of <31%

Provinces	# Wastewater Systems	# of Wastewater systems with <31% GD score	% Systems in Critical Space (<31%)
Eastern Cape	123	48	39%
Free State	96	64	67%
Gauteng	60	9	15%
KwaZulu Natal	147	20	14%
Limpopo	64	50	78%
Mpumalanga	76	33	43%
Northern Cape	78	59	76%
North West	48	33	69%
Western Cape	158	18	11%
National Totals	**850**	**334**	**39%**

Further to the Green Drop critical state systems, the CRR% set out to identify WWTWs that fall in high risk and critical risk positions.

This points to specific risk indicators being in a precarious state, i.e. operational flow, technical capacity, and effluent quality. Such WWTWs pose a serious risk to public health, environment and water quality of natural resources. A shift in business practice and refocus by municipal leadership would be required to effect an urgent turnaround in wastewater management. Table 7 summarises the number of WWTWs that are required to reassess their risk and develop corrective measures to mitigate these hazards.

Of the total 850 WWTWs, 208 are in critical risk (24%) and 252 in high risk (30%). The provinces with the highest number of municipal WWTWs in critical risk are North West, which has 60% of its works in critical risk, followed by Northern Cape with 59%, and Free State with 44%. Limpopo has 38% of its plants in critical risk, and 48% as high-risk plants, which places the bulk of treatment facilities in a vulnerable state.

The first course of action for the above municipalities, would be to follow a risk-based approach. Green Drop prescribes the development of site-specific W_2RAPs that are informed by Process Audits or Condition Assessments as a first course of action to identify, prioritise and mitigate risk. The plan is to be supported by zealous implementation of corrective measures, with adequate budget, and ongoing monitoring of risk movement.

Table 7 - %CRR/CRR$_{max}$ scores and WWTWs in critical and high-risk space

Provinces	# WWTWs	2021 Average CRR/CRRmax % deviation	# of WWTWs in critical and high-risk space			
			Critical Risk (90-100%CRR)	%	High Risk (70-<90%CRR)	%
Eastern Cape	123	72.3%	24	20%	47	38%
Free State	96	81.2%	42	44%	34	35%
Gauteng	60	58.8%	4	7%	12	20%
KwaZulu Natal	147	60.3%	10	7%	42	29%
Limpopo	64	84.7%	24	38%	31	48%
Mpumalanga	76	74.1%	26	34%	24	32%
Northern Cape	78	89.7%	46	59%	27	35%
North West	48	85.0%	29	60%	8	17%
Western Cape	158	53.1%	3	2%	27	17%
National Totals	**850**	**70.1%**	**208**	**24%**	**252**	**30%**

Performance Barometer

The **Cumulative Risk Log** expresses the level of risk that a municipality faces in respect of its wastewater treatment facility, based on the ***individual Cumulative Risk Ratios***. Figure 6 presents the cumulative risks for the 9 provinces. On average, the collective of WWTWs are in the medium and high-risk positions. WSAs in Gauteng, KwaZulu Natal and Western Cape are commended for maintaining their collective systems in the medium risk position.

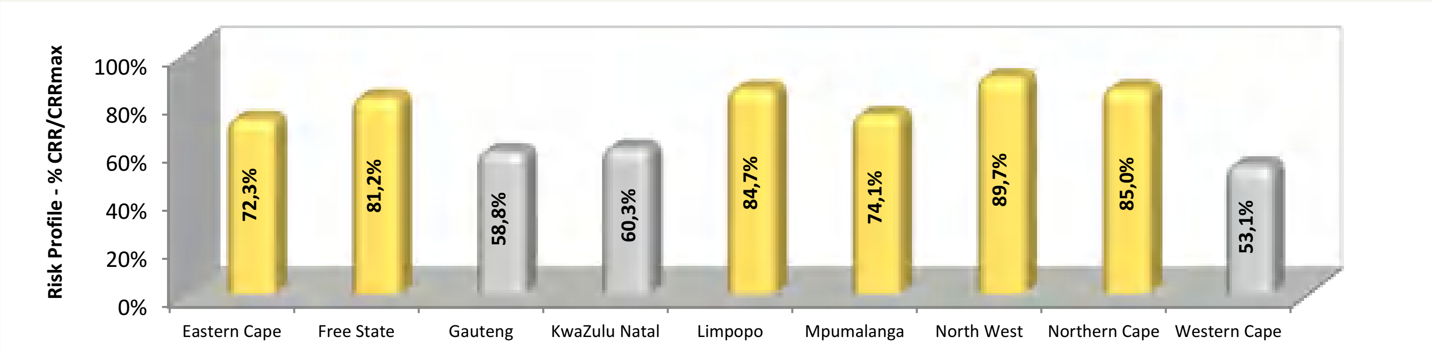


Figure 6 - a) %CRR/CRRmax Risk Performance Log 2021; b) Colour legend

90 – 100% Critical risk WWTPs	
70 - <90% High Risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low Risk WWTPs	

Table 8 indicates that 309 wastewater systems achieved more than 50% Green Drop scores. These systems were confirmed to have average, good and excellent status. Western Cape had 35% of its systems achieving ≥50%, with KwaZulu Natal 25% and Gauteng 15%. These provincial scores are reflected in the number of Green Drop Certifications and Contenders, with Western Cape having 33, Gauteng 12 and KwaZulu Natal 4. None of the WSAs in the North West, Northern Cape, Free State and Limpopo were able to achieve scores in these performance categories.

Table 8 - Summary of Systems with GD scores > 50%, and Number of GD Certifications and GD Contenders

Provinces	# Wastewater Systems	# Wastewater systems with ≥50% GD scores	% Wastewater systems with ≥50% GD scores	# of Green Drop Certification	# of Green Drop Contenders
Eastern Cape	123	40	33%	0	0
Free State	96	5	5%	0	0
Gauteng	60	45	75%	7	5
KwaZulu Natal	147	76	52%	3	1
Limpopo	64	3	5%	0	0
Mpumalanga	76	20	26%	0	3
North West	78	4	8%	0	0
Northern Cape	48	7	9%	0	0
Western Cape	158	109	69%	12	21
National Totals	**850**	**309**	**36%**	**22**	**30**

Pockets of excellence exist in local government and these need to be leveraged through programmatic approaches, to identify and replicate these good practices in lesser capacitated institutions to transfer knowledge and build capacity.

There is a significant task ahead in improving wastewater management and to get the remaining systems (64%) to score above the 50% performance mark. The approach will be detailed as part of the Water Services Improvement Programme.

KPA Diagnostics

The Green Drop Audit process collects a vast amount of data that yield valuable insight into the state of the wastewater sector in each Province. These insights have been captured into 7 thematic areas or 'Diagnostics', as discussed below.

Table 9 - Summary of the key diagnostic themes and reference to the respective Green Drop KPAs

Diagnostic #	Diagnostic Description	Diagnostic Reference
1	**Green Drop KPA Analysis**	KPAs A-E
2	**Technical Competence**	KPA A, B & Bonus
3	**Treatment Capacity**	KPA D
4	**Wastewater Monitoring and Compliance**	KPA B & D & Bonus
5	**Energy Efficiency**	KPA C & Bonus
6	**Technical Site Assessments**	TSA
7	**Operation, Maintenance and Refurbishment of Assets**	KPA C, D & Bonus

Diagnostic 1: Green Drop KPA Analysis

Aim: The Green Drop audit assesses evidence based on five KPAs, i.e. technical skills, environmental plans, financial management, technical capacity, and regulatory compliance. Evaluation of these KPAs provides insight to the inherent strengths and weaknesses of institutions responsible for wastewater services. These insights can inform interventions and strategies to improve the individual systems' KPAs and ultimately, the collective KPA performance at a provincial level.

Findings: At a national level, it was found that the mean GD score for each KPA was relatively low. The mean GD scores range from 43%, the highest for KPA A (Capacity Management) to 19%, the lowest for KPA E (Effluent/Sludge Compliance). While it is ideal to have most of the systems in the >80% scoring category and to have a low standard deviation between the outer parameters (min and max), all KPAs displayed scores at the minimum (0%) and maximum (100%). This highlights the range of results achieved by WSAs. Similarly, provincial KPA profiles were found to be highly variable and unique to each province. These are summarised in the Provincial Green Drop Reports.

Table 10 - Green Drop scores KPA profiles (graph legend included)

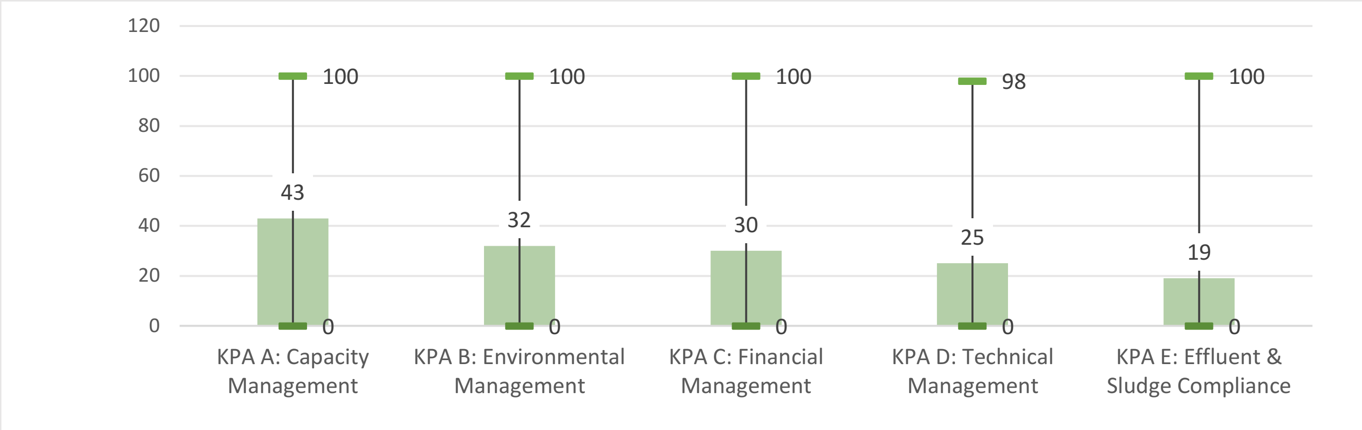
KPA #	Key Performance Area	*Weight*	Minimum GD Score (%)	Maximum GD Score (%)	Mean GD Score (%)	# Systems <31%	# Systems ≥80%
A	Capacity Management	*15%*	0%	100%	43%	141 (17%)	303 (36%)
B	Environmental Management	*15%*	0%	100%	32%	246 (29%)	152 (18%)
C	Financial Management	*20%*	0%	100%	30%	262 (31%)	136 (16%)
D	Technical Management	*20%*	0%	98%	25%	380 (45%)	109 (13%)
E	Effluent and Sludge Compliance	*30%*	0%	100%	19%	475 (56%)	73 (9%)

Note: The high and low lines represent the Min and Max range, and the shaded green represents the Mean (arithmetical average)

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	

The KPA distribution is as follows:

- Capacity Management (KPA A) reflects the highest mean of 43%. This indicates that pockets of expertise and capacity resides across South Africa. Areas in which WSAs had fared well were in the registration of WWTWs, maintenance plans and records, maintenance teams, and registered, qualified staff (process controllers, supervisors, scientists, technicians, engineers). Nonetheless, some WSAs scored the 0% minimum, reflected in the high standard deviation, which highlights an absence of these requirements.
- Effluent and Sludge Quality Compliance (KPA E) received the lowest mean of 19%, indicating a deficiency in data management, IRIS upload, effluent quality compliance and sludge quality compliance.
- Technical Management (KPA D) received the next lowest mean of 25%, indicating a vulnerability in basic design information, inflow, outflow, meter reading credibility, process and condition assessments, site inspection reports, asset registers, asset values, bylaws and enforcement.
- The mean averages decreased steadily from KPA A to KPA E, with institutions finding KPA E the hardest to comply with.



Note: The high and low lines represent the Min and Max range, and the shaded green represents the mean (arithmetic average)

Figure 7 - Maximum, minimum, and mean Green Drop KPA scores

The data in the last two columns of Table 10 reiterates the KPA performance distribution findings:

- ***KPA Score >80%:*** Capacity Management (KPA A) achieved the best results, with 30% of systems achieving a GD score of >80%. Environmental Management (KPA B) had the next highest number of systems, 11%, with a GD score >80%. Technical Management (KPA D) was the worst performing KPA with only 4% of systems achieving >80%, followed by Financial Management (KPA C) with 6%
- ***KPA Score <31%:*** Effluent and Sludge Compliance (KPA E) was the worst performing KPA with 73% of systems lying in the 0-31% bracket, followed by Technical Management (KPA D) with 55% and Environmental Management (KPA B) with 37%.

Diagnostic 2: Technical Competence

Aim: Theory suggests a link between human resources capacity/competency and a municipality's performance and operational capability. It is generally accepted that a high technical capacity would translate to compliant and efficient wastewater services, hence the aggressive investment by progressive institutions in human capital. This diagnostic assesses the human resources (technical) capacity to manage wastewater systems and testing the hypothesis of relations between technical capacity and performance.

Findings: Regulations make provision to classify WWTWs as Class A to E plants, whilst registering Process Controllers and Plant Supervisors as Class I to VI operators. WWTWs with high classifications require a higher level of operators due to their complexity and strict regulatory standards, as defined by Reg. 2834 and draft Reg. 813 of the National Water Act 1998. Furthermore, shifts have been introduced to ensure optimal operations while addressing security risks, particularly as it relates to vandalism. Telemetry also reduces the requirement for on-site staff during night shifts, but these relaxations will have to be done within the DWS regulatory guidelines.

Table 11 compares the compliance and shortfall of operational staff with selected Green Drop performance parameters, i.e. systems with acceptable GD scores (≥50%) and those in critical state (<30%).

Table 11 - Summary of compliant versus shortfall in Supervisor and Process Controller staff

Provinces	# WWTWs	# Compliant staff		# Staff Shortfall		Ratio*	% Wastewater systems with ≥50% GD score	% Wastewater systems with <31% score
		Supervisor	PCs	Supervisor	PCs			
Eastern Cape	123	33	131	20	138	1.3	33%	39%
Free State	96	10	58	26	165	0.7	5%	67%
Gauteng	60	48	181	16	45	3.8	75%	15%
KwaZulu Natal	147	42	146	28	186	1.3	52%	14%
Limpopo	64	16	62	17	79	1.2	5%	78%
Mpumalanga	76	33	153	12	80	2.4	26%	43%
Northern Cape	78	10	40	21	85	0.6	8%	69%
North West	48	19	43	32	91	1.3	9%	76%
Western Cape	158	61	267	19	106	2.1	69%	11%
National Totals	**850**	**272**	**1081**	**191**	**975**	-	**36%**	**39%**

** The single number Ratio is derived from the number of qualified staff divided by the number of WWTWs operated by this number of staff. E.g. for EC, 164 qualified staff is available to support 123 WWTW, thus 164/123 = 1.3 ratio. A ratio >2.0 is considered acceptable.*
Note: "Compliant staff" means qualified and registered staff that meet the GD standard for a particular Class Works. "Staff shortfall" means staff that do not meet the GD standard for a particular Class of works (+1 for a shift) and/or staffing gaps exist at the respective WWTWs.

Competent human resources are a vital enabler to ensure efficient and sustainable management of treatment processes and infrastructure. The national overview shows that operational capacity range widely across the provinces. The collective picture shows that 59% of Supervisors, and 53% of Process Controllers comply with Green Drop standards, leaving a shortfall of 191 Supervisors and 975 Process Controllers. Observations from physical site assessments also suggest that operational knowledge may not always match the classification status of an operator. It will take a dedicated recruitment and upskilling process to address the identified gaps.

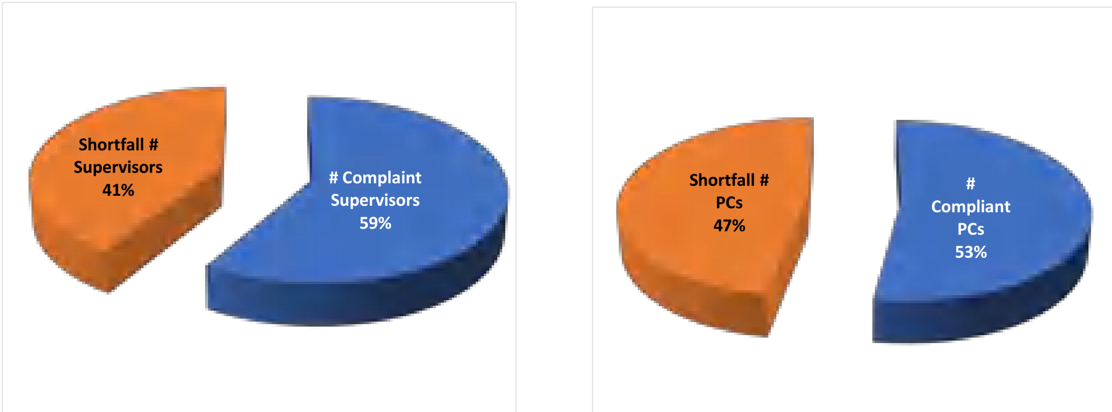


Figure 8 - Schematic illustration of compliant versus non-compliant Supervisors (a) and Process Controllers (b)

There is a correlation between competence of an operational team and performance of a treatment plant, as measured by the GD results. Similarly, the ratio analysis indicates that there is a correlation between technical capacity and wastewater performance.

The data shows that WSAs in Gauteng, Mpumalanga, and Western Cape have a good operational capacity (≥2) – reflecting the impact of operational capacity on the overall wastewater performance, as is evident in the results recorded in Table 11.

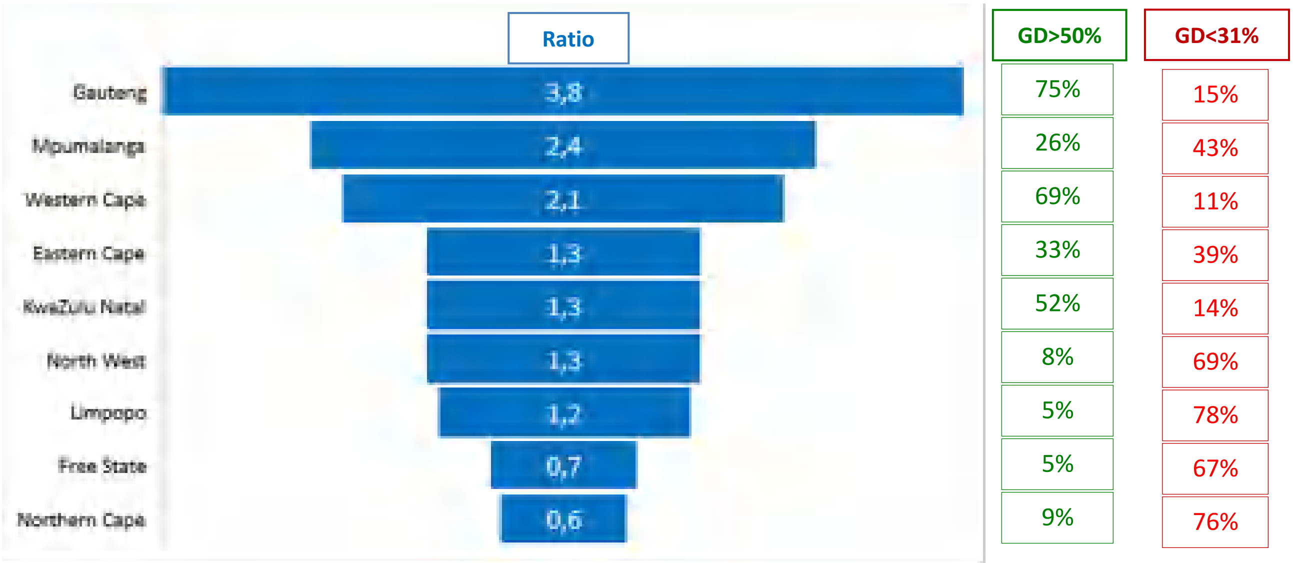


Figure 9 - Comparison of operational staff compliance with wastewater performance

In addition to operational capacity, access to qualified engineers, technicians, technologists, scientists, and maintenance capability is also considered essential for efficient wastewater services provision. Table 12 compares the compliance and shortfall of technical staff with selected Green Drop performance parameters.

Table 12 - Summary of maintenance capacity and the number of qualified and shortfall in Engineering, Technical and Scientific staff

Provinces	# WWTW	Qualified Technical Staff (#)				Technical Shortfall (#)	Qualified Scientists (#)	Scientists Shortfall (#)	Ratio*	Wastewater systems with ≥50% GD score	# Wastewater systems with <31% score
		Engineers	Technologists	Technicians	Total						
Eastern Cape	123	8	9	12	29	12	14	10	0.2	33%	39%
Free State	96	4	17	33	54	6	12	11	0.6	5%	67%
Gauteng	60	31	13	20	64	2	18	4	1.1	75%	15%
KwaZulu Natal	147	29	20	26	75	6	55	4	0.5	52%	14%
Limpopo	64	2	7	7	16	6	8	5	0.3	5%	78%
Mpumalanga	76	7	26	22	55	4	14	8	0.7	26%	43%
Northern Cape	78	9	17	20	46	20	8	23	0.6	8%	76%
North West	48	5	4	8	17	11	5	7	0.4	9%	69%
Western Cape	158	38	30	56	124	10	33	8	0.8	69%	11%
National Totals	**850**	**133**	**143**	**204**	**480**	**77**	**153**	**72**	-	**36%**	**39%**

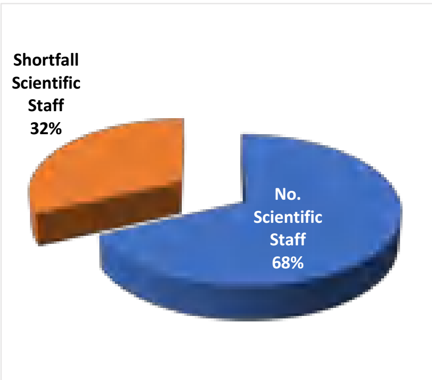
** The single number Ratio depicts the number of qualified technical staff divided by the number of WWTWs that have access to the staff. E.g. for Free State: 54 qualified persons supporting 96 wastewater systems = 54/96 = 0.6 ratio*

Note 1: "Qualified Technical Staff" means staff appointed in positions to support wastewater services, and who have the required qualifications. "Technical Shortfall" is calculated based on a minimum requirement of at least 2 Engineers/Technologists/Technicians and at least one 1 Scientist per WSI.

Note 2: "Qualified Scientists" means professional registered scientists (SACNASP) appointed in positions to support wastewater services. "Scientist shortfall" means that the WSA does not have at least one qualified, SACNASP registered scientist in their employ or on contract.

The results in Table 12 are summarised as follows:

- There are a total of 633 qualified staff, consisting of 133 engineers, 143 technologists, 204 technicians and 153 SACNASP registered scientists that support the 850 systems
- The ratio of qualified staff to WWTWs indicates that there are between 0.2 and 1.1 qualified staff available to support 1 wastewater system
- A total shortfall of 149 persons made up of 77 technical staff and 72 scientists
- 86% of municipalities have qualified technical staff
- 65% of municipalities have at least 1 qualified registered scientist
- 64% of municipalities have access to water laboratories that comply with Green Drop standards.



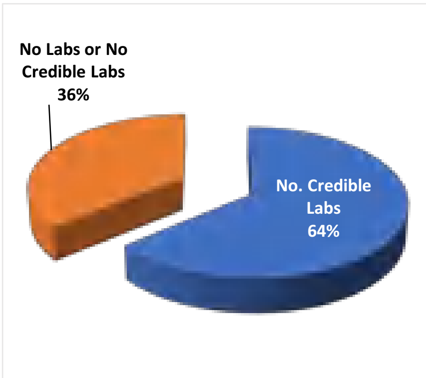


Figure 10 - Distribution of qualified engineering/technical staff b) professional scientists c) access to credible laboratories

It is expected that a higher ratio would correspond with well-planned and maintained wastewater systems. Similar to the operational ratios, it is again observed that higher technical skills ratios correspond with higher Green Drop performance.

The technical skills profile could be improved if all municipal staff were able to present their qualifications and registration certificates. In many cases, engineers, technicians, technologists, and scientists were unable to verify their qualifications. Another observation was that staff claimed credit against incorrect qualifications, e.g. technician qualification incorrectly claimed credit for an engineer. Scientists were often found to be qualified but not professionally registered.

Figure 11 - Comparison of engineering, technical and scientific staff compliance with wastewater performance

The Green Drop also assesses the availability of qualified maintenance staff and the arrangements through which these resources are procured (in-house resources, term contracts, external specialists). All the provinces have a reasonable contingent of qualified maintenance staff through either in-house, contracted, or outsourced personnel. Of the 144 municipalities:

- 120 have in-house maintenance teams
- 56 have internal maintenance teams supplemented with term contracts
- 63 have internal maintenance teams supplemented with specific outsourced services
- 21 have no capacity, inadequate capacity and/or are partially capacitated.

Site inspections revealed that adequate maintenance capacity often exists, but that maintenance is not always prioritised, preventative plans are not developed or implemented, budgets are insufficient, ineffective supply chain management, and extensive backlogs created through vandalism and theft. The site visit also revealed that in some cases pump stations and treatment plants, stripped through vandalism, are left abandoned or inoperable without electrical supply.

Table 13 - Summary of the maintenance capacity and contractual arrangements

Provinces	# WWTW	# WSAs	Maintenance Arrangements
Eastern Cape	123	14	- 10 of 14 municipalities have in-house maintenance teams - 3 municipalities have internal maintenance teams supplemented with term contracts - 4 municipalities have internal maintenance teams supplement with specific outsourced services - 4 municipalities have inadequate capacity or are partially capacitated
Free State	96	19	- 13 of 19 municipalities have in-house maintenance teams - 5 municipalities have internal maintenance teams supplemented with term contracts - 9 municipalities have internal maintenance teams supplement with specific outsourced services - 6 municipalities have either no capacity, are partially capacitated or have inadequate capacity
Gauteng	60	9	- 9 of 9 municipalities have in-house maintenance teams - 7 municipalities have internal maintenance teams supplemented with term contracts - 4 municipalities have internal maintenance teams supplement with specific outsourced services
KwaZulu Natal	147	14	- 13 of 14 municipalities have in-house maintenance teams - 9 municipalities have internal maintenance teams supplemented with term contracts - 8 municipalities have internal maintenance teams supplement with specific outsourced services
Limpopo	64	10	- 8 of 10 municipalities have in-house maintenance teams - 2 municipalities have internal maintenance teams supplemented with term contracts - 5 municipalities have internal maintenance teams supplement with specific outsourced services - 2 municipalities have no capacity
Mpumalanga	76	17	- 16 of 17 municipalities have in-house maintenance teams - 9 municipalities have internal maintenance teams supplemented with term contracts - 8 municipalities have internal maintenance teams supplement with specific outsourced services - 1 municipality is partially capacitated
Northern Cape	78	26	- 22 of 26 municipalities have in-house maintenance teams - 3 municipalities have internal maintenance teams supplemented with term contracts - 12 municipalities have internal maintenance teams supplement with specific outsourced services
North West	48	10	- 8 of 10 municipalities have in-house maintenance teams - 3 municipalities have internal maintenance teams supplemented with term contracts - 4 municipalities have internal maintenance teams supplement with specific outsourced services - 4 municipalities have either no capacity, are partially capacitated or have inadequate capacity

Provinces	# WWTW	# WSAs	Maintenance Arrangements
Western Cape	158	25	- 21 municipalities have in-house maintenance teams - 15 municipalities have internal maintenance teams supplemented with term contracts - 9 municipalities have internal maintenance teams supplement with specific outsourced services - 4 municipalities have either no capacity or inadequate capacity
National Totals	**850**	**144**	

One of the options to enhance operational capacity is through dedicated training programmes. The Green Drop audit incentivises training of operational staff over the 2-year period prior to the audit date. The results are summarised in Table 14 and Figure 12:

Table 14 - No. of WWTWs with operational staff sent on training over the past 2 years and vice versa

Provinces	# WWTW staff attending training over past 2 years	# of WWTW without training over past 2 years
Eastern Cape	47 (38%)	76 (62%)
Free State	23 (24%)	73 (76%)
Gauteng	43 (72%)	17 (28%)
KwaZulu Natal	75 (51%)	72 (49%)
Limpopo	12 (19%)	52 (81%)
Mpumalanga	44 (58%)	32 (42%)
Northern Cape	11 (14%)	67 (86%)
North West	14 (29%)	34 (71%)
Western Cape	100 (63%)	58 (37%)
Totals	**369 (43%)**	**481 (57%)**

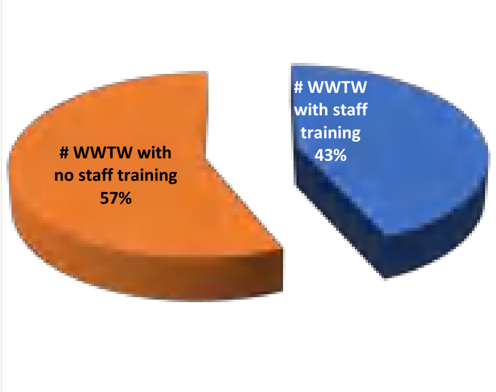


Figure 12 - %WWTWs that have trained operational staff over the past two years

The results confirmed that many WSAs across all provinces under-invest in human capacity and skills development. Only 369 systems (43%) had operational staff attending training over the past 2 years. There is still a considerable skills gap, particularly at a Supervisor and Process Controller level, and it will require a concerted effort to address these gaps.

The type of training also becomes relevant, as most training events focus on chlorine handling and NQF, with insufficient training emphasis on operational know-how. The more acute gaps are noted in the operation of treatment processes, especially sludge clarification and treatment, chemical dosing, understanding technology and their design specifications, application of analytical data in process control, compliance monitoring and use of IRIS.

Diagnostic 3: Treatment Capacity

Aim: A capable treatment plant requires adequate design capacity and functional equipment to operate optimally. If the plant capacity is exceeded by way of inflow volume or strength, a plant will not be capable to achieve its compliance standards. Capacity is typically exceeded when the demand exceeds the installed design capacity, or when processes or equipment is not operational or dysfunctional, or when the electrical supply cannot support the treatment infrastructure. This diagnostic assesses the status of plant capacity and operational flows to the plants.

Findings: Analysis of the hydraulic capacities and operational flows indicate a total design capacity of 6,971 Ml/d, receiving an inflow of 4,840 Ml/day. Theoretically, this implies that approximately 69% of the design capacity is used, with 31% available to meet medium term demand. However, the full 6,971 Ml/d day is not fully available as some infrastructure is dysfunctional, leaving 6,311 Ml/d available. Furthermore, the operational flow excludes data from 341 WWTWs that are not measuring flow, which would take up a significant portion of the installed capacity.

The audit data shows that nationally, there are 82 systems that are hydraulically overloaded. Most of these systems are in municipalities in the Eastern Cape (20), Gauteng (13), Free State (9) and Western Cape (17). This figure could be higher as there are 341 systems nationally that are not measuring inflows and hence it is not possible to determine the system's hydraulic loading. Social and economic development will be constrained in these drainage areas, without expansion of the capacity. The location of the hydraulically overloaded wastewater treatment systems are as follows:

- Eastern Cape: 20 of 123 systems (41 unknown)
- Free State: 9 of 96 systems (62)
- Gauteng: 13 of 60 systems (5)
- KwaZulu Natal: 7 of 147 systems (47)

- Limpopo: 6 of 64 systems (34)
- Mpumalanga: 6 of 76 systems (35)
- Northern Cape: 1 of 78 systems (57)
- North West: 3 of 48 systems (35)
- Western Cape: 17 of 158 systems (18).

Table 15 - Summary of WWTWs design and available capacities, inflows, % use design capacities, and inflows measured per WWTW

Provinces	# WWTWs	Design Capacity (Ml/d)	Available Capacity (Ml/d)	Operational Flow (Ml/d)	Variance (Ml/d)	% Use Design Capacity	# and % of WSAs monitoring inflow
Eastern Cape	123	540.6	531.0	323.4	217.2	60%	82 (67%)
Free State	96	457.6	365.6	243.4	214.9	53%	34 (35%)
Gauteng	60	2,679.6	2,572	2,460.2	84.5	97%	55 (92%)
KwaZulu Natal	147	1,121.6	1,055.7	634.2	487.4	57%	100 (68%)
Limpopo	64	213.11	143.5	92.5	120.8	43%	23 (36%)
Mpumalanga	76	352.0	238.0	177.6	174.4	51%	41 (54%)
Northern Cape	78	164.7	95.3	41.7	123	25%	21 (27%)
North West	48	334.8	214.6	132.6	202.3	40%	13 (27%)
Western Cape	158	1,107.9	1,095.7	734.5	373.4	66%	140 (89%)
National Totals	**850**	**6,971.9**	**6,311.4**	**4,840.1**	**2,131.8**	**69%**	**509 (60%)**

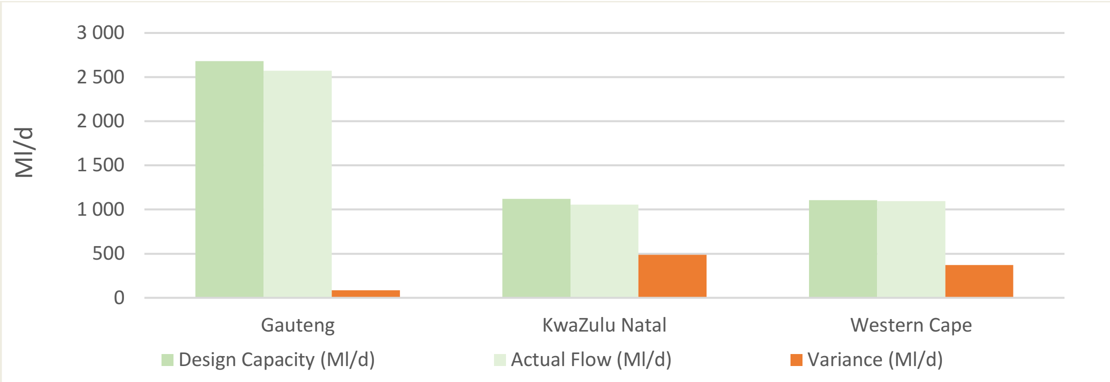


Figure 13 - WWTWs design capacity, inflow, and available capacity for Gauteng, KwaZulu Natal and Western cape

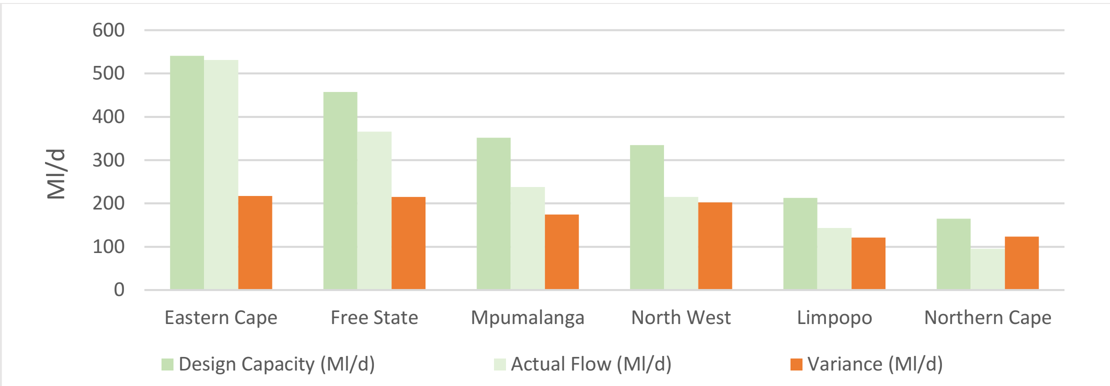


Figure 14 - WWTWs design capacity, inflow, and available capacity for Eastern Cape, Free State, Mpumalanga, North West, Limpopo and Northern Cape

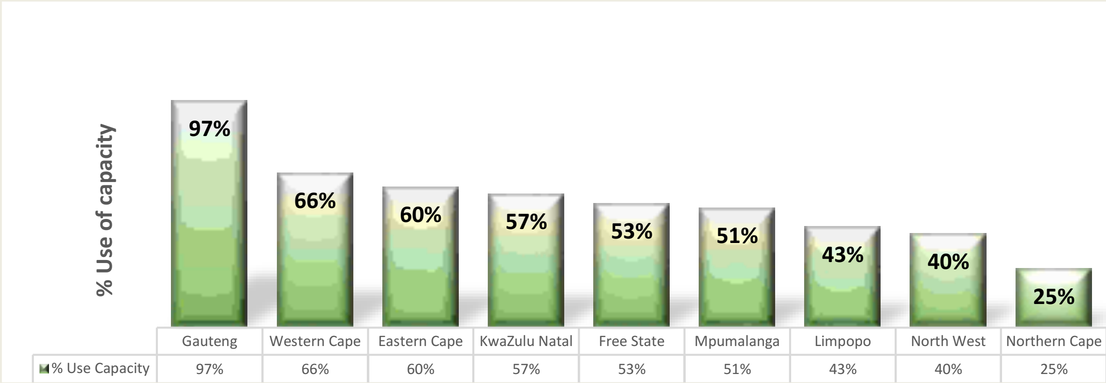


Figure 15 - Use of design capacity as % of operational flow as function of design

Many municipalities have also reported a low usage of their capacity (<50%), which reportedly have been the result of dysfunctional or vandalised sewer networks or pumpstations, whereby the full flow does not reach WWTWs. These spillages often continue for extended periods. Having identified this risk, the Green Drop design requires a wastewater flow balance to identify and quantify possible losses from the network and/or ingress into the sewers. It was noted that the majority of municipalities do not have flow balances to track the wastewater pathway from consumer to treatment plant.

It is of concern that some WWTWs do not measure flow to the treatment works. Water Use Authorisations mandate that all municipalities install flow meters and monitor their inflows, whilst the GD also requires WSAs to report inflows on IRIS and to calibrate meters annually. The audit results indicate that operational flow is only monitored in 509 systems (60%). In addition, the majority of WSAs do not calibrate or verify their flow meters annually, thereby failing to meet good practice standards. Quality flow information is a prerequisite to operate wastewater infrastructure efficiently and to plan future demand.

Diagnostic 4: Wastewater Monitoring and Compliance

Aim: "*To measure is to know*" and "*To know is to manage*". The primary objective of a wastewater treatment plant is to produce final effluent and biosolids to a safe standard. This standard cannot be measured or managed if operational and compliance monitoring is lacking. This diagnostic assesses the monitoring status and final effluent compliance against each WWTW's mandatory standards.

Findings: For operational monitoring, a satisfactory level of 90% is applied as the benchmark, in giving weight to the importance of monitoring. For compliance monitoring, the audit evaluates the sampling point, sampling frequency, final effluent quality, biomonitoring, heavy metals, and any specific condition that the DWS may have included in the water use authorisation. Final effluent quality compliance is calculated against the mandatory limits as listed under "Authorisation Status". A >90% compliance figure confirms high quality final effluent, whereas a <30% indicates poor effluent quality. The enforcement measures are summarised in Table 17 and include NWA Notices and Directives issued, criminal cases opened, and court interdicts granted during the period 1 April 2019 to 30 June 2021.

Table 16 - Summary of the WSA operational and compliance monitoring status

Provinces	# WWTW	Operational monitoring (KPA B2)		Compliance monitoring (KPA B3)	
		Satisfactory [GD score >90%]	Not Satisfactory [GD score <90%]	Satisfactory [GD score >90%]	Not Satisfactory [GD score <90%]
Eastern Cape	123	22 (18%)	101 (82%)	32 (26%)	91 (74%)
Free State	96	0 (0%)	96 (100%)	12 (13%)	84 (87%)
Gauteng	60	33 (55%)	27 (45%)	29 (48%)	31 (52%)
KwaZulu Natal	147	64 (44%)	83 (56%)	106 (72%)	41 (28%)
Limpopo	64	1 (2%)	63 (98%)	2 (3%)	62 (97%)
Mpumalanga	76	6 (8%)	70 (92%)	33 (43%)	43 (57%)
Northern Cape	78	3 (4%)	75 (96%)	8 (10%)	70 (90%)
North West	48	2 (4%)	46 (96%)	2 (4%)	46 (96%)
Western Cape	158	70 (44%)	88 (56%)	125 (79%)	33 (21%)
National Totals	**850**	**201 (24%)**	**649 (76%)**	**349 (41%)**	**501 (59%)**

The performance recorded in Table 16 stems from performance data as measured against the Green Drop Standard expressed in KPAs B2 and B3. This indicates that only 201 plants (24%) are on par with good practice for operational monitoring – this includes raw sewage and the various process units responsible for treatment of effluent and sludge. The municipalities are generally performing better at compliance monitoring than with operational monitoring. Table 16 shows an overall unsatisfactory monitoring regime for both operational and compliance sampling and analysis (76% and 59% , respectively).

The above finding is concerning but it also presents an explanation as to the root of many failing systems. Compliance monitoring is not only a legal requirement but is also the only means to measure performance of a treatment facility. Operational monitoring is the cornerstone of day-to-day process adjustments and optimisation to ensure treatment is efficient and delivers quality effluent/sludge that meets the design expectations. Sludge monitoring is also essential as poor sludge handling is the root cause of many WWTWs failing to meet final effluent standards. The results indicate that the municipalities on average are not achieving regulatory and industry standards.

Table 17 summarises the results of KPA E, which also carries the highest weighting in the Green Drop audit. Note that all averages shown as '0%' under Effluent Compliance, include actual 0% compliance plus systems with no information or insufficient data. Final effluent quality compliance is calculated against the mandatory limits as listed under "Authorisation Status". A >90% compliance figure confirms high quality final effluent, whereas a <30% indicate poor effluent quality. The enforcement measures are summarised in the last column and includes NWA Notices and Directives issued, criminal cases opened, and court interdicts granted during the period 1 April 2019 to 30 June 2021.

Table 17 - Summary of authorisation status, effluent compliance status, and directives/notices issued

Provinces	**Effluent Compliance**									**Enforcement Measures***
	Microbiological Compliance (%)			**Chemical Compliance (%)**			**Physical Compliance (%)**			
	Ave. (%)	**# WWTWs >90%**	**# WWTWs <30%**	**Ave. (%)**	**# WWTWs >90%**	**# WWTWs <30%**	**Ave. (%)**	**# WWTWs >90%**	**# WWTWs <30%**	
Eastern Cape	14%	16	94	20%	19	81	20%	20	82	22
Free State	11%	2	85	17%	4	81	21%	6	76	12
Gauteng	**34%**	13	32	**48%**	13	17	**56%**	24	13	13
KwaZulu Natal	**31%**	40	66	**39%**	28	39	**45%**	44	35	3
Limpopo	**10%**	3	54	**12%**	0	52	**20%**	5	43	19
Mpumalanga	**19%**	8	58	**25%**	7	53	**34%**	11	44	24
Northern Cape	**8%**	3	69	**4%**	0	72	**6%**	0	66	14
North West	**23%**	4	44	**22%**	3	42	**29%**	8	41	10
Western Cape	**64%**	68	33	**62%**	46	38	**70%**	66	18	2
National Totals	**24%**	**157**	**535**	**28%**	**120**	**475**	**33%**	**184**	**418**	**119**

** The enforcement measures (notices or directives issued) are taken over a two-year financial period from July 2019 to June 2021*

Overall, municipalities under-performed in terms of final effluent quality compliance, as established under Diagnostic 1. On average, 24% compliance with microbial effluent quality, 28% with chemical, and 33% with physical effluent quality was attained. This data is unpacked as follows:

- For the microbiological compliance category, 157 systems achieved >90% and 535 systems fell below 30%
- For the chemical compliance category, 120 systems achieved >90% and 475 systems fell below 30%
- For the physical compliance category, 184 systems achieved >90% and 418 systems fell below 30%.

Sludge handling is often the rate limiting step and the highest risk in the wastewater treatment process. In terms of sludge monitoring and compliance status, the data confirms that:

- 193 plants (23%) classify biosolids according to the WRC Sludge Guidelines
- 113 plants (13.3%) monitor sludge streams
- 107 plants (12.5%) have Sludge Management Plans in place
- 27 plants (3.1%) have sludge reuse projects in place, with 8 planning sludge reuse in future
- 165 plants (19.4%) use sludge mostly for agricultural purposes, landfill, thermal sludge practice and commercial products.

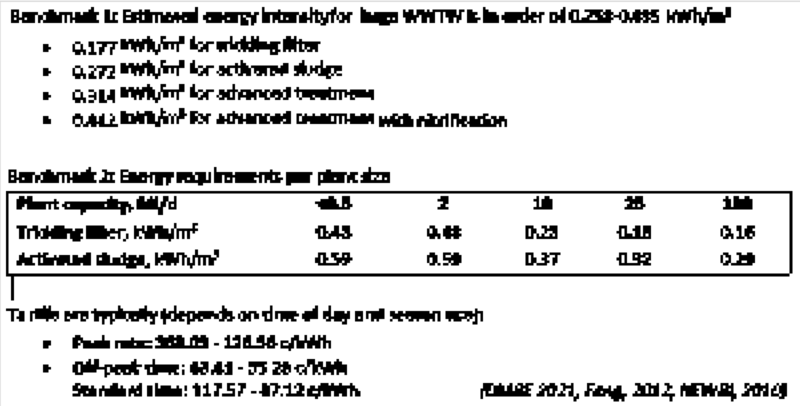
A total of 119 Directives/Notices have been issued to municipalities in the respective provinces. The highest number was issued in Mpumalanga (24 no.), Eastern Cape (22 no.) and Limpopo (19 no.) These enforcement measures were initiated by the Regulator and require municipal leadership intervention and correction. The successes of such interventions warrant further investigation by the Regulator and other sector partners, to ensure that the intended turnaround is achieved.

The data also confirmed that 64% of all WSAs have access to credible laboratories for compliance and operational analysis. These in-house or contracted laboratories have been accredited and/or have Proficiency Testing Schemes with suitable analytical methods and quality assurance. The remaining WSAs are not meeting the regulatory expectation that require them to have access to analytical services for compliance, operational and sludge monitoring.

Diagnostic 5: Energy Efficiency

Aim: The wastewater industry offers many opportunities to respond to climate change challenges by improving energy efficiency, reducing greenhouse gases, and generating energy. The energy cost of sophisticated treatment technologies are in the order of 25 to 40% of the O&M budget (cited WRC 2021). This diagnostic investigates the status of energy efficiency management at a national level with an aim to motivate for improved operational wastewater treatment efficiency.

Findings: The audit results suggest a widespread response and awareness amongst WSAs in the different provinces. Very few WSAs conducted baseline energy audits or could account for the CO_2 footprint associated with the WWTWs. The more capacitated WSAs were able to report on SPC as kWh/m^3, energy tariffs and electricity cost as R/kWh. Limited energy efficiency initiatives are in place, except for some municipalities in Gauteng, Western Cape and KwaZulu Natal. The Western Cape fared the best in terms of energy efficiency and provision of SPC data, followed by Gauteng, KwaZulu Natal, Eastern Cape and Mpumalanga. Except for a few, WSAs in other Provinces do not practice energy management as part of the wastewater business.


Benchmark 1: Estimated energy intensity for large WWTW is in order of [illegible] kWh/m³

- 0.177 kWh/m³ for trickling filter
- 0.272 kWh/m³ for activated sludge
- 0.314 kWh/m³ for advanced treatment
- 0.412 kWh/m³ for advanced treatment with nitrification

Benchmark 2: Energy requirements per plant size

Plant capacity, Ml/d	[illegible]	2	[illegible]	[illegible]	[illegible]
Trickling filter, kWh/m³	0.43	[illegible]	0.23	[illegible]	0.16
Activated sludge, kWh/m³	0.59	[illegible]	0.37	[illegible]	[illegible]

Tariffs are typically (depends on time of day and season etc)

- Peak rate: [illegible] c/kWh
- Off-peak time: [illegible] c/kWh
Standard time: 117.57 - [illegible] c/kWh [illegible]

Table 18 - Summary of actual Specific Power Consumption versus industry benchmarks

Provinces	System Classification	# Systems	SPC (kWh/m³) range	Median (kWh/m³)	Average (kWh/m³)
Original data set	Advanced	166	0.0025to 1418	1.03	30.39
	Basic	26	0.01 to 486.67	0.67	24.51
After removal of Outliers (top 20%)	Advanced	135	0.0025 to 3.95	0.76	0.943
	Basic	22	0.01 to 2.94	0.53	0.900
Eastern Cape	Advanced	11	0.07 to 1.55	0.07 to 1.55	0.636
	Basic	0	-		-
Free State	Advanced	3	0.0025 to 0.613	0.003 to 0.61	0.388
	Basic	0	-		-
Gauteng	Advanced	24	0.1 to 1.67	0.1 to 1.67	0.635
	Basic	0	-		-
KwaZulu Natal	Advanced	28	0.01 to 3.95	0.01 to 3.95	0.720
	Basic	2	0.01 to 0.13	0.01 to 0.13	0.07
Limpopo	Advanced	1	0.288 to 0.288	0.29 to 0.289	0.288
	Basic	0	-		-
Mpumalanga	Advanced	7	0.2 to 1.19	0.2 to 1.19	0.498
	Basic	0	-		-
North West	Advanced	1	2.37 to 2.37	2.37 to 2.37	2.37
	Basic	0	-		-
Northern Cape	Advanced	1	0.481 to 0.481	0.48 to 0.48	0.481
	Basic	0	-		-
Western Cape	Advanced	53	0.05 to 3.6	0.05 to 3.6	1.317
	Basic	19	0.02 to 2.85	0.02 to 2.85	0.880
Non-municipal systems	Basic	6	0.13 to 3.51	0.76	1.210583
	Advanced	1	2.94 to 2.94	2.94	2.94

Despite considerable work done by sector partners, no current SPC database exists for municipal WWTWs. The data collected during the audit therefore is of considerable value and sets a baseline for new knowledge and improvement opportunities. The data collated indicated the following:

- Data was presented for 166 advanced technology WWTWs and 26 basic technology WWTWs
- Some of the WSAs had very little or no data available
- The SPC values range from 0.002 to 1418 kWh/m^3 - outliers were removed to keep approximately 80% of the original data set. The data indicates:
    - A marginal difference between the basic and advanced systems - 0.90 and 0.94 kWh/m^3
    - The median values differ slightly - 0.76 kWh/m^3 for advanced systems and 0.53 kWh/m^3 for basic systems
    - This is notably higher than the international standard of 0.177 for trickling filter and 0.412 for advanced activated sludge technologies
    - The average SPC for advanced systems varies from 0.289 to 2.37 kWh/m^3 and for basic systems between 0.07 to 2.94 kWh/m^3.

The chart below presents the SPC data for the whole of South Africa. The values are compared with all 4 international standards, as well as the median South African value of 0.76 kWh/m^3 for advanced systems. It was noted that at a national scale, no discernible trend could be observed for SPC as a function of increased design capacity. The analysis at a provincial level is discussed in the respective Green Drop Reports for Eastern Cape, Gauteng, KwaZulu-Natal, Mpumalanga, and Western Cape systems.

The data suggests that the majority of WWTWs exceed the international benchmarks as published for specific technology types.

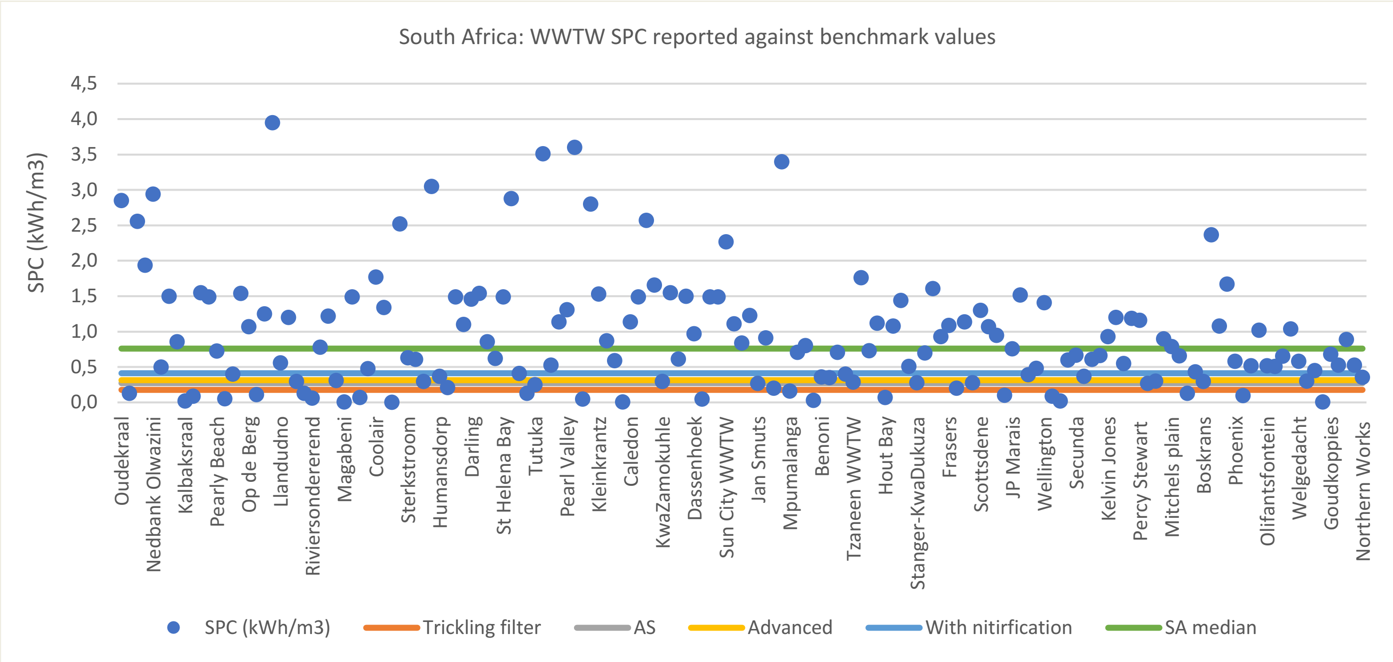


Figure 16 - Specific Power Production per municipal WWTW (kWh/m³) in order of increased design capacity, and compared to international technology benchmarks

It is concluded that most WSAs have not established a specific report to monitor energy as part of their wastewater business. With some exceptions, energy efficiency management is still not entrenched in the municipal sector, and potential cost savings and environmental gains are therefore forfeited.

Diagnostic 6: Technical Site Assessments

Aim: The Green Drop process makes provision for the desktop audit to be followed by a Technical Site Assessment (TSA) to verify the desktop evidence. The assessment includes physical inspection of the sewer network, pump stations, and treatment facility, coupled with asset condition checks to determine an approximate cost to restore existing infrastructure to functional status (VROOM).

Findings: The results of the TSAs are summarised in Table 19. The Green Drop standard upholds a difference of <10% between the GD and TSA score as a good correlation between administration and work on the ground. The Regulator regards a wastewater system with a TSA score of >80% to have an acceptable level of operational control and functional equipment. A TSA of 90% would represent an excellent plant that complies with most of the Green Drop TSA standards.

Table 19 - Summary of the WWTW Technical Site Assessments conducted and %deviation between GD and TSA scores

Provinces	# TSA audited	# of WWTWs TSA ≥80%	# of WWTWs TSA <30%	% Deviation between TSA and GD score	National Summary
Eastern Cape	16	1	6	2% to 28%	Only Buffalo City scored above 80%, a satisfactory site score, with 11 of 16 systems with poor scores <50%. An acceptably low percentage deviation between GD and TSA scores were observed for most of the WSIs, except for Sundays River Valley (28%), Makana and Alfred Nzo (26% each), Blue Crane (24%) and Nelson Mandela Bay (20%). East Bank of Buffalo City impressed with a high TSA score of 85% and a GD score of 73%
Free State	20	0	14	1% to 38%	North Eastern Works in Mangaung performed the best with 70% TSA score. A <15% deviation between Green Drop score and TSA score is observed for 10 of the 19 WSIs. A >20% deviation is observed for 8 of the 19 WSIs with the highest deviations occurring for the North-eastern works (38%), Villiers (30%) and Bothaville (28%)
Gauteng	12	4	0	1% to 23%	Three WSAs scored above 80% (4 WWTWs in total), a satisfactory site score, with Merafong and Rand West receiving very poor scores. An acceptably low percentage deviation between GD and TSA scores were observed for all WSIs, except for Merafong (23%), Midvaal (16%), and Rand West (15%). The City of Ekurhuleni impressed with very high TSA scores of 88% and 96%, which is an almost exact match to the GD scores of 89% and 98%. Merafong and Rand West obtained 37% and 38% TSA scores, combined with large deviations of 23% and 15% respectively
KwaZulu Natal	15	5	0	1% to 57%	Five WSAs scored above 80%, a satisfactory site score, with Ugu, uMkhanyakude and uThukela receiving poor scores <50%. An acceptably low percentage deviation between GD and TSA scores were observed for all WSAs, except for uMzinyathi (57%), Amajuba (40%), King Cetshwayo (24%), eThekwini (20%) and Harry Gwala (22%). eThekwini, uMgungundlovu, Msunduzi, iLembe and Harry Gwala impressed with very high TSA scores >80% with uMgungundlovu, Msunduzi, iLembe systems having a close correlation with their GD scores. Amajuba and uMzinyathi obtained 27% and 17% TSA scores, combined with large deviations of 40% and 57%, respectively
Limpopo	10	0	5	5% to 17%	No WSA scored above 80%, a satisfactory site score, with all except Greater Sekhukhune receiving a TSA score <50%. An acceptably low percentage deviation between GD and TSA scores were observed for all WSIs (<20%). The % deviation ranged from 5 to 17%
Mpumalanga	17	1	2	0% to 36%	Only Steve Tshwete scored above 80%, with only 3 other municipalities having a TSA score above 50%. Seven municipalities had TSA scores <30%. An acceptably low percentage deviation between GD and TSA scores were observed for all WSIs, except for Dipaleseng (36%), Albert Luthuli and Thembisile Hani (30%), Standerton (22%), and Nkomazi (21%). Steve Tshwete impressed with very high TSA score of 90% and close match with GD score of 88%
Northern Cape	26	1	12	0% to 45%	An acceptably low percentage deviation between GD and TSA scores was not observed for all WSIs. There are high deviations for Karoo Hoogland (45%), Joe Morolong (40%), Tsantsabane (37%), Hantam (34%), Siyathemba (32%) and Umsobomvu (30%), and another 6 municipalities in the 20-29% deviation range. Siyathemba impressed with the highest TSA score of 82% but with a low GD score of 50% (32% deviation). 14 of the 26 municipalities fell within a deviation of <20% compared to the remaining municipalities that reflected >20% deviations between their respective TSA and GD scores
North West	13	1	8	2% to 29%	No municipalities scored above 80%, a satisfactory site score. An acceptably low percentage deviation between GD and TSA scores were observed for all WSIs, except for Rustenburg (29%), Maquassi Hills (26%), Madibeng (24%), and JB Marks (20%). JB Marks and Rustenburg had high GD scores but lower TSA scores with % deviations of 29% and 20% respectively. Close correlations between the GD scores and the TSA scores (although low scores) were observed for Moretele, Moses Kotane, Kgetlengriver, Ngaka Modiri Molema, and Matlosana
Western Cape	26	9	0	0% to 37%	Nine municipalities scored ≥ 80%, which is regarded to be a satisfactory site score. Three of the 26 systems had a TSA score of <50%, indicating that these systems fail to meet operational, asset functionality, and workplace safety standards. An acceptably low difference between GD and TSA scores were observed for the majority of municipalities, except for Prince Albert (37%), Kannaland (34%), Hessequa (32%), Langeberg and Theewaterskloof (26% each). City of Cape Town, Drakenstein, Stellenbosch, Witzenberg, Mossel Bay, Bitou, Swartland and Saldanha had TSA scores ≥80%, which also include a close match to their respective GD scores with the exception of Witzenberg but still both scores ≥ 80%. Prince Albert, Kannaland, Hessequa, Langeberg, Theewaterskloof, Witzenberg and Breede Valley had large deviations between their GD score and the TSA score (all >20%) with the highest deviation for Klaarstroom WWTW in Prince Albert
Totals	**155**	**22**	**47**	**0% to 57%**	

A total of 155 TSAs were conducted across South Africa, with 1 to 2 inspections per municipality. A low percentageTSA score would indicate a WWTW that failed to meet operational, asset functionality, and workplace safety standards, whereas a high % deviation between TSA scores and GD scores would indicate a potential disconnect between management and operational aspects.

Some of the highlights include:

- The highest number of WWTWs ≥80% TSA scores was Western Cape (9 no.), KwaZulu Natal (5 no.), and Gauteng (4 No.) - this is commendable
- The highest number of WWTWs with <30% TSA scores was Free State (14 no.), Northern Cape (12 no.), and North West (8 no.)
- WWTWs linked to Limpopo had all WWTWs assessed <20% deviation. Northern Cape had a deviation >20% for 12 of the 26 WWTWs – this ''unacceptable'' deviation is however explained by predominantly low GD and TSA scores
- KwaZulu Natal had the highest %deviation of 56% followed by Northern Cape with 45% - indicating a severe disconnect between wastewater administration and field conditions.

Diagnostic 7: Operation, Maintenance and Refurbishment of Assets

Aim: Insufficient financial resources are often cited as a root cause to dysfunctional or non-compliant wastewater systems. Knowledge and monitoring of budget and expenditure are therefore a critical part of wastewater management. This diagnostic investigates the status of financial information pertaining to O&M budgets and expenditure, asset registers, and capital funding.

Findings: A substantial amount of financial information was presented during the audit process. Unfortunately, the evidence was presented in different formats, levels of detail, or absent for some municipalities. It was observed that municipal teams with financial officials that were present during the audits, typically performed better, and had a better understanding of the wastewater challenges experienced by their technical peers. Discrepancies observed included amongst others - generic or non-ringfenced budgets, contract lump sums for service providers presented as budgets, outdated or incomplete asset registers, and some cost drivers which were lacking (mostly electricity). The Regulator grouped data into different certainty levels, as summarised at the end of this Diagnostic.

It must be noted that there were limitations with the financial and asset information. Not all WSAs submitted current information or complete financial data sets. The use of the data must therefore be exercised with caution.

Regulatory Observation

The Green Drop process required WSA's to provide current asset values for the sewer system which includes the wastewater plant, sewer network and any pump stations. Information gathered reflects a total current asset value for wastewater infrastructure as being R72.6 billion as indicated in Table 22. This figure excludes asset values from a number of WSAs who did not provide this information - these include 6 WSAs in the Eastern Cape, 7 WSAs in Free State, 2 WSAs in Gauteng, 3 WSAs in KwaZulu Natal (including eThekwini Metro), 6 WSAs in Limpopo, 8 WSAs in Mpumalanga, 22 WSAs in Northern Cape, 10 WSAs in North West, and 7 the in Western Cape – a total of 71 of 144 (49%) of all WSAs in the country. The highest asset values are observed for Gauteng (R27.6b), followed by Eastern Cape (R22.6b), and Western Cape (R8.4b). In addition, current asset values often incorporate depreciated values which do not provide a clear reflection of the replacement value of the sewer system. The Regulator therefore accepts that this asset value is currently an under-reported figure and should realistically be 4-5 times higher to reflect actual replacement values.

The data shows a total design capacity of 6,972 Ml/d of all the wastewater treatment plants in South Africa. As per DWS Cost Benchmark Study (2016) and escalated to 2022 figures, a total unit cost of R47.2 million per Ml/d can be used to estimate the cost of a sewer system which is further broken down into R27.4 million per Ml/d for the sewer reticulation system, R3 million per Ml/d for the main sewer lines and R16.8 million per Ml/d for a conventional treatment plant. The implication is therefore that the total replacement cost of the current water sanitation infrastructure can be estimated to be R329 billion. Using an annual maintenance figure of 0.75% of the value of the pipelines and 2.14% of the value of the treatment plant, a total annual cost of R4.1 billion will be required to maintain these assets. The importance of regular maintenance cannot be over emphasized, as this annual cost of R4.1 billion is marginal when compared with the cost of refurbishment of these assets due to non-maintenance.

The result of each financial portfolio is discussed hereunder, **with due caution to the quality of data**.

Vroom Cost Analysis

The VROOM cost presents a ''very rough order of measurement" cost to return a WWTWs functionality to its original design. The VROOM costs breakdown is discussed under the TSA Diagnostic but is further illustrated as follows.

Table 20 - VROOM cost split for civil, mechanical, and electrical and total VROOM cost estimate

Province	Civil cost estimate	Mechanical cost estimate	Electrical & C&I cost estimate	Total VROOM cost
Eastern Cape	R294,515,835	R242,203,637	R126,491,187	R653,719,530
Free State	R328,457,457	R353,453,024	R242,232,267	R929,245,540
Gauteng	R310,056,951	R2,378,470,249	R491,324,099	R3,179,851,300
KwaZulu-Natal	R116,714,627	R307,570,031	R83,985,543	R508,270,200
Limpopo	R87,532,528	R185,659,167	R27,255,957	R300,479,100
Mpumalanga	R387,561,894	R333,960,366	R111,213,099	R832,735,300
Northern Cape	R95,339,134	R394,868,531	R17,790,532	R503,962,740
North West	R136,221,671	R250,822,674	R106,645,155	R493,689,500
Western Cape	R234,593,504	R382,167,028	R123,044,804	R739,691,155
Totals	**R1,990,993,601**	**R4,829,174,707**	**R1,329,982,643**	**R8,141,644,365**
% Distribution	**25%**	**59%**	**16%**	**100%**

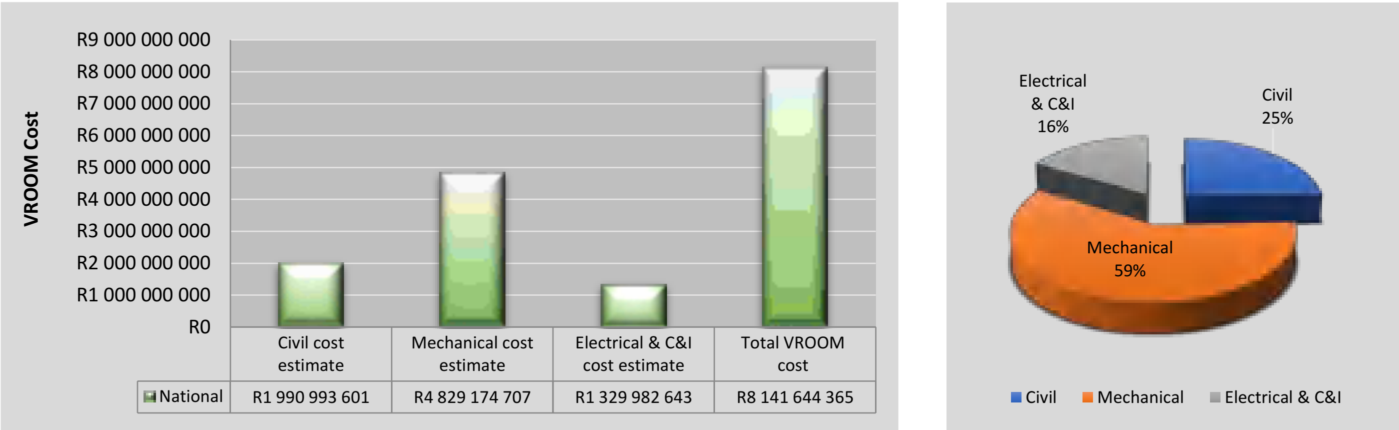


Figure 17 - Graphic illustration of the total cost estimated to restore functionality to existing assets (a), broken down to civil, mechanical, and electrical components

It is estimated that a total budget of R8.14 billion is required, nationally, to restore the WWTWs functionality. This equates to approximately 11% of the total asset value of R72.6 billion. Restoration of the mechanical and civil infrastructure makes up a large part of the cost, requiring approximately 59% and 25% respectively, of the estimated budget. WSAs in Gauteng will have the largest funding requirement, needing approximately R3.1 billion, followed by the Free State and Mpumalanga Provinces, requiring R929 million and R832 million, respectively.

Table 21 indicates that a capital budget of R25.1 billion has been secured over the MTREF period to address infrastructural needs. While it is likely that some of the VROOM requirements will be addressed through this budget, it is probable that additional funding will be required to address the full VROOM requirements. In addition to the R8.41 billion to restore the infrastructure, it is estimated that a total of R1.55 billion will be required by all WSAs, on an annual basis, to maintain their assets. The maintenance estimate is based on the WATCOST-SALGA model that makes provision for maintenance at 2.14%, annually, of the asset value.

Capital, O&M Budget and Actual, and Asset Value

The capital budgets, O&M budgets, O&M actual expenditure, and current asset values are summarised below.

Table 21 - Summary of the capital budgets, O&M budgets, O&M actual expenditure, and current asset values

Province	Capital budget available	O&M budget (2020/21)	O&M expended (2020/21)	% Expended	Total Current Asset Value
Eastern Cape	R2,292,775,620	R814,393,630	R804,948,820	99%	R22,555,904,880
Free State	R954,617,362	R603,499,990	R593,726,485	98%	R4,071,106,560

Province	Capital budget available	O&M budget (2020/21)	O&M expended (2020/21)	% Expended	Total Current Asset Value
Gauteng	R2,472,396,560	R1,249,094,813	R1,217,788,063	97%	R27,604,378,822
KwaZulu-Natal	R1,988,838,230	R1,329,261,359	R1,169,396,567	88%	R4,095,148,631
Limpopo	R268,832,740	R368,310,710	R309,577,460	84%	R423,221,080
Mpumalanga	R1,793,871,200	R202,689,510	R180,226,095	89%	R5,120,951,880
Northern Cape	R328,807,940	R180,452,707	R174,584,347	97%	R367,213,520
North West	R453,281,540	R232,700,075	R150,883,770	65%	NI
Western Cape	R14,517,650,325	R2,198,172,650	R2,273,744,350	103%	R8,376,818,082
Totals	**R25,071,071,517**	**R7,178,575,444**	**R6,874,875,957**	**96%**	**R72,614,743,455**

The Green Drop process provides a bonus (incentive) in cases where a municipality provided evidence of capital projects with secured funding since this is deemed as a definitive means of addressing wastewater services inadequacies. This incentive encourages wastewater infrastructure investment. A total capital budget of R25.1 billion has been reported for the refurbishment and upgrades of wastewater infrastructure for all the municipalities over the MTREF period

For the 2020/21 financial year, the national total O&M budget was R7.18 billion, of which R6.87 billion (96%) has been expended. The table shows that only the Western Cape has a 3% over-expenditure on their budgets. WSAs in the North West reported the lowest expenditure level of 65%. **The national figures excludes all the municipalities that did not have financial information.**

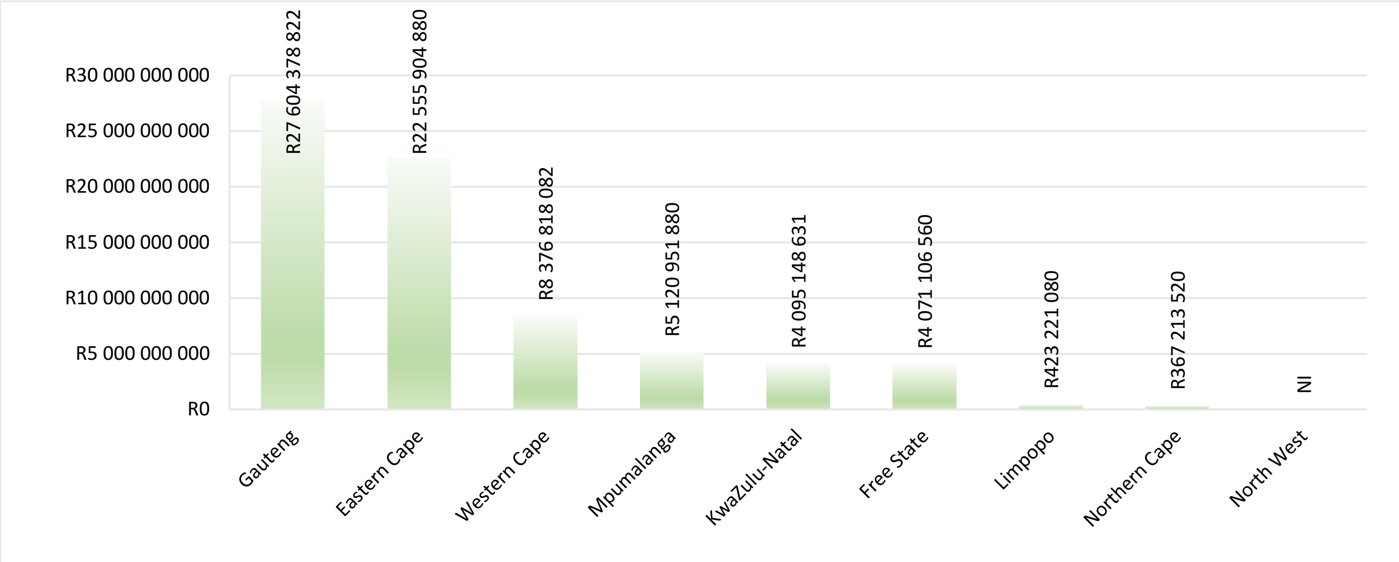


Figure 18 - Total current asset value reported per Province

The total current asset value for wastewater infrastructure (networks, pump stations, treatment plants) is reportedly R72.6 billion (excluding municipalities with no information - 6 WSAs in Eastern Cape, 7 WSAs in Free State, 2 WSAs in Gauteng, 3 WSAs in KwaZulu Natal that includes eThekwini Metropolitan Municipality, 6 WSAs in Limpopo, 8 WSAs in Mpumalanga, 22 WSAs in Northern Cape, 10 WSAs in North West, 7 WSAs in Western Cape – a total of 71 of 144 (49%) of all WSAs in the country. The highest asset values are observed for Gauteng (R27.6b), followed by Eastern Cape (R22.56b), and Western Cape (R8.38b). The Regulator therefore accepts that this asset value is currently an under-reported figure.

O&M Cost Benchmarking

By combining the SALGA and WRC WATCOST models, an estimation of the maintenance cost required per asset type can be done, i.e. civil, buildings, pipelines, mechanical, electrical, and instrumentation.

Table 22 - SALGA-WRC annual maintenance budget guideline and cost estimation

Description	% of Current Asset Value	Asset Value Estimate	Modified SALGA Maintenance Guideline	Annual Maintenance Budget Guideline
Current Asset Value estimate	**100%**	**R72,614,743,455**	**15.75%**	**R1,553,955,510**
Broken down into:				
1. Civil Structures	46%	R33,402,781,989	0.50%	R167,013,910

Description	% of Current Asset Value	Asset Value Estimate	Modified SALGA Maintenance Guideline	Annual Maintenance Budget Guideline
2, Buildings	3%	R2,178,442,304	1.50%	R32,676,635
3. Pipelines	6%	R4,356,884,607	0.75%	R32,676,635
4. Mechanical Equipment	35%	R25,415,160,209	4.00%	R1,016,606,408
5. Electrical Equipment	8%	R5,809,179,476	4.00%	R232,367,179
6. Instrumentation	2%	R1,452,294,869	5.00%	R72,614,743
Totals	**100%**	**R72,614,743,455**	**15.75%**	**R1,553,955,510**
			Minus 20% P&Gs and 10% Installation	**R466,186,653**
			Total	**R1,087,768,857**

The model estimates that R1.55 billion (2.14%) is required per year to maintain the assets valued at R72.6 billion. Notably, this maintenance estimate assumes that all assets are functional. The VROOM cost represents the monies needed to get assets functional, from which basis routine maintenance could then focus on maintaining the assets.

Table 23 provides the SALGA maintenance cost estimation in relation to the VROOM cost, O&M budget, and O&M actual expenditure.

Table 23 - O&M cost estimates by the SALGA and VROOM models versus actual budget and expenditure figures

Cost Reference	O&M Cost Estimate	Period
Modified SALGA	R1,553,955,510	Annually, estimation
O&M Budget	R7,178,575,444.00	Actual for 2020/21
O&M Spend	R6,874,875,957.00	Actual for 2020/21
VROOM	R8,141,644,365.00	Once off estimation

The cost dynamics can be summarised as follows:

- The SALGA estimations for the maintenance budget is approximately 22% of the reported O&M budgets for the 2020/21 financial year. This figure would be influenced by the under reported asset values i.e. where WSAs weno asset values have been provided by the WSAs in each of the respective Provinces
- The actual O&M budget does not seem to be adequate when compared with the SALGA guideline. The results will be skewed by the many municipalities that did not provide financial information
- The VROOM cost represents an indication of the refurbishment cost to restore WWTWs functionality and design capacity.

Production Cost and Comparison

It is good business practice to monitor and manage the production costs of wastewater treatment in Rand/m^3 treated, and to compare such cost with industry norms. Updated benchmarks are not available for typical treatment costs, but significant cost increases are expected since 2013, given the variable input factors such as Covid, cost of chemicals, transport and electricity. From an economic perspective, it is valuable to compare budgeted versus actual production costs.

Based on the limited data sets, a generic trend can be established between the cost to treat wastewater as a function of operational flow. The data suggests that WWTWs with lower operational flow are associated with higher production costs, as can be seen by the grouping of data to the left of the charts below. Some of the reported production costs seems excessive and needs to be investigated by the respective Superintendents and municipal line managers. Typically, larger plants with higher inflows benefit from economies of scale and would show a lower production cost when compared to its low-flow counterparts. The main factors that influence costs are staff, which is a fixed cost, and energy, chemical and repairs/maintenance costs, which are variable costs and depend on the operational status of a plant.

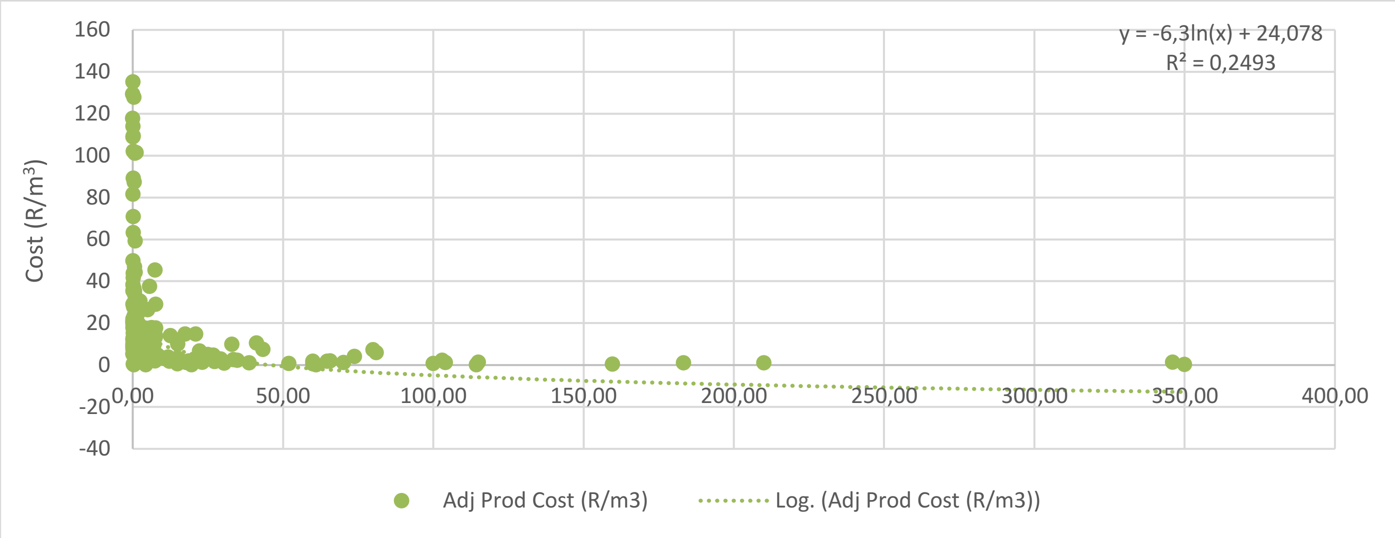


Figure 19 - Adjusted production cost (R/m³) for wastewater treatment, sorted by operational capacity (inflow) per WWTW

The following chart shows that the production cost for treatment of wastewater ranges from R0.137 to R135.16 per m³. The average cost to treat 1 m³ of wastewater is R18.50 and median cost is R8.93, with the latter giving a more representative estimate of production cost. A logarithmic trendline was fitted to the reported values with a correlation coefficient of 49.93%. Using this fit, 25% (R^2) of the variation in the costs to treat wastewater in South Africa depends on the operational flow.

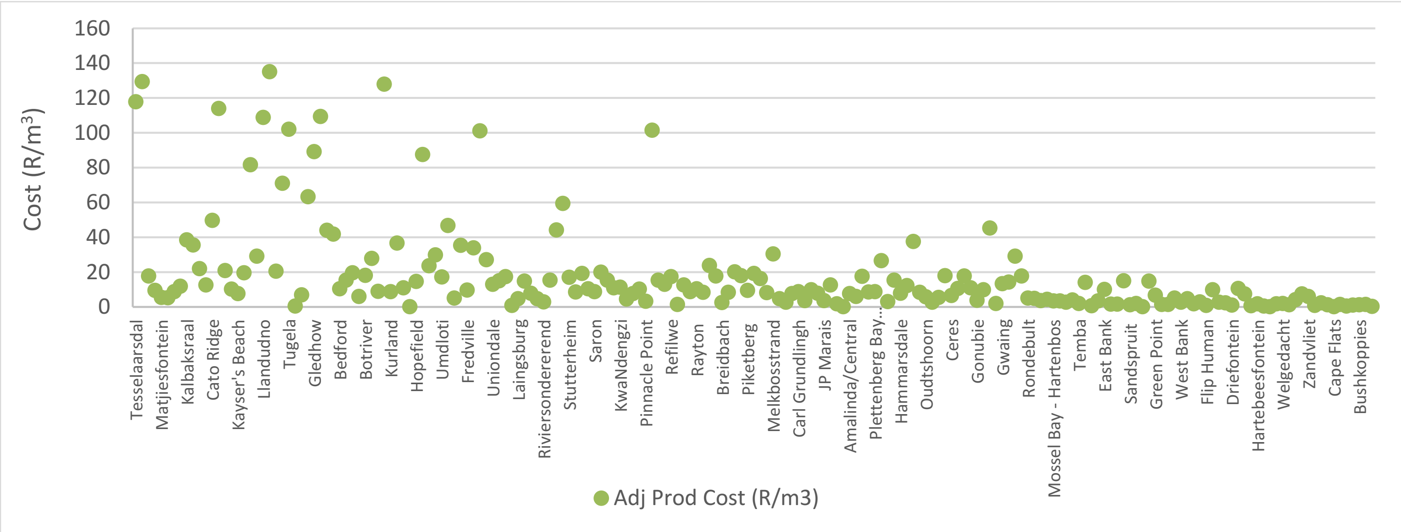


Figure 20 - Adjusted production cost (R/m³) for wastewater treatment, as a function of operational capacity (inflow)

The statistics combined with observations from the audits, implies that many of municipalities have verified, accurate production costs, and recognise production cost as an important driver in the context of economic value and benefit. Given the lack of data by some municipalities, it is imperative that Superintendents start to monitor production cost as a critical parameter within the budget reporting framework, and that line managers use this data to justify operational and capital budgets when planning for the next financial year.

Data Certainty

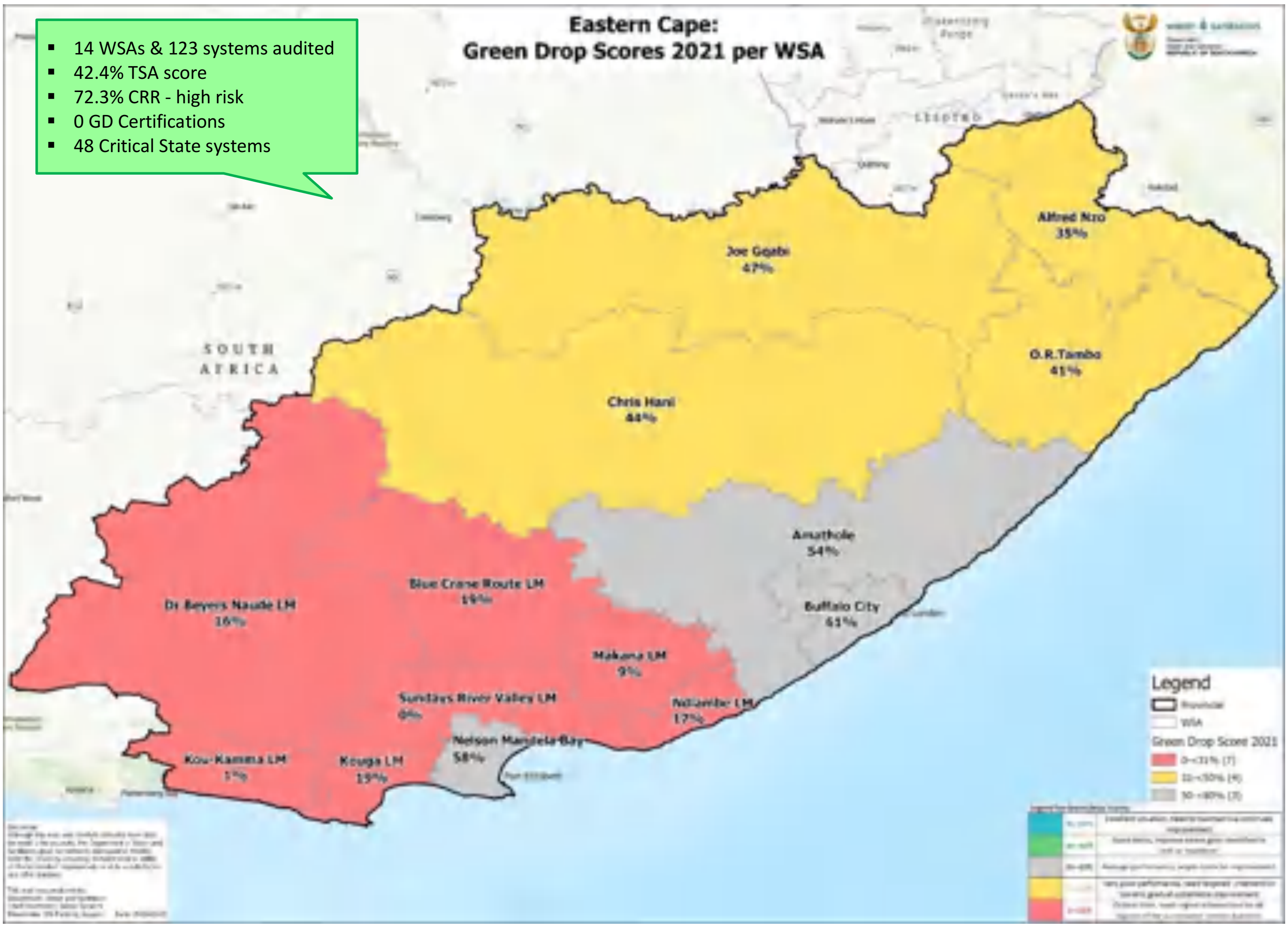
Data certainty is expressed at different levels for the financial and asset figures reported within this Diagnostic. Certainty levels differ from system to system, hence some WSAs are included in multiple data certainty categories - as the data is variable, inconsistent, limited or non-existent (NI) for each of the systems. The various WSAs in each province that were identified under the category ''High Certainty", presented consistent and verifiable evidence in the form of budgets, expenditure, asset registers, and unit costs.

Table 24 - Levels of certainty associated with financial and asset information reported by municipalities

Data Certainty	Description	WSA
No certainty	Absent data or no certainty in data presented - not ringfenced for WWTW & Network	- EC: Makana, Blue Crane - FS: Maluti-A-Phofung, Masilonyana, Nala, Mafube, Moqhaka, Metsimaholo and Phumelela - GP: Rand West - KZN: uMzinyathi, uMkhanyakude - LP: Polokwane, Bela Bela, Thabazimbi, Vhembe - MP: Msukaligwa, Bushbuckridge, Pixley ka Seme, Albert Luthuli - NC: Ga-Segonyana, Gamagara, Kgatelopele, Tsantsabane, Siyancuma, Siyathemba, Kheis, Richtersveld, Kamiesberg, Karoo Hoogland, Kai Garib, Khai Ma, Phokwane, Renosterberg, Umsobomvu, Joe Morolong - NW: Moretele, Moses Kotane, Kgetlengriver, Ngaka Modiri Molema, Maquassi Hills - WC: Prince Albert, Matzikama, Swellendam, Hessequa
Low certainty	Minor or little certainty in the data - partially ringfenced for WWTW only or data as extreme outliers	- EC: All the remaining 9 WSAs - FS: All the remaining WSAs - GP: Midvaal, Lesedi, Merafong, Johannesburg, Tshwane, Mogale City - KZN: eThekwini, Harry Gwala; All the remaining systems - LP: Greater Sekhukhune, Lephalale, Capricorn - MP: Mkhondo, Govan Mbeki, Thembisile Hani, Emakhazeni, Dipaleseng, Lekwa, Thaba Chweu - NC: Nama Khoi, Hantam, Dawid Kruiper, Magareng, Dikgatlong, Sol Plaatje - NW: Matlosana, Madibeng, Rustenburg, Dr Ruth S Mompati - WC: George, Breede Valley, Theewaterskloof, Cederburg, Cape Agulhas
Reasonable/ good certainty	Reasonable to good level of certainty in the data - ringfenced for WWTW and/or Network and data falls within/ close to expected parameters	- EC: Amathole. Nelson Mandela Bay, Buffalo City - GP: Johannesburg, Tshwane, Mogale City - KZN: uMgungundlovu, eThekwini, iLembe, Msunduzi, Harry Gwala - LP: Modimolle-Mookgopong, Mopani, Mogalakwena - MP: City of Mbombela, Dr JS Moroka, Steve Tshwete, Nkomazi, Emalahleni, Victor Khanye - NC: Thembelihle, Emthanjeni, Ubuntu, Kareeberg - NW: JB Marks - WC: Bitou, Laingsburg, Stellenbosch, Oudtshoorn, Swartland, Overstrand, Berg River, Mossel bay
High certainty	High level of certainty in the data - ringfenced for WWTW and Network and data falls within expected parameters	- GP: Ekurhuleni - KZN: iLembe (2 no. Siza Water systems only) - WC: City of Cape Town, Witzenberg, Drakenstein, Saldanha, Beaufort West.

Witzenberg Municipality – a True Top Performer.
A well-managed sewage transfer pump station on the outskirts of Ceres. All records of monitoring and management schedules are kept on site and clearly updated.

4. EASTERN CAPE PROVINCE: MUNICIPAL WASTEWATER MANAGEMENT PERFORMANCE



Provincial Synopsis

An audit attendance record of 100% affirms the Eastern Cape's commitment to the Green Drop national incentive-based regulatory programme.

The Regulator determined that no wastewater system scored the minimum of 90% when measured against the Green Drop standards for the audited period and thus no WSA qualified for the prestigious Green Drop Certification. In 2013 one system was awarded Green Drop Status. The audit has nonetheless established an accurate, current baseline from where improvement can be driven, and excellence be incentivised.

OR Tambo and Ndlambe improved on their 2013 scores. The remaining 12 WSAs regressed to lower Green Drop scores compared to 2013 baselines. Buffalo City obtained the highest Green Drop score in the Eastern Cape (61%), although the regress from 81% in the 2013 baseline is concerning. OR Tambo achieved the best overall progress from a baseline of 20% in 2013 to a municipal score of 41% in 2021. Unfortunately, 48 systems were identified to be in a critical state, compared to the 34 in 2013. The majority of these systems are managed by Koukamma (12 systems), Dr Beyers Naude (8 systems), Kouga (7 systems) and Ndlambe (6 systems).

The Eastern Capes' overall Green Drop performance is characterised by some strengths in the technical capacity, especially at Metros and District Municipality level. All Green Drop KPAs require varying degrees of attention, depending on the municipality, especially in KPAs C and D (financial and technical management), followed by KPA E (effluent quality compliance).

The provincial Risk Ratio for treatment plants regressed from 66.7% (medium risk) to 72.3% (high risk) in 2021. The most prominent risks were observed at a treatment level and points to WWTWs that exceeded their design capacity, dysfunctional processes and equipment (especially disinfection), lack of flow monitoring, and effluent and sludge non-compliance. Opportunities are presented in terms of reducing cost through process optimisation, improved energy efficiency, beneficial use of sludge and other energy resources.

The Regulator is hopeful that the 2021 audits will set a baseline from where a positive trajectory for wastewater services and improved performance will follow. Municipalities are encouraged to start their preparation for the 2023 Green Drop audit. The 2021 Green Drop status is summarised in Table 25.

Table 25 - 2021 Green Drop Summary

WSA Name	2013 GD Score (%)	2021 GD Score (%)	2021 GD Certified ≥90%	2021 GD Contenders (89%)	2021 Critical State (<31%)
Buffalo City	81	61↓			
Nelson Mandela Bay	65	58↓			
Amathole DM	60	54↓			
Joe Gqabi DM	50	47↓			
Chris Hani DM	52	44↓			Dordrect, Lady Frere
OR Tambo DM	20	41↑			Tsolo, Port St Johns
Alfred Nzo DM	39	35↓			Cedarville
Kouga LM	53	19↓			All 7 plants
Blue Crane LM	19	19			All 3 plants
Ndlambe LM	13	17↑			All 6 plants
Dr Beyers Naude*	40	16↓			All 8 plants
Makana LM	62	9↓			All 3 plants
Koukamma LM	23	1↓			All 12 plants
Sundays River Valley LM	36	0↓			All 4 plants
Totals	-	-	**None**	**None**	**48**

The Department of Water and Sanitation acknowledges the excellence in wastewater management achieved for the Green Drop Audit year of 2021.

No Green Drop Certificates are awarded to WSAs in the Eastern Cape Province

Background to Eastern Cape Wastewater Infrastructure

There are 14 WSAs, delivering wastewater services through a sewer network comprising of 123 WWTWs, 425 network pump stations and 7,863 km outfall and main sewer pipelines. The sewer network figure excludes the pipelines from 8 WSAs that were unable to provide data. There is a total installed treatment capacity of 540 Ml/d, with the majority of this capacity residing in the medium, large, and macro-sized treatment plants.

Table 26 - Summary of WWTW capacity and flow distribution according to plant sizes

	Micro Size Plants	Small Size Plants	Medium Size Plants	Large Size Plants	Macro Size Plants	Unknown (NI)*	Total
	<0.5 Ml/day	0.5-2 Ml/day	2-10 Ml/day	10-25 Ml/day	>25 Ml/day		
No. of WWTW	29 (24%)	51 (41%)	32 (26%)	6 (5%)	4 (3%)	1 (1%)	123
Total Design Capacity (Ml/day)	7.03	48.48	148.57	114.50	222.00	1	540.6
Total Daily Inflow (Ml/day)	4.88	25.56	81.60	51.54	159.80	41	323.4
Use of Design Capacity (%)	69%	52%	55%	45%	72%	-	60%

** "Unknown" means the number of WWTWs with NI (No Information) on design capacity or daily inflow*

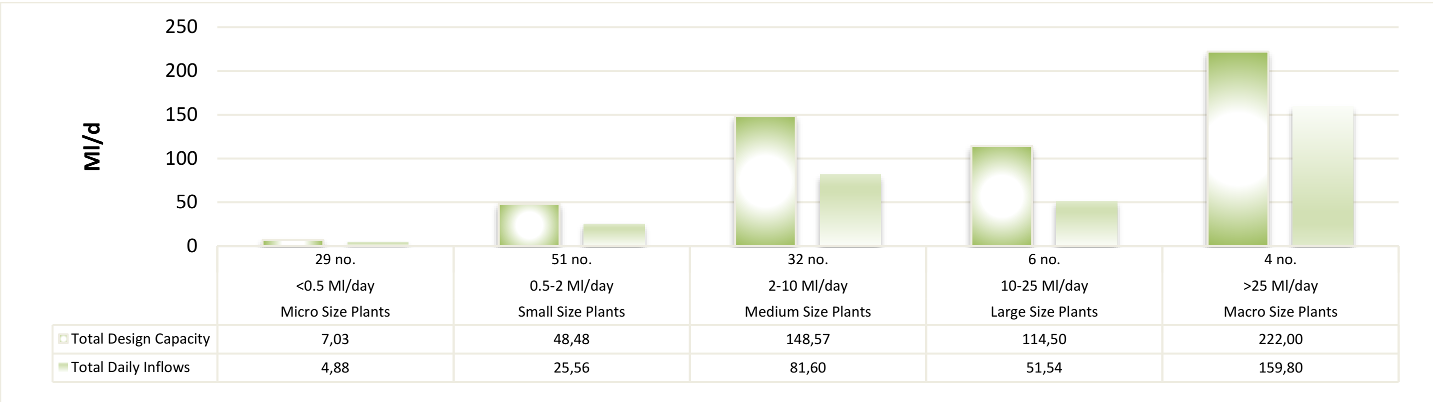


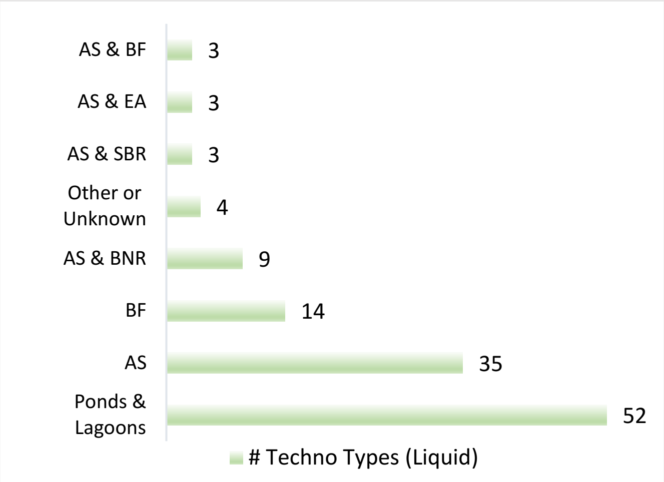
Figure 21 - Design capacities and operational inflow to micro to large sized WWTWs (a) and macro sized WWTWs

Based on the current operational flow of 323 Ml/d, the treatment facilities are operating at 60% of their design capacity. The two largest inflow contributors are the metropolitan municipalities with 230 Ml/d, namely, Nelson Mandela Bay with 143 Ml/d and Buffalo City with 87 Ml/d.

Given the current capacity, this implies that there is 40% spare capacity to meet the medium term demand. It must however be noted that inflow is not monitored in 41 systems and as a result the spare capacity could be substantially less than the 40% if those flows are taken into account. Diagnostic #3 unpacks these statistics in more detail. This spare capacity would also be compromised at systems where some of the infrastructure or treatment modules are non-operational or dysfunctional. The VROOM Cost Diagnostic #7 provides more detail on the refurbishment requirements to restore such capacity and functionality.

The audit data shows that nationally, 20 systems are hydraulically overloaded. This figure could theoretically be higher, given that there are 41 systems where inflow monitoring is not taking place. The hydraulically overloaded systems in each of the WSAs is as follows:

- Joe Gqabi: 5 of 15 systems (Aliwal North, Barley East Ponds, Burgersdorp, Prentjiesberg, Sterkspruit)
- OR Tambo: 1 of 6 systems (Lusikisiki)
- Chris Hani: 2 of 16 systems (Cofimvaba, Tsomo)
- Buffalo City: 3 of 15 systems (Breidbach, Kidds Beach and Schornville)
- Kouga: 1 of 7 systems (Humansdorp)
- Makana: 2 of 3 systems (Belmont Valley and Mayfield)
- Ndlambe: 1 of 6 systems (Kenton on Sea)
- Koukamma: 2 of 12 systems (Joubertina-Ravinia and Sanddrift)
- Amathole: 3 of 15 systems (Amabele, Keiskammahoek and Peddie)



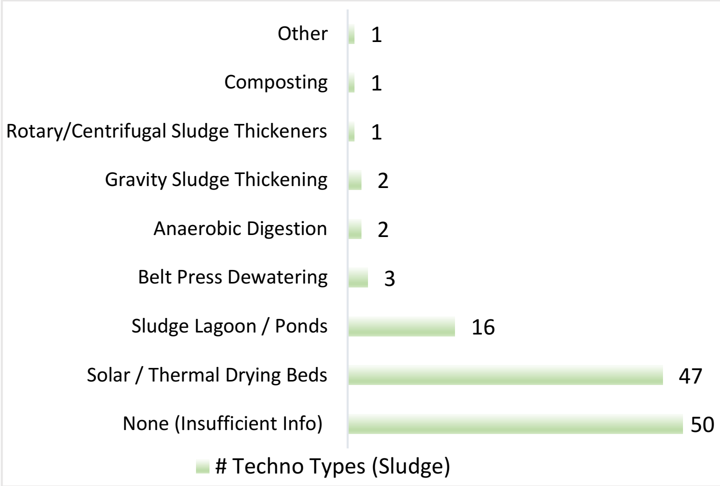


Figure 22 - Treatment technologies for wastewater effluent (a) and sludge (b)

The predominant treatment technologies employed at Eastern Cape WWTWs comprise of activated sludge (variations thereof), and pond systems (for effluent treatment), and solar drying beds (for sludge treatment). The next audit will need to verify sludge treatment technologies, as insufficient information ("Other") is observed in this area.

Table 27 - Summary of Collection Network Pump Stations and Sewer Pipelines

WSA Name	# WWTWs	Pump Stations (#)	Sewer Pipelines (km)
Joe Gqabi	15	23	NI
Alfred Nzo	6	2	NI
OR Tambo	6	14	960
Chris Hani	16	34	NI
Buffalo City	15	86	2,428
Nelson Mandela Bay	7	86	3,900
Kouga	7	47	124
Sundays River Valley	4	7	NI
Makana	3	6	NI
Ndlambe	6	36	237
Blue Crane	3	7	NI
Dr Beyers Naude	8	18	214
Koukamma	12	6	NI
Amathole	15	53	NI
EC Totals	**123**	**425**	**7,863**

The sewer network consists of the sewer mains and pump stations as summarised in Table 27. Nelson Mandela Bay and Buffalo City own and manage the bulk of the sewer collector infrastructure, approximately 3,900 km and 2,428 km; and 86 sewer pump stations each, respectively. Eight municipalities could not provide information on sewer pipelines, indicating limitation in asset management information.

Provincial Green Drop Analysis

The 100% response from the 14 municipalities audited during the 2021 Green Drop process demonstrates a firm commitment to wastewater services in the province. Local Government reforms resulted in the merging of Baviaans LM, Camdeboo LM and Ikwezi LM into Dr Beyers Naude LM. Therefore 14 WSAs were audited in 2021 compared to the 16 WSAs in 2013.

Table 28 - Green Drop Comparative Analysis from 2009 to 2021

GREEN DROP COMPARATIVE ANALYSIS					
Performance Category	**2009**	**2011**	**2013**	**2021**	**Performance trend 2013 and 2021**
Incentive-based indicators					
Municipalities assessed (#)	5 (26%)	17 (100%)	16 (100%)	14 (100%)	→
Wastewater systems assessed (#)	16	123	124	123	↓
Average Green Drop score	29%	33.0%	46.1%	35.9%	↓
Green Drop scores ≥50% (#)	11/16 (69%)	32/123 (26%)	62/124 (50%)	40/123 (33%)	↓
Green Drop scores <50% (#)	5/16 (31%)	91/123 (74%)	62/124 (50%)	83/123 (67%)	↓
Green Drop Certifications (#)	0	3	1	0	↓
Technical Site Inspection Score (%)	NA	44.0%	54.1%	42.4%	↓

NA = Not Applied NI = No Information *↑= improvement, ↓= regress, →= no change*

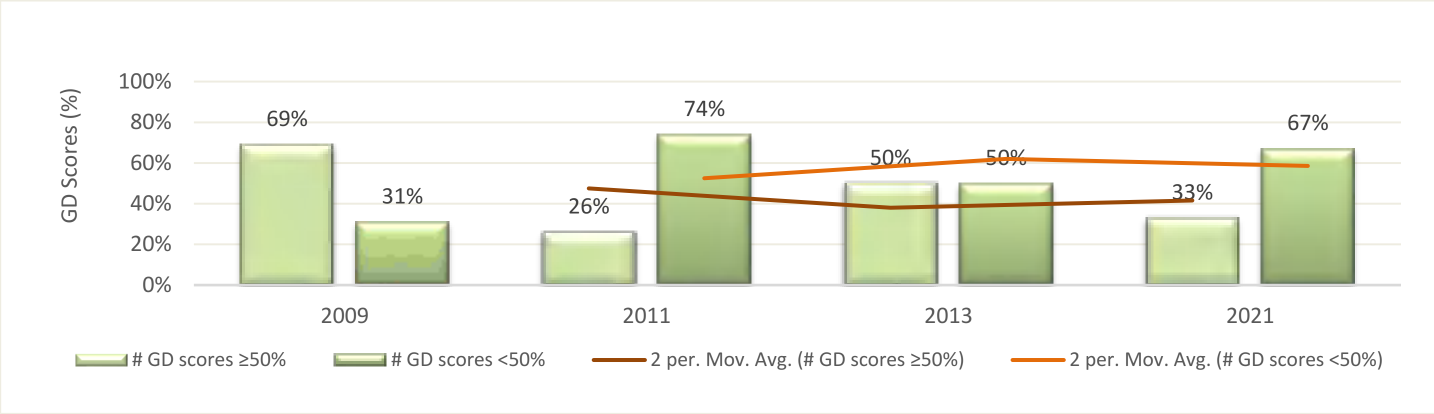


Figure 23 - GD trend analysis over the period 2009 to 2021, indicating the percentage GD scores above 50% (left bar) and below 50% (right bar)

The trend analysis indicates that:

- The number of systems audited increased from 2009, and has remained consistent at 123-124 systems from 2011 to 2021
- Despite an upward trend in previous GD average scores, 29% in 2009, 33% in 2011, 46% in 2013, there was a drop-off to 36% in 2021
- Similarly, the number of systems with GD scores of ≥50% increased between from 32 (26%) in 2011 to 62 (50%) in 2013 but decreased to 40 (33%) in 2021
- This trend was also mirrored in the TSA score, which had increased from 44% in 2011 to 54% in 2013, but decreased to 42% in 2021
- This trend was balanced by the number of systems with GD score of ≤50% decreasing from 91 (74%) in 2011 to 62 (50%) in 2013, followed by a regress to 83 (67%) in 2021
- The Green Drop Certifications decreased from 3 awards in 2011, 1 award in 2013 and 0 awards in 2021
- An overall performance trend from 2013 to 2021 signals the need for repeat/regular audits to ensure continued improvement. There are indications that performance has declined in the absence of the consistent regulatory engagement of the GD audits.

The analysis for the period 2009, 2011, 2013 and 2021, indicates that the majority of the system scores are in the 0-<50% (Critical and Poor Performance) categories, with the 50-<80% (Average Performance) being the next largest category. Most concerning is that 48 systems are in critical state (<31%) compared to 34 systems in this space in 2013.

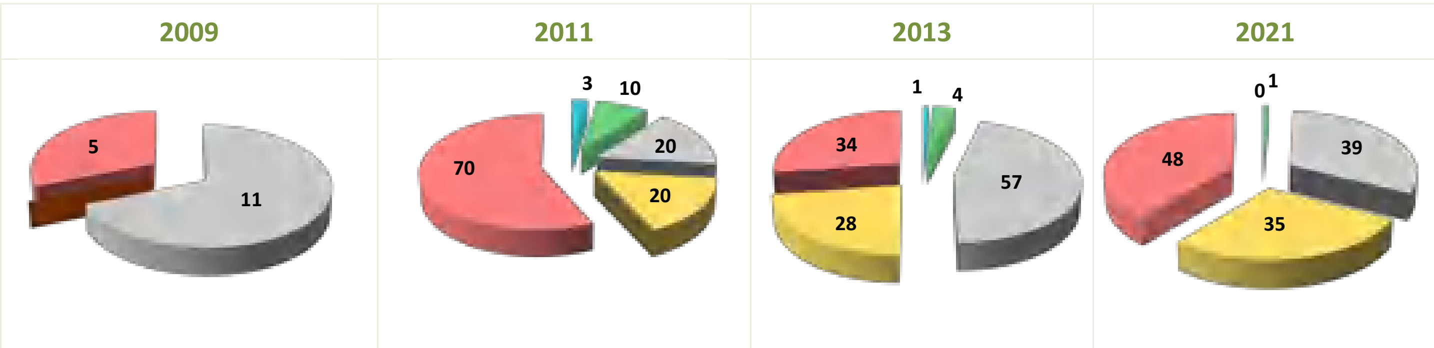


Figure 24 - No. WWTWs in the Green Drop score categories over the period 2009 to 2021 (graph legend to right)

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	

In summary, trends over the years 2013 and 2021 indicate as follows:

- Systems in a 'poor state' increased from 28 systems in 2013 to 35 systems in 2021
- Systems in a 'critical state' increased from 34 systems in 2013 to 48 systems in 2021
- Systems in the 'excellent and good state' decreased from 5 systems in 2013 to 1 system in 2021.

Provincial Risk Analysis

Green Drop risk analysis (CRR) focuses specifically on the treatment function. It considers 4 risk indicators, i.e., design capacity, operational flow, technical capacity, and effluent quality. The CRR values do not factor risks associated with sanitation or wastewater network and collector systems.

Table 29 - Cumulative Risk Comparative Analysis from 2009 to 2021

CUMULATIVE RISK COMPARATIVE ANALYSIS					
Performance Category	**2009**	**2011**	**2013**	**2021**	**Performance Trend 2013 to 2021**
Highest CRR	29	25	21	21	→
Average CRR	14.5	14.0	12.0	13.0	↓
Lowest CRR	8	6	6	3	↑
Design Rating (A)	1.2	1.2	1.2	1.3	↓
Capacity Exceedance Rating (B)	4.5	4.3	3.6	3.6	→
Effluent Failure Rating (C)	6.6	6.1	5.4	6.1	↓
Technical Skills Rating (D)	2.5	3.0	2.3	2.6	↓
CRR% Deviation	**76.5**	**74.6**	**66.7**	**72.3**	↓

↑= improvement, ↓= regress, →= no change

Table 29 above indicates a consistent CRR% deviation from 2013 to 2021, which suggests significant changes in the technical expertise (D) and final effluent quality (C) for WSAs overall. Individual systems, however, show higher deviations and indicate specific risk categories, as highlighted under "***Regulator's Comment***". The CRR analysis, in context of the Green Drop results, suggests that further improvements should focus on 1) capacity exceedance at plants which are hydraulically overloaded or approaching its design lifespan, 2) effluent quality failures, especially for microbiological compliance, and 3) strengthening of technical skills and operational competency, especially related to sludge management.

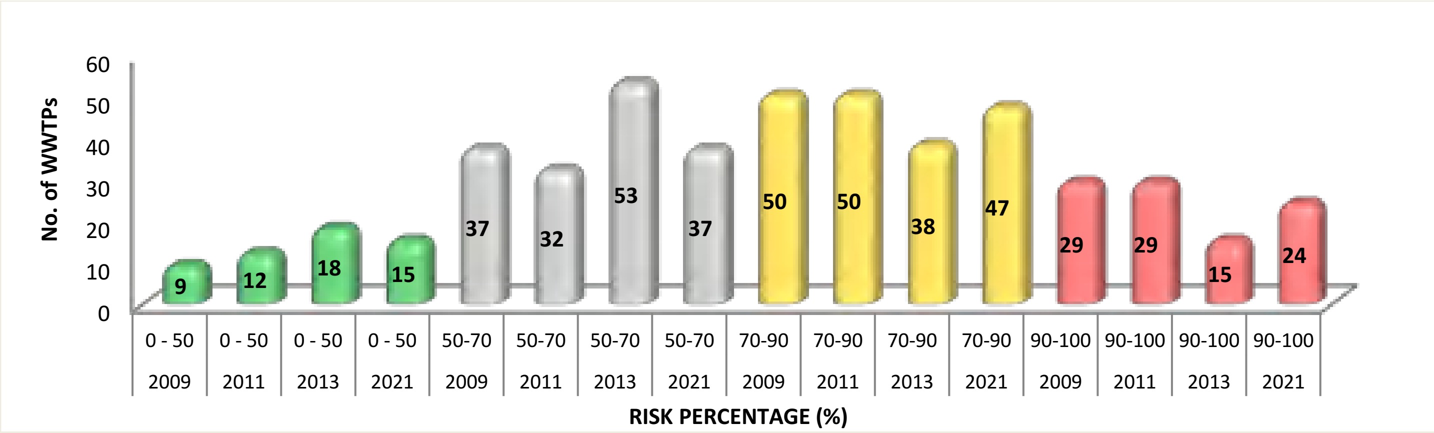


Figure 25 - a) WWTW Risk distribution and trends from 2009 to 2021; b) Colour legend

90 – 100% Critical risk WWTPs	
70 - <90% High risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low risk WWTPs	

Trend analysis of the CRR ratings for the period 2009 to 2021 indicate that:

- The most prominent movement in risk can be seen between 2013 and 2011, when a significant number of plants moved from low to medium and high-risk positions, indicating a regressive state for WWTWs
- The CRR% improved from 2011 to 2013, at a time when W$_2$RAPs and risk-mitigation strategies were being embedded in WSIs, but these gains have been lost between 2013 to 2021
- The 2021 assessment cycle highlighted regressive shifts with a decrease in the number of medium risk WWTWs (53 to 37) and increase in high risk (38 to 47) and critical risk WWTWs (15 to 24).

Regulatory Enforcement

Wastewater systems which failed to achieve the minimum Green Drop target of 31%, are placed under regulatory focus. The Regulator requires these municipalities to submit a detailed corrective action plan within 60 days from publishing of this report.

Ten (10) municipalities and 48 wastewater systems that received Green Drop scores below 31%, are to be placed under **regulatory surveillance**, in accordance with the Water Services Act (108 0f 1997). In addition, these municipalities will be compelled to ringfence water services grant allocation to rectify/restore wastewater collection and treatment shortcomings identified in this report .

Table 30 - WWTWs with <31% Green Drop scores

WSA Name	2021 Municipal GD Score	WWTWs with <31% score
Chris Hani DM	44%	Dordrect, Lady Frere
OR Tambo DM	41%	Tsolo, Port St Johns
Alfred Nzo DM	35%	Cedarville
Kouga LM	19%	All 7 plants
Blue Crane LM	19%	All 3 plants
Ndlambe LM	17%	All 6 plants
Dr Beyers Naude	16%	All 8 plants
Makana LM	9%	All 3 plants
Koukamma LM	1%	All 12 plants
Sundays River Valley LM	0%	All 4 plants

The following municipalities and their associated wastewater treatment plants are in high CRR risk positions, which means that some or all of the risk indicators are in a precarious state, i.e., operational flow, technical capacity and effluent quality. WWTWs in high risk and critical risk positions poses a serious risk to public health and the environment. The following municipalities will be required to assess their risk contributors and develop corrective measures to mitigate these risks.

Table 31 - %CRR/CRR$_{max}$ scores and WWTWs in critical and high-risk space

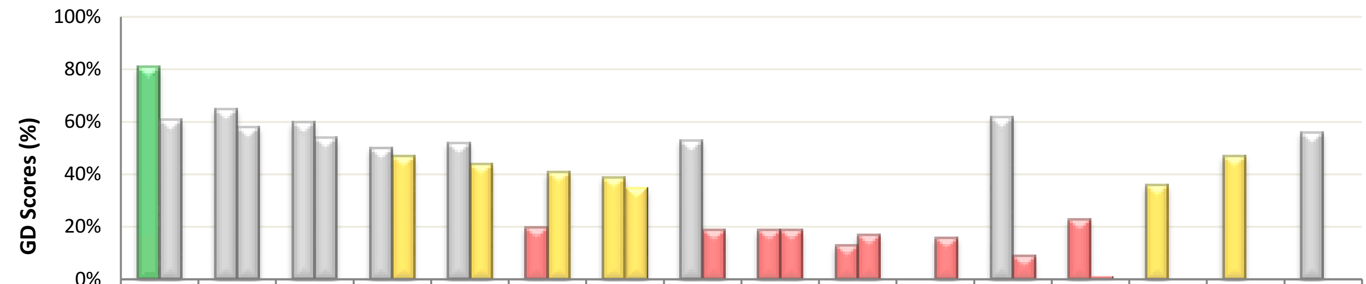
WSA Name	2021 Average CRR/CRRmax % deviation	WWTWs in critical and high-risk space	
		Critical Risk (90-100%CRR)	High Risk (70-<90%CRR)
Buffalo City LM	53.2%		Kidds Beach, West Bank
Amathole DM	56.3%	Peddie	Cathcart, Keiskammahoek, Middledrift, Seymour
Chris Hani DM	72.8%	Lady Frere, Sada	Cala, Cofimvaba, Dordrecht, Elliot, Indwe, Molteno, Middleburg, Sterkstroom, Tarkastad
Joe Gqabi DM	74.0%	Burgersdorp, Herschell, Sterkspruit, Steynsburg	Barkly East New Ponds, Oviston, Venterstad
Alfred Nzo DM	74.5%		Mt Ayliff, Matatiele, Cedarville, Bizana
Blue Crane Route LM	74.5%		All 3 plants
Dr Beyers Naude LM	78.7%		Aberdeen, Graaf-Reinet, Jansenville, Steytlerville, Willowmore
Kouga LM	80.5%	Hankey	Humansdorp, Kruisfontein, Loerie, St Francis, Thornhill
OR Tambo DM	80.7%		Ngqeleni, Lusikisiki, Port St Johns, Qumbu, Tsolo
Makana LM	81.7%		All 3 plants
Koukamma LM	86.3%	Louterwater, Clarkson, Coldstream, Kareedouw, Krakeelriver, Misgund, Stormsriver, Woodlands	Joubertina-Ravinia, Sanddrift
Ndlambe LM	93.5%	Alexandria, Bathurst, Kenton-on-sea, Rosehill Mall	Bushmans River Mouth, Port Alfred
Sundays River Valley LM	100.0%	All 4 plants	

Good practice risk management requires that the W$_2$RAPs are informed by meaningful Process and Condition Assessments, supported by zealous implementation of corrective measures and ongoing monitoring of risk movement. Nelson Mandela Bay is commended for maintaining all their treatment facilities in low and moderate risk positions - an exemplary status.

Performance Barometer

The **Green Drop Performance Barometer** presents the individual Municipal Green Drop Scores, which essentially reflects the level of mastery that a municipality has achieved in terms of its overall municipal wastewater services business. The bar chart below shows the comparison of the 2013 and 2021 GD scores, ranked the from highest to lowest performing WSI.

Buffalo City regressed from good to average performance; Nelson Mandela Bay and Amathole maintained the average performance; Joe Gqabi, Chris Hani, Makana and Kouga regressed from average to poor and critical performances respectively. In contrast, OR Tambo was the only WSA to demonstrate improvement, albeit from critical to poor performance.



	Buffalo City LM	Nelson Mandela Metro	Amathole DM	Joe Gqabi DM	Chris Hani DM	OR Tambo DM	Alfred Nzo DM	Kouga LM	Blue Crane LM	Ndlambe LM	Dr Beyers Naude*	Makana LM	KouKamma LM	Sundays River Valley LM	Camdebo o LM	Ikwezi LM
2013 GD Score	81%	65%	60%	50%	52%	20%	39%	53%	19%	13%	0%	62%	23%	36%	47%	56%
2021 GD Score	61%	58%	54%	47%	44%	41%	35%	19%	19%	17%	16%	9%	1%	0%	0%	0%

Figure 26 - a) Green Drop scores 2013 (left) and 2021 (bar right), with colour legend inserted

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	

The **Cumulative Risk Log** expresses the level of risk that a municipality pose in respect of its wastewater treatment facility. It is based on the ***individual Cumulative Risk Ratios***. Figure 27 presents the cumulative risks in ascending order – with the low-risk municipalities on the left and critical risk municipalities to the far right. All the wastewater systems are in high-risk and critical risk positions with the exception of Buffalo City, Nelson Mandela Bay and Amathole in the medium risk positions.

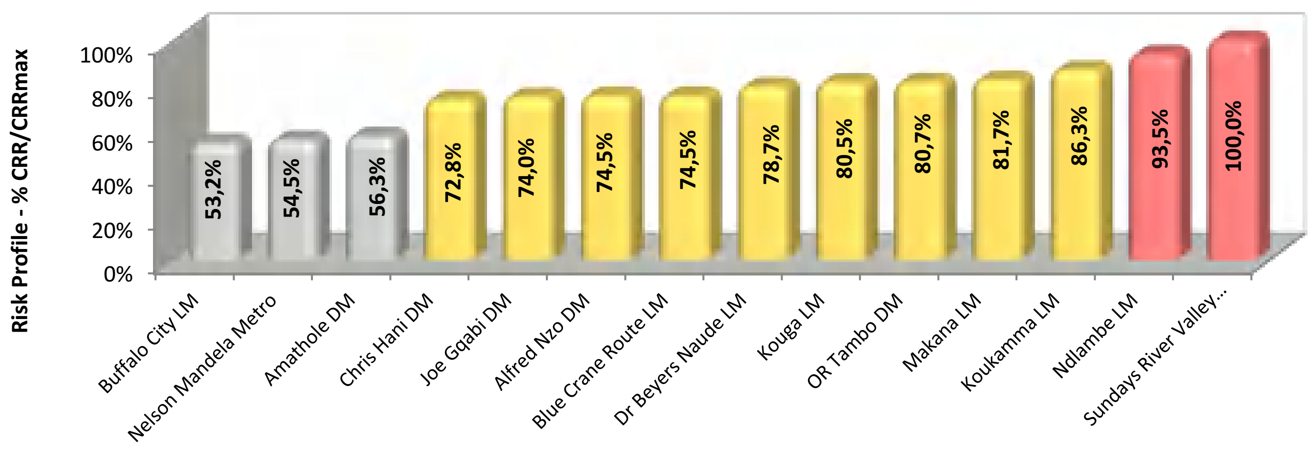


Figure 27 - a) %CRR/CRRmax Risk Performance Log 2021; b) Colour legend

90 – 100% Critical risk WWTPs	
70 - <90% High risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low risk WWTPs	

Provincial Best Performers

Buffalo City is the **BEST PERFORMING** municipality in the province, based on the following record of achievement:

- ✓ 61% Municipal Green Drop Score
- ✓ 2013 Green Drop Score of 81%
- ✓ %CRR/CRRmax decreased from 51.9% in 2013 to 53.2% in 2021
- ✓ 13 of 15 (87%) plants in the low and medium risk positions
- ✓ Technical Site Assessment scores of 85% (East Bank) and 46% (Mdantsane)

Nelson Mandela Bay is the second-best scoring municipality:

- ✓ 58% Municipal Green Drop Score
- ✓ All 7 plants in low & medium risk positions
- ✓ TSA scores of 56% (Kelvin Jones) and 63% (KwaNobuhle)

Amathole DM is the third best scoring municipality:

- ✓ 54% Municipal Green Drop Score
- ✓ 10 of 15 plants in low & medium risk positions
- ✓ TSA of 47% (Stutterheim)

KPA Diagnostics

The Green Drop Audit process collects a vast amount of data that yield valuable insight on the state of the wastewater sector in each Province. These insights have been captured into 7 thematic areas or 'Diagnostics', as discussed below.

Table 32 - Summary of the key diagnostic themes and reference to the respective Green Drop KPAs

Diagnostic #	Diagnostic Description	Diagnostic Reference
1	**Green Drop KPA Analysis**	KPAs A-E
2	**Technical Competence**	KPA A, B & Bonus
3	**Treatment Capacity**	KPA D
4	**Wastewater Monitoring and Compliance**	KPA B & D & Bonus
5	**Energy Efficiency**	KPA C & Bonus
6	**Technical Site Assessments**	TSA
7	**Operation, Maintenance and Refurbishment of Assets**	KPA C, D & Bonus

Diagnostic 1: Green Drop KPA Analysis

Aim: Analysis of technical skills, environmental plans, financial management, technical capacity, and regulatory compliance provides insight into the strengths and weaknesses of wastewater management in WSAs in the province. These insights in turn, may inform appropriate interventions and strategies to improve the individual KPAs and ultimately, collective KPA performance.

Findings: The Eastern Cape is characterised by a highly variable KPA profile. A good KPA profile typically depicts a high mean GD score, coupled with a low Standard Deviation (SD) between the outer parameters (min and max). Similarly, a well performing system is one which has most/all systems in the >80% bracket and no systems in the <31% bracket.

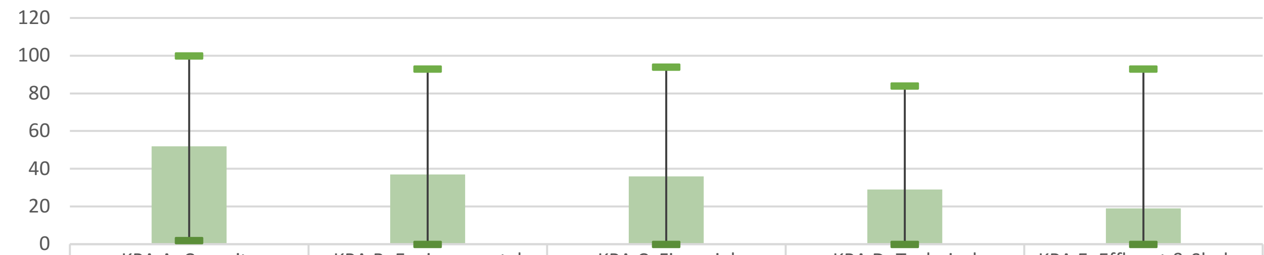
Table 33 - Green Drop scores KPA profiles (graph legend included)

KPA #	Key Performance Area	*Weight*	Minimum GD Score (%)	Maximum GD Score (%)	Mean GD Score (%)	# Systems <31%	# Systems ≥80%
A	Capacity Management	*15%*	2%	100%	**52%**	29 (24%)	37 (30%)
B	Environmental Management	*15%*	0%	93%	**37%**	45 (37%)	14 (11%)
C	Financial Management	*20%*	0%	94%	**36%**	37 (30%)	7 (6%)
D	Technical Management	*20%*	0%	84%	**29%**	68 (55%)	5 (4%)
E	Effluent and Sludge Compliance	*30%*	0%	93%	**19%**	90 (73%)	9 (7%)

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	

The KPA distribution indicates as follows:

- Capacity Management (KPA A) depicts the highest mean of 52%, highest maximum of 100%, highest minimum of 2%, and the highest Standard Deviation (SD) of 98%. These results indicate some strengths pertaining to the registration of WWTWs, maintenance plans and records, maintenance teams, and registered, qualified staff (process controllers, supervisors, scientists, technicians, engineers)
- Effluent and Sludge Quality Compliance (KPA E) received the lowest mean of 19%, indicating a deficiency in data management, IRIS upload, effluent quality compliance, and sludge quality compliance
- This was followed by the Technical Management (KPA D) that received the next lowest mean of 29%, indicating a deficiency in basic design information, inflow, outflow, meter reading credibility, process and condition assessments, site inspection reports, asset registers, asset values, bylaws and enforcement
- The mean decreased steadily from KPA A to KPA E.



	KPA A: Capacity Management	KPA B: Environmental Management	KPA C: Financial Management	KPA D: Technical Management	KPA E: Effluent & Sludge Compliance
Mean	52	37	36	29	19
Max	100	93	94	84	93
Min	2	0	0	0	0

Note: The High and low lines represent the Min and Max range, and the shaded green represents the Mean

Figure 28 - Maximum, minimum, and mean Green Drop KPA scores

The GD bracket performance distribution reiterates the above findings:

- ***KPA Score >80%:*** Capacity Management (KPA A) is the best performing KPA with 30% of systems achieving >80%, followed by Environmental Management (KPA B) with 11%. Technical Management (KPA D) was the worst performing KPA with only 4% achieving >80%, followed by Financial Management (KPA C) with 6%
- ***KPA Score <31%:*** Effluent and Sludge Compliance (KPA E) represent the worst performing KPA with 73% of systems lying in the 0-31% bracket, followed by Technical Management (KPA D) with 55% and Environmental Management (KPA B) with 37%.

Diagnostic 2: Technical Competence

Aim: This focus area assesses the human resources (technical) capacity to manage wastewater systems. Theory suggests a correlation between human resources capacity (sufficient number of appropriately qualified staff) and a municipality's performance and operational capability. It is expected that high HR capacity would translate to compliant wastewater services and protection of scarce water resources.

Findings: According to regulations, wastewater plants are classified as Class A, B, C, D or E plants. Similarly, Process Controllers and Plant Supervisors are registered as Class I, II, III, IV, V or VI operators. Higher classed plants require a higher level of operators due to their complexity and strict regulatory standards. Technical compliance of Process Controllers and Supervisors is determined against Green Drop standards, as defined by Reg. 2834 and draft Reg. 813 of the National Water Act 1998.

Table 34 – Number of compliant versus shortfall in Supervisor and Process Controller staff

WSA Name	# WWTWs	# Compliant staff		# Staff Shortfall		Ratio*	WSA 2021 GD Score (%)
		Supervisor	PCs	Supervisor	PCs		
Joe Gqabi	15	1	10	3	16	0.7	47%
Alfred Nzo	6	1	19	1	0	3.3	35%
OR Tambo	6	1	12	1	3	2.2	41%
Chris Hani	16	7	18	3	21	1.6	44%
Buffalo City	15	8	15	1	16	1.5	61%
Nelson Mandela Bay	7	4	12	2	9	2.3	58%
Kouga	7	1	0	1	22	0.1	19%
Sundays River Valley	4	0	0	1	5	0	0%
Makana	3	0	2	1	6	0.7	9%
Ndlambe	6	0	1	1	9	0.2	17%
Blue Crane	3	1	3	0	0	1.3	19%
Dr Beyers Naude	8	1	4	2	7	0.6	16%
Koukamma	12	0	1	3	17	0.1	1%
Amathole	15	8	34	0	7	2.8	54%
EC Totals	**123**	**33**	**131**	**20**	**138**		

** The Ratio depicts the number of qualified staff divided by the number of WWTWs operated by this number of staff*
Note: "Compliant staff" means staff that meets the GD standard i.e., qualified and registered in terms of the Green Drop standards for a particular Class Works. "Staff shortfall" means staff that do not meet the GD standard for a particular Class of works (+1 for a shift) and/or staffing gaps exist at the respective WWTWs.

Competent human resources are a vital enabler to ensure efficient and sustainable management of treatment processes and infrastructure. For the Eastern Cape, the operational competencies are not on par with regulatory expectations, as illustrated by the high shortfalls against the Green Drop standards.

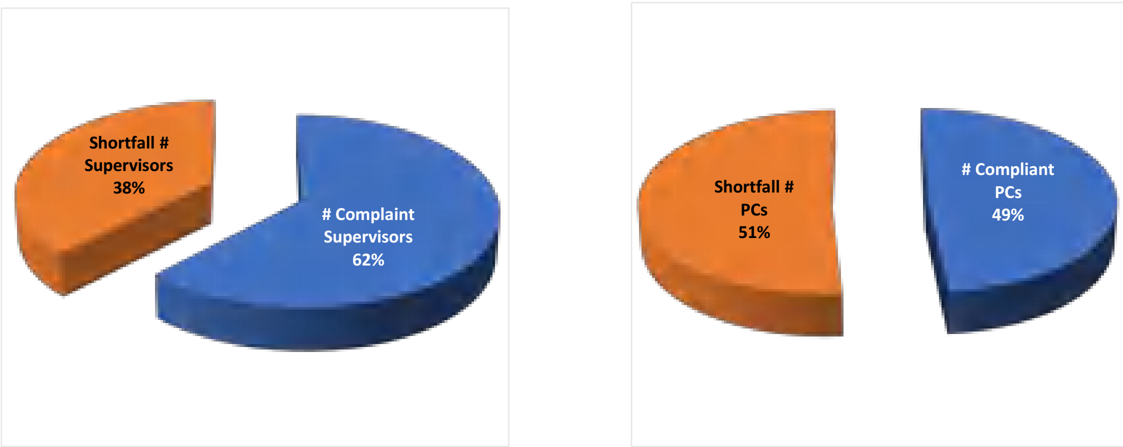


Figure 29 - Schematic illustration of compliant versus non-compliant Supervisors (a) and Process Controllers (b)

Plant Supervisors: The pie charts indicate that 62% (33 of 53) of Plant Supervisors complies with the Green Drop standard, with zero shortfall for Blue Crane and Amathole. A 38% (20 of 53) shortfall is noted for Supervisors overall, with the highest shortfall seen at Joe Gqabi, Chris Hani and Koukamma (3 no. each).

Process Controllers: Similarly, 49% (131 of 269) of the PC staff is compliant for EC, with a zero shortfall in Blue Crane and Alfred Nzo. There is a 51% (138 of 269) shortfall in PCs with the highest shortfall for Kouga (22 no.), followed by Chris Hani (21 no.), Koukamma (17 no.), Joe Gqabi and Buffalo City (16 no. each).

Green Drop standards require of Class A and B plants to employ dedicated Supervisors and Process Controllers per shift per Works, whereas Class C to E plants may consider sharing of staff across works. Furthermore, shifts have been introduced to ensure optimal operations while addressing security risks, particularly as it relates to vandalism. Telemetry also reduces the requirement for on-site staff during night shifts, but these relaxations will have to be done within the DWS regulatory guidelines.

It is expected that a correlation would exist between the competence of an operational team and the performance of a treatment plant, as measured by the GD score. The results from the ratio analysis indicate high ratios for Alfred Nzo, OR Tambo, Nelson Mandela Bay and Amathole, and reasonably high ratios for Chris Hani, Blue Crane, and Buffalo City.

Overall, the comparative bar chart confirms a correlation between municipalities with high ratios and high GD scores, whereas lower ratios are associated with lower GD scores. The exceptions are Alfred Nzo that has a low GD score but the highest ratio of 3.3 and Blue Crane having a low GD score of 19% with a >1 ratio.

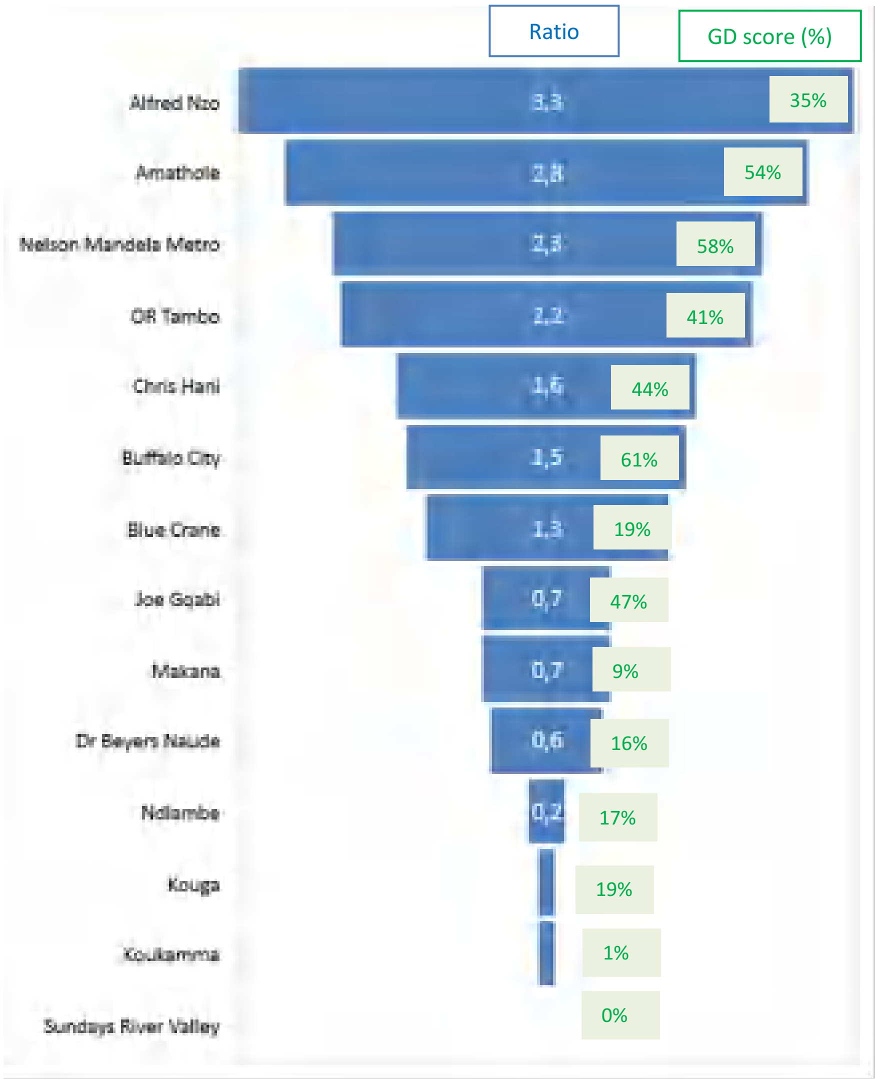


Figure 30 - Ratio of compliant operational staff to no. of WWTWs and Comparison of Ratios with GD scores

In addition to operational capacity, good management practice also requires access to qualified engineers, technicians, technologists, scientists, and maintenance capability. Such competencies could reside in-house or accessible through term contracts and external specialists.

Table 35 - Summary of the maintenance capacity and no. of qualified and shortfall of Engineering, Technical and Scientific staff

WSA Name	# WWTW	Maintenance Arrangement	Qualified Technical Staff (#)				Technical Shortfall (#)	Qualified Scientists (#)	Scientists Shortfall (#)	Ratio*	WSA 2021 GD Score (%)
			Engineers	Technologists	Technicians	Total					
Joe Gqabi	15	Internal Team (Only)	0	0	1	1	1	0	1	0.1	47%
Alfred Nzo	6	Internal + Term Contract	0	0	0	0	2	2	0	0	35%
OR Tambo	6	Internal + Term Contract; Internal + Specific Outsourcing	0	3	2	5	0	0	1	0.8	41%
Chris Hani	16	Internal Team (Only)	0	2	3	5	0	2	0	0.3	44%
Buffalo City	15	Internal + Specific Outsourcing	0	0	1	1	1	8	0	0.1	61%
Nelson Mandela Bay	7	Internal + Specific Outsourcing	0	2	3	5	0	2	0	0.7	58%
Kouga	7	Internal + Specific Outsourcing	4	0	1	5	0	0	1	0.7	19%
Sundays River Valley	4	Partially Capacitated	0	0	0	0	2	0	1	0	0%
Makana	3	Inadequate Capacity	3	0	0	3	0	0	1	1	9%
Ndlambe	6	Inadequate Capacity	0	0	1	1	1	0	1	0.2	17%
Blue Crane	3	Internal Team (Only)	0	1	0	1	1	0	1	0.3	19%
Dr Beyers Naude	8	Interna l+ Term Contract	0	0	0	0	2	0	1	0	16%

WSA Name	# WWTW	Maintenance Arrangement	Qualified Technical Staff (#) Engineers	Technologists	Technicians	Total	Technical Shortfall (#)	Qualified Scientists (#)	Scientists Shortfall (#)	Ratio*	WSA 2021 GD Score (%)
Koukamma	12	Inadequate Capacity	0	0	0	0	2	0	1	0	1%
Amathole	15	Internal Team (Only)	1	1	0	2	0	0	1	0.1	54%
EC Totals	**123**		**8**	**9**	**12**	**29**	**12**	**14**	**10**		

** The Ratio depicts the number of qualified technical staff divided by the number of WWTWs that have access to the staff*

Note 1: "Qualified Technical Staff" means staff appointed in positions to support wastewater services, and who has the required qualifications. "Technical Shortfall" is calculated based on a minimum requirement of at least 2 Engineers/Technologists/Technicians and at least one 1 Scientist per WSI.

Note 2: "Qualified Scientists" means professional registered scientists (SACNASP) appointed in positions to support wastewater services. "Scientists shortfall" means that the WSA does not have at least one qualified, SACNASP registered scientist in their employ or contracted.

The Eastern Cape has a reasonable contingent of qualified maintenance staff for at least 10 of the 14 WSAs, with the current qualified maintenance staff from a collective of inhouse, contracted or outsourced personnel. In terms of maintenance capacity, Eastern Cape has several maintenance arrangements in place via in-house maintenance teams, in combination with contracted private service providers. The data indicates that:

- 10 WSAs have in-house maintenance teams
- 3 WSAs have internal maintenance teams supplemented with term contracts
- 4 WSAs have internal maintenance teams supplement with specific outsourced services.
- 4 WSAs have inadequate capacity or are partially capacitated.

For qualified technical staff across the WSAs, the data indicates as follows:

- A total of 43 qualified staff, comprising of 8 engineers, 9 technologists, 12 technicians (qualified) and 14 SACNASP registered scientists are assigned to the 14 municipalities
- A total shortfall of 22 persons is identified, consisting of 12 technical staff and 10 scientists
- Most of the municipalities have some shortfall in qualified technical staff, with the exception of OR Tambo, Chris Hani, Nelson Mandela Bay, Kouga, Makana and Amathole
- 50% of WWTWs have access to water laboratories that complies with Green Drop standards.

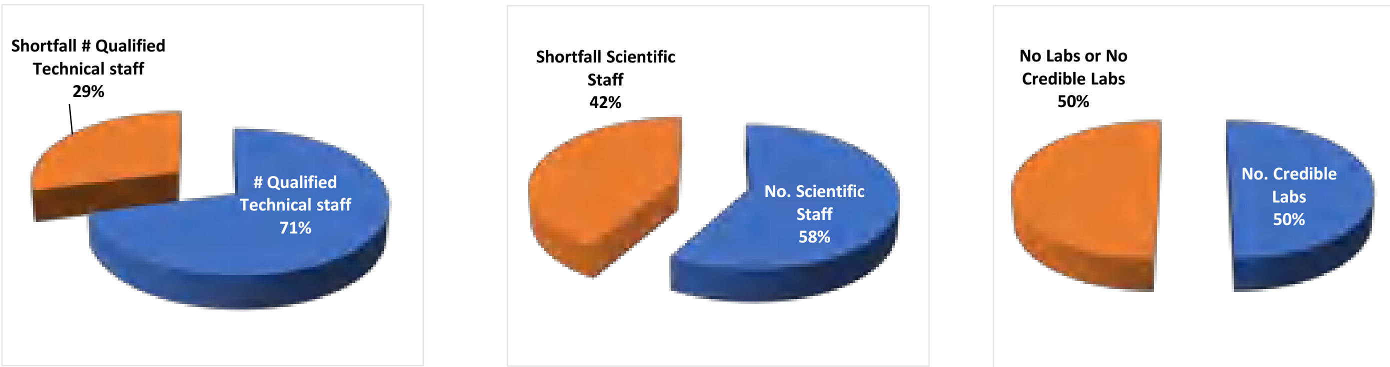


Figure 31 - Graphic illustration of the number and %: a) qualified engineering/technical staff; b) professional scientists; c) access to credible laboratory services that complies with Green Drop standards

Ratio analysis has been done to determine the number of qualified technical and scientific staff assigned per WWTW. It is expected that a higher ratio would correspond with well-performing and maintained wastewater systems, as represented by the GD score. Table 35 shows a reasonable correlation between high ratios and high GD scores for OR Tambo 41%, Nelson Mandela Bay 58%, and Chris Hani 44%. Likewise, a reasonable correlation was found between lower ratios and lower Green Drop scores (Sundays River Valley 0%, Dr Beyers Naude 16% and Koukamma 1%). However, there are some anomalies observed. The results suggest that wastewater performance is less sensitive to engineering, technical and scientific staff, and more dependent on operational capacity.

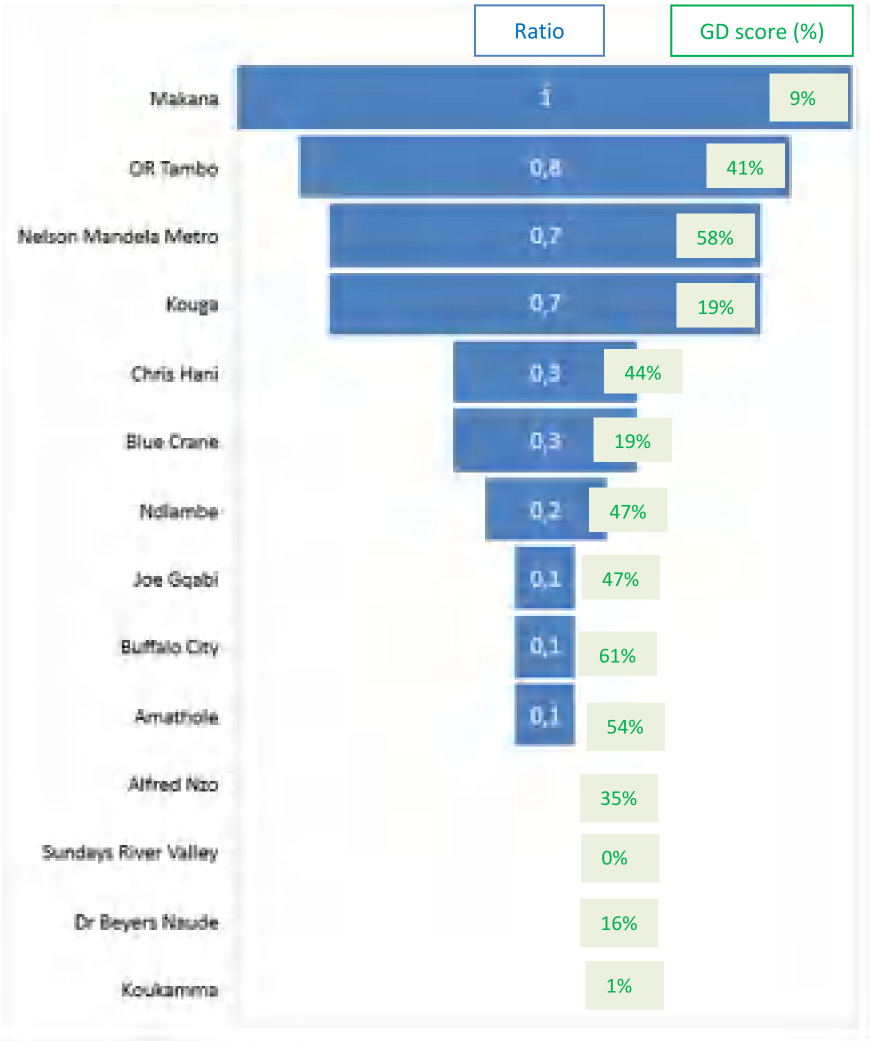


Figure 32 - Ratio of compliant technical staff to no. of WWTWs and Comparison of Ratios with GD scores

One of the options to enhance operational capacity is through dedicated training programmes. The Green Drop audit incentivises training of operational staff over the 2-year period prior to the audit date. The results are summarised as follows:

Table 36 - Number of WWTWs with operational staff sent on training over the past 2 years and vice versa

WSA Name	# of WWTW staff attending training over past 2 years	# of WWTW without training over past 2 years
Joe Gqabi	2	13
Alfred Nzo	5	1
OR Tambo	1	5
Chris Hani	5	11
Buffalo City	10	5
Nelson Mandela Bay	6	1
Kouga	0	7
Sundays River Valley	0	4
Makana	0	3
Ndlambe	5	1
Blue Crane	0	3
Dr Beyers Naude	0	8
Koukamma	0	12
Amathole	13	2
Totals	**47 (38%)**	**76 (62%)**

Figure 33 - %WWTWs that have trained operational staff over the past two years

The results confirmed that only 47 systems (38%) had operational staff attending training over the past 2 years. Training gaps persist in many of the WSAs and require a concerted effort to strengthen training initiatives of Supervisors and Process Controllers. Recent training events focused primarily on chlorine handling and NQF, and needs to be expanded to operation of technology, sludge treatment and energy efficiency.

Diagnostic 3: Treatment Capacity

Aim: A capable treatment plant requires adequate design capacity and functional equipment to operate optimally. If the plant capacity is exceeded by way of inflow volume or strength, the plant will not be capable to achieve its compliance standards. Capacity is typically exceeded when the demand exceeds the installed design capacity, or when processes or equipment is not operational or dysfunctional, or when the electrical supply cannot support the treatment infrastructure. This diagnostic assesses the status of plant capacity and operational flows to the plants.

Findings: Analysis of the hydraulic capacities and operational flows indicate a total design capacity of 540 Ml/d for the province, with a total inflow of 323 Ml/day (considering that 41 systems are not measuring their inflows). Theoretically, this implies that approximately 60% of the design capacity is used with 40% available to meet additional demand. However, the full 540 Ml/d day is not fully available as some infrastructure is dysfunctional, leaving 531 Ml/d available. Furthermore, the operational flow excludes data from 41 WWTWs that are not measuring flow, which would take up a significant portion of the installed capacity.

Most plants in the Eastern Cape are operating within their design capacities, except for Joe Gqabi and Makana with capacity exceedance of 110% and 117% respectively. Alfred Nzo, Chris Hani, Kouga, Ndlambe, Dr Beyers Naude, Koukamma and Amathole report a low usage of their capacity (<50%). Treatment systems with low use may have been affected by breakdown in sewer networks or pump stations whereby all sewage is not reaching the WWTW and/or are not measuring the inflow into some of their systems and therefore producing skewed results. The Green Drop audit requires a wastewater flow balance to identify and quantify possible losses in the network and/or ingress into the sewers. It was noted that the majority of municipalities do not have flow balances to track the wastewater pathway from consumer to treatment plant.

Table 37 - Summary of WWTWs design and available capacities, inflows, % use design capacities, and inflows measured per WWTW

WSA Name	# WWTWs	Design Capacity (Ml/d)	Available Capacity (Ml/d)	Operational Flow (Ml/d)	Variance (Ml/d)	% Use Design Capacity	Inflow measured #
Joe Gqabi	15	18.8	18.3	20.7	-1.9	110%	13
Alfred Nzo	6	7.0	7.0	1.6	5.4	23%	3
OR Tambo	6	32.0	31.0	19.8	12.2	62%	2
Chris Hani	16	47.5	45.5	17.8	29.8	37%	9
Buffalo City	15	155.5	154.0	86.9	68.6	56%	15
Nelson Mandela Bay	7	203.8	201.8	143.4	60.3	70%	7
Kouga	7	16.6	16.6	6.3	10.4	38%	4
Sundays River Valley	4	4.7	4.6	NI	4.7	NI	0
Makana	3	8.9	8.9	10.3	-1.5	117%	3
Ndlambe	6	9.2	9.2	3.6	5.6	39%	3
Blue Crane	3	4.0	2.9	2.1	1.8	54%	2
Dr Beyers Naude	8	8.7	8.7	3.7	5.0	42%	2
Koukamma	12	4.6	4.6	0.8	3.8	18%	4
Amathole	15	19.4	17.9	6.3	13.0	33%	15
EC Totals	**123**	**540.6**	**531.0**	**323.4**	**217.2**	**60%**	**82**

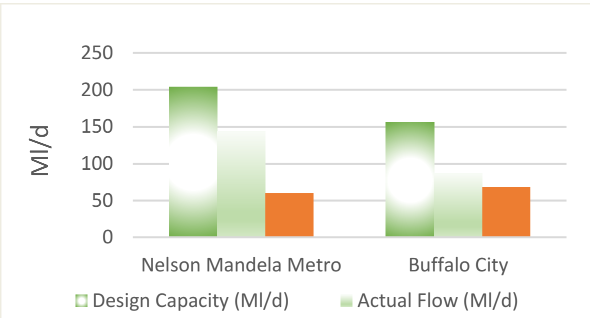


Figure 34 - WSA design capacity, actual flow, and variance in Ml/d for larger sized WWTWs

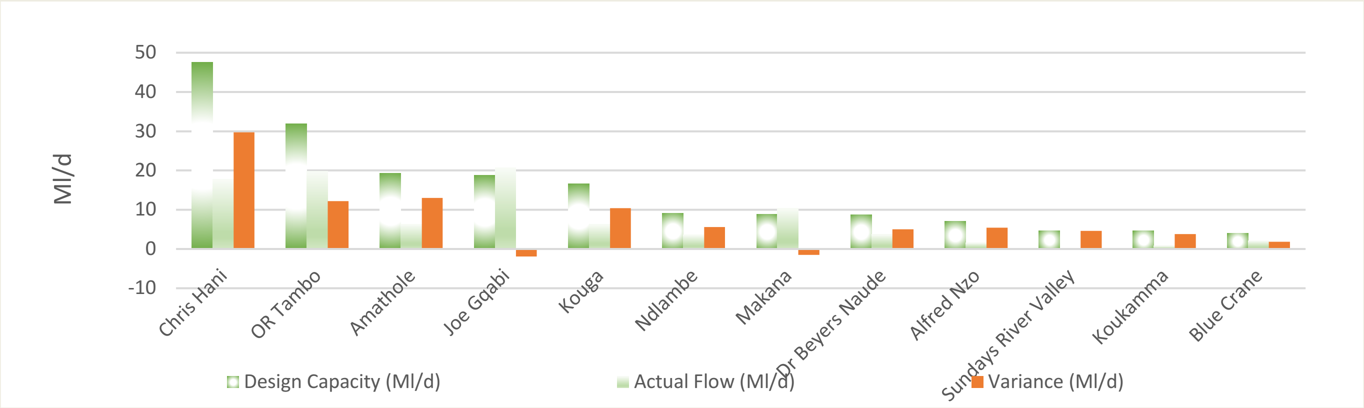


Figure 35 - WSA design capacity, actual flow, and variance in Ml/d for smaller sized WWTW

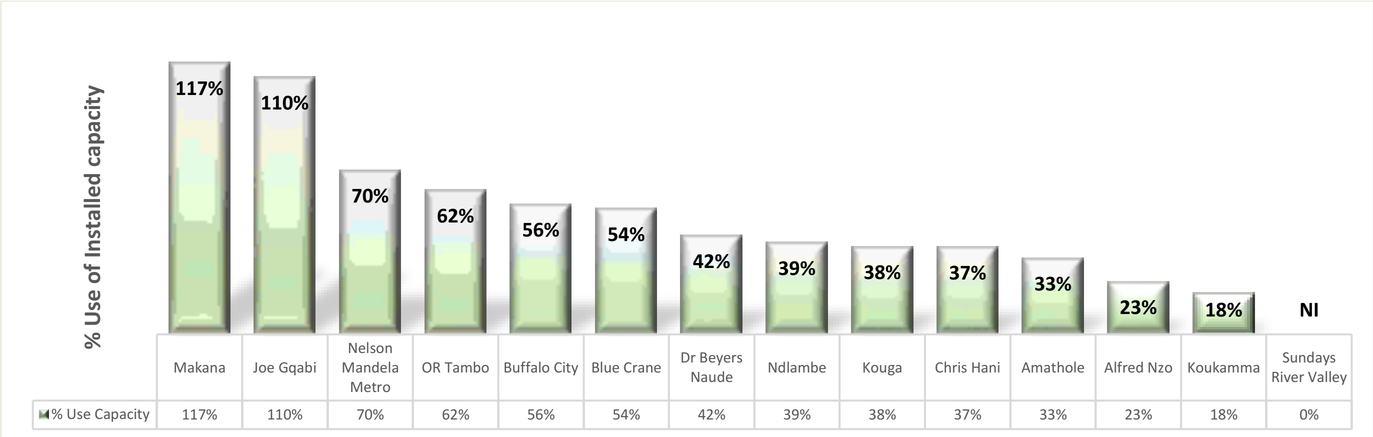


Figure 36 - WSA % use of installed design capacity

The audit data indicates that 20 systems are hydraulically overloaded. This figure could theoretically be higher, given that there are 41 systems where inflow monitoring is not taking place. The capacity limitations may impede social and economic development in the drainage areas, if not addressed. The hydraulically overloaded systems in each of the WSAs is as follows:

- Joe Gqabi: 5 of 15 systems (Aliwal North, Barley east Ponds, Burgersdorp, Prentjiesberg, Sterkspruit)
- OR Tambo: 1 of 6 systems (Lusikisiki)
- Chris Hani: 2 of 16 systems (Cofimvaba, Tsomo)
- Buffalo City: 3 of 15 systems (Breidbach, Kidds Beach and Schornville)
- Kouga: 1 of 7 systems (Humansdorp)
- Makana: 2 of 3 systems (Belmont Valley and Mayfield)
- Ndlambe: 1 of 6 systems (Kenton on Sea)
- Koukamma: 2 of 12 systems (Joubertina-Ravinia and Sanddrift)
- Amathole: 3 of 15 systems (Amabele, Keiskammahoek and Peddie).

Water Use Authorisations mandate municipalities to install meters and monitor inflows, whilst GD requires WSAs to report inflows on IRIS and to calibrate meters annually. The audit results indicate that only 67% (82 of 123) of WSAs monitor their inflow. Buffalo City, Nelson Mandela, Makana and Amathole monitor inflow to their treatment plants. The majority of WSAs do not calibrate or verify their flow meters on an annual basis, thereby failing to meet good practice standards.

Diagnostic 4: Wastewater Monitoring and Compliance

Aim: "To measure is to know" and "To know is to manage". The primary objective of a wastewater treatment plant is to produce final effluent and biosolids to a safe standard. This standard cannot be measured or managed if operational and compliance monitoring is lacking. This diagnostic assesses the monitoring status and final effluent compliance against each WWTW's mandatory standards.

Findings: For operational monitoring, a satisfactory level of 90% is applied as the benchmark, to give weight to the importance of monitoring. For compliance monitoring, the audit evaluates the sampling point, sampling frequency, final effluent quality, biomonitoring, heavy metals, and any specific condition that the DWS may have included in the water use license. Final effluent quality compliance is calculated against the mandatory limits as listed under "Authorisation Status".

A >90% compliance figure confirms high quality final effluent, whereas a <30% indicates poor effluent quality. The enforcement measures are summarised in the last column (Table 39) and include NWA Notices and Directives issued, criminal cases opened, and court interdicts granted during the period 1 April 2019 to 30 June 2021.

Table 38 - Summary of the WSA operational and compliance monitoring status

WSA Name	# WWTW	Operational monitoring (KPA B2)		Compliance monitoring (KPA B3)	
		Satisfactory [GD score >90%]	Not Satisfactory [GD score <90%]	Satisfactory [GD score >90%]	Not Satisfactory [GD score <90%]
Joe Gqabi	15	2	13	13	2
Alfred Nzo	6	0	6	0	6
OR Tambo	6	0	6	1	5
Chris Hani	16	3	13	9	7
Buffalo City	15	12	3	0	15
Nelson Mandela Bay	7	3	4	0	7
Kouga	7	0	7	0	7
Sundays River Valley	4	0	4	0	4
Makana	3	0	3	0	3
Ndlambe	6	0	6	0	6
Blue Crane	3	0	3	0	3
Dr Beyers Naude	8	0	8	0	8
Koukamma	12	0	12	0	12
Amathole	15	2	13	9	6
EC Totals	**123**	**22 (18%)**	**101 (82%)**	**32 (26%)**	**91 (74%)**

The performance recorded in Table 39 stems from performance data as measured against the Green Drop Standard expressed in KPAs B2 and B3. The data indicates that only 22 plants (18%) are on par with good practice for operational monitoring of raw sewage and the respective units responsible for the processing of effluent and sludge. Buffalo City with 12 of 15 plants meeting the standard is doing exceptional work on compliance monitoring, whilst the remaining municipalities are not meeting the Green Drop standard.

Overall, an unsatisfactory sampling and analysis regime is observed for both operational (82%) and compliance (74%) monitoring. This is a concerning observation. Compliance monitoring is a legal requirement and the only means to measure performance of a treatment facility. Operational monitoring is the cornerstone of day-to-day process adjustments and optimisation, to ensure treatment is efficient and delivers quality effluent/sludge that meets the design expectations. Sludge monitoring is also essential as poor sludge handling is the root cause of many WWTWs failing to meet final effluent standards. The results indicate that the WSAs on average, are not achieving regulatory and industry standards.

Table 39 summarises the results of KPA E, which also carries the highest Green Drop score weighting. Note that all averages shown as '0%' under Effluent Compliance, include actual 0% compliance plus systems with no information or insufficient data.

Table 39 - Summary of authorisation status, effluent compliance status, and directives/notices issued

WSA Name	Authorisation Status	Effluent Compliance									Enforce-ment Measures*
		Microbiological Compliance (%)			Chemical Compliance (%)			Physical Compliance (%)			
		Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	
Joe Gqabi	7 WUL; 3 GA; 3 Not authorised; 1 Unknown; 1 Permit	45%	5	8	44%	2	6	48%	2	6	2
Alfred Nzo	5 GA; 1 Not authorised	0%	0	6	0%	0	6	0%	0	6	1
OR Tambo	3 WUL; 1 GA; 2 Not authorised	1%	0	6	5%	0	5	13%	0	5	1
Chris Hani	8 GA; 5 Not authorised; 1 Exempted; 2 Permit	27%	4	12	28%	3	11	39%	4	8	4
Buffalo City	3 WUL; 3 Not authorised; 9 Exempted	39%	2	8	56%	6	5	60%	7	5	0
Nelson Mandela Bay	2 WUL; 1 Not authorised; 4 Exempted	52%	1	1	61%	0	0	75%	3	0	1

WSA Name	Authorisation Status	Effluent Compliance									Enforce-ment Measures*
		Microbiological Compliance (%)			Chemical Compliance (%)			Physical Compliance (%)			
		Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	
Kouga	1 GA; 2 Not authorised	0%	0	7	0%	0	7	0%	0	7	1
Sundays River Valley	1 GA; 3 Not authorised	0%	0	4	0%	0	4	0%	0	4	0
Makana	1 WUL; 2 Not authorised	0%	0	3	0%	0	3	0%	0	3	1
Ndlambe	1 WUL; 4 GA; 1 Not authorised	0%	0	6	0%	0	6	0%	0	6	0
Blue Crane	1 WUL; 1 GA; 1 Permit	0%	0	3	0%	0	3	0%	0	3	1
Dr Beyers Naude	1 GA; 7 Not authorised	0%	0	8	25%	2	6	0%	0	8	1
Koukamma	12 Not authorised	0%	0	12	17%	2	10	0%	0	12	6
Amathole	9 GA; 1 Not authorised; 1 Unknown; 2 Permit; 2 Exempted	36%	4	10	38%	4	9	39%	4	9	3
EC Totals		**14%**	**16**	**94**	**20%**	**19**	**81**	**20%**	**20**	**82**	**22**

** The enforcement measures (notices or directives issued) are taken over a two-year financial period from July 2019 to June 2021*

Overall the municipalities fared poorly in terms of final effluent quality compliance. There was a 14% compliance with microbial effluent quality, 20% with chemical, and 20% with physical effluent quality. For the microbiological compliance category, 16 systems achieved >90% and 94 systems fell below 30%. For the chemical compliance category, 19 systems achieved >90% and 81 systems fell below 30%. For the physical compliance category, 20 systems achieved >90% and 82 systems fell below 30%.

A total of 22 Directives/Notices have been issued to 11 municipalities. Koukamma (6 no.), Chris Hani (4 no.), and Amathole (3 no.) have the highest number of enforcement measures initiated by the Regulator. These require municipal leadership intervention and correction action.

In terms of sludge monitoring and compliance status, it is found that:

- 26 WWTWs (21%) classify their biosolids according to the WRC Sludge Guidelines, with 24 (of 37 total) WWTWs linked to the Buffalo City, Nelson Mandela Bay and Amathole
- Only 6 WWTWs (5%) monitor sludge streams with 5 (of 7 total) plants linked to Nelson Mandela Bay
- 19 WWTWs (15%) have Sludge Management Plans in place, with 16 (of total 18) linked to the Nelson Mandela Bay and Amathole
- 16 WWTWs (13%) use sludge mostly for agricultural purposes and landfill.

The data confirmed that only 7 of 14 (50%) of the WSAs have access to credible laboratories for compliance and operational analysis. These in-house or contracted laboratories have been accredited and/or have Proficiency Testing Schemes with suitable analytical methods and quality assurance. At 50%, the Eastern Cape is not meeting the regulatory requirement that all WSAs have access to analytical services for compliance, operational and sludge monitoring.

Diagnostic 5: Energy Efficiency

Aim: The wastewater industry offers many opportunities to respond to climate change challenges by improving energy efficiency, reducing greenhouse gases, and generating energy. The energy cost of sophisticated treatment technologies are in the order of 25-40% of the O&M budget (cited WRC 2021). This diagnostic investigates the status of energy efficiency management at a provincial level with an aim to motivate for improved operational wastewater treatment efficiency.

Findings: The audit results indicate an overall low awareness of energy management in the province. Only one municipality (OR Tambo) conducted baseline energy audits and only 3 municipalities could report on electricity cost as R/kWh, viz. Chris Hani (2 of 15 systems), Nelson Mandela Bay (6 of 7 systems) and Kouga (5 of 7 systems). Limited energy efficiency initiatives are in place, and none of the municipalities could account for CO_2 equivalents associated with energy efficiency. The majority of the WWTWs exceed the industry benchmarks for their respective technology type, except for Kouga's Hankey WWTW that fell below the technology SPC benchmark.

Benchmark 1: Estimated energy intensity for large WWTW is in order of [illegible] kWh/m³

- 0.177 kWh/m³ for trickling filter
- 0.272 kWh/m³ for activated sludge
- 0.314 kWh/m³ for advanced treatment
- 0.412 kWh/m³ for advanced treatment with nitrification

Benchmark 2: Energy requirements per plant size

Plant capacity, Ml/d	[illegible]	2	10	25	100
Trickling filter, kWh/m³	0.43	[illegible]	0.25	[illegible]	0.16
Activated sludge, kWh/m³	0.59	[illegible]	0.37	[illegible]	[illegible]

Tariffs are typically depends on time of day and season e.g.

- Peak rate: [illegible] c/kWh
- Off-peak time: [illegible] c/kWh

Standard time: 117.57 - 87.12 c/kWh [illegible]

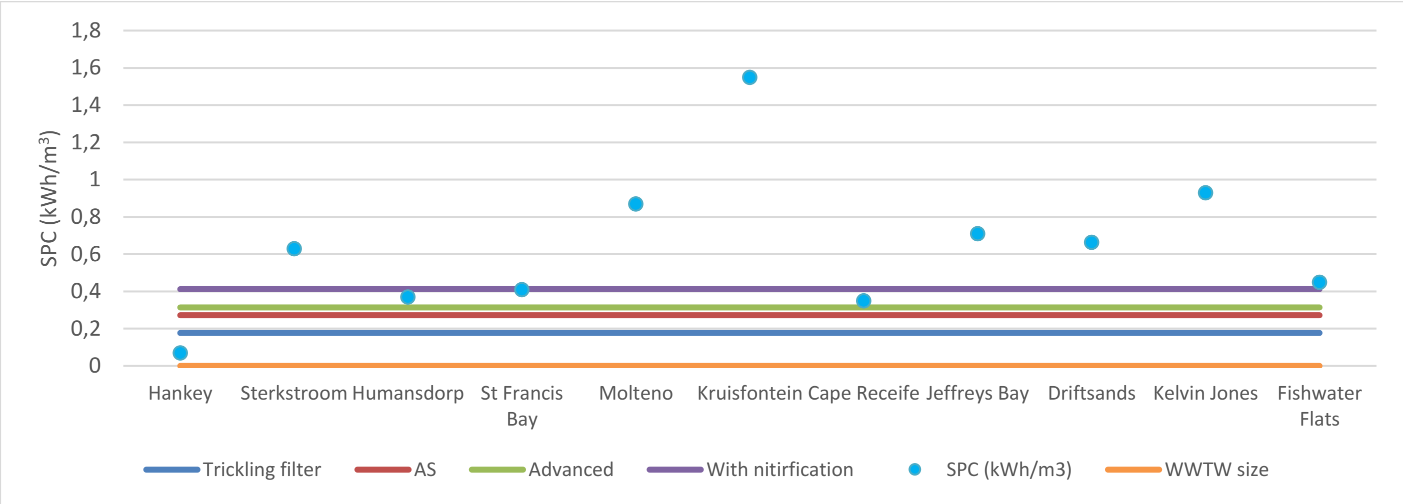


Figure 37 - Specific Power Production per municipal WWTW (kWh/m³) in order of increased design capacity, and compared to international technology benchmarks

The information indicates that most municipalities have not established a specific report to monitor energy as part of their wastewater business. With some exceptions, energy efficiency management is still not embedded in the provincial municipal sector, and potential cost savings and environmental gains are forfeited.

Diagnostic 6: Technical Site Assessments

Aim: The Green Drop process makes provision for the desktop audit to be followed by a Technical Site Assessment (TSA) in order to verify the desktop evidence. The assessment includes physical inspection of the sewer network, pump stations, and treatment facility, coupled with asset condition checks to determine an approximate cost to restore existing infrastructure to functional status (VROOM).

Findings: The results of the Eastern Cape TSAs are summarised in Table 40. A deviation of >10% between the GD and TSA score indicates a poor correlation between the administrative aspects and the work on the ground. The Regulator regards a wastewater system with a TSA score of >80% as one that has an acceptable level of process control and functional equipment. A TSA score of 90% would represent an excellent plant that complies with most of the Green Drop TSA standards.

Table 40 - Summary of the WWTW Technical Site Assessments scores and hardware problems and %deviation between GD and TSA scores

WSA Name	TSA WWTW Name	WWTW GD Score (%)	%TSA	Key Hardware Problems	Difference between TSA & GD score
Amathole	Stutterheim	52%	47%	1. Aerators; 2. Secondary clarifier; 3. 5. Screening	5%
Kouga	Humansdorp	9%	11%	1. Security	2%
Nelson Mandela Bay	Kelvin Jones	76%	56%	1. Screens; 2. Sludge wasting & disposal; 3. Clarifiers	20%
	KwaNobuhle	66%	63%	1. Sludge lagoons fencing; 2. Sludge disposal	3%
Buffalo City	East Bank	73%	85%	1. Screening; 2. Sludge wastage; 3. Disposal of the dried/stabilised sludge	12%

WSA Name	TSA WWTW Name	WWTW GD Score (%)	%TSA	Key Hardware Problems	Difference between TSA & GD score
	Mdantsane	63%	46%	Screens required at Mdantsane, Digesters to be cleaned. Chlorination to be repaired and secured.	17%
Sundays River Valley	Kirkwood	0%	28%	1. Flow meters; 2. RAS pumps; 3. Sludge drying; 4. Scum removal and clarification	28%
Ndlambe	Kenton on Sea	15%	22%	1. Capital upgrade work did not address key deficiencies; 2. Plant not operational; 3. Sludge handling inefficient; 4. Flow metering absent; 5. Pump station maintenance lacking.	7%
Makana	Alicedale	1%	27%	1. Flow measurement to be Implemented; 2. Sludge management to be addressed; 3. Loading and quality to be determined; 4. Maintenance of existing infrastructure to be addressed	26%
OR Tambo	Mthatha	42%	48%	1. Emergency shower that is not working; 2. Sludge mixing pumps for the digester of the new plant are not working; 3. Maintenance of the old section of the plant needs attention	6%
Alfred Nzo	Mt Ayliff	35%	61%	1. Fencing of the wastewater treatment system; 2. Sludge lagoons lining	26%
Chris Hani	Sada	43%	51%	1. Digesters; 2. Raw sludge pumps; 3. Biofilter booms; 4. Humus sludge pumps	8%
Joe Gqabi	Aliwal North	40%	44%	1. Aerators (both modules); 2. RAS pumps (Module 1); 3. Sludge drying (new beds needed)	4%
Blue Crane Route	Somerset East	17%	41%	1. The network is poorly managed at somerset east, pump station was flooded and not working at all due to vandalism; 2. Settling tanks were not working due to final effluent pump that trips	24%
Koukamma	Stormsriver	25%	20%	1. Security; 2. Facilities; 3. Head od Works; 4. Reactor clean	5%
Dr Beyers Naude	Graaff-Reinet	22%	29%	1. Security; 2. Screens; 3. Clarifiers; 4. Chlorine; 5. Sludge Drying	7%
Totals	**16**				**2% to 28%**

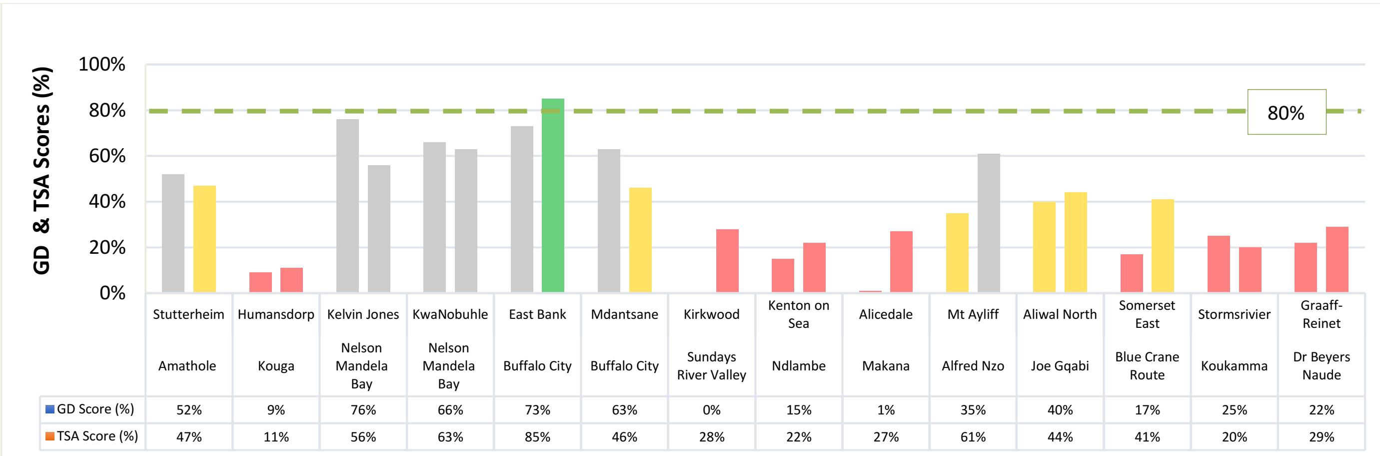


Figure 38 - Municipal GD (bar left) and System TSA score (bar right) comparison (colour legends as for GD – blue excellent; red critical)

A total of 16 site assessments were conducted, with 1 to 2 inspections per municipality. Only Buffalo City scored above 80%, which is considered to be a satisfactory site score, with 11 of the 16 systems achieving poor scores of <50%. A low TSA score would indicate a WWTW failed to meet operational, asset functionality, and workplace safety standards.

A low percentage deviation between GD and TSA scores were observed for most of the WSAs, except for Sundays River Valley (28%), Makana and Alfred Nzo (26% each), Blue Crane (24%) and Nelson Mandela Bay (20%). This represents an ideal situation as a low deviation confirms that the wastewater management aspects correlate with the condition of processes and infrastructure in the field. Some focal points include:

- East Bank of Buffalo City impressed with a high TSA score of 85% and a GD score of 73%
- The large deviations between the TSA scores and GD scores do not reflect positively on the operation and functionality of the sewer network and treatment processes.

The VROOM cost presents a ''very rough order of measurement” cost to return a WWTWs functionality to its original design. A total budget of approximately R654 million is estimated for WSAs in the province, with the bulk of the work required in restoration of mechanical equipment (37%) and civil structures (45%).

Table 41 - VROOM cost split for civil, mechanical, and electrical and total VROOM cost estimate

WSA	Civil cost estimate	Mechanical cost estimate	Electrical & C&I cost estimate	Total VROOM cost
Amathole	R14,873,126	R28,788,514	R12,675,960	R54,337,600
Kouga	R52,825,340	R69,810,980	R47,220,079	R169,856,400
Nelson Mandela Bay	R61,643,450	R39,227,650	R11,207,900	R112,079,000
Buffalo City	R80,947,080	R23,511,600	R7,501,320	R111,960,000
Sundays River Valley	R9,068	R1,311,161	R493,272	R1,813,500
Ndlambe	R812,503	R135,417	R608,599	R1,556,520
Makana	R8,323,473	R4,506,420	R3,068,738	R8,407,500
OR Tambo	R1,939,834	R4,694,725	R9,666,570	R16,301,130
Alfred Nzo	R1,616,900	R0	R0	R1,616,900
Chris Hani	R13,912,836	R28,903,789	R8,522,254	R51,338,880
Joe Gqabi	R19,823,229	R7,277,250	R2,008,521	R29,109,000
Blue Crane Route	R2,623,025	R1,153,175	R2,198,800	R5,975,000
Koukamma	R32,611,094	R21,487,394	R14,992,812	R69,091,300
Dr Beyers Naude	R2,554,877	R11,395,562	R6,326,362	R20,276,800
Totals	**R294,515,835**	**R242,203,637**	**R126,491,187**	**R653,719,530**
% Distribution	**45%**	**37%**	**18%**	**100%**

The key hardware problems are listed in Table 41 and need to be addressed at each system. Predominant defects include electrical cables, sludge settling in primary and secondary clarification, disinfection, sludge pumps, sludge treatment, and power backup.

Mechanical defects typically include dysfunctional aerators, sludge and effluent pumps, mixers, screens, degritters, and disinfection equipment. Vandalism and theft, long procurement lead times, lack of management involvement, lack of maintenance, and lack of budget are the main reasons for dysfunctional assets.

Diagnostic 7: Operation, Maintenance and Refurbishment of Assets

Aim: Insufficient financial resources are often cited as a root cause to dysfunctional or non-compliant wastewater systems. Knowledge and monitoring of budget and expenditure are therefore a critical part of wastewater management. This diagnostic investigates the status of financial information as it relates to O&M budgets and expenditure, asset figures, and capital funding.

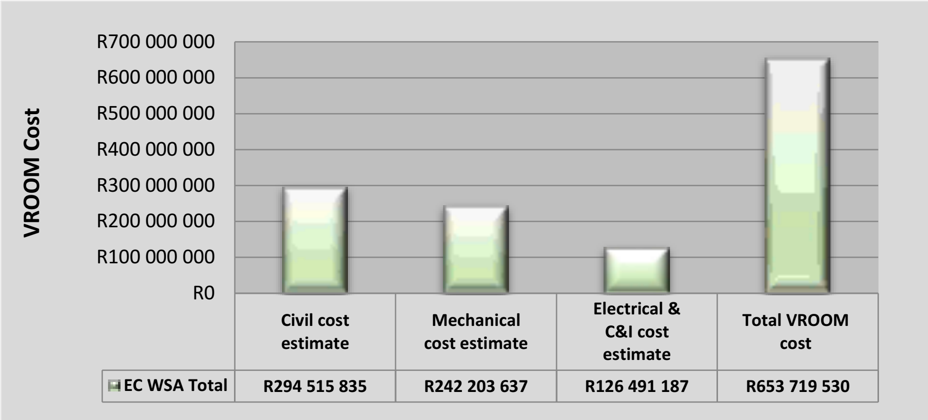
Findings: A substantial amount of financial information was presented during the audit process. Unfortunately, the evidence was presented in different formats, levels of detail, or absent for some municipalities. It was observed that municipal teams with financial officials that were present during the audits, typically performed better, and had a better understanding of the wastewater challenges experienced by their technical peers. Discrepancies observed included amongst others - generic or non-ringfenced budgets, contract lump sums for service providers presented as budgets, outdated or incomplete asset registers, and some cost drivers which were lacking (mostly electricity). The Regulator grouped data into different certainty levels, as summarised at the end of this Diagnostic.

It must be noted that there were limitations with the financial and asset information. Not all WSAs submitted current information or complete financial data sets.

The result of each financial portfolio is discussed hereunder.

Vroom Cost Analysis

The VROOM costs breakdown is discussed under the TSA Diagnostic but is further illustrated as follows.



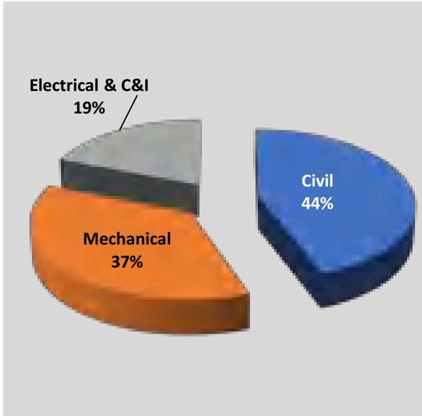


Figure 39 - Graphic illustration of the total cost estimated to restore functionality to existing assets (a), broken down to civil, mechanical, and electrical components

It is estimated that a total budget of R654 million will be required to restore existing treatment works to their design capacity and functionality. This estimate provides for R242 million for mechanical repairs, R126 million for electrical repairs, and R295 million for civil structures. Table 42 indicates that a capital budget of R2.29 billion is secured over the MTREF period to address infrastructure needs. While it is likely that some of the VROOM requirements will be addressed through this budget, it is probable that additional funding will be required to address the full VROOM requirements. In addition to the R654 million to restore the infrastructure, it is estimated that a total of R138 million will be required by all WSAs, on an annual basis, to maintain their assets. The maintenance estimate is based on the WATCOST-SALGA model that makes provision for maintenance at 2.14%, annually, of the asset value.

Capital, O&M Budget and Actual, and Asset Value

The capital budgets, O&M budgets, O&M actual expenditure, and current asset values are summarised below.

Table 42 - Summary of the capital budgets, O&M budgets, O&M actual expenditure, and current asset values

WSA	Capital budget available	O&M budget (2020/21)	O&M expended (2020/21)	% Expended	Total Current Asset Value
Amathole	R60,121,000	R91,198,000	R99,399,000	109%	R97,816,000
Kouga	NI	R64,494,000	R71,756,000	111%	R223,246,500
Nelson Mandela Bay	R397,195,000	R145,360,000	R120,365,000	83%	R582,376,100
Buffalo City	R62,700,000	R236,101,000	R224,508,000	95%	R4,800,000,000
Sundays River Valley	R41,600,000	R650,000	R1,200,000	185%	NI
Ndlambe	R617,844,000	R2,810,000	R294,000	10%	NI
Makana	R33,000,000	NI	NI	NI	NI
OR Tambo	R188,916,710	NI	NI	NI	R576,524,960
Alfred Nzo	R206,961,590	R50,772,580	R43,165,340	85%	R37,273,426
Chris Hani	R277,737,000	R178,036,000	R202,188,000	114%	NI
Joe Gqabi	R367,200,320	R22,080,000	R21,195,000	96%	R14,341,478
Blue Crane Route	R10,000,000	NI	NI	NI	NI
Koukamma	NI	R7,343,450	R8,789,230	120%	NI
Dr Beyers Naude	R29,500,000	R15,548,600	R12,089,250	78%	R121,480,980
Totals	**R2,292,775,620**	**R814,393,630**	**R804,948,820**	**99%**	**R6,453,059,444**

The Green Drop process provides a bonus (incentive) in cases where a municipality provides evidence of capital projects with secured funding since this is deemed as a definitive means of addressing wastewater service inadequacies. This incentive encourages wastewater infrastructure investment. A total capital budget of R2.29 billion has been reported for the refurbishment and upgrades of wastewater infrastructure for all the municipalities over MTREF period. The largest capital budgets are observed for Ndlambe (R618m), Nelson Mandela Bay (R397m), Joe Gqabi (R367m) and Chris Hani (R278m).

For the 2020/21 fiscal year, the total O&M budget reported for the province was R814 million, of which R805 million (99%) has been expended. The table shows that 5 municipalities over-spent on their budgets. Very low expenditure was indicated for Ndlambe. The provincial figures exclude 3 of the municipalities that did not have financial information.

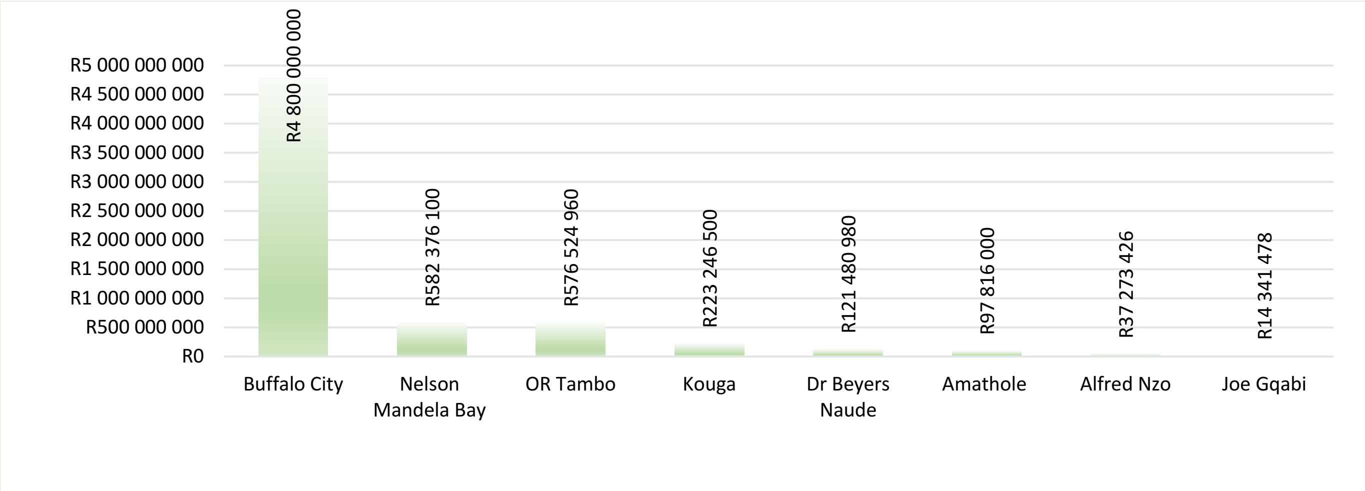


Figure 40 - Total current asset value reported by the municipalities (excluding those with NI)

The total current asset value for wastewater infrastructure (networks, pump stations, treatment plants) is reportedly R6.45 billion (excluding 6 of the 14 municipalities with no information). The highest asset values are observed for Buffalo City (R4.8b), followed by Nelson Mandela Bay (R582m) and OR Tambo (R576m).

O&M Cost Benchmarking

By combining the SALGA and WRC WATCOST models, an estimation of the maintenance cost required per asset type can be done, i.e. civil, buildings, pipelines, mechanical, electrical, and instrumentation.

Table 43 - SALGA-WRC annual maintenance budget guideline and cost estimation

Description	% of Current Asset Value	Asset Value Estimate	Modified SALGA Maintenance Guideline	Annual Maintenance Budget Guideline
Current Asset Value estimate	**100%**	**R6,453,059,444**	**15.75%**	**R138,095,472**
Broken down into:				
1. Civil Structures	46%	R2,968,407,344	0.50%	R14,842,037
2, Buildings	3%	R193,591,783	1.50%	R2,903,877
3. Pipelines	6%	R387,183,567	0.75%	R2,903,877
4. Mechanical Equipment	35%	R2,258,570,805	4.00%	R90,342,832
5. Electrical Equipment	8%	R516,244,756	4.00%	R20,649,790
6. Instrumentation	2%	R129,061,189	5.00%	R6,453,059
Totals	**100%**	**R6,453,059,444**	**15.75%**	**R138,095,472**
Minus 20% P&Gs and 10% Installation				**R41,428,642**
Total				**R96,666,830**

The model estimates that R138 million (2.14%) is required per year to maintain the assets valued at R6.54 billion. Notably, this maintenance estimate assumes that all assets are functional. The VROOM cost represents the funding required return the assets to a fully functional state, from which basis routine maintenance could then focus on maintaining the assets.

Table 44 shows the SALGA maintenance cost estimation in relation to the VROOM cost, O&M budget, and O&M actual expended.

Table 44 - O&M cost estimates by the SALGA and VROOM models versus actual budget and expenditure figures

Cost Reference	O&M Cost Estimate	Period
Modified SALGA	R138,095,472	Annually, estimation
O&M Budget	R814,393,630	Actual for 2020/21
O&M Spend	R804,948,820	Actual for 2020/21
VROOM	R653,719,530	Once off estimation

The cost dynamics can be summarised as follows:

- The SALGA estimations for maintenance budgets is approximately 17% of the reported budgets for the 2020/21 fiscal year. This figure would be influenced by inaccurate asset values and where no asset values have been provided for
- The actual O&M budget seems inadequate when compared with the SALGA guideline. A relook at how O&M funds are expended should be considered for infrastructure that is dysfunctional (not maintained)
- The VROOM cost represents an estimation of the refurbishment cost to restore WWTWs functionality and design capacity.

Production Cost and Comparison

It is good business practice to monitor and manage the production costs of wastewater treatment in Rand/m^3 treated, and to compare such cost with industry norms. Published benchmarks are not currently available for typical treatment costs, but significant cost increases are expected since 2013, given the variable input factors such as Covid, cost of chemicals, transport, and electricity. From an economic perspective, it would be valuable to compare production cost budgeted with actual production costs. However, due to limitations in the available information, it is not possible to provide further insights.

Based on the limited data sets, the graph below indicates that WWTWs with lower operational flow are mostly associated with higher production costs, e.g. Cinsta, Fort Beaufort, Butterworth, and Adelaide WWTWs. Some of the reported production costs seems excessive and needs to be investigated by the respective municipalities. The WWTW to the right end of the plot shows lower production costs as a function of higher operational flow. This is in line with international industry norms, as larger plants with higher inflows benefit from economies of scale. The main cost drivers are staff (fixed cost), and energy and chemical costs, which are variable costs, and which depend on the operational status of a plant.

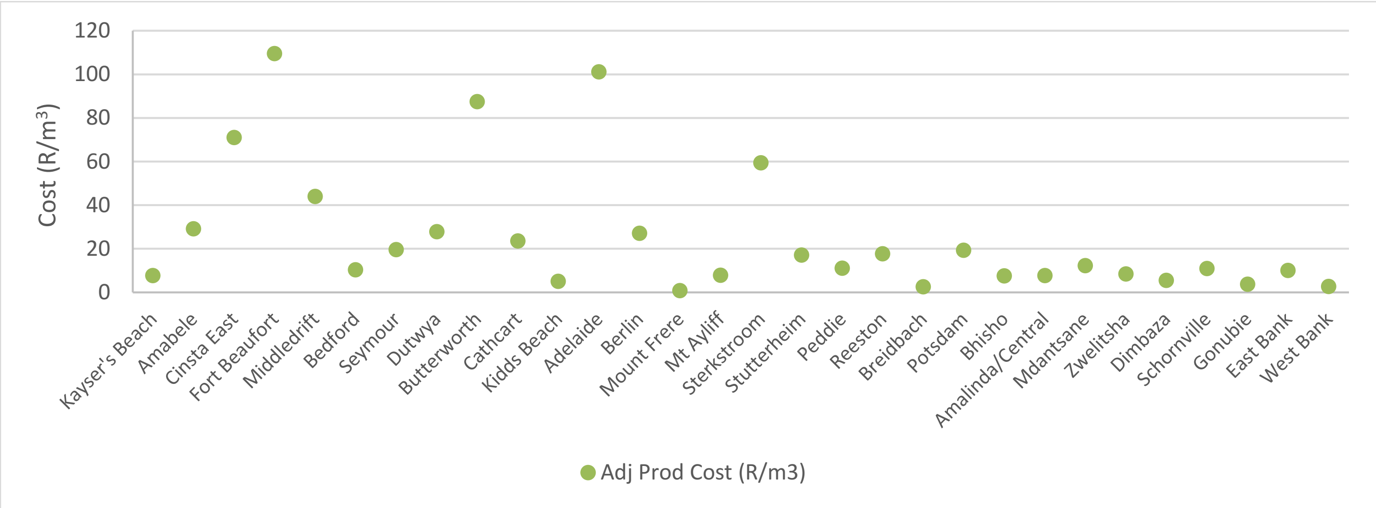


Figure 41 - Adjusted production cost (R/m^3) for wastewater treatment, sorted by operational capacity (inflow) per WWTW

The following plot shows that the production cost for treatment of wastewater ranges from R8.88 to R109.46. The average cost is R25,61 and median cost is R11.63.

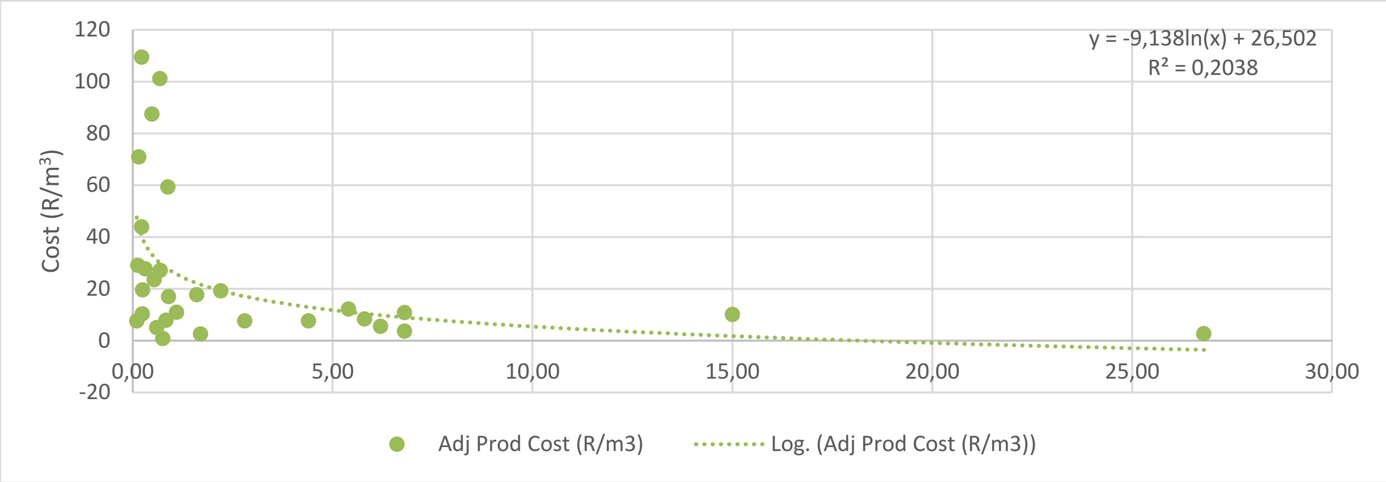


Figure 42 - Adjusted production cost (R/m³) for wastewater treatment, as a function of operational capacity (inflow)

Data Certainty

Data certainty is expressed at different levels for the financial and asset figures reported within this Diagnostic. Certainty levels differ from system to system, hence some WSAs are included in multiple data certainty categories - as the data is variable, inconsistent, limited or non-existent (NI) for each of the systems. The various WSAs in the province that were identified under the category ''High Certainty", presented consistent and verifiable evidence in the form of budgets, expenditure, asset registers, and unit costs.

Table 45 - Levels of certainty associated with financial and asset information reported by municipalities

Data Certainty	Description	WSA
No certainty	Absent data or no certainty in data presented - not ringfenced for WWTW & Network	Makana, Blue Crane
Low certainty	Minor or little certainty in the data - partially ringfenced for WWTW only or data as extreme outliers	All the remaining 9 WSAs
Reasonable/good certainty	Reasonable to good level of certainty in the data - ringfenced for WWTW and/or Network and data falls within/close to expected parameters	Amathole. Nelson Mandela Bay, Buffalo City
High certainty	High level of certainty in the data - ringfenced for WWTW and Network and data falls within expected parameters	None

4.1 Alfred Nzo District Municipality

Water Service Institution	**Alfred Nzo District Municipality**	
Water Service Provider	Alfred Nzo **District** Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Maintenance delays 2. Defective equipment 3. Sludge handling lacking 4. Operational monitoring lacking **VROOM Estimate:** - R1,616,900
2021 Green Drop Score	**35%↓**	
2013 Green Drop Score	**39%**	
2011 Green Drop Score	**38%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Mt Ayliff**	**Mount Frere**	**Matatiele**	**Cedarville**
Green Drop Score (2021)		**35%**	**39%**	**33%**	**27%**
2013 Green Drop Score		**46%**	**58%**	**34%**	**NA**
2011 Green Drop Score		**47%**	**45%**	**37%**	**0%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	1.2	2	2.5	0.55
Design Capacity Utilisation (%)		69%	38%	NI	NI
Resource Discharged into		Mzintlava River	Chapoti River	Khoapa Stream – Tyinirha River	Wetland
Wastewater Risk Rating (CRR% of CRR_{max})		**Mt Ayliff**	**Mount Frere**	**Matatiele**	**Cedarville**
CRR (2011)	%	65.0%	59.0%	65.0%	82.0%
CRR (2013)	%	59.0%	59.0%	82.0%	94.0%
CRR (2021)	%	70.6%	64.7%	82.4%	88.2%

Key Performance Area	**Unit**	**Bizana**	**Ntabankulu**
Green Drop Score (2021)		**42%**	**37%**
2013 Green Drop Score		**9%**	**9%**
2011 Green Drop Score		**8%**	**8%**
2009 Green Drop Score		**0%**	**0%**
System Design Capacity	Ml/d	0.28	0.5
Design Capacity Utilisation (%)		NI	NI
Resource Discharged into		Ledeke dam - Mtamvuna River	No discharge
Wastewater Risk Rating (CRR% of CRR_{max})		**Bizana**	**Ntabankulu**
CRR (2011)	%	53.0%	53.0%
CRR (2013)	%	82.0%	94.0%
CRR (2021)	%	82.4%	58.8%

Technical Site Assessment: **Mount Ayliff WWTW 61%**

4.2 Amathole District Municipality

Water Service Institution	**Amathole District Municipality**	
Water Service Provider	Amathole District Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Aerators 2. Secondary clarifier 3. Fine screening 4. Office and amenities 5. Security and site control. **VROOM Estimate:** - R56,337,600
2021 Green Drop Score	**54%↓**	
2013 Green Drop Score	**60%**	
2011 Green Drop Score	**56%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Adelaide**	**Amabele**	**Bedford**	**Butterworth**
Green Drop Score (2021)		**59%**	**59%**	**76%**	**55%**
2013 Green Drop Score		**59%**	**52%**	**59%**	**55%**
2011 Green Drop Score		**30%**	**68%**	**38%**	**70%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	1.8	0.05	0.5	6
Design Capacity Utilisation (%)		38%	260%	48%	8%
Resource Discharged into		Koonap River	No discharge	Irrigated to golf course	Gcuwa
Wastewater Risk Rating (CRR% of CRR_{max})		**Adelaide**	**Amabele**	**Bedford**	**Butterworth**
CRR (2011)	%	72.2%	44.4%	72.2%	69.8%
CRR (2013)	%	58.8%	52.9%	47.1%	50.0%
CRR (2021)	%	58.8%	41.2%	23.5%	50.0%

Key Performance Area	**Unit**	**Cathcart**	**Cinsta East**	**Dutwya**	**Fort Beaufort**
Green Drop Score (2021)		**53%**	**81%**	**47%**	**47%**
2013 Green Drop Score		**63%**	**65%**	**50%**	**58%**
2011 Green Drop Score		**58%**	**66%**	**56%**	**62%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	1	0.3	1.1	2.7
Design Capacity Utilisation (%)		54%	50%	28%	8%
Resource Discharged into		Thorn River	No discharge Evaporation Ponds	Gxakaxha	Kat River
Wastewater Risk Rating (CRR% of CRR_{max})		**Cathcart**	**Cinsta East**	**Dutwya**	**Fort Beaufort**
CRR (2011)	%	55.6%	65.9%	61.1%	61.1%
CRR (2013)	%	47.1%	41.2%	47.1%	70.6%
CRR (2021)	%	76.5%	17.6%	64.7%	58.8%

Key Performance Area	**Unit**	**Kei Mouth**	**Keiskammahoek**	**Komga**	**Middledrift**
Green Drop Score (2021)		**74%**	**43%**	**52%**	**54%**
2013 Green Drop Score		**63%**	**63%**	**75%**	**59%**
2011 Green Drop Score		**57%**	**32%**	**56%**	**28%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.7	0.7	0.63	0.33
Design Capacity Utilisation (%)		19%	129%	12%	68%
Resource Discharged into		No discharge	Keiskamma	Kei	Keiskamma

Key Performance Area	Unit	Kei Mouth	Keiskammahoek	Komga	Middledrift
Wastewater Risk Rating (CRR% of CRR_{max})		Kei Mouth	Keiskammahoek	Komga	Middledrift
CRR (2011)	%	50.0%	72.2%	56.3%	72.2%
CRR (2013)	%	58.8%	58.8%	58.8%	58.8%
CRR (2021)	%	17.6%	82.4%	64.7%	76.5%

Key Performance Area	Unit	Peddie	Seymour	Stutterheim
Green Drop Score (2021)		48%	57%	52%
2013 Green Drop Score		64%	56%	73%
2011 Green Drop Score		55%	58%	59%
2009 Green Drop Score		0%	0%	0%
System Design Capacity	Ml/d	0.3	0.25	3
Design Capacity Utilisation (%)		367%	100%	30%
Resource Discharged into		Keiskamma	Gesi	Cumakala
Wastewater Risk Rating (CRR% of CRR_{max})		Peddie	Seymour	Stutterheim
CRR (2011)	%	50.0%	55.6%	38.9%
CRR (2013)	%	47.1%	64.7%	58.8%
CRR (2021)	%	94.1%	70.6%	47.1%

Technical Site Assessment: **Stutterheim WWTW 47%**

4.3 Blue Crane Local Municipality

Water Service Institution	**Blue Crane Local Municipality**	
Water Service Provider	Blue Crane Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Vandalism 2. Two SST flooded 3. Cable theft resulting dysfunctional pump stations 4. Pumps dysfunctional causing flooding 5. Chlorination dosage and controls 6. Inappropriate technology choices. **VROOM Estimate:** - R5,975,000
2021 Green Drop Score	**18%↓**	
2013 Green Drop Score	**22%**	
2011 Green Drop Score	**5%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Cookhouse	Pearston	Somerset East
Green Drop Score (2021)		**17%**	**23%**	**17%**
2013 Green Drop Score		**22%**	**23%**	**15%**
2011 Green Drop Score		**7%**	**4%**	**0%**
2009 Green Drop Score		**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.47	1	2.5
Design Capacity Utilisation (%)		100%	74%	56%
Resource Discharged into		Little Orange Fish River	Little Orange Fish River	Little Orange Fish River
Wastewater Risk Rating (CRR% of CRR_{max})		**Cookhouse**	**Pearston**	**Somerset East**
CRR (2011)	%	94.0%	94.0%	94.0%
CRR (2013)	%	76.0%	76.0%	88.0%
CRR (2021)	%	70.6%	82.4%	70.6%

Technical Site Assessment: **Somerset East WWTW 41%**

4.4 Buffalo City Metropolitan Municipality

Water Service Institution	**Buffalo City politan Municipality**	
Water Service Provider	Buffalo City politan Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Screening 2. Vandalism and security issues 3. Biofilters dysfunctional 4. Settling 5. Chlorination 6. Anaerobic digesters 7. Sludge drying beds. **VROOM Estimate:** - R111,960,000
2021 Green Drop Score	**59%↓**	
2013 Green Drop Score	**81%**	
2011 Green Drop Score	**87%**	
2009 Green Drop Score	**53%**	

Key Performance Area	Unit	Amalinda / Central	Berlin	Breidbach	Bhisho
Green Drop Score (2021)		**59%**	**62%**	**43%**	**53%**
2013 Green Drop Score		**69%**	**62%**	**65%**	**68%**
2011 Green Drop Score		**78%**	**66%**	**75%**	**75%**
2009 Green Drop Score		**0%**	**53%**	**0%**	**0%**
System Design Capacity	Ml/d	5	2	1,6	2
Design Capacity Utilisation (%)		88%	34%	175%	85%
Resource Discharged into		Buffalo River	Nahoon River	Irrigation	Irrigation
Wastewater Risk Rating (CRR% of CRR_{max})		**Amalinda/ Central**	**Berlin**	**Breidbach**	**Bhisho**
CRR (2011)	%	58.8%	41.2%	58.8%	58.8%
CRR (2013)	%	58.8%	58.8%	64.7%	58.8%
CRR (2021)	%	59.1%	35.3%	64.5%	64.7%

Key Performance Area	Unit	Dimbaza	East Bank	Gonubie	Kayser's Beach
Green Drop Score (2021)		**64%**	**73%**	**63%**	**51%**
2013 Green Drop Score		**72%**	**91%**	**63%**	**51%**
2011 Green Drop Score		**74%**	**91%**	**86%**	**0%**
2009 Green Drop Score		**0%**	**0%**	**54%**	**0%**
System Design Capacity	Ml/d	7	30	18	0.5
Design Capacity Utilisation (%)		89%	50%	38%	20%
Resource Discharged into		Mdizeni stream	Sea & Irrigation	Sea	Zero discharge
Wastewater Risk Rating (CRR% of CRR_{max})		**Dimbaza**	**East Bank**	**Gonubie**	**Kayser's Beach**
CRR (2011)	%	50.0%	51.9%	54.5%	23.5%
CRR (2013)	%	72.7%	48.2%	63.6%	35.3%
CRR (2021)	%	45.5%	37.0%	36.4%	23.5%

Key Performance Area	Unit	Kidds Beach	Mdantsane	Potsdam	Reeston
Green Drop Score (2021)		**38%**	**63%**	**56%**	**50%**
2013 Green Drop Score		**53%**	**68%**	**70%**	**81%**
2011 Green Drop Score		**0%**	**82%**	**84%**	**85%**
2009 Green Drop Score		**0%**	**0%**	**53%**	**51%**
System Design Capacity	Ml/d	0,4	24	9	10
Design Capacity Utilisation (%)		150%	23%	24%	16%

Key Performance Area	Unit	Kidds Beach	Mdantsane	Potsdam	Reeston
Resource Discharged into		Mcantsi River	Buffalo River	Buffalo River	Buffalo River
Wastewater Risk Rating (CRR% of CRR_{max})		Kidds Beach	Mdantsane	Potsdam	Reeston
CRR (2011)	%	23.5%	37.0%	45.5%	35.5%
CRR (2013)	%	23.5%	48.2%	50.0%	41.2%
CRR (2021)	%	82.4%	29.6%	59.1%	63.6%

Key Performance Area	Unit	Schornville	West Bank	Zwelitsha
Green Drop Score (2021)		60%	46%	58%
2013 Green Drop Score		72%	86%	67%
2011 Green Drop Score		83%	93%	76%
2009 Green Drop Score		0%	0%	0%
System Design Capacity	Ml/d	5	32	9
Design Capacity Utilisation (%)		136%	84%	64%
Resource Discharged into		Buffalo River	Marine outfall	Buffalo River
Wastewater Risk Rating (CRR% of CRR_{max})		Schornville	West Bank	Zwelitsha
CRR (2011)	%	52.9%	25.9%	50.0%
CRR (2013)	%	58.8%	29.6%	54.6%
CRR (2021)	%	59.1%	70.4%	68.2%

Technical Site Assessment: **East Bank 85%; Mdantsane 46%**

4.5 Chris Hani District Municipality

Water Service Institution	**Chris Hani District Municipality**
Water Service Provider	Chris Hani District Municipality

Municipal Green Drop Score	
2021 Green Drop Score	44%↓
2013 Green Drop Score	52%
2011 Green Drop Score	31%
2009 Green Drop Score	0%

VROOM Impression (Towards restoring functionality):

1. Sada urgently need to clear the blocked digesters which has put the PSTs out of commission
2. Plant being bypassed into maturation ponds
3. Raw sludge pumps.

VROOM Estimate:

- R51,338,880

Key Performance Area	Unit	Cala	Cofimvaba	Cradock	Dordrecht
Green Drop Score (2021)		**38%**	**33%**	**42%**	**27%**
2013 Green Drop Score		**53%**	**41%**	**23%**	**49%**
2011 Green Drop Score		**10%**	**10%**	**16%**	**5%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.341	1.3	4.2	2.8
Design capacity utilisation (%)		NI	138%	100%	100%
Resource Discharged into		Tsomo River	Ngconorho River	Fish River	Anderson Dam
Wastewater Risk Rating (CRR% of CRR_{max})		**Cala**	**Cofimvaba**	**Cradock**	**Dordrecht**
CRR (2011)	%	94.1%	100.0%	88.2%	94.1%
CRR (2013)	%	64.7%	47.1%	82.4%	52.9%
CRR (2021)	%	70.6%	88.2%	64.7%	82.4%

Key Performance Area	Unit	Elliot	Engcobo	Hofmeyr	Indwe
Green Drop Score (2021)		**39%**	**71%**	**47%**	**39%**
2013 Green Drop Score		**55%**	**46%**	**52%**	**47%**
2011 Green Drop Score		**3%**	**19%**	**17%**	**11%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	1.7	0.5	2	1.8
Design capacity utilisation (%)		94%	50%	100%	100%
Resource Discharged into		Slang River	Chefane River	No discharge	Doring River
Wastewater Risk Rating (CRR% of CRR_{max})		**Elliot**	**Engcobo**	**Hofmeyr**	**Indwe**
CRR (2011)	%	94.1%	**100.0%**	**100.0%**	**100.0%**
CRR (2013)	%	52.9%	64.7%	52.9%	58.8%
CRR (2021)	%	76.5%	23.5%	47.1%	88.2

Key Performance Area	Unit	Lady Frere	Molteno	Middelburg	Queenstown
Green Drop Score (2021)		**25%**	**51%**	**39%**	**50%**
2013 Green Drop Score		**29%**	**24%**	**21%**	**73%**
2011 Green Drop Score		**9%**	**13%**	**14%**	**57%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.8	2.7	4	16.5
Design capacity utilisation (%)		100%	50%	100%	49%
Resource Discharged into		Machubeni Dam	Stormberg River	Brak River	Komani River
Wastewater Risk Rating (CRR% of CRR_{max})		**Lady Frere**	**Molteno**	**Middelburg**	**Queenstown**

Key Performance Area	Unit	Lady Frere	Molteno	Middelburg	Queenstown
CRR (2011)	%	94.1%	100.0%	70.6%	100.0%
CRR (2013)	%	41.2%	70.6%	82.4%	59.1%
CRR (2021)	%	94.1%	88.2%	88.2%	45.5%

Key Performance Area	Unit	Sada	Sterkstroom	Tarkastad	Tsomo
Green Drop Score (2021)		**43%**	**49%**	**31%**	**41%**
2013 Green Drop Score		**53%**	**52%**	**53%**	**21%**
2011 Green Drop Score		**30%**	**12%**	**14%**	**1%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	7.07	1.1	0.55	0.175
Design capacity utilisation (%)		NI	80%	100%	251%
Resource Discharged into		Klipplaat River	Hekstroom River	Riet River	No discharge
Wastewater Risk Rating (CRR% of CRR_{max})		**Sada**	**Sterkstroom**	**Tarkastad**	**Tsomo**
CRR (2011)	%	52.9%	100.0%	100.0%	100.0%
CRR (2013)	%	47.1%	47.1%	52.9%	82.4%
CRR (2021)	%	95.5%	88.2%	70.6%	52.9%

Technical Site Assessment: **Sada WWTW 51%**

4.6 Dr Beyers Naude Local Municipality

Water Service Institution	**Dr Beyers Naude Local Municipality**	
Water Service Provider	Dr Beyers Naude Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Site security 2. Pump stations 3. Automated screens 4. Degritting 5. Drying beds 6. Clarifiers dysfunctional 7. Disinfection equipment vandalised **VROOM Estimate:** - R20,276,800
2021 Green Drop Score	**16% ↓**	
2013 Green Drop Score	**48%**	
2011 Green Drop Score	**7%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Aberdeen	Graaff-Reinet	Jansenville	Klipplaat
Green Drop Score (2021)		**10%**	**22%**	**4%**	**10%**
2013 Green Drop Score		**46%**	**47%**	**57%**	**52%**
2011 Green Drop Score		**5%**	**6%**	**3%**	**2%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	1	4.5	1	0.09
Design Capacity Utilisation (%)		100%	82%	60%	100%
Resource Discharged into		Kaai River	Sundays River	No Discharge	Unknown
Wastewater Risk Rating (CRR% of CRR_{max})		**Aberdeen**	**Graaff-Reinet**	**Jansenville**	**Klipplaat**
CRR (2011)	%	88.2%	94.1%	52.9%	100.0%
CRR (2013)	%	82.4%	82.4%	52.9%	64.7%
CRR (2021)	%	88.2%	82.4%	88.2%	64.7%

Key Performance Area	Unit	Nieu-Bethesda	Rietbron	Steytlerville	Willowmore
Green Drop Score (2021)		**12%**	**11%**	**12%**	**12%**
2013 Green Drop Score		**48%**	**7%**	**42%**	**44%**
2011 Green Drop Score		**7%**	**16%**	**19%**	**15%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.05	0.2	1	0.9
Design Capacity Utilisation (%)		100%	75%	80%	61%
Resource Discharged into		Gats River	Irrigation Sportsfield	Irrigation Sportsfield	Irrigation Sportsfield
Wastewater Risk Rating (CRR% of CRR_{max})		**Nieu-Bethesda**	**Rietbron**	**Steytlerville**	**Willowmore**
CRR (2011)	%	35.3%	52.9%	100.0%	100.0%
CRR (2013)	%	82.4%	94.1%	82.4%	82.4%
CRR (2021)	%	64.7%	64.7%	88.2%	88.2%

Technical Site Assessment: **Graaff Reinet WWTW 29%**

4.7 Joe Gqabi District Municipality

Water Service Institution	**Joe Gqabi District Municipality**	
Water Service Provider	Joe Gqabi District Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Three aerators dysfunctional 2. RAS pumps on module one dysfunctional 3. MCC building 4. Sludge ponds and lining 5. Sludge drying beds **VROOM Estimate:** - R29,109,000
2021 Green Drop Score	**47%↓**	
2013 Green Drop Score	**50%**	
2011 Green Drop Score	**22%**	

Key Performance Area	**Unit**	**Aliwal North**	**Barkly East Ponds (New)**	**Barkly East Ponds (Old)**	**Burgersdorp**
Green Drop Score (2021)		**40%**	**48%**	**57%**	**35%**
2013 Green Drop Score		**47%**	**63%**	**59%**	**54%**
2011 Green Drop Score		**36%**	**20%**	**0%**	**32%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	5.5	0.6	0.73	2.5
Design capacity utilisation (%)		138%	200%	44%	224%
Resource Discharged into		Orange	Langkloof River	Langkloof River	Stormberg River
Wastewater Risk Rating (CRR% of CRR_{max})		**Aliwal North**	**Barkly East Ponds (New)**	**Barkly East Ponds (Old)**	**Burgersdorp**
CRR (2011)	%	94.4%	66.7%	64.7%	82.4%
CRR (2013)	%	63.6%	58.8%	52.9%	58.8%
CRR (2021)	%	68.2%	70.6%	52.9%	94.1%

Key Performance Area	**Unit**	**Herschel**	**Jamestown**	**Lady Grey**	**Maclear AS**
Green Drop Score (2021)		**36%**	**68%**	**70%**	**56%**
2013 Green Drop Score		**44%**	**49%**	**35%**	**70%**
2011 Green Drop Score		**11%**	**29%**	**13%**	**27%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.7	1.2	1.5	1.4
Design capacity utilisation (%)		NI	83%	53%	3%
Resource Discharged into		Unknown	No discharge	Unknown	Mooi River
Wastewater Risk Rating (CRR% of CRR_{max})		**Herschel**	**Jamestown**	**Lady Grey**	**Maclear**
CRR (2011)	%	66.7%	100.0%	50.0%	72.2%
CRR (2013)	%	58.8%	64.7%	70.6%	35.3%
CRR (2021)	%	100.0%	64.7%	64.7%	58.8%

Key Performance Area	**Unit**	**Mount Fletcher**	**Oviston**	**Prentjiesberg**	**Sterkspruit**
Green Drop Score (2021)		**55%**	**37%**	**55%**	**39%**
2013 Green Drop Score		**35%**	**42%**	**82%**	**37%**
2011 Green Drop Score		**10%**	**31%**	**31%**	**17%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.5	0.2	0.5	0.35
Design capacity utilisation (%)		4%	100%	400%	NI
Resource Discharged into		Mt Fletcher River	Gariep Dam	Wildebeest River	Sterkspruit
Wastewater Risk Rating (CRR% of CRR_{max})		**Mount Fletcher**	**Oviston**	**Prentjiesberg**	**Sterkspruit**
CRR (2011)	%	82.4%	94.1%	33.3%	50.0%

Key Performance Area	Unit	Mount Fletcher	Oviston	Prentjiesberg	Sterkspruit
CRR (2013)	%	64.7%	76.5%	35.3%	58.8%
CRR (2021)	%	52.9%	88.2%	64.7%	94.1%

Key Performance Area	UNIT	Steynsburg	Ugie	Venterstad
Green Drop Score (2021)		**43%**	**51%**	**44%**
2013 Green Drop Score		**56%**	**40%**	**47%**
2011 Green Drop Score		**29%**	**21%**	**41%**
2009 Green Drop Score		**0%**	**0%**	**0%**
System Design Capacity	Ml/d	1.65	0.45	1
Design capacity utilisation (%)		NI	100%	45%
Resource Discharged into		Unknown	Inuxu	Brak Spruit River
Wastewater Risk Rating (CRR% of CRR_{max})		**Steynsburg**	**Ugie**	**Venterstad**
CRR (2011)	%	83.3%	72.2%	70.6%
CRR (2013)	%	64.7%	52.9%	70.6%
CRR (2021)	%	94.1%	64.7%	76.5%

Technical Site Assessment: **Aliwal North WWTW 44%**

4.8 Kouga Local Municipality

Water Service Authority	**Kouga Local Municipality**	
Water Service Provider	Kouga Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Severe vandalism 2. Pump station building and equipment 3. Grit removal dysfunctional 4. Flow measurement 5. Sludge management. **VROOM Estimate:** - R169,856,400
2021 Green Drop Score	**19%↓**	
2013 Green Drop Score	**53%**	
2011 Green Drop Score	**36%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Hankey	Humansdorp	Kruisfontein	Jeffreys Bay
Green Drop Score (2021)		**20%**	**9%**	**17%**	**20%**
2013 Green Drop Score		**55%**	**57%**	**55%**	**48%**
2011 Green Drop Score		**29%**	**39%**	**36%**	**42%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	1	1.25	4	8
Design Capacity Utilisation (%)		NI	200%	26%	25%
Resource Discharged into		Kleinrivier	Seekoerivier	Seekoerivier	Swartriver
Wastewater Risk Rating (CRR% of CRR_{max})		**Hankey**	**Humansdorp**	**Kruisfontein**	**Jeffreys Bay**
CRR (2011)	%	88.2%	88.2%	82.4%	882%
CRR (2013)	%	76.5%	70.6%	70.6%	70.6%
CRR (2021)	%	94.1%	88.2%	70.6%	63.6%

Key Performance Area	Unit	Loerie	St Francis Bay	Thornhill
Green Drop Score (2021)		**13%**	**24%**	**17%**
2013 Green Drop Score		**78%**	**49%**	**55%**
2011 Green Drop Score		**21%**	**33%**	**35%**
2009 Green Drop Score		**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.02	2	0.35
Design Capacity Utilisation (%)		NI	38%	NI
Resource Discharged into		Loeriespruit	Wetland	Dam
Wastewater Risk Rating (CRR% of CRR_{max})		**Loerie**	**St Francis Bay**	**Thornhill**
CRR (2011)	%	88.2%	88.2%	88.2%
CRR (2013)	%	76.5%	82.4%	64.7%
CRR (2021)	%	88.2%	70.6%	88.2%

Technical Site Assessment: **Humansdorp 11%**

4.9 Koukamma Local Municipality

Water Service Institution	**Koukamma Local Municipality**	
Water Service Provider	Koukamma Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Site security 2. Basic staff amenities 3. Grit removal 4. Sludge lagoons 5. Cable theft 6. Pumps dysfunctional 7. Pump under capacity **VROOM Estimate:** - R69,091,300
2021 Green Drop Score	**1%↓**	
2013 Green Drop Score	**23%**	
2011 Green Drop Score	**14%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Louterwater	Blikkiesdorp	Clarkson	Coldstream
Green Drop Score (2021)		**2%**	**0%**	**3%**	**2%**
2013 Green Drop Score		**17%**	**NA**	**23%**	**24%**
2011 Green Drop Score		**10%**	**NA**	**14%**	**13%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.817	0.05	0.33	0.3
Design Capacity Utilisation (%)		NI	40%	NI	NI
Resource Discharged into		Irrigate on farm	Unknown small stream	Unknown small stream	Varkrivier
Wastewater Risk Rating (CRR% of CRR_{max})		**Louterwater**	**Blikkiesdorp**	**Clarkson**	**Coldstream**
CRR (2011)	%	100.0%	NA	100.0%	100.0%
CRR (2013)	%	76.5%	NA	64.7%	70.6%
CRR (2021)	%	94.1%	52.9%	94.1%	94.1%

Key Performance Area	Unit	Coldstream 2-Laurel Ridge	Joubertina-Ravinia	Kareedouw	Krakeel River
Green Drop Score (2021)		**0%**	**1%**	**1%**	**0%**
2013 Green Drop Score		**NA**	**24%**	**22%**	**19%**
2011 Green Drop Score		**NA**	**14%**	**15%**	**12%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.05	0.53	0.75	1
Design Capacity Utilisation (%)		40%	119%	NI	NI
Resource Discharged into		Coldstream	Kouga River	Unknown small stream	Unknown small stream
Wastewater Risk Rating (CRR% of CRR_{max})		**Coldstream 2-Laurel Ridge**	**Joubertina-Ravinia**	**Kareedouw**	**Krakeel River**
CRR (2011)	%	**NA**	100.0%	100.0%	52.9%
CRR (2013)	%	**NA**	58.8%	76.5%	82.4%
CRR (2021)	%	52.9%	88.2%	94.1%	94.1%

Key Performance Area	Unit	Woodlands	Misgund	Sanddrift	Stormsrivier
Green Drop Score (2021)		**2%**	**0%**	**2%**	**2%**
2013 Green Drop Score		**33%**	**22%**	**33%**	**28%**
2011 Green Drop Score		11%	**15%**	**14%**	**15%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.25	0.18	0.13	0.25
Design Capacity Utilisation (%)		NI	NI	115%	NI
Resource Discharged into		Unknown small stream	Farmer's Dam	Unknown small stream	Witteklipriver

Key Performance Area	Unit	Woodlands	Misgund	Sanddrift	Stormsrivier
		through plantation		leading to Sanddriftrivier	
Wastewater Risk Rating (CRR% of CRR_{max})		**Woodlands**	**Misgund**	**Sanddrift**	**Stormsrivier**
CRR (2011)	%	100.0%	100.0%	100.0%	100.0%
CRR (2013)	%	70.6%	76.5%	70.6%	58.8%
CRR (2021)	%	94.1%	94.1%	88.2%	94.1%

Technical Site Assessment: **Stormsriver WWTW 20%**

4.10 Makana Local Municipality

Water Service Institution	**Makana Local Municipality**	
Water Service Provider	Makana Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Vandalism 2. Flow measurement absent 3. Sludge management lacking 4. Loading and water quality unknown 5. Maintenance lacking 6. Process knowledge severely lacking **VROOM Estimate**: - R8,407,500
2021 Green Drop Score	**9%↓**	
2013 Green Drop Score	**62%**	
2011 Green Drop Score	**49%**	
2009 Green Drop Score	**7%**	

Key Performance Area	**Unit**	**Alicedale**	**Belmont Valley**	**Mayfield**
Green Drop Score (2021)		**1%**	**8%**	**14%**
2013 Green Drop Score		**37%**	**66%**	**60%**
2011 Green Drop Score		**29%**	**53%**	**48%**
2009 Green Drop Score		**7%**	**7%**	**7%**
System Design Capacity	Ml/d	0.85	5.5	2.5
Design Capacity Utilisation (%)		3%	136%	112%
Resource Discharged into		Kabega River	Kowie	Botha River
Wastewater Risk Rating (CRR% of CRR_{max})		**Alicedale**	**Belmont Valley**	**Mayfield**
CRR (2011)	%	88.2%	68.2%	70.6%
CRR (2013)	%	82.4%	63.6%	58.8%
CRR (2021)	%	70.6%	86.4%	88.2%

Technical Site Assessment: **Alicedale WWTW 27%**

4.11 Ndlambe Local Municipality

Water Service Authority	**Ndlambe Local Municipality**	
Water Service Institution	Ndlambe Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Capital upgrade work did not address key deficiencies 2. Plant not operational 3. Sludge handling inefficient 4. Flow metering absent 5. Pump station maintenance lacking. **VROOM Estimate:** - R1,556,520
2021 Green Drop Score	**17%↑**	
2013 Green Drop Score	**13%**	
2011 Green Drop Score	**41%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Alexandria-Kwanonkqubela**	**Bathurst-Nolukhanyo**	**Bushmans River Mouth-Marselle**	**Port Alfred**
Green Drop Score (2021)		**15%**	**16%**	**18%**	**17%**
2013 Green Drop Score		**10%**	**8%**	**10%**	**16%**
2011 Green Drop Score		**49%**	**37%**	**36%**	**41%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	1.2	1	1.296	5
Design Capacity Utilisation (%)		100%	120%	93%	24%
Resource Discharged into		Berg River	Jozini River	Bushmans River	Kowie Estuary
Wastewater Risk Rating (CRR% of CRR_{max})		**Alexandria-Kwanonkqubela**	**Bathurst-Nolukhanyo**	**Bushmans River Mouth-Marselle**	**Port Alfred**
CRR (2011)	%	76.5%	47.1%	100.0%	94.1%
CRR (2013)	%	100.0%	100.0%	100.0%	100.0%
CRR (2021)	%	100.0%	100.0%	88.2%	72.7%

Key Performance Area	**Unit**	**Kenton on Sea-Ekuphumleni**	**Rosehill Mall**
Green Drop Score (2021)		**15%**	**0%**
2013 Green Drop Score		**15%**	**NA**
2011 Green Drop Score		**43%**	**NA**
2009 Green Drop Score		**0%**	**0%**
System Design Capacity	Ml/d	0.66	NI
Design Capacity Utilisation (%)		182%	NI
Resource Discharged into		Kariega River	Irrigation
Wastewater Risk Rating (CRR% of CRR_{max})		**Kenton on Sea-Ekuphumleni**	**Rosehill Mall**
CRR (2011)	%	100.0%	**NA**
CRR (2013)	%	100.0%	**NA**
CRR (2021)	%	100.0%	100.0%

Technical Site Assessment: **Kenton on Sea WWTW 22%**

4.12 Nelson Mandela Bay Metropolitan Municipality

Water Service Authority	**Nelson Mandela Bay politan Municipality**	
Water Service Provider	Nelson Mandela Bay politan Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Screening 2. Sludge wastage 3. Disposal of the dried/stabilised sludge 4. Sludge lagoons fencing 5. Sludge disposal **VROOM Estimate:** - R112,079,000
2021 Green Drop Score	**58%↓**	
2013 Green Drop Score	**65%**	
2011 Green Drop Score	**81%**	
2009 Green Drop Score	**70%**	

Key Performance Area	Unit	Cape Receife	Despatch	Fishwater Flats	Kelvin Jones
Green Drop Score (2021)		**71%**	**75%**	**62%**	**76%**
2013 Green Drop Score		**71%**	**71%**	**63%**	**63%**
2011 Green Drop Score		**83%**	**87%**	**79%**	**82%**
2009 Green Drop Score		**71%**	**72%**	**51%**	**72%**
System Design Capacity	Ml/d	8	8.6	132	24
Design Capacity Utilisation (%)		75%	38%	76%	71%
Resource Discharged into		Marine outfall	Swartkkops River	Marine Outfall	Swartkops River
Wastewater Risk Rating (CRR% of CRR_{max})		**Cape Receife**	**Despatch**	**Fishwater Flats**	**Kelvin Jones**
CRR (2011)	%	36.4%	36.4%	50.0%	59.3%
CRR (2013)	%	59.1%	50.0%	65.6%	63.0%
CRR (2021)	%	59.1%	45.5%	56.8%	55.6%

Key Performance Area	Unit	KwaNobuhle	Rocklands	Driftsands
Green Drop Score (2021)		**66%**	**67%**	**73%**
2013 Green Drop Score		**67%**	**60%**	**88%**
2011 Green Drop Score		**86%**	**71%**	**91%**
2009 Green Drop Score		**72%**	**72%**	**77%**
System Design Capacity	Ml/d	9	0.18	22
Design Capacity Utilisation (%)		50%	50%	57%
Resource Discharged into		Swartkops River	Elands River	Marine outfall
Wastewater Risk Rating (CRR% of CRR_{max})		**KwaNobuhle**	**Rocklands**	**Driftsands**
CRR (2011)	%	59.1%	47.8%	59.1%
CRR (2013)	%	68.2%	70.6%	50.0%
CRR (2021)	%	50.0%	58.8%	55.6%

Technical Site Assessment: **KwaNobuhle WWTW 63%; Kelvin Jones WWTW 56%**

4.13 OR Tambo District Municipality

Water Service Institution	**OR Tambo District Municipality**	
Water Service Provider	OR Tambo District Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Maintenance lacking the old and new sections of the plant 2. Flow meter calibration 3. Grit removal 4. Dysfunctional pumps 5. Half of PSTs dysfunctional 6. Sludge handling **VROOM Estimate:** - R16,301,130
2021 Green Drop Score	**41%↑**	
2013 Green Drop Score	**21%**	
2011 Green Drop Score	**26%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Mthatha**	**Ngqeleni**	**Lusikisiki**	**Port St Johns**
Green Drop Score (2021)		**42%**	**34%**	**36%**	**23%**
2013 Green Drop Score		**22%**	**12%**	**16%**	**10%**
2011 Green Drop Score		**33%**	**8%**	**11%**	**8%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	28	0.4	1	0.563
Design Capacity Utilisation (%)		64%	NI	180%	NI
Resource Discharged into		Mthatha River – then to the sea	No discharge	Manzamnyama	Directly to the ocean
Wastewater Risk Rating (CRR% of CRR_{max})		**Mthatha**	**Ngqeleni**	**Lusikisiki**	**Port St Johns**
CRR (2011)	%	81.8%	52.9%	94.1%	52.9%
CRR (2013)	%	77.3%	94.1%	94.1%	94.1%
CRR (2021)	%	66.7%	82.4%	76.5%	82.4%

Key Performance Area	**Unit**	**Qumbu**	**Tsolo**
Green Drop Score (2021)		**37%**	**30%**
2013 Green Drop Score		**15%**	**15%**
2011 Green Drop Score		**8%**	**9%**
2009 Green Drop Score		**0%**	**0%**
System Design Capacity	Ml/d	1	1
Design Capacity Utilisation (%)		NI	NI
Resource Discharged into		Mzike - Tsitsa	Xhokonxa
Wastewater Risk Rating (CRR% of CRR_{max})		**Qumbu**	**Tsolo**
CRR (2011)	%	52.9%	94.1%
CRR (2013)	%	94.1%	94.1%
CRR (2021)	%	88.2%	88.2%

Technical Site Assessment: **Mthatha WWTW 48%**

4.14 Sunday River Valley Local Municipality

Water Service Institution	**Sunday's River Valley Local Municipality**	
Water Services Provider	Sunday's River Valley Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Flow metering absent 2. Muffin monster slows velocity causing downstream problems 3. RAS pumps 4. Sludge drying 5. Sludge disposal to surrounding farmers. **VROOM Estimate:** - R1,813,500
2021 Green Drop Score	**0%↓**	
2013 Green Drop Score	**36%**	
2011 Green Drop Score	**6%**	
2009 Green Drop Score	**0%**	

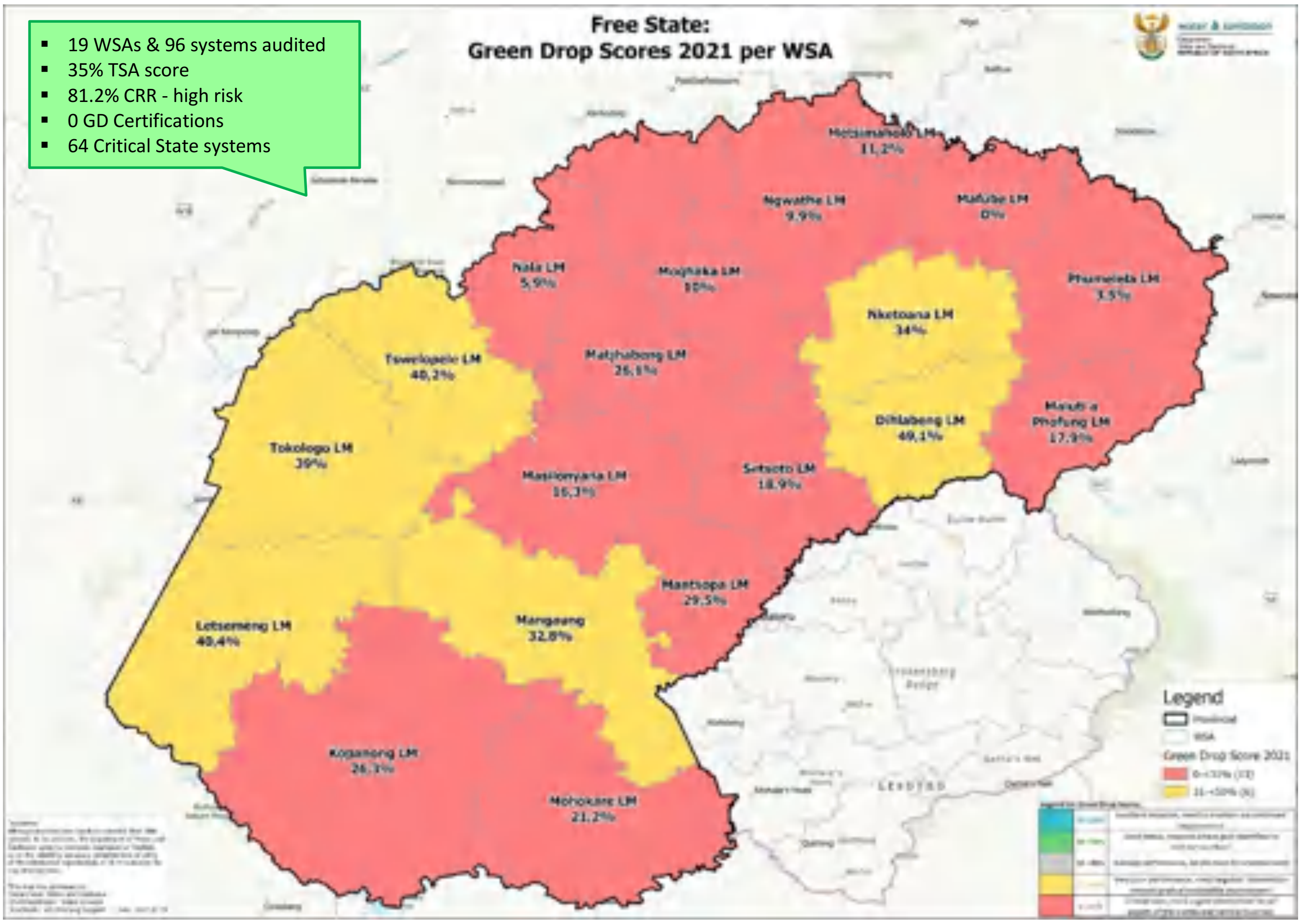
Key Performance Area	Unit	Addo	Enon-Bersheba	Kirkwood	Patterson
Green Drop Score (2021)		**2%**	**2%**	**0%**	**0%**
2013 Green Drop Score		**38%**	**29%**	**40%**	**34%**
2011 Green Drop Score		**7%**	**7%**	**3%**	**1%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.85	0.3	3	0.5
Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Sundays River	Zero Effluent	Sundays River	Irrigation
Wastewater Risk Rating (CRR% of CRR$_{max}$)		**Addo**	**Enon-Bersheba**	**Kirkwood**	**Patterson**
CRR (2011)	%	82.4%	82.4%	82.4%	76.5%
CRR (2013)	%	82.4%	70.6%	58.8%	70.6%
CRR (2021)	%	100%	100%	100%	100%

Technical Site Assessment: Kirkwood WWTW 28%

Kenton on Sea Treatment Works, Ndlambe Local Municipality. Process Controller Ms Nosithembiso Mjuza and the Contractor explains the repair work which is being done to ensure compliance to the effluent quality standards – they hope to meet Green Drop standards in 2023.

East Bank Wastewater Treatment Works, Buffalo City Metropolitan Municipality. Mr Jonathan Clarke, the Class V Process Controller explains the control philosophy of the biological process and the use of online instrumentation to the Green Drop Inspectors during a Technical Site Assessment.

5. FREE STATE PROVINCE: MUNICIPAL WASTEWATER MANAGEMENT PERFORMANCE



Provincial Synopsis

An audit attendance record of 100% affirms the WSAs firm commitment to the Green Drop national incentive-based regulatory programme.

The Regulator determined that no wastewater system scored the minimum of 90% when measured against the Green Drop standards for the audited period and thus no WSA qualified for the prestigious Green Drop Certification. In 2013 one system was awarded Green Drop Status. The audit nonetheless established an accurate, current baseline from where improvement can be driven, and excellence be incentivised.

Seven (7) of the 19 WSAs improved on their 2013 scores. The remaining WSAs regressed to lower Green Drop scores compared to 2013 baselines. Dihlabeng LM is the best performing WSA in the province. Letsemeng achieved the best overall progress from a 16% in 2013 to a municipal score of 40% in 2021. Unfortunately, 64 systems were identified to be in a critical state, compared to 46 systems in 2013. The highest number of systems in critical state are owned and managed by Mangaung, Matjhabeng and Maluti-A-Phofung (23 of 64 systems). The remaining systems fall within the other 14 municipalities. The full range of KPAs require attention by all municipalities, with no exceptions.

The provincial Risk Ratio for treatment plants regressed from 77% in 2013 to 81.2% in 2021. The most prominent risks were observed at a treatment level and pointed to WWTWs that exceeded their design capacity, dysfunctional processes and equipment (especially disinfection), and effluent and sludge non-compliance. Opportunities are presented in terms of reducing cost through process optimisation, improved energy efficiency and beneficial use of sludge, nutrients, biogas, and other energy resources.

The Regulator is hopeful that the 2021 audits will set a baseline from where a positive trajectory for wastewater services and improved performance will follow. Municipalities are encouraged to start their preparation for the 2023 Green Drop audit. The 2021 Green Drop status is summarised in Table 46.

Table 46 - 2021 Green Drop Summary

WSA Name	2013 GD Score (%)	2021 GD Score (%)	2021 GD Certified ≥90%	2021 GD Contenders (89%)	2021 Critical State (<31%)
Dihlabeng LM	47	49↑			
Letsemeng LM	16	40↑			Koffiefontein, Oppermansgronde
Tswelopele LM	49	40↓			Hoopstad
Tokologo LM	24	39↑			
Nketoana LM	19	34↑			Lindley-Ntha
Mangaung LM	79	33			Northern Works, Bloemindustria, Soutpan, Dewetsdorp, Van Stadensrus, Wepener
Naledi LM*	7				
Mantsopa LM	32	30			Excelsior, Ladybrand, Tweespruit
Kopanong LM	19	26↑			Fauresmith, Gariep Dam, Jagersfontein, Reddersburg
Matjhabeng LM	58	26↓			10 of 11 plants except Kutlwanong
Mohokare LM	30	21↓			All 3 plants
Setsoto LM	5	19↑			Ficksburg, Clocolan, Marquard New
Maluti-A-Phofung LM	76	18↓			All 7 plants
Masilonyana LM	11	16↑			Brandfort, Theunissen-Masilo, Winburg
Metsimaholo	69	11↓			Both plants
Moqhaka LM	26	10↓			All 3 plants
Ngwathe LM	16	10↓			All 5 plants
Nala LM	8	6↓			All 3 plants
Phumelela LM	25	4↓			All 3 plants
Mafube LM	36	0↓			All 5 plants
Totals	**-**	**-**	**None**	**None**	**64**

* Now Part of Mangaung

The Department of Water and Sanitation acknowledges the excellence in wastewater management achieved for the Green Drop Audit year of 2021.

No Green Drop Certificates are awarded to WSAs in the Province.

Background to Free State Wastewater Infrastructure

There are 19 WSAs, delivering wastewater services through a sewer network comprising of 96 WWTWs, 287 network pump stations and 1,995 km outfall and main sewer pipelines. The sewer network excludes the pipeline data of 14 municipalities who were unable to provide this data. There is a total installed treatment capacity of 457 Ml/d, with the majority of this capacity residing in the medium to macro-sized treatment plants.

Table 47 - Summary of WWTW capacity and flow distribution according to plant sizes

	Micro Size Plants	Small Size Plants	Medium Size Plants	Large Size Plants	Macro Size Plants	Unknown (NI)*	Total
	<0.5 Ml/day	0.5-2 Ml/day	2-10 Ml/day	10-25 Ml/day	>25 Ml/day		
No. of WWTW	6 (6%)	35 (36%)	42 (44%)	9 (10%)	3 (3)	1 (1%)	96
Total Design Capacity (Ml/day)	1.28	31.65	166.77	150.30	107.60	1	457.6
Total Daily Inflow (Ml/day)	0.00	11.78	46.22	78.00	97.30	62	233.3
Use of Design Capacity (%)	0%	37%	22%	52%	90%	-	51%

** "Unknown" means the number of WWTWs with NI (No Information) on design capacity or daily inflow*

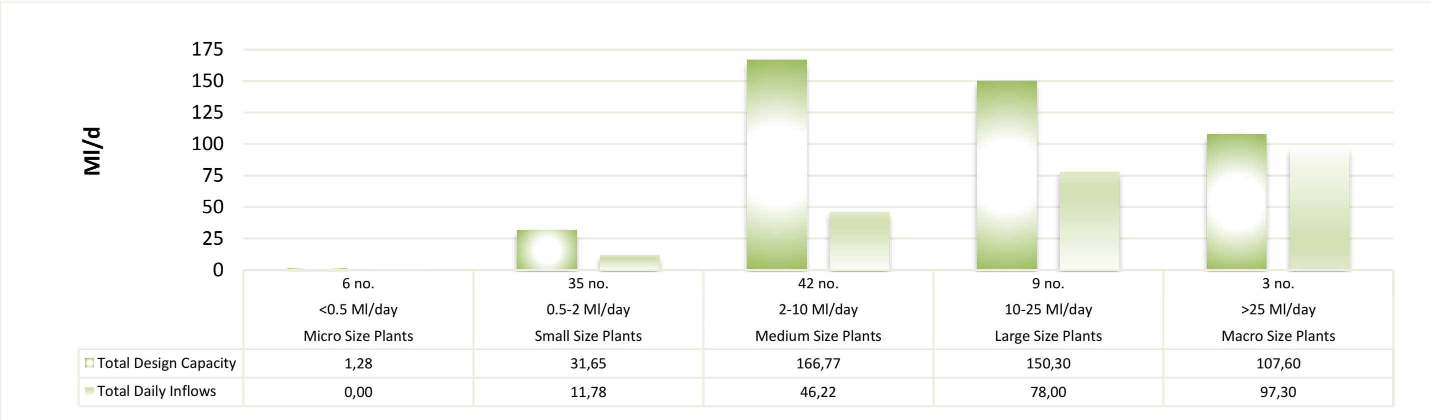
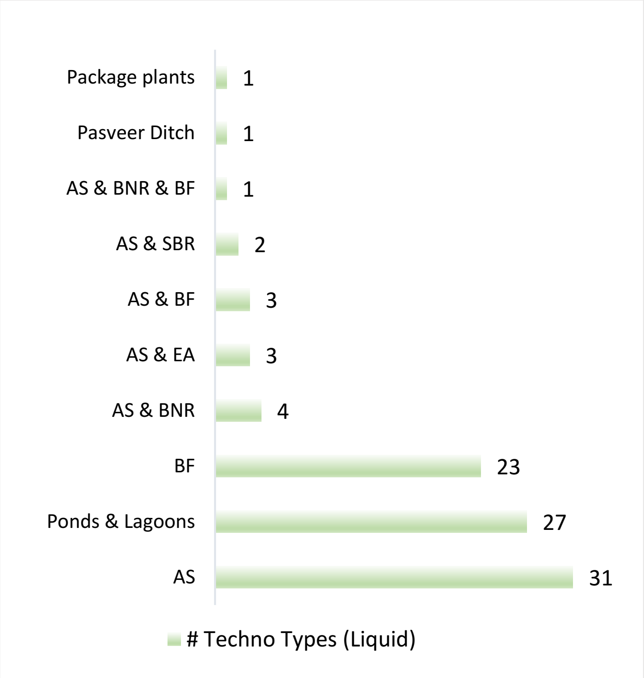


Figure 43 - Design capacities and operational inflow of the WWTWs

Based on the current operational flow of 233 Ml/d, the treatment facilities are operating at 51% of their design capacity. The largest flow contributor is Mangaung with 140 Ml/d (31%). Given the current capacity, this implies that there is 49% spare capacity to meet the medium term demand. It must however be noted that inflow is not monitored in 62 systems (65%) and as a result the spare capacity could be substantially less than the 49%. Diagnostic #3 unpacks these statistics in more detail. This spare capacity would also be compromised at systems where some of the infrastructure or treatment modules are non-operational or dysfunctional. The VROOM Cost Diagnostic #7 provides more detail on the refurbishment requirements to restore such capacity and functionality.

The audit data shows that there are 9 systems that are hydraulically overloaded. This figure could theoretically be higher, given that there are 62 systems where inflow monitoring is not taking place. The hydraulically overloaded systems are: Ngwathe (Koppies), Mangaung (Bloemspruit, Botshabelo, Sterkwater), Nketoana (Petrus Steyn), Mohokare (Rouxville, Zastron), Setsotso (Clocolan) and Masilonyana (Winburg).

The predominant treatment technologies employed at the WWTWs comprise of activated sludge, ponds and biofilters (for effluent treatment); and solar drying beds and sludge lagoons/ponds (for sludge treatment). The next audit will need to verify sludge treatment technologies, as insufficient information ("Other") is observed in this area.



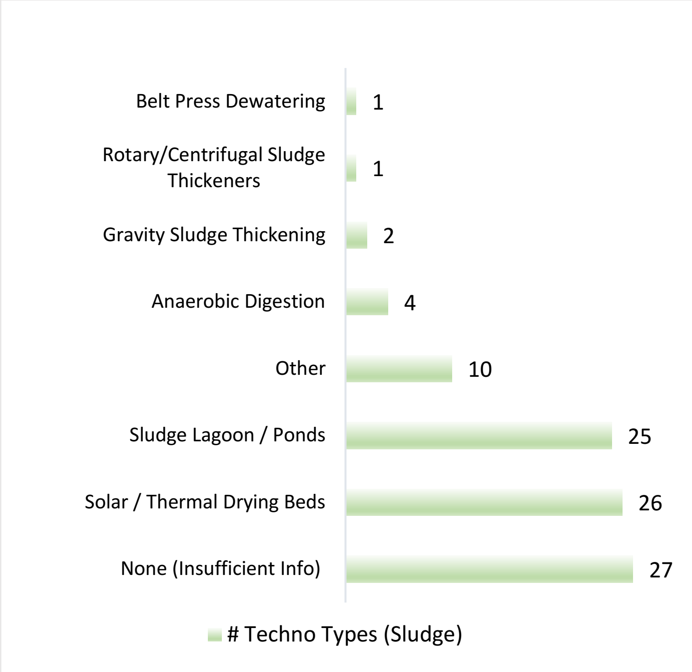


Figure 44 - Treatment technologies for wastewater effluent (a) and sludge (b)

Table 48 - Summary of Collection Network Pump Stations and Sewer Pipelines

WSA Name	# WWTWs	Pump Stations (#)	Sewer Pipelines (km)
Nala	3	4	NI
Matjhabeng	11	61	1,443
Ngwathe	5	16	NI
Moqhaka	3	11	NI
Metsimaholo	2	21	NI
Mafube	5	10	NI
Phumelela	3	31	NI
Dihlabeng	5	15	NI
Mangaung	13	26	388
Nketoana	4	7	NI
Setsotso	4	15	NI
Mantsopa	5	3	NI
Mohokare	3	4	NI
Kopanong	9	14	NI
Letsemeng	5	8	125
Maluti-A-Phofung	7	23	NI
Masilonyana	4	7	32
Tokologo	3	2	7
Tswelopele	2	9	NI
Totals	96	287	1,995

The sewer network consists of the sewer mains and pump stations as summarised in Table 48. Matjhabeng and Mangaung own and manage the bulk of the sewer collector infrastructure, approximately 1,463 km and 388 km; and 61 and 26 sewer pump stations, respectively. Fourteen municipalities could not provide information on sewer pipelines, indicating limitations in asset management information.

Provincial Green Drop Analysis

The 100% response from the 19 municipalities audited during the 2021 Green Drop process demonstrates a high level of commitment to wastewater services in the province. Local Government reforms resulted in the merging of Naledi LM into Mangaung Metro. Therefore 19 WSAs were audited in 2021 compared to the 20 WSAs in 2013.

Table 49 - Green Drop Comparative Analysis from 2009 to 2021

GREEN DROP COMPARATIVE ANALYSIS					
Performance Category	**2009**	**2011**	**2013**	**2021**	**Performance trend 2013 and 2021**
Incentive-based indicators					
Municipalities assessed (#)	8 (40%)	20 (100%)	20 (100%)	19 (100%)	→
Wastewater systems assessed (#)	35	95	93	96	↑

GREEN DROP COMPARATIVE ANALYSIS					
Performance Category	**2009**	**2011**	**2013**	**2021**	**Performance trend 2013 and 2021**
Incentive-based indicators					
Average Green Drop score	15%	24.1%	37.0%	24.1%	↓
Green Drop scores ≥50% (#)	7/35 (20%)	11/95 (11.8%)	26/93 (28%)	5/96 (5.2%)	↓
Green Drop scores <50% (#)	28/35 (80%)	84/95 (88.2%)	67/93 (72%)	91/96 (94.8%)	↓
Green Drop Certifications (#)	0	0	1	0	↓
Technical Site Inspection Score (%)	None	46.6%	48.0%	34.9%	↓

NA = Not Applied NI = No Information *↑= improvement, ↓= regress, →= no change*

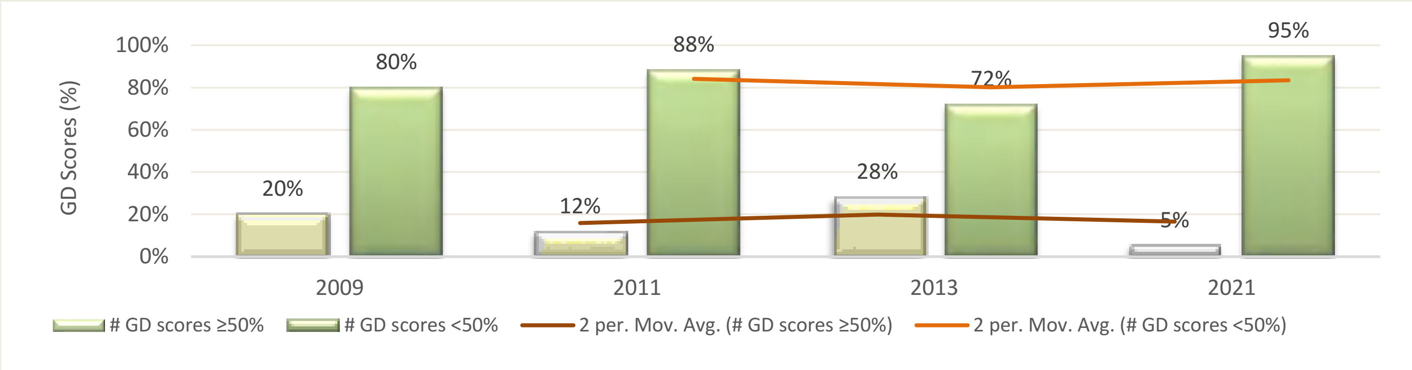


Figure 45 - Green Drop trend analysis over the period 2009 to 2021, indicating the percentage GD scores above and below 50%

The trend analysis indicates that:

- The number of systems audited has increased from 35 systems in 2009, when the first assessments were undertaken, to 96 systems in 2021
- Despite an upward trend in previous GD average scores, 15% in 2009, 24% in 2011, 37% to 2013, there was a drop-off to 24% in 2021
- Similarly, the number of systems with GD scores of ≥50% increased between from 11 (12%) in 2011 to 26 (28%) in 2013 but decreased to 5 (5%) in 2021
- This trend was also mirrored in the Technical Site Assessment score, which had increased marginally from 47% in 2011 to 48% in 2013 but decreased to 35% in 2021
- This trend was balanced by the number of systems with GD score of ≤50% decreasing from 84 (88%) in 2011 to 67 (72%) in 2013, followed by a significant regress to 91 (95%) in 2021
- The Green Drop Certifications decreased from 1 award in 2013 to no awards in 2021
- An overall performance trend from 2013 to 2021 signals the need for repeat/regular audits to ensure continued improvement. There are indications that performance has declined in the absence of the consistent regulatory engagement of the GD audits.

The analysis for the period 2009, 2011, 2013 and 2021, indicates that most of the system scores are in the 0-<50% (Critical and Poor Performance) categories, with the 50-<80% (Average Performance) being the next largest category. The most concerning data point is that 64 systems are in a critical state (<31%) compared to 46 systems in this category in 2013.

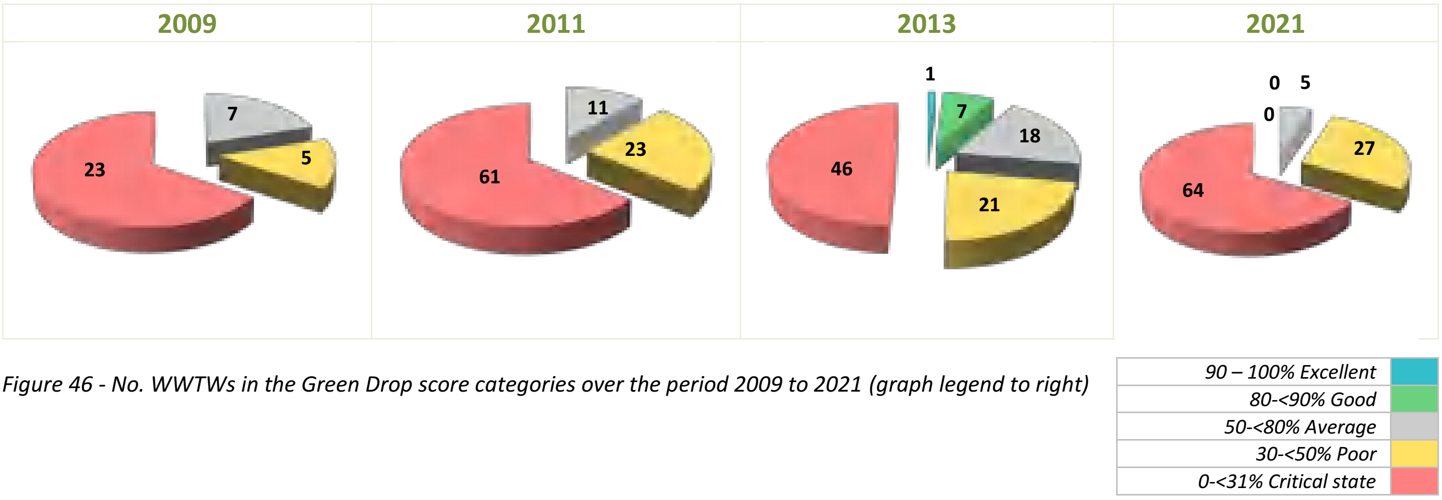


Figure 46 - No. WWTWs in the Green Drop score categories over the period 2009 to 2021 (graph legend to right)

In summary, trends over the years 2013 and 2021 indicate as follows:

- Systems in a 'poor state' increased from 21 systems in 2013 to 27 systems in 2021
- Systems in a 'critical state' increased from 46 in 2013 to 64 systems in 2021
- Systems in the 'excellent and good state' decreased from 8 systems in 2013 to no systems in 2021.

Provincial Risk Analysis

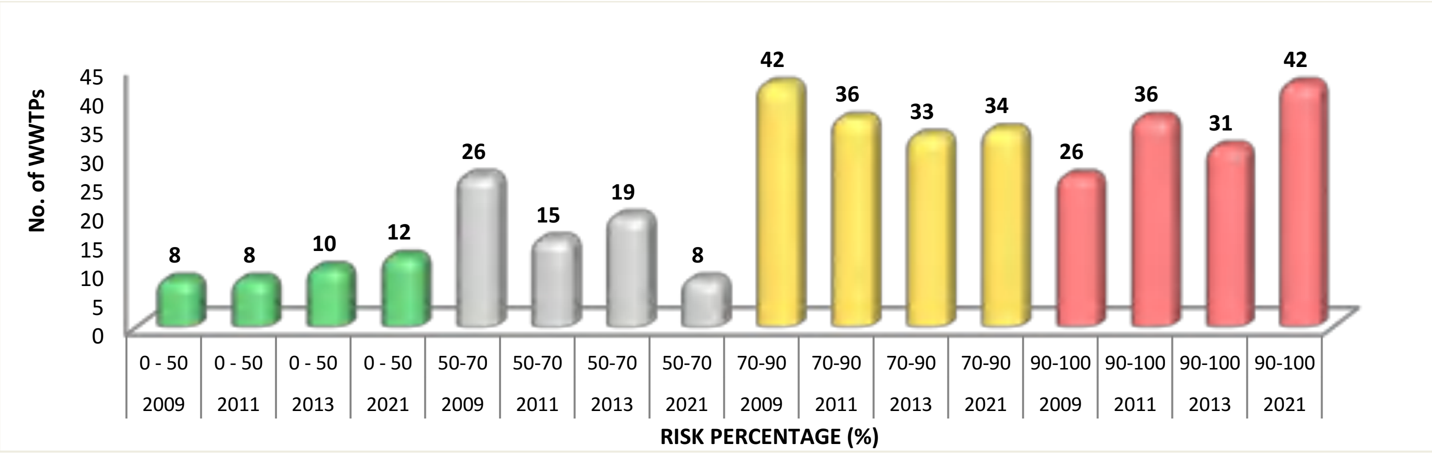
Green Drop risk analysis (CRR) focuses specifically on the treatment function. It considers 4 risk indicators, i.e. design capacity, operational flow, technical capacity, and effluent quality. The CRR values do not factor risks associated with sanitation or wastewater network and collector systems.

Table 50 - Cumulative Risk Comparative Analysis from 2009 to 2021

CUMULATIVE RISK COMPARATIVE ANALYSIS					
Performance Category	**2009**	**2011**	**2013**	**2021**	**Performance Trend 2013 to 2021**
Highest CRR	28.0	28.0	22.0	27.0	↓
Average CRR	14.7	16.2	13.8	15.1	↓
Lowest CRR	5.0	4.0	6.0	5.0	↑
Design Rating (A)	1.4	1.4	1.3	1.3	→
Capacity Exceedance Rating (B)	4.4	4.5	4.0	4.4	↓
Effluent Failure Rating (C)	5.8	7.1	6.0	6.6	↓
Technical Skills Rating (D)	3.1	2.8	3.0	2.9	↑
CRR% Deviation	**74.7**	**81.1**	**77.0**	**81.2**	↓

↑= improvement, ↓= regress, →= no change

Table 50 indicates a consistent CRR% deviation from 2013 to 2021, which suggests significant changes in the capacity exceedance (B) and final effluent quality (C) for the WSAs overall. Individual systems, however, show higher deviations and indicate specific risk categories, as highlighted under "***Regulator's Comment***". The CRR analysis in context of the Green Drop results suggests that further improvements should focus on 1) capacity exceedance at plants which are hydraulically overloaded or approaching its design lifespan, 2) effluent quality failures, especially for microbiological compliance, and 3) strengthening of technical skills and operational competency, especially related to sludge management.



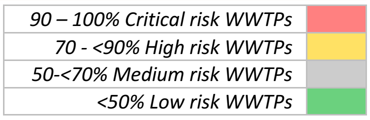


Figure 47 - a) WWTW Risk distribution and trends from 2009 to 2021; b) Colour legend

Trend analysis of the CRR ratings for the period 2009 to 2021 indicates that:

- The most prominent movement in risk can be seen from 2013 to 2021, where a significant number of plants moved from medium to critical risk positions, indicating a regressive state for the WWTWs
- The CRR remained fairly constant during 2011 to 2013, at a time when W_2RAPs and risk-mitigation strategies were being embedded in WSIs
- The 2021 assessment cycle highlighted regressive shifts with a decrease in the number of medium risk WWTWs (19 to 8) and increase in high risk (33 to 34) and critical risk WWTWs (31 to 42).

Regulatory Enforcement

Wastewater systems which failed to achieve the minimum Green Drop target of 31%, are placed under regulatory focus. The Regulator requires these municipalities to submit a detailed corrective action plan within 60 days from publishing of this report.

Seventeen (17) municipalities and 64 wastewater systems that received Green Drop scores below 31%, are to be placed under **regulatory surveillance**, in accordance with the Water Services Act (108 0f 1997). In addition, these municipalities will be compelled to ringfence water services grant allocation to rectify/restore wastewater collection and treatment shortcomings identified in this report.

Table 51 - WWTWs with <31% Green Drop scores

WSA Name	2021 Municipal GD Score	WWTWs with <31% score
Letsemeng LM	40%	Koffiefontein, Oppermansgronde
Tswelopele LM	40%	Hoopstad
Nketoana LM	34%	Lindley-Ntha
Mangaung LM	33%	Northern Works, Bloemindustria, Soutpan, Dewetsdorp, Van Stadensrus, Wepener
Mantsopa LM	30%	Excelsior, Ladybrand, Tweespruit
Kopanong LM	26%	Fauresmith, Gariep Dam, Jagersfontein, Reddersburg
Matjhabeng LM	26%	10 of 11 plants except Kutlwanong
Mohokare LM	21%	All 3 plants
Setsoto LM	19%	Ficksburg, Clocolan, Marquard New
Maluti-A-Phofung LM	18%	All 7 plants
Masilonyana LM	16%	Brandfort, Theunissen-Masilo, Winburg
Metsimaholo	11%	Both plants
Moqhaka LM	10%	All 3 plants
Ngwathe LM	10%	All 5 plants
Nala LM	6%	All 3 plants
Phumelela LM	4%	All 3 plants
Mafube LM	0%	All 5 plants

The following municipalities and their associated wastewater treatment plants are in high CRR risk positions, which means that some or all the risk indicators are in a precarious state, i.e. operational flow, technical capacity and effluent quality. WWTWs in high risk and critical risk positions poses a serious risk to public health and the environment. The following municipalities will be required to assess their risk contributors and develop corrective measures to mitigate these risks.

Table 52 - %CRR/CRR$_{max}$ scores and WWTWs in critical and high-risk space

WSA Name	2021 Mean %CRR/CRRmax deviation	WWTWs in critical and high-risk space	
		Critical Risk (90-100%CRR)	High Risk (70-<90%CRR)
Letsemeng LM	64.7%	Luckoff	Koffiesfontein
Dihlabeng LM	65.1%		Fouriesburg, Mautse-Rosendal, Paul Roux
Kopanong LM	68.0%	Fauresmith, Gariep Dam, Jagersfontein, Philippolis	
Tswelopele LM	73.5%		Hoopstad
Moqhaka LM	74.3%		All 3 plants
Metsimaholo	76.5%		Both plants (2)
Nketoana LM	77.9%		Lindley-Ntha, Petrus Steyn, Reitz
Setsoto LM	79.8%	Ficksburg	Clocolan, Marquard New
Mantsopa LM	80.4%		All 5 plants
Mangaung LM	82.7%	Dewetsdorp, Vanstadensrus, Wepener, Soutpan	Bloemindustria, Bloemspruit, Botshabelo, Sterkwater, Thaba Nchu, Welvaart
Masilonyana LM	85.3%	Brandfort, Winburg	Masilo-Theunissen
Mohokare LM	90.2%	Rouxville, Zastron	Smithfield
Maluti-A-Phofung LM	90.5%	Moeding, Phuthaditjhaba, Wilge-Harrismith	Elands, Kestell, Makwane, Tshiame
Matjhabeng LM	90.8%	9 of 11 plants	Allanridge AS

WSA Name	2021 Mean %CRR/CRRmax deviation	WWTWs in critical and high-risk space	
		Critical Risk (90-100%CRR)	High Risk (70-<90%CRR)
Ngwathe LM	**93.1%**	All 5 plants	
Nala LM	**94.6%**	All 3 plants	
Phumelela LM	**98.0%**	All 3 plants	
Mafube LM	**100.0%**	All 5 plants	

Good practice risk management requires that the W_2RAPs are informed by meaningful Process and Condition Assessments, supported by zealous implementation of corrective measures and ongoing monitoring of risk movement. Tokologo is commended for maintaining their treatment facilities in the low-risk position - an exemplary status.

Performance Barometer

The **Green Drop Performance Barometer** presents the individual Municipal Green Drop Scores, which essentially reflects the level of mastery that a municipality has achieved in terms of its overall municipal wastewater services business. The bar chart shows the comparison of the 2013 and 2021 GD scores, ranked the from highest to lowest performing WSI. All the systems are in poor and critical performance categories. Although there are improvements in the GD scores for Dihlabeng, Letsemeng, Tokologo and Nketoana in the poor performance category, five municipalities regressed from average performance positions in 2013 to poor and critical performance categories in 2021, viz. Mangaung, Matjhabeng, Setsotso, Maluti-A-Phofung and Metsimaholo.

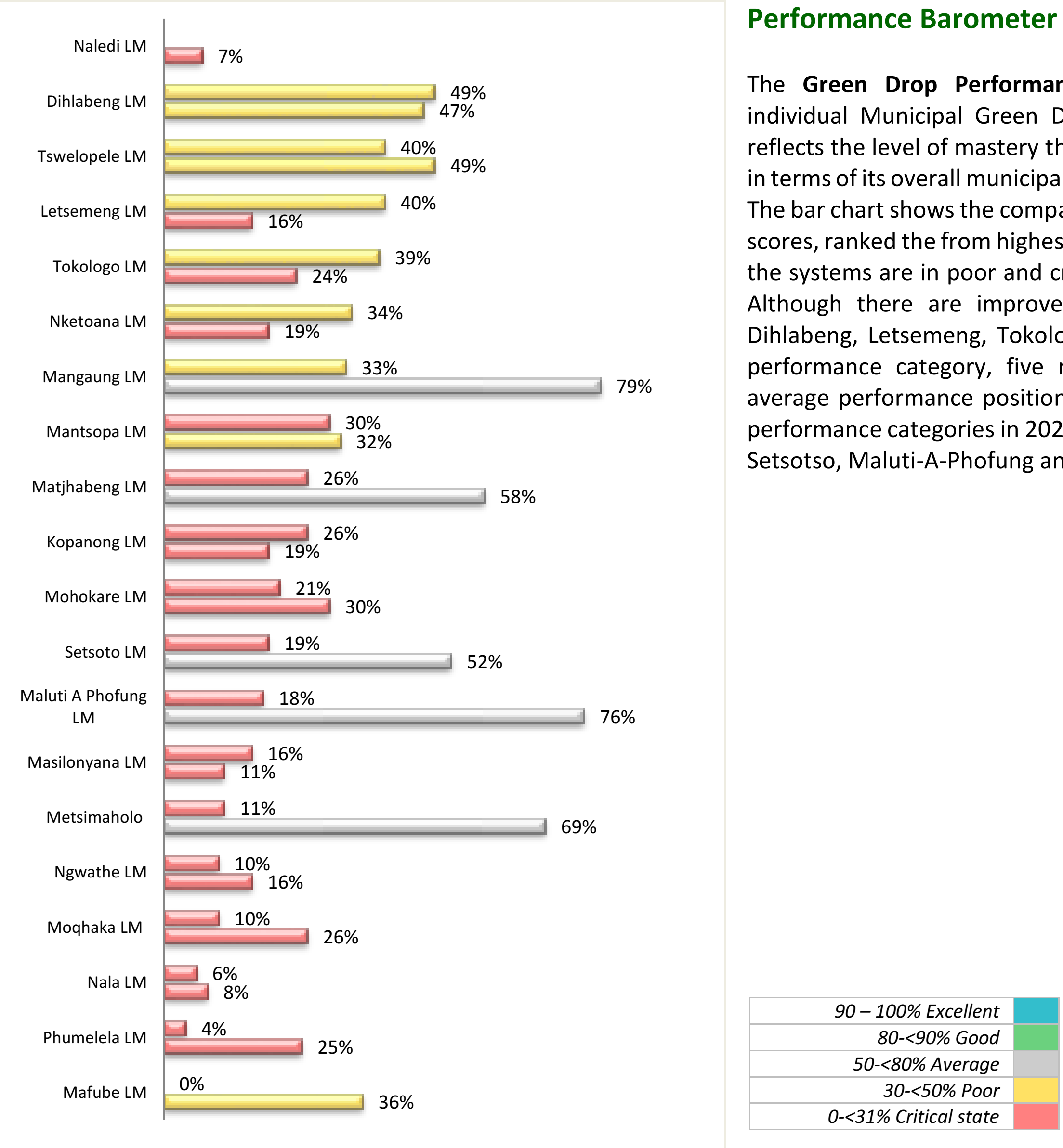


Figure 48 - Green Drop scores 2013 (bottom bar) and 2021 (top bar), with colour legend inserted

The **Cumulative Risk Log** expresses the level of risk that a municipality poses in respect of its wastewater treatment facility. It is based on the ***individual Cumulative Risk Ratios***. Figure 49 presents the cumulative risks in ascending order – with the low-risk municipalities on the left and critical risk municipalities to the far right. The analysis reveals that there are 7 critical risk municipalities and 8 high-risk municipalities in the province (15 of the 19 WSAs). Only Tokologo LM resides in a low-risk position.

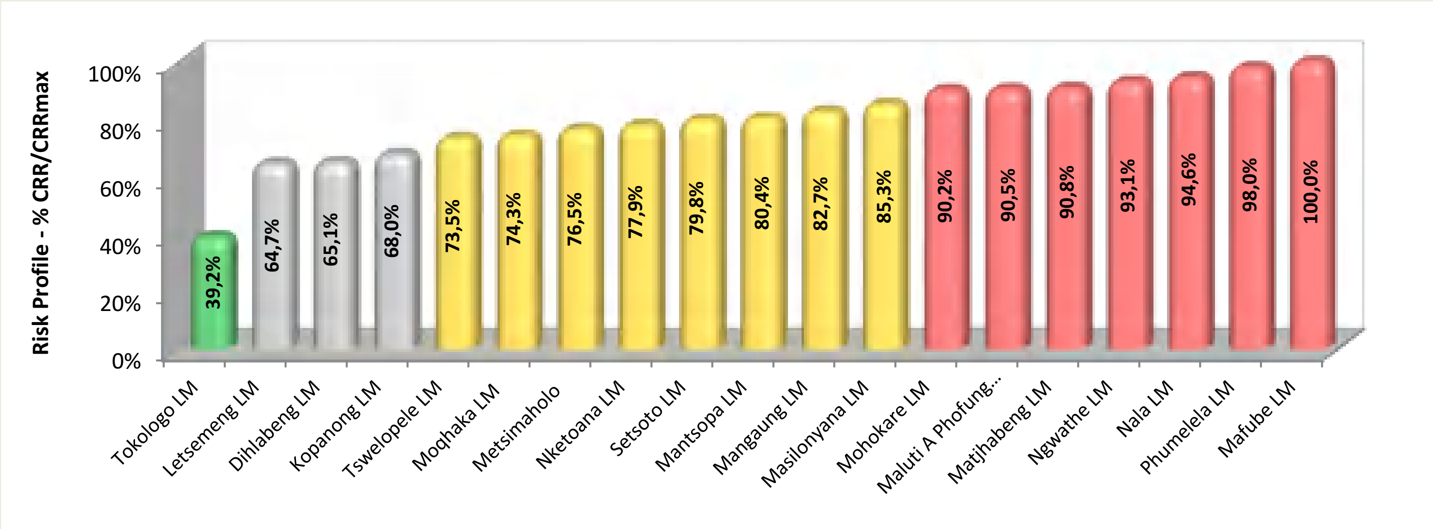


Figure 49 - a) %CRR/CRRmax Risk Performance Log 2021; b) Colour legend

90 – 100% Critical risk WWTPs	
70 - <90% High risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low risk WWTPs	

Provincial Best Performer

The **Dihlabeng LM** received the highest Green Drop score in the province, based on the following record:

- ✓ 49% Municipal Green Drop Score
- ✓ 2013 Green Drop Score of 47%
- ✓ Improvement on the CRR risk profile from 68.8% in 2013 to 65.1% in 2021
- ✓ 2 of 5 (40%) plants in the low and medium risk positions
- ✓ Technical Site Assessment score of 42% (Mashaeng).

KPA Diagnostics

The Green Drop Audit process collects a vast amount of data that yield valuable insight on the state of the wastewater sector in each Province. These insights have been captured into 7 thematic areas or 'Diagnostics', as discussed below.

Table 53 - Summary of the key diagnostic themes and reference to the respective Green Drop KPAs

Diagnostic #	Diagnostic Description	Diagnostic Reference
1	**Green Drop KPA Analysis**	KPAs A-E
2	**Technical Competence**	KPA A, B & Bonus
3	**Treatment Capacity**	KPA D
4	**Wastewater Monitoring and Compliance**	KPA B & D & Bonus
5	**Energy Efficiency**	KPA C & Bonus
6	**Technical Site Assessments**	TSA
7	**Operation, Maintenance and Refurbishment of Assets**	KPA C, D & Bonus

Diagnostic 1: Green Drop KPA Analysis

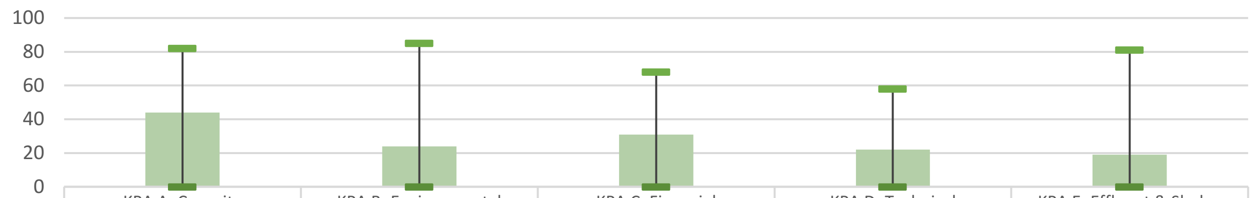
Aim: Analysis of technical skills, environmental plans, financial management, technical capacity, and regulatory compliance provides insight into the strengths and weaknesses of wastewater management in WSAs in the province. These insights in turn, may inform appropriate interventions and strategies to improve the individual KPAs and ultimately, collective KPA performance.

Findings: The WSAs are characterised by a highly variable KPA profile. A good KPA profile typically depicts a high mean GD score, coupled with a low Standard Deviation (SD) between the outer parameters (min and max). Similarly, a well performing system is one which has most/all systems in the >80% bracket and no systems in the <31% bracket.

Table 54 - Green Drop scores KPA profiles (graph legend included)

KPA #	Key Performance Area	*Weight*	Minimum GD Score (%)	Maximum GD Score (%)	Mean GD Score (%)	# Systems <31%	# Systems ≥80%
A	Capacity Management	*15%*	0%	82%	**44%**	21 (22%)	5 (5%)
B	Environmental Management	*15%*	0%	85%	**24%**	63 (66%)	1 (1%)
C	Financial Management	*20%*	0%	68%	**31%**	34 (35%)	0 (0%)
D	Technical Management	*20%*	0%	58%	**22%**	50 (52%)	0 (0%)
E	Effluent and Sludge Compliance	*30%*	0%	81%	**19%**	81 (84%)	7 (7%)

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	



	KPA A: Capacity Management	KPA B: Environmental Management	KPA C: Financial Management	KPA D: Technical Management	KPA E: Effluent & Sludge Compliance
Mean	44	24	31	22	19
Max	82	85	68	58	81
Min	0	0	0	0	0

Note: The High and low lines represent the Min and Max range, and the shaded green represents the Mean

Figure 50 - Maximum, minimum, and mean Green Drop KPA scores

The KPA distribution indicates as follows:

- Capacity Management (KPA A) reflects the highest mean of 44%, 2nd highest maximum of 82%, and the 2nd highest Standard Deviation (SD) of 82%. These results indicate some strengths pertaining to the registration of WWTWs, maintenance plans and records, maintenance teams, and registered, qualified staff (process controllers, supervisors, scientists, technicians, engineers)
- Effluent and Sludge Quality Compliance (KPA E) received the lowest mean of 19%, indicating a deficiency in data management, IRIS upload, effluent quality compliance, and sludge quality compliance
- This was followed by the Technical Management (KPA D) that received the next lowest mean of 22%, indicating a vulnerability in basic design information, inflow, outflow, meter reading credibility, process and condition assessments, site inspection reports, asset registers, asset values, bylaws and enforcement.
- Environmental Management (KPA B) had a mean of 24%, indicating a deficiency in risk abatement plans, operations and compliance monitoring, sludge management compliance and laboratory credibility
- Financial Management (KPA C) had a mean of 31%, indicating a deficiency in credible information pertaining to the budget drivers, O&M budgets and expenditure, operational cost (R/m^3), energy use and cost (R/kWh), and supply chain management and contract management

The GD bracket performance distribution reiterates the above findings:

- ***KPA Score ≥80%:*** Effluent & Sludge Compliance (KPA E) is the best performing KPA with 7% of systems achieving >80%, followed by Capacity management (KPA A) with 5% & Environmental Management (KPA B) with 1%. Financial Management (KPA C) & Technical Management (KPA D) were the worst performing KPAs with no systems achieving >80%
- ***KPA Score <31%:*** Effluent & Sludge Compliance (KPA E) represent the worst performing KPA with 84% of the systems scoring <31%, followed by Environmental Management (KPA B) with 66% & Technical Management (KPA D) with 52%.

Diagnostic 2: Technical Competence

Aim: This focus area assesses the human resources (technical) capacity to manage wastewater systems. Theory suggests a correlation between human resources capacity (sufficient number of appropriately qualified staff) and a municipality's performance and operational capability. It is projected that high HR capacity would translate to compliant wastewater services and protection of scarce water resources.

Findings: According to regulations, wastewater plants are classified as Class A, B, C, D or E plants. Similarly, Process Controllers and Plant Supervisors are registered as Class I, II, III, IV, V or VI operators. Higher classed plants require a higher level of operators due to their complexity and strict regulatory standards. Technical compliance of PCs and Supervisors is determined against Green Drop standards, as defined by Reg. 2834 and draft Reg. 813 of the National Water Act 1998.

Note: "Compliant staff" means qualified and registered that meets the GD standard for a particular Class Works. "Staff shortfall" means staff that does not meet the GD standard for a particular Class of works (+1 for a shift) and/or staffing gaps exist at the respective WWTWs.

Table 55 - No. compliant versus shortfall in Supervisor and Process Controller staff

WSA Name	# WWTWs	# Compliant staff		# Staff Shortfall		Ratio*	WSA 2021 GD Score (%)
		Supervisor	PCs	Supervisor	PCs		
Nala	3	0	1	2	7	0.3	6%
Matjhabeng	11	2	14	2	16	1.5	26%
Ngwathe	5	0	8	1	6	1.6	10%
Moqhaka	3	0	0	2	9	0	10%
Metsimaholo	2	0	0	1	4	0	11%
Mafube	5	0	1	3	10	0.2	0%
Phumelela	3	1	2	0	7	1	4%
Dihlabeng	5	2	9	1	9	2.2	49%
Mangaung	13	1	13	2	17	1.1	33%
Nketoana	4	1	3	0	3	1	34%
Setsotso	4	1	3	1	8	1	19%
Mantsopa	5	0	0	1	11	0	30%
Mohokare	3	0	0	1	8	0	21%
Kopanong	9	0	0	3	11	0	26%
Letsemeng	5	0	0	2	7	0	40%
Maluti-A-Phofung	7	2	0	1	18	0.3	18%
Masilonyana	4	0	0	1	9	0	16%
Tokologo	3	0	2	1	1	0.7	39%
Tswelopele	2	0	2	1	4	1	40%
Totals	**96**	**10**	**58**	**26**	**165**		

** The single number Ratio is derived from the number of qualified staff divided by the number of WWTWs operated by this number of staff. E.g., for Matjhabeng, 16 qualified staff is available to support 11 WWTW, thus 16/11 = 1.5 ratio*

Competent human resources are a vital enabler to ensure efficient and sustainable management of treatment processes and infrastructure. For the Free State in general, the operational competencies are not on par with regulatory expectations, as illustrated by the high shortfalls against the Green Drop standards.

Plant Supervisors: The pie charts indicate that 28% (10 of 36) of Plant Supervisors complies with the Green Drop standard, with zero shortfall for Phumelela and Nketoana. A 72% (26 of 36) shortfall is noted for Supervisors overall, with the highest shortfall seen at the Mafube and Kopanong (3 no. each).

Process Controllers: Similarly, 26% (58 of 223) of the Process Control staff is compliant, with shortfalls in every municipality. There is a 74% (165 of 223) shortfall in Process Controlers with the highest shortfall for Maluti-A-Phofung (18 no.), Mangaung (17 no.), Matjhabeng (16 no.), and Mafube (10 no.).

Green Drop standards require of Class A and B plants to employ dedicated Supervisors and Process Controllers per shift per WWTWS, whereas Class C to E plants may consider sharing of staff across works. Shifts have been introduced to ensure optimal operations while addressing security risks, particularly as it relates to vandalism. Telemetry also reduces the requirement for on-site staff during night shifts, but these relaxations will have to be done within the DWS regulatory guidelines.

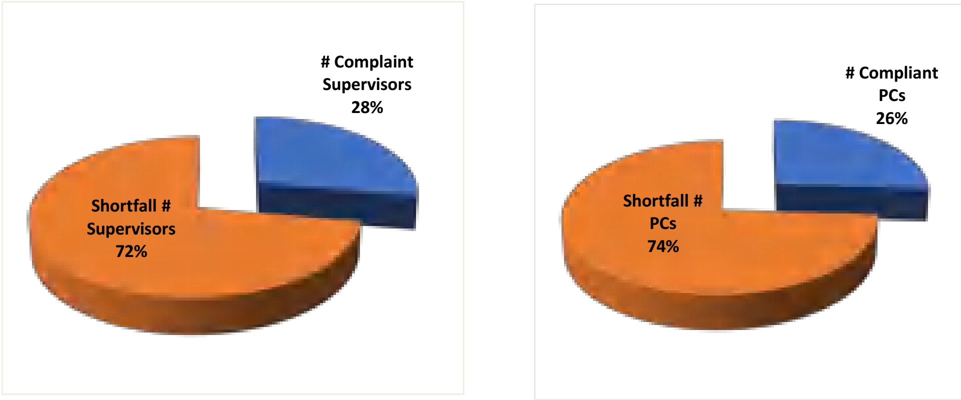


Figure 51 - Schematic illustration of compliant versus non-compliant Supervisors (a) and Process Controllers (b)

It is expected that a correlation exists between the competence of an operational team and the performance of a treatment plant, as measured by the GD score. The data indicates as follows:

- None of the municipalities have good Supervisor/Process Controller ratios in place (≥3). Only Dihlabeng has a fair ratio >2. Seven (7) municipalities have fair ratios between 1 and 2
- Except for Phumelela and Nketoana, all municipalities have shortfalls in registered Supervisors. All municipalities have shortfalls in registered Process Controllers.

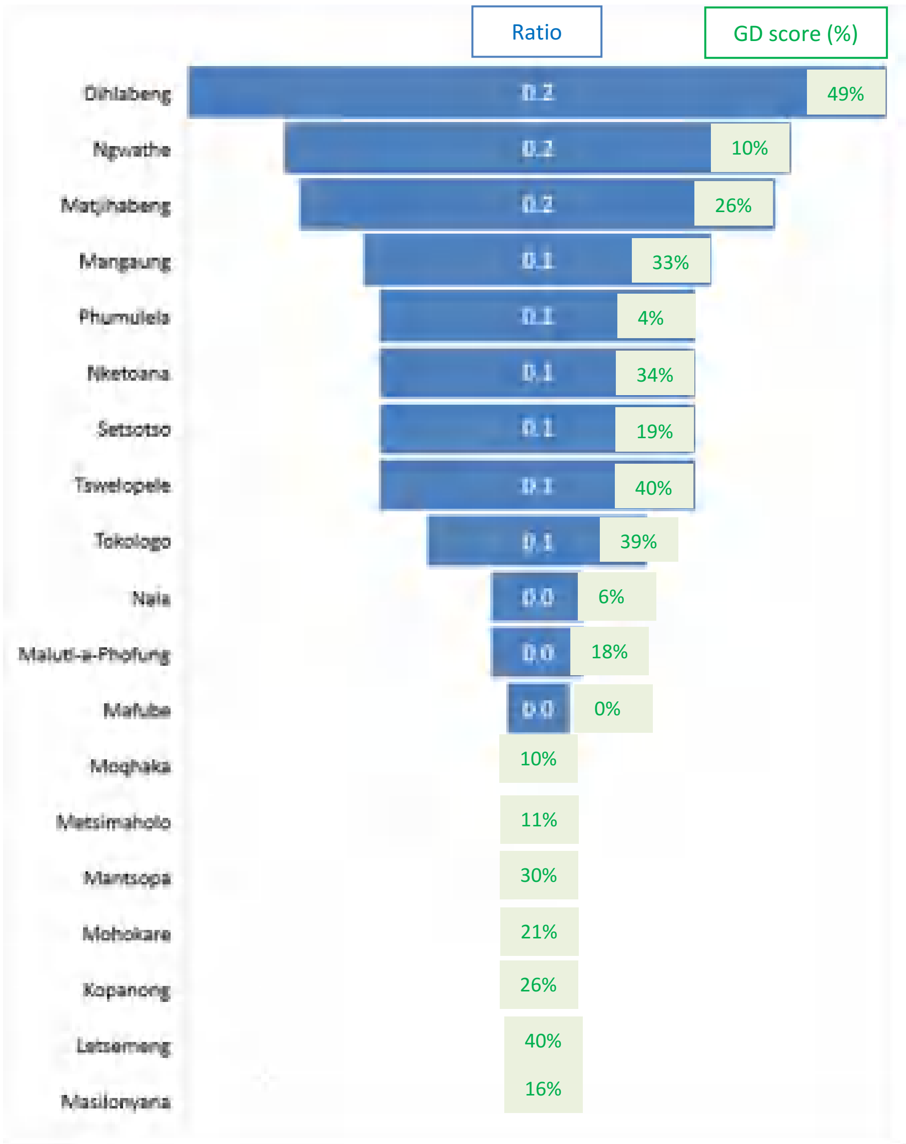


Figure 52 - Ratio of compliant operational staff to no. of WWTWs and Comparison of Ratios with GD scores

A reasonable correlation is noted between municipalities with high ratios and higher GD scores (Dihlabeng 49%, Mangaung 39%, Nketoana 34%, Tswelopele 40%). Whereas lower ratios are associated with lower GD scores Moqhaka 10%, Metsimaholo 11%, etc). However, there are anomalies with high GD scores and low ratios, and vice versa, as can be seen with Ngwathe, Phumelela, Setsotso, Letsemeng, and Mantsopa.

In addition to operational capacity (above), good management practice also requires access to qualified engineers, technicians, technologists, scientists, and maintenance capability. Such competencies could reside in-house or accessible through term contracts and external specialists.

Table 56 - Summary of the maintenance capacity and no. of qualified and shortfall of Engineering, Technical and Scientific staff

WSA Name	# WWTW	Maintenance Arrangement	Qualified Technical Staff (#)				Technical Shortfall (#)	Qualified Scientists (#)	Scientists Shortfall (#)	Ratio*	WSA 2021 GD Score (%)
			Engineers	Technologists	Technicians	Total					
Nala	3	Internal + Specific Outsourcing	0	0	2	2	0	0	1	0.7	6%
Matjhabeng	11	Internal Team (Only)	0	4	2	6	0	1	0	0.5	26%
Ngwathe	5	Internal + Specific Outsourcing	0	0	0	0	2	3	0	0	10%
Moqhaka	3	Partially Capacitated	0	0	1	1	1	1	0	0.3	10%
Metsimaholo	2	Internal + Term Contract	0	1	0	1	1	1	0	0.5	11%
Mafube	5	Internal + Term Contract	1	0	1	2	0	1	0	0.4	0%
Phumelela	3	No Capacity	0	1	2	3	0	0	1	1.0	4%
Dihlabeng	5	Internal + Term Contract	0	4	1	5	0	1	0	1.0	49%
Mangaung	13	Inadequate Capacity	1	0	0	1	1	3	0	0.1	33%
Nketoana	4	Internal + Specific Outsourcing; Internal Team (Only); Internal + Term Contract	0	0	3	3	0	0	1	0.8	34%
Setsotso	4	Partially Capacitated	2	0	0	2	0	1	0	0.5	19%
Mantsopa	5	Internal + Specific Outsourcing	0	0	2	2	0	0	1	0.4	30%
Mohokare	3	Partially Capacitated	0	1	3	4	0	0	1	1.3	21%
Kopanong	9	Internal + Specific Outsourcing; Internal + Term Contract	0	0	2	2	0	0	1	0.2	26%
Letsemeng	5	Internal + Specific Outsourcing	0	1	4	5	0	0	1	1.0	40%
Maluti-A-Phofung	7	Internal + Specific Outsourcing	0	2	3	5	0	0	1	0.7	18%
Masilonyana	4	Partially Capacitated	0	2	3	5	0	0	1	1.3	16%
Tokologo	3	Internal + Specific Outsourcing	0	1	3	4	0	0	1	1.3	39%
Tswelopele	2	Internal + Specific Outsourcing	0	0	1	1	1	0	1	0.5	40%
Totals	**96**	**0**	**4**	**17**	**33**	**54**	**6**	**12**	**11**		

** The Ratio depicts the number of qualified technical staff divided by the number of WWTWs that have access to the staff*

Note 1: "Qualified Technical Staff" means staff appointed in positions to support wastewater services, and who has the required qualifications. "Technical Shortfall" is calculated based on a minimum requirement of at least 2 Engineers/Technologists/Technicians and at least one 1 Scientist per WSI.

Note 2: "Qualified Scientists" means professional registered scientists (SACNASP) appointed in positions to support wastewater services. "Scientists shortfall" means that the WSA do not have at least one qualified, SACNASP registered scientist in their employ or contracted.

The Free State has a reasonable contingent of qualified maintenance staff for at least 18 of the 19 municipalities, with the current qualified maintenance staff forming a collective of inhouse, contracted or outsourced personnel. The data indicates that:

- 13 municipalities have in-house maintenance teams
- 5 municipalities have internal maintenance teams supplemented with term contracts
- 9 municipalities have internal maintenance teams supplement with specific outsourced services
- 6 municipalities have either no capacity, are partially capacitated or have inadequate capacity.

In general, the WSAs have access to qualified technical staff and credible laboratories. The data indicates as follows:

- A total of 66 qualified staff, comprised of 4 engineers, 17 technologists, 33 technicians (qualified) and 12 SACNASP registered scientists are assigned to the 19 municipalities
- A total shortfall of 17 persons is identified, consisting of 6 technical staff and 11 scientists

- Municipalities with a shortfall in qualified technical staff are Ngwathe, Moqhaka, Metsimaholo, and Tswelopele
- 42% of WWTWs have access to credible laboratories that complies with Green Drop standards.

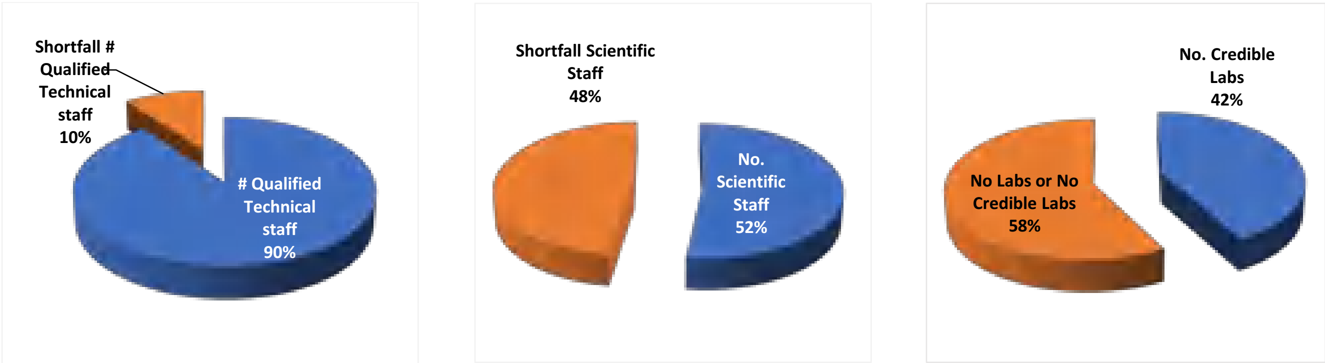


Figure 53 - Graphic illustration of the number and %: a) qualified engineering/technical staff; b) professional scientists; c) access to credible laboratory services that complies with Green Drop standards

Ratio analysis has been done to determine the number of qualified technical and scientific staff assigned per WWTW. It is expected that a higher ratio would correspond with well-performing and maintained wastewater systems, as represented by the GD score.

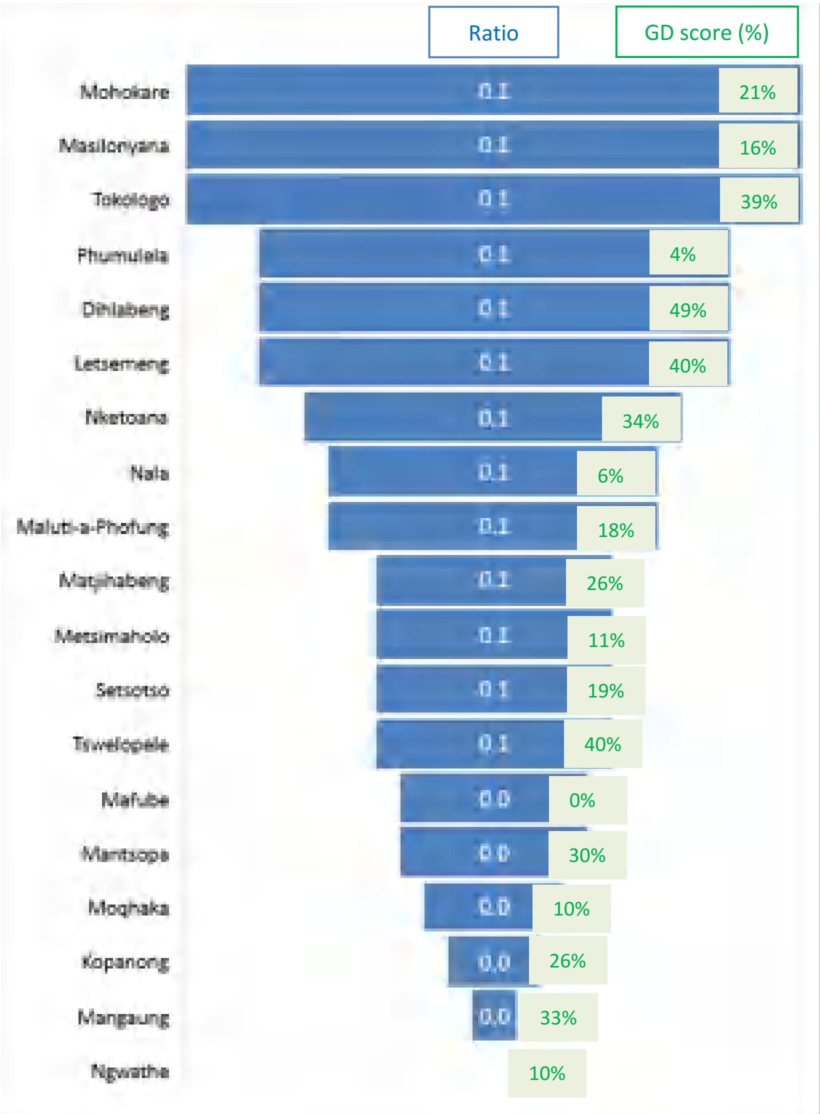


Figure 54 - Ratio of compliant technical staff to no. of WWTWs and Comparison of Ratios with GD scores

Figure 54 shows a reasonable correlation between high ratios and high GD scores at 3 municipalities (Tokologo 39%, Dihlabeng 49%, Letsemeng and Nketoana 34%). Likewise, a high correlation was found between lower ratios and lower Green Drop scores (Mafube 0%, Moqhaka 10%, Ngwathe 10%).

However, there are anomalies with high GD scores and low ratios and vice versa. These results suggest that wastewater performance may be less sensitive towards engineering, technical and scientific staff, and more dependent on operational competencies (Superintendents and PCs).

One of the options to enhance operational capacity is through dedicated training programmes. The Green Drop audit incentivises training of operational staff over the 2-year period prior to the audit date. The results are summarised as follows:

Table 57 - No. of WWTWs with operational staff sent on training over the past 2 years and vice versa

WSA Name	# of WWTW staff attending training over past 2 years	# of WWTW without training over past 2 years
Nala	0	3
Matjhabeng	0	11
Ngwathe	0	5
Moqhaka	0	3
Metsimaholo	2	0
Mafube	0	5
Phumelela	0	3
Dihlabeng	5	0
Mangaung	13	0
Nketoana	0	4
Setsotso	0	4
Mantsopa	0	5
Mohokare	0	3
Kopanong	0	9
Letsemeng	0	5
Maluti-A-Phofung	0	7
Masilonyana	0	4
Tokologo	3	0
Tswelopele	0	2
Totals	**23 (24%)**	**73 (76%)**

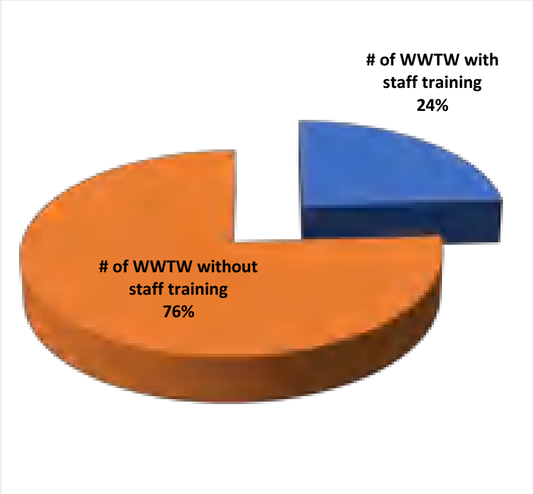


Figure 55 - %WWTWs that have trained operational staff over the past two years

The results confirmed that only 23 systems (24%) had operational staff attending training over the past 2 years. Training gaps persist in the WSAs and require a concerted effort to strengthen training initiatives of Supervisors and Process Controllers. Recent training events focused primarily on chlorine handling and NQF, and needs to be expanded to operation of technology, sludge treatment and energy efficiency.

Diagnostic 3: Treatment Capacity

Aim: A capable treatment plant requires adequate design capacity and functional equipment to operate optimally. If the plant capacity is exceeded by way of inflow volume or strength, the plant will not be capable to achieve its compliance standards. Capacity is typically exceeded when the demand exceeds the installed design capacity, or when processes or equipment is not operational or dysfunctional, or when the electrical supply cannot support the treatment infrastructure. This diagnostic assesses the status of plant capacity and operational flows to the plants.

Findings: Analysis of the hydraulic capacities and operational flows indicate a total design capacity of 457 Ml/d for the Province, with a total inflow of 243.4 Ml/day (considering that 62 systems are not measuring their inflows). Theoretically, this implies that approximately 51% of the design capacity is used with 49% available to meet additional demand. However, the full 457 Ml/d day is not fully available as some infrastructure is dysfunctional, leaving 365.6 Ml/d available. Furthermore, the operational flow excludes data from 62 WWTWs that are not measuring flow, which would take up a significant portion of the installed capacity.

Most plans in the Free State are operating within their design capacities, with the exception of Mangaung and Mohokare - exceedance of 104% and 160% respectively. Matjhabeng, Setsotso and Tokologo report a low percentage use of their capacity (<50%). Treatment systems with low percentage use may have been affected by breakdown in sewer networks or pump stations whereby all sewage is not reaching the treatment and/or are not measuring the inflow into some of their systems and therefore producing skewed results. The Green Drop audit requires a wastewater flow balance to identify and quantify possible losses from the network and/or ingress into the sewers. It was noted that the majority of municipalities do not have flow balances to track the wastewater pathway from consumer to treatment plant.

Table 58 - Summary of WWTWs design and available capacities, inflows, % use design capacities, and inflows measured per WWTW

WSA Name	# WWTWs	Design Capacity (Ml/d)	Available Capacity (Ml/d)	Operational Flow (Ml/d)	Variance (Ml/d)	% Use Design Capacity	Inflow measured #
Nala	3	13.2	13.0	10.1	3.10	77%	0
Matjhabeng	11	83.7	70.7	9.5	74.25	11%	2
Ngwathe	5	23.2	21.7	13.8	9.36	60%	1
Moqhaka	3	25.4	11.0	NI	NI	0%	0
Metsimaholo	2	3.1	1.5	NI	NI	0%	0
Mafube	5	9.9	9.9	NI	NI	0%	0
Phumelela	3	7.7	7.7	NI	NI	0%	0
Dihlabeng	5	32.4	32.4	24.1	8.26	75%	5
Mangaung	13	140.0	139.9	146.2	-6.22	104%	9
Nketoana	4	10.9	10.9	6.1	4.89	55%	3
Setsotso	4	18.4	18.4	6.1	12.29	33%	2
Mantsopa	5	20.5	20.5	15.3	5.25	74%	5
Mohokare	3	3.6	3.6	5.7	-2.13	160%	3
Kopanong	9	8.4	NI	NI	NI	NI	0
Letsemeng	5	7.5	NI	NI	NI	NI	1
Maluti-A-Phofung	7	30.9	NI	NI	NI	NI	0
Masilonyana	4	7.7	NI	5.1	2.55	67%	2
Tokologo	3	4.8	NI	1.5	3.24	32%	1
Tswelopele	2	6.6	4.5	NI	NI	NI	0
Totals	**96**	**457.6**	**365.6**	**243.4**	**214.9**	**53%**	**34**

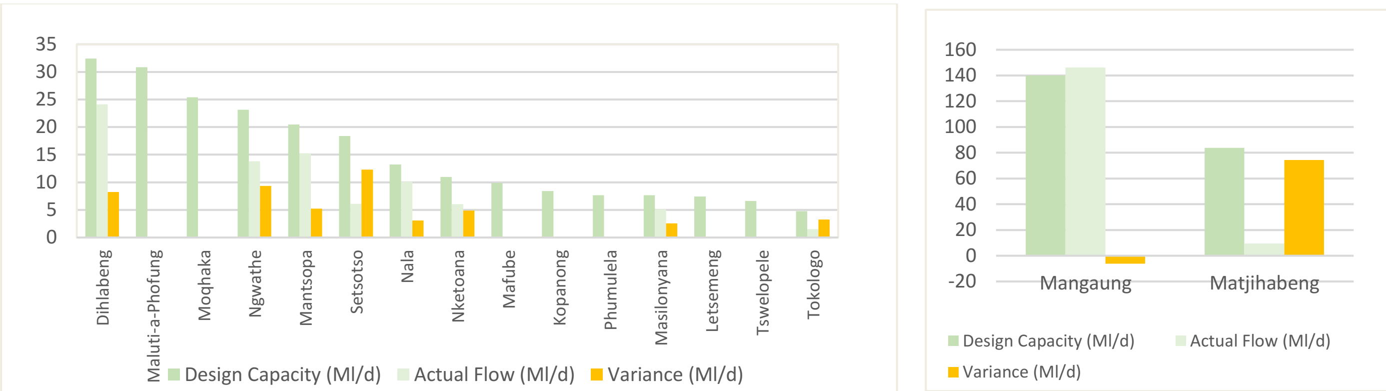


Figure 56 - WSA design capacity, actual flow, and variance in Ml/d for smaller and larger sized WWTWs

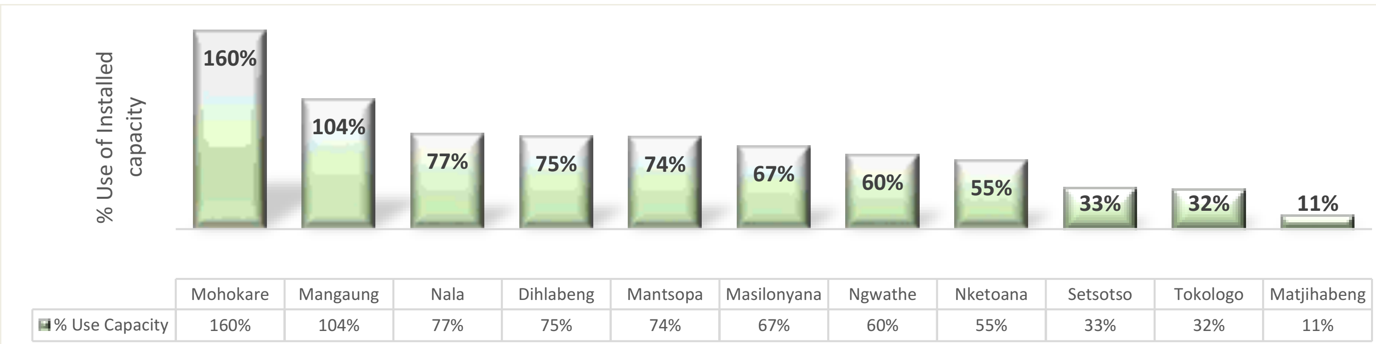


Figure 57 - WSA % use of installed design capacity for WWTWs measuring inflows only

The audit data indicates that 9 systems are hydraulically overloaded. This figure could theoretically be higher, given that there are 62 systems where inflow monitoring is not taking place. The capacity limitations may impede social and economic development in the drainage areas, if not addressed. The hydraulically overloaded systems in each of the WSAs is as follows:

- Ngwathe: Koppies
- Mangaung: Bloemspruit, Botshabelo, Sterkwater
- Nketoana: Petrus Steyn
- Mohokare: Rouxville, Zastron
- Setsotso: Clocolan
- Masilonyana: Winburg.

Water Use Authorisations mandate municipalities to install and monitor flow meters, whilst GD requires WSAs to report inflows on IRIS and to calibrate meters annually.

The audit results indicate that 35% (34 of 96) of municipalities monitor their inflow. The majority of WSAs calibrate or verify their flow meters on an annual basis and by doing so meet good practice standards.

Whilst the WSAs do not fare well in terms of monitoring inflow and outflows, i.e. hydraulic loads to the treatment works, few municipalities know their organic design capacity and does not monitor organic loading to the works. This presents a gap that would impede on forward planning and system optimisation strategies.

Diagnostic 4: Wastewater Monitoring and Compliance

Aim: "*To measure is to know*" and "*To know is to manage*". The primary objective of a wastewater treatment plant is to produce final effluent and biosolids to a safe standard. This standard cannot be measured or managed if operational and compliance monitoring is lacking. This diagnostic assesses the status monitoring and final effluent compliance against each WWTW's mandatory standards.

Findings: For operational monitoring, a satisfactory level of 90% is applied as the benchmark, to give weight to the importance of monitoring. For compliance monitoring, the audit evaluates the sampling point, sampling frequency, final effluent quality, biomonitoring, heavy metals, and any specific condition that the DWS may have included in the water use license. Final effluent quality compliance is calculated against the mandatory limits as listed under "Authorisation Status". A >90% compliance figure confirms high quality final effluent, whereas a <30% indicates poor effluent quality. The enforcement measures are summarised in the last column of Table 60 and include NWA Notices and Directives issued, criminal cases opened, and court interdicts granted during the period 1 April 2019 to 30 June 2021.

Table 59 - Summary of the WSA operational and compliance monitoring status

WSA Name	# WWTW	Operational monitoring (KPA B2)		Compliance monitoring (KPA B3)	
		Satisfactory [GD score >90%]	Not Satisfactory [GD score <90%]	Satisfactory [GD score >90%]	Not Satisfactory [GD score <90%]
Nala	3	0	3	0	3
Matjhabeng	11	0	11	0	11
Ngwathe	5	0	5	0	5
Moqhaka	3	0	3	2	1
Metsimaholo	2	0	2	0	2
Mafube	5	0	5	0	5
Phumelela	3	0	3	0	3
Dihlabeng	5	0	5	0	5
Mangaung	13	0	13	0	13
Nketoana	4	0	4	3	1
Setsotso	4	0	4	1	3
Mantsopa	5	0	5	5	0
Mohokare	3	0	3	1	2
Kopanong	9	0	9	0	9
Letsemeng	5	0	5	0	5
Maluti-A-Phofung	7	0	7	0	7
Masilonyana	4	0	4	0	4
Tokologo	3	0	3	0	3
Tswelopele	2	0	2	0	2
Totals	**96**	**0 (0%)**	**96 (100%)**	**12 (13%)**	**84 (87%)**

The performance recorded in Table 59 stems from performance data as measured against the Green Drop Standard expressed in KPAs B2 and B3. Overall, an unsatisfactory sampling and analysis regime is observed for both operational (100%) and compliance (87%) monitoring. This is a concerning observation. Compliance monitoring is a legal requirement and the only means to measure performance of a treatment facility. Operational monitoring is the cornerstone of day-to-day process adjustments and optimisation to ensure treatment is efficient and delivers quality effluent/sludge that meet design expectations. Sludge monitoring is essential as poor sludge handling is the root cause of many WWTWs failing to meet final effluent standards. The results indicate that WSAs on average, is not achieving regulatory and industry standards.

Table 60 summarises the results of KPA E, which also carries the highest Green Drop score weighting. Note that averages shown as '0%' under Effluent Compliance include actual 0% compliance plus systems with no information or insufficient data.

Table 60 - Summary of authorisation status, effluent compliance status, and directives/notices issued

WSA Name	Authorisation Status	Effluent Compliance									Enforce-ment Measures*
		Microbiological Compliance (%)			Chemical Compliance (%)			Physical Compliance (%)			
		Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	
Nala	All not authorised	0%	0	3	0%	0	3	0%	0	3	0
Matjhabeng	All not authorised	0%	0	11	0%	0	11	0%	0	11	5
Ngwathe	All not authorised	0%	0	5	0%	0	5	0%	0	5	1
Moqhaka	All not authorised	19%	0	2	61%	1	0	72%	1	0	1
Metsimaholo	1 WUL; 1 Not authorised	25%	0	2	33%	0	0	67%	0	0	0
Mafube	All not authorised	0%	0	5	0%	0	5	0%	0	5	3
Phumelela	All not authorised	0%	0	3	0%	0	3	0%	0	3	0
Dihlabeng	4 WUL; 1 Not authorised	2%	0	5	31%	1	3	29%	1	3	1
Mangaung	3 WUL; 1 GA; 1 Permit; 7 Not authorised; 1 Unknown	13%	0	10	6%	0	12	12%	0	10	0
Nketoana	1 WUL; 3 GA	29%	0	2	14%	0	4	24%	0	2	2
Setsotso	1 WUL; 2 GA; 1 Not authorised	19%	0	3	21%	0	3	23%	1	3	1
Mantsopa	3 GA; 2 Not authorised	17%	0	4	17%	0	4	17%	0	4	1
Mohokare	3 Permits	0%	0	3	0%	0	3	0%	0	3	1
Kopanong	All Unknown	0%	0	9	0%	0	9	0%	0	9	0
Letsemeng	All Unknown	46%	2	3	58%	2	2	65%	2	1	0
Maluti-A-Phofung	4 WUL; 1 Not authorised; 2 Unknown	0%	0	7	0%	0	7	0%	0	7	4
Masilonyana	All Unknown	0%	0	4	0%	0	4	0%	0	4	1
Tokologo	All not authorised	0%	0	3	0%	0	3	0%	0	3	0
Tswelopele	1 WUL; 1 Unknown	48%	0	1	77%	0	0	88%	1	0	0
Totals		**11%**	**2**	**85**	**17%**	**4**	**81**	**21%**	**6**	**76**	**21**

* The enforcement measures (notices or directives issued) are taken over a two-year financial period from July 2019 to June 2021

Overall, the municipalities fared poorly in terms of final effluent quality compliance. There was an 11% compliance with microbial effluent quality, 17% with chemical, and 21% with physical effluent quality. For the microbiological compliance category, 2 systems achieved >90% and 85 systems fell below 30%. For the chemical compliance category, 4 systems achieved >90% and 81 systems fell below 30%. For the physical compliance category, 6 systems achieved >90% and 76 systems fell below 30%.

A total of 21 Directives/Notices have been issued to 10 municipalities. Matjabeng (5 no.), Maluti-a-Phofung (4 no.), Mafube (3 no.) and Nketoana (2 no.) have the highest number of enforcement measures initiated by the Regulator which require municipal leadership intervention and correction.

In terms of sludge compliance status, it is found that:

- 0% of the municipalities classify their biosolids according to the WRC Sludge Guidelines
- 0% of the municipalities monitor their sludge streams
- 18 of 96 systems (19%) have Sludge Management Plans in place all linked to Matjhabeng (11 systems) and Mangaung (7 systems)
- 14 of 96 plants (15%) use sludge mostly for agricultural purposes and landfill, predominantly the latter.

Only 8 (42%) of the municipalities have access to credible laboratories for compliance and operational analysis. These in-house or contracted laboratories have been verified to be accredited and/or have Proficiency Testing Schemes with suitable analytical methods and quality assurance. At 42%, the Free State is not meeting the regulatory expectation that all municipalities have access to analytical services for compliance, operational and sludge monitoring.

Diagnostic 5: Energy Efficiency

Aim: The wastewater industry offers many opportunities to respond to climate change challenges by improving energy efficiency, reducing greenhouse gases, and generating energy. The energy cost of sophisticated treatment technologies are in the order of 25-40% of the O&M budget (cited WRC 2021). This diagnostic investigates the status of energy efficiency management at a provincial and municipal level with an aim to motivate for improved operational wastewater treatment efficiency.

Findings: The audit results indicate an overall low awareness of energy management in the province. None of the municipalities conducted baseline energy audits or could report on electricity cost as R/kWh, apart from 2 municipalities, viz. Dihlabeng (0.55 kWh/m^3) and Tswelopele (0.61 kWh/m^3). Limited energy efficiency initiatives are in place, and none of the municipalities could account for CO_2 equivalents associated with energy efficiency.

The information collated suggests that municipalities have not established a specific report to monitor energy as part of the wastewater business. Energy efficiency management has not found any foothold in the Free State municipal sector, and potential cost savings and environmental gains are therefore forfeited.

Benchmark 1: Estimated energy intensity for large WWTW is in order of 0.258-0.455 kWh/m^3

- 0.177 kWh/m^3 for trickling filter
- 0.272 kWh/m^3 for activated sludge
- 0.314 kWh/m^3 for advanced treatment
- 0.412 kWh/m^3 for advanced treatment with nitrification

Benchmark 2: Energy requirements per plant size

Plant capacity, Ml/d	<0.5	2	10	25	100
Trickling filter, kWh/m^3	0.43	0.44	0.23	0.18	0.16
Activated sludge, kWh/m^3	0.59	0.59	0.37	0.32	0.29

Tariffs are typically depends on time of day and season e.g.

- Peak rate: 369.09 - 138.56 c/kWh
- Off-peak time: 62.41 - 55.28 c/kWh
  Standard time: 117.57 - 87.12 c/kWh

(EMARE 2021, Fang, 2012, NEWRI, 2016)

Diagnostic 6: Technical Site Assessments

Aim: The Green Drop process makes provision for the desktop audit to be followed by a Technical Site Assessment (TSA) in order to verify the desktop evidence. The assessment includes physical inspection of the sewer network, pump stations, and treatment facility, coupled with asset condition checks to determine an approximate cost to restore existing infrastructure to functional status (VROOM).

Findings: The results of the TSAs are summarised in Table 61. A deviation of >10% between the GD and TSA score indicates a misalignment between the administrative aspects and the work on the ground. The Regulator regards a wastewater system with a TSA score of >80% as one that has an acceptable level of process control and functional equipment. A TSA score of 90% would represent an excellent plant that complies with most of the Green Drop TSA standards.

Table 61 - Summary of the WWTW Technical Site Assessments scores and hardware problems and %deviation between GD and TSA scores

WSA Name	TSA WWTW Name	WWTW GD Score (%)	%TSA	Hardware problems	Difference between TSA & GD score
Kopanong	Gariep Dam	12%	23%	Fauna Park pump station dysfunctional; The WWTW is in dire condition, with process units completely blocked and raw sewage flooding the area	11%
Letsemeng	Koffiefontein	29%	13%	Pump stations and plant are completely vandalised; The situation within this wastewater treatment system is a dire emergency	16%
Metsimaholo	Deneysville	10%	21%	Lack of Disinfection; Lack of flow metering; Sewer pump stations spilling/leaking; Sewer network manholes poor condition; Anaerobic pond requires maintenance and cleaning	11%
Moqhaka	Kroonstad	9%	13%	Raw sewage pumps failure has created an environmental disaster at Kroonstad; WWTW is dysfunctional; Raw sewage to Vals River causing major pollution; Disinfection capacity is lacking; Dysfunctional aerators and clarifiers; Grit classifiers repaired, despite no flow entering the plant	4%
Tokologo	Boshof	32%	45%	A build-up of sludge in the system; No constructed discharge point for tankers and night soil	13%
Tswelopele	Bultfontein	45%	54%	One screw pump not operational; Screenings press not operational; Vortex degritter not operational; No disinfection; Reactor mechanical equipment not operational	9%
Maluti-A-Phofung	Tshiame	16%	11%	All electrical equipment either stolen or vandalised; Due to plant not being in operation, the mechanical equipment could not be assessed; No flow metering; No disinfection	5%
Masilonyana	Winburg	7%	31%	Non-functional aerators; Non-functional clarifiers; Non-functional Supernatant pumps; Flow metering; Unpractical sludge ponds	24%

WSA Name	TSA WWTW Name	WWTW GD Score (%)	%TSA	Hardware problems	Difference between TSA & GD score
Ngwathe	Parys	7%	29%	Network blockages; Biofilters dysfunctional; Unused anaerobic digesters; Sludge pump station spillages; Emergency pond discharging untreated sewage into a tributary of the Vaal river	22%
Matjhabeng	Virginia	29%	51%	Little management support; Maintenance and operation defects and no budget; Vandalism and theft -> 8/11 plants out of operation; Electrical contactors burnt; Rake gearbox and rags removal problematic; RAS pumps, scum line flooding; No disinfection of final effluent	22%
Nala	Bothaville	8%	36%	No disinfection of final effluent; Lack of Activated Sludge Biomass; Aeration of Racetrack requires refurbishment; Recycle pumps dysfunctional; Lack of flow meter readings; Lack of water quality data; Lack of operations	28%
Mafube	Villiers	0%	30%	Grit moved to the oxidation pond; Flow measurement absent; No documentation or logbooks; No operational or compliance monitoring; Clarifier, desludging, recycle pumps dysfunctional; Disinfection dysfunctional	30%
Phumelela	Vrede	4%	19%	Sewer capacity constraints; Lack of disinfection of final effluent; Flow meters dysfunctional; No desludging of primary pond; Biofilter arms blocked; Dysfunctional screenings and grit removal; Grit compromises oxidation pond functionality	15%
Nketoana	Petrus Steyn	33%	59%	Mechanical equipment breakdown; Screen offline for 2 years; Pumps; Sludge withdrawal equipment - sludge to Cl2 contact tank; Biofilter arms; Staff facilities and ablution	26%
Dihlabeng	Mashaeng	40%	42%	Civil and mechanical works dilapidated - upgrades underway; Sub-standard workmanship - PST, weir, concrete quality; Staff facilities; Fencing; Load to plant; Flooding; SBR aerators - 8 months not operational - effluent quality compromised	2%
Setsoto	Clocolan	24%	46%	Staff facilities; Chlorine contact tanks; Dispute with farmer; Module 1 offline; Aerators dysfunctional for long time; Clarification blockages due to weed infestation; Vandalism	22%
Mantsopa	Ladybrand	29%	28%	Major issues on civil & mechanical components; No maintenance, vegetation, bridges at ASP collapsed, aerators inaccessible; Fencing - open access to animals and vandals; Mechanical breakdown - mixers, aerators offline, clarifiers not operational, pumps dysfunctional; Chlorine dosing facility vandalized – no disinfection	1%
Mohokare	Zastron	13%	32%	Major civil issues re vandalism, electrical cables & pump stations stolen; Zastron works not operational; Spillages at pump stations; Major safety hazards across plant	19%
Mangaung metro	Bloemspruit	32%	44%	Good biofilter condition, Module 3 offline; Primary Settling Tanks and Humus tanks; Vegetation on civil structures; Most mechanical equipment dysfunctional; MCC, screening, flow meters, PST bridges, digesters steam pipes, sludge pumps, electrical component	12%
	North-eastern works	32%	70%	Recently upgraded; Degritting	38%

A total of 20 site assessments were conducted, with 1 to 2 inspections per municipality. No treatment facility scored above 80%, which is generally regarded to be a satisfactory TSA score. The North Eastern Works in Mangaung performed the best with a 70% TSA score.

A difference of ≤15% between the respective Green Drop and TSA scores is observed for 9 WSAs. A >20% deviation is observed for 8 WSAs with the highest differences noted for the North-Eastern works (38%), Villiers (30%) and Bothaville (28%).

A low number indicates that administration of the wastewater services correlate with the condition and functionality of infrastructure in the field, which is an ideal situation. Similarly, a high difference implies that wastewater administration shows a poor correlation with the condition and functionality of infrastructure in the field.

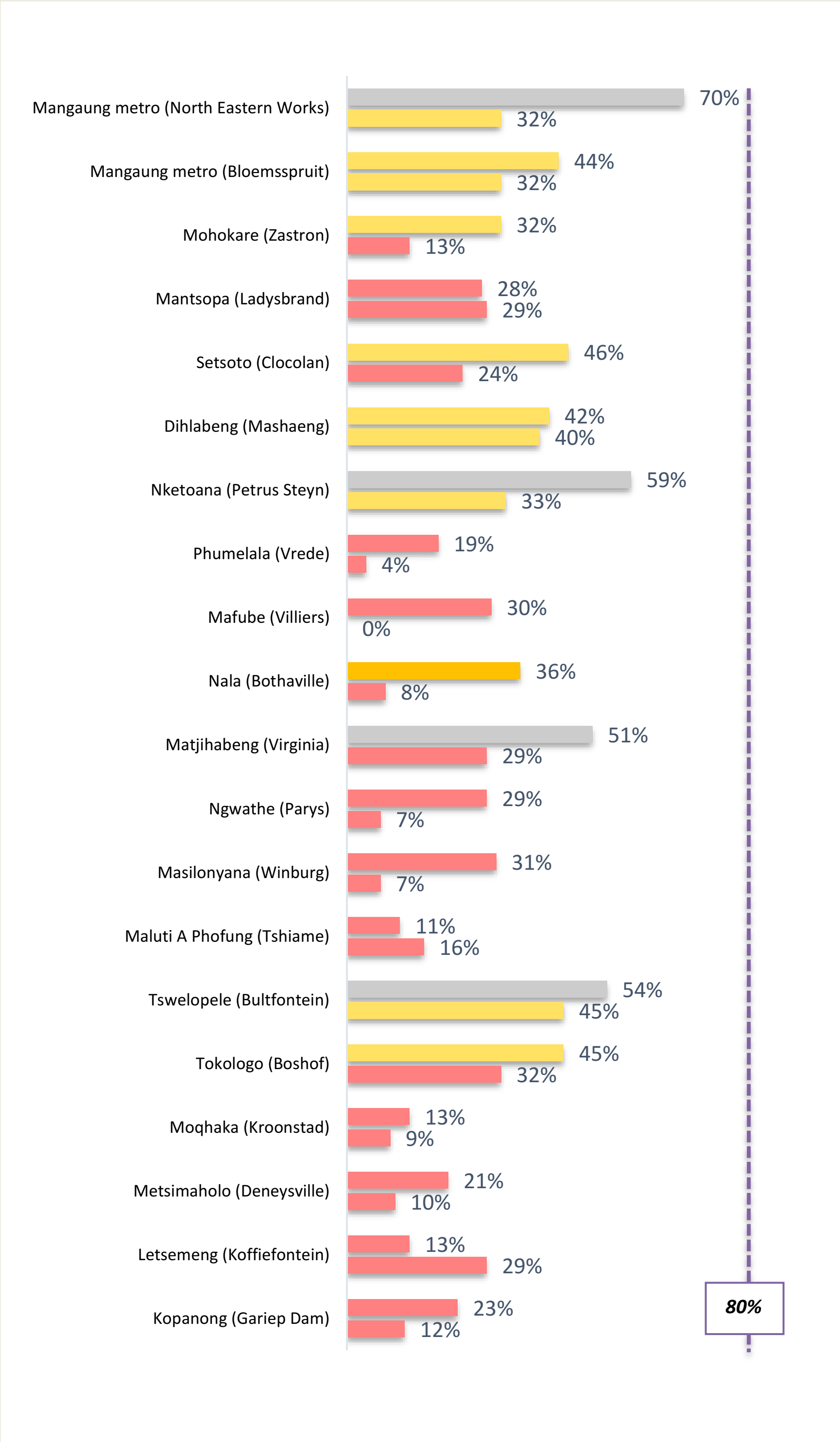


Figure 58 - Municipal GD (bottom bar) and System TSA score (top bar) comparison (colour legends as for GD – blue excellent; red critical)

The VROOM cost presents a ''very rough order of measurement" cost to return a WWTWs functionality to its original design. The analysis indicates that an estimated R930 million is required to return wastewater treatment works to its functional state. The highest budget requirement is for Mangaung Metro (R164m), followed by Maluti-A-Phofung (R134m) and Matjhabeng (R126m). The cost is influenced by size, technology sophistication, and state of disrepair of the WWTWs.

Table 62 - VROOM cost split for civil, mechanical, and electrical and total VROOM cost estimate

WSA	Civil cost estimate	Mechanical cost estimate	Electrical & C&I cost estimate	Total VROOM cost
Kopanong	R16,313,115	R12,219,090	R2,960,295	R31,492,500
Letsemeng	R752,525	R28,827,447	R28,306,499	R57,886,500
Metsimaholo	R7,588,056	R6,504,048	R3,391,896	R17,484,000
Moqhaka	R13,763,752	R8,692,896	R911,352	R23,368,000

WSA	Civil cost estimate	Mechanical cost estimate	Electrical & C&I cost estimate	Total VROOM cost
Tokologo	R3,294,000	None	None	R3,294,000
Tswelopele	R6,185,916	R2,078,736	R117,348	R8,382,000
Maluti-A-Phofung	R47,932,262	R24,367,798	R61,588,940	R133,889,000
Masilonyana	R24,615,252	R33,887,664	R2,205,084	R66,780,000
Ngwathe	R7,072,557	R29,942,210	R14,609,734	R51,624,500
Matjhabeng	R45,120,100	R50,807,500	R30,459,200	R126,387,000
Nala	R10,397,376	R6,633,792	R1,976,832	R19,008,000
Mafube	R8,641,641	R8,641,641	R2,674,318	R19,957,600
Phumelela	R12,481,686	R2,898,290	R5,775,424	R21,155,400
Nketoana	R7,281,664	R17,959,104	R9,767,232	R35,008,000
Dihlabeng	R8,100,600	R7,610,700	R1,754,500	R17,496,000
Setsoto	R3,585,700	R19,217,400	R19,412,736	R41,216,000
Mantsopa	R29,546,400	R30,665,100	R5,593,400	R65,805,000
Mohokare	R3,885,900	R8,125,000	R13,222,100	R25,233,100
Mangaung metro	R71,898,955	R54,374,608	R37,505,377	R163,778,940
FS WSA Total	**R328,457,457**	**R353,453,024**	**R242,232,267**	**R929,245,540**

The key hardware problems are listed in Table 61, with predominant defects in electrical cables, primary and secondary sludge settling, disinfection, sludge pumps, sludge treatment, and power backup. Mechanical defects typically include dysfunctional aerators, sludge and effluent pumps, mixers, screens, degritters, and disinfection equipment. Vandalism and theft, long procurement lead times, lack of management involvement, lack of maintenance, and lack of budget are the main reasons for dysfunctional assets.

Diagnostic 7: Operation, Maintenance and Refurbishment of Assets

Aim: Insufficient financial resources are often cited as a root cause to dysfunctional or non-compliant wastewater systems. Knowledge and monitoring of fiscal spending are therefore a critical part of wastewater management. This diagnostic investiga tes the status of financial information as pertaining to O&M budgets and expenditure, asset figures, and capital funding.

Findings: A substantial amount of financial information was presented during the audit process. Unfortunately, the evidence was presented in different formats, levels of detail, or absent for some municipalities. It was observed that municipal teams with financial officials that were present during the audits typically performed better, and also had a better understanding of the wastewater challenges experienced by their technical peers Discrepancies observed included amongst others generic or non-ringfenced budgets, contract lump sums for service providers presented as budgets, outdated or incomplete asset registers, and some cost drivers which were lacking (mostly electricity). The Regulator grouped data into different certainty levels, as summarised at the end of this Diagnostic.

It must be noted that there were limitations with the financial and asset information. Not all WSAs submitted current information or complete financial data sets.

The result of each financial portfolio is discussed hereunder.

Vroom Cost Analysis

The VROOM costs breakdown is discussed under the TSA Diagnostic but is further illustrated as follows.

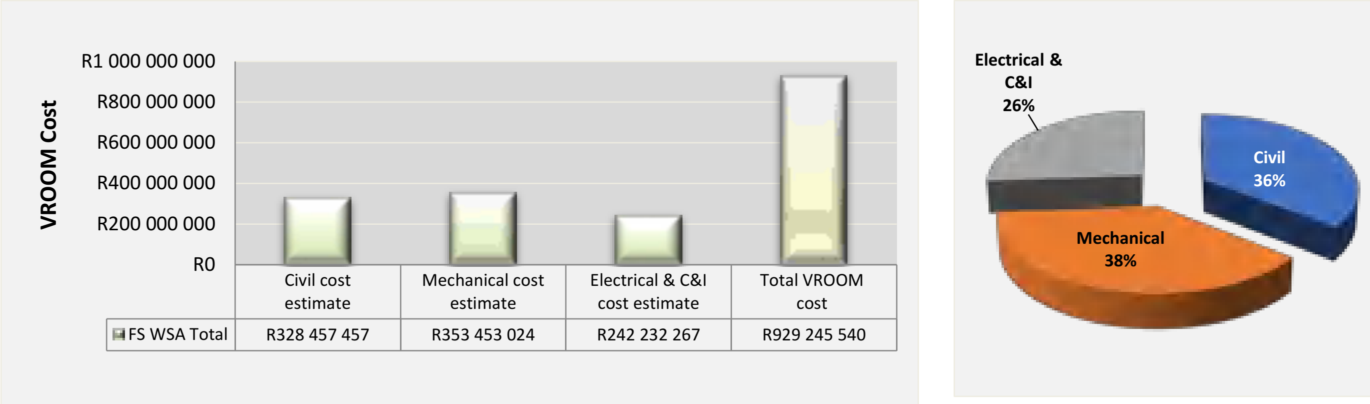


Figure 59 - Graphic illustration of the total cost estimated to restore functionality to existing assets (a), broken down to civil, mechanical, and electrical components

It is estimated that a total budget of R930 million will be required to restore existing treatment works to their design capacity and functionality. This estimate provides for R353 million for mechanical repairs, R242 million for electrical repairs, and R328 million for civil structures.

From the figures in Table 63, a capital budget of R955 million has been secured over MTREF period to address infrastructural needs. While it is likely that some of the VROOM requirements will be addressed through this budget, it is probable that additional funding will be required to address the full VROOM requirements. In addition to the R930 million to restore the infrastructure, it is estimated that a total of R87 million will be required by all WSAs, on an annual basis, to maintain their assets. The maintenance estimate is based on the WATCOST-SALGA model that makes provision for maintenance at 2.14%, annually, of the asset value.

Capital, O&M Budget and Actual, and Asset Value

The capital budgets, O&M budgets, O&M actual expenditure, and current asset values are summarised below.

Table 63 - Summary of the capital budgets, O&M budgets, O&M actual expenditure, and current asset values

WSA	Capital budget available	O&M budget (2020/21)	O&M expended (2020/21)	% Expended	Total Current Asset Value
Kopanong	R60,848,780	R15,894,408	R17,108,352	108%	NI
Letsemeng	R8,112,000	R9,416,000	R9,180,000	97%	R76,305,600
Metsimaholo	R94,316,000	R42,370,000	NI	NI	R59,369,180
Moqhaka	R15,000,000	NI	NI	NI	R219,096,860
Tokologo	R19,886,000	R9,800,000	R5,700,000	58%	R8,726,700
Tswelopele	R40,053,000	R13,837,232	R14,599,863	106%	R106,755,000
Maluti-A-Phofung	R19,740,164	NI	NI	NI	NI
Masilonyana	R127,487,000	NI	NI	NI	NI
Ngwathe	R25,010,460	R65,522,540	R64,934,560	99%	R298,343,800
Matjhabeng	R239,616,350	R44,909,300	R54,360,200	121%	NI
Nala	NI	R675,000	NI	0%	NI
Mafube	NI	NI	NI	NI	NI
Phumelela	R70,042,120	NI	R14,558,140	NI	R71,188,460
Nketoana	R19,396,708	R31,081,980	R23,564,320	76%	NI
Dihlabeng	R22,906,000	R200,000	R97,400	49%	R297,303,800
Setsoto	R44,761,490	R46,515,200	R31,631,300	68%	R175,816,930
Mantsopa	R12,443,150	R99,759,500	R74,711,200	75%	R177,876,700
Mohokare	R24,902,070	R20,524,100	R17,869,500	87%	R52,787,140
Mangaung	R110,096,070	R202,994,730	R265,411,650	131%	R2,527,536,390
FS WSA Total	**R954,617,362**	**R603,499,990**	**R593,726,485**	**98%**	**R4,071,106,560**

The Green Drop process provides a bonus (incentive) in cases where a municipality provides evidence of capital projects with secured funding since this is deemed as a definitive means of addressing wastewater services inadequacies. This incentive encourages wastewater infrastructure investment. A total capital budget of R955 million has been reported for the refurbishment and upgrades of wastewater infrastructure for all the municipalities over the MTREF period. The largest capital budgets allocated to Matjhabeng (R240m), Masilonyana (R127m), Mangaung metro (R110m) and Metsimaholo (R94m).

The total reported O&M budget of R603.5m is reported for the 2020/21 financial year, of which R593.7m (98%) has been spent. The total overall O&M actual is close to the total overall approved budget despite excessive variations in the overspending and underspending of some of the WSAs, and in addition, the lack of full or credible budgets and actuals for 8 of the 19 WSAs (42%).

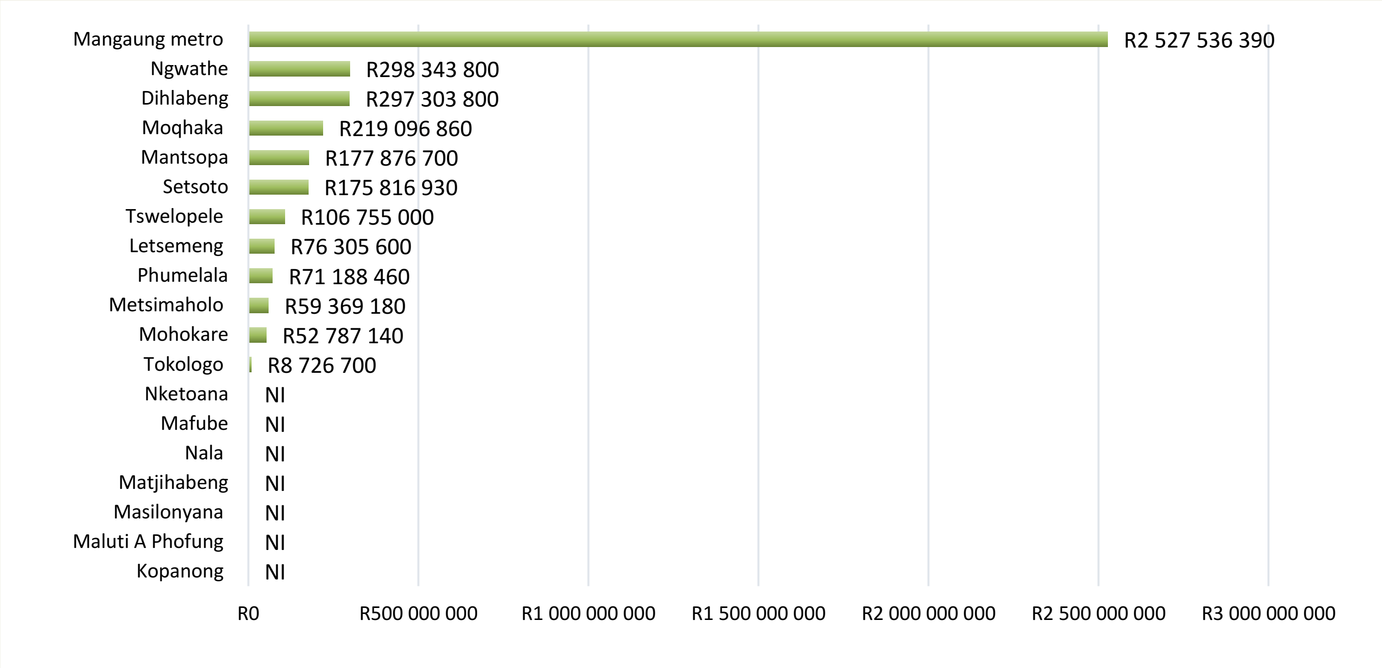


Figure 60 - Total current asset value reported by the municipalities

The total current asset value for wastewater infrastructure (networks, pump stations, treatment plants) is reportedly R4.07 billion (excluding 7 municipalities with no information). The highest asset values are observed for Mangaung (R2.53b), followed by Ngwathe (R298m), Dihlabeng (R297m) and Moqhaka (R219m).

O&M Cost Benchmarking

By combining the SALGA and WRC WATCOST models, an estimation of the maintenance cost required per asset type can be done, i.e. civil, buildings, pipelines, mechanical, electrical, and instrumentation.

Table 64 - SALGA-WRC annual maintenance budget guideline and cost estimation

Description	% of Current Asset Value	Asset Value Estimate	Modified SALGA Maintenance Guideline	Annual Maintenance Budget Guideline
Current Asset Value estimate	**100%**	**R4,071,106,560**	**15.75%**	**R87,121,680**
Broken down into:				
1. Civil Structures	46%	R1,872,709,018	0.50%	R9,363,545
2, Buildings	3%	R122,133,197	1.50%	R1,831,998
3. Pipelines	6%	R244,266,394	0.75%	R1,831,998
4. Mechanical Equipment	35%	R1,424,887,296	4.00%	R56,995,492
5. Electrical Equipment	8%	R325,688,525	4.00%	R13,027,541
6. Instrumentation	2%	R81,422,131	5.00%	R4,071,107
Totals	**100%**	**R4,071,106,560**	**15.75%**	**R87,121,680**
			Minus 20% P&Gs and 10% Installation	**R26,136,504**
			Total	**R60,985,176**

From the analysis, it is estimated that just over R87m (2.14%) is required per year to maintain the assets valued at R4.07b. Notably, this maintenance estimation assumes that all assets are functional. In a case where the assets are not functional, these figures will grossly under-estimate the maintenance funding need.

Table 65 indicates the SALGA maintenance cost estimation in relation to the VROOM cost, O&M budget, and O&M actual expended.

Table 65 - O&M cost estimates by the SALGA and VROOM models versus actual budget and expenditure figures (Figure illustrates the % split)

Cost Reference	O&M Cost Estimate	Period
Modified SALGA	R87,121,680	Annually, estimation
O&M Budget	R603,499,990	Actual for 2020/21
O&M Spend	R593,726,485	Actual for 2020/21
VROOM	R929,245,540	Once off estimation

The cost dynamics can be summarised as follows:

- The SALGA estimations for maintenance budgets is about 15%. In the absence of additional information, it is difficult to compare the actual maintenance budgets, to the benchmarks to draw conclusions.
- The actual O&M budget seems inadequate when compared with the SALGA guideline. A relook at how O&M funds are expended should be considered for infrastructure that is dysfunctional (not maintained)
- The VROOM cost represents an estimation of the refurbishment cost to restore WWTWs functionality and design capacity.

Production Cost and Comparison

It is good business practice to monitor and manage the production costs of wastewater treatment in Rand/m^3 treated, and to compare such costs with industry norms. Published benchmarks is not currently available for typical treatment costs, but significant cost increases are expected since 2013, given the variable input factors such as Covid, and cost of chemicals, transport, and electricity. From an economic perspective, it is valuable to compare production cost at time of budgeting versus actual production costs. However, due to scarce information, it is not possible to provide insight as to possible shortfalls from an economic perspective. Based on the lack of data, no production costs for wastewater treatment could be extracted for the Free State. Nonetheless, the results obtained for Gauteng, KwaZulu Natal, Eastern Cape and Western Cape, can provide WSAs in the Free State with guidance on typical production costs at South African wastewater treatment facilities.

Data Certainty

Data certainty is expressed at different levels for the financial and asset figures reported within this Diagnostic. Certainty levels differ from system to system, hence some WSAs are included in multiple data certainty categories - as the data is variable, inconsistent, limited or non-existent (NI) for each of the systems.

Table 66 - Levels of certainty associated with financial and asset information reported by municipalities

Data Certainty	Description	WSA
No certainty	Absent data or no certainty in data presented - not ringfenced for WWTW & Network	Maluti-A-Phofung, Masilonyana, Nala, Mafube, Moqhaka, Metsimaholo and Phumelela
Low certainty	Minor or little certainty in the data - partially ringfenced for WWTW only or data as extreme outliers	All the remaining systems
Reasonable/good certainty	Reasonable to good level of certainty in the data - ringfenced for WWTW and/or Network and data falls within/close to expected parameters	None
High certainty	High level of certainty in the data - ringfenced for WWTW and Network and data falls within expected parameters	None

5.1 Dihlabeng Local Municipality

Water Service Institution	**Dihlabeng Local Municipality**	
Water Service Provider	Dihlabeng Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Civil and mechanical works dilapidated - upgrades underway 2. Sub-standard workmanship - PST, weir, concrete quality 3. Staff facilities and fencing 4. Major flooding and pollutions events 5. SBR aerators - 8 months not operational - effluent quality compromised 6. Groundskeeping lacking **VROOM Estimate:** - R17,496,000
2021 Green Drop Score	**49%↑**	
2013 Green Drop Score	**47%**	
2011 Green Drop Score	**32%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Bethlehem**	**Clarens**	**Mashaeng**	**Mautse**	**Paul Roux**
Green Drop Score (2021)		**51%**	**52%**	**41%**	**33%**	**38%**
2013 Green Drop Score		**49%**	**32%**	**28%**	**27%**	**47%**
2011 Green Drop Score		**34%**	**22%**	**16%**	**23%**	**18%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	25.6	2.5	1.1	2	1.2
Design Capacity Utilisation (%)		84%	56%	45%	17%	33%
Resource Discharged into		Jordan River	Little Caledon River	Meiringspoort spruit	Meulspruit	Sand River
Wastewater Risk Rating (CRR% of CRR_{max})		**Bethlehem**	**Clarens**	**Mashaeng**	**Mautse**	**Paul Roux**
CRR (2011)	%	70.4%	76.5%	82.4%	88.2%	94.1%
CRR (2013)	%	55.6%	76.5%	76.5%	58.8%	76.5%
CRR (2021)	%	66.7%	47.1%	70.6%	70.6%	70.6%

Technical Site Assessment: **Mashaeng WWTW** **42%**

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5.2 Kopanong Local Municipality

Water Service Institution	**Kopanong Local Municipality**	
Water Service Provider	Kopanong Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Fauna Park pump station dysfunctional 2. Spillages from sewer lines 3. WWTW is in dire condition 4. All process units blocked and dysfunctional 5. Raw sewage flooding the area **VROOM Estimate:** - R31,492,500
2021 Green Drop Score	**26%↑**	
2013 Green Drop Score	**19%**	
2011 Green Drop Score	**1%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Bethulie	Edenburg	Fauriesmith	Gariep Dam
Green Drop Score (2021)		**44%**	**41%**	**16%**	**12%**
2013 Green Drop Score		**13%**	**15%**	**34%**	**34%**
2011 Green Drop Score		**1%**	**1%**	**1%**	**1%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
Design Capacity	Ml/d	0.5	1	1	1
Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Orange River	Riet River	Riet River	Natural pan
Wastewater Risk Rating (CRR% of CRR_{max})		**Bethulie**	**Edenburg**	**Fauriesmith**	**Gariep Dam**
CRR (2021)	%	47.1%	47.1%	94.1%	94.1%
CRR (2013)	%	88.2%	100.0%	100.0%	100.0%
CRR (2011)	%	83.3%	100.0%	100.0%	100.0%

Key Performance Area	Unit	Jagersfontein	Philippolis	Reddersburg	Springfontein
Green Drop Score (2021)		**14%**	**52%**	**16%**	**49%**
2013 Green Drop Score		**13%**	**34%**	**12%**	**12%**
2011 Green Drop Score		**1%**	**1%**	**7%**	**1%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
Design Capacity	Ml/d	2.2	0.467	1	0.5
Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Re-use	Otterspoortspruit	Fouriespruit	Bossiespruit
Wastewater Risk Rating (CRR% of CRR_{max})		**Jagersfontein**	**Philippolis**	**Reddersburg**	**Springfontein**
CRR (2021)	%	94.1%	47.1%	94.1%	47.1%
CRR (2013)	%	94.1%	88.2%	88.2%	100.0%
CRR (2011)	%	100.0%	83.3%	83.3%	83.3%

Key Performance Area	Unit	Trompsburg
Green Drop Score (2021)		**46%**
2013 Green Drop Score		**13%**
2011 Green Drop Score		**1%**
2009 Green Drop Score		**0%**
Design Capacity	Ml/d	0.731
Capacity Utilisation (%)		NI

Resource Discharged into	Tributary of Van Zyl spruit
Wastewater Risk Rating (CRR% of CRR_{max})	**Trompsburg**
CRR (2021)	47.1%
CRR (2013)	100.0%
CRR (2011)	83.3%

Technical Site Assessment: Gariep WWTW 22%

5.3 Letsemeng Local Municipality

Water Service Institution	**Letsemeng Local Municipality**	
Water Service Provider	Letsemeng Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Pump stations and plant are completely vandalised 2. No electrical feed, mechanical and civil structures dysfunctional 3. Dire state of infrastructure – emergency situation **VROOM Estimate:** - R57,886,500
2021 Green Drop Score	**40%↑**	
2013 Green Drop Score	**16%**	
2011 Green Drop Score	**30%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Koffiefontein	Jacobsdal	Luckhoff	Oppermansgronde	Petrusburg
Green Drop Score (2021)		**29%**	**33%**	**46%**	**26%**	**61%**
2013 Green Drop Score		**12%**	**25%**	**26%**	**22%**	**7%**
2011 Green Drop Score		**43%**	**26%**	**33%**	**18%**	**32%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**	**0%**
Design Capacity	Ml/d	2.5	1.5	0.95	0.5	2
Capacity Utilisation (%)		NI	NI	NI	NI	NI
Resource Discharged into		Riet River	Riet River	Riet River	Evaporation ponds	Evaporation ponds
Wastewater Risk Rating (CRR% of CRR_{max})		**Koffiefontein**	**Jacobsdal**	**Luckhoff**	**Oppermansgronde**	**Petrusburg**
CRR (2021)		94.1%	88.2%	47.1%	94.1%	47.1%
CRR (2013)		94.1%	82.4%	82.4%	94.1%	100.0%
CRR (2011)		88.9%	94.4%	95.6%	88.9%	72.7%

Technical Site Assessment: **Letsemeng WWTW 13%**

5.4 Mafube Local Municipality

Water Service Institution	**Mafube Local Municipality**	
Water Service Provider	Mafube Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Grit moved to the oxidation pond 2. Flow measurement absent 3. No documentation or logbooks 4. No operational or compliance monitoring 5. Clarifier, desludging, recycle pumps dysfunctional 6. Disinfection dysfunctional. **VROOM Estimate:** - R19,957,600
2021 Green Drop Score	**0%↓**	
2013 Green Drop Score	**36%**	
2011 Green Drop Score	**10%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Frankfort	Villiers	Cornelia	Tweeling
Green Drop Score (2021)		**0%**	**0%**	**0%**	**0%**
2013 Green Drop Score		**33%**	**40%**	**44%**	**31%**
2011 Green Drop Score		**15%**	**7%**	**12%**	**6%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.8	5	0.28	1
Design Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Wilge River	Vaal River	Small unnamed stream	Liebensberg Vlei to Wilge
Wastewater Risk Rating (CRR% of CRR_{max})		**Frankfort**	**Villiers**	**Cornelia**	**Tweeling**
CRR (2011)	%	100.0%	94.1%	94.1%	100.0%
CRR (2013)	%	52.9%	76.5%	70.6%	76.5%
CRR (2021)	%	100.0%	100.0%	100.0%	100.0%

Key Performance Area	Unit	Namahadi
Green Drop Score (2021)		**0%**
2013 Green Drop Score		**36%**
2011 Green Drop Score		**11%**
2009 Green Drop Score		**0%**
System Design Capacity	Ml/d	2.8
Design Capacity Utilisation (%)		NI
Resource Discharged into		Wilge River
Wastewater Risk Rating (CRR% of CRR_{max})		**Namahadi**
CRR (2011)	%	100.0%
CRR (2013)	%	58.8%
CRR (2021)	%	100.0%

Technical Site Assessment: **Villiers WWTW 30%**

5.5 Maluti-A-Phofung Local Municipality

Water Service Institution	**Maluti-A-Phofung Local Municipality**	
Water Service Provider	Maluti-A-Phofung Water	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Extreme vandalism 2. Manholes and pumps stations are dysfunctional 3. WWTW constitute an emergency situation, posing serious environmental, health, and water resouce risks **VROOM Estimate:** - R133,889,000
2021 Green Drop Score	**18% ↓**	
2013 Green Drop Score	**76%**	
2011 Green Drop Score	**67%**	
2009 Green Drop Score	**51%**	

Key Performance Area	Unit	Elands	Kestell	Makwane	Moeding
Green Drop Score (2021)		**11%**	**17%**	**13%**	**6%**
2013 Green Drop Score		**76%**	**76%**	**91%**	**63%**
2011 Green Drop Score		**55%**	**76%**	**63%**	**50%**
2009 Green Drop Score		**52%**	**0%**	**52%**	**52%**
Design Capacity	Ml/d	3	0.75	0.75	0.75
Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Elands River	Sandspruit	Namahadi River	Namahadi River
Wastewater Risk Rating (CRR% of CRR$_{max}$)		**Elands**	**Kestell**	**Makwane**	**Moeding**
CRR (2021)	%	88.2%	88.2%	88.2%	94.1%
CRR (2013)	%	52.9%	64.7%	41.2%	58.8%
CRR (2011)	%	38.9%	22.2%	27.8%	55.6%

Key Performance Area	Unit	Phuthaditjhaba	Tshiame	Wilge (Harrismith)
Green Drop Score (2021)		**22%**	**16%**	**14%**
2013 Green Drop Score		**75%**	**78%**	**76%**
2011 Green Drop Score		**73%**	**73%**	**56%**
2009 Green Drop Score		**48%**	**0%**	**0%**
Design Capacity	Ml/d	16.6	3	6
Capacity Utilisation (%)		NI	NI	NI
Resource Discharged into		Namahadi River	Wilge River	Nuwejaarspruit
Wastewater Risk Rating (CRR% of CRR$_{max}$)		**Phuthaditjhaba**	**Tshiame**	**Wilge (Harrismith)**
CRR (2021)	%	90.9%	88.2%	95.5%
CRR (2013)	%	59.1%	64.7%	59.1%
CRR (2011)	%	39.3%	22.2%	56.5%

Technical Site Assessment: **Tshiame WWTW 11%**

5.6 Mangaung Local Municipality

Water Service Institution	**Mangaung Metropolitan Municipality**
Water Service Provider	Mangaung Metropolitan Municipality

Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** (*Bloemspruit Works*) 1. Good biofilter condition, Module 3 offline 2. Primary Settling Tanks and Humus tanks; Vegetation on civil structures 3. Most mechanical equipment dysfunctional 4. MCC, screening, flow meters, PST bridges, digesters steam pipes, sludge pumps, electrical components. (*North Eastern Works*) 1. Recently upgraded 2. Degritting. **VROOM Estimate:** - R163,778,940
2021 Green Drop Score	**33%↓**	
2013 Green Drop Score	**79%** (Mangaung) **7%** (Naledi)	
2011 Green Drop Score	**38%**	
2009 Green Drop Score	**54%**	

Key Performance Area	Unit	Bainsvlei	Bloemindustria	Bloemspruit	Botshabelo
Green Drop Score (2021)		**35%**	**30%**	**32%**	**36%**
2013 Green Drop Score		**82%**	**87%**	**2%**	**81%**
2011 Green Drop Score		**44%**	**3%**	**13%**	**39%**
2009 Green Drop Score		**65%**	**4%**	**65%**	**66%**
System Design Capacity	Ml/d	5	0.9	56	20
Design Capacity Utilisation (%)		76%	56%	120%	110%
Resource Discharged into		Unknown stream to farmer	Renosterspruit	Bloemspruit	Small Modder River
Wastewater Risk Rating (CRR% of CRR_{max})		**Bainsvlei**	**Bloemindustria**	**Bloemspruit**	**Botshabelo**
CRR (2011)	%	35.3%	67.0%	58.8%	45.5%
CRR (2013)	%	35.3%	41.2%	41.2%	31.8%
CRR (2021)	%	68.2%	82.4%	84.4%	77.3%

Key Performance Area	Unit	Dewetsdorp	North-Eastern Works	Northern Works	Sterkwater
Green Drop Score (2021)		**24%**	**32%**	**30%**	**33%**
2013 Green Drop Score		**14%**	**NA**	**81%**	**83%**
2011 Green Drop Score		**5%**	**NA**	**39%**	**39%**
2009 Green Drop Score		**0%**	**NA**	**37%**	**44%**
System Design Capacity	Ml/d	0.052	20	5	20
Design Capacity Utilisation (%)		38%	90%	38%	128%
Resource Discharged into		NI	Irrigation by estate & botanical gardens	Breeriver	Renosterspruit
Wastewater Risk Rating (CRR% of CRR_{max})		**Dewetsdorp**	**North-Eastern Works**	**Northern Works**	**Sterkwater**
CRR (2011)	%	100.0%	**NA**	31.8%	77.3%
CRR (2013)	%	100.0%	**NA**	31.8%	59.1%
CRR (2021)	%	94.1%	77.3%	68.2%	86.4%

Key Performance Area	Unit	Thaba Nchu	Van Stadensrus	Welvaart	Wepener
Green Drop Score (2021)		**41%**	**17%**	**32%**	**21%**
2013 Green Drop Score		**81%**	**8%**	**79%**	**0%**
2011 Green Drop Score		**20%**	**10%**	**47%**	**3%**

Key Performance Area	Unit	Thaba Nchu	Van Stadensrus	Welvaart	Wepener
2009 Green Drop Score		**65%**	**0%**	**44%**	**0%**
System Design Capacity	Ml/d	5	0.03	5	2
Design Capacity Utilisation (%)		70%	33%	80%	1%
Resource Discharged into		Koranaspruit	Unknown	Kaalspruit	Caledon river
Wastewater Risk Rating (CRR% of CRR_{max})		**Thaba Nchu**	**Van Stadensrus**	**Welvaart**	**Wepener**
CRR (2011)	%	54.5%	100.0%	54.5%	100.0%
CRR (2013)	%	40.9%	88.2%	45.5%	82.4%
CRR (2021)	%	77.3%	94.1%	77.3%	94.1%

Key Performance Area	Unit	Soutpan
Green Drop Score (2021)		**18%**
2009 Green Drop Score		**30%**
2011 Green Drop Score		**0%**
2013 Green Drop Score		**NA**
System Design Capacity	Ml/d	1
Design Capacity Utilisation (%)		NI
Resource Discharged into		Kleinmodder River
Wastewater Risk Rating (CRR% of CRR_{max})		**Soutpan**
CRR (2011)	%	100.0%
CRR (2013)	%	94.1%
CRR (2021)	%	94.1%

Technical Site Assessment: **Bloemspruit WWTW 44%; North Eastern WWTW 70%**

5.7 Mantsopa Local Municipality

Water Service Institution	**Mantsopa Local Municipality**	
Water Service Provider	Mantsopa Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Major issues on civil & mechanical components 2. No maintenance, vegetation, bridges at ASP collapsed, aerators inaccessible 3. Fencing - open access to animals and vandals 4. Mechanical breakdown - mixers, aerators offline, clarifiers not operational, pumps dysfunctional 5. Chlorine dosing facility vandalised – no disinfection. **VROOM Estimate:** - R65,805,000
2021 Green Drop Score	**29%↓**	
2013 Green Drop Score	**32%**	
2011 Green Drop Score	**20%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Excelsior	Hobhouse	Ladybrand	Thaba Patchoa	Tweespruit
Green Drop Score (2021)		**30%**	**31%**	**29%**	**33%**	**22%**
2013 Green Drop Score		**40%**	**51%**	**31%**	**20%**	**20%**
2011 Green Drop Score		**6%**	**8%**	**22%**	**13%**	**8%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.5	0.5	17.5	1.5	0.5
Design Capacity Utilisation (%)		70%	80%	71%	100%	100%
Resource Discharged into		Lilana Spruit	Non-discharge	Cathcartdrift Dam	Non-discharge	Private land
Wastewater Risk Rating (CRR% of CRR_{max})		**Excelsior**	**Hobhouse**	**Ladybrand**	**Thaba Patchoa**	**Tweespruit**
CRR (2011)	%	83.3%	100.0%	95.6%	83.3%	77.8%
CRR (2013)	%	76.5%	76.5%	82.4%	82.4%	82.4%
CRR (2021)	%	82.4%	82.4%	72.7%	82.4%	82.4%

Technical Site Assessment: **Ladybrand WWTW 28%**

5.8 Masilonyana Local Municipality

Water Service Institution	**Masilonyana Local Municipality**	
Water Service Provider	Masilonyana Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Pump station in poor condition or not functional 2. Screening, degritting and flow meters dysfunctional 3. Flow metering 4. Aeration and bridges on SST not functional 5. Chlorination not functional **VROOM Estimate:** - R66,708,000
2021 Green Drop Score	**16%↑**	
2013 Green Drop Score	**11%**	
2011 Green Drop Score	**0%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Brandfort**	**Theunissen**	**Verkeerdevlei**	**Winburg**
Green Drop Score (2021)		**11%**	**18%**	**39%**	**7%**
2013 Green Drop Score		**5%**	**10%**	**28%**	**5%**
2011 Green Drop Score		**0%**	**0%**	**0%**	**0%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
Design Capacity	Ml/d	2.4	3.5	0.75	1
Capacity Utilisation (%)		NI	91%	NI	190%
Resource Discharged into		Keerom Spruit	Klein Vet River	No discharge	Rietfontein River
Wastewater Risk Rating (CRR% of CRR_{max})		**Brandfort**	**Theunissen**	**Verkeerdevlei**	**Winburg**
CRR (2021)	%	100.0%	88.2%	52.9%	100.0%
CRR (2013)	%	94.1%	94.1%	82.4%	94.1%
CRR (2011)	%	100.0%	100.0%	100.0%	100.0%

Technical Site Assessment: **Winburg WWTW 31%**

5.9 Matjhabeng Local Municipality

Water Service Institution	**Matjhabeng Local Municipality**	
Water Service Providers	Matjhabeng Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Little management support 2. Maintenance and operation defects and no budget 3. Vandalism and theft -> 8/11 plants out of operation 4. Electrical contactors burnt 5. Rake gearbox and rags removal problematic 6. RAS pumps, scum line flooding 7. No disinfection of final effluent. **VROOM Estimate:** - R126,387,000
2021 Green Drop Score	**26%↓**	
2013 Green Drop Score	**58%**	
2011 Green Drop Score	**14%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Allanridge	Henneman	Phomolong	Virginia
Green Drop Score (2021)		**24%**	**27%**	**29%**	**29%**
2013 Green Drop Score		**47%**	**59%**	**64%**	**57%**
2011 Green Drop Score		**16%**	**9%**	**16%**	**27%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	4	4	4	26
Design Capacity Utilisation (%)		16%	NI	NI	34%
Resource Discharged into		Voelpan (Evaporation Pond)	Riet Spruit	Sloot Spruit	Sand River
Wastewater Risk Rating (CRR% of CRR_{max})		**Allanridge**	**Henneman**	**Phomolong**	**Virginia**
CRR (2011)	%	82.4%	76.5%	70.6%	85.2%
CRR (2013)	%	76.5%	52.9%	52.9%	40.7%
CRR (2021)	%	76.5%	94.1%	94.1%	63.0%

Key Performance Area	Unit	Kutlwa-nong	Mmama-habane	Venters-burg	Thabong
Green Drop Score (2021)		**31%**	**26%**	**27%**	**29%**
2013 Green Drop Score		**58%**	**55%**	**55%**	**77%**
2011 Green Drop Score		**15%**	**16%**	**16%**	**25%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	6	0.6	0.5	12
Design Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Sand Spruit	Erasmsus Spruit	Erasmus Spruit	Mosterd Channel to Sand River
Wastewater Risk Rating (CRR% of CRR_{max})		**Kutlwa-nong**	**Mmama-habane**	**Venters-burg**	**Thabong**
CRR (2011)	%	59.1%	82.4%	64.7%	77.3%
CRR (2013)	%	63.6%	76.5%	58.8%	45.5%
CRR (2021)	%	95.5%	100.0%	94.1%	100.0%

Key Performance Area	Unit	Theronia	Odendaalsrus	Witpan
H. Disqualifiers		None	None	None
Green Drop Score (2021)		**24%**	**19%**	**21%**
2013 Green Drop Score		**50%**	**NA**	**NA**
2011 Green Drop Score		**16%**	**NA**	**NA**
2009 Green Drop Score		**0%**	**NA**	**NA**
System Design Capacity	Ml/d	8.6	6	12
Design Capacity Utilisation (%)		NI	NI	NI

Resource Discharged into		Flamingo Pan	Sand Spruit	Witpan Pan pumped to Mostert Canal to Sand River
Wastewater Risk Rating (CRR% of CRR_{max})		**Theronia**	**Odendaalsrus**	**Witpan**
CRR (2011)	%	85.2%	100.0%	**NA**
CRR (2013)	%	55.6%	50.0%	**NA**
CRR (2021)	%	90.9%	95.5%	95.5%

***Technical Site Assessment:* Virginia WWTW 51%**

5.10 Metsimaholo Local Municipality

Water Service Institution	**Metsimaholo Local Municipality**	
Water Service Provider	Metsimaholo Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Disinfection dysfunctional 2. Flow metering not operational 3. Sewer pump stations spillages 4. Sewer network manholes in poor condition 5. Anaerobic pond sludged up and inefficient. **VROOM Estimate:** - R17,484,000
2021 Green Drop Score	**11%↓**	
2013 Green Drop Score	**69%**	
2011 Green Drop Score	**62%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Deneysville- Refengkgotso**	**Oranjeville**
Green Drop Score (2021)		**10%**	**13%**
2013 Green Drop Score		**67%**	**72%**
2011 Green Drop Score		**47%**	**50%**
2009 Green Drop Score		**0%**	**0%**
System Design Capacity	Ml/d	2.1	1
Design Capacity Utilisation (%)		NI	NI
Resource Discharged into		Vaal Dam	Vaal Dam
Wastewater Risk Rating (CRR % of CRR_{max})		**Deneysville- Refengkgotso**	**Oranjeville**
CRR (2011)	%	77.8%	66.7%
CRR (2013)	%	58.8%	41.2%
CRR (2021)	%	76.5%	76.5%

Technical Site Assessment: **Denysville WWTW 21%**

5.11 Mohokare Local Municipality

Water Service Institution	**Mohokare Local Municipality**	
Water Service Provider	Mohokare Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Major civil issues re vandalism 2. Electrical cables & pump stations stolen 3. Zastron works not operational 4. Spillages at pump stations, open manholes 5. Disinfection dysfunctional. **VROOM Estimate:** - R25,233,120
2021 Green Drop Score	**21%↓**	
2013 Green Drop Score	**30%**	
2011 Green Drop Score	**59%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Rouxville**	**Smithfield**	**Zastron**
Green Drop Score (2021)		**24%**	**30%**	**15%**
2013 Green Drop Score		**25%**	**26%**	**39%**
2011 Green Drop Score		**65%**	**60%**	**49%**
2009 Green Drop Score		**0%**	**0%**	**0%**
System Design Capacity	Ml/d	1.5	1.032	1.032
Design Capacity Utilisation (%)		156%	73%	252%
Resource Discharged into		Caledon River	Caledon River	Montagu Dam
Wastewater Risk Rating (CRR% of CRR_{max})		**Rouxville**	**Smithfield**	**Zastron**
CRR (2011)	%	100.0%	100.0%	100.0%
CRR (2013)	%	94.1%	94.1%	94.1%
CRR (2021)	%	94.1%	82.4%	94.1%

Technical Site Assessment: **Zastron WWTW 32%**

5.12 Moqhaka Local Municipality

Water Service Institution	**Moqhaka Local Municipality**	
Water Service Provider	Moqhaka Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Raw sewage pumps failure has created an environmental disaster at Kroonstad 2. WWTW is dysfunctional 3. Raw sewage to Vals River causing major pollution 4. Disinfection capacity is lacking 5. Dysfunctional aerators and clarifiers 6. Grit classifiers repaired, despite NO FLOW entering the plant **VROOM Estimate:** - R23,368,000
2021 Green Drop Score	**10%↓**	
2013 Green Drop Score	**26%**	
2011 Green Drop Score	**42%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Kroonstad	Viljoenskroon	Steynsrus
Green Drop Score (2021)		**9%**	**14%**	**12%**
2013 Green Drop Score		**26%**	**26%**	**16%**
2011 Green Drop Score		**41%**	**41%**	**43%**
2009 Green Drop Score		**0%**	**0%**	**0%**
System Design Capacity	Ml/d	20	3.9	1.5
Design Capacity Utilisation (%)		NI	NI	NI
Resource Discharged into		Vals River	Olifantsvlei	Evaporation - Jas se Spruit → Blomspruit
Wastewater Risk Rating (CRR% of CRR_{max})		**Kroonstad**	**Viljoenskroon**	**Steynsrus**
CRR (2011)	%	90.9%	82.4%	88.2%
CRR (2013)	%	77.3%	76.5%	76.5%
CRR (2021)	%	81.8%	70.6%	70.6%

Technical Site Assessment: **Kroonstad WWTW 15%**

5.13 Nala Local Municipality

Water Service Institution	**Nala Local Municipality**	
Water Service Provider	Nala Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. No disinfection of final effluent 2. Lack of Activated Sludge Biomass 3. Aeration of Racetrack requires refurbishment 4. Recycle pumps dysfunctional 5. Lack of flow meter readings, water quality data, and operations **VROOM Estimate:** - R163,008,000
2021 Green Drop Score	**6%↓**	
2013 Green Drop Score	**8%**	
2011 Green Drop Score	**20%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Bothaville**	**Wesselsbron**	**Monyakeng**
Green Drop Score (2021)		**8%**	**8%**	**1%**
2013 Green Drop Score		**8%**	**5%**	**NA**
2011 Green Drop Score		**21%**	**18%**	**NA**
2009 Green Drop Score		**0%**	**0%**	**NA**
System Design Capacity	Ml/d	8.5	0.2	4.5
Capacity Utilisation (%)		NI	NI	NI
Resource Discharged into		Vals River	Irrigation Dam	Irrigation dam
Wastewater Risk Rating (CRR% of CRR_{max})		**Bothaville**	**Wesselsbron**	**Monyakeng**
CRR (2011)	%	86.4%	82.4%	**NA**
CRR (2013)	%	100.0%	100.0%	**NA**
CRR (2021)	%	95.5%	94.1%	94.1%

Technical Site Assessment: **Bothaville WWTW 36%**

5.14 Ngwathe Local Municipality

Water Service Institution	**Ngwathe Local Municipality**	
Water Service Provider	Ngwathe Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Network blockages 2. Biofilters dysfunctional 3. Unused anaerobic digesters 4. Sludge pump station spillages 5. Emergency pond discharging untreated sewage into a tributary of Vaal river. **VROOM Estimate:** - R51,624,500
2021 Green Drop Score	**10%↓**	
2013 Green Drop Score	**16%**	
2011 Green Drop Score	**45%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Edenville**	**Heilbron**	**Koppies**	**Parys**
Green Drop Score (2021)		**5%**	**12%**	**10%**	**7%**
2013 Green Drop Score		**36%**	**13%**	**11%**	**23%**
2011 Green Drop Score		**34%**	**63%**	**53%**	**42%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.25	7	3.1	7.3
Design Capacity Utilisation (%)		NI	NI	NI	189%
Resource Discharged into		Evaporation ponds (Rooikraal Spruit)	Eland Spruit	Renoster River	Vaal River
Wastewater Risk Rating (CRR% of CRR_{max})		**Edenville**	**Heilbron**	**Koppies**	**Parys**
CRR (2011)	%	94.1%	94.1%	94.1%	90.9%
CRR (2013)	%	88.2%	88.2%	94.1%	77.3%
CRR (2021)	%	94.1%	90.9%	94.1%	95.5%

Key Performance Area	**Unit**	**Vredefort**
Green Drop Score (2021)		**12%**
2013 Green Drop Score		**11%**
2011 Green Drop Score		**36%**
2009 Green Drop Score		**0%**
System Design Capacity	Ml/d	5.5
Design Capacity Utilisation (%)		NI
Resource Discharged into		Vaal
Wastewater Risk Rating (CRR% of CRR_{max})		**Vredefort**
CRR (2011)	%	90.9%
CRR (2013)	%	95.5%
CRR (2021)	%	90.9%

Technical Site Assessment: **Parys WWTW 29%**

5.15 Nketoana Local Municipality

Water Service Institution	**Nketoana Local Municipality**	
Water Service Provider	Nketoana Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Mechanical equipment breakdown 2. Screen offline for 2 years 3. Pumps 4. Sludge withdrawal equipment - sludge to Cl_2 contact tank 5. Biofilter arms 6. Staff facilities and ablution. **VROOM Estimate:** - R35,008,000
2021 Green Drop Score	**34%↑**	
2013 Green Drop Score	**19%**	
2011 Green Drop Score	**23%**	
2009 Green Drop Score	**6%**	

Key Performance Area	Unit	Arlington	Lindley	Petrus Steyn	Reitz
Green Drop Score (2021)		**53%**	**2%**	**33%**	**46%**
2013 Green Drop Score		**21%**	**18%**	**22%**	**18%**
2011 Green Drop Score		**20%**	**23%**	**23%**	**28%**
2009 Green Drop Score		**5%**	**8%**	**5%**	**5%**
System Design Capacity	Ml/d	1.54	2.5	2.4	4.5
Design Capacity Utilisation (%)		3%	NI	104%	78%
Resource Discharged into		NI	Vals River	NI	Langspruit
Wastewater Risk Rating (CRR% of CRR_{max})		**Arlington**	**Lindley**	**Petrus Steyn**	**Reitz**
CRR (2011)	%	100.0%	94.1%	94.1%	94.1%
CRR (2013)	%	94.1%	94.1%	94.1%	94.1%
CRR (2021)	%	64.7%	88.2%	82.4%	76.5%

Technical Site Assessment: **Petrus Steyn WWTW 59%**

5.16 Phumelela Local Municipality

Water Service Institution	**Phumelela Local Municipality**	
Water Service Provider	Phumelela Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Sewer capacity constraints 2. Lack of disinfection of final effluent 3. Flow meters dysfunctional 4. No desludging of primary pond 5. Biofilter arms blocked 6. Dysfunctional screenings and grit removal 7. Grit compromises oxidation pond functionality. **VROOM Estimate:** - R21,155,400
2021 Green Drop Score	**4%↓**	
2013 Green Drop Score	**25%**	
2011 Green Drop Score	**5%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Vrede**	**Memel**	**Warden**
Green Drop Score (2021)		**4%**	**6%**	**5%**
2013 Green Drop Score		**35%**	**15%**	**23%**
2011 Green Drop Score		**5%**	**4%**	**4%**
2009 Green Drop Score		**0%**	**0%**	**0%**
System Design Capacity	Ml/d	3.765	0.5	3.4
Design Capacity Utilisation (%)		NI	NI	NI
Resource Discharged into		Spruitsondersdrif - Klip River	Klip River (Pampeonspruit)	Cornelius River
Wastewater Risk Rating (CRR% of CRR_{max})		**Vrede**	**Memel**	**Warden**
CRR (2011)	%	100.0%	52.9%	100.0%
CRR (2013)	%	82.4%	100.0%	88.2%
CRR (2021)	%	100.0%	100.0%	94.1%

Technical Site Assessment: **Vrede WWTW 19%**

5.17 Setsoto Local Municipality

Water Service Institution	**Setsoto Local Municipality**	
Water Service Provider	Setsoto Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Staff facilities 2. Chlorine contact tanks 3. Dispute with farmer 4. Module 1 offline 5. Aerators dysfunctional for long time 6. Clarification blockages due to weed infestation 7. Vandalism **VROOM Estimate:** - R41,216,000
2021 Green Drop Score	**19%↑**	
2013 Green Drop Score	**5%**	
2011 Green Drop Score	**23%**	
2009 Green Drop Score	**7%**	

Key Performance Area	Unit	Clocolan	Ficksburg	Marquad	Senekal
Green Drop Score (2021)		**24%**	**14%**	**28%**	**35%**
2013 Green Drop Score		**2%**	**5%**	**2%**	**11%**
2011 Green Drop Score		**12%**	**25%**	**15%**	**26%**
2009 Green Drop Score		**7%**	**7%**	**7%**	**7%**
System Design Capacity	Ml/d	4.2	12.2	NI	2
Design Capacity Utilisation (%)		122%	122%	NI	NI
Resource Discharged into		Mopedi River and applied to land	Caledon River, tributary to Orange River	Laaispruit	Sand River
Wastewater Risk Rating (CRR% of CRR_{max})		**Clocolan**	**Ficksburg**	**Marquad**	**Senekal**
CRR (2011)	%	100.0%	54.5%	100.0%	100.0%
CRR (2013)	%	94.1%	90.9%	94.1%	94.1%
CRR (2021)	%	88.2%	95.5%	70.6%	64.7%

Technical Site Assessment: **Clocolan WWTW 46%**

5.18 Tokologo Local Municipality

Water Service Institution	**Tokologo Local Municipality**	
Water Service Provider	Tokologo Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Pumpstation dysfunctional 2. Sludge build-up in the system 3. Flow metering absent 4. No constructed discharge point for tankers and night soil **VROOM Estimate:** - R3,294,000
2021 Green Drop Score	**39%↑**	
2013 Green Drop Score	**24%**	
2009-11 Green Drop Score	**0%**	

Key Performance Area	Unit	Boshof	Dealesville	Hertzogville
Green Drop Score (2021)		**32%**	**46%**	**43%**
2013 Green Drop Score		**23%**	**25%**	**25%**
2011 Green Drop Score		**0%**	**0%**	**0%**
2009 Green Drop Score		**0%**	**0%**	**0%**
Design Capacity	Ml/d	2.0	0.76	2.0
Capacity Utilisation (%)		76%	NI	NI
Resource Discharged into		No discharge	No discharge	No discharge
Wastewater Risk Rating (CRR% of CRR_{max})		**Boshof**	**Dealesville**	**Hertzogville**
CRR (2021)	%	29.4%	47.1%	41.2%
CRR (2013)	%	100.0%	82.4%	82.4%
CRR (2011)	%	100.0%	100.0%	100.0%

Technical Site Assessment: **Boshof WWTW 45%**

5.19 Tswelopele Local Municipality

Water Service Institution	**Tswelopele Local Municipality**	
Water Service Provider	Tswelopele Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Equipment being dysfunctional for long periods of time 2. Screenings press, degritter dysfunctional 3. Aerators, recycle pumps, mixers partly dysfunctional 4. Disinfection not operational **VROOM Estimate:** - R8,382,000
2021 Green Drop Score	**40%↓**	
2013 Green Drop Score	**49%**	
2011 Green Drop Score	**46%**	
2009 Green Drop Score	**0%**	

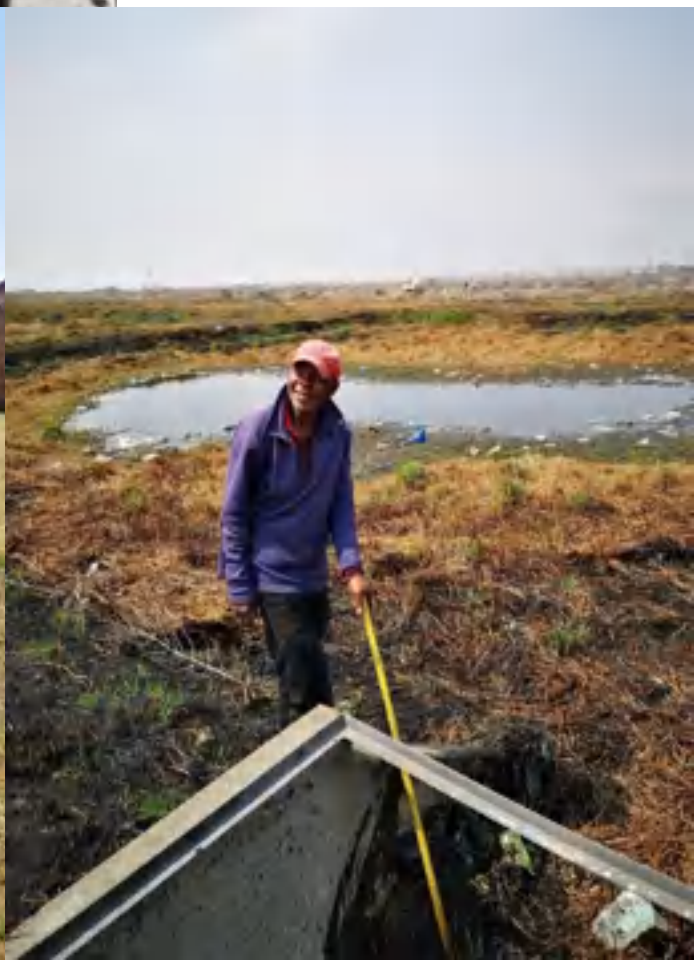
Key Performance Area	**Unit**	**Bultfontein**	**Hoopstad**
Green Drop Score (2021)		**45%**	**30%**
2013 Green Drop Score		**50%**	**49%**
2011 Green Drop Score		**46%**	**47%**
2009 Green Drop Score		**0%**	**0%**
Design Capacity	Ml/d	4.5	2.1
Capacity Utilisation (%)		NI	NI
Resource Discharged into		Natural pan	Irrigation / Vet River
Wastewater Risk Rating (CRR% of CRR_{max})		**Bultfontein**	**Hoopstad**
CRR (2021)	%	64.7%	82.4%
CRR (2013)	%	82.4%	88.2%
CRR (2011)	%	83.3%	88.9%

Technical Site Assessment: **Tswelopele WWTW 54%**

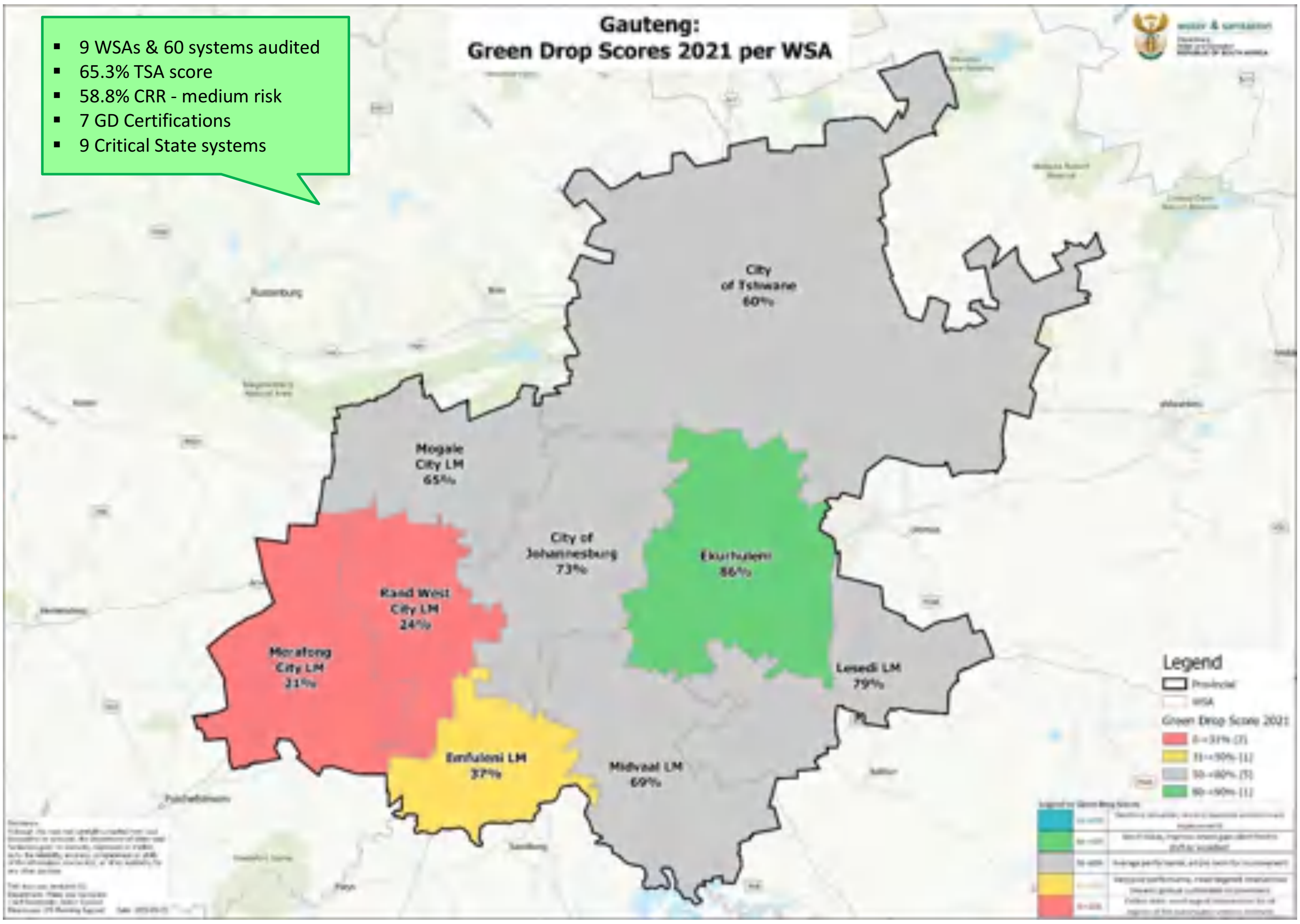
Left: Marius Steenkamp from Ngwathe Municipality demonstrating how they clean the rake. Well done to this dedicated person – who is doing so much under very difficult circumstances.

Left below: Nala Municipality. Staff working with the Inspectors to establish how much sludge is in the reactor using baseline information.

Right below: Mr Mokoena is due to retire in November 2022, but assisted the Inspectors to clear the debris on the anaerobic pond once he realised that there should be water and not grass. He was open to advice and no task to big.



6. GAUTENG PROVINCE: MUNICIPAL WASTEWATER MANAGEMENT PERFORMANCE



Provincial Synopsis

An audit attendance record of 100% affirms Gauteng's commitment to the Green Drop national incentive-based regulatory programme.

The Regulator determined that 7 wastewater system scored a minimum of 90% when measured against the Green Drop standards for the audited period and thus qualified for the prestigious Green Drop Certification. In 2013, 8 systems were awarded Green Drop Status. The audit nonetheless established an accurate, current baseline from where improvement can be driven, and excellence be incentivised.

Three (3) of the 9 WSAs improved on their 2013 scores, namely the City of Ekurhuleni, Lesedi LM, and Midvaal LM. The remainder 5 WSAs regressed to lower Green Drop scores compared to 2013 baselines. The City of Ekurhuleni (and ERWAT) is the best performing WSA in Gauteng, achieving 6 Green Drop Certifications out of their 17 wastewater systems, and 5 systems as Green Drop Contenders to certification. The Green Drop scores are supported by excellent technical site scores of 88% and 96%. Lesedi is the 2nd best achiever with a GD score of 79% and TSA of 94%. Midvaal impressed with achieving the best overall progress from a 53% in 2013 to a municipal score of 69% in 2021. Unfortunately, 9 systems were identified to be in a critical state in Gauteng, compared to none in 2013. The majority of these systems are managed by Merafong and Rand West, with 1 system each in the City of Tshwane and Lesedi.

Gauteng's overall Green Drop performance is characterised by particular strengths in technical capacity and capability at most municipalities, combined with risk management practices that are well embedded in the wastewater business. The predominant KPA that requires attention is effluent quality compliance, and financial administration.

The provincial Risk Ratio for treatment plants remained constant at 58.8% in 2021, compared to 58.5% in 2013, which suggests limited risk movement since 2013. The most prominent risks were observed at a treatment level, and pointed to WWTWs that exceeded their design capacity, dysfunctional processes and equipment (especially disinfection), and effluent and sludge non-compliance. Opportunities are presented in terms of reducing cost through process optimisation, improved energy efficiency and beneficial use of sludge, nutrients, biogas, and other energy resources.

The Regulator is hopeful that the 2021 audits will set a baseline from where a positive trajectory for wastewater services and improved performance will follow. Municipalities are encouraged to start their preparation for the 2023 Green Drop audit. The 2021 Green Drop status for WSAs in Gauteng are summarised in Table 67.

Table 67 - 2021 Green Drop Summary

WSA Name	2013 GD Score (%)	2021 GD Score (%)	2021 GD Certified ≥90%	2021 GD Contenders (89%)	2021 Critical State (<31%)
City of Ekurhuleni	84	86↑	Rondebult, Herbert Bickley, JP Marais, Esther Park, Carl Grundling, Daveyton	Tsakane, Hartebeesfontein, Welgedacht, Benoni, Rynfield	
Lesedi LM	78	79↑	Ratanda		Devon
City of Johannesburg	86	73↓			
Midvaal LM	53	69↑			
Mogale City LM	75	65↓			
City of Tshwane	82	60↓			Klipgat
Emfuleni LM	81	37↓			
Rand West LM					
-Randfontein LM	67	24↓			Randfontein, Hannes van Niekerk
-Westonaria LM	40				
Merafong LM	54	21↓			Khutsong, Kokosi-Fochville, Murray & Roberts, Wedela, Welverdiend
Totals	-	-	7	5	9

The Department of Water and Sanitation acknowledges the excellence in wastewater management achieved for the Green Drop Audit year of 2021. Seven (7) Green Drop Certificates are awarded in the Gauteng Province to 6 systems in the City of Ekurhuleni and 1 system in the Lesedi Local Municipality:

Province	2021 Drop Certified Systems	Acknowledgement of 2021 Contender Systems for Green Drop Certification
Gauteng	**City of Ekurhuleni** ○ Rondebult ○ Herbert Bickley ○ JP Marais ○ Esther Park ○ Carl Grundling ○ Daveyton **Lesedi LM** ○ Ratanda	✓ **City of Ekurhuleni** ○ Tsakane ○ Hartebeesfontein ○ Welgedacht ○ Benoni ○ Rynfield

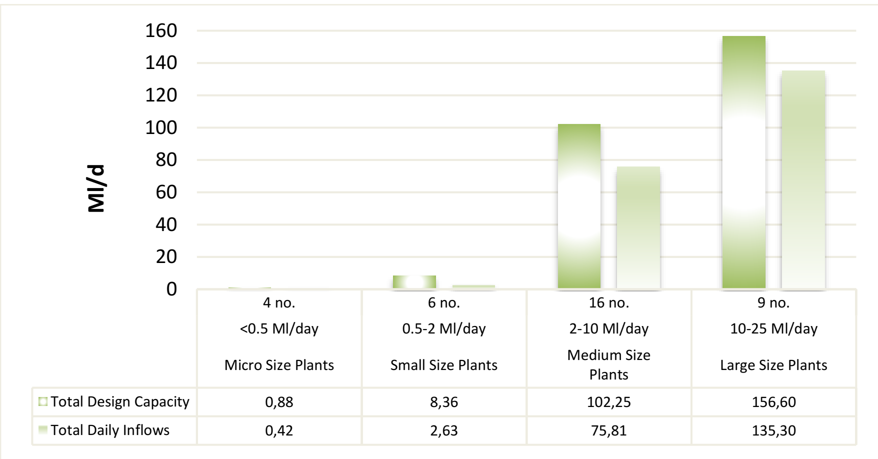
Background to Gauteng Wastewater Infrastructure

Gauteng represents the highest volume of wastewater treated in South Africa with 2,460 Ml/d. There are 9 WSAs, delivering wastewater services through a sewer network comprising of 60 WWTWs, 263 network pump stations and 20,048 km outfall and main sewer pipelines. The sewer network excludes pipeline information from 4 municipalities who were unable to provide this data. There is a total installed treatment capacity of 2,679 Ml/d, with most of this capacity (92%) residing in 25 macro-sized treatment plants.

Table 68 - Summary of WWTW capacity and flow distribution according to plant sizes

	Micro Size Plants	Small Size Plants	Medium Size Plants	Large Size Plants	Macro Size Plants	Unknown (NI)*	Total
	<0.5 Ml/day	0.5-2 Ml/day	2-10 Ml/day	10-25 Ml/day	>25 Ml/day		
No. of WWTW	4 (6%)	6 (10%)	16 (27%)	9 (15%)	22 (42%)	None	60
Total Design Capacity (Ml/day)	0.88	8.36	102.25	156.60	2411.50	None	2679.6
Total Daily Inflow (Ml/day)	0.42	2.63	75.81	135.30	2246.02	5	2460.2
Use of Design Capacity (%)	48%	31%	74%	86%	93%	-	92%

** "Unknown" means the number of WWTWs with NI (No Information) on design capacity or daily inflow*



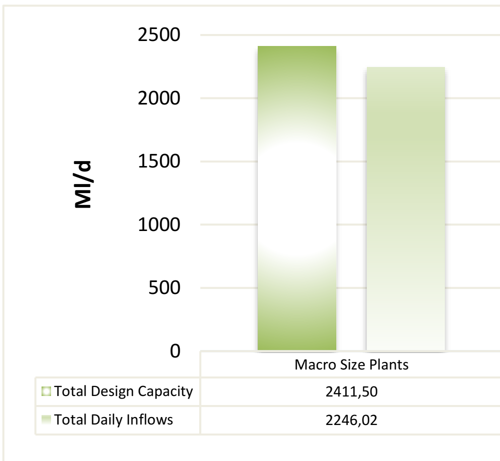


Figure 61 - Design capacities and operational inflow to micro to large sized WWTWs (a) and macro sized WWTWs

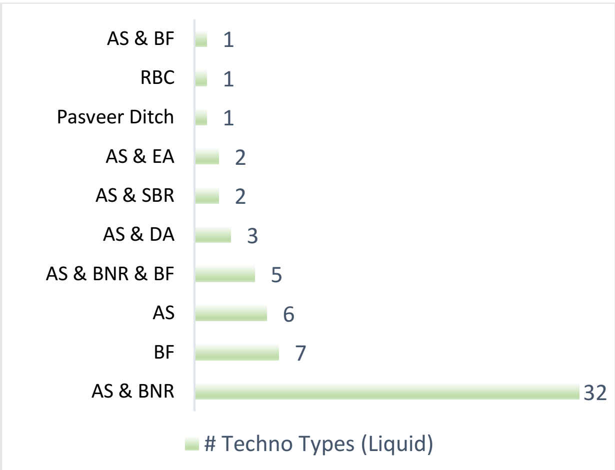
Based on the current operational flow of 2,460 Ml/d, the treatment facilities are operating close to their design capacity (92%). The three flow largest contributors are the metropolitan municipalities with a total contribution of 2,271 Ml/d (92.3%) - namely, City of Johannesburg with 944 Ml/d, City of Ekurhuleni with 819 Ml/d and City of Tshwane with 508 Ml/d. A theoretical surplus of 8% is 'available' for future demand. It must however be noted that inflow is not monitored in 5 systems and as a result the spare capacity could be less than the 8%. Diagnostic #3 unpacks these statistics in more detail. This spare capacity would also be compromised at systems where some of the infrastructure or treatment modules are non-operational or dysfunctional. The VROOM Cost Diagnostic #7 provides more detail on the refurbishment requirements to restore such capacity and functionality.

While the provincial picture indicates that spare capacity, a number of wastewater systems are over-committed in terms of their hydraulic design capacity. This means that Gauteng's socio-economic growth trajectory may be impeded, coupled with environmental risk when discharging sub-standard effluent quality that would typically be a consequence of capacity constraints. Hence, the need to invest in reducing water use (which could lead to a reduction in wastewater generation), as well as additional wastewater treatment capacity as per the planned growth trajectory.

The audit data shows that 13 systems are hydraulically overloaded. This figure could theoretically be higher, given that there are 5 systems where inflow monitoring is not taking place. The hydraulically overloaded systems in each of the WSAs is as follows:

- City of Johannesburg: 2 of 6 systems (Bushkoppies and Ennerdale)
- City of Tshwane: 4 of 16 systems (Baviaanspoort, Rayton, Sunderland Ridge, and Rooiwal North)
- Lesedi: 1 of 3 systems (Heidelberg)
- City of Ekurhuleni: 6 of 17 systems (Ancor, Jan Smuts, Waterval, Vlakplaats, Herbert Bickley, and Olifantsfontein).

The predominant treatment technologies employed at Gauteng WWTWs comprise of activated sludge and biological nutrient removal (for effluent treatment), and anaerobic digestion (for sludge treatment). The next audit will need to verify sludge treatment technologies, as insufficient information ("Other") is observed in this area.



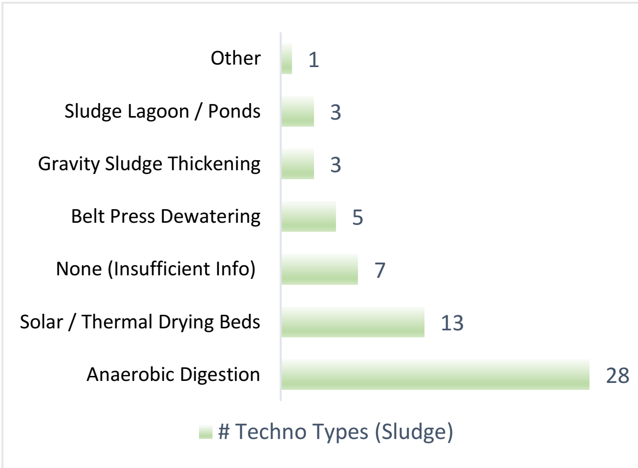


Figure 62 - Treatment technologies for wastewater effluent (a) and sludge (b)

Considering climate change objectives, Gauteng is presented with remarkable opportunities to generate electrical and heat energy on-site and reduce its reliance on external energy supply. With the exception of Midvaal and Merafong, all municipalities use anaerobic digestion to treat and stabilise sludge, with 28 of 60 plants having digesters (44%). Most sludge digesters are located in the Cities of Ekurhuleni and Tshwane. A total of 197 anaerobic digesters are operational in the Gauteng with a total capacity of 353 Ml/d. Some of the digesters are fully committed or have limited spare capacity for sludge treatment. Any limitations in sludge treatment capacity will cause a restriction in the overall wastewater treatment capacity, as sludge and liquid treatment are inter-dependent.

Table 69 - Summary of Collection Network Pump Stations and Sewer Pipelines

WSA Name	# WWTWs	Pump Stations (#)	Sewer Pipelines (km)
City of Johannesburg	6	40	9,145
City of Tshwane	16	13	NI
Midvaal	4	23	95
Lesedi	3	4	NI
Mogale City	3	11	650
City of Ekurhuleni	17	113	9,629
Merafong	6	3	NI
Rand West	2	8	NI
Emfuleni	3	48	529
GP Totals	**60**	**263**	**20,048**

The sewer network consists of the sewer mains and pump stations as summarised in Table 69. City of Ekurhuleni and City of Johannesburg own and manage the bulk of the sewer collector infrastructure, approximately 9,629 km and 9,145 km; and 113 and 40 sewer pump stations, respectively. Four municipalities could not provide information on sewer pipelines, indicating limitation in asset management information.

Provincial Green Drop Analysis

The 100% response from the 9 municipalities audited during the 2021 Green Drop process demonstrates a firm commitment to wastewater services in the province. Local Government reforms resulted in the merging of Randfontein LM and Westonaria LM into Rand West LM. Therefore 9 WSAs were audited in 2021 compared to the 10 WSAs in 2013.

Table 70 - Green Drop Comparative Analysis from 2009 to 2021

GREEN DROP COMPARATIVE ANALYSIS					
Performance Category	2009	2011	2013	2021	Performance trend 2013 and 2021
Incentive-based indicators					
Municipalities assessed (#)	9 (82%)	12 (100%)	10 (100%)	9 (100%)	→
Wastewater systems assessed (#)	43	56	58	60	↑
Average Green Drop score	53%	68.1%	74.2%	63.0%	↓
Green Drop scores ≥50% (#)	35 (81%)	50 (89%)	53 (91%)	45 (75%)	↓
Green Drop scores <50% (#)	8 (19%)	6 (11%)	5 (9%)	15 (25%)	↓
Green Drop Certifications (#)	10	5	8	7	↓
Technical Site Inspection Score (%)	NA	62.3%	73.6%	65.3%	↓

NA = Not Applied   NI = No Information   *↑= improvement, ↓= regress, →= no change*

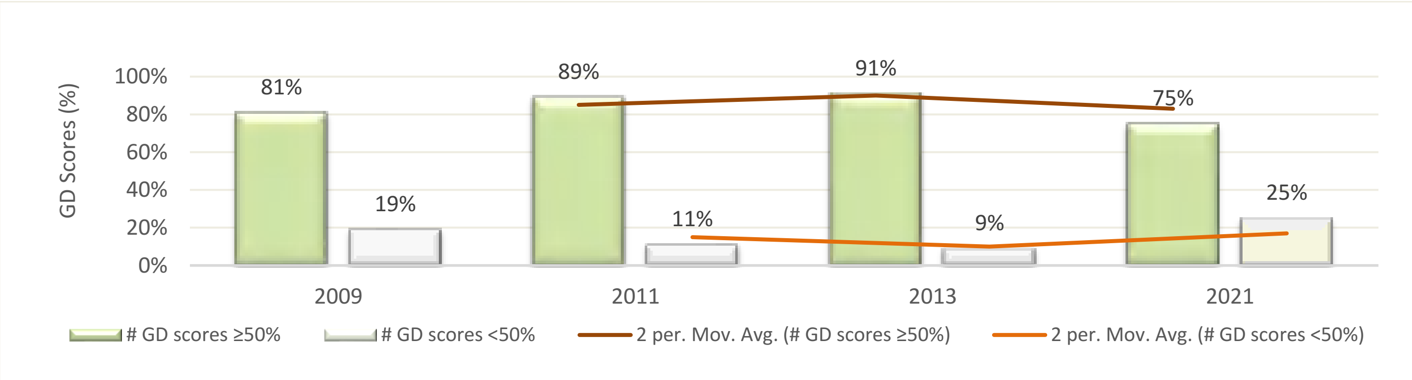


Figure 63 - Green Drop trend analysis over the period 2009 to 2021, indicating the percentage GD scores above and below 50%

The trend analysis indicates that:

- The number of systems audited has increased from 43 systems in 2009, when the first assessments were undertaken, to 60 systems in 2021
- Despite an upward trend in previous GD assessments, 53% in 2009, 68% in 2011, 72% to 2013, there was a drop-off to 63% in 2021
- Similarly, the number of systems with GD scores of ≥50% increased between from 35 (81%) in 2009 to 53 (91%) in 2013 but decreased to 45 (75%) in 2021
- This trend was also mirrored in the Technical Site Assessment score, which had increased from 62% in 2001 to 74% in 2013 but decreased to 65% in 2021
- This trend was balanced by the number of systems with GD score of ≤50% decreasing from 8 (19%) in 2009 to 5 (9%) in 2013, followed by drastic regress to 15 (25%) in 2021

- The Green Drop Certifications remained relatively constant with 8 awards in 2013 and 7 awards in 2021.
- An overall performance trend from 2013 to 2021 signals the need for repeat/regular audits to ensure continued improvement. There are indications that performance has declined in the absence of the consistent regulatory engagement of the GD audits.

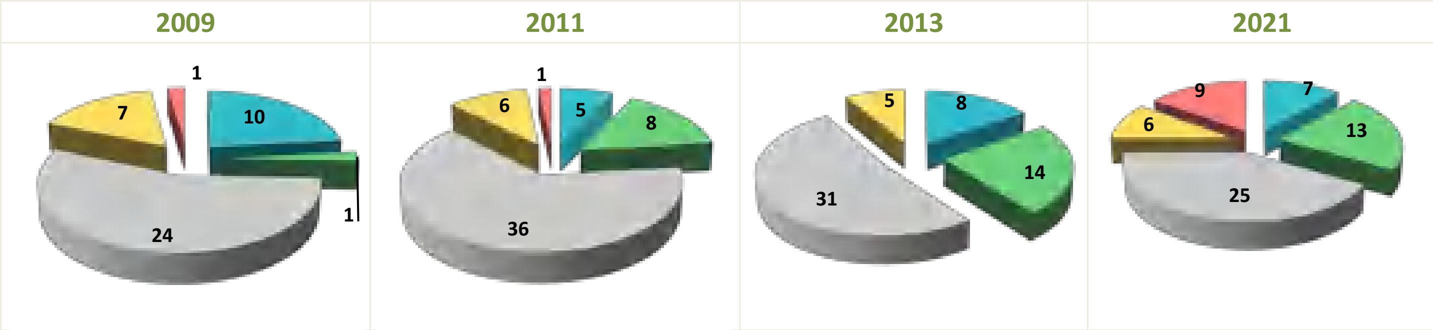


Figure 64 - No. WWTWs in the Green Drop score categories over the period 2009 to 2021 (graph legend to right)

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	

The analysis for the period 2009, 2011, 2013 and 2021, indicates that most of the system scores are in the 50-80% (Average Performance) category, with the 80-90% (Good Performance) being the next largest category. The most concerning data point is that 9 systems are in critical state (<31%) compared to 0 systems in this category in 2013.

In summary, trends over the years 2013 and 2021 indicate as follows:

- Systems in a 'poor state' increased from 5 systems in 2013 to 6 systems in 2021
- Systems in a 'critical state' increased from zero (0) in 2013 to 9 systems in 2021
- Systems in the 'excellent and good state' decreased from 22 systems (38%) in 2013 to 20 systems (35%) in 2021.

Provincial Risk Analysis

Green Drop risk analysis (CRR) focuses specifically on the treatment function. It considers 4 risk indicators, i.e. design capacity, operational flow, technical capacity, and effluent quality. The CRR values do not factor risks associated with sanitation or wastewater network and collector systems.

Table 71 - Cumulative Risk Comparative Analysis from 2009 to 2021

CUMULATIVE RISK COMPARATIVE ANALYSIS					
Performance Category	**2009**	**2011**	**2013**	**2021**	**Performance Trend 2013 to 2021**
Highest CRR	31	32	30	31	-
Average CRR	14.3	15.3	14.6	14.9	↓
Lowest CRR	7	6	7	4	-
Design Rating (A)	2.8	2.6	2.6	2.6	→
Capacity Exceedance Rating (B)	3.3	3.6	3.3	3.3	→
Effluent Failure Rating (C)	3.5	4.4	4.3	4.5	↓
Technical Skills Rating (D)	1.5	1.6	1.6	1.6	→
CRR% Deviation	**48.0**	**58.5**	**58.5**	**58.8**	↓

↑= improvement, ↓= regress, →= no change

The concept of risk management appears to be well embedded within Gauteng municipalities. This is reflected in the fact that 7 out of the 9 WSAs have W_2RAPs, which would in theory inform decisions and risk mitigation strategies. Table 71 indicates a consistent CRR% deviation from 2013 to 2021 for Gauteng, which suggests little to no change in design capacity (A), operational flow (B), technical expertise (C) and final effluent quality (D) for Gauteng overall. Individual systems, however, show higher deviations and indicate specific risk categories, as highlighted under "***Regulator's Comment***". The CRR analysis in context of the Green Drop results suggests that further improvements should focus on 1) capacity exceedance at plants which are hydraulically overloaded or approaching its design lifespan, 2) effluent quality failures, especially for microbiological compliance, and 3) strengthening of technical skills and operational competency, especially related to sludge management.

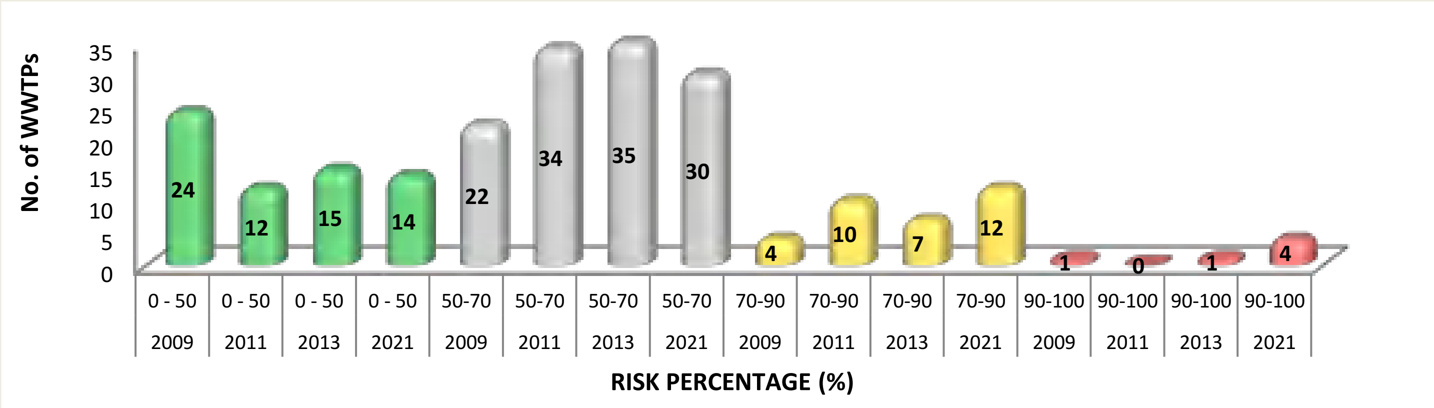


Figure 65 - a) WWTW risk distribution and trends from 2009 to 2021; b) Colour legend

90 – 100% Critical risk WWTPs	
70 - <90% High Risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low Risk WWTPs	

Trend analysis of the CRR ratings for the period 2009 to 2021 indicates that:

- The most prominent movement in risk can be seen between 2009 and 2011, when a significant number of plants moved from low to medium and high-risk positions, indicating a regressive state for WWTWs
- The CRR remained fairly constant during 2011 to 2013, at a time when W$_2$RAPs and risk-mitigation strategies were being embedded in WSIs
- The 2021 assessment cycle highlighted regressive shifts with a decrease in the number of medium risk WWTWs (35 to 30) and increase in high risk (7 to 12) and critical risk WWTWs (1 to 4).

Regulatory Enforcement

Wastewater systems which failed to achieve the minimum Green Drop target of 31%, are placed under regulatory focus. The Regulator requires these municipalities to submit a detailed corrective action plan within 60 days from publishing of this report. Four (4) municipalities and 9 wastewater systems that received Green Drop scores below 31%, are to be placed under **regulatory surveillance**, in accordance with the Water Services Act (108 0f 1997). In addition, these municipalities will be compelled to ringfence water services grant allocation to rectify/restore wastewater collection and treatment shortcomings identified in this report.

Table 72 - WWTWs with <31% Green Drop scores

WSA Name	2021 GD Score	WWTWs with <31% score
Lesedi LM	**79%**	Devon
City of Tshwane	**60%**	Klipgat
Rand West LM	**24%**	Randfontein, Hannes van Niekerk
Merafong LM	**21%**	Khutsong, Kokosi-Fochville, Murray & Roberts, Wedela, Welverdiend

The following municipalities and their associated wastewater treatment plants are in high CRR risk positions, which means that some or all the risk indicators are in a precarious state, i.e. operational flow, technical capacity, and effluent quality. WWTWs in high risk and critical risk positions poses a serious risk to public health and the environment. The following municipalities will be required to assess their risk contributors and develop corrective measures to mitigate these risks.

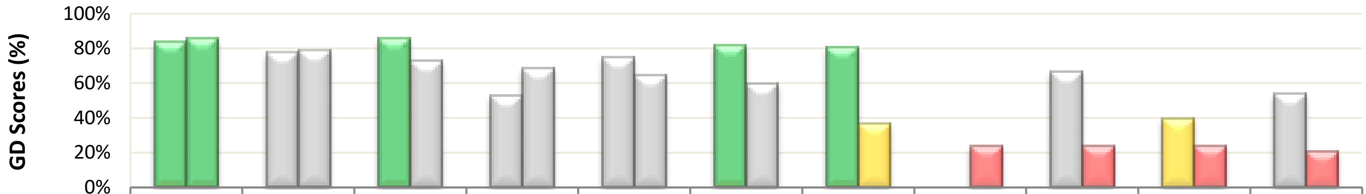
Table 73 - %CRR/CRR$_{max}$ scores and WWTWs in critical and high-risk space

WSA Name	2021 Average CRR/CRRmax % deviation	WWTWs in critical and high-risk space	
		Critical Risk (90-100%CRR)	High Risk (70-<90%CRR)
City of Ekurhuleni	50.2%	None	Ancor, Waterval, Vlakplaats, Olifantsfontein
Lesedi LM	59.4%	Devon	None
City of Tshwane	60.9%	Klipgat	Baviaanspoort, Rayton, Rooiwal North
Emfuleni LM	61.2%		Rietspruit
Mogale City LM	63.0%	None	Magalies
Rand West LM	74.2%	None	Randfontein
Merafong LM	77.1%	Kokosi, Wedela	Welverdiend, Murray & Roberts
Provincial Average	**58.8%**	**4 of 60 (6.7%)**	**12 of 60 (20%)**

Good practice risk management requires that the W$_2$RAPs are informed by meaningful Process and Condition Assessments, supported by zealous implementation of corrective measures and ongoing monitoring of risk movement. City of Johannesburg and Midvaal are commended for maintaining all their treatment facilities in low and medium risk positions - an exemplary status.

Performance Barometer

The **Green Drop Performance Barometer** presents the individual Municipal Green Drop Scores, which essentially reflects the level of mastery that a municipality has achieved in terms of its overall municipal wastewater services business. The bar chart below shows the comparison of the 2013 and 2021 GD scores, ranked the from highest to lowest performing WSI. The City of Ekurhuleni/ERWAT maintains good performance; Lesedi, Midvaal, Mogale City LMs maintains average performance; the Cities of Tshwane and Johannesburg regressed from good- to average performance; and Rand West and Merafong LM regressed to critical state.



	Ekurhuleni Metro	Lesedi LM	City of Johannesburg	Midvaal LM	Mogale City LM	City of Tshwane	Emfuleni LM	Rand West (New merged LM)	Randfontein (Now Rand West)	Westonaria (Now Rand West)	Merafong LM
2013 GD Score	84%	78%	86%	53%	75%	82%	81%		67%	40%	54%
2021 GD Score	86%	79%	73%	69%	65%	60%	37%	24%	24%	24%	21%

Figure 66 - a) Green Drop scores 2013 (bar left) and 2021 (bar right; b) Colour legend

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	

The **Cumulative Risk Log** expresses the level of risk that a municipality poses in respect of its wastewater treatment facility. It is based on the ***individual Cumulative Risk Ratios***. Figure 67 presents the cumulative risks in ascending order – with the low-risk municipalities on the left and critical risk municipalities to the far right. The analysis reveals that there are no critical risk municipalities in the province. The Merafong and Rand West wastewater systems are in high-risk positions.

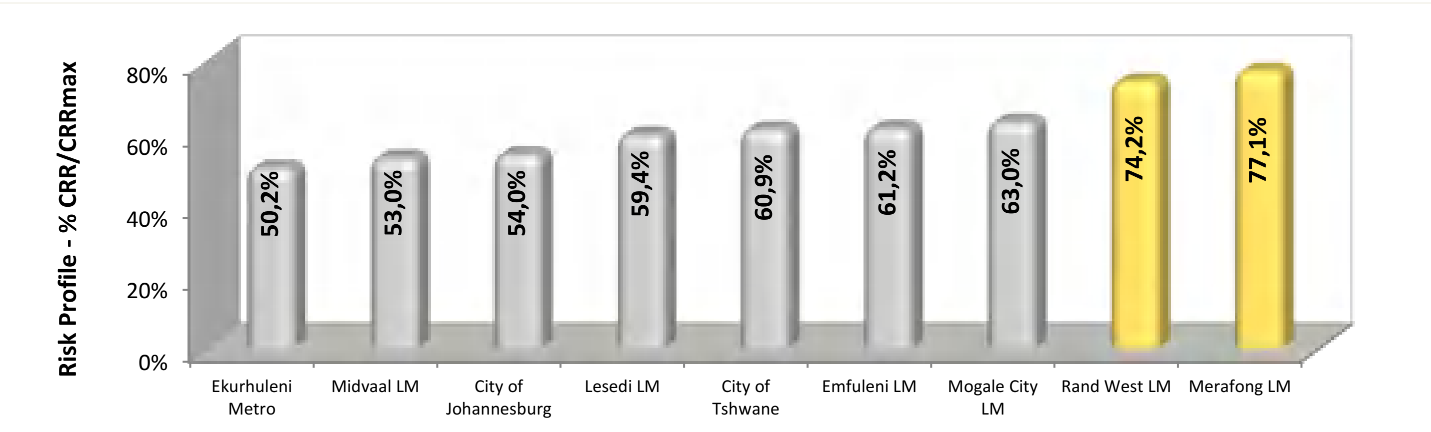


Figure 67 - a) %CRR/CRRmax Risk Performance Log 2021; b) Colour legend

90 – 100% Critical risk WWTPs	
70 - <90% High risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low risk WWTPs	

Provincial Best Performers

The **City of Ekurhuleni** and **ERWAT** is the **BEST PERFORMING** municipality in the Gauteng Province, based on the following record of excellence:

- ✓ 86% Municipal Green Drop Score
- ✓ 2013 Green Drop Score of 84%
- ✓ Improvement on the CRR risk profile from 61.3% in 2013 to 50.2% in 2021
- ✓ 13 of 17 (76%) plants in the low and medium risk positions
- ✓ TSA scores of 88% (Welgedacht) and 96% (Esther Park)

Lesedi Local Municipality and **ERWAT** is the second-best scoring municipality:

- ✓ 79% Municipal Green Drop Score
- ✓ 67% of plants (2 of 3) in low & medium risk positions
- ✓ TSA score of 94% (Ratanda)

City of Johannesburg Metropolitan Municipality and **Johannesburg Water** is the third best scoring municipality:

- ✓ 73% Municipal Green Drop Score
- ✓ All plants (6 no.) in low and medium risk positions
- ✓ TSA of 59% (Goudkoppies) and 71% (Bushkoppies)

KPA Diagnostics

The Green Drop Audit process collects a vast amount of data that yield valuable insight on the state of the wastewater sector in each Province. These insights have been captured into 7 thematic areas or 'Diagnostics', as discussed below.

Table 74 – Summary of the key diagnostic themes and reference to the respective Green Drop KPAs

Diagnostic #	Diagnostic Description	Diagnostic Reference
1	**Green Drop KPA Analysis**	KPAs A-E
2	**Technical Competence**	KPA A, B & Bonus
3	**Treatment Capacity**	KPA D
4	**Wastewater Monitoring and Compliance**	KPA B & D & Bonus
5	**Energy Efficiency**	KPA C & Bonus
6	**Technical Site Assessments**	TSA
7	**Operation, Maintenance and Refurbishment of Assets**	KPA C, D & Bonus

Diagnostic 1: Green Drop KPA Analysis

Aim: Analysis of technical skills, environmental plans, financial management, technical capacity, and regulatory compliance provides insight into the strengths and weaknesses of wastewater management in WSAs in the province. These insights in turn, may inform appropriate interventions and strategies to improve the individual KPAs and ultimately, collective KPA performance.

Findings: Gauteng is characterised by a highly variable KPA profile. A good KPA profile is one which shows a high mean GD score, coupled with a small Standard Deviation (SD) between the outer parameters (min and max). Similarly, a well performing system is one which has a most/all systems in the >80% bracket and no systems in the <31% bracket.

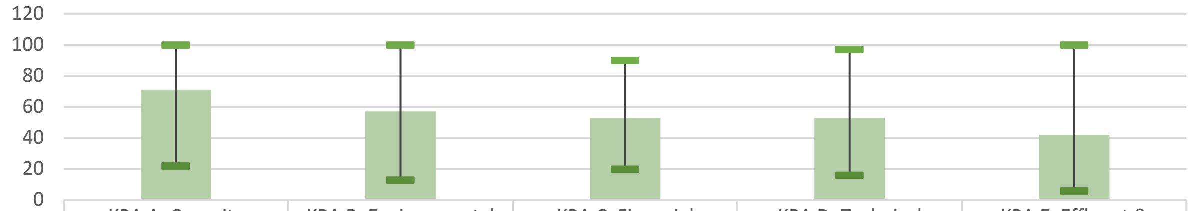
Table 75 - Green Drop scores KPA profiles (graph legend included)

KPA #	Key Performance Area	*Weight*	Minimum GD Score (%)	Maximum GD Score (%)	Mean GD Score (%)	# Systems <31%	# Systems ≥80%
A	Capacity Management	*15%*	22%	100%	71%	4 (7%)	41 (68%)
B	Environmental Management	*15%*	13%	100%	57%	10 (17%)	22 (37%)
C	Financial Management	*20%*	20%	90%	53%	8 (13%)	7 (12%)
D	Technical Management	*20%*	16%	97%	53%	6 (10%)	17 (28%)
E	Effluent and Sludge Compliance	*30%*	6%	100%	42%	25 (42%)	16 (27%)

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	

The KPA distribution indicates a general distribution profile as follows:

- Capacity Management (KPA A) depicts the highest maximum of 100%, highest minimum of 22%, the highest mean of 71%, with the lowest SD. These results indicate strengths pertaining to the registration of WWTWs, maintenance plans and records, maintenance teams, and registered, qualified staff (process controllers, supervisors, scientists, technicians, engineers)
- Effluent and Sludge Quality Compliance (KPA E) depicts the lowest minimum of 6%, the lowest mean of 42%, and the highest SD. The data points to significant weaknesses in underlying causes, i.e. water use authorisations, data management, IRIS uploads, effluent quality compliance, and sludge classification
- Financial Management (KPA C) received the lowest maximum score of 90%, indicating a vulnerability in the use of budget drivers, and information on O&M budgets and expenditure, production cost (R/m^3), energy management and cost (R/kWh), and contract management
- The KPA mean follows an almost linear decreasing trend from KPA A to E.



	KPA A: Capacity Management	KPA B: Environmental Management	KPA C: Financial Management	KPA D: Technical Management	KPA E: Effluent & Sludge Compliance
Mean	71	57	53	53	42
Max	100	100	90	97	100
Min	22	13	20	16	6

Note: The High and low lines represent the Min and Max range, and the shaded green represents the Mean

Figure 68 - Maximum, minimum, and mean Green Drop KPA scores

The GD bracket performance distribution indicates as follows:

- ***KPA Score ≥80%:*** Capacity Management (KPA A) is the best performing KPA with 68% of systems achieving >80%, followed by Environmental Management (KPA B) with 37%. Financial Management (KPA C) was the worst performing KPA with only 12% achieving >80%, followed by Effluent and Sludge Compliance (KPA E) with 27%
- ***KPA Score <31%:*** Effluent & Sludge Compliance (KPA E) represent the worst performing KPA with 42% of systems lying in the 0-31% bracket, followed by Environmental Management (KPA B) with 17% & Financial Management (KPA C) with 13%.

Diagnostic 2: Technical Competence

Aim: This focus area assesses the human resources (technical) capacity to manage wastewater systems. Theory suggests a correlation between human resources capacity (sufficient number of appropriately qualified staff) and a municipality's performance and operational capability. It is projected that high HR capacity would translate to compliant wastewater services and protection of scarce water resources.

Findings: According to regulations, wastewater plants are classified as Class A, B, C, D or E plants. Similarly, Process Controllers and Plant Supervisors are registered as Class I, II, III, IV, V or VI operators. Higher classed plants require a higher level of operators due to their complexity and strict regulatory standards. Technical compliance of PCs and Supervisors is determined against Green Drop standards, as defined by Reg. 2834 and draft Reg. 813 of the National Water Act 1998.

Table 76 - No. compliant versus shortfall in Supervisor and Process Controller staff

WSA Name	# WWTWs	# Compliant staff		# Staff Shortfall		Ratio*	WSA 2021 GD Score (%)
		Supervisor	PCs	Supervisor	PCs		
City of Johannesburg	6	8	20	1	2	4.7	73%
City of Tshwane	16	9	23	6	16	2.0	60%
Midvaal	4	4	4	0	6	2.0	69%
Lesedi	3	2	8	1	2	3.3	79%
Mogale City	3	1	1	2	6	0.7	65%
City of Ekurhuleni	17	17	82	0	0	5.8	86%
Merafong	6	2	8	4	7	1.7	21%
Rand West	2	0	0	2	6	0	24%
Emfuleni	3	5	35	0	0	13.3	37%
GP Totals	**60**	**48**	**181**	**16**	**45**		

** The Ratio depicts the number of qualified staff divided by the number of WWTWs operated by this number of staff. E.g., CoJ has 28 compliant Sups + PCs, divided by 6 plants = 4.7 qualified staff per plant*

Note: "Compliant staff" means qualified and registered staff that meets the GD standard for a particular Class Works. "Staff shortfall" means staff that do not meet the GD standard for a particular Class of works (+1 for a shift) and/or staffing gaps exist at the respective WWTWs.

Competent human resources are a vital enabler to ensure efficient and sustainable management of treatment processes and infrastructure. For Gauteng in general, the operational competencies are found to be reasonably good, as illustrated by the high compliance statistics.

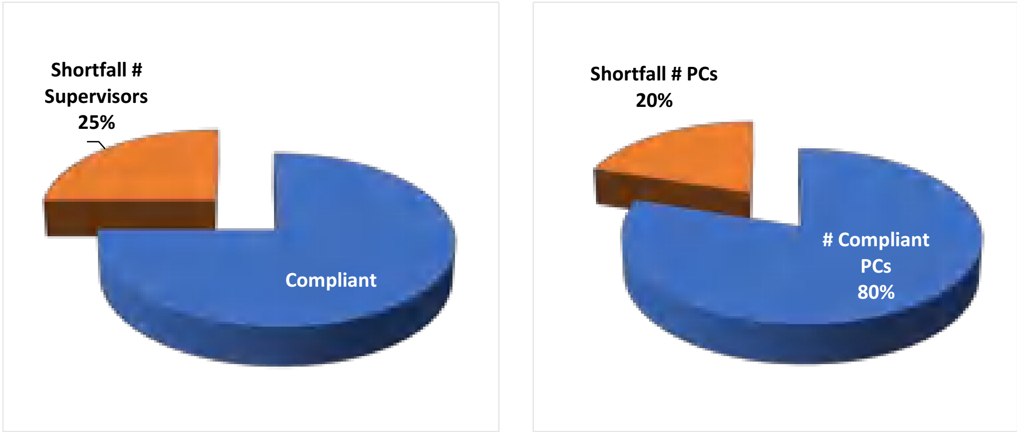


Figure 69 - Schematic illustration of compliant versus non-compliant Supervisors (a) and Process Controllers (b)

Plant Supervisors: The pie charts indicate that 75% (48 of 64) of Plant Supervisors complies with the Green Drop standard, noting a zero shortfall for Ekurhuleni and Midvaal. A 25% (16 of 64) shortfall is noted for Supervisors overall, with the highest shortfall seen at the City of Tshwane (6 no.) and Merafong (4 no.).

Process Controllers: Similarly, 80% (181 of 226) of the PC staff is compliant for Gauteng, noting a zero shortfall in Ekurhuleni and Emfuleni. There is a 20% (45 of 226) shortfall in Process Controllers with the highest shortfall for the City of Tshwane (16 no.), followed Merafong (7 no.), Mogale City (6 no.), Midvaal and Rand West (6 no. each).

Green Drop standards require of Class A and B plants to employ dedicated Supervisors and Process Controllers per shift per works, whereas Class C to E plants may consider sharing of staff across works. Shifts have been introduced to ensure optimal operations while addressing security risks, particularly as it relates to vandalism. Telemetry also reduces the requirement for on-site staff during night shifts, but these relaxations will have to be done within the DWS regulatory guidelines.

It is expected that a correlation would exist between the competence of an operational team and the performance of a treatment plant, as measured by the GD score. The data indicates as follows:

- 4 municipalities have good Supervisor/Process Controller ratios in place (3) – Cities of Ekurhuleni, Johannesburg, Emfuleni, and Lesedi
- Only 4 municipalities have a qualified Supervisor per plant – Cities of Ekurhuleni, Johannesburg, Emfuleni, and Midvaal
- All municipalities have shortfalls in qualified Process Controllers, except for Ekurhuleni and Emfuleni.

The results from the ratio analysis indicate high ratios for Emfuleni (13.3), Ekurhuleni (5.8), Johannesburg (4.7) and Lesedi (3.3), and low ratios for Merafong (1.7), Mogale City (0.7), and Rand West (0).

Figure 70 - Ratio of compliant operational staff to no. of WWTWs and Comparison of Ratios with GD scores

Overall, the comparative bar chart confirms a correlation between municipalities with high ratios and high GD scores (Ekurhuleni 86%, Johannesburg 73%, and Lesedi 79%), whereas lower ratios are associated with lower GD scores (Merafong 21%, and Rand West 24%). Emfuleni and Mogale City are exceptions with Emfuleni having the highest ratio yet having a low GD score and Mogale City having a low ratio and a moderate GD score. Emfuleni presents a case where a high number of staff have been appointed as Process Controllers with lower classification levels.

In addition to operational capacity (above), good management practice also requires access to qualified engineers, technicians, technologists, scientists, and maintenance capability. Such competencies could reside in-house or accessible through term contracts and external specialists.

Table 77 - Summary of the maintenance capacity and no. of qualified and shortfall of Engineering, Technical and Scientific staff

WSA Name	# WWTW	Maintenance Arrangement	Qualified Technical Staff (#)				Technical Shortfall (#)	Qualified Scientists (#)	Scientists Shortfall (#)	Ratio*	WSA 2021 GD Score (%)
			Engineers	Technologists	Technicians	Total					
City of Johannesburg	6	Internal + Term Contract	6	5	1	12	0	5	0	2.0	73%
City of Tshwane	16	Internal + Term Contract; 15 Internal + Specific Outsourcing	2	0	2	4	0	1	0	0.25	60%
Midvaal	4	2 Internal + Term Contract + 2 Internal Team (Only)	0	5	4	9	0	0	1	2.25	69%
Lesedi	3	2 Internal + Specific Outsourcing + 1 Partially Capacitated	11	3	4	22	1	3	1	7.3	79%
Mogale City	3	Internal + Term Contract	3	0	0	4	0	1	0	1.3	65%
City of Ekurhuleni	17	16 Internal+ Term Contract; 1 Internal+ Specific Outsourcing	6	0	6	20	0	8	0	1.2	86%
Merafong	6	5 Internal + Term Contract; 1 Internal + Specific Outsourcing	2	0	3	5	0	0	1	0.8	21%
Rand West	2	Internal + Term Contract	1	0	0	1	1	0	1	0.5	24%
Emfuleni	3	Internal Team (Only)	0	0	2	2	0	1	0	0.7	37%
GP Totals	**60**		**31**	**13**	**22**	**66**	**2**	**19**	**4**		

* *The **single number ratio** depicts the number of qualified technical staff divided by the number of WWTWs that have access to the staff. E.g., CoJ has 12 qualified staff, divided by 6 plants = 2 qualified staff per plant*

Note 1: "Qualified Technical Staff" means staff appointed in positions to support wastewater services, and who has the required qualifications. "Technical Shortfall" is calculated based on a minimum requirement of at least 2 Engineers/Technologists/Technicians and at least one 1 Scientist per WSI.

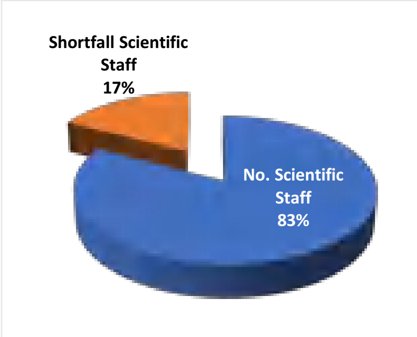
Note 2: "Qualified Scientists" means professional registered scientists (SACNASP) appointed in positions to support wastewater services. "Scientists shortfall" means that the WSA does not have at least one qualified, SACNASP registered scientist in their employ or contracted.

In terms of maintenance capacity, all WSAs in Gauteng have a reasonable contingent of qualified technical/maintenance staff. The maintenance staff comprise of a collective of in-house, contracted, or outsourced personnel. The data indicates that:

- 9 of 9 (100%) municipalities have in-house maintenance teams
- 7 (78%) municipalities have internal maintenance teams supplemented with term contracts
- 4 (44%) municipalities have internal maintenance teams supplement with specific outsourced services.

In general, Gauteng presents a strong case for qualified professional technical staff. The data indicates as follows:

- A total of 82 qualified staff comprised of 31 engineers, 13 technologists, 20 technicians (qualified) and 18 SACNASP registered scientists are assigned to the 9 municipalities
- A total shortfall of 6 persons is identified, consisting of 2 technical staff and 4 scientists
- All municipalities have some shortfall in qualified technical staff, with the exception of the Cities of Ekurhuleni and Johannesburg
- 80% of WWTWs have access to credible laboratories that comply with Green Drop standards.



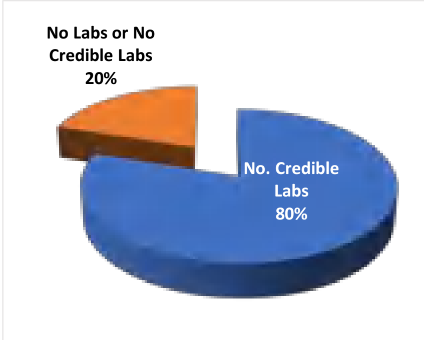


Figure 71 - Graphic illustration of the number and %: a) qualified engineering/technical staff; b) professional scientists; c) access to credible laboratory services that complies with Green Drop standards

Ratio analysis has been done to determine the number of qualified technical and scientific staff assigned per WWTW. It is expected that a higher ratio would correspond with well-performing and maintained wastewater systems, as represented by the GD score.

Figure 72 - Ratio of compliant technical staff to no. of WWTWs and Comparison of Ratios with GD scores

Figure 72 shows a strong correlation between high ratios and high GD scores at 4 municipalities (Lesedi 79%, Midvaal 69%, Johannesburg 73%, and Ekurhuleni 86%). Likewise, a high correlation was found between lower ratios and lower Green Drop scores (Emfuleni 37%, Merafong 21% and Rand West 24%). Tshwane presents an exception by combining a low ratio with a moderate GD of 60%. These results suggest that wastewater performance may be less sensitive towards engineering, technical and scientific staff, and more dependent on operational competencies (Superintendents and PCs).

One of the options to enhance operational capacity is through dedicated training programmes. The Green Drop audit incentivises training of operational staff over the 2-year period prior to the audit date. The results are summarised as follows:

Table 78 - No. of WWTWs with operational staff sent on training over the past 2 years and vice versa

WSA Name	# of WWTW staff attending training	# of WWTW without training
City of Johannesburg	6	1
City of Tshwane	15	1
Midvaal	1	3
Lesedi	2	1
Mogale City	0	3
City of Ekurhuleni	17	0
Merafong	1	5
Rand West	0	2
Emfuleni	1	2
GP Totals	**43 (72%)**	**17 (28%)**

Figure 73 - %WWTWs that have trained operational staff over the past two years

The results confirmed that the majority of operational staff attended training over the past 2 years. However, some training gaps persist, which require a concerted effort to strengthen training initiatives of Supervisors and Process Controllers. Recent training events focused primarily on chlorine handling and NQF, and needs to be expanded to operation of technology, sludge treatment and energy efficiency.

Diagnostic 3: Treatment Capacity

Aim: A capable treatment plant requires adequate design capacity and functional equipment to operate optimally. If the plant capacity is exceeded by way of inflow volume or strength, the plant will not be capable to achieve its compliance standards. Capacity is typically exceeded when the demand exceeds the installed design capacity, or when processes or equipment is not operational or dysfunctional, or when the electrical supply cannot support the treatment infrastructure. This diagnostic assesses the status of plant capacity and operational flows to the plants.

Findings: Analysis of the hydraulic capacities and operational flows indicate a total design capacity of 2,679 Ml/d for Gauteng, with a total inflow of 2,460 Ml/day. Theoretically, this implies that 92% of the design capacity is used with 8% available to meet additional demand. However, the full 2,679 Ml/d day is not available as some infrastructure is dysfunctional, leaving 2,572 Ml/d available. The reduced capacity means that Gauteng is closer to its total available capacity (96%) with only a 4% surplus available. This capacity constrain could impede social and economic development in the drainage areas. It must be noted that many municipalities do not report or have knowledge of reduced capacity, and a higher figure than 8% can be expected.

The City of Johannesburg, Midvaal, Emfuleni and Lesedi have their full installed capacity available. The balance of Gauteng WSAs have capacity impairment ranging from 3 Ml/d (Ekurhuleni) to 52 Ml/d (City of Tshwane). It must be noted that Gauteng's average is skewed by the City of Ekhurhuleni's higher utilisation figures, which if removed, would result in the capacity utilisation figure for Gauteng reducing to 79%.

For Gauteng in general, most plants are operating within their design capacities, with the exception of Ekurhuleni that exceeds its total design capacity by 34%. This risk is currently mitigated through operational optimisation and preventative maintenance regimes. Emfuleni, Merafong and Rand West reported a low percentage use of their capacity. Treatment systems with low percentage use may have been affected by breakdown in sewer networks or pump stations resulting in sewage not reaching the WWTW. Treatment facilities in tourist areas have been experiencing low flows as results of close-down of resorts, however, this is not the case in Gauteng. The Green Drop audit requires a wastewater flow balance to identify and quantify possible losses from the network and/or ingress into the sewers. It was noted that the majority of municipalities do not have flow balances to track the wastewater pathway from consumer to treatment plant.

Table 79 - Summary of WWTWs design and available capacities, inflows, % use design capacities, and inflows measured per WWTW

WSA Name	# WWTWs	Design Capacity (Ml/d)	Available Capacity (Ml/d)	Operational Flow (Ml/d)	Variance (Ml/d)	% Use Design Capacity	Inflow measured #
City of Jhbg	6	1,058	1,058	943.7	114.3	89%	6
City of Tshwane	16	600	548	507.8	92.2	85%	15
Midvaal	4	12.4	12.4	7.7	4.7	62%	4
Lesedi	3	11.5	11.5	10.2	1.3	88%	2
Mogale City	3	78.1	58.1	45.3	32.8	58%	2
City of Ekurhuleni	17	613.3	610.3	819.6	-206.4	134%*	17
Merafong	6	27.3	9.7	10	17.3	37%	4
Rand West	2	57	42	28.8	28.8	51%	2
Emfuleni	3	222	222	87.1	134.9	39%	3
GP Totals	**60**	**2,679.6**	**2,572**	**2,460.2**	**84.5**	**97%**	**55**

** The high figure for Ekurhuleni skews the average for Gauteng. If removed, an average of 79% is presented for the province as a whole. If taken as 100%, an average of 84% is presented*

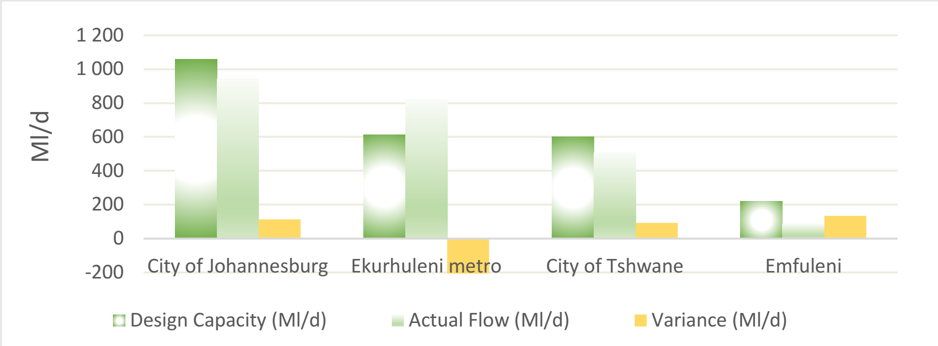


Figure 74 - WSA design capacity, actual flow, and variance in Ml/d for larger sized WWTWs

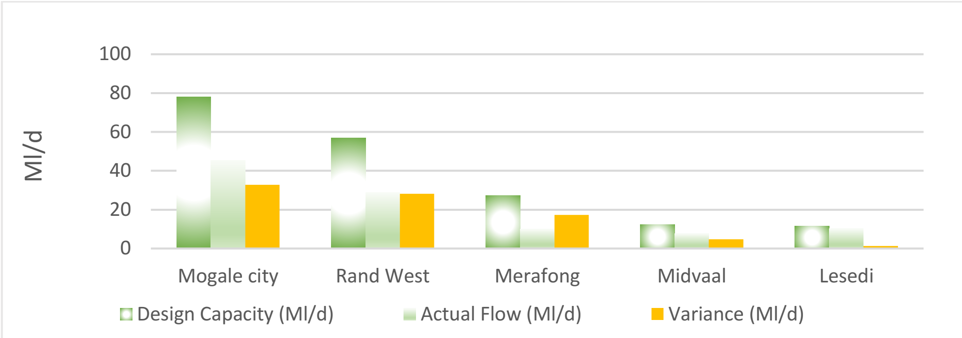


Figure 75 - WSA design capacity, actual flow, and variance in Ml/d for smaller sized WWTW

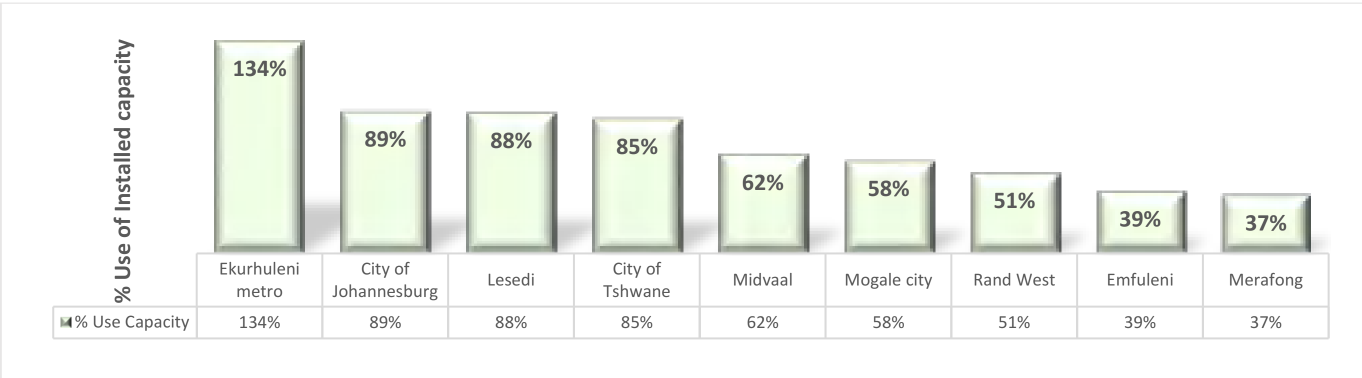


Figure 76 - WSA % use of installed design capacity

The audit data indicates that 13 systems are hydraulically overloaded. This figure could theoretically be higher, given that there are 5 systems where inflow monitoring is not taking place. The capacity limitations may impede social and economic development in the drainage areas, if not addressed. The hydraulically overloaded systems in each of the WSAs is as follows:

- City of Johannesburg - 2 of 6 systems (Bushkoppies and Ennerdale)
- City of Tshwane - 4 of 16 systems (Baviaanspoort, Rayton, Sunderland Ridge, and Rooiwal North)
- Lesedi - 1 of 3 systems (Heidelberg)
- City of Ekurhuleni - 6 of 17 systems (Ancor, Jan Smuts, Waterval, Vlakplaats, Herbert Bickley, and Olifantsfontein).

Water Use Authorisations mandate municipalities to install and monitor flow meters, whilst GD requires WSAs to report inflows on IRIS and to calibrate meters annually. The audit results indicate that 92% (55 of 60) of municipalities monitor their inflow. The majority of WSAs calibrate or verify their flow meters on an annual basis, which correspond with good practice standards.

Whilst the WSAs fare generally well in terms of monitoring inflow and outflows, i.e. hydraulic loads to the treatment works, few municipalities know their organic design capacity and do not monitor organic loading to the works. This presents a gap that would impede planning and system optimisation strategies.

Diagnostic 4: Wastewater Monitoring and Compliance

Aim: "*To measure is to know*" and "*To know is to manage*". The primary objective of a wastewater treatment plant is to produce final effluent and biosolids to a safe standard. This standard cannot be measured or achieved if operational and compliance monitoring is lacking. This diagnostic assesses the monitoring status and final effluent compliance against each WWTW's mandatory standards.

Findings: For operational monitoring, a satisfactory level of 90% is applied as the benchmark, to give weight to the importance of monitoring. For compliance monitoring, the audit evaluates the sampling point, sampling frequency, final effluent quality, biomonitoring, heavy metals, and any specific condition that the DWS may have included in the water use license. Final effluent quality compliance is calculated against the mandatory limits as listed under "Authorisation Status". A >90% compliance figure confirms high quality final effluent, whereas a <30% indicates poor effluent quality. The enforcement measures are summarised in the last column of Table 81 and includes NWA Notices and Directives issued, criminal cases opened, and court interdicts granted during the period 1 April 2019 to 30 June 2021.

Table 80 - Summary of the WSA operational and compliance monitoring status

WSA Name	# WWTW	Operational monitoring (KPA B2)		Compliance monitoring (KPA B3)	
		Satisfactory [GD score >90%]	Not Satisfactory [GD score <90%]	Satisfactory [GD score >90%]	Not Satisfactory [GD score <90%]
City of Johannesburg	6	0	6	6	0
City of Tshwane	16	9	7	0	16
Midvaal	4	3	1	4	0
Lesedi	3	2	1	2	1
Mogale City	3	2	1	0	3
City of Ekurhuleni	17	17	0	17	0
Merafong	6	0	6	0	6
Rand West	2	0	2	0	2
Emfuleni	3	0	3	0	3
GP Totals	**60**	**33 (55%)**	**27 (45%)**	**29 (48%)**	**31 (52%)**

The performance recorded in Table 80 stems from performance data as measured against the Green Drop Standard expressed in KPAs B2 and B3. The data indicates that only 33 of 60 plants (55%) are on par with good practice for operational monitoring of raw sewage and the respective treatment units responsible for the processing of effluent and sludge. The City of Ekurhuleni is doing exceptionally well followed closely by City of Tshwane, whilst Merafong, Rand West, Emfuleni and City of Johannesburg fail to meet the Green Drop standard.

Overall, an unsatisfactory sampling and analysis regime is observed for both operational (45%) and compliance (52%) monitoring. This is a concerning observation. Compliance monitoring is a legal requirement and the only means to measure performance of a treatment facility. Operational monitoring is the cornerstone of day-to-day process adjustments and optimisation to ensure treatment is efficient and delivers quality effluent/sludge that meets design expectations. Sludge monitoring is essential as poor sludge handling is the root cause of many WWTWs failing to meet final effluent standards. The results indicate that WSAs on average, are not achieving regulatory and industry standards.

Table 81 summarises the results of KPA E, which also carries the highest Green Drop score weighting. Note that all averages shown as '0%' under Effluent Compliance, include actual 0% compliance plus systems with no information or insufficient data.

Table 81 - Summary of authorisation status, effluent compliance status, and directives/notices issued

WSA Name	Effluent Compliance										Enforce-ment Measures*
	Authorisation Status	Microbiological Compliance (%)			Chemical Compliance (%)			Physical Compliance (%)			
		Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	
City of Jhbg	6 WULs	**58%**	1	2	**85%**	3	0	**93%**	5	0	1
City of Tshwane	7 WULs; 2 Exemptions; 3 GAs; 2 Permits; 2 None	**13%**	0	14	**57%**	0	3	**78%**	4	1	2
Midvaal	2 WULs; 1 GA; 1 None	**59%**	1	0	**64%**	1	1	**71%**	1	0	1
Lesedi	2 WULs; 1 None	**96%**	2	1	**90%**	1	1	**98%**	2	1	1

WSA Name	Effluent Compliance										Enforce-ment Measures*
	Authorisation Status	Microbiological Compliance (%)			Chemical Compliance (%)			Physical Compliance (%)			
		Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	
Mogale City	3 WULs	**0%**	0	3	**54%**	0	1	**74%**	0	0	1
City of Ekurhuleni	16 WULs; 1 GA	**82%**	9	1	**82%**	8	0	**92%**	12	0	3
Merafong	2 WULs; 1 None; 1 Exemption; 2 GAs	**0%**	0	6	**0%**	0	6	**0%**	0	6	3
Rand West	2 WULs	**0%**	0	2	**0%**	0	2	**0%**	0	2	0
Emfuleni	3 WULs	**0%**	0	3	**0%**	0	3	**0%**	0	3	1
GP Totals		**34%**	**13**	**32**	**48%**	**13**	**17**	**56%**	**24**	**13**	**13**

* The enforcement measures (notices or directives issued) are taken over a two-year financial period from July 2019 to June 2021

On average, Gauteng municipalities reached 34% for microbiological compliance monitoring, followed by 48% for chemical, and 56% for physical compliance monitoring. For the microbiological compliance category, 13 systems achieved >90% and 32 systems fell below 30%. For the chemical compliance category, 13 systems achieved >90% and 17 systems fell below 30%. For the physical compliance category, 24 systems achieved >90% and 13 systems fell below 30%.

A total of 13 Directives/Notices have been issued to 8 municipalities. Ekurhuleni and Merafong (3 no. each) and City of Tshwane (2 no.) have the highest number of enforcement measures initiated by the Regulator which require municipal leadership intervention and correction.

In terms of sludge compliance status, it is found that:

- 31 WWTWs (52%) classify their biosolids according to the WRC Sludge Guidelines, with the exception being Rand West, Merafong, Mogale City, Emfuleni and the bulk of the City of Tshwane systems (13 of 16)
- 39 WWTWs (65%) monitor sludge streams with the exception of Midvaal, City of Tshwane (7 of 16 systems), Rand West and Merafong
- 21 WWTWs (35%) have Sludge Management Plans in place, these being Johannesburg (In place but not compliant), Lesedi, Ekurhuleni and Mogale
- 8 WWTWs (13%) have sludge reuse projects in place, with a further 8 (13%) planning sludge reuse in future
- 27 WWTWs (45%) use sludge mostly for agricultural purposes but also land application, instant lawn, and for commercial products.

The data confirms that 80% of WWTWs in Gauteng have access to credible laboratories for compliance and operational analysis. These in-house or contracted laboratories have accredited and/or have Proficiency Testing Schemes with suitable analytical methods and quality assurance. Gauteng is meeting regulatory expectation that all municipalities have access to analytical services for compliance, operational and sludge monitoring.

Diagnostic 5: Energy Efficiency

Aim: The wastewater industry offers many opportunities to respond to climate change challenges by improving energy efficiency, reducing greenhouse gases, and generating energy. The energy cost of sophisticated treatment technologies are in the order of 25-40% of the O&M budget (cited WRC 2021). This diagnostic investigates the status of energy efficiency management at a provincial and municipal level with an aim to motivate for improved operational wastewater treatment efficiency.

Findings: The audit results indicate an overall low awareness of energy management in Gauteng. None of the municipalities conducted baseline energy audits or could report on electricity cost as R/kWh, (except Ekurhuleni). Limited energy efficiency initiatives are in place.

Benchmark 1: Estimated energy intensity for large WWTW is in order of 0.258-0.455 kWh/m³

- 0.177 kWh/m³ for trickling filter
- 0.272 kWh/m³ for activated sludge
- 0.314 kWh/m³ for advanced treatment
- 0.412 kWh/m³ for advanced treatment with nitrification

Benchmark 2: Energy requirements per plant size

Plant capacity, Ml/d	<0.5	2	10	25	100
Trickling filter, kWh/m³	0.43	0.44	0.23	0.18	0.16
Activated sludge, kWh/m³	0.59	0.59	0.37	0.32	0.29

Tariffs are typically (depends on time of day and season etc)

- Peak rate: 300.09 - 136.56 c/kWh
- Off-peak time: 48.41 - 35.28 c/kWh
  Standard time: 117.57 - 47.12 c/kWh

(EMASE 2021, Fang, 2012, NEWRI, 2016)

Table 82 - Summary of actual Specific Power Consumption versus industry benchmarks

WSIs	System Classification	WWTW	SPC (kWh/m³)		WSIs	System Classification	WWTW	SPC (kWh/m³)
Lesedi	Advanced	Ratanda	1.5		Mogale City	Advanced	Percy Stewart	1.16
Ekurhuleni	Advanced	Carl Grundlingh	1.11		Ekurhuleni	Advanced	Rondebult	0.61
Lesedi	Advanced	Heidelberg	0.84		Mogale City	Advanced	Percy Stewart	1.16
Ekurhuleni	Advanced	Jan Smuts	0.27		Ekurhuleni	Advanced	Dekema	0.3
Ekurhuleni	Advanced	Benoni	0.36		Mogale City	Advanced	Flip Human	1.67
Johannesburg	Advanced	Ennerdale	0.4		Ekurhuleni	Advanced	Vlakplaats	0.1
Ekurhuleni	Advanced	Rynfield	0.51		Johannesburg	Advanced	Driefontein	0.52
Ekurhuleni	Advanced	Ancor	0.10		Ekurhuleni	Advanced	Hartebeesfontein	1.02
Ekurhuleni	Advanced	JP Marais	0.76		Ekurhuleni	Advanced	Olifantsfontein	0.52
Ekurhuleni	Advanced	Herbert Bickley	0.39		Ekurhuleni	Advanced	Welgedacht	0.58
Ekurhuleni	Advanced	Daveyton	0.6		Johannesburg	Advanced	Goudkoppies	0.68
Ekurhuleni	Advanced	Tsakane	0.37		Johannesburg	Advanced	Olifantsvlei	0.53
Ekurhuleni	Advanced	Rondebult	0.61		Johannesburg	Advanced	Northern Works	0.36

In terms of energy management, the data depicts the following:

- None of the municipalities conducted energy audits in the past 24 months
- System SPCs are calculated by Johannesburg, Tshwane, Ekurhuleni, Lesedi and Mogale as part of good practice
- Ekurhuleni was the only WSA that could account for CO_2 equivalents associated with energy efficiency (for 2 of 17 systems).

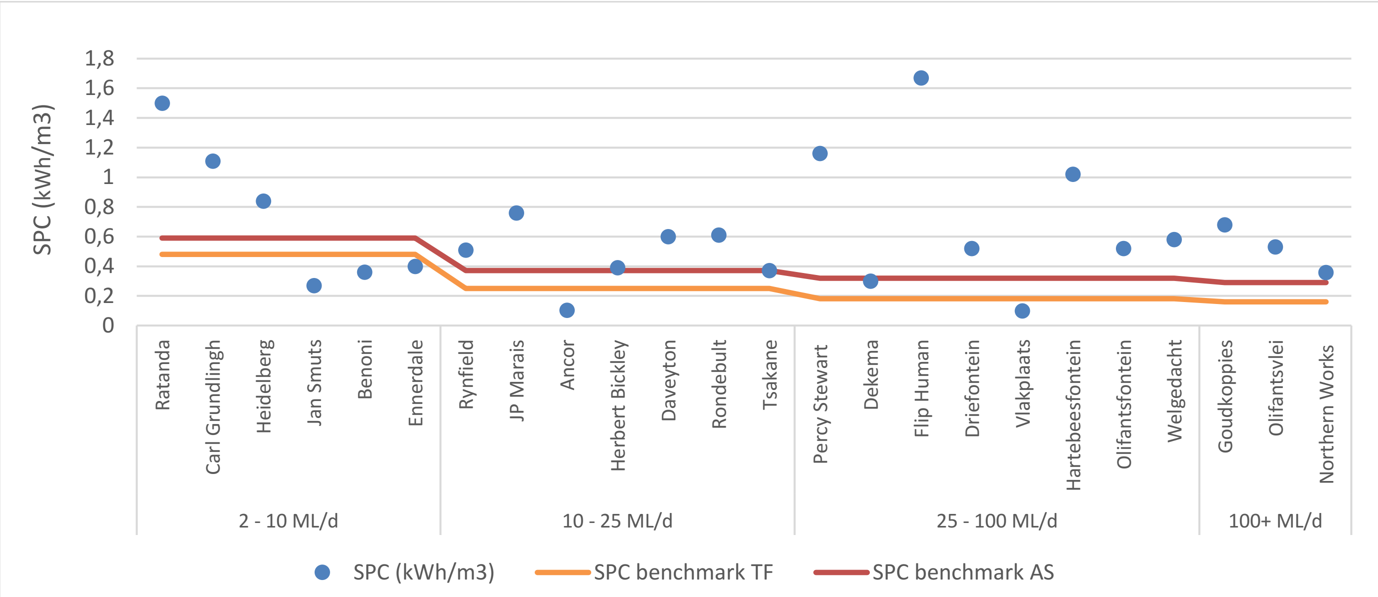


Figure 77 - Schematic illustrations of SPC as a function of plant size compared with a trickling filter (TF) and activated sludge (AS) benchmark

In terms of energy efficiency, the data shows:

- No specific relation is observed between SPC and plant design capacity, as can be seen from Figure 77
- For advanced systems, SPCs ranged from 0.1-1.67 kWh/m³, with an average SPC of 0.58 and median of 0.64 kWh/m³. These values are within the benchmark range of 0.27-0.41 for advanced systems, and indicate that energy efficiency optimisation initiatives may already be underway at some municipalities, whilst others still lack such interventions
- Ekurhuleni, Tshwane, and Mogale City demonstrated to have energy efficiency measures and/or plans in place
- Ekurhuleni had comprehensive knowledge of their energy tariffs (R/kWh) and energy cost (R/m³)
- The three smallest WWTWs had significantly higher SPCs when compared to the larger plants – Ratanda, Carl Grundling and Heidelberg.

The data indicates that some municipalities have established a specific report to monitor energy as part of their wastewater business. However, for the larger part of the WSAs, energy efficiency management have not been embedded in the Gauteng municipal sector, and potential cost savings and environmental gains are therefore forfeited.

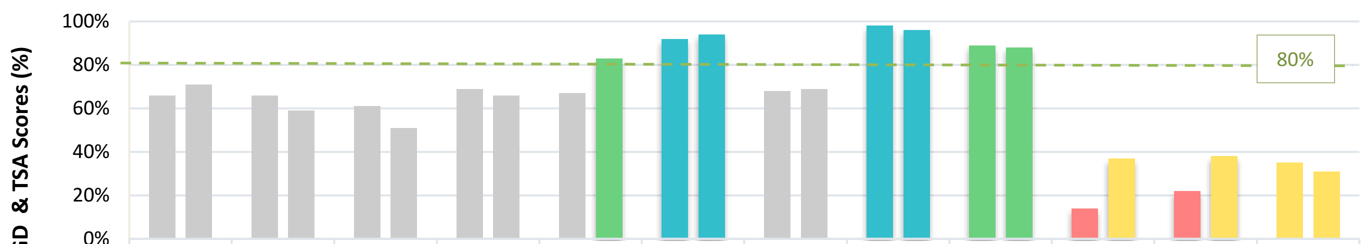
Diagnostic 6: Technical Site Assessments

Aim: The Green Drop process makes provision for the desktop audit to be followed by a Technical Site Assessment (TSA) in order to verify the desktop evidence. The assessment includes physical inspection of the sewer network, pump stations, and treatment facility, coupled with asset condition checks to determine an approximate cost to restore existing infrastructure to functional status (VROOM).

Findings: The results of the Gauteng TSAs are summarised in Table 83. A deviation of >10% between the GD and TSA score indicate a misalignment between the administrative aspects and the work on the ground. The Regulator regards a wastewater system with a TSA score of >80% as one that has an acceptable level of process control and functional equipment. A TSA score of 90% would represent an excellent plant that complies with most of the Green Drop TSA standards.

Table 83 - Summary of the WWTW Technical Site Assessments scores and hardware problems and %deviation between GD and TSA scores

WSA Name	TSA WWTW Name	WWTW GD Score (%)	%TSA	Key Hardware Problems	Difference between TSA and GD score
City of Johannesburg	Bushkoppies Goudkoppies	66% 66%	71% 59%	1. Primary & secondary settling tanks; 2. Aerators; 3. Belt; presses; 4. Boiler; 5. Gas holder	5% 7%
City of Tshwane	Zeekoegat Rooiwal East	61% 69%	51% 66%	1. Disinfection; 2. Belt presses; 3. Primary & secondary settling; 4. Sludge pumps 1. PSTs; 2. SSTs; 3. BNR reactor; 4. Disinfection	10% 3%
Midvaal	Oheni Muri	67%	83%	1. Chlorine disinfection; 2. SBR reactor; 3. Settling; 4. Screening disposal	16%
Lesedi	Ratanda	92%	94%	1. Drying bed drainage; 2. Chlorine safety shower water connection; 3. WAS pump started to move; 4. General grass cutting in less travelled area; 5. Section of handrail at bioreactor	2%
Mogale City	Percy Stewart	68%	69%	1. Primary settling tanks; 2. Biofilters; 3. BNR; 4. Disinfection; 5. Stolen electrical cables	1%
City of Ekurhuleni	JP Marais Welgedacht	98% 89%	96% 88%	1. Ad-hoc civil repairs can be made to reduce further corrosion to structures - plants are well maintained mechanical and electrical equipment; 2. Back-up power during power failure from main feed from the ESKOM grid – at critical units only	2% 1%
Merafong	Khutsong	14%	37%	1. Lack of any electrical equipment & cables resulted in this plant being non-functional since 2016; 2. Mechanical equipment needs refurbishment & replacement; 3. Civil works require some renovation at areas; 4. Repair cost estimated at 50% of the cost of a new plant	23%
Rand West	Hannes Van Niekerk	22%	38%	1. Screen; 2. Grit removal; 3. Disinfection; 4. Aerators; 5. Recycle pumps	15%
Emfuleni	Leeuwkuil	35%	31%	1. Vandalism and theft; 2. Electricity supply dysfunctional; 3. Mechanical upgrades required as most units have deteriorated due the non-functioning of the works; 4. Civil upgrades required - especially on the biofilters; 5. Mechanical, Civil & Electrical upgrades are required at all works	4%
GP Totals	**12**				**1% to 23%**



	CoJ (Bushkoppies)	CoJ (Goudkoppies)	CoT (Zeekoegat)	CoT (Rooiwal East)	Midvaal (Oheni Muri)	Lesedi (Ratanda)	Mogale (Percy Stewart)	Ekurhuleni (JP Marais)	Ekurhuleni (Welgedacht)	Merafong (Khutsong)	Rand West (Hannes v Niekerk)	Emfuleni
	66%	66%	61%	69%	67%	92%	68%	98%	89%	14%	22%	35%
	71%	59%	51%	66%	83%	94%	69%	96%	88%	37%	38%	31%

Figure 78 - Municipal GD (left bar) and System TSA score (right bar) comparison (colour legends as for GD)

A total of 12 site assessments were conducted, with 1 to 2 inspections per municipality. Three municipalities scored above 80% (4 WWTWs in total), which is considered to be a satisfactory site score. Merafong and Rand West receiving very poor TSA scores which indicate that these treatment facilities fail to meet operational, asset functionality, and workplace safety standards.

An acceptably low percentage difference between GD and TSA scores were observed for all WSIs, except for Merafong (23%), Midvaal (16%), and Rand West (15%). A low difference implies that the wastewater management aspects correlate with the condition of processes and infrastructure in the field. Some focal points include:

- The City of Ekurhuleni impressed with very high TSA scores of 88% and 96%, which is an almost an exact match to the GD scores of 89% and 98%
- Merafong and Rand West obtained 37% and 38% TSA scores, combined with large deviations from the GD score, 23% and 15% respectively, which does not reflect positively on the operation and functionality of the sewer network and treatment processes.

The VROOM cost presents a ''very rough order of measurement "cost to return a WWTWs functionality to its original design. For Gauteng, a total budget of R3.18 billion is estimated, with the bulk of the work going towards restoration of mechanical equipment (75%).

Table 84 - VROOM cost split for civil, mechanical, and electrical and total VROOM cost estimate

WSA Name	Civil cost estimate	Mechanical cost estimate	Electrical & C&I cost estimate	Total VROOM cost
City of Ekurhuleni	R0	R30,662,500	R0	R30,662,500
City of Tshwane	R2,520,000	R158,424,000	R7,056,000	R168,000,000
City of Johannesburg	R114,750,680	R1,768,743,240	R94,966,080	R1,978,460,000
Mogale City	R7,652,238	R9,215,019	R37,021,743	R53,889,000
Rand West	R39,407,520	R72,599,760	R20,232,720	R132,240,000
Lesedi	R508,875	R6,276,125	R0	R6,785,000
Midvaal	R4,340,000	R2,604,000	R0	R6,944,000
Merafong	R35,452,058	R66,069,745	R77,528,996	R179,050,800
Emfuleni	R105,425,580	R263,875,860	R254,518,560	R623,820,000
GP WSA Total	**R310,056,951**	**R2,378,470,249**	**R491,324,099**	**R3,179,851,300**
% Distribution	**10%**	**75%**	**15%**	**100%**

The key hardware problems are listed in Table 83, with predominant defects in electrical cables, primary and secondary sludge settling, disinfection, sludge pumps, sludge treatment, and power backup. Mechanical defects typically include dysfunctional aerators, sludge and effluent pumps, mixers, screens, degritters, and disinfection equipment. Vandalism and theft, long procurement lead times, lack of management involvement, lack of maintenance, and lack of budget are the main reasons for dysfunctional assets.

Diagnostic 7: Operation, Maintenance and Refurbishment of Assets

Aim: Insufficient financial resources are often cited as a root cause to dysfunctional or non-compliant wastewater systems. Knowledge and monitoring of fiscal spending are therefore a critical part of wastewater management. This diagnostic investigates the status of financial information as pertaining to O&M budgets and expenditure, asset figures, and capital funding.

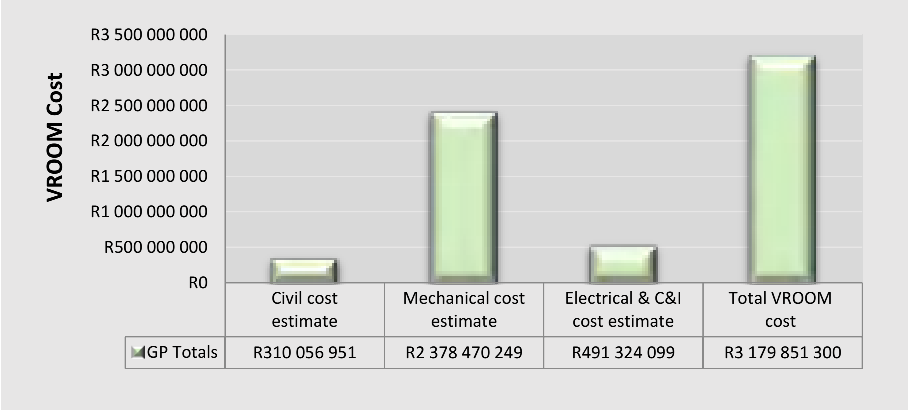
Findings: A substantial amount of financial information was presented during the audit process. Unfortunately, the evidence was presented in different formats, levels of detail, or absent for some municipalities. It was observed that municipal teams with financial officials that were present during the audits, typically performed better, and had a better understanding of the wastewater challenges experienced by their technical peers. Discrepancies observed included amongst others - generic or non-ringfenced budgets, contract lump sums for service providers presented as budgets, outdated or incomplete asset registers, and some cost drivers which were lacking (mostly electricity). The Regulator grouped data into different certainty levels, as summarised at the end of this Diagnostic.

It must be noted that there were limitations with the financial and asset information. Not all WSAs submitted current information or complete financial data sets.

The result of each financial portfolio is discussed hereunder.

Vroom Cost Analysis

The VROOM costs breakdown is discussed under the TSA Diagnostic but is further illustrated as follows.



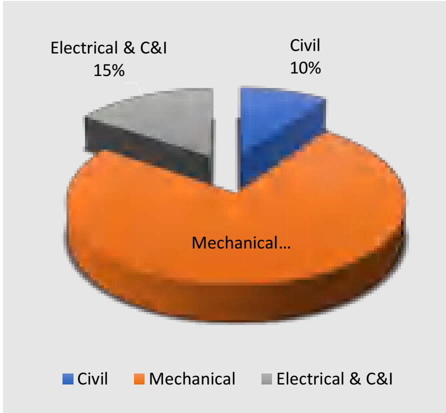


Figure 79 - Graphic illustration of the total cost estimated to restore functionality to existing assets (a), broken down to civil, mechanical, and electrical components

The total cost of R3.18 billion is estimated to restore existing treatment works to their design capacity and functionality - consisting of R2.38 billion for mechanical repairs, R491 million for electrical repairs, and R310 million for civil structures.

Table 85 indicates that a capital budget of R2.47 billion has been secured over MTREF period to address infrastructural needs. While it is likely that some of the VROOM requirements will be addressed through this budget, it is probable that additional funding will be required to address the full VROOM requirements. In addition to the R3.18 billion to restore the infrastructure, it is estimated that a total of R590 million will be required by all WSAs, on an annual basis, to maintain their assets. The maintenance estimate is based on the WATCOST-SALGA model that makes provision for maintenance at 2.14%, annually, of the asset value.

Capital, O&M Budget and Actual, and Asset Value

The capital budgets, O&M budgets, O&M actual expenditure, and current asset values are summarised below.

Table 85 - Summary of the capital budgets, O&M budgets, O&M actual expenditure, and current asset values

WSA Name	Capital budget available	O&M budget (2020/21)	O&M expended (2020/21)	% Expended	Total Current Asset Value
City of Ekurhuleni	R200,000,000	R487,682,210	R418,818,890	86%	R14,484,446,682
City of Tshwane	R220,600,000	R284,466,000	R257,584,000	91%	R1,320,405,000
City of Johannesburg	R206,587,000	R372,115,116	R483,342,266	130%	R10,973,823,320
Mogale City	R42,000,000	R40,758,527	R29,784,267	73%	R237,190,900
Rand West	R110,841,000	NI	NI	NI	NI
Lesedi	R117,500,000	R17,800,000	NI	NI	R298,454,360
Midvaal	R100,043,000	R9,639,000	R7,699,000	80%	NI
Merafong	R193,716,560	R5,951,960	R523,640	9%	R51,996,560
Emfuleni	R1,281,109,000	R30,702,000	R20,036,000	65%	R238,062,000
GP WSA Total	**R2,472,396,560**	**R1,249,094,813**	**R1,217,788,063**	**97%**	**R27,604,378,822**

The Green Drop process provides a bonus (incentive) in cases where a municipality provides evidence of capital projects with secured funding since this is deemed as a definitive means of addressing wastewater service inadequacies. This incentive encourages wastewater infrastructure investment. A total capital budget of R2.47 billion has been reported for the refurbishment and upgrades of wastewater infrastructure for all the municipalities over the MTREF period. The largest capital budgets are observed for City of Tshwane (R221m), City of Johannesburg (R207m), City of Ekurhuleni (R200m), and Merafong (R194m).

For the 2020/21 fiscal year, the total O&M budget reported for Gauteng was R1.25 billion, of which R1.22 billion (97%) has been expended. Over-expenditure of 30% by the City of Johannesburg and low expenditure by Merafong was observed. The provincial figures exclude Rand West and Lesedi, which did not have financial information.

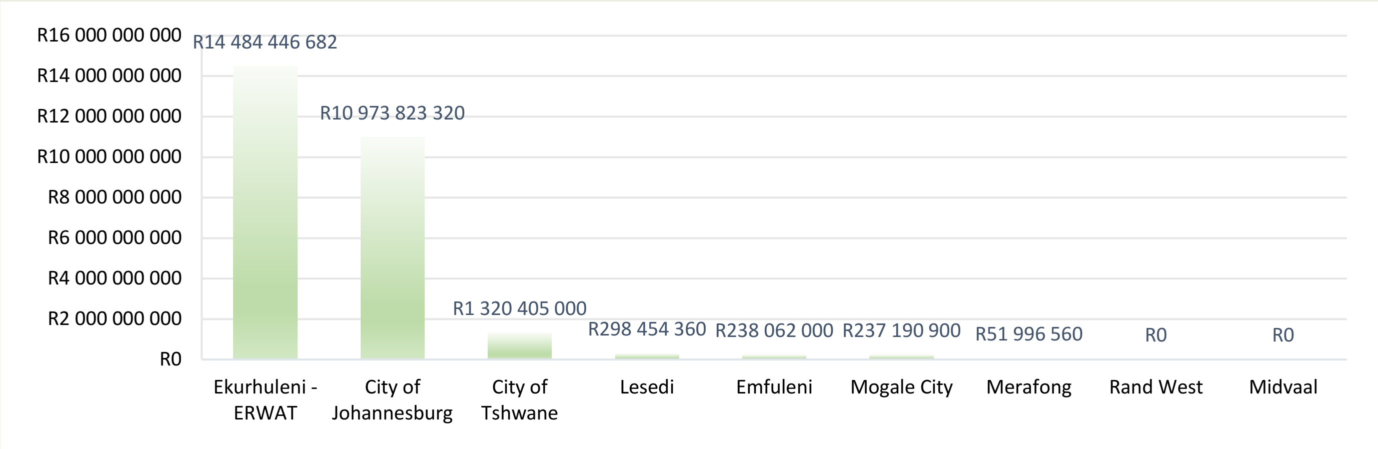


Figure 80 - Total current asset value reported by the municipalities

The total current asset value for wastewater infrastructure (networks, pump stations, treatment plants) is reportedly R27.6 billion (excluding Rand West and Midvaal with no information). The highest asset values are observed for Ekurhuleni (R14.4b), followed by City of Johannesburg (R10.9b) and City of Tshwane (R1.3b).

O&M Cost Benchmarking

By combining the SALGA and WRC WATCOST models, an estimation of the maintenance cost required per asset type can be done, i.e. civil, buildings, pipelines, mechanical, electrical, and instrumentation.

Table 86 - SALGA-WRC annual maintenance budget guideline and cost estimation

Description	% of Current Asset Value	Asset Value Estimate	Modified SALGA Maintenance Guideline	Annual Maintenance Budget Guideline
Current Asset Value estimate	**100%**	**R27,604,378,822**	**15.75%**	**R590,733,707**
Broken down into:				
1. Civil Structures	46%	R12,698,014,258	0.50%	R63,490,071
2, Buildings	3%	R828,131,365	1.50%	R12,421,970
3. Pipelines	6%	R1,656,262,729	0.75%	R12,421,970
4. Mechanical Equipment	35%	R9,661,532,588	4.00%	R386,461,304
5. Electrical Equipment	8%	R2,208,350,306	4.00%	R88,334,012
6. Instrumentation	2%	R552,087,576	5.00%	R27,604,379
Totals	**100%**	**R27,604,378,822**	**15.75%**	**R590,733,707**
			Minus 20% P&Gs and 10% Installation	**R177,220,112**
			Total	**R413,513,595**

The model estimate that R591 million (2.14%) is required per year to maintain the assets valued at R27.6 billion. Notably, this maintenance estimate assumes that all assets are functional. The VROOM cost represents the funding required return the assets to a fully functional state, from which basis routine maintenance could then focus on maintaining the assets.

Table 87 indicates the SALGA maintenance cost estimation in relation to the VROOM cost, O&M budget, and O&M actual expended.

Table 87 – O&M cost estimates by the SALGA and VROOM models versus actual budget and expenditure figures

Cost Reference	O&M Cost Estimate	Period
Modified SALGA	R590,733,707	Annually, estimation
O&M Budget	R1,249,094,813.00	Actual for 2020/21
O&M Spend	R1,217,788,063.00	Actual for 2020/21
VROOM	R3,179,851,300.00	Once off estimation

The cost dynamics can be summarised as follows:

- The SALGA estimations for maintenance budgets are <50% below the actual reported budgets for the 2020/21 fiscal year. This figure would be influenced by inaccurate asset values and where no asset values have been provided for
- The actual O&M budget seems adequate when compared with the SALGA guideline, suggesting a relook at how O&M funds are expended if considering the extent of infrastructure that is dysfunctional (not maintained)
- The VROOM cost represents an estimation of the refurbishment cost to restore WWTWs functionality and design capacity.

Production Cost and Comparison

It is good business practice to monitor and manage the production costs of wastewater treatment in Rand/m^3 treated, and to compare such cost with industry norms. Published benchmarks is not currently available for typical treatment costs, but significant cost increases are expected since 2013, given the variable input factors such as Covid, cost of chemicals, transport, and electricity. From an economic perspective, it would be valuable to compare production cost budgeted with actual production costs. However, due to scarce information, it is not possible to provide insight as to possible shortfalls from an economic perspective.

Based on the data sets, a trend can be established between the cost to treat wastewater and the operational flow. WWTWs with lower operational flow are mostly associated with higher production costs, e.g. Welverdiend, Babelegi, Ancor, Benoni. The cost reaches an almost even plateau between Godrich and Northern Works. This trend is in line with international finding that larger plants benefit from economies of scale and would show a lower production cost compared to its low-flow counterparts. The main cost drivers are staff (fixed cost), and energy and chemical costs, which are variable costs and which depend on the operational status of a plant.

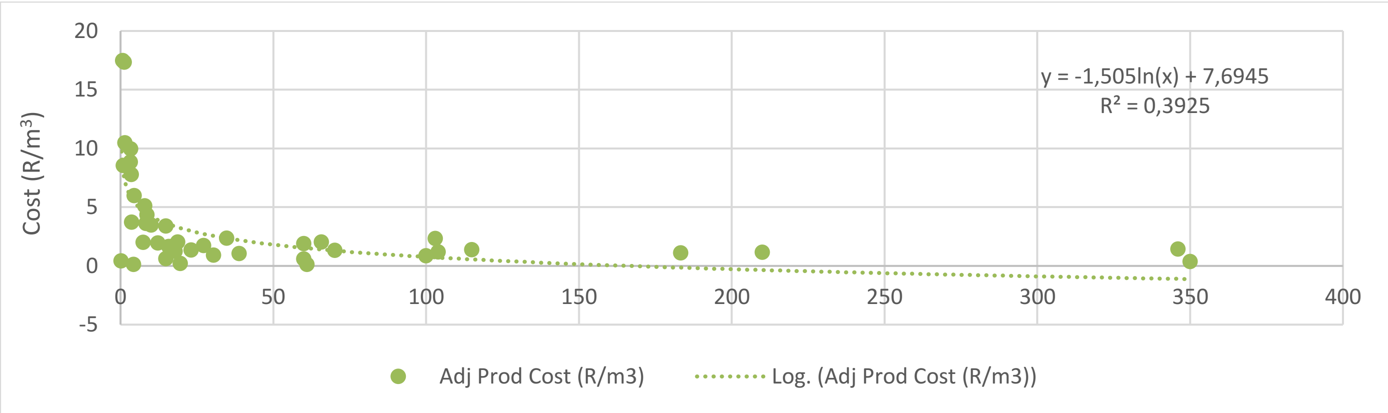


Figure 81 - Adjusted production cost (R/m³) for wastewater treatment, sorted by operational capacity (inflow) per WWTW

The following plot shows that the production cost for treatment of wastewater ranges from R0.14 to R17.48 per m^3. The average cost to treat 1 m^3 of wastewater is R3.47 and median cost is R1.82, with the latter giving the more representative estimate of production cost. A logarithmic trendline was fitted to the reported values with a correlation coefficient of 62.6%. Using this fit, 39.3% (R^2) of the variation in the costs to treat wastewater in the Gauteng depends on the operational flow.

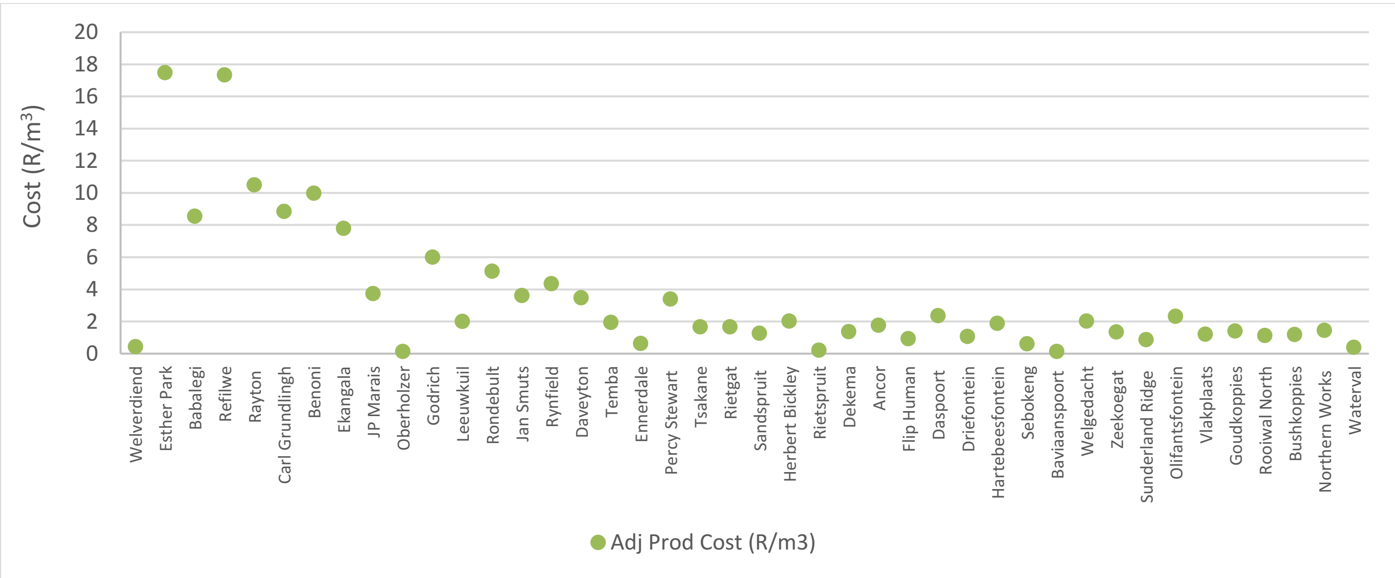


Figure 82 - Adjusted production cost (R/m³) for wastewater treatment, as a function of operational capacity (inflow)

The implication of these statistics combined with observations from the audits, is that a number of municipalities have verified, accurate production costs, which is recognised for its value in the context of economic value and benefit. Given the lack of data by some municipalities, it is imperative that Superintendents start to determine and monitor production (treatment) cost as a parameter within the fiscal reporting framework.

Data Certainty

Data certainty is expressed at different levels for the financial and asset figures reported within this Diagnostic. Certainty levels differ from system to system, hence some WSAs are included in multiple data certainty categories - as the data is variable, inconsistent, limited or non-existent (NI) for each of the systems. The various WSAs in the province that were identified under the category ''High Certainty", presented consistent and verifiable evidence in the form of budgets, expenditure, asset registers, and unit costs.

Table 88 - Levels of certainty associated with financial and asset information reported by municipalities

Data Certainty	Description	WSA
No certainty	Absent data or no certainty in data presented - not ringfenced for WWTW & Network	Rand West
Low certainty	Minor or little certainty in the data - partially ringfenced for WWTW only or data as extreme outliers	Midvaal, Lesedi, Merafong, Emfuleni, Johannesburg, Tshwane, Mogale City
Reasonable/good certainty	Reasonable to good level of certainty in the data - ringfenced for WWTW and/or Network and data falls within/close to expected parameters	Johannesburg, Tshwane, Mogale City
High certainty	High level of certainty in the data - ringfenced for WWTW and Network and data falls within expected parameters	Ekurhuleni

6.1 City of Ekurhuleni

Water Service Institution	**City of Ekurhuleni**
Water Service Provider	ERWAT (Ekurhuleni Water Care Company)

Municipal Green Drop Score	
2021 Green Drop Score	**86%↑**
2013 Green Drop Score	**84%**
2011 Green Drop Score	**79%**
2009 Green Drop Score	**65%**

VROOM Impression (towards restoring functionality):

1. Civil structure repairs
2. Corrosion to structures
3. Back-up power to critical units during power failure from main feed from the ESKOM grid
4. Plants overall well maintained mechanical and electrical equipment

VROOM Estimate:

- R30,662,500

Key Performance Area	**Unit**	**Hartebeesfontein**	**Esther Park**	**Rynfield**	**Benoni**
Green Drop Score (2021)		**90%->89%**	**95%**	**96%->89%**	**97%->89%**
2013 Green Drop Score		**90%**	**79%**	**73%**	**79%**
2011 Green Drop Score		**81%**	**67%**	**65%**	**64%**
2009 Green Drop Score		**55%**	**55%**	**55%**	**55%**
System Design Capacity	Ml/d	63	1.4	10	7.5
Design Capacity Utilisation (%)		95%	53%	87%	45%
Resource Discharged into		Rietspruit	Modder spruit	Penning Bird Estuary on Cloverspruit	Blesbok upper
Wastewater Risk Rating (CRR% of CRR_{max})		**Hartebeesfontein**	**Esther Park**	**Rynfield**	**Benoni**
CRR (2011)		66.7%	52.9%	59.1%	63.6%
CRR (2013)		48.2%	58.8%	59.1%	55.0%
CRR (2021)		56.3%	29.4%	36.4%	27.3%

Key Performance Area	**Unit**	**JP Marais**	**Daveyton**	**Welgedacht**	**Ancor**
Green Drop Score (2021)		**98%**	**99%**	**96%->89%**	**84%**
2013 Green Drop Score		**73%**	**79%**	**71%**	**73%**
2011 Green Drop Score		**67%**	**73%**	**71%**	**81%**
2009 Green Drop Score		**55%**	**79%**	**55%**	**55%**
System Design Capacity	Ml/d	15	19	95	15
Design Capacity Utilisation (%)		64%	53%	69%	181%
Resource Discharged into		Blesbokspruit	Blesbokspruit	Blesbokspruit	Blesbokspruit (Tributary)
Wastewater Risk Rating (CRR% of CRR_{max})		**JP Marais**	**Daveyton**	**Welgedacht**	**Ancor**
CRR (2011)		68.2%	63.6%	70.4%	74.1%
CRR (2013)		68.2%	45.5%	74.1%	66.7%
CRR (2021)		36.4%	31.8%	43.8%	72.7%

Key Performance Area	**Unit**	**Jan Smuts**	**Waterval**	**Vlakplaats**	**Rondebult**
Green Drop Score (2021)		**89%**	**80%**	**84%**	**95%**
2013 Green Drop Score		**70%**	**90%**	**83%**	**87%**
2011 Green Drop Score		**65%**	**84%**	**85%**	**80%**
2009 Green Drop Score		**55%**	**79%**	**79%**	**100%**
System Design Capacity	Ml/d	6	170	55	20
Design Capacity Utilisation (%)		140%	206%	189%	40%

Key Performance Area	Unit	Jan Smuts	Waterval	Vlakplaats	Rondebult
Resource Discharged into		Jans Smuts dam into Blesbokspruit	Klip River	Klip river - tributary of the Natalspruit	Elsburg spruit – into Natalspruit
Wastewater Risk Rating (CRR% of CRR_{max})		**Jan Smuts**	**Waterval**	**Vlakplaats**	**Rondebult**
CRR (2011)		68.2%	62.2%	81.3%	55.6%
CRR (2013)		72.7%	62.2%	68.8%	44.4%
CRR (2021)		59.1%	83.8%	81.3%	22.7%

Key Performance Area	Unit	Dekema	Herbert Bickley	Carl Grundlingh	Tsakane
Green Drop Score (2021)		**88%**	**94%**	**95%**	**91%->89%**
2013 Green Drop Score		**90%**	**74%**	**78%**	**71%**
2011 Green Drop Score		**90%**	**73%**	**79%**	**70%**
2009 Green Drop Score		**100%**	**55%**	**79%**	**55%**
System Design Capacity	Ml/d	31	15.1	5.25	20
Design Capacity Utilisation (%)		75%	124%	61%	79%
Resource Discharged into		Natalspruit, goes to Rietspruit	Blesbokspruit	Blesbokspruit	Tributary of Blesbokspruit
Wastewater Risk Rating (CRR% of CRR_{max})		**Dekema**	**Herbert Bickley**	**Carl Grundlingh**	**Tsakane**
CRR (2011)		44.4%	72.7%	63.6%	63.6%
CRR (2013)		37.0%	63.6%	45.5%	90.9%
CRR (2021)		55.6%	50.0%	31.8%	50.0%

Key Performance Areat	Unit	Olifantsfontein
Green Drop Score (2021)		**81%**
2013 Green Drop Score		**84%**
2011 Green Drop Score		**79%**
2009 Green Drop Score		**55%**
System Design Capacity	Ml/d	65
Design Capacity Utilisation (%)		158%
Resource Discharged into		Kaal spruit
Wastewater Risk Rating (CRR% of CRR_{max})		**Olifantsfontein**
CRR (2011)		51.4%
CRR (2013)		64.9%
CRR (2021)		84.4%

Technical Site Assessment: **JP Marais WWTW 96%; Welgedacht WWTW 88%**

6.2 City of Johannesburg Metropolitan Municipality

Water Service Institution	**City of Johannesburg**	
Water Service Provider	Johannesburg Water	
Municipal Green Drop Score		**VROOM Impression (towards restoring functionality):** 1. Primary & secondary settling tanks 2. Aerators 3. Belt presses 4. Boiler 5. Gas holder **VROOM Estimate:** - R1,978,460,000
2021 Green Drop Score	**73%↓**	
2013 Green Drop Score	**86%**	
2011 Green Drop Score	**91%**	
2009 Green Drop Score	**94%**	

Key Performance Area	Unit	Bushkoppies	Driefontein	Ennerdale	Goudkoppies
Green Drop Score (2021)		**67%**	**87%**	**64%**	**66%**
2013 Green Drop Score		**90%**	**93%**	**96%**	**94%**
2011 Green Drop Score		**82%**	**89%**	**91%**	**93%**
2009 Green Drop Score		**94%**	**94%**	**94%**	**94%**
System Design Capacity	Ml/d	200	55	8	150
Design Capacity Utilisation (%)		105%	71%	186%	77%
Resource Discharged into		Harrington Spruit	Crocodile River	Rietspruit	Harrington spruit Klipriver
Wastewater Risk Rating (CRR% of CRR_{max})		**Bushkoppies**	**Driefontein**	**Ennerdale**	**Goudkoppies**
CRR (2011)		59.5%	37.0%	31.8%	43.2%
CRR (2013)		45.2%	37.0%	31.8%	43.2%
CRR (2021)		64.9%	40.6%	59.1%	56.8%

Key Performance Area	Unit	Northern Works	Olifantsvlei
Green Drop Score (2021)		**77%**	**73%**
2013 Green Drop Score		**77%**	**94%**
2011 Green Drop Score		**92%**	**93%**
2009 Green Drop Score		**94%**	**92%**
System Design Capacity	Ml/d	405	240
Design Capacity Utilisation (%)		85%	91%
Resource Discharged into		Jukskei River	Klip River
Wastewater Risk Rating (CRR% of CRR_{max})		**Northern Works**	**Olifantsvlei**
CRR (2011)		46.8%	43.2%
CRR (2013)		63.8%	56.8%
CRR (2021)		55.3%	47.6%

***Technical Site Assessment*: Bushkoppies WWTW 71%; Goudkoppies WWTW 59%**

6.3 City of Tshwane Metropolitan Municipality

Water Service Institution	**City of Tshwane**	
Water Service Provider	City of Tshwane	
Municipal Green Drop Score		**VROOM Impression (towards restoring functionality):** (Zeekoegat) 1. Disinfection 2. Belt presses 3. Primary & secondary settling 4. Sludge pumps (Rooiwal) 1. PSTs 2. SSTs 3. BNR reactor 4. Disinfection **VROOM Estimate:** R168,000,000
2021 Green Drop Score	**60%↓**	
2013 Green Drop Score	**82%**	
2011 Green Drop Score	**64%**	
2009 Green Drop Score	**75%**	

Key Performance Area	Unit	Baviaanspoort	Godrich	Babalegi	Ekangala
Green Drop Score (2021)		**57%**	**61%**	**56%**	**55%**
2013 Green Drop Score		**82%**	**70%**	**75%**	**58%**
2011 Green Drop Score		**58%**	**31%**	**47%**	**24%**
2009 Green Drop Score		**63%**	**0%**	**66%**	**0%**
System Design Capacity	Ml/d	40	5	2.3	10
Design Capacity Utilisation (%)		153%	86%	41%	36%
Resource Discharged into		Pienaar's River	Bronkhorstspruit River	Apies River	Bronkhorstspruit River
Wastewater Risk Rating (CRR% of CRR_{max})		**Baviaanspoort**	**Godrich**	**Babalegi**	**Ekangala**
CRR (2011)		62.5%	77.3%	76.5%	82.4%
CRR (2013)		62.5%	64.7%	76.5%	76.5%
CRR (2021)		81.5%	50.0%	64.7%	59.1%

Key Performance Area	Unit	Klipgat	Daspoort	Rayton	Refilwe
Green Drop Score (2021)		**29%**	**58%**	**49%**	**53%**
2013 Green Drop Score		**82%**	**87%**	**74%**	**75%**
2011 Green Drop Score		**67%**	**69%**	**61%**	**74%**
2009 Green Drop Score		**68%**	**92%**	**44%**	**44%**
System Design Capacity	Ml/d	55	55	1.2	2.2
Design Capacity Utilisation (%)		NI	63%	120%	58%
Resource Discharged into		Sand River	Apies River	Elands River	Cullinan Mine Slurry Dam
Wastewater Risk Rating (CRR% of CRR_{max})		**Klipgat**	**Daspoort**	**Rayton**	**Refilwe**
CRR (2011)	%	56.3%	59.4%	76.5%	82.4%
CRR (2013)	%	53.0%	50.0%	58.8%	82.4%
CRR (2021)	%	96.9%	59.4%	70.6%	52.9%

Key Performance Area	Unit	Rietgat	Sandspruit	Summer Place	Sunderland Ridge
Green Drop Score (2021)		**63%**	**54%**	**57%**	**66%**
2013 Green Drop Score		**83%**	**76%**	**67%**	**80%**
2011 Green Drop Score		**63%**	**53%**	**0%**	**71%**
2009 Green Drop Score		**89%**	**68%**	**0%**	**68%**
System Design Capacity	Ml/d	27	20	0.3	95
Design Capacity Utilisation (%)		62%	90%	63%	105%
Resource Discharged into		Soutpans Rivier	Sandspruit River	Bronkhorstspruit River	Hennops River
Wastewater Risk Rating (CRR % of CRR_{max})		**Rietgat**	**Sandspruit**	**Summer Place**	**Sunderland Ridge**
CRR (2011)		59.3%	60.0%	94.0%	75.0%
CRR (2013)		56.0%	64.0%	77.0%	72.0%
CRR (2021)		51.9%	50.0%	47.1%	65.6%

Key Performance Area	Unit	Temba	Zeekoegat	Rooiwal East	Rooiwal North
Green Drop Score (2021)		**64%**	**61%**	**69%**	**67%**
2013 Green Drop Score		**86%**	**85%**	**78%**	**82%**
2011 Green Drop Score		**60%**	**76%**	**61%**	**61%**
2009 Green Drop Score		**68%**	**92%**	**73%**	**73%**
System Design Capacity	Ml/d	12.5	70	54.5	150
Design Capacity Utilisation (%)		98%	100%	50%	104%
Resource Discharged into		Apies River	Roodeplaat Dam	Apies River	Apies River
Wastewater Risk Rating (CRR% of CRR_{max})		**Temba**	**Zeekoegat**	**Rooiwal East**	**Rooiwal North**
CRR (2011)		54.5%	78.0%	63.0%	59.0%
CRR (2013)		54.5%	63.0%	63.0%	76.0%
CRR (2021)		45.5%	56.3%	50.0%	73.0%

Technical Site Assessment: **Zeekoegat WWTW 51%**

6.4 Emfuleni Local Municipality

Water Service Institution	**Emfuleni Local Municipality**	
Water Service Provider	Rand Water (2022 – after audit period)	

Municipal Green Drop Score		VROOM Impression (Towards restoring functionality):
2021 Green Drop Score	**37%↓**	1. Vandalism and theft – June 2021 2. Electricity supply dysfunctional 3. Mechanical upgrades required as most units have deteriorated due the non-functioning of the works 4. Civil upgrades required - especially on the biofilters 5. Mechanical, Civil & Electrical upgrades are required at all works.
2013 Green Drop Score	**81%**	
2011 Green Drop Score	**67%**	**VROOM Estimate:**
2009 Green Drop Score	**0%**	➢ R623,820,000

Key Performance Area	Unit	Leeuwkuil	Rietspruit	Sebokeng
Green Drop Score (2021)		**35%**	**42%**	**36%**
2013 Green Drop Score		**86%**	**78%**	**80%**
2011 Green Drop Score		**73%**	**61%**	**67%**
2009 Green Drop Score		**0%**	**0%**	**0%**
System Design Capacity	Ml/d	36	36	150
Design Capacity Utilisation (%)		21%	54%	40%
Resource Discharged into		Vaal River	Rietspruit River	Rietspruit River
Wastewater Risk Rating (CRR% of CRR_{max})		**Leeuwkuil**	**Rietspruit**	**Sebokeng**
CRR (2011)	%	51.9%	48.1%	56.3%
CRR (2013)	%	48.2%	48.2%	56.3%
CRR (2021)	%	59.30%	70.4%	54.1%

Technical Site Assessment: **Leeuwkuil WWTW 31%**

6.5 Lesedi Local Municipality

Water Service Institution	**Lesedi Local Municipality**
Water Service Provider	Lesedi LM and ERWAT (Heidelberg and Ratanda)

Municipal Green Drop Score	
2021 Green Drop Score	**79%↑**
2013 Green Drop Score	**78%**
2011 Green Drop Score	**67%**
2009 Green Drop Score	**55%**

VROOM Impression (towards restoring functionality):

1. Drying bed drainage
2. Chlorine safety shower water connection
3. WAS pump started to move
4. General grass cutting in less travelled area
5. Section of handrail at bioreactor

VROOM Estimate:

- R6,785,000

Key Performance Area	**Unit**	**Devon**	**Heidelberg**	**Ratanda**
Green Drop Score (2021)		**25%**	**81%**	**92%**
2013 Green Drop Score		**NA**	**84%**	**72%**
2011 Green Drop Score		**NA**	**68%**	**67%**
2009 Green Drop Score		**NA**	**NA**	**55%**
System Design Capacity	Ml/d	1.4	5.4	4.7
Design capacity utilisation (%)		**NA**	131%	67%
Resource Discharged into		Blesbokspruit	Blesbokspruit	Blesbokspruit
Wastewater Risk Rating (CRR% of CRR_{max})		**Devon**	**Heidelberg**	**Ratanda**
CRR (2011)		**NA**	68.2%	41.2%
CRR (2013)		**NA**	54.6%	47.1%
CRR (2021)		100.0%	54.5%	23.5%

Technical Site Assessment: **Ratanda WWTW 94%**

6.6 Merafong Local Municipality

Water Service Institution	**Merafong City Local Municipality**
Water Service Provider	Merafong City Local Municipality

Municipal Green Drop Score		VROOM Impression (towards restoring functionality):
2021 Green Drop Score	21%↓	1. Lack of any electrical equipment and cables resulted in this plant being non-functional since 2016 2. Mechanical equipment needs refurbishment and replacement 3. Civil works require some renovation at areas 4. Repair cost estimated at 50% of the cost of a new plant
2013 Green Drop Score	54%	
2011 Green Drop Score	78%	**VROOM Estimate:**
2009 Green Drop Score	44%	- R179,050,800

Key Performance Area	Unit	Welverdiend	Khutsong	Oberholzer	Kokosi
Green Drop Score (2021)		**22%**	**14%**	**32%**	**22%**
2009 Green Drop Score		**36%**	**55%**	**45%**	**43%**
2011 Green Drop Score		**69%**	**79%**	**80%**	**77%**
2013 Green Drop Score		**41%**	**61%**	**55%**	**54%**
System Design Capacity	Ml/d	1.256	7.5	8.3	7.5
Design Capacity Utilisation (%)		13%	72%	52%	NI
Resource Discharged into		Wonderfontein Spruit	Wonderfontein Spruit	Wonderfontein Spruit	Loopspruit
Wastewater Risk Rating (CRR% of CRR_{max})		**Welverdiend**	**Khutsong**	**Oberholzer**	**Kokosi**
CRR (2011)		52.9%	45.5%	50.0%	54.5%
CRR (2013)		52.9%	54.6%	59.1%	68.2%
CRR (2021)		70.6%	68.2%	68.2%	90.9%

Key Performance Area	Unit	Wedela	Murray & Roberts
Green Drop Score (2021)		**8%**	**0%**
2009 Green Drop Score		**36%**	**NA**
2011 Green Drop Score		**71%**	**NA**
2013 Green Drop Score		**39%**	**NA**
System Design Capacity	Ml/d	2.6	0.18
Capacity Utilisation (%)		0%	50%
Resource Discharged into		Leeu spruit and then Loop Spruit	Eerste rivier
Wastewater Risk Rating (CRR% of CRR_{max})		**Wedela**	**Murray & Roberts**
CRR (2011)		70.6%	NA
CRR (2013)		52.9%	NA
CRR (2021)		94.1%	70.6%

Technical Site Assessment: **Khutsong WWTW 37%**

6.7 Midvaal Local Municipality

Water Service Institution	**Midvaal Local Municipality**	
Water Service Provider	Khanya Engineered Projects (Vaal Marina)	
Municipal Green Drop Score		**VROOM Impression (towards restoring functionality):** 1. Chlorine disinfection 2. SBR reactor 3. Settling 4. Screening disposal **VROOM Estimate:** - R6,944,000
2021 Green Drop Score	**69%↑**	
2013 Green Drop Score	**53%**	
2011 Green Drop Score	**54%**	
2009 Green Drop Score	**15%**	

Key Performance Area	**Unit**	**Bantu Bonke**	**Meyerton**	**Oheni Muri**	**Vaal Marina**
Green Drop Score (2021)		**70%**	**71%**	**67%**	**57%**
2013 Green Drop Score		**NA**	**54%**	**58%**	**47%**
2011 Green Drop Score		**NA**	**57%**	**39%**	**39%**
2009 Green Drop Score		**NA**	**16%**	**14%**	**14%**
System Design Capacity	Ml/d	0.1	10	0.3	2
Design Capacity Utilisation (%)		78%	73%	19%	15%
Resource Discharged into		Unknown stream to Klip River	Fourie Spruit to Klip River	Oheni Muri Spruit	Vaal Dam
Wastewater Risk Rating (CRR% of CRR_{max})		**Bantu Bonke**	**Meyerton**	**Oheni Muri**	**Vaal Marina**
CRR (2011)		NI	72.7%	70.6%	64.7%
CRR (2013)		NI	68.2%	64.7%	47.1%
CRR (2021)		35.3%	59.1%	52.9%	64.7%

Technical Site Assessment: **Oheni Muri WWTW 83%**

6.8 Mogale City Local Municipality

Water Service Institution	**Mogale City Local Municipality**	
Water Service Provider	Mogale City Local Municipality	
Municipal Green Drop Score		**VROOM Impression (towards restoring functionality):** 1. Primary settling tanks 2. Biofilters 3. BNR 4. Disinfection 5. Stolen electrical cables **VROOM Estimate:** - R53,889,000
2021 Green Drop Score	**65%↓**	
2013 Green Drop Score	**75%**	
2011 Green Drop Score	**67%**	
2009 Green Drop Score	**36%**	

Key Performance Area	**Unit**	**Flip Human**	**Percy Stewart**	**Magalies**
Green Drop Score (2021)		**64%**	**68%**	**49%**
2013 Green Drop Score		**76%**	**74%**	**72%**
2011 Green Drop Score		**69%**	**62%**	**38%**
2009 Green Drop Score		**36%**	**36%**	**36%**
System Design Capacity	Ml/d	50	27	1.1
Design Capacity Utilisation (%)		61%	55%	NI
Resource Discharged into		Wonderfontein Spruit	Irrigation + discharge to Blaauwbank spruit	Magalies River
Wastewater Risk Rating (CRR% of CRR_{max})		**Flip Human**	**Percy Stewart**	**Magalies**
CRR (2011)		63.0%	63.0%	63.0%
CRR (2013)		59.2%	67.0%	67.0%
CRR (2021)		59.3%	59.3%	70.6%

Technical Site Assessment: **Percy Stewart WWTW 69%**

6.9 Rand West Local Municipality

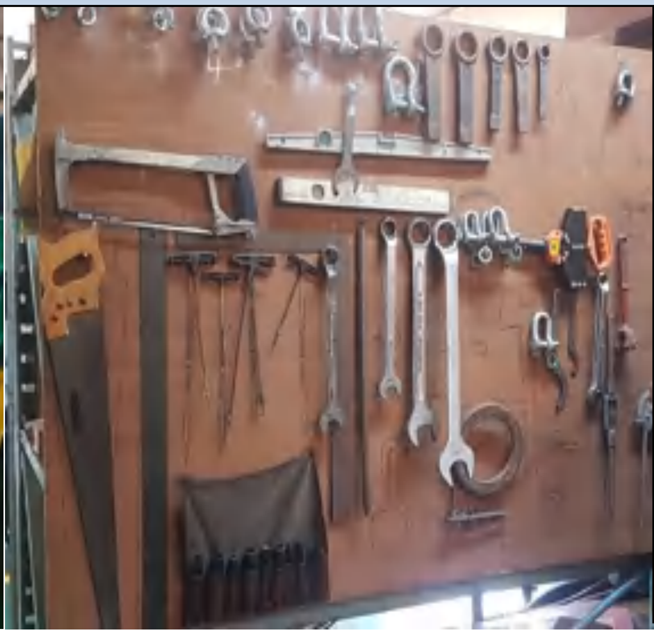
Water Service Institution	**Rand West Local Municipality**		
Water Service Provider	Rand Water Board		
Municipal Green Drop Score			**VROOM Impression (towards restoring functionality):** 1. Screen 2. Grit removal 3. Disinfection 4. Aerators 5. Recycle pumps **VROOM Estimate:** - R132,240,000
2021 Green Drop Score	**24%↓**		
2013 Green Drop Score	**40% (HvN)**	**67% (Rft)**	
2011 Green Drop Score	**57%**	**80.4%**	
2009 Green Drop Score	**30%**	**66%**	

Key Performance Area	**Unit**	**Randfontein**	**Hannes Van Niekerk**
Green Drop Score (2021)		**26%**	**22%**
2013 Green Drop Score		**67%**	**40%**
2011 Green Drop Score		**80%**	**57%**
2009 Green Drop Score		**66%**	**30%**
System Design Capacity	Ml/d	20	37
Capacity Utilisation (%)		79%	35%
Resource Discharged into		Elandsvleispruit (via Blaaubankspruit)	Wonderfontein spruit
Wastewater Risk Rating (CRR% of CRR_{max})		**Randfontein**	**Hannes Van Niekerk**
CRR (2011)		54.5%	37.0%
CRR (2013)		68.2%	51.9%
CRR (2021)		81.8%	66.7%

Technical Site Assessment: **Hannes Van Niekerk WWTW 38%**

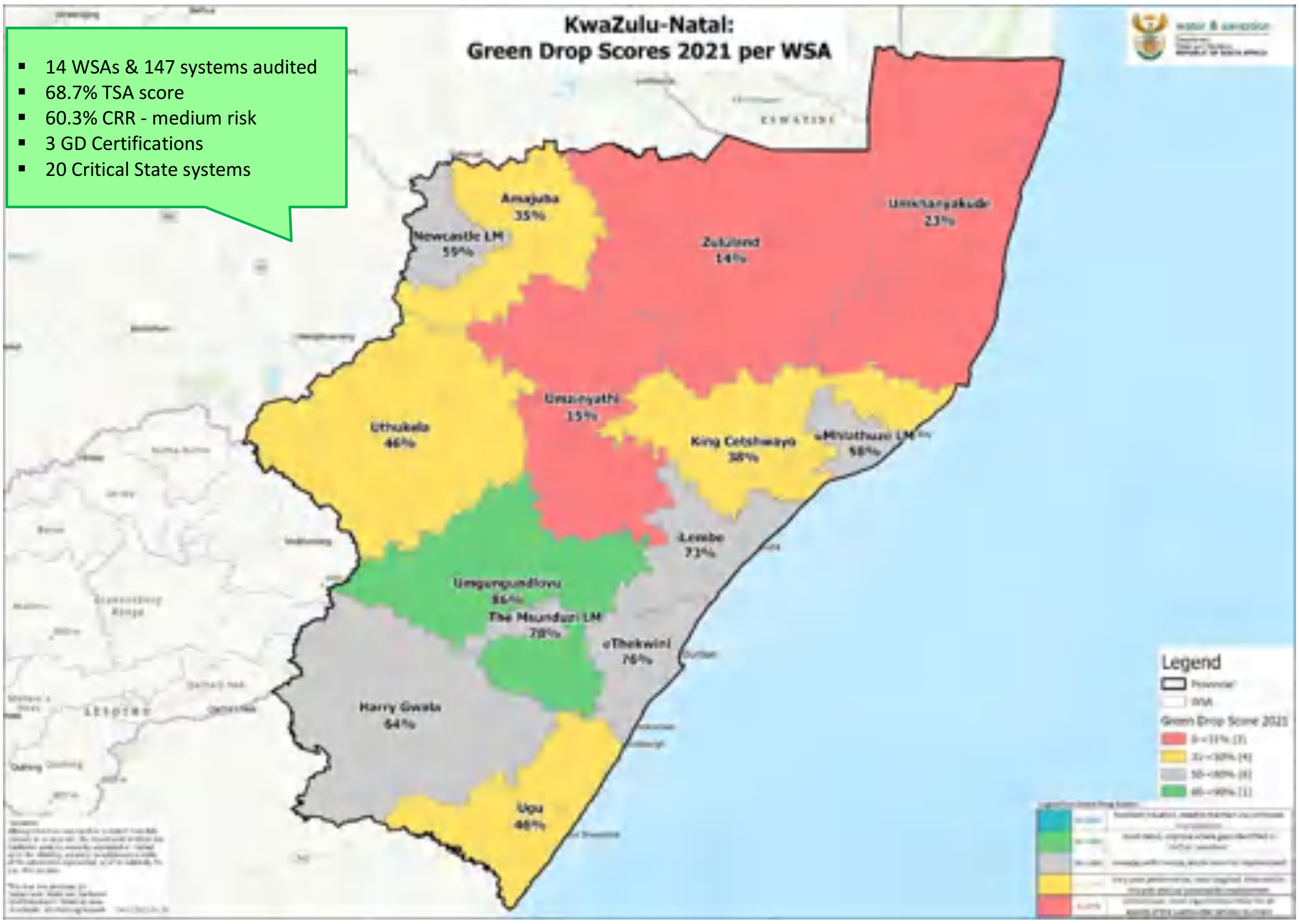
Erwat team at Lesedi's Ratanda WWTW – very well versed in their plants operation and the Green Drop requirements, thereby ensuring a pleasant, productive audit process with good evidence.

Technical Site Inspection score of 96%. No words required. This final effluent captures the excellent operations which is a characteristic of the JP Marais WWTW. This final settling tank will not look out of sorts at any potable water treatment plant, showing excellent final water quality, level weirs, clean surface and a working walkway.



Left: Excellent maintenance workshop at Bushkoppies WWTW with engineering equipment (compressor, grinder, lathes, etc), detailed inventory of spares, supply of oil and greases, vehicles, and TLBs. Good skills and equipment to strip and repair critical equipment.

7. KWAZULU NATAL PROVINCE: MUNICIPAL WASTEWATER MANAGEMENT PERFORMANCE



Provincial Synopsis

An audit attendance record of 100% affirms the WSAs commitment to the Green Drop national incentive-based regulatory programme.

The Regulator determined that 3 wastewater system scored a minimum of 90% when measured against the Green Drop standards for the audited period and thus qualified for the prestigious Green Drop Certification. In 2013, 19 systems were awarded Green Drop Status. The audit has nonetheless established an accurate, current baseline from where improvement can be driven, and excellence be incentivised.

Three (3) of the 14 WSAs improved on their 2013 scores, namely uMgungundlovu, King Cetshwayo, and uThukela. The remaining 11 WSAs regressed to lower Green Drop scores compared to 2013 baselines. uMgungundlovu is the best performing municipality, achieving a municipal Green Drop score of 86%, with 1 Green Drop Certification out of its 6 wastewater systems, supported by an 86% site assessment score. Msunduzi achieved the 2nd highest municipal Green Drop score with 78%, supported by 87% for the Lynnfield Park WWTW. eThekwini was the next best performing WSA, in 3rd place with 76% Green Drop score, and TSA scores of 91% and 67%. iLembe and its Water Services Provider Siza Water, achieved Green Drop Certification for 2 systems, and Harry Gwala has 1 system as a Contender for Green Drop Certification. uThukela impressed with achieving the best overall progress from 27% in 2013 to a municipal score of 46% in 2021. Unfortunately, twenty (20) systems were identified to be in a critical state, compared to 32 systems in 2013. The majority of these systems are managed by uMkhanyakude, uMzinyathi, and Zululand.

The province's overall Green Drop performance is characterised by particular strengths in technical capacity and capability at many municipalities, access to credible laboratories, and risk management practices that are well embedded in the wastewater business. The predominant KPAs that require attention include effluent quality compliance (and monitoring) and technical management.

The provincial Risk Ratio for treatment plants regressed from 55.1% in 2013 to 60.3% in 2021, which suggests some risk movement since 2013. The most prominent risks were observed on treatment level, and pointed to works that exceeded their design capacity, dysfunctional processes and equipment (especially disinfection), and effluent and sludge non-compliance. Opportunities are presented in terms of reducing cost through process optimisation, improved energy efficiency and beneficial use of sludge, nutrients, biogas, and other energy resources.

The Regulator is hopeful that the 2021 audits will set a baseline from where a positive trajectory for wastewater services and improved performance will follow. Municipalities are encouraged to start their preparation for the 2023 Green Drop audit. The 2021 Green Drop status for WSAs in the KwaZulu Natal Province are summarised in Table 89.

Table 89 - 2021 Green Drop Summary

WSA Name	2013 GD Score (%)	2021 GD Score (%)	2021 GD Certified ≥90%	2021 GD Contenders (89%)	2021 Critical State (<31%)
uMgungundlovu DM	76	86↑	Cool Air		
Msunduzi LM	79	78↓			
eThekwini Metro	90	76↓			
iLembe DM	83	73↓	Frasers, Shakaskraal		
Harry Gwala DM	67	64↓		Ixopo	
Newcastle LM	78	59↓			
uMhlathuze LM	85	58↓			
Ugu DM	74	46↓			
uThukela DM	27	46↑			
King Cetshwayo DM	26	38↑			
Amajuba DM	60	35↓			Durnacol
uMkhanyakude DM	30	23↓			St Lucia, Bethesda-Ubombo, Hluhluwe, Ingwavuma-Mosvold, Mtubatuba, Hlabisa Hospital, Mseleni Hospital
uMzinyathi DM	69	15↓			Dundee, Nqutu Ponds, Pomeroy, Tugela Ferry, Greytown
Zululand DM	23	14↓			Vryheid-Klipfontein, Coronation, Cliffdale-Vrede, Mlokothwa, Nkongolwane, Enyathi, Hlobane
Totals	**-**	**-**	**3**	**1**	**20**

The Department of Water and Sanitation acknowledges the excellence in wastewater management achieved for the Green Drop Audit year of 2021.

Three (3) Green Drop Certificates are awarded in the Province to 1 system in uMgungundlovu DM and 2 systems in the iLembe DM:

Province	2021 Green Drop Certified Systems	Acknowledgement of 2021 Contender Systems for Green Drop Certification
KwaZulu Natal	♦ **iLembe DM** ○ Frasers ○ Shakaskraal ♦ **uMgungundlovu DM** ○ Cool Air	✓ **Harry Gwala DM** ○ Ixopo

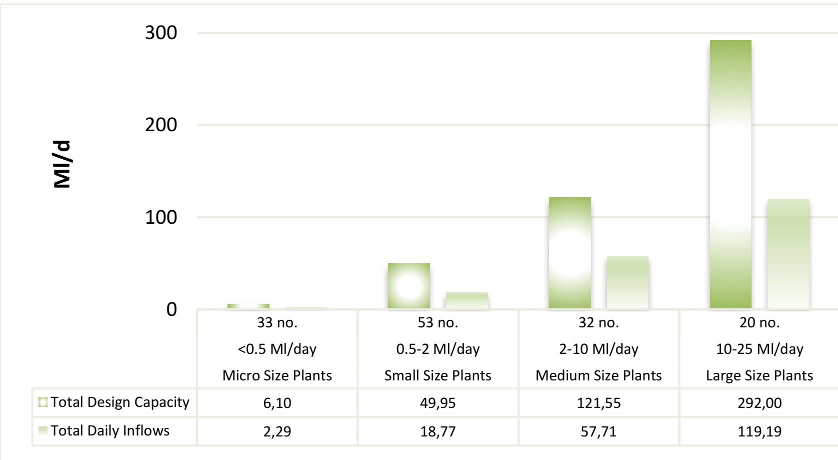
Background to KwaZulu Natal Wastewater Infrastructure

There are 14 WSAs, delivering wastewater services through a sewer network comprising of 147 WWTWs, 578 network pump stations and 12,690 km outfall and main sewer pipelines. The sewer network excludes pipeline data from 7 municipalities that were unable to provide the information. There is a total installed treatment capacity of 1,121 Ml/d, with most of this capacity (67%) residing in 7 macro-sized treatment plants.

Table 90 - Summary of WWTW capacity and flow distribution according to plant sizes

	Micro Size Plants	Small Size Plants	Medium Size Plants	Large Size Plants	Macro Size Plants	Unknown (NI)*	Total
	<0.5 Ml/day	0.5-2 Ml/day	2-10 Ml/day	10-25 Ml/day	>25 Ml/day		
No. of WWTW	33 (22%)	53 (36%)	32 (22%)	20 (14%)	7 (5%)	2 (1%)	147
Total Design Capacity (Ml/day)	6.10	49.95	121.55	292.00	652.00	2	1,121.6
Total Daily Inflow (Ml/day)	2.29	18.77	57.71	119.19	436.23	47	634.2
Use of Design Capacity (%)	38%	38%	47%	41%	67%	-	57%

** "Unknown" means the number of WWTWs with NI (No Information) on design capacity or daily inflow*



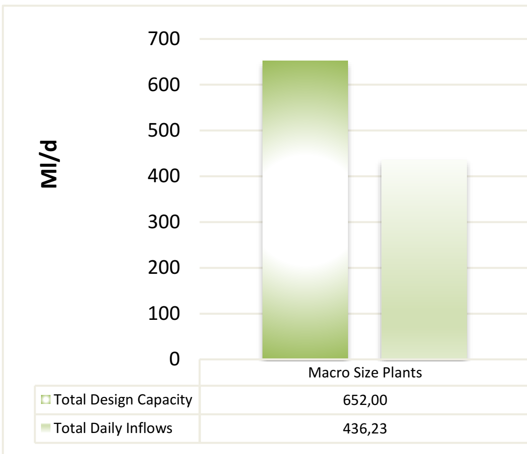


Figure 83 - Design capacities and operational inflow to micro to large sized WWTWs (a) and macro sized WWTWs

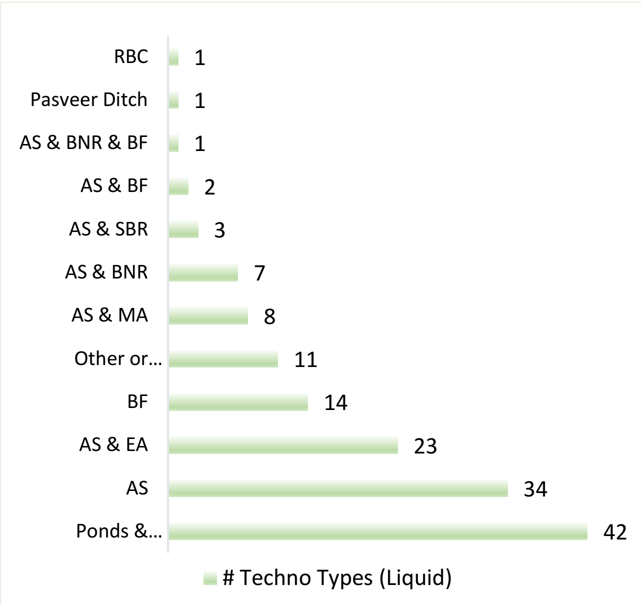
Based on the current operational flow of 634 Ml/d, the treatment facilities are operating at 57% of their design capacity. The two largest flow contributors are eThekwini with 427 Ml/d, and Msunduzi 74 Ml/d. Given the current capacity, this implies that there is 43% spare capacity to meet the medium term demand. It must however be noted that inflow is not monitored in 47 systems and as a result the spare capacity could be substantially less than the 43%.

Diagnostic #3 unpacks these statistics in more detail. This spare capacity would also be compromised at systems where some of the infrastructure or treatment modules are non-operational or dysfunctional. The VROOM Cost Diagnostic #7 provides more detail on the refurbishment requirements to restore such capacity and functionality.

The audit data shows that 7 systems are hydraulically overloaded. This figure could theoretically be higher, given that there are 47 systems where inflow monitoring is not taking place. The hydraulically overloaded systems in each of the WSAs is as follows:

- Harry Gwala: 2 of 12 systems (Kokstad and Franklin)
- uMzinyathi: 1 of 5 systems (Greytown)
- eThekwini: 2 of 27 systems (Glenwood Road and Craigieburn)
- Zululand: 1 of 18 systems (James Nxumalo)
- King Cetshwayo: 1 of 13 systems (Oceanview).

The predominant treatment technologies employed at KZN WWTWs comprise of ponds & lagoons, activated sludge (variations thereof) for effluent treatment and solar drying beds for sludge treatment. The next audit will need to verify sludge treatment technologies, as insufficient information ("Other") is observed in this area.



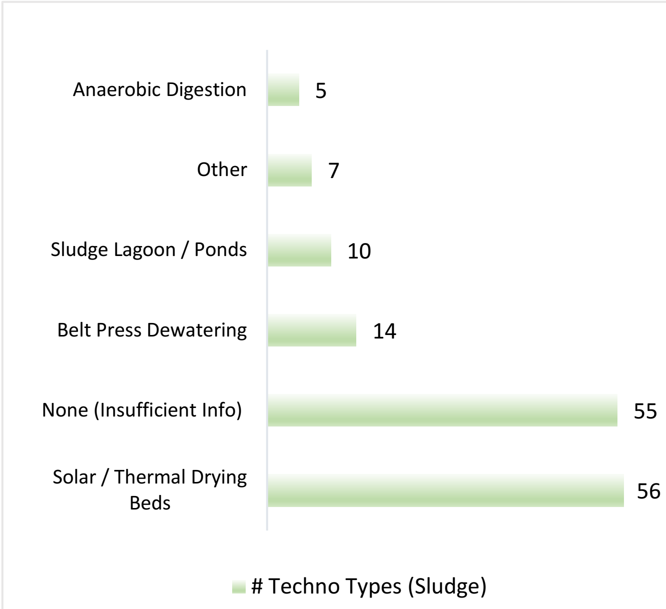


Figure 84 - Treatment technologies for wastewater effluent (a) and sludge (b)

Table 91 - Summary of Collection Network Pump Stations and Sewer Pipelines

WSA Name	# WWTWs	Pump Stations (#)	Sewer Pipelines (km)
Amajuba	3	11	47
Msunduzi	2	18	1,350
Harry Gwala	12	14	48
Newcastle	5	28	NI
uMgungundlovu	6	14	280
Ugu	19	81	315
uMhlathuze	5	7	NI
iLembe	12	36	1,501
uMzinyathi	5	11	NI
eThekwini	27	289	9,149
Zululand	18	4	NI
King Cetshwayo	13	18	NI
uMkhanyakude	11	10	NI
uThukela	9	37	NI
Totals	**147**	**578**	**12,690**

The sewer network consists of the sewer mains and pump stations as summarised in Table 91. eThekwini, iLembe and Msunduzi own and manage the bulk of the sewer collector infrastructure, approximately 9,149 km, 1,501 km and 1,350 km: and 289, 36 and 18 sewer pump stations, respectively. Ugu has the 2nd highest number of pump stations at 81. Seven municipalities could not provide information on sewer pipelines, indicating limitations in asset management information.

Provincial Green Drop Analysis

The 100% response from the 14 WSAs audited during the 2021 Green Drop process demonstrates a firm commitment to wastewater services in the province. There were no changes to the number of WSAs audited however 2 WSAs have changed their names – namely, Sisonke to Harry Gwala and uThungulu to King Cetshwayo.

Table 92 - Green Drop Comparative Analysis from 2009 to 2021

GREEN DROP COMPARATIVE ANALYSIS					
Performance Category	**2009**	**2011**	**2013**	**2021**	**Performance trend 2013 and 2021**
Incentive-based indicators					
Municipalities assessed (#)	14 (100%)	14 (100%)	14 (100%)	14 (100%)	→
Wastewater systems assessed (#)	134	143	141	147	↑
Average Green Drop score	44%	61.2%	59.9%	48.9%	↓
Green Drop scores ≥50% (#)	78 (58 %)	95 (66%)	94 (67%)	76 (52%)	↓
Green Drop scores <50% (#)	56 (42%)	48 (34%)	47 (33%)	71 (48%)	↓
Green Drop Certifications (#)	11	11	19	3	↓
Technical Site Inspection Score (%)	NA	64.0%	67.1%	68.7%	↑

NA = Not Applied NI = No Information *↑= improvement, ↓= regress, →= no change*

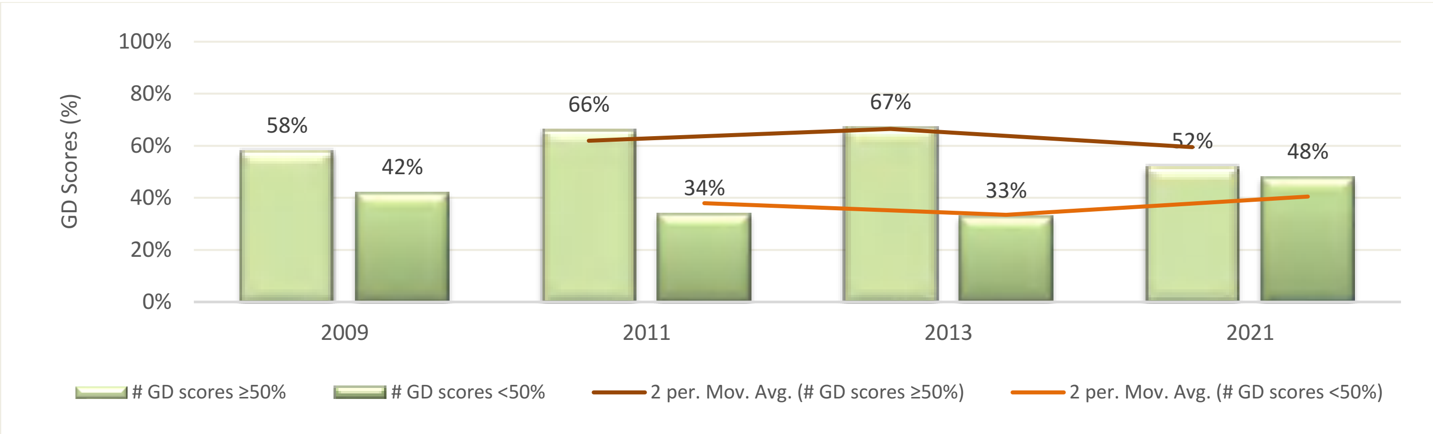


Figure 85 - Green Drop trend analysis over the period 2009 to 2021, indicating the percentage GD scores above and below 50%

The trend analysis indicates that:

- The number of systems audited has increased from 134 systems in 2009, when the first assessments were undertaken, to 147 systems in 2021
- Despite an upward trend in previous GD average scores - 44% in 2009 to 60 in 2013, there was a drop-off to 49% in 2021
- Similarly, the number of systems with GD scores of ≥50% increased between from 78 (58%) in 2009 to 94 (67%) in 2013 but decreased to 76 (52%) in 2021
- The TSA scores continued on an upward trajectory, increasing from 64% in 2011 to 67% in 2013 to 69% in 2021 – this is commendable
- The number of systems with GD score of ≤50% decreased from 56 (42%) in 2009 to 47 (33%) in 2013, followed by a significant regress to 71 (48%) in 2021
- The number of Green Drop Certifications decreased significantly form 19 awards in 2013 to only 3 awards in 2021
- An overall performance trend from 2013 to 2021 signals the need for repeat/regular audits to ensure continued improvement. There are indications that performance has declined in the absence of the consistent regulatory engagement of the GD audits.

The analysis for the period 2009, 2011, 2013 and 2021, indicates that most of the system scores are in the 50-<80% (Average Performance) category, with the 31-<50% (Poor Performance) being the next largest category. The most concerning data points are that 50 systems are in poor state compared to 15 systems in 2013, and that the number of GD certifications regressed from 19 to 3 from 2013 to 2021.

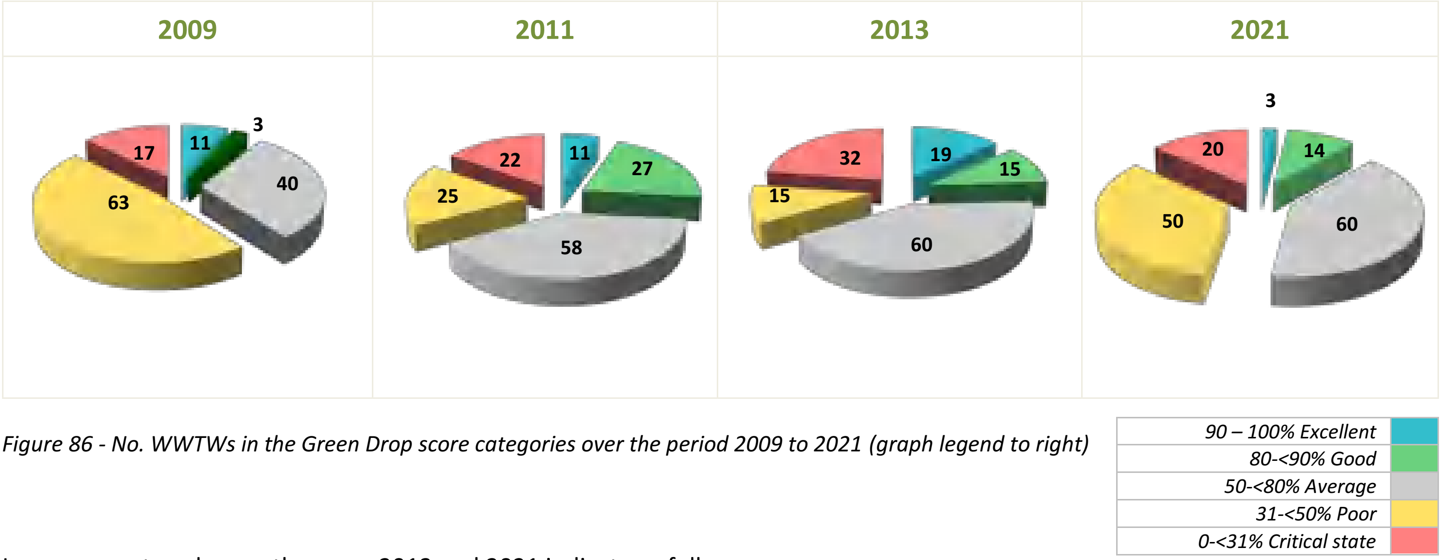


Figure 86 - No. WWTWs in the Green Drop score categories over the period 2009 to 2021 (graph legend to right)

In summary, trends over the years 2013 and 2021 indicate as follows:

- The number of systems in a 'poor state' increased from 15 systems in 2013 to 50 systems in 2021
- A positive trend was that the number of systems in a 'critical state' decreased from 32 in 2013 to 20 systems in 2021
- The number of systems in the 'excellent and good state' decreased significantly from 34 systems in 2013 to 17 systems in 2021.

Provincial Risk Analysis

Green Drop risk analysis (CRR) focuses specifically on the treatment function. It considers 4 risk indicators, i.e. design capacity, operational flow, technical capacity, and effluent quality. The CRR values do not factor risks associated with sanitation or wastewater network and collector systems.

Table 93 - Cumulative Risk Comparative Analysis from 2009 to 2021

CUMULATIVE RISK COMPARATIVE ANALYSIS					
Performance Category	**2009**	**2011**	**2013**	**2021**	**Performance Trend 2013 to 2021**
Highest CRR	24	24	23	24	↓
Average CRR	10.9	10.7	10.4	11.4	↓
Lowest CRR	4	3	4	3	↑
Design Rating (A)	1.4	1.4	1.4	1.4	→
Capacity Exceedance Rating (B)	3.3	3.7	3.3	3.4	↓
Effluent Failure Rating (C)	4.2	3.8	3.5	4.5	↓
Technical Skills Rating (D)	2.0	2.1	2.4	2.3	↑
CRR% Deviation	**53.8**	**54.4**	**55.1**	**60.3**	↓

↑= improvement, ↓= regress, →= no change

The concept of risk management appears to be well embedded within the larger municipalities. Table 93 indicates a consistent CRR% deviation from 2013 to 2021 for the WSAs overall, which suggests no change in the design capacity rating (A), a slight increase in the capacity exceedance rating (B), a slight decrease in the technical expertise (D); however, the final effluent quality (C) increased significantly for the province overall. Individual systems, however, show higher deviations and indicate specific risk categories, as highlighted under "***Regulator's Comment***". The CRR analysis in context of the Green Drop results suggests that further improvements should focus on 1) capacity exceedance at plants which are hydraulically overloaded or approaching its design lifespan, 2) effluent quality failures, especially for microbiological compliance, and 3) strengthening of technical skills and operational competency, especially related to sludge management.

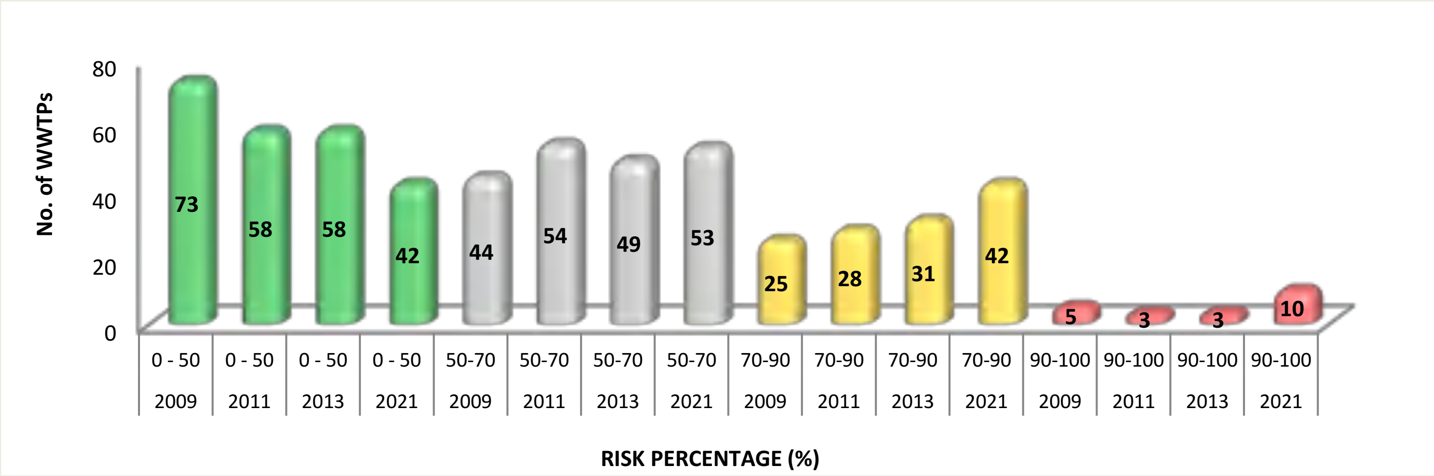


Figure 87 - a) WWTW Risk distribution and trends from 2009 to 2021; b) Colour legend

90 – 100% Critical risk WWTPs	
70 - <90% High risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low risk WWTPs	

Trend analysis of the CRR ratings for the period 2009 to 2021 indicates that:

- The most prominent movement in risk can be seen between 2013 and 2021, when a significant number of plants moved from low to medium and from high to critical risk positions, indicating a regressive state for the WWTWs
- The CRR remained constant from 2011 to 2013, at a time when W_2RAPs and risk-mitigation strategies were being embedded in WSIs
- The 2021 assessment cycle highlighted regressive shifts with a decrease in low risk WWTWs (58 to 42), increase in medium risk WWTWs (49 to 53), increase in high risk (31 to 42), and critical risk WWTWs (3 to 10).

Regulatory Enforcement

Wastewater systems which failed to achieve the minimum Green Drop target of 31%, are placed under regulatory focus. The Regulator requires these municipalities to submit a detailed corrective action plan within 60 days from publishing of this report. Four (4) municipalities and 20 wastewater systems that received Green Drop scores below 31%, are to be placed under **regulatory surveillance**, in accordance with the Water Services Act (108 0f 1997). In addition, these municipalities will be compelled to ringfence water services grant allocation to rectify/restore wastewater collection and treatment shortcomings identi fied in this report.

Table 94 - WWTWs with <31% Green Drop scores

WSA Name	2021 GD Score	WWTWs with <31% score
Amajuba DM	35%	Durnacol
uMkhanyakude DM	23%	St Lucia, Bethesda-Ubombo, Hluhluwe, Ingwavuma-Mosvold, Mtubatuba, Hlabisa Hospital, Mseleni Hospital
uMzinyathi DM	15%	Dundee, Nqutu Ponds, Pomeroy, Tugela Ferry, Greytown
Zululand DM	14%	Vryheid-Klipfontein, Coronation, Cliffdale-Vrede, Mlokothwa, Nkongolwane, Enyathi, Hlobane

The following municipalities and their associated wastewater treatment plants are in high CRR risk positions, which means that some or all the risk indicators are in a precarious state, i.e. operational flow, technical capacity and effluent quality. WWTWs in high risk and critical risk positions pose a serious risk to public health and the environment. The following municipalities will be required to assess their risk contributors and develop corrective measures to mitigate these risks.

Table 95 - %CRR/CRR$_{max}$ scores and WWTWs in critical and high-risk space

WSA Name	2021 Average CRR/CRRmax % deviation	WWTWs in critical and high-risk space	
		Critical Risk (90-100%CRR)	High Risk (70-<90%CRR)
iLembe DM	45.0%		Montebello Hospital, Stanger-KwaDukuza
Ugu DM	59.5%		Harding, Malangeni, Murchison Hospital, Southbroom, Umzinto
Harry Gwala DM	65.2%		Underberg New, Himeville, Franklin, Umzimkhulu, Ibisi, Riverside
uMzinyathi DM	66.0%		Dundee-Glencoe, Greytown, Nqutu Ponds

WSA Name	2021 Average CRR/CRRmax % deviation	WWTWs in critical and high-risk space	
		Critical Risk (90-100%CRR)	High Risk (70-<90%CRR)
Amajuba DM	**68.6%**		Tweediedale, Durnacol
uMkhanyakude DM	**73.3%**	St Lucia Ponds, Umseleni	Bethesda Hospital, Hluhluwe, Ingwavuma Hospital, Manguzi, Mkuze
King Cetshwayo DM	**74.2%**		Catherine Booth Hospital, Gingindlovu Ponds, King Dinuzulu, Mbongolwane Hospital, Melmoth ponds, Mpushini ponds, Mtunzini, Nkandla, Oceanview, Owen Sithole Agric College
uThukela DM	**74.7%**		Bergville, Colenso, Ekuvukeni, Ezakheni, Ladysmith, Wembezi, Winterton, Estcourt
Zululand DM	**76.1%**	Cliffdale-Vrede, Coronation, Emondlo, Enyathi, Hlobane, Klipfontein, Mlokothwa, Nkongolwane	St Francis Hospital

Good practice risk management requires that the W_2RAPs are informed by meaningful Process and Condition Assessments, supported by zealous implementation of corrective measures and ongoing monitoring of risk movement. uMgungundlovu, Msunduzi, Newcastle, eThekwini Metro and uMhlathuze are commended for maintaining all their treatment facilities in low and moderate risk positions - an exemplary status.

Performance Barometer

The **Green Drop Performance Barometer** presents the individual Municipal Green Drop Scores, which essentially reflects the level of mastery that a municipality has achieved in terms of its overall municipal wastewater services business. The bar chart below indicates the GD scores for 2013 in comparison to 2021, from highest to lowest performing WSA. uMgungundlovu achieved good performance; Msunduzi, Harry Gwala and Newcastle maintain average performance; eThekwini Metro regressed from excellent to average performance, and iLembe and uMhlathuze regressed from good to average performance; Ugu, Amajuba and uMzinyathi regressed from average to poor and critical performances respectively.

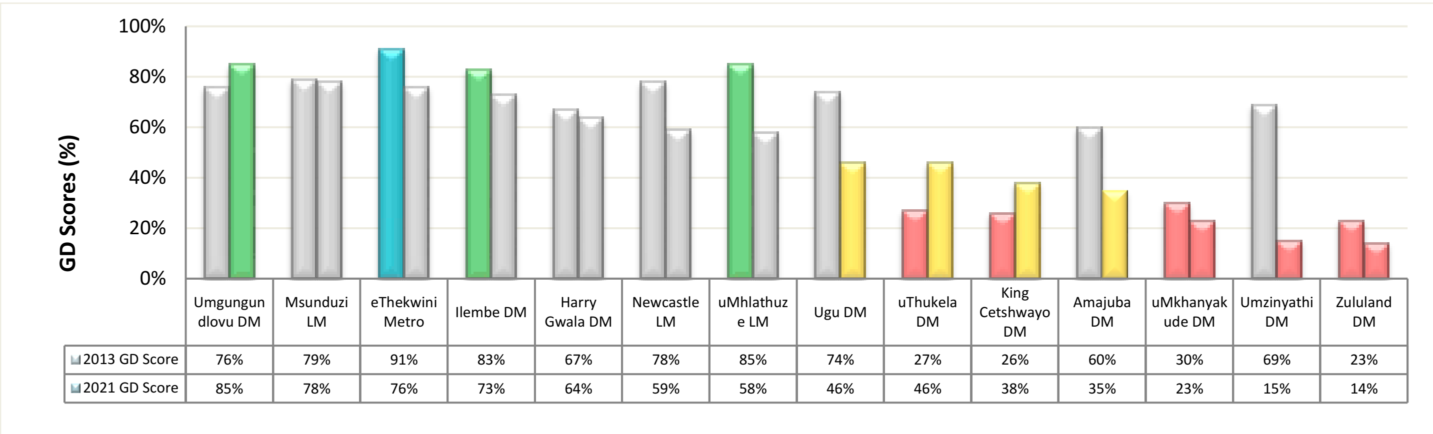


Figure 88 - a) Green Drop scores 2013 (bar left) and 2021 (bar right), with colour legend inserted

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	

The **Cumulative Risk Log** expresses the level of risk that a municipality poses in respect of its wastewater treatment facility. It is based on the ***individual Cumulative Risk Ratios***. Figure 89 presents the cumulative risks in ascending order, with the low-risk municipalities on the left and critical risk municipalities to the far right. The analysis reveals that there are no critical risk municipalities in the Province.

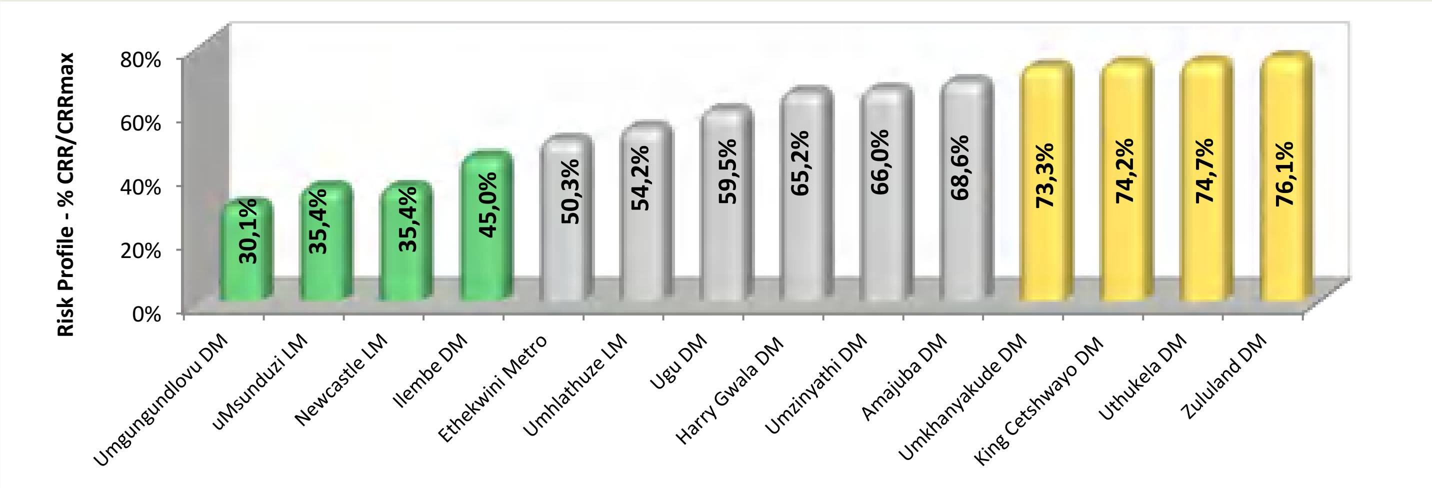


Figure 89 - a) %CRR/CRRmax Risk Performance Log 2021; b) Colour legend

90 – 100% Critical risk WWTPs	
70 - <90% High risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low risk WWTPs	

Provincial Best Performers

uMgungundlovu DM is the **BEST PERFORMING** municipality in the Province based on the following record of excellence:

- ✓ 86% Municipal Green Drop Score
- ✓ 2013 Green Drop Score of 76%
- ✓ Improvement on the CRR risk profile from 39.7% in 2013 to 30.1% in 2021
- ✓ 6 of 6 (100%) plants in the low-risk positions
- ✓ Technical Site Assessment scores of 86% (Howick)

Msunduzi LM is the 2nd best scoring municipality:

- ✓ 78% Municipal Green Drop Score
- ✓ 100% of plants (2 of 2) in low & medium risk positions
- ✓ TSA score of 87% (Lynnfield Park)

eThekwini Metro is the 3rd best scoring municipality:

- ✓ 76% Municipal Green Drop Score
- ✓ All plants (27 no.) in low and medium risk positions
- ✓ TSA of 91% (Umbilo) and 67% (KwaMashu)

KPA Diagnostics

The Green Drop Audit process collects a vast amount of data that yield valuable insight on the state of the wastewater sector in each Province. These insights have been captured into 7 thematic areas or 'Diagnostics', as discussed below.

Table 96 - Summary of the key diagnostic themes and reference to the respective Green Drop KPAs

Diagnostic #	Diagnostic Description	Diagnostic Reference
1	**Green Drop KPA Analysis**	KPAs A-E
2	**Technical Competence**	KPA A, B & Bonus
3	**Treatment Capacity**	KPA D
4	**Wastewater Monitoring and Compliance**	KPA B & D & Bonus
5	**Energy Efficiency**	KPA C & Bonus
6	**Technical Site Assessments**	TSA
7	**Operation, Maintenance and Refurbishment of Assets**	KPA C, D & Bonus

Diagnostic 1: Green Drop KPA Analysis

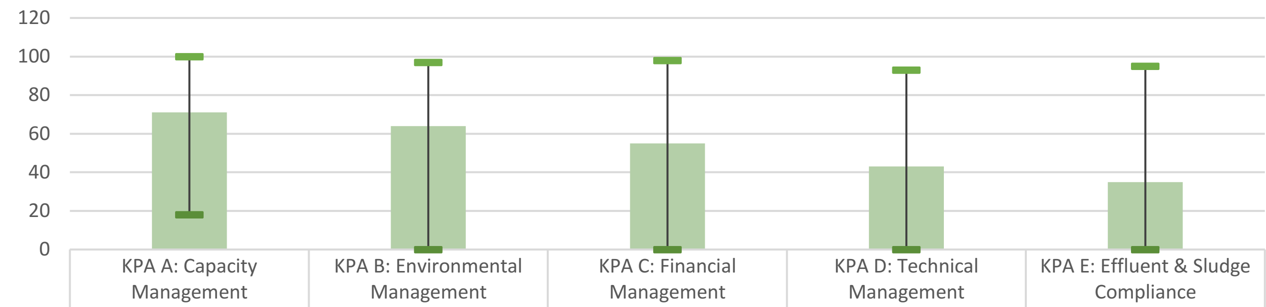
Aim: Analysis of technical skills, environmental plans, financial management, technical capacity, and regulatory compliance provides insight into the strengths and weaknesses of wastewater management in WSAs in the province. These insights in turn, may inform appropriate interventions and strategies to improve the individual KPAs and ultimately, collective KPA performance.

Findings: The WSAs are characterised by a highly variable KPA profile. A good KPA profile typically has a high mean GD score, coupled with a low Standard Deviation (SD) between the outer parameters (min and max). Similarly, a well performing system is one which has most/all systems in the >80% bracket and no systems in the <31% bracket.

Table 97 - Green Drop scores KPA profiles (graph legend included)

KPA #	Key Performance Area	*Weight*	Minimum GD Score (%)	Maximum GD Score (%)	Mean GD Score (%)	# Systems <31%	# Systems >80%
A	Capacity Management	*15%*	18%	100%	**71%**	10 (7%)	84 (57%)
B	Environmental Management	*15%*	0%	97%	**64%**	15 (10%)	33 (22%)
C	Financial Management	*20%*	0%	98%	**55%**	30 (20%)	24 (16%)
D	Technical Management	*20%*	0%	93%	**43%**	56 (38%)	32 (22%)
E	Effluent and Sludge Compliance	*30%*	0%	95%	**35%**	71 (48%)	11 (7%)

90 – 100% Excellent
80-<90% Good
50-<80% Average
30-<50% Poor
0-<31% Critical state



	KPA A: Capacity Management	KPA B: Environmental Management	KPA C: Financial Management	KPA D: Technical Management	KPA E: Effluent & Sludge Compliance
Mean	71	64	55	43	35
Max	100	97	98	93	95
Min	18	0	0	0	0

Note: The High and low lines represent the Min and Max range, and the shaded green represents the Mean (arithmetical average)

Figure 90 - Maximum, minimum, and mean Green Drop KPA scores

The KPA distribution indicates as follows:

- Capacity Management (KPA A) depicts the highest mean of 71%, highest maximum of 100%, highest minimum of 18%, and the lowest Standard Deviation (SD) of 82%. These results indicate some strengths pertaining to the registration of WWTWs, maintenance plans and records, maintenance teams, and registered, qualified staff (process controllers, supervisors, scientists, technicians, engineers)
- Effluent and Sludge Quality Compliance (KPA E) received the lowest mean of 35%, indicating a deficiency in data management, IRIS upload, effluent quality compliance, and sludge quality compliance
- This was followed by the Technical Management (KPA D) that received the next lowest mean of 43%, indicating vulnerabilities in basic design information, inflow, outflow, meter reading credibility, process and condition assessments, site inspection reports, asset registers, asset values, bylaws and enforcement
- The mean decreased steadily from KPA A to KPA E.

The GD bracket performance distribution reiterates the above findings:

- ***KPA Score >80%:*** Capacity Management (KPA A) is the best performing KPA with 57% of systems achieving >80%, followed by Environmental Management (KPA B) with 22%. Effluent and Sludge Quality Compliance (KPA E) was the worst performing KPA with only 7% achieving >80%, followed by Financial Management (KPA C) with 16%
- ***KPA Score <31%:*** Effluent and Sludge Compliance (KPA E) represent the worst performing KPA with 48% of the systems scoring <31%, followed by Technical Management (KPA D) with 38% and Financial Management (KPA C) with 20%.

Diagnostic 2: Technical Competence

Aim: This focus area assesses the human resources (technical) capacity to manage wastewater systems. Theory suggests a correlation between human resources capacity (sufficient number of appropriately qualified staff) and a municipality's performance and operational capability. It is projected that high HR capacity would translate to compliant wastewater services and protection of scarce water resources.

Findings: According to regulations, wastewater plants are classified as Class A, B, C, D or E plants. Similarly, Process Controllers and Plant Supervisors are registered as Class I, II, III, IV, V or VI operators. Higher classed plants require a higher level of operators due to their complexity and strict regulatory standards. Technical compliance of Process Controllers and Supervisors is determined against Green Drop standards, as defined by Reg. 2834 and draft Reg. 813 of the National Water Act 1998.

Note: "Compliant staff" means qualified and registered staff that meets the GD standard for a particular Class Works. "Staff shortfall" means staff that do not meet the GD standard for a particular Class of works (+1 for a shift) and/or staffing gaps exist at the respective WWTWs.

Table 98 - No. compliant versus shortfall in Supervisor and Process Controller staff

WSA Name	# WWTWs	# Compliant staff		# Staff Shortfall		Ratio*	WSA 2021 GD Score (%)
		Supervisor	PCs	Supervisor	PCs		
Amajuba	3	0	0	1	6	0	35%
Msunduzi	2	2	13	0	0	7.5	78%
Harry Gwala	12	7	15	0	13	1.8	64%
Newcastle	5	1	24	1	0	5	59%
uMgungundlovu	6	5	26	0	0	5.2	86%
Ugu	19	2	7	2	29	0.5	46%
uMhlathuze	5	2	3	1	9	1	58%
iLembe	12	4	21	0	6	2.1	73%
uMzinyathi	5	1	1	0	10	0.4	15%
eThekwini	27	13	26	4	43	1.4	76%
Zululand	18	3	1	8	29	0.2	14%
King Cetshwayo	13	1	2	2	15	0.2	38%
uMkhanyakude	11	0	2	5	12	0.2	23%
uThukela	9	1	5	4	14	0.7	46%
Totals	**147**	**42**	**146**	**28**	**186**		

** The single number Ratio depicts the number of qualified staff divided by the number of WWTWs operated by this number of staff. E.g., Msunduzi have 15 compliant operational staff for 2 WWTWs, thus ratio of 15/2=7.5*

Competent human resources are a vital enabler to ensure efficient and sustainable management of treatment processes and infrastructure. For KZN, the operational competencies are not on par with regulatory expectations, as illustrated by the high shortfall on Process Controllers, with better prospective for plant supervisors noted.

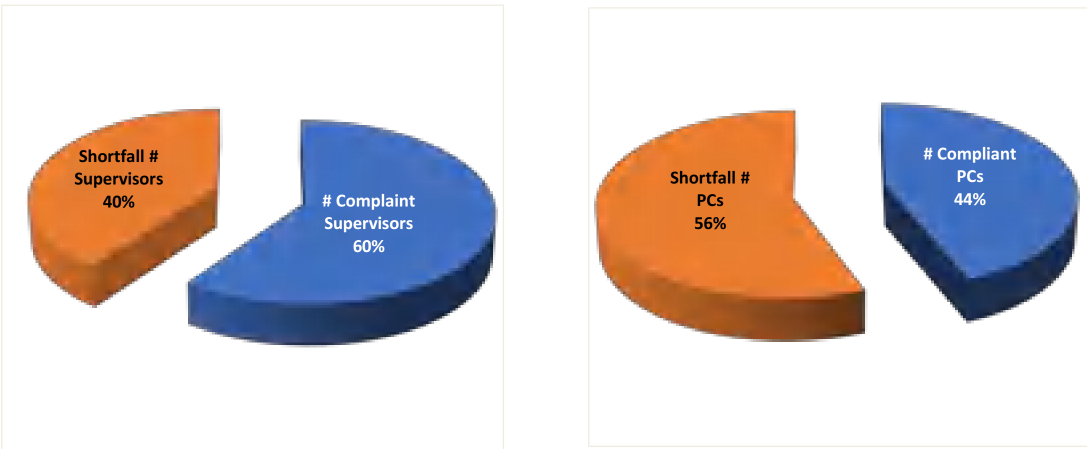


Figure 91 - Schematic illustration of compliant versus non-compliant Supervisors (a) and Process Controllers (b)

Plant Supervisors: The pie charts indicate that 60% (42 of 70) of Plant Supervisors complies with the Green Drop standard, with zero shortfall for Msunduzi, Harry Gwala, uMgungundlovu, iLembe, and uMzinyathi. A 40% (28 of 70) shortfall is noted for Supervisors overall, with the highest shortfall seen at Zululand (8 no.), uMkhanyakude (5 no.), and uThukela and eThekwini (4 no. each).

Process Controllers: Similarly, 44% (146 of 332) of the PC staff is compliant, with a zero shortfall in Msunduzi, Harry Gwala and uMgungundlovu. There is a 56% (186 of 332) shortfall in PCs with the highest shortfall for eThekwini (43 no.), Zululand and Ugu (29 no.), King Cetshwayo (15 no.) and uThukela (14 no.).

Green Drop standards require of Class A and B plants to employ dedicated Supervisors and Process Controllers per shift per Works, whereas Class C to E plants may consider sharing of staff across works. Shifts have been introduced to ensure optimal operations while addressing security risks, particularly as it relates to vandalism. Telemetry also reduces the requirement for on-site staff during night shifts, but these relaxations will have to be done within the DWS regulatory guidelines.

It is expected that a close correlation would exist between the competence of an operational team and the performance of a treatment plant, as measured by the GD score. The data indicates as follows:

- 3 of the 14 municipalities have good Supervisor/Process Controller ratios in place (≥3) – Msunduzi, uMgungundlovu and Newcastle
- Only 4 municipalities have a qualified Supervisor per plant (including roaming) – Msunduzi, uMgungundlovu and Harry Gwala
- Apart from Msunduzi, Newcastle, Harry Gwala and uMgungundlovu, all municipalities have shortfalls in registered Supervisors and Process Controllers (either one or both).

The results from the ratio analysis indicate high ratios for Msunduzi, uMgungundlovu, Newcastle and iLembe, and low ratios for Zululand, King Cetshwayo, uMkhanyakude, and Amajuba.

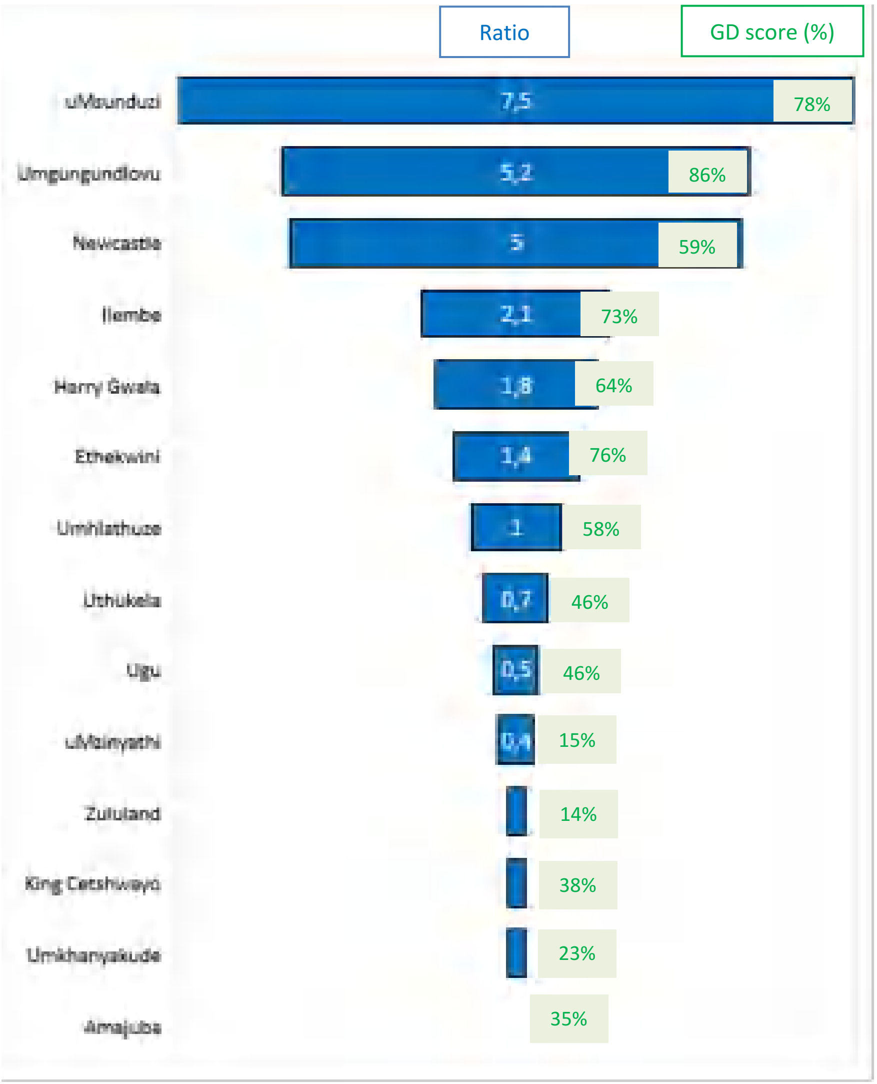


Figure 92 - Ratio of compliant operational staff to no. of WWTWs and Comparison of Ratios with GD scores

Overall, the comparative bar chart confirms a correlation between municipalities with high ratios and high GD scores (Msunduzi 78%, uMgungundlovu 86%, etc down to eThekwini 76%), whereas lower ratios are associated with lower GD scores (uThukela 46% to Amajuba 35%). There are minor positional exceptions, but the general trend of the ratios are reasonable, with no erratic variations between the GD score and the respective ratios.

In addition to operational capacity (above), good management practice also requires access to qualified engineers, technicians, technologists, scientists, and maintenance capability. Such competencies could reside in-house or be accessed through term contracts and external specialists.

Note 1: "Qualified Technical Staff" means staff appointed in positions to support wastewater services, and who has the required qualifications. "Technical Shortfall" is calculated based on a minimum requirement of at least 2 Engineers/Technologists/Technicians and at least one 1 Scientist per WSI.

Note 2: "Qualified Scientists" means professional registered scientists (SACNASP) appointed in positions to support wastewater services. "Scientists shortfall" means that the WSA does not have at least one qualified, SACNASP registered scientist in their employ or contracted.

Table 99 - Summary of the maintenance capacity and no. of qualified and shortfall of Engineering, Technical and Scientific staff

WSA Name	# WWTW	Maintenance Arrangement	Qualified Technical Staff (#)				Technical Shortfall (#)	Qualified Scientists (#)	Scientists Shortfall (#)	Ratio*	WSA 2021 GD Score (%)
			Engineers	Technologists	Technicians	Total					
Amajuba	3	Internal + Term Contract	0	1	0	1	1	1	0	0.3	35%
Msunduzi	2	Internal + Specific Outsourcing	5	2	6	13	0	9	0	6.5	78%
Harry Gwala	12	Internal + Specific Outsourcing; Internal + Term Contract; Internal Team (Only)	3	3	3	9	0	6	0	0.8	64%
Newcastle	5	Internal + Term Contract	1	1	1	3	0	0	1	0.6	59%
uMgungundlovu	6	Internal + Specific Outsourcing	4	0	3	7	0	12	0	1.2	86%
Ugu	19	Internal + Term Contract	1	2	3	6	0	8	0	0.3	46%
uMhlathuze	5	Internal + Term Contract; Internal + Specific Outsourcing	0	2	0	2	0	2	0	0.4	58%
iLembe	12	Internal + Specific Outsourcing; Internal + Term Contract	5	4	3	12	0	8	0	1	73%
uMzinyathi	5	Inadequate Capacity	0	0	0	0	2	0	1	0	15%
eThekwini	27	Internal + Specific Outsourcing	9	1	1	11	0	7	0	0.4	76%
Zululand	18	Internal + Term Contract; Internal Team (Only); No Capacity	1	3	4	8	0	0	1	0.4	14%
King Cetshwayo	13	Internal + Term Contract; Internal + Specific Outsourcing	0	0	0	0	2	1	0	0	38%
uMkhanyakude	11	Internal + Term Contract; No Capacity	0	1	1	2	0	1	0	0.2	23%
uThukela	9	Internal + Specific Outsourcing	0	0	1	1	1	0	1	0.1	46%
Totals	**147**		**29**	**20**	**26**	**75**	**6**	**55**	**4**		

* *The Ratio depicts the number of qualified technical staff divided by the number of WWTWs that have access to the staff*

In terms of maintenance capacity, KZN has a reasonable contingent of qualified maintenance staff for all municipalities, except uMzinyathi and King Cetshwayo. Arrangements are in place for maintenance staff from a collective of inhouse, contracted or outsourced personnel. The data indicates that:

- 13 of 14 municipalities have in-house maintenance teams except for uMzinyathi that has inadequate capacity
- 9 municipalities have internal maintenance teams supplemented with term contracts
- 8 municipalities have internal maintenance teams supplement with specific outsourced services.

In general, KZN has access to a reasonable pool of qualified technical/scientific staff with a few exceptions, as summarised below:

- A total of 125 qualified staff comprising of 29 engineers, 20 technologists, 26 technicians (qualified) and 55 SACNASP registered scientists are assigned to the 14 municipalities
- A total shortfall of 10 persons is identified, consisting of 6 technical staff and 4 scientists
- Amajuba, uMzinyathi, King Cetshwayo, and uThukela have some shortfall in qualified technical staff
- 87% of the WWTWs have access to credible laboratories that complies with Green Drop standards – this is commendable.

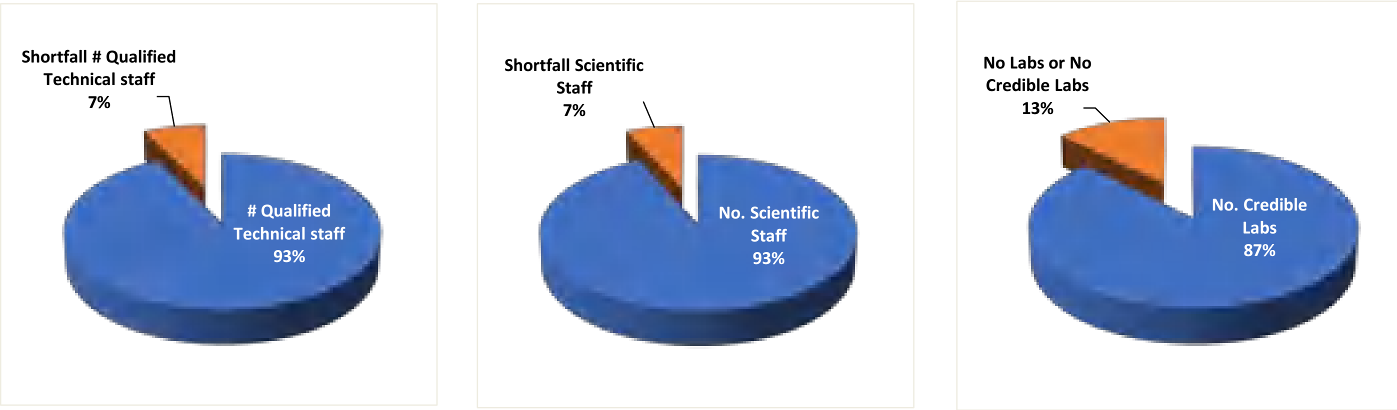


Figure 93 - Graphic illustration of the number and %: a) qualified engineering/technical staff; b) professional scientists; c) access to credible laboratory services that complies with Green Drop standards

Ratio analysis has been done to determine the number of qualified technical and scientific staff assigned per WWTW. It is expected that a higher ratio would correspond with well-performing and maintained wastewater systems, as represented by the GD score.

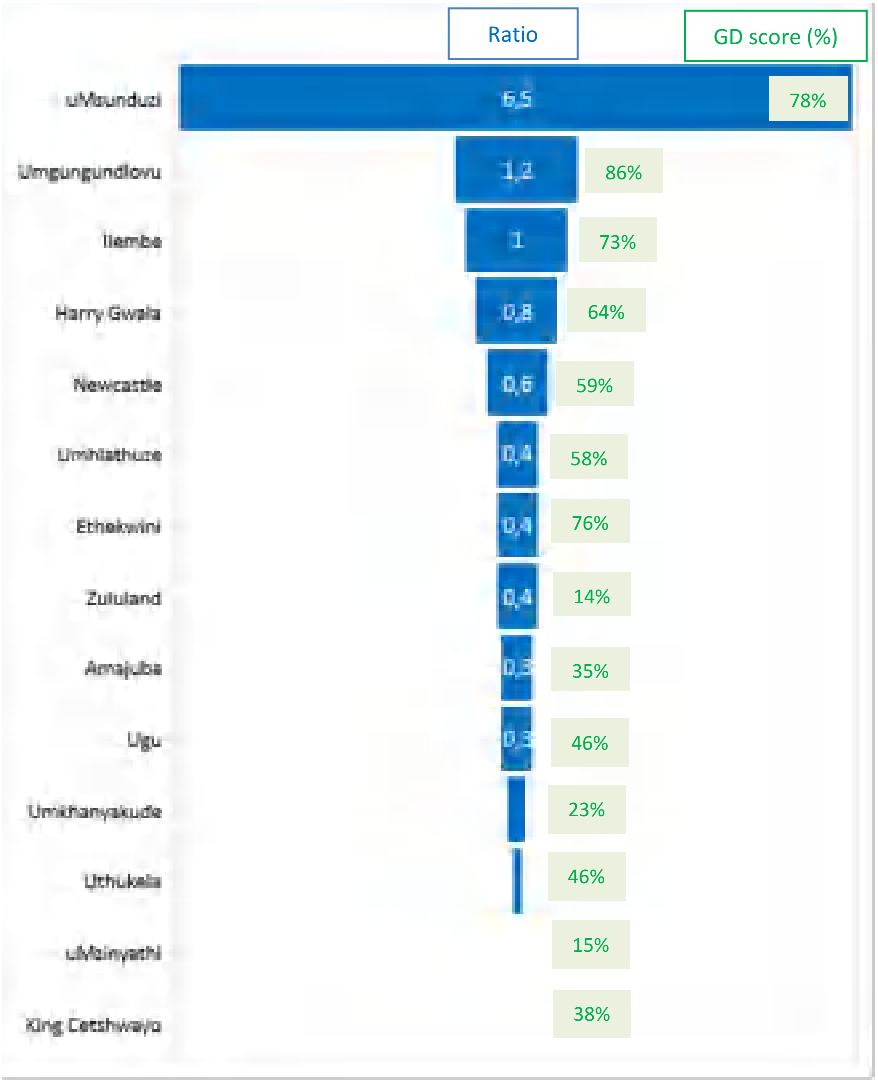


Figure 94 - Ratio of compliant technical staff to no. of WWTWs and Comparison of Ratios with GD scores

Figure 94 shows a correlation between high ratios and high GD scores at 4 municipalities (Msunduzi 78%, uMgungundlovu 86%, iLembe 73%, and Harry Gwala 64%). Likewise, a correlation was found between lower ratios and lower Green Drop scores (From Zululand 14% to King Cetshwayo 38% in Figure 94. uThukela and eThekwini present exceptions with lower ratios but higher GD scores.

These results suggest that wastewater performance may be less sensitive towards engineering, technical and scientific staff, and more dependent on operational competencies (Superintendents and PCs).

One of the options to enhance operational capacity is through dedicated training programmes. The Green Drop audit incentivises training of operational staff over the 2-year period prior to the audit date. The results are summarised as follows:

Table 100 - No. of WWTWs with operational staff sent on training over the past 2 years and vice versa

WSA Name	# of WWTW staff attending training over past 2 years	# of WWTW without training over past 2 years
Amajuba	3	0
Msunduzi	1	1
Harry Gwala	12	0
Newcastle	5	0
uMgungundlovu	4	2
Ugu	0	19
uMhlathuze	0	5
iLembe	12	0
uMzinyathi	2	3
eThekwini	27	0
Zululand	0	18
King Cetshwayo	4	9
uMkhanyakude	1	10
uThukela	4	5
Totals	**75 (51%)**	**72 (49%)**

Figure 95 - %WWTWs that have trained operational staff over the past two years

The results confirmed that just over 50% of the systems have sent operational staff on training over the past 2 years. However, some training gaps persist which require a concerted effort to strengthen training initiatives of Supervisors and Process Controllers. Recent training events focused primarily on chlorine handling and NQF, and needs to be expanded to operation of technology, sludge treatment and energy efficiency.

Diagnostic 3: Treatment Capacity

Aim: A capable treatment plant requires adequate design capacity and functional equipment to operate optimally. If the plant capacity is exceeded by way of inflow volume or strength, the plant will not be capable to achieve its compliance standards. Capacity is typically exceeded when the demand exceeds the installed design capacity, or when processes or equipment is not operational or dysfunctional, or when the electrical supply cannot support the treatment infrastructure. This diagnostic assesses the status of plant capacity and operational flows to the plants.

Findings: Analysis of the hydraulic capacities and operational flows indicate a total design capacity of 1,121 Ml/d for the province, with a total inflow of 634 Ml/day (considering that 47 systems are not measuring their inflows). Theoretically, this implies that 57% of the design capacity is used with 43% available to meet additional demand. However, the full 1,121 Ml/d day is not available as some infrastructure is dysfunctional, leaving 1,055.7 Ml/d available. The reduced capacity means that the province may be closer to its total available capacity than the data suggests.

In general, all WWTWs are operating within their total design capacities. Amajuba, uMhlathuze, iLembe, Zululand, King Cetshwayo, and uMkhanyakude are reported a low percentage use of their capacity (<50%) and the exception of uThukela that provided no inflow data. Treatment systems with low percentage use may have been affected by breakdown in sewer networks or pump stations whereby all sewage is not reaching the treatment. Treatment facilities in tourist areas have experienced low flows as results of close-down of resorts, industries etc., but it may also be attributed to the high number of systems that have not been measuring their inflows. The Green Drop audit requires a wastewater flow balance to identify and quantify possible losses from the network and/or ingress into the sewers. Most municipalities do not have flow balances that follows the wastewater trail from consumer to treatment plant.

Table 101 - Summary of WWTWs design and available capacities, inflows, % use design capacities, and inflows measured per WWTW

WSA Name	# WWTWs	Design Capacity (Ml/d)	Available Capacity (Ml/d)	Operational Flow (Ml/d)	Variance (Ml/d)	% Use Design Capacity	Inflow measured #
Amajuba	3	5.0	5.0	1.3	3.7	26%	3
Msunduzi	2	75.5	80.5	74.0	1.5	98%	2
Harry Gwala	12	12.8	12.8	11.4	1.4	89%	10
Newcastle	5	53.2	52.9	31.2	22.1	59%	5
uMgungundlovu	6	13.3	13.3	9.6	3.7	72%	6
Ugu	19	39.3	28.9	26.1	13.3	66%	18
uMhlathuze	5	39.1	39.1	18.9	20.2	48%	5
iLembe	12	40.8	33.8	15.9	24.9	39%	11
uMzinyathi	5	15.7	15.7	12.6	3.1	80%	4
eThekwini	27	716.2	688.0	427.0	289.2	60%	27
Zululand	18	31.7	10.0	3.4	28.4	11%	4
King Cetshwayo	13	8.4	8.4	2.3	6.2	27%	4
uMkhanyakude	11	9.5	6.2	0.7	8.8	7%	1
uThukela	9	61.2	61.2	0.0	61.2	0%	0
Totals	**147**	**1,121.6**	**1,055.7**	**634.2**	**487.4**	**57%**	**100**

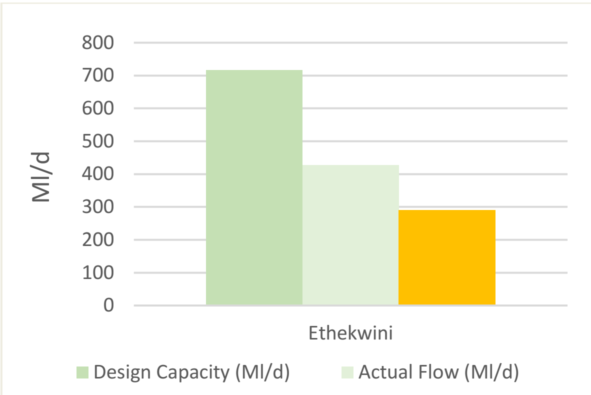


Figure 96 - WSA design capacity, actual flow, and variance in Ml/d for larger sized WWTWs

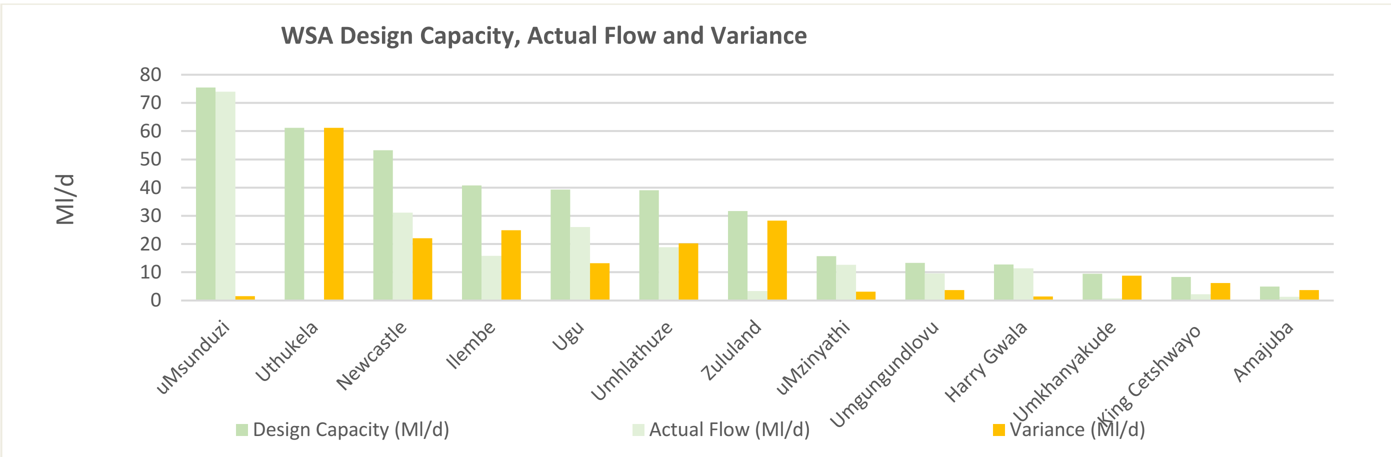


Figure 97 - WSA design capacity, actual flow, and variance in Ml/d for smaller sized WWTW

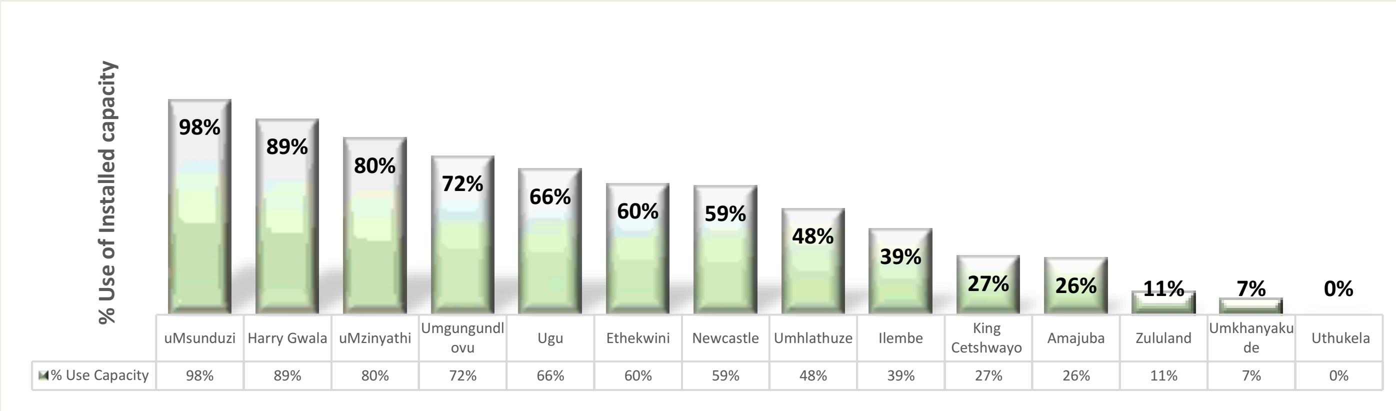


Figure 98 - WSA % use of installed design capacity

The audit data indicates that 7 systems are hydraulically overloaded. This figure could theoretically be higher, given that there are 47 systems where inflow monitoring is not taking place. The capacity limitations may impede social and economic development in the drainage areas, if not addressed. The hydraulically overloaded systems in each of the WSAs is as follows:

- Harry Gwala: 2 of 12 systems (Kokstad and Franklin)
- uMzinyathi: 1 of 5 systems (Greytown)
- eThekwini: 2 of 27 systems (Glenwood Road and Craigieburn)
- Zululand: 1 of 18 systems (James Nxumalo)
- King Cetshwayo: 1 of 13 systems (Oceanview)

Water Use Authorisations mandate municipalities to install meters and monitor inflows, whilst GD requires WSAs to report inflows on IRIS and to calibrate meters annually.

The audit results indicate that 68% (100 of 147) of systems monitor their inflow. The 47 systems where flow is not monitored are managed by Zululand, King Cetshwayo, uMkhanyakude, and uThukela. This presents a major shortfall in critical data required to plan for future capacity, and to operate existing treatment facilities. The majority of WSAs that have flow metering in place, calibrate or verify their flow meters on an annual basis, which correspond with good practice standards.

Diagnostic 4: Wastewater Monitoring and Compliance

Aim: "*To measure is to know*" and "*To know is to manage*". The primary objective of a wastewater treatment plant is to produce final effluent and biosolids to a safe standard. This standard cannot be measured or managed if operational and compliance monitoring is lacking. This diagnostic assesses the monitoring status and final effluent compliance against each WWTW's mandatory standards.

Findings: For operational monitoring, a satisfactory level of 90% is applied as the benchmark, to give weight to the importance of monitoring. For compliance monitoring, the audit evaluates the sampling point, sampling frequency, final effluent quality, biomonitoring, heavy metals, and any specific condition that the DWS may have included in the water use license. Final effluent quality compliance is calculated against the mandatory limits as listed under "Authorisation Status". A >90% compliance figure confirms high quality final effluent, whereas a <30% indicates poor effluent quality. The enforcement measures are summarised in the last column of Table 103 and includes NWA Notices and Directives issued, criminal cases opened, and court interdicts granted during the period 1 April 2019 to 30 June 2021.

Table 102 - Summary of the WSA operational and compliance monitoring status

WSA Name	# WWTW	Operational monitoring (KPA B2)		Compliance monitoring (KPA B3)	
		Satisfactory [GD score ≥90%]	Not Satisfactory [GD score <90%]	Satisfactory [GD score ≥90%]	Not Satisfactory [GD score <90%]
Amajuba	3	3	0	3	0
Msunduzi	2	2	0	2	0
Harry Gwala	12	3	9	1	11
Newcastle	5	3	2	3	2
uMgungundlovu	6	6	0	6	0
Ugu	19	1	18	17	2
uMhlathuze	5	0	5	5	0
iLembe	12	2	10	9	3
uMzinyathi	5	0	5	0	5

WSA Name	# WWTW	Operational monitoring (KPA B2)		Compliance monitoring (KPA B3)	
		Satisfactory [GD score >90%]	Not Satisfactory [GD score <90%]	Satisfactory [GD score >90%]	Not Satisfactory [GD score <90%]
eThekwini	27	27	0	23	4
Zululand	18	10	8	10	8
King Cetshwayo	13	7	6	13	0
uMkhanyakude	11	0	11	9	2
uThukela	9	0	9	5	4
Totals		**64 (44%)**	**83 (56%)**	**106 (72%)**	**41 (28%)**

The performance recorded in Table 102 stems from performance data as measured against the Green Drop Standard expressed in KPAs B2 and B3. The data indicates an overall unsatisfactory monitoring regime for operational (56% dissatisfaction) monitoring, countered by 72% satisfaction with compliance monitoring. Amajuba, Msunduzi, uMgungundlovu, eThekwini are doing exceptionally well, whilst Harry Gwala, Ugu, iLembe, uMzinyathi, uMkhanyakude, and uThukela do not meet the Green Drop standard.

Compliance monitoring is a legal requirement and the only means to measure performance of a treatment facility, and KZN must strive for 100% satisfaction. Operational monitoring is the cornerstone of day-to-day process adjustments and optimisation to ensure treatment is efficient and deliver quality effluent/sludge that meet design expectations. Sludge monitoring is essential as poor sludge handling is the root cause of many WWTWs failing to meet final effluent standards. The results indicate that the WSAs on average, are not achieving regulatory- and industry standards.

Table 103 summarises the results of KPA E, which also carries the highest Green Drop scoring weight. Note that all averages shown as '0%' under Effluent Compliance, include actual 0% compliance plus systems with no information or insufficient data.

Table 103 - Summary of authorisation status, effluent compliance status, and directives/notices issued

WSA Name	Authorisation Status	Effluent Compliance									Enforce-ment Measures*
		Microbiological Compliance (%)			Chemical Compliance (%)			Physical Compliance (%)			
		Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	
Amajuba	1 GA; 2 Not authorised	79%	1	0	84%	1	0	77%	0	1	2
Msunduzi	1 WUL; 1 GA	77%	1	0	91%	1	0	91%	1	0	0
Harry Gwala	1 WUL; 3 GA; 8 Not authorised	24%	1	8	36%	1	6	49%	2	4	0
Newcastle	1 GA; 4 Not authorised	95%	4	0	87%	2	0	90%	2	0	0
uMgungundlovu	2 WUL; 4 GA	83%	1	0	94%	5	0	98%	6	0	0
Ugu	19 Not authorised	20%	2	16	42%	2	5	70%	4	2	0
uMhlathuze	5 Not authorised	13%	0	4	53%	0	0	75%	1	0	0
iLembe	2 WUL; 1 GA; 1 Exemption; 8 Not authorised	81%	9	2	68%	4	2	68%	4	2	2
uMzinyathi	5 Not authorised	40%	2	3	40%	2	3	40%	0	3	0
eThekwini	3 WUL; 5 GA; 13 Exemptions; 3 Permits; 3 Not authorised	56%	5	5	67%	3	1	82%	13	1	0
Zululand	1 WUL; 1 GA; 12 Not authorised; 4 Unknown	52%	6	8	42%	2	8	45%	3	8	0
King Cetshwayo	2 GA; 11 Not authorised	23%	3	10	23%	3	10	23%	3	10	0
uMkhanyakude	11 Not authorised	49%	4	4	53%	1	3	61%	3	3	0
uThukela	1 GA; 8 Not authorised	38%	1	6	63%	1	1	74%	2	1	1
Totals		**31%**	**40**	**66**	**39%**	**28**	**39**	**45%**	**44**	**35**	**5**

* The enforcement measures (notices or directives issued) are taken over a two-year financial period from July 2019 to June 2021

On average, municipalities reached 31% for microbiological compliance monitoring, followed by 39% for chemical, and 45% for physical compliance monitoring. For the microbiological compliance category, 40 of 147 systems achieved >90% and 66 systems fell below 30%. For the chemical compliance category, 28 systems achieved >90% and 39 systems fell below 30%. For the physical compliance category, 44 systems achieved >90% and 35 systems fell below 30%.

A total of 5 Directives/Notices have been issued to 3 municipalities. Amajuba (2 no.), iLembe DM (2 no.) and uThukela (1 no.) have enforcement measures initiated by the Regulator, which require municipal leadership intervention and correction.

In terms of sludge compliance status, it is found that:

- 35 WWTWs (24%) classify their biosolids according to the WRC Sludge Guidelines, with the exception being Amajuba, Harry Gwala, Newcastle, Ugu, uMhlathuze, uMzinyathi, Zululand, King Cetshwayo, uMkhanyakude, and uThukela
- Only 11 WWTWs (7%) monitor sludge streams
- 21 WWTWs (14%) have Sludge Management Plans in place with full plans for all systems only for uMgungundlovu and Msunduzi, and for 11 of 13 plants at iLembe
- 8 WWTWs plants (5%) have sludge reuse projects in place linked to uMgungundlovu and Msunduzi
- 15 WWTWs (10%) use sludge mostly for agricultural purposes but also land application, instant lawn, and for commercial products.

The data confirms that 12 of the 14 (86%) WSAs have access to credible laboratories for compliance and operational analysis. These in-house or contracted laboratories are accredited and/or have Proficiency Testing Schemes with suitable analytical methods and quality assurance.

Diagnostic 5: Energy Efficiency

Aim: The wastewater industry offers many opportunities to respond to climate change challenges by improving energy efficiency, reducing greenhouse gases, and generating energy. The energy cost of sophisticated treatment technologies are in the order of 25-40% of the O&M budget (cited WRC 2021). This diagnostic investigates the status of energy efficiency management at a provincial and municipal level with an aim to motivate for improved operational wastewater treatment efficiency.

Findings: The audit results indicate an average awareness of energy management in the Province. Seven municipalities conducted baseline energy audits, and 5 municipalities reported on SPC and energy tariffs and costs. Limited energy efficiency initiatives are in place.

Benchmark 1: Estimated energy intensity for large WWTW is in order of [illegible] kWh/m³

- 0.177 kWh/m³ for trickling filter
- 0.272 kWh/m³ for activated sludge
- 0.314 kWh/m³ for advanced treatment
- 0.412 kWh/m³ for advanced treatment with nitrification

Benchmark 2: Energy requirements per plant size

Plant capacity, Ml/d	[illegible]	2	10	[illegible]	100
Trickling filter, kWh/m³	0.43	[illegible]	0.23	0.18	0.16
Activated sludge, kWh/m³	0.59	[illegible]	0.37	0.32	0.29

Tariffs are typically dependent on time of day and season e.g.

- Peak rates: [illegible] - [illegible] c/kWh
- Off-peak time: [illegible] - 35.28 c/kWh

Standard time: 117.57 - 47.12 c/kWh [illegible]

Table 104 - Summary of actual Specific Power Consumption versus industry benchmarks

WSIs	System Classification	WWTW	SPC (kWh/m³)		WSIs	System Classification	WWTW	SPC (kWh/m³)
eThekwini	Basic	Glenwood Road	0.13		eThekwini	Advanced	Mpumalanga	0.16
iLembe	Advanced	Ntunjambili Hospital	1.55		Harry Gwala	Advanced	Kokstad	0.71
uMgungundlovu	Advanced	Camperdown	0.11		uMgungundlovu	Advanced	Howick	0.803
Msunduzi	Advanced	Lynnfield Park	1.25		eThekwini	Advanced	New Germany	0.03
uMgungundlovu	Advanced	Appelbosch Hospital	3.95		iLembe	Advanced	Stanger-KwaDukuza	0.28
iLembe	Advanced	Gledhow	0.13		eThekwini	Advanced	Tongaat Central	0.7
iLembe	Advanced	Tugela	1.22		iLembe	Advanced	Frasers	1.09
eThekwini	Basic	Magabeni	0.01		iLembe	Advanced	Sundumbili	0.28
uMgungundlovu	Advanced	Richmond	0.48		eThekwini	Advanced	uMhlatuzana	0.95
uMgungundlovu	Advanced	Coolair	1.773		eThekwini	Advanced	Isipingo	0.02
eThekwini	Advanced	Hillcrest	0.61		eThekwini	Advanced	Phoenix	0.58
iLembe	Advanced	Mandeni	0.21		eThekwini	Advanced	KwaMashu	0.51
iLembe	Advanced	Shakaskraal	0.86		eThekwini	Advanced	Central-Marine Outfall	0.01
eThekwini	Advanced	KwaNdengezi	0.05		eThekwini	Advanced	Southern Works	0.89
eThekwini	Advanced	Dassenhoek	0.97					

In terms of energy management, the data indicates the following:

- 7 municipalities (Msunduzi, uMgungundlovu, Harry Gwala, Newcastle, uMhlathuze, uMzinyathi and King Cetshwayo) conducted energy audits in the past 24 months
- System SPCs are calculated by Msunduzi, uMgungundlovu, iLembe, Harry Gwala, and eThekwini as part of good practice
- Msunduzi was the only WSA that could account for CO_2 equivalents associated with energy efficiency (for Darvill only).

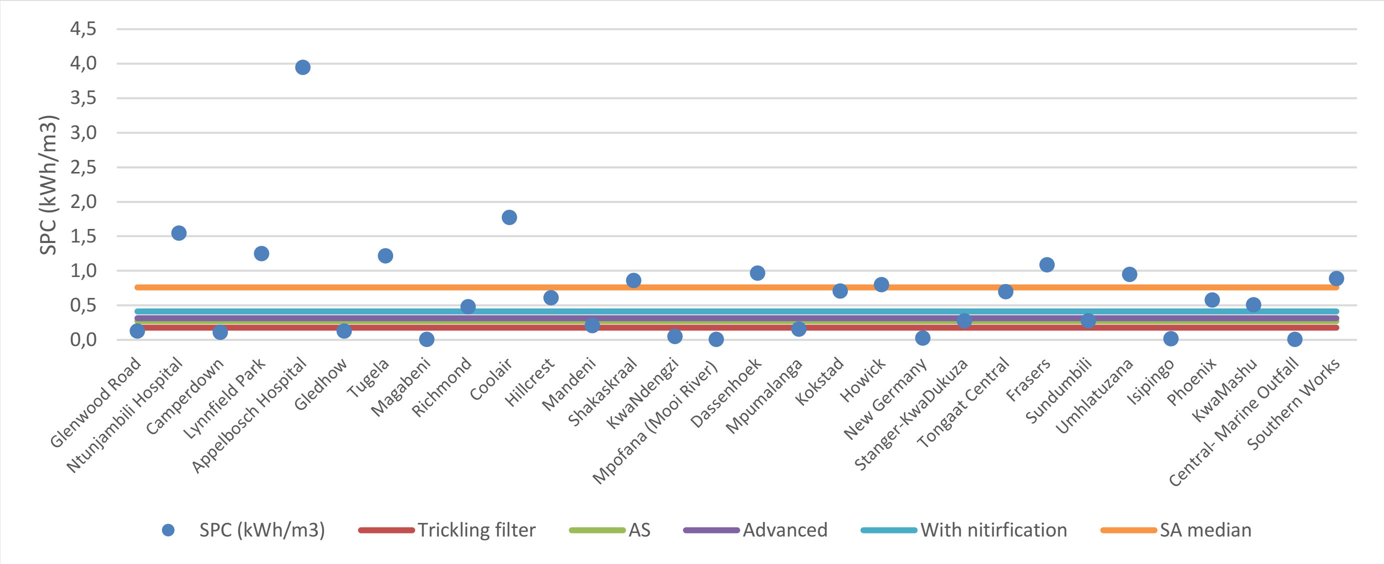


Figure 99 - WWTW Specific Power Consumption reported against industry benchmarks, sorted from low to high design capacity

In terms of energy efficiency:

- Data has been received for 28 advanced and 2 basic systems
- A marginal relation is observed between SPC and plant design capacity, whereby higher SPCs are associated with lower operational flow, i.e. Lynnfield Park, Ntunjambili, Tugela and Coolair
- For advanced systems, SPCs ranged from 0.1-3.95 kWh/m^3, with an average SPC of 0.7 and median of 0.7 kWh/m^3. These values are well above the benchmark range of 0.27-0.41, and indicate that considerable opportunities exist for energy efficiency improvement
- For basic systems, SPCs ranged from 0.01-0.13 kWh/m^3, with an average SPC of 0.07 and median of 0.0.07 kWh/m^3. These values measure well the benchmark range of 0.177, and indicate that considerable opportunities exist for energy efficiency improvement
- Msunduzi, Harry Gwala, uMgungundlovu & iLembe had knowledge of their energy tariffs (R/kWh) and energy cost (R/m^3).

The information indicates that some municipalities have established a specific report to monitor energy as part of the wastewater business, and that energy efficiency management is gaining traction in the province. Improvement opportunities include the completion of energy audits for all systems, monitoring of SPCs by the WSAs that are not doing so already, improvement in energy efficiency, and exploring alternative energy sources such as methane and solar energy.

Diagnostic 6: Technical Site Assessments

Aim: The Green Drop process makes provision for the desktop audit to be followed by a Technical Site Assessment (TSA) in order to verify the desktop evidence. The assessment includes physical inspection of the sewer network, pump stations, and treatment facility, coupled with asset condition checks to determine an approximate cost to restore existing infrastructure to functional status (VROOM).

Findings: The results of the TSAs are summarised in Table 105. A deviation of >10% between the GD and TSA score indicates a misalignment between the administrative aspects and the work on the ground. The Regulator regards a wastewater system with a TSA score of >80% as one that has an acceptable level of process control and functional equipment. A TSA score of 90% would represent an excellent plant that complies with most of the Green Drop TSA standards.

Table 105 - Summary of the WWTW Technical Site Assessments scores and hardware problems and %deviation between GD and TSA scores

WSA Name	TSA WWTW Name	WWTW GD Score (%)	% TSA	Key Hardware Problems	Difference between TSA and GD score
eThekwini Metro	KwaMashu	74%	67%	1. No sludge treatment is taking place; 2. Poly contract issue with SCM	7%
eThekwini Metro	Umbilo	71%	91%	1. Mechanical equipment needs attention; 2. Belt presses at some plant stationary	20%
Harry Gwala	Kokstad	63%	85%	1.Vandalisn and theft; Develop SOPs	22%
iLembe	Frasers (Siza Water)	95%	94%	1. Stockpiling and disposal of the sludge at the works. The sludge management options at the plant; 2. Desludging the sludge ponds; 3. Removing the debris layer on the emergency dams; 4. Putting the mechanical screen back into operation and purchasing a discharge chute to replace the corrugated iron sheeting; 5. Sorting out the wall seepage problem at the inlet and balancing tank structures	1%
Ugu	uMbango	49%	42%	1. Mechanical problems a prevailing major issue and problem at all the process units; 2. Mechanical screens and the electricals at the Inlet Works; 2 of 3 reactors not operational including one of each of the WAS & RAS pumps and the screw pumps and at least 3 (or 6) of the aerators; 2 of 3 clarifiers and a partially dysfunctional 3rd; the dewatering unit; 3. The Cl disinfection unit and the contact tank; 4. The state of the electricals and MCC panels at the Works as a whole; 5. Security, health and safety issues and risks hazards are an issue at both the WWTW and the pump station	7%
uMgungundlovu	Howick	87%	86%	1. Non-functional inflow meters; 2. Excess sludge problem at the Works; 3. RAS recycle pumps are not functional and one in for repairs; 4. No $FeCl_3$ or similar dosing; Disinfection during high flows; 5. Acquisition of critical spares and the associated procurement problems	1%
Msunduzi	Lynnfield Park	88%	87%	1. Turnaround times up to 8 months for pump and mechanical screen repairs. Procurement of spare parts is a major problem; 2. Lack of the mechanical screening; 3. Primary sludge accumulation in the balancing tank. Sludge draw off system or cleaning of the balancing tank. Some attention to be given to the electricals at the balancing tank; 4. Pump station and network issues	1%
Zululand	Ulundi	48%	61%	1. Maintenance of the biofilter arms requires attention; 2. Contact time for the temporary chlorination measures need to be determined to optimise disinfection	13%
uMkhanyakude	Jozini	31%	34%	1.Surrounding fence required repair; 2. No flow meter in place; 3. Minor cracks and corrosion were observed at the Inlet works	3%
Amajuba	Durnacol	27%	67%	1. Durnacol WWTW was in a good condition, with minor civil, mechanical and instrumentation refurbishment requirements; 2. The works is receiving very low flow due to a pipeline spillage and as such the activated sludge reactor does not receive sufficient nutrients and no MLSS is generated.	40%
Newcastle	Osizweni	61%	68%	1. Main issues include the lack of aeration in activated sludge reactor and inability to return sludge to reactor from non-functional clarifier, which results in low MLSS concentration in reactor; 2. Two PSTs are blocked and overflowing and should be cleaned; 3. There is no chlorine contact tank for the biofilter plant which impacts on disinfection; 4. The maturation ponds are full of sludge and should be cleaned	7%
uMhlathuze	Ngwelezana	66%	59%	1. Mechanical screen not operational; 2. Degritting channels and chamber not in use 3. One mixer and one aerator in reactor not operational; 4. Clarifier 2 is blocked with a non-functional bridge; 5. No sludge wastage; sludge drying beds overgrown & not in use	7%
uMzinyathi	Dundee	17%	74%	1. Mechanical screens at head of works need refurbishment; 2. Mixers in anoxic sone of activated sludge reactor not operational (more than 2 years); 3. One aerator in activated sludge reactor not operational; 4. One humus sludge pumps is not operational; 5. Chlorine gas dosing facility has been vandalised and needs refurbishment and replacement of equipment	57%
uThukela	Ezakheni	44%	45%	1. Mechanical screen and degritter not operational; 2. Two mixers and three aerators required on activated sludge reactor; 3. One humus sludge pump removed. 4. Digester supernatant and sludge pumps not operational; 5. Chlorine booster pump for gas dosing and new final flow meter required	1%
King Cetshwayo	Mtunzini	46%	70%	1. Apart from corrosion in the buffer tank and leaks in the clarifier of the second reactor, the state of civil infrastructure was good; 2. Mechanical equipment was operational; 3. Final outflow meter was not operational and inflow meter not calibrated; 4. Staff facilities needed attention	24%
Totals	**15**				**1% to 57%**

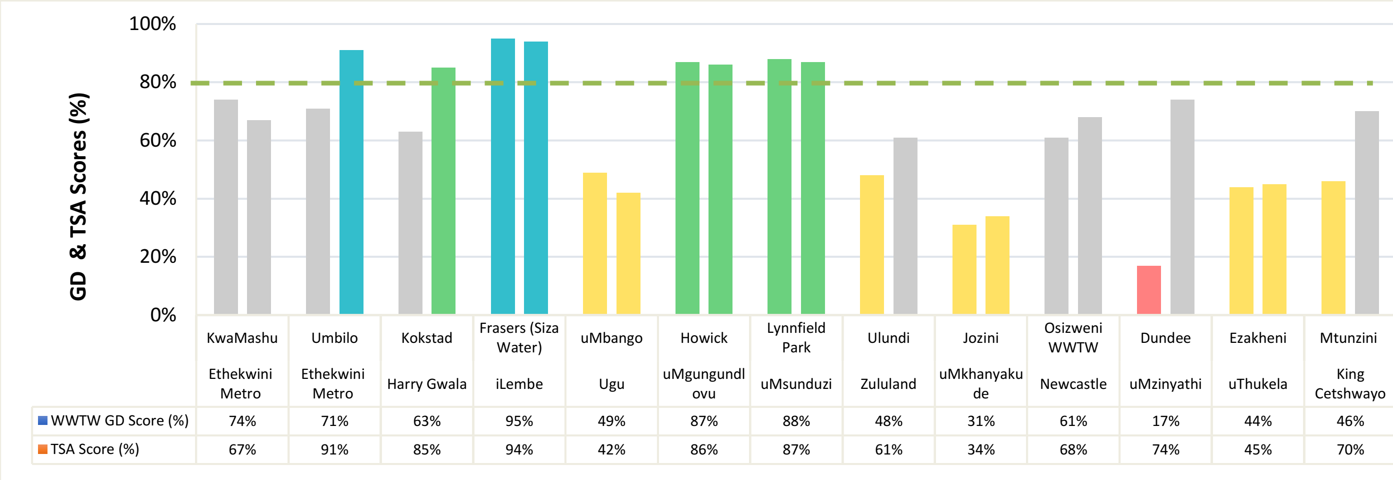


Figure 100 - Municipal GD (bottom bar) and TSA score (bottom bar) comparison (colour legends as for GD – blue excellent; red critical)

A total of 15 site assessments were conducted, with 1 to 2 inspections per municipality. Five municipalities scored above 80%, which is considered to be a satisfactory site score. Ugu, uMkhanyakude and uThukela receiving poor scores of <50%, which indicate that the treatment facilities fail to meet operational, asset functionality, and workplace safety standards.

An acceptably low difference between GD and TSA scores were observed for all WSIs, except for uMzinyathi (57%), Amajuba (40%), King Cetshwayo (24%), eThekwini (20%) and Harry Gwala (22%). A low difference implies that the wastewater management aspects correlate with the condition of processes and infrastructure in the field.

eThekwini, uMgungundlovu, Msunduzi, iLembe and Harry Gwala impressed with very high TSA scores >80% with the uMgungundlovu, Msunduzi, iLembe systems having a very close correlation with their GD scores. Amajuba and uMzinyathi obtained 27% and 17% TSA scores, combined with large deviations of 40% and 57% respectively, which does reflect on sub-standard operation and functionality of the sewer network and treatment processes.

The VROOM cost presents a ''very rough order of measurement" cost to return a WWTWs functionality to its original design. A total budget of approximately R508 million is estimated for WSAs in the province, with the bulk of the work required in restoration of mechanical equipment (61%).

Table 106 - VROOM cost split for civil, mechanical, and electrical and total VROOM cost estimate

WSA	Civil cost estimate	Mechanical cost estimate	Electrical & C&I cost estimate	Total VROOM cost
eThekwini Metro	R17,417,741	R98,927,325	R19,731,035	R136,076,100
Harry Gwala	R5,681,988	R485,640	R3,545,172	R9,712,800
iLembe	R1,948,424	R89,676	R0	R2,038,100
Ugu	R9,553,610	R129,784,896	R40,918,294	R180,256,800
uMgungundlovu	R602,756	R2,296,910	R26,334	R2,926,000
Msunduzi	R0	R4,270,280	R1,769,720	R6,040,000
Zululand	R1,816,287	R404,113	R0	R2,220,400
uMkhanyakude	R2,864,675	R1,822,975	R520,850	R5,208,500
Amajuba	R6,539,565	R2,213,967	R646,468	R9,400,000
Newcastle	R2,345,056	R24,036,824	R4,474,120	R30,856,000
uMhlathuze	R30,358,900	R19,319,300	R5,519,800	R55,198,000
uMzinyathi	R5,958,150	R3,791,550	R1,083,300	R10,833,000
uThukela	R20,515,825	R13,055,525	R3,730,150	R37,301,500
King Cetshwayo	R11,111,650	R7,071,050	R2,020,300	R20,203,000
Totals	**R116,714,627**	**R307,570,031**	**R83,985,543**	**R508,270,200**
% Distribution	**23%**	**61%**	**16%**	**100%**

The key hardware problems are listed in Table 105, with predominant defects in electrical cables, primary and secondary clarification, disinfection, sludge pumps, sludge treatment, and power backup.

Mechanical defects typically include dysfunctional aerators, sludge and effluent pumps, mixers, screens, degritters, and disinfection equipment. Vandalism and theft, long procurement lead times, lack of management involvement, lack of maintenance, and lack of budget are the main reasons for dysfunctional assets.

Diagnostic 7: Operation, Maintenance and Refurbishment of Assets

Aim: Insufficient financial resources are often cited as a root cause to dysfunctional or non-compliant wastewater systems. Knowledge and monitoring of fiscal spending are therefore a critical part of wastewater management. This diagnostic investigates the status of financial information as pertaining to O&M budgets and expenditure, asset figures, and capital funding.

Findings: A substantial amount of financial information was presented during the audit process. Unfortunately, the evidence was presented in different formats, levels of detail, or absent for some municipalities. It was observed that municipal teams with financial officials that were present during the audits typically performed better, and also had a better understanding of the wastewater challenges experienced by their technical peers. Discrepancies observed included amongst others - generic or non-ringfenced budgets, contract lump sums for service providers presented as budgets, outdated or incomplete asset registers, and some cost drivers which were lacking (mostly electricity). The Regulator grouped data into different certainty levels, as summarised at the end of this Diagnostic.

It must be noted that there were limitations with the financial and asset information. Not all WSAs submitted current information or complete financial data sets.

The result of each financial portfolio is discussed hereunder.

Vroom Cost Analysis

The VROOM costs breakdown is discussed under the TSA Diagnostic but is further illustrated as follows.

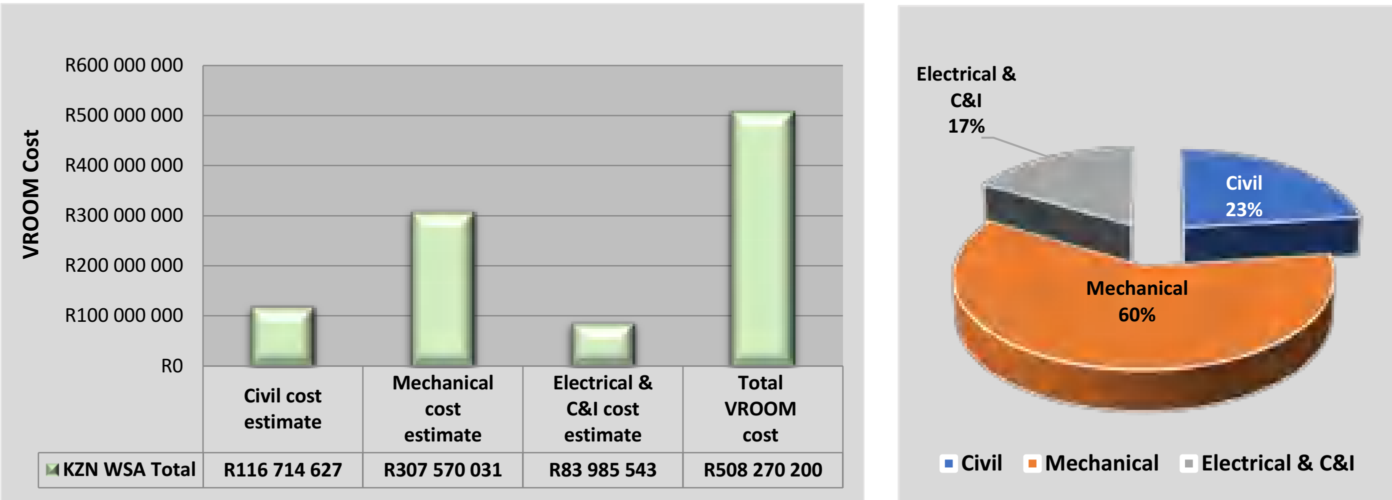


Figure 101 - Graphic illustration of the total cost estimated to restore functionality to existing assets (a), broken down to civil, mechanical, and electrical components

The total cost of R508 million is estimated to restore existing treatment works to their design capacity and functionality - consisting of R308 million for mechanical repairs, R84 million for electrical repairs, and R117 million for civil structures.

Table 107 indicates that a capital budget of R1.99 billion has been secured over the MTREF period to address infrastructural needs. While it is likely that some of the VROOM requirements will be addressed through this budget, it is probable that additional funding will be required to address the full VROOM requirements. In addition to the R508 million to restore the infrastructure, it is estimated that a total of R87 million will be required by all WSAs, on an annual basis, to maintain their assets. The maintenance estimate is based on the WATCOST-SALGA model that makes provision for maintenance at 2.14%, annually, of the asset value.

Capital, O&M Budget and Actual, and Asset Value

The capital budgets, O&M budgets, O&M actual expenditure, and current asset values are summarised below.

Table 107 - Summary of the capital budgets, O&M budgets, O&M actual expenditure, and current asset values

WSA	Capital budget available	O&M budget (2020/21)	O&M expended (2020/21)	% Expended	Total Current Asset Value
eThekwini Metro	R34,353,000	R441,857,000	R313,121,000	71%	NI
Harry Gwala	R853,139,174	R37,538,410	R36,555,290	97%	R2,289,044,710
iLembe	R117,040,052	R66,780,879	R51,493,167	77%	R58,148,732
Ugu	R7,617,000	R11,590,000	R2,380,000	21%	R656,246,739
uMgungundlovu	R133,656,000	R65,396,000	R74,605,000	114%	R213,436,700
Msunduzi	R56,376,384	R108,046,000	R118,211,000	109%	R287,760,000
Zululand	NI	R1,667,070	R1,282,110	77%	R28,515,950
uMkhanyakude	R213,858,620	NI	NI	NI	NI
Amajuba	R42,431,000	R107,892,000	R94,395,000	87%	R24,691,000
Newcastle	R114,099,000	R3,770,000	R3,309,000	88%	R375,000,000
uMhlathuze	R5,600,000	R29,933,000	R27,632,000	92%	R41,285,000
uMzinyathi	NI	NI	NI	NI	NI
uThukela	R72,052,000	R449,431,000	R441,053,000	98%	R101,429,000
King Cetshwayo	R338,616,000	R5,360,000	R5,360,000	100%	R19,590,800
Totals	**R1,988,838,230**	**R1,329,261,359**	**R1,169,396,567**	**88%**	**R4,095,148,631**

The Green Drop process provides a bonus (incentive) in cases where a municipality provides evidence of capital projects with secured funding since this is deemed as a definitive means of addressing wastewater service inadequacies. This incentive encourages wastewater infrastructure investment. A total capital budget of R1.99 billion has been reported for the refurbishment and upgrades of wastewater infrastructure for all the municipalities over the MTREF period. The largest capital budgets are observed for Harry Gwala (R853m), King Cetshwayo (R339m), uMkhanyakude (R214m), and uMgungundlovu (R134m).

For the 2020/21 fiscal year, the total O&M budget reported for the Province was R1.33 billion, of which R1.17 billion (88%) has been spent. Over expenditure was evident at two municipalities and low expenditure was observed at Ugu as clear financial figures for their wastewater business was not provided. The provincial figures exclude uMkhanyakude and uMzinyathi, that did not provide financial information.

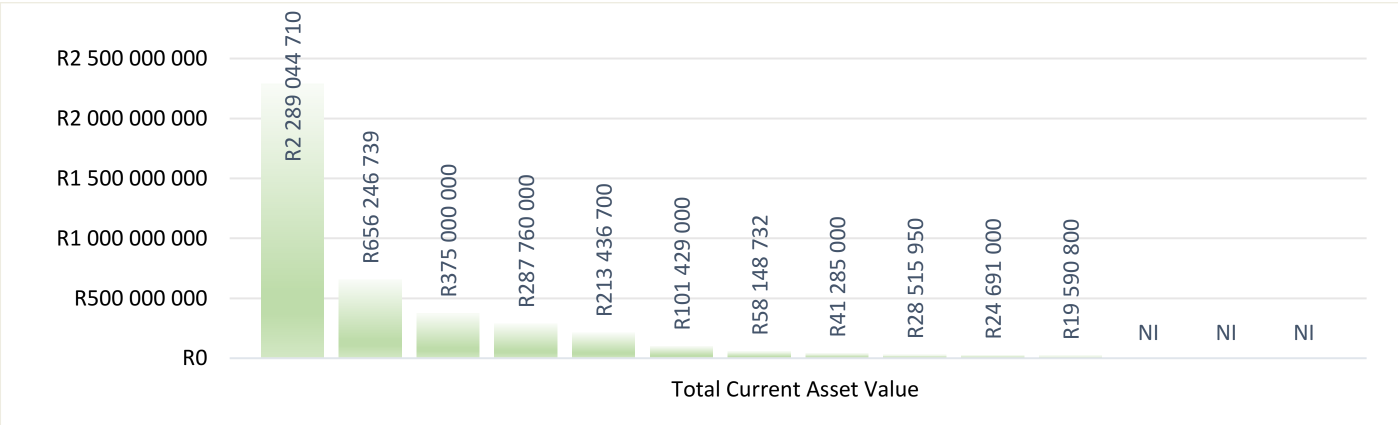


Figure 102 - Total current asset value reported by the municipalities

The total current asset value for wastewater infrastructure (networks, pump stations, treatment plants) is R4.1 billion (excluding 3 municipalities with no/incomplete information). The highest asset values are observed for Harry Gwala (R2.3b), followed by Ugu (R656m) and Newcastle (R375m). The asset values are skewed as NI was provided for by eThekwini Metro.

O&M Cost Benchmarking

By combining the SALGA and WRC WATCOST models, an estimation of the maintenance cost required per asset type can be done, i.e. civil, buildings, pipelines, mechanical, electrical, and instrumentation.

Table 108 - SALGA-WRC annual maintenance budget guideline and cost estimation

Description	% of Current Asset Value	Asset Value Estimate	Modified SALGA Maintenance Guideline	Annual Maintenance Budget Guideline
Current Asset Value estimate	**100%**	**R4,095,148,631**	**15.75%**	**R87,636,181**
Broken down into:				
1. Civil Structures	46%	R1,883,768,370	0.50%	R9,418,842
2, Buildings	3%	R122,854,459	1.50%	R1,842,817
3. Pipelines	6%	R245,708,918	0.75%	R1,842,817
4. Mechanical Equipment	35%	R1,433,302,021	4.00%	R57,332,081
5. Electrical Equipment	8%	R327,611,890	4.00%	R13,104,476
6. Instrumentation	2%	R81,902,973	5.00%	R4,095,149
Totals	**100%**	**R4,095,148,631**	**15.75%**	**R87,636,181**
			Minus 20% P&Gs and 10% Installation	**R26,290,854**
			Total	**R61,345,326**

The model estimates that R88 million (2.14%) is required per year to maintain the assets valued at R4.1 billion (should be more, noting that no figures could be verified for eThekwini). Notably, this maintenance estimate assumes that all assets are functional. The VROOM cost represents the funding required return the assets to a fully functional state, from which basis routine maintenance could then focus on maintaining the assets.

Table 109 indicates the SALGA maintenance cost estimation in relation to the VROOM cost, O&M budget, and O&M actual expended.

Table 109 - O&M cost estimates by the SALGA and VROOM models versus actual budget and expenditure figures

Cost Reference	O&M Cost Estimate	Period
Modified SALGA	R87,636,181	Annually, estimation
O&M Budget	R1,329,261,359.00	Actual for 2020/21
O&M Spend	R1,169,396,567.00	Actual for 2020/21
VROOM	R508,270,200.00	Once off estimation

The cost dynamics can be summarised as follows:

- The SALGA estimations for maintenance budgets are well below the actual reported budgets for the 2020/21 fiscal year. This figure would be influenced by inaccurate asset values and where no asset values have been provided for
- The actual O&M budget seems adequate when compared with the SALGA guideline
- The VROOM cost represents an estimation of the refurbishment cost to restore WWTWs functionality and design capacity.

Production Cost and Comparison

It is good business practice to monitor and manage the production costs of wastewater treatment in Rand/m^3 treated, and to compare such costs with industry norms. Published benchmarks is not currently available for typical treatment costs, but significant cost increases are expected since 2013, given the variable input factors such as Covid, cost of chemicals, transport, and electricity. From an economic perspective, it would be valuable to compare production cost budgeted with actual production costs. However, due to scarce information, it is not possible to provide insight as to possible shortfalls from an economic perspective.

A well-defined trend can be observed in KZN between the cost to treat wastewater and the operational flow. The data does highlight that WWTWs with lower operational flow have higher production costs, e.g. Appelbosch, Glenwood, Darnall, Lynnfield Park, and Montebello. Some of the reported production costs seems excessive and needs to be investigated by the respective Superintendents. Typically, larger plants with higher inflows benefit from economies of scale and would show a lower production cost compared to its low-flow counterparts. The main cost drivers are staff (fixed cost), and energy and chemical costs, which are variable costs, and which depend on the operational status of a plant.

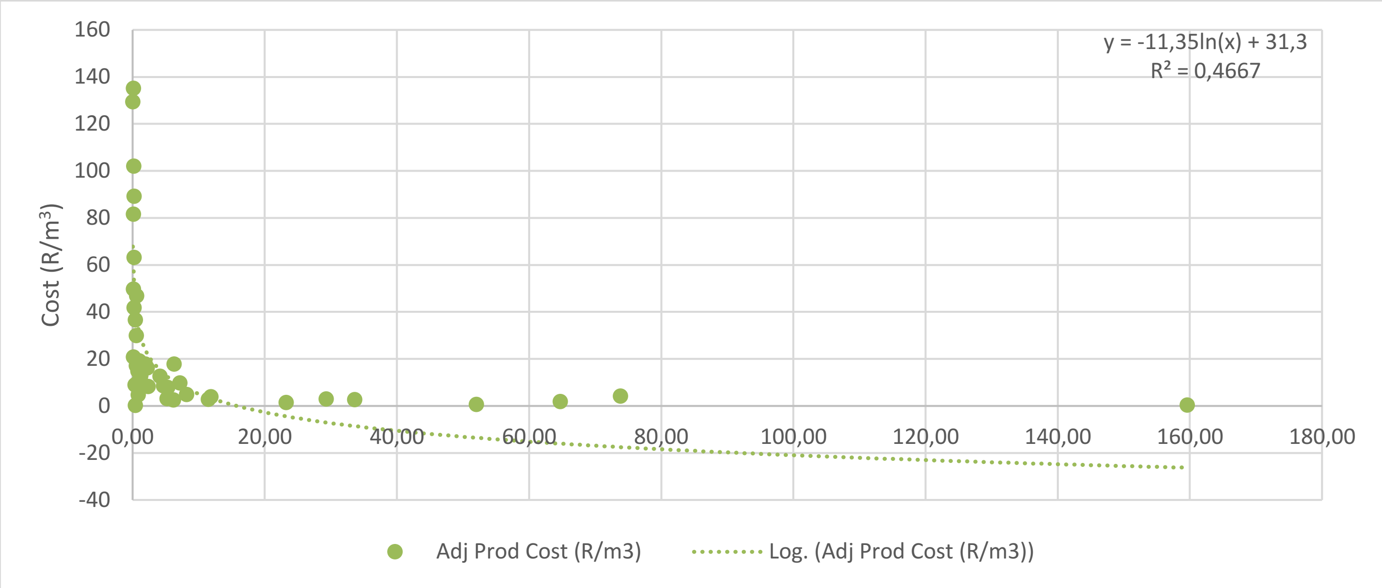


Figure 103 - Adjusted production cost (R/m³) for wastewater treatment, sorted by operational capacity (inflow) per WWTW

The following plot shows that the production cost for treatment of wastewater ranges from R0.22 to R135 per m³. The average cost to treat 1 m³ of wastewater is R24.65 and median cost is R10.12, with the latter giving the more representative estimate of production cost. A logarithmic trendline was fitted to the reported values with a correlation coefficient of 68.3%. Using this fit, 46.7% (R^2) of the variation in the costs to treat wastewater in the KZN depends on the operational flow.

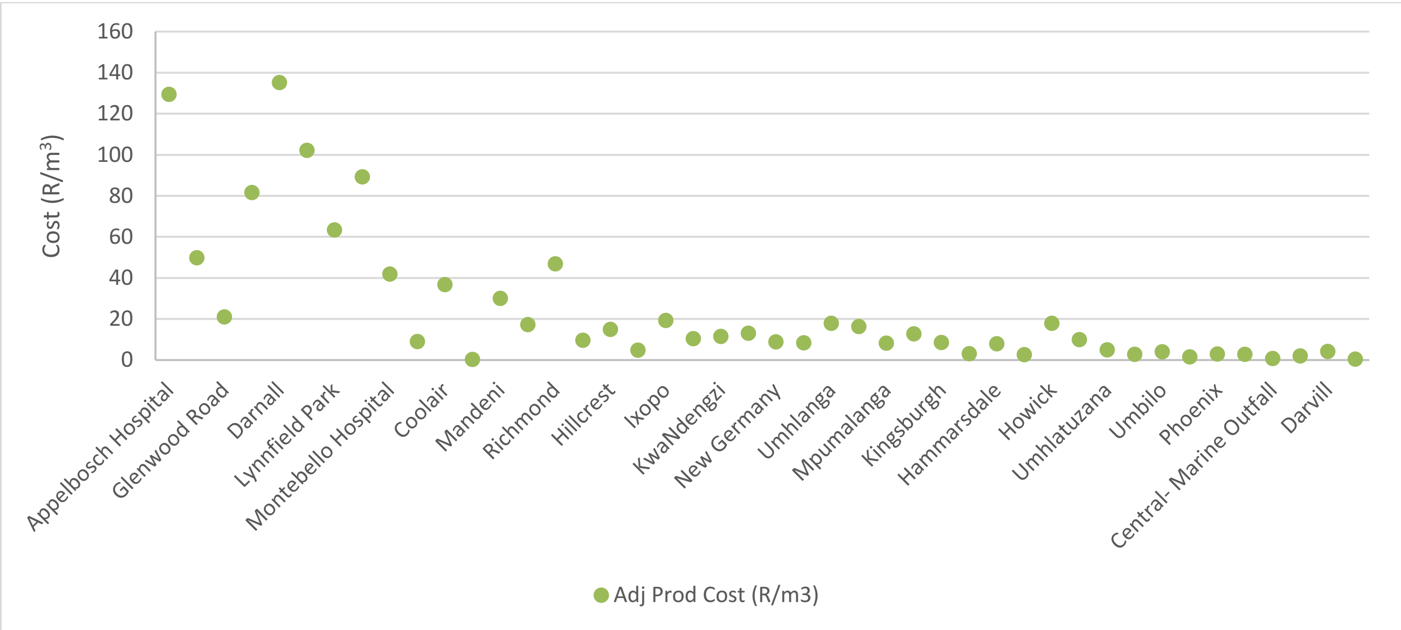


Figure 104 - Adjusted production cost (R/m³) for wastewater treatment, as a function of operational capacity (inflow)

The implication of these statistics combined with observations from the audits, is that a number of municipalities have verified, accurate production costs, and is recognised as an valuable input in optimising plant operations. Given the lack of data by some municipalities, it is imperative that Superintendents start to monitor production (treatment) cost as a parameter within the reporting framework.

Data Certainty

Data certainty is expressed at different levels for the financial and asset figures reported within this Diagnostic. Certainty levels differ from system to system, hence some WSAs are included in multiple data certainty categories - as the data is variable, inconsistent, limited or non-existent (NI) for each of the systems. The various WSAs in the province that were identified under the category ''High Certainty", presented consistent and verifiable evidence in the form of budgets, expenditure, asset registers, and unit costs.

Table 110 - Levels of certainty associated with financial and asset information reported by municipalities

Data Certainty	Description	WSA
No certainty	Absent data or no certainty in data presented - not ringfenced for WWTW & Network	uMzinyathi, uMkhanyakude
Low certainty	Minor or little certainty in the data - partially ringfenced for WWTW only or data as extreme outliers	eThekwini, Harry Gwala; All the remaining systems
Reasonable/good certainty	Reasonable to good level of certainty in the data - ringfenced for WWTW and/or Network and data falls within/close to expected parameters	uMgungundlovu, eThekwini, iLembe Msunduzi, Harry Gwala
High certainty	High level of certainty in the data - ringfenced for WWTW and Network and data falls within expected parameters	iLembe (2 no. Siza Water systems only)

7.1 Amajuba District Municipality

Water Service Institution	**Amajuba DM**	
Water Service Provider	Amajuba DM	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Low incoming flow due to collector system failure 2. Faulty clarifier bridge - gearbox leaking oil, noisy 3. Faulty gas chlorination system 4. Faulty flow inducer in the reactor 5. Faulty mechanical screen remover **VROOM estimate:** - R9,400,000
2021 Green Drop Score	**35%↓**	
2013 Green Drop Score	**60%**	
2011 Green Drop Score	**59%**	
2009 Green Drop Score	**47%**	

Key Performance Area	Unit	Utrecht	Tweediedale	Durnacol
Green Drop Score (2021)		**59%**	**32%**	**27%**
2013 Green Drop Score		**46%**	**56%**	**70%**
2011 Green Drop Score		**70%**	**72%**	**40%**
2009 Green Drop Score		**47%**	**47%**	**47%**
System Design Capacity	Ml/d	1	2	2
Design capacity utilised (%)		75%	11%	23%
Resource Discharged into		Dorpspruit	Alcockspruit	Kalabas Stream
Wastewater Risk Rating (CRR% of CRR_{max})		**Utrecht**	**Tweediedale**	**Durnacol**
CRR (2011)	%	64.7%	47.1%	58.8%
CRR (2013)	%	70.6%	47.1%	41.2%
CRR (2021)	%	52.9%	76.5%	76.5%

Technical Site Assessment: **Durnacol WWTW 67%**

7.2 eThekwini Metropolitan Municipality

Water Service Institution	**eThekwini Metro**	
Water Service Provider	eThekwini Metro	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Mechanical equipment needs attention 2. Belt presses at some plant stationary 3. Sludge pumps, aerators, mixers, clarifiers 4. Sludge treatment infrastructure and chemicals **VROOM Estimate**: - R136,076,100
2021 Green Drop Score	**76%↓**	
2013 Green Drop Score	**90%**	
2011 Green Drop Score	**91%**	
2009 Green Drop Score	**80%**	

Key Performance Area	**Unit**	**Verulam**	**Tongaat Central**	**Genazzano**	**Umdloti**
Green Drop Score (2021)		**80%**	**76%**	**80%**	**84%**
2013 Green Drop Score		**78%**	**86%**	**91%**	**91%**
2011 Green Drop Score		**81%**	**82%**	**75%**	**90%**
2009 Green Drop Score		**91%**	**69%**	**68%**	**90%**
System Design Capacity	Ml/d	13	10	1.8	3
Design Capacity Utilisation (%)		32%	62%	46%	18%
Resource Discharged into		Umdloti River	Tongaat River	Storm water drain to beach	Umdloti River
Wastewater Risk Rating (CRR% of CRR_{max})		**Verulam**	**Tongaat Central**	**Genazzano**	**Umdloti**
CRR (2011)	%	45.5%	59.1%	47.1%	29.4%
CRR (2013)	%	36.4%	50.0%	35.3%	29.4%
CRR (2021)	%	45.5%	54.6%	52.9%	41.2%

Key Performance Area	**Unit**	**Phoenix**	**KwaMashu**	**Umhlanga**	**Hammarsdale**
Green Drop Score (2021)		**84%**	**74%**	**73%**	**74%**
2013 Green Drop Score		**93%**	**96%**	**88%**	**90%**
2011 Green Drop Score		**99%**	**88%**	**87%**	**78%**
2009 Green Drop Score		**92%**	**71%**	**90%**	**73%**
System Design Capacity	Ml/d	50	65	6.8	13
Design Capacity Utilisation (%)		59%	100%	28%	41%
Resource Discharged into		Ohlanga River	Piesang River	Ohlanga River	Sterk River
Wastewater Risk Rating (CRR% of CRR_{max})		**Phoenix**	**KwaMashu**	**Umhlanga**	**Hammarsdale**
CRR (2011)	%	48.1%	59.4%	54.5%	54.5%
CRR (2013)	%	48.2%	43.8%	45.5%	40.7%
CRR (2021)	%	48.1%	56.3%	45.5%	50.0%

Key Performance Area	**Unit**	**Mpumalanga**	**Fredville**	**KwaNdengzi**	**Hillcrest**
Green Drop Score (2021)		**76%**	**76%**	**78%**	**75%**
2013 Green Drop Score		**87%**	**90%**	**89%**	**90%**
2011 Green Drop Score		**89%**	**88%**	**88%**	**86%**
2009 Green Drop Score		**89%**	**59%**	**68%**	**71%**
System Design Capacity	Ml/d	6.4	2	2.4	1.2
Design Capacity Utilisation (%)		37%	33%	46%	66%
Resource Discharged into		Umlaas River	Umgeni River	Mlazi River	Umhlatuzana River
Wastewater Risk Rating (CRR% of CRR_{max})		**Mpumalanga**	**Fredville**	**KwaNdengzi**	**Hillcrest**

Key Performance Area	Unit	Mpumalanga	Fredville	KwaNdengzi	Hillcrest
CRR (2011)	%	36.4%	58.8%	35.3%	47.1%
CRR (2013)	%	31.8%	35.3%	41.2%	52.9%
CRR (2021)	%	40.9%	35.3%	58.8%	52.9%

Key Performance Area	Unit	Dassenhoek	Glenwood Road	Cato Ridge	Umbilo
Green Drop Score (2021)		**86%**	**78%**	**74%**	**71%**
2013 Green Drop Score		**91%**	**77%**	**97%**	**78%**
2011 Green Drop Score		**80%**	**80%**	**82%**	**78%**
2009 Green Drop Score		**89%**	**87%**	**68%**	**69%**
System Design Capacity	Ml/d	5	0.04	0.95	23.2
Design Capacity Utilisation (%)		25%	250%	9%	51%
Resource Discharged into		Umlaas River / Situndu river	Umhlatuzana River	Tributary of Umlaas River	Umbilo River
Wastewater Risk Rating (CRR% of CRR_{max})		**Dassenhoek**	**Glenwood Road**	**Cato Ridge**	**Umbilo**
CRR (2011)	%	31.8%	29.4%	71.4%	59.3%
CRR (2013)	%	41.2%	41.2%	23.5%	55.7%
CRR (2021)	%	27.3%	64.7%	47.1%	59.3%

Key Performance Area	Unit	Northern works	Umhlatuzana	New Germany	Isipingo
Green Drop Score (2021)		**79%**	**79%**	**72%**	**78%**
2013 Green Drop Score		**81%**	**86%**	**79%**	**78%**
2011 Green Drop Score		**86%**	**88%**	**87%**	**81%**
2009 Green Drop Score		**71%**	**91%**	**68%**	**91%**
System Design Capacity	Ml/d	70	14.8	7	18.8
Design Capacity Utilisation (%)		48%	55%	20%	61%
Resource Discharged into		Umgeni River	Umhlatuzana River	Aller River	Isipingo River
Wastewater Risk Rating (CRR% of CRR_{max})		**Northern works**	**Umhlatuzana**	**New Germany**	**Isipingo**
CRR (2011)	%	59.4%	40.9%	50.0%	45.5%
CRR (2013)	%	53.1%	40.9%	50.0%	36.4%
CRR (2021)	%	46.9%	54.5%	50.0%	54.5%

Key Performance Area	Unit	Central- Marine Outfall	Southern Works	Amanzimtoti	Craigieburn
Green Drop Score (2021)		**71%**	**76%**	**74%**	**70%**
2013 Green Drop Score		**97%**	**94%**	**78%**	**80%**
2011 Green Drop Score		**96%**	**92%**	**96%**	**90%**
2009 Green Drop Score		**90%**	**91%**	**93%**	**92%**
System Design Capacity	Ml/d	135	230	27	1
Design Capacity Utilisation (%)		39%	69%	86%	101%
Resource Discharged into		Indian Ocean	Indian Ocean	Umbogintwini/ Mbokodweni River	Hlongwana River
Wastewater Risk Rating (CRR% of CRR_{max})		**Central- Marine Outfall**	**Southern Works**	**Amanzimtoti**	**Craigieburn**
CRR (2011)	%	43.2%	52.4%	48.1%	41.2%
CRR (2013)	%	46.0%	47.6%	40.7%	58.8%
CRR (2021)	%	37.8%	57.1%	51.9%	64.7%

Key Performance Area	Unit	Kingsburgh	Umkomaas	Magabeni
Green Drop Score (2021)		**85%**	**79%**	**81%**
2013 Green Drop Score		**83%**	**96%**	**88%**
2011 Green Drop Score		**95%**	**92%**	**90%**
2009 Green Drop Score		**69%**	**91%**	**68%**
System Design Capacity	Ml/d	7	1	0.8
Design Capacity Utilisation (%)		67%	36%	53%
Resource Discharged into		Little Manzimtoti river	Umkomaas River	Little Ngane river
Wastewater Risk Rating (CRR% of CRR_{max})		**Kingsburgh**	**Umkomaas**	**Magabeni**
CRR (2011)	%	50.0%	29.4%	47.1%
CRR (2013)	%	45.5%	35.3%	47.1%
CRR (2021)	%	54.5%	52.9%	52.9%

Technical Site Assessment: **KwaMuashu WWTW 67%; Umbilo WWTW 91%**

7.3 Harry Gwala District Municipality

Water Service Institution	**Harry Gwala DM**	
Water Service Providers	Harry Gwala DM Umgeni Water (Ixopo only)	
Municipal Green Drop Score		
2021 Green Drop Score	**64%↓**	**VROOM Impression (Towards restoring functionality):** 1. Vandalism and theft 2. Operational improvements and SOPs. **VROOM Estimate**: - R9,712,800
2013 Green Drop Score	**67%**	
2011 Green Drop Score	**55%**	
2009 Green Drop Score	**34%**	

Key Performance Area	Unit	Bulwer	Polela	St Apolinaris	Underberg Old
Green Drop Score (2021)		**58%**	**56%**	**53%**	**57%**
2013 Green Drop Score		**49%**	**60%**	**52%**	**54%**
2011 Green Drop Score		**41%**	**31%**	**34%**	**27%**
2009 Green Drop Score		**NA**	**NA**	**NA**	**37%**
System Design Capacity	Ml/d	0.13	0.03	0.7	0.24
Design Capacity Utilisation (%)		85%	67%	100%	50%
Resource Discharged into		Orange River	uMkomaas	Umzimkhulu	Umzimkhulu
Wastewater Risk Rating (CRR% of CRR_{max})		**Bulwer**	**Polela**	**St Apolinaris**	**Underberg Old**
CRR (2011)	%	82.4%	64.7%	70.6%	82.4%
CRR (2013)	%	58.8%	64.7%	52.9%	58.8%
CRR (2021)	%	58.8%	52.9%	58.8%	58.8%

Key Performance Area	Unit	Underberg New	Himeville	Kokstad	Franklin
Green Drop Score (2021)		**67%**	**60%**	**63%**	**57%**
2013 Green Drop Score		**NA**	**NA**	**64%**	**45%**
2011 Green Drop Score		**NA**	**NA**	**56%**	**NA**
2009 Green Drop Score		**0%**	**0%**	**37%**	**0%**
Design System Design Capacity	Ml/d	0.18	0.15	6.4	0.15
Capacity Utilisation (%)		NI	NI	125%	133%
Resource Discharged into		Polena	Polena	Umzintlava	Umzintlava
Wastewater Risk Rating (CRR % of CRR_{max})		**Underberg New**	**Himeville**	**Kokstad**	**Franklin**
CRR (2011)	%	NA	NA	59.1%	45.0%
CRR (2013)	%	NA	NA	68.2%	70.6%
CRR (2021)	%	70.6%	76.5%	59.1%	82.4%

Key Performance Area	Unit	Mzimkhulu	Ibisi	Riverside	Ixopo
Green Drop Score (2021)		**61%**	**58%**	**54%**	**91%->89%**
2013 Green Drop Score		**71%**	**NA**	**73%**	**92%**
2011 Green Drop Score		**60%**	**NA**	**41%**	**65%**
2009 Green Drop Score		**37%**	**NA**	**21%**	**39%**
System Design Capacity	Ml/d	2	0.8	0.6	1.4
Design Capacity Utilisation (%)		20%	49%	74%	71%
Resource Discharged into		Umzimkhulu River	Ibisi River	Ngwagwane	Ixopo River

Wastewater Risk Rating (CRR % of CRR_{max})		Mzimkhulu	Ibisi	Riverside	Ixopo
CRR (2011)	%	52.9%	NA	52.9%	33.2%
CRR (2013)	%	41.2%	NA	52.9%	29.4%
CRR (2021)	%	70.6%	70.6%	76.5%	47.1%

Technical Site Assessment: **Kokstad WWTW 85%**

7.4 iLembe District Municipality

Water Service Institution	**iLembe District Municipality**
Water Service Providers	iLembe District Municipality (10 of 12 systems) Siza Water (Frasers and Shakaskraal)

Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):**
2021 Green Drop Score	**73%↓**	1. The stockpiling and disposal of the sludge
2013 Green Drop Score	**83%**	2. Desludging the sludge ponds 3. Removing the debris layer on the emergency dams
2011 Green Drop Score	**80%**	4. Mechanical screen 5. Wall seepage problem at the inlet and balancing tank structures
2009 Green Drop Score	**43%**	**VROOM Estimate:** - R2,038,100

Key Performance Area	**Unit**	**Darnall**	**Frasers**	**Gledhow**	**Mandeni**
Green Drop Score (2021)		**63%**	**95%**	**66%**	**67%**
2013 Green Drop Score		**75%**	**99%**	**69%**	**73%**
2011 Green Drop Score		**70%**	**98%**	**69%**	**82%**
2009 Green Drop Score		**44%**	**52%**	**44%**	**45%**
System Design Capacity	Ml/d	0.33	12	0.7	1.3
Design Capacity Utilisation (%)		40%	60%	29%	41%
Resource Discharged into		Nonoti River	Tongaat River	Ntshawini River	Tugela River
Wastewater Risk Rating (CRR% of CRR_{max})		**Darnall**	**Frasers**	**Gledhow**	**Mandeni**
CRR (2011)	%	50.0%	30.0%	56.0%	28.0%
CRR (2013)	%	29.0%	27.0%	59.0%	47.0%
CRR (2021)	%	58.8%	31.8%	41.2%	35.3%

Key Performance Areat	**Unit**	**Maphumulo Hospital**	**Montebello Hospital**	**Ntunjambili Hospital**	**Shakaskraal**
Green Drop Score (2021)		**61%**	**48%**	**74%**	**93%**
2013 Green Drop Score		**61%**	**69%**	**52%**	**97%**
2011 Green Drop Score		**76%**	**65%**	**52%**	**68%**
2009 Green Drop Score		**44%**	**44%**	**43%**	**45%**
System Design Capacity	Ml/d	0.2	0.25	0.2	1.6
Design Capacity Utilisation (%)		49%	93%	36%	93%
Resource Discharged into		Notweni River	Umdlotshana Stream	Stream into Tugela River	Umhlahli River
Wastewater Risk Rating (CRR% of CRR_{max})		**Maphumulo Hospital**	**Montebello Hospital**	**Ntunjambili Hospital**	**Shakaskraal**
CRR (2011)	%	39.0%	50.0%	44.0%	17.0%
CRR (2013)	%	53.0%	53.0%	35.0%	24.0%
CRR (2021)	%	29.4%	70.6%	41.2%	29.4%

Key Performance Area	**Unit**	**Stanger-KwaDukuza**	**Sundumbili**	**Tugela**	**Vukile**
Green Drop Score (2021)		**56%**	**67%**	**60%**	**66%**
2013 Green Drop Score		**71%**	**83%**	**79%**	**32%**
2011 Green Drop Score		**75%**	**68%**	**74%**	**NA**
2009 Green Drop Score		**44%**	**46%**	**0%**	**0%**
System Design Capacity	Ml/d	10	12.5	0.75	0.932

Key Performance Area	Unit	Stanger-KwaDukuza	Sundumbili	Tugela	Vukile
System Design Capacity		NI	42%	21%	67%
Resource Discharged into		Mbozambo Stream	Mandeni Stream	Tugela River	No discharge
Wastewater Risk Rating (CRR % of CRR_{max})		**Stanger-KwaDukuza**	**Sundumbili**	**Tugela**	**Vukile**
CRR (2011)	%	39.0%	61.0%	39.0%	NA
CRR (2013)	%	55.0%	50.0%	41.0%	82.0%
CRR (2021)	%	86.4%	45.5%	41.2%	29.4%

Technical Site Assessment: **Frasers WWTW 94%**

7.5 King Cetshwayo District Municipality

Water Service Institution	**King Cetshwayo District Municipality**	
Water Service Provider	King Cetshwayo District Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Mtunzini WWTW was in a good condition and was operated well 2. Apart from corrosion in the buffer tank and leaks in the clarifier of the second reactor, the state of civil infrastructure was good 3. Mechanical equipment was operational 4. Final outflow meter was not operational and inflow meter not calibrated 5. Staff facilities needed attention. **VROOM Estimate:** - R20,203,000
2021 Green Drop Score	**38%↑**	
2013 Green Drop Score	**26%**	
2011 Green Drop Score	**68%**	
2009 Green Drop Score	**50%**	

Key Performance Area	Unit	Catherine Booth Hospital	Ekhombe Hospital	Ekuphumuleni Hospital	Gingindlovu Ponds
Green Drop Score (2021)		**36%**	**52%**	**48%**	**34%**
2013 Green Drop Score		**23%**	**19%**	**19%**	**19%**
2011 Green Drop Score		**53%**	**48%**	**51%**	**49%**
2009 Green Drop Score		**52%**	**53%**	**53%**	**53%**
System Design Capacity	Ml/d	0.2	0.2	0.1	0.5
Design Capacity Utilisation (%)		80%	NI	90%	NI
Resource Discharged into		Unknown	No discharge	No discharge	Matikulu River
Wastewater Risk Rating (CRR% of CRR_{max})		**Catherine Booth Hospital**	**Ekhombe Hospital**	**Ekuphumuleni Hospital**	**Gingindlovu Ponds**
CRR (2011)	%	100.0%	100.0%	100.0%	100.0%
CRR (2013)	%	76.5%	76.5%	70.6%	88.2%
CRR (2021)	%	76.5%	41.2%	29.4%	88.2%

Key Performance Area	Unit	King Dinuzulu	KwaBadala	Mbongolwane Hospital	Melmoth Ponds
Green Drop Score (2021)		**35%**	**50%**	**32%**	**41%**
2013 Green Drop Score		**33%**	**26%**	**16%**	**45%**
2011 Green Drop Score		**48%**	**48%**	**51%**	**50%**
2009 Green Drop Score		**53%**	**53%**	**52%**	**53%**
System Design Capacity	Ml/d	0.9	0.1	0.2	0.4
Design Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Gezinsila Stream	No discharge	Unknown	Mfulazane
Wastewater Risk Rating (CRR% of CRR_{max})		**King Dinuzulu**	**KwaBadala**	**Mbongolwane Hospital**	**Melmoth Ponds**
CRR (2011)	%	100.0%	100.0%	100.0%	100.0%
CRR (2013)	%	88.2%	70.6%	70.6%	64.7%
CRR (2021)	%	88.2%	41.2%	88.2%	88.2%

Key Performance Area	Unit	Mpushini Ponds	Mtunzini	Nkandla	Oceanview
Green Drop Score (2021)		**39%**	**46%**	**34%**	**32%**
2013 Green Drop Score		**29%**	**22%**	**23%**	**32%**
2011 Green Drop Score		**49%**	**47%**	**52%**	**51%**
2009 Green Drop Score		**53%**	**52%**	**53%**	**53%**
System Design Capacity	Ml/d	1.5	1.5	0.8	0.5
Design Capacity Utilisation (%)		NI	93%	NI	120%

Key Performance Area	Unit	Mpushini Ponds	Mtunzini	Nkandla	Oceanview
Resource Discharged into		Sugar Cane fields	Siyayi Stream to Umlalazi river	Mahlayezeni	Mkhukhuzwe
Wastewater Risk Rating (CRR% of CRR_{max})		**Mpushini Ponds**	**Mtunzini**	**Nkandla**	**Oceanview**
CRR (2011)	%	100.0%	100.0%	100.0%	100.0%
CRR (2013)	%	82.4%	58.8%	70.6%	70.6%
CRR (2021)	%	88.2%	76.5%	88.2%	82.4%

Key Performance Area	Unit	Owen Sithole Agriculture College
Green Drop Score (2021)		**33%**
2013 Green Drop Score		**24%**
2011 Green Drop Score		**50%**
2009 Green Drop Score		**52%**
System Design Capacity	Ml/d	1.5
Design Capacity Utilisation (%)		NI
Resource Discharged into		Cwaka Stream to Nseleni River
Wastewater Risk Rating (CRR% of CRR_{max})		**Owen Sithole Agriculture College**
CRR (2011)	%	100.0%
CRR (2013)	%	82.4%
CRR (2021)	%	88.2%

Technical Site Assessment: **Mtunzini WWTW 70%**

7.6 Msunduzi Local Municipality

Water Service Institution	**Msunduzi LM**	
Water Service Providers	Umgeni Water	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Pump and mechanical screen repairs 2. Procurement of spare parts 3. Mechanical screening 4. Primary sludge accumulation in balancing tank 5. Pump station and network issues **VROOM Estimate:** - R6,040,000
2021 Green Drop Score	**78%↓**	
2013 Green Drop Score	**79%**	
2011 Green Drop Score	**79%**	
2009 Green Drop Score	**43%**	

Key Performance Area	Unit	Darvill	Lynnfield Park
Green Drop Score (2021)		**78%**	**88%**
2013 Green Drop Score		**79%**	**62%**
2011 Green Drop Score		**79%**	**33%**
2009 Green Drop Score		**56%**	**29%**
System Design Capacity	Ml/d	75	0.5
Design capacity utilisation (%)		98%	40%
Resource Discharged into		Msunduzi river	Malkopspruit River
Wastewater Risk Rating (CRR% of CRR_{max})		**Darvill**	**Lynnfield Park**
CRR (2011)	%	45.0%	72.0%
CRR (2013)	%	69.0%	41.0%
CRR (2021)	%	53.1%	17.6%

Technical Site Assessment: **Lynnfield Park WWTW 87%**

7.7 Newcastle Local Municipality

Water Service Institution		**Newcastle Local Municipality**
Water Service Provider		Newcastle Local Municipality
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Aeration in activated sludge reactor 2. Return sludge to reactor 3. Non-functional clarifier 4. Blocked PSTs resulting in sludge carry-over 5. No chlorine contact channel on biofilter plant module 6. Disinfection compromised 7. Maturation ponds sludged up 8. Mechanical maintenance defects **VROOM Estimate**: - R30,856,000
2021 Green Drop Score	**58%↓**	
2013 Green Drop Score	**78%**	
2011 Green Drop Score	**72%**	
2009 Green Drop Score	**41%**	

Key Performance Area	**Unit**	**Charlestown**	**Kilbarchan**	**Madadeni**	**Newcastle**
Green Drop Score (2021)		**54%**	**65%**	**53%**	**60%**
2013 Green Drop Score		**56%**	**76%**	**75%**	**80%**
2011 Green Drop Score		**18%**	**59%**	**0%**	**79%**
2009 Green Drop Score		**24%**	**50%**	**0%**	**38%**
System Design Capacity	Ml/d	0.5	1	12	25
Design capacity utilisation (%)		30%	20%	58%	44%
Resource Discharged into		No Discharge	Ngagane River	Buffalo River	Ngagane River
Wastewater Risk Rating (CRR % of CRR_{max})		**Charlestown**	**Kilbarchan**	**Madadeni**	**Newcastle**
CRR (2011)	%	35.3%	35.3%	54.5%	44.4%
CRR (2013)	%	41.2%	35.3%	59.1%	48.1%
CRR (2021)	%	29.4%	23.5%	50.0%	33.3%

Key Performance Area	**Unit**	**Osizweni**
Green Drop Score (2021)		**61%**
2013 Green Drop Score		**78%**
2011 Green Drop Score		**65%**
2009 Green Drop Score		**50%**
System Design Capacity	Ml/d	14.7
Design capacity utilisation (%)		87%
Resource Discharged into		Buffalo River
Wastewater Risk Rating (CRR % of CRR_{max})		**Osizweni**
CRR (2011)	%	45.5%
CRR (2013)	%	40.9%
CRR (2021)	%	40.9%

Technical Site Assessment: **Osizweni WWTW 66%**

7.8 Ugu District Municipality

Water Service Institution	**Ugu District Municipality**	
Water Service Provider	Ugu District Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Mechanical problems prevailing major issue at all process units 2. Mechanical screen 3. WAS and RAS pumps, screw pumps, aerators, clarifiers, and dewatering unit 4. Chlorine disinfection unit and the contact tank 5. Electricals and MCC panels as a whole 6. Security, health and safety issues and risks hazards at both WWTW and pump station **VROOM Estimate:** - R180,256,800
2021 Green Drop Score	**46%↓**	
2013 Green Drop Score	**74%**	
2011 Green Drop Score	**70%**	
2009 Green Drop Score	**51%**	

Key Performance Area	Unit	Eden Wilds	Gamalakhe	Harding	KwaMbonwa
Green Drop Score (2021)		**45%**	**52%**	**46%**	**50%**
2013 Green Drop Score		**66%**	**75%**	**78%**	**70%**
2011 Green Drop Score		**65%**	**78%**	**61%**	**81%**
2009 Green Drop Score		**40%**	**40%**	**40%**	**40%**
System Design Capacity	Ml/d	0.25	3	1.6	0.1
Design Capacity Utilisation (%)		96%	68%	71%	63%
Resource Discharged into		Umthamvuna River	Uvungu River (Uvongo)	Umzimkhulwana River	Mkhoba Stream
Wastewater Risk Rating (CRR% of CRR_{max})		**Eden Wilds**	**Gamalakhe**	**Harding**	**KwaMbonwa**
CRR (2011)	%	39.0%	44.0%	44.0%	33.0%
CRR (2013)	%	59.0%	53.0%	59.0%	41.0%
CRR (2021)	%	58.8%	64.7%	70.6%	47.1%

Key Performance Area	Unit	Malangeni	Margate	uMbango	Melville
Green Drop Score (2021)		**39%**	**45%**	**49%**	**42%**
2013 Green Drop Score		**35%**	**75%**	**76%**	**70%**
2011 Green Drop Score		**NA**	**72%**	**67%**	**62%**
2009 Green Drop Score		**NA**	**68%**	**43%**	**47%**
System Design Capacity	Ml/d	0.45	8	12	0.7
Design Capacity Utilisation (%)		89%	46%	75%	100%
Resource Discharged into		Sezela River	Deep sea outfall and River discharge	Umbango River	Domba River
Wastewater Risk Rating (CRR% of CRR_{max})		**Malangeni**	**Margate**	**uMbango**	**Melville**
CRR (2011)	%	NA	49.0%	57.0%	NA
CRR (2013)	%	65.0%	55.0%	50.0%	71.0%
CRR (2021)	%	70.6%	54.5%	59.1%	58.8%

Key Performance Area	Unit	Munster	Murchison Hospital	Palm Beach/ Empanjathi	Pennington
Green Drop Score (2021)		**50%**	**39%**	**43%**	**45%**
2013 Green Drop Score		**88%**	**60%**	**65%**	**76%**
2011 Green Drop Score		**79%**	**NA**	**73%**	**77%**
2009 Green Drop Score		**38%**	**45%**	**50%**	**47%**
System Design Capacity	Ml/d	0.18	0.25	0.7	2
Design Capacity Utilisation (%)		NI	20%	86%	40%

Key Performance Area	Unit	Munster	Murchison Hospital	Palm Beach/ Empanjathi	Pennington
Resource Discharged into		No discharge	Mtengwane river – tributary to Boboyi River	Mpenjathi River	Nkomba River and Deep-Sea Outfall
Wastewater Risk Rating (CRR% of CRR_{max})		Munster	Murchison Hospital	Palm Beach/ Empanjathi	Pennington
CRR (2011)	%	44.0%	NA	44.0%	33.0%
CRR (2013)	%	59.0%	76.0%	35.0%	53.0%
CRR (2021)	%	41.2%	70.6%	58.8%	58.8%

Key Performance Area	Unit	Ramsgate	Red Desert	Scottburgh	Shelly Beach
Green Drop Score (2021)		43%	58%	40%	47%
2013 Green Drop Score		65%	90%	67%	76%
2011 Green Drop Score		68%	84%	78%	69%
2009 Green Drop Score		47%	40%	70%	50%
System Design Capacity	Ml/d	1.5	0.6	2.25	0.75
Design Capacity Utilisation (%)		51%	75%	100%	60%
Resource Discharged into		Little Ibilanhlolo River	No-discharge	Deep Sea Outfall and River discharge	Umhlangeni River
Wastewater Risk Rating (CRR% of CRR_{max})		Ramsgate	Red Desert	Scottburgh	Shelly Beach
CRR (2011)	%	61.0%	44.0%	44.0%	50.0%
CRR (2013)	%	65.0%	47.0%	59.0%	41.0%
CRR (2021)	%	58.8%	29.4%	64.7%	58.8%

Key Performance Area	Unit	Southbroom	Umzinto	Uvongo
Green Drop Score (2021)		35%	44%	47%
2013 Green Drop Score		73%	70%	76%
2011 Green Drop Score		77%	69%	62%
2009 Green Drop Score		47%	47%	70%
System Design Capacity	Ml/d	0.1	2.5	2.4
Design Capacity Utilisation (%)		50%	72%	67%
Resource Discharged into		Kaba River	Unknown Tributary to Mpambyoni River	Uvungu River
Wastewater Risk Rating (CRR% of CRR_{max})		Southbroom	Umzinto	Uvongo
CRR (2011)	%	39.0%	56.0%	50.0%
CRR (2013)	%	47.0%	53.0%	65.0%
CRR (2021)	%	70.6%	70.6%	64.7%

Technical Site Assessment: **uMbango WWTW 42%**

7.9 uMgungundlovu District Municipality

Water Service Institution	**uMgungundlovu District Municipality**		
Water Service Provider	Umgeni Water		
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Non-functional inflow meters 2. Excess sludge and sludge handling 3. RAS recycle pumps dysfunctional and under repair 4. Disinfection during high flows 5. Acquisition of critical spares and associated procurement problems **VROOM Estimate:** - R2,926,000	
2021 Green Drop Score	**86%↑**		
2013 Green Drop Score	**76%**		
2011 Green Drop Score	**74%**		
2009 Green Drop Score	**27%**		

Key Performance Area	Unit	Appelbosch Hospital	Camperdown	Coolair	Howick
Green Drop Score (2021)		**84%**	**85%**	**91%**	**87%**
2013 Green Drop Score		**88%**	**65%**	**88%**	**75%**
2011 Green Drop Score		**83%**	**72%**	**89%**	**74%**
2009 Green Drop Score		**11%**	**30%**	**33%**	**36%**
System Design Capacity	Ml/d	0.5	0.5	1	6.8
Design capacity utilisation (%)		8%	24%	40%	92%
Resource Discharged into		Toboti River	Unknown	Mhlalane River	Umgeni River
Wastewater Risk Rating (CRR% of CRR$_{max}$)		**Appelbosch Hospital**	**Camperdown**	**Coolair**	**Howick**
CRR (2011)	%	28.0%	50.0%	22.0%	43.0%
CRR (2013)	%	29.0%	41.0%	35.0%	50.0%
CRR (2021)	%	17.6%	23.5%	17.6%	45.5%

Key Performance Area	Unit	Mpofana (Mooi River)	Richmond
Green Drop Score (2021)		**81%**	**86%**
2013 Green Drop Score		**71%**	**86%**
2011 Green Drop Score		**60%**	**81%**
2009 Green Drop Score		**26%**	**28%**
System Design Capacity	Ml/d	3.5	1
Design capacity utilisation (%)		63%	58%
Resource Discharged into		Mooi River	Lovu River
Wastewater Risk Rating (CRR% of CRR$_{max}$)		**Mpofana (Mooi River)**	**Richmond**
CRR (2011)	%	44.0%	33.0%
CRR (2013)	%	47.0%	35.0%
CRR (2021)	%	47.1%	29.4%

Technical Site Assessment: **Howick WWTW 86%**

7.10 City of uMhlathuze Local Municipality

Water Service Institution	**uMhlathuze Local Municipality**	
Water Service Provider	uMhlathuze Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Inlet works requires attention 2. One mixer and one aerator in reactor not operational 3. Clarifier 2 blocked with a non-functional bridge 4. No sludge wastage 5. Sludge drying beds overgrown and not in use. **VROOM Estimate:** - R55,198,000
2021 Green Drop Score	**58%↓**	
2013 Green Drop Score	**85%**	
2011 Green Drop Score	**83%**	
2009 Green Drop Score	**72%**	

Key Performance Area	**Unit**	**Empangeni**	**Esikhawini**	**Ngwelezana**	**Nseleni**	**Vulindlela**
Green Drop Score (2021)		**57%**	**55%**	**66%**	**58%**	**52%**
2013 Green Drop Score		**77%**	**87%**	**91%**	**91%**	**96%**
2011 Green Drop Score		**84%**	**83%**	**83%**	**86%**	**83%**
2009 Green Drop Score		**72%**	**72%**	**72%**	**72%**	**72%**
System Design Capacity	Ml/d	15	12.5	5.8	3	2.8
Design Capacity Utilisation (%)		43%	52%	83%	24%	12%
Resource Discharged into		Empangeni River	Sea outfall	Umhlathuze River	Nsesi River	Umhlathuze River
Wastewater Risk Rating (CRR% of CRR_{max})		**Empangeni**	**Esikhawini**	**Ngwelezana**	**Nseleni**	**Vulindlela**
CRR (2011)	%	50.0%	50.0%	36.4%	35.3%	35.3%
CRR (2013)	%	54.5%	50.0%	40.9%	29.4%	29.4%
CRR (2021)	%	50.0%	63.6%	45.5%	52.9%	58.8%

Technical Site Assessment: **Ngwelezana WWTW 59%**

7.11 uMkhanyakude District Municipality

Water Service Institution	**uMkhanyakude DM**	
Water Service Provider	Novubu Construction CC	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Surrounding fence required repair 2. No flow meter in place 3. Minor cracks and corrosion were observed at the Inlet works. **VROOM Estimate:** - R5,208,500
2021 Green Drop Score	**23%↓**	
2013 Green Drop Score	**30%**	
2011 Green Drop Score	**22%**	
2009 Green Drop Score	**4%**	

Key Performance Area	**Unit**	**Bethesda-Ubombo Hospital**	**Hlabisa**	**Hluhluwe**	**Ingwavuma-Mosvolt Hospital**
Green Drop Score (2021)		**20%**	**27%**	**19%**	**23%**
2013 Green Drop Score		**25%**	**27%**	**27%**	**23%**
2011 Green Drop Score		**25%**	**23%**	**21%**	**23%**
2009 Green Drop Score		**2%**	**1%**	**10%**	**1%**
System Design Capacity	Ml/d	0.3	0.72	0.25	1
Design Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Unknown stream to Mkuze River	Unknown stream to uMfolozi River	Mzimneni River	Unknonw stream to Pongola River
Wastewater Risk Rating (CRR% of CRR_{max})		**Bethesda-Ubombo Hospital**	**Hlabisa**	**Hluhluwe**	**Ingwavuma-Mosvolt Hospital**
CRR (2011)	%	64.7%	70.6%	64.7%	47.1%
CRR (2013)	%	64.7%	58.8%	58.8%	58.8%
CRR (2021)	%	70.6%	64.7%	70.6%	70.6%

Key Performance Area	**Unit**	**Jozini**	**Kwa Msane**	**Manguzi**	**Mkuze**
Green Drop Score (2021)		**31%**	**38%**	**42%**	**37%**
2013 Green Drop Score		**23%**	**40%**	**23%**	**26%**
2011 Green Drop Score		**24%**	**19%**	**24%**	**21%**
2009 Green Drop Score		**19%**	**0%**	**16%**	**1%**
System Design Capacity	Ml/d	0.5	1	0.5	1.2
Design Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Pongola River	Umfolozi River	No discharge	Mkuze River
Wastewater Risk Rating (CRR% of CRR_{max})		**Jozini**	**Kwa Msane**	**Manguzi**	**Mkuze**
CRR (2011)	%	58.8%	76.5%	52.9%	64.7%
CRR (2013)	%	47.1%	52.9%	58.8%	64.7%
CRR (2021)	%	58.8%	64.7%	70.6%	70.6%

Key Performance Area	**Unit**	**Mtubatuba**	**St Lucia Ponds**	**Umseleni**
Green Drop Score (2021)		**25%**	**0%**	**0%**
2013 Green Drop Score		**31%**	**27%**	**NA**
2011 Green Drop Score		**22%**	**24%**	**NA**
2009 Green Drop Score		**0%**	**1%**	**NA**
System Design Capacity	Ml/d	2	1	1
Design Capacity Utilisation (%)		35%	NI	NI
Resource Discharged into		Mfolozi River	St Lucia Wetland	Unknown

Key Performance Area	Unit	Mtubatuba	St Lucia Ponds	Umseleni
Wastewater Risk Rating (CRR% of CRR_{max})		Mtubatuba	St Lucia Ponds	Umseleni
CRR (2011)	%	35.3%	64.7%	NA
CRR (2013)	%	64.7%	58.8%	NA
CRR (2021)	%	64.7%	100.0%	100.0%

Technical Site Assessment: **Jozini WWTW 34%**

7.12 uMzinyathi District Municipality

Water Service Institution	**uMzinyathi District Municipality**	
Water Service Provider	uMzinyathi District Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Mechanical maintenance lacking (screens, mixers, sludge pumps) 2. Chlorine dosing facility 3. General preventative maintenance of mechanical and electrical equipment required **VROOM Estimate:** - R10,833,000
2021 Green Drop Score	**15%↓**	
2013 Green Drop Score	**57%**	
2011 Green Drop Score	**33%**	
2009 Green Drop Score	**48%**	

Key Performance Area	**Unit**	**Dundee**	**Greytown**	**Nquthu**	**Pomeroy Ponds**	**Tugela Ferry**
Green Drop Score (2021)		**16%**	**7%**	**15%**	**23%**	**27%**
2013 Green Drop Score		**70%**	**68%**	**73%**	**51%**	**24%**
2011 Green Drop Score		**31%**	**45%**	**55%**	**22%**	**24%**
2009 Green Drop Score		**48%**	**48%**	**48%**	**48%**	**48%**
System Design Capacity	Ml/d	10	3.2	1	1	0.5
Design Capacity Utilisation (%)		70%	141%	92%	10%	40%
Resource Discharged into		Steenkool Spruit	Nyokane River	Batshe River	No discharge	No discharge
Wastewater Risk Rating (CRR% of CRR_{max})		**Dundee**	**Greytown**	**Nquthu**	**Pomeroy Ponds**	**Tugela Ferry**
CRR (2011)	%	59.1%	58.8%	94.1%	47.1%	64.7%
CRR (2013)	%	45.5%	47.1%	29.4%	29.4%	35.3%
CRR (2021)	%	77.3%	82.4%	82.4%	52.9%	35.3%

Technical Site Assessment: **Dundee WWTW 74%**

7.13 uThukela District Municipality

Water Service Institution	**uThukela District Municipality**	
Water Service Provider	uThukela District Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Ezakheni is undergoing refurbishment, and is currently in a fair condition 2. Mechanical screens and degritters were not operational 3. Refurbishment of activated sludge reactor was close to complete but there was no power to plant and generator could only power one aerator and one mixer 4. Plant was receiving low flow due to vandalised pump stations. **VROOM Estimate:** - R37,301,500
2021 Green Drop Score	**46%↑**	
2013 Green Drop Score	**27%**	
2011 Green Drop Score	**38%**	
2009 Green Drop Score	**34%**	

Key Performance Area	**Unit**	**Bergville**	**Colenso**	**Ekuvukeni**	**Ezakheni**
Green Drop Score (2021)		**44%**	**43%**	**47%**	**44%**
2013 Green Drop Score		**28%**	**25%**	**26%**	**30%**
2011 Green Drop Score		**33%**	**30%**	**24%**	**35%**
2009 Green Drop Score		**20%**	**40%**	**37%**	**40%**
System Design Capacity	Ml/d	0.4	2.2	4	22
Design Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Tugela River	Tugela River	Sundays River	Klip River
Wastewater Risk Rating (CRR% of CRR$_{max}$)		**Bergville**	**Colenso**	**Ekuvukeni**	**Ezakheni**
CRR (2011)	%	90.9%	86.4%	70.6%	76.5%
CRR (2013)	%	85.2%	86.4%	58.8%	70.6%
CRR (2021)	%	70.6%	70.6%	88.2%	85.2%

Key Performance Area	**Unit**	**Ladysmith**	**Weenen Ponds**	**Wembezi**	**Winterton**
Green Drop Score (2021)		**45%**	**49%**	**50%**	**47%**
2013 Green Drop Score		**24%**	**50%**	**26%**	**26%**
2011 Green Drop Score		**35%**	**26%**	**48%**	**26%**
2009 Green Drop Score		**39%**	**18%**	**37%**	**39%**
System Design Capacity	Ml/d	18	0.1	1.25	1.2
Design Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Klip River	No discharge	Little Bushmans	Small Tugela
Wastewater Risk Rating (CRR% of CRR$_{max}$)		**Ladysmith**	**Weenen Ponds**	**Wembezi**	**Winterton**
CRR (2011)	%	76.5%	94.1%	77.3%	47.1%
CRR (2013)	%	76.5%	76.5%	77.3%	76.5%
CRR (2021)	%	81.8%	47.1%	70.6%	76.5%

Key Performance Area	**Unit**	**Estcourt**
Green Drop Score (2021)		**51%**
2013 Green Drop Score		**29%**
2011 Green Drop Score		**48%**
2009 Green Drop Score		**40%**
System Design Capacity	Ml/d	12
Design Capacity Utilisation (%)		NI
Resource Discharged into		Bushmans River

Key Performance Area	Unit	Estcourt
Wastewater Risk Rating (CRR% of CRR_{max})		Estcourt
CRR (2011)	%	70.6%
CRR (2013)	%	76.5%
CRR (2021)	%	81.8%

Technical Site Assessment: **Ezakheni WWTW 45%**

7.14 Zululand District Municipality

Water Service Institution	**Zululand District Municipality**
Water Service Providers	WSSA (12 systems) Abaqulusi Local Municipality (6 Systems)

Municipal Green Drop Score		
2021 Green Drop Score	**14%↓**	**VROOM Impression (Towards restoring functionality):** 1. Maintenance of the biofilter arms requires attention 2. Contact time for the temporary chlorination measures need to be determined to optimise disinfection. **VROOM Estimate:** - R2,220,400
2013 Green Drop Score	**23%**	
2011 Green Drop Score	**53%**	
2009 Green Drop Score	**44%**	

Key Performance Area	**Unit**	**Ceza Hospital**	**Cliffdale - Vrede**	**Coronation**	**eDumbe**
Green Drop Score (2021)		**46%**	**1%**	**0%**	**49%**
2013 Green Drop Score		**61%**	**NA**	**13%**	**54%**
2011 Green Drop Score		**79%**	**NA**	**43%**	**60%**
2009 Green Drop Score		**45%**	**NA**	**0%**	**44%**
System Design Capacity	Ml/d	0.14	1	1	0.5
Design Capacity Utilisation (%)		NI	NI	NI	14%
Resource Discharged into		Vungu to Black Mfolozi	Unknown	Unknown	Pongola River
Wastewater Risk Rating (CRR% of CRR_{max})		**Ceza Hospital**	**Cliffdale - Vrede**	**Coronation**	**eDumbe**
CRR (2011)	%	35.0%	NA	59.0%	65.0%
CRR (2013)	%	71.0%	NA	94.0%	71.0%
CRR (2021)	%	58.8%	100.0%	100.0%	52.9%

Key Performance Area	**Unit**	**eMondlo**	**Enyathi**	**Hlobane**	**James Nxumalo**
Green Drop Score (2021)		**0%**	**8%**	**0%**	**43%**
2013 Green Drop Score		**13%**	**NA**	**6%**	**49%**
2011 Green Drop Score		**48%**	**NA**	**35%**	**79%**
2009 Green Drop Score		**44%**	**NA**	**0%**	**45%**
System Design Capacity	Ml/d	4	**NA**	3	0.11
Design Capacity Utilisation (%)		NI	NI	NI	136%
Resource Discharged into		Mvunyana dam	Black Mfolozi	Unknown	White Mfolozi
Wastewater Risk Rating (CRR% of CRR_{max})		**eMondlo**	**Enyathi**	**Hlobane**	**James Nxumalo**
CRR (2011)	%	41.0%	**NA**	35.0%	53.0%
CRR (2013)	%	100.0%	**NA**	76.0%	47.0%
CRR (2021)	%	100.0%	100.0%	100.0%	58.8%

Key Performance Area	**Unit**	**Klipfontein**	**Mlokothwa**	**Nkongolwane**	**Nkonjeni Hospital**
Green Drop Score (2021)		**2%**	**4%**	**0%**	**37%**
2013 Green Drop Score		**8%**	**NA**	**NA**	**50%**
2011 Green Drop Score		**42%**	**NA**	**NA**	**82%**
2009 Green Drop Score		**44%**	**NA**	**NA**	**45%**
System Design Capacity	Ml/d	11.5	1	**NA**	0.08
Design Capacity Utilisation (%)		NI	NI	NI	0%

Key Performance Area	Unit	Klipfontein	Mlokothwa	Nkongolwane	Nkonjeni Hospital
Resource Discharged into		White Mfolozi River	Black Umfolozi River	Unknown	White Umfolozi
Wastewater Risk Rating (CRR% of CRR_{max})		Klipfontein	Mlokothwa	Nkongolwane	Nkonjeni Hospital
CRR (2011)	%	59.0%	NA	NA	59.0%
CRR (2013)	%	95.0%	NA	NA	53.0%
CRR (2021)	%	100.0%	94.1%	100.0%	58.8%

Key Performance Area	Unit	Nongoma	Pongola	St Francis Hospital	Thulasizwe Hospital
Green Drop Score (2021)		37%	32%	44%	51%
2013 Green Drop Score		44%	51%	64%	45%
2011 Green Drop Score		78%	66%	79%	49%
2009 Green Drop Score		42%	0%	46%	45%
System Design Capacity	Ml/d	3	3.6	0.12	0.06
Design Capacity Utilisation (%)		30%	NI	NI	NI
Resource Discharged into		Umjiniwayo	Pongola	White Mfolozi	Isihululu River
Wastewater Risk Rating (CRR% of CRR_{max})		Nongoma	Pongola	St Francis Hospital	Thulasizwe Hospital
CRR (2011)	%	59.0%	53.0%	41.0%	71.0%
CRR (2013)	%	71.0%	76.0%	47.0%	47.0%
CRR (2021)	%	47.1%	70.6%	64.7%	52.9%

Key Performance Area	Unit	Ulundi	Itshelejuba Hospital
Green Drop Score (2021)		48%	41%
2013 Green Drop Score		53%	50%
2011 Green Drop Score		75%	68%
2009 Green Drop Score		45%	46%
System Design Capacity	Ml/d	2.5	0.11
Design Capacity Utilisation (%)		90%	NI
Resource Discharged into		White Mfolozi	Mzinsangu River
Wastewater Risk Rating (CRR% of CRR_{max})		Ulundi	Itshelejuba Hospital
CRR (2011)	%	53.0%	59.0%
CRR (2013)	%	82.0%	53.0%
CRR (2021)	%	47.1%	64.7%

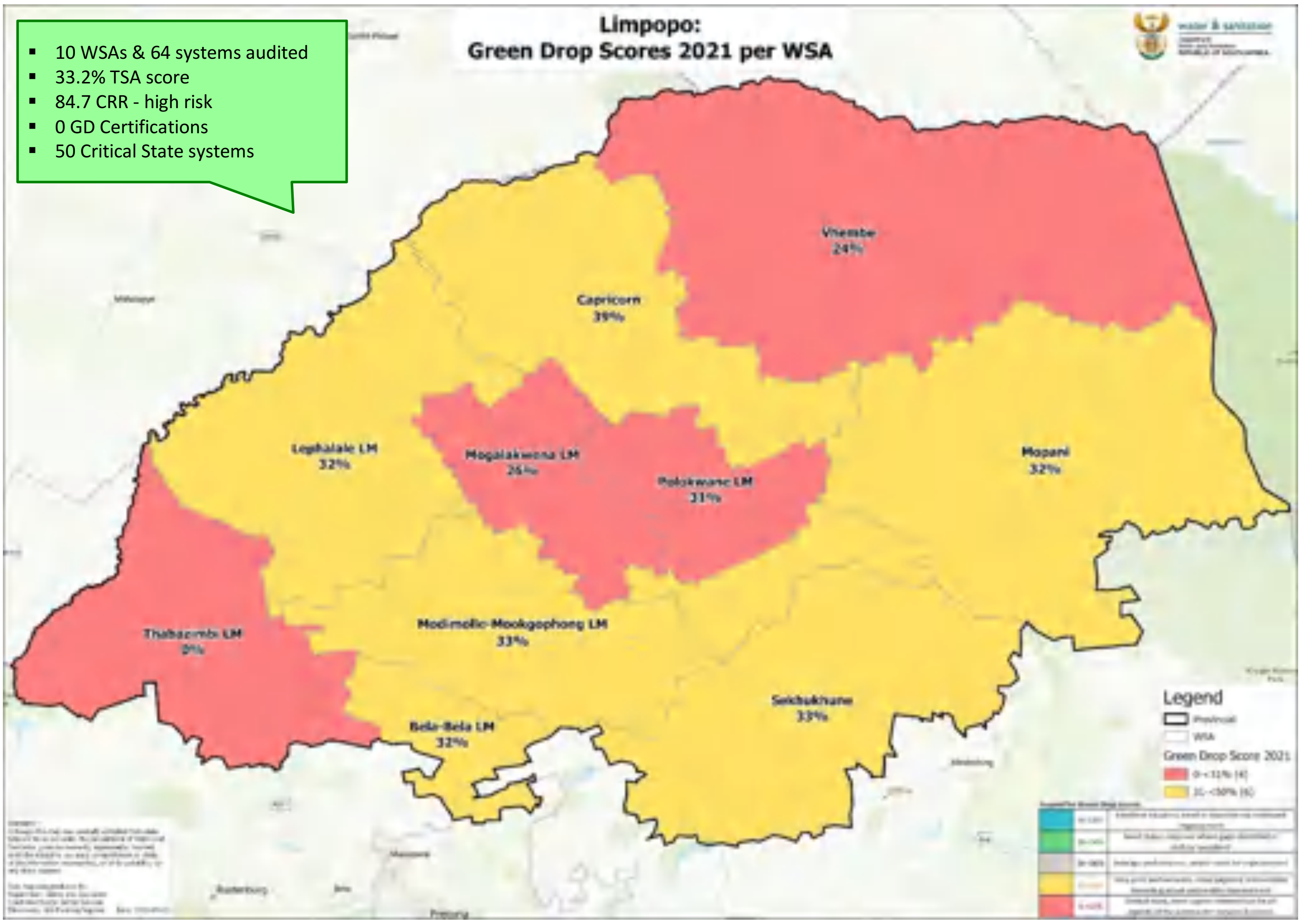
Technical Site Assessment: **Ulundi WWTW 61%**

A well-maintained pump station

Clean, accessible, control panels secured and noise proof, provision for expansion and equipment in excellent condition and a well-maintained Head of Works of an older WWTW. The GD21 audit proved a close synergy between well-maintained works and well-run operations, even when all circumstances are not perfect or the works slightly aged.

Well-done to the iLembe DM and Siza Water teams.

8. LIMPOPO PROVINCE: MUNICIPAL WASTEWATER MANAGEMENT PERFORMANCE



Provincial Synopsis

An audit attendance record of 100% affirms the WSAs commitment to the Green Drop national incentive-based regulatory programme.

The Regulator determined that no wastewater system scored the minimum of 90% when measured against the Green Drop standards for the audited period and thus no WSA qualified for the prestigious Green Drop Certification. In 2013, one Green Drop Certificate was awarded. The audit has nonetheless established an accurate, current baseline from where improvement can be driven, and excellence be incentivised.

Only Vhembe improved on their GD score from 12% in 2013 to 24% in 2021. The remaining WSAs regressed to lower Green Drop scores compared to 2013 baselines. Capricorn DM achieved the highest Green Drop score in the province (39%). It is evident by the overall low audit and technical scores that a concerted effort will be required on provincial scale to improve wastewater services at all WSAs. Unfortunately, 50 systems were identified to be in a critical state, compared to 32 systems in 2013. Most of these critical systems are managed by Greater Sekhukhune, Mopani, Mogalakwena and Vhembe.

All Green Drop KPAs require attention from all the WSAs, without exceptions.

The provincial Risk Ratio for treatment plants regressed significantly from 74.9% in 2013 to 84.7% in 2021. The most prominent risks were observed at a treatment level and pointed to WWTWs that exceeded their design capacity, dysfunctional processes (especially disinfection) and equipment, lack of flow measurement, as well as effluent and sludge non-compliance.

The Regulator is hopeful that the 2021 audits will set a baseline from where a positive trajectory for wastewater services and improved performance will follow. Municipalities are encouraged to start their preparation for the 2023 Green Drop audit. The 2021 Green Drop status for WSAs in the Limpopo Province are summarised in Table 111.

Table 111 - 2021 Green Drop Summary

WSA Name	2013 GD Score (%)	2021 GD Score (%)	2021 GD Certified ≥90%	2021 GD Contenders (89%)	2021 Critical State (<31%)
Capricorn DM	60	39↓			Senwabarwana, Mogwadi
Modimolle-Mookgopong LM	48	33↓			Vaalwater-Mabatlane, Mookgophong Naboomspruit, Roedtan-Thusang
Mookgopong LM	46				
Greater Sekhukhune DM	40	33↓			Dennilton, Motetema, Roosenekal, Monsterlus-Hlogotlou, Elandkraal, Leeufontein-Mokganyak, Phokwane Ponds, Nebo, Mecklenburg-Moroke, Tubatse, Mapodile, Penge
Bela Bela LM	44	32↓			Pienaars Rivier, Radium
Mopani DM	37	32↓			Giyani, Ga-Kgapane, Senwamokgope, Phalaborwa, Namakgale, Lulekane, Lenyenye, Nkowankowa
Lephalale LM	56	32↓			Witpoort, Zongesien
Polokwane LM	65	31↓			Seshego, Mankweng
Mogalakwena LM	84	26↓			Mokopane Old&New, Mosadi Ponds, Rebone
Vhembe DM	12	24↑			13 of 14 plants
Thabazimbi LM	28	0↓			All 3 plants
Totals	**-**	**-**	**0**	**0**	**50**

The Department of Water and Sanitation acknowledges the excellence in wastewater management achieved for the Green Drop Audit year of 2021.

No Green Drop Certificates are awarded to WSAs in the Province

Background to Limpopo Wastewater Infrastructure

There are 10 WSAs, delivering wastewater services through a sewer network comprising of 64 WWTWs and 137 network pump stations. The outfall and main sewer pipelines (km) could not be determined as this information was not available from municipalities. There is a total installed treatment capacity of 213 Ml/d, with most of this capacity residing in 49 small to large-sized treatment plants. Seven WWTWs did not know their design capacities.

Table 112 - Summary of WWTW capacity and flow distribution according to plant sizes

	Micro Size Plants	Small Size Plants	Medium Size Plants	Large Size Plants	Macro Size Plants	Unknown (NI)*	Total
	<0.5 Ml/day	0.5-2 Ml/day	2-10 Ml/day	10-25 Ml/day	>25 Ml/day		
No. of WWTW	7 (11%)	22 (34%)	23 (36%)	4 (6%)	1 (2%)	7 (11%)	64
Total Design Capacity (Ml/day)	1.65	21.75	109.8	47.91	32	7	213.1
Total Daily Inflow (Ml/day)	1.244	5.7	46.873	7.78	30.9	41	92.5
Use of Design Capacity (%)	75%	26%	43%	16%	97%	-	43%

** "Unknown" means the number of WWTWs with NI (No Information) on design capacity or daily inflow*

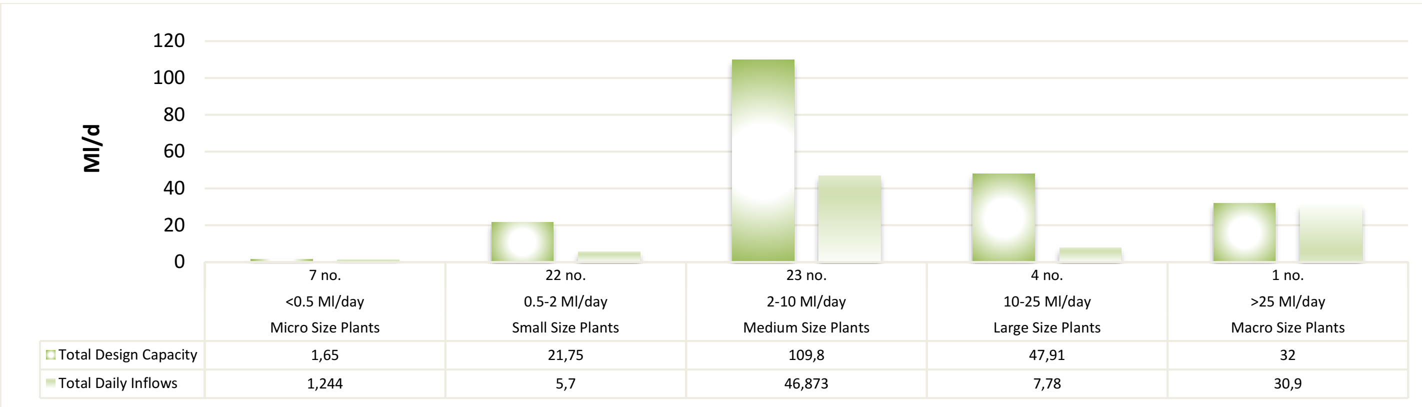


Figure 105 - Design capacities and operational inflow to micro to large sized WWTWs (a) and macro sized WWTWs

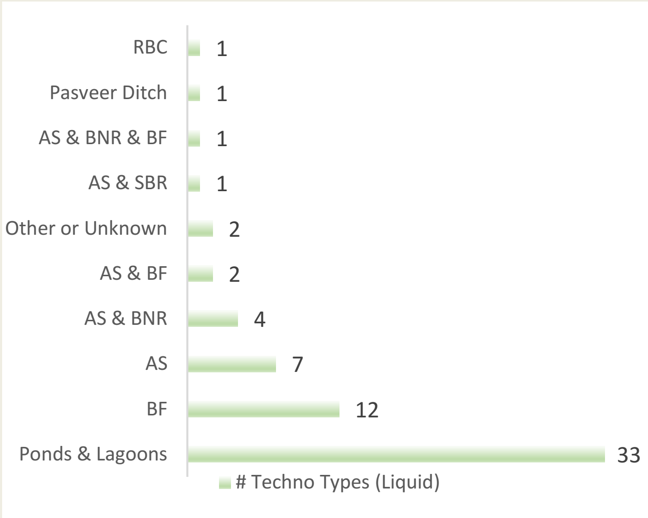
Based on the inflow figures, the treatment facilities are operating at close to 43% of their total design capacity, with the current operational flow of 92.5 Ml/d. The largest flow contributor is Polokwane with 45.5 Ml/d.

Given the current capacity, this implies that there is 57% spare capacity to meet the medium-term demand. It must however be noted that inflow is not monitored in 41 systems (64%) and as a result the spare capacity could be substantially less than the 57%. Diagnostic #3 unpacks these statistics in more detail. This spare capacity would also be compromised at systems where some of the infrastructure or treatment modules are non-operational or dysfunctional. The VROOM Cost Diagnostic #7 provides more detail on the refurbishment requirements to restore such capacity and functionality.

The audit data shows that 6 systems are hydraulically overloaded. This figure could theoretically be higher, given that there are 41 systems where inflow monitoring is not taking place. The hydraulically overloaded systems in each of the WSAs is as follows:

- Greater Sekhukhune: 3 of 16 systems (Burgersfort, Marble Hall, Steelpoort) – no inflows for the remaining 13 systems
- Capricorn: 1 of 5 systems (Mogwadi)
- Mopani: 1 of 9 systems (Lenyenye) - no inflows for 3 systems
- Polokwane: 1 of 3 systems (Mankweng).

The predominant treatment technologies employed at WWTWs comprise of ponds/ lagoons, activated sludge variations, and biofilters for effluent treatment and solar drying beds for sludge treatment. The next audit will need to verify sludge treatment technologies, as insufficient information ("Other") is observed in this area.



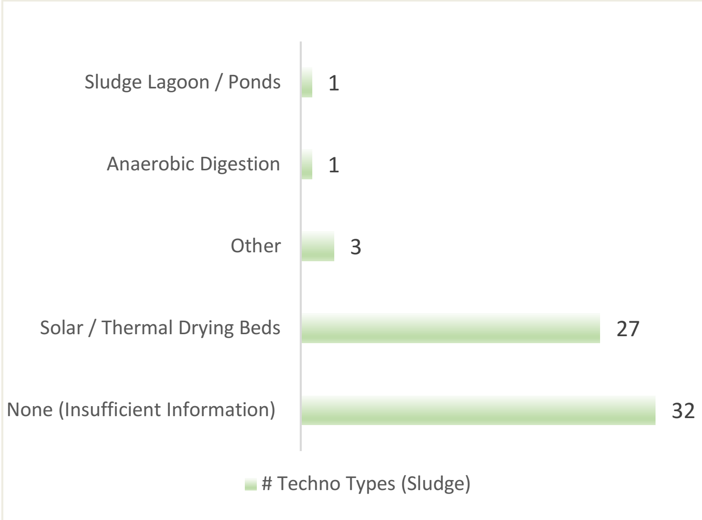


Figure 106 - Treatment technologies for wastewater effluent (a) and sludge (b)

Table 113 - Summary of Collection Network Pump Stations and Sewer Pipelines

WSA Name	# WWTWs	Pump Stations (#)	Sewer Pipelines (km)
Bela Bela	3	8	NI
Modimolle	5	8	NI
Greater Sekhukhune	16	9	NI
Capricorn	5	2	NI
Lephalale	3	39	NI
Mogalakwena	3	5	NI
Mopani	9	40	NI
Polokwane	3	6	NI
Vhembe	14	18	NI
Thabazimbi	3	2	NI
Totals	**64**	**137**	**NI**

The sewer network consists of the sewer mains and pump stations as summarised in Table 113. The bulk of the pump stations are in Lephalale (39), Mopani (40) and Vhembe (18). Information on the length of the sewer pipelines was not provided (not known) by any of the Limpopo municipalities, indicating limitations in asset management information.

Provincial Green Drop Analysis

The 100% response from the 10 municipalities audited during the 2021 Green Drop process demonstrates a firm commitment to wastewater services in the province. Local Government reforms resulted in the merging of Mookgopong LM and Modimolle LM into Modimolle-Mookgopong LM. Therfore 10 WSAs were audited in 2021 compared to the 11 WSAs in 2013.

Table 114 - Green Drop Comparative Analysis from 2009 to 2021

GREEN DROP COMPARATIVE ANALYSIS					
Performance Category	**2009**	**2011**	**2013**	**2021**	**Performance trend 2013 and 2021**
Incentive-based indicators					
Municipalities assessed (#)	4 (31%)	11 (100%)	11 (100%)	10 (100%)	→
Wastewater systems assessed (#)	7	67	58	64	↑
Average Green Drop score	18%	24%	34%	23%	↓
Green Drop scores ≥50% (#)	1/7 (14%)	10/67 (15%)	12/58 (21%)	3/64 (5%)	↓
Green Drop scores <50% (#)	6/7 (86%)	57/67 (85%)	46/58 (79%)	61/64 (95%)	↓
Green Drop Certifications (#)	0	0	1	0	↓
Technical Site Inspection Score (%)	NA	21.0%	54.5%	33.2%	↓

NA = Not Applied NI = No Information *↑= improvement, ↓= regress, →= no change*

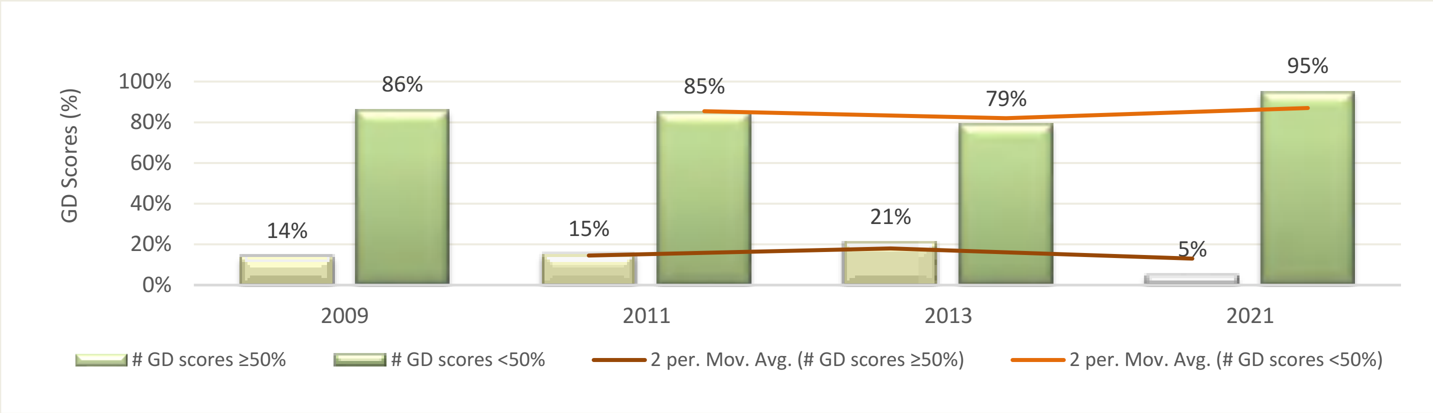


Figure 107 - Green Drop trend analysis over the period 2009 to 2021, indicating the percentage GD scores above and below 50%

The trend analysis indicates that:

- The number of systems audited decreased from 67 systems in 2011 to 64 systems in 2011 but increased from 58 systems in 2013 to 64 systems in 2021
- Despite an upward trend in previous 2009 and 2011 GD average scores, there was a drop-off from 34% in 2013 to 23% in 2021
- Similarly, the number of systems with GD scores of ≥50% increased from 1 (14%) in 2009 to 12 (21%) in 2013 but decreased to 3 (5%) in 2021
- The TSA score increased from 21% in 2011 to 55% in 2013 but decreased to 33% in 2021
- This trend was balanced by the number of systems with GD score of ≤50% decreasing from 57 (85%) in 2011 to 46 (79%) in 2013, followed by a regress to 61 (95%) in 2021
- The number of Green Drop Certifications decreased from 1 award in 2013 to none in 2021
- An overall performance trend from 2013 to 2021 signals the need for repeat/regular audits to ensure continued improvement. There are indications that performance has declined in the absence of the consistent regulatory engagement of the GD audits.

The analysis for the period 2009, 2011, 2013 and 2021, indicates that most of the system scores are in the 0-<31% (Critical state) category, with the 31-<50% (Poor Performance) being the next largest category. The most concerning data point is that 50 systems are in critical state (<31%) compared to 32 systems in this category in 2013.

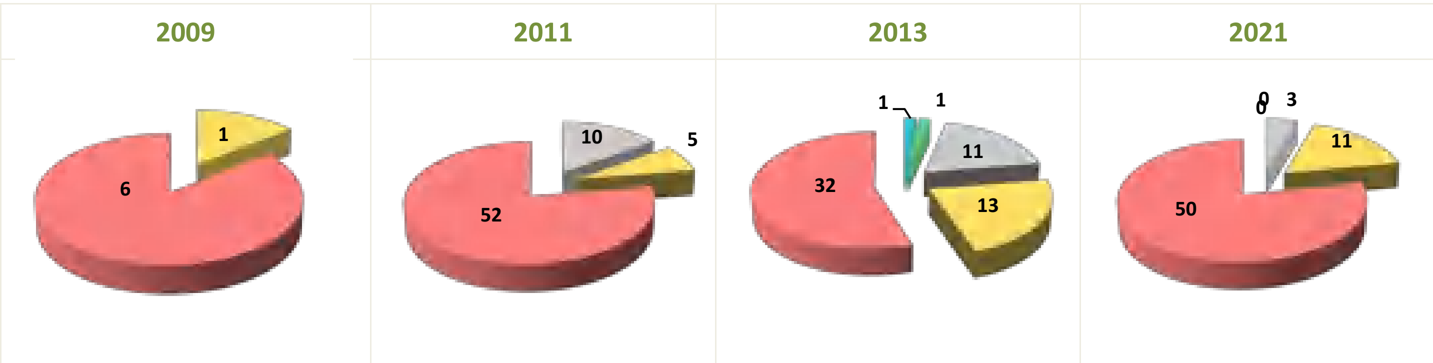


Figure 108 - No. WWTWs in the Green Drop score categories over the period 2009 to 2021 (graph legend to right)

90 – 100% Excellent
80-<90% Good
50-<80% Average
31-<50% Poor
0-<31% Critical state

In summary, trends over the years 2013 and 2021 indicate as follows:

- The number of systems in a 'poor state' decreased from 13 systems in 2013 to 11 systems in 2021
- The number of systems in a 'critical state' increased from 32 systems in 2013 to 50 systems in 2021
- The number of systems in the 'excellent and good state' decreased from 2 systems in 2013 to 0 systems in 2021.

Provincial Risk Analysis

Green Drop risk analysis (CRR) focuses specifically on the treatment function. It considers 4 risk indicators, i.e. design capacity, operational flow, technical capacity, and effluent quality. The CRR values do not factor risks associated with sanitation or wastewater network and collector systems.

Table 115 - Cumulative Risk Comparative Analysis from 2009 to 2021

CUMULATIVE RISK COMPARATIVE ANALYSIS					
Performance Category	**2009**	**2011**	**2013**	**2021**	**Performance Trend 2013 to 2021**
Highest CRR	18	22	20	21	↓
Average CRR	14.4	15.7	13.4	15.4	↓
Lowest CRR	8	7	9	10	↓
Design Rating (A)	1.1	1.1	1.2	1.3	↓
Capacity Exceedance Rating (B)	4.2	4.7	4.0	4.3	↓
Effluent Failure Rating (C)	6.0	7.8	6.2	7.4	↓
Technical Skills Rating (D)	3.8	2.8	2.5	2.7	↓
CRR% Deviation	**76.5**	**84.7**	**74.9**	**84.7**	↓

↑= improvement, ↓= regress, →= no change

The concept of risk management is not well embedded within municipalities. Table 115 indicates an overall decline in CRR% deviation from 2013 to 2021, which suggests slight changes in design capacity rating (A), increase in the capacity exceedance rating (B), a decrease in the technical skills rating (D), and a marked increase in the final effluent quality failures rating (E). Individual systems, however, shows higher deviations and indicate specific risk categories, as highlighted under "***Regulator's Comment***". The CRR analysis in context of the Green Drop results suggests that further improvements should focus on 1) capacity exceedance at plants which are hydraulically overloaded or approaching its design lifespan, 2) effluent quality failures, especially for microbiological compliance, and 3) strengthening of technical skills and operational competency, especially related to sludge management.

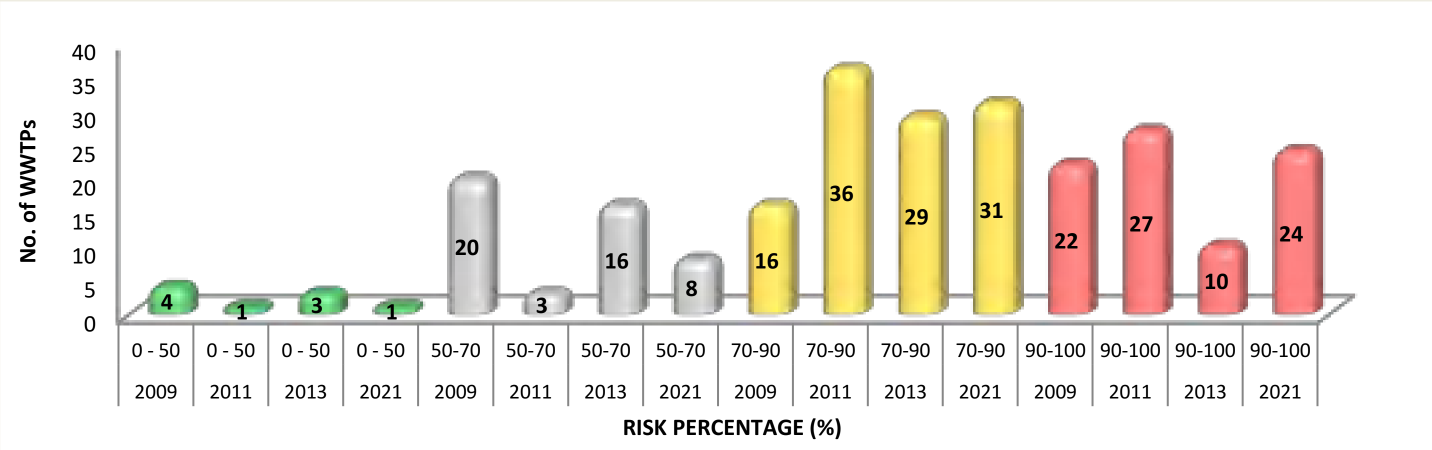


Figure 109 - a) WWTW Risk distribution and trends from 2009 to 2021; b) Colour legend

90 – 100% Critical risk WWTPs	
70 - <90% High risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low risk WWTPs	

Trend analysis of the CRR ratings for the period 2009 to 2021 indicate that:

- The most prominent movements in risk can be seen between 2009 and 2011 and between 2013 and 2021, when a high number of plants moved from medium to high and critical risk positions, indicating a regressive state for WWTWs
- The 2021 assessment cycle highlighted regressive shifts with a decrease in the number of low risks WWTWs from 3 in 2013 to 1 in 2021, a decrease in medium risk WWTWs (16 to 8), and an increase in high risk (29 to 31) and critical risk WWTWs (10 to 24).

Regulatory Enforcement

Wastewater systems which failed to achieve the minimum Green Drop target of 31%, are placed under regulatory focus. The Regulator requires these municipalities to submit a detailed corrective action plan within 60 days from publishing of this report. All 10 municipalities and 50 wastewater systems that received Green Drop scores below 31%, are to be placed under **regulatory surveillance**, in accordance with the Water Services Act (108 0f 1997). In addition, these municipalities will be compelled to ringfence water services grant allocation to rectify/restore wastewater collection and treatment shortcomings identified in this report.

Table 116 - WWTWs with <31% Green Drop scores

WSA Name	2021 Municipal GD Score	WWTWs with <31% score
Capricorn DM	39%	Senwabarwana, Mogwadi
Modimolle-Mookgopong LM	33%	Vaalwater-Mabatlane, Mookgophong Naboomspruit, Roedtan-Thusang
Greater Sekhukhune DM	33%	Dennilton, Motetema, Roosenekal, Monsterlus-Hlogotlou, Elandkraal, Leeufontein-Mokganyak, Phokwane, Nebo, Mecklenburg-Moroke, Tubatse, Mapodile, Penge
Bela Bela LM	32%	Pienaars Rivier, Radium
Mopani DM	32%	Giyani, Ga-Kgapane, Senwamokgope, Phalaborwa, Namakgale, Lulekane, Lenyenye, Nkowankowa
Lephalale LM	32%	Witpoort, Zongesien
Polokwane LM	31%	Seshego, Mankweng
Mogalakwena LM	26%	Mokopane Old&New, Mosodi, Rebone
Vhembe DM	24%	13 of 14 plants
Thabazimbi LM	0%	All 3 plants

The following municipalities and their associated wastewater treatment plants are in high CRR risk positions, which means that some or all the risk indicators are in a precarious state, i.e. operational flow, technical capacity and effluent quality. WWTWs in high risk and critical risk positions poses a serious risk to public health and the environment. The following municipalities will be required to assess their risk contributors and develop corrective measures to mitigate these risks.

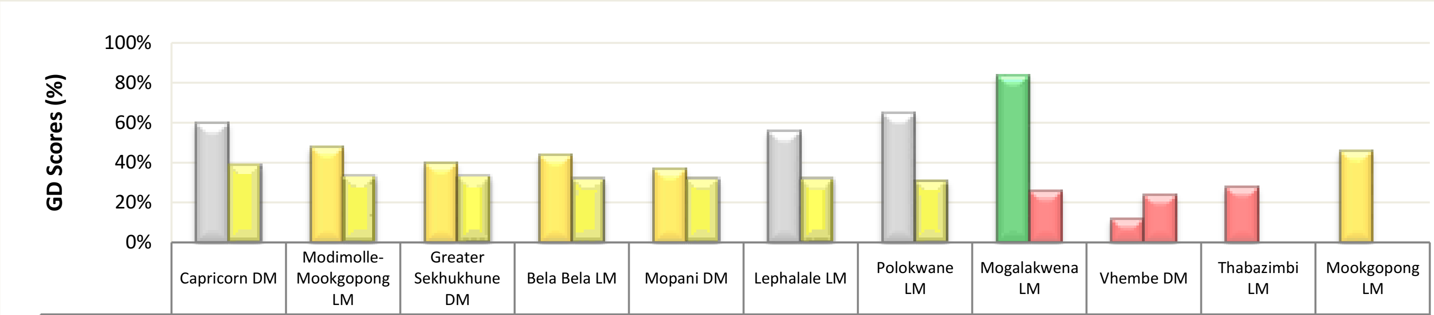
Table 117 - %CRR/CRR$_{max}$ scores and WWTWs in critical and high-risk space

WSA Name	2021 Average CRR/CRRmax % deviation	WWTWs in critical and high-risk space	
		Critical Risk (90-100%CRR)	High Risk (70-<90%CRR)
Polokwane LM	70.4%		Polokwane, Seshego
Capricorn DM	75.1%		Alldays, Lebowakgomo, Mogwadi, Senwabarwana ponds
Bela Bela LM	76.6%		Pienaarsrivier, Radium
Mopani DM	82.3%	Lenyenye, Namakgale, Phalaborwa, Senwamokgope	Ga-Kgapane, Giyani, Lulekane, Nkowankowa
Greater Sekhukhune DM	86.8%	Elandskraal, Leeufontein, Mapodile, Mecklenburg, Nebo, Penge, Tubatse ponds	Motetema, Phokwane, Roosenenkraal, Dennilton, Groblersdal, Monsterlus, Steelpoort
Vhembe DM	87.2%	Mhinga ponds, Musina, Mutale ponds, Nancefield, Tshifulanani ponds, Vleifontein ponds, Vuwani ponds	Waterval, Biaba ponds, Makhado
Modimolle-Mookgophong LM	87.9%		All 5 plants
Lephalale LM	89.1%	Paarl	Witpoort, Zongesien
Thabazimbi LM	90.9%	Northam, Rooiberg	Thabazimbi
Mogalakwena LM	92.4%	Rebone, Mosodi	Mokopane Old & New

Good practice risk management requires that the W$_2$RAPs are informed by meaningful Process and Condition Assessments, supported by zealous implementation of corrective measures and ongoing monitoring of risk movement.

Performance Barometer

The **Green Drop Performance Barometer** presents the individual Municipal Green Drop Scores, which essentially reflects the level of mastery that a municipality has achieved in terms of its overall municipal wastewater services business. The bar chart below indicates the GD scores for 2013 in comparison to 2021, from highest to lowest performing WSA. Every municipality regressed in their GD scores from 2013 to 2021 apart from Vhembe DM albeit still remaining in the critical risk position. The biggest relapse was for Mogalakwena from good performance 84% GD score in 2013 to a critical state 26% GD score in 2021. Capricorn, Lephalale and Polokwane also regressed from a good to poor performance from 2013 to 2021.



	Capricorn DM	Modimolle-Mookgopong LM	Greater Sekhukhune DM	Bela Bela LM	Mopani DM	Lephalale LM	Polokwane LM	Mogalakwena LM	Vhembe DM	Thabazimbi LM	Mookgopong LM
2013 GD Score	60%	48%	40%	44%	37%	56%	65%	84%	12%	28%	46%
2021 GD Score	39%	33%	33%	32%	32%	32%	31%	26%	24%	0%	0%

Figure 110 - a) Green Drop scores 2013 (bar left) and 2021 (bar right), with colour legend inserted

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	

The **Cumulative Risk Log** expresses the level of risk that a municipality poses in respect of its wastewater treatment facility. It is based on the ***individual Cumulative Risk Ratios***. Figure 111 presents the cumulative risks in ascending order, with the low risk municipalities on the left and critical risk municipalities to the far right. The analysis reveals that there are two critical risk municipalities in the Province.

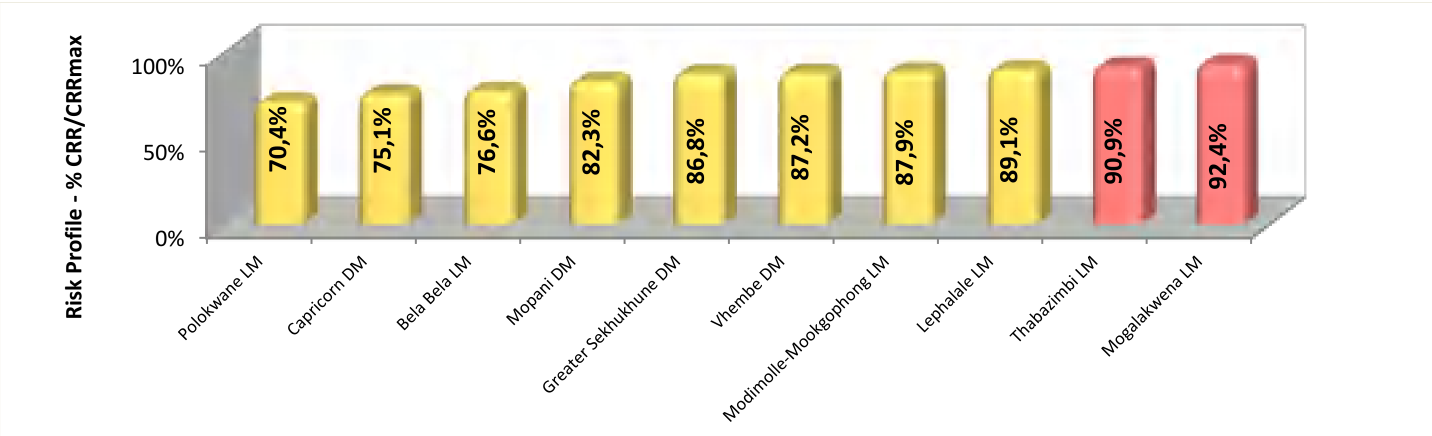


Figure 111 - a) %CRR/CRRmax Risk Performance Log 2021; b) Colour legend

90 – 100% Critical risk WWTPs	
70 - <90% High risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low risk WWTPs	

Provincial Best Performer

Capricorn DM achieved the highest Green Drop score in the Province:

- ✓ 39% Municipal Green Drop Score
- ✓ 2013 Green Drop Score of 60%
- ✓ Regress on the CRR risk profile from 65.9% in 2013 to 75.1% in 2021
- ✓ 1 of 5 (20%) plants in medium risk position
- ✓ Technical Site Assessment score of 48% (Lebowakgomo AS)

KPA Diagnostics

The Green Drop Audit process collects a vast amount of data that yield valuable insight on the state of the wastewater sector in each Province. These insights have been captured into 7 thematic areas or ‘Diagnostics’, as discussed below.

Table 118 - Summary of the key diagnostic themes and reference to the respective Green Drop KPAs

Diagnostic #	Diagnostic Description	Diagnostic Reference
1	**Green Drop KPA Analysis**	KPAs A-E
2	**Technical Competence**	KPA A, B & Bonus
3	**Treatment Capacity**	KPA D
4	**Wastewater Monitoring and Compliance**	KPA B & D & Bonus
5	**Energy Efficiency**	KPA C & Bonus
6	**Technical Site Assessments**	TSA
7	**Operation, Maintenance and Refurbishment of Assets**	KPA C, D & Bonus

Diagnostic 1: Green Drop KPA Analysis

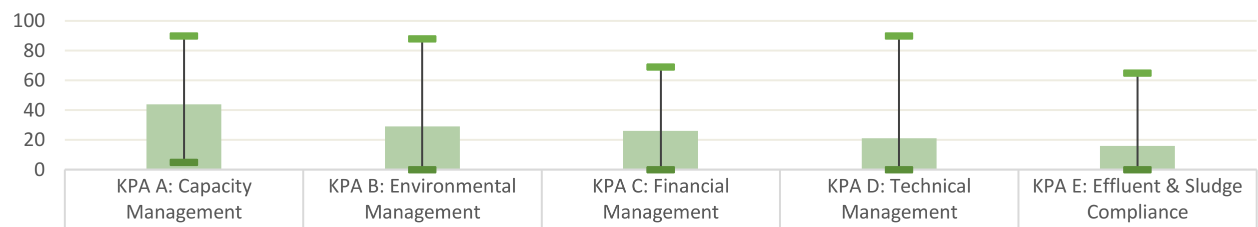
Aim: Analysis of technical skills, environmental plans, financial management, technical capacity, and regulatory compliance provides insight into the strengths and weaknesses of wastewater management in WSAs in the province. These insights in turn, may inform appropriate interventions and strategies to improve the individual KPAs and ultimately, collective KPA performance.

Findings: The WSAs are characterised by a highly variable KPA profile. A good KPA profile typically has a high mean GD score, coupled with a low Standard Deviation (SD) between the outer parameters (min and max). Similarly, a well performing system is one that has most/all systems in the >80% bracket and no systems in the <31% bracket.

Table 119 - Green Drop scores KPA profiles (graph legend included)

KPA #	Key Performance Area	*Weight*	Minimum GD Score (%)	Maximum GD Score (%)	Mean GD Score (%)	# Systems <31%	# Systems ≥80%
A	Capacity Management	*15%*	5%	90%	**44%**	19 (30%)	6 (9%)
B	Environmental Management	*15%*	0%	88%	**29%**	34 (53%)	1 (2%)
C	Financial Management	*20%*	0%	69%	**26%**	33 (52%)	0 (0%)
D	Technical Management	*20%*	0%	90%	**21%**	45 (70%)	0 (0%)
E	Effluent and Sludge Compliance	*30%*	0%	65%	**16%**	56 (88%)	0 (0%)

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	



	KPA A: Capacity Management	KPA B: Environmental Management	KPA C: Financial Management	KPA D: Technical Management	KPA E: Effluent & Sludge Compliance
Mean	44	29	26	21	16
Max	90	88	69	90	65
Min	5	0	0	0	0

Note: The High and low lines represent the Min and Max range, and the shaded green represents the Mean (arithmetical average)

Figure 112 - Maximum, minimum, and mean Green Drop KPA scores

The KPA distribution indicates as follows:

- Capacity Management (KPA A) depicts the highest mean of 44%, the shared highest maximum of 90%, and the 2nd highest Standard Deviation (SD) of 85%. These results indicate some (but limited) strengths pertaining to the registration of WWTWs, maintenance plans and records, maintenance teams, and registered, qualified staff (process controllers, supervisors, scientists, technicians, engineers) at some municipalities

- Effluent and Sludge Quality Compliance (KPA E) received the lowest mean of 16%, indicating a deficiency in data management, IRIS upload, effluent quality compliance, and sludge quality compliance
- This was followed by the Technical Management (KPA D) that received the next lowest mean of 21%, indicating a vulnerability in basic design information, inflow, outflow, meter reading credibility, process and condition assessments, site inspection reports, asset registers, asset values, bylaws and enforcement
- The mean decreased steadily from KPA A to KPA E.

The GD bracket performance distribution reiterates the above findings:

- ***KPA Score >80%:*** Capacity Management (KPA A) is the best performing KPA with 9% of systems achieving >80%, followed by Environmental Management (KPA B) with 2%. KPAs C to E (Financial Management, Technical Management and Effluent and Sludge Compliance) all reflected 0%
- ***KPA Score <31%:*** Effluent and Sludge Compliance (KPA E) represents the worst performing KPA with 88% of systems lying in the 0-31% bracket, followed by Technical Management (KPA D) with 70% and Environmental Management (KPA B) with 53%.

Diagnostic 2: Technical Competence

Aim: This focus area assesses the human resources (technical) capacity to manage wastewater systems. Theory suggests a correlation between human resources capacity (sufficient number of appropriately qualified staff) and a municipality's performance and operational capability. It is projected that high HR capacity would translate to compliant wastewater services and protection of scarce water resources.

Findings: According to regulations, wastewater plants are classified as Class A, B, C, D or E plants. Similarly, Process Controllers and Plant Supervisors are registered as Class I, II, III, IV, V or VI operators. Higher classed plants require a higher level of operators due to their complexity and strict regulatory standards. Technical compliance of Process Controllers and Supervisors is determined against Green Drop standards, as defined by Reg. 2834 and draft Reg. 813 of the National Water Act 1998.

Table 120 - No. compliant versus shortfall in Supervisor and Process Controller staff

WSA Name	# WWTWs	# Compliant staff		# Staff Shortfall		Ratio*	WSA 2021 GD Score (%)
		Supervisor	PCs	Supervisor	PCs		
Bela Bela	3	1	5	0	2	2.0	32%
Modimolle	5	1	7	0	2	1.6	33%
Greater Sekhukhune	16	4	16	2	11	1.3	33%
Capricorn	5	1	4	1	4	1.0	39%
Lephalale	3	1	0	1	5	0.3	32%
Mogalakwena	3	0	5	2	3	1.7	26%
Mopani	9	5	12	3	17	1.9	32%
Polokwane	3	1	2	1	7	1.0	31%
Vhembe	14	2	11	5	21	0.9	24%
Thabazimbi	3	0	0	2	7	0.0	0%
Totals	**64**	**16**	**62**	**17**	**79**	**12**	

** The single number Ratio is derived from the number of qualified staff divided by the number of WWTWs operated by this number of staff. E.g., for Bela Bela, 6 qualified staff is available to support 3 WWTWs, thus 6/3 = 2 ratio*

Note: "Compliant staff" means qualified and registered staff that meets the GD standard for a particular Class Works. "Staff shortfall" means staff that do not meet the GD standard for a particular Class of works (+1 for a shift) and/or staffing gaps exist at the respective WWTWs.

Competent human resources are a vital enabler to ensure efficient and sustainable management of treatment processes and infrastructure. For Limpopo, the operational competencies are found to be seriously compromised and not meeting regulatory standards, as illustrated below.

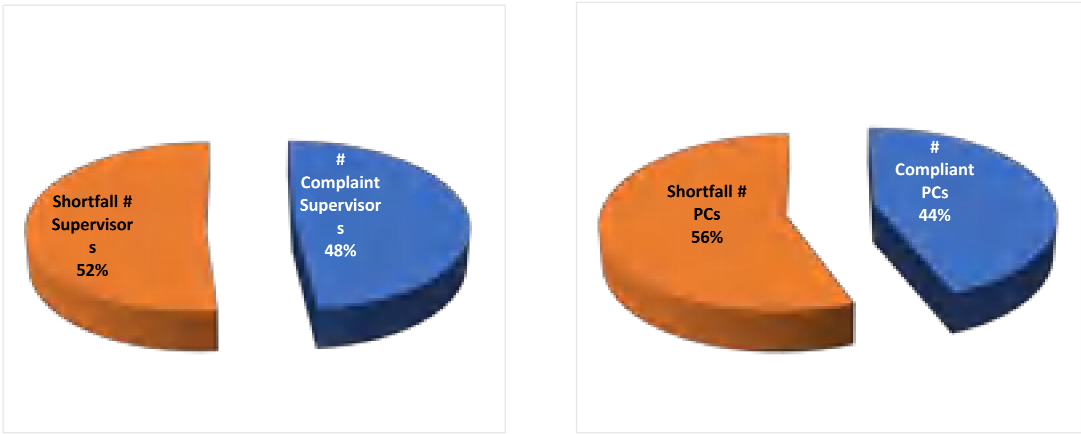


Figure 113 - Schematic illustration of compliant versus non-compliant Supervisors (a) and Process Controllers (b)

Plant Supervisors: The pie charts indicate that 48% (16 of 33) of Plant Supervisors complies with the Green Drop standard, with zero shortfall for Bela Bela and Modimolle. A 52% (17 of 33) shortfall is noted for Supervisors overall, with the highest shortfall seen at the Vhembe (5 no.) and Mopani (3 no.).

Process Controllers: Similarly, 44% (62 of 141) of the PC staff is compliant for the Province, with a no zero shortfall in any municipality. There is a 56% (79 of 141) shortfall in PCs with the highest shortfall for the Vhembe (21 no.), followed Mopani (17 no.), Greater Sekhukhune (11 no.), and Polokwane and Thabazimbi (7 no. each).

Green Drop standards require of Class A and B plants to employ dedicated Supervisors and Process Controllers per shift per Works, whereas Class C to E plants may consider sharing of staff across works. Shifts have been introduced to ensure optimal operations while addressing security risks, particularly as it relates to vandalism. Telemetry also reduces the requirement for on-site staff during night shifts, but these relaxations will have to be done within the DWS regulatory guidelines.

It is expected that a correlation would exist between the competence of an operational team and the performance of a treatment plant, as measured by the GD score. The data indicates as follows:

- 1 municipality has a fair Supervisor/Process Controller ratio in place (≥ 2) – Bela Bela
- All municipalities have shortfalls in registered Supervisors, with the exception of Bela Bela and Modimolle
- All municipalities have shortfalls in registered Process Controllers.

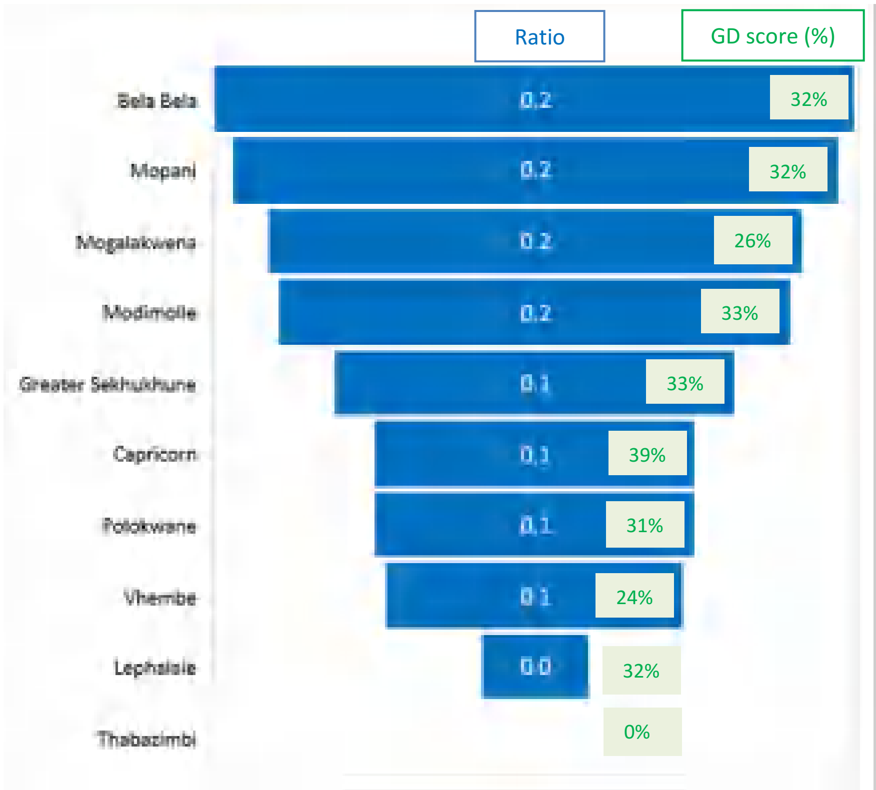


Figure 114 - Ratio of compliant operational staff to no. of WWTWs and Comparison of Ratios with GD scores

In addition to operational capacity (above), good management practice also requires access to qualified engineers, technicians, technologists, scientists, and maintenance capability. Such competencies could reside in-house or accessible through term contracts and external specialists.

Table 121 - Summary of the maintenance capacity and no. of qualified and shortfall of Engineering, Technical and Scientific staff

WSA Name	# WWTW	Maintenance Arrangement	Qualified Technical Staff (#)				Technical Shortfall (#)	Qualified Scientists (#)	Scientists Shortfall (#)	Ratio*	WSA 2021 GD Score (%)
			Engineers	Technologists	Technicians	Total					
Bela Bela	3	Internal + Specific Outsourcing	0	2	0	2	**0**	0	1	0.7	32%
Modimolle	5	Internal + Specific Outsourcing	0	2	0	2	0	0	1	0.4	33%
Greater Sekhukhune	16	Internal + Specific Outsourcing; Internal Team (Only); Partially Capacitated; No Capacity; Inadequate Capacity	1	0	1	2	0	4	0	0.1	33%
Capricorn	5	Internal + Specific Outsourcing	0	0	0	0	2	1	0	0.0	39%
Lephalale	3	Internal + Specific Outsourcing; Internal Team (Only)	0	0	1	1	1	0	1	0.3	32%
Mogalakwena	3	No Capacity	1	0	2	3	0	0	1	1.0	26%
Mopani	9	Internal Team (Only); Internal + Term Contract	0	2	1	3	0	1	0	0.3	32%
Polokwane	3	Internal + Term Contract	0	1	0	1	1	1	0	0.3	31%
Vhembe	14	No Capacity	0	0	0	0	2	1	0	0.0	24%
Thabazimbi	3	Internal Team (Only)	0	0	2	2	0	0	1	0.7	0%
Totals	**64**		**2**	**7**	**7**	**16**	**6**	**8**	**5**		

** The Ratio depicts the number of qualified technical staff divided by the number of WWTWs that have access to the staff*

Note 1: "Qualified Technical Staff" means staff appointed in positions to support wastewater services, and who has the required qualifications. "Technical Shortfall" is calculated based on a minimum requirement of at least 2 Engineers/Technologists/Technicians and at least one 1 Scientist per WSI.

Note 2: "Qualified Scientists" means professional registered scientists (SACNASP) appointed in positions to support wastewater services. "Scientists shortfall" means that the WSA does not have at least one qualified, SACNASP registered scientist in their employ or contracted.

Limpopo has a reasonable contingent of qualified maintenance staff for at least 8 of the 10 municipalities, with the current qualified maintenance staff forming a collective of in-house-, contracted- or outsourced personnel. The data indicates the maintenance capacity as follows:

- 8 municipalities have in-house maintenance teams
- 2 municipalities have internal maintenance teams supplemented with term contracts
- 5 municipalities have internal maintenance teams supplement with specific outsourced services
- 2 municipalities have no capacity. Greater Sekhukhune DM has a broad mix of internal maintenance teams, with some specific outsourcing, but also partial to inadequate to no capacity for some systems.

In general, the WSAs access to qualified technical staff is as follows:

- A total of 16 qualified staff, comprising 2 engineers, 7 technologists, 7 technicians (qualified) and 8 SACNASP registered scientists are assigned to the 10 municipalities
- A total shortfall of 11 persons, consisting of 6 technical staff and 5 scientists
- Only 4 of 10 municipalities have some shortfall in qualified technical staff
- 50% of the WWTWs have access to credible laboratories that complies with Green Drop standards.

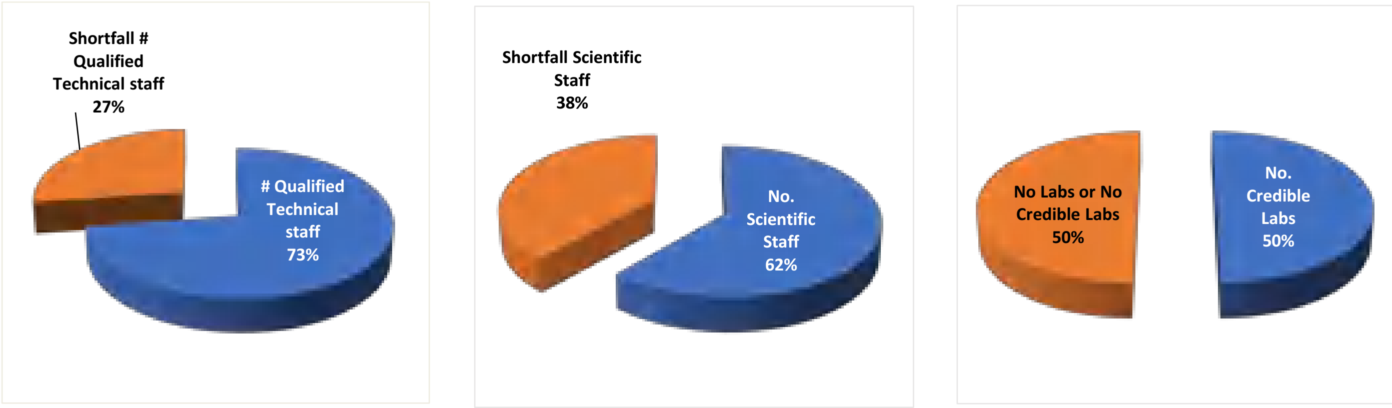


Figure 115 - Graphic illustration of the number and %: a) qualified engineering/technical staff; b) professional scientists; c) access to credible laboratory services that complies with Green Drop standards

Ratio analysis has been done to determine the number of qualified technical and scientific staff assigned per WWTW. It is expected, that a higher ratio would correspond with well-performing and maintained wastewater systems, as represented by the GD score.

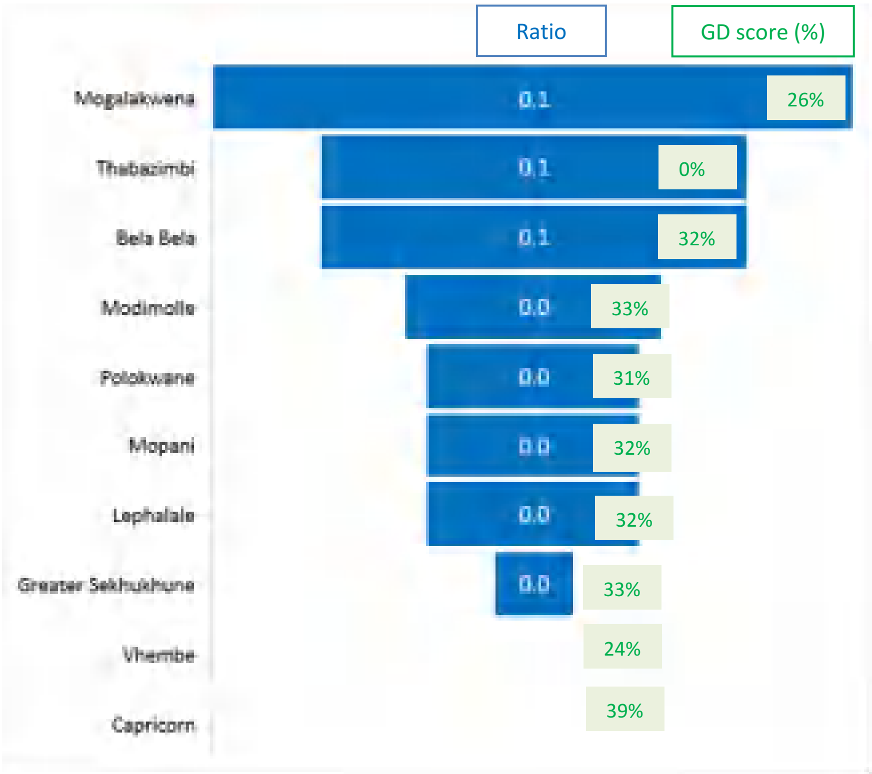


Figure 116 - Ratio of compliant technical staff to no. of WWTWs and Comparison of Ratios with GD scores

No correlation could be established between high ratios and high GD scores, as 9 of 10 municipalities fell in the same GD score range (24-39%). The anomaly being Thabazimbi at 0% GD score, and Capricorn that has the highest GD score of 39% and reported to have no technical staff.

One of the options to enhance operational capacity is through dedicated training programmes. The Green Drop audit incentivises training of operational staff over the 2-year period prior to the audit date. The results are summarised as follows:

Table 122 - No. of WWTWs with operational staff sent on training over the past 2 years and vice versa

WSA Name	# of WWTW staff attending training over past 2 years	# of WWTW without training over past 2 years
Bela Bela	0	3
Modimolle	0	5
Greater Sekhukhune	4	12
Capricorn	5	0
Lephalale	0	3
Mogalakwena	0	3
Mopani	2	7
Polokwane	1	2
Vhembe	0	14
Thabazimbi	0	3
Totals	**12 (19%)**	**52 (81%)**

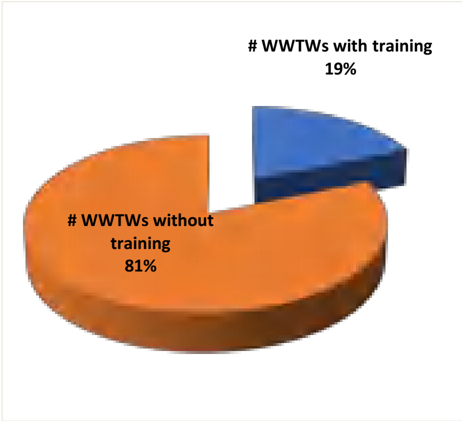


Figure 117 - %WWTWs that have trained operational staff over the past two years

The results confirmed that technical staff from 81% of the WWTWs have not attended any training events for the past 2 years. This figure highlights a severe gap in capacity and upskilling of existing staff and would require a concerted effort to strengthen training initiatives of Supervisors and Process Controllers. Recent training events focused primarily on chlorine handling and NQF, and needs to be expanded to operation of technology, sludge treatment and energy efficiency.

Diagnostic 3: Treatment Capacity

Aim: A capable treatment plant requires adequate design capacity and functional equipment to operate optimally. If the plant capacity is exceeded by way of inflow volume or strength, the plant will not be capable to achieve its compliance standards. Capacity is typically exceeded when the demand exceeds the installed design capacity, or when processes or equipment is not operational or dysfunctional, or when the electrical supply cannot support the treatment infrastructure. This diagnostic assesses the status of plant capacity and operational flows to the plants.

Findings: Analysis of the hydraulic capacities and operational flows indicate a total design capacity of 213 Ml/d for the Province, with a total inflow of 93 Ml/day. Theoretically, this implies that 43% of the design capacity is used with 57% available to meet additional demand. This figure does not represent the full hydraulic load to the WWTWs, as 41 systems are not measuring their inflows. Also, the full 213 Ml/d day is not available as some infrastructure is dysfunctional, leaving 144 Ml/d available. The reduced capacity, coupled with absent inflow data, means that the Province would be closer to its total available capacity than the 43% reported.

Most plants are operating within their design capacities, with the exception of some systems in Greater Sekhukhune, Capricorn, Polokwane, and Mopani. Mopani, Greater Sekhukhune, Thabazimbi and Vhembe reported a low percentage use of their capacity, and that is excluding Modimolle and Lephalale that did not provide flow data. Treatment systems with low percentage use may have been affected by breakdown in sewer networks or pump stations whereby all sewage is not reaching the treatment works. The Green Drop audit requires a wastewater flow balance to identify and quantify possible losses from the network and/or ingress into the sewers. It was noted that the majority of municipalities do not have flow balances to track the wastewater pathway from consumer to treatment plant.

Table 123 - Summary of WWTWs design and available capacities, inflows, % use design capacities, and inflows measured per WWTW

WSA Name	# WWTWs	Design Capacity (Ml/d)	Available Capacity (Ml/d)	Operational Flow (Ml/d)	Variance (Ml/d)	% Use Design Capacity	Inflow measured #
Bela Bela	3	7.2	7.2	4.5	2.7	62.5%	1
Modimolle	5	13	13.0	NI	13	NI	0
Greater Sekhukhune	16	17.35	3.2	4.6	12.9	26.5%	3
Capricorn	5	15.85	6.6	7.8	8.1	49.3%	5
Lephalale	3	10.7	4.0	NI	10.7	NI	0
Mogalakwena	3	11	7.6	8.0	3	72.7%	1
Mopani	9	37.2	30.1	11.4	25.8	30.6%	6
Polokwane	3	47.8	31.8	45.5	2.3	95.1%	3
Vhembe	14	43.21	38.1	8.2	35	19.0%	3
Thabazimbi	3	9.8	1.9	2.5	7.3	25.5%	1
Totals	**64**	**213.11**	**143.5**	**92.5**	**120.8**	**43.4%**	**23**

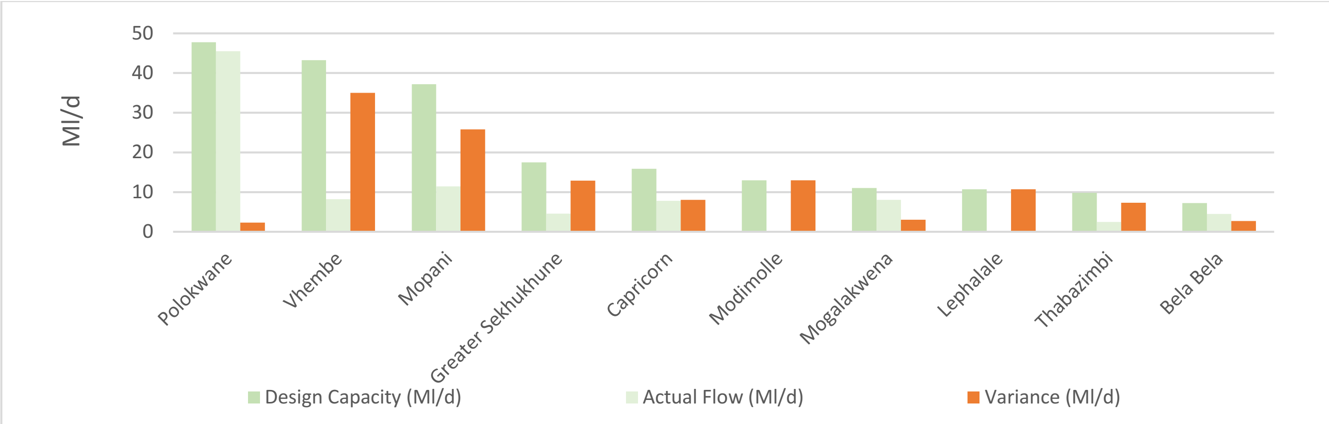


Figure 118 - WSA design capacity, actual flow, and variance in Ml/d for all WWTWs

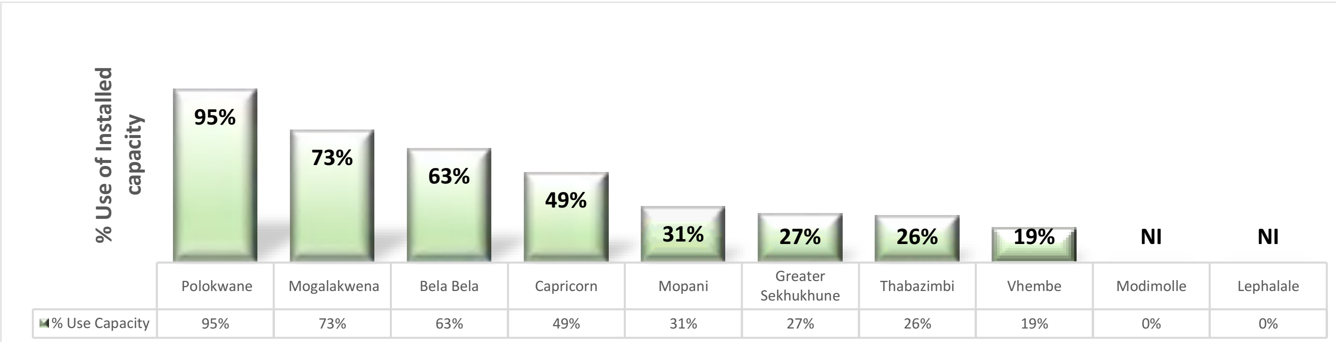


Figure 119 - WSA % use of installed design capacity

The audit data indicates that 6 systems are hydraulically overloaded. This figure could theoretically be higher, given that there are 41 systems where inflow monitoring is not taking place. The capacity limitations may impede social and economic development in the drainage areas, if not addressed. The hydraulically overloaded systems in each of the WSAs is as follows:

- Greater Sekhukhune: 3 of 16 systems (Burgersfort, Marble Hall, Steelpoort) – no inflows for the remaining 13 systems
- Capricorn: 1 of 5 systems (Mogwadi)
- Mopani: 1 of 9 systems (Lenyenye) - no inflows for 3 systems
- Polokwane: 1 of 3 systems (Mankweng).

Water Use Authorisations mandate municipalities to install meters and monitor inflows, whilst GD requires WSAs to report inflows on IRIS and to calibrate meters annually.

The audit results indicate that 36% (23 of 64 systems) monitor their inflow. The majority of WSAs do not calibrate or verify their flow meters on an annual basis, which thereby failing to meet good practice standards.

The province does not meet the expectations pertaining to monitoring inflow and outflows, i.e. hydraulic loads to the treatment works, few municipalities know their organic design capacity and does not monitor organic loading to the works. This presents a gap that would impede planning and system optimisation strategies.

Diagnostic 4: Wastewater Monitoring and Compliance

Aim: "*To measure is to know*" and "*To know is to manage*". The primary objective of a wastewater treatment plant is to produce final effluent and biosolids to a safe standard. This standard cannot be measured or managed if operational and compliance monitoring is lacking. This diagnostic assesses the monitoring status and final effluent compliance against each WWTW's mandatory standards.

Findings: For operational monitoring, a satisfactory level of 90% is applied as the benchmark, to give weight to the importance of monitoring. For compliance monitoring, the audit evaluates the sampling point, sampling frequency, final effluent quality, biomonitoring, heavy metals, and any specific condition that the DWS may have included in the water use license. Final effluent quality compliance is calculated against the mandatory limits as listed under "Authorisation Status".

A >90% compliance figure confirms high quality final effluent, whereas a <30% indicates poor effluent quality. The enforcement measures are summarised in the last column of Table 125 and includes NWA Notices and Directives issued, criminal cases opened, and court interdicts granted during the period 1 April 2019 to 30 June 2021.

Table 124 - Summary of the WSA operational and compliance monitoring status

WSA Name	# WWTW	Operational monitoring (KPA B2)		Compliance monitoring (KPA B3)	
		Satisfactory [GD score ≥90%]	Not Satisfactory [GD score <90%]	Satisfactory [GD score ≥90%]	Not Satisfactory [GD score <90%]
Bela Bela	3	0	3	0	3
Modimolle	5	0	5	0	5
Greater Sekhukhune	16	0	16	2	14
Capricorn	5	0	5	0	5
Lephalale	3	0	3	0	3
Mogalakwena	3	0	3	0	3
Mopani	9	1	8	0	9
Polokwane	3	0	3	0	3
Vhembe	14	0	14	0	14
Thabazimbi	3	0	3	0	3
Totals	**64**	**1 (2%)**	**63 (98%)**	**2 (3%)**	**62 (97%)**

The performance recorded in Table 124 stems from performance data as measured against the Green Drop Standard expressed in KPAs B2 and B3. Overall, an unsatisfactory sampling and analysis regime is observed for both operational (98%) and compliance (97%) monitoring. This is a concerning observation as it points to a root cause to poor effluent quality compliance. Compliance monitoring is crucial, not is it a legal requirement but also the only means to measure (and correct) the performance of a treatment facility. Operational monitoring is the cornerstone of day-to-day process adjustments and optimisation to ensure treatment is efficient and delivers quality effluent/sludge that meets the design expectations. Sludge monitoring is essential as poor sludge handling is the root cause of many WWTWs failing to meet final effluent standards. The results indicate that the WSAs on average, is not achieving regulatory and industry standards.

Table 125 summarises the results of KPA E, which also carries the highest Green Drop score weighting. Note that averages shown as '0%' under Effluent Compliance include actual 0% compliance plus systems with no information or insufficient data.

Table 125 - Summary of authorisation status, effluent compliance status, and directives/notices issued

WSA Name	Effluent Compliance										Enforce-ment Measures*
	Authorisation Status	Microbiological Compliance (%)			Chemical Compliance (%)			Physical Compliance (%)			
		Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	
Bela Bela	2 GA; 1 Not authorised	**60%**	2	1	**36%**	0	2	**65%**	0	0	1
Modimolle	2 WUL; 3 GA	**0%**	0	5	**0%**	0	5	**0%**	0	5	2
Greater Sekhukhune	3 WUL; 14 Not authorised	**9%**	0	14	**9%**	0	13	**15%**	0	12	3
Capricorn	1 WUL; 4 Not authorised	**0%**	0	5	**0%**	0	5	**0%**	0	4	0
Lephalale	2 WUL; 1 Not authorised	**0%**	0	3	**0%**	0	3	**0%**	0	1	1
Mogalakwena	1 Exempted; 2 Not authorised	**0%**	0	3	**0%**	0	3	**0%**	0	3	2
Mopani	2 WUL; 7 Not authorised	**7%**	0	8	**10%**	0	8	**16%**	1	7	3
Polokwane	1 WUL; 1 GA; 1 Not authorised	**1%**	0	3	**48%**	0	1	**69%**	1	0	2
Vhembe	5 WUL; 1 GA; 8 Not authorised	**20%**	1	9	**21%**	0	9	**36%**	3	8	5
Thabazimbi	3 Not authorised	**0%**	0	3	**0%**	0	3	**0%**	0	3	0
Totals		**10%**	**3**	**54**	**12%**	**0**	**52**	**20%**	**5**	**43**	**19**

* The enforcement measures (notices or directives issued) are taken over a two-year financial period from July 2019 to June 2021

Overall, the municipalities reached 10% for microbiological compliance monitoring, followed by 12% for chemical, and 20% for physical compliance monitoring. For the microbiological compliance category, 3 of 64 systems achieved >90% and 54 systems fell below 30%. For the chemical compliance category, 0 systems achieved >90% and 52 systems fell below 30%. For the physical compliance category, 5 systems achieved >90% and 43 systems fell below 30%.

A total of 19 Directives/Notices have been issued to 8 municipalities. Vhembe (5 no.), Greater Sekhukhune and Mopani (3 no. each) have the highest number of enforcement measures initiated by the Regulator which require municipal leadership intervention and correction.

In terms of sludge compliance status, it is found that:

- 2 WWTWs (3%) classify their biosolids according to the WRC Sludge Guidelines – 1 system in Lephalale and Mopani partially classified
- 7 WWTWs (11%) monitor sludge streams – 7 of 14 systems in Vhembe
- No municipalities have Sludge Management Plans in place
- 5 WWTWs (8%) use sludge for agricultural purposes and landfill.

The data confirmed that only 5 of the 10 municipalities have access to credible laboratories for compliance and operational analysis. Hence, municipalities have some access to internal and/or contracted laboratories with accreditation and/or have Proficiency Testing Schemes with suitable analytical methods and quality assurance. At 50%, Limpopo is not meeting the regulatory expectation that all municipalities have access to analytical services for compliance, operational and sludge monitoring.

Diagnostic 5: Energy Efficiency

Aim: The wastewater industry offers many opportunities to respond to climate change challenges by improving energy efficiency, reducing greenhouse gases, and generating energy. The energy cost of sophisticated treatment technologies are in the order of 25-40% of the O&M budget (cited WRC 2021). This diagnostic investigates the status of energy efficiency management at a provincial and municipal level with an aim to motivate for improved operational wastewater treatment efficiency.

Benchmark 1: Estimated energy intensity for large WWTW is in order of [illegible] kWh/m³

- 0.177 kWh/m³ for trickling filter
- 0.272 kWh/m³ for activated sludge
- 0.314 kWh/m³ for advanced treatment
- 0.412 kWh/m³ for advanced treatment with nitrification

Benchmark 2: Energy requirements per plant size

Plant capacity, Ml/d	[illegible]	2	10	[illegible]	100
Trickling filter, kWh/m³	0.43	[illegible]	0.23	0.18	0.16
Activated sludge, kWh/m³	0.59	[illegible]	0.37	[illegible]	[illegible]

Tariffs are typically dependent on time of day and season, e.g.

- Peak rate: [illegible] c/kWh
- Off-peak time: [illegible] c/kWh
  Standard time: 117.57 - 87.12 c/kWh

([illegible])

Findings: The audit results indicate an overall negligible awareness of energy management in Limpopo. None of the municipalities conducted baseline energy audits or could report on electricity cost as R/kWh, except for 1 system (Tzaneen at 0.29 kWh/m^3). No energy efficiency initiatives are in place. No WSA could account for CO_2 equivalents associated with energy efficiency. It is thus evident that municipalities have not established a specific report to monitor energy as part of the wastewater business. Energy efficiency management is not embedded in the Limpopo municipal sector, despite having several energy intensive technologies. Potential cost savings and environmental gains are thus forfeited.

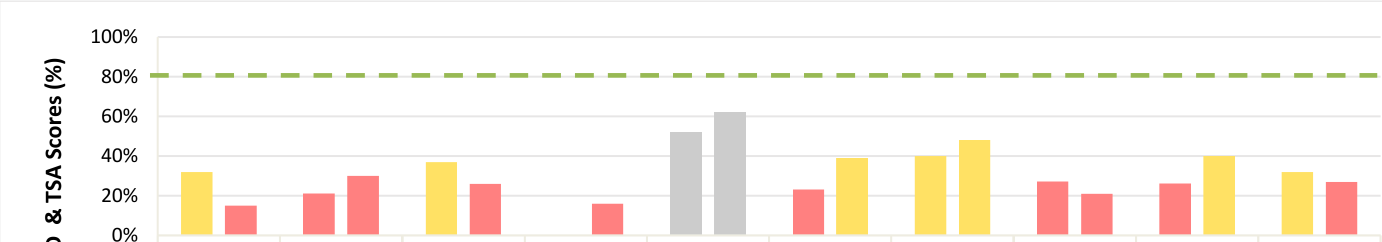
Diagnostic 6: Technical Site Assessments

Aim: The Green Drop process makes provision for the desktop audit to be followed by a Technical Site Assessment (TSA) in order to verify the desktop evidence. The assessment includes physical inspection of the sewer network, pump stations, and treatment facility, coupled with asset condition checks to determine an approximate cost to restore existing infrastructure to functional status (VROOM).

Findings: The results of the TSAs are summarised in Table 126. A deviation of >10% between the GD and TSA score indicates a misalignment between the administrative aspects and the work on the ground. The Regulator regards a wastewater system with a TSA score of >80% as one that has an acceptable level of process control and functional equipment. A TSA score of 90% would represent an excellent plant that complies with most of the Green Drop TSA standards.

Table 126 - Summary of the WWTW Technical Site Assessments scores and hardware problems and %deviation between GD and TSA scores

WSA Name	TSA WWTW Name	WWTW GD Score (%)	% TSA	Key Hardware Problems	Difference between TSA & GD score
Polokwane	Polokwane	32%	15%	1. Screening and degritting not working; 2. Only one PST operation; 3. Secondary treatment not optimal; 4. Chlorination not working	17%
Bela Bela	Radium	21%	30%	1. Backup power for PST's; 2. PSTs; 3. Biofilters; 4. Disinfection; 5. Sludge drying beds	9%
Modimolle-Mookgopong	Modimolle	37%	26%	1. Industrial effluent pipeline; 2. Raw water pumps; 3. Aerator on Orbal reactor; 4. Sludge recycle pumps; 5. Cables for blowers	11%
Thabazimbi	Thabazimbi	0%	16%	1. Biofilter wall requires detail structural investigation;2. Old bioreactor aerators to be refurbished; 3. New BNRAS electrical switchgear and plant to be commissioned	16%
Greater Sekhukhune	Marble Hall	52%	62%	1. Boundary fence compromised; 2. Total lack of degritting; 3. Lack of primary settling, digestion; 4. Sludge not removed from ponds; 5. 0/3 floating aerators are operational	10%
Vhembe	Malamulele	23%	39%	1. pH correction not successful in protecting the infrastructure; 2. Securing pump stations and manage spills and leakages; 3. Biofilter arms not rotating, and nozzles blocked; 4. Disinfection and final effluent flow metered; 5. Laboratory equipment, reagents, and training for proper process control	16%
Capricorn	Lebowakgomo AS	40%	48%	1. Repair desludge pumps; 2. Repair faulty aerators; 3. Acquire instruments to monitor processes at the WWTW; 4. Increase the capacity of the WWTW I.T. O design capacity of 12 Ml/d; 5. Calibrate both flow meters	8%
Mopani	Giyani	27%	21%	1. Safety rails; 2. Desludging of sludge @ maturation ponds and drying beds; 3. Disinfection, Monitoring of sewer network, and pump stations	6%
Mogalakwena	Mokopane	26%	40%	1. Degritting pumps and mechanics; 2. Motors of aerators and related mechanical support 3. Disinfection equipment; 4. De-sludging and sludge removal from drying beds	14%
Lephalale	Paarl	32%	27%	1. Screens, disinfection, sludge pumps; 2. Degritting pumps and mechanics; 3. Motors of aerators; 5. General maintenance and repairs at the plant	5%
Totals	**10**				**5% to 17%**



	Polokwane	Radium	Modimolle	Thabazimbi	Marble Hall	Malamulele	Lebowakgomo AS	Giyani	Mokopane	Paarl
	Polokwane	Bela Bela	Modimolle / Mookgopong	Thabazimbi	Greater Sekhukhune	Vhembe	Capricorn	Mopani	Mogalakwena	Lephalale
GD Score (%)	32%	21%	37%	0%	52%	23%	40%	27%	26%	32%
TSA Score (%)	15%	30%	26%	16%	62%	39%	48%	21%	40%	27%

Figure 120 - Municipal GD (left bar) and TSA score (right bar) comparison (colour legends as for GD)

A total of 10 site assessments were conducted, with 1 inspection per municipality. No treatment works scored above 80%, which is a satisfactory TSA score. Apart from Sekhukhune, all WWTW had TSA scores of <50%, with the lowest for Polokwane at 15%. These results indicate a very low operational and equipment functionality at the inspected treatment facilities.

A reasonably low difference between GD and TSA scores were observed for most systems (<20%), which implies that the wastewater administration correlate with the condition of processes and infrastructure in the field. Despite the low differences, most WSAs have low TSA and Green Drop scores, which indicate failure of systems on all levels of the wastewater business.

The VROOM cost presents a ‘’very rough order of measurement” cost to return a WWTWs functionality to its original design. A total budget of approximately R300 million is estimated for WSAs in the province, with the bulk of the work required in restoration of mechanical equipment (62%).

Table 127 - VROOM cost split for civil, mechanical, and electrical and total VROOM cost estimate

WSA	Civil cost estimate	Mechanical cost estimate	Electrical & C&I cost estimate	Total VROOM cost
Polokwane	R7,915,680	R59,539,680	R1,376,640	R68,832,000
Bela Bela	R4,800,672	R6,836,400	R3,554,928	R15,192,000

WSA	Civil cost estimate	Mechanical cost estimate	Electrical & C&I cost estimate	Total VROOM cost
Modimolle-Mookgopong	R2,620,800	R41,230,800	R2,948,400	R46,800,000
Thabazimbi	R6,126,505	R16,034,318	R5,181,178	R27,342,000
Greater Sekhukhune	R35,862,450	R14,124,288	R5,186,262	R55,173,000
Vhembe	R16,413,319	R12,639,789	R1,625,992	R30,679,100
Capricorn	R9,468,156	R13,997,452	R626,392	R24,092,000
Mopani	R3,559,296	R6,261,505	R2,083,200	R11,904,000
Mogalakwena	R331,650	R3,529,350	R1,089,000	R4,950,000
Lephalale	R434,000	R11,465,585	R3,583,965	R15,515,000
Totals	**R87,532,528**	**R185,659,167**	**R27,255,957**	**R300,479,100**
% Distribution	**29%**	**62%**	**9%**	**100%**

The key hardware problems are listed Table 126, with predominant defects in electrical cables, primary and secondary clarification, disinfection, sludge pumps, sludge treatment and power backup. Mechanical defects typically include dysfunctional aerators, flow meters, sludge and effluent pumps, mixers, screens, degritters, and disinfection equipment. Vandalism and theft, long procurement lead times, lack of management involvement, lack of maintenance, and lack of budget are the main reasons for dysfunctional assets.

Diagnostic 7: Operation, Maintenance and Refurbishment of Assets

Aim: Insufficient financial resources are often cited as a root cause to dysfunctional or non-compliant wastewater systems. Knowledge and monitoring of fiscal spending are therefore a critical part of wastewater management. This diagnostic investigates the status of financial information as pertaining to O&M budgets and expenditure, asset figures, and capital funding.

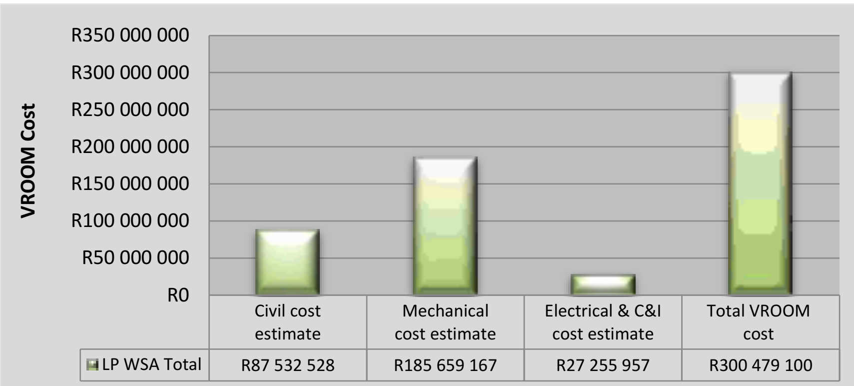
Findings: A substantial amount of financial information was presented during the audit process. Unfortunately, the evidence was presented in different formats, levels of detail, or absent for some municipalities. It was observed that municipal teams with financial officials that were present during the audits typically performed better, and also had a better understanding of the wastewater challenges experienced by their technical peers. Discrepancies observed included amongst others - generic or non-ringfenced budgets, contract lump sums for service providers presented as budgets, outdated or incomplete asset registers, and some cost drivers which were lacking (mostly electricity). The Regulator grouped data into different certainty levels, as summarised at the end of this Diagnostic.

It must be noted that there were limitations with the financial and asset information. Not all WSAs submitted current information or complete financial data sets.

The result of each financial portfolio is discussed hereunder.

Vroom Cost Analysis

The VROOM costs breakdown is discussed under the TSA Diagnostic but is further illustrated as follows.



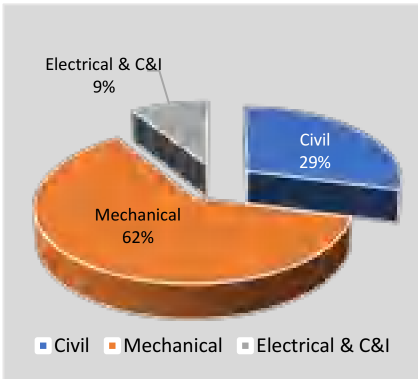


Figure 121 - Graphic illustration of the total cost estimated to restore functionality to existing assets (a), broken down to civil, mechanical, and electrical components

The total cost of R300 million is estimated to restore existing treatment works to their design capacity and functionality - consisting of R186 million for mechanical repairs, R27 million for electrical repairs, and R88 million for civil structures.

Table 128 indicates that a capital budget of R269 million has been secured over MTREF period to address infrastructural needs. While it is likely that some of the VROOM requirements will be addressed through this budget, it is probable that additional funding will be required to address the full VROOM requirements. In addition to the R300 million to restore the infrastructure, it is estimated that a total of R9 million will be required by all WSAs, on an annual basis, to maintain their assets.

Capital, O&M Budget and Actual, and Asset Value

The capital budgets, O&M budgets, O&M actual expenditure, and current asset values are summarised below.

Table 128 - Summary of the capital budgets, O&M budgets, O&M actual expenditure, and current asset values

WSA	Capital budget available	O&M budget (2020/21)	O&M expended (2020/21)	% Expended	Total Current Asset Value
Polokwane	NI	NI	NI	NI	NI
Bela Bela	R49,500,000	NI	NI	NI	NI
Modimolle-Mookgopong	R45,600,000	R22,543,000	R19,250,000	85%	R148,833,200
Thabazimbi	NI	NI	NI	NI	NI
Greater Sekhukhune	NI	R70,000,000	R330,000	NI	NI
Vhembe	NI	NI	NI	NI	NI
Capricorn	R134,000,000	R227,035,000	R134,000,000	59%	R61,285,000
Mopani	R2,800,000	R12,002,940	R30,089,090	251%	R7,977,180
Mogalakwena	R3,200,000	R14,233,550	R11,496,140	81%	R205,125,700
Lephalale	R33,732,740	R22,496,220	R22,177,030	99%	NI
Totals	**R268,832,740**	**R368,310,710**	**R217,342,260**	**59%**	**R423,221,080**

The Green Drop process provides a bonus (incentive) in cases where a municipality provides evidence of capital projects with secured funding since this is deemed as a definitive means of addressing wastewater service inadequacies. This incentive encourages wastewater infrastructure investment. A total capital budget of R269 million has been reported for the refurbishment and upgrades of wastewater infrastructure for all the municipalities over the MTREF period. The largest capital budgets are observed for Capricorn (R134m), Bela Bela (R50m), and Modimolle-Mookgopong (R46m).

For the 2020/21 fiscal year, the total O&M budget reported for the Province was R368 million, of which R217 million (59%) has been expended. Over expenditure of 151% by Mopani and low expenditure by Capricorn was observed. The provincial figures exclude Polokwane, Bela Bela, Thabazimbi and Vhembe, that did not provide financial information.

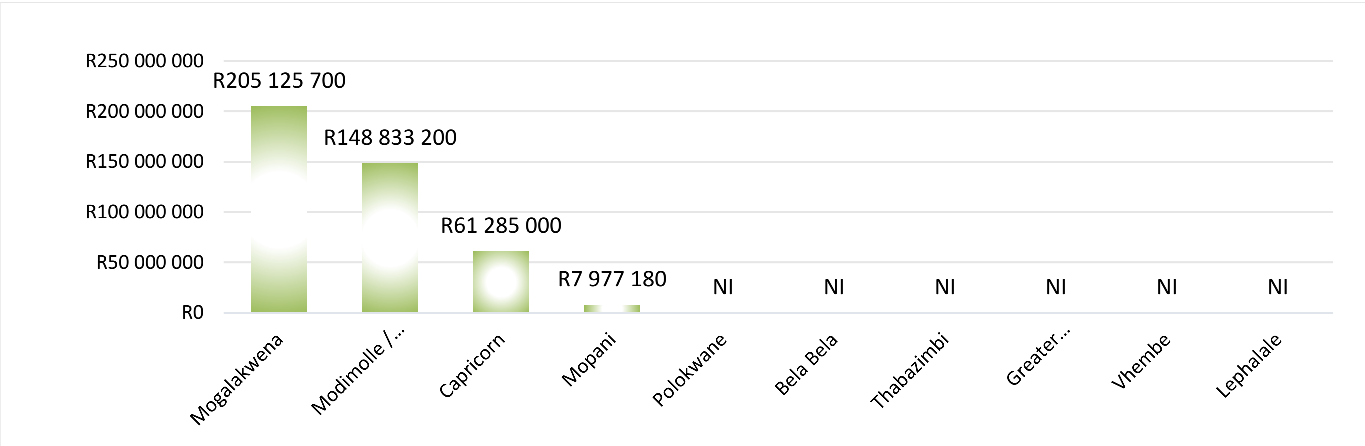


Figure 122 - Total current asset value reported by the municipalities

The total current asset value for wastewater infrastructure (networks, pump stations, treatment plants) is reportedly R423 million. This figure excludes Polokwane, Bela Bela, Thabazimbi, Greater Sekhukhune, Vhembe and Lephalale who did not have the required information. The highest asset values are observed of Mogalakwena (R205m) followed by Modimolle-Mookgopong (R149m).

O&M Cost Benchmarking

By combining the SALGA and WRC WATCOST models, an estimation of the maintenance cost required per asset type can be done, i.e. civil, buildings, pipelines, mechanical, electrical, and instrumentation.

Table 129 - SALGA-WRC annual maintenance budget guideline and cost estimation

Description	% of Current Asset Value	Asset Value Estimate	Modified SALGA Maintenance Guideline	Annual Maintenance Budget Guideline
Current Asset Value estimate	**100%**	**R423,221,080**	**15.75%**	**R9,056,931**
Broken down into:				
1. Civil Structures	46%	R194,681,697	0.50%	R973,408
2, Buildings	3%	R12,696,632	1.50%	R190,449
3. Pipelines	6%	R25,393,265	0.75%	R190,449
4. Mechanical Equipment	35%	R148,127,378	4.00%	R5,925,095
5. Electrical Equipment	8%	R33,857,686	4.00%	R1,354,307
6. Instrumentation	2%	R8,464,422	5.00%	R423,221
Totals	**100%**	**R423,221,080**	**15.75%**	**R9,056,931**
			Minus 20% P&Gs and 10% Installation	**R2,717,079**
			Total	**R6,339,852**

The model estimates that R9 million (2.14%) is required per year to maintain the assets valued at R423 million. Notably, this maintenance estimate assumes that all assets are functional. The VROOM cost represents the funding required return the assets to a fully functional state, from which basis routine maintenance could then focus on maintaining the assets.

Table 130 indicates the SALGA maintenance cost estimation in relation to the VROOM cost, O&M budget, and O&M actual expended.

Table 130 - O&M cost estimates by the SALGA and VROOM models versus actual budget and expenditure figures

Cost Reference	O&M Cost Estimate	Period
Modified SALGA	R9,056,931	Annually, estimation
O&M Budget	R368,310,710	Actual for 2020/21
O&M Spend	R217,342,260	Actual for 2020/21
VROOM	R300,479,100	Once off estimation

The cost dynamics can be summarised as follows:

- The SALGA estimations for maintenance budgets is approximately 2.5% of the actual reported budgets for the 2020/21 fiscal year. This figure is influenced by the lack of asset values for 6 of the 10 municipalities
- The actual O&M budget seems over adequate when compared with the SALGA guideline, suggesting the skewed estimates based on the lack of financial data for both O&M budgets & actuals, and current asset values
- The VROOM cost represents an estimation of the refurbishment cost to restore WWTWs functionality and design capacity.

Production Cost and Comparison

It is good business practice to monitor and manage the production costs of wastewater treatment in Rand/m^3 treated, and to compare such cost with industry norms. Published benchmarks is not currently available for typical treatment costs, but significant cost increases are expected since 2013, given the variable input factors such as Covid, cost of chemicals, transport, and electricity. From an economic perspective, it is valuable to compare production cost at time of budgeting versus actual production costs. However, due to scarce information, it is not possible to provide insight as to possible shortfalls from an economic perspective.

Due to the lack of data, no production costs for wastewater treatment could be determined. Only Mogalakwena and Mopani provided production cost, i.e. budgeted at R15 versus actual cost of R1.44/m^3 for Mogalakwena, and R1.77m^3 versus actual cost of R2/m^3 for Mopani. WSAs in the Limpopo Province may view the results obtained for Gauteng, KwaZulu Natal, Eastern Cape and Western Cape, to obtain a sense of typical production costs at South African wastewater treatment facilities.

Data Certainty

Data certainty is expressed at different levels for the financial and asset figures reported within this Diagnostic. Certainty levels differ from system to system, hence some WSAs are included in multiple data certainty categories - as the data is variable, inconsistent, limited or non-existent (NI) for each of the systems. The various WSAs in the province that were identified under the category ''High Certainty", presented consistent and verifiable evidence in the form of budgets, expenditure, asset registers, and unit costs.

Table 131 - Levels of certainty associated with financial and asset information reported by municipalities

Data Certainty	Description	WSA
No certainty	Absent data or no certainty in data presented - not ringfenced for WWTW & Network	Polokwane, Bela Bela, Thabazimbi, Vhembe
Low certainty	Minor or little certainty in the data - partially ringfenced for WWTW only or data as extreme outliers	Greater Sekhukhune, Lephalale, Capricorn
Reasonable/good certainty	Reasonable to good level of certainty in the data - ringfenced for WWTW and/or Network and data falls within/close to expected parameters	Modimolle-Mookgopong, Mopani, Mogalakwena
High certainty	High level of certainty in the data - ringfenced for WWTW and Network and data falls within expected parameters	None

8.1 Bela Bela Local Municipality

Water Service Institution	**Bela Bela Local Municipality**	
Water Service Providers	Bela Bela Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. PST to be unblocked 2. Backup power for PST's 3. Repairs to Biofilters 4. Install disinfection **VROOM Estimate:** - R15,192,000
2021 Green Drop Score	**32%↓**	
2013 Green Drop Score	**44%**	
2011 Green Drop Score	**17%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Pienaarsrivier**	**Radium**	**Warmbaths**
Green Drop Score (2021)		**25%**	**21%**	**34%**
2013 Green Drop Score		**46%**	**42%**	**44%**
2011 Green Drop Score		**2%**	**21%**	**17%**
2009 Green Drop Score		**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.2	1	6
Design Capacity Utilisation (%)		NI	NI	75%
Resource Discharged into		Discharge in farm dam, private property	Discharge to maturation ponds	Discharge to maturation ponds, evaporation
Wastewater Risk Rating (CRR % of CRR_{max})		**Pienaarsrivier**	**Radium**	**Warmbaths**
CRR (2011)	%	88.2%	53.0%	60.0%
CRR (2013)	%	88.2%	76.5%	76.0%
CRR (2021)	%	82.4%	88.2%	59.1%

Technical Site Assessment: **Warmbaths WWTW 30%**

8.2 Capricorn District Municipality

Water Service Institution	**Capricorn District Municipality**	
Water Service Provider	Capricorn District Municipality	
Municipal Green Drop Score		**Vroom Impression (Towards restoring functionality):** 1. Repair desludge pumps 2. Repair faulty aerators 3. Increase the capacity of the WWTW I.T. O design capacity of 12 Ml/d 4. Calibrate both flow meters **VROOM Estimate:** - R24,092,000
2021 Green Drop Score	**39%↓**	
2013 Green Drop Score	**60%**	
2011 Green Drop Score	**46%**	
2009 Green Drop Score	**10%**	

Key Performance Area	Unit	Alldays	Lebowakgomo	Lebowakgomo	Mogwadi (Dendron)	Senwabarwana
Green Drop Score (2021)		**33%**	**40%**	**41%**	**27%**	**31%**
2013 Green Drop Score		**78%**	**62%**	**58%**	**48%**	**48%**
2011 Green Drop Score		**29%**	**51%**	**NA**	**NA**	**38%**
2009 Green Drop Score		**0%**	**10%**	**0%**	**0%**	**0%**
Design Capacity	Ml/d	0.6	12	1.9	0.35	1
Capacity Utilisation (%)		17%	48%	58%	126%	40%
Resource Discharged into		**NA**	Chuenie River	NI	NI	Senwabarwana River
Wastewater Risk Rating (CRR% of CRR_{max})		**Alldays**	**Lebowakgomo**	**Lebowakgomo**	**Mogwadi (Dendron)**	**Senwabarwana**
CRR (2011)		78.0%	94.0%	**NA**	**NA**	72.0%
CRR (2013)		59.0%	71.0%	59.0%	71.0%	71.0%
CRR (2021)		76.5%	63.6%	76.5%	88.2%	70.6%

Technical Site Assessment: **Lebowakgomo WWTW 48%**

8.3 Greater Sekhukhune District Municipality

Water Service Institution	**Sekhukhune District Municipality**	
Water Service Providers	Sekhukhune District Municipality Lepelle Northern Water	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Extensive vandalism with regard to pumps, chlorine dosing equipment and associated electrical equipment 2. Mechanical screen, inflow meter, effluent recycle pumpstation and sludge drying beds require refurbishment **VROOM Estimate**: - R55,173,000
2021 Green Drop Score	**33%↓**	
2013 Green Drop Score	**40%**	
2011 Green Drop Score	**20%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Burgersfort**	**Dennilton**	**Elandskraal**	**Groblersdal**
Green Drop Score (2021)		**52%**	**20%**	**20%**	**45%**
2013 Green Drop Score		**70%**	**27.2%**	**20.7%**	**29.8%**
2011 Green Drop Score		**48%**	**20.0%**	**11.8%**	**51.2%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	1.5	1	0.5	5
Capacity Utilisation (%)		167%	NI	NI	NI
Resource Discharged into		Spekboom River	Moses River	Olifants River	Olifants River
Wastewater Risk Rating (CRR% of CRR_{max})		**Burgersfort**	**Dennilton**	**Elandskraal**	**Groblersdal**
CRR (2011)	%	88.2%	88.2%	82.4%	88.2%
CRR (2013)	%	76.5%	64.7%	82.4%	94.1%
CRR (2021)	%	64.7%	88.2%	94.1%	77.3%

Key Performance Area	**Unit**	**Leeufontein**	**Mapodile**	**Marble Hall**	**Mecklenburg**
Green Drop Score (2021)		**20%**	**14%**	**52%**	**17%**
2013 Green Drop Score		**17.8%**	**8.7%**	**62.3%**	**17.4%**
2011 Green Drop Score		**20.8%**	**14.5%**	**23.4%**	**17.3%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.5	0.5	1.5	0.5
Capacity Utilisation (%)		NI	NI	107%	NI
Resource Discharged into		Flag Boshielo River	Steelpoort River	Olifants River	No discharge
Wastewater Risk Rating (CRR% of CRR_{max})		**Leeufontein**	**Mapodile**	**Marble Hall**	**Mecklenburg**
CRR (2011)	%	82.4%	100.0%	88.2%	82.4%
CRR (2013)	%	82.4%	88.2%	50.0%	82.4%
CRR (2021)	%	94.1%	100.0%	77.3%	94.1%

Key Performance Area	**Unit**	**Monsterlus /Thlokotlou**	**Motetema**	**Nebo**	**Penge**
Green Drop Score (2021)		**23%**	**20%**	**17%**	**19%**
2013 Green Drop Score		**24.0%**	**26.2%**	**17%**	**19%**
2011 Green Drop Score		**16.0%**	**10.5%**	**10%**	**21%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.5	2.5	0.5	0.25
Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Mahlangu River	Blood River	Motsipiri River	Olifants River

Wastewater Risk Rating (CRR% of CRR_{max})		Monsterlus	Motetema	Nebo	Penge
CRR (2011)	%	88.2%	100.0%	82.4%	94.1%
CRR (2013)	%	82.4%	82.4%	82.4%	82.4%
CRR (2021)	%	88.2%	88.2%	94.1%	94.1%

Key Performance Area	Unit	Phokwane	Roosenekal	Steelpoort	Tubatse
Green Drop Score (2021)		20%	17%	46%	17%
2013 Green Drop Score		17%	46%	69.2%	17.4%
2011 Green Drop Score		18%	41%	51.5%	10.3%
2009 Green Drop Score		0%	0%	0%	0%
System Design Capacity	Ml/d	0.5	1.65	0.2	0.25
Capacity Utilisation (%)		NI	NI	250%	NI
Resource Discharged into		Olifants River	Tonteldoos River	Tubatse River	Spekboom River
Wastewater Risk Rating (CRR% of CRR_{max})		Phokwane	Roosenekal	Steelpoort	Tubatse
CRR (2011)	%	88.2%	76.5%	76.5%	94.1%
CRR (2013)	%	82.4%	58.8%	70.6%	94.1%
CRR (2021)	%	88.2%	88.2%	76.5%	94.1%

Technical Site Assessment: **Dennilton WWTW 41%; Marble Hall WWTW 62%**

8.4 Lephalale Local Municipality

Water Service Institution	**Lephalale Local Municipality**	
Water Service Provider	Lephalale Local Municipality	
Municipal Green Drop Score		**Vroom Impression (Towards restoring functionality):** 1. Mechanical screens not operational 2. Disinfection infrastructure to be replaced 3. Sludge pumps not operational 4. Degritting pumps not in operation 5. Aerators not in operation. **VROOM Estimate:** - R15,515,000
2021 Green Drop Score	**32%↓**	
2013 Green Drop Score	**56%**	
2011 Green Drop Score	**19%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Paarl	Witpoort	Zongesien
Green Drop Score (2021)		**32%**	**24%**	**20%**
2013 Green Drop Score		**57%**	**34%**	**34%**
2011 Green Drop Score		**19%**	**11%**	**25%**
2009 Green Drop Score		**0%**	**0%**	**0%**
Design Capacity	Ml/d	10	0.2	0.5
Capacity Utilisation (%)		NI	NI	NI
Resource Discharged into		Mogol River	No discharge	Sandsloot River
Wastewater Risk Rating (CRR% of CRR_{max})		**Paarl**	**Witpoort**	**Zongesien**
CRR (2011)		89.0%	78.0%	72.0%
CRR (2013)		54.6%	70.6%	76.5%
CRR (2021)		90.9%	88.2%	88.2%

Technical Site Assessment: **Paarl WWTW 23%**

8.5 Modimolle-Mookgopong Local Municipality

Water Service Institution	**Modimolle-Mookgophong LM**	
Water Service Providers	Modimolle-Mookgophong LM	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Industrial effluent pipeline 2. Inlet pumps 3. Aerators on Orbal reactor 4. Sludge recycle pumps 5. Cables for blowers 6. Disinfection **VROOM Estimate:** - R46,800,000
2021 Green Drop Score	**33%↓**	
2013 Green Drop Score	**48%**	
2011 Green Drop Score	**38%**	
2009 Green Drop Score	**9%**	

Key Performance Area	Unit	Modimolle	Mookgophong	Vaalwater	Alma
Green Drop Score (2021)		**37%**	**29%**	**27%**	**34%**
2013 Green Drop Score		**48%**	**46%**	**48%**	NA
2011 Green Drop Score		**43%**	**67%**	**20%**	NA
2009 Green Drop Score		**12%**	**0%**	**6%**	NA
System Design Capacity	Ml/d	6.5	2	2	2
Design Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Nyl River	No discharge, irrigation of effluent	Irrigation on site	Irrigation
Wastewater Risk Rating (CRR % of CRR_{max})		**Modimolle**	**Mookgophong**	**Vaalwater**	**Alma**
CRR (2011)	%	71.0%	41.2%	100.0%	NA
CRR (2013)	%	59.0%	59.0%	65.0%	NA
CRR (2021)	%	86.4%	88.2%	88.2%	88.2%

Key Performance Area	Unit	Roedtan/Thusang
Green Drop Score (2021)		**30%**
2013 Green Drop Score		**0%**
2011 Green Drop Score		**0%**
2009 Green Drop Score		**0%**
System Design Capacity	Ml/d	0.5
Design Capacity Utilisation (%)		NI
Resource Discharged into		No discharge
Wastewater Risk Rating (CRR % of CRR_{max})		**Roedtan/Thusang**
CRR (2011)	%	23.5%
CRR (2013)	%	100.0%
CRR (2021)	%	88.2%

Technical Site Assessment: **Modimolle WWTW 26%**

8.6 Mogalakwena Local Municipality

Water Service Institution	**Mogalakwena Local Municipality**	
Water Service Provider	Mogalakwena Local Municipality	
Municipal Green Drop Score		**Vroom Impression (Towards restoring functionality):** 1. Degritting pumps is not functional 2. Aerators and motors to be repaired 3. Disinfection equipment is not functional **VROOM Estimate:** - R4,950,000
2021 Green Drop Score	**26%↓**	
2013 Green Drop Score	**84%**	
2011 Green Drop Score	**26%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Mokopane	Rebone	Mosodi
Green Drop Score (2021)		**26%**	**25%**	**25%**
2013 Green Drop Score		**85%**	**68%**	NA
2011 Green Drop Score		**28%**	**17%**	NA
2009 Green Drop Score		**0%**	**0%**	NA
Design Capacity	Ml/d	9	0.5	1.5
Capacity Utilisation (%)		89%	NI	NI
Resource Discharged into		Mogalakwena River	Mogalakwena River	Mogalakwena River
Wastewater Risk Rating (CRR% of CRR_{max})		**Mokopane**	**Rebone**	**Mosodi**
CRR (2011)		83.0%	100.0%	NA
CRR (2013)		50.0%	47.1%	NA
CRR (2021)		81.8%	100.0%	94.1%

Technical Site Assessment: **Mokopane WWTW 40%**

8.7 Mopani District Municipality

Water Service Institution	**Mopani District Municipality**
Water Service Providers	Mopani District Municipality
	Tzaneen Local Municipality

Municipal Green Drop Score	
2021 Green Drop Score	32%↓
2013 Green Drop Score	37%
2011 Green Drop Score	52%
2009 Green Drop Score	0%

Vroom Impression (Towards restoring functionality):

1. Flow meters checked and calibrated
2. Only one of the primary settling tanks are in use
3. The pumps in the anoxic tanks (3) of the old biofilter system are not functional
4. Only one of the three biofilters is in use
5. Disinfection infrastructure in poor condition

VROOM Estimate:

- R11,904,000

Key Performance Area	Unit	Ga-Kgapane	Giyani	Lenyenye	Lulekane
A. Capacity Management	15%	49.0%	49.0%	54.0%	46.0%
B. Environmental Management	15%	39.0%	42.0%	33.0%	38.0%
C. Financial Management	20%	15.0%	17.0%	9.0%	17.0%
D. Technical Management	20%	47.5%	47.5%	24.9%	47.5%
E. Effluent & Sludge Compliance	30%	19.2%	7.8%	3.5%	8.5%
F. Bonus		0.0%	0.0%	0.0%	0.0%
G. Penalties		-25.0%	0.0%	-50.0%	-25.0%
Green Drop Score (2021)		**26%**	**27%**	**11%**	**22%**
2013 Green Drop Score		**NA**	**NA**	**NA**	**23%**
2011 Green Drop Score		**6%**	**18%**	**22%**	**24%**
2009 Green Drop Score		**10%**	**17%**	**8%**	**0%**
Design Capacity	Ml/d	4	3	0.2	3.5
Capacity Utilisation (%)		13%	77%	152%	34%
Resource Discharged into		Mudubatsi Stream	Klein Letaba River	Thabina River	Selati River
Wastewater Risk Rating (CRR% of CRR_{max})		**Ga-Kgapane**	**Giyani**	**Lenyenye**	**Lulekane**
CRR (2011)		94.0%	83.0%	94.0%	94.0%
CRR (2013)		76.0%	65.0%	94.0%	76.0%
CRR (2021)		70.6%	76.5%	94.1%	76.5%

Key Performance Area	Unit	Tzaneen	Namakgale	Nkowankowa	Phalaborwa
Green Drop Score (2021)		**61%**	**21%**	**26%**	**24%**
2013 Green Drop Score		**94%**	**26%**	**25%**	**22%**
2011 Green Drop Score		**84%**	**22%**	**78%**	**24%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
Design Capacity	Ml/d	8	6	4.5	8
Capacity Utilisation (%)		63%	NI	44%	NI
Resource Discharged into		Greater Letaba River	Selati River	Letsitele River	Selati River
Wastewater Risk Rating (CRR% of CRR_{max})		**Tzaneen**	**Namakgale**	**Nkowankowa**	**Phalaborwa**
CRR (2011)		30.0%	97.0%	72.0%	94.0%
CRR (2013)		45.0%	82.0%	59.0%	68.0%
CRR (2021)		54.5%	90.9%	82.4%	95.5%

Key Performance Area	Unit	Senwamokgopo
Green Drop Score (2021)		**3%**
2013 Green Drop Score		**0%**
2011 Green Drop Score		**0%**
2009 Green Drop Score		**NA**
Design Capacity	Ml/d	NI
Capacity Utilisation (%)		NI
Resource Discharged into		NI
Wastewater Risk Rating (CRR% of CRR_{max})		**Senwamokgopo**
CRR (2011)		100.0%
CRR (2013)		100.0%
CRR (2021)		100.0%

Technical Site Assessment: **Giyani WWTW 21%**

8.8 Polokwane Local Municipality

Water Service Institution	**Polokwane Local Municipality**	
Water Service Provider	Polokwane Local Municipality	
Municipal Green Drop Score		**Vroom Impression (Towards restoring functionality):** 1. Screening and degritting not operational 2. Only one PST in operation 3. Secondary treatment not optimal 4. Chlorination equipment not functioning **VROOM Estimate:** - R68,832,000
2021 Green Drop Score	**31%↓**	
2013 Green Drop Score	**65%**	
2011 Green Drop Score	**67%**	
2009 Green Drop Score	**38%**	

Key Performance Area	**Unit**	**Mankweng**	**Polokwane**	**Seshego**
Green Drop Score (2021)		**30%**	**32%**	**27%**
2013 Green Drop Score		**79%**	**65%**	**54%**
2011 Green Drop Score		**62%**	**70%**	**65%**
2009 Green Drop Score		**38%**	**38%**	**38%**
Design Capacity	Ml/d	8	32	7.8
Capacity Utilisation (%)		113%	97%	71%
Resource Discharged into		Pou River	Sand River	Bloed River
Wastewater Risk Rating (CRR% of CRR_{max})		**Mankweng**	**Polokwane**	**Seshego**
CRR (2011)		74.0%	71.0%	74.0%
CRR (2013)		45.0%	56.0%	64.0%
CRR (2021)		68.2%	70.4%	72.7%

Technical Site Assessment: **Polokwane WWTW 15%**

8.9 Thabazimbi Local Municipality

Water Service Institution	**Thabazimbi Local Municipality**
Water Service Provider	Thabazimbi Local Municipality

Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):**
2021 Green Drop Score	**0%↓**	1. Biofilter wall requires detail structural investigation 2. Old bioreactor aerators to be refurbished 3. New BNRAS electrical switchgear and plant to be commissioned 4. Old clarifier bridge refurbishment required 5. Old anaerobic digestor refurbishment required **VROOM Estimate:** - R27,342,000
2013 Green Drop Score	**48%**	
2011 Green Drop Score	**38%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Northam**	**Rooiberg**	**Thabazimbi**
Green Drop Score (2021)		**0%**	**0%**	**0%**
2013 Green Drop Score		**25%**	**16%**	**37%**
2011 Green Drop Score		**41%**	**45%**	**52%**
2009 Green Drop Score		**0%**	**0%**	**0%**
Design Capacity	Ml/d	1.7	1.6	6.5
Design Capacity Utilisation (%)		NI	NI	38%
Resource Discharged into		Unknown	Bloubankleegte Stream	Crocodile River
Wastewater Risk Rating (CRR% of CRR_{max})		**Northam**	**Rooiberg**	**Thabazimbi**
CRR (2011)		72.2%	72.2%	77.8%
CRR (2013)		76.5%	76.5%	88.2%
CRR (2021)		100.0%	100.0%	72.7%

Technical Site Assessment: **Thabazimbi WWTW** **16%**

8.10 Vhembe District Municipality

Water Service Institution	**Vhembe District Municipality**	
Water Service Provider	Vhembe District Municipality	
Municipal Green Drop Score		**Vroom Impression (Towards restoring functionality):** 1. Removal of screenings not effective 2. Biofilter arms not rotating, and nozzles blocked 3. Ineffective disinfection infrastructure 4. Final effluent flow not metered **VROOM Estimate:** - R30,679,100
2021 Green Drop Score	**24%↑**	
2013 Green Drop Score	**12%**	
2011 Green Drop Score	**14%**	
2009 Green Drop Score	**16%**	

Key Performance Area	Unit	Biaba	Waterval	Hlanganani	Makhado
Green Drop Score (2021)		**16%**	**27%**	**0%**	**17%**
2013 Green Drop Score		**0%**	**17%**	NA	**16%**
2011 Green Drop Score		**11%**	**14%**	NA	**20%**
2009 Green Drop Score		**4%**	**0%**	NA	**8%**
Design Capacity	Ml/d	1.8	2.5	NA	13.91
Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Nwambedi River	Midzwiriti River	NI	Litshovhu River
Wastewater Risk Rating (CRR% of CRR_{max})		**Biaba**	**Waterval**	**Hlanganani**	**Makhado**
CRR (2011)		94.0%	89.0%	NA	89.0%
CRR (2013)		88.0%	88.0%	NA	77.0%
CRR (2021)		88.2%	76.5%	100.0%	86.4%

Key Performance Area	Unit	Malamulele	Mhinga	Musina	Mutale
Green Drop Score (2021)		**23%**	**0%**	**22%**	**0%**
2013 Green Drop Score		**13%**	**4%**	**45%**	**3%**
2011 Green Drop Score		**21%**	**13%**	**17%**	**6%**
2009 Green Drop Score		**20%**	**0%**	**0%**	**20%**
Design Capacity	Ml/d	3	NI	2	NI
Capacity Utilisation (%)		73%	NI	NI	NI
Resource Discharged into		Shingwidzi River	NI	Sand River	NI
Wastewater Risk Rating (CRR% of CRR_{max})		**Malamulele**	**Mhinga**	**Musina**	**Mutale**
CRR (2011)		89.0%	94.0%	94.0%	100.0%
CRR (2013)		76.0%	82.0%	76.0%	65.0%
CRR (2021)		58.8%	100.0%	100.0%	100.0%

Key Performance Area	Unit	Nancefield	Rietvlei	Thohoyandou	Tshifulanani
Green Drop Score (2021)		**21%**	**30%**	**32%**	**0%**
2013 Green Drop Score		**25%**	NA	**12%**	**13%**
2011 Green Drop Score		**10%**	NA	**15%**	**12%**
2009 Green Drop Score		**0%**	NA	**0%**	**0%**
Design Capacity	Ml/d	3	5	12	NI
Capacity Utilisation (%)		NI	80%	17%	NI

Key Performance Area	Unit	Nancefield	Rietvlei	Thohoyandou	Tshifulanani
Resource Discharged into		Malala stream	Litshovhu River	Luvuvhu River	NI
Wastewater Risk Rating (CRR% of CRR_{max})		Nancefield	Rietvlei	Thohoyandou	Tshifulanani
CRR (2011)		89.0%	NA	91.0%	94.0%
CRR (2013)		76.0%	NA	91.0%	94.0%
CRR (2021)		100.0%	63.6%	45.5%	100.0%

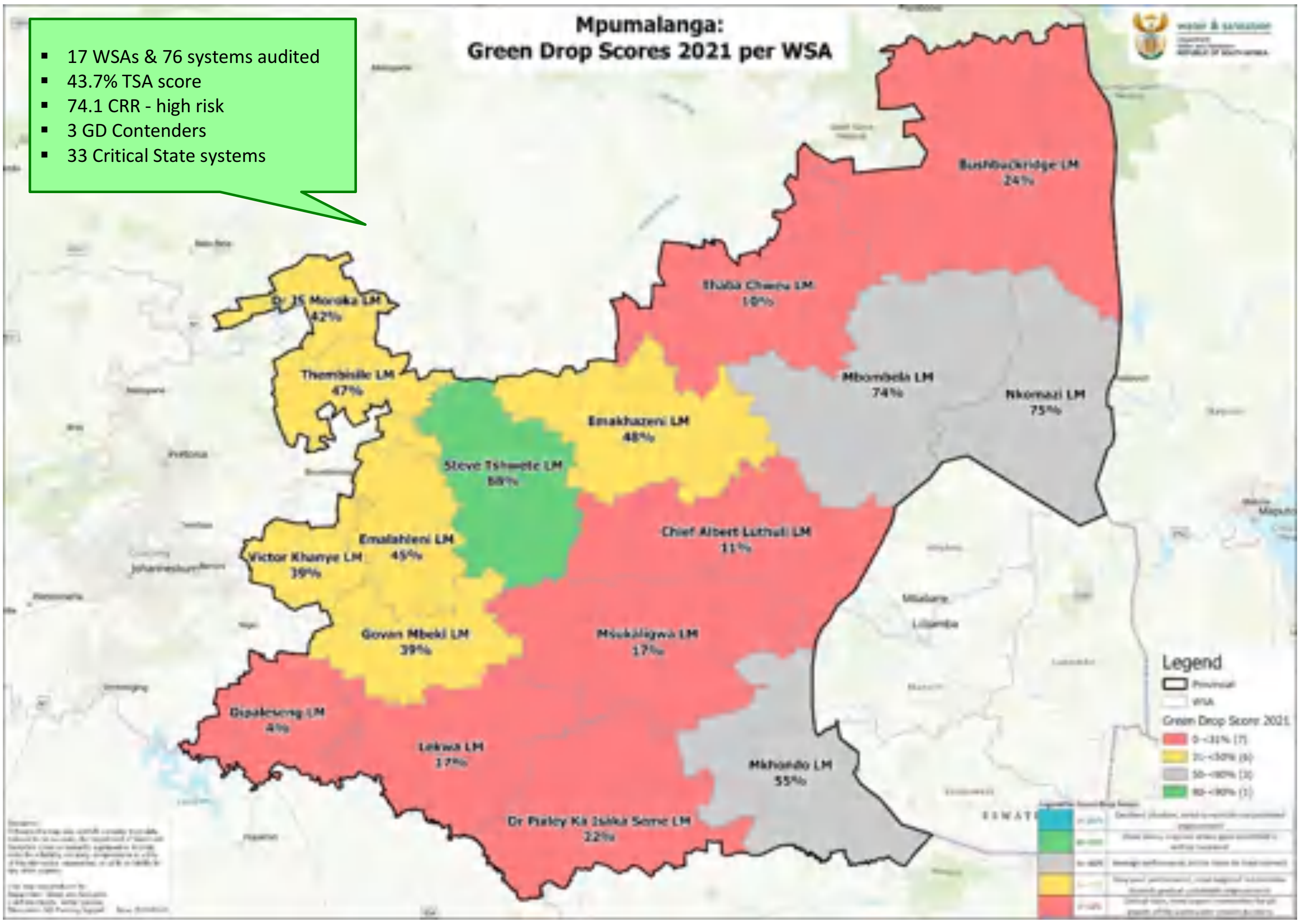
Key Performance Area	Unit	Vleifontein	Vuwani
Green Drop Score (2021)		0%	0%
2013 Green Drop Score		NA	NA
2011 Green Drop Score		NA	NA
2009 Green Drop Score		NA	NA
Design Capacity	Ml/d	NI	NI
Capacity Utilisation (%)		NI	NI
Resource Discharged into		NI	NI
Wastewater Risk Rating (CRR% of CRR_{max})		Vleifontein	Vuwani
CRR (2011)		NA	NA
CRR (2013)		NA	NA
CRR (2021)		100.0%	100.0%

Technical Site Assessment: **Malamulele WWTW 39%**

Wastewater Technician, Mrs Julia Nemutavhanani (with red mask) at Vhembe District Municipality, demonstrated dedication, passion and set an example at the Malamulele WWTWs. She updates records on IRIS and presented evidence to the Green Drop Inspectors.

Dr Chokwe and his team displayed a positive spirit, despite several financial and institutional challenges in managing the wastewater business.

9. MPUMALANGA PROVINCE: MUNICIPAL WASTEWATER MANAGEMENT PERFORMANCE



Provincial Synopsis

An audit attendance record of 100% affirms a firm commitment of the Mpumalanga Province to the Green Drop national incentive based regulatory programme.

The Regulator determined that no wastewater system scored the minimum of 90% when measured against the Green Drop standards for the audited period and thus no WSA qualified for the prestigious Green Drop Certification. In 2013, 2 systems were awarded Green Drop Status. The audit nonetheless established an accurate, current baseline from where improvement can be driven, and excellence be incentivised.

Twelve (12) of the 17 WSAs improved on their 2013 scores, whilst five (5) WSAs regressed to lower Green Drop scores compared to 2013 baselines. Steve Tshwete is the best performing WSA in the province with 3 contenders to Green Drop Certification, supported by a technical site score of 90% (Komati). Nkomazi impressed by achieving an excellent overall progress from 32% in 2013 to a municipal score of 75% in 2021, followed by 74% for Mbombela-Umjindi (and its WSP Silulumanzi, for selected systems). Unfortunately, 33 systems were identified to be in a critical state, compared to 41 in 2013. The systems are managed by 8 municipalities.

The WSAs overall Green Drop performance is characterised by pockets of strengths in technical capacity and capability, combined with good environmental management practices that have been embedded in the wastewater business at some municipalities. The most critical KPA that require attention include effluent quality compliance, technical expertise and management, and financial administration.

The provincial Risk Ratio for treatment plants improved to 74.1% in 2021, compared to 76% in 2013, which suggests some positive risk movement since 2013. The most prominent risks were observed at a treatment level and pointed to WWTWs that exceeded their design capacity, dysfunctional processes and equipment (especially disinfection), and effluent and sludge non-compliance. Opportunities are presented in terms of reducing cost through process optimisation, improved energy efficiency and beneficial use of sludge, nutrients, biogas, and other energy resources.

The Regulator is hopeful that the 2021 audits will set a baseline from where a positive trajectory for wastewater services and improved performance will follow. Municipalities are encouraged to start their preparation for the 2023 Green Drop audit. The 2021 Green Drop status for WSAs in the Mpumalanga Province are summarised in Table 132.

Table 132 - 2021 Green Drop Summary

WSA Name	2013 GD Score (%)	2021 GD Score (%)	2021 GD Certified ≥90%	2021 GD Contenders (89%)	2021 Critical State (<31%)
Steve Tshwete LM	73	88↑		KwaZamokuhle-Hendrina, Blinkpan-Mine village, Komati	
Nkomazi LM	32	75↑			
Mbombela-Umjindi LM	83	74↓			
Mkhondo LM	51	55↑			
Emakhazeni LM	46	48↑			
Thembisile Hani LM	26	47↑			
Emalahleni LM	16	45↑			Thubelihle
Dr JS Moroka LM	46	42↓			
Govan Mbeki LM	48	39↓			
Victor Khanye LM	35	39↑			
Bushbuckridge LM	13	24↑			Dwarsloop, Maviljan, Tintswalo, Mkhuhlu, Thulamahashe
Pixley ka Seme LM	21	22↑			All 5 plants
Lekwa LM	3	17↑			Both plants (2)
Msukaligwa LM	10	17↑			All 7 plants
Albert Luthuli LM	36	11↓			All 5 plants
Thaba Chweu LM	80	10↓			All 4 plants
Dipaleseng LM	3	4↑			All 4 plants
Totals	-	-	None	3	33

The Department of Water and Sanitation acknowledges the excellence in wastewater management achieved for the Green Drop Audit year of 2021.

No Green Drop Certificates are awarded in the Province. Steve Tshwete Local Municipality be acknowledged for 3 Contender Systems:

Province	Green Drop Certified Systems	Acknowledgement of Contender Systems for Green Drop Certification
Mpumalanga	-	✓ **Steve Tshwete LM** ○ KwaZamokuhle-Hendrina ○ Blinkpan-Mine village ○ Komati

Background to Mpumalanga Wastewater Infrastructure

There are 17 WSAs, delivering wastewater services through a sewer network comprising of 76 WWTWs, 195 network pump stations and 1,635 km outfall and main sewer pipelines. The sewer network excludes the pipelines data for 14 municipalities who could not provide this information. There is a total installed treatment capacity of 352 Ml/d, with most of this capacity (92%) residing in the 43 medium-to-macro sized treatment plants.

Table 133 - Summary of WWTW capacity and flow distribution according to plant sizes

	Micro Size Plants	Small Size Plants	Medium Size Plants	Large Size Plants	Macro Size Plants	Unknown (NI)*	Total
	<0.5 Ml/day	0.5-2 Ml/day	2-10 Ml/day	10-25 Ml/day	>25 Ml/day		
No. of WWTW	3 (4%)	30 (40%)	32 (42%)	9 (12%)	2 (2%)	None	76
Total Design Capacity (Ml/day)	0.70	31.69	141.59	107.00	71.00	None	351.98
Total Daily Inflow (Ml/day)	0.33	10.39	51.02	70.45	45.40	35	177.59
Use of Design Capacity (%)	47%	33%	36%	66%	64%	-	51%

** "Unknown" means the number of WWTWs with NI (No Information) on design capacity or daily inflow*

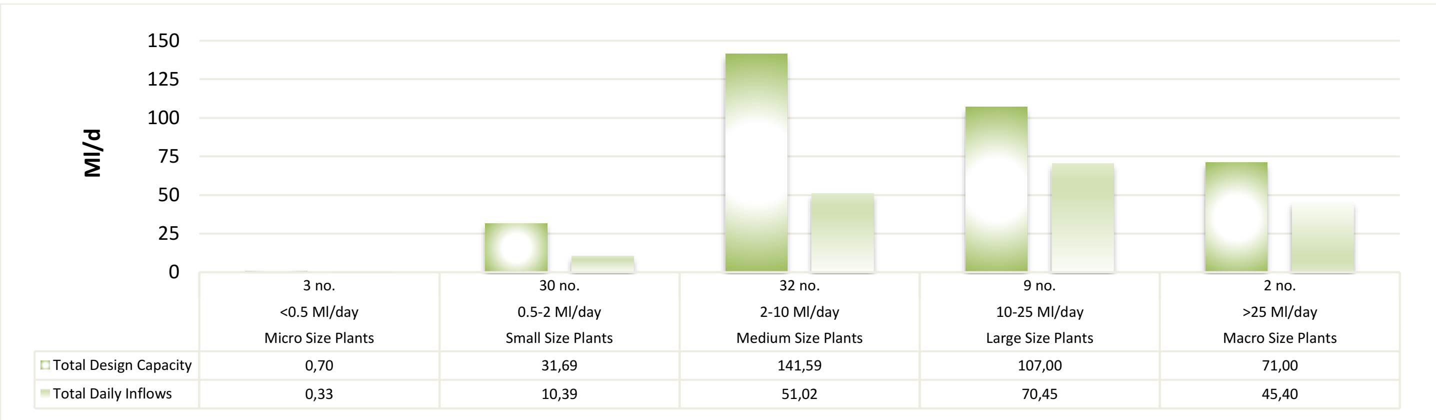
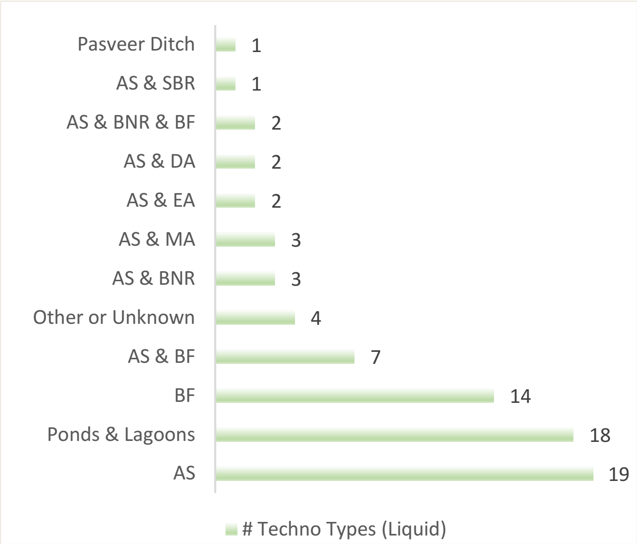


Figure 123 - Design capacities and operational inflow to micro to large sized WWTWs (a) and macro sized WWTWs

Based on the current operational flow of 177 Ml/d, the treatment facilities are operating at 51% of the design capacity. Given the current capacity, this implies that there is 49% spare capacity to meet the medium-term demand. It must however be noted that inflow is not monitored in 35 systems (46%) and as a result the spare capacity could be substantially less than the 49%. Diagnostic #3 unpacks these statistics in more detail. This spare capacity would also be compromised at systems where some of the infrastructure or treatment modules are non-operational or dysfunctional. The VROOM Cost Diagnostic #7 provides more detail on the refurbishment requirements to restore such capacity and functionality.

The audit data shows that 6 systems are hydraulically overloaded. This figure could theoretically be higher, given that there are 35 systems where inflow monitoring is not taking place. The hydraulically overloaded systems in each of the WSAs is as follows:

- Emalahleni: 2 of 8 systems (Klipspruit, Riverview)
- Dipaleseng: 2 of 4 systems (Balfour, Grootvlei Eskom)
- Lekwa: 1 of 2 systems (Standerton)
- Victor Khanye: 1 of 2 systems (Delmas).



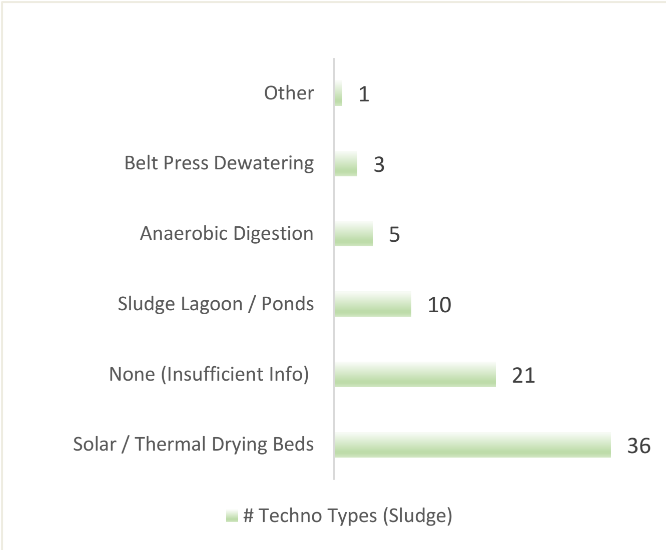


Figure 124 - Treatment technologies for wastewater effluent (a) and sludge (b)

The predominant treatment technologies employed at WWTWs comprise of activated sludge, ponds/ lagoons, and biological filters for effluent treatment, and solar drying beds and sludge lagoons/ ponds for sludge treatment. The next audit will need to verify sludge treatment technologies, as insufficient information ("Other") is observed in this area.

Table 134 - Summary of Collection Network Pump Stations and Sewer Pipelines

WSA Name	# WWTWs	Pump Stations (#)	Sewer Pipelines (km)
Dr JS Moroka	1	None	NI
Thembisile Hani	3	1	NI
Pixley ka Seme	5	10	NI
Emalahleni	8	15	825
Govan Mbeki	6	31	NI
Albert Luthuli	5	6	NI
Emakhazeni	4	7	NI
Mkhondo	2	6	NI
Msukaligwa	7	9	NI
Steve Tshwete	4	9	NI
Thaba Chweu	4	8	NI
Mbombela-Umjindi	8	61	775
Nkomazi	5	7	35
Bushbuckridge	6	2	NI
Dipaleseng	4	5	NI
Lekwa	2	11	NI
Victor Khanye	2	7	NI
Totals	**76**	**195**	**1,635**

The sewer network consists of the sewer mains and pump stations as summarised in Table 134. Mbombela-Umjindi and Emalahleni own and manage the bulk of the sewer collector infrastructure, approximately 775 km and 825 km; and 61 and 15 sewer pump stations, respectively. Fourteen (14) of 17 municipalities could not provide information on sewer pipelines, indicating limitations in asset management information.

Provincial Green Drop Analysis

The 100% response from the 17 municipalities audited during the 2021 Green Drop process demonstrates a firm commitment to wastewater services in the province. Local Government reforms resulted in the merging of Umjindi LM with Mbombela LM. Therefore 17 WSAs were audited in 2021 compared to the 18 WSAs in 2013.

Table 135 – Green Drop Comparative Analysis from 2009 to 2021

GREEN DROP COMPARATIVE ANALYSIS					
Performance Category	**2009**	**2011**	**2013**	**2021**	**Performance trend 2013 and 2021**
Incentive-based indicators					
Municipalities assessed (#)	10 (53%)	18 (100%)	18 (100%)	17 (100%)	→
Wastewater systems assessed (#)	50	76	76	76	→
Average Green Drop score	30%	42.0%	34.1%	38.3%	↑
Green Drop scores ≥50% (#)	14/50 (37%)	31/76 (41%)	19/76 (25%)	20/76 (26%)	↑
Green Drop scores <50% (#)	36/50 (63%)	45/76 (59%)	57/76 (75%)	56/76 (74%)	↑
Green Drop Certifications (#)	2	1	2	0	↓
Technical Site Inspection Score (%)	NA	57.0%	52.4%	43.7%	↓

NA = Not Applied NI = No Information *↑= improvement, ↓= regress, →= no change*

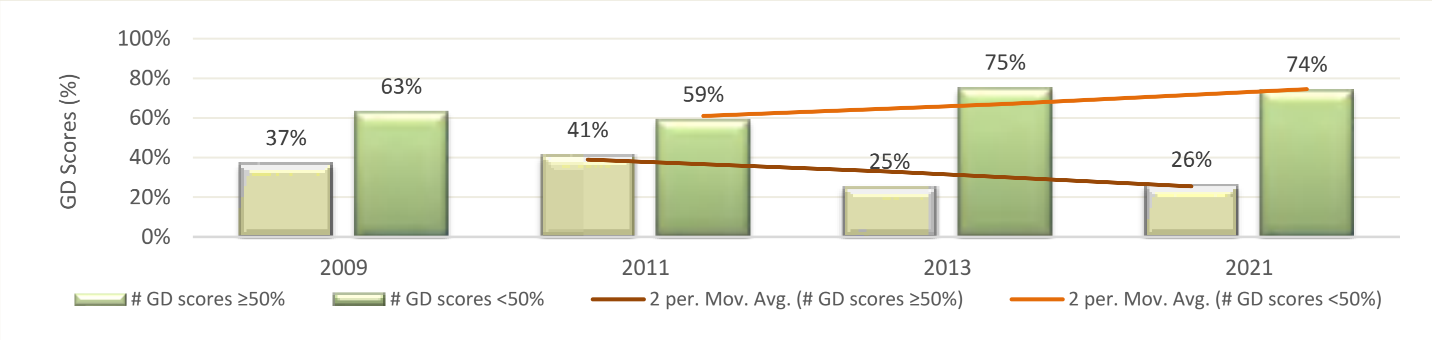


Figure 125 – Green Drop trend analysis over the period 2009 to 2021, indicating the percentage GD scores above and below 50%

The trend analysis indicates that:

- The number of systems audited has increased from 50 systems in 2009, when the first assessments were undertaken, to 76 systems in 2011, 2013 and 2021
- There is an upward trend in previous GD average scores in 2009 (37%) and 2011 (41%), and in 2013 (34%) and 2021 (38%)
- The number of systems with GD scores of ≥50% was 37% in 2009 and 41% in 2011, and there is a little increase from 2013 to 2021 from 25 % to 26%
- However, the TSA score have regressed from 57% in 2011 to 52% in 2013 to 44% in 2021
- The number of systems with GD score of ≤50% has shown a slight improvement from 57 (75%) in 2013 to 56 (74%) in 2021
- The Green Drop Certifications regressed from 2 awards in 2013 to no awards in 2021
- An overall performance trend from 2013 to 2021 signals the need for repeat/regular audits to ensure continued improvement. There are indications that performance has declined in the absence of the consistent regulatory engagement of the GD audits.

The analysis for the period 2009, 2011, 2013 and 2021, indicates that most of the system scores are in the 0-<31% (Critical state) space, with the 31-<50% (Poor Performance) being the next largest category.

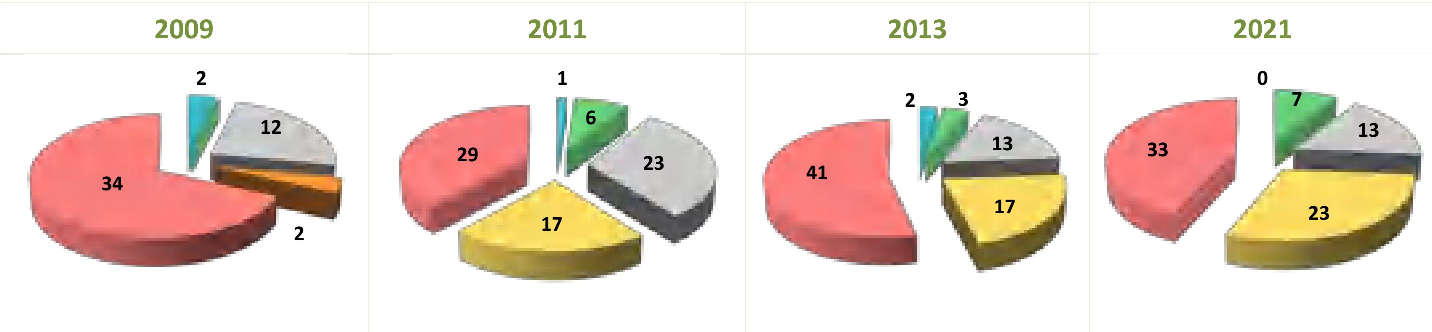


Figure 126 - No. WWTWs in the Green Drop score categories over the period 2009 to 2021 (graph legend to right)

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
31-<50% Poor	
0-<31% Critical state	

In summary, trends over the years 2013 and 2021 indicate as follows:

- The number of systems in a ‘poor state’ increased from 17 systems in 2013 to 23 systems in 2021
- The number of systems in a ‘critical state’ decreased from 41 systems in 2013 to 33 systems in 2021
- The number of systems in the ‘excellent and good state’ increased from 5 systems in 2013 to 7 systems in 2021.

Provincial Risk Analysis

Green Drop risk analysis (CRR) focuses specifically on the treatment function. It considers 4 risk indicators, i.e. design capacity, operational flow, technical capacity, and effluent quality. The CRR values do not factor risks associated with sanitation or wastewater network and collector systems.

Table 136 - Cumulative Risk Comparative Analysis from 2009 to 2021

CUMULATIVE RISK COMPARATIVE ANALYSIS					
Performance Category	**2009**	**2011**	**2013**	**2021**	**Performance Trend 2013 to 2021**
Highest CRR	18	23	22	21	↑
Average CRR	12.1	14.0	13.9	13.7	↑
Lowest CRR	5	5	5	4	↑
Design Rating (A)	1.3	1.3	1.3	1.3	→
Capacity Exceedance Rating (B)	3.5	4.2	4.1	4	↑
Effluent Failure Rating (C)	5.1	6.1	6	6.5	↓
Technical Skills Rating (D)	2.5	2.7	2.8	2	↑
CRR% Deviation	**62.6**	**72.6**	**76.0**	**74.1**	↑

↑= improvement, ↓= regress, →= no change

Table 136 indicates a slight improvement in the CRR% deviation from 2013 to 2021, which suggests little to no change in design capacity rating (A), a slight decrease in the capacity exceedance rating (B), a good improvement in the technical skills rating (D), and a regression in the effluent failure rating (C). Individual systems, however, show higher deviations and indicate specific risk categories, as highlighted under “***Regulator’s Comment***”. The CRR analysis in context of the Green Drop results suggests that further improvements should focus on 1) capacity exceedance at plants which are hydraulically overloaded or approaching its design lifespan, 2) effluent quality failures, especially for microbiological compliance, and 3) strengthening of technical skills and operational competency, especially related to sludge management.

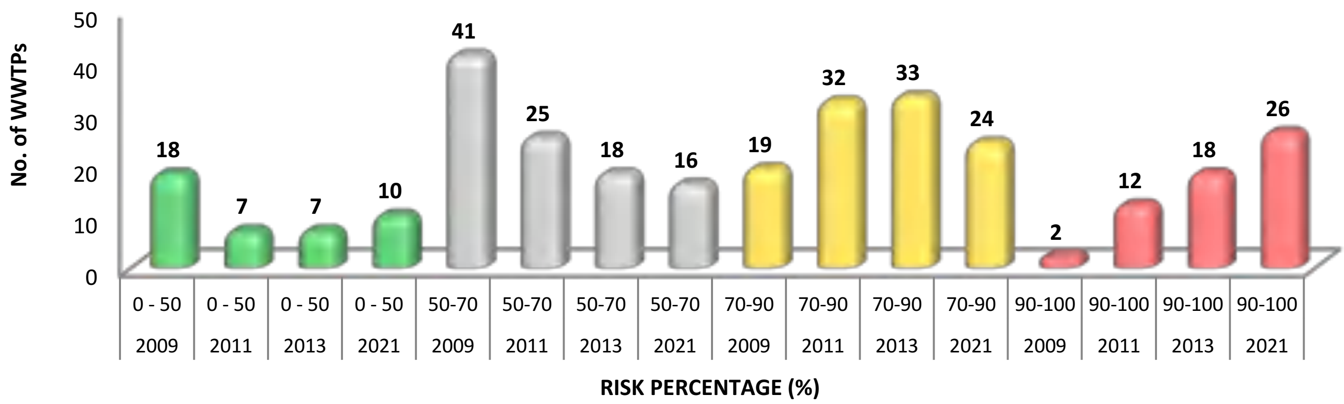


Figure 127 - a) WWTW Risk distribution and trends from 2009 to 2021; b) Colour legend

90 – 100% Critical risk WWTPs	
70 - <90% High risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low risk WWTPs	

Trend analysis of the CRR ratings for the period 2009 to 2021 indicates that:

- There has been a steady regression in risk from 2009 (63%) to 73% in 2011 to 76% in 2013 but with marginal improvement to 74% in 2021
- The CRR increased from 2011 to 2013 at a time when W_2RAPs and risk-mitigation strategies were being embedded in WSAs and have been maintained, with slight improvement in risk rating, in the period between 2013 and 2021
- The 2021 assessment cycle highlighted progressive and regressive shifts with a decrease in the number of medium risk WWTWs (18 to 16), a decrease in high risk (33 to 24) but an increase in critical risk WWTWs (18 to 26).

Regulatory Enforcement

Wastewater systems which failed to achieve the minimum Green Drop target of 31%, are placed under regulatory focus. The Regulator requires these municipalities to submit a detailed corrective action plan within 60 days from publishing of this report.

Eight (8) municipalities and 33 wastewater systems that received Green Drop scores below 31%, are to be placed under **regulatory surveillance**, in accordance with the Water Services Act (108 of 1997). In addition, these WSAs will be compelled to ringfence water services grant allocation to rectify/restore wastewater collection and treatment shortcomings identified herein.

Table 137 - WWTWs with <31% Green Drop scores

WSA Name	2021 Municipal GD Score	WWTWs with <31% score
Emalahleni LM	45%	Thubelihle
Bushbuckridge LM	24%	Dwarsloop, Maviljan, Tintswalo, Mkhuhlu, Thulamahashe
Pixley ka Seme LM	22%	All 5 plants
Lekwa LM	17%	Both plants (2)
Msukaligwa LM	17%	All 7 plants
Albert Luthuli LM	11%	All 5 plants
Thaba Chweu LM	10%	All 4 plants
Dipaleseng LM	4%	All 4 plants

The following municipalities and their associated wastewater treatment plants are in high CRR risk positions, which means that some or all the risk indicators are in a precarious state, i.e. operational flow, technical capacity and effluent quality. WWTWs in high risk and critical risk positions poses a serious risk to public health and the environment. The following municipalities will be required to assess their risk contributors and develop corrective measures to mitigate these risks.

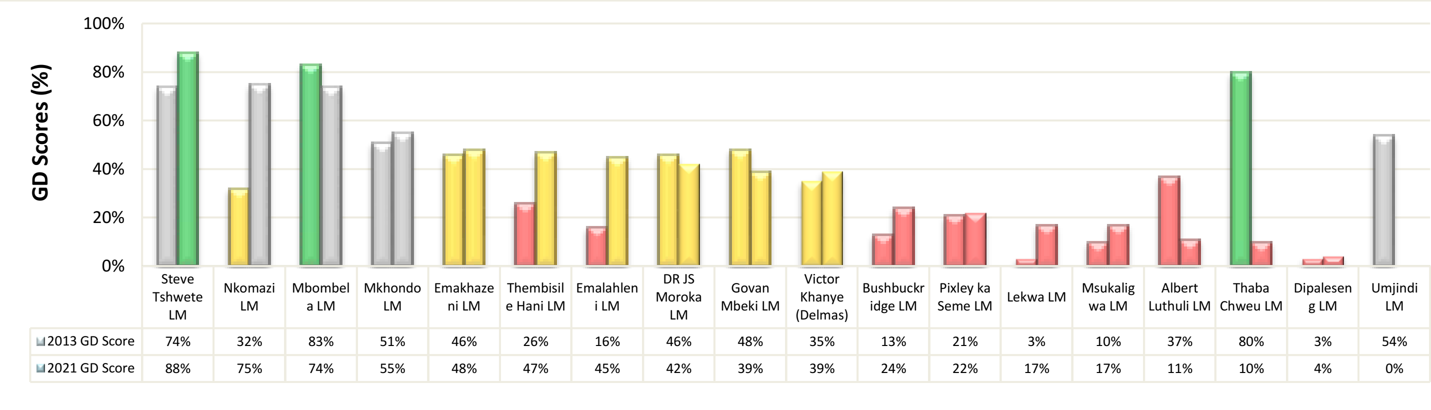
Table 138 - %CRR/CRR$_{max}$ scores and WWTWs in critical and high-risk space

WSA Name	2021 Average CRR/CRRmax % deviation	WWTWs in critical and high-risk space	
		Critical Risk (90-100%CRR)	High Risk (70-<90%CRR)
Emalahleni LM	56.7%		Ferrobank, Ga-Nala
Govan Mbeki LM	60.7%		Bethal, Evander
Mbombela LM	62.0%		Hazyview, Kabokweni, Rockys Drift, White River
Mkhondo LM	62.8%		Piet Retief
Bushbuckridge LM	71.5%		Dwarsloop, Maviljan, Thulamahashe, Tintswalo Hospital
Dr JS Moroka LM	77.3%		Siyabuswa
Emakhazeni LM	77.9%		All 4 plants
Victor Khanye LM	81.4%		Both plants (2)
Thembisile LM	82.4%		All 3 plants
Pixley ka Seme LM	92.9%	4 of 5 plants	Volksrust
Msukaligwa LM	93.7%	All 7 plants	
Thaba Chweu LM	94.1%	All 4 plants	
Albert Luthuli LM	94.4%	All 5 plants	
Lekwa LM	94.8%	Both plants (2)	
Dipaleseng LM	95.6%	All 4 plants	

Good practice risk management requires that the W$_2$RAPs are informed by meaningful Process and Condition Assessments, supported by zealous implementation of corrective measures and ongoing monitoring of risk movement. Steve Tshwete LM and Nkomazi LM are commended for maintaining all their treatment facilities in low and moderate risk positions - an exemplary status.

Performance Barometer

The **Green Drop Performance Barometer** presents the individual Municipal Green Drop Scores, which essentially reflects the level of mastery that a municipality has achieved in terms of its overall municipal wastewater services business. The bar chart below indicates the GD scores for 2013 in comparison to 2021, from highest to lowest performing WSA.



	Steve Tshwete LM	Nkomazi LM	Mbombela LM	Mkhondo LM	Emakhazeni LM	Thembisile Hani LM	Emalahleni LM	DR JS Moroka LM	Govan Mbeki LM	Victor Khanye (Delmas)	Bushbuckridge LM	Pixley ka Seme LM	Lekwa LM	Msukaligwa LM	Albert Luthuli LM	Thaba Chweu LM	Dipaleseng LM	Umjindi LM
2013 GD Score	74%	32%	83%	51%	46%	26%	16%	46%	48%	35%	13%	21%	3%	10%	37%	80%	3%	54%
2021 GD Score	88%	75%	74%	55%	48%	47%	45%	42%	39%	39%	24%	22%	17%	17%	11%	10%	4%	0%

Figure 128 - a) Green Drop scores 2013 (left bar) and 2021 (right bar), with colour legend inserted

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	

Steve Tshwete is commended for moving from average performance in 2013 (73%) to good performance in 2021 (88%) whilst it is the reverse for Mbombela (83% to 74%). Nkomazi also demonstrated a good upward trend from 32% in 2013 to 75% in 2021. However, Thaba Chweu demonstrated the worst relapse from good performance in 2013 (80%) to a critical state in 2021 (10%). The bigger municipalities like Mbombela and Emalahleni have regressed since 2013.

The **Cumulative Risk Log** expresses the level of risk that a municipality poses in respect of its wastewater treatment facility. It is based on the ***individual Cumulative Risk Ratios***. Figure 129 presents the cumulative risks in ascending order, with the low-risk municipalities on the left and critical risk municipalities to the far right. The analysis reveals that there are 6 critical risk municipalities in Mpumalanga. Steve Tshwete and Nkomazi are in low-risk positions, which indicate effective risk management in these institutions.

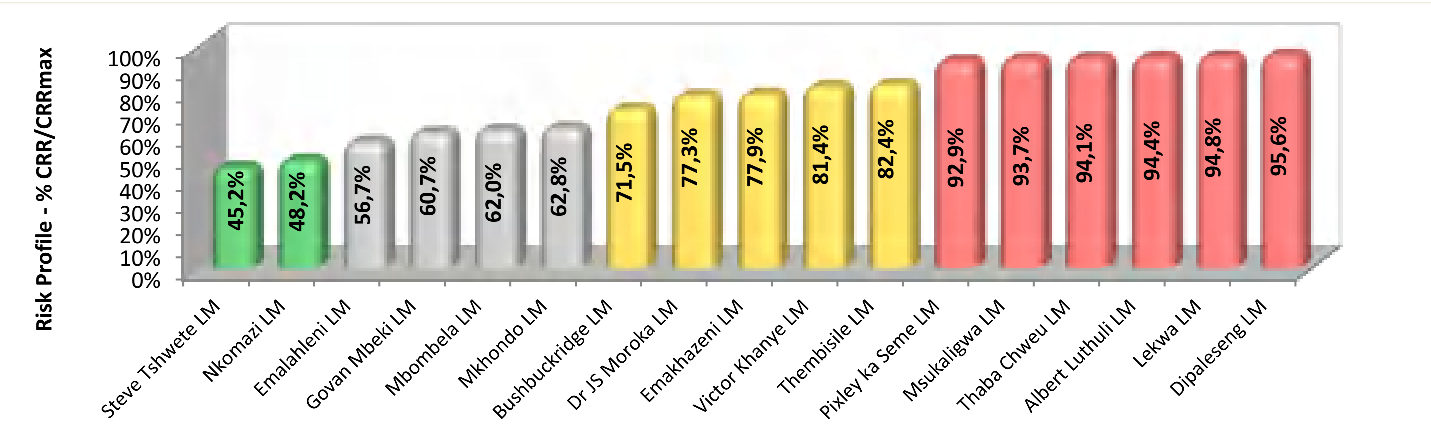


Figure 129 - %CRR/CRRmax Risk Performance Log 2021; Colour legend

90 – 100% Critical risk WWTPs	
70 - <90% High risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low risk WWTPs	

Provincial Best Performers

Steve Tshwete Local Municipality is the **BEST PERFORMING** municipality in the Province, based on the following record of excellence:

- ✓ 88% Municipal Green Drop Score
- ✓ 2013 Green Drop Score of 73%
- ✓ Improvement on the CRR risk profile from 62.8% in 2013 to 45.2% in 2021
- ✓ All 4 plants in the low and medium risk positions
- ✓ Technical Site Assessment score of 90% (Komati)

Nkomazi Local Municipality is the 2nd best scoring municipality in the Province:

- ✓ 75% Municipal Green Drop Score
- ✓ All 5 plants in low & medium risk positions
- ✓ TSA score of 46% (Mhlatikop)

Mbombela-Umjindi Local Municipality is 3rd best scoring municipality in the Province:

- ✓ 74% Municipal Green Drop Score
- ✓ 4 of 8 plants in low and medium risk positions
- ✓ TSA of 44% (White River)

KPA Diagnostics

The Green Drop Audit process collects a vast amount of data that yield valuable insight on the state of the wastewater sector in each Province. These insights have been captured into 7 thematic areas or 'Diagnostics', as discussed below.

Table 139 - Summary of the key diagnostic themes and reference to the respective Green Drop KPAs

Diagnostic #	Diagnostic Description	Diagnostic Reference
1	**Green Drop KPA Analysis**	KPAs A-E
2	**Technical Competence**	KPA A, B & Bonus
3	**Treatment Capacity**	KPA D
4	**Wastewater Monitoring and Compliance**	KPA B & D & Bonus
5	**Energy Efficiency**	KPA C & Bonus
6	**Technical Site Assessments**	TSA
7	**Operation, Maintenance and Refurbishment of Assets**	KPA C, D & Bonus

Diagnostic 1: Green Drop KPA Analysis

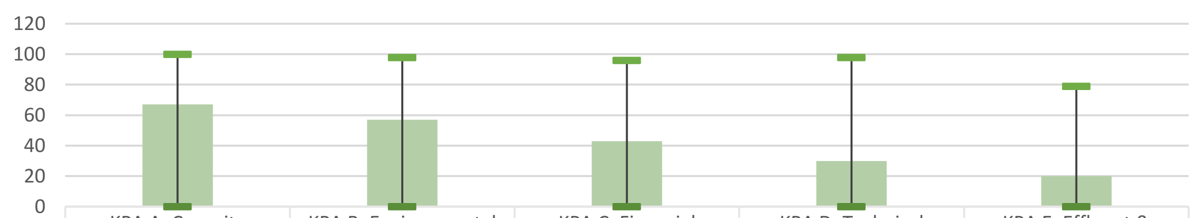
Aim: Analysis of technical skills, environmental plans, financial management, technical capacity, and regulatory compliance provides insight into the strengths and weaknesses of wastewater management in WSAs in the province. These insights in turn, may inform appropriate interventions and strategies to improve the individual KPAs and ultimately, collective KPA performance.

Findings: Mpumalanga is characterised by a highly variable KPA profile. A good KPA profile typically has a high mean GD score, coupled with a low Standard Deviation (SD) between the outer parameters (min and max). Similarly, a well performing system is one that has most/all systems in the >80% bracket and no systems in the <31% bracket.

Table 140 - Green Drop scores KPA profiles (graph legend included)

KPA #	Key Performance Area	*Weight*	Minimum GD Score (%)	Maximum GD Score (%)	Mean GD Score (%)	# Systems <31%	# Systems >80%
A	Capacity Management	*15%*	0%	100%	**67%**	4 (5%)	27 (36%)
B	Environmental Management	*15%*	0%	98%	**57%**	12 (16%)	8 (10%)
C	Financial Management	*20%*	0%	96%	**43%**	28 (37%)	12 (16%)
D	Technical Management	*20%*	0%	98%	**30%**	46 (61%)	4 (5%)
E	Effluent and Sludge Compliance	*30%*	0%	79%	**20%**	56 (74%)	0 (0%)

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	



	KPA A: Capacity Management	KPA B: Environmental Management	KPA C: Financial Management	KPA D: Technical Management	KPA E: Effluent & Sludge Compliance
Mean	67	57	43	30	20
Max	100	98	96	98	79
Min	0	0	0	0	0

Note: The High and low lines represent the Min and Max range, and the shaded green represents the Mean (arithmetical average)

Figure 130 - Maximum, minimum, and mean Green Drop KPA scores

The KPA distribution indicates as follows:

- Capacity Management (KPA A) depicts the highest mean of 67%, highest maximum of 100%, but also a high Standard Deviation (SD) of 100%. These results indicate strengths pertaining to the registration of WWTWs, maintenance plans and records, maintenance teams, and registered, qualified staff (process controllers, supervisors, scientists, technicians, engineers) in specific municipalities. However, the SD indicate that some municipalities do not have any capacity
- Effluent and Sludge Quality Compliance (KPA E) received the lowest mean of 20%, indicating a deficiency in data management, IRIS upload, effluent quality compliance, and sludge quality compliance
- This was followed by the Technical Management (KPA D) that received the next lowest mean of 30%, indicating vulnerability in basic design information, inflow, outflow, meter reading credibility, process and condition assessments, site inspection reports, asset registers, asset values, bylaws and enforcement
- The mean scores decreased in an almost linear fashion from KPA A to KPA E.

The GD bracket performance distribution reiterates the above findings:

- ***KPA Score ≥80%:*** Capacity Management (KPA A) is the best performing KPA with 36% of systems achieving >80%, followed by Financial Management (KPA C) with 16%. Effluent and Sludge Compliance (KPA E) was the worst performing KPA with only 0% achieving >80%, followed by Technical Management (KPA D) with 5%
- ***KPA Score <31%:*** Effluent and Sludge Compliance (KPA E) represent the worst performing KPA with 74% of systems lying in the 0-31% bracket, followed by Technical Management (KPA D) with 61% and Financial Management (KPA C) with 37%.

Diagnostic 2: Technical Competence

Aim: This focus area assesses the human resources (technical) capacity to manage wastewater systems. Theory suggests a correlation between human resources capacity (sufficient number of appropriately qualified staff) and a municipality's performance and operational capability. It is projected that high HR capacity would translate to compliant wastewater services and protection of scarce water resources.

Findings: According to regulations, wastewater plants are classified as Class A, B, C, D or E plants. Similarly, Process Controllers and Plant Supervisors are registered as Class I, II, III, IV, V or VI operators. Higher classed plants require a higher level of operators due to their complexity and strict regulatory standards. Technical compliance of PCs and Supervisors is determined against Green Drop standards, as defined by Reg. 2834 and draft Reg. 813 of the National Water Act 1998.

Table 141 - No. compliant versus shortfall in Supervisor and Process Controller staff

WSA Name	# WWTWs	# Compliant staff		# Staff Shortfall		Ratio*	WSA 2021 GD Score (%)
		Supervisor	PCs	Supervisor	PCs		
Dr JS Moroka	1	1	3	0	1	4.0	42%
Thembisile Hani	3	1	4	0	0	1.7	47%
Pixley ka Seme	5	0	6	1	6	1.2	22%
Emalahleni	8	2	20	0	4	3	45%
Govan Mbeki	6	6	22	0	3	5	39%
Albert Luthuli	5	0	0	1	6	0.0	11%
Emakhazeni	4	0	0	1	11	0	48%
Mkhondo	2	2	2	0	2	2.0	55%
Msukaligwa	7	0	1	3	11	0.1	17%
Steve Tshwete	4	6	43	0	0	12.3	88%
Thaba Chweu	4	0	0	3	11	0	10%
Mbombela-Umjindi	8	7	18	0	8	3.1	74%
Nkomazi	5	2	17	0	0	3.8	75%
Bushbuckridge	6	4	11	1	7	2.5	24%
Dipaleseng	4	0	0	1	7	0	4%
Lekwa	2	0	0	1	3	0.0	17%
Victor Khanye	2	2	6	0	0	4	39%
Totals	**76**	**33**	**153**	**12**	**80**		

** The single number Ratio is derived from the number of qualified staff divided by the number of WWTWs operated by this number of staff. E.g., for JS Moroka, 4 qualified staff is available to support 1 WWTW, thus 4/1 = ratio of 4.*

Note: "Compliant staff" means qualified and registered staff that meets the GD standard for a particular Class Works. "Staff shortfall" means staff that do not meet the GD standard for a particular Class of works (+1 for a shift) and/or staffing gaps exist at the respective WWTWs.

Competent human resources are a vital enabler to ensure efficient and sustainable management of treatment processes and infrastructure. From a provincial perspective, the operational competencies are found to be reasonably good, as illustrated below.

Plant Supervisors: The pie charts indicate that 73% (33 of 45) of Plant Supervisors complies with the Green Drop standard, with zero shortfall for 9 of the 17 municipalities. A 27% (12 of 45) shortfall is noted for Supervisors overall, with the highest shortfall seen at the Msukaligwa and Thaba Chweu (3 no. each).

Process Controllers: Similarly, 66% (153 of 233) of the PC staff is compliant for the Province, with a shortfall for 4 of the 17 municipalities. There is a 34% (80 of 233) shortfall in PCs with the highest shortfall for Emakhazeni, Msukaligwa and Thaba Chweu (11 no. each), followed by Mbombela (8 no.), Bushbuckridge and Dipaleseng (7 no. each).

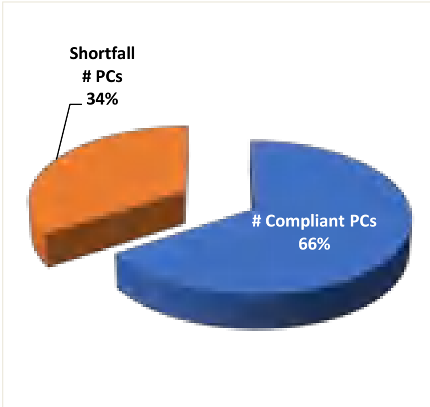


Figure 131 - Schematic illustration of compliant versus non-compliant Supervisors (a) and Process Controllers (b)

Green Drop standards require of Class A and B plants to employ dedicated Supervisors and Process Controllers per shift per Works, whereas Class C to E plants may consider sharing of staff across works. Shifts have been introduced to ensure optimal operations while addressing security risks, particularly as it relates to vandalism. Telemetry also reduces the requirement for on-site staff during night shifts, but these relaxations will have to be done within the DWS regulatory guidelines.

It is expected that a correlation would exist between the competence of an operational team and the performance of a treatment plant, as measured by the GD score. The data indicates as follows:

- 6 of the 17 municipalities have good Supervisor/Process Controller ratios in place (≥3) – Steve Tshwete, Govan Mbeki, Dr JS Moroka, Victor Khanye, Nkomazi and Mbombela
- Except for Thembisile Hani, Steve Tshwete, Govan Mbeki, Dr JS Moroka, Victor Khanye, Nkomazi and Mbombela, the remaining municipalities have shortfalls in registered Supervisors
- Apart from Thembisile Hani, Steve Tshwete, Victor Khanye and Nkomazi, the remaining municipalities have shortfalls in registered Process Controllers.

The results from the ratio analysis indicate high ratios for Steve Tshwete, Govan Mbeki, Dr JS Moroka, Victor Khanye, Nkomazi and Mbombela, and low ratios for Msukaligwa, Albert Luthuli, Emakhazeni, Thaba Chweu, Dipaleseng and Lekwa.

Overall, the comparative bar chart on the following page confirms a high correlation between municipalities with high ratios and higher GD scores (Steve Tshwete 88%, Nkomazi 75% and Mbombela 74%). Some anomalies were evident with lower scoring municipalities like Dr JS Moroka, Victor Khanye and Govan Mbeki. Municipalities with lower ratios and associated lower GD scores are observed for Msukaligwa 17%, Albert Luthuli 11%, Thaba Chweu 10%, Dipaleseng 4% and Lekwa 17% the exception being Emakhazeni at 48% due to a high shortfall in compliant Process Controllers.

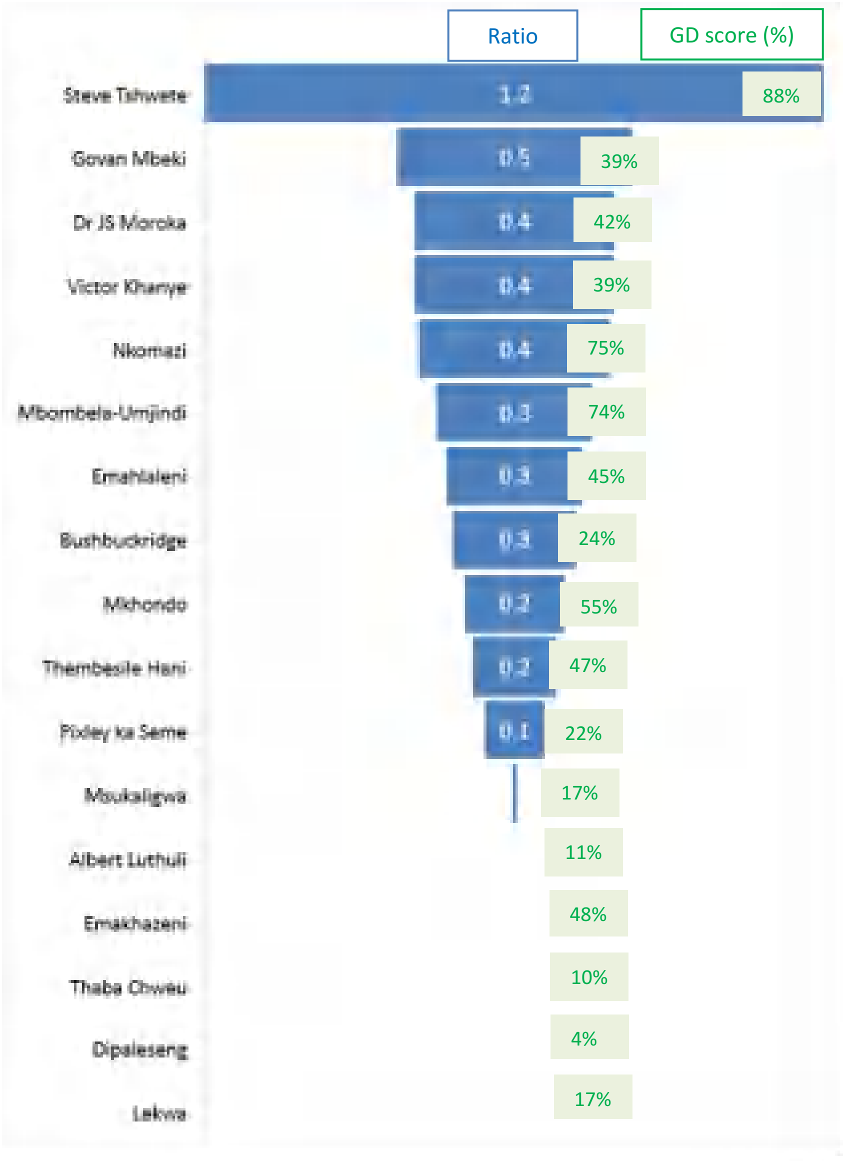


Figure 132 - Ratio of compliant operational staff to no. of WWTWs and Comparison of Ratios with GD scores

In addition to operational capacity (above), good management practice also requires access to qualified engineers, technicians, technologists, scientists, and maintenance capability. Such competencies could reside in-house or accessible through term contracts and external specialists.

Table 142 - Summary of the maintenance capacity and no. of qualified and shortfall of Engineering, Technical and Scientific staff

WSA Name	# WWTW	Maintenance Arrangement	Qualified Technical Staff (#)				Technical Shortfall (#)	Qualified Scientists (#)	Scientists Shortfall (#)	Ratio*	WSA 2021 GD Score (%)
			Engineers	Technologists	Technicians	Total					
Dr JS Moroka	1	Internal + Term Contract	0	3	0	3	0	0	1	0.3	42%
Thembisile Hani	3	Internal + Term Contract	0	4	0	4	0	1	0	1.3	47%
Pixley ka Seme	5	Internal + Term Contract	1	0	2	3	0	0	1	1	22%
Emalahleni	8	Internal + Term Contract	0	2	2	4	0	0	1	0.5	45%
Govan Mbeki	6	Internal + Term Contract	0	1	2	3	0	2	0	0.5	39%
Albert Luthuli	5	Internal + Specific Outsourcing	1	2	3	6	0	1	0	1.2	11%
Emakhazeni	4	Internal + Term Contract	1	1	1	3	0	1	0	0.8	48%
Mkhondo	2	Internal Team (Only)	0	1	1	2	0	0	1	1.0	55%
Msukaligwa	7	Internal + Specific Outsourcing	1	1	2	4	0	0	1	0.6	17%
Steve Tshwete	4	Internal + Term Contract	1	4	1	6	0	2	0	1.5	88%
Thaba Chweu	4	Partially Capacitated	0	2	1	3	0	1	0	0.8	10%

WSA Name	# WWTW	Maintenance Arrangement	Qualified Technical Staff (#)				Technical Shortfall (#)	Qualified Scientists (#)	Scientists Shortfall (#)	Ratio*	WSA 2021 GD Score (%)
			Engineers	Technologists	Technicians	Total					
Mbombela-Umjindi	8	Internal + Specific Outsourcing; Internal Team (Only); Internal + Term Contract; Inadequate Capacity	1	2	0	3	0	3	0	0.4	74%
Nkomazi	5	Internal + Specific Outsourcing	1	1	2	4	0	1	0	0.8	75%
Bushbuckridge	6	Internal + Specific Outsourcing	0	0	5	5	0	1	0	0.8	24%
Dipaleseng	4	Internal + Specific Outsourcing; Internal + Term Contract; No Capacity	0	0	0	0	2	0	1	0.0	4%
Lekwa	2	Internal + Specific Outsourcing	0	0	0	0	2	1	1	0.0	17%
Victor Khanye	2	Internal + Specific Outsourcing	0	2	0	2	0	0	1	1.0	39%
Totals	**76**		**7**	**26**	**22**	**55**	**4**	**14**	**8**		

** The single number Ratio depicts the number of qualified technical staff divided by the number of WWTWs that have access to the staff*

Note 1: "Qualified Technical Staff" means staff appointed in positions to support wastewater services, and who has the required qualifications. "Technical Shortfall" is calculated based on a minimum requirement of at least 2 Engineers/Technologists/Technicians and at least one 1 Scientist per WSI.

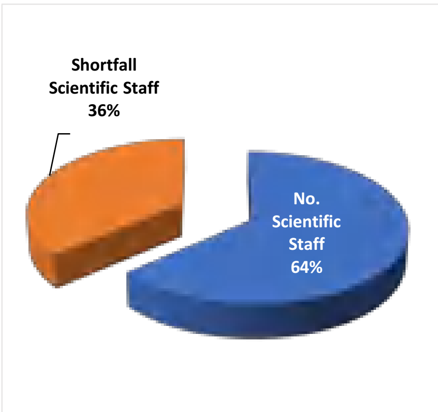
Note 2: "Qualified Scientists" means professional registered scientists (SACNASP) appointed in positions to support wastewater services. "Scientists shortfall" means that the WSA does not have at least one qualified, SACNASP registered scientist in their employ or contracted.

In terms of maintenance capacity, the WSAs has a reasonable contingent of qualified maintenance staff for at least 15 municipalities, with the current qualified maintenance staff from a collective of in-house, contracted or outsourced personnel. The data indicates that:

- 16 municipalities have in-house maintenance teams
- 9 municipalities have internal maintenance teams supplemented with term contracts
- 8 municipalities have internal maintenance teams supplement with specific outsourced services
- 1 municipalities is partially capacitated.

In general, the WSAs present a strong case for access to qualified technical staff. The data indicates as follows:

- A total of 69 qualified staff comprising of 7 engineers, 26 technologists, 22 technicians (qualified) and 14 SACNASP registered scientists are assigned to the 17 municipalities
- A total shortfall of 12 persons is identified, consisting of 4 technical staff and 8 scientists
- Only Dipaleseng and Lekwa have shortfalls in qualified technical staff
- 94% of the WWTWs has access to credible laboratories – this is commendable.



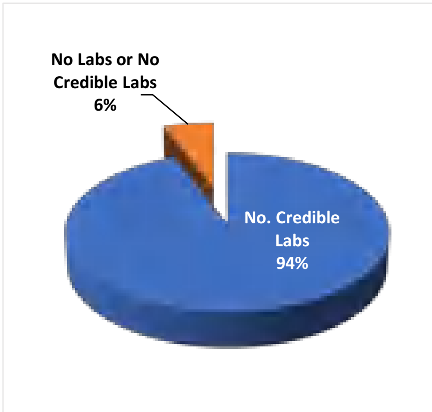


Figure 133 - Graphic illustration of the number and %: a) qualified engineering/technical staff; b) professional scientists; c) access to credible laboratory services that complies with Green Drop standards

Ratio analysis has been done to determine the number of qualified technical and scientific staff assigned per WWTW. It is expected that a higher ratio would be associated with well-performing and maintained wastewater systems, as represented by the GD score.

Figure 134 shows a strong correlation between high ratios and high GD scores at 5 municipalities - Steve Tshwete 88%, Nkomazi 75%, Mkhondo 55%, Emakhazeni 48%, and Thembisile Hani 47. Albert Luthuli and Thaba Chweu are the exceptions to the general trend. Likewise, a high correlation was found between lower ratios and lower Green Drop scores (Bushbuckridge to Lekwa). The exceptions include Emalahleni, Govan Mbeki, Mbombela-Umjindi, and Dr JS Moroka. The results suggest that wastewater performance may be less sensitive towards engineering, technical and scientific staff, and more dependent on operational competencies (Superintendents and PCs).

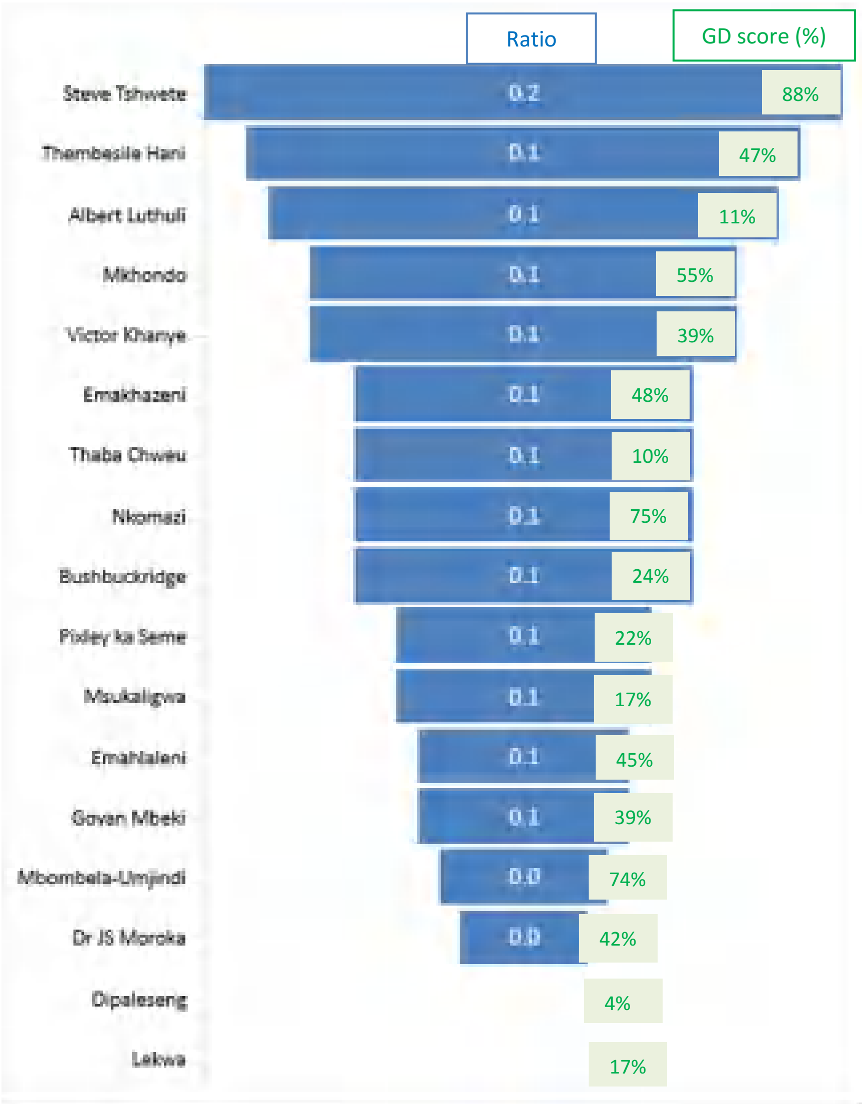


Figure 134 - Ratio of compliant technical staff to no. of WWTWs and Comparison of Ratios with GD scores

One of the options to enhance operational capacity is through dedicated training programmes. The Green Drop audit incentivises training of operational staff over the 2-year period prior to the audit date. The results are summarised as follows:

Table 143 - No. of WWTWs with operational staff sent on training over the past 2 years and vice versa

WSA Name	# of WWTW staff attending training over past 2 years	# of WWTW without training over past 2 years
Dr JS Moroka	1	0
Thembisile Hani	3	0
Pixley ka Seme	3	2
Emalahleni	7	1
Govan Mbeki	6	0
Albert Luthuli	2	3
Emakhazeni	0	4
Mkhondo	2	0
Msukaligwa	1	6
Steve Tshwete	4	0
Thaba Chweu	0	4
Mbombela-Umjindi	7	1
Nkomazi	5	0
Bushbuckridge	0	6
Dipaleseng	1	3
Lekwa	0	2
Victor Khanye	2	0
Totals	**44 (58%)**	**32 (42%)**

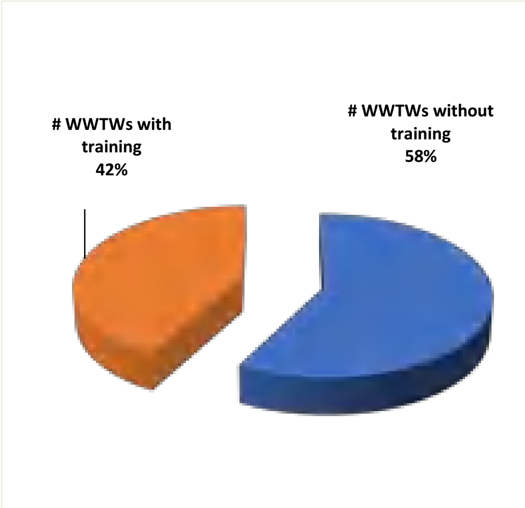


Figure 135 - %WWTWs that have trained operational staff over the past two years

The results confirmed that over 50% of the operational staff attending training over the past 2 years. It is, however, evident that training gaps persist which require a concerted effort to strengthen training initiatives of Supervisors and Process Controllers. Recent training events focused primarily on chlorine handling and NQF, and needs to be expanded to operation of technology, sludge treatment and energy efficiency.

Diagnostic 3: Treatment Capacity

Aim: A capable treatment plant requires adequate design capacity and functional equipment to operate optimally. If the plant capacity is exceeded by way of inflow volume or strength, the plant will not be capable to achieve its compliance standards. Capacity is typically exceeded when the demand exceeds the installed design capacity, or when processes or equipment is not operational or dysfunctional, or when the electrical supply cannot support the treatment infrastructure. This diagnostic assesses the status of plant capacity and operational flows to the plants.

Findings: Analysis of the hydraulic capacities and operational flows indicate a total design capacity of 352 Ml/d for the Province, with a total inflow of 178 Ml/day (considering that 35 systems are not measuring their inflows). Theoretically, this implies that close to 51% of the design capacity is used with 49% available to meet additional demand. However, the full 352 Ml/d day is not available as some infrastructure is dysfunctional, leaving 238 Ml/d available capacity (75%). Furthermore, the operational flow excludes data from 35 WWTWs that are not measuring flow, which would take up a significant portion of the installed capacity. This may result in a further reduced capacity that may move the Province closer to its total available capacity.

In general, most plants are operating within their design capacities, with the exception of Dipaleseng at 112% and Lekwa at 157%. Govan Mbeki, Albert Luthuli, Emakhazeni and Bushbuckridge report a low percentage use of their capacity (<50%). Treatment systems with low percentage use may have been affected by breakdown in sewer networks or pump stations whereby all sewage is not reaching the treatment works and/or are not measuring all the inflows into their respective systems. The Green Drop audit requires a wastewater flow balance to identify and quantify possible losses from the network and/or ingress into the sewers. The majority of municipalities do not have flow balances that follows the wastewater trail from consumer to treatment plant.

Table 144 - Summary of WWTWs design and available capacities, inflows, % use design capacities, and inflows measured per WWTW

WSA Name	# WWTWs	Design Capacity (Ml/d)	Available Capacity (Ml/d)	Operational Flow (Ml/d)	Variance (Ml/d)	% Use Design Capacity	# Inflow measured
Dr JS Moroka	1	65.2	44.2	NI	NI	NI	0
Thembisile Hani	3	64.1	47.3	1.3	1.2	52%	1
Pixley ka Seme	5	50.5	28.7	NI	NI	NI	0
Emalahleni	8	43.4	7.9	44.2	21.0	68%	8
Govan Mbeki	6	16.5	0.0	7.9	35.5	18%	4

WSA Name	# WWTWs	Design Capacity (Ml/d)	Available Capacity (Ml/d)	Operational Flow (Ml/d)	Variance (Ml/d)	% Use Design Capacity	# Inflow measured
Albert Luthuli	5	15.5	0.0	0.0	16.5	0%	1
Emakhazeni	4	13.0	7.8	1.6	5.7	22%	0
Mkhondo	2	12.7	1.2	7.8	5.2	60%	2
Msukaligwa	7	12.0	8.5	NI	NI	NI	0
Steve Tshwete	4	11.5	18.0	28.7	21.8	57%	4
Thaba Chweu	4	10.0	0.0	NI	NI	NI	0
Mbombela-Umjindi	8	8.9	0.0	47.3	16.8	74%	8
Nkomazi	5	7.3	1.6	3.3	1.3	72%	5
Bushbuckridge	6	7.2	0.0	1.2	11.5	9%	2
Dipaleseng	4	7.0	7.8	7.8	-0.8	112%	2
Lekwa	2	4.7	3.3	18.0	-6.5	157%	2
Victor Khanye	2	2.5	1.3	8.5	3.5	71%	1
Totals	**76**	**352.0**	**238.0**	**177.6**	**174.4**	**50.5%**	**41**

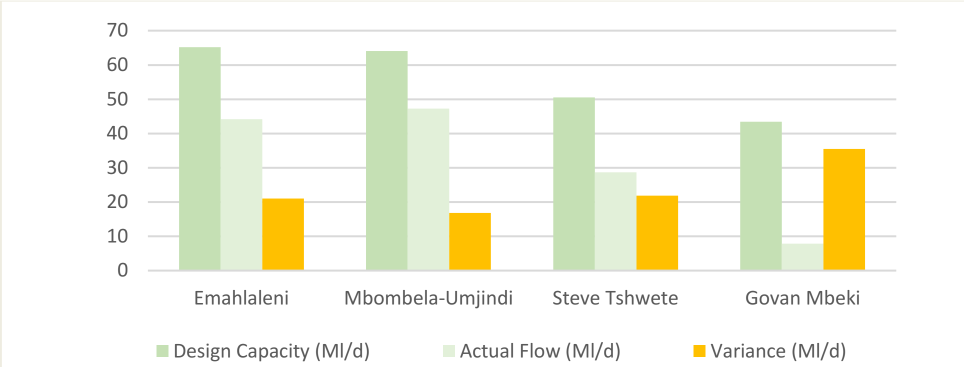


Figure 136 - WSA design capacity, actual flow, and variance in Ml/d for larger sized WWTWs

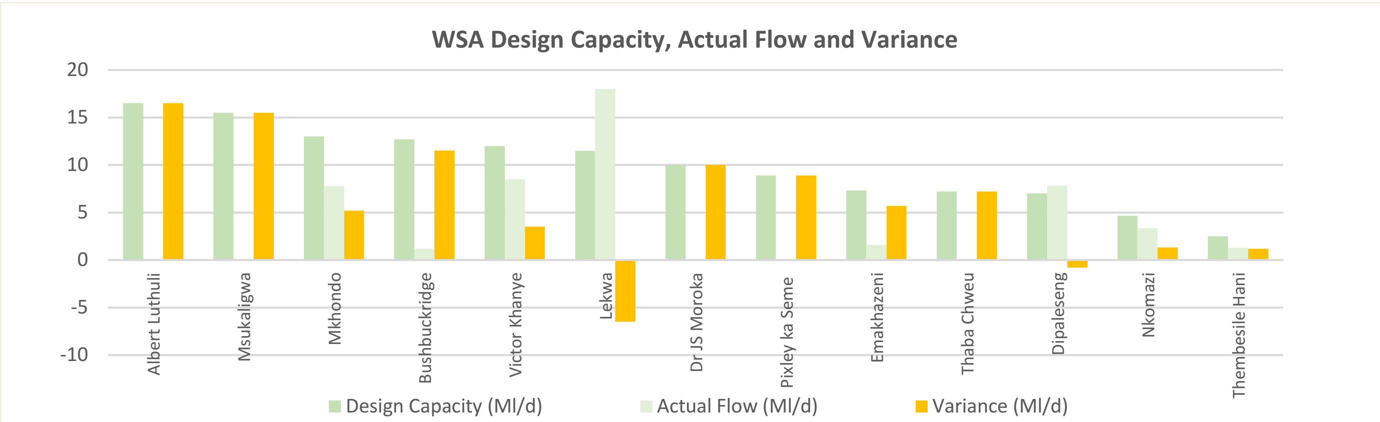


Figure 137 - WSA design capacity, actual flow, and variance in Ml/d for smaller sized WWTW

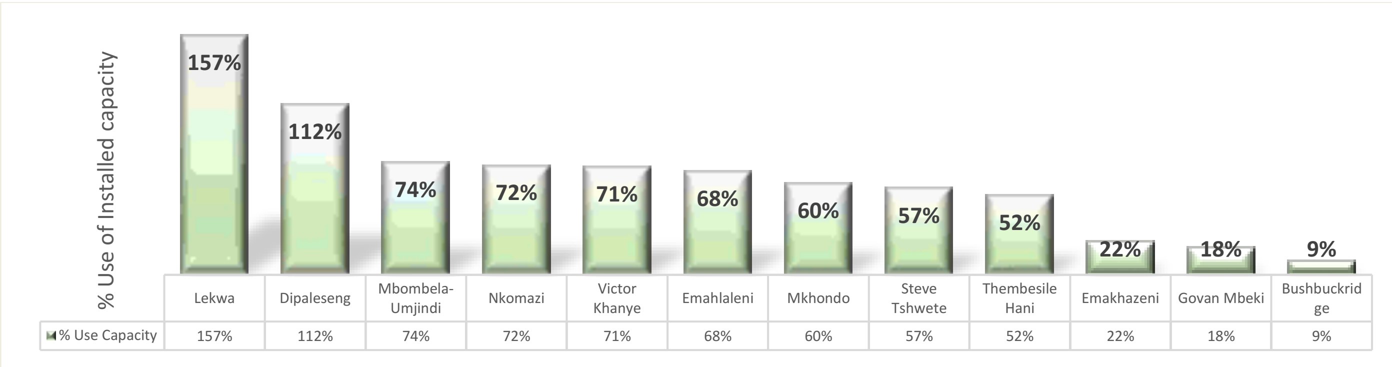


Figure 138 - WSA % use of installed design capacity

The audit data shows that 6 systems are hydraulically overloaded. This figure could theoretically be higher, given that there are 35 systems where inflow monitoring is not taking place. The capacity limitations may impede social and economic development in the drainage areas, if not addressed. The hydraulically overloaded systems in each of the WSAs is as follows:

- Emalahleni: 2 of 8 systems (Klipspruit, Riverview)
- Dipaleseng: 2 of 4 systems (Balfour, Grootvlei Eskom)
- Lekwa: 1 of 2 systems (Standerton)
- Victor Khanye: 1 of 2 systems (Delmas).

Water Use Authorisations mandate municipalities to install meters and monitor inflows, whilst GD requires WSAs to report inflows on IRIS and to calibrate meters annually.

The audit results indicate that 54% (41 of 76) of systems monitor their inflow. Dr JS Moroka, Pixley ka Seme, Msukaligwa and Thaba Chweu do not monitor their inflows. The majority of WSAs do not calibrate or verify their flow meters on an annual basis, thereby failing to meet good practice standards.

The WSAs fares poorly in terms of monitoring inflow and outflows, i.e. hydraulic loads to the treatment works. In addition, few municipalities know their WWTWs organic design capacity and does not monitor organic loading to the works. This presents a gap that would impede on forward planning and system optimisation strategies.

Diagnostic 4: Wastewater Monitoring and Compliance

Aim: "*To measure is to know*" and "*To know is to manage*". The primary objective of a wastewater treatment plant is to produce final effluent and biosolids to a safe standard. This standard cannot be measured or managed if operational and compliance monitoring is lacking. This diagnostic assesses the monitoring status and final effluent compliance against each WWTW's mandatory standards.

Findings: For operational monitoring, a satisfactory level of 90% is applied as the benchmark, to give weight to the importance of monitoring. For compliance monitoring, the audit evaluates the sampling location, sampling frequency, final effluent quality, biomonitoring, heavy metals, and any specific condition that the DWS may have included in the water use license.

Table 145 - Summary of the WSA operational and compliance monitoring status

WSA Name	# WWTW	Operational monitoring (KPA B2)		Compliance monitoring (KPA B3)	
		Satisfactory [GD score >90%]	Not Satisfactory [GD score <90%]	Satisfactory [GD score >90%]	Not Satisfactory [GD score <90%]
Dr JS Moroka	1	0	1	1	0
Thembisile Hani	3	0	3	0	3
Pixley ka Seme	5	0	5	0	5
Emalahleni	8	1	7	0	8
Govan Mbeki	6	0	6	5	1
Albert Luthuli	5	0	5	0	5
Emakhazeni	4	0	4	4	0
Mkhondo	2	1	1	2	0
Msukaligwa	7	0	7	0	7
Steve Tshwete	4	0	4	4	0
Thaba Chweu	4	0	4	0	4
Mbombela-Umjindi	8	0	8	3	5
Nkomazi	5	4	1	5	0
Bushbuckridge	6	0	6	5	1
Dipaleseng	4	0	4	0	4
Lekwa	2	0	2	2	0
Victor Khanye	2	0	2	2	0
Totals	**76**	**6 (8%)**	**70 (92%)**	**33 (43%)**	**43 (57%)**

The performance recorded in Table 145 stems from performance data as measured against the Green Drop Standard expressed in KPAs B2 and B3. The data indicates that only 6 of 76 plants (8%) are on par with good practice for operational monitoring, which includes raw sewage and the various process units responsible for effluent and sludge treatment.

Nkomazi is doing exceptionally well, followed closely by Mkhondo for both operational and compliance monitoring, whilst a further 9 of the 17 municipalities are doing well on the compliance monitoring requirement. The remaining municipalities are not meeting the Green Drop standard.

Overall, an unsatisfactory sampling and analysis regime is observed for both operational (92%) and compliance (57%) monitoring. Compliance monitoring is a legal requirement and the only means to measure performance of a treatment facility. Operational monitoring is the cornerstone of day-to-day process adjustments and optimisation to ensure treatment is efficient and delivers quality effluent/sludge that meets design expectations. The results indicate that the WSAs on average, is not achieving regulatory and industry standards.

Table 146 summarises the results of KPA E, which also carries the highest Green Drop score weighting. Note that averages shown as '0%' under Effluent Compliance include actual 0% compliance plus systems with no information or insufficient data.

Final effluent quality compliance is calculated against the mandatory limits as listed under "Authorisation Status". A >90% compliance figure confirms high quality final effluent, whereas a <30% indicate poor effluent quality. The enforcement measures are summarised in the column to the far right and include NWA Notices and Directives issued, criminal cases opened, and court interdicts granted during the period 1 April 2019 to 30 June 2021.

Table 146 - Summary of authorisation status, effluent compliance status, and directives/notices issued

WSA Name	Effluent Compliance										Enforce-ment Measures*
	Authorisation Status	Microbiological Compliance (%)			Chemical Compliance (%)			Physical Compliance (%)			
		Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	
Dr JS Moroka	1 Not authorised	8%	0	1	25%	0	1	61%	0	0	0
Thembisile Hani	3 GA	0%	0	3	0%	0	3	0%	0	3	0
Pixley ka Seme	4 WUL; 1 Not authorised	0%	0	5	0%	0	5	0%	0	5	0
Emalahleni	3 WUL; 1 GA; 4 Not authorised	16%	0	6	43%	2	4	45%	3	4	5
Govan Mbeki	5 WUL; 1 Not authorised	15%	0	5	27%	0	3	76%	2	0	4
Albert Luthuli	5 Not authorised	0%	0	5	0%	0	5	0%	0	5	0
Emakhazeni	2 WUL; 2 Not authorised	100%	4	0	9%	0	4	28%	0	1	1
Mkhondo	1 WUL; 1 Not authorised	0%	0	2	63%	0	1	77%	0	1	3
Msukaligwa	7 Not authorised	0%	0	7	0%	0	7	0%	0	7	6
Steve Tshwete	4 WUL	29%	0	3	73%	2	1	74%	1	1	0
Thaba Chweu	4 Not authorised	0%	0	4	0%	0	4	0%	0	4	2
Mbombela-Umjindi	8 WUL	16%	0	6	33%	2	5	36%	3	5	0
Nkomazi	5 GA	80%	3	1	63%	0	0	84%	1	0	0
Bushbuckridge	6 Not authorised	40%	1	2	35%	1	4	52%	1	2	0
Dipaleseng	3 Not authorised; 1 Unknown	0%	0	4	0%	0	4	0%	0	4	1
Lekwa	1 WUL; 1 Not authorised	0%	0	2	0%	0	2	0%	0	2	1
Victor Khanye	1 WUL; 1 Not authorised	18%	0	2	49%	0	0	45%	0	0	1
Totals		**19%**	**8**	**58**	**25%**	**7**	**53**	**34%**	**11**	**44**	**24**

* The enforcement measures (notices or directives issued) are taken over a two-year financial period from July 2019 to June 2021

Overall, municipalities reached 19% for microbiological compliance monitoring, followed by 25% for chemical, and 34% for physical compliance monitoring. For the microbiological compliance category, 8 of 76 systems achieved >90% and 58 systems fell below 30%. For the chemical compliance category, 7 systems achieved >90% and 53 systems fell below 30%. For the physical compliance category, 11 systems achieved >90% and 44 systems fell below 30%.

A total of 24 Directives/Notices have been issued to 9 municipalities. Msukaligwa (6 no.), Emalahleni (5 no.) and Govan Mbeki (4 no.) have the highest number of enforcement measures initiated by the Regulator, which require municipal leadership intervention and correction.

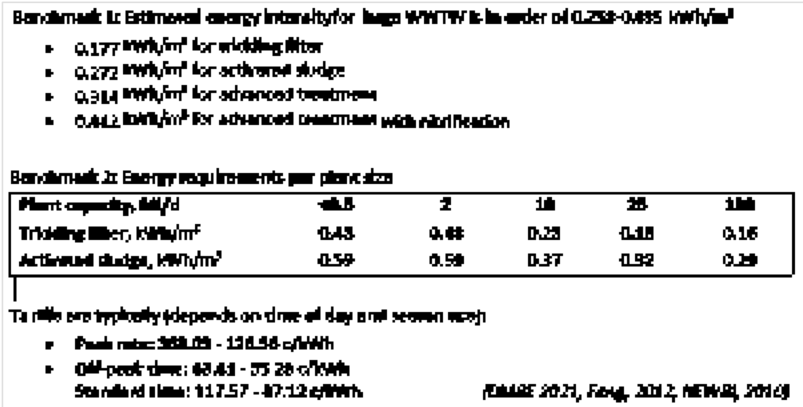
In terms of sludge compliance status, it is found that:

- 17 of the 76 WWTWs (22%) classify their biosolids according to the WRC Sludge Guidelines – Govan Mbeki, Steve Tshwete and Mbombela-Umjindi
- 1 WWTWs (1.3%) monitor sludge streams – Kingstonvale in Mbombela only
- 3 WWTWs (4%) have Sludge Management Plans in place – Mkhondo (in part) and Kingstonvale In Mbombela
- No sludge reuse projects in place
- 19 WWTWs (25%) use sludge mostly for agricultural purposes but also landfill application and commercial products.

The data confirm that 16 of the 17 municipalities (94%) have access to credible laboratories for compliance and operational analysis, which confirms that internal and/or contracted laboratories are accredited and/or have Proficiency Testing Schemes with suitable analytical methods and quality assurance.

Diagnostic 5: Energy Efficiency

Aim: The wastewater industry offers many opportunities to respond to climate change challenges by improving energy efficiency, reducing greenhouse gases, and generating energy. The energy cost of sophisticated treatment technologies are in the order of 25-40% of the O&M budget (cited WRC 2021). This diagnostic investigates the status of energy efficiency management at a provincial and municipal level with an aim to motivate for improved operational wastewater treatment efficiency.


Benchmark 1: Estimated energy intensity for large WWTW is in order of 0.258-0.485 kWh/m³

- 0.177 kWh/m³ for trickling filter
- 0.272 kWh/m³ for activated sludge
- 0.314 kWh/m³ for advanced treatment
- 0.412 kWh/m³ for advanced treatment with nitrification

Benchmark 2: Energy requirements per plant size

Plant capacity, Ml/d	<0.5	2	10	20	100
Trickling filter, kWh/m³	0.43	0.48	0.23	0.18	0.16
Activated sludge, kWh/m³	0.59	0.50	0.37	0.32	0.29

Tariffs are typically (depends on time of day and season mostly)

- Peak rate: 300.09 - 130.56 c/kWh
- Off-peak time: 48.41 - 35.28 c/kWh

Standard time: 117.57 - 87.12 c/kWh [illegible]

Findings: The audit results indicate an overall low awareness of energy management in the Province. Few of the municipalities conducted baseline energy audits or could report on electricity cost as R/kWh. No energy efficiency initiatives are in place except for Kingstonvale.

In terms of energy management, the data depicts the following:

- Dr JS Moroka, Mbombela and Thaba Chweu conducted energy audits in the past 24 months
- System SPCs are calculated by Steve Tshwete (0.3 kWh/m³ not system specific), Mbombela (0.91 kWh/m³ for plants operated by Silulumanzi), and Nkomazi (4.7 kWh/m³ for 3 systems)
- Kingstonvale of Mbombela was the only system that could account for CO_2 equivalents associated with energy efficiency
- No systems fell within the SPC industry benchmarks
- Steve Tshwete, Nkomazi and Mbombela (Silulumanzi) had knowledge of their energy tariffs (R/kWh) and energy cost (R/m³).

It is evident that municipalities in general, have not established a specific report to monitor energy as part of the wastewater business. Energy efficiency management has not been embedded in the Mpumalanga municipal sector, and potential cost savings and environmental gains are therefore forfeited.

Diagnostic 6: Technical Site Assessments

Aim: The Green Drop process makes provision for the desktop audit to be followed by a Technical Site Assessment (TSA) in order to verify the desktop evidence. The assessment includes physical inspection of the sewer network, pump stations, and treatment facility, coupled with asset condition checks to determine an approximate cost to restore existing infrastructure to functional status (VROOM).

Findings: The results of the TSAs are summarised in Table 176. A deviation of >10% between the GD and TSA score indicates a misalignment between the administrative aspects and the work on the ground. The Regulator regards a wastewater system with a TSA score of >80% as one that has an acceptable level of process control and functional equipment. A TSA score of 90% would represent an excellent plant that complies with most of the Green Drop TSA standards.

Table 147 - Summary of the WWTW Technical Site Assessments scores and hardware problems and %deviation between GD and TSA scores

WSA Name	TSA WWTW Name	WWTW GD Score (%)	% TSA	Key Hardware Problems	Difference between TSA & GD score
City of Mbombela	White River	53%	44%	1. Low level of process control, screening, and grit removal; 2. ASP module decommissioned; 3. Secondary clarification not effective; 4. Chlorination not effective; 5. Management commitment not visible	9%
Mkhondo	Mkhondo/ Piet Retief	54%	39%	1. BNR Aerators; 2. BNR Mixers; 3. SST sludge extraction system; 4. RAS pumps; 5. BNR Recycle pumps	15%
Nkomazi	Mhlathikop	67%	46%	1. Aeration; 2. Clarification	21%
Dr JS Moroka	Siyabuswa	42%	31%	1. Electrical cables; 2. Disinfection; 3. Clarification; 4. Aeration; 5. Recycle pumps	11%
Thembisile Hani	Tweefontein K	48%	78%	1. Repair automated screen; 2. build new kitchen and buy chlorine	30%
Thaba Chweu	Sabie	12%	46%	1. Dosing system will require replacement; 2. A new CCT tank is required; 3. Process unit is operational; aerators might need some minor refurbishment; 4. Return pumps' electrical board requires refurbishment; 5. Concrete is eroded and may require some rehabilitation & hand stops must be replaced	34%
Emakhazeni	Dullstroom	45%	40%	1. Mechanical screen to be refurbished; 2. Flowmeter requires replacement; 3. Aerators to be refurbished/replaced; 4. SST Rotating bridge not operational; 5. Reedbeds to be re-planted or by-passed	5%
Albert Luthuli	Carolina	19%	49%	1. Inlet flowmeter; 2. Aeration system; 3. Reactor level control gate; 4. RAS pump standby; 5. Gas chlorination system	30%
Steve Tshwete	Komati	88%	90%	1.Gas chlorination system requires service/upgrading	2%
Msukaligwa	Ermelo	18%	37%	1. recommission 4 Ml/d Pasveer ditch module; 2. repair and recommission sludge disposal facility; 3. Degritting system; 4. AS aerators; 5. AS mixers and recycle pumps	19%
Emahlahleni	Ferrobank	46%	61%	1. Mechanical screens; 2. Humas tank and recirculation pumps; 3. Primary settling tanks; 4. Biological filters; 5. Disinfection	15%
Govan Mbeki	Bethal	36%	42%	1. The biofilter module is not in use due to the ongoing refurbishment project; 2. No desludging is taking place from the Activated Sludge unit due to faulty sludge pumps; 3. No disinfection of effluent is taking place due to lack of chlorine gas supply; 4. The WWTW is not receiving all of the raw sewage for treatment as there are pump stations that are non-functional	6%
Pixley ka Seme	Volksrust	24%	24%	1. Pump stations all not working; 2. flow not reaching the plant; 3. flow meters stolen/vandalised	0%
Bushbuckridge	Dwarsloop	25%	26%	1. Secondary Clarification; 2. Uncommissioned equipment	1%
Victor Khanye	Delmas	37%	57%	1. Chlorination; 2. Chlorine contact channel; 3. Sludge ponds; 4. Maturation Ponds; 5. Grit Channels	20%
Dipaleseng	Balfour	2%	38%	1. Disinfection; 2. Ablutions and kitchen; 3. Signposting and safety signage to be reviewed	36%
Lekwa	Standerton	17%	39%	1. Chlorination; 2. Drying beds; 3. Sludge recycle standby pump; 4. Flow monitoring	22%
Totals	**17**				**0% to 36%**

A total of 17 site assessments were conducted, with 1 inspection per municipality. Only Steve Tshwete scored above 80%, which is regarded to be an acceptable TSA score. Only 3 other municipalities having a TSA score above 50%. Seven municipalities had TSA scores <30%, indicate that treatment facilities fail to meet operational, asset functionality, and workplace safety standards.

An acceptably low difference between GD and TSA scores were observed for all WSAs, except for Dipaleseng (36%), Albert Luthuli and Thembisile Hani (30%), Standerton (22%), and Nkomazi (21%). A low number indicates that wastewater administration correlate with the condition of processes and infrastructure in the field, and vice versa.

Steve Tshwete impressed with an excellent TSA score of 90% and close match with its GD score of 89% - this is commendable.

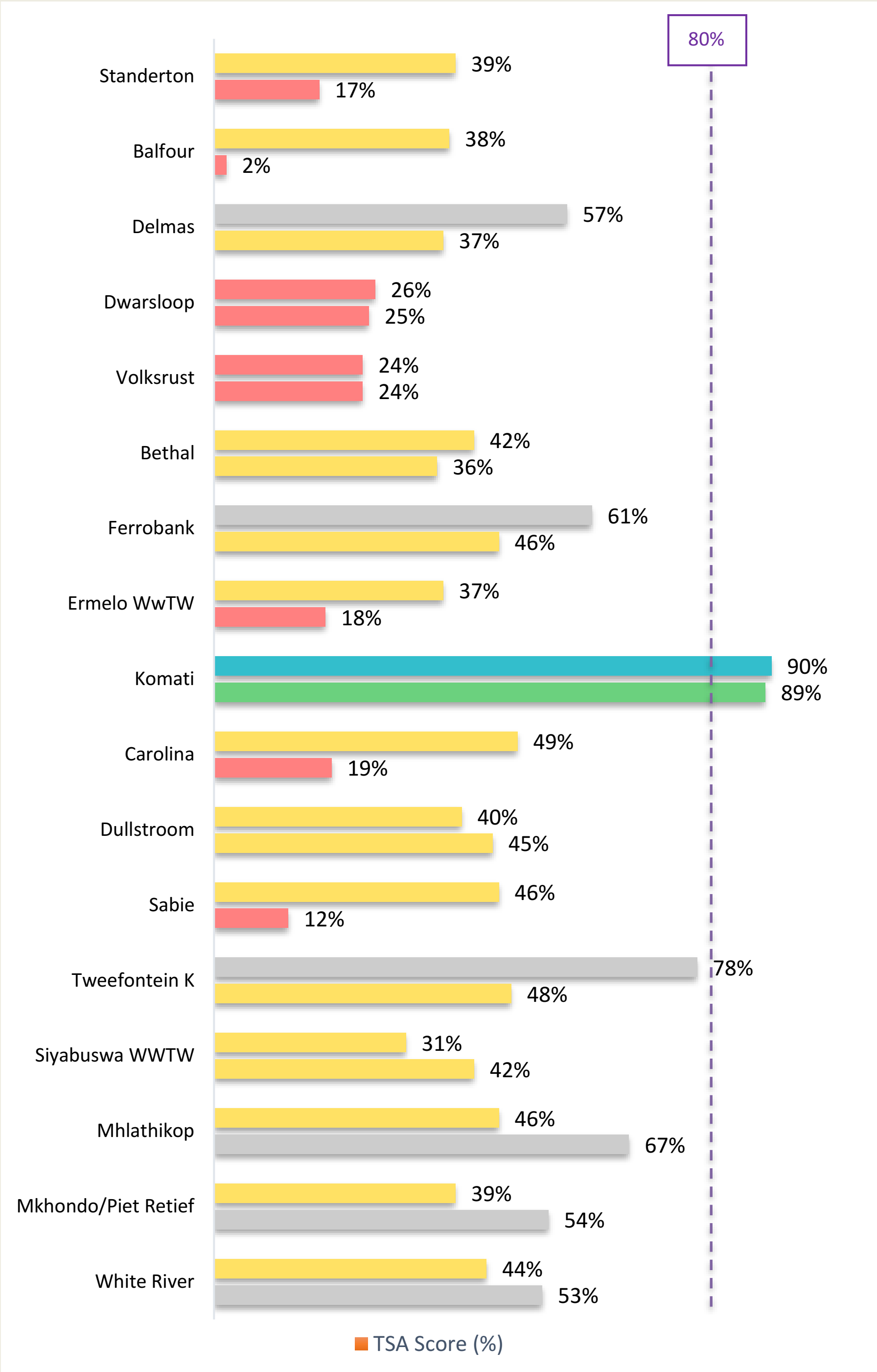


Figure 139 - Municipal GD (bottom car) and System TSA score (top bar) comparison (colour legends as for GD – blue excellent; red critical)

The VROOM cost presents a ''very rough order of measurement" cost to return a WWTWs functionality to its original design. A total budget of approximately R833 million is estimated for WSAs in the province, with the bulk of the work required in restoration of mechanical equipment (40%) and civil structures (47%).

Table 148 - VROOM cost split for civil, mechanical, and electrical and total VROOM cost estimate

WSA	Civil cost estimate	Mechanical cost estimate	Electrical & C&I cost estimate	Total VROOM cost
City of Mbombela	R170,716,248	R122,592,532	R57,959,220	R351,268,000
Mkhondo	R1,344,835	R12,866,635	R3,728,530	R17,940,000
Nkomazi	R10,328,022	R12,134,268	R694,710	R23,157,000
Dr JS Moroka	R4,145,100	R19,546,000	R10,008,900	R33,700,000
Thembisile Hani	R160,750	R89,250	None	R250,000
Thaba Chweu	R83,463,840	R14,268,240	R9,547,920	R107,280,000
Emakhazeni	R3,215,520	R2,986,830	R727,650	R6,930,000

WSA	Civil cost estimate	Mechanical cost estimate	Electrical & C&I cost estimate	Total VROOM cost
Albert Luthuli	R2,754,418	R43,912,166	R2,503,416	R49,170,000
Steve Tshwete	R81,182,400	R21,379,300	R10,142,500	R112,704,000
Msukaligwa	R9,215,151	R33,265,854	R7,583,994	R50,065,000
Emahlahleni	R5,551,128	R14,222,076	R1,742,796	R21,516,000
Govan Mbeki	R1,460,500	R3,555,400	R2,360,400	R7,376,300
Pixley ka Seme	R162,692	None	R15,308	R178,000
Bushbuckridge	R1,780,700	R29,957,900	R3,177,300	R34,916,000
Victor Khanye	R2,802,960	R734,400	R542,600	R4,080,000
Dipaleseng	R732,900	R73,500	R243,600	R1,050,000
Lekwa	R8,544,730	R2,376,015	R234,255	R11,155,000
Totals	**R387,561,894**	**R333,960,366**	**R111,213,099**	**R832,735,300**
% Distribution	**47%**	**40%**	**13%**	**100%**

The key hardware problems are listed in Table 147, with predominant defects in electrical cables, primary and secondary clarification, disinfection, sludge pumps, sludge treatment, and power backup. Mechanical defects typically include dysfunctional aerators, sludge and effluent pumps, mixers, screens, degritters, and disinfection equipment. Vandalism and theft, long procurement lead times, lack of management involvement, lack of maintenance, and lack of budget are the main reasons for dysfunctional assets.

Diagnostic 7: Operation, Maintenance and Refurbishment of Assets

Aim: Insufficient financial resources are often cited as a root cause to dysfunctional or non-compliant wastewater systems. Knowledge and monitoring of fiscal spending are therefore a critical part of wastewater management. This diagnostic investigates the status of financial information as pertaining to O&M budgets and expenditure, asset figures, and capital funding.

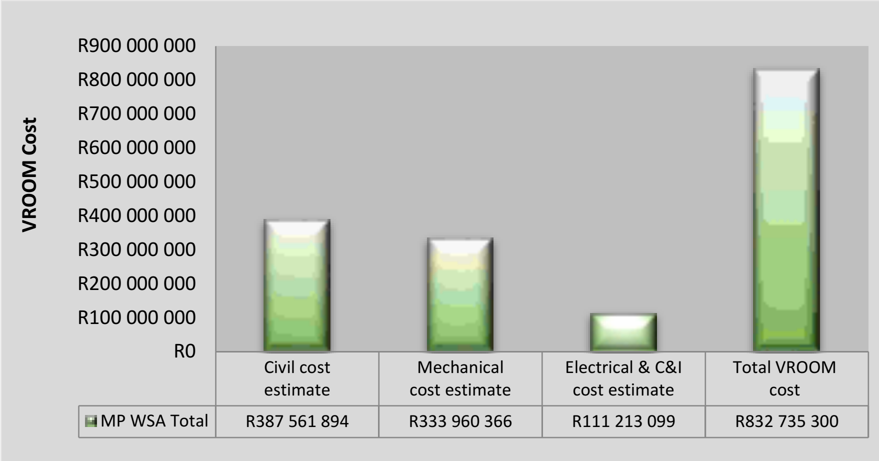
Findings: A substantial amount of financial information was presented during the audit process. Unfortunately, the evidence was presented in different formats, levels of detail, or absent for some municipalities. It was observed that municipal teams with financial officials that were present during the audits, typically performed better, and had a better understanding of the wastewater challenges experienced by their technical peers. Discrepancies observed included amongst others - generic or non-ringfenced budgets, contract lump sums for service providers presented as budgets, outdated or incomplete asset registers, and some cost drivers which were lacking (mostly electricity). The Regulator grouped data into different certainty levels, as summarised at the end of this Diagnostic.

It must be noted that there were limitations with the financial and asset information. Not all WSAs submitted current information or complete financial data sets.

The result of each financial portfolio is discussed hereunder.

Vroom Cost Analysis

The VROOM costs breakdown is discussed under the TSA Diagnostic but is further illustrated as follows. The total cost of R833 million is estimated to restore existing treatment works to their design capacity and functionality - consisting of R334 million for mechanical repairs, R111 million for electrical repairs, and R388 million for civil structures.



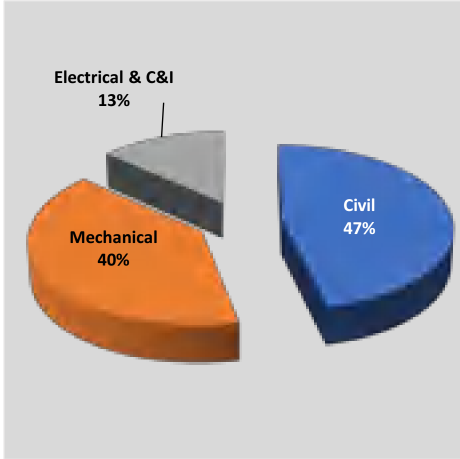


Figure 140 - Graphic illustration of the total cost estimated to restore functionality to existing assets (a), broken down to civil, mechanical, and electrical components

Table 149 indicates that a capital budget of R1.79 billion has been secured over the MTREF period to address infrastructural needs. While it is likely that some of the VROOM requirements will be addressed through this budget, it is probable that additional funding will be required to address the full VROOM requirements. In addition to the R833 million to restore the infrastructure, it is estimated that a total of R110 million will be required by all WSAs, on an annual basis, to maintain their assets. The maintenance estimate is based on the WATCOST-SALGA model that makes provision for maintenance at 2.14%, annually, of the asset value.

Capital, O&M Budget and Actual, and Asset Value

The capital budgets, O&M budgets, O&M actual expenditure, and current asset values are summarised below.

Table 149 - Summary of the capital budgets, O&M budgets, O&M actual expenditure, and current asset values

WSA	Capital budget available	O&M budget (2020/21)	O&M expended (2020/21)	% Expended	Total Current Asset Value
City of Mbombela	R53,037,650	R24,434,360	R49,593,180	203%	R2,877,438,000
Mkhondo	R48,000,000	NI	NI	NI	R276,189,000
Nkomazi	R10,186,250	R14,698,680	R15,203,800	103%	R857,140,560
Dr JS Moroka	R50,000,000	R25,320,000	R24,065,000	95%	R157,147,000
Thembisile Hani	R10,508,000	R1,464,770	R1,321,030	90%	NI
Thaba Chweu	R12,520,000	R1,000,000	NI	NI	R17,000,000
Emakhazeni	R90,000,000	R12,590,000	R1,150,000	9%	NI
Albert Luthuli	R10,000,000	NI	NI	NI	NI
Steve Tshwete	R50,069,000	R19,613,000	R55,160,995	281%	R516,553,000
Msukaligwa	NI	NI	NI	NI	NI
Emahlahleni	R828,706,430	R2,894,600	R2,661,090	92%	R194,541,320
Govan Mbeki	R12,923,670	R62,697,100	NI	NI	NI
Pixley ka Seme	R173,321,200	NI	NI	NI	NI
Bushbuckridge	NI	R2,028,000	NI	NI	NI
Victor Khanye	R298,778,000	R34,173,000	R28,519,000	83%	R31,385,000
Dipaleseng	NI	R1,776,000	R2,552,000	144%	NI
Lekwa	R145,821,000	NI	NI	NI	R193,558,000
Totals	**R1,793,871,200**	**R202,689,510**	**R180,226,095**	**89%**	**R5,120,951,880**

The Green Drop process provides a bonus (incentive) in cases where a municipality provides evidence of capital projects with secured funding since this is deemed as a definitive means of addressing wastewater service inadequacies. This incentive encourages wastewater infrastructure investment. A total capital budget of R1.79 billion has been reported for the refurbishment and upgrades of wastewater infrastructure for all the municipalities over the MTREF period. The largest capital budgets are observed for Emahlahleni (R829m), Victor Khanye (R299m), Pixley a Seme (R173m), and Emakhazeni (R90m).

For the 2020/21 fiscal year, the total O&M budget reported for Province was R203 million, of which R180 million (89%) has been expended. Large over-expenditure was observed for Steve Tshwete (281%), City of Mbombela (203%) and Dipaleseng (144%) and low expenditure for Emakhazeni (9%). The provincial figures exclude a number of municipalities with no information (NI).

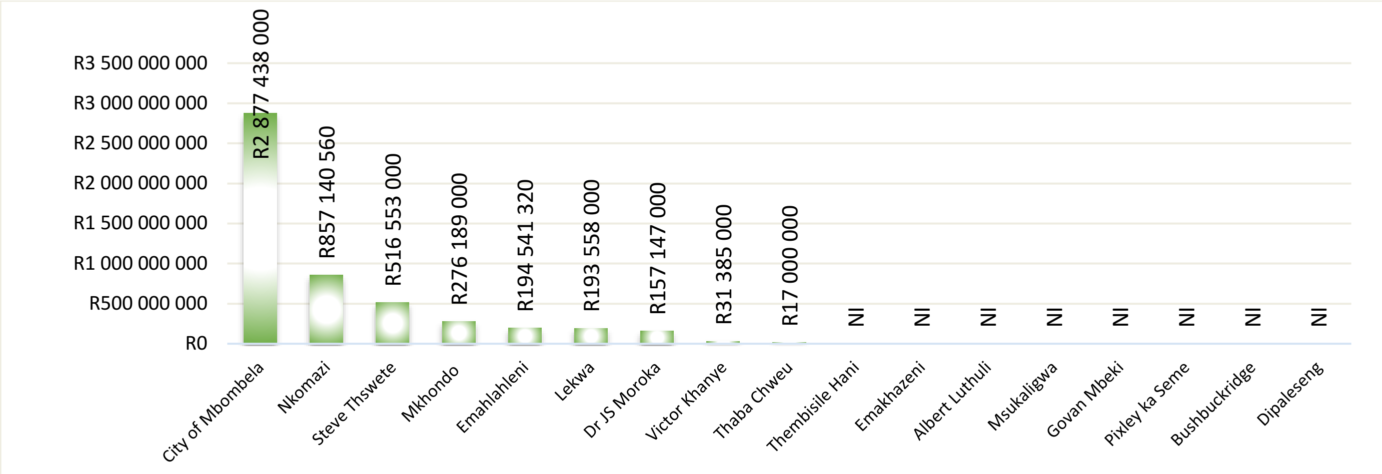


Figure 141 - Total current asset value reported by the municipalities

The total current asset value for wastewater infrastructure (networks, pump stations, treatment plants) is reportedly R5.12 billion (excluding 8 municipalities with no information). The highest asset values are observed for City of Mbombela (R2.9b), followed by Nkomazi (R857m) and Steve Tshwete (R517m).

O&M Cost Benchmarking

By combining the SALGA and WRC WATCOST models, an estimation of the maintenance cost required per asset type can be done, i.e. civil, buildings, pipelines, mechanical, electrical, and instrumentation.

Table 150 - SALGA-WRC annual maintenance budget guideline and cost estimation

Description	% of Current Asset Value	Asset Value Estimate	Modified SALGA Maintenance Guideline	Annual Maintenance Budget Guideline
Current Asset Value estimate	**100%**	**R5,120,951,880**	**15.75%**	**R109,588,370**
Broken down into:				
1. Civil Structures	46%	R2,355,637,865	0.50%	R11,778,189
2, Buildings	3%	R153,628,556	1.50%	R2,304,428
3. Pipelines	6%	R307,257,113	0.75%	R2,304,428
4. Mechanical Equipment	35%	R1,792,333,158	4.00%	R71,693,326
5. Electrical Equipment	8%	R409,676,150	4.00%	R16,387,046
6. Instrumentation	2%	R102,419,038	5.00%	R5,120,952
Totals	**100%**	**R5,120,951,880**	**15.75%**	**R109,588,370**
			Minus 20% P&Gs and 10% Installation	**R32,876,511**
			Total	**R76,711,859**

The model estimates that R110 million (2.14%) is required per year to maintain the assets valued at R5.12 billion. Notably, this maintenance estimate assumes that all assets are functional. The VROOM cost represents the funding required to return the assets to a fully functional state, from which basis routine maintenance could then focus on maintaining the assets.

Table 151 indicates the SALGA maintenance cost estimation in relation to the VROOM cost, O&M budget, and O&M actual expended.

Table 151 - O&M cost estimates by the SALGA and VROOM models versus actual budget and expenditure figures

Cost Reference	O&M Cost Estimate	Period
Modified SALGA	R109,588,370	Annually, estimation
O&M Budget	R202,689,510.00	Actual for 2020/21
O&M Spend	R180,226,095.00	Actual for 2020/21
VROOM	R832,735,300.00	Once off estimation

The cost dynamics can be summarised as follows:

- The SALGA estimations for maintenance budgets is 54% of the actual reported budgets for the 2020/21 fiscal year. This figure is influenced by inaccurate or absent asset values and incorrect information on O&M budget and spend
- The actual O&M budget does not appear to be adequate when compared with the SALGA guideline
- The VROOM cost represents an estimation of the refurbishment cost to restore WWTWs functionality and design capacity.

Production Cost and Comparison

It is good business practice to monitor and manage the production costs of wastewater treatment in Rand/m^3 treated, and to compare such cost with industry norms. Published benchmarks is not currently available for typical treatment costs, but significant cost increases are expected since 2013, given the variable input factors such as Covid, cost of chemicals, transport, and electricity. From an economic perspective, it is valuable to compare production cost at time of budgeting versus actual production costs. However, due to scarce information, it is not possible to provide insight as to possible shortfalls from an economic perspective. Based on the scarce data, no production costs for wastewater treatment could be concluded, which leaves a significant gap in the financial portfolio of WSAs in Mpumalanga. Only 3 municipalities provided production cost, i.e. budgeted at R7/m^3 compared to actual cost of R0.08/m^3 (Emalahleni), R3.42/m^3 budget and actual (Mkhondo), R10.81/m^3 compared to actual cost of R0.01/m^3 (Steve Tshwete), and R6.12/m^3 compared to actual of R0.69/m^3 (Mbombela-Umjindi). WSAs may view the results obtained for Gauteng, KwaZulu Natal, Eastern Cape and Western Cape, to obtain a sense of typical production costs at South African wastewater treatment facilities.

Data Certainty

Data certainty is expressed at different levels for the financial and asset figures reported within this Diagnostic. Certainty levels differ from system to system, hence some WSAs are included in multiple data certainty categories - as the data is variable, inconsistent, limited or non-existent (NI) for each of the systems. The various WSAs in the province that were identified under the category ''High Certainty", presented consistent and verifiable evidence in the form of budgets, expenditure, asset registers, and unit costs.

Table 152 - Levels of certainty associated with financial and asset information reported by municipalities

Data Certainty	Description	WSA
No certainty	Absent data or no certainty in data presented - not ringfenced for WWTW & Network	Msukaligwa, Bushbuckridge, Pixley ka Seme, Albert Luthuli
Low certainty	Minor or little certainty in the data - partially ringfenced for WWTW only or data as extreme outliers	Mkhondo, Govan Mbeki, Thembisile Hani, Emakhazeni, Dipaleseng, Lekwa, Thaba Chweu
Reasonable/good certainty	Reasonable to good level of certainty in the data - ringfenced for WWTW and/or Network and data falls within/close to expected parameters	City of Mbombela, Dr JS Moroka, Steve Tshwete, Nkomazi, Emalahleni, Victor Khanye
High certainty	High level of certainty in the data - ringfenced for WWTW and Network and data falls within expected parameters	None

9.1 Bushbuckridge Local Municipality

Water Service Institution	**Bushbuckridge Local Municipality**
Water Service Provider	Bushbuckridge Local Municipality

Municipal Green Drop Score	
2021 Green Drop Score	**24%↑**
2013 Green Drop Score	**13%**
2011 Green Drop Score	**29%**
2009 Green Drop Score	**0%**

VROOM Impression (Towards restoring functionality):

1. The majority of wastewater treatment facilities are being upgraded and are near completion. In some cases, merely awaiting final commissioning and handover

VROOM Estimate:

- R34,916,000

Key Performance Area	Unit	Dwarsloop	Manghwazi	Maviljan
Green Drop Score (2021)		**25%**	**33%**	**25%**
2013 Green Drop Score		**11%**	**36%**	**20%**
2011 Green Drop Score		**31%**	**22%**	**30%**
2009 Green Drop Score		**0%**	**0%**	**0%**
Design Capacity	Ml/d	1.6	0.1	5
Capacity Utilisation (%)		63%	NI	NI
Resource Discharged into		Motlumuvi River	No discharge	Inyaka Dam
Wastewater Risk Rating (CRR% of CRR_{max})		**Dwarsloop**	**Manghwazi**	**Maviljan**
CRR (2011)	%	76.5%	31.6%	76.5%
CRR (2013)	%	76.6%	47.1%	70.6%
CRR (2021)	%	70.6%	47.1%	81.8%

Key Performance Area	Unit	Makhulu	Thulamahashe	Tintswalo Hospital
Green Drop Score (2021)		**25%**	**26%**	**18%**
2013 Green Drop Score		**18%**	**14%**	**9%**
2011 Green Drop Score		**33%**	**31%**	**21%**
2009 Green Drop Score		**0%**	**0%**	**0%**
Design Capacity	Ml/d	0.5	4	1.5
Capacity Utilisation (%)		36%	NI	NI
Resource Discharged into		Sabie River	At confluence of Motlumuvi and Sand Rivers	Klaserie River
Wastewater Risk Rating (CRR% of CRR_{max})		**Mkhuhlu**	**Thulamahashe**	**Tintswalo Hospital**
CRR (2011)	%	88.2%	88.2%	88.2%
CRR (2013)	%	82.4%	70.6%	88.2%
CRR (2021)	%	52.9%	88.2%	88.2%

Technical Site Assessment: **Dwarsloop WWTW 26%**

9.2 Chief Albert Luthuli Local Municipality

Water Service Institution	**Albert Luthuli Local Municipality**	
Water Service Providers	Albert Luthuli Local Municipality Gert Sibande Laboratory	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Urgent action is required for the supply and refurbishment of most mechanical equipment 2. Including: additional RAS pump, aerators, SSTs, chlorine dosing equipment, flowmeter and sludge drying beds **VROOM Estimate:** - R49,170,000
2021 Green Drop Score	**11%↓**	
2013 Green Drop Score	**36%**	
2011 Green Drop Score	**17%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Badplaas	Carolina	Elukwatini	Empuluzi	Ekulindeni
Green Drop Score (2021)		**11%**	**19%**	**9%**	**13%**	**9%**
2013 Green Drop Score		**51%**	**30%**	**24%**	**23%**	**47%**
2011 Green Drop Score		**19%**	**19%**	**13%**	**19%**	**15%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	3	2.5	6	3	2
Capacity Utilisation (%)		NI	NI	NI	NI	NI
Resource Discharged into		No discharge	No discharge	Bosmanspruit River	Enkomazi River	No discharge
Wastewater Risk Rating (CRR% of CRR_{max})		**Badplaas**	**Carolina**	**Elukwatini**	**Empuluzi**	**Ekulindeni**
CRR (2011)	%	41.2%	64.7%	64.7%	47.1%	64.7%
CRR (2013)	%	94.1%	76.5%	94.1%	94.1%	94.1%
CRR (2021)	%	94.1%	94.1%	95.5%	94.1%	94.1%

Technical Site Assessment: **Carolina WWTW 49%**

9.3 Dipaleseng Local Municipality

Water Service Institution	**Dipaleseng Local Municipality**	
Water Service Provider	Dipaleseng Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Delays in commissioning upgraded infrastructure 2. No treatment of sewage **VROOM Estimate:** - R1,050,000
2021 Green Drop Score	**4%↑**	
2013 Green Drop Score	**3%**	
2011 Green Drop Score	**26%**	
2009 Green Drop Score	**8%**	

Key Performance Area	Unit	Balfour	Greylingstad	Grootvlei Mine	Grootvlei Eskom
Green Drop Score (2021)		**0%**	**10%**	**10%**	**6%**
2013 Green Drop Score		**3%**	**3%**	**3%**	**3%**
2011 Green Drop Score		**27%**	NA	NA	**20%**
2009 Green Drop Score		**10%**	**7%**	**7%**	**7%**
Design Capacity	Ml/d	4	1	1.5	0.5
Design capacity utilisation (%)		158%	NI	NI	300%
Resource Discharged into		Blesbokspruit	Unknown vlei	Vaal River	Vaal River
Wastewater Risk Rating (CRR% of CRR_{max})		**Balfour**	**Greylingstad**	**Grootvlei Mine**	**Grootvlei Eskom**
CRR (2011)	%	94.1%	100.0%	100.0%	76.5%
CRR (2013)	%	100.0%	100.0%	88.2%	88.2%
CRR (2021)	%	94.1%	94.1%	100.0%	94.1%

Technical Site Assessment: **Balfour WWTW 38%**

9.4 Dr JS Moroka Local Municipality

Water Service Institution	**Dr JS Moroka LM**	
Water Service Providers	Dr JS Moroka LM	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Electrical cables 2. Disinfection 3. Clarification 4. Aeration 5. Recycle pump **VROOM Estimate:** - R50,000,000
2021 Green Drop Score	**42%↓**	
2013 Green Drop Score	**46%**	
2011 Green Drop Score	**59%**	
2009 Green Drop Score	**35%**	

Key Performance Area	**Unit**	**Siyabuswa**
Green Drop Score (2021)		**42%**
2013 Green Drop Score		**46%**
2011 Green Drop Score		**59%**
2009 Green Drop Score		**40%**
System Design Capacity	Ml/d	10
Design Capacity Utilisation (%)		NI
Resource Discharged into		Elands River
Wastewater Risk Rating (CRR % of CRR_{max})		**Siyabuswa**
CRR (2011)	%	63.6%
CRR (2013)	%	59.0%
CRR (2021)	%	77.3%

Technical Site Assessment: **Siyabuswa WWTW** **31%**

9.5 Emakhazeni Local Municipality

Water Service Institution	**Emakhazeni Local Municipality**	
Water Service Provider	Emakhazeni Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Mechanical screen to be refurbished 2. Flowmeter requires replacement 3. Aerators to be refurbished/replaced 4. SST Rotating bridge not operational 5. Reedbeds to be re-planted or by-passed **VROOM Estimate:** - R6,930,000
2021 Green Drop Score	**48%↑**	
2013 Green Drop Score	**46%**	
2011 Green Drop Score	**70%**	
2009 Green Drop Score	**19%**	

Key Performance Area	Unit	Belfast	Dullstroom	Emthonjeni	Emgwenya
Green Drop Score (2021)		**53%**	**45%**	**45%**	**48%**
2013 Green Drop Score		**42%**	**51%**	**45%**	**49%**
2011 Green Drop Score		**76%**	**58%**	**61%**	**76%**
2009 Green Drop Score		**23%**	**18%**	**25%**	**8%**
System Design Capacity	Ml/d	1.8	1	1.5	3
Capacity Utilisation (%)		NI	NI	NI	53%
Resource Discharged into		Steelpoort River	Steelpoort River	Leeuspruit	Leeuspruit
Wastewater Risk Rating (CRR as % of CRR_{max})		**Belfast**	**Dullstroom**	**Emthonjeni**	**Emgwenya**
CRR (2011)	%	70.6%	58.8%	64.7%	47.1%
CRR (2013)	%	52.9%	64.7%	76.5%	70.6%
CRR (2021)	%	82.4%	82.4%	76.5%	70.6%

Technical Site Assessment: **Dullstroom WWTW 40%**

9.6 Emalahleni Local Municipality

Water Service Institution	**Emalahleni Local Municipality**	
Water Service Provider	Emalahleni Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Maintenance of plant infrastructure lacking 2. Many unit processes dysfunctional 3. Collector system pumps defective 4. Mechanical screen, PSTs, biofilters and recirculation pumps out of operation 5. Drying beds, disinfection, and associated contact channels dysfunctional. **VROOM Estimate:** - R21,516,000
2021 Green Drop Score	**45%↑**	
2013 Green Drop Score	**16%**	
2011 Green Drop Score	**46%**	
2009 Green Drop Score	**18%**	

Key Performance Area	Unit	Klipspruit	Phola	Ferrobank	Naaupoort
Green Drop Score (2021)		**50%**	**38%**	**46%**	**57%**
2013 Green Drop Score		**26%**	**18%**	**NA**	**12%**
2011 Green Drop Score		**47%**	**25%**	**46%**	**53%**
2009 Green Drop Score		**16%**	**19%**	**10%**	**18%**
System Design Capacity	Ml/d	10	6	17	10
Design Capacity Utilisation (%)		103%	36%	54%	68%
Resource Discharged into		Bruigspruit	Saalklap	Bruigspruit	Olifants
Wastewater Risk Rating (CRR% of CRR_{max})		**Klipspruit**	**Phola**	**Ferrobank**	**Naaupoort**
CRR (2011)	%	95.5%	47.1%	86.4%	86.4%
CRR (2013)	%	95.5%	88.2%	86.4%	76.5%
CRR (2021)	%	63.6%	59.1%	72.7%	50.0%

Key Performance Area	Unit	Ga-Nala	Rietspruit	Thubelihle	Riverview
Green Drop Score (2021)		**41%**	**52%**	**20%**	**42%**
2013 Green Drop Score		**21%**	**17%**	NA	**11%**
2011 Green Drop Score		**34%**	**34%**	NA	**49%**
2009 Green Drop Score		**23%**	**23%**	NA	**17%**
System Design Capacity	Ml/d	4.2	2	10	11
Design Capacity Utilisation (%)		83%	40%	7%	101%
Resource Discharged into		Steenkoolspruit	Rietspruit Dam	Rietkuilspruit to Steenkoolspruit	Olifants
Wastewater Risk Rating (CRR% of CRR_{max})		**Ga-Nala**	**Rietspruit**	**Thubelihle**	**Riverview**
CRR (2011)	%	84.2%	64.7%	**NA**	84.4%
CRR (2013)	%	64.7%	94.1%	**NA**	95.5%
CRR (2021)	%	70.6%	23.5%	54.5%	59.1%

Technical Site Assessment: **Ferrobank WWTW 61%**

9.7 Govan Mbeki Local Municipality

Water Service Institution	**Govan Mbeki Local Municipality**	
Water Service Provider	Govan Mbeki Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Biofilter module not operational due to current refurbishment 2. Faulty sludge pumps leads – no sludge control in activated sludge basin 3. Disinfection not operational – no chlorine gas 4. Low flow to WWTW - pump stations dysfunctional. **VROOM Estimate:** - R7,376,300
2021 Green Drop Score	**39%↓**	
2013 Green Drop Score	**48%**	
2011 Green Drop Score	**51%**	
2009 Green Drop Score	**57%**	

Key Performance Area	Unit	Bethal	Embalenhle	Evander	Kinross
Green Drop Score (2021)		**36%**	**41%**	**35%**	**44%**
2013 Green Drop Score		46%	44%	49%	46%
2011 Green Drop Score		**50%**	**59%**	**52%**	49%
2009 Green Drop Score		**59%**	**57%**	**58%**	**57%**
System Design Capacity	Ml/d	6.89	8	16	2
Design Capacity Utilisation (%)		NI	40%	NI	75%
Resource Discharged into		Blesbokspruit	Trichardt Spruit	Grootspruit	Vaalbunkspruit
Wastewater Risk Rating (CRR% of CRR_{max})		**Bethal**	**Embalenhle**	**Evander**	**Kinross**
CRR (2011)	%	77.3%	90.9%	77.3%	90.9%
CRR (2013)	%	68.2%	86.4%	50.0%	70.6%
CRR (2021)	%	77.3%	50.0%	72.7%	58.8%

Key Performance Area	Unit	Leandra	Trichardt
Green Drop Score (2021)		**43%**	**49%**
2013 Green Drop Score		49%	48%
2011 Green Drop Score		49%	**54%**
2009 Green Drop Score		**57%**	**48%**
System Design Capacity	Ml/d	8.5	2
Design Capacity Utilisation (%)		18%	85%
Resource Discharged into		Waterval River	Trichardspruit
Wastewater Risk Rating (CRR% of CRR_{max})		**Leandra**	**Trichardt**
CRR (2011)	%	86.4%	76.5%
CRR (2013)	%	68.2%	64.7%
CRR (2021)	%	40.9%	64.7%

Technical Site Assessment: **Bethel WWTW 42%**

9.8 Lekwa Local Municipality

Water Service Institution	**Lekwa Local Municipality**	
Water Service Provider	Lekwa Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Flowmeter not operational 2. Chlorination 3. Drying beds 4. sludge recycle pumps 5. sewer pump stations **VROOM Estimate:** - R11,155,000
2021 Green Drop Score	**17%↓**	
2013 Green Drop Score	**3%**	
2011 Green Drop Score	**19%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Morgenzon	Standerton
Green Drop Score (2021)		**21%**	**17%**
2013 Green Drop Score		**2%**	**3%**
2011 Green Drop Score		**11%**	**19%**
2009 Green Drop Score		**0%**	**0%**
Design Capacity	Ml/d	0.5	11
Capacity utilisation (%)		NI	164%
Resource Discharged into		Osspruit to Blesbokspruit to Vaal River	Vaal River
Wastewater Risk Rating (CRR% of CRR_{max})		**Morgenzon**	**Standerton**
CRR (2011)	%	78.0%	100.0%
CRR (2013)	%	88.0%	100.0%
CRR (2021)	%	94.1%	95.5%

Technical Site Assessment: ***Standerton WWTW*** **39%**

9.9 Mbombela Local Municipality

Water Service Institution	**Mbombela-Umjindi Local Municipality**		
Water Service Provider	Silulumanzi (for Kingstonvale, Kanyamazane, Matsulu)		
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Screening and grit removal 2. ASP module decommissioned 3. Secondary clarification not effective 4. Chlorination not effective **VROOM Estimate:** - R351,268,000	
2021 Green Drop Score	**74%↓**		
2013 Green Drop Score	**83%**		
2011 Green Drop Score	**86%**		
2009 Green Drop Score	**72%**		

Key Performance Area	Unit	Hazyview	Kabokweni	Kanyamazane	Kingstonvale
Green Drop Score (2021)		**48%**	**48%**	**84%**	**88%**
2013 Green Drop Score		**68%**	**29%**	**93%**	**90%**
2011 Green Drop Score		**69%**	**46%**	**88%**	**91%**
2009 Green Drop Score		**72%**	**44%**	**91%**	**71%**
Design Capacity	Ml/d	1	3.6	12	26
Capacity Utilisation (%)		100%	58%	76%	78%
Resource Discharged into		Nels Creek Spruit to Sabie River	Gutshwa River	Crocodile River	Crocodile River
Wastewater Risk Rating (CRR% of CRR_{max})		**Hazyview**	**Kabokweni**	**Kanyamazane**	**Kingstonvale**
CRR (2011)	%	70.6%	70.0%	45.5%	48.2%
CRR (2013)	%	64.7%	64.7%	45.5%	44.4%
CRR (2021)	%	76.5%	70.6%	40.9%	55.6%

Key Performance Area	Unit	Matsulu	Rocky's Drift	White River	Barberton-Umjindi
Green Drop Score (2021)		**86%**	**52%**	**52%**	**42%**
2013 Green Drop Score		**90%**	**76%**	**68%**	**54%**
2011 Green Drop Score		**88%**	**81%**	**62%**	**56%**
2009 Green Drop Score		**94%**	**73%**	**57%**	**0%**
Design Capacity	Ml/d	6	1.5	6	8
Capacity Utilisation (%)		58%	67%	67%	78%
Resource Discharged into		Crocodile	Sand River	White River Stream	Suid Kaap River
Wastewater Risk Rating (CRR% of CRR_{max})		**Matsulu**	**Rocky's Drift**	**White River**	**Barberton-Umjindi**
CRR (2011)	%	36.4%	29.4%	40.9%	72.7%
CRR (2013)	%	40.9%	41.2%	54.6%	72.7%
CRR (2021)	%	40.9%	70.6%	72.7%	68.2%

Technical Site Assessment: **White River WWTW 44%**

9.10 Mkhondo Local Municipality

Water Service Institution	**Mkhondo Local Municipality**		
Water Service Provider	Mkhondo Local Municipality		
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. PST bridges and automated desludge valves to be refurbished 2. Aerators are not operational 3. Recycle pumps not operational 4. SSTs are blocked with sludge and weir and baffle plate require adjustment/ fixing **VROOM Estimate:** - R17,940,000	
2021 Green Drop Score	**55%↑**		
2013 Green Drop Score	**51%**		
2011 Green Drop Score	**0%**		
2009 Green Drop Score	**0%**		

Key Performance Area	Unit	Amsterdam	Mkhondo/ Piet Retief
Green Drop Score (2021)		**56%**	**54%**
2013 Green Drop Score		**51%**	**51%**
2011 Green Drop Score		**0%**	**0%**
2009 Green Drop Score		**0%**	**0%**
System Design Capacity	Ml/d	3	10
Capacity Utilisation (%)		60%	60%
Resource Discharged into		Ithole River	Klipmesselspriut
Wastewater Risk Rating (CRR% of CRR_{max})		**Amsterdam**	**Mkhondo/Piet Retief**
CRR (2011)	%	88.2%	88.2%
CRR (2013)	%	70.6%	82.4%
CRR (2021)	%	52.9%	72.7%

Technical Site Assessment: **Mkhondo/Piet Retief WWTW 39%**

9.11 Msukaligwa Local Municipality

Water Service Institution	**Msukaligwa Local Municipality**	
Water Service Provider	Msukaligwa Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** (Ermelo WWTW) 1. Grit classifier to be refurbished 2. Aerators, recycle pumps non-operational 3. Facilities related to sludge handling, i.e. blocked SSTs, pumps, sludge drying beds and lagoons need to be refurbished 4. Pasveer ditch out of operation. **VROOM Estimate:** - R50,065,000
2021 Green Drop Score	**17%↑**	
2013 Green Drop Score	**10%**	
2011 Green Drop Score	**9%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Breyton Ponds**	**Chrissiesmeer**	**Davel**	**Ermelo**
Green Drop Score (2021)		**12%**	**10%**	**13%**	**18%**
2013 Green Drop Score		**8%**	**5%**	**7%**	**7%**
2011 Green Drop Score		**0%**	**7%**	**5%**	**5%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	1	1	1.5	7
Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		No discharge	Chrisies Lake	No discharge	Vaal River
Wastewater Risk Rating (CRR% of CRR_{max})		**Breyton Ponds**	**Chrissiesmeer**	**Davel**	**Ermelo**
CRR (2011)	%	95.5%	94.1%	47.1%	47.1%
CRR (2013)	%	88.2%	94.1%	100.0%	100.0%
CRR (2021)	%	94.1%	94.1%	94.1%	90.9%

Key Performance Area	**Unit**	**Lothair**	**Sheepmoor**	**KwaZanele-Breyton AS**
Green Drop Score (2021)		**11%**	**11%**	**23%**
2013 Green Drop Score		**10%**	NA	NA
2011 Green Drop Score		**12%**	NA	NA
2009 Green Drop Score		**0%**	NA	NA
System Design Capacity	Ml/d	1	1	3
Capacity Utilisation (%)		NI	NI	NI
Resource Discharged into		Impulusi River	No discharge	Vaal River
Wastewater Risk Rating (CRR% of CRR_{max})		**Lothair**	**Sheepmoor**	**KwaZanele-Breyton AS**
CRR (2011)	%	81.0%	NA	96.0%
CRR (2013)	%	100.0%	NA	100.0%
CRR (2021)	%	94.1%	94.1%	94.1%

Technical Site Assessment: **Ermelo WWTW 37%**

9.12 Nkomazi Local Municipality

Water Service Institution	**Nkomazi Local Municipality**
Water Service Provider	Nkomazi Local Municipality

Municipal Green Drop Score	
2021 Green Drop Score	**75%↑**
2013 Green Drop Score	**32%**
2011 Green Drop Score	**43%**
2009 Green Drop Score	**0%**

VROOM Impression (Towards restoring functionality):
1. Flow metering
2. Aeration
3. Secondary clarification
4. Process monitoring and operation.

VROOM Estimate:
- R23,157,000

Key Performance Area	Unit	Hectorspruit	Komatipoort	Mhlathikop
Green Drop Score (2021)		**75%**	**78%**	**67%**
2013 Green Drop Score		**29%**	**30%**	**27%**
2011 Green Drop Score		**48%**	**53%**	**34%**
2009 Green Drop Score		**0%**	**0%**	**0%**
Design Capacity	Ml/d	0.4	1.25	1
Capacity Utilisation (%)		83%	83%	81%
Resource Discharged into		Crocodile River	Crocodile River	Crocodile River
Wastewater Risk Rating (CRR% of CRR_{max})		**Hectorspruit**	**Komatipoort**	**Mhlathikop**
CRR (2011)	%	66.7%	100.0%	72.2%
CRR (2013)	%	88.2%	82.4%	88.2%
CRR (2021)	%	52.9%	52.9%	47.1%

Key Performance Area	Unit	Tonga	Mhlatiplaas/Malalane
Green Drop Score (2021)		**76%**	**78%**
2013 Green Drop Score		**36%**	**38%**
2011 Green Drop Score		**18%**	**48%**
2009 Green Drop Score		**0%**	**0%**
Design Capacity	Ml/d	1.25	0.75
Capacity Utilisation (%)		52%	66%
Resource Discharged into		Komati River	Crocodile River
Wastewater Risk Rating (CRR% of CRR_{max})		**Tonga**	**Mhlatiplaas/Malalane**
CRR (2011)	%	83.3%	50.0%
CRR (2013)	%	88.2%	88.2%
CRR (2021)	%	47.1%	41.2%

Technical Site Assessment: **Mhlatikop WWTW 46%**

9.13 Pixley ka Seme Local Municipality

Water Service Institution	**Pixley ka Seme Local Municipality**	
Water Service Provider	Pixley ka Seme Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Pump stations vandalised 2. Spillages 3. No standby pumps, pumps dysfunctional 5. No flow measurement devices installed 6. Plant dysfunctional, no flow received into plant. **VROOM Estimate:** - R178,000
2021 Green Drop Score	**22%↑**	
2013 Green Drop Score	**21%**	
2011 Green Drop Score	**54%**	
2009 Green Drop Score	**21%**	

Key Performance Area	**Unit**	**Volksrust**	**Vukuzakhe**	**Wakkerstroom**	**Amersfoort**
Green Drop Score (2021)		**24%**	**18%**	**21%**	**21%**
2013 Green Drop Score		**21%**	**18%**	**17%**	**25%**
2011 Green Drop Score		**52%**	**51%**	**50%**	**55%**
2009 Green Drop Score		**20%**	**20%**	**18%**	**20%**
System Design Capacity	Ml/d	4	1	1	2.1
Design capacity utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Mahawane River	Mahawane River	Uthaka River (trib. of Wakkerstroom river)	Skulpspruit River
Wastewater Risk Rating (CRR% of CRR_{max})		**Volksrust**	**Vukuzakhe**	**Wakkerstroom**	**Amersfoort**
CRR (2011)	%	76.5%	82.4%	76.5%	70.6%
CRR (2013)	%	94.1%	94.1%	88.2%	82.4%
CRR (2021)	%	88.2%	94.1%	94.1%	94.1%

Key Performance Area	**Unit**	**Perdekop**
Green Drop Score (2021)		**21%**
2013 Green Drop Score		**20%**
2011 Green Drop Score		**46%**
2009 Green Drop Score		**25%**
System Design Capacity	Ml/d	0.8
Design capacity utilisation (%)		NI
Resource Discharged into		Kaalspruit river
Wastewater Risk Rating (CRR% of CRR_{max})		**Perdekop**
CRR (2011)	%	58.8%
CRR (2013)	%	82.4%
CRR (2021)	%	94.1%

Technical Site Assessment: **Volksrust WWTW 24%**

9.14 Steve Tshwete Local Municipality

Water Service Institution	**Steve Tshwete Local Municipality**	
Water Service Provider	Steve Tshwete Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Gas chlorination system **VROOM Estimate:** - R112,704,000
2021 Green Drop Score	**88%↑**	
2013 Green Drop Score	**73%**	
2011 Green Drop Score	**76%**	
2009 Green Drop Score	**11%**	

Key Performance Area	**Unit**	**Boskrans**	**Komati**	**Blinkpan**	**KwaZamokuhle**
Green Drop Score (2021)		**88%**	**94%->89%**	**93%->89%**	**90%->89%**
2013 Green Drop Score		**22%**	**6%**	**6%**	**10%**
2011 Green Drop Score		**64%**	**50%**	**44%**	**61%**
2009 Green Drop Score		**74%**	**70%**	**67%**	**70%**
System Design Capacity	Ml/d	45	1.2	0.54	3.8
Capacity Utilisation (%)		56%	89%	63%	61%
Resource Discharged into		Klein Olifants River	Koringspruit	Koringspruit	Klein Olifants River
Wastewater Risk Rating (CRR% of CRR_{max})		**Boskrans**	**Komati**	**Blinkpan**	**KwaZamokuhle**
CRR (2011)	%	64.3%	50.0%	44.4%	61.1%
CRR (2013)	%	63.0%	58.8%	64.7%	64.7%
CRR (2021)	%	63.0%	29.4%	35.3%	52.9%

Technical Site Assessment: **Komati WWTW 90%**

9.15 Thaba Chweu Local Municipality

Water Service Institution	**Thaba Chweu Local Municipality**	
Water Service Provider	Thaba Chweu Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** *(Lydenburg WWTW)* 1. Plant not operational for >year 2. All electrical and mechanical equipment dysfunctional 3. All pump stations dysfunctional 4. Vandalism *(Sabie WWTW)* 1. Flood erosion requires urgent repair 2. No chlorine contact tank 3. Flow meter dysfunctional 4. Sludge drying beds require refurbishment 5. Disinfection dosing system ineffective **VROOM Estimate:** - R107,280,000
2021 Green Drop Score	**10%↓**	
2013 Green Drop Score	**79.8%**	
2011 Green Drop Score	**81%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Lydenburg**	**Sabie**	**Graskop**	**Coromandel**
Green Drop Score (2021)		**7%**	**11%**	**20%**	**11%**
2013 Green Drop Score		**79%**	**82%**	**83%**	NA
2011 Green Drop Score		**77%**	**78%**	**83%**	NA
2009 Green Drop Score		**0%**	**0%**	**0%**	NA
System Design Capacity	Ml/d	4	2	1	0.2
Design Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Spekboom River	Sabie River	MacMac stream	Dorps Rivier
Wastewater Risk Rating (CRR% of CRR_{max})		**Lydenburg**	**Sabie**	**Graskop**	**Coromandel**
CRR (2011)	%	36.4%	17.6%	17.6%	**NA**
CRR (2013)	%	54.6%	35.3%	35.3%	**NA**
CRR (2021)	%	94.1%	94.1%	94.1%	94.1%

Technical Site Assessment: **Lydenburg WWTW 0%; Sabie WWTW 46%**

9.16 Thembisile Hani Local Municipality

Water Service Institution	**Thembisile Hani LM**
Water Service Provider	Thembisile Hani LM

Municipal Green Drop Score	
2021 Green Drop Score	**47%↑**
2013 Green Drop Score	**26%**
2011 Green Drop Score	**30%**
2009 Green Drop Score	**0%**

VROOM Impression (Towards restoring functionality):

1. Repair automated screen
2. Lack of kitchen
3. Chlorine stock

VROOM Estimate:

- R250,000

Key Performance Area	Unit	Tweefontein K	KwaMhlanga East	KwaMhlanga West
Green Drop Score (2021)		**48%**	**44%**	**43%**
2013 Green Drop Score		**38%**	**14%**	**11%**
2011 Green Drop Score		**34%**	**23%**	**23%**
2009 Green Drop Score		**0%**	**0%**	**0%**
System Design Capacity	Ml/d	1.5	0.5	0.5
Design Capacity Utilisation (%)		87%	NI	NI
Resource Discharged into		Klipriver	NI	NI
Wastewater Risk Rating (CRR % of CRR_{max})		**Tweefontein K**	**KwaMhlanga East**	**KwaMhlanga West**
CRR (2011)	%	70.6%	47.1%	70.6%
CRR (2013)	%	52.9%	76.5%	76.5%
CRR (2021)	%	70.6%	88.2%	88.2%

Technical Site Assessment: **Tweefontein WWTW 78%**

9.17 Victor Khanye Local Municipality

Water Service Institution	**Victor Khanye Local Municipality**
Water Service Provider	Victor Khanye Local Municipality

Municipal Green Drop Score		VROOM Impression (Towards restoring functionality):
2021 Green Drop Score	**39%↑**	1. Flow meter to be installed 2. Disinfection 3. Chlorine Contact channel 4. Overflow balancing tank
2013 Green Drop Score	**35%**	
2011 Green Drop Score	**29%**	**VROOM Estimate:**
2009 Green Drop Score	**52%**	- R112,704,000

Key Performance Area	Unit	Botleng	Delmas
Green Drop Score (2021)		**40%**	**37%**
2013 Green Drop Score		36%	33%
2011 Green Drop Score		**29%**	**28%**
2009 Green Drop Score		**54%**	**50%**
Design Capacity	Ml/d	7.5	4.5
Capacity utilisation (%)		NI	189%
Resource Discharged into		Bronkhorstspruit	Blesbokspruit
Wastewater Risk Rating (CRR% of CRR_{max})		**Botleng**	**Delmas**
CRR (2011)	%	94.1%	94.1%
CRR (2013)	%	59.1%	70.6%
CRR (2021)	%	86.4%	76.5%

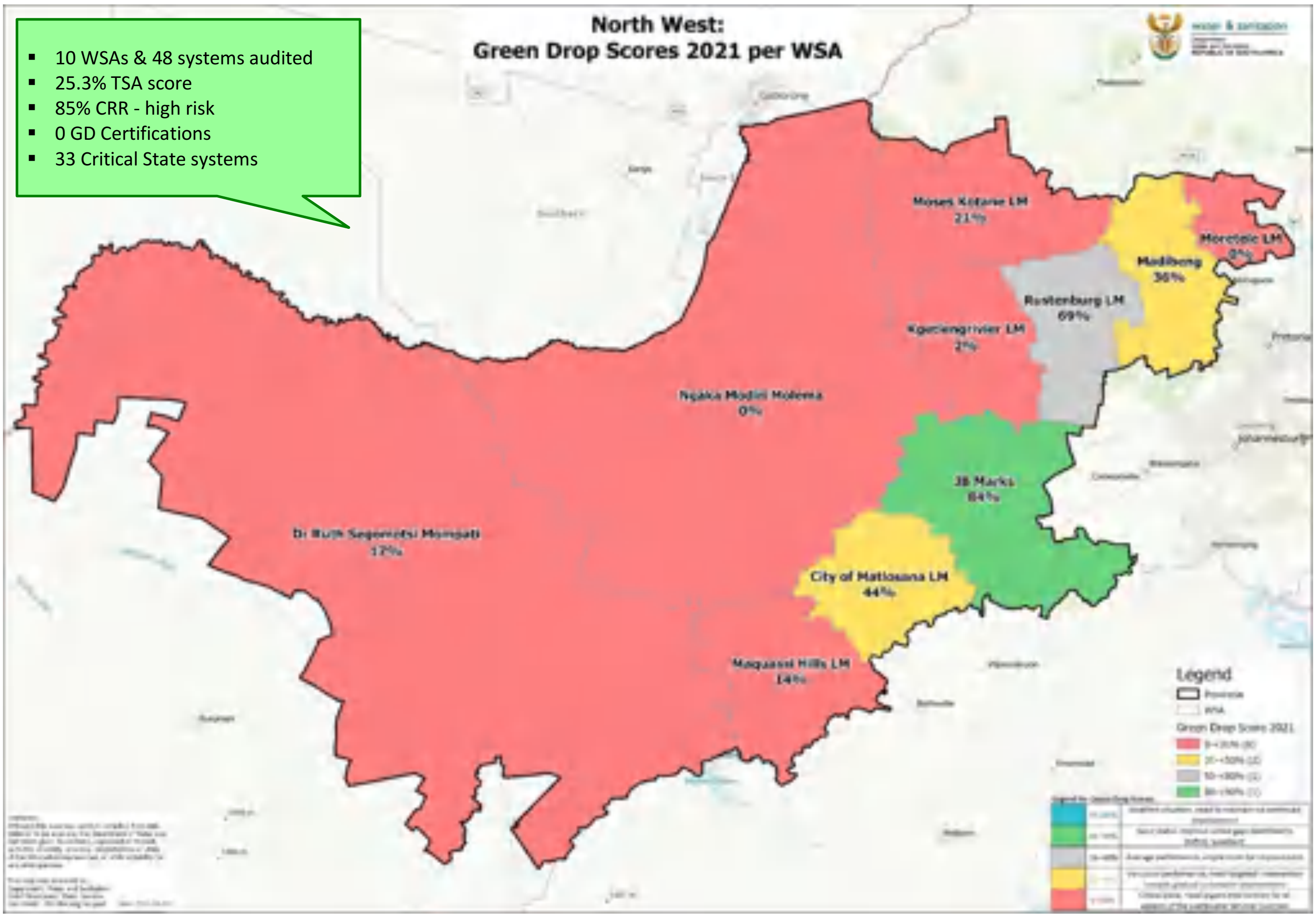
Technical Site Assessment: **Delmas WWTW 57%**

Dudu Sifunda and her A-team at Nkomazi Mhlatikop WWTW. A focussed team, with new laboratory and dynamic young scientists.

Despite difficult circumstances, the Mbombela team strives to produce quality effluent at the Witriver WWTWs, supported by EPWP staff to clean the terrain.

Mbombela and Silulumanzi getting ready for their audit. Jo-Anne, Tom, Elize and team – well done on excellent follow-through after the audit.

10. NORTH WEST PROVINCE: MUNICIPAL WASTEWATER MANAGEMENT PERFORMANCE



Provincial Synopsis

An audit attendance record of 100% affirms the North West's commitment to the Green Drop national incentive-based regulatory programme.

The Regulator determined that no wastewater system scored the minimum of 90% when measured against the Green Drop standards for the audited period and thus no WSA qualified for the prestigious Green Drop Certification. This is consistent with the outcomes of the 2013 Green Drop process. The audit nonetheless established an accurate, current baseline from where improvement can be driven, and excellence be incentivised.

Four (4) of the 10 WSAs improved on their 2013 scores, namely Rustenburg, Matlosana, Moses Kotane and Maquassi Hills. Except for JB Marks, the remaining 5 WSAs regressed to lower Green Drop scores compared to 2013 baselines. JB Marks is the best performing WSA in the North West Province. Rustenburg is the 2nd best performer in the province and improved on the Green Drop score of 63% in 2013 to 69% in 2021. Unfortunately, 33 systems were identified to be in a critical state, compared to 21 systems in 2013. The majority of these systems are managed by Dr Ruth Mompati DM (8 of 10 systems) and Ngaka Modiri Molema (all 13 systems).

The full range of Green Drop KPAs require attention from all the municipalities, with some exceptions from JB Marks and Rustenburg.

The provincial Risk Ratio for treatment plants regressed significantly from 73% in 2013 to 85% in 2021. The most prominent risks were observed at a treatment level, and pointed to WWTWs that exceeded their design capacity, lack of inflow monitoring, dysfunctional processes and equipment (especially disinfection), as well as effluent and sludge non-compliance or lack of monitoring.

The Regulator is hopeful that the 2021 audits will set a baseline from where a positive trajectory for wastewater services and improved performance will follow. Municipalities are encouraged to start their preparation for the 2023 Green Drop audit. The 2021 Green Drop status for WSAs in the North West Province are summarised in Table 153.

Table 153 - 2021 Green Drop Summary

WSA Name	2013 GD Score (%)	2021 GD Score (%)	2021 GD Certified ≥90%	2021 GD Contenders (89%)	2021 Critical State (<31%)
JB Marks		84			
Rustenburg	63	69↑			
Matlosana	40	44↑			
Madibeng	44	36↓			Mothotlung, Eagles Landing, Sunway
Moses Kotane	16	21↑			Both plants (2)
Dr Ruth Mompati	22	17↓			8 of 10 plants
Maquassi Hills	2	14↑			Leeudoringstad, Wolmaranstad
Kgetlengriver	22	2↓			All 4 plants
Moretele	28	0↓			Swartdam
Ngaka Modiri Molema	18	0↓			All 13 plants
Tlokwe	93	Now JB Marks			
Ventersdorp	32				
Totals	-	-	0	0	33

The Department of Water and Sanitation acknowledges the excellence in wastewater management achieved for the Green Drop Audit year of 2021.

No Green Drop Certificates are awarded to WSAs in the Province

Background to North West Wastewater Infrastructure

There are 10 WSAs, delivering wastewater services through a sewer network comprising of 48 WWTWs, 174 network pump stations and 2,163 km outfall and main sewer pipelines. The sewer network excludes the pipelines data for 7 municipalities who could not provide the information. There is a total installed treatment capacity of 335 Ml/d, with the majority of this capacity residing in 29 medium to macro-sized treatment plants.

Table 154 - Summary of WWTW capacity and flow distribution according to plant sizes

	Micro Size Plants	Small Size Plants	Medium Size Plants	Large Size Plants	Macro Size Plants	Unknown (NI)*	Total
	<0.5 Ml/day	0.5-2 Ml/day	2-10 Ml/day	10-25 Ml/day	>25 Ml/day		
No. of WWTW	1 (2%)	13 (27%)	20 (42%)	6 (13%)	3 (6%)	5 (10%)	48
Total Design Capacity (Ml/day)	0.1	13.05	83.35	115.30	123.00	5	334.8
Total Daily Inflow (Ml/day)	0	1.80	17.87	26.00	86.94	35	132.6
Use of Design Capacity (%)	0%	14%	21%	23%	71%	-	40%

** "Unknown" means the number of WWTWs with NI (No Information) on design capacity or daily inflow*

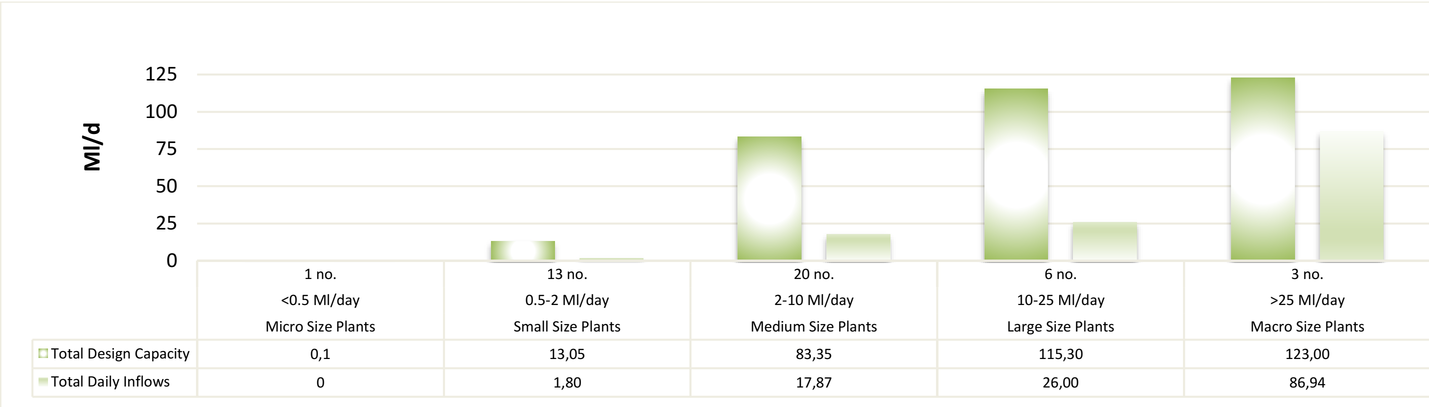


Figure 142 - Design capacities and operational inflow to micro to large sized WWTWs (a) and macro sized WWTWs

Based on the current operational flow of 133 Ml/d, the treatment facilities are operating at 40% of their design capacity. The four largest flow contributors are Matlosana, Ngaka Modiri Molema, Rustenburg, and JB Marks, however, the inflows for the former two municipalities skew the data set with exceptionally low inflow volumes (2 of a total of 15 systems measure their inflow).

Given the current capacity, this implies that there is 60% spare capacity to meet the medium-term demand. It must however be noted that inflow is not monitored in 35 systems (73%) and as a result the spare capacity could be substantially less than the 60%. Diagnostic #3 unpacks these statistics in more detail. This spare capacity would also be compromised at systems where some of the infrastructure or treatment modules are non-operational or dysfunctional. The VROOM Cost Diagnostic #7 provides more detail on the refurbishment requirements to restore such capacity and functionality.

The audit data shows that 3 systems are hydraulically overloaded. This figure could theoretically be higher, given that there are 35 systems where inflow monitoring is not taking place. The hydraulically overloaded systems in each of the WSAs is as follows:

- Kgetlengriver: 1 of 4 systems (Koster AS – 3 remaining plants NI for inflows)
- Rustenburg: 2 of 4 systems (Rustenburg, Monakato).

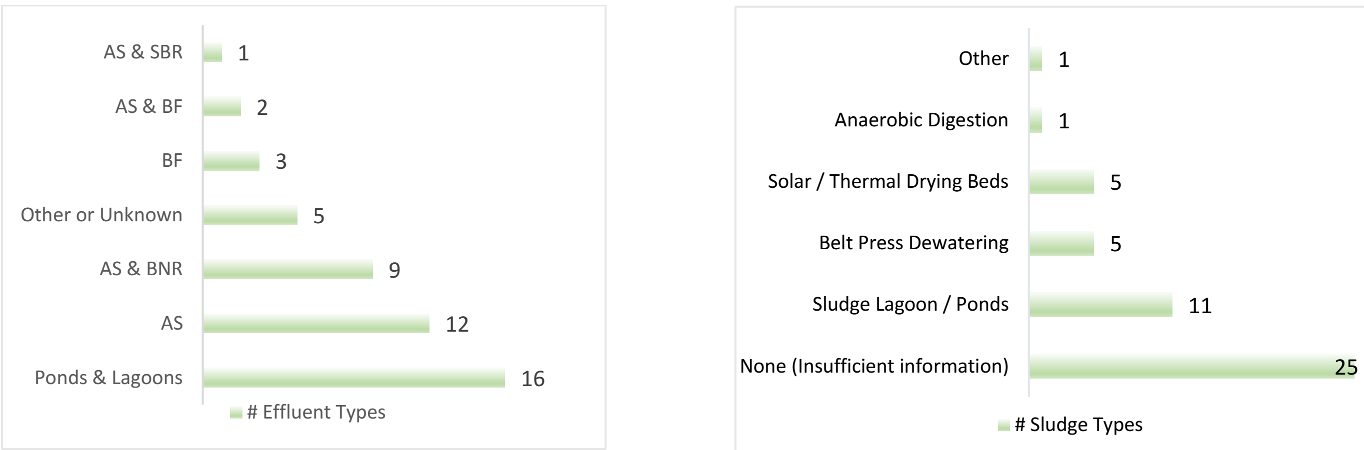


Figure 143 - Treatment technologies for wastewater effluent (a) and sludge (b)

The predominant treatment technologies employed at WWTWs comprise of ponds/lagoons, activated sludge and variations and biofilters for effluent treatment and sludge lagoons/ponds for sludge treatment. The next audit will need to verify sludge treatment technologies, as insufficient information ("Other") is observed in this area.

Table 155 - Summary of Collection Network Pump Stations and Sewer Pipelines

WSA Name	# WWTWs	Pump Stations (#)	Sewer Pipelines (km)
JB Marks	2	56	1,129
Dr Ruth S Mompati	10	15	NI
Kgetlengriver	4	3	NI
Madibeng	6	32	NI
Moretele	1	0	NI
Moses Kotane	2	1	NI
Ngaka Modiri Molema	13	38	NI
Rustenburg	4	3	1,003
Maquassi Hills	2	3	NI
Matlosana	4	23	31
Totals	**48**	**174**	**2,163**

The sewer network consists of sewer mains and pump stations as summarised in Table 155. JB Marks and Rustenburg own and manage the bulk of the sewer collector infrastructure, approximately 1,129 km and 1,003 km; and 56 and 3 sewer pump stations, respectively. Seven of the ten municipalities could not provide information on sewer pipelines, indicating limitations in asset management information.

Provincial Green Drop Analysis

The 100% response from the 10 municipalities audited during the 2021 Green Drop process demonstrates a firm commitment to wastewater services in the province. Local Government reforms resulted in the merging of Ventersdorp LM and Tlokwe LM into JB Marks LM. Therefore 10 WSAs were audited in 2021 compared to the 11 WSAs in 2013.

Table 156 - Green Drop Comparative Analysis from 2009 to 2021

GREEN DROP COMPARATIVE ANALYSIS					
Performance Category	2009	2011	2013	2021	Performance trend 2013 and 2021
Incentive-based indicators					
Municipalities assessed (#)	8 (78%)	10 (100%)	11 (100%)	10 (100%)	→
Wastewater systems assessed (#)	17	35	37	48	↑
Average Green Drop score	33%	29%	29%	18%	↓
Green Drop scores ≥50% (#)	5/17 (29%)	6/35 (17%)	6/37 (16%)	7/48 (15%)	↓
Green Drop scores <50% (#)	12/17 (71%)	29/35 (83%)	31/37 (84%)	41/48 (85%)	↓
Green Drop Certifications (#)	0	1	1	0	↓
Technical Site Inspection Score (%)	NA	45.3%	46.7%	25.3%	↓

NA = Not Applied NI = No Information *↑= improvement, ↓= regress, →= no change*

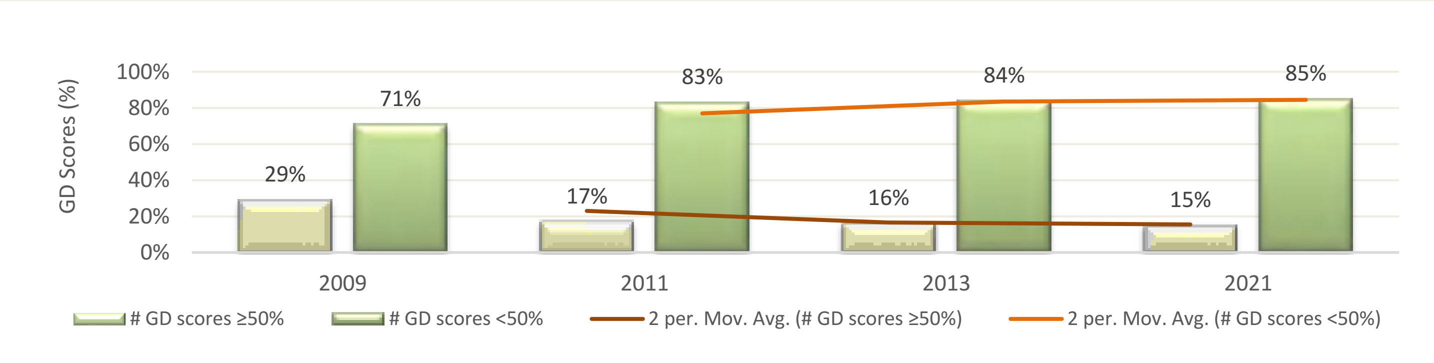


Figure 144 - Green Drop trend analysis over the period 2009 to 2021, indicating the percentage GD scores above and below 50%

The trend analysis indicates that:

- The number of WSAs audited has increased from 8 systems in 2009, when the first assessments were undertaken, to 11 systems in 2013 but reduced to 10 systems in 2021
- A downward trend is observed in the GD average scores from 2009 to 2021

- Similarly, a downward trend is observed for the percentage of systems with GD scores of ≥50% from 29% in 2009 to 15% in 2021
- The Technical Site Assessment score decreased from 47% in 2013 to 25% in 2021
- This trend was balanced by the number of systems with GD score of ≤50% increasing from 12 (71%) in 2009 to 31 (84%) in 2013 to 41 (85%) in 2021
- The number of Green Drop Certifications remained at 0 awards for 2013 and 2021
- An overall performance trend from 2013 to 2021 signals the need for repeat/regular audits to ensure continued improvement. There are indications that performance has declined in the absence of the consistent regulatory engagement of the GD audits.

The analysis for the period 2009, 2011, 2013 and 2021, indicates that most of the system scores are in the 0-<31% (Critical state) space, with the 31-<50% (Poor Performance) being the next largest category.

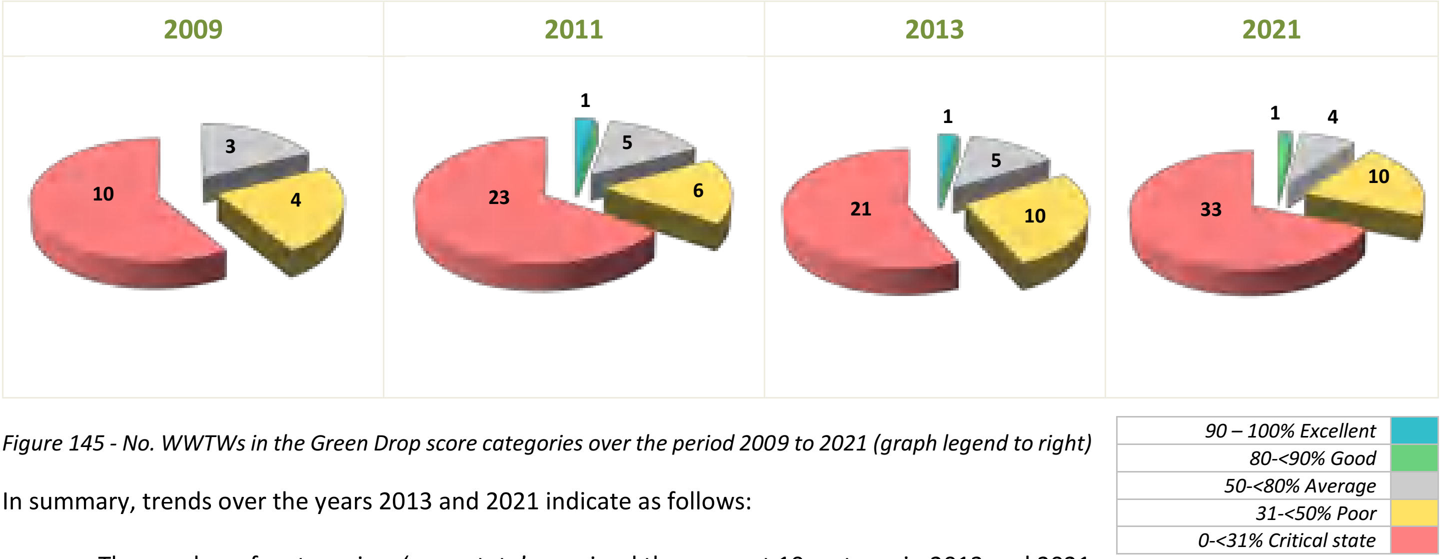


Figure 145 - No. WWTWs in the Green Drop score categories over the period 2009 to 2021 (graph legend to right)

In summary, trends over the years 2013 and 2021 indicate as follows:

- The number of systems in a 'poor state' remained the same at 10 systems in 2013 and 2021
- The most concerning observation is that the systems in a 'critical state' increased from 21 in 2013 to 33 in 2021
- The number of systems in the 'excellent and good state' decreased slightly from 6 systems in 2013 to 5 systems in 2021.

Provincial Risk Analysis

Green Drop risk analysis (CRR) focuses specifically on the treatment function. It considers 4 risk indicators, i.e. design capacity, operational flow, technical capacity, and effluent quality. The CRR values do not factor risks associated with sanitation or wastewater network and collector systems.

Table 157 - Cumulative Risk Comparative Analysis from 2009 to 2021

CUMULATIVE RISK COMPARATIVE ANALYSIS					
Performance Category	**2009**	**2011**	**2013**	**2021**	**Performance Trend 2013 to 2021**
Highest CRR	28	25	22	22	→
Average CRR	16.5	16.3	13.7	15.9	↓
Lowest CRR	6	9	8	5	↑
Design Rating (A)	1.7	1.5	1.5	1.4	↑
Capacity Exceedance Rating (B)	3.7	4.0	3.5	4.4	↓
Effluent Failure Rating (C)	7.0	7.5	5.8	6.9	↓
Technical Skills Rating (D)	3.3	2.9	2.9	3.0	↓
CRR% Deviation	**78.3**	**79.9**	**72.5**	**85.0**	↓

↑= improvement, ↓= regress, →= no change

The concept of risk management is not embedded within the municipalities. Table 157 indicates a regression in the CRR% deviation from 2013 to 2021, which suggests little change in the design capacity rating (A), increase in the capacity exceedance rating (B) mainly due to the NI status of inflows into so many of the systems, slight regress in the technical skills rating (D) and an increase in the final effluent failure rating (E).

Individual systems, however, show higher deviations and indicate specific risk categories, as highlighted under "***Regulator's Comment***". The CRR analysis in context of the Green Drop results suggests that further improvements should focus on 1) capacity exceedance at plants which are hydraulically overloaded or approaching its design lifespan, 2) effluent quality failures, especially for microbiological compliance, and 3) strengthening of technical skills and operational competency, especially related to sludge management.

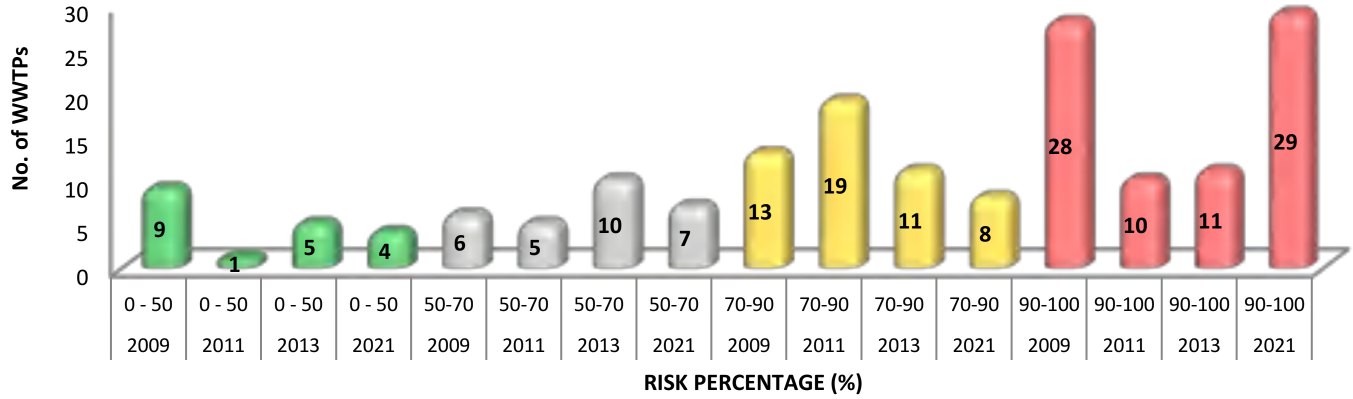


Figure 146 - a) WWTW Risk distribution and trends from 2009 to 2021; b) Colour legend

90 – 100% Critical risk WWTPs	
70 - <90% High risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low risk WWTPs	

Trend analysis of the CRR ratings for the period 2009 to 2021 indicates that:

- The most prominent movement in risk can be seen in 2009 and in 2021 with some minor movement between 2011 and 2013 and a regress in 2021.
- The CRR remained fairly constant during 2011 to 2013, at a time when W_2RAPs and risk-mitigation strategies were being embedded in WSAs and lost momentum in the period between 2013 to 2021
- The 2021 assessment cycle highlighted regressive shifts in the low risk from 5 to 4, medium risk from 10 to 7, high risk from 11 to 8, and a sharp increase in the critical risk from 11 to 29.

Regulatory Enforcement

Wastewater systems which failed to achieve the minimum Green Drop target of 31%, are placed under regulatory focus. The Regulator requires these municipalities to submit a detailed corrective action plan within 60 days from publishing of this report. Seven (7) municipalities and 33 wastewater systems that received Green Drop scores below 31%, are to be placed under **regulatory surveillance**, in accordance with the Water Services Act (108 0f 1997). In addition, these municipalities will be compelled to ringfence water services grant allocation to rectify/restore wastewater collection and treatment shortcomings identified in this report.

Table 158 - WWTWs with <31% Green Drop scores

WSA Name	2021 Municipal GD Score	WWTWs with <31% score
Madibeng LM	36%	Mothotlung, Eagles Landing, Sunway
Moses Kotane LM	21%	Both plants (2)
Dr Ruth Mompati DM	17%	8 of 10 plants
Maquassi Hills LM	14%	Leeudoringstad, Wolmaranstad
Kgetlengriver LM	2%	All 4 plants
Moretele LM	0%	Swartdam
Ngaka Modiri Molema DM	0%	All 13 plants

The following municipalities and their associated wastewater treatment plants are in high CRR risk positions, which means that some or all the risk indicators are in a precarious state, i.e. operational flow, technical capacity, and effluent quality. WWTWs in high risk and critical risk positions pose a serious risk to public health and the environment. The following municipalities will be required to assess their risk contributors and develop corrective measures to mitigate these risks.

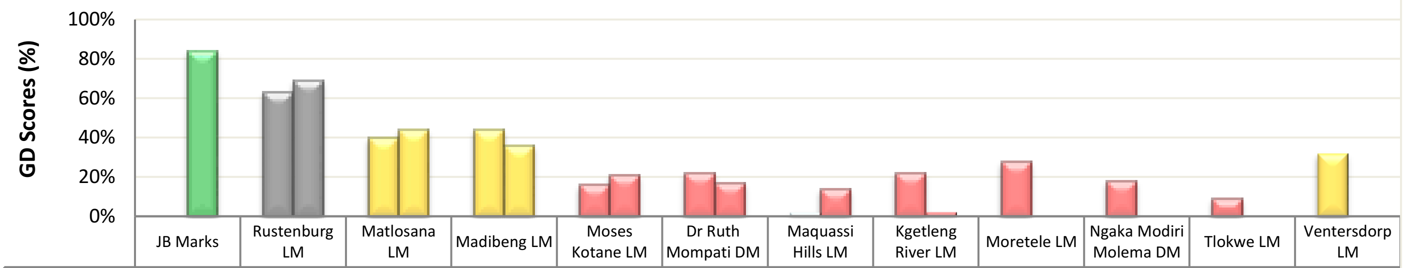
Table 159 - %CRR/CRR$_{max}$ scores and WWTWs in critical and high-risk space

WSA Name	2021 Average CRR/CRRmax % deviation	WWTWs in critical and high-risk space	
		Critical Risk (90-100%CRR)	**High Risk (70-<90%CRR)**
Rustenburg LM	**57.2%**		Rustenburg
Matlosana LM	**76.1%**		Klerksdorp, Orkney, Stilfontein
Madibeng LM	**78.1%**	Mothotlung, Eagles Landing, Sunway	Lethalbile
Maquassi Hills LM	**89.6%**	Wolmaranstad	Leeudoringstad
Dr. Ruth S Mompati DM	**89.8%**	8 of 10 plants	
Kgetlengriver LM	**92.6%**	Koster ponds, Mazista, Swartruggens	Koster AS
Moses Kotane LM	**94.1%**	Madikwe	Mogwase
Ngaka Modiri Molema DM	**97.4%**	12 of 13 plants	
Moretele LM	**100.0%**	Swartdam	

Good practice risk management requires that the W$_2$RAPs are informed by meaningful Process and Condition Assessments, supported by zealous implementation of corrective measures and ongoing monitoring of risk movement. JB Marks is commended for maintaining all their treatment facilities in low and moderate risk positions - an exemplary status.

Performance Barometer

The **Green Drop Performance Barometer** presents the individual Municipal Green Drop Scores, which essentially reflects the level of mastery that a municipality has achieved in terms of its overall municipal wastewater services business. The bar chart below indicates the GD scores for 2013 in comparison to 2021, from highest to lowest performing WSI. As a general trend, almost half of the municipalities maintained their performance status with some slight improvement and some slight regression, except for~~,~~ Maquassi Hills, Kgetlengriver, Moretele and Ngaka Modiri Molema.



	JB Marks	Rustenburg LM	Matlosana LM	Madibeng LM	Moses Kotane LM	Dr Ruth Mompati DM	Maquassi Hills LM	Kgetleng River LM	Moretele LM	Ngaka Modiri Molema DM	Tlokwe LM	Ventersdorp LM
2013 GD Score	0%	63%	40%	44%	16%	22%	2%	22%	28%	18%	9%	32%
2021 GD Score	84%	69%	44%	36%	21%	17%	14%	2%	0%	0%	0%	0%

Figure 147 - a) Green Drop scores 2013 (bar left) and 2021 (bar right), with colour legend inserted

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	

The **Cumulative Risk Log** expresses the level of risk that a municipality poses in respect of its wastewater treatment facility. It is based on the ***individual Cumulative Risk Ratios***. Figure 148 presents the cumulative risks in ascending order – with the low-risk municipalities on the left and critical risk municipalities to the far right. JB Marks is the only municipality that resides in low-risk space, whilst Kgetlengriver, Moses Kotane, Ngaka Modiri and Moretele in critical risk positions.

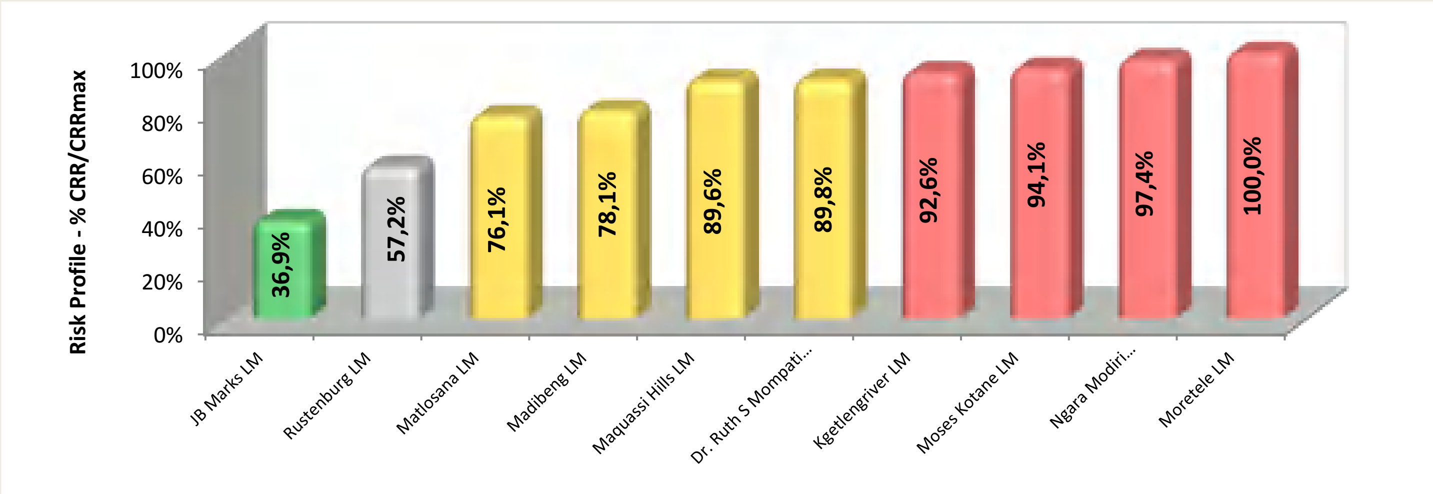


Figure 148 - a) %CRR/CRRmax Risk Performance Log 2021; b) Colour legend

90 – 100% Critical risk WWTPs	
70 - <90% High risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low risk WWTPs	

Provincial Best Performers

JB Marks LM is the **BEST PERFORMING** municipality in the Province based on the following record of excellence:

- ✓ 84% Municipal Green Drop Score
- ✓ 2013 Green Drop Score for Tlokwe LM of 93% and 32% for Ventersdorp LM
- ✓ Improvement on the CRR risk profile from 40.7% in 2013 to 36.9% in 2021
- ✓ Both plants in low-risk positions
- ✓ Technical Site Assessment score of 57% (Ventersdorp)

Rustenburg LM received the 2nd highest Green Drop score in the Province:

- ✓ 69% Municipal Green Drop Score
- ✓ 75% of plants (3 of 4) in low & medium risk positions
- ✓ TSA score of 51% (Boitekong)

KPA Diagnostics

The Green Drop audit process collects a vast amount of data that yield valuable insight on the state of the wastewater sector in each Province. These insights have been captured into 7 thematic areas or ‘Diagnostics’, as discussed below.

Table 160 - Summary of the key diagnostic themes and reference to the respective Green Drop KPAs

Diagnostic #	Diagnostic Description	Diagnostic Reference
1	**Green Drop KPA Analysis**	KPAs A-E
2	**Technical Competence**	KPA A, B & Bonus
3	**Treatment Capacity**	KPA D
4	**Wastewater Monitoring and Compliance**	KPA B & D & Bonus
5	**Energy Efficiency**	KPA C & Bonus
6	**Technical Site Assessments**	TSA
7	**Operation, Maintenance and Refurbishment of Assets**	KPA C, D & Bonus

Diagnostic 1: Green Drop KPA Analysis

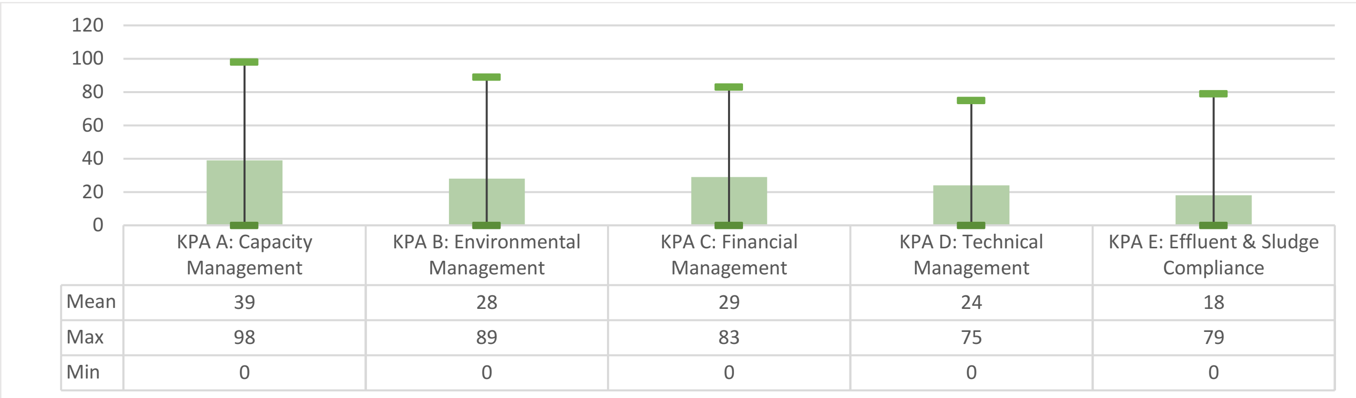
Aim: Analysis of technical skills, environmental plans, financial management, technical capacity, and regulatory compliance provides insight into the strengths and weaknesses of wastewater management in WSAs in the province. These insights in turn, may inform appropriate interventions and strategies to improve the individual KPAs and ultimately, collective KPA performance.

Findings: The WSAs are characterised by a highly variable KPA profile. A good KPA profile typically has a high mean GD score, coupled with a low Standard Deviation (SD) between the outer parameters (min and max). Similarly, a well performing system is one which has most/all systems in the >80% bracket and no systems in the <31% bracket.

Table 161 - Green Drop scores KPA profiles (graph legend included)

KPA #	Key Performance Area	*Weight*	Minimum GD Score (%)	Maximum GD Score (%)	Mean GD Score (%)	# Systems <31%	# Systems >80%
A	Capacity Management	*15%*	0%	98%	39%	31 (65%)	4 (8%)
B	Environmental Management	*15%*	0%	89%	28%	33 (69%)	2 (4%)
C	Financial Management	*20%*	0%	83%	29%	31 (65%)	1 (2%)
D	Technical Management	*20%*	0%	75%	24%	38 (79%)	0 (0%)
E	Effluent and Sludge Compliance	*30%*	0%	79%	18%	40 (83%)	0 (0%)

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	



Note: The High and low lines represent the Min and Max range, and the shaded green represents the Mean (arithmetical average)

Figure 149 - Maximum, minimum, and mean Green Drop KPA scores

The KPA distribution indicates as follows:

- Capacity Management (KPA A) depicts the highest mean of 39%, the highest maximum of 98%, and the highest Standard Deviation (SD) of 98%. These results indicate some strengths pertaining to the registration of WWTWs, maintenance plans and records, maintenance teams, and registered, qualified staff (process controllers, supervisors, scientists, technicians, engineers)
- Effluent and Sludge Quality Compliance (KPA E) received the lowest mean of 18%, indicating a deficiency in data management, IRIS upload, effluent quality compliance, and sludge quality compliance
- This was followed by the Technical Management (KPA D) that received the next lowest mean of 24%, indicating a vulnerability in basic design information, inflow, outflow, meter reading credibility, process and condition assessments, site inspection reports, asset registers, asset values, bylaws and enforcement
- The KPA mean follows an almost linear decreasing trend from KPA A to E.

The GD bracket performance distribution reiterates the above findings:

- ***KPA Score >80%:*** Capacity Management (KPA A) is the best performing KPA with 8% of systems achieving >80%, followed by Environmental Management (KPA B) with 4%. Technical Management (KPA D) and Effluent and Sludge Compliance were the worst performing KPAs with 0% achieving >80%
- ***KPA Score <31%:*** Effluent & Sludge Compliance (KPA E) represents the worst performing KPA with 83% of systems lying in the 0-31% bracket, followed by Technical Management (KPA D) with 79% & Environmental Management (KPA B) with 69%.

Diagnostic 2: Technical Competence

Aim: This focus area assesses the human resources (technical) capacity to manage wastewater systems. Theory suggests a correlation between human resources capacity (sufficient number of appropriately qualified staff) and a municipality's performance and operational capability. It is projected that high HR capacity would translate to compliant wastewater services and protection of scarce water resources.

Findings: According to regulations, wastewater plants are classified as Class A, B, C, D or E plants. Similarly, Process Controllers and Plant Supervisors are registered as Class I, II, III, IV, V or VI operators. Higher classed plants require a higher level of operators due to their complexity and strict regulatory standards. Technical compliance of PCs and Supervisors is determined against Green Drop standards, as defined by Reg. 2834 and draft Reg. 813 of the National Water Act 1998.

Note: "Compliant staff" means qualified and registered staff that meets the GD standard for a particular Class Works. "Staff shortfall" means staff that do not meet the GD standard for a particular Class of works (+1 for a shift) and/or staffing gaps exist at the respective WWTWs.

Table 162 - No. compliant versus shortfall in Supervisor and Process Controller staff

WSA Name	# WWTWs	# Compliant staff		# Shortfall staff		Ratio*	WSA 2021 GD Score (%)
		Supervisor	PCs	Supervisor	PCs		
JB Marks	2	5	8	0	0	6.5	**84%**
Dr Ruth S Mompati	10	1	3	8	19	0.4	**17%**
Kgetlengriver	4	0	0	4	12	0	**1%**
Madibeng	6	3	16	3	6	3.2	**35%**
Moretele	1	0	0	1	2	0	**0%**
Moses Kotane	2	0	0	2	6	0	**21%**
Ngaka Modiri Molema	13	0	0	13	27	0	**0%**
Rustenburg	4	4	10	0	5	3.5	**69%**
Maquassi Hills	2	2	0	0	8	1	**14%**
Matlosana	4	4	6	1	6	2.5	**44%**
NW Totals	**48**	**19**	**43**	**32**	**91**		

** The single number Ratio is derived from the number of qualified staff divided by the number of WWTWs operated by this number of staff. E.g., for JB Marks, 13 qualified staff is available to support 2 WWTWs, thus 13/2 = 6.5 ratio*

Competent human resources are a vital enabler to ensure efficient and sustainable management of treatment processes and infrastructure. For North West, the operational competencies are not on par with regulatory expectations, as illustrated by the high shortfalls against the Green Drop standards.

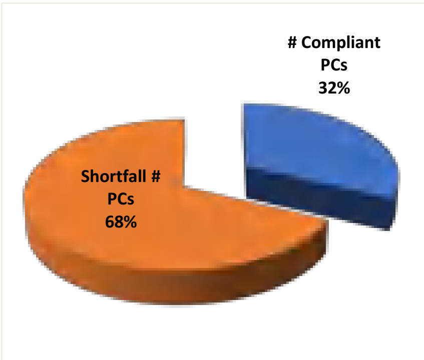


Figure 150 - Schematic illustration of compliant versus non-compliant Supervisors (a) and Process Controllers (b)

Plant Supervisors: The pie charts indicate that 37% (19) of Plant Supervisors complies with the Green Drop standard, with zero shortfall for JB Marks, Rustenburg and Maquassi Hills. A 63% (32) shortfall is noted for Supervisors overall, with the highest shortfall seen at Ngaka Modiri Molema (13), Dr Ruth S Mompati (8) and Kgetlengriver (4).

Process Controllers: Similarly, 32% (43) of the PC staff is compliant for North West, with a zero shortfall in JB Marks only. There is a 68% (91) shortfall in PCs with the highest shortfall for Ngaka Modiri Molema (27), Dr Ruth S Mompati (19), Kgetlengriver (12) and Maquassi Hills (8).

Green Drop standards require of Class A and B plants to employ dedicated Supervisors and Process Controllers per shift per works, whereas Class C to E Works may consider sharing of staff across works. Shifts have been introduced to ensure optimal operations while addressing security risks, particularly as it relates to vandalism. Telemetry also reduces the requirement for on-site staff during night shifts, but these relaxations will have to be done within the DWS regulatory guidelines.

Ratio analysis of the # WWTW: # Qualified Staff allows conversion to a decimal number, e.g. 2:13 ~6.5, which means that 1 WWTW have 6.5 qualified staff. It is expected that a close correlation would exist between the competence of an operational team and the performance of a treatment plant, as measured by the GD score. The data indicates as follows:

- 3 of the 10 municipalities have good Supervisor/Process Controller ratios in place (1:3 ~3) – JB Marks, Rustenburg and Madibeng followed very closely by Matlosana
- Only 3 municipalities have a qualified Supervisor per plant – JB Marks, Rustenburg and Maquassi Hills
- All municipalities have shortfalls in qualified Process Controllers, except for JB Marks.

The results from the ratio analysis indicate:

- Highest positive ratios were determined for: JB Marks (6.5), Rustenburg (3.5) and Madibeng (3.2)
- Lower positive ratios were determined for: Matlosana (2.5) and Maquassi Hills (1)
- Zero ratios were determined for: Kgetlengriver, Moretele, Moses Kotane and Ngaka Modiri Molema.

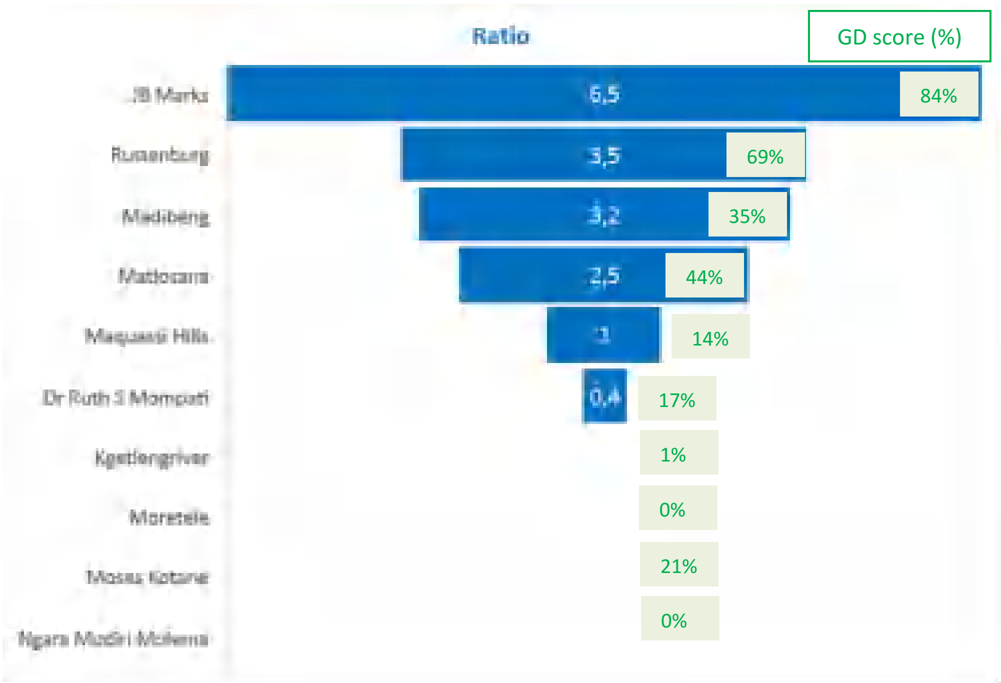


Figure 151 - Ratio of compliant operational staff to no. of WWTWs and Comparison of Ratios with GD scores

The comparative bar chart indicates a relatively high correlation between municipalities with high ratios and higher GD scores with JB Marks (84%), Rustenburg (69%), Madibeng (35%) and Matlosana (44%). Whereas lower ratios are associated with lower GD scores for all the remaining systems that range with GD score from 0% to 21%. However, an exact correlation between municipal ratios and GD scores is not a given, as can be seen by Moses Kotane which has a zero ratio and GD score of 21%.

In addition to operational capacity (above), good management practice also requires access to qualified engineers, technicians, technologists, scientists, and maintenance capability. Such competencies could reside in-house or accessible through term contracts and external specialists.

Table 163 - Summary of the maintenance capacity and no. of qualified and shortfall of Engineering, Technical and Scientific staff

WSA Name	# WWTW	Maintenance Arrangement	Qualified Technical Staff (#)				Technical Shortfall (#)	Qualified Scientists (#)	Scientists Shortfall (#)	Ratio*	WSA 2021 GD Score (%)
			Engineers	Technologists	Technicians	Total					
JB Marks	2	Internal + Specific Outsourcing	2	2	1	5	0	1	0	2:5 ~2.5	84%

WSA Name	# WWTW	Maintenance Arrangement	Qualified Technical Staff (#)				Technical Shortfall (#)	Qualified Scientists (#)	Scientists Shortfall (#)	Ratio*	WSA 2021 GD Score (%)
			Engineers	Technologists	Technicians	Total					
Dr Ruth S Mompati	10	No capacity + Inadequate capacity + Internal team (only)	2	1	1	4	1	1	1	10:4 ~0.4	**17%**
Kgetlengriver	4	Internal + Specific Outsourcing	0	0	0	0	2	0	1	4:0 ~0	**1%**
Madibeng	6	Internal + Term Contract & Internal team (only)	1	0	2	3	0	0	1	6:3 ~0.5	**35%**
Moretele	1	Inadequate Capacity	0	0	0	0	2	0	1	1:0 ~0	**0%**
Moses Kotane	2	No Capacity	0	0	0	0	2	1	0	2:0 ~0	**21%**
Ngaka Modiri Molema	13	No capacity + Inadequate capacity + Internal team (only)	0	0	0	0	2	0	1	13:0 ~0	**0%**
Rustenburg	4	Internal + Term Contract & Internal + Specific Outsourcing	0	1	2	3	0	2	0	4:3 ~0.75	**69%**
Maquassi Hills	2	Internal Team (only) + Specific Outsourcing	0	0	0	0	2	0	1	2:0 ~0	**14%**
Matlosana	4	Internal + Term Contract & Internal team (only)	0	0	2	2	0	0	1	4:2 ~0.5	**44%**
Totals	**48**		**5**	**4**	**8**	**17**	**11**	**5**	**7**		

* *The **single number ratio** depicts the number of qualified technical staff divided by the number of WWTWs that have access to the staff. (E.g., JB Marks has 5 qualified staff, divided by 2 plants = 2.5 qualified staff per plant)*

Note 1: "Qualified Technical Staff" means staff appointed in positions to support wastewater services, and who has the required qualifications. "Technical Shortfall" is calculated based on a minimum requirement of at least 2 Engineers/Technologists/Technicians and at least one 1 Scientist per WSI.

Note 2: "Qualified Scientists" means professional registered scientists (SACNASP) appointed in positions to support wastewater services. "Scientists shortfall" means that the WSA does not have at least one qualified, SACNASP registered scientist in their employ or contracted.

In terms of maintenance capacity, the North West has a reasonable contingent of qualified maintenance staff for at least 5 of the 10 municipalities, with the current qualified maintenance staff forming a collective of in-house, contracted or outsourced personnel.

- 23 of 48 (48%) systems have internal maintenance teams supplemented with term contracts
- 8 systems (17%) have internal maintenance teams supplement with specific outsourced services
- 17 systems (35%) have no capacity or inadequate capacity

North West also presents a fair case for qualified professional technical staff. The data indicates as follows:

- A total of 22 qualified staff comprising of 5 Engineers, 4 Technologists, 8 Technicians (qualified) and 5 SACNASP registered Scientists are assigned to the municipalities
- A total shortfall of 18 persons is identified, consisting of 11 technical staff and 7 scientists
- All municipalities have some shortfall in qualified technical staff, with the exception of JB Marks, Madibeng, Rustenburg and Matlosana
- 50% of the WWTWs have access to credible laboratories that comply with Green Drop standards.

Figure 152 - Graphic illustration of the number and %: a) qualified engineering/technical staff; b) professional scientists; c) access to credible laboratory services that complies with Green Drop standards

Ratio analysis has been done to determine the number of qualified technical and scientific staff assigned per WWTW. It is expected that a higher ratio would correspond with well-performing and maintained wastewater systems, as represented by the GD score.

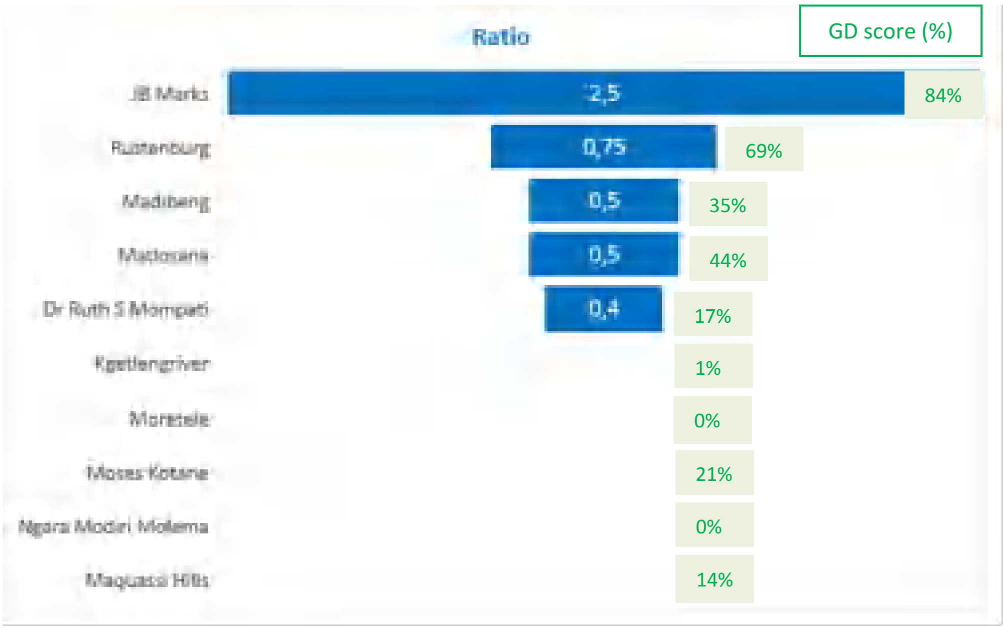


Figure 153 - Ratio of compliant technical staff to no. of WWTWs and Comparison of Ratios with GD scores

Again, the comparative bar chart indicates a relatively high correlation between municipalities with high ratios and higher GD scores with JB Marks (84%), Rustenburg (69%), Madibeng (35%) and Matlosana (44%). Whereas lower ratios are associated with lower GD scores for all the remaining systems. These results suggest that wastewater performance is sensitive towards engineering, technical and scientific staff, as well as a dependence on and correlation with the operational competencies.

One of the options to enhance operational capacity is through dedicated training programmes. The Green Drop audit incentivises training of operational staff over the 2-year period prior to the audit date. The results are summarised as follows:

Table 164 - No. of WWTWs with operational staff sent on training over the past 2 years and vice versa

WSA Name	Training for WWTW staff over past 2 years	No Training for WWTW staff over past 2 years
JB Marks	2	0
Dr Ruth S Mompati	2	8
Kgetlengriver	0	4
Madibeng	3	3
Moretele	0	1
Moses Kotane	0	2
Ngaka Modiri Molema	0	13
Rustenburg	3	1
Maquassi Hills	0	2
Matlosana	4	0
NW Totals	**14 (29%)**	**34 (71%)**

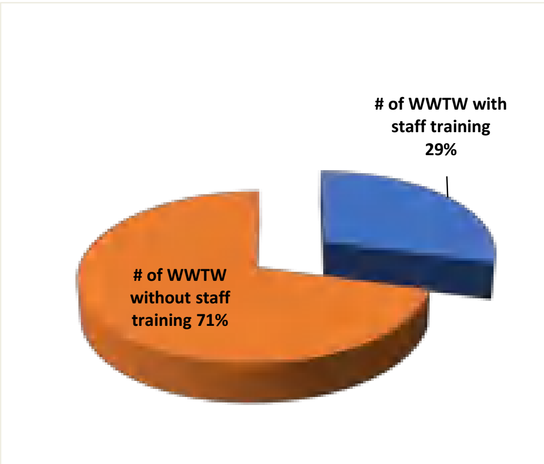


Figure 154 - % WWTWs that have trained operational staff over the past two years

The results indicate that 14 (of 48) WWTWs had operational staff attending training over the past 2 years, whilst 34 (of 48) systems had no training of operational staff. A concerted effort is required to elevate training of Supervisors and Process Controllers in process control. Training revolves to a large extent around chlorine handling and NQF, and needs to be expanded to beneficial uses, sludge treatment and energy efficiency.

Diagnostic 3: Treatment Capacity

Aim: A capable treatment plant requires adequate design capacity and functional equipment to operate optimally. If the plant capacity is exceeded by way of inflow volume or strength, the plant will not be capable to achieve its compliance standards. Capacity is typically exceeded when the demand exceeds the installed design capacity, or when processes or equipment is not operational or dysfunctional, or when the electrical supply cannot support the treatment infrastructure. This diagnostic assesses the status of plant capacity and operational flows to the plants.

Findings: Analysis of the hydraulic capacities and operational flows indicate a total design capacity of 335 Ml/d for the Province, with a total inflow of 133 Ml/day - considering that 35 systems are not measuring their inflows. Theoretically, this implies that 40% of the design capacity is used with 60% available to meet additional demand. However, the full 335 Ml/d day is not available as some infrastructure is dysfunctional, leaving 215 Ml/d available. The reduced capacity means that the Province may be closer to its total available capacity than the data suggests.

For WSAs in general, most plants are operating within their design capacities, except for some systems in Kgetlengriver and Rustenburg. Dr Ruth S Mompati, Kgetlengriver, Madibeng, Ngaka Modiri Molema and Matlosana report a low percentage use of their capacity (<50%) including no flow measurement for Moretele and Maquassi Hills. Treatment systems with low percentage use may have been affected by breakdown in sewer networks or pump stations whereby all sewage is not reaching the treatment and/or are not measuring all the inflows into their respective systems. The Green Drop audit requires a wastewater flow balance to identify and quantity possible losses from the network and/or ingress into the sewers. It was noted that the majority of municipalities do not have flow balances to track the wastewater pathway from consumer to treatment plant.

Table 165 - Summary of WWTWs design and available capacities, inflows, % use design capacities, and inflows measured per WWTW

WSA Name	# WWTWs	Design Capacity (Ml/d)	Available Capacity (Ml/d)	Operational Flow (Ml/d)	Variance (Ml/d)	% Use Design Capacity	Inflow measured #
JB Marks	2	48	48	43.1	4.9	90%	2
Dr Ruth S Mompati	10	24	5.2	2.4	21.6	10%	1
Kgetlengriver	4	5	4	2.4	2.6	48%	1
Madibeng	6	29.3	3.8	6.9	22.5	23%	2
Moretele	1	1.5	0	NI	1.5	NI	NI
Moses Kotane	2	4	0	3.4	0.6	85%	1
Ngaka Modiri Molema	13	69.4	0	10.0	59.4	14%	1
Rustenburg	4	68.9	68.9	58.7	10.2	85%	4
Maquassi Hills	2	8.5	8.5	NI	8.5	NI	NI
Matlosana	4	76.3	76.3	5.8	70.5	8%	1
Totals	**48**	**334.8**	**214.6**	**132.6**	**202.3**	**40%**	**13**

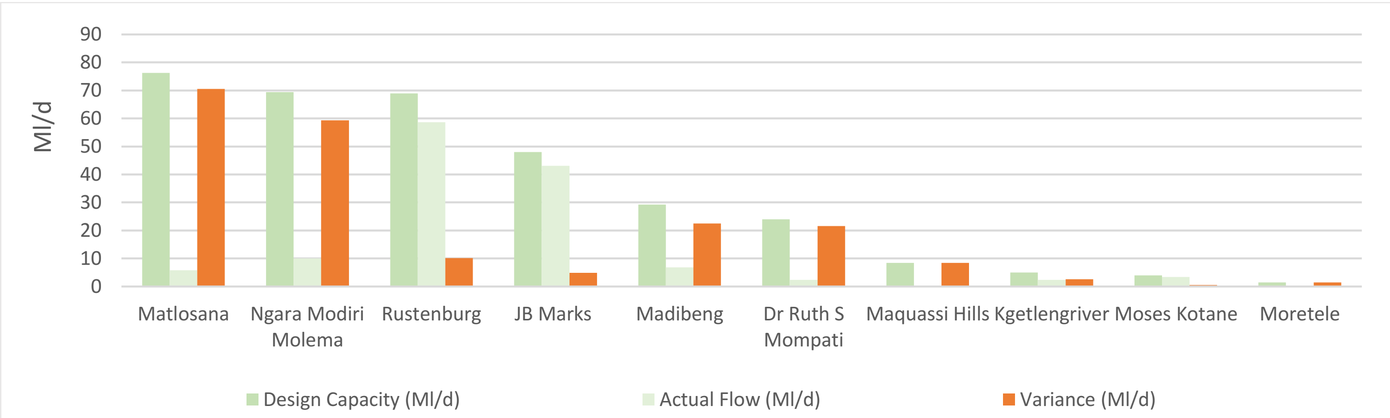


Figure 155 - WSA design capacity, actual flow, and variance in Ml/d

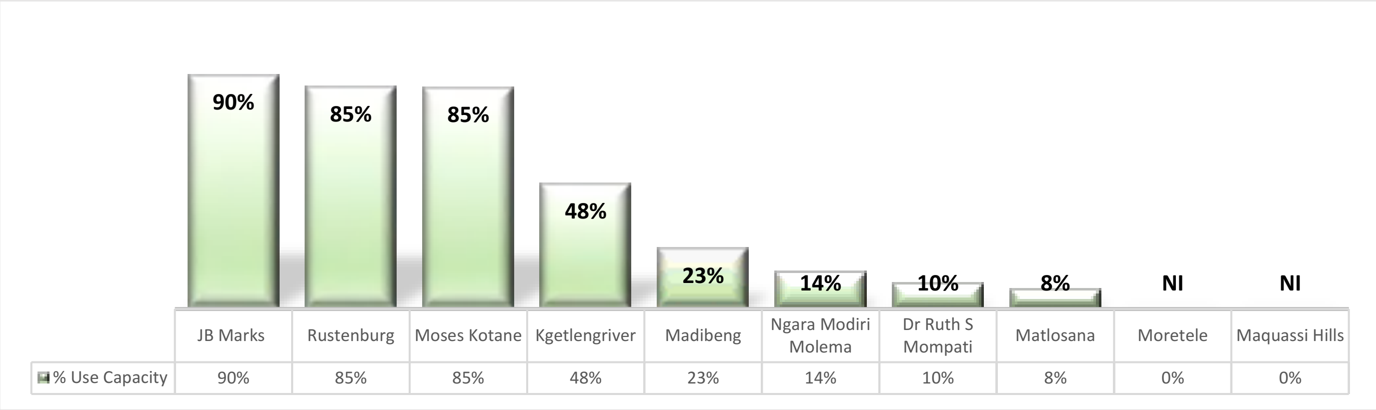


Figure 156 - WSA % use of installed design capacity

The audit data shows that 3 systems are hydraulically overloaded. This figure could theoretically be higher, given that there are 35 systems where inflow monitoring is not taking place. The capacity limitations may impede social and economic development in the drainage areas, if not addressed. The hydraulically overloaded systems in each of the WSAs is as follows:

- Kgetlengriver: 1 of 4 systems (Koster AS – 3 remaining plants NI for inflows)
- Rustenburg: 2 of 4 systems (Rustenburg, Monakato)

Water Use Authorisations mandate municipalities to install meters and monitor inflows, whilst GD requires WSAs to report inflows on IRIS and to calibrate meters annually.

The audit results indicate that 27% (13 of 48 systems) monitor their inflow. Dr Ruth S Mompati, Kgetlengriver, Madibeng, Moretele, Moses Kotane, Ngaka Modiri Molema, Maquassi Hills and Matlosana do not monitor their inflow. The majority of WSAs do not calibrate or verify their flow meters on an annual basis, thereby failing to meet good practice standards.

The province fares poorly in terms of monitoring inflow and outflows, i.e. hydraulic loads to the treatment works. In addition, few municipalities know their WWTWs organic design capacity and does not monitor organic loading to the works. This presents a gap that would impede on forward planning and system optimisation strategies.

Diagnostic 4: Wastewater Monitoring and Compliance

Aim: "*To measure is to know*" and "*To know is to manage*". The primary objective of a wastewater treatment plant is to produce final effluent and biosolids to a safe standard. This standard cannot be measured or managed if operational and compliance monitoring is lacking. This diagnostic assesses the monitoring status and final effluent compliance against each WWTW's mandatory standards.

Findings: For operational monitoring, a satisfactory level of 90% is applied as the benchmark, to give weight to the importance of monitoring. For compliance monitoring, the audit evaluates the sampling location, sampling frequency, final effluent quality, biomonitoring, heavy metals, and any specific condition that the DWS may have included in the water use license. Final effluent quality compliance is calculated against the mandatory limits as listed under "Authorisation Status". A >90% compliance figure confirms high quality final effluent, whereas a <30% indicate poor effluent quality. The enforcement measures are summarised in the last column of Table 167 and includes NWA Notices and Directives issued, criminal cases opened, and court interdicts granted during the period 1 April 2019 to 30 June 2021.

Table 166 - Summary of the WSA operational and compliance monitoring status

WSA Name	# WWTW	Operational monitoring (KPA B2)		Compliance monitoring (KPA B3)	
		Satisfactory [GD score ≥90%]	Not Satisfactory [GD score <90%]	Satisfactory [GD score ≥90%]	Not Satisfactory [GD score <90%]
JB Marks	2	1	1	2	0
Dr Ruth S Mompati	10	0	10	0	10
Kgetlengriver	4	0	4	0	4
Madibeng	6	0	6	0	6
Moretele	1	0	1	0	1
Moses Kotane	2	0	2	0	2
Ngaka Modiri Molema	13	0	13	0	13
Rustenburg	4	1	3	0	4
Maquassi Hills	2	0	2	0	2

WSA Name	# WWTW	Operational monitoring (KPA B2)		Compliance monitoring (KPA B3)	
		Satisfactory [GD score >90%]	Not Satisfactory [GD score <90%]	Satisfactory [GD score >90%]	Not Satisfactory [GD score <90%]
Matlosana	4	0	4	0	4
Totals	**48**	**2 (4%)**	**46 (96%)**	**2 (4%)**	**46 (96%)**

The performance recorded in Table 166 stems from performance data as measured against the Green Drop Standard expressed in KPAs B2 and B3. The data indicates that only 2 of 48 (4%) are on par with good practice for operational monitoring of raw sewage and the respective units responsible for the processing of effluent and sludge. JB Marks is doing well, whilst all the remaining municipalities do not meet the Green Drop standard.

Overall, an unsatisfactory sampling and analysis regime is observed for both operational and compliance monitoring. Compliance monitoring is a legal requirement and the only means to measure performance of a treatment facility, and WSAs must strive for 100% satisfaction. Operational monitoring is the cornerstone of day-to-day process adjustments and optimisation to ensure treatment is efficient and delivers quality effluent/sludge that meets design expectations. Sludge monitoring is essential as poor sludge handling is the root cause of many WWTWs failing to meet final effluent standards. The results indicate that the WSAs on average, are not achieving regulatory and industry standards.

Table 167 summarises the results of KPA E, which also carries the highest Green Drop score weighting. Note that averages shown as '0%' under Effluent Compliance include actual 0% compliance plus systems with no information or insufficient data.

Table 167 - Summary of authorisation status, effluent compliance status, and directives/notices issued

WSA Name	Effluent Compliance										Enforce-ment Measures*
	Authorisation Status	Microbiological Compliance (%)			Chemical Compliance (%)			Physical Compliance (%)			
		Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	
JB Marks	1 WUL; 1 GA	72%	1	11	91%	2	11	100 %	4	11	0
Dr Ruth S Mompati	2 WUL; 8 Not authorised	15%	1	8	17%	1	8	19%	2	8	2
Kgetlengriver	4 Unknown	0%	0	4	0%	0	4	0%	0	4	1
Madibeng	3 WUL; 3 Unknown	18%	0	4	25%	0	3	34%	0	3	3
Moretele	1 Unknown	0%	0	1	0%	0	1	0%	1	0	0
Moses Kotane	1 WUL; 1 Not authorised	0%	0	2	0%	0	2	0%	0	2	0
Ngaka Modiri Molema	1 Exempted; 1 Not authorised; 11 Unknown	0%	0	13	0%	0	13	0%	0	13	1
Rustenburg	2 WUL; 2 Not authorised	84%	2	0	49%	0	0	82%	1	0	0
Maquassi Hills	1 WUL; 1 Not authorised	0%	0	0	0%	0	0	0%	0	0	0
Matlosana	4 GA	42%	0	1	35%	0	0	60%	0	0	3
Totals		**23%**	**4**	**44**	**22%**	**3**	**42**	**29%**	**8**	**41**	**10**

* The enforcement measures (notices or directives issued) are taken over a two-year financial period from July 2019 to June 2021

Overall, North West WSAs did not fare well in terms of final effluent quality compliance, with an average of 23% compliance with microbial effluent quality, 22% with chemical, and 29% with physical effluent quality. For the microbiological compliance category, 4 of 48 systems achieved >90% and 44 systems fell below 30%. For the chemical compliance category, 3 of 48 systems achieved >90% and 42 of 48 systems fell below 30%. For the physical compliance category, 8 of 48 systems achieved >90% and 41 of 48 systems fell below 30%.

A total of 10 Directives/Notices have been issued to 5 municipalities. Matlosana and Madibeng (3 no. each) and Dr Ruth S Mompati (2 no.) have the highest number of enforcement measures initiated by the Regulator which require municipal leadership intervention and correction.

In terms of sludge compliance status, it is found that:

- 2 of the 48 plants (4%) classify their biosolids according to the WRC Sludge Guidelines - both systems (2) in JB Marks

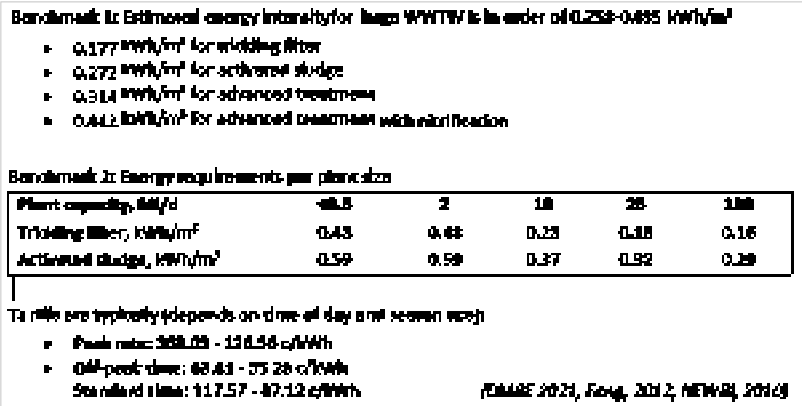
- 2 of the 48 plants (4%) monitor sludge streams – 2 of 4 systems in Rustenburg
- 1 of 48 plants (2%) have Sludge Management Plans in place - 1 system in JB Marks
- 4 of 48 plants (8%) use sludge for agricultural purposes, land disposal and for commercial products.

In closing of this diagnostic, the data confirmed that only 5 of 10 of the municipalities have access to credible laboratories for compliance and operational analysis. These in-house or contracted laboratories have been verified to be accredited and/or have Proficiency Testing Schemes with suitable analytical methods and quality assurance. At 50%, North West is not meeting the regulatory expectation that all municipalities have access to analytical services for compliance, operational and sludge monitoring.

Diagnostic 5: Energy Efficiency

Aim: The wastewater industry offers many opportunities to respond to climate change challenges by improving energy efficiency, reducing greenhouse gasses, and generating energy. The energy cost of sophisticated treatment technologies are in the order of 25-40% of the O&M budget (cited WRC 2021). This diagnostic investigates the status of energy efficiency management of the wastewater treatment works.

Findings: The audit results suggest an overall very low awareness of energy management. Only Kgetlengriver conducted energy audits for 3 of the 4 systems during the past 24 months. SPCs were calculated by JB Marks only, i.e. 2.27 kWh/m^3 which is above the technology target of 0.412 kWh/m^3. No WSA who could account for CO_2 equivalents associated with energy efficiency. No energy efficiency measures and/or plans in place for any of the municipalities. It is thus evident that municipalities have not established a specific report to monitor energy as part of the wastewater business. Energy efficiency management is still not embedded in the provincial municipal sector, and potential cost savings and environmental gains are forfeited.



Benchmark 1: Estimated energy intensity for large WWTW is in order of 0.258-0.495 kWh/m³

- 0.177 kWh/m³ for trickling filter
- 0.272 kWh/m³ for activated sludge
- 0.314 kWh/m³ for advanced treatment
- 0.412 kWh/m³ for advanced treatment with nitrification

Benchmark 2: Energy requirements per plant size

Plant capacity, Ml/d	[illegible]	2	[illegible]	[illegible]	[illegible]
Trickling filter, kWh/m³	0.43	[illegible]	[illegible]	[illegible]	0.16
Activated sludge, kWh/m³	0.59	[illegible]	0.37	[illegible]	[illegible]

Tariffs are typically (depends on time of day and season worth)

- Peak rate: [illegible] c/kWh
- Off-peak time: [illegible] c/kWh
  Standard time: 117.57 - [illegible] c/kWh

([illegible])

Diagnostic 6: Technical Site Assessments

Aim: The Green Drop process makes provision for the desktop audit being followed by a Technical Site Assessment (TSA) to verify the desktop evidence. The assessment includes physical inspection of the sewer network, pump stations, and treatment facility, coupled with asset condition checks to determine an approximate cost to restore existing infrastructure to functional status (VROOM).

Findings: The results of the TSAs are summarised in Table 168. A deviation of >10% between the GD and TSA score indicate a misalignment between the administrative aspects and the work on the ground. The Regulator regards a wastewater system with a TSA score of >80% as one that have an acceptable level of process control and functional equipment. 90% would represent an excellent plant that complies with most of the Green Drop TSA standards.

Table 168 - Summary of the WWTW Technical Site Assessments scores and hardware problems and %deviation between GD and TSA scores

WSA Name	TSA WWTW Name	WWTW GD Score (%)	%TSA	Key Hardware Problems	Difference between TSA & GD score
JB Marks	Ventersdorp	77%	57%	1. Screening removal; 2. Grit removal; 3. Primary settling; 4. No sludge	20%
Moretele	Swartdam	0%	11%	1. Pneumatic Actuated Control valves are dysfunctional; 2. The system automation should be refurbished; 3. MCC cables from sludge lagoon must be replaced; 4. Grit removal hand gates to be replaced and pumps to be automated	11%
Madibeng	Brits	40%	16%	1. Get sewer/Pump Stations cleaned and refurbished to get wastewater to work; 2. Refurbish inlet works; 3. Refurbish Primary Settling Tanks; 4. Refurbish BNRAS and clarifiers; 5. Refurbish sludge handling.	24%
Moses Kotane	Mogwase	21%	12%	1. Chlorine dosing facility; 2. Clarifier bridges to be refurbished, motors & pumps to be serviced; 3. Plant security, improved fencing; 4. Clean sludge lagoon	9%
Rustenburg	Boitekong	80%	51%	1. Sluice and hand gate arrangement for distribution of flow around the pre-fermenter tanks; 2. Parallel inlet flumes are not independent of downstream back water; 3. Refurbish an aerated zones' mixers; 4. WAS thickeners overflow water to be redirected to RAS pump station; 5. WAS pump/withdrawal process.	29%
Kgetlengriver	Koster AS	0%	11%	1. RAS PS is dysfunctional; 2. Flowmeter required; 3. Sludge not withdrawn and WAS pumps to be commissioned	11%

WSA Name	TSA WWTW Name	WWTW GD Score (%)	%TSA	Key Hardware Problems	Difference between TSA & GD score
Ngaka Modiri Molema	Mmabatho	0%	16%	1. Aerators not working for a long period; 2. PST bridges not functional for all PSTs; 3. Clarifier bridges not functional; 4. Anaerobic digestor not functional	16%
	Lichtenburg	0%	2%	NI	2%
	Delareyville	0%	12%	1. Replace/refurbish aerator; 2. Replace/refurbish RAS pumps; 3. Refurbish SST; 4. Chlorination facility is not in operation	12%
Dr Ruth S Mompati	Vryburg	0%	19%	NI	19%
	Bloemhof	43%	46%	1. Pump station well maintained and in excellent condition; 2. Flow meters to be calibrated and a flow meter installed after the SBR; 3. SBR plant not in operation, to be recommissioned	3%
Maquassi hills	Wolmaranstad	16%	42%	1. Mechanical screens at the Head of Works not functioning; 2. Degritter unit process motor not functional; 3. Activated sludge blower motor has not been functional for more than a year; 4. Flow measurement & balancing to be properly executed; 5. Operational & compliance monitoring to be properly executed.	26%
Matlosana	Klerksdorp	46%	35%	1. Mechanical screens and degritting dysfunctional; 2. PST & clarifier not fully operational; 3. Majority of ASP aerators dysfunctional; 4. Cable theft; 5. Flow meters	11%
Totals	**13**				**2% to 29%**

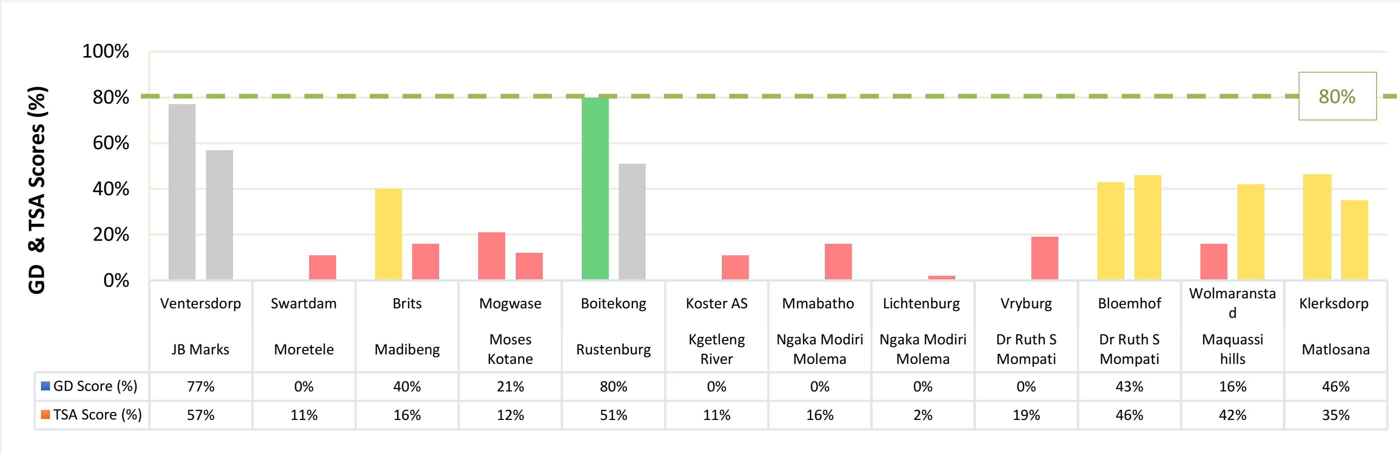


Figure 157 - Municipal GD (left bar) and System TSA score (right bar) comparison (colour legends as for GD – blue excellent; red critical)

A total of 13 site assessments were conducted, with 1 to 2 inspections per municipality. No treatment works scored above 80%, which is generally regarded to be a satisfactory TSA score. Poor TSA scores indicate that these systems fail to meet operational, asset functionality, and workplace safety standards.

A reasonably low difference was observed between GD and TSA scores for all WSIs, except for Rustenburg (29%), Maquassi Hills (26%), Madibeng (24%), and JB Marks (20%). A low difference implies that the wastewater management aspects correlate with the condition of processes and infrastructure in the field, which is an ideal situation. Similarly, a high difference implies that wastewater administration shows a poor correlation with the condition and functionality of infrastructure in the field. Some focal points include:

- JB Marks and Rustenburg had high GD scores but lower TSA scores with high % deviations of 29% and 20% respectively.
- Close correlations between the GD scores and the TSA scores (although low scores) were observed for Moretele, Moses Kotane, Kgetlengriver, Ngaka Modiri Molema, and Matlosana, which does reflect positively on the current operation and functionality of the sewer network and treatment processes.

The VROOM cost presents a ''very rough order of measurement'' cost to return a WWTWs functionality to its original design. For the Province, a total budget of R494 million is estimated, with the bulk of the work going towards restoration of mechanical equipment (51%).

Table 169 - VROOM cost split for civil, mechanical, and electrical and total VROOM cost estimate

WSA	Civil cost estimate	Mechanical cost estimate	Electrical & C&I cost estimate	Total VROOM cost
JB Marks	R16,884,000	R19,116,000	R0	R36,000,000
Moretele	R1,068,086	R1,120,187	R1,396,727	R3,585,000
Madibeng	R13,589,296	R70,223,909	R57,119,796	R140,933,000
Moses Kotane	R590,392	R2,799,858	R1,129,750	R4,520,000
Rustenburg	R33,893,619	R14,704,458	R7,210,922	R55,809,000
Kgetlengriver	R1,512,500	R962,500	R275,000	R2,750,000
Ngaka Modiri Molema	R20,978,375	R13,349,875	R3,814,250	R38,142,500
Dr Ruth S Mompati	R14,256,000	R9,072,000	R2,592,000	R25,920,000
Maquassi hills	R905,164	R15,770,742	R731,094	R17,407,000
Matlosana	R32,544,239	R103,703,145	R32,375,616	R168,623,000
Totals	**R136,221,671**	**R250,822,674**	**R106,645,155**	**R493,689,500**
% Distribution	**28%**	**51%**	**21%**	**100%**

The key hardware problems are listed in Table 168, with predominant defects in electrical cables, sludge settling in primary- and secondary clarifiers, disinfection, sludge pumps, sludge treatment, and power backup. Mechanical defects typically include dysfunctional flow meters, aerators, sludge and effluent pumps, mixers, screens, degritters, and disinfection equipment. Vandalism and theft, long procurement lead times, lack of management involvement, lack of maintenance, and lack of budget are the main reasons for dysfunctional assets.

Diagnostic 7: Operation, Maintenance and Refurbishment of Assets

Aim: Insufficient financial resources are often cited as a root cause to dysfunctional or non-compliant wastewater systems. Knowledge and monitoring of fiscal spending are therefore a critical part of wastewater management. This diagnostic investigates the status of financial information as pertaining to O&M budgets and expenditure, asset figures, and capital funding.

Findings: A substantial amount of financial information was presented during the audit process. Unfortunately, the evidence was presented in different formats, levels of detail, or absent for some municipalities. It was observed that municipal teams with financial officials present during the audits typically performed better, and also had a good understanding of the wastewater challenges experienced by their technical peers. Discrepancies observed included: generic or non-ringfenced budgets, contract lump sums for Service Providers presented as budgets, outdated or incomplete asset registers, some cost drivers are lacking (mostly electricity), etc. The Regulator grouped data into different “certainty” levels, as can be summarised at the end of this Diagnostic.

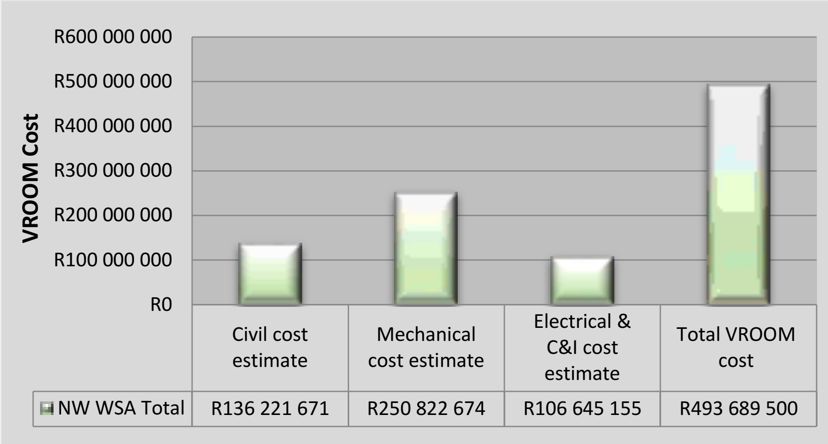
It must be noted that there were limitations with the financial and asset information. Not all WSAs submitted current information or complete financial data sets.

The result of each financial portfolio is discussed hereunder.

Vroom Cost Analysis

The VROOM costs breakdown is discussed under the TSA Diagnostic but is further illustrated as follows.

The total cost of R494 million is estimated to restore existing treatment works to their design capacity and functionality - consisting of R251 million for mechanical repairs, R107 million for electrical repairs, and R136 million for civil structures.



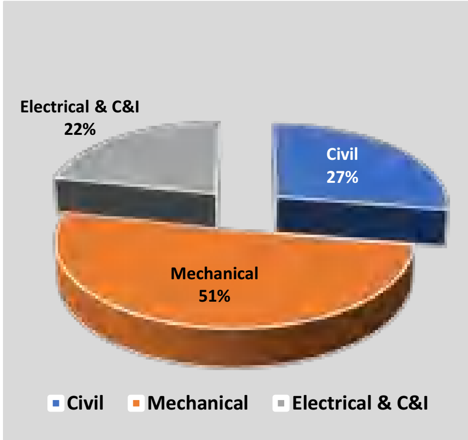


Figure 158 - Graphic illustration of the total cost estimated to restore functionality to existing assets(a), broken down to civil, mechanical, and electrical components

Table 170 indicates that a capital budget of R453 million has been secured over 1-3 years to address infrastructural needs, which does not adequately cover the R494 million VROOM refurbishment need and by implication, does not allow any surplus for other capital projects. The WATCOST-SALGA guideline figures provides for an annual 2.14% of the asset value required to maintain the assets. These figures could not be calculated as no information was provided for current asset values.

Capital, O&M Budget and Actual, and Asset Value

The capital budgets, O&M budgets, O&M actual expenditure, and current asset values are summarised below.

Table 170 - Summary of the capital budgets, O&M budgets, O&M actual expenditure, and current asset values

WSA	Capital budget available	O&M budget (2020/21)	O&M expended (2020/21)	% Expended	Total Current Asset Value
JB Marks	R139,393,020	R89,067,760	R139,393,020	157%	NI
Moretele	NI	NI	NI	NI	NI
Madibeng	R28,995,000	R43,836,640	R39,244,230	90%	NI
Moses Kotane	NI	NI	NI	NI	NI
Rustenburg	R256,307,000	NI	NI	NI	NI
Kgetlengriver	NI	NI	NI	NI	NI
Ngaka Modiri Molema	NI	NI	NI	NI	NI
Dr Ruth S Mompati	NI	R65,485,000	R65,488,000	100%	NI
Maquassi hills	NI	R3,150,000	NI	NI	NI
Matlosana	R28,586,520	R31,160,675	R8,448,220	27%	NI
Totals	**R453,281,540**	**R232,700,075**	**R252,573,470**	**109%**	NI

The Green Drop process provides a bonus (incentive) in cases where a municipality provide evidence of capital projects with secured funding since this is deemed as a definitive means of addressing wastewater services inadequacies. This incentive encourages wastewater infrastructure investment. A total capital budget of R453 million has been reported for the refurbishment and upgrades of wastewater infrastructure for all the municipalities over a 1 to 3-year fiscal period. The largest capital budget is observed for Rustenburg (R256m).

For the 2020/21 fiscal year, the total O&M budget reported for the Province was R233 million, of which R253 million (109%) has been expended. Over-expenditure of 57% by JB Marks and low expenditure by Matlosana was observed. The provincial figures exclude 5 of the 10 municipalities who had no financial information and one municipality that had not spend figure.

The total current asset value for wastewater infrastructure (networks, pump stations, treatment plants) is not known.

O&M Cost Benchmarking

By combining the SALGA and WRC WATCOST models, an estimation of the maintenance cost required per asset type can be done, i.e. civil, buildings, pipelines, mechanical, electrical, and instrumentation. The maintenance benchmark departs from the basis that 15.75% of the asset value is required to maintain these assets. This could not be calculated as no/limited information was provided on current asset values.

Table 171 indicates the SALGA maintenance cost estimation in relation to the VROOM cost, O&M budget, and O&M actual expended.

Table 171 - O&M cost estimates by the SALGA and VROOM models versus actual budget and expenditure figures

Cost Reference	O&M Cost Estimate	Period
Modified SALGA	Could not be calculated	Annually, estimation
O&M Budget	R232,700,075.00	Actual for 2020/21
O&M Spend	R252,573,470.00	Actual for 2020/21
VROOM	R493,689,500.00	Once off estimation

The cost dynamics can be summarised as follows:

- The SALGA estimations for O&M budgets against the actual reported budgets for the 2020/21 fiscal year could not be determined, because no current asset values could be verified
- The actual O&M budget could not be compared with the SALGA guideline
- The VROOM cost represents an estimation of the refurbishment cost to restore WWTWs functionality and design capacity.

Production Cost and Comparison

It is good business practice to monitor and manage the production costs of wastewater treatment in Rand/m^3 treated, and to compare such cost with industry norms. Published benchmarks is not currently available for typical treatment (production) costs, but significant cost increases are expected since 2013, given the variable input factors such as Covid, and cost of chemicals, transport, and electricity. From an economic perspective, it is valuable to compare production cost at time of budgeting versus actual production costs. However, due to scarce information, it is not possible to provide insight as to possible shortfalls from an economic perspective.

Based on the scarce, no production costs for wastewater treatment could be concluded, which leaves a significant gap in the financial portfolio of the WSAs in North West. Only JB Marks provided production cost, i.e. budgeted at R3.00/m^3 compared to actual cost of R3.84/m^3. Readers may view the results obtained for Gauteng, KwaZulu Natal, Eastern Cape and Western Cape, to obtain a sense of typical production costs at South African wastewater treatment facilities.

Data Certainty

Data certainty is expressed at different levels for the financial and asset figures reported within this Diagnostic. Certainty levels differ from system to system, hence some WSAs are included in multiple data certainty categories - as the data is variable, inconsistent, limited or non-existent (NI) for each of the systems. The various WSAs in the province that were identified under the category ''High Certainty", presented consistent and verifiable evidence in the form of budgets, expenditure, asset registers, and unit costs.

Table 172 - Levels of certainty associated with financial and asset information reported by municipalities

Data Certainty	Description	WSA
No certainty	Absent data or no certainty in data presented - not ringfenced for WWTW & Network	Moretele, Moses Kotane, Kgetlengriver, Ngaka Modiri Molema, Maquassi Hills
Low certainty	Minor or little certainty in the data - partially ringfenced for WWTW only or data as extreme outliers	Matlosana, Madibeng, Rustenburg, Dr Ruth S Mompati
Reasonable/good certainty	Reasonable to good level of certainty in the data - ringfenced for WWTW and/or Network and data falls within/close to expected parameters	JB Marks
High certainty	High level of certainty in the data - ringfenced for WWTW and network and data falls within expected parameters	None

10.1 Dr Ruth Segomotsi District Municipality

Water Service Institution	**Dr Ruth Segomotsi Mompati District Municipality**
Water Service Providers	Greater Taung Local Municipality Lekwa Teemane Local Municipality Mamusa Local Municipality Naledi Local Municipality

Municipal Green Drop Score	
2021 Green Drop Score	**17%↓**
2013 Green Drop Score	**22%**
2011 Green Drop Score	**22%**
2009 Green Drop Score	**3%**

VROOM Impression (Towards restoring functionality):
1. Pump station well maintained and in excellent condition
2. Flow meters to be calibrated and a flow meter installed after the SBR
3. SBR plant not in operation, to be recommissioned.

VROOM Estimate:
- R25,920,000

Key Performance Area	Unit	Schweizer Reneke	Taung Hospital	Taung Station
Green Drop Score (2021)		**0%**	**0%**	**0%**
2013 Green Drop Score		**16%**	NA	NA
2011 Green Drop Score		**26%**	NA	NA
2009 Green Drop Score		**2%**	NA	NA
Design Capacity	Ml/d	6	0.6	NA
Design Capacity Utilisation (%)		NI	NI	NI
Resource Discharged into		Harts River	Harts River	Harts River
Wastewater Risk Rating (CRR% of CRR_{max})		**Schweizer Reneke**	**Taung Hospital**	**Taung Station**
CRR (2011)		78.3%	**NA**	**NA**
CRR (2013)		95.5%	**NA**	**NA**
CRR (2021)		100.0%	100.0%	100.0%

Key Performance Area	Unit	Diplankeni/ Mogogong	Maganeng/ Pudimoe	Reivilo
Green Drop Score (2021)		**0%**	**0%**	**0%**
2013 Green Drop Score		NA	NA	NA
2011 Green Drop Score		NA	NA	NA
2009 Green Drop Score		NA	NA	NA
Design Capacity	Ml/d	0.1	1.7	NI
Design Capacity Utilisation (%)		NI	NI	NI
Resource Discharged into		No Discharge	Harts River	No Discharge
Wastewater Risk Rating (CRR% of CRR_{max})		**Diplankeni/ Mogogong**	**Maganeng/ Pudimoe**	**Reivilo**
CRR (2011)		NA	NA	NA
CRR (2013)		NA	NA	NA
CRR (2021)		100.0%	100.0%	100.0%

Key Performance Area	Unit	Stella	Vryburg	Bloemhof
Green Drop Score (2021)		**0%**	**1%**	**43%**
2013 Green Drop Score		NA	**12%**	**14%**
2011 Green Drop Score		NA	**21%**	**17%**

Key Performance Area	Unit	Stella	Vryburg	Bloemhof
2009 Green Drop Score		NA	6%	2%
Design Capacity	Nl	Nl	6.5	5.6
Design Capacity Utilisation (%)		Nl	Nl	Nl
Resource Discharged into		No Discharge	Harts River	Vaal River
Wastewater Risk Rating (CRR% of CRR$_{max}$)		**Stella**	**Vryburg**	**Bloemhof**
CRR (2011)		NA	78.3%	78.3%
CRR (2013)		NA	81.8%	100.0%
CRR (2021)		100.0%	100.0%	68.2%

Key Performance Area	Unit	Christiana
Green Drop Score (2021)		**49%**
2013 Green Drop Score		**66%**
2011 Green Drop Score		**22%**
2009 Green Drop Score		**2%**
Design Capacity	Ml/d	3.5
Capacity Utilisation (%)		69%
Resource Discharged into		Vaal River
Wastewater Risk Rating (CRR% of CRR$_{max}$)		**Christiana**
CRR (2011)		83.3%
CRR (2013)		47.1%
CRR (2021)		29.4%

Technical Site Assessment: **Vryburg WWTW 19%; Bloemhof WWTW 47%**

10.2 JB Marks Local Municipality

Water Service Institution	**JB Marks Municipality**
Water Service Providers	Moedi Engineers Korone Engineers

Municipal Green Drop Score		VROOM Impression (Towards restoring functionality):
2021 Green Drop Score	**84%↓**	1. Network and pumpstation in poor condition 2. Screening removal, Grit removal substandard 3. Primary settling dysfunctional 4. No sludge in drying beds 5. Screening not effective **VROOM Estimate:** - R36,000,000
2013 Green Drop Score	**93%**	
2011 Green Drop Score	**97%**	
2009 Green Drop Score	**78%**	

Key Performance Area	Unit	Potchefstroom	Ventersdorp
Green Drop Score (2021)		**84%**	**77%**
2013 Green Drop Score		**97%**	**32%**
2011 Green Drop Score		**97%**	**6%**
2009 Green Drop Score		**78%**	**3%**
Design Capacity	Ml/d	45	3
Capacity Utilisation (%)		91%	72%
Resource Discharged into		Mooi River	Schoonspruit
Wastewater Risk Rating (CRR% of CRR_{max})		**Potchefstroom**	**Ventersdorp**
CRR (2011)	%	35.7%	76.5%
CRR (2013)	%	93.2%	53.0%
CRR (2021)	%	44.4%	29.4%

Technical Site Assessment: **Ventersdorp WWTW 57%**

10.3 Kgetlengriver Local Municipality

Water Service Institution	**Kgetlengriver Local Municipality**	
Water Service Provider	Magalies Water	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. RAS PS is dysfunctional 2. Flowmeter required 3. Sludge not withdrawn and WAS pumps to be commissioned **VROOM Estimate:** - R2,750,000
2021 Green Drop Score	**2%↓**	
2013 Green Drop Score	**22%**	
2011 Green Drop Score	**9%**	
2009 Green Drop Score	**22%**	

Key Performance Area	Unit	Swartruggens	Koster AS	Mazista	Koster Ponds
Green Drop Score (2021)		**3%**	**4%**	**0%**	**0%**
2013 Green Drop Score		**26%**	**NA**	**NA**	**15%**
2011 Green Drop Score		**9%**	**NA**	**NA**	**10%**
2009 Green Drop Score		**32%**	**NA**	**NA**	**11%**
System Design Capacity	Ml/d	1	1	1	2
Design Capacity Utilisation (%)		NI	NI	NI	120%
Resource Discharged into		Elands River	Unknown	Land Disposal	Kgetlengriver
Wastewater Risk Rating (CRR% of CRR_{max})		**Swartruggens**	**Koster AS**	**Mazista**	**Koster Ponds**
CRR (2011)		72.2%	**NA**	**NA**	94.7%
CRR (2013)		70.6%	**NA**	**NA**	88.2%
CRR (2021)		94.1%	94.1%	94.1%	88.2%

Technical Site Assessment: **Koster WWTW 3%; Swartruggens WWTW 21%**

10.4 Madibeng Local Municipality

Water Service Institution	**Madibeng Local Municipality**	
Water Service Provider	Madibeng Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Sewer Pump Stations to be refurbished 2. Refurbish inlet works 3. Refurbish Primary Settling Tank 4. Refurbish BNRAS system and SSTs 5. Refurbish sludge handling **VOOM Estimate:** - R140,933,000
2021 Green Drop Score	**36%↓**	
2013 Green Drop Score	**44%**	
2011 Green Drop Score	**7%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Brits	Lethalbile	Hartbeespoort
Green Drop Score (2021)		**40%**	**40%**	**42%**
2013 Green Drop Score		**53%**	**32%**	**40%**
2011 Green Drop Score		**9%**	**3%**	**7%**
2009 Green Drop Score		**0%**	**0%**	**0%**
System Design Capacity	Ml/d	14	6.3	5
Design Capacity Utilisation (%)		39%	NI	27%
Resource Discharged into		Crocodile River	Xolwani River	Swartspruit
Wastewater Risk Rating (CRR % of CRR_{max})		**Brits**	**Lethalbile**	**Hartbeespoort**
CRR (2011)		78.3%	78.3%	77.8%
CRR (2013)		45.5%	50.0%	47.1%
CRR (2021)		50.0%	72.7.6%	63.6%

Key Performance Area	Unit	Eagles Landing	Sunway	Mothotlung
Green Drop Score (2021)		**14%**	**11%**	**1%**
2013 Green Drop Score		NA	NA	**35%**
2011 Green Drop Score		NA	NA	**4%**
2009 Green Drop Score		NA	NA	**0%**
System Design Capacity	Ml/d	1	3	3
Capacity Utilisation (%)		NI	NI	NI
Resource Discharged into		Hartbeespoort Dam	Unknown Stream	Unknown Stream
Wastewater Risk Rating (CRR% of CRR_{max})		**Eagles Landing**	**Sunway**	**Mothotlung**
CRR (2011)		NA	NA	77.8%
CRR (2013)		NA	NA	47.1%
CRR (2021)		94.1%	94.1%	94.1%

Technical Site Assessment: **Brits WWTW 16%**

10.5 Maquassi Hills Local Municipality

Water Service Institution	**Maquassi Hills Local Municipality**	
Water Service Providers	CMS Water Engineering Sedibeng Water	
Municipal Green Drop Score		**VROOM Impression (towards restoring functionality):** 1. All equipment in disrepair 2. Mechanical screens 3. Degritter motor 4. Activated sludge blower motor 5. Operational monitoring instrumentation dysfunctional **VROOM Estimation:** - R 17 407 000
2021 Green Drop Score	**13%↑**	
2013 Green Drop Score	**2%**	
2011 Green Drop Score	**17%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Wolmaranstad	Leeudoringstad
Green Drop Score (2021)		**15%**	**8%**
2013 Green Drop Score		**3%**	**2%**
2011 Green Drop Score		**21%**	**10%**
2009 Green Drop Score		**0%**	**0%**
System Design Capacity	Ml/d	6	2.45
Design Capacity Utilisation (%)		NI	NI
Resource Discharged into		Vaal	Vaal
Wastewater Risk Rating (CRR% of CRR_{max})		**Wolmaranstad**	**Leeudoringstad**
CRR (2011)	%	76.5%	88.2%
CRR (2013)	%	100.0%	94.2%
CRR (2021)	%	95.5%	94.1%

Technical Site Assessment: **Wolmaranstad WWTW: 42%**

10.6 Matlosana Local Municipality

Water Service Institution	**Matlosana Local Municipality**	
Water Service Providers	CMS Water Engineering Korone Engineers Midvaal Water (analytical)	
Municipal Green Drop Score		**VROOM Impression (towards restoring functionality):** 1. Mechanical screens and degritting dysfunctional 2. PST & clarifier not fully operational 3. Majority of ASP aerators dysfunctional 4. Cable theft 5. Flow meters **VROOM Estimate:** - R168,623,000
2021 Green Drop Score	**43%↑**	
2013 Green Drop Score	**40%**	
2011 Green Drop Score	**52%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Klerksdorp	Orkney	Stilfontein	Hartebees fontein
Green Drop Score (2021)		**46%**	**40%**	**40%**	**47%**
2013 Green Drop Score		**36%**	**41%**	**53%**	**34%**
2011 Green Drop Score		**42%**	**61%**	**65%**	**53%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	36	20	12,3	8
Design Capacity Utilisation (%)		NI	NI	NI	72%
Resource Discharged into		Schoonspruit (stream), Vaal	Schoonspruit, then Vaal	Koekemoer spruit, then Vaal	Jagspruit into Vaa
Wastewater Risk Rating (CRR% as of CRR_{max})		**Klerksdorp**	**Orkney**	**Stilfontein**	**Hartebees fontein**
CRR (2011)	%	63.0%	54.5%	50.0%	58.8%
CRR (2013)	%	55.6%	54.6%	54.6%	70.6%
CRR (2021)	%	81.5%	77.3%	86.4%	59.1%

Technical Site Assessment: **Klerksdorp WWTW: 35%**

10.7 Moretele Local Municipality

Water Service Institution	**Moretele Local Municipality**	
Water Service Provider	Moretele Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Pneumatic Actuated Control valves are dysfunctional 2. The system automation should be refurbished 3. MCC cables from sludge lagoon must be replaced 4. Grit removal hand gates to be replaced and pumps to be automated **VROOM Estimate**: - R3,585,000
2021 Green Drop Score	**0%↓**	
2013 Green Drop Score	**28%**	
2011 Green Drop Score	**0%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Ga Motle/Swartdam**
Green Drop Score (2021)		**0%**
2013 Green Drop Score		**28%**
2011 Green Drop Score		NA
2009 Green Drop Score		NA
System Design Capacity	Ml/d	1.5
Design Capacity Utilisation (%)		NI
Resource Discharged into		Kutswane River
Wastewater Risk Rating (CRR as % of CRR_{max})		**Ga Motle/Swartdam**
CRR (2011)	%	**NA**
CRR (2013)	%	64.7%
CRR (2021)	%	100.0%

Technical Site Assessment: **Ga Motle-Swartdam WWTW** **11%**

10.8 Moses Kotane Local Municipality

Water Service Institution	**Moses Kotane Local Municipality**	
Water Service Provider	Moses Kotane Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Chlorine dosing facility 2. Clarifier bridges to be refurbished, motors & pumps to be serviced 3. Plant security, improved fencing 4. Clean sludge lagoon **VROOM Estimate:** - R4,520,000
2021 Green Drop Score	**21%↑**	
2013 Green Drop Score	**16%**	
2011 Green Drop Score	**30%**	
2009 Green Drop Score	**61%**	

Key Performance Area	**Unit**	**Mogwase**	**Madikwe**
Green Drop Score (2021)		**21%**	**0%**
2013 Green Drop Score		**23%**	**10%**
2011 Green Drop Score		**35%**	**16%**
2009 Green Drop Score		**70%**	**51%**
Design Capacity	Ml/d	NI	NI
Design Capacity Utilisation (%)		85%	NI
Resource Discharged into		Elands River	No Discharge
Wastewater Risk Rating (CRR% of CRR_{max})		**Mogwase**	**Madikwe**
CRR (2011)		35.0%	41.0%
CRR (2013)		82.0%	82.0%
CRR (2021)		88.2%	100.0%

Technical Site Assessment: **Mogwase WWTW 11%**

10.9 Ngaka Modiri Molema District Municipality

Water Service Institution		**Ngaka Modiri Molema District Municipality**
Water Service Providers		Mafikeng Local Municipality Ramotshere-Moiloa Local Municipality
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Replace/refurbish aerator 2. Replace/refurbish RAS pumps 3. Refurbish SST 4. Chlorination facility is not in operation **VROOM Estimate:** - R38,142,500
2009 Green Drop Score	**0%↓**	
2011 Green Drop Score	**18%**	
2013 Green Drop Score	**28%**	
2021 Green Drop Score	**5%**	

Key Performance Area	Unit	Mmabatho	Mahikeng	Zeerust
Green Drop Score (2021)		**0%**	**0%**	**0%**
2013 Green Drop Score		**22%**	**27%**	**21%**
2011 Green Drop Score		**35%**	**29%**	**24%**
2009 Green Drop Score		**10%**	**10%**	**3%**
Design Capacity	Ml/d	24.5	4.5	3.5
Design Capacity Utilisation (%)		41%	222%	93%
Resource Discharged into		Molopo River	Molopo River	Klein Marico River
Wastewater Risk Rating (CRR% of CRR_{max})		**Mmabatho**	**Mahikeng**	**Zeerust**
CRR (2011)		75.0%	73.9%	100.0%
CRR (2013)		51.9%	77.3%	70.6%
CRR (2021)		66.7%	100.0%	100.0%

Key Performance Area	Unit	Lehurutshe	Groot Marico	Lichtenburg
Green Drop Score (2021)		**0%**	**0%**	**0%**
2013 Green Drop Score		**33%**	NA	**8%**
2011 Green Drop Score		**11%**	NA	**34%**
2009 Green Drop Score		**3%**	NA	**0%**
Design Capacity	Ml/d	1	0.8	20.5
Design Capacity Utilisation (%)		138%	110%	144%
Resource Discharged into		Oxidation Ponds	Marico River	Harts River
Wastewater Risk Rating (CRR% of CRR_{max})		**Lehurutshe**	**Groot Marico**	**Lichtenburg**
CRR (2011)		100.0%	**NA**	**NA**
CRR (2013)		76.5%	**NA**	94.1%
CRR (2021)		100.0%	100.0%	100.0%

Key Performance Area	Unit	Coligny	Itsoseng	Itekeng Ponds
Green Drop Score (2021)		**0%**	**0%**	**0%**
2013 Green Drop Score		**4%**	**1%**	NA
2011 Green Drop Score		**25%**	**26%**	NA
2009 Green Drop Score		**0%**	**0%**	NA
Design Capacity	Ml/d	2	3	0.55
Design Capacity Utilisation (%)		200%	133%	279%

Key Performance Area	Unit	Coligny	Itsoseng	Itekeng Ponds
Resource Discharged into		Taaibosspruit	Unknown stream	Land discharge
Wastewater Risk Rating (CRR% of CRR_{max})		**Coligny**	**Itsoseng**	**Itekeng Ponds**
CRR (2011)		**NA**	**NA**	**NA**
CRR (2013)		94.1%	**NA**	**NA**
CRR (2021)		100.0%	100.0%	100.0%

Key Performance Area	Unit	Delareyville	Sannieshof	Atamelang
Green Drop Score (2021)		**0%**	**0%**	**0%**
2013 Green Drop Score		**15%**	**8%**	**25%**
2011 Green Drop Score		**16%**	**17%**	**17%**
2009 Green Drop Score		**0%**	**05**	**0%**
Design Capacity	Ml/d	4	1	1
Design Capacity Utilisation (%)		75%	279%	133%
Resource Discharged into		Harts River	Ponds	Ponds
Wastewater Risk Rating (CRR% of CRR_{max})		**Delareyville**	**Sannieshof**	**Atamelang**
CRR (2011)		**NA**	**NA**	**NA**
CRR (2013)		76.5%	94.1%	70.6%
CRR (2021)		100.0%	100.0%	100.0%

Key Performance Area	Unit	Ottosdal
Green Drop Score (2021)		**0%**
2013 Green Drop Score		**1%**
2011 Green Drop Score		**13%**
2009 Green Drop Score		**0%**
Design Capacity	Ml/d	3
Design Capacity Utilisation (%)		135%
Resource Discharged into		Harts River
Wastewater Risk Rating (CRR% of CRR_{max})		**Ottosdal**
CRR (2011)		**NA**
CRR (2013)		94.1%
CRR (2021)		100.0%

Technical Site Assessment: **Delareyville WWTW 12%; Lichtenburg WWTW 2%; Mmabatho WWTW 15%**

10.10 Rustenburg Local Municipality

Water Service Institution	**Rustenburg Local Municipality**	
Water Service Provider	Water and Sanitation Services South Africa (WSSA)	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Refurbish BNR mixers **VROOM Estimate**: - R55,809,000
2021 Green Drop Score	**69%↓**	
2011 Green Drop Score	**76%**	
2013 Green Drop Score	**63%**	
2009 Green Drop Score	**69%**	

Key Performance Area	Unit	Boitekong	Rustenburg	Lethabong	Monakato
Green Drop Score (2021)		**73%**	**68%**	**49%**	**56%**
2013 Green Drop Score		**75%**	**61%**	**47%**	**48%**
2011 Green Drop Score		**70%**	**79%**	**48%**	**45%**
2009 Green Drop Score		**41%**	**74%**	**30%**	**30%**
Design Capacity	Ml/d	24	42	2	0.9
Design Capacity Utilisation (%)		44%	110%	20%	200%
Resource Discharged into		Hex River	Hex River	Hex River	Hex River
Wastewater Risk Rating (CRR% of CRR_{max})		**Boitekong**	**Rustenburg**	**Lethabong**	**Monakato**
CRR (2011)	%	37.0%	26.8%	48.2%	40.7%
CRR (2013)	%	68.2%	59.3%	58.8%	70.6%
CRR (2021)	%	37.0%	74.1%	52.9%	64.7%

Technical Site Assessment: **Biotekong WWTW** **51%**

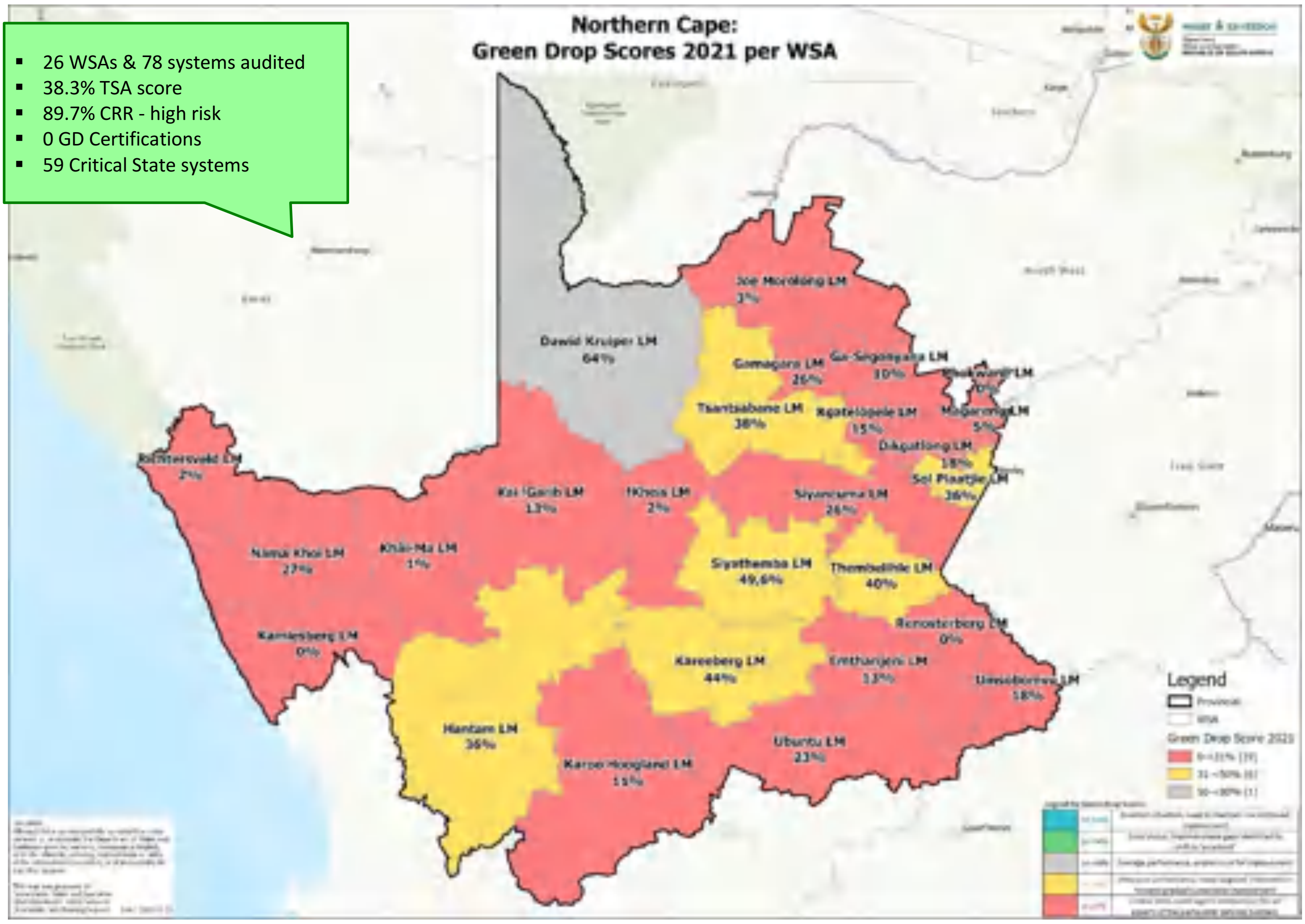
Extraordinary team spirit.
JB Marks presented excellent evidence with all departments, leadership and consultants present during the audit.
Dr Stanley, Liande Bothma and Esther de Beer.

Ventersdorp technical site inspection revealed many areas of improvement, underscored by institutional difficulties. However, the municipal team and contractor committed to aim for Green Drop Certification in 2023. Watch this space...

Despite considerable challenges facing the Rustenburg Municipality, the Boiketong WWTW attained a 100% score for degritting and removal to the Holfontein landfill facility. Well done to the general workers who make this happen.

11. NORTHERN CAPE PROVINCE: MUNICIPAL WASTEWATER MANAGEMENT PERFORMANCE

- 26 WSAs & 78 systems audited
- 38.3% TSA score
- 89.7% CRR - high risk
- 0 GD Certifications
- 59 Critical State systems



Provincial Synopsis

An audit attendance record of 100% affirms the Northern Capes WSA's commitment to the Green Drop national incentive-based regulatory programme.

The Regulator determined that no wastewater systems scored the minimum of 90% when measured against the Green Drop standards for the audited period and thus no WSA qualified for the prestigious Green Drop Certification. This compares lower than the one system awarded Green Drop Status in 2013 but is recognised for its inherent value to establish an accurate, current baseline from where improvement can be driven, and excellence be incentivised.

Five (5) of the 26 WSAs improved on their 2013 scores – namely, Siyathemba, Kareeberg, Siyancuma, Umsobomvu and Karoo Hoogland. Dawid Kruiper is the best performing WSA in the province. Siyathemba made the best overall progress from a 38% in 2013 to a municipal score of 49.6% in 2021. Fifty-nine (59) systems were identified to be in a critical state, compared to 33 in 2013. The full range of Green Drop KPAs require attention from all the municipalities, with some exceptions noted for Dawid Kruiper.

The provincial Risk Ratio for treatment plants regressed considerably from 78.4% in 2013 to 89.7% in 2021. The most prominent risks were observed on treatment level, and pointed to WWTWs that exceeded their design capacity, dysfunctional processes and equipment (especially disinfection), and effluent and sludge non-compliance.

The Regulator is hopeful that the 2021 audits will set a baseline from where a positive trajectory for wastewater services and improved performance will follow. Municipalities are encouraged to start their preparation for the 2023 Green Drop audit. The 2021 Green Drop status for WSAs in the Northern Cape Province are summarised in Table 173.

Table 173 - 2021 Green Drop Summary

WSA Name	2013 GD Score (%)	2021 GD Score (%)	2021 GD Certified ≥90%	2021 GD Contenders (89%)	2021 Critical State (<31%)
Dawid Kruiper: Khara Hais LM	60	64			
Mier LM	1				
Siyathemba LM	38	49.6↑			
Kareeberg LM	21	44↑			2 of 3 plants
Thembelihle LM	56	40↓			
Tsantsabane LM	83	38↓			Jen haven
Hantam LM	52	36↓			Brandvlei
Sol Plaatje LM	56	36↓			Richie-Rietvale
Nama Khoi LM	34	27↓			6 of 8 plants
Siyancuma LM	17	26↑			2 of 3 plants
Gamagara LM	42	26↓			3 of 4 plants
Ubuntu LM	24	23↓			All 3 plants
Umsobomvu LM	13	18↑			All 3 plants
Dikgatlong LM	39	18↓			All 3 plants
Kgatelopele LM	78	15↓			Danielskuil
!Kai !Garib LM	34	13↓			All 4 plants
Emthanjeni LM	66	13↓			All 3 plants
Karoo Hoogland LM	5	11↑			All 3 plants
Ga-Segonyana LM	64	10↓			Both plants (2)
Magareng LM	34	5↓			Warrenton
Joe Morolong LM	39	3↓			Both plants (2)
!Kheis LM	25	2↓			All 5 plants
Richtersveld LM	9	2↓			Port Nolloth
Khai-Ma LM	28	1↓			All 4 plants
Phokwane LM	53	0↓			All 3 plants
Kamiesberg LM	0	0→			Both plants (2)
Renosterberg LM	1	0↓			All 3 plants
Khara Hais LM	60				
Mier LM	1				
Totals	**-**	**-**	**0**	**0**	**59**

The Department of Water and Sanitation acknowledges the excellence in wastewater management achieved for the Green Drop Audit year of 2021.

No Green Drop Certificates are awarded to WSAs in the Province

Background to Northern Cape Wastewater Infrastructure

There are 26 WSAs, delivering wastewater services through a sewer network comprising of 78 WWTWs, 207 network pump stations and 1,040 km outfall and main sewer pipelines. The sewer network excludes the pipeline data for 17 municipalities who could not provide that information. There is a total installed treatment capacity of 165 Ml/d, with most of this capacity residing in 51 small to medium-sized treatment plants.

Table 174 - Summary of WWTW capacity and flow distribution according to plant sizes

	Micro Size Plants	Small Size Plants	Medium Size Plants	Large Size Plants	Macro Size Plants	Unknown (NI)*	Total
	<0.5 Ml/day	0.5-2 Ml/day	2-10 Ml/day	10-25 Ml/day	>25 Ml/day		
No. of WWTW	20 (26%)	33 (42%)	18 (23%)	2 (3%)	1 (1%)	4 (5%)	78
Total Design Capacity (Ml/day)	4.14	28.88	57.60	26.00	48.00	4	164.61
Total Daily Inflow (Ml/day)	0.84	3.43	18.18	19.3	NI	57	41.75
Use of Design Capacity (%)	20%	12%	32%	74%	0%	-	25%

"Unknown" means the number of WWTWs with NI (No Information) on design capacity or daily inflow

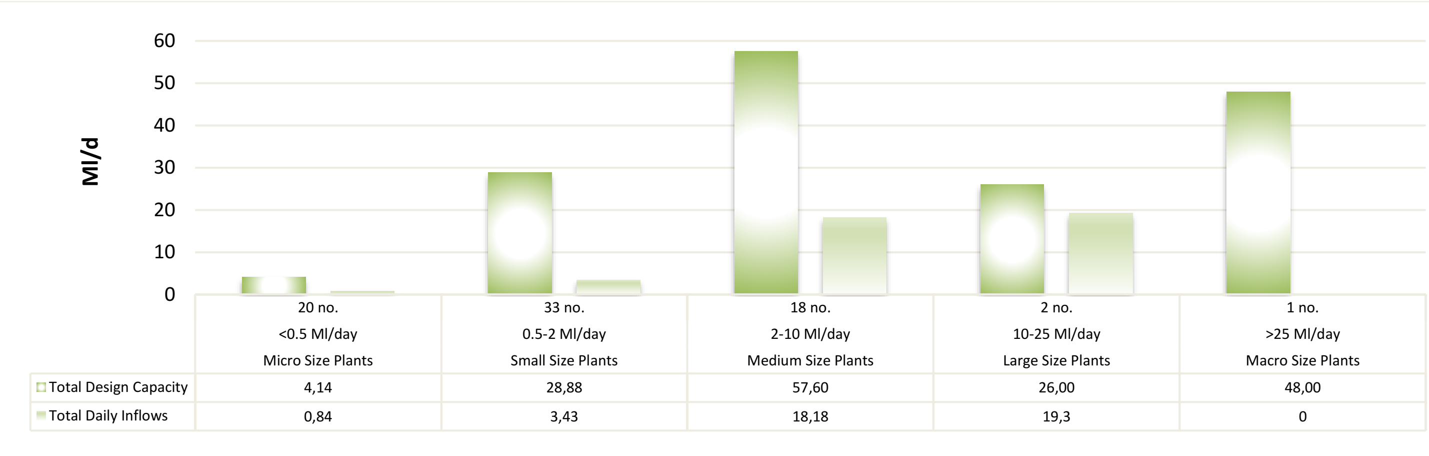


Figure 159 - Design capacities and operational inflow to micro to large sized WWTWs (a) and macro sized WWTWs

Based on the current operational flow of 41.8 Ml/d, the treatment facilities are operating at 25% of the total design capacity. The three largest contributors are Sol Plaatje, Dawid Kruiper and Gamagara. Given the current capacity, this implies that there is 75% spare capacity to meet the medium-term demand. It must however be noted that inflow is not monitored in 57 systems (73%) and as a result the spare capacity could be substantially less than the 75%. Diagnostic #3 unpacks these statistics in more detail. This spare capacity would also be compromised at systems where some of the infrastructure or treatment modules are non-operational or dysfunctional. The VROOM Cost Diagnostic #7 provides more detail on the refurbishment requirements to restore such capacity and functionality.

The audit data shows that 1 system is hydraulically overloaded. This figure could theoretically be higher, given that there are 57 systems where inflow monitoring is not taking place. The hydraulically overloaded system (Beaconsfield) is located within the Sol Plaatje municipality.

The predominant treatment technologies employed at Northern Cape WWTWs comprise predominantly of pond & lagoons, activated sludge and variations thereof (for effluent treatment), and solar drying beds and belt press dewatering (for sludge treatment). The next audit will need to verify sludge treatment technologies, as insufficient information ("Other") is observed in this area.

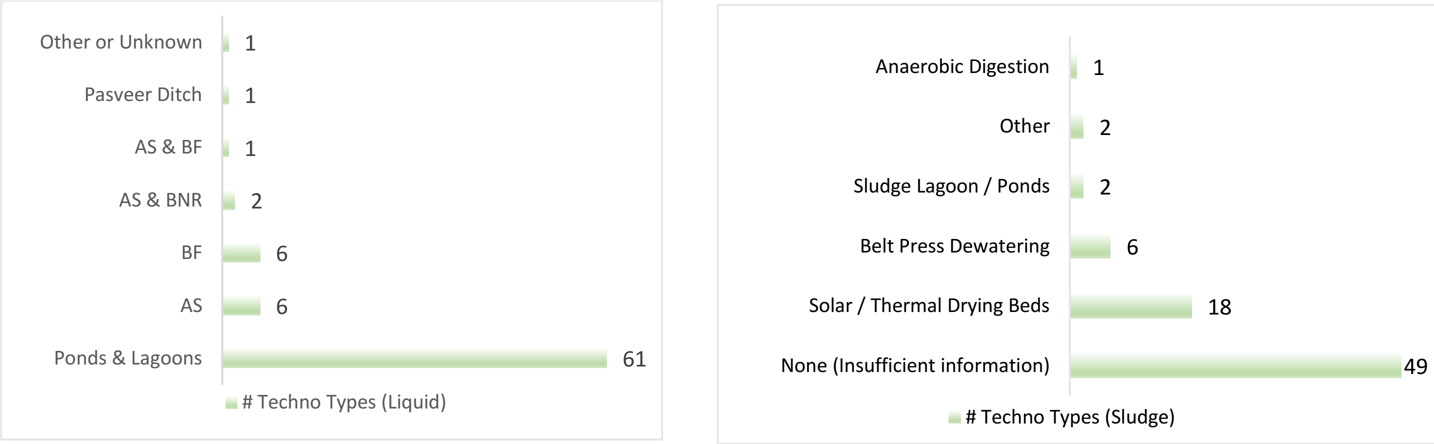


Figure 160 - Treatment technologies for wastewater effluent (a) and sludge (b)

Table 175 - Summary of Collection Network Pump Stations and Sewer Pipelines

WSA Name	# WWTWs	Pump Stations (#)	Sewer Pipelines (km)
Dawid Kruiper	4	15	6
Hantam	4	4	7
Kai Garib	4	8	NI
Kamiesberg	2	2	NI
Karoo Hoogland	3	2	NI
Khai Ma	4	2	15
Nama Khoi	8	8	NI
Richtersveld	1	9	NI
!Kheis	5	0	NI
Joe Morolong	2	6	NI
Siyathemba	3	3	64
Dikgatlong	3	5	NI
Emthanjeni	3	3	107
Kareeberg	3	4	31
Magareng	1	2	NI
Phokwane	3	0	NI
Renosterberg	3	0	NI
Sol Plaatje	3	35	748
Thembelihle	2	4	49
Ubuntu	3	6	NI
Umsobomvu	3	5	NI
Ga-Segonyana	2	13	NI
Gamagara	3	50	NI
Kgatelopele	1	10	NI
Tsantsabane	2	6	NI
Siyancuma	3	5	**13**
Totals	**78**	**207**	**1,040**

The sewer network consists of the sewer mains and pump stations as summarised in Table 175. Sol Plaatje manages the bulk of the sewer collector infrastructure, approximately 748 km and 35 sewer pump stations. Seventeen (17) of 26 municipalities could not provide information on sewer pipelines, indicating asset management information limitations.

Provincial Green Drop Analysis

The 100% response from the 26 municipalities audited during the 2021 Green Drop process demonstrates a firm commitment to wastewater services in the province. Local Government reforms resulted in the merging of Khara Hais LM and Mier LM into Dawid Kruiper LM, which means that there were 26 WSAs audited in 2021 compared to the 27 WSAs in 2013.

Table 176 - Green Drop Comparative Analysis from 2009 to 2021

GREEN DROP COMPARATIVE ANALYSIS					
Performance Category	**2009**	**2011**	**2013**	**2021**	**Performance trend 2013 and 2021**
Incentive-based indicators					
Municipalities assessed (#)	13 (45%)	27 (100%)	27(100%)	26 (100%)	→
Wastewater systems assessed (#)	35	71	79	78	↓
Average Green Drop score	29%	26.1%	33.8%	19.2%	↓
Green Drop scores ≥50% (#)	20/35 (43%)	9/71 (13%)	20/79 (25%)	4/78 (5%)	↓
Green Drop scores <50% (#)	15/35 (57%)	62/71 (87%)	59/79 (75%)	74/78 (95%)	↓
Green Drop Certifications (#)	0	0	1	0	↓
Technical Site Inspection Score (%)	NA	37.0%	47.0%	38.3%	↓

NA = Not Applied NI = No Information *↑= improvement, ↓= regress, →= no change*

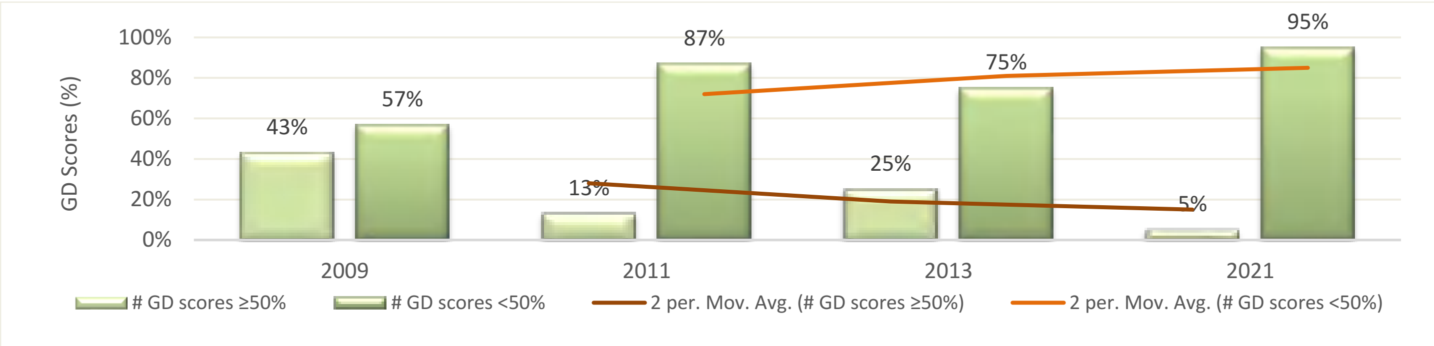


Figure 161 - Green Drop trend analysis over the period 2009 to 2021, indicating the percentage GD scores above and below 50%

The trend analysis indicates that:

- The number of systems audited has increased from 35 systems in 2009, when the first assessments were undertaken, to 78 systems in 2021
- Despite an upward trend in previous GD scores, 26% in 2011, 34% to 2013, there was a drop-off to 19% in 2021
- Similarly, the number of systems with GD scores of ≥50% increased between from 9 (13%) in 2011 to 20 (25%) in 2013 but decreased to 4 (5%) in 2021
- This trend was also mirrored in the TSA score, which had increased from 37% in 2011 to 47% in 2013 but decreased to 38% in 2021
- This trend was balanced by the number of systems with GD score of ≤50% decreasing from 62 (87%) in 2011 to 59 (75%) in 2013, followed a regress to 74 (95%) in 2021
- The number of Green Drop Certifications decreased form 1 award in 2013 and to no awards in 2021
- An overall performance trend from 2013 to 2021 signals the need for repeat/regular audits to ensure continued improvement. There are indications that performance has declined in the absence of the consistent regulatory engagement.

The analysis for the period 2009, 2011, 2013 and 2021, indicates that most of the system scores are in the 0-<31% (Critical state) category, with the 31-<50% (Poor Performance) being the next largest category. The most concerning data point is that 59 systems are in critical state (<31%) which is a sharp increase compared to 33 systems in this category in 2013.

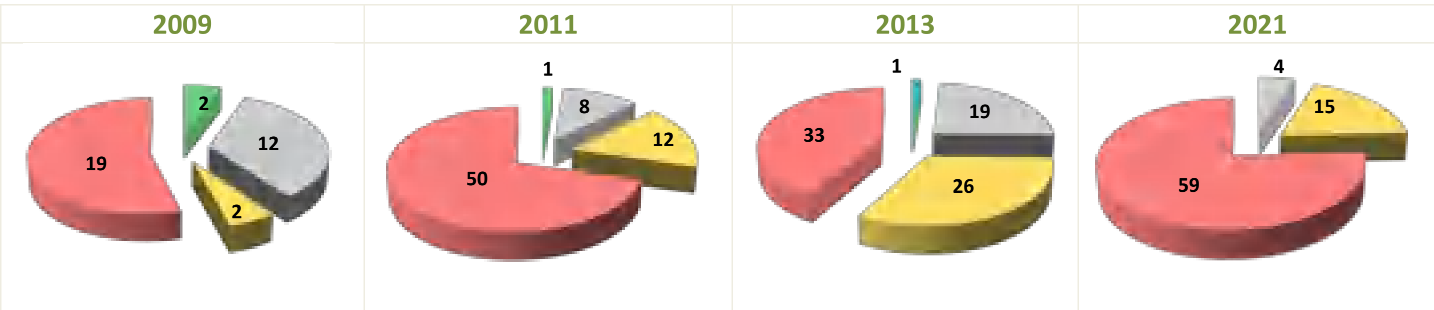


Figure 162 - No. WWTWs in the Green Drop score categories over the period 2009 to 2021 (graph legend to right)

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
31-<50% Poor	
0-<31% Critical state	

In summary, trends over the years 2013 and 2021 indicate as follows:

- The number of systems in a 'poor state' decreased from 26 systems in 2013 to 15 systems in 2021
- The number of systems in a 'critical state' increased from 33 systems in 2013 to 59 systems in 2021
- The number of systems in the 'excellent and good state' decreased from 20 systems in 2013 to 4 systems in 2021.

Provincial Risk Analysis

Green Drop risk analysis (CRR) focuses specifically on the treatment function. It considers 4 risk indicators, i.e. design capacity, operational flow, technical capacity, and effluent quality. The CRR values do not factor risks associated with sanitation or wastewater network and collector systems.

Table 177 – Cumulative Risk Comparative Analysis from 2009 to 2021

CUMULATIVE RISK COMPARATIVE ANALYSIS					
Performance Category	**2009**	**2011**	**2013**	**2021**	**Performance Trend 2013 to 2021**
Highest CRR	23	28	17	32	↑
Average CRR	14.4	14.1	13.5	15.9	↓
Lowest CRR	6	5	4	10	↓
Design Rating (A)	1.1	1.1	1.1	1.1	→
Capacity Exceedance Rating (B)	3.4	4.1	4.1	4.4	↓
Effluent Failure Rating I	7.9	6.5	6.1	7.8	↓
Technical Skills Rating (D)	2.8	3.0	3.1	3.1	→
CRR% Deviation	**78.4**	**75.8**	**78.4**	**89.7**	↓

↑= improvement, ↓= regress, →= no change

The concept of risk management has still not been embedded within the municipal sector of the Northern Cape. Table 177 shows a considerable regression in the CRR% deviation from 2013 to 2021, underscored by an unchanged design capacity rating (A) and technical skills rating (D), but with increased risk in the capacity exceedance rating (B), and a considerable increase in risk in the final effluent failures rating (E). Individual systems show high deviations in specific risk categories, as highlighted under "***Regulator's Comment***". The CRR analysis in context of the Green Drop results suggests that future improvements should focus on 1) capacity exceedance at plants which are hydraulically overloaded or approaching its design lifespan, 2) effluent quality failures, especially for microbiological compliance, and 3) strengthening of technical skills and operational competency, especially related to sludge management.

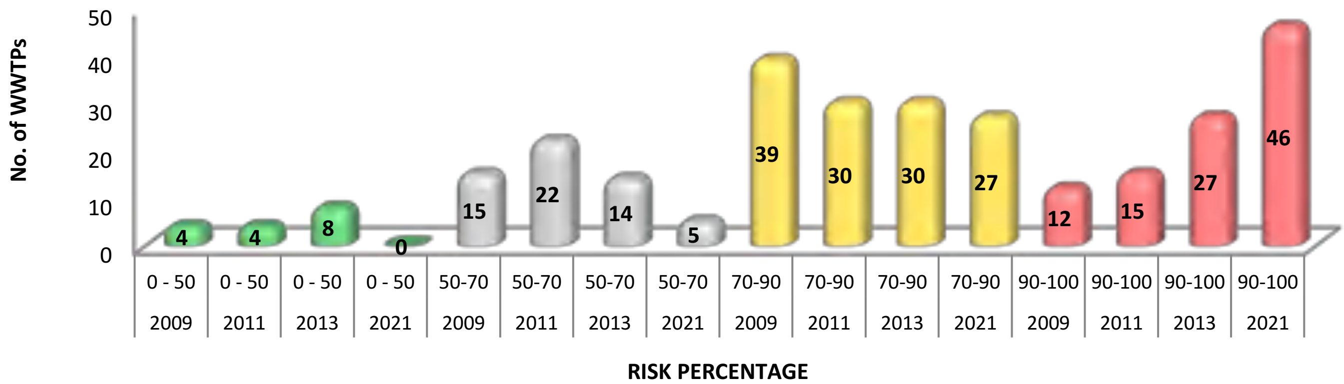


Figure 163 - a) WWTW Risk distribution and trends from 2009 to 2021; b) Colour legend

90 – 100% Critical risk WWTPs	
70 - <90% High risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low risk WWTPs	

Trend analysis of the CRR ratings for the period 2009 to 2021 reveals that:

- The most prominent movement in risk can be seen between 2013 and 2021, when a significant number of plants moved from low, medium, and high-risk positions to critical positions, indicating a regressive state for the WWTWs
- The CRR decline has been consistent from 2011 to 2021
- The 2021 assessment cycle highlighted regressive shifts with a decrease in the number of low (8 to 0), medium (14 to 5) and high risk (30 to 27) WWTWs, and an increase in critical risk WWTWs (27 to 46).

Regulatory Enforcement

Wastewater systems which failed to achieve the minimum Green Drop target of 31%, are placed under regulatory focus. The Regulator requires these municipalities to submit a detailed corrective action plan within 60 days of publishing of this report.

Twenty-three (23) municipalities and fifty-nine (59) wastewater systems that received Green Drop scores below 31%, are to be placed under **regulatory surveillance**, in accordance with the Water Services Act (108 0f 1997). In addition, these municipalities will be compelled to ringfence water services grant allocation to rectify/restore wastewater collection and treatment shortcomings identified in this report.

Table 178 - WWTWs with <31% Green Drop scores

WSA Name	2021 Municipal GD Score	WWTWs with <31% score
Kareeberg LM	44%	2 of 3 plants
Tsantsabane LM	38%	Jen haven
Hantam LM	36%	Brandvlei
Sol Plaatje LM	36%	Richie-Rietvale
Nama Khoi LM	27%	6 of 8 plants
Siyancuma LM	26%	2 of 3 plants
Gamagara LM	26%	3 of 4 plants
Ubuntu LM	23%	All 3 plants
Umsobomvu LM	18%	All 3 plants
Dikgatlong LM	18%	All 3 plants
Kgatelopele LM	15%	Danielskuil
!Kai !Garib LM	13%	All 4 plants
Emthanjeni LM	13%	All 3 plants
Karoo Hoogland LM	11%	All 3 plants
Ga-Segonyana LM	10%	Both plants (2)
Magareng LM	5%	Warrenton
Joe Morolong LM	3%	Both plants (2)
!Kheis LM	2%	All 5 plants
Richtersveld LM	2%	Port Nolloth
Khai-Ma LM	1%	All 4 plants
Phokwane LM	0%	All 3 plants
Kamiesberg LM	0%	Both plants (2)
Renosterberg LM	0%	All 3 plants

The following municipalities and their associated wastewater treatment plants are in high CRR risk positions, which means that some or all the risk indicators are in a precarious state, i.e. operational flow, technical capacity, and effluent quality. WWTWs in high risk and critical risk positions pose a serious risk to public health and the environment. The following municipalities will be required to assess their risk contributors and develop corrective measures to mitigate these risks.

Table 179 - %CRR/CRR$_{max}$ scores and WWTWs in critical and high-risk space

WSA Name	2021 Average CRR/CRRmax % deviation	WWTWs in critical and high-risk space	
		Critical Risk (90-100%CRR)	High Risk (70-<90%CRR)
Siyathemba LM	68.6%		Prieska, Niekerkshoop
Dawid Kruiper LM	70.0%		Askham, Rietfontein
Hantam LM	72.1%		Brandvlei, Loeriesfontein
Gamagara LM	81.1%	Olifantshoek	Kathu, Dibeng
Richtersveld LM	82.4%		Port Nolloth
Thembelihle LM	82.4%		Hopetown New, Strydenburg New
Siyancuma LM	86.3%	Schmidtsdrift	Douglas, Griekwastad
Kareeberg LM	88.2%	Van Wyksvlei, Vosburg	Carnarvon
Magareng LM	88.2%		Warrenton
Tsantsabane LM	88.2%	Jenn-Haven	Postmasburg
Nama Khoi LM	90.4%	Bergsig, Concordia, Komaggas, Nababeep	Springbok, Carolusberg, Okiep, Steinkopf
Sol Plaatje LM	90.7%	Homevale, Rietvale-Richie	Beaconsfield
Emthanjeni LM	92.2%	Hanover, Britstown	De Aar

WSA Name	2021 Average CRR/CRRmax % deviation	WWTWs in critical and high-risk space	
		Critical Risk (90-100%CRR)	High Risk (70-<90%CRR)
Umsobomvu LM	**92.2%**	Noupoort, Norvalspont	Colesburg
!Kai! Garib LM	**92.6%**	Keimoes, Kenhardt, Vredesvallei	Kakamas
!Kheis LM	**94.1%**	Grootdrink, Topline, Wegdraai	Groblershoop, Brandboom
Ga-Segonyana LM	**94.1%**	Both plants (2)	
Joe Morolong LM	**94.1%**	Both plants (2)	
Kgatelopele LM	**94.1%**	Danielskuil	
Khai-Ma LM	**97.1%**	Aggenys, Pella, Onseepkans	Pofadder
Ubuntu LM	**98.0%**	All 3 plants	
Dikgatlong LM	**100.0%**	All 3 plants	
Kamiesberg LM	**100.0%**	Both plants (2)	
Karoo Hoogland LM	**100.0%**	All 3 plants	
Phokwane LM	**100.0%**	All 3 plants	
Renosterberg LM	**100.0%**	All 3 plants	

Good practice risk management requires that the W_2RAPs are informed by meaningful Process and Condition Assessments, supported by zealous implementation of corrective measures and ongoing monitoring of risk movement. None of the Northern Cape WSAs can be commended for maintaining all their treatment facilities in low and medium risk positions.

Performance Barometer

The **Green Drop Performance Barometer** presents the individual Municipal Green Drop Scores, which essentially reflects the level of mastery that a municipality has achieved in terms of its overall municipal wastewater services business. The bar chart below indicates the GD scores for 2013 in comparison to GD 2021, from highest to lowest performing WSI. Dawid Kruiper is the only municipality that maintains an average performance. Tsantsabane moved from a good performance score of 83% in 2013 to a poor performance score of 38% in 2021. Other municipalities that moved from an average performance score to a poor performance or critical state are Thembelihle, Hantam, Sol Plaatje, Kgatelopele, Emthanjeni and Phokwane.

The **Cumulative Risk Log** expresses the level of risk that a municipality poses in respect its wastewater treatment facility. It is based on the ***individual Cumulative Risk Ratios***. Figure 164b presents the cumulative risks in ascending order – with the low-risk municipalities on the left and critical risk municipalities to the far right. The analysis reveals that there 16 critical risk municipalities and 9 high-risk municipalities in the Province. Only Siyathemba resides in the medium risk position.

The remainder of the municipalities received <50% Green Drop scores.

Provincial Best Performer

Dawid Kruiper LM is the **BEST SCORING** municipality in the Province:

- ✓ 64% Municipal Green Drop Score
- ✓ 2013 Green Drop Scores of 60% (Khara Hais LM) and 1% (Mier LM)
- ✓ 2 of 4 (50%) plants in the medium risk positions
- ✓ Technical Site Assessment score of 55% (Upington-Kameelmond)

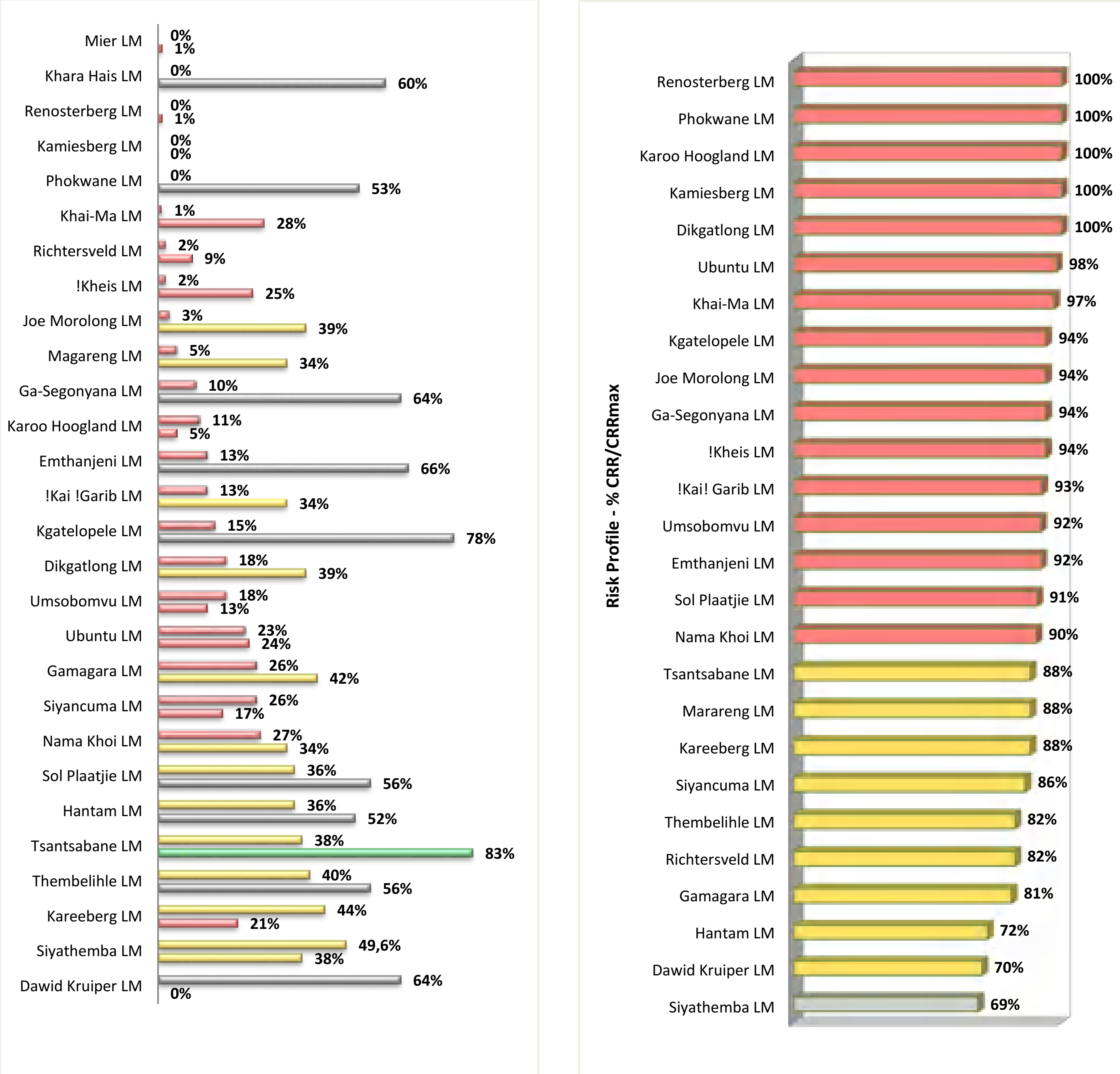


Figure 164 - a) Green Drop scores 2013 (bottom bar) and 2021 (top bar), with colour legend inserted; b) %CRR/CRRmax Risk Performance Log 2021 with colour legends inserted

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	

90 – 100% Critical risk WWTPs	
70 - <90% High risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low risk WWTPs	

KPA Diagnostics

The Green Drop Audit process collects a vast amount of data that yield valuable insight on the state of the wastewater sector in each Province. These insights have been captured into 7 thematic areas or 'Diagnostics', as discussed below.

Table 180 - Summary of the key diagnostic themes and reference to the respective Green Drop KPAs

Diagnostic #	Diagnostic Description	Diagnostic Reference
1	**Green Drop KPA Analysis**	KPAs A-E
2	**Technical Competence**	KPA A, B & Bonus

Diagnostic #	Diagnostic Description	Diagnostic Reference
3	**Treatment Capacity**	KPA D
4	**Wastewater Monitoring and Compliance**	KPA B & D & Bonus
5	**Energy Efficiency**	KPA C & Bonus
6	**Technical Site Assessments**	TSA
7	**Operation, Maintenance and Refurbishment of Assets**	KPA C, D & Bonus

Diagnostic 1: Green Drop KPA Analysis

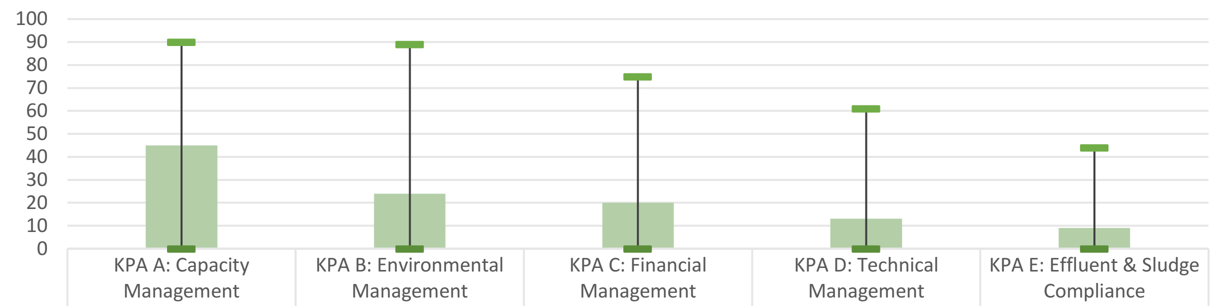
Aim: Analysis of technical skills, environmental plans, financial management, technical capacity, and regulatory compliance provides insight to the strengths and weaknesses that distinguish the Provinces' wastewater industry. These insights in return, may inform appropriate interventions and strategies to improve the individual KPAs and ultimately, collective KPA performance.

Findings: The WSAs are characterised by a highly variable KPA profile. A good KPA profile typically depicts a high mean GD score, coupled with a low Standard Deviation (SD) between the outer parameters (min and max). Similarly, a well performing system is one which has most/all systems in the >80% bracket and no systems in the <31% bracket.

Table 181 - Green Drop scores KPA profiles (graph legend included)

KPA #	Key Performance Area	*Weight*	Minimum GD Score (%)	Maximum GD Score (%)	Mean GD Score (%)	# Systems <31%	# Systems >80%
A	Capacity Management	*15%*	0%	90%	**45%**	11 (14%)	5 (6%)
B	Environmental Management	*15%*	0%	89%	**24%**	20 (26%)	1 (1%)
C	Financial Management	*20%*	0%	75%	**20%**	19 (24%)	0 (0%)
D	Technical Management	*20%*	0%	61%	**13%**	23 (29%)	0 (0%)
E	Effluent and Sludge Compliance	*30%*	0%	44%	**9%**	25 (32%)	0 (0%)

90 – 100% Excellent
80-<90% Good
50-<80% Average
30-<50% Poor
0-<31% Critical state



	KPA A: Capacity Management	KPA B: Environmental Management	KPA C: Financial Management	KPA D: Technical Management	KPA E: Effluent & Sludge Compliance
Mean	45	24	20	13	9
Max	90	89	75	61	44
Min	0	0	0	0	0

Note: The High and low lines represent the Min and Max range, and the shaded green represents the Mean

Figure 165 - Maximum, minimum, and mean Green Drop KPA scores

The KPA distribution indicates as follows:

- Capacity Management (KPA A) depicts the highest mean of 45%, the highest maximum of 90%, and the highest Standard Deviation (SD) of 91%. These results indicate pockets of strengths pertaining to the registration of WWTWs, maintenance plans and records, maintenance teams, and registered, qualified staff (process controllers, supervisors, scientists, technicians, engineers)
- Effluent and Sludge Quality Compliance (KPA E) received the lowest mean of 9%, indicating a deficiency in data management, IRIS upload, effluent quality compliance, and sludge quality compliance
- This was followed by the Technical Management (KPA D) that received the next lowest mean of 13%, indicating a vulnerability in basic design information, inflow, outflow, meter reading credibility, process and condition assessments, site inspection reports, asset registers, asset values, bylaws, and enforcement
- Uniquely, the mean averages decreased steadily from KPA A to KPA E.

The GD bracket performance distribution reiterates the above findings:

- ***KPA Score >80%:*** Capacity Management (KPA A) is the best performing KPA with 6% of systems achieving >80%, followed by Environmental Management (KPA B) with a distant 1%. For all the remaining KPAs, no system achieved >80%.
- ***KPA Score <31%:*** Effluent & Sludge Compliance (KPA E) represents the worst performing KPA with 32% of systems lying in the 0-31% bracket, followed by Technical Management (KPA D) with 29%, and Environmental Management (KPA B) with 26%.

Diagnostic 2: Technical Competence

Aim: This focus area assesses the human resources (technical) capacity to manage wastewater systems. Theory suggests a correlation between human resources capacity (sufficient number of appropriately qualified staff) and a municipality's performance- and operational capability. It is projected that high HR capacity would translate to compliant wastewater services and protection of scarce water resources.

Findings: According to regulations, wastewater plants are classified as Class A, B, C, D or E plants. Similarly, Process Controllers and Plant Supervisors are registered as Class I, II, III, IV, V or VI operators. High classed plants require a higher level of operators due to their complexity and strict regulatory standards. Technical compliance of PCs and Supervisors is determined against Green Drop standards, as defined by Reg. 2834 and draft Reg. 813 of the National Water Act 1998.

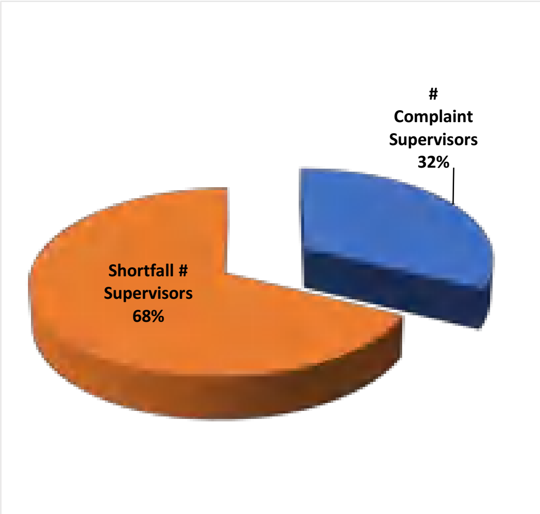
Note: "Compliant staff" means qualified and registered staff that meets the GD standard for a particular Class Works. "Staff shortfall" means staff that does not meet the GD standard for a particular Class of works (+1 for a shift) and/or staffing gaps exist at the respective WWTWs.

Table 182 - No. compliant versus shortfall in Supervisor and Process Controller staff

WSA Name	# WWTWs	# Compliant staff		# Staff Shortfall		Ratio*	WSA 2021 GD Score (%)
		Supervisor	PCs	Supervisor	PCs		
Dawid Kruiper	4	1	7	1	3	2.0	64%
Hantam	4	1	2	0	3	0.8	36%
Kai Garib	4	1	0	0	5	0.3	13%
Kamiesberg	2	0	0	1	2	0.0	0%
Karoo Hoogland	3	1	0	0	5	0.3	11%
Khai Ma	4	0	0	1	4	0.0	1%
Nama Khoi	8	0	0	2	10	0.0	27%
Richtersveld	1	0	0	1	1	0.0	2%
!Kheis	5	0	0	1	5	0.0	2%
Joe Morolong	2	1	0	0	3	0.5	3%
Siyathemba	3	0	4	1	1	1.3	50%
Dikgatlong	3	0	0	1	5	0.0	18%
Emthanjeni	3	0	3	1	2	1.0	13%
Kareeberg	3	1	2	0	2	1.0	44%
Magareng	1	0	4	1	0	4.0	5%
Phokwane	3	0	0	1	5	0.0	0%
Renosterberg	3	0	0	1	4	0.0	0%
Sol Plaatje	3	1	3	2	8	1.3	36%
Thembelihle	2	2	4	0	0	3.0	40%
Ubuntu	3	0	2	1	2	0.7	23%
Umsobomvu	3	0	3	1	2	1.0	18%
Ga-Segonyana	2	0	1	1	3	0.5	10%
Gamagara	3	1	4	0	3	1.7	26%
Kgatelopele	1	0	1	1	0	1.0	15%
Tsantsabane	2	0	0	1	4	0.0	38%
Siyancuma	3	0	0	1	3	0.0	26%
Totals	**78**	**10**	**40**	**21**	**85**		

** The single number Ratio depicts the number of qualified staff divided by the number of WWTWs operated by this number of staff. E.g., Dawid Kruiper has 8 qualified staff to operate 4 WWTWs, thus 8/4 = 2 ratio*

Competent human resources is a vital enabler to ensure efficient and sustainable management of treatment processes and infrastructure. For the Northern Cape, operational competencies are not on par with regulatory expectations, as illustrated by the high shortfalls against the Green Drop standards.



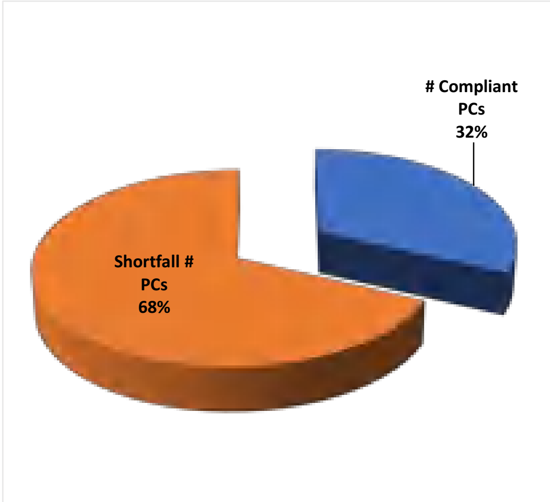


Figure 166 - Schematic illustration of compliant versus non-compliant Supervisors (a) and Process Controllers (b)

Plant Supervisors: The pie charts indicate that 32% (10 of 31) of Plant Supervisors complies with the Green Drop standard, with zero shortfall for 7 of 26 municipalities. A 68% (21 of 31) shortfall is noted for Supervisors overall, with the highest shortfall seen at Nama Khoi and Sol Plaatje (2 no. each). A shortfall in one roaming Supervisor for most of the municipalities.

Process Controllers: Similarly, 32% (40 of 125) of the PC staff is compliant for the Northern Cape, with a zero shortfall for Magareng, Thembelihle and Kgatelopele. There is a 68% (85 of 125) shortfall in PCs with the highest shortfall for the Nama Khoi (10 no.), Sol Plaatje (8 no.), and Kai Garib, Karoo Hoogland, Kheis, Dikgatlong and Phokwane (5 no. each).

Green Drop standards require of Class A and B plants to employ dedicated Supervisors and Process Controllers per shift per works, whereas Class C to E Works may consider sharing of staff across works. Furthermore, shifts have been introduced to ensure optimal operations while addressing security risks, particularly as it relates to vandalism. Telemetry also reduces the requirement for on-site staff during night shifts, but these relaxations will have to be done within the DWS regulatory guidelines.

It is anticipated, but never tested before, that a correlation would exist between the competence of an operational team and the performance of a treatment plant, as measured by the GD score. The results from the ratio analysis indicate high ratios for Magareng, Thembelihle and Dawid Kruiper, and low ratios from Hantam to Siyancuma (Figure 167).

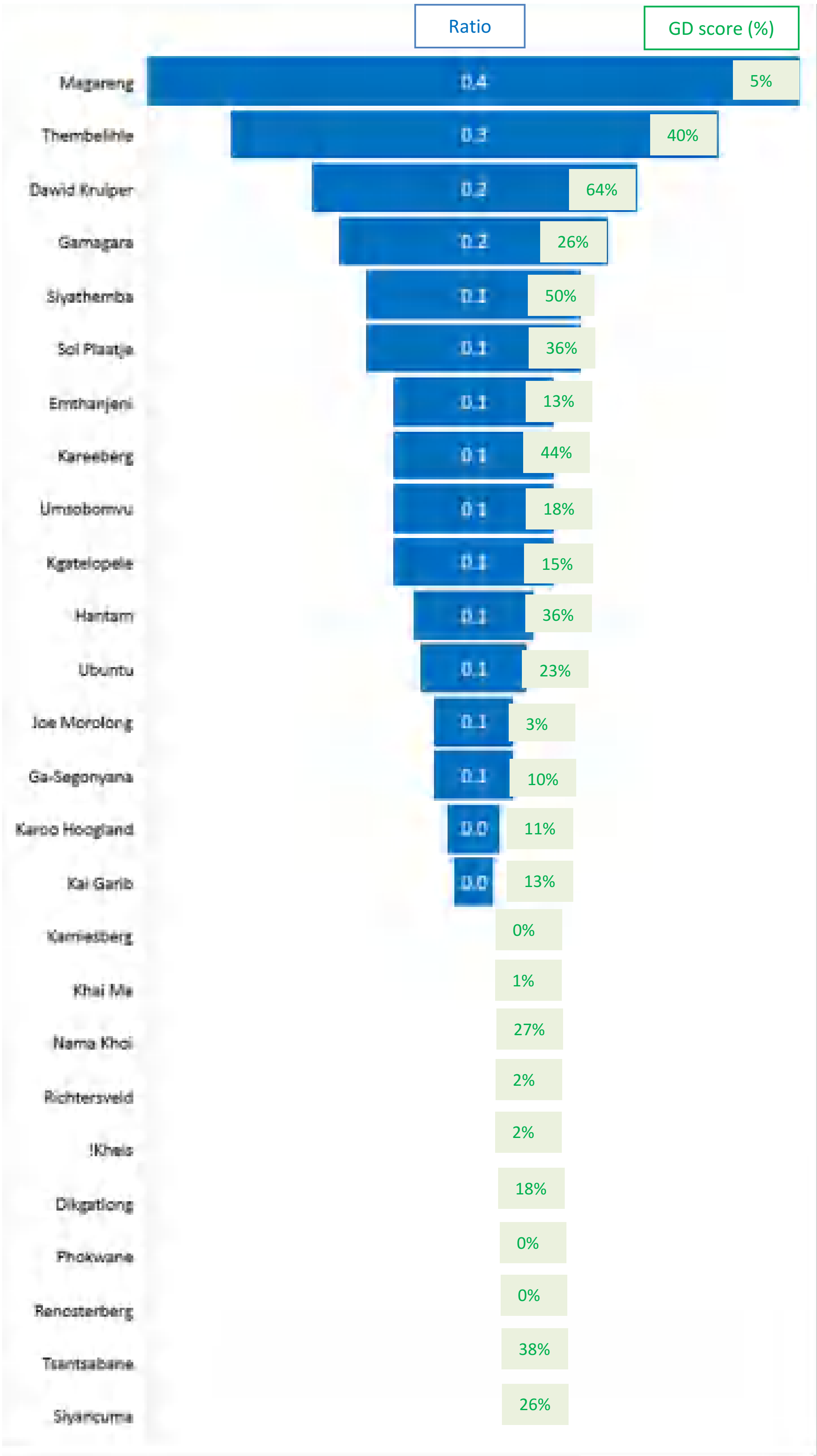


Figure 167 - Ratio of compliant operational staff to no. of WWTWs and Comparison of Ratios with GD scores

Overall, the comparative bar chart confirms a high correlation between high ratios and higher GD scores. Some anomalies include Magareng that has a high ratio with 4 staff managing 1 WWTW only. Also, municipalities with higher ratios and low GD scores like Emthanjeni, Umsobomvu and Kgatelopele, and vice versa for municipalities with lower ratio and higher GD scores like Tsantsabane, Siyancuma and Nama Khoi.

In addition to operational capacity (above), good management practice also requires access to qualified engineers, technicians, technologists, scientists, and maintenance capability. Such competencies could reside in-house or accessible through term contracts and external specialists.

Table 183 - Summary of the maintenance capacity and no. of qualified and shortfall of Engineering, Technical and Scientific staff

WSA Name	# WWTW	Maintenance Arrangement	Qualified Technical Staff (#)				Technical Shortfall (#)	Qualified Scientists (#)	Scientists Shortfall (#)	Ratio*	WSA 2021 GD Score (%)
			Engineers	Technologists	Technicians	Total					
Dawid Kruiper	4	Internal + Specific Outsourcing	2	1	0	3	0	0	1	0.8	64%
Hantam	4	Internal + Specific Outsourcing	1	0	0	1	0	0	1	0.3	36%
Kai Garib	4	Internal + Term Contract: Internal + Specific Outsourcing	1	0	0	1	0	0	1	0.3	13%
Kamiesberg	2	Internal Team (Only)	0	0	0	0	0	0	1	0.0	0%
Karoo Hoogland	3	Internal Team (Only)	0	0	2	2	2	0	1	0.7	11%
Khai Ma	4	Internal Team (Only)	0	0	2	2	2	0	1	0.5	1%
Nama Khoi	8	Internal Team (Only)	0	0	0	0	0	0	1	0.0	27%
Richtersveld	1	Internal + Specific Outsourcing	1	1	0	2	0	0	1	2.0	2%
!Kheis	5	Internal Team (Only): Internal + Term Contract: Inadequate Capacity	0	0	2	2	2	0	1	0.4	2%
Joe Morolong	2	Partially Capacitated: Internal Team (Only)	0	0	2	2	2	0	1	1.0	3%
Siyathemba	3	Internal Team (Only)	1	1	0	2	0	0	1	0.7	50%
Dikgatlong	3	No Capacity: Internal + Specific Outsourcing	0	0	2	2	2	0	1	0.7	18%
Emthanjeni	3	Internal + Specific Outsourcing	0	4	0	4	0	0	1	1.3	13%
Kareeberg	3	No Capacity: Internal + Specific Outsourcing	0	1	0	1	0	0	0	0.3	44%
Magareng	1	Internal + Specific Outsourcing	0	0	2	2	2	1	0	2.0	5%
Phokwane	3	No Capacity	0	0	2	2	2	0	1	0.7	0%
Renosterberg	3	No Capacity	0	0	2	2	2	0	1	0.7	0%
Sol Plaatje	3	Internal + Specific Outsourcing	0	1	0	1	0	6	0	0.3	36%
Thembelihle	2	Internal + Specific Outsourcing	0	1	0	1	0	0	1	0.5	40%
Ubuntu	3	Internal Team (Only)	0	1	0	1	0	0	1	0.3	23%
Umsobomvu	3	Internal + Specific Outsourcing	0	3	0	3	0	1	0	1.0	18%
Ga-Segonyana	2	Internal + Specific Outsourcing	0	0	2	2	2	0	1	1.0	10%
Gamagara	3	Internal Team (Only)	3	1	0	4	0	0	1	1.3	26%
Kgatelopele	1	Internal + Term Contract	0	0	2	2	2	0	1	2.0	15%
Tsantsabane	2	Internal + Term Contract: Internal Team (Only)	0	1	0	1	0	0	1	0.5	38%
Siyancuma	3	Internal Team (Only)	0	1	0	1	0	0	1	0.3	26%
Totals	**78**		**9**	**17**	**20**	**46**	**20**	**8**	**23**		

** The single number Ratio is derived from the number of qualified staff divided by the number of WWTWs operated by this number of staff. E.g., for Dawid Kruiper, 3 qualified staff is available to support 4 WWTW,¾us 3/4 = 0.8 ratio*

Note 1: "Qualified Technical Staff" means staff appointed in positions to support wastewater services, and who has the required qualifications. "Technical Shortfall" is calculated based on a minimum requirement of at least 2 Engineers/Technologists/Technicians and at least one 1 Scientist per WSI.

Note 2: "Qualified Scientists" means professional registered scientists (SACNASP) appointed in positions to support wastewater services. "Scientist's shortfall" means that the WSA does not have at least one qualified, SACNASP registered scientist in their employ or contracted.

The Northern Cape has access to a pool of qualified technical staff:

- A total of 9 engineers, 17 technologists, 20 technicians (qualified) and 8 SACNASP registered scientists are assigned to the 26 municipalities, totalling 54 qualified staff for the province
- A total shortfall of 43 persons is identified, consisting of 20 technical staff and 23 scientists
- 10 of 26 municipalities have some shortfall in qualified technical staff
- 10 of 26 (38%) municipalities have access to credible laboratories which complies with Green Drop standards.

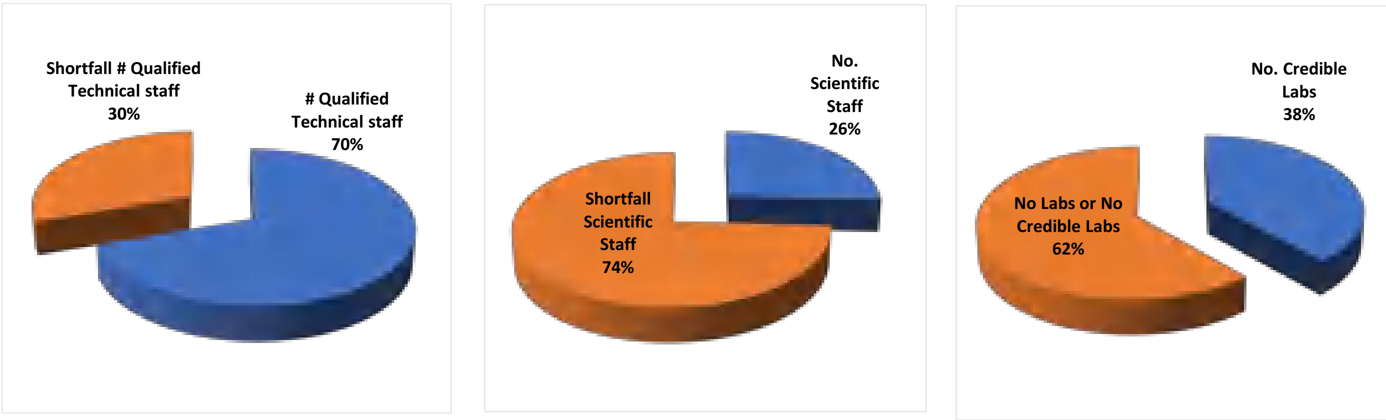


Figure 168 - Graphic illustration of the number and %: a) qualified engineering/technical staff; b) professional scientists; c) access to credible laboratory services that complies with Green Drop standards

Ratio analysis has also been done to determine the number of qualified technical and scientific staff assigned per WWTW. It is expected, but never tested before, that a higher ratio would correspond with well-performing and maintained wastewater systems, as represented by the GD score.

Dissimilar to the operational staff ratios, no pattern or correlation is evident between high ratios and high GD scores (Figure 169). There appear to be many anomalies between the ratios and the GD scores. These results suggest that wastewater performance may be less sensitive towards engineering, technical and scientific staff, and more dependent on operational competencies (Superintendents and PCs).

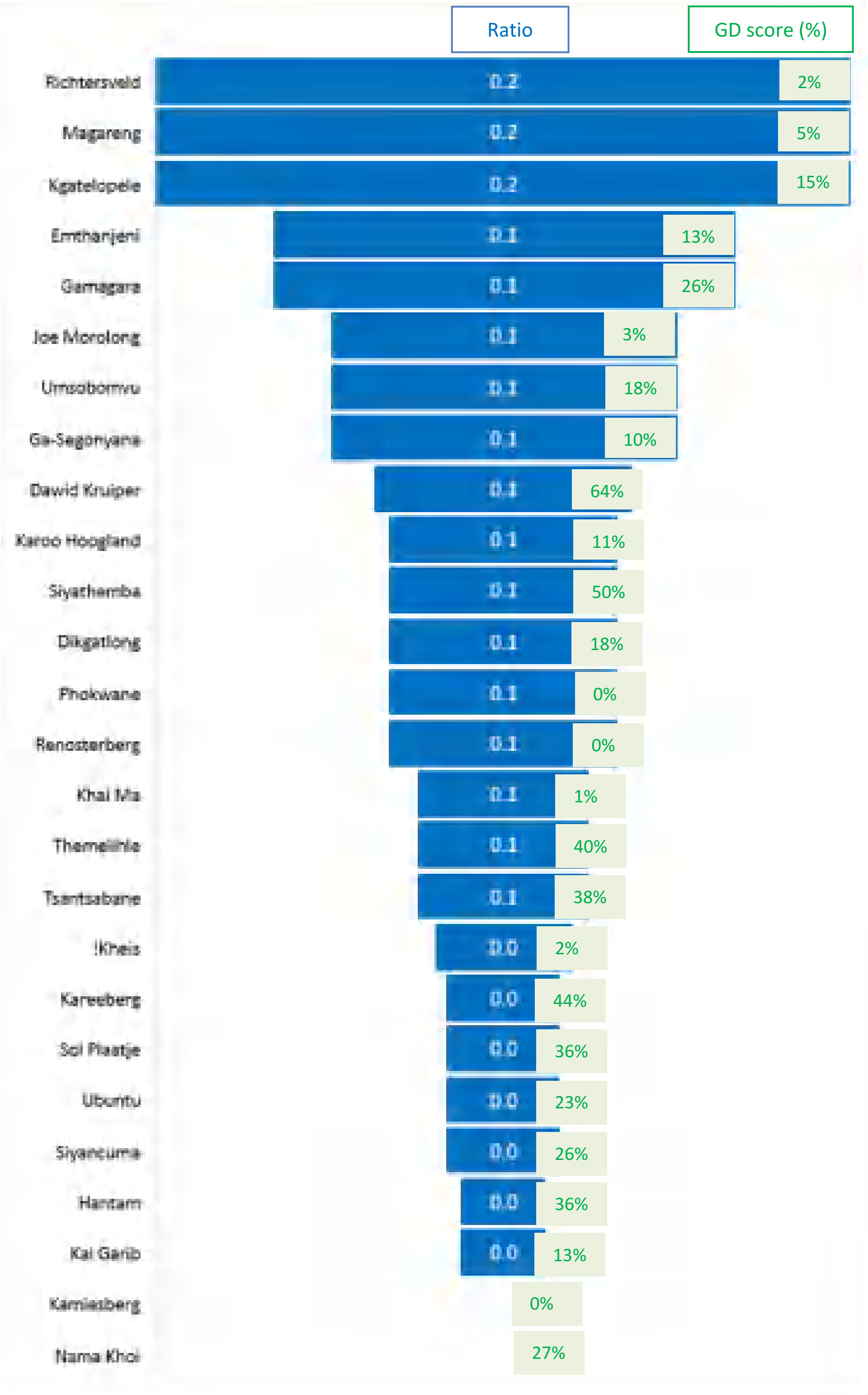


Figure 169 - Ratio of compliant technical staff to no. of WWTWs and Comparison of Ratios with GD scores

In terms of maintenance capacity, the Northern Cape has a reasonable contingent of qualified maintenance staff for at least 22 of the 26 municipalities, with the current qualified maintenance staff from a collective of inhouse, contracted or outsourced personnel. The data indicates that:

- 22 of 26 municipalities have in-house maintenance teams
- 3 of 26 municipalities have internal maintenance teams supplemented with term contracts
- 12 of 26 municipalities have internal maintenance teams supplement with specific outsourced services.

One manner of enhancing operational capacity is via dedicated training programmes. The Green Drop audit incentivise appropriate training of operational staff over a 2-year period prior to the audit date. The results are summarised as follows:

Table 184 - No. of WWTWs with operational staff sent on training over the past 2 years and vice versa

WSA Name	# of WWTW staff attending training over past 2 years	# of WWTW without training over past 2 years
Dawid Kruiper	4	0
Hantam	0	4
Kai Garib	3	1
Kamiesberg	0	2
Karoo Hoogland	0	3
Khai Ma	0	4
Nama Khoi	0	8
Richtersveld	0	1
!Kheis	0	5
Joe Morolong	0	2
Siyathemba	0	3
Dikgatlong	0	3
Emthanjeni	0	3
Kareeberg	0	3
Magareng	1	0
Phokwane	0	3
Renosterberg	0	3
Sol Plaatje	3	0
Thembelihle	0	2
Ubuntu	0	3
Umsobomvu	0	3
Ga-Segonyana	0	2
Gamagara	0	3
Kgatelopele	0	1
Tsantsabane	0	2
Siyancuma	0	3
Totals	**11 (14%)**	**67 (86%)**

Figure 170 - %WWTWs that have trained operational staff over the past two years

The results confirmed that less than only 11 (14%) of the WWTWs had operational staff that attended training over the past 2 years. Significant training gaps are observed, which would require a concerted effort to strengthen training initiatives of Supervisors and Process Controllers. Recent training events focussed primarily on chlorine handling and NQF, and need to be expanded to operation of technology, sludge treatment and energy efficiency.

Diagnostic 3: Treatment Capacity

Aim: A capable treatment plant requires adequate design capacity and functional equipment to deliver a quality final water. If the plant capacity is exceeded by way of inflow volume or strength, a plant will not be capable to achieve its compliance standards. Capacity is typically exceeded when the demand exceeds the installed design capacity, or when processes or equipment is not operational or dysfunctional, or when the electrical supply cannot support the treatment infrastructure. This diagnostic assesses the status of plant capacity and operational flows to the plants.

Findings: Analysis of the hydraulic capacities and operational flows indicate a total design capacity of 164.7 Ml/d for the Province, with a total inflow of 41.7 Ml/day - considering that 57 systems are not measuring their inflows. Theoretically, this implies that 25% of the design capacity is used with 75% available to meet additional demand. However, the full 164.7 Ml/d is not available as some infrastructure is dysfunctional, leaving 95.3 Ml/d available. The reduced capacity means that the Northern Cape Province is closer to its total available capacity (44%) with a 56% surplus available. The lack of flow monitoring would further impact on this availability. The consequence of insufficient capacity is that new housing and industrial developments would be impeded, which would counter local socio-economic initiatives. *It must be noted that many municipalities do not report or have knowledge of reduced capacity.*

For the WSAs in general, most plants are operating within their design capacities, with the exception one system in Sol Plaatje. Sol Plaatje, Richtersveld and Khai Ma reported a low percentage use of their capacity. Treatment systems with low percentage use may have been affected by breakdown in sewer networks or pump stations whereby all sewage is not reaching the treatment works. The Green Drop audit requires a wastewater flow balance to identify and quantify possible losses from the network and/or ingress into the sewers. Most municipalities do not have flow balances that follow the wastewater trail from consumer to treatment plant.

Table 185 - Summary of WWTWs design and available capacities, inflows, % use design capacities, and inflows measured per WWTW

WSA Name	# WWTWs	Design Capacity (Ml/d)	Available Capacity (Ml/d)	Operational Flow (Ml/d)	Variance (Ml/d)	% Use Design Capacity	Inflow measured #
Sol Plaatje	3	59.0	9	9.4	49.6	16%	1
Dawid Kruiper	4	17.7	17.7	14.1	3.6	80%	4
Gamagara	3	12.1	12.1	6.4	5.7	53%	2
Phokwane	3	7.9	2.7	NI	7.9	NI	NI
Ubuntu	3	7.4	7.4	NI	7.4	NI	NI
Nama Khoi	8	7.0	6	NI	7.0	NI	NI
Ga-Segonyana	2	6.4	6.3	NI	6.4	NI	NI
Tsantsabane	2	5.8	5.8	4.0	1.8	69%	1
Emthanjeni	3	5.6	1.6	NI	5.6	NI	NI
Siyancuma	3	4.4	4.4	2.3	2.1	52%	2
Dikgatlong	3	3.7	3.7	NI	3.7	NI	NI
Khai Ma	4	3.4	0	0.2	3.2	6%	1
Siyathemba	3	3.3	3.3	2.6	0.7	80%	3
Kai Garib	4	3.2	3.2	NI	3.2	NI	NI
Richtersveld	1	3.0	3	1.0	2.0	33%	1
Umsobomvu	3	2.7	2.7	NI	2.7	NI	NI
Hantam	4	2.2	2.2	1.1	1.1	51%	4
Thembelihle	2	2.1	0.8	NI	2.1	NI	NI
Magareng	1	2.0	0.2	NI	2.0	NI	NI
Kareeberg	3	1.4	0.6	NI	1.4	NI	NI
Renosterberg	3	1.2	0.7	NI	1.2	NI	NI
Karoo Hoogland	3	0.9	0	NI	0.9	NI	NI
!Kheis	5	0.7	0.7	0.6	0.1	83%	2
Kgatelopele	1	0.7	0.7	NI	0.7	NI	NI
Kamiesberg	2	0.5	0.5	NI	0.5	NI	NI
Joe Morolong	2	0.4	0	NI	0.4	NI	NI
Totals	**78**	**164.7**	**95.3**	**41.7**	**123**	**25%**	**21**

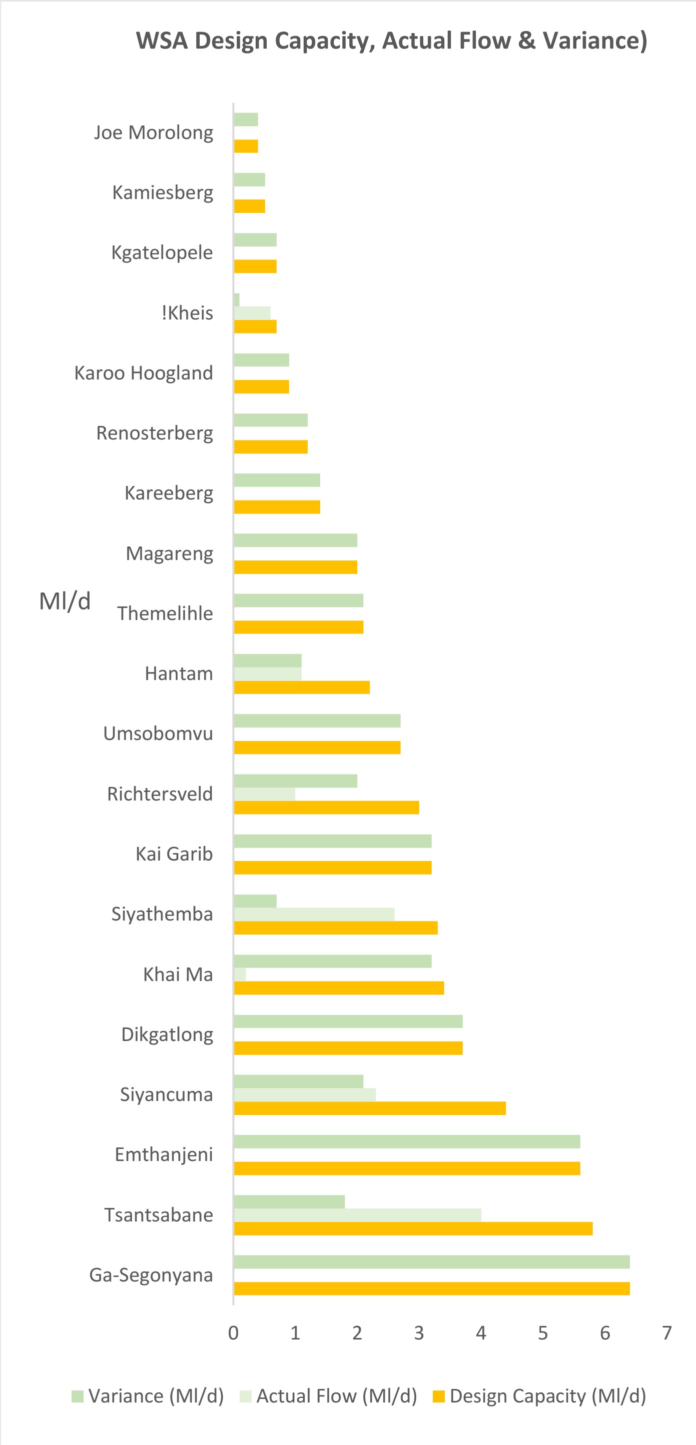
The audit data shows that 1 system with known design capacity is hydraulically overloaded. This figure will be higher as there are 57 systems that are not measuring their inflows and hence it is not possible to determine whether these systems are hydraulically overloaded as well. New housing and industrial developments planned in these drainage areas would not be able to proceed, without expansion of the capacity. The systems with known design capacities, that are hydraulically overloaded, are as follows:

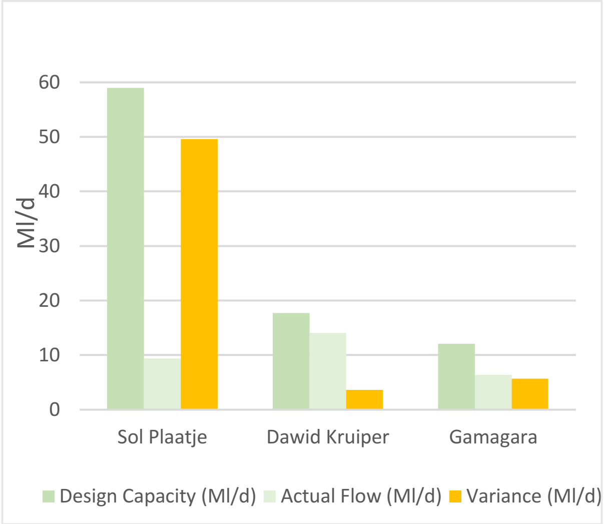
- Sol Plaatje: 1 of 3 systems (Beaconsfield) – inflows not recorded for the other 2 systems.

Lastly, Water Use Authorisations mandate municipalities to install meters and monitor inflows, whilst GD requires WSAs to report inflows on IRIS and to calibrate meters annually.

The audit results indicate that 27% (21 of 78) of municipalities monitor their inflow, with the balance of 73% (57 of 78) not monitoring their inflow (16 of the 26 municipalities). The majority of WSAs calibrate or verify their flow meters on an annual basis, thereby meeting good practice standards.

The Northern Cape does not fare well in terms of monitoring inflow and outflows, i.e. hydraulic loads to the treatment works, and few municipalities know their organic design capacity and do not monitor organic loading to the works. This presents a gap that would impede on forward planning and system optimisation strategies.





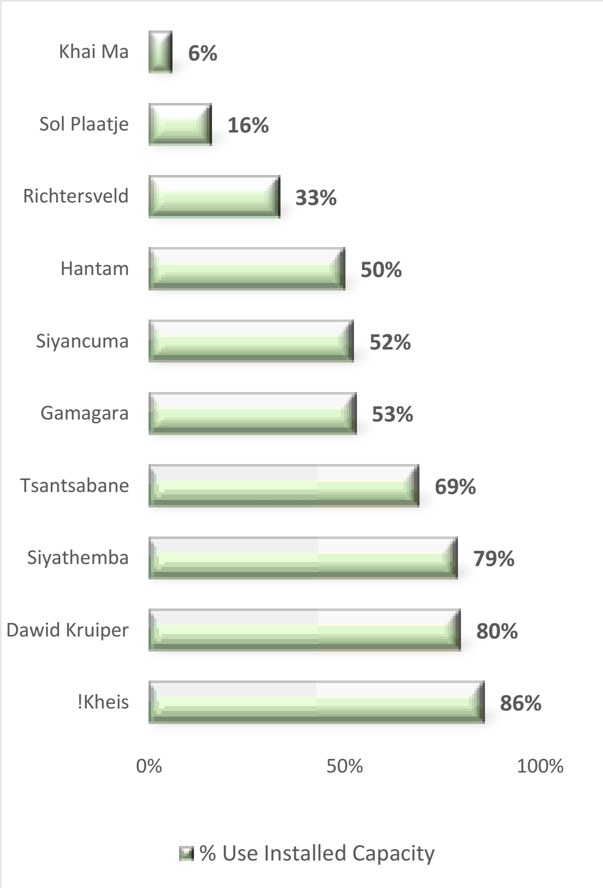


Figure 171 - a) WSA design capacity, actual flow, and variance in Ml/d for WWTWs, b) WSA % use of installed design capacity

Diagnostic 4: Wastewater Monitoring and Compliance

Aim: "*To measure is to know*" and "*To know is to manage*". The primary objective of a wastewater treatment plant is to produce final effluent and biosolids to a safe standard. This standard cannot be measured or managed if operational- and compliance monitoring is lacking. This diagnostic assesses the monitoring status and final effluent compliance against each WWTW's mandatory standards.

Findings: For operational monitoring, a satisfactory level of 90% is applied as the benchmark, to give weight to the importance of monitoring. For compliance monitoring, the audit evaluates the sampling point, sampling frequency, final effluent quality, biomonitoring, heavy metals, and any specific condition that the DWS may have included in the water use license. Final effluent quality compliance is calculated against the mandatory limits as listed under "Authorisation Status". A >90% compliance figure confirms high quality final effluent, whereas a <30% indicate poor effluent quality. The enforcement measures are summarised in the column to the far right and include legal Notices and Directives issued, criminal cases opened, and court interdicts granted during the period 1 April 2019 to 30 June 2021.

Table 186 - Summary of the WSA operational and compliance monitoring status

WSA Name	# WWTW	Operational monitoring (KPA B2)		Compliance monitoring (KPA B3)	
		Satisfactory [GD score >90%]	Not Satisfactory [GD score <90%]	Satisfactory [GD score >90%]	Not Satisfactory [GD score <90%]
Dawid Kruiper	4	0	4	0	4
Hantam	4	0	4	4	0
Kai Garib	4	0	4	0	4
Kamiesberg	2	0	2	0	2
Karoo Hoogland	3	0	3	0	3
Khai Ma	4	0	4	0	4
Nama Khoi	8	0	8	0	8
Richtersveld	1	0	1	0	1
!Kheis	5	0	5	0	5
Joe Morolong	2	0	2	0	2
Siyathemba	3	3	0	3	0
Dikgatlong	3	0	3	0	3
Emthanjeni	3	0	3	0	3
Kareeberg	3	0	3	1	2
Magareng	1	0	1	0	1
Phokwane	3	0	3	0	3
Renosterberg	3	0	3	0	3
Sol Plaatje	3	0	3	0	3
Thembelihle	2	0	2	0	2
Ubuntu	3	0	3	0	3
Umsobomvu	3	0	3	0	3
Ga-Segonyana	2	0	2	0	2
Gamagara	3	0	3	0	3
Kgatelopele	1	0	1	0	1
Tsantsabane	2	0	2	0	2
Siyancuma	3	0	3	0	3
Totals	**78**	**3 (4%)**	**75 (96%)**	**8 (10%)**	**70 (90%)**

The performance recorded in Table 186 stems from performance data as measured against the Green Drop Standard expressed in KPAs B2 and B3. The data indicates that only 3 of 78 plants (4%) are on par with good practice for operational monitoring of raw sewage and the respective units responsible for the processing effluent and sludge. Siyathemba is the only municipality that meets the Green Drop standard for operational and compliance monitoring.

An overall unsatisfactory monitoring regime is observed for both operational- and compliance sampling and analysis (96% and 90% dissatisfaction). Compliance monitoring is a legal requirement and the only means to measure performance of a treatment facility. Operational monitoring is the cornerstone of day-to-day process adjustments and optimisation to ensure treatment is efficient and deliver quality effluent/sludge that meet design expectations. Sludge monitoring is essential as poor sludge handling is the root cause of many WWTWs failing to meet final effluent standards. The results indicate that the Northern Cape on average, is not achieving regulatory- and industry standards.

Table 187 summarises the results of KPA E, which also carries the highest Green Drop scoring weight. Note that averages shown as '0%' under Effluent Compliance, include actual 0% compliance plus systems with no information or insufficient data.

Table 187 - Summary of authorisation status, effluent compliance status, and directives/notices issued

WSA Name	Effluent Compliance										Enforce-ment Measures*
	Authorisation Status	Microbiological Compliance (%)			Chemical Compliance (%)			Physical Compliance (%)			
		Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	
Dawid Kruiper	1 WUL; 3 Not authorised	25%	1	3	19%	0	2	23%	0	3	1
Hantam	1 WUL; 3 GA	81%	1	0	13%	0	4	32%	0	1	0
Kai Garib	4 Not authorised	0%	0	4	0%	0	4	0%	0	4	1
Kamiesberg	1 WUL; 1 Unknown	0%	0	2	0%	0	2	0%	0	2	2

WSA Name	Authorisation Status	Effluent Compliance									Enforce-ment Measures*
		Microbiological Compliance (%)			Chemical Compliance (%)			Physical Compliance (%)			
		Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	
Karoo Hoogland	1 WUL; 2 Not authorised	0%	0	3	0%	0	3	0%	0	3	0
Khai Ma	4 Not authorised	0%	0	4	0%	0	4	0%	0	4	0
Nama Khoi	1 GA; 1 Not authorised; 6 Unknown	16%	1	7	6%	0	7	22%	0	4	2
Richtersveld	1 WUL	0%	0	1	0%	0	1	0%	0	1	0
!Kheis	2 WUL; 2 GA; 1 Not authorised	0%	0	5	0%	0	5	0%	0	5	1
Joe Morolong	2 Not authorised	0%	0	2	0%	0	2	0%	0	2	1
Siyathemba	3 GA	12%	0	3	34%	0	1	54%	0	0	0
Dikgatlong	3 Unknown	0%	0	3	0%	0	3	0%	0	3	0
Emthanjeni	3 Unknown	0%	0	3	0%	0	3	0%	0	3	0
Kareeberg	1 Not authorised; 2 Unknown	28%	0	2	21%	0	2	14%	0	2	0
Magareng	1 Not authorised	0%	0	1	0%	0	1	0%	0	1	1
Phokwane	1 WUL; 1 GA; 1 Unknown	0%	0	3	0%	0	3	0%	0	3	2
Renosterberg	1 WUL; 1 GA; 1 Unknown	0%	0	3	0%	0	3	0%	0	3	0
Sol Plaatje	1 WUL; 1 GA; 1 Not authorised	0%	0	3	0%	0	3	0%	0	3	0
Thembelihle	1 WUL; 1 Not authorised	0%	0	2	0%	0	2	0%	0	2	1
Ubuntu	3 Not authorised	0%	0	3	0%	0	3	0%	0	3	0
Umsobomvu	1 WUL; 2 GA	0%	0	3	0%	0	3	0%	0	3	1
Ga-Segonyana	2 GA	0%	0	2	0%	0	2	0%	0	2	0
Gamagara	1 WUL; 2 GA	0%	0	3	0%	0	3	0%	0	3	0
Kgatelopele	1 GA	0%	0	1	0%	0	1	0%	0	1	0
Tsantsabane	2 GA	0%	0	2	0%	0	2	0%	0	2	0
Siyancuma	1 GA; 2 Not authorised	46%	0	1	0%	0	3	0%	0	3	1
Totals		**8%**	**3**	**69**	**4%**	**0**	**72**	**6%**	**0**	**66**	**14**

* The enforcement measures (notices or directives issued) are taken over a two-year financial period from July 2019 to June 2021

On average, the Northern Cape municipalities failed to meet final effluent quality compliance, with an average of 8% compliance with microbial effluent quality, 4% with chemical-, and 6% with physical effluent quality. For the microbiological compliance category, only 3 of 78 systems achieved >90% and 69 of 78 systems fell below 30%. For the chemical compliance category, 0 of 78 systems achieved >90% and 72 of 78 systems fell below 30%. For the physical compliance category, 0 of 78 systems achieved >90% and 66 of 78 systems fell below 30%.

A total of 14 Directives/Notices have been issued to 11 municipalities. Kamiesberg, Nama Khoi and Phokwane (2 no. each) have the highest number of enforcement measures initiated by the Regulator, which require municipal leadership intervention and correction.

In terms of sludge compliance status, it is found that:

- 2 of the 78 plants (3%) classify their biosolids according to the WRC Sludge Guidelines, with 2 plants only (Dawid Kruiper and Tsantsabane)
- None of the plants monitor sludge streams
- 1 of 78 plants (1.5%) have Sludge Management Plans in place (1 plant with Dawid Kruiper)
- 3 of 78 plants (4.5%) use sludge for landfill and thermal sludge practice.

In closing of this diagnostic, the data confirmed that only 10 of 26 (38%) of the municipalities have access to credible laboratories for compliance and operational analysis. These in-house or contracted laboratories have been verified to be accredited and/or have Proficiency Testing Schemes with suitable analytical methods and quality assurance. At 38%, the Northern Cape is not meeting the regulatory expectation that all municipalities have access to analytical services for compliance, operational and sludge monitoring.

Diagnostic 5: Energy Efficiency

Aim: The wastewater industry offers many opportunities to respond to climate change challenges by improving energy efficiency, reducing greenhouse gasses, and generating energy. The energy cost of sophisticated treatment technologies are in the order of 25-40% of the O&M budget (cited WRC 2021). This diagnostic investigates the status of energy efficiency management at a provincial and municipal level with an aim to motivate for improved operational wastewater treatment efficiency.

Findings: The audit results suggest no energy management awareness in the Province. No baseline audits have been done and no WSA could account for CO_2 equivalents associated with energy efficiency, had knowledge of their energy tariffs (R/kWh) or energy cost (R/m³), and no energy efficiency measures and/or plans were in place. It was noted that 1 WWTW (Dawid Kruiper) reported a SPC value.

Benchmark 1: Estimated energy intensity for large WWTW is in order of [illegible] kWh/m³

- 0.177 kWh/m³ for trickling filter
- 0.272 kWh/m³ for activated sludge
- 0.314 kWh/m³ for advanced treatment
- 0.412 kWh/m³ for advanced treatment with nitrification

Benchmark 2: Energy requirements per plant size

Plant capacity, Ml/d	[illegible]	2	[illegible]	[illegible]	[illegible]
Trickling filter, kWh/m³	0.43	[illegible]	[illegible]	[illegible]	0.16
Activated sludge, kWh/m³	[illegible]	[illegible]	0.37	[illegible]	[illegible]

Tariffs are typically (depends on time of day and season etc.)

- Peak rate: [illegible] - [illegible] c/kWh
- Off-peak time: [illegible] - [illegible] c/kWh
  Standard time: 117.57 - [illegible] c/kWh (ESKOM 2021, [illegible] 2012, [illegible] 2016)

It is evident that municipalities have not established a specific report to monitor energy as part of the wastewater business. Understandably, most of the Northern Cape WWTWs are ponds systems, with very little to no energy demand. It would, however, be wise to start embedding energy efficiency optimisation in the provincial municipal sector, as cost savings and environmental gains could be realised via the sewer network, considering the 207 pumping stations.

Diagnostic 6: Technical Site Assessments

Aim: The Green Drop process makes provision for the desktop audit being followed by a Technical Site Assessment (TSA) to verify the desktop evidence. The assessment includes physical inspection of the sewer network, pump stations, and treatment facility, coupled with asset condition checks to determine an approximate cost to restore existing infrastructure to functional status (VROOM).

Findings: The results of the Province TSAs are summarised in Table 188. A deviation of >10% between the GD and TSA score indicate a misalignment between the administrative aspects and the work on the ground. The Regulator regards a wastewater system with a TSA score of >80% as one that have an acceptable level of process control and functional equipment, where 90% would represent an excellent plant that complies with most of the Green Drop TSA standards.

Table 188 - Summary of the WWTW Technical Site Assessments scores and hardware problems and %deviation between GD and TSA scores

WSA Name	TSA WWTW Name	WWTW GD Score (%)	%TSA	Key Hardware Problems	Difference between TSA & GD score
Ga-Segonyana	Kuruman	11%	4%	1. Sand replacement; 2. Vandalism of infrastructure, especially pump stations; 3. Aged civil infrastructure including buildings; 4. Submersible pump at degritting unit; 5. RBC motor faulty; 6. Office building burnt, no documentation, no data storage	7%
Gamagara	Kathu	28%	55%	1. Spares for replacement; 2. Monitoring sensors; 3. BNR, manholes; 4. Cable theft, vandalism, degritting	27%
Kgatelopele	Danielskuil	15%	31%	Screening, fence, vandalism, staff facilities, inlet works, flowmeters absent	16%
Tsantsabane	Postmasburg	41%	78%	Mechanical screen, pumps, aerators	37%
Siyancuma	Douglas	33%	60%	1. Screens; 2. Flow meters; 3. Trickling Filter pumps; 4. Humus Tank pump; 5. OHS contraventions	27%
Siyathemba	Marydale	50%	82%	1. No security presence; 2. Vandalism; 3. No serious defects	32%
!Kheis	Wegdraai	0%	0%	1. Vandalism; 2. WWTW not operational; 3. No flow to plant, all process units dry	0%
Richtersveld	Port Nolloth	2%	29%	1. Vandalism; 2. Ponds lining; 3. Flow metering	27%
Nama Khoi	Springbok	29%	18%	1. Lining of the ponds; 2. Proper office and ablution facilities; 3. New inlet works with screen and flow meter; 4. Proper site for disposal of screenings	9%

WSA Name	TSA WWTW Name	WWTW GD Score (%)	%TSA	Key Hardware Problems	Difference between TSA & GD score
Kamiesberg	Garies	0%	27%	1. The ponds could not be inspected because the gate was locked; 2. A building should be provided for amenities on site	27%
Hantam	Calvinia	37%	71%	1. Collapsed wall of a horizontal flow reed bed; 2. Stabilisation of eroded wall; 3. Repair of fencing (not extensive)	34%
Karoo Hoogland	Fraserburg	12%	57%	1. Office and ablutions; 2. Vandalism; 3. Flow metering; 4. Signage at plant	45%
Kai Garib	Kakamas	18%	27%	1. Lining of the ponds; 2. Provide a site building (office, toilet); 3. Rehabilitation of the pond embankments; 4. Improvement of the roads; 5. Provide fencing	9%
Khai Ma	Pofadder	0%	15%	1. The ponds have reduced retention time; 2. The ponds are not lined and pollutes the groundwater; 3. There is no fencing which creates hazards for humans and animals; 4. There is no inlet works; 5. There is no building with amenities on site	15%
Dawid Kruiper	Kameelmond-Upington	66%	55%	1. New SST required; 2. Bioreactor needs to be upgraded; 3. Biofilters require refurbishment; 4. Maturation ponds require refurbishment	11%
Phokwane	Hartswater	1%	19%	1. Newly constructed reactor basin, including return flows, and SST to be to be commissioned; 2. Chlorine disinfection to be reinstated	18%
Magareng	Warrenton	5%	18%	1. Screening; 2. Grit removal; 3. Chlorine disinfection; 4. Screening bypass channel; 5. Dysfunctional aerator equipment.	13%
Dikgatlong	Barkly-West	18%	41%	1. Screening – consider automated screens at the head of works; 2. Grit removal not effective; 3. Chlorine disinfection; 4. Discharge point to be cleaned up	23%
Sol Plaatje	Beaconsfield	32%	53%	1. Only one mechanical screen is installed; 2. The primary tank mechanical, which are the original drive units installed; 3. Smaller secondary settling tank broken desludge pipe; 4. The secondary tank mechanical, which are the original drive unit installed 5. Chlorine disinfection	21%
Thembelihle	Hopetown (New)	43%	57%	1. Screening channels to be constructed; 2. Flowmeter to be calibrated; 3. No disinfection in place, LM stated zero discharge	14%
Emthanjeni	De Aar	11%	16%	1. Calibrate flow meters; 2. Consider automating the screening process; 3. Grit removal not effective; 4. AS plant to urgently be reinstated to prevent untreated wastewater spillages; 5. Chlorine disinfection need to be reinstated	5%
Renosterberg	Petrusville	0%	10%	1. Tanker dumping facility and inlet works to be constructed; 2. Oxidation ponds to be relined; 3. Fencing around the WWTW requires upgrading	10%
Umsobomvu	Colesberg	18%	48%	1. Screening not effe–tive - consider automated screens at the head of works; 2. Grit removal not effective; 3. Chlorine disinfection need to be reinstated	30%
Ubuntu	Victoria West	21%	10%	1. Tanker dumping site and inlet works to be reconstructed; 2. Ponds are not lined; 3. Flow meters to be installed; 4. Fencing to be upgraded	11%
Kareeberg	Carnarvon	45%	42%	1. No disinfection is in place; 2. Additional treatment capacity is required	3%
Joe Morolong	Hotazel	0%	40%	1. Hand rake screens bars to be refurbished; 2. Flow meter to be replaced; 3. Magnetic flow meter to be installed at Dwars Street pump station; 4. Refurbish, repair and/or service all four aeration compressors; 7. Repair all SBR decanting valves; 8. Recommission chlorination	40%
Totals	**26**				**0% to 45%**

A total of 26 site assessments were conducted, with 1 to 2 inspections per municipality. One system in Siyathemba (Marydale) scored 82%, which is regarded to be a satisfactory TSA score. Seventeen (17) systems scored <50%, which indicate that a high number of wastewater systems failed to meet operational, asset functionality, and workplace safety standards.

A high difference is evident between GD and TSA scores for most WSIs, some of the more pronounced differences being for Karoo Hoogland (45%), Joe Morolong (40%), Tsantsabane (37%), Hantam (34%), Siyathemba (32%) and Umsobomvu (30%), and a further 6 municipalities in the 20-29% deviation range. A high difference implies misalignment between wastewater administration and the condition of processes and infrastructure in the field. Some focal points include:

- Siyathemba impressed with the highest TSA score of 82%, however a substantial difference was found between the good TSA score and low GD score of 50% (32% deviation)
- 12 of 26 municipalities had >20% deviations between their TSA and GD scores, which indicate misalignment between the administration and the actual field conditions.

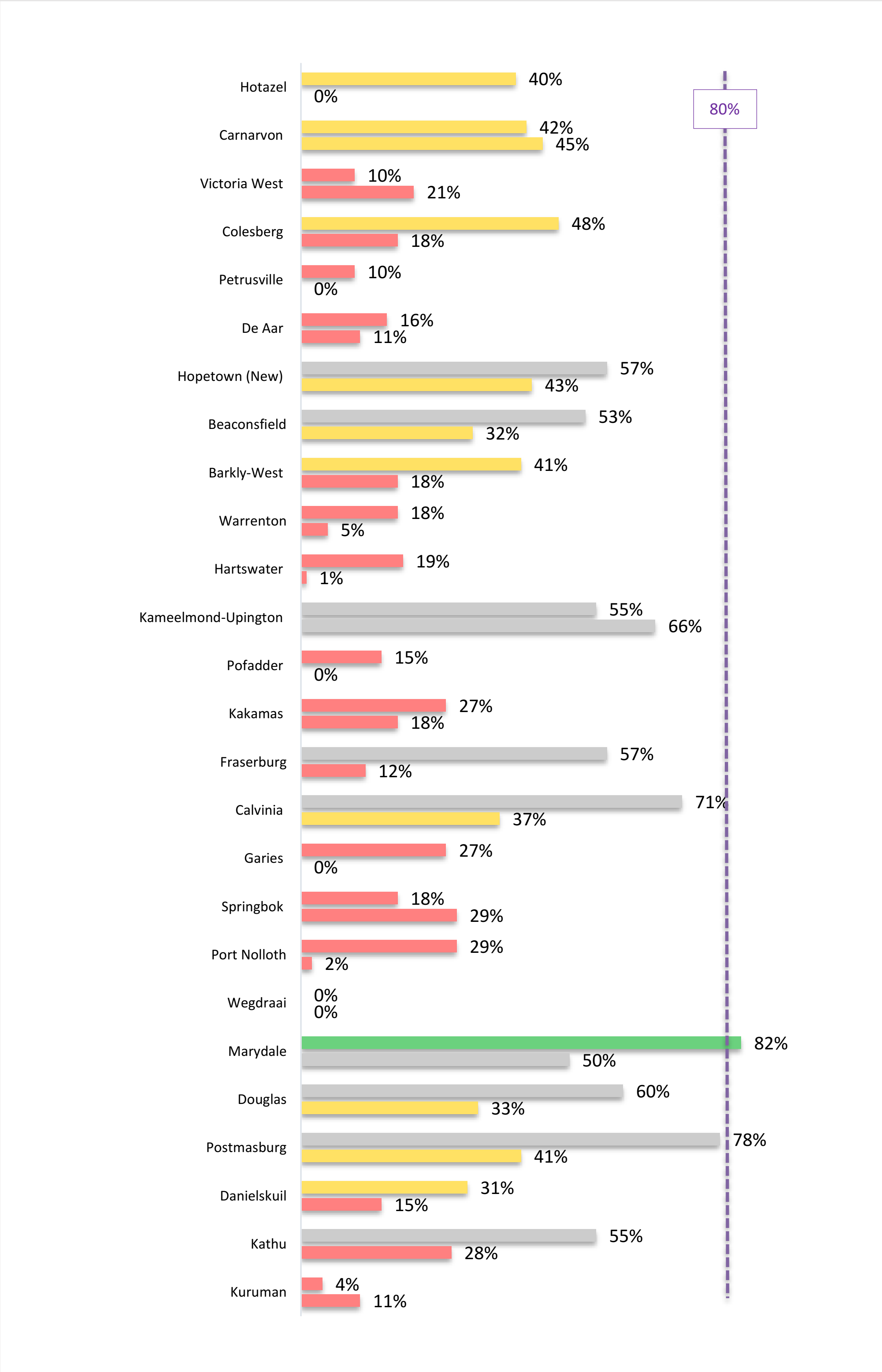


Figure 172 - Municipal GD (bottom bar) and System TSA (top bar) score comparison (colour legends as for GD)

The VROOM cost presents a ''very rough order of measurement" cost to return a WWTWs functionality to its original design. For the Northern Cape, a total budget of R504 million is estimated, with the bulk of the work going towards restoration of mechanical equipment (78%).

Table 189 - VROOM cost split for civil, mechanical, and electrical and total VROOM cost estimate

WSA	Civil cost estimate	Mechanical cost estimate	Electrical & C&I cost estimate	Total VROOM cost
Ga-Segonyana	R1,235,968	R12,559,616	R4,380,416	R18,176,000
Gamagara	R10,528,456	R14,989,666	R4,223,279	R29,741,400
Kgatelopele	R977,962	R716,688	R119,750	R1,814,400
Tsantsabane	R708,296	R2,454,328	R955,376	R4,118,000
Siyancuma	R120,868	R1,969,264	R857,868	R3,564,000
Siyathemba	R37,907,280	R333,732,720	R0	R371,640,000
!Kheis	R422,928	R307,584	R551,088	R1,281,600
Richtersveld	R907,500	R3,765,300	R226,380	R628,320
Nama Khoi	R7,472,990	R84,560	R3,012,450	R10,570,000
Kamiesberg	R157,480	R0	R0	R157,480
Hantam	R4,179,483	R251,282	R697,435	R5,128,200
Karoo Hoogland	R404,544	R0	R317,856	R722,400
Kai Garib	R642,000	R0	R0	R642,000
Khai Ma	R2,940,600	R0	R0	R2,940,600
Dawid Kruiper	R10,051,616	R757,163	R164,601	R10,973,380
Phokwane	R980,153	R520,847	R0	R1,501,000
Magareng	R46,800	R197,640	R115,560	R360,000
Dikgatlong	R476,338	R843,452	R198,727	R1,517,000
Sol Plaatje	R10,569,260	R19,575,020	R1,125,720	R31,270,000
Thembelihle	R707,427	R462,042	R275,310	R1,197,000
Emthanjeni	R665,728	R224,896	R5,376	R896,000
Renosterberg	R51,000	R40,680	R28,320	R120,000
Umsobomvu	R749,414	R673,690	R13,056	R1,305,600
Ubuntu	R490,620	R103,600	R146,520	R740,000
Kareeberg	R567,000	R0	R0	R567,000
Joe Morolong	R1,377,423	R638,493	R375,444	R2,391,360
Ga-Segonyana	R1,235,968	R12,559,616	R4,380,416	R18,176,000
Gamagara	R10,528,456	R14,989,666	R4,223,279	R29,741,400
Kgatelopele	R977,962	R716,688	R119,750	R1,814,400
Tsantsabane	R708,296	R2,454,328	R955,376	R4,118,000
Totals	**R95,339,134**	**R394,868,531**	**R17,790,532**	**R503,962,740**
% Distribution	**19%**	**78%**	**3%**	**100%**

The key hardware problems are listed in Table 188, with predominant defects in electrical cables, primary- and secondary sludge, disinfection, sludge pumps, sludge treatment, and power backup. Mechanical defects typically include dysfunctional flow meters, aerators, sludge and effluent pumps, mixers, screens, degritters, and disinfection equipment. Vandalism and theft, long procurement lead times, lack of management involvement, lack of maintenance, and lack of budget are the main reasons for dysfunctional assets.

Diagnostic 7: Operation, Maintenance and Refurbishment of Assets

Aim: Insufficient financial resources are often cited as a root cause to dysfunctional or non-compliant wastewater systems. Knowledge and monitoring of fiscal spending are therefore a critical part of wastewater management. This diagnostic investigates the status of financial information as pertaining to O&M budgets and expenditure, asset figures, and capital funding.

Findings: A substantial amount of financial information was presented during the audit process. Unfortunately, the evidence was presented in different formats, levels of detail, or absent for some municipalities. It was observed that municipal teams with financial officials present during the audits typically performed better and had a good understanding of the wastewater challenges experienced by their technical peers.

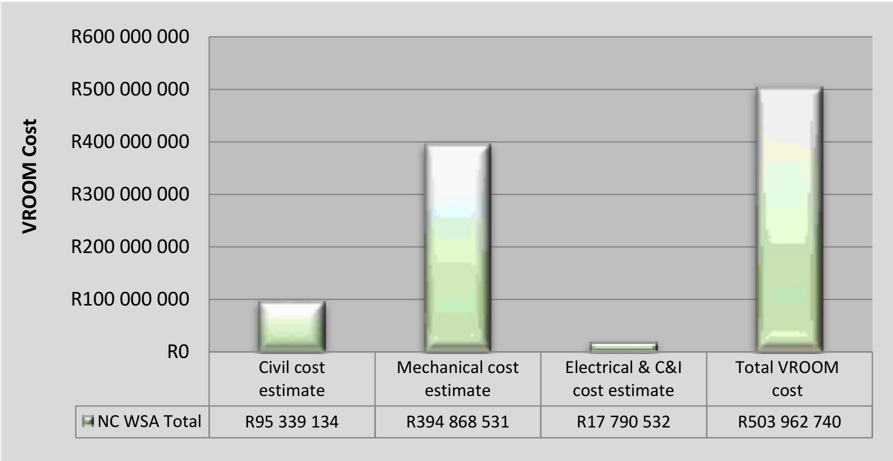
Discrepancies observed included: generic or non-ringfenced budgets, contract lump sums for Service Providers presented as budgets, outdated or incomplete asset registers, some cost drivers are lacking (mostly electricity), etc. The Regulator grouped data into different certainty levels, as can be summarised at the end of this Diagnostic.

It must be noted that there were limitations with the financial and asset information. Not all WSAs submitted current information or complete financial data sets.

The result of each financial portfolio is discussed hereunder.

Vroom Cost Analysis

The VROOM costs breakdown is discussed under the TSA Diagnostic but is further illustrated as follows.



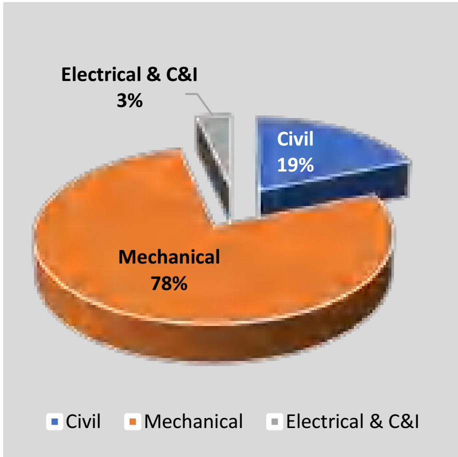


Figure 173 - Graphic illustration of the total cost estimated to restore functionality to existing assets (a), broken down to civil, mechanical, and electrical components

The total cost of R504 million is estimated to restore existing treatment works to their design capacity and function–lity - consisting of R395 million for mechanical repairs, R18 million for electrical repairs, and R95 million for civil structures.

Table 190 indicates that a capital budget of R329 million has been secured over 1-3 years to address infrastructural needs, which does not adequately cover the R504 million VROOM refurbishment need and by implication, does not allow any surplus for other capital projects. The R504 million estimated VROOM cost constitutes 137% of the total asset value of R367.2 million. Furthermore, the WATCOST-SALGA figures provides for an annual 2.14% of the asset value required to maintain these assets. This constitutes an amount of R7.9 million required by the various WSA's annually to maintain the assets, while a once-off R504 million is required to restore existing assets.

Capital, O&M Budget and Actual, and Asset Value

The capital budgets, O&M budgets, O&M actual expenditure, and current asset values are summarised below.

Table 190 - Summary of the capital budgets, O&M budgets, O&M actual expenditure, and current asset values

WSA	Capital budget available	O&M budget (2020/21)	O&M expended (2020/21)	% Expended	Total Current Asset Value
Ga-Segonyana	R10,350,000	NI	NI	NI	NI
Gamagara	NI	NI	NI	NI	NI
Kgatelopele	R40,282,080	NI	NI	NI	NI
Tsantsabane	NI	NI	NI	NI	NI
Siyancuma	NI	NI	NI	NI	NI
Siyathemba	NI	NI	NI	NI	NI
!Kheis	NI	NI	NI	NI	NI
Richtersveld	NI	NI	NI	NI	NI
Nama Khoi	NI	R22,117,000	R16,451,000	74%	NI
Kamiesberg	NI	NI	NI	NI	NI

WSA	Capital budget available	O&M budget (2020/21)	O&M expended (2020/21)	% Expended	Total Current Asset Value
Hantam	NI	R5,978,000	R2,843,000	48%	NI
Karoo Hoogland	R30,000,000	NI	NI	NI	NI
Kai Garib	R60,300,000	NI	NI	NI	NI
Khai Ma	R10,000,000	NI	NI	NI	NI
Dawid Kruiper	R65,000,000	R25,573,610	R27,264,130	107%	NI
Phokwane	NI	NI	NI	NI	NI
Magareng	NI	R8,067,000	R7,926,000	98%	NI
Dikgatlong	R2,949,000	R4,000,000	R4,000,000	100%	NI
Sol Plaatje	NI	R84,500,000	R86,000,000	102%	NI
Thembelihle	R47,096,000	R79,000	R95,000	120%	R47,060,000
Emthanjeni	R62,830,860	R22,003,370	R22,003,370	100%	R57,807,000
Renosterberg	NI	NI	NI	NI	NI
Umsobomvu	NI	NI	NI	NI	NI
Ubuntu	NI	R5,300,910	R5,263,030	99%	R244,228,740
Kareeberg	NI	R2,833,817	R2,738,817	97%	R18,117,780
Joe Morolong	NI	NI	NI	NI	NI
Totals	**R328,807,940**	**R180,452,707**	**R174,584,347**	**97%**	**R367,213,520**

The Green Drop process provides a bonus (incentive) in cases where a municipality provide evidence of capital projects with secured funding since this is deemed as a definitive means of addressing wastewater services inadequacies. This incentive encourages wastewater infrastructure investment. A total capital budget of R329 million has been reported for the refurbishment and upgrades of wastewater infrastructure for all the municipalities over a 1-to-3-year fiscal period. The largest capital budgets are observed for Dawid Kruiper (R65m), Emthanjeni (R63m) and Kai Garib (R60m).

For the 2020/21 fiscal year, the total O&M budget reported for the Northern Cape was R180m, of which R175m (97%) has been expended. Small %deviations in over-expenditure was observed for 3 municipalities and low expenditure was observed for 1 municipality. The provincial figures exclude 16 municipalities who did not have financial information.

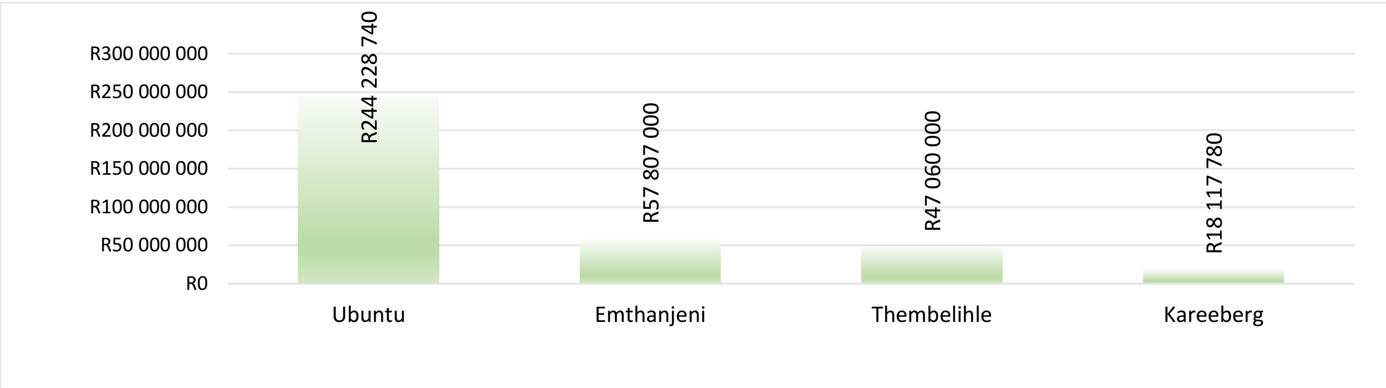


Figure 174 - Total current asset value reported by municipalities with information

The total current asset value for wastewater infrastructure (networks, pump stations, treatment plants) is reportedly R367 million (excluding 22 of 26 municipalities with no information). The highest asset value is observed for Ubuntu (R244m).

O&M Cost Benchmarking

By combining the SALGA and WRC WATCOST models, an estimation of the maintenance cost required per asset type can be done, i.e. civil, buildings, pipelines, mechanical, electrical, and instrumentation. The maintenance benchmark departs from the basis that 15.75% of the asset value is required to maintain these assets.

Table 191- SALGA-WRC annual maintenance budget guideline and cost estimation

Description	% of Current Asset Value	Asset Value Estimate	Modified SALGA Maintenance Guideline	Annual Maintenance Budget Guideline
Current Asset Value estimate	**100%**	**R367,213,520**	**15.75%**	**R7,858,369**
Broken down into:				
1. Civil Structures	46%	R168,918,219	0.50%	R844,591
2, Buildings	3%	R11,016,406	1.50%	R165,246
3. Pipelines	6%	R22,032,811	0.75%	R165,246
4. Mechanical Equipment	35%	R128,524,732	4.00%	R5,140,989
5. Electrical Equipment	8%	R29,377,082	4.00%	R1,175,083
6. Instrumentation	2%	R7,344,270	5.00%	R367,214
Totals	**100%**	**R367,213,520**	**15.75%**	**R7,858,369**
Minus 20% P&Gs and 10% Installation				**R2,357,511**
Total				**R5,500,859**

The model estimates that R7.9 million (2.14%) is required per year to maintain the assets valued at R367 million. Notably, this maintenance estimate assumes that all *assets are functional*. The VROOM cost represents the monies needed to get assets functional, from which basis route maintenance could then focus on maintaining the assets.

Table 192 indicates the SALGA maintenance cost estimation in relation to the VROOM cost, O&M budget, and O&M actual expended.

Table 192 - O&M cost estimates by the SALGA and VROOM models versus actual budget and expenditure figures

Cost Reference	O&M Cost Estimate	Period
Modified SALGA	R7,858,369	Annually, estimation
O&M Budget	R180,452,707	Actual for 2020/21
O&M Spend	R174,584,347	Actual for 2020/21
VROOM	R503,962,740	Once off estimation

The cost dynamics can be summarised as follows:

- The SALGA estimations for O&M budgets is 4% of the actual reported budgets for the 2020/21 fiscal year. This figure is influenced by the 22 of 26 municipalities with no information of their asset values
- The actual O&M budget could not be compared with the SALGA guideline, due to insufficient information
- The VROOM cost represents an estimation of the refurbishment cost to restore WWTWs functionality and design capacity.

Production Cost and Comparison

It is good business practice to monitor and manage the production costs of wastewater treatment in Rand/m^3 treated, and to compare such cost with industry norms. Published benchmarks is not currently available for typical treatment (production) costs, but significant cost increases are expected since 2013, given the variable input factors such as Covid, and cost of chemicals, transport, and electricity. From an economic perspective, it would be valuable to compare production cost budgeted with actual production costs. However, due to scarce information, it is not possible to provide insight as to possible shortfalls from an economic perspective.

Based on the lack of data, no production costs for wastewater treatment could be concluded for the Northern Cape. Only Dawid Kruiper provided production costs for one of their systems, whilst Sol Plaatje provided information for the total municipality. Readers may view the results obtained for Gauteng, KwaZulu Natal, Eastern Cape and Western Cape, to obtain a sense of typical production costs at South African wastewater treatment facilities.

Data Certainty

Data certainty is expressed at different levels for the financial and asset figures reported within this Diagnostic. Certainty levels differ from system to system, hence some WSAs are included in multiple data certainty categories - as the data is variable, inconsistent, limited, or non-existent (NI) for each of the systems. The various WSAs in the province that were identified under the category ''High Certainty", presented consistent and verifiable evidence in the form of budgets, expenditure, asset registers, and unit costs.

Table 193 - Levels of certainty associated with financial and asset information reported by municipalities

Data Certainty	Description	WSA
No certainty	Absent data or no certainty in data pres–nted - not ringfenced for WWTW & Network	Ga-Segonyana, Gamagara, Kgatelopele, Tsantsabane, Siyancuma, Siyathemba, Kheis, Richtersveld, Kamiesberg, Karoo Hoogland, Kai Garib, Khai Ma, Phokwane, Renosterberg, Umsobomvu, Joe Morolong
Low certainty	Minor or little certainty in the–data - partially ringfenced for WWTW only or data as extreme outliers	Nama Khoi, Hantam, Dawid Kruiper, Magareng, Dikgatlong, Sol Plaatje
Reasonable/good certainty	Reasonable to good level of certainty in the–data - ringfenced for WWTW and/or Network and data falls within/close to expected parameters	Thembelihle, Emthanjeni, Ubuntu, Kareeberg
High certainty	High level of certainty in the–data - ringfenced for WWTW and Network and data falls within expected parameters	None

11.1 Dikgatlong Local Municipality

Water Service Institution	**Dikgatlong Local Municipality**	
Water Service Provider	Dikgatlong Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Screening not effective. Automated screens at the head of works to be considered 2. Grit removal not effective and require intervention 3. Chlorine disinfection need to be reinstated **VROOM Estimate:** - R1,517,000
2021 Green Drop Score	**18%↓**	
2013 Green Drop Score	**39%**	
2011 Green Drop Score	**16%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Windsorton**	**Delportshoop**	**Barkly-Wes**
Green Drop Score (2021)		**16%**	**13%**	**18%**
2013 Green Drop Score		**57%**	**56%**	**33%**
2011 Green Drop Score		**9%**	**9%**	**17%**
2009 Green Drop Score		**0%**	**0%**	**0%**
Design Capacity	Ml/d	0.5	0.2	3
Design Capacity Utilisation (%)		100%	500%	60%
Resource Discharged into		Vaal River	No Discharge	Vaal River
Wastewater Risk Rating (CRR% of CRR_{max})		**Windsorton**	**Delportshoop**	**Barkly-Wes**
CRR (2011)		52.9%	NA	52.9%
CRR (2013)		64.7%	NA	64.7%
CRR (2021)		100.0%	100.0%	100.0%

Technical Site Assessment: **Barkly-Wes WWTW 41%**

11.2 Dawid Kruiper Local Municipality

<table>
<tr><td>Water Service Institution</td><td colspan="3">Dawid Kruiper Local Municipality</td></tr>
<tr><td>Water Service Provider</td><td colspan="3">Dawid Kruiper Local Municipality</td></tr>
<tr><td colspan="3">Municipal Green Drop Score</td><td rowspan="5">VROOM Impression (Towards restoring functionality):
1. Degritting requires upgrading
2. Distribution arms of the biofilters dysfunctional
3. PST in poor condition
4. Aerators in poor condition
5. SSTs need to be reconstructed
6. Chlorination facilities and maturation ponds in poor condition.
VROOM Estimate:
- R10,973,380
The plant has recently commenced with an upgrading project to address most of the issues above.</td></tr>
<tr><td>2021 Green Drop Score</td><td colspan="2">64%↑</td></tr>
<tr><td>2013 Green Drop Score</td><td>60% (KHLM)</td><td>1% (MLM)</td></tr>
<tr><td>2011 Green Drop Score</td><td>36% (KHLM)</td><td>5% (MLM)</td></tr>
<tr><td>2009 Green Drop Score</td><td>22% (KHLM)</td><td>13% (MLM)</td></tr>
</table>

NOTE: *KHLM = Khara Hais Local Municipality; MLM = Mier Local Municipality. These two LMs have joined to form the Dawid Kruiper Local Municipality*

Key Performance Area	Unit	Kameelmond	Louisvaleweg	Askham	Rietfontein
Green Drop Score (2021)		**66%**	**55%**	**40%**	**36%**
2013 Green Drop Score		**61%**	**47%**	**4%**	NA
2011 Green Drop Score		**36%**	**38%**	**5%**	NA
2013 Green Drop Score		**61%**	**47%**	**4%**	NA
System Design Capacity	Ml/d	16	1.242	0.135	0.322
Design Capacity Utilisation (%)		86%	30%	11%	16%
Resource Discharged into		Orange River	No information	Evaporation	Evaporation
Wastewater Risk Rating (CRR% of CRR_{max})		**Kameelmond**	**Louisvaleweg**	**Askham**	**Rietfontein**
CRR (2011)	%	50.0%	47.1%	NA	100.0%
CRR (2013)	%	45.5%	70.6%	100.0%	71.0%
CRR (2021)	%	68.2%	58.8%	76.5%	76.5%

Technical Site Assessment: **Kameelmond WWTW 55%**

11.3 Emthanjeni Local Municipality

Water Service Institution	**Emthanjeni Local Municipality**
Water Service Provider	Emthanjeni Local Municipality

Municipal Green Drop Score	
2021 Green Drop Score	**13%↓**
2013 Green Drop Score	**66%**
2011 Green Drop Score	**21%**
2009 Green Drop Score	**10%**

VROOM Impression (Towards restoring functionality):

1. Calibrate flowmeters
2. Consideration should be given to automating the screening process
3. Grit removal not effective
4. AS plant to urgently be reinstated to prevent untreated wastewater spillages
5. Chlorine disinfection need to be reinstated

VROOM Estimate:

- R896,000

Key Performance Area	Unit	De Aar	Britstown	Hanover
Green Drop Score (2021)		**11%**	**20%**	**18%**
2013 Green Drop Score		**62%**	**74%**	**74%**
2011 Green Drop Score		**21%**	**19%**	**22%**
2009 Green Drop Score		**31%**	**0%**	**0%**
Design Capacity	Ml/d	4	0.6	1
Design Capacity Utilisation (%)		NI	NI	NI
Resource Discharged into		Orange River	No Discharge	No Discharge
Wastewater Risk Rating (CRR% of CRR_{max})		**De Aar**	**Britstown**	**Hanover**
CRR (2011)		88.0%	29.0%	29.0%
CRR (2013)		41.2%	47.1%	58.8%
CRR (2021)		88.2%	94.1%	94.1%

Technical Site Assessment: **De Aar WWTW** **16%**

11.4 Ga-Segonyana Local Municipality

Water Service Institution	**Ga-Segonyana Local Municipality**	
Water Service Provider	Sedibeng Water	
Municipal Green Drop Score		**VROOM Impression (Towards restoration of functionality):** 1. Sand replacement 2. Vandalism of infrastructure, especially pump stations 3. Aged civil infrastructure including buildings 4. Submersible pump at degritting unit 5. RBC motor faulty 6. Office building burnt, no documentation, no data storage **VROOM Estimate:** - R 18 176 000 - *Kuruman WWTW under refurbishment*
2021 Green Drop Score	**9%↓**	
2013 Green Drop Score	**64%**	
2011 Green Drop Score	**66%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Kuruman**	**Mothibistad**
Green Drop Score (2021)		**11%**	**7%**
2013 Green Drop Score		**66%**	**45%**
2011 Green Drop Score		**69%**	**44%**
2009 Green Drop Score		**0%**	**0%**
System Design Capacity	Ml/d	4	2,4
Design Capacity Utilisation (%)		NI	NI
Resource Discharged into		Wetland	Orange River
Wastewater Risk Rating (CRR% of CRR_{max})		**Kuruman**	**Mothibistad**
CRR (2011)	%	76.5%	76.5%
CRR (2013)	%	29.4%	52.9%
CRR (2021)	%	94.1%	94.1%

Technical Site Assessment: **Kuruman WWTW: 62%**

11.5 Gamagara Local Municipality

Water Service Institution	**Gamagara Local Municipality**
Water Service Provider	Gamagara Local Municipality

Municipal Green Drop Score	
2021 Green Drop Score	**26% ↓**
2013 Green Drop Score	**42%**
2011 Green Drop Score	**11%**
2009 Green Drop Score	**45%**

VROOM Impression (Towards restoring functionality):

1. Vandalism and theft
2. Sewage overflow during loadshedding events
3. Dysfunctional electrical control panel at Head of Works
4. Degritting unit not functional
5. Chlorine requires civil and mechanical investigation
6. General maintenance and spares stock
7. Manhole covers

VROOM Estimation:

- R29,741,400

Key Performance Area	Unit	Kathu	Dibeng	Olifantshoek
Green Drop Score (2021)		**28%**	**19%**	**14%**
2013 Green Drop Score		**52%**	**12%**	**9%**
2011 Green Drop Score		**19%**	**13%**	**9%**
2009 Green Drop Score		**23%**	**66%**	**66%**
System Design Capacity	Ml/d	10	1,1	0,99
Design Capacity Utilisation (%)		56%	73%	NI
Resource Discharged into		Outflow onto pond	Gamagara River	Farmer receives final effluent
Wastewater Risk Rating (CRR% of CRR_{max})		**Kathu**	**Dibeng**	**Olifantshoek**
CRR (2011)	%	94.1%	41.2%	41.2%
CRR (2013)	%	50.0%	82.4%	94.1%
CRR (2021)	%	72.7%	76.5%	94.1%

Technical Site Assessment: **Kathu WWTW: 55%**

11.6 Hantam Local Municipality

Water Service Institution	**Hantam Local Municipality**	
Water Service Provider	Hantam Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Collapsed wall of reed bed 2. Eroded wall 3. Fence defects. **VROOM Estimate:** - R5,128,200
2021 Green Drop Score	**36%↓**	
2013 Green Drop Score	**52%**	
2011 Green Drop Score	**15%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Calvinia**	**Nieuwoudtville**	**Brandvlei**	**Loeriesfontein**
Green Drop Score (2021)		**37%**	**42%**	**27%**	**34%**
2013 Green Drop Score		**39%**	**62%**	**61%**	**40%**
2011 Green Drop Score		**19%**	**25%**	**18%**	**23%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	1.085	0.325	0.31	0.5
Design Capacity Utilisation (%)		35%	88%	60%	57%
Resource Discharged into		Oorlogskloof River	Oorloogsklof River	Sak River	Kamdanie River
Wastewater Risk Rating (CRR% of CRR_{max})		**Calvinia WWTW**	**Nieuwoudtville**	**Brandvlei**	**Loeriesfontein**
CRR (2011)	%	89.0%	67.0%	89.0%	67.0%
CRR (2013)	%	71.0%	76.0%	94.0%	82.0%
CRR (2021)	%	64.7%	64.7%	76.5%	82.4%

Technical Site Assessment: **Calvinia WWTW 71%**

11.7 Joe Morolong Local Municipality

Water Service Institution	**Joe Morolong Local Municipality**	
Water Service Provider	Joe Morolong Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Hand rake screens bars to be refurbished 2. Flow meter to be replaced 3. Magnetic flow meter to be installed at Dwars Street pump station 4. Refurbish, repair and/or service all four aeration compressors 7. Repair all SBR decanting valves 8. Recommission chlorination **VROOM Estimate:** - R2,391,360
2021 Green Drop Score	**3%↓**	
2013 Green Drop Score	**39%**	
2011 Green Drop Score	**49%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Hotazel**	**Van Zylsrus**
Green Drop Score (2021)		**3%**	**0%**
2013 Green Drop Score		**20%**	**44%**
2011 Green Drop Score		**65%**	**36%**
2009 Green Drop Score		**0%**	**0%**
Design Capacity	Ml/d	0.35	0.03
Design Capacity Utilisation (%)		143%	38%
Resource Discharged into		Irrigation	No Discharge
Wastewater Risk Rating (CRR% of CRR_{max})		**Hotazel**	**Van Zylsrus**
CRR (2011)	%	50.0%	83.3%
CRR (2013)	%	52.9%	94.1%
CRR (2021)	%	94.1%	94.1%

Technical Site Assessment: **Hotazel WWTW 40%; Van Zylsrus WWTW 12%**

11.8 Kamiesberg Local Municipality

Water Service Institution	**Kamiesberg Local Municipality**	
Water Service Providers	Kamiesberg Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Ponds lined and embankments in satisfactory condition 2. Office/guardhouse facility lacking 3. New pump house is new, no work needed. **VROOM Estimate:** - R157,480
2021 Green Drop Score	**0%→**	
2013 Green Drop Score	**0%**	
2011 Green Drop Score	**5%**	
2009 Green Drop Score	**87%**	

Key Performance Area	**Unit**	**Garies**	**Kamieskroon**
Green Drop Score (2021)		**0%**	**2%**
2013 Green Drop Score		**0%**	**0%**
2011 Green Drop Score		**7%**	**3%**
2009 Green Drop Score		**87%**	**87%**
System Design Capacity	Ml/d	0.5	0.008
Design Capacity Utilisation (%)		NI	NI
Resource Discharged into		Evaporation	Evaporation
Wastewater Risk Rating (CRR% of CRR_{max})		**Garies**	**Kamieskroon**
CRR (2011)	%	100.0%	88.2%
CRR (2013)	%	100.0%	100.0%
CRR (2021)	%	100.0%	100.0%

Technical Site Assessment: **Garies WWTW 27%**

11.9 Kareeberg Local Municipality

Water Service Institution	**Kareeberg Local Municipality**	
Water Service Provider	Kareeberg Local Municipality	
Municipal Green Drop Score		
2021 Green Drop Score	**44%↑**	**VROOM Impression (Towards restoring functionality):** 1. No disinfection is in place 2. Additional treatment capacity is required **VROOM Estimate:** - R567,000
2013 Green Drop Score	**21%**	
2011 Green Drop Score	**28%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Carnarvon**	**Van Wyksvlei**	**Vosburg**
Green Drop Score (2021)		**45%**	**0%**	**29%**
2013 Green Drop Score		**18%**	**31%**	**26%**
2011 Green Drop Score		**45%**	**19%**	**17%**
2009 Green Drop Score		**0%**	**0%**	**0%**
Design Capacity	Ml/d	1.3	0	0.05
Design Capacity Utilisation (%)		NI	NI	NI
Resource Discharged into		Land Discharge	No Discharge	No Discharge
Wastewater Risk Rating (CRR% of CRR_{max})		**Carnarvon**	**Van Wyksvlei**	**Vosburg**
CRR (2011)		76.5%	52.9%	52.9%
CRR (2013)		76.5%	58.8%	76.5%
CRR (2021)		70.6%	100.0%	94.1%

Technical Site Assessment: **Carnarvon WWTW 42%**

11.10 Karoo Hoogland Local Municipality

Water Service Institution	**Karoo Hoogland LM**	
Water Service Provider	Karoo Hoogland LM	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Office and ablution 2. Vandalism 3. Flow metering 4. Signage at plant. **VROOM Estimate:** - R722,400
2021 Green Drop Score	**11%↑**	
2013 Green Drop Score	**5%**	
2011 Green Drop Score	**12%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Fraserburg**	**Williston**	**Sutherland**
Green Drop Score (2021)		**11%**	**9%**	**9%**
2013 Green Drop Score		**6%**	**6%**	**2%**
2011 Green Drop Score		**12%**	**14%**	**10%**
2009 Green Drop Score		**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.447	0.447	0.447
Design Capacity Utilisation (%)		NI	NI	NI
Resource Discharged into		Sout River	Sak River	Dorps River
Wastewater Risk Rating (CRR% of CRR_{max})		**Fraserburg**	**Williston**	**Sutherland**
CRR (2011)	%	41.2%	41.2%	41.2%
CRR (2013)	%	100.0%	100.0%	100.0%
CRR (2021)	%	100.0%	100.0%	100.0%

Technical Site Assessment: **Fraserburg WWTW 57%**

11.11 Kgatelopele Local Municipality

Water Service Institution	**Kgatelopele Local Municipality**	
Water Service Provider	Kgatelopele Local Municipality	
Municipal Green Drop Score		**VROOM Impression (towards restoring functionality):** 1. Screening 2. Fences and security 3. Vandalism 4. Staff facilities 5. Inlet works 6. Flowmeters absent **VROOM Estimate:** - R 1 814 000 - The plant is currently being upgraded
2021 Green Drop Score	**15%↓**	
2013 Green Drop Score	**78%**	
2011 Green Drop Score	**42%**	
2009 Green Drop Score	**3%**	

Key Performance Area	**Unit**	**Danielskuil**
Green Drop Score (2021)		**15%**
2013 Green Drop Score		**78%**
2011 Green Drop Score		**42%**
2009 Green Drop Score		**3%**
System Design Capacity	Ml/d	0.72
Design Capacity Utilisation (%)		NI
Resource Discharged into		We–land - eventually into Bouplaas Pan
Wastewater Risk Rating (CRR% of CRR_{max})		**Danielskuil**
CRR (2011)	%	70.6%
CRR (2013)	%	47.1%
CRR (2021)	%	94.1%

Technical Site Assessment: **Danielskuil WWTW: 31%**

11.12 Khai Ma Local Municipality

Water Service Institution	**Khai Ma Local Municipality**	
Water Service Provider	Khai Ma Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Pond capacity unknown (no flow meters) 2. Ponds are unlined 3. No fencing 4. No inlet works 5. No building amenities 6. Pump dysfunctional **VROOM Estimate:** - R2,940,600
2021 Green Drop Score	**1%↓**	
2013 Green Drop Score	**28%**	
2011 Green Drop Score	**14%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Pofadder	Aggenys	Pella	Onseepkans
Green Drop Score (2021)		**0%**	**0%**	**3%**	**0%**
2013 Green Drop Score		**28%**	NA	NA	NA
2011 Green Drop Score		**14%**	NA	NA	NA
2009 Green Drop Score		**0%**	NA	NA	NA
System Design Capacity	Ml/d	NI	NI	NI	NI
Design Capacity Utilisation (%)		53%	NI	NI	NI
Resource Discharged into		Evaporation	NI	Orange River	Orange River
Wastewater Risk Rating (CRR% of CRR_{max})		**Pofadder**	**Aggenys**	**Pella**	**Onseepkans**
CRR (2011)	%	35.3%	**NA**	**NA**	**NA**
CRR (2013)	%	88.2%	**NA**	**NA**	**NA**
CRR (2021)	%	88.2%	100.0%	100.0%	100.0%

Technical Site Assessment: **Pofadder WWTW 15%**

11.13 Kai Garib Local Municipality

Water Service Institution	**Kai Garib Local Municipality**	
Water Service Provider	Kai Garib Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Pond lining 2. Site office 3. Pond embankments 4. Roads 5. Fencing. **VROOM Estimate**: - R642,000
2021 Green Drop Score	**13%↓**	
2013 Green Drop Score	**34%**	
2011 Green Drop Score	**22%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Kakamas**	**Keimoes**	**Kenhardt**	**Vredesvallei**
Green Drop Score (2021)		**18%**	**14%**	**10%**	**4%**
2013 Green Drop Score		**33%**	**28%**	**50%**	NA
2011 Green Drop Score		**11%**	**8%**	**8%**	NA
2009 Green Drop Score		**0%**	**0%**	**0%**	NA
System Design Capacity	Ml/d	0.43	1.9	0.7	0.18
Design Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Orange River	Orange River	Hartbees River	Orange River
Wastewater Risk Rating (CRR% of CRR_{max})		**Kakamas**	**Keimoes**	**Kenhardt**	**Vredesvallei**
CRR (2011)	%	94.1%	94.1%	47.1%	NA
CRR (2013)	%	76.5%	82.4%	88.2%	NA
CRR (2021)	%	88.2%	94.1%	94.1%	94.1%

Technical Site Assessment: **Kakamas WWTW 27%**

11.14 !Kheis Local Municipality

Water Service Institution	**!Kheis Local Municipality**	
Water Service Provider	!Kheis Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Vandalism 2. Wegdraai WWTW not operational 3. No flow to plant, all process units dry **VROOM Estimate:** - R1,281,600
2021 Green Drop Score	**2% ↓**	
2013 Green Drop Score	**25%**	
2011 Green Drop Score	**8%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Groblershoop**	**Brandboom**	**Wegdraai***	**Topline***	**Grootdrink***
Green Drop Score (2021)		**2%**	**2%**	**0%**	**0%**	**0%**
2013 Green Drop Score		**4%**	**29.6%**	**27%**	**27%**	**27%**
2011 Green Drop Score		**8%**	NA	NA	NA	NA
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.6	0.12	NI	NI	NI
Design Capacity Utilisation (%)		90%	50%	NI	NI	NI
Resource Discharged into		NI	NI	NI	NI	NI
Wastewater Risk Rating (CRR% of CRR_{max})		**Groblershoop**	**Brandboom**	**Wegdraai**	**Topline**	**Grootdrink**
CRR (2011)	%	52.9%	**NA**	**NA**	**NA**	**NA**
CRR (2013)	%	94.1%	94.1%	94.1%	94.1%	94.1%
CRR (2021)	%	88.2%	82.4%	100.0%	100.0%	100.0%

Technical Site Assessment: **Wegdraai WWTW 0%**

11.15 Magareng Local Municipality

Water Service Institution	**Magareng Local Municipality**	
Water Service Provider	Magareng Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Screening not effective 2. Grit removal not effective 3. Chlorine disinfection to be reinstated 4. Screening bypass channel needs to be considered 5. Dysfunctional aerator equipment to be addressed **VROOM Estimate:** - R360,000
2021 Green Drop Score	**5%↓**	
2013 Green Drop Score	**33%**	
2011 Green Drop Score	**20%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Warrenton**
Green Drop Score (2021)		**5%**
2013 Green Drop Score		**34%**
2011 Green Drop Score		**30%**
2009 Green Drop Score		**0%**
Design Capacity	Ml/d	2
Design Capacity Utilisation (%)		70%
Resource Discharged into		Vaal River
Wastewater Risk Rating (CRR% of CRR_{max})		**Warrenton**
CRR (2011)		88.2%
CRR (2013)		88.2%
CRR (2021)		88.2%

Technical Site Assessment: **Warrenton WWTW 18%**

11.16 Nama Khoi Local Municipality

Water Service Institution	**Nama Khoi Local Municipality**		
Water Service Provider	Nama Khoi Local Municipality		
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Lining of ponds 2. Office and ablution facilities 3. Inlet works 4. Screening 5. Flow meter dysfunctional 6. Screenings disposal and health hazards. **VROOM Estimate:** - R10,570,000	
2021 Green Drop Score	**27%↓**		
2013 Green Drop Score	**34%**		
2011 Green Drop Score	**37%**		
2009 Green Drop Score	**58%**		

Key Performance Area	**Unit**	**Springbok**	**Bergsig**	**Carolusberg**	**Concordia**
Green Drop Score (2021)		**29%**	**35%**	**28%**	**28%**
2013 Green Drop Score		**38%**	**40%**	**32%**	**45%**
2011 Green Drop Score		**32%**	**58%**	**54%**	**39%**
2009 Green Drop Score		**62%**	**62%**	**19%**	**19%**
System Design Capacity	Ml/d	1	1	0.5	0.5
Design Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Orange River	Orange River	Orange River	Orange River
Wastewater Risk Rating (CRR% of CRR_{max})		**Springbok**	**Bergsig**	**Carolusberg**	**Concordia**
CRR (2011)	%	64.7%	82.4%	64.7%	70.6%
CRR (2013)	%	94.1%	82.4%	94.1%	82.4%
CRR (2021)	%	88.2%	94.1%	88.2%	94.1%

Key Performance Area	**Unit**	**Komaggas**	**Nababeep**	**Okiep**	**Steinkopf**
Green Drop Score (2021)		**28%**	**19%**	**29%**	**35%**
2013 Green Drop Score		**51%**	**22%**	**34%**	**37%**
2011 Green Drop Score		**44%**	**18%**	**21%**	**29%**
2009 Green Drop Score		**62%**	**62%**	**62%**	**62%**
System Design Capacity	Ml/d	0.5	2	1	0.5
Design Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Orange River	Orange River	Orange River	Orange River
Wastewater Risk Rating (CRR% of CRR_{max})		**Komaggas**	**Nababeep**	**Okiep**	**Steinkopf**
CRR (2011)	%	82.4%	82.4%	82.4%	82.4%
CRR (2013)	%	82.4%	82.4%	88.2%	88.2%
CRR (2021)	%	94.1%	94.1%	88.2%	82.4%

Technical Site Assessment: **Springbok WWTW 20%**

11.17 Phokwane Local Municipality

Water Service Institution	**Phokwane Local Municipality**
Water Service Provider	Phokwane Local Municipality

Municipal Green Drop Score	
2021 Green Drop Score	**0%↓**
2013 Green Drop Score	**34%**
2011 Green Drop Score	**30%**
2009 Green Drop Score	**0%**

VROOM Impression (Towards restoring functionality):

1. Newly constructed reactor basin, including return flows, and SST to be to be commissioned
2. Chlorine disinfection to be reinstated

VROOM Estimate:

- R1,501,000

Key Performance Area	Unit	Hartswater	Jan Kempsdorp	Pampierstad
Green Drop Score (2021)		**1%**	**0%**	**0%**
2013 Green Drop Score		**40%**	**40%**	**66%**
2011 Green Drop Score		**21%**	**0%**	**0%**
2009 Green Drop Score		**7%**	**7%**	**0%**
Design Capacity	Ml/d	1.2	2.7	4
Design Capacity Utilisation (%)		192%	196%	118%
Resource Discharged into		Vaal River	Vaal River	Harts River
Wastewater Risk Rating (CRR% of CRR_{max})		**Hartswater**	**Jan Kempsdorp**	**Pampierstad**
CRR (2011)	%	41.1%	64.7%	76.5%
CRR (2013)	%	70.6%	64.7%	41.2%
CRR (2021)	%	100.0%	100.0%	100.0%

Technical Site Assessment: **Hartswater WWTW 19%**

11.18 Renosterberg Local Municipality

Water Service Institution	**Renosterberg Local Municipality**	
Water Service Provider	Renosterberg Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Tanker dumping FACILITY and inlet works to be constructed 2. Oxidation ponds to be relined 3. Fencing around the WWTW requires upgrading **VROOM Estimate:** - R120,000
2021 Green Drop Score	**0%↓**	
2013 Green Drop Score	**1%**	
2011 Green Drop Score	**28%**	
2009 Green Drop Score	**1%**	

Key Performance Area	**Unit**	**Petrusville**	**Phillips Town**	**Vanderkloof**
Green Drop Score (2021)		**0%**	**0%**	**0%**
2013 Green Drop Score		**69%**	**0%**	**0%**
2011 Green Drop Score		**32%**	**31%**	**22%**
2009 Green Drop Score		**1%**	**1%**	**1%**
Design Capacity	Ml/d	0.7	0.3	0.2
Design Capacity Utilisation (%)		157%	233%	150%
Resource Discharged into		Orange River	Vanderkloof Dam	Vanderkloof Dam
Wastewater Risk Rating (CRR% of CRR_{max})		**Petrusville**	**Phillips Town**	**Vanderkloof**
CRR (2011)		94.1%	47.1%	94.1%
CRR (2013)		88.2%	88.2%	94.1%
CRR (2021)		100.0%	100.0%	100.0%

Technical Site Assessment: **Petrusville WWTW 10%**

11.19 Richtersveld Local Municipality

Water Service Institution	**Richtersveld Local Municipality**	
Water Service Provider	Richtersveld Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Vandalism 2. Ponds lining 3. Flow metering. **VROOM Estimate:** - R628,320
2021 Green Drop Score	**2%↓**	
2013 Green Drop Score	**9%**	
2011 Green Drop Score	**28%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Port Nolloth**
Green Drop Score (2021)		**2%**
2013 Green Drop Score		**9%**
2011 Green Drop Score		**28%**
2009 Green Drop Score		**0%**
System Design Capacity	Ml/d	3
System Capacity Utilisation (%)		33%
Resource Discharged into		Irrigation
Wastewater Risk Rating (CRR% of CRR_{max})		**Port Nolloth**
CRR (2011)	%	47.1%
CRR (2013)	%	94.1%
CRR (2021)	%	82.4%

Technical Site Assessment: **Port Nolloth WWTW 29%**

11.20 Siyancuma Local Municipality

Water Service Institution	**Siyancuma Local Municipality**	
Water Service Providers	Internal, if services required, source from SCM database	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Screens 2. Flow meters 3. Trickling filter pumps 4. Humus tank pump **VROOM Estimation:** - R 2 948 000 - *Upgrade of sewer network currently undertaken*
2021 Green Drop Score	**26%↑**	
2013 Green Drop Score	**17%**	
2011 Green Drop Score	**4%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Douglas**	**Griekwastad**	**Schmidtsdrift**
Green Drop Score (2021)		**32%**	**22%**	**13%**
2013 Green Drop Score		**9%**	**26%**	**24%**
2011 Green Drop Score		**4%**	**4%**	**0%**
2009 Green Drop Score		**9%**	**26%**	**24%**
System Design Capacity	Ml/d	2.7	0.7	1
Design Capacity Utilisation (%)		59%	97%	NI
Resource Discharged into		Vaal	Vaal	Vaal
Wastewater Risk Rating (CRR% of CRR_{max})		**Douglas**	**Griekwastad**	**Schmidtsdrift**
CRR (2011)	%	100.0%	52.9%	52.9%
CRR (2013)	%	100.0%	100.0%	100.0%
CRR (2021)	%	82.4%	82.4%	94.1%

Technical Site Assessment: **Douglas WWTW 60%**

11.21 Siyathemba Local Municipality

Water Service Institution	**Siyathemba Local Municipality**	
Water Service Provider	Siyathemba Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. No security presence at the Marydale WWTW 2. Vandalism is prevalent 3. No serious defects **VROOM Estimate:** - R371,640,000
2021 Green Drop Score	**50%↑**	
2013 Green Drop Score	**38%**	
2011 Green Drop Score	**18%**	
2009 Green Drop Score	**67%**	

Key Performance Area	**Unit**	**Prieska**	**Marydale**	**Niekerkshoop**
2021 Green Drop Score		**50%**	**50%**	**37%**
2013 Green Drop Score		**23.36%**	**47.5%**	**47.56%**
2011 Green Drop Score		**21.9%**	**15.2%**	**17%**
2009 Green Drop Score		**71%**	**65%**	**65%**
System Design Capacity	Ml/d	2.2	0.94	0.12
Design Capacity Utilisation (%)		100%	40%	35%
Resource Discharged into		Vaal	Vaal	Vaal
Wastewater Risk Rating (CRR% as of CRR_{max})		**Prieska**	**Marydale**	**Niekerkshoop**
CRR (2011)	%	82.4%	52.9%	52.9%
CRR (2013)	%	76.5%	82.4%	88.2%
CRR (2021)	%	70.6%	64.7%	70.6%

Technical Site Assessment: **Marydale WWTW 82%**

11.22 Sol Plaatje Local Municipality

Water Service Institution	**Sol Plaatje Local Municipality**	
Water Service Provider	Sol Plaatje Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. The main outfall sewer towards Beaconsfield has collapsed 2. Standby screen to be installed 3. PST drive units to be refurbished 4. SST desludge pipework to be refurbished 5. Chlorine disinfection system is dysfunctional **VROOM Estimate:** - R31,270,000
2021 Green Drop Score	**34% ↓**	
2013 Green Drop Score	**56%**	
2011 Green Drop Score	**76%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Homevale	Beaconsfield	Ritchie
Green Drop Score (2021)		**36%**	**32%**	**28%**
2013 Green Drop Score		**53%**	**53%**	**55%**
2011 Green Drop Score		**80%**	**62%**	**43%**
2009 Green Drop Score		**0%**	**0%**	**0%**
Design Capacity	Ml/d	48	9	2
Design Capacity Utilisation (%)		NI	104%	NI
Resource Discharged into		Kamfers Dam	De Beers Mine & du Toits Pan	Modder River
Wastewater Risk Rating (CRR% of CRR_{max})		**Homevale**	**Beaconsfield**	**Ritchie**
CRR (2011)		59.3%	63.6%	76.5%
CRR (2013)		59.6%	68.2%	58.8%
CRR (2021)		96.3%	81.8%	94.1%

Technical Site Assessment: **Beaconsfield WWTW 53%**

11.23 Thembelihle Local Municipality

Water Service Institution	**Thembelihle Local Municipality**
Water Service Provider	Thembelihle Local Municipality

Municipal Green Drop Score	
2021 Green Drop Score	**40%↓**
2013 Green Drop Score	**56%**
2011 Green Drop Score	**56%**
2009 Green Drop Score	**52%**

VROOM Impression (Towards restoring functionality):

1. Screening channels to be constructed
2. Flowmeter to be calibrated
3. No disinfection in place, LM stated zero discharge

VROOM Estimate:

- R1,197,000

Key Performance Area	Unit	Hopetown	Strydenburg
Green Drop Score (2021)		**43%**	**35%**
2013 Green Drop Score		**(New) 62% (Old) 54%**	**(New) 55% (Old) 33%)**
2011 Green Drop Score		**(New) NA (Old) 62%**	**(New) NA (Old) 26%**
2009 Green Drop Score		**(New) NA (Old) 25%**	**(New) NA (Old) 79%**
Design Capacity	Ml/d	1.3	0.8
Design Capacity Utilisation (%)		NI	NI
Resource Discharged into		Orange River	Orange River
Wastewater Risk Rating (CR% of CRR_{max})		**Hopetown**	**Strydenburg**
CRR (2011)		100.0%	70.6%
CRR (2013)		64.7%	64.7%
CRR (2021)		82.4%	82.4%

Technical Site Assessment: **Hopetown WWTW 57%**

11.24 Tsantsabane Local Municipality

Water Service Institution	**Tsantsabane Local Municipality**	
Water Service Providers	Spangenberg Laboratory Services C-PaC Pumps & Valves	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Vandalism 2. Mechanical screen 3. Pumps and aerators faulty **VROOM Estimate:** - R 4 118 000 *Postmasburg WWTW under construction*
2021 Green Drop Score	**38%**	
2013 Green Drop Score	**83%**	
2011 Green Drop Score	**24%**	
2009 Green Drop Score	**13%**	

Key Performance Area	**Unit**	**Postmasburg**	**Jenn-Haven**
Green Drop Score (2021)		**40%**	**28%**
2013 Green Drop Score		**94%**	**34%**
2011 Green Drop Score		**15%**	**38%**
2009 Green Drop Score		**21%**	**0%**
System Design Capacity	Ml/d	4.8	1
Design Capacity Utilisation (%)		83%	NI
Resource Discharged into		Groenwaterspruit & mining	Groenwaterspruit & mining
Wastewater Risk Rating (CRR% of CRR_{max})		**Postmasburg**	**Jenn-Haven**
CRR (2011)	%	76.5%	41.2%
CRR (2013)	%	23.5%	100.0%
CRR (2021)	%	82.4%	94.1%

Technical Site Assessment: **Postmasburg WWTW: 78%**

11.25 Ubuntu Local Municipality

Water Service Institution	**Ubuntu Local Municipality**
Water Service Provider	Ubuntu Local Municipality

Municipal Green Drop Score	
2021 Green Drop Score	**23%↓**
2013 Green Drop Score	**24%**
2011 Green Drop Score	**24%**
2009 Green Drop Score	**0%**

VROOM Impression (Towards restoring functionality):

1. Tanker dumping site and inlet works to be reconstructed
2. Ponds are not lined
3. Flow meters to be installed
4. Fencing to be upgraded

VROOM Estimate:

- R740,000

Key Performance Area	Unit	Victoria West	Richmond	Loxton
Green Drop Score (2021)		**21%**	**24%**	**24%**
2013 Green Drop Score		**30%**	**6%**	**36%**
2011 Green Drop Score		**24%**	**25%**	**24%**
2009 Green Drop Score		**0%**	**0%**	**0%**
Design Capacity	Ml/d	2.5	2.5	2.4
Design Capacity Utilisation (%)		NI	NI	NI
Resource Discharged into		No Discharge	NI	No Discharge
Wastewater Risk Rating (CRR% of CRR_{max})		**Victoria West**	**Richmond**	**Loxton**
CRR (2011)		47.1%	47.1%	52.9%
CRR (2013)		76.5%	94.1%	94.1%
CRR (2021)		94.1%	100.0%	100.0%

Technical Site Assessment: **Victoria West WWTW 10%**

11.26 Umsobomvu Local Municipality

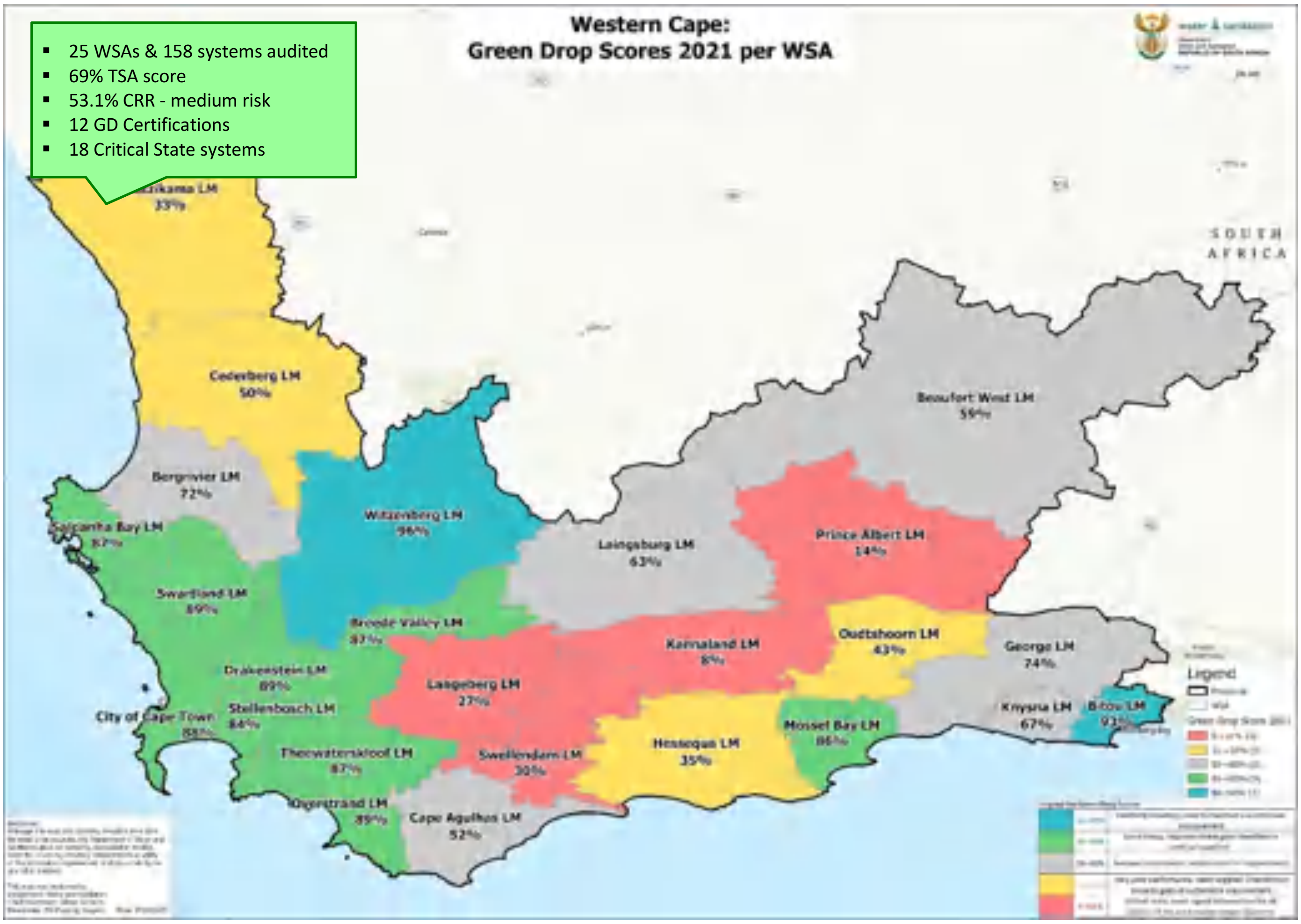
Water Service Institution	**Umsobomvu Local Municipality**	
Water Service Provider	Umsobomvu Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Install screen in emergency by-pass channel and installation of automatic screen should be considered 2. Grit removal is not effective 3. Chlorine disinfection needs to be reinstated **VROOM Estimate:** - R1,305,600
2021 Green Drop Score	**18%↑**	
2013 Green Drop Score	**13%**	
2011 Green Drop Score	**7%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Colesberg**	**Noupoort**	**Norvalspont**
Green Drop Score (2021)		**18%**	**17%**	**17%**
2013 Green Drop Score		**12%**	**35%**	**4%**
2011 Green Drop Score		**6%**	**10%**	**4%**
2009 Green Drop Score		**0%**	**0%**	**0%**
Design Capacity	Ml/d	2.4	0.18	0.14
Design Capacity Utilisation (%)		NI	NI	NI
Resource Discharged into		Orange River	Zeekoei River	**NA**
Wastewater Risk Rating (CRR % of CRR_{max})		**Colesberg**	**Noupoort**	**Norvalspont**
CRR (2011)		82.4%	100.0%	100.0%
CRR (2013)		47.1%	100.0%	100.0%
CRR (2021)		88.2%	94.1%	94.1%

Technical Site Assessment: **Colesberg WWTW 48%**

Kai Garib team making the most of the audit. Now that they are aware of the Green Drop audit criteria, they hope to raise the level of performance in the next Green Drop audit in 2023.

Green Drop Inspectors assessing the standard practice for discharge in the urine diversion system at Fraserburg, Karoo Hoogland Local Municipality.


Western Cape:
Green Drop Scores 2021 per WSA
25 WSAs & 158 systems audited
69% TSA score
53.1% CRR - medium risk
12 GD Certifications
18 Critical State systems
Cederberg LM 50%
Beaufort West LM 59%
Bergrivier LM 72%
Witzenberg LM 96%
Saldanha Bay LM 87%
Laingsburg LM 63%
Prince Albert LM 14%
Swartland LM 89%
Breede Valley LM 87%
Kannaland LM 8%
Oudtshoorn LM 43%
George LM 74%
Drakenstein LM 89%
Langeberg LM 27%
City of Cape Town 88%
Stellenbosch LM 84%
Knysna LM 67%
Bitou LM 93%
Mossel Bay LM 86%
Hessequa LM 35%
Theewaterskloof LM 87%
Swellendam LM 30%
Overstrand LM 89%
Cape Agulhas LM 52%
SOUTH AFRICA
Legend


Western Cape:
Green Drop Score Trend 2013 vs 2021 per WSA
SOUTH AFRICA
Matzikama LM 2013: 58% 2021: 33%
Cederberg LM 2013: 36% 2021: 50%
Bergrivier LM 2013: 44% 2021: 72%
Saldanha Bay LM 2013: 81% 2021: 87%
Witzenberg LM 2013: 98% 2021: 96%
Beaufort West LM 2013: 80% 2021: 59%
Laingsburg LM 2013: 37% 2021: 63%
Prince Albert LM 2013: 66% 2021: 14%
Swartland LM 2013: 72% 2021: 89%
Breede Valley LM 2013: 90% 2021: 87%
Drakenstein LM 2013: 78% 2021: 89%
Kannaland LM 2013: 50% 2021: 8%
Oudtshoorn LM 2013: 70% 2021: 43%
George LM 2013: 65% 2021: 74%
Langeberg LM 2013: 52% 2021: 27%
Stellenbosch LM 2013: 40% 2021: 84%
Knysna LM 2013: 78% 2021: 67%
Bitou LM 2013: 99% 2021: 93%
City of Cape Town 2013: 89% 2021: 88%
Theewaterskloof LM 2013: 56% 2021: 87%
Swellendam LM 2013: 71% 2021: 30%
Hessequa LM 2013: 48% 2021: 35%
Mossel Bay LM 2013: 79% 2021: 86%
Overstrand LM 2013: 89% 2021: 89%
Cape Agulhas LM 2013: 52% 2021: 52%
Legend

Provincial Synopsis

An audit attendance record of 100% affirms the Western Cape WSA's commitment to the Green Drop national incentive-based regulatory programme.

The Regulator determined that 12 wastewater systems scored the minimum of 90% when measured against the Green Drop standards for the audited period and thus qualified for the prestigious Green Drop Certification. This compares lower than the 26 systems awarded Green Drop Status in 2013 but is recognised for its inherent value to establish an accurate, current baseline from where improvement can be driven, and excellence can be incentivised. However, there are 21 GD Contenders to the GD Certification.

Nine (9) of the 25 WSAs improved on their 2013 scores. Fourteen (14) WSAs regressed to lower Green Drop scores compared to 2013 baselines. The remaining two municipalities maintained their GD scores from 2013 to 2021. Witzenberg is the best performing WSA in the province, achieving 3 GD Certifications out of their 4 wastewater systems, with a 80% TSA score. The City of Cape Town achieved the highest number GD Certifications (4 of 26 systems) and the most GD Contenders to certification (8 of 26 systems). Bitou is the second-best performing municipality with a 93% GD score and 84% TSA score, followed by Drakenstein with 89% GD score and 95% TSA for the Wellington plant. Stellenbosch impressed with achieving the best overall progress from a 40% GD score in 2013 to a 84% GD score in 2021 – this is an excellent turnaround in service delivery over the past 8 years. Unfortunately, 18 systems were identified to be in a critical state, compared to 9 in 2013. The majority of these systems are managed by Matzikama, Kannaland, Swellendam and Prince Albert.

The WSA's overall Green Drop performance is characterised by particular strengths in technical capacity and capability at most municipalities, combined with risk management practices that are well embedded in the wastewater business. The predominant KPA that requires attention include effluent quality compliance and technical management aspects of the wastewater business.

The provincial Risk Ratio for treatment plants remained constant from 52.7% in 2013 to 53.1% in 2021 (0.4% movement), which suggests limited risk movement since 2013. The most prominent risks were observed on the effluent and sludge non-compliance. Opportunities are presented in terms of reducing cost through process optimisation, improved energy efficiency, and beneficial use of sludge, nutrients, biogas, and other energy resources.

The Regulator is hopeful that the 2021 audits will set a baseline from where a positive trajectory for wastewater services and improved performance will follow. Municipalities are encouraged to start their preparation for the 2023 Green Drop audit. The 2021 Green Drop status for WSAs in the Western Cape Province are summarised in Table 194.

Table 194 - 2021 Green Drop Summary

WSA Name	2013 GD Score (%)	2021 GD Score (%)	2021 GD Certified ≥90%	2021 GD Contenders (89%)	2021 Critical State (<31%)
Witzenberg LM	98%	96%↓	Ceres, Op die berg, Tulbach		
Bitou LM	99%	93%↓	Plettenberg-Bitou, Kurland		
Drakenstein LM	78%	89%↑	Hermon	Paarl, Wellington, Saron, Gouda, Kliprug-Pearl Valley-Val de Vie	
Overstrand LM	89%	89%		Gansbaai, Stanford, Hermanus, Darling	
Swartland LM	72%	89%↑		Riebeeck Valley, Malmesbury-Abbotsdale	
City of Cape Town	89%	88%↓	Green Point Outfall, Houtbay, Philadelphia, Wesfleur Domestic	Athlone, Macassar-Strand, Kraaifontein, Mitchells Plain, Bo'cherd's Quarry, Potsdam-Milnerton, Melkbosstrand, Fisentekraal	
Breede Valley LM	90%	87%↓		Worcester	
Theewaterskloof LM	56%	87%↑			
Saldanha Bay LM	81%	87%↑	Hopefield		
Mossel Bay LM	79%	86%↑	Herbertsdale	Mossel Bay-Hartenbos	
Stellenbosch LM	40%	84%↑			
George LM	85%	74%↓			
Bergrivier LM	44%	72%↑			
Knysna LM	79%	67%↓			
Laingsburg LM	37%	63%↑			
Beaufort West LM	80%	59%↓			Murraysburg
Cape Agulhas LM	52%	52%			
Cederberg LM	36%	50%↑			
Oudtshoorn LM	70%	43%↓			
Hessequa LM	48%	35%↓			Garcia

WSA Name	2013 GD Score (%)	2021 GD Score (%)	2021 GD Certified ≥90%	2021 GD Contenders (89%)	2021 Critical State (<31%)
Matzikama LM	58%	33%↓			Vredendal North, Strandfontein, Van Rhynsdorp, Rietpoort, Nuwerus
Swellendam LM	71%	30%↓			Buffelsjagsrivier, Barrydale, Klipperivier
Langeberg LM	52%	27%↓			Robertson
Prince Albert LM	66%	14%↓			Prince Albert, Klaarstroom, Leeugamka
Kannaland LM	50%	8%↓			Ladismith, Calitzdorp, Van Wyksdorp, Zoar
Totals	-	-	12	21	18

The Department of Water and Sanitation acknowledges the excellence in wastewater management achieved for the Green Drop Audit year of 2021.

Twelve (12) Green Drop Certificates are awarded in the Province to 4 systems in the City of Cape Town, 3 systems in the Witzenberg LM, 2 systems in the Bitou LM, and 1 system each in the Drakenstein LM, Saldanha LM and Mossel Bay LM:

Province	2021 Green Drop Certified Systems	Acknowledgement of 2021 Contender Systems for Green Drop Certification
Western Cape	**Witzenberg LM** ○ Ceres ○ Op die berg ○ Tulbach **Bitou LM** ○ Plettenberg-Bitou ○ Kurland **Drakenstein LM** ○ Hermon **City of Cape Town** ○ Green Point Outfall ○ Houtbay ○ Philadelphia ○ Wesfleur Domestic **Saldanha Bay LM** ○ Hopefield **Mossel Bay LM** ○ Herbertsdale	✓ **Drakenstein LM** ○ Paarl ○ Wellington ○ Saron ○ Gouda ○ Kliprug-Pearl Valley-Val de Vie ✓ **City of Cape Town** ○ Athlone ○ Macassar-Strand ○ Kraaifontein ○ Mitchells Plain ○ Bo'cherd's Quarry ○ Potsdam-Milnerton ○ Melkbosstrand ○ Fisentekraal ✓ **Mossel Bay LM** ○ Mossel Bay-Hartenbos ✓ **Overstrand LM** ○ Gansbaai ○ Stanford ○ Hermanus ○ Darling ✓ **Swartland LM** ○ Riebeeck Valley ○ Malmesbury-Abbotsdale ✓ **Breede Valley LM** ○ Worcester

Background to Western Cape Wastewater Infrastructure

There are 25 WSAs, delivering wastewater services through a sewer network comprising of 158 WWTWs, 945 network pump stations and 14,522 km outfall and main sewer pipelines. The sewer network excludes the pipeline data for 8 municipalities who could not provide that information. There is a total installed treatment capacity of 1,108 Ml/d, with most of this capacity (67%) residing in 12 macro-sized treatment plants.

Table 195 - Summary of WWTW capacity and flow distribution according to plant sizes

	Micro Size Plants	Small Size Plants	Medium Size Plants	Large Size Plants	Macro Size Plants	Unknown (NI)*	Total
	<0.5 Ml/day	**0.5-2 Ml/day**	**2-10 Ml/day**	**10-25 Ml/day**	**>25 Ml/day**		
No. of WWTW	53 (33%)	38 (24%)	42 (27%)	9 (6%)	12 (8%)	4 (2%)	158
Total Design Capacity (Ml/day)	9.93	40.30	184.25	132.40	741.00	4	1,107.9
Total Daily Inflow (Ml/day)	4.99	29.50	108.56	70.19	521.27	18	734.5
Use of Design Capacity (%)	50%	73%	59%	53%	70%	-	66%

* *"Unknown" means the number of WWTWs with NI (No Information) on design capacity or daily inflow*

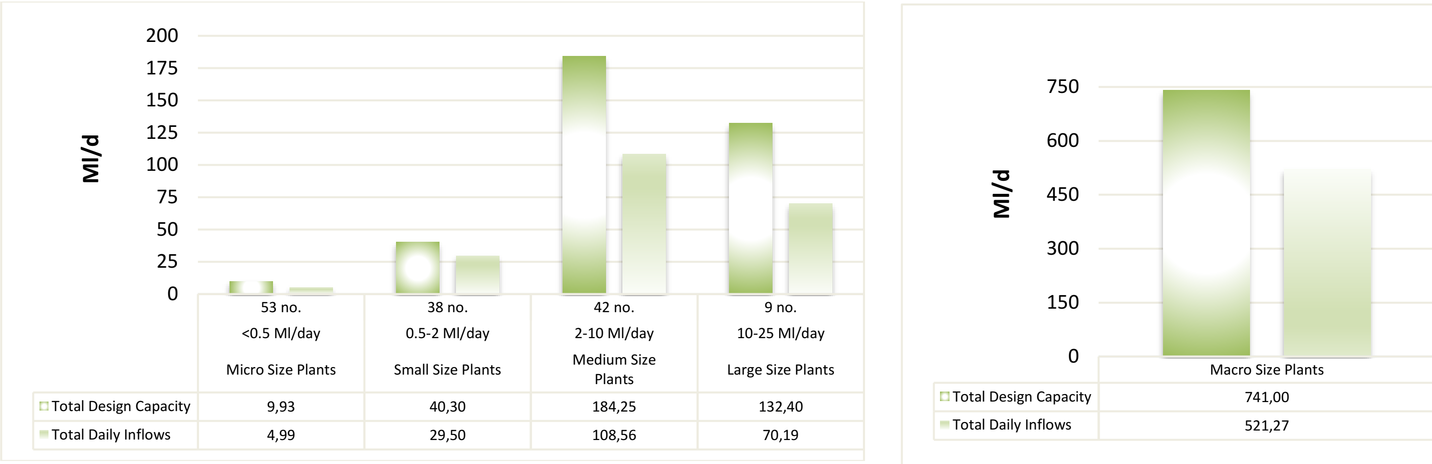


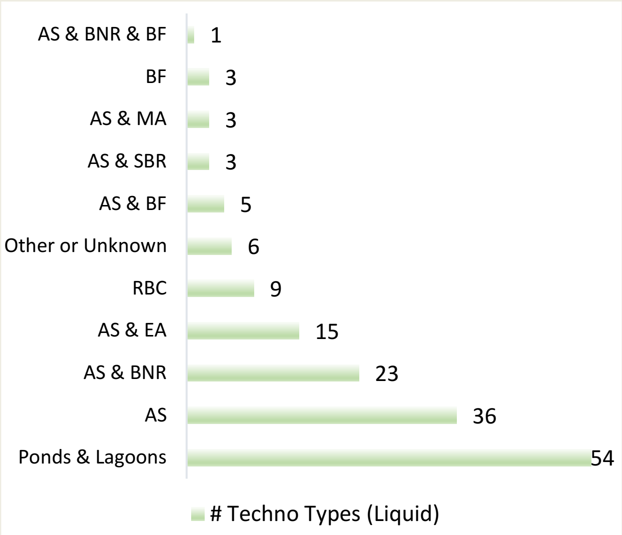
Figure 175 - Design capacities and operational inflow to micro to large sized WWTWs (a) and macro sized WWTWs

Based on the current operational flow of 735 Ml/d, the WWTWs are operating at 66% of the total design capacity. The largest flow contributor is the City of Cape Town with 527 Ml/d. The next largest contributor is Drakenstein with 30 Ml/d. Given the current capacity, this implies that there is 34% spare capacity to meet the medium-term demand. It must however be noted that inflow is not monitored in 18 systems and as a result the spare capacity could be substantially less than the 34%. Diagnostic #3 unpacks these statistics in more detail. This spare capacity would also be compromised at systems where some of the infrastructure or treatment modules are non-operational or dysfunctional. The VROOM Cost Diagnostic #7 provides more detail on the refurbishment requirements to restore such capacity and functionality.

The audit data shows that 17 system is hydraulically overloaded. This figure could theoretically be higher, given that there are 18 systems where inflow monitoring is not taking place. The hydraulically overloaded systems in each of the WSAs is as follows:

- City of Cape Town: 3 of 26 systems (Zandvliet, Gordons Bay, Klipheuwel)
- Breede Valley: 2 of 4 systems (Rawsonville, Touwsriver)
- Theewaterskloof: 1 of 8 systems (Riviersondererend)
- Stellenbosch: 1 of 5 systems (Pniel)
- Oudtshoorn: 1 of 3 systems (De Rust)
- Swartland: 1 of 7 systems (Koringberg)
- Hessequa: 3 of 10 systems (Melkhoutfontein, Riversdale, Slangrivier)
- Langeberg: 1 of 5 systems (Robertson)
- Mossel Bay: 1 of 7 systems (Grootbrak)
- Matzikama: 2 of 13 systems (Lutzville, Van Rhynsdorp)
- Knysna: 1 of 6 systems (Knysna ASP)

The predominant treatment technologies employed in Western Cape WWTWs comprise of ponds & lagoons and activated sludge (variations thereof) for effluent treatment, and belt press dewatering, solar/thermal drying beds for sludge treatment. The next audit will need to verify sludge treatment technologies, as insufficient information ("Other") is observed in this area.



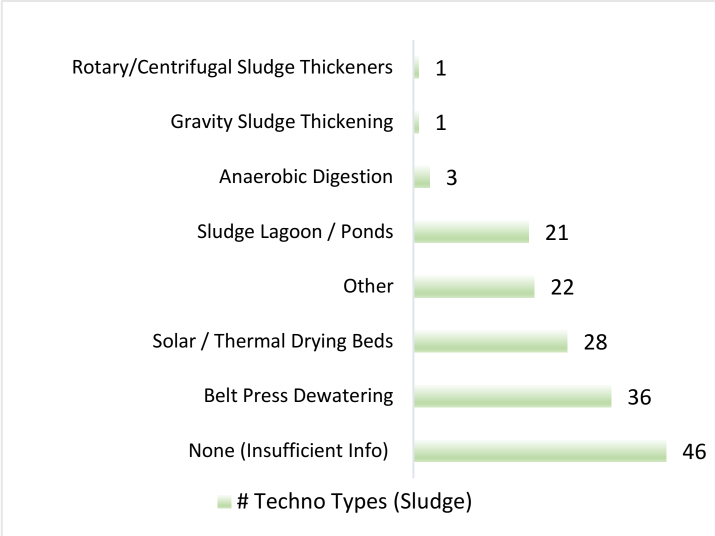


Figure 176 - Treatment technologies for wastewater effluent (a) and sludge (b)

Table196 - Summary of Collection Network Pump Stations and Sewer Pipelines

WSA Name	# WWTWs	Pump Stations (#)	Sewer Pipelines (km)
City of Cape Town	26	346	9,597
Breede Valley	4	16	436
Theewaterskloof	8	13	215
Cederburg	7	22	83
Swellendam	4	3	NI
Stellenbosch	5	18	423
Witzenberg	4	22	214
Bitou	2	73	286
Cape Agulhas	4	6	129
Oudtshoorn	3	0	NI
Drakenstein	6	19	873
Swartland	7	20	315
Saldanha Bay	7	120	552
Overstrand	6	50	680
Hessequa	10	31	NI
Beaufort West	4	6	141
Kannaland	4	6	74
Laingsburg	2	3	22
Langeberg	5	21	NI
Prince Albert	3	2	NI
Berg River	5	61	140
Mossel Bay	7	87	342
Matzikama	13	0	NI
Knysna	6	0	NI
George	6	0	NI
Totals	**158**	**945**	**14,522**

The sewer network consists of the sewer mains and pump stations as summarised in Table 196. City of Cape Town owns and manages the bulk of the sewer collector infrastructure of approximately 9,597 km and 346 sewer pump stations. Eight municipalities could not provide information on sewer pipelines, indicating asset management information limitations.

Provincial Green Drop Analysis

The 100% response from the 25 municipalities audited during the 2021 Green Drop process demonstrates a firm commitment to wastewater services in the province.

Table 197 - Green Drop Comparative Analysis from 2009 to 2021

GREEN DROP COMPARATIVE ANALYSIS					
Performance Category	**2009**	**2011**	**2013**	**2021**	**Performance trend 2013 and 2021**
Incentive-based indicators					
Municipalities assessed (#)	20 (100 %)	27 (100%)	25 (100%)	25 (100%)	→
Wastewater systems assessed (#)	107	155	158	158	→
Average Green Drop score	47%	65%	69%	66%	↓

GREEN DROP COMPARATIVE ANALYSIS					
Performance Category	**2009**	**2011**	**2013**	**2021**	**Performance trend 2013 and 2021**
Incentive-based indicators					
Green Drop scores ≥50% (#)	46/107 (44%)	117/155 (75%)	123/158 (78%)	109/158 (69%)	↓
Green Drop scores <50% (#)	61/107 (56%)	38/155 (25%)	35/158 (22%)	49/158 (31%)	↓
Green Drop Certifications (#)	10	19	26	12	↓
Technical Site Inspection Score (%)	NA	65%	74%	69%	↓

NA = Not Applied NI = No Information ↑= improvement, ↓= regress, →= no change

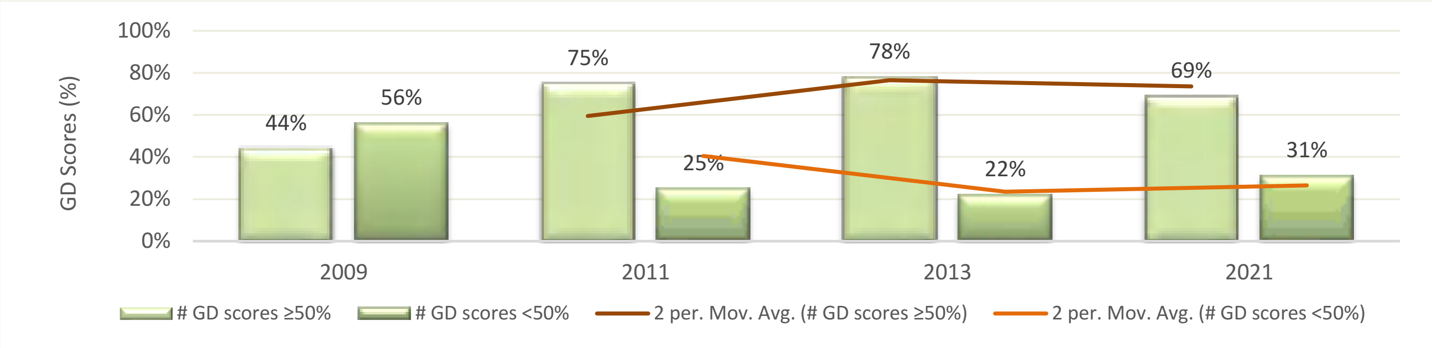


Figure 177 - Green Drop trend analysis over the period 2009 to 2021, indicating the percentage GD scores above and below 50%

The trend analysis indicates that:

- The number of systems audited has increased from 107 systems in 2009, when the first assessments were undertaken, to 158 systems in 2013 and 2021
- Despite an upward trend in previous GD average scores, 47% in 2009, 65% in 2011, 69% to 2013, there was a drop-off to 66% in 2021
- Similarly, the number of systems with GD scores of ≥50% increased between from 46 (44%) in 2009 to 123 (78%) in 2013 but decreased to 109 (69%) in 2021
- This trend was also mirrored in the TSA score, which had increased from 65% in 2011 to 74% in 2013 but decreased to 69% in 2021
- This trend was balanced by the number of systems with GD score of ≤50% decreasing from 61 (56%) in 2009 to 35 (22%) in 2013, followed by a regress to 49 (31%) in 2021
- The number of Green Drop Certifications decreased from 26 awards in 2013 to 12 awards in 2021
- An overall performance trend from 2013 to 2021 signals the need for repeat/regular audits to ensure continued improvement. There are indications that performance has declined in the absence of the consistent regulatory engagement.

The analysis for the period 2009, 2011, 2013 and 2021, indicates that many of the system scores are in the 50-80% (Average Performance) space, with the 80-90% (Good Performance) being the next largest category. The most concerning data point is that 18 systems are in critical state (<31%) compared to 9 systems in this space in 2013.

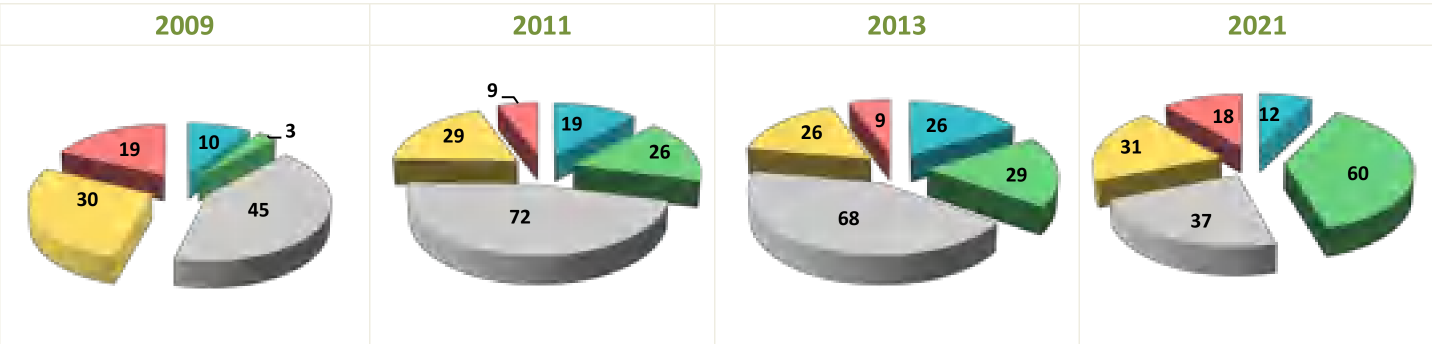
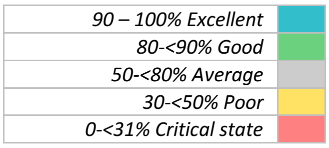


Figure 178 - No. WWTWs in the Green Drop score categories over the period 2009 to 2021 (graph legend to right)



In summary, trends over the years 2013 and 2021 indicate as follows:

- The number of systems in a 'poor state' increased from 26 in 2013 to 31 in 2021
- The number of systems in a 'critical state' increased from 9 in 2013 to 18 systems in 2021
- The number of systems in the 'excellent and good state' increased from 55 (35%) in 2013 to 72 (46%) in 2021.

Provincial Risk Analysis

Green Drop risk analysis (CRR) focuses specifically on the treatment function. It considers 4 risk indicators, i.e. design capacity, operational flow, technical capacity, and effluent quality. The CRR values do not factor risks associated with sanitation or wastewater network and collector systems.

Table 198 - Cumulative Risk Comparative Analysis from 2009 to 2021

CUMULATIVE RISK COMPARATIVE ANALYSIS					
Performance Category	**2009**	**2011**	**2013**	**2021**	**Performance Trend 2013 to 2021**
Highest CRR	27	26	24	22	↑
Average CRR	12.4	11.9	9.7	9.9	↓
Lowest CRR	5	4	4	3	↑
Design Rating (A)	1.4	1.3	1.3	1.3	→
Capacity Exceedance Rating (B)	3.3	3.7	3.1	3.0	↑
Effluent Failure Rating (C)	6.2	4.7	3.5	3.9	↓
Technical Skills Rating (D)	1.7	2.5	2.2	2.0	↑
CRR% Deviation	**62.5**	**61.1**	**52.7**	**53.1**	↓

↑= improvement, ↓= regress, →= no change

Table 198 indicates a slight CRR% deviation from 2013 to 2021, which suggests little to no change in design capacity rating (A), a decrease in the capacity exceedance rating (B), an improvement in the technical expertise (D), and a regress in the final effluent quality (C). Individual systems, however, show higher deviations and indicate specific risk categories, as highlighted under "***Regulator's Comment***". The CRR analysis in context of the Green Drop results suggests that further improvements should focus on 1) capacity exceedance at plants which are hydraulically overloaded or approaching its design lifespan, 2) effluent quality failures, especially for microbiological compliance, and 3) strengthening of technical skills and operational competency, especially related to sludge management.

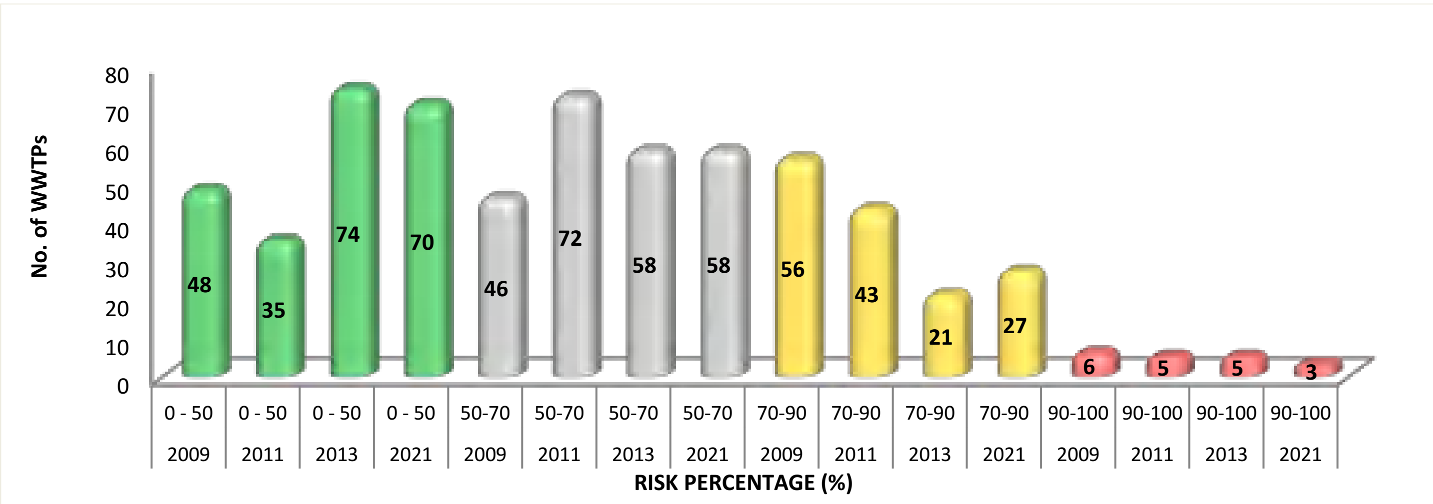


Figure 179 - a) WWTW Risk distribution and trends from 2009 to 2021; b) Colour legend

90 – 100% Critical risk WWTPs	
70 - <90% High risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low risk WWTPs	

Trend analysis of the CRR ratings for the period 2009 to 2021 reveals that:

- The most prominent movement in risk can be seen between 2011 and 2013, when a large number of plants moved from low to medium and high-risk positions, indicating a progressive state for the WWTWs
- The CRR improved from 2011 to 2013, at a time when W_2RAPs and risk-averse strategies were being embedded in WSIs
- The 2021 assessment cycle highlighted a slight regressive shift with a decrease in low (74 to 70), an increase in high (21 to 27) but a decrease in critical risk WWTWs (5 to 3).

Regulatory Enforcement

Wastewater systems which failed to achieve the minimum Green Drop target of 31%, are placed under regulatory focus. The Regulator requires these municipalities to submit a detailed corrective action plan within 60 days of publishing of this report.

Seven (7) municipalities and eighteen (18) wastewater systems that received Green Drop scores below 31%, are to be placed under **regulatory surveillance**, in accordance with the Water Services Act (108 0f 1997). In addition, these municipalities will be compelled to ringfence water services grant allocation to rectify/restore wastewater collection and treatment shortcomings identified in this report.

Table 199 - WWTWs with <31% Green Drop scores

WSA Name	2021 Municipal GD Score	WWTWs with <31% score
Beaufort West LM	80%	Murraysburg
Hessequa LM	48%	Garcia
Matzikama LM	58%	Vredendal North, Strandfontein, Van Rhynsdorp, Rietpoort, Nuwerus
Swellendam LM	71%	Buffelsjagsrivier, Barrydale, Klipperivier
Langeberg LM	52%	Robertson
Prince Albert LM	66%	Prince Albert, Klaarstroom, Leeugamka
Kannaland LM	50%	Ladismith, Calitzdorp, Van Wyksdorp, Zoar

The following municipalities and their associated wastewater treatment plants are in high CRR risk positions, which means that some or all the risk indicators are in a precarious state, i.e. operational flow, technical capacity, and effluent quality. WWTWs in high risk and critical risk positions pose a serious risk to public health and the environment. The following municipalities will be required to assess their risk contributors and develop corrective measures to mitigate these risks.

Table 200 - %CRR/CRR_{max} scores and WWTWs in critical and high-risk space

WSA Name	2021 Average CRR/CRRmax % deviation	WWTWs in critical and high-risk space	
		Critical Risk (90-100%CRR)	High Risk (70-<90%CRR)
Swartland LM	49.7%		Chartsworth, Morreesburg, Koringberg
City of Cape Town Metro	50.2%		Grootspringfontein
Langeburg LM	54.1%		Robertson
Hessequa LM	56.5%		Gouritzmond, Heidelberg, Riversdale, Stilbaai
Oudtshoorn LM	59.5%		Dysseldorp, Oudtshoorn
Cape Agulhas LM	61.8%		Bredasdorp. Waenhuiskrans
Prince Albert LM	68.6%		Klaarstroom, Prince Albert
Cederberg LM	68.9%		Clanwilliam, Algeria, Graafwater
Matzikama LM	75.6%	Nuwerus, Rietpoort, Strandfontein	Bitterfontein, Koekenaap, Luttzville Wes, Lutzville, Vredendal North, Vredendal South
Kannaland LM	79.4%		Calitzdorp, Ladismith, Zoar

Good practice risk management requires that the W_2RAPs are informed by meaningful Process and Condition Assessments, supported by zealous implementation of corrective measures and ongoing monitoring of risk movement. The municipalities that are not reflected in the above table are commended for maintaining all their treatment facilities in low and moderate risk positions - an exemplary status.

Performance Barometer

The **Green Drop Performance Barometer** presents the individual Municipal Green Drop Scores, which essentially reflects the level of mastery that a municipality has achieved in terms of its overall municipal wastewater services business. The bar chart to follow indicates the GD scores for 2013 in comparison to GD 2021, from highest to lowest performing WSI. Witzenberg and Bitou are commended for maintaining their excellent status. In addition, 9 of the 25 municipalities from Drakenstein to Stellenbosch are in the good performance category. Drakenstein, Swartland, Theewaterskloof, Saldanha Bay, Mossel Bay and Stellenbosch are commended on improving their GD scores from poor and average performance to good performance especially a giant leap for Stellenbosch from 40% to 84%. In 2013, the Province had no municipalities in the critical state but now Swellendam, Langeberg, Prince Albert and Kannaland have regressed to the critical state.

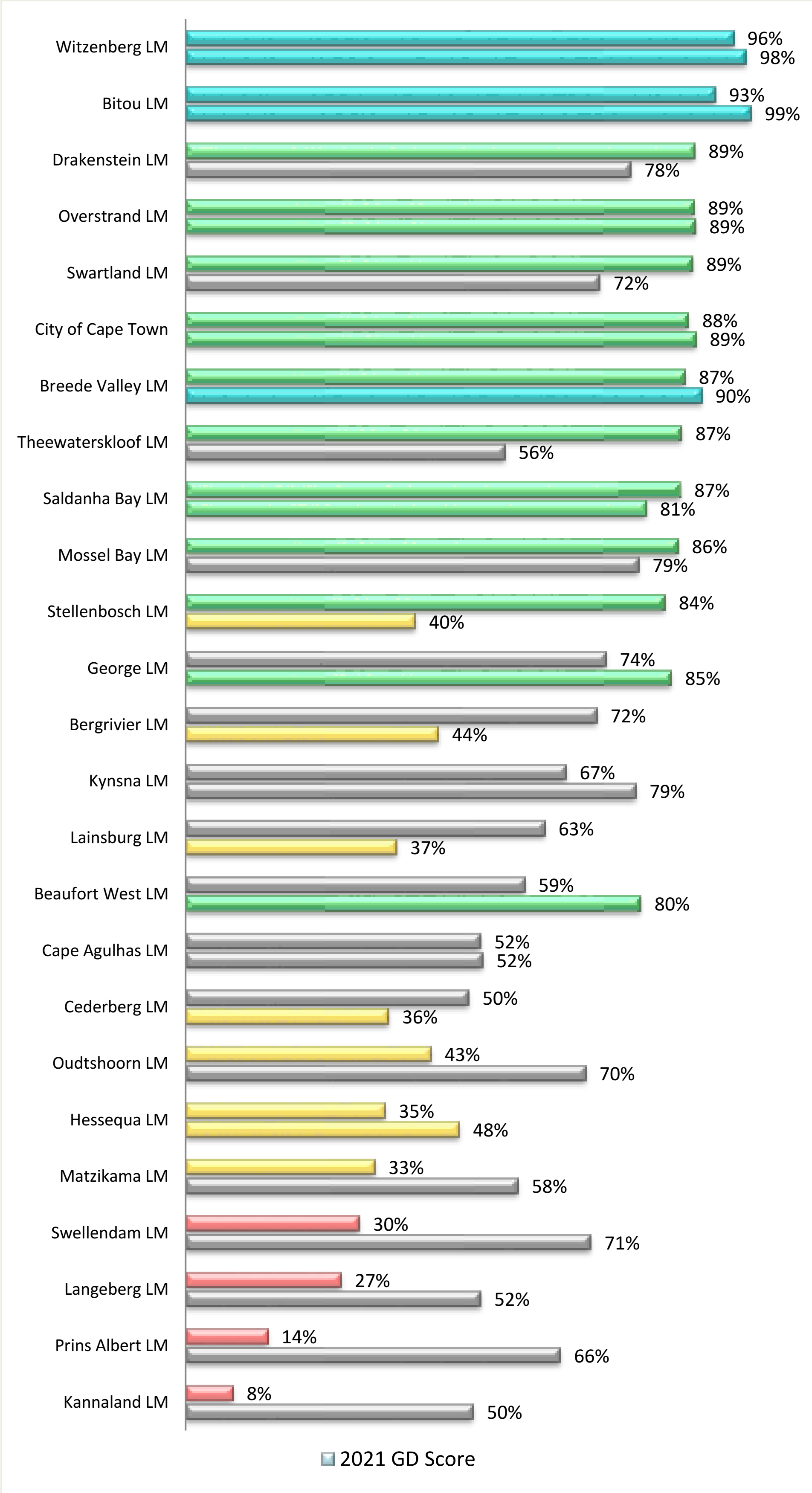


Figure 180 - a) Green Drop scores 2013 (top bar) and 2021 (bottom bar), with colour legend inserted

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	

The **Cumulative Risk Log** expresses the level of risk that a municipality poses in respect its wastewater treatment facility. It is based on the ***individual Cumulative Risk Ratios***. Figure 181 presents the cumulative risks in ascending order – with the low-risk municipalities on the top and high-risk municipalities at the bottom. Twelve municipalities from Bitou LM to Swartland LM are commended for maintaining their systems in the low-risk space. The Matzikama and Kannaland wastewater systems are in high-risk positions. The analysis reveals that there are no critical risk municipalities in the Province.

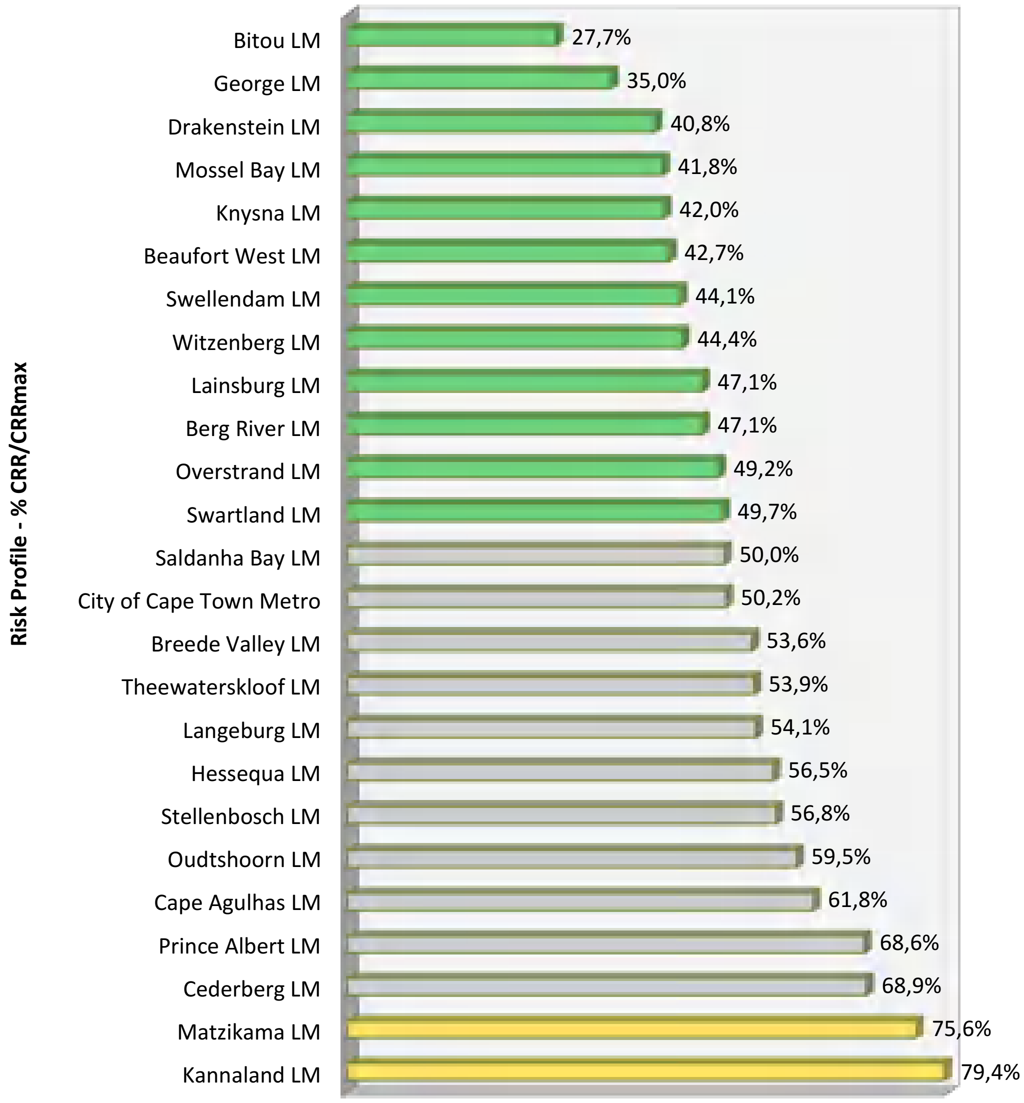


Figure 181 - a) %CRR/CRRmax Risk Performance Log 2021; b) Colour legend

90 – 100% Critical risk WWTPs	
70 - <90% High risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low risk WWTPs	

Provincial Best Performers

Witzenberg LM is the **BEST PERFORMING** municipality in the Province based on the following record of excellence:

- ✓ 96% Municipal Green Drop Score
- ✓ 2013 Green Drop Score of 98%
- ✓ Regression on the CRR risk profile from 35.6% in 2013 to 44.4% in 2021
- ✓ All plants (4 no.) in the low and medium risk positions
- ✓ Technical Site Assessment scores of 80% (Ceres)

Bitou LM is the 2nd best performing municipality:

- ✓ 93% Municipal Green Drop Score
- ✓ Both plants (2 no.) in low-risk positions
- ✓ TSA score of 84% (Plettenberg-Gansevallei)

Drakenstein LM is the 3rd best performing municipality:

- ✓ 89% Municipal Green Drop Score
- ✓ All plants (6 no.) in low and medium risk positions
- ✓ TSA of 95% (Wellington)

KPA Diagnostics

The Green Drop Audit process collects a vast amount of data that yield valuable insight on the state of the wastewater sector in each Province. These insights have been captured into 7 thematic areas or 'Diagnostics', as discussed below.

Table 201 - Summary of the key diagnostic themes and reference to the respective Green Drop KPAs

Diagnostic #	Diagnostic Description	Diagnostic Reference
1	**Green Drop KPA Analysis**	KPAs A-E
2	**Technical Competence**	KPA A, B & Bonus
3	**Treatment Capacity**	KPA D
4	**Wastewater Monitoring and Compliance**	KPA B & D & Bonus
5	**Energy Efficiency**	KPA C & Bonus
6	**Technical Site Assessments**	TSA
7	**Operation, Maintenance and Refurbishment of Assets**	KPA C, D & Bonus

Diagnostic 1: Green Drop KPA Analysis

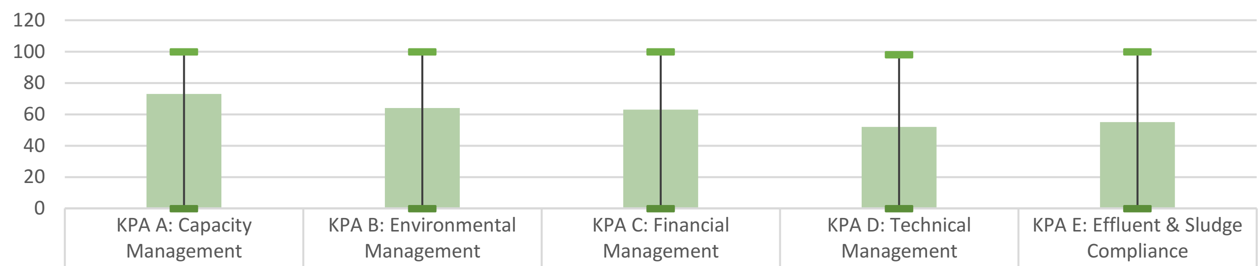
Aim: Analysis of technical skills, environmental plans, financial management, technical capacity, and regulatory compliance provides insight to the strengths and weaknesses that distinguish the Provinces' wastewater industry. These insights in return, may inform appropriate interventions and strategies to improve the individual KPAs and ultimately, collective KPA performance.

Findings: The WSAs are characterised by a variable KPA profile. A good KPA profile typically depicts a high mean GD score, coupled with a low Standard Deviation (SD) between the outer parameters (min and max). Similarly, a well performing system is one which has most/all systems in the >80% bracket and no systems in the <31% bracket.

Table 202 - Green Drop scores KPA profiles (graph legend included)

KPA #	Key Performance Area	*Weight*	Minimum GD Score (%)	Maximum GD Score (%)	Mean GD Score (%)	# Systems <31%	# Systems ≥80%
A	Capacity Management	*15%*	0%	100%	**73%**	12 (8%)	94 (59%)
B	Environmental Management	*15%*	0%	100%	**64%**	14 (9%)	70 (44%)
C	Financial Management	*20%*	0%	100%	**63%**	42 (27%)	85 (54%)
D	Technical Management	*20%*	0%	98%	**52%**	48 (30%)	51 (32%)
E	Effluent and Sludge Compliance	*30%*	0%	100%	**55%**	31 (20%)	30 (19%)

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	



	KPA A: Capacity Management	KPA B: Environmental Management	KPA C: Financial Management	KPA D: Technical Management	KPA E: Effluent & Sludge Compliance
Mean	73	64	63	52	55
Max	100	100	100	98	100
Min	0	0	0	0	0

Note: The High and low lines represent the Min and Max range, and the shaded green represents the Mean (arithmetical average)

Figure 182 - Maximum, minimum, and mean Green Drop KPA scores

The KPA distribution indicates as follows:

- Capacity Management (KPA A) depicts the highest mean of 73%, highest maximum of 100%, and the consistent Standard Deviation (SD) of 100% for 4 of the 5 KPAs. These results indicate some strengths pertaining to the registration of WWTWs, maintenance plans and records, maintenance teams, and registered, qualified staff (process controllers, supervisors, scientists, technicians, engineers)
- Technical Management (KPA D) received the lowest mean of 52%, indicating a vulnerability in basic design information, inflow, outflow, meter reading credibility, process and condition assessments, site inspection reports, asset registers, asset values, bylaws, and enforcement
- This was followed by the Effluent and Sludge Quality Compliance (KPA E) that received the next lowest mean of 55%, indicating a deficiency in data management, IRIS upload, effluent quality compliance, and sludge quality compliance.

The GD bracket performance distribution reiterates the above findings:

- ***KPA Score >80%:*** Capacity Management (KPA A) is by far the best performing KPA with 59% of systems achieving >80%, followed by Financial Management (KPA C) with 54%. Effluent and Sludge Compliance (KPA E) was the worst performing KPA with only 19% achieving >80%, followed by Technical Management (KPA D) with 32%
- ***KPA Score <31%:*** Technical Management (KPA D) represents the worst performing KPA with 30% of systems lying in the 0-31% bracket, followed by Financial Management (KPA C) with 27% and Effluent and Sludge Compliance (KPA E) with 20%.

Diagnostic 2: Technical Competence

Aim: This focus area assesses the human resources (technical) capacity to manage wastewater systems. Theory suggests a correlation between human resources capacity (sufficient number of appropriately qualified staff) and a municipality's performance- and operational capability. It is projected that high HR capacity would translate to compliant wastewater services and protection of scarce water resources.

Findings: According to regulations, wastewater plants are classified as Class A, B, C, D or E plants. Similarly, Process Controllers and Plant Supervisors are registered as Class I, II, III, IV, V or VI operators. High classed plants require a higher level of operators due to their complexity and strict regulatory standards. Technical compliance of PCs and Supervisors is determined against Green Drop standards, as defined by Reg. 2834 and draft Reg. 813 of the National Water Act 1998.

Table 203 - No. compliant versus shortfall in Supervisor and Process Controller staff

WSA Name	# WWTWs	# Compliant staff		# Staff Shortfall		Ratio*	WSA 2021 GD Score (%)
		Supervisor	PCs	Supervisor	PCs		
City of Cape Town	26	19	88	1	3	4.1	88%
Breede Valley	4	1	11	1	2	3	87%
Theewaterskloof	8	3	18	1	4	2.6	87%
Cederburg	7	0	4	1	6	0.6	50%
Swellendam	4	0	0	2	5	0	30%
Stellenbosch	5	3	8	1	6	2.2	84%
Witzenberg	4	1	10	0	0	2.8	96%
Bitou	2	2	7	0	1	4.5	93%
Cape Agulhas	4	1	3	1	4	1	52%
Oudtshoorn	3	1	0	1	9	0.3	43%
Drakenstein	6	4	9	0	3	2.2	89%
Swartland	7	2	11	1	4	1.9	89%
Saldanha Bay	7	3	14	0	3	2.4	87%
Overstrand	6	8	24	0	0	5.3	89%
Hessequa	10	1	14	2	6	1.5	35%
Beaufort West	4	2	5	0	1	1.8	59%
Kannaland	4	1	2	0	3	0.8	8%
Laingsburg	2	0	2	1	0	1	63%
Langeberg	5	0	3	2	8	0.6	27%
Prince Albert	3	1	3	0	0	1.3	14%

WSA Name	# WWTWs	# Compliant staff		# Staff Shortfall		Ratio*	WSA 2021 GD Score (%)
		Supervisor	PCs	Supervisor	PCs		
Berg River	5	1	0	0	8	0.2	72%
Mossel Bay	7	3	7	0	7	1.4	86%
Matzikama	13	1	9	2	8	0.8	33%
Knysna	6	2	7	0	7	1.5	67%
George	6	1	8	2	8	1.5	74%
Totals	**158**	**61**	**267**	**19**	**106**		

** The Ratio depicts the number of qualified staff divided by the number of WWTWs operated by this number of staff. E.g. Bitou has 9 qualified staff for 2 WWTWs, thus 9/2 = 4.5 ratio*

Note: "Compliant staff" means qualified and registered staff that meets the GD standard as required for a particular Class Works. "Staff shortfall" means staff that does not meet the GD standard for a particular Class of works (+1 for a shift) and/or staffing gaps exist at the respective WWTWs.

Competent human resources is a vital enabler to ensure efficient and sustainable management of treatment processes and infrastructure. For the WSAs in general, the operational capacity are found to be good, as illustrated by the high compliance figures below.

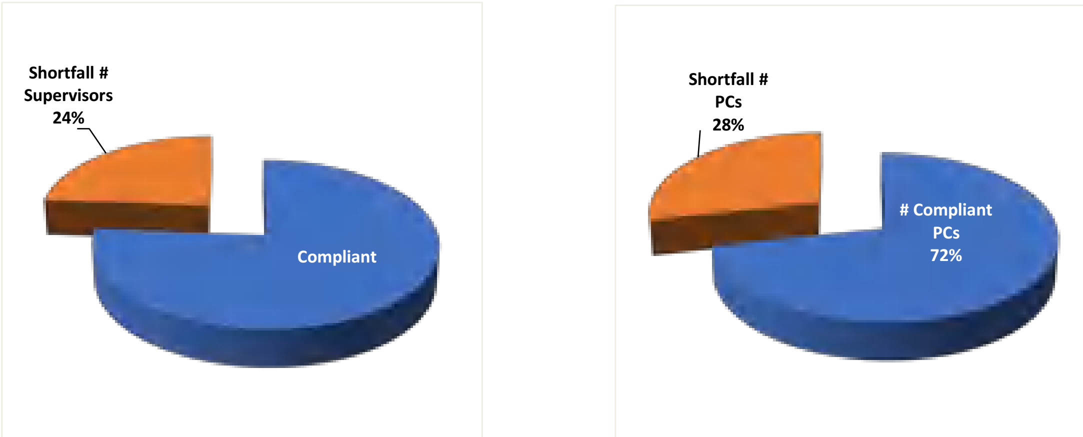


Figure 183 - Schematic illustration of compliant versus non-compliant Supervisors (a) and Process Controllers (b)

Plant Supervisors: The pie charts indicate that 76% (61 of 80) of Plant Supervisors complies with the Green Drop standard, with zero shortfall for 11 of the 25 municipalities. A 24% (19 of 80) shortfall is noted for Supervisors overall, with the highest shortfall seen at the Swellendam, Hessequa, Langeberg, Matzikama and George (2 no. each).

Process Controllers: Similarly, 72% (267 of 373) of the PC staff is compliant, with a zero shortfall for Witzenberg, Overstrand, Laingsburg and Prince Albert. There is a 28% (106 of 373) shortfall in PCs with the highest shortfalls: Oudtshoorn (9 no.); Langeberg, Berg River, Matzikama and George (8 no. each); and Mossel Bay and Knysna (7 no. each).

Green Drop standards require of Class A and B plants to employ dedicated Supervisors and Process Controllers per shift per Works, whereas Class C to E plants may consider sharing of staff across works. Furthermore, shifts have been introduced to ensure optimal operations while addressing security risks, particularly as it relates to vandalism. Telemetry also reduces the requirement for on-site staff during night shifts, but these relaxations will have to be done within the DWS regulatory guidelines.

It is anticipated, but never tested before, that a correlation would exist between the competence of an operational team and the performance of a treatment plant, as measured by the GD score

Figure 184 shows high ratios for Overstrand, Bitou, City of Cape Town, Breede Valley, and low ratios from Kannaland to Swellendam (see graph to follow). Overall, the comparative bar chart confirms a high correlation between municipalities with high ratios and higher GD scores - from Overstrand 89% to Swartland 89% in the top part of the graph. Whereas lower ratios are associated with lower GD scores - from Prince Albert 14% to Swellendam 30%. Some anomalies are observed for systems that have high GD scores but lower ratios and vice versa.

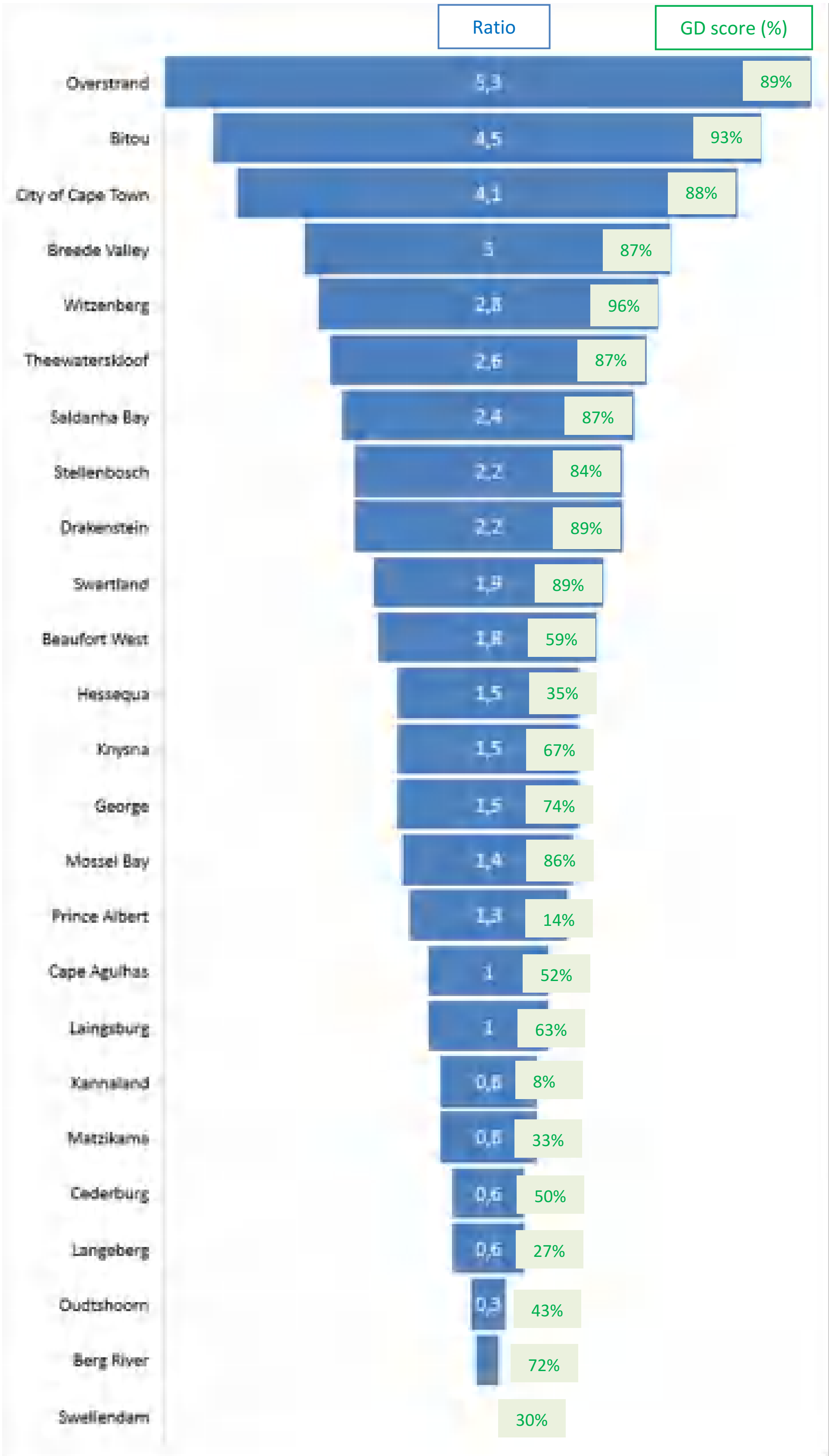


Figure 184 - Ratio of compliant operational staff to no. of WWTWs and Comparison of Ratios with GD scores

In addition to operational capacity, good management practice also requires access to qualified engineers, technicians, technologists, scientists, and maintenance capability. Such competencies could reside in-house or accessible through term contracts and external specialists.

Table 204 - Summary of the maintenance capacity and no. of qualified and shortfall of Engineering, Technical and Scientific staff

WSA Name	# WWTW	Maintenance Arrangement	Qualified Technical Staff (#)				Technical Shortfall (#)	Qualified Scientists (#)	Scientists Shortfall (#)	Ratio*	WSA 2021 GD Score (%)
			Engineers	Technologists	Technicians	Total					
City of Cape Town	26	Internal + Term Contract	13	2	22	37	0	8	0	1.4	88%
Breede Valley	4	Internal + Specific Outsourcing	0	3	2	5	0	1	0	1.3	87%
Theewaterskloof	8	Internal + Term Contract	4	4	5	13	0	2	0	1.6	87%
Cederburg	7	Internal + Term Contract	1	0	3	4	0	2	0	0.6	50%
Swellendam	4	No Capacity	1	0	2	3	0	0	1	0.8	30%
Stellenbosch	5	Internal + Term Contract	2	1	1	4	0	2	0	0.8	84%
Witzenberg	4	Internal + Term Contract	1	1	5	7	0	2	0	1.8	96%
Bitou	2	Internal + Term Contract	1	0	1	2	0	1	0	1	93%
Cape Agulhas	4	Internal + Term Contract	0	0	1	1	1	1	0	0.3	52%
Oudtshoorn	3	Internal + Specific Outsourcing	1	1	0	2	0	0	1	0.7	43%
Drakenstein	6	Internal + Specific Outsourcing	1	1	1	3	0	1	0	0.5	89%
Swartland	7	Internal + Specific Outsourcing	1	6	2	9	0	3	0	1.3	89%
Saldanha Bay	7	4 Internal + Specific Outsourcing + 1 Internal + Term Contract + 2 Internal Team (Only)	0	1	1	2	0	1	0	0.3	87%
Overstrand	6	5 Internal + Specific Outsourcing + 1 Internal + Term Contract	7	2	5	14	0	3	0	2.3	89%
Hessequa	10	Internal + Specific Outsourcing	0	1	0	1	1	0	1	0.1	35%
Beaufort West	4	Internal + Term Contract	0	1	1	2	0	0	1	0.5	59%
Kannaland	4	Inadequate Capacity	0	0	0	0	2	0	1	0	8%
Laingsburg	2	Internal + Term Contract	0	0	0	0	2	0	0	0	63%
Langeberg	5	Internal + Specific Outsourcing	0	0	0	0	2	0	1	0	27%
Prince Albert	3	Inadequate Capacity	0	0	0	0	2	0	1	0	14%
Berg River	5	4 Internal + Specific Outsourcing + 1 Internal + Term Contract	3	1	1	5	0	2	0	1	72%
Mossel Bay	7	Internal + Term Contract	1	0	1	2	0	1	0	0.3	86%
Matzikama	13	Inadequate Capacity	0	3	1	4	0	0	1	0.3	33%
Knysna	6	Internal + Term Contract	0	2	0	2	0	2	0	0.3	67%
George	6	Internal + Term Contract	1	0	1	2	0	1	0	0.3	74%
Totals	**158**		**38**	**30**	**56**	**124**	**10**	**33**	**8**		

* *The Ratio depicts the number of qualified technical staff divided by the number of WWTWs that have access to the staff*

Note 1: "Qualified Technical Staff" means staff appointed in positions to support wastewater services, and who has the required qualifications. "Technical Shortfall" is calculated based on a minimum requirement of at least 2 Engineers/Technologists/Technicians and at least one 1 Scientist per WSI.

Note 2: "Qualified Scientists" means professional registered scientists (SACNASP) appointed in positions to support wastewater services. "Scientist's shortfall" means that the WSA does not have at least one qualified, SACNASP registered scientist in their employ or contracted.

In terms of maintenance capacity, a reasonable contingent of qualified maintenance staff is in observed for at least 21 municipalities, with the current qualified maintenance staff from a collective of inhouse, contracted or outsourced personnel. The data indicates that:

- 21 of 25 municipalities have in-house maintenance teams
- 15 of 25 municipalities have internal maintenance teams supplemented with term contracts
- 9 of 25 municipalities have internal maintenance teams supplement with specific outsourced services
- 4 of 25 municipalities have either no capacity or inadequate capacity.

In general, a strong case is noted in terms of access to qualified technical staff. The data indicates as follows:

- A total of 38 engineers, 30 technologists, 56 technicians (qualified) and 33 SACNASP registered scientists are assigned to the 25 municipalities, totalling 124 qualified staff
- A total shortfall of 18 persons is identified, consisting of 10 technical staff and 8 scientists
- Cape Agulhas, Hessequa, Kannaland, Langeberg, Laingsburg, Prince Albert and Kannaland have some shortfall in qualified technical staff
- 84% of the WWTWs has access to credible laboratories which complies with Green Drop standards.

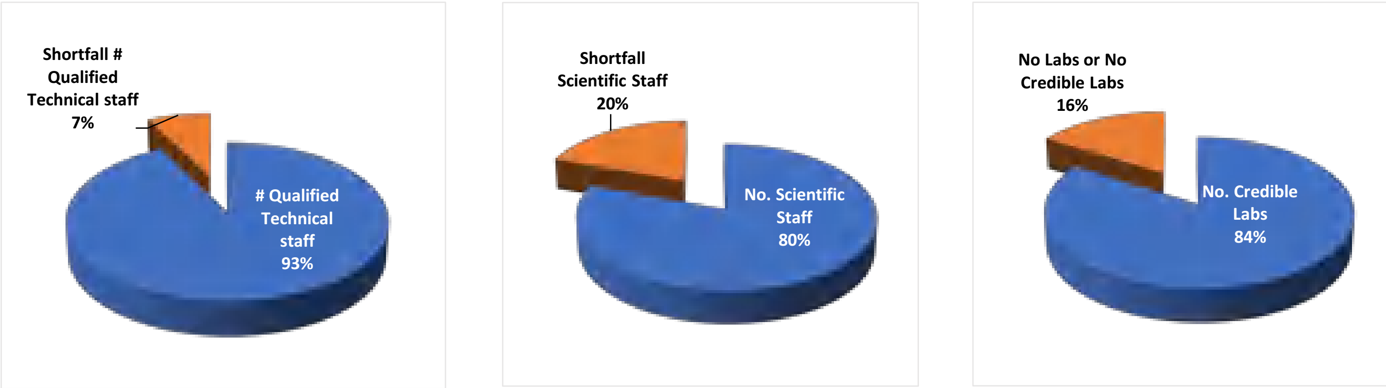


Figure 185 - Graphic illustration of the number and %: a) qualified engineering/technical staff; b) professional scientists; c) access to credible laboratory services that complies with Green Drop standards

Ratio analysis has been done to determine the number of qualified technical and scientific staff assigned per WWTW. It is expected, but never tested before, that a higher ratio would correspond with well-performing and maintained wastewater systems, as represented by the GD score.

The results shows a strong correlation between high ratios and high GD scores at 9 municipalities. i.e. from Overstrand 89% to Stellenbosch 84% in the top half of Figure 186. The only anomalies between the GD score and the ratio being that for Swellendam.

Similarly, a high correlation was found between lower ratios and lower Green Drop scores - from Cape Agulhas 52% to Prince Albert 14%, with anomalies between GD score and the ratios for Saldanha Bay, Mossel Bay, Knysna, George and Laingsburg. These results suggest that wastewater performance may be less sensitive towards engineering, technical and scientific staff, and more dependent on operational competencies (Superintendents and PCs).

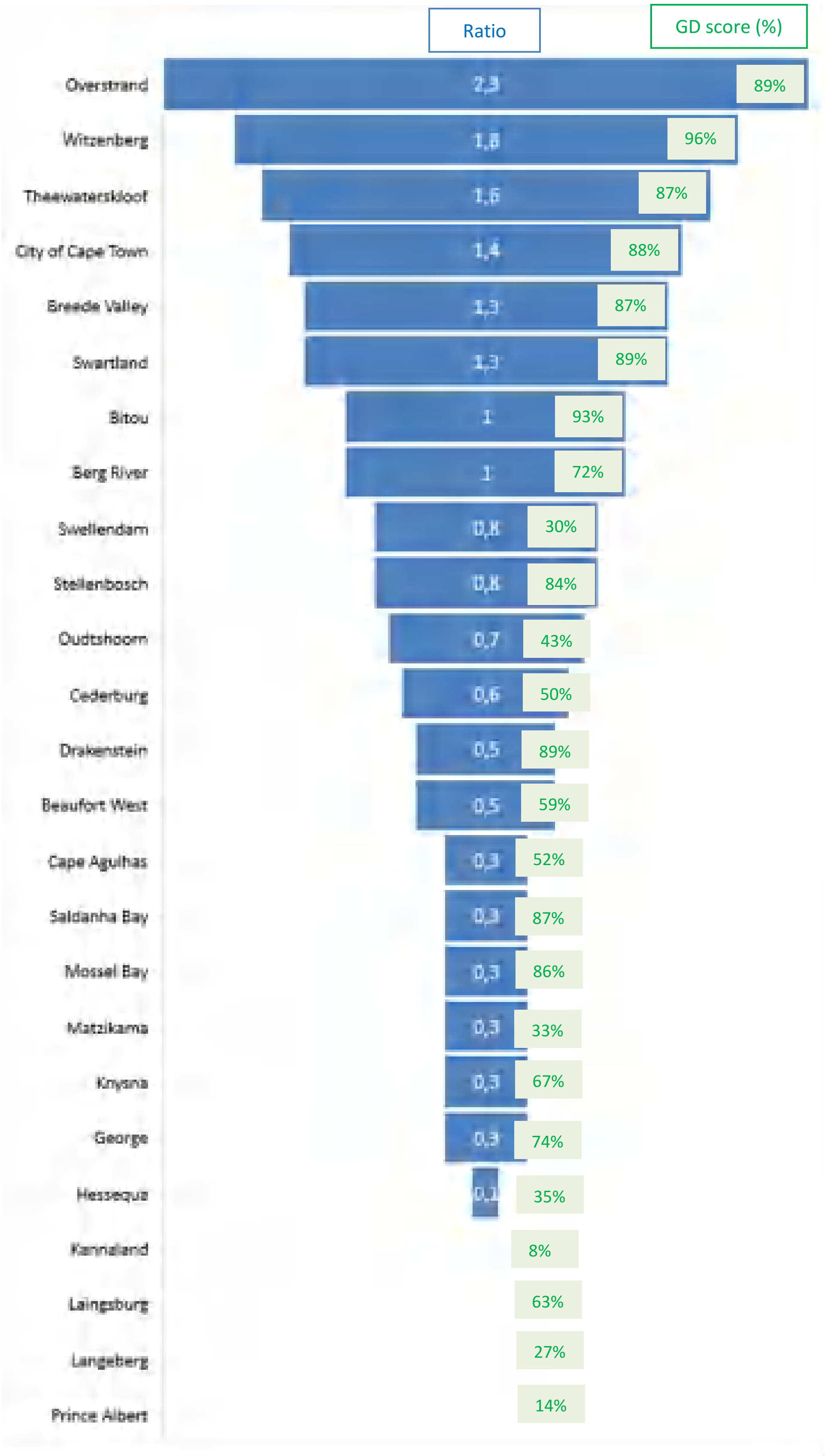


Figure 186 - Ratio of compliant technical staff to no. of WWTWs and Comparison of Ratios with GD scores

One manner of enhancing operational capacity is via dedicated training programmes. The Green Drop audit incentivise appropriate training of operational staff over a 2-year period prior to the audit date. The results are summarised as follows:

Table 205 - No. of WWTWs with operational staff sent on training over the past 2 years and vice versa

WSA Name	# of WWTW staff attending training over past 2 years	# of WWTW without training over past 2 years
City of Cape Town	26	0
Breede Valley	4	0
Theewaterskloof	6	2
Cederburg	3	4
Swellendam	0	4
Stellenbosch	5	0
Witzenberg	4	0
Bitou	2	0
Cape Agulhas	4	0
Oudtshoorn	3	0
Drakenstein	6	0
Swartland	4	3
Saldanha Bay	7	0
Overstrand	6	0
Hessequa	2	8
Beaufort West	0	4
Kannaland	2	2
Laingsburg	1	1
Langeberg	0	5
Prince Albert	0	3
Berg River	5	0
Mossel Bay	0	7
Matzikama	1	12
Knysna	6	0
George	3	3
Totals	**100 (63%)**	**58 (37%)**

Figure 187 - %WWTWs that have trained operational staff over the past two years

The training results confirmed that 100 (63%) of WWTWs operational staff attended training over the past 2 years. However, some training gaps persist which requires a concerted effort to strengthen training initiatives of Supervisors and Process Controllers. Recent training events focussed primarily on chlorine handling and NQF and need to be expanded to include operation of technology, sludge treatment and energy efficiency.

Diagnostic 3: Treatment Capacity

Aim: A capable treatment plant requires adequate design capacity and functional equipment to deliver a quality final water. If the plant capacity is exceeded by way of inflow volume or strength, a plant will not be capable to achieve its compliance standards. Capacity is typically exceeded when the demand exceeds the installed design capacity, or when processes or equipment is not operational or dysfunctional, or when the electrical supply cannot support the treatment infrastructure. This diagnostic assesses the status of plant capacity and operational flows to the plants.

Findings: Analysis of the hydraulic capacities and operational flows indicate a total design capacity of 1,107.9 Ml/d for the Province, with a total inflow of 734.5 Ml/day (considering that 18 systems are not measuring their inflows). Theoretically, this implies that 66% of the design capacity is used with 34% available to meet additional demand. However, the full 1,107.9 Ml/d day is not available as some infrastructure is dysfunctional, leaving 1,095.7 Ml/d available. All the municipalities indicate that they have installed capacity available.

All Western Cape WWTWs are operating within their design capacities, with the highest capacity use reported for Hessequa. Treatment systems with low percentage use (<50%) include Swellendam, Stellenbosch, Kannaland and Laingsburg, and this may have been affected by breakdown in sewer networks or pump stations whereby all sewage is not reaching the treatment. Cape Agulhas and Prince Albert provided no inflow data for all their systems, and this again will skew the overall Provincial data sets. The Green Drop audit requires a wastewater flow balance to identify and quantity possible losses from the network and/or ingress into the sewers. Many municipalities do not have flow balances that follows the wastewater trail from consumer to treatment plant.

Table 206 - Summary of WWTWs design and available capacities, inflows, % use design capacities, and inflows measured per WWTW

WSA Name	# WWTWs	Design Capacity (Ml/d)	Available Capacity (Ml/d)	Operational Flow (Ml/d)	Variance (Ml/d)	% Use Design Capacity	Inflow measured #
City of Cape Town	26	744.2	744.2	526.5	217.7	71%	25
Breede Valley	4	33.4	23.4	21.8	11.6	65%	4
Theewaterskloof	8	18.3	18.3	9.8	8.5	53%	8
Cederburg	7	9.9	9.9	5.0	4.8	51%	7
Swellendam	4	4.8	4.8	2.1	2.6	45%	3
Stellenbosch	5	44.0	44.0	21.3	22.7	49%	5
Witzenberg	4	14.9	14.9	9.3	5.6	62%	4
Bitou	2	9.5	9.5	5.2	4.3	55%	2
Cape Agulhas	4	4.7	4.7	NI	4.7	NI	NI
Oudtshoorn	3	11.2	11.2	6.9	4.3	62%	3
Drakenstein	6	55.4	55.4	30.1	25.3	54%	6
Swartland	7	15.4	14.4	8.9	6.5	58%	7
Saldanha Bay	7	17.7	17.7	10.3	7.4	58%	7
Overstrand	6	18.5	18.5	10.6	7.8	58%	6
Hessequa	10	7.2	7.2	6.5	0.7	90%	10
Beaufort West	4	5.7	4.3	3.0	2.7	53%	2
Kannaland	4	2.7	2.7	1.1	1.7	39%	2
Laingsburg	2	1.8	1.8	0.8	0.9	46%	2
Langeberg	5	13.7	13.7	9.9	3.8	72%	5
Prince Albert	3	0.8	0.8	NI	0.8	0%	NI
Berg River	5	7.1	7.1	4.8	2.3	68%	5
Mossel Bay	7	22.7	22.7	11.8	10.9	52%	7
Matzikama	13	5.5	5.5	4.5	1.0	83%	9
Knysna	6	9.0	9.1	7.5	1.4	84%	6
George	6	30.0	30.0	16.7	13.3	56%	5
Totals	**158**	**1,107.9**	**1,095.7**	**734.5**	**373.4**	**66%**	**140**

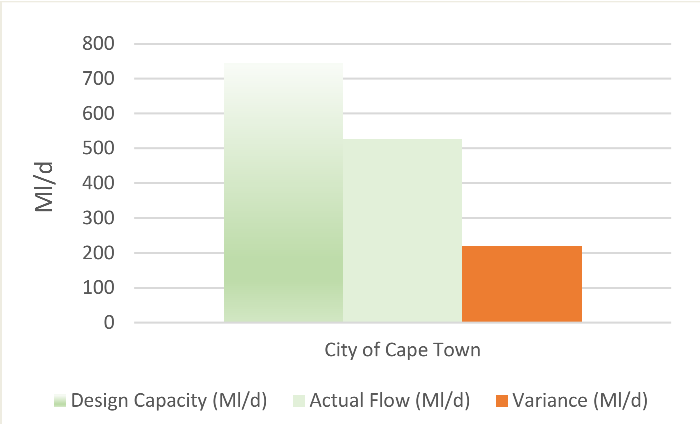
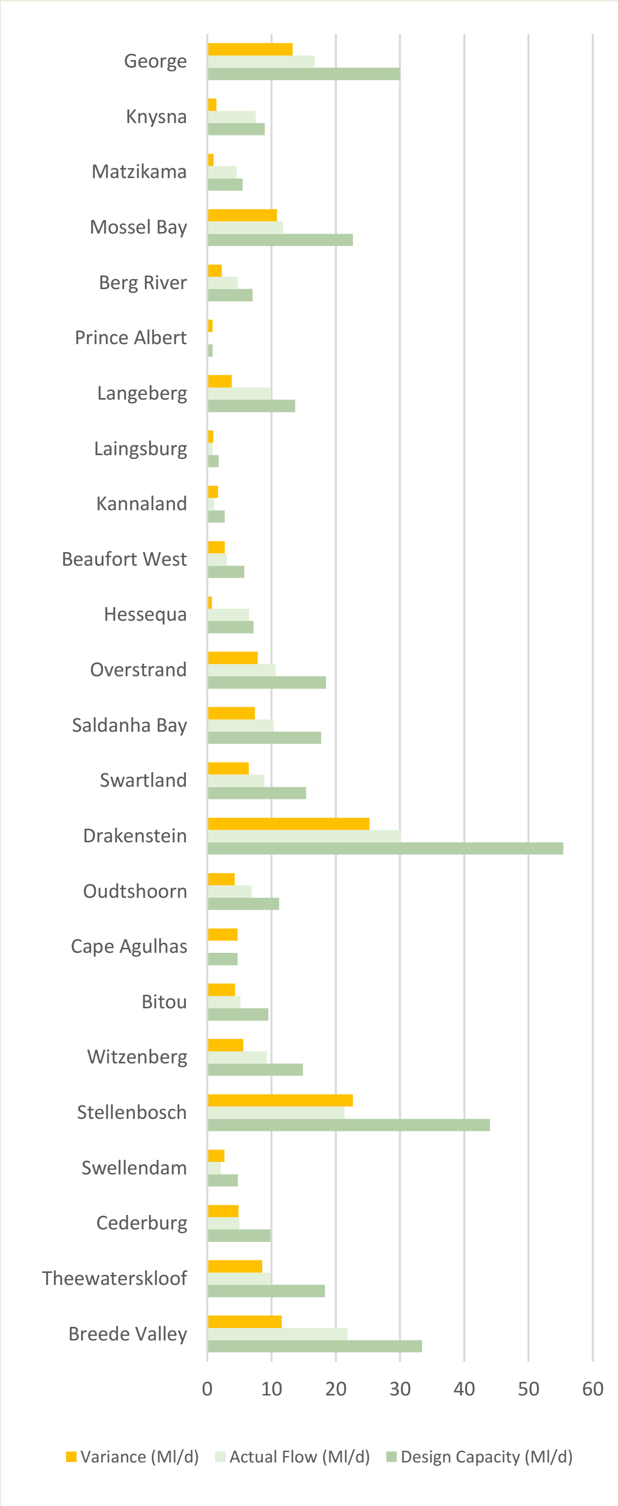


Figure 188 - WSA design capacity, actual flow, and variance in Ml/d for City of Cape Town (CoCT) only



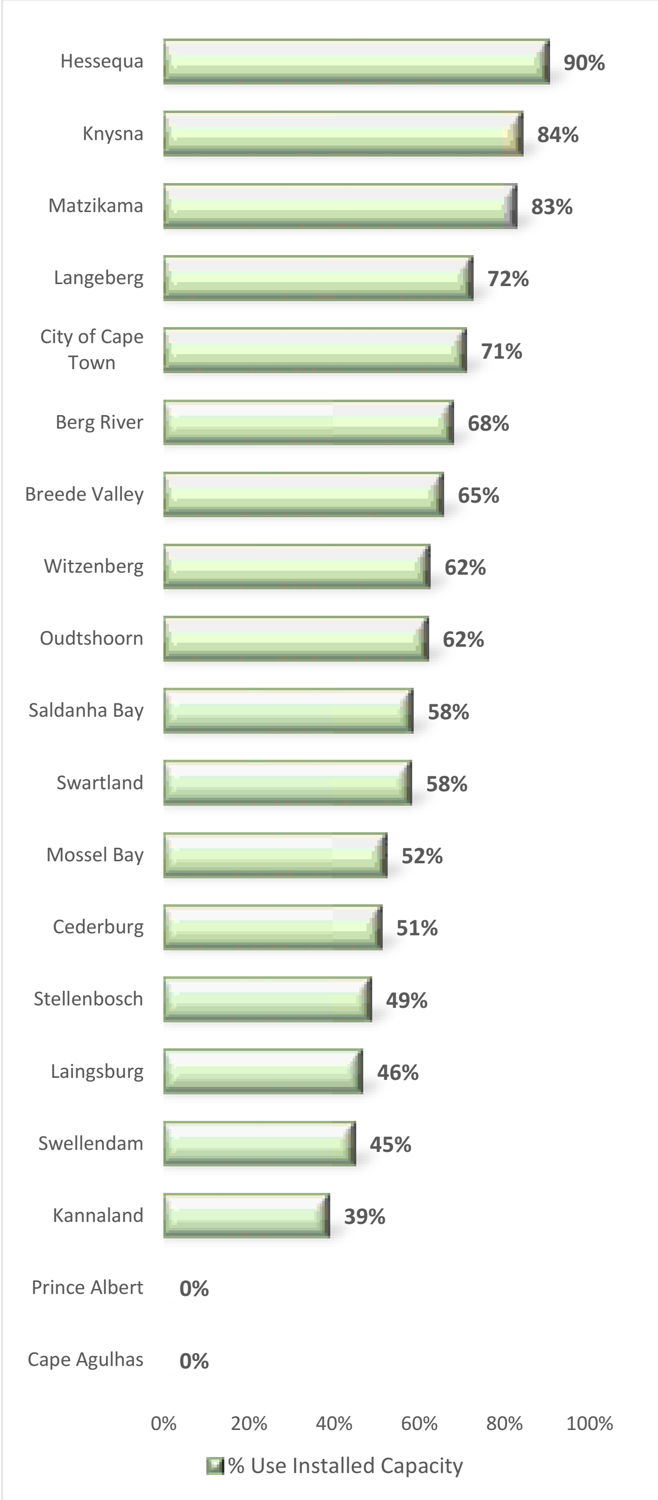


Figure 189 - (a) WSA design capacity, actual flow, and variance in Ml/d for WWTWs (excl. CoCT); (b) WSA % use of installed design capacity

The audit data shows that 17 systems with known design capacities are hydraulically overloaded. This figure will be higher as there are 18 systems that are not measuring their inflows and hence it is not possible to determine whether these systems are hydraulically overloaded as well. New housing and industrial developments planned in these drainage areas would not be able to proceed, without expansion of the capacity. The systems with known design capacities, that are hydraulically overloaded, are as follows:

- City of Cape Town: 3 of 26 systems (Zandvliet, Gordons Bay, Klipheuwel)
- Breede Valley: 2 of 4 systems (Rawsonville, Touwsriver)
- Theewaterskloof: 1 of 8 systems (Riviersondererend)
- Stellenbosch: 1 of 5 systems (Pniel)
- Oudtshoorn: 1 of 3 systems (De Rust)
- Swartland: 1 of 7 systems (Koringberg)
- Hessequa: 3 of 10 systems (Melkhoutfontein, Riversdale, Slangrivier)

- Langeberg: 1 of 5 systems (Robertson)
- Mossel Bay: 1 of 7 systems (Grootbrak)
- Matzikama: 2 of 13 systems (Lutzville, Van Rhynsdorp)
- Knysna: 1 of 6 systems (Knysna).

Lastly, Water Use Authorisations mandate municipalities to install meters and monitor inflows, whilst GD requires WSAs to report inflows on IRIS and to calibrate meters annually.

The audit results indicate that 89% (140 of 158) of municipalities monitor their inflow, with the balance of 18 WWTWs not monitoring their inflow. The latter are WWTWs linked to Cape Agulhas, Prince Albert, Swellendam, Beaufort West, Kannaland, Matzikama, and George. The majority of WSAs calibrate or verify their flow meters on an annual basis, which correspond with good practice standards.

Diagnostic 4: Wastewater Monitoring and Compliance

Aim: "*To measure is to know*" and "*To know is to manage*". The primary objective of a wastewater treatment plant is to produce final effluent and biosolids to a safe standard. This standard cannot be measured or managed if operational- and compliance monitoring is lacking. This diagnostic assesses the monitoring status and final effluent compliance against each WWTW's mandatory standards.

Findings: For operational monitoring, a satisfactory level of 90% is applied as the benchmark, to give weight to the importance of monitoring. For compliance monitoring, the audit evaluates the sampling point, sampling frequency, final effluent quality, biomonitoring, heavy metals, and any specific condition that the DWS may have included in the water use license. Final effluent quality compliance is calculated against the mandatory limits as listed under "Authorisation Status". A >90% compliance figure confirms high quality final effluent, whereas a <30% indicate poor effluent quality. The enforcement measures are summarised in the column to the far right and include NWA Notices and Directives issued, criminal cases opened, and court interdicts granted during the period 1 April 2019 to 30 June 2021.

Table 207 - Summary of the WSA operational and compliance monitoring status

WSA Name	# WWTW	Operational monitoring (KPA B2)		Compliance monitoring (KPA B3)	
		Satisfactory [GD score ≥90%]	Not Satisfactory [GD score <90%]	Satisfactory [GD score ≥90%]	Not Satisfactory [GD score <90%]
City of Cape Town	26	23	3	23	3
Breede Valley	4	2	2	4	0
Theewaterskloof	8	4	4	8	0
Cederburg	7	0	7	6	1
Swellendam	4	0	4	4	0
Stellenbosch	5	5	0	5	0
Witzenberg	4	4	0	4	0
Bitou	2	0	2	2	0
Cape Agulhas	4	1	3	4	0
Oudtshoorn	3	0	3	0	3
Drakenstein	6	5	1	5	1
Swartland	7	1	6	7	0
Saldanha Bay	7	7	0	7	0
Overstrand	6	6	0	6	0
Hessequa	10	0	10	1	9
Beaufort West	4	1	3	2	2
Kannaland	4	0	4	0	4
Laingsburg	2	0	2	0	2
Langeberg	5	0	5	5	0
Prince Albert	3	0	3	0	3
Berg River	5	0	5	3	2
Mossel Bay	7	4	3	6	1
Matzikama	13	0	13	13	0
Knysna	6	2	4	6	0
George	6	5	1	4	2
Totals	**158**	**70 (44%)**	**88 (56%)**	**125 (79%)**	**33 (21%)**

The performance recorded in Table 207 stems from performance data as measured against the Green Drop Standard expressed in KPAs B2 and B3. The data indicates that 70 of 158 plants (44%) are on par with good practice for operational monitoring of raw sewage and the respective units responsible for the processing effluent and sludge. The City of Cape Town, Stellenbosch, Witzenberg, Drakenstein, Saldanha Bay, Overstrand and George are doing exceptionally well.

Overall, a satisfactory monitoring of compliance parameters (79%) were observed, with lower satisfaction for operational sampling and analysis (44%). Compliance monitoring is a legal requirement and the only means to measure performance of a treatment facility. Operational monitoring is the cornerstone of day-to-day process adjustments and optimisation to ensure treatment is efficient and deliver quality effluent/sludge that meet design expectations. Sludge monitoring is essential as poor sludge handling is the root cause of many WWTWs failing to meet final effluent standards. It is evident that monitoring gaps exist at many WWTWs.

Table 208 summarises the results of KPA E, which also carries the highest Green Drop scoring weight. Note that averages shown as '0%' under Effluent Compliance include actual 0% compliance plus systems with no information or insufficient data.

Table 208 - Summary of authorisation status, effluent compliance status, and directives/notices issued

WSA Name	Effluent Compliance										Enforce-ment Measures*
	Authorisation Status	Microbiological Compliance (%)			Chemical Compliance (%)			Physical Compliance (%)			
		Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	
City of Cape Town	23 WULs; 3 GAs	84%	17	2	69%	8	2	76%	8	0	0
Breede Valley	2 WUL; 1 GA; 1 Permit	96%	4	0	70%	0	0	85%	2	0	0
Theewaterskloof	4 WULs; 2 GAs; 2 Permits	40%	0	2	43%	0	3	72%	1	0	0
Cederburg	2 WULs; 5 GAs	42%	1	3	21%	0	5	64%	3	2	0
Swellendam	1 WUL; 3 Unknown	75%	3	1	80%	2	0	99%	4	0	0
Stellenbosch	2 WULs; 3 GAs	43%	1	2	54%	0	0	66%	0	0	0
Witzenberg	2 GAs; 2 Permits	98%	4	0	82%	3	0	91%	2	0	0
Bitou	2 WULs; 3 GAs	100%	2	0	100%	2	0	100%	2	0	0
Cape Agulhas	1 Exempted; 1 Not authorised; 2 Unknown	77%	2	0	69%	1	0	65%	1	0	0
Oudtshoorn	1 Exempted; 1 GA; 1 Unknown	49%	1	1	33%	1	2	33%	1	2	0
Drakenstein	3 WULs; 3 GAs	76%	2	0	89%	4	0	90%	5	0	0
Swartland	1 WUL; 5 GAs; 1 Permit	53%	2	3	54%	3	3	65%	4	2	0
Saldanha Bay	2 WULs; 4 GAs; 1 Not authorised	74%	2	0	69%	1	0	74%	2	0	0
Overstrand	1 WUL; 5 GAs	85%	2	0	74%	1	0	76%	2	1	0
Hessequa	5 GAs; 4 Not authorised; 1 Unknown	49%	4	5	53%	4	4	60%	5	3	0
Beaufort West	4 GAs	73%	3	1	71%	2	1	64%	2	1	0
Kannaland	4 Not authorised	0%	0	4	0%	0	4	0%	0	4	1
Laingsburg	2 GAs	50%	1	1	70%	1	0	44%	0	0	0
Langeberg	4 GAs; 1 Not authorised	60%	1	1	83%	1	0	89%	4	0	0
Prince Albert	3 GAs	22%	0	2	43%	1	2	52%	0	0	0
Berg River	1 WUL; 4 Not authorised	51%	1	1	43%	0	2	72%	2	0	0
Mossel Bay	2 WULs; 5 GAs	84%	2	0	75%	3	0	92%	6	0	0
Matzikama	5 WULs; 8 GAs	65%	6	3	16%	0	10	50%	0	3	0
Knysna	2 Exempted; 1 WUL; 3 GAs	71%	2	0	86%	3	0	87%	4	0	1
George	2 WULs; 4 GAs	84%	5	1	94%	5	0	98%	6	0	0
Totals		**64%**	**68**	**33**	**62%**	**46**	**38**	**70%**	**66**	**18**	**2**

* The enforcement measures (notices or directives issued) are taken over a two-year financial period from July 2019 to June 2021

On average, the municipalities reached 64% for microbiological compliance monitoring, followed by 62% for chemical-, and 70% for physical compliance monitoring. For the microbiological compliance category, 68 of 158 systems achieved >90% and 33 of 158 systems fell below 30%. For the chemical compliance category, 46 of 158 systems achieved >90% and 38 systems fell below 30%. For the physical compliance category, 66 of 158 systems achieved >90% and 18 systems fell below 30%.

A total of 2 Directives/Notices have been issued to 2 municipalities, Knysna and Kannaland (1 no. each). These enforcement measures initiated by the Regulator require municipal leadership intervention and correction.

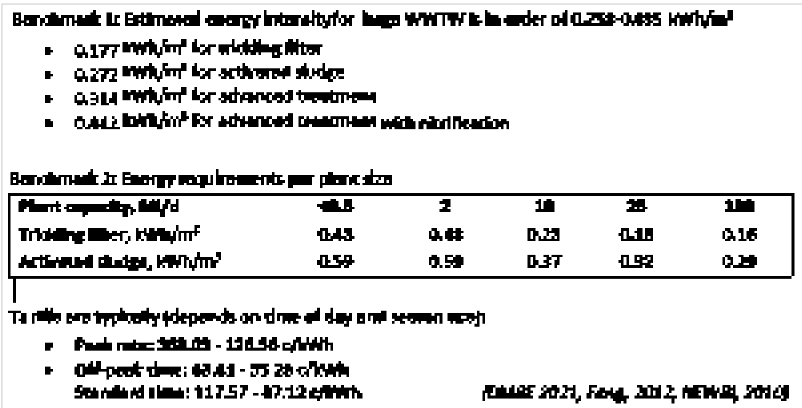
In terms of sludge compliance status, it is found that:

- 78 of the 158 plants (49%) classify their biosolids according to the WRC Sludge Guidelines, with the exception being of 8 of the 25 municipalities who do not classify their sludge
- 47 of the 158 plants (30%) monitor sludge streams with the exception of 13 of the 25 municipalities
- 42 of 158 plants (27%) have Sludge Management Plans in place with the exception of 13 of the 25 municipalities
- 11 of the 158 plants (7%) have sludge reuse projects in place – Breede Valley, Overstrand and Mossel Bay. On a positive note, the City of Cape Town is planning to install a centralised Biosolids beneficiation facility for methane gas and nutrient recovery as well as nutrient recovery and this will lead to a reduction in the carbon footprint.
- 45 of 158 plants (28%) use sludge mostly for agricultural purposes and landfills but also includes for commercial products and thermal sludge practice.

In closing of this diagnostic, the data confirms that 21 of the 25 (84%) municipalities have access to credible laboratories for compliance and operational analysis, which confirms that internal and/or contracted laboratories are accredited and/or have Proficiency Testing Schemes with suitable analytical methods and quality assurance.

Diagnostic 5: Energy Efficiency

Aim: The wastewater industry offers many opportunities to respond to climate change challenges by improving energy efficiency, reducing greenhouse gasses, and generating energy. The energy cost of sophisticated treatment technologies are in the order of 25-40% of the O&M budget (cited WRC 2021). This diagnostic investigates the status of energy efficiency management at a provincial and municipal level with an aim to motivate for improved operational wastewater treatment efficiency.


Benchmark 1: Estimated energy intensity for large WWTW is in order of [illegible] kWh/m³

- 0.177 kWh/m³ for trickling filter
- 0.272 kWh/m³ for activated sludge
- 0.314 kWh/m³ for advanced treatment
- 0.412 kWh/m³ for advanced treatment with nitrification

Benchmark 2: Energy requirements per plant size

Plant capacity, Ml/d	[illegible]	2	[illegible]	[illegible]	[illegible]
Trickling filter, kWh/m³	0.43	[illegible]	[illegible]	[illegible]	0.16
Activated sludge, kWh/m³	0.59	[illegible]	0.37	[illegible]	[illegible]

Tariffs are typically (depends on time of day and season [illegible])

- Peak rate: [illegible] c/kWh
- Off-peak time: [illegible] c/kWh
  Standard time: 117.57 - [illegible] c/kWh

([illegible])

Findings: The audit results suggest a fairly good level of awareness of energy management in the Province. Several municipalities monitor SPC, energy tariffs, energy cost, and could account for the CO_2 footprint associated with the WWTWs. Also, some initiatives are in place to improve energy efficiency and energy generation.

Table 209 - Summary of actual Specific Power Consumption versus industry benchmarks

WSA	System Classification	WWTW	SPC (kWh/m³)		WSA	System Classification	WWTW	SPC (kWh/m³)
City of Cape Town	Basic	Oudekraal	2.85		Saldanha Bay	Advanced	Vredenburg	1.49
Theewaterskloof	Basic	Tesselaarsdal	2.56		City of Cape Town	Advanced	Melkbosstrand	1.23
Laingsburg	Basic	Matjiesfontein	1.94		City of Cape Town	Basic	Camps Bay	0.2
City of Cape Town	Basic	Klipheuwel	0.5		City of Cape Town	Advanced	Westfleur Industrial	3.4
Drakenstein	Basic	Hermon	1.5		City of Cape Town	Advanced	Westfleur Domestic	1.76
Mossel Bay	Advanced	Ruiterbos	0.86		Theewaterskloof	Advanced	Grabouw	0.73
Swartland	Basic	Kalbaskraal	0.02		Witzenberg	Advanced	Ceres	1.12
Mossel Bay	Advanced	Friemersheim Western Works	0.09		City of Cape Town	Basic	Hout Bay	0.07
Saldanha Bay	Advanced	Shellypoint	1.49		Bitou	Advanced	Plettenberg - Gansevallei	1.08
Overstrand	Basic	Pearly Beach	0.73		City of Cape Town	Advanced	Kraaifontein	1.44
Swartland	Basic	Chartsworth	0.05		Swartland	Advanced	Malmesbury	1.61
George	Basic	Herolds Bay	0.4		George	Advanced	Gwaing	0.93
Theewaterskloof	Basic	Greyton	1.54		Overstrand	Advanced	Hermanus	1.14
Witzenberg	Advanced	Op de Berg	1.07		City of Cape Town	Advanced	Scottsdene	1.3
City of Cape Town	Basic	Llandudno	0.56		City of Cape Town	Advanced	Wildevoëlsvlei	1.07
Bitou	Advanced	Kurland	1.2		George	Advanced	Outeniqua	1.52
Theewaterskloof	Basic	Riviersondererend	0.06		Drakenstein	Advanced	Wellington	1.41

WSA	System Classification	WWTW	SPC (kWh/m³)		WSA	System Classification	WWTW	SPC (kWh/m³)
Theewaterskloof	Advanced	Genadendal	0.78		Mossel Bay	Advanced	Mossel Bay - Hartenbos	0.09
Drakenstein	Basic	Gouda	0.31		City of Cape Town	Basic	Fisantekraal	1.2
Saldanha Bay	Advanced	Hopefield	1.49		City of Cape Town	Advanced	Macassar	0.27
Overstrand	Advanced	Hawston	1.34		Drakenstein	Advanced	Paarl	0.9
Theewaterskloof	Advanced	Botriver	2.52		City of Cape Town	Advanced	Mitchell's plain	0.79
Overstrand	Advanced	Stanford	3.05		City of Cape Town	Advanced	Borcherd's Quarry	0.66
Saldanha Bay	Basic	Paternoster	1.49		City of Cape Town	Basic	Green Point	0.13
Swartland	Advanced	Moorreesburg	1.1		City of Cape Town	Advanced	Potsdam	1.08
Swartland	Advanced	Darling	1.46		City of Cape Town	Advanced	Zandvliet	0.66
Drakenstein	Advanced	Saron	1.54		City of Cape Town	Advanced	Belville	1.04
Laingsburg	Basic	Laingsburg	0.62		City of Cape Town	Advanced	Athlone	0.3
Saldanha Bay	Advanced	St Helena Bay	1.49		City of Cape Town	Advanced	Cape Flats	0.53
Swartland	Advanced	Riebeek valley	2.88		Saldanha Bay	Advanced	Vredenburg	1.49
Overstrand	Advanced	Kleinmond	0.53		City of Cape Town	Advanced	Melkbosstrand	1.23
Overstrand	Advanced	Gansbaai	1.14		City of Cape Town	Basic	Camps Bay	0.2
Drakenstein	Advanced	Pearl Valley	1.31		City of Cape Town	Advanced	Westfleur Industrial	3.4
Breede Valley	Advanced	De Doorns	3.6		City of Cape Town	Advanced	Westfleur Domestic	1.76
Witzenberg	Advanced	Tulbagh	2.8		Theewaterskloof	Advanced	Grabouw	0.73
George	Advanced	Kleinkrantz	1.53		Witzenberg	Advanced	Ceres	1.12
City of Cape Town	Advanced	Gordons Bay	0.59		City of Cape Town	Basic	Hout Bay	0.07
Theewaterskloof	Advanced	Caledon	1.14		Bitou	Advanced	Plettenberg Bay (Gansevallei)	1.08
Saldanha Bay	Advanced	Langebaan	1.49		City of Cape Town	Advanced	Kraaifontein	1.44
Witzenberg	Advanced	Wolseley	2.57		Swartland	Advanced	Malmesbury	1.61
Mossel Bay	Advanced	Pinnacle Point	1.66		George	Advanced	Gwaing	0.93
City of Cape Town	Advanced	Simons Town	0.05		Overstrand	Advanced	Hermanus	1.14
Saldanha Bay	Advanced	Saldanha	1.49		City of Cape Town	Advanced	Scottsdene	1.3

In terms of energy management, the data depicts the following:

- 6 of 25 municipalities conducted energy audits in the past 24 months – City of Cape Town, Theewaterskloof, Drakenstein, Swartland, Saldanha Bay and Overstrand
- System SPCs are calculated by City of Cape Town, Breede Valley, Swartland, Overstrand, Mossel Bay, Laingsburg
- City of Cape Town and Overstrand were able to account for CO_2 equivalents associated with energy efficiency. The City of Cape Town is planning to install a centralised biosolids beneficiation facility for methane gas and nutrient recovery.

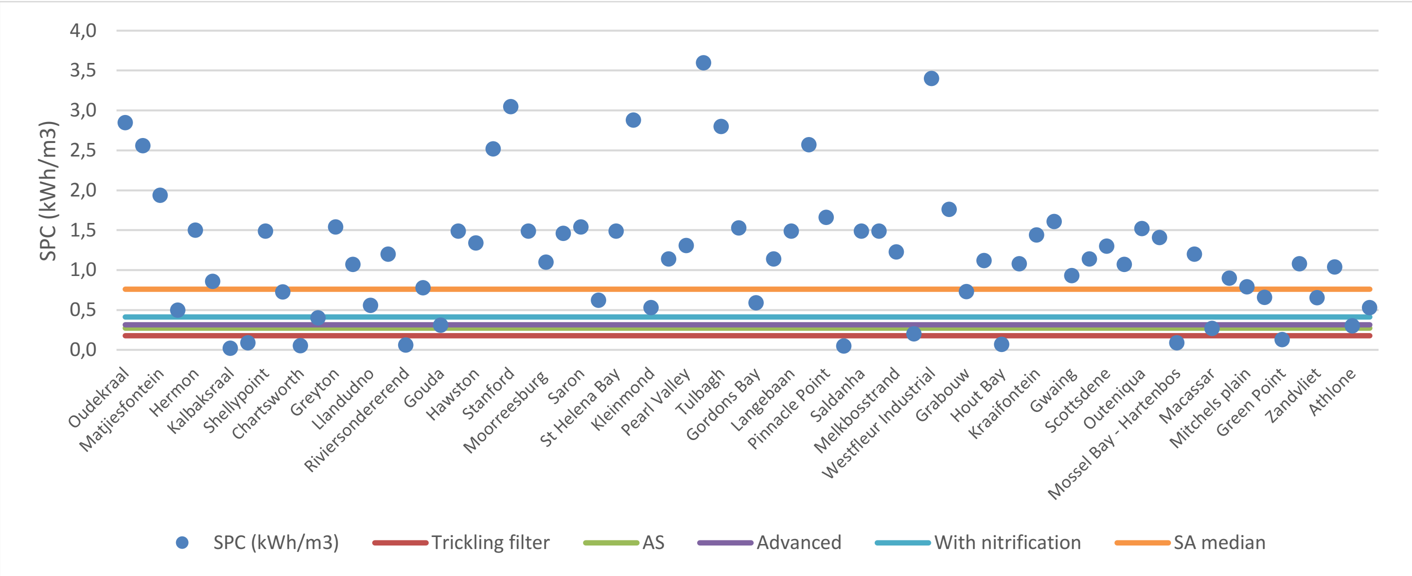


Figure 190 - WWTW Specific Power Consumption reported against industry benchmarks, sorted from low to high design capacity

In terms of energy efficiency, the data shows:

- Data has been received for 53 advanced systems and 19 basic systems
- No specific relation is observed between SPC and plant design capacity, as can be seen in Figure 190

- For advanced systems, SPCs ranged from 0.5-3.6 kWh/m^3, with an average SPC of 0.8 and median of 1.3 kWh/m^3. These values are well above the benchmark range of 0.27-0.41, and indicate that considerable opportunities exist for energy efficiency improvement
- For basic systems, SPCs ranged from 0.02-2.85 kWh/m^3, with an average SPC of 0.6 and median of 0.9 kWh/m^3. These values are well above the benchmark range of 0.177, and indicate that considerable opportunities exist for energy efficiency improvement
- 12 of 53 systems fell within the SPC industry benchmarks and the split per WWTW size is as follows:
  - Up to 2 Ml/d - 5 of 17 systems
  - 2 to 10 Ml/d - 3 of 17 systems
  - 10 to 25 Ml/d - 1 of 8 systems
  - 25 to 100 Ml/d - 3 of 10 systems
- City of Cape Town, Breede Valley, Swartland, Overstrand, Mossel Bay, Laingsburg had excellent knowledge of their energy tariffs (R/kWh) and energy cost (R/m^3)
- City of Cape Town and Overstrand demonstrated to have energy efficiency measures and/or plans in place.

The information collated suggests that many municipalities have established a specific report to monitor energy as part of the wastewater business, and that energy efficiency management is enjoying a good foothold in the Province. Improvement opportunities include the completion of energy audits for all systems, monitoring of SPCs by the municipalities who are not doing so already, improvement in energy efficiency, and exploring alternative energy sources such as methane and solar energy.

Diagnostic 6: Technical Site Assessments

Aim: The Green Drop process makes provision for the desktop audit being followed by a Technical Site Assessment (TSA) to verify the desktop evidence. The assessment includes physical inspection of the sewer network, pump stations, and treatment facility, coupled with asset condition checks to determine an approximate cost to restore existing infrastructure to functional status (VROOM).

Findings: The results of the TSAs are summarised in Table 210. A deviation of >10% between the GD and TSA score indicate a misalignment between the administrative aspects and the work on the ground. The Regulator regards a wastewater system with a TSA score of >80% as one that have an acceptable level of process control and functional equipment. 90% would represent an excellent plant that complies with most of the Green Drop TSA standards.

Table 210 - Summary of the WWTW Technical Site Assessments scores and hardware problems and %deviation between GD and TSA scores

WSA Name	TSA WWTW Name	WWTW GD Score (%)	%TSA	Key Hardware Problems	Difference between TSA and GD score
City of Cape Town	Borcherds Quarry	89%	91%	1. The PSTs are old, and work will be required on mechanical equipment and weirs; 2. FBA will always require fine monitoring to check for clogged units	2%
	Wesfleur Industrial	89%	96%	1. The air blowers for fine bubble aeration need to be reinstalled; 2. FBA will always require fine monitoring to check for clogged units	7%
Langeberg	Robertson	12%	38%	1. Automated screen out of order; 2. Grit removal unable to cope. Unlikely that channels can be cleaned; 3. Only 1 x Humus tank operational - other tanks overloaded 4. Maturation Ponds full of sludge; 5. Dewatering plant to be repaired	26%
Laingsburg	Laingsburg	63%	61%	1. Flow metering; 2. Aeration; 3. OSEC pump; 4. Irrigation pump; 5. Outlet meter.	2%
Kannaland	Ladismith	15%	49%	1. 2nd Auto Screen; 2. Refurb's being done; 3. Formalise discharge	34%
Prince Albert	Klaarstroom	15%	52%	1. Ponds to be lined; 2. Disinfection formalised; 3. 2nd Irrigation Pump needed	37%
Beaufort West	Beaufort West	64%	64%	1. Screening and compactor; 2. BNR, disinfection	0%
Drakenstein	Wellington	89%	95%	No major hardware issues	6%
Berg river	Piketberg	73%	66%	1. THEFT - entire reactor out of service - raw sewage discharge; 2. Screen out for repair; 3. Flow control dam return to HOW urgently required; 4. Out of service Mixers and standby equipment to be replaced; 5. Only one sludge return pump installed; 6. Flow balancing sluice gates	7%
Cederberg	Clanwilliam	51%	65%	1. Disinfection; 2. Flow metering & balancing; 3. Process knowledge & improved process control; 4. Characteristic monitoring of aeration reactor; 5. Chlorine gas safety training	14%
Matzikama	Vredendal South	32%	31%	1. RAS pumps dysfunctional; 2. Chlorine dosing (chlorinator) repair; 3. Aerator's dysfunctional; 4. Anaerobic dam and maturation high solids content	0%
Stellenbosch	Stellenbosch	84%	86%	1. Repair clarified scum baffle and install proper scum draw-off; 2. Work on SPC's; 3. A few more safety signs	2%
Witzenberg	Ceres	100%	80%	1. Chlorine dosing room; 2. Outlet flow metering; 3. Outlet dam wall; 4. Older structures may need upgrade in future; 5. Possible better lime dosing facility	20%

WSA Name	TSA WWTW Name	WWTW GD Score (%)	%TSA	Key Hardware Problems	Difference between TSA and GD score
Breede Valley	De Doorns	75%	54%	1. Need to get the 2 x 20% A/S modules reconfigured and commissioned; 2. Sludge recycle pumps need to be working; 3. Sludge wasting; 4. Chlorine gas disinfection	21%
Theewaterskloof	Grabouw	87%	61%	1. Urgently desludge maturation dams and repair; 2. Repair weirs of clarifiers; 3. Repair composting plant; 4. Replace sludge thickening; 5. Implement more regular desludging	26%
Swellendam	Klipperivier	31%	54%	1. Unlined sludge ponds; 2. None of the mixers are operational, with phased repair; 3. Lined solar drying pad required	23%
Cape Agulhas	Bredasdorp	50%	67%	1. Unlined sludge ponds; 2. Network pump station needs fencing; 3. Staff Facilities needs improvements	17%
Hessequa	Heidelberg	36%	68%	There are no serious hardware issues	32%
Mossel Bay	Mossel Bay	92%	80%	There were no major hardware risks	12%
George	Gwaing	71%	70%	1. Erosion at CCT; 2. Sludge Stockpile; 3. Cow in inlet, major safety risk in reticulation network	1%
Knysna	Sedgefield	73%	75%	1. Clarity in CCT is poor, sludge present in CCT consider secondary clarification; 2. Problems with disinfection evident from poor micro-bio results; 3. Establish FE measurement point after final polishing (maturation Ponds); 4. Securing of the network pump station	2%
Bitou	Plettenberg Bay	93%	84%	1. No Sludge management; 2. Storage of backup chlorine gas cylinders	9%
Oudtshoorn	Oudtshoorn	44%	55%	1. Feed to Biofilter; 2. Scum blanket in BNR System	11%
Swartland	Riebeek valley	89%	97%	1. Minor issues - new plant; 2. Scum withdrawal	8%
Overstrand	Hermanus	89%	74%	1. Settling tanks distribution box; 2. Lime storage in a industrial container; 3. Security	15%
Saldanha	Langebaan	85%	90%	1. Plant in excellent condition – no hardware defects; 2. Scum management at clarifiers	5%
Totals	**26**				**0% to 37%**

A total of 26 site assessments were conducted, with 1 to 2 inspections per municipality. Nine municipalities scored ≥80%, which is regarded to be a satisfactory site score. Three of the 26 systems had a TSA score of <50%, indicating that these systems fail to meet operational, asset functionality, and workplace safety standards.

An acceptably low difference between GD and TSA scores were observed for the majority of municipalities, except for Prince Albert (37%), Kannaland (34%), Hessequa (32%), Langeberg and Theewaterskloof (26% each). A low difference implies that the wastewater management aspects correlate with the condition of processes and infrastructure in the field.

Some focal points include:

- City of Cape Town, Drakenstein, Stellenbosch, Witzenberg, Mossel Bay, Bitou, Swartland and Saldanha had TSA scores ≥80%, which also include a close match to their respective GD scores with the exception of Witzenberg but still both scores ≥ 80%
- Prince Albert, Kannaland, Hessequa, Langeberg, Theewaterskloof, Witzenberg and Breede Valley had large deviations between their GD score and the TSA score (all ≥20%) with the highest deviation for Klaarstroom WWTW in Prince Albert. This does not reflect positively on the operation and functionality of the sewer network and treatment processes.

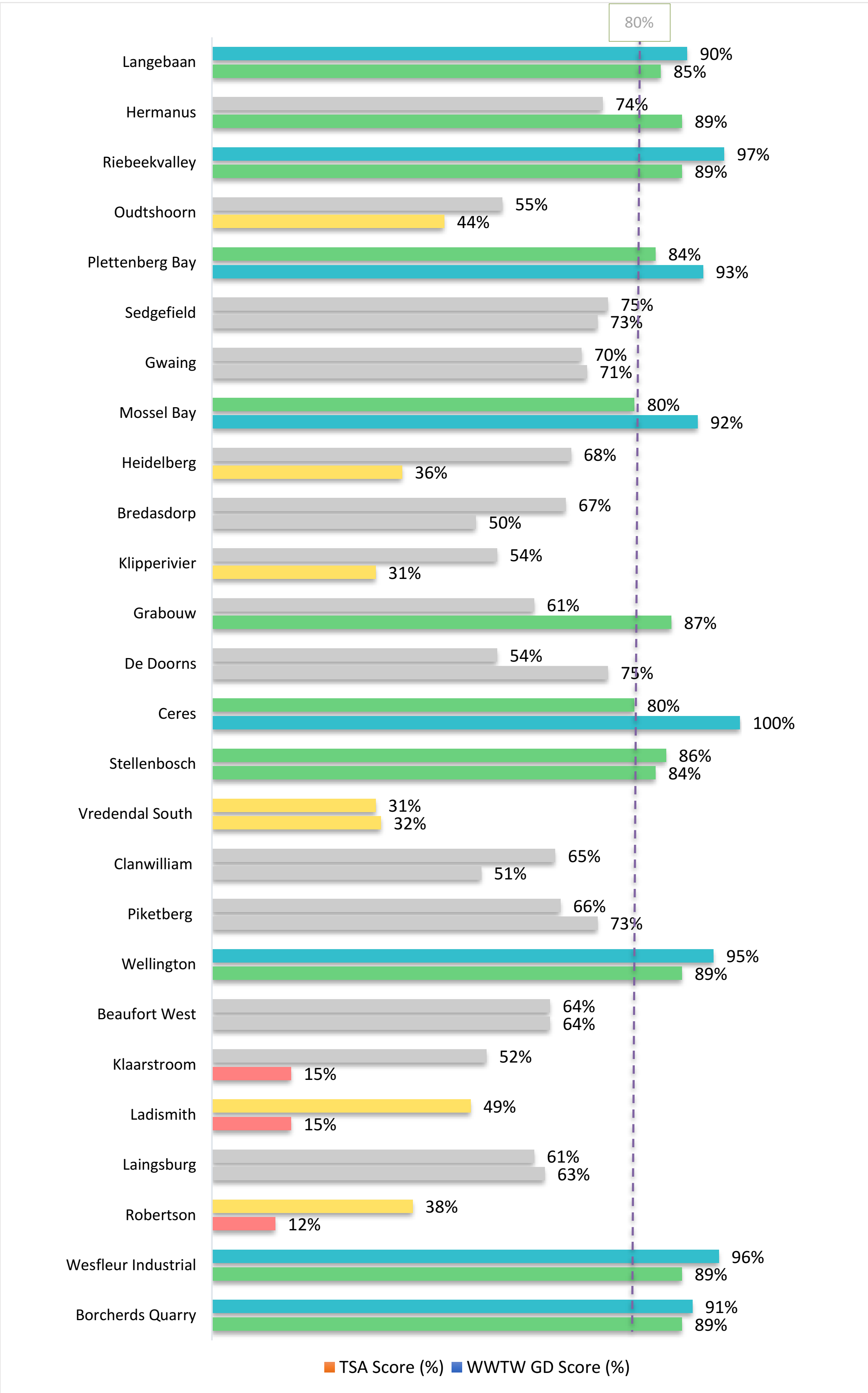


Figure 191 - Municipal GD (bottom bar) and TSA (top bar) score comparison (colour legends as for GD – blue excellent; red critical)

The VROOM cost presents a ''very rough order of measurement" cost to return a WWTWs functionality to its original design. For the Province, a total budget of R740 million is estimated, with the bulk of the work going towards restoration of mechanical equipment (52%).

Table 211 - VROOM cost split for civil, mechanical, and electrical and total VROOM cost estimate

WSA	Civil cost estimate	Mechanical cost estimate	Electrical & C&I cost estimate	Total VROOM cost
City of Cape Town	R52,202,614	R118,953,496	R0	R171,156,110
Langeberg	R5,646,592	R21,990,144	R7,435,264	R35,072,000
Laingsburg	R113,913	R87,256	R26,656	R227,825
Kannaland	R4,289,658	R4,260,608	R1,132,934	R9,683,200
Prince Albert	R42,200	R168,800	R0	R211,000
Beaufort West	R6,549,548	R2,726,463	R784,738	R10,060,750
Drakenstein	R0	R1,107,780	R0	R1,107,780
Berg river	R1,650,902	R10,398,536	R9,390,843	R21,440,280
Cederberg	R17,971,128	R4,209,811	R2,755,242	R24,822,000
Matzikama	R806,153	R17,417,154	R2,991,253	R21,214,560
Stellenbosch	R18,161,000	R9,809,800	R629,200	R28,600,000
Witzenberg	R20,845,956	R5,436,769	R3,754,675	R30,037,400
Breede Valley	R70,197,039	R117,241,370	R58,866,991	R246,305,400
Theewaterskloof	R13,232,444	R46,802,000	R28,773,905	R88,808,350
Swellendam	R1,389,000	R2,528,000	R0	R3,917,000
Cape Agulhas	R2,308,044	R3,832,224	R1,117,732	R7,258,000
Hessequa	R176,000	R1,187,000	R0	R1,363,000
Mossel Bay	R0	R1,005,804	R662,196	R1,668,000
George	R7,614,000	R1,709,000	R633,000	R9,956,000
Knysna	R19,000	R426,000	R186,000	R631,000
Bitou	R409,000	R1,669,000	R1,522,000	R3,600,000
Oudtshoorn	R764,000	R4,584,000	R738,000	R6,086,000
Swartland	R67,000	R709,000	R172,000	R948,000
Overstrand	R9,526,800	R530,400	R142,800	R10,200,000
Saldanha	R611,513	R3,376,613	R1,329,375	R5,317,500
Totals	**R234,593,504**	**R382,167,028**	**R123,044,804**	**R739,691,155**
% Distribution	**32%**	**52%**	**16%**	**100%**

The key hardware problems are listed in Table 210, with the most predominant defects observed in faulty or vandalised electrical cables, primary- and secondary sludge settling, disinfection, sludge pumps, sludge treatment, and power backup. Mechanical defects typically include dysfunctional aerators, sludge and effluent pumps, mixers, screens, degritters, and disinfection equipment. Vandalism and theft, long procurement lead times, lack of management involvement, lack of maintenance, and lack of budget are the main reasons for dysfunctional assets.

Diagnostic 7: Operation, Maintenance and Refurbishment of Assets

Aim: Insufficient financial resources are often cited as a root cause to dysfunctional or non-compliant wastewater systems. Knowledge and monitoring of fiscal spending are therefore a critical part of wastewater management. This diagnostic investigates the status of financial information as pertaining to O&M budgets and expenditure, asset figures, and capital funding.

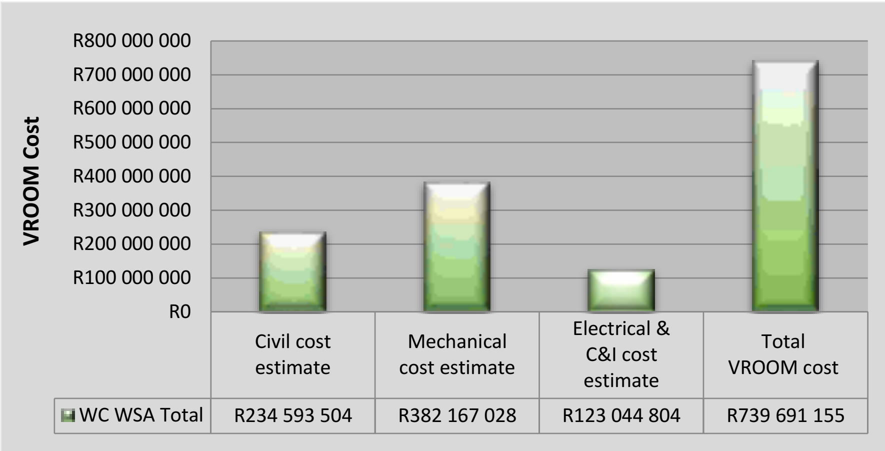
Findings: A substantial amount of financial information was presented during the audit process. Unfortunately, the evidence was presented in different formats, levels of detail, or absent for some municipalities. It was observed that municipal teams with financial officials present during the audits typically performed better, and also had a good understanding of the wastewater challenges experienced by their technical peers. Discrepancies observed included: generic or non-ringfenced budgets, contract lump sums for Service Providers presented as budgets, outdated or incomplete asset registers, some cost drivers are lacking (mostly electricity), etc. The Regulator grouped data into different certainty levels, as can be summarised at the end of this Diagnostic.

It must be noted that there were limitations with the financial and asset information. Not all WSAs submitted current information or complete financial data sets.

The result of each financial portfolio is discussed hereunder.

Vroom Cost Analysis

The VROOM costs breakdown is discussed under the TSA Diagnostic but is further illustrated as follows.



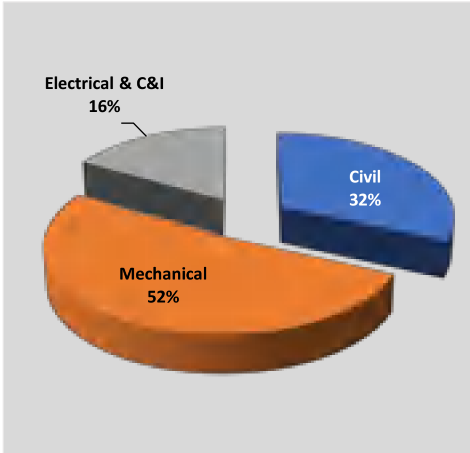


Figure 192 - Graphic illustration of the total cost estimated to restore functionality to existing assets (a), broken down to civil, mechanical, and electrical components

The total cost of R740 million is estimated to restore existing treatment works to their design capacity and functionality - consisting of R382 million for mechanical repairs, R123 million for electrical repairs, and R235 million for civil structures.

Table 212 indicates that a capital budget of R14.52 billion has been secured over 1-3 years to address infrastructural needs, which covers the R740 million VROOM refurbishment need and by implication, allows surplus for other capital projects. The R740 million estimated VROOM cost constitutes 8.8% of the total asset value of R8.4 billion. Furthermore, the WATCOST-SALGA figures provides for an annual 2.14% of the asset value required to maintain these assets. This constitutes an amount of R179 million required by the various WSA's annually to maintain the assets, while a once-off R740 million is required to restore existing assets.

Capital, O&M Budget and Actual, and Asset Value

The capital budgets, O&M budgets, O&M actual expenditure, and current asset values are summarised below.

Table 212 - Summary of the capital budgets, O&M budgets, O&M actual expenditure, and current asset values

WSA	Capital budget available	O&M budget (2020/21)	O&M expended (2020/21)	% Expended	Total Current Asset Value
City of Cape Town	R12,471,000,000	R1,457,609,560	R1,519,030,180	104%	R3,558,167,000
Langeberg	NI	R6,138,780	NI	NI	NI
Laingsburg	R3,410,180	R1,619,380	R1,438,390	89%	R3,378,580
Kannaland	R8,400,000	R6,549,080	NI	NI	R73,821,020
Prince Albert	NI	NI	NI	NI	R3,498,920
Beaufort West	R42,696,730	R7,017,760	R5,182,360	74%	R20,382,420
Drakenstein	R12,052,010	R190,294,000	R179,675,000	94%	R894,133,000
Berg river	R44,300,000	R20,800,000	R20,800,000	100%	R91,380,000
Cederberg	R20,275,000	R2,016,000	R478,000	24%	R38,478,000
Matzikama	R26,382,825	NI	NI	NI	NI
Stellenbosch	R1,147,000,000	R30,133,000	R23,155,000	77%	R942,663,000
Witzenberg	R9,760,000	R29,166,000	R26,858,000	92%	R114,669,400
Breede Valley	R28,200,000	R123,000,000	R119,000,000	97%	R422,946,000
Theewaterskloof	R59,028,000	R13,035,000	R12,882,000	99%	NI
Swellendam	NI	NI	NI	NI	NI
Cape Agulhas	R55,924,000	R19,559,000	R18,360,000	94%	NI
Hessequa	R39,170,300	NI	NI	NI	NI

WSA	Capital budget available	O&M budget (2020/21)	O&M expended (2020/21)	% Expended	Total Current Asset Value
Mossel Bay	R134,318,000	R16,230,330	R14,816,130	91%	NI
George	R270,600,000	NI	R99,423,380	NI	R150,567,342
Knysna	R1,674,000	NI	NI	NI	R180,434,920
Bitou	R7,700,000	R42,042,170	R16,620,200	40%	R117,081,000
Oudtshoorn	R11,293,000	R14,285,590	R12,597,850	88%	R29,954,480
Swartland	R64,576,000	R55,489,300	R50,615,520	91%	R329,107,000
Overstrand	R35,132,000	R95,106,980	R97,700,390	103%	R692,434,000
Saldanha	R24,758,280	R68,080,720	R55,111,950	81%	R713,722,000
Totals	**R14,517,650,325**	**R2,198,172,650**	**R2,273,744,350**	**103%**	**R8,376,818,082**

The Green Drop process provides a bonus (incentive) in cases where a municipality provide evidence of capital projects with secured funding since this is deemed as a definitive means of addressing wastewater services inadequacies. This incentive encourages wastewater infrastructure investment. A total capital budget of R14.52 billion has been reported for the refurbishment and upgrades of wastewater infrastructure for 22 of 25 municipalities over a 1-to-3-year fiscal period. The largest capital budget is observed for City of Cape Town (R12.5b), followed by Stellenbosch (R1.15b), George (R271m), and Mossel Bay (R134m).

For the 2020/21 fiscal year, the total O&M budget reported was R2.2 billion, of which R2.27 billion (103%) has been expended. The biggest budget is with the City of Cape Town that over-expended on their budget by 4%. Over-expenditure was also observed for with Overstrand (103%) which are not large deviations, but they are large budgets. Low expenditure was observed for Cederburg and Bitou. Prince Albert, Matzikama, Swellendam, Knysna and Hessequa provided no information. Partial financial info was observed for Langeberg, Kannaland and George.

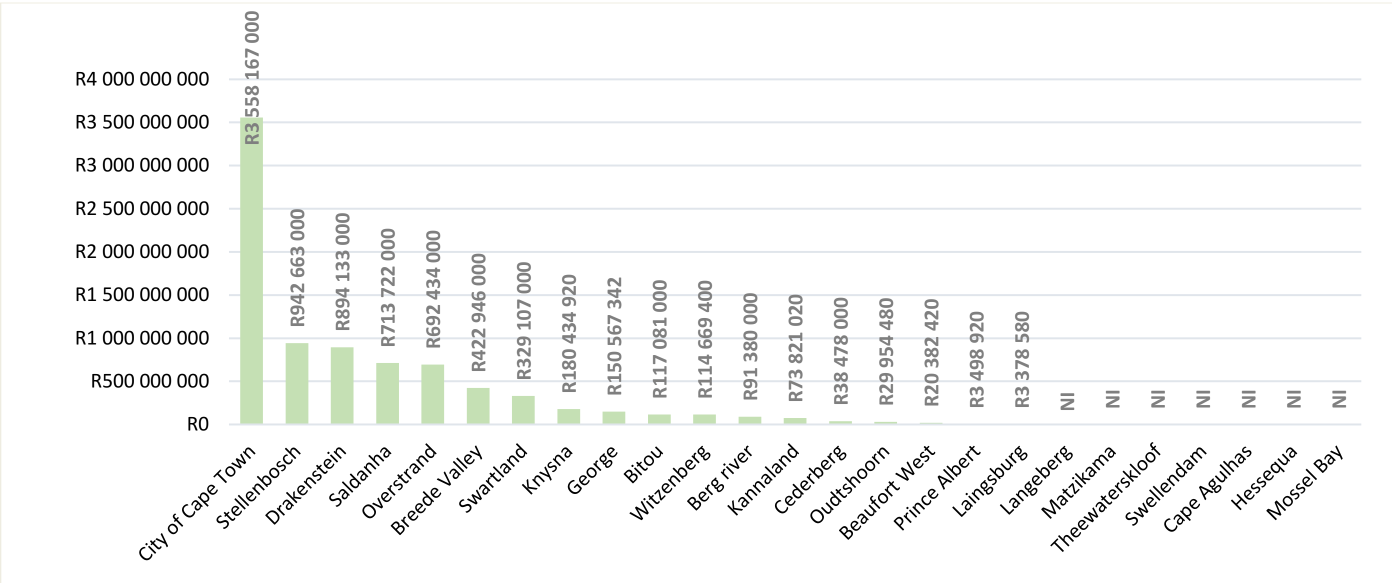


Figure 193 - Total current asset value reported by the municipalities

The total current asset value for wastewater infrastructure (networks, pump stations, treatment plants) is reportedly R8.38 billion (excluding Langeburg, Matzikama, Theewaterskloof, Swellendam, Cape Agulhas, Hessequa and Mossel Bay with no information). The highest asset values are observed for City of Cape Town (R3.56b), followed by Stellenbosch (R943m), Drakenstein (R894m), Saldanha (R714m), and Overstrand (R692m).

O&M Cost Benchmarking

By combining the SALGA and WRC WATCOST models, an estimation of the maintenance cost required per asset type can be done, i.e. civil, buildings, pipelines, mechanical, electrical, and instrumentation. The maintenance benchmark departs from the basis that 15.75% of the asset value is required to maintain these assets.

Table 213 - SALGA-WRC annual maintenance budget guideline and cost estimation

Description	% of Current Asset Value	Asset Value Estimate	Modified SALGA Maintenance Guideline	Annual Maintenance Budget Guideline
Current Asset Value estimate	**100%**	**R8,376,818,082**	**15.75%**	**R179,263,907**
Broken down into:				
1. Civil Structures	46%	R3,853,336,318	0.50%	R19,266,682
2, Buildings	3%	R251,304,542	1.50%	R3,769,568
3. Pipelines	6%	R502,609,085	0.75%	R3,769,568
4. Mechanical Equipment	35%	R2,931,886,329	4.00%	R117,275,453
5. Electrical Equipment	8%	R670,145,447	4.00%	R26,805,818
6. Instrumentation	2%	R167,536,362	5.00%	R8,376,818
Totals	**100%**	**R8,376,818,082**	**15.75%**	**R179,263,907**
			Minus 20% P&Gs and 10% Installation	**R53,779,172**
			Total	**R125,484,735**

The model estimates that close to R180 million (2.14%) is required per year to maintain the assets valued at R8.38 billion. Notably, this maintenance estimate assumes that all assets are functional. The VROOM cost represents the monies needed to get assets functional, from which basis route maintenance could then focus on maintaining the assets.

Table 214 indicates the SALGA maintenance cost estimation in relation to the VROOM cost, O&M budget, and O&M actual expended.

Table 214 - O&M cost estimates by the SALGA and VROOM models versus actual budget and expenditure figures)

Cost Reference	O&M Cost Estimate	Period
Modified SALGA	R179,263,907	Annually, estimation
O&M Budget	R2,198,172,650.00	Actual for 2020/21
O&M Spend	R2,273,744,350.00	Actual for 2020/21
VROOM	R739,691,155.00	Once off estimation

The cost dynamics can be summarised as follows:

- The SALGA estimations for O&M budgets is 8% of the actual reported budgets for the 2020/21 fiscal year
- The actual O&M budget seems adequate when compare with the SALGA guideline
- The VROOM cost represents an estimation of the refurbishment cost to restore WWTWs functionality and design capacity.

Production Cost and Comparison

It is good business practice to monitor and manage the production costs of wastewater treatment in Rand/m^3 treated, and to compare such cost with industry norms. Published benchmarks is not currently available for typical treatment (production) costs, but significant cost increases are expected since 2013, given the variable input factors such as Covid, and cost of chemicals, transport, and electricity. From an economic perspective, it would be valuable to compare production cost budgeted with actual production costs. However, due to scarce information, it is not possible to provide insight as to possible shortfalls from an economic perspective.

Based on the limited data sets, no specific trend can be established between the cost to treat wastewater and the operational flow. The data does highlight some WWTWs with lower operational flow are mostly associated with higher production costs, e.g. Tesselaarsdal, Dwarskersbos, and Gouda. Some of the reported production costs seems excessive and need to be investigated by the respective Superintendents. Typically, larger plants with higher inflows benefit from economies of scale and would show a lower production cost compared to its low-flow counterparts. The main factors that influence costs would be staff, which is a fixed cost, and energy, chemical and repairs/maintenance costs, which is a variable cost which depends on the operational status of a plant.

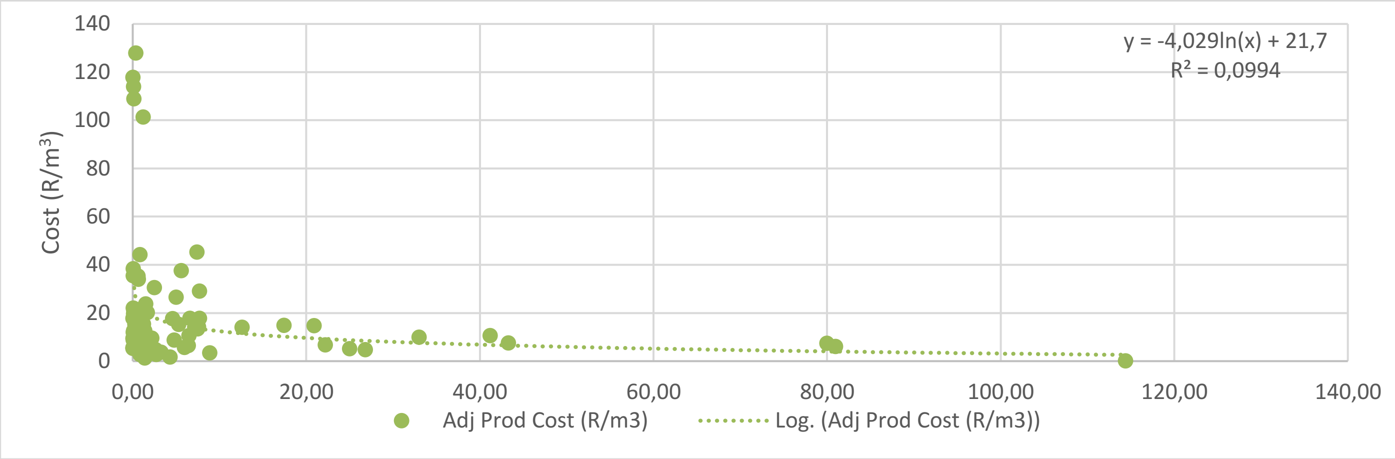


Figure 194 - Adjusted production cost (R/m³) for wastewater treatment, sorted by operational capacity (inflow) per WWTW

The following plot shows that the production cost for treatment of wastewater ranges from R0.19 to R128 per m³. The average cost to treat 1 m³ of wastewater is R20.40 and median cost is R12.66, with the latter giving the more representative estimate of production cost. A logarithmic trendline was fitted to the reported values with a correlation coefficient of 31.6%. Using this fit, 9.94% (R^2) of the variation in the costs to treat wastewater in the Western Cape depends on the operational flow.

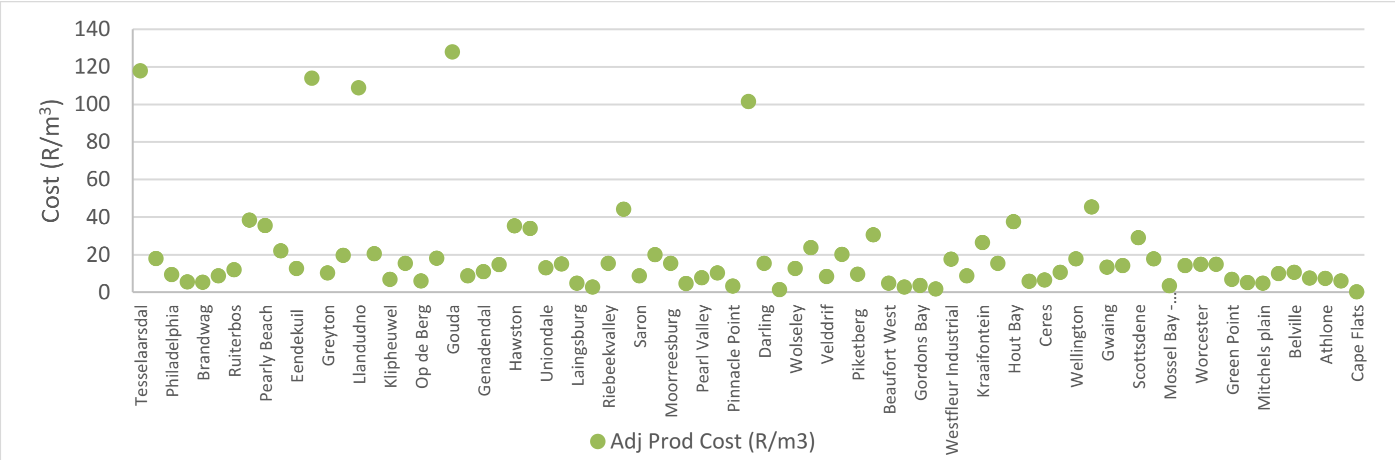


Figure 195 - Adjusted production cost (R/m³) for wastewater treatment, as a function of operational capacity (inflow)

The implication of these statistics combined with observations from the audits, is that a good number of municipalities have verified, accurate production costs, and is recognised as an invaluable parameter in the context of economic value and benefit. Given the lack of data by some municipalities, it is imperative that Superintendents start to monitor production (treatment) cost as a parameter within the fiscal reporting framework.

Data Certainty

Data certainty is expressed at different levels for the financial and asset figures reported within this Diagnostic. Certainty levels differ from system to system, hence some WSAs are included in multiple data certainty categories - as the data is variable, inconsistent, limited or non-existent (NI) for each of the systems. The various WSAs in the province that were identified under the category ''High Certainty", presented consistent and verifiable evidence in the form of budgets, expenditure, asset registers, and unit costs.

Table 215 - Levels of certainty associated with financial and asset information reported by municipalities

Data Certainty	Description	WSA
No certainty	Absent data or no certainty in data presented - not ringfenced for WWTW & Network	Prince Albert, Matzikama, Swellendam, Hessequa
Low certainty	Minor or little certainty in the data - partially ringfenced for WWTW only or data as extreme outliers	Knysna, Langeberg, Kannaland, George, Breede Valley, Theewaterskloof, Cederburg, Cape Agulhas
Reasonable/good certainty	Reasonable to good level of certainty in the data - ringfenced for WWTW and/or Network and data falls within/close to expected parameters	Bitou, Laingsburg, Stellenbosch, Oudtshoorn, Swartland, Overstrand, Berg River, Mossel bay
High certainty	High level of certainty in the data - ringfenced for WWTW and Network and data falls within expected parameters	City of Cape Town, Witzenberg, Drakenstein, Saldanha, Beaufort West

12.1 Beaufort West Local Municipality

Water Service Institution	**Beaufort West Local Municipality**	
Water Service Provider	Beaufort West Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Screening washer / compactor 2. Aeration capacity 3. Disinfection station **VROOM Estimate:** - R10,060,750
2021 Green Drop Score	**59% ↓**	
2013 Green Drop Score	**80%**	
2011 Green Drop Score	**90%**	
2009 Green Drop Score	**43%**	

Key Performance Area	**Unit**	**Beaufort West**	**Merweville**	**Nelspoort**	**Murraysburg**
Green Drop Score (2021)		**64%**	**64%**	**56%**	**16%**
2013 Green Drop Score		**94%**	**89%**	**89%**	**12%**
2011 Green Drop Score		**91%**	**59%**	**88%**	**57%**
2009 Green Drop Score		**83%**	**20%**	**26%**	**0%**
System Design Capacity	Ml/d	4.659	0.39	0.2	0.5
Design Capacity Utilisation (%)		57%	NI	NI	77%
Resource Discharged into		Reclamation	No Discharge	No Discharge	Irrigation to Field - 400m from Buffelsrivier
Wastewater Risk Rating (CRR% of CRR_{max})		**Beaufort West**	**Merweville**	**Nelspoort**	**Murraysburg**
CRR (2011)	%	35.3%	23.5%	29.4%	NA
CRR (2013)	%	23.5%	58.8%	64.7%	94.1%
CRR (2021)	%	47.1%	35.3%	35.3%	52.9%

Technical Site Assessment: **Beaufort West WWTW 64%**

12.2 Berg River Local Municipality

Water Service Institution	**Bergrivier Local Municipality**	
Water Service Provider	Bergrivier Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Raw sewage spillage to surrounds 2. Cable theft and vandalism 3. Biological reactor not in operation 4. No screening – extended repair times 5. Mixers and standby equipment not in service 6. Only one sludge return pump functional **VROOM Estimate:** - R21,440,280
2021 Green Drop Score	**72%↑**	
2013 Green Drop Score	**44%**	
2011 Green Drop Score	**70%**	
2009 Green Drop Score	**11%**	

Key Performance Area	**Unit**	**Piketberg**	**Porterville**	**Velddrif**	**Eendekuil**	**Dwarskesbos**
Green Drop Score (2021)		**73%**	**81%**	**66%**	**61%**	**59%**
2013 Green Drop Score		**49%**	**63%**	**41%**	**24%**	**49%**
2011 Green Drop Score		**74%**	**82%**	**58%**	**38%**	**73%**
2009 Green Drop Score		**11%**	**17%**	**5%**	**0%**	**11%**
System Design Capacity	**Ml/d**	3.15	1.5	1.992	0.14	0.294
Capacity Utilisation (% ADWF)		70%	47%	85%	64%	32%
Resource Discharged into		Irrigation	Irrigation	Golf course + sportsfields	Evaporation	Evaporation Ponds
Wastewater Risk Rating (CRR as %CRR$_{max}$)		**Piketberg**	**Porteville**	**Velddrif**	**Eendekuil**	**Dwarskesbos**
CRR (2011)	**%**	58.8%	41.2%	58.8%	52.9%	52.9%
CRR (2013)	**%**	58.8%	41.2%	58.8%	76.5%	76.5%
CRR (2021)	**%**	58.8%	47.1%	64.7%	35.3%	29.4%

Site Inspection report: **Bergrivier WWTW 67%**

12.3 Bitou West Local Municipality

Water Service Institution	**Bitou Local Municipality**	
Water Service Provider	Bitou Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. There were no major hardware risks 2. The TSA site (Gansevallei) was in excellent condition. **Vroom Estimate:** - R3,600,000
2021 Green Drop Score	**93%↓**	
2013 Green Drop Score	**99%**	
2011 Green Drop Score	**96%**	
2009 Green Drop Score	**78%**	

Key Performance Area	**Unit**	**Kurland**	**Plettenberg Bay (Gansevallei)**
Green Drop Score (2021)		**91%**	**93%**
2013 Green Drop Score		**99%**	**99%**
2011 Green Drop Score		**96%**	**97%**
2009 Green Drop Score		**78%**	**79%**
System Design Capacity	Ml/d	0.5	9
Design capacity utilisation (%)		76%	53%
Resource Discharged into		Salt River	Bitou River into Keurbooms Estuary
Wastewater Risk Rating (CRR % of CRR$_{max}$)		**Kurland**	**Plettenberg Bay (Gansevallei)**
CRR (2011)	%	17.6%	22.7%
CRR (2013)	%	35.3%	22.7%
CRR (2021)	%	23.5%	31.8%

Technical Site Assessment: **Gansevallei WWTW 84%**

12.4 Breede Valley Local Municipality

Water Service Institution	**Breede Valley Local Municipality**	
Water Service Providers	Breede Valley Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. 40% of the De Doorns plant is non-operational 2. Sludge recycle pumps dysfunctional 3. Chlorine gas is not operational. **VROOM Estimate:** - R246,305,400
2021 Green Drop Score	**87%↓**	
2013 Green Drop Score	**90%**	
2011 Green Drop Score	**78%**	
2009 Green Drop Score	**33%**	

Key Performance Area	Unit	Worcester	De Doorns	Rawsonville	Touwsriver
Green Drop Score (2021)		**90%->89%**	**75%**	**71%**	**66%**
2013 Green Drop Score		**91%**	**87%**	**87%**	**84%**
2011 Green Drop Score		**78%**	**79%**	**79%**	**67%**
2009 Green Drop Score		**50%**	**28%**	**26%**	**26%**
System Design Capacity	**Ml/d**	30	2.34	0.24	0.84
Capacity Utilisation (% ADWF ito Design Capacity)		58%	87%	154%	235%
Resource Discharged into		Breede River (95%) - Irrigation (5%)	Golf course irrigation -50% and re-use via UF - 50%	Smalblaar river	Donkies River
Wastewater Risk Rating (CRR % of CRR_{max})		**Worcester**	**De Doorns**	**Rawsonville**	**Touwsriver**
CRR (2011)	**%**	48.2%	52.9%	41.2%	47.1%
CRR (2013)	**%**	51.9%	47.1%	41.2%	41.2%
CRR (2021)	**%**	55.6%	47.1%	58.8%	52.9%

Site Inspection report: **De Doorns WWTW 54%**

12.5 Cape Agulhas Local Municipality

Water Service Institution	**Cape Agulhas Local Municipality**	
Water Service Provider	Cape Agulhas Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Bredasdorp WWTW was recently upgraded and commissioned in early 2021 - the plant infrastructure and equipment are in excellent condition 2. Network pump stations must be securely fenced 3. Unlined sludge ponds 4. Staff facilities needs improvement. **VROOM Estimate:** - R7,258,000
2021 Green Drop Score	**52%→**	
2013 Green Drop Score	**52%**	
2011 Green Drop Score	**34%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Bredasdorp	Napier	Struisbaai	Waenhuiskrans-Arniston
Green Drop Score (2021)		**50%**	**66%**	**48%**	**42%**
2013 Green Drop Score		**53%**	**50%**	**50%**	**53%**
2011 Green Drop Score		**38%**	**32%**	**18%**	**12%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	3.6	0.55	0.37	0.2
Design Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Kars river (Droë River)	No discharge	Discharge into dunes	Soak away/Dunes
Wastewater Risk Rating (CRR% of CRR_{max})		**Bredasdorp**	**Napier**	**Struisbaai**	**Waenhuiskrans-Arniston**
CRR (2011)	%	47.1%	47.1%	52.9%	52.9%
CRR (2013)	%	52.9%	52.9%	64.7%	52.9%
CRR (2021)	%	70.6%	41.2%	64.7%	70.6%

Technical Site Assessment: **Bredasdorp WWTW 67%**

12.6 Cederberg Local Municipality

Water Service Institution	**Cederberg Local Municipality**	
Water Service Provider	Cederberg Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Disinfection system at Clanwilliam – structural, chemical, and electrical defects 2. Flow metering is dysfunctional 3. Lacking process knowledge & improved process control – staff training **VROOM Estimate:** - R24,822,000
2021 Green Drop Score	**49%↑**	
2013 Green Drop Score	**36%**	
2011 Green Drop Score	**63%**	
2009 Green Drop Score	**3%**	

Key Performance Area	**Unit**	**Clanwilliam**	**Citrusdal**	**Lambertsbay**	**Elandsbay**
Green Drop Score (2021)		**51%**	**55%**	**48%**	**42%**
2013 Green Drop Score		**52%**	**40%**	**41%**	**24%**
2011 Green Drop Score		**63%**	**67%**	**66%**	**57%**
2009 Green Drop Score		**3%**	**3%**	**3%**	**3%**
System Design Capacity	Ml/d	3	2.3	3	0.5
Design Capacity Utilisation (%)		70%	22%	53%	50%
Resource Discharged into		20% to Jan Diese l (80% irrigated)	Boontjies River	Irrigation	Jakkels River (100% irrigated)
Wastewater Risk Rating (CRR% of CRR$_{max}$)		**Clanwilliam**	**Citrusdal**	**Lambertsbay**	**Elandsbay**
CRR (2011)	%	82.4%	35.3%	35.5%	70.6%
CRR (2013)	%	58.8%	64.7%	82.4%	64.7%
CRR (2021)	%	82.4%	52.9%	64.7%	64.7%

Key Performance Area	**Unit**	**Algeria**	**Wupperthal**	**Graafwater**
Green Drop Score (2021)		**39%**	**51%**	**32%**
2013 Green Drop Score		**18%**	**10%**	**27%**
2011 Green Drop Score		**0%**	**0%**	**57%**
2009 Green Drop Score		**0%**	**0%**	**3%**
System Design Capacity	Ml/d	0.05	0.5	0.5
Design Capacity Utilisation (%)		20%	50%	60%
Resource Discharged into		Rondegat river	Grootvis river	None (full irrigation use)
Wastewater Risk Rating (CRR% of CRR$_{max}$)		**Algeria**	**Wupperthal**	**Graafwater**
CRR (2011)	%	**N/A**	100.0%	35.5%
CRR (2013)	%	88.2%	100.0%	52.9%
CRR (2021)	%	70.6%	64.7%	82.4%

Site Inspection report: **Clanwilliam WWTW 67%**

12.7 City of Cape Town Metropolitan Municipality

Water Service Institution	**City of Cape Town Metro**	
Water Service Providers	Cape Town Metro WSSA (Zandvliet & Fisantekraal)	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. All major equipment is in good working condition 2. Regular operational monitoring enhanced with the adding of several flowmeters 3. Corrosion of concrete 4. Clogging of fine bubble aerators 5. Chlorination. **VROOM Estimate:** - R171,156,110
2021 Green Drop Score	**88%↓**	
2013 Green Drop Score	**89%**	
2011 Green Drop Score	**87%**	
2009 Green Drop Score	**82%**	

Key Performance Area	Unit	Westfleur Domestic	Westfleur Industrial	Philadelphia	Groot Springfontein
Green Drop Score (2021)		**100%**	**89%**	**96%**	**62%**
2013 Green Drop Score		**89%**	**81%**	**85%**	**82%**
2011 Green Drop Score		**93%**	**88%**	**82%**	**41%**
2009 Green Drop Score		**97%**	**97%**	**0%**	**0%**
System Design Capacity	Ml/d	8	6	0.086	NI
Design Capacity Utilisation (%)		95%	77%	52%	NI
Resource Discharged into		Donkergat river to Atlantis artificial aquifer	Donkergat river to Atlantis artificial aquifer	Evaporation pond	Ponds - no effluent
Wastewater Risk Rating (CRR % of CRR_{max})		**Westfleur Domestic**	**Westfleur Industrial**	**Philadelphia**	**Groot Springfontein**
CRR (2011)	%	40.9%	54.5%	41.2%	47.1%
CRR (2013)	%	45.5%	40.9%	35.3%	23.5%
CRR (2021)	%	36.4%	59.1%	29.4%	82.4%

Key Performance Area	Unit	Potsdam	Macassar	Mitchell's plain	Cape Flats
Green Drop Score (2021)		**90%->89%**	**90%->89%**	**89%->89%**	**85%**
2013 Green Drop Score		**91%**	**92%**	**82%**	**96%**
2011 Green Drop Score		**86%**	**97%**	**85%**	**80%**
2009 Green Drop Score		**76%**	**90%**	**97%**	**97%**
System Design Capacity	Ml/d	47	28	36	200
Design Capacity Utilisation (%)		92%	89%	74%	57%
Resource Discharged into		Diep river	Eerste rivier	Sea - onto beach	Zeekoevlei canal and then ocean
Wastewater Risk Rating (CRR % of CRR_{max})		**Potsdam**	**Macassar**	**Mitchell's plain**	**Cape Flats**
CRR (2011)	%	48.1%	40.6%	55.6%	54.1%
CRR (2013)	%	46.9%	40.7%	48.2%	43.2%
CRR (2021)	%	59.3%	59.3%	48.1%	56.8%

Key Performance Area	Unit	Zandvliet	Gordons Bay	Belville	Kraaifontein
Green Drop Score (2021)		**85%**	**86%**	**89%**	**93%->89%**
2013 Green Drop Score		**92%**	**89%**	**78%**	**95%**
2011 Green Drop Score		**92%**	**93%**	**85%**	**81%**

Key Performance Area	Unit	Zandvliet	Gordons Bay	Belville	Kraaifontein
2009 Green Drop Score		**76%**	**76%**	**65%**	**74%**
System Design Capacity	Ml/d	72	3.06	75	9
Design Capacity Utilisation (%)		113%	107%	55%	56%
Resource Discharged into		Kuils River	Sir Lowry's Pass river	Kuilsrivier	Mosselbank River
Wastewater Risk Rating (CRR % of CRR_{max})		**Zandvliet**	**Gordons Bay**	**Belville**	**Kraaifontein**
CRR (2011)	%	56.3%	41.2%	68.8%	68.2%
CRR (2013)	%	43.8%	58.8%	59.4%	40.9%
CRR (2021)	%	68.8%	64.7%	59.4%	40.9%

Key Performance Area	Unit	Klipheuwel	Fisantekraal	Borcherd's Quarry	Melkbosstrand
Green Drop Score (2021)		**88%**	**93%->89%**	**92%->89%**	**92%->89%**
2013 Green Drop Score		**86%**	NA	**74%**	**90%**
2011 Green Drop Score		**91%**	NA	**86%**	**93%**
2009 Green Drop Score		**74%**	NA	**76%**	**90%**
System Design Capacity	Ml/d	0.075	24	38	5.4
Design Capacity Utilisation (%)		113%	53%	55%	46%
Resource Discharged into		Mosselbank River	Mosselbank River	Salt River	Kleine Zoute River
Wastewater Risk Rating (CRR of CRR_{max})		**Klipheuwel**	**Fisantekraal**	**Borcherd's Quarry**	**Melkbosstrand**
CRR (2011)	%	63.6%	**NA**	66.7%	31.8%
CRR (2013)	%	41.2%	**NA**	70.4%	50.0%
CRR (2021)	%	52.9%	51.9%	59.3%	31.8%

Key Performance Area	Unit	Scottsdene	Green Point	Hout Bay	Camps Bay
Green Drop Score (2021)		**89%**	**93%**	**93%**	**87%**
2013 Green Drop Score		**94%**	**91%**	**77%**	**90%**
2011 Green Drop Score		**83%**	**92%**	**91%**	**92%**
2009 Green Drop Score		**74%**	**76%**	**74%**	**76%**
System Design Capacity	Ml/d	12.5	40	9	6
Design Capacity Utilisation (%)		62%	56%	62%	28%
Resource Discharged into		Bottelary river	Sea	Sea	Sea
Wastewater Risk Rating (CRR % of CRR_{max})		**Scottsdene**	**Green Point**	**Hout Bay**	**Camps Bay**
CRR (2011)	%	31.8%	37.0%	72.7%	59.1%
CRR (2013)	%	40.9%	44.4%	59.1%	36.4%
CRR (2021)	%	54.6%	44.4%	45.5%	40.9%

Key Performance Area	Unit	Oudekraal	Llandudno	Simons Town	Wildevoëlsvlei
Green Drop Score (2021)		**82%**	**87%**	**81%**	**89%**
2013 Green Drop Score		**86%**	**86%**	**72%**	**96%**
2011 Green Drop Score		**79%**	**93%**	**82%**	**96%**
2009 Green Drop Score		**97%**	**97%**	**76%**	**76%**
System Design Capacity	Ml/d	0.03	0.5	5	14.5
Design Capacity Utilisation (%)		10%	26%	24%	51%
Resource Discharged into		Sea	Ocean	Ocean	Wildevoelvlei
Wastewater Risk Rating (CRR % of CRR_{max})		**Oudekraal**	**Llandudno**	**Simons Town**	**Wildevoëlsvlei**

Key Performance Area	Unit	Oudekraal	Llandudno	Simons Town	Wildevoëlsvlei
CRR (2011)	%	35.3%	17.6%	47.1%	40.9%
CRR (2013)	%	64.7%	47.1%	70.6%	36.4%
CRR (2021)	%	52.9%	35.3%	40.9%	50.0%

Key Performance Area	Unit	Millerspoint	Athlone
Green Drop Score (2021)		**88%**	**90%->89%**
2013 Green Drop Score		**86%**	**84%**
2011 Green Drop Score		**78%**	**90%**
2009 Green Drop Score		**74%**	**69%**
System Design Capacity	**Ml/d**	0.006	105
Design Capacity Utilisation (%)		50%	76%
Resource Discharged into		Ocean	Vygekraal River
Wastewater Risk Rating (CRR % of CRR_{max})		**Millerspoint**	**Athlone**
CRR (2011)	%	35.3%	70.3%
CRR (2013)	%	29.4%	64.9%
CRR (2021)	%	17.6%	62.2%

Technical Site Assessment: **Wesfleur WWTW (Industrial) 96%; Borcherd's Quarry WWTW 91%**

12.8 Drakenstein Local Municipality

Water Service Institution	**Drakenstein Local Municipality**	
Water Service Providers	Bulk Water Provider City of Cape Town (Drinking Water) Bulk Water Provider West Coast DM (Drinking Water)	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. No major infrastructure 2. All works in good condition **VROOM Estimate**: - R1,107,780
2021 Green Drop Score	**89%↑**	
2013 Green Drop Score	**78%**	
2011 Green Drop Score	**80%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Paarl**	**Wellington**	**Hermon**	**Gouda**
Green Drop Score (2021)		**91%-89%**	**92%->89%**	**93%**	**91%->89%**
2013 Green Drop Score		**78%**	**75%**	**91%**	**80%**
2011 Green Drop Score		**85%**	**66%**	**70%**	**77%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	35	16	0.092	0.797
Design Capacity Utilisation (%)		60%	41%	48%	46%
Resource Discharged into		Berg River	Berg River	No Discharge	Natural Water Course
Wastewater Risk Rating (CRR% of CRR_{max})		**Paarl**	**Wellington**	**Hermon**	**Gouda**
CRR (2011)	%	48.1%	63.6%	29.4%	29.4%
CRR (2013)	%	51.9%	86.4%	41.2%	47.1%
CRR (2021)	%	55.6%	36.4%	23.5%	47.1%

Key Performance Area	**Unit**	**Saron**	**Pearl Valley**
Green Drop Score (2021)		**94%->89%**	**93%->89%**
2013 Green Drop Score		**79%**	**79%**
2011 Green Drop Score		**80%**	**82%**
2009 Green Drop Score		**0%**	**0%**
System Design Capacity	Ml/d	1.5	2
Design Capacity Utilisation (%)		69%	58%
Resource Discharged into		Klein Berg River	Berg River
Wastewater Risk Rating (CRR% of CRR_{max})		**Saron**	**Pearl Valley**
CRR (2011)	%	58.8%	52.9%
CRR (2013)	%	70.6%	64.7%
CRR (2021)	%	35.3%	47.1%

Technical Site Assessment: **Wellington WWTW 95%**

12.9 George Local Municipality

Water Service Institution	**George Local Municipality**	
Water Service Provider	George Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. No major hardware risks 2. Erosion at Chlorine contact channel 3. Sludge Stockpiled in an unlined area 4. Cow found in in inlet, major safety risk in reticulation network **VROOM Estimate:** - R9,956,000
2021 Green Drop Score	**74%↓**	
2013 Green Drop Score	**85%**	
2011 Green Drop Score	**91%**	
2009 Green Drop Score	**94%**	

Key Performance Area	**Unit**	**Gwaing**	**Harlem**	**Herolds Bay**	**Kleinkrantz**
Green Drop Score (2021)		**71%**	**64%**	**80%**	**74%**
2013 Green Drop Score		**91%**	**83%**	**95%**	**90%**
2011 Green Drop Score		**95%**	**15%**	**65%**	**88%**
2009 Green Drop Score		**83%**	**0%**	**0%**	**100%**
System Design Capacity	Ml/d	11	0.17	0.3	2.5
Design Capacity Utilisation (%)		68%	NI	44%	27%
Resource Discharged into		Gwaing River	Irrigation	No discharge	Infiltration into dunes
Wastewater Risk Rating (CRR% of CRR_{max})		**Gwaing**	**Harlem**	**Herolds Bay**	**Kleinkrantz**
CRR (2011)	%	40.9%	88.2%	23.5%	29.4%
CRR (2013)	%	40.9%	41.2%	29.4%	29.4%
CRR (2021)	%	40.9%	41.2%	23.5%	29.4%

Key Performance Area	**Unit**	**Outeniqua**	**Uniondale**
Green Drop Score (2021)		**76%**	**69%**
2013 Green Drop Score		**80%**	**80%**
2011 Green Drop Score		**89%**	**1%**
2009 Green Drop Score		**100%**	**0%**
System Design Capacity	Ml/d	15	1
Design Capacity Utilisation (%)		51%	70%
Resource Discharged into		Skaapkop River	Unknown seasonal stream to irrigation dam
Wastewater Risk Rating (CRR% of CRR_{max})		**Outeniqua**	**Uniondale**
CRR (2011)	%	45.5%	100.0%
CRR (2013)	%	50.0%	35.3%
CRR (2021)	%	45.5%	29.4%

Technical Site Assessment: **Gwaing WWTW 70%**

12.10 Hessequa Local Municipality

Water Service Institution	**Hessequa Local Municipality**	
Water Service Provider	Hessequa Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. No serious hardware issues 2. Record keeping lacking. **VROOM Estimate:** - R1,363,000
2021 Green Drop Score	**35%↓**	
2013 Green Drop Score	**48%**	
2011 Green Drop Score	**50%**	
2009 Green Drop Score	**0%**	

Key Performance Area	**Unit**	**Albertinia**	**Garcia**	**Gouritzmond**	**Heidelberg**
Green Drop Score (2021)		**32%**	**31%**	**39%**	**36%**
2013 Green Drop Score		**48%**	**63%**	**43%**	**44%**
2011 Green Drop Score		**51%**	**58%**	**36%**	**45%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.7	0.05	0.15	2
Design Capacity Utilisation (%)		93%	40%	97%	49%
Resource Discharged into		Irrigating to Golf Course	Irrigated	Seasonal overflow into Gouritz	Duidenhoks River
Wastewater Risk Rating (CRR% of CRR_{max})		**Albertinia**	**Garcia**	**Gouritzmond**	**Heidelberg**
CRR (2011)	%	70.6%	47.1%	47.1%	64.7%
CRR (2013)	%	58.8%	58.8%	58.8%	70.6%
CRR (2021)	%	64.7%	47.1%	82.4%	70.6%

Key Performance Area	**Unit**	**Jongensfontein**	**Melkhoutfontein**	**Riversdale**	**Slangrivier**
Green Drop Score (2021)		**48%**	**38%**	**33%**	**36%**
2013 Green Drop Score		**42%**	**46%**	**57%**	**42%**
2011 Green Drop Score		**37%**	**38%**	**65%**	**40%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.15	0.15	1.695	0.15
Design Capacity Utilisation (%)		85%	101%	160%	155%
Resource Discharged into		No discharge	No discharge	Goukou River	No discharge
Wastewater Risk Rating (CRR% of CRR_{max})		**Jongensfontein**	**Melkhoutfontein**	**Riversdale**	**Slangrivier**
CRR (2011)	%	52.9%	52.9%	88.2%	52.9%
CRR (2013)	%	64.7%	47.1%	82.4%	58.8%
CRR (2021)	%	35.3%	41.2%	70.6%	47.1%

Key Performance Area	**Unit**	**Stilbaai**	**Witsand**
Green Drop Score (2021)		**34%**	**44%**
2013 Green Drop Score		**46%**	**51%**
2011 Green Drop Score		**56%**	**39%**
2009 Green Drop Score		**0%**	**0%**
System Design Capacity	Ml/d	2.014	0.16
Design Capacity Utilisation (%)		71%	35%
Resource Discharged into		Irrigating to golf course	No discharge

Key Performance Area	Unit	Stilbaai	Witsand
Wastewater Risk Rating (CRR% of CRR_{max})		**Stilbaai**	**Witsand**
CRR (2011)	%	76.5%	52.9%
CRR (2013)	%	64.7%	64.7%
CRR (2021)	%	76.5%	29.4%

Technical Site Assessment: **Heidelberg WWTW 68%**

12.11 Kannaland Local Municipality

Water Service Institution	**Kannaland Local Municipality**	
Water Service Provider	Kannaland Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Ladismith WWTW was refurbished at the time of the TSA 2. Vandalism 3. MCC room 4. Screening ineffective 5. Outlet channel not provided **VROOM Estimate:** - R9,683,200
2021 Green Drop Score	**8%↓**	
2013 Green Drop Score	**50%**	
2011 Green Drop Score	**49%**	
2009 Green Drop Score	**15%**	

Key Performance Area	**Unit**	**Calitzdorp**	**Ladismith**	**Van Wyksdorp**	**Zoar**
Green Drop Score (2021)		**8%**	**15%**	**3%**	**1%**
2013 Green Drop Score		**66%**	**50%**	**NA**	**44%**
2011 Green Drop Score		**21%**	**63%**	**NA**	**40%**
2009 Green Drop Score		**10%**	**23%**	**NA**	**18%**
System Design Capacity	Ml/d	0.32	1.2	0.4	0.8
Design Capacity Utilisation (%)		NI	75%	38%	NI
Resource Discharged into		Nels River	Knuy River	Irrigate to Sportsfield	Huis River
Wastewater Risk Rating (CRR% of CRR_{max})		**Calitzdorp**	**Ladismith**	**Van Wyksdorp**	**Zoar**
CRR (2011)	%	47.1%	47.1%	**NA**	88.2%
CRR (2013)	%	70.6%	82.4%	**NA**	70.6%
CRR (2021)	%	88.2%	82.4%	58.8%	88.2%

Technical Site Assessment: **Ladismith WWTW 49%**

12.12 Knysna Local Municipality

Water Service Institution	**Knysna Local Municipality**	
Water Service Provider	Knysna Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Securing of the network pump station, recent vandalism observed 2. There were no major hardware risks on this WWTW 3. Clarity in chlorine contact tank was poor, sludge was present 4. Problems with disinfection evident from poor micro-bio results 5. Establish FE measurement point after final polishing (maturation Ponds) **VROOM Estimate:** - R631,000
2021 Green Drop Score	**67%↓**	
2013 Green Drop Score	**79%**	
2011 Green Drop Score	**61%**	
2009 Green Drop Score	**76%**	

Key Performance Area	**Unit**	**Knysna ASP**	**Sedgefield**	**Belvidere**	**Rheenendal**
Green Drop Score (2021)		**64%**	**73%**	**72%**	**73%**
2013 Green Drop Score		**80%**	**75%**	**70%**	**82%**
2011 Green Drop Score		**57%**	**54%**	**56%**	**54%**
2009 Green Drop Score		**79%**	**0%**	**0%**	**70%**
System Design Capacity	Ml/d	6	1.5	0.3	0.7
Design Capacity Utilisation (%)		107%	36%	16%	47%
Resource Discharged into		Knysna estuary	Infiltration in dunes	Irrigation	Homtini to Goukamma River
Wastewater Risk Rating (CRR% of CRR_{max})		**Knysna ASP**	**Sedgefield**	**Belvidere**	**Rheenendal**
CRR (2011)	%	50.0%	64.7%	58.8%	52.9%
CRR (2013)	%	50.0%	41.2%	47.1%	35.3%
CRR (2021)	%	63.6%	47.1%	23.5%	41.2%

Key Performance Area	**Unit**	**Brenton on Sea**	**Karatara**
Green Drop Score (2021)		**70%**	**66%**
2013 Green Drop Score		**87%**	**89%**
2011 Green Drop Score		**59%**	**53%**
2009 Green Drop Score		**75%**	**77%**
System Design Capacity	Ml/d	0.3	0.17
Design Capacity Utilisation (%)		47%	46%
Resource Discharged into		Infiltration into dunes	Huis River
Wastewater Risk Rating (CRR% of CRR_{max})		**Brenton on Sea**	**Karatara**
CRR (2011)	%	44.1%	41.2%
CRR (2013)	%	29.4%	35.3%
CRR (2021)	%	41.2%	35.3%

Technical Site Assessment: **Sedgefield WWTW 75%**

12.13 Laingsburg Local Municipality

Water Service Institution	**Laingsburg Local Municipality**	
Water Service Provider	Laingsburg Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Floating aerators - in the process of being replaced 2. Standby pumps absent **VROOM Estimate:** - R227,825
2021 Green Drop Score	**63%↑**	
2013 Green Drop Score	**37%**	
2011 Green Drop Score	**56%**	
2009 Green Drop Score	**77%**	

Key Performance Area	Unit	Laingsburg	Matjiesfontein
Green Drop Score (2021)		**63%**	**60%**
2013 Green Drop Score		**37%**	NA
2011 Green Drop Score		**56%**	NA
2009 Green Drop Score		**77%**	NA
System Design Capacity	Ml/d	1.7	0.0525
Design Capacity Utilisation (%)		45%	91%
Resource Discharged into		Irrigation (Lucerne)	Irrigation (Sportsfield)
Wastewater Risk Rating (CRR% of CRR_{max})		**Laingsburg**	**Matjiesfontein**
CRR (2011)	%	70.6%	NA
CRR (2013)	%	58.8%	NA
CRR (2021)	%	52.9%	41.2%

Technical Site Assessment: **Laingsburg Ponds 61%**

12.14 Langeberg Local Municipality

Water Service Institution	**Langeberg Local Municipality**	
Water Service Provider	Langeberg Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Robertson WWTW hydraulically overloaded 2. Upgrade of works is imminent, but long overdue 3. RAS pump failure 4. Biofilter structural defects; Clarifier defects 5. Maturation ponds over-saturated with sludge 6. Buildings, vandalism, theft **VROOM Estimate:** - R35,072,000
2021 Green Drop Score	**27%↓**	
2013 Green Drop Score	**52%**	
2011 Green Drop Score	**43%**	
2009 Green Drop Score	**50%**	

Key Performance Area	Unit	Ashton	Bonnievale	McGregor	Montagu	Robertson
Green Drop Score (2021)		**36%**	**32%**	**41%**	**34%**	**12%**
2013 Green Drop Score		**47%**	**65%**	**69%**	**50%**	**47%**
2011 Green Drop Score		**40%**	**50%**	**51%**	**44%**	**37%**
2009 Green Drop Score		**49%**	**49%**	**52%**	**49%**	**49%**
System Design Capacity	Ml/d	3.1	2.5	0.3	3.5	4.3
Design Capacity Utilisation (%)		42%	31%	77%	63%	125%
Resource Discharged into		Sarahs River to Cogmanskloof to Breede River	Breede River	Irrigated	Kligna River	Breede River
Wastewater Risk Rating (CRR as %CRR$_{max}$)		**Ashton**	**Bonnievale**	**McGregor**	**Montagu**	**Robertson**
CRR (2011)	%	52.9%	47.1%	58.8%	58.8%	64.7%
CRR (2013)	%	64.7%	29.4%	35.3%	58.8%	74.7%
CRR (2021)	%	58.8%	52.9%	41.2%	47.1%	70.6%

Technical Site Assessment: **Robertson WWTW 39%**

12.15 Matzikama Local Municipality

Water Service Institution	**Matzikama Local Municipality**
Water Service Provider	Matzikama Local Municipality

Municipal Green Drop Score	
2021 Green Drop Score	33%↓
2013 Green Drop Score	58%
2011 Green Drop Score	66%
2009 Green Drop Score	0%

VROOM Impression (Towards restoring functionality):

1. RAS pumps dysfunctional - urgent
2. Chlorine dosing (chlorinator) repair
3. Aerator's dysfunctional
4. Anaerobic dam and maturation high solids content

VROOM Estimate:

- R21,214,560

Key Performance Area	Unit	Doringbaai	Bitterfontein	Klawer	Koekenaap
Green Drop Score (2021)		**45%**	**39%**	**40%**	**35%**
2013 Green Drop Score		**77%**	**4%**	**77%**	**76%**
2011 Green Drop Score		**64%**	**0%**	**64%**	**62%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.26	0.096	0.9	0.2
Design Capacity Utilisation (%)		38%	63%	46%	50%
Resource Discharged into		Irrigation	Irrigation	NI	Irrigation
Wastewater Risk Rating (CRR% of CRR_{max})		**Doringbaai**	**Bitterfontein**	**Klawer**	**Koekenaap**
CRR (2011)	%	58.8%	76.5%	35.3%	35.3%
CRR (2013)	%	41.2%	94.1%	52.9%	52.9%
CRR (2021)	%	64.7%	82.4%	58.8%	76.5%

Key Performance Area	Unit	Lutzville West	Lutzville	Strandfontein	Van Rhynsdorp
Green Drop Score (2021)		**43%**	**33%**	**25%**	**27%**
2013 Green Drop Score		**77%**	**65%**	**73%**	**71%**
2011 Green Drop Score		**63%**	**63%**	**64%**	**64%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	0.123	0.3	NI	0.7
Design Capacity Utilisation (%)		NI	133%	NI	108%
Resource Discharged into		Irrigation	Irrigation	Irrigation	Irrigation
Wastewater Risk Rating (CRR% of CRR_{max})		**Lutzville West**	**Lutzville**	**Strandfontein**	**Van Rhynsdorp**
CRR (2011)	%	17.6%	41.2%	52.9%	52.9%
CRR (2013)	%	35.3%	58.8%	41.2%	58.8%
CRR (2021)	%	76.5%	70.6%	94.1%	58.8%

Key Performance Area	Unit	Vredendal North	Vredendal South	Ebenhaezer	Nuwerus	Rietpoort
Green Drop Score (2021)		**30%**	**32%**	**31%**	**14%**	**14%**
2013 Green Drop Score		**79%**	**85%**	**77%**	**6%**	NI
2011 Green Drop Score		**77%**	**68%**	**63%**	**0%**	NI
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**	NI
System Design Capacity	Ml/d	1.66	1	NI	NI	NI
Design Capacity Utilisation (%)		100%	96%	36%	NI	NI
Resource Discharged into		Irrigation	Irrigation	No discharge	No discharge	No discharge
Wastewater Risk Rating (CRR% of CRR_{max})		**Vredendal North**	**Vredendal South**	**Ebenhaezer**	**Nuwerus**	**Rietpoort**
CRR (2011)	%	58.8%	58.8%	47.1%	100.0%	NA
CRR (2013)	%	58.8%	52.9%	47.1%	91.1%	NA

Key Performance Area	Unit	Vredendal North	Vredendal South	Ebenhaezer	Nuwerus	Rietpoort
CRR (2021)	%	70.6%	76.5%	52.9%	100.0%	100.0%

Site Inspection report: **Vredendal North WTWW 30%**

12.16 Mossel Bay Local Municipality

Water Service Institution	**Mossel Bay Local Municipality**	
Water Service Provider	Mossel Bay Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. There were no major hardware risks 2. The site was in excellent condition. **VROOM Estimate:** - R1,668,000
2021 Green Drop Score	**86%↑**	
2013 Green Drop Score	**79%**	
2011 Green Drop Score	**89%**	
2009 Green Drop Score	**12%**	

Key Performance Area	**Unit**	**Brandwag**	**Friemersheim Western Works**	**Grootbrak**	**Herbertsdale**
Green Drop Score (2021)		**87%**	**85%**	**63%**	**91%**
2013 Green Drop Score		**75%**	**83%**	**82%**	**73%**
2011 Green Drop Score		**45%**	**91%**	**83%**	**49%**
2009 Green Drop Score		**NA**	**8%**	**11%**	**1%**
System Design Capacity	Ml/d	0.128	0.18	1	0.126
Design Capacity Utilisation (%)		38%	61%	140%	48%
Resource Discharged into		No discharge	Unknown Spruit to Moordkuil River	Irrigation to land	No discharge
Wastewater Risk Rating (CRR% of CRR_{max})		**Brandwag**	**Friemersheim Western Works**	**Grootbrak**	**Herbertsdale**
CRR (2011)	%	35.3%	58.8%	35.5%	35.5%
CRR (2013)	%	52.9%	41.2%	47.1%	58.8%
CRR (2021)	%	23.5%	47.1%	64.7%	17.6%

Key Performance Area	**Unit**	**Mossel Bay – Hartenbos**	**Pinnacle Point**	**Ruiterbos**
Green Drop Score (2021)		**92%->89%**	**79%**	**79%**
2013 Green Drop Score		**79%**	**81%**	**80%**
2011 Green Drop Score		**91%**	**83%**	**77%**
2009 Green Drop Score		**33%**	**19%**	**3%**
System Design Capacity	Ml/d	17.4	3.7	0.12
Design Capacity Utilisation (%)		51%	32%	62%
Resource Discharged into		Hartenbos River	Irrigation (Golf course)	Paardekraal river
Wastewater Risk Rating (CRR% of CRR_{max})		**Mossel Bay – Hartenbos**	**Pinnacle Point**	**Ruiterbos**
CRR (2011)	%	50.0%	41.2%	29.4%
CRR (2013)	%	54.6%	41.2%	23.5%
CRR (2021)	%	45.5%	47.1%	47.1%

Technical Site Assessment: **Mossel Bay - Hartenbos WWTW 80%**

12.17 Oudtshoorn Local Municipality

Water Service Institution	**Oudtshoorn LM**	
Water Service Provider	Oudtshoorn LM	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Feed to Biofilter 2. Scum blanket in BNR System **VROOM Estimate:** - R6,086,000
2021 Green Drop Score	**43%**	
2013 Green Drop Score	**70%**	
2011 Green Drop Score	**41%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Dysseldorp	De Rust	Oudtshoorn
Green Drop Score (2021)		**37%**	**44%**	**44%**
2013 Green Drop Score		**63%**	**44%**	**71%**
2011 Green Drop Score		**44%**	**28%**	**42%**
2009 Green Drop Score		**0%**	**0%**	**0%**
System Design Capacity	Ml/d	2	0.2	9
Design Capacity Utilisation (%)		35%	130%	66%
Resource Discharged into		Olifants	No discharge	Olifants
Wastewater Risk Rating (CRR% of CRR_{max})		**Dysseldorp**	**De Rust**	**Oudtshoorn**
CRR (2011)	%	58.8%	47.1%	63.6%
CRR (2013)	%	35.3%	52.9%	68.1%
CRR (2021)	%	70.6%	35.3%	72.7%

Technical Site Assessment: **Oudtshoorn WWTW 58%**

12.18 Overstrand Local Municipality

Water Service Institution	**Overstrand Local Municipality**	
Water Service Provider	Veolia Water	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Flow distribution to SSTs 2. Lime storage facility 3. Security 4. Scum control. **VROOM Estimate:** - R10,200,000
2021 Green Drop Score	**89%→**	
2013 Green Drop Score	**89%**	
2011 Green Drop Score	**89%**	
2009 Green Drop Score	**63%**	

Key Performance Area	Unit	Gansbaai	Hawston	Hermanus	Kleinmond
Green Drop Score (2021)		**96%->89%**	**89%**	**96%->89%**	88%
2013 Green Drop Score		**92%**	**90%**	**91%**	**78%**
2011 Green Drop Score		**76%**	**88%**	**92%**	**83%**
2009 Green Drop Score		**66%**	**57%**	**66%**	**66%**
System Design Capacity	Ml/d	2	1	12	2
Design Capacity Utilisation (%)		43%	61%	54%	76%
Resource Discharged into		Irrigation – Sports complex	Maturation Pond into Wetland	Ocean	Reed- bed/wetland area linked to sea
Wastewater Risk Rating (CRR% of CRR$_{max}$)		**Gansbaai**	**Hawston**	**Hermanus**	**Kleinmond**
CRR (2011)	%	31.0%	33.0%	35.0%	44.0%
CRR (2013)	%	35.3%	29.0%	45.0%	47.0%
CRR (2021)	%	41.2%	52.9%	36.4%	47.1%

Key Performance Area	Unit	Pearly Beach	Stanford
Green Drop Score (2021)		**88%**	**90%->89%**
2013 Green Drop Score		NA	**93%**
2011 Green Drop Score		NA	**83%**
2009 Green Drop Score		NA	**61%**
System Design Capacity	Ml/d	0.259	1.2
Design Capacity Utilisation (%)		31%	89%
Resource Discharged into		An aquifer	Constructed reed bed to Klein River
Wastewater Risk Rating (CRR% of CRR$_{max}$)		**Pearly Beach**	**Stanford**
CRR (2011)	%	**NA**	44.0%
CRR (2013)	%	**NA**	29.0%
CRR (2021)	%	52.9%	64.7%

Technical Site Assessment: **Hermanus WWTW 74%**

12.19 Prince Albert Local Municipality

Water Service Institution	**Prince Albert Local Municipality**	
Water Service Provider	Prince Albert Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Upgrades to Klaarstroom Ponds almost completed at the time of TSA 2. Irrigation pumps 3. Disinfection lacking **VROOM Estimate:** - R211,000
2021 Green Drop Score	**14% ↓**	
2013 Green Drop Score	**66%**	
2011 Green Drop Score	**68%**	
2009 Green Drop Score	**18%**	

Key Performance Area	Unit	Klaarstroom	Leeu Gamka	Prince Albert
Green Drop Score (2021)		**15%**	**20%**	**13%**
2013 Green Drop Score		**42%**	**61%**	**69%**
2011 Green Drop Score		**56%**	**60%**	**73%**
2009 Green Drop Score		**0%**	**0%**	**53%**
System Design Capacity	Ml/d	0.061	0.16	0.623
Design Capacity Utilisation (%)		NI	NI	NI
Resource Discharged into		Irrigation	Irrigation	Irrigation
Wastewater Risk Rating (CRR% of CRR_{max})		**Klaarstroom**	**Leeu Gamka**	**Prince Albert**
CRR (2011)	%	47.1%	88.2%	35.3%
CRR (2013)	%	47.1%	41.2%	35.3%
CRR (2021)	%	70.6%	58.8%	76.5%

Technical Site Assessment: **Klaarstroom Ponds 51%**

12.20 Saldanha Bay Local Municipality

Water Service Institution	**Saldanha Bay Local Municipality**
Water Service Provider	Saldanha Bay Local Municipality

Municipal Green Drop Score		
2021 Green Drop Score	**87%↑**	**VROOM Impression (Towards restoring functionality):** 1. Plant in excellent condition – no hardware defects 2. Scum management/control at clarifiers **VROOM Estimate:** - R5,317,500
2013 Green Drop Score	**81%**	
2011 Green Drop Score	**39%**	
2009 Green Drop Score	**59%**	

Key Performance Area	Unit	Hopefield	St Helena Bay	Langebaan	Paternoster
Green Drop Score (2021)		**96%**	**84%**	**85%**	**85%**
2013 Green Drop Score		**81%**	**76%**	**80%**	**59%**
2011 Green Drop Score		**42%**	**34%**	**36%**	**32%**
2009 Green Drop Score		**56%**	**0%**	**73%**	**40%**
System Design Capacity	Ml/d	0.9	1.825	3.5	1.3
Design Capacity Utilisation (%)		50%	82%	54%	29%
Resource Discharged into		Irrigation to parks/ fields	Flood irrigation/ adjacent farm	Golf course	NI
Wastewater Risk Rating (CRR% of CRR_{max})		**Hopefield**	**St Helena Bay**	**Langebaan**	**Paternoster**
CRR (2011)	%	83.0%	89.0%	89.0%	72.0%
CRR (2013)	%	35.0%	47.0%	41.0%	59.0%
CRR (2021)	%	23.5%	64.7%	64.7%	35.3%

Key Performance Area	Unit	Saldanha	Shellypoint	Vredenburg
Green Drop Score (2021)		**88%**	**83%**	**86%**
2013 Green Drop Score		**80%**	**75%**	**84%**
2011 Green Drop Score		**39%**	**30%**	**45%**
2009 Green Drop Score		**76%**	**58%**	**57%**
System Design Capacity	Ml/d	5	0.2	5
Design Capacity Utilisation (%)		52%	75%	67%
Resource Discharged into		Bok river	evaporated ponds	irrigation golf grounds
Wastewater Risk Rating (CRR% of CRR_{max})		**Saldanha**	**Shellypoint**	**Vredenburg**
CRR (2011)	%	83.0%	83.0%	94.0%
CRR (2013)	%	53.0%	35.0%	41.0%
CRR (2021)	%	50.0%	52.9%	58.8%

Technical Site Assessment: **Langebaan WWTW** **90%**

12.21 Stellenbosch Local Municipality

Water Service Institution	**Stellenbosch Local Municipality**
Water Service Provider	Stellenbosch Local Municipality

Municipal Green Drop Score	
2021 Green Drop Score	**84%↑**
2013 Green Drop Score	**40%**
2011 Green Drop Score	**71%**
2009 Green Drop Score	**53%**

VROOM Impression (Towards restoring functionality):

1. Clarifier scum baffles and scum draw-off needed to improve operations
2. Safety signs

VROOM Estimate:

- R28,600,000

Key Performance Area	Unit	Stellenbosch	Wemmers hoek	Pniel	Klapmuts	Raithby
Green Drop Score (2021)		**84%**	**83%**	**83%**	**82%**	**73%**
2013 Green Drop Score		**41%**	**37%**	**40%**	**39%**	**32%**
2011 Green Drop Score		**72%**	**70%**	**58%**	**72%**	**62%**
2009 Green Drop Score		**55%**	**47%**	**52%**	**59%**	**52%**
System Design Capacity	Ml/d	35	5	1.35	2.5	0.15
Design Capacity Utilisation (%)		46%	52%	117%	44%	41%
Resource Discharged into		Veldwachters River	Berg River (Sensitive)	Dwars River	Klapmuts River	Raithby River
Wastewater Risk Rating (CRR% of CRR_{max})		**Stellenbosch**	**Wemmers hoek**	**Pniel**	**Klapmuts**	**Raithby**
CRR (2011)	%	74.1%	58.8%	64.7%	58.8%	47.1%
CRR (2013)	%	81.8%	76.5%	82.4%	94.1%	76.5%
CRR (2021)	%	55.6%	63.6%	58.8%	41.2%	64.7%

Site Inspection report: **Stellenbosch WWTW 80%**

12.22 Swartland Local Municipality

Water Service Institution	**Swartland Local Municipality**	
Water Service Provider	Swartland Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Plant in excellent condition 2. Scum removal on secondary clarifiers **VROOM Estimate:** - R948,000
2021 Green Drop Score	**89%↑**	
2013 Green Drop Score	**72%**	
2011 Green Drop Score	**73%**	
2009 Green Drop Score	**75%**	

Key Performance Area	**Unit**	**Chartsworth**	**Darling**	**Kalbaskraal**	**Moorreesburg**
Green Drop Score (2021)		**85%**	**95%->89%**	**83%**	**87%**
2013 Green Drop Score		**60%**	**71%**	**68%**	**69%**
2011 Green Drop Score		**62%**	**73%**	**69%**	**71%**
2009 Green Drop Score		**0%**	**75%**	**0%**	**73%**
System Design Capacity	Ml/d	0.27	1.5	0.157	1.5
Design Capacity Utilisation (%)		91%	83%	48%	73%
Resource Discharged into		Swart River	Groen River	Non-discharge	Sand River
Wastewater Risk Rating (CRR% of CRR_{max})		**Chartsworth**	**Darling**	**Kalbaskraal**	**Moorreesburg**
CRR (2011)	%	72.0%	72.0%	72.0%	61.0%
CRR (2013)	%	59.0%	53.0%	35.0%	53.0%
CRR (2021)	%	70.6%	29.4%	23.5%	76.5%

Key Performance Area	**Unit**	**Riebeek valley**	**Malmesbury**	**Koringberg**
Green Drop Score (2021)		**92%->89%**	**92%->89%**	**70%**
2013 Green Drop Score		**62%**	**76%**	**69%**
2011 Green Drop Score		**64%**	**74%**	**64%**
2009 Green Drop Score		**0%**	**77%**	**0%**
System Design Capacity	Ml/d	1.9	10	0.03
Design Capacity Utilisation (%)		44%	53%	273%
Resource Discharged into		Krom river and irrigation	Diep River	Brak River
Wastewater Risk Rating (CRR% of CRR_{max})		**Riebeek valley**	**Malmesbury**	**Koringberg**
CRR (2011)	%	67.0%	83.0%	56.0%
CRR (2013)	%	59.0%	71.0%	53.0%
CRR (2021)	%	23.5%	36.4%	88.2%

Technical Site Assessment: **Riebeek valley WWTW 97%**

12.23 Swellendam Local Municipality

Water Service Institution	**Swellendam Local Municipality**	
Water Service Provider	Swellendam Local Municipality	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Sludge ponds are unlined 2. All of the mixers are dysfunctional - phased repair 3. Solar drying pad to receive dewatered sludge required 4. Contact channel requires cleaning. **VROOM Estimate:** - R3,917,000
2021 Green Drop Score	**30%↓**	
2013 Green Drop Score	**76%**	
2011 Green Drop Score	**29%**	
2009 Green Drop Score	**0%**	

Key Performance Area	Unit	Klipperivier	Barrydale	Buffeljagsrivier	Suurbraak
Green Drop Score (2021)		**31%**	**23%**	**30%**	**33%**
2013 Green Drop Score		**76%**	**76%**	**65%**	**64%**
2011 Green Drop Score		**48%**	**29%**	**29%**	**36%**
2009 Green Drop Score		**0%**	**0%**	**0%**	**0%**
System Design Capacity	Ml/d	4.07	0.16	0.168	0.38
Design capacity utilisation (%)		48%	NI	17%	46%
Resource Discharged into		Klipperivier	Irrigation to land	No discharge	Irrigation to land
Wastewater Risk Rating (CRR% of CRR_{max})		**Klipperivier**	**Barrydale**	**Buffeljagsrivier**	**Suurbraak**
CRR (2011)	%	76.5%	70.6%	29.4%	76.5%
CRR (2013)	%	47.1%	47.1%	52.9%	47.1%
CRR (2021)	%	47.1%	58.8%	35.3%	35.3%

Technical Site Assessment: **Klipperivier WWTW 54%**

12.24 Theewaterskloof Local Municipality

Water Service Institution	**Theewaterskloof LM**	
Water Service Providers	Theewaterskloof LM	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Maturation dams sludged up and need repair 2. Weirs of clarifiers in poor condition 3. Composting plant compromised 4. Sludge thickening dysfunctional 5. Desludging practices not on standard. **VROOM Estimate**: - R88,808,350
2021 Green Drop Score	**87%↑**	
2013 Green Drop Score	**56%**	
2011 Green Drop Score	**66%**	
2009 Green Drop Score	**30%**	

Key Performance Area	Unit	Caledon	Botriver	Grabouw	Riviersonder=erend
Green Drop Score (2021)		**88%**	**87%**	**87%**	**84%**
2013 Green Drop Score		**65%**	**70%**	**43%**	**64%**
2011 Green Drop Score		**68%**	**58%**	**68%**	**52%**
2009 Green Drop Score		**30%**	**30%**	**30%**	**30%**
System Design Capacity	**Ml/d**	3.5	1.05	8.5	0.7
Design capacity utilisation (%)		78%	24%	51%	119%
Resource Discharged into		Bas River	Botriver	Kogel Dam via Palmiet River	Irrigation only
Wastewater Risk Rating (CRR % of CRR_{max})		**Caledon**	**Botriver**	**Grabouw**	**Riviersonder=erend**
CRR (2011)	%	76.5%	64.7%	64.7%	58.8%
CRR (2013)	%	58.8%	35.3%	52.9%	35.3%
CRR (2021)	%	58.8%	58.8%	54.5%	64.7%

Key Performance Area	Unit	Genadendal	Villiersdorp	Greyton	Tesselaarsdal
Green Drop Score (2021)		**83%**	**87%**	**80%**	**78%**
2013 Green Drop Score		**65%**	**60%**	**25%**	NA
2011 Green Drop Score		**59%**	**61%**	**58%**	NA
2009 Green Drop Score		**0%**	**30%**	**0%**	NA
System Design Capacity	**Ml/d**	0.721	3.5	0.3	0.04
Design capacity utilisation (%)		56%	33%	33%	53%
Resource Discharged into		Botriver	Elandskloof river to Theewaterskloof dam	Irrigation	Kleinrivier
Wastewater Risk Rating (CRR % of CRR_{max})		**Genadendal**	**Villiersdorp**	**Greyton**	**Tesselaarsdal**
CRR (2011)	%	41.2%	41.2%	47.1%	NA
CRR (2013)	%	23.5%	52.9%	88.2%	NA
CRR (2021)	%	58.8%	35.3%	58.8%	41.2%

Site Inspection report: **Grabouw WWTW 61%**

12.25 Witzenberg Local Municipality

Water Service Institution	**Witzenberg Local Municipality**
Water Service Provider	Witzenberg Local Municipality

Municipal Green Drop Score	
2021 Green Drop Score	**96%↓**
2013 Green Drop Score	**98%**
2011 Green Drop Score	**90%**
2009 Green Drop Score	**67%**

VROOM Impression (Towards restoring functionality):

1. Vandalism
2. Chlorine dosing
3. Outlet dam wall collapsed
4. Aging infrastructure.

VROOM Estimate:

- R30,037,400

Key Performance Area	**Unit**	**Ceres**	**Tulbagh**	**Wolseley**	**Op de Berg**
Green Drop Score (2021)		**100%**	**97%**	**86%**	**98%**
2013 Green Drop Score		**99%**	**95%**	**95%**	**94%**
2011 Green Drop Score		**93%**	**84%**	**84%**	**81%**
2009 Green Drop Score		**74%**	**60%**	**60%**	**74%**
System Design Capacity	Ml/d	8.5	2.46	3.6	0.31
Design Capacity Utilisation (%)		75%	48%	39%	81%
Resource Discharged into		Dwars River	Berg river	Wetland	Klein Vlei River
Wastewater Risk Rating (CRR % of CRR_{max})		**Ceres**	**Tulbagh**	**Wolseley**	**Op de Berg**
CRR (2011)	%	40.9%	29.1%	41.2%	58.8%
CRR (2013)	%	36.4%	35.3%	29.4%	41.2%
CRR (2021)	%	36.4%	41.2%	64.7%	35.3%

Site Inspection report: **Ceres WWTW 80%**

Ceres inhouse laboratory stocked with equipment and chemicals – they aim for a fully optimised plant, brought about by scientific knowledge and diligent monitoring. The worker's at this plant is highly enthusiastic – this is a most desirable place to work!
External laboratory (AL Abbott) is valued for their process monitoring analytical support, a highly organised and coherent team. Well done with your excellence status.

Stay clear of the grit classifier outlet at Grabouw pumpstation! Well done Sir – you impressed with a good score for your remarkable fervour and grit quality.

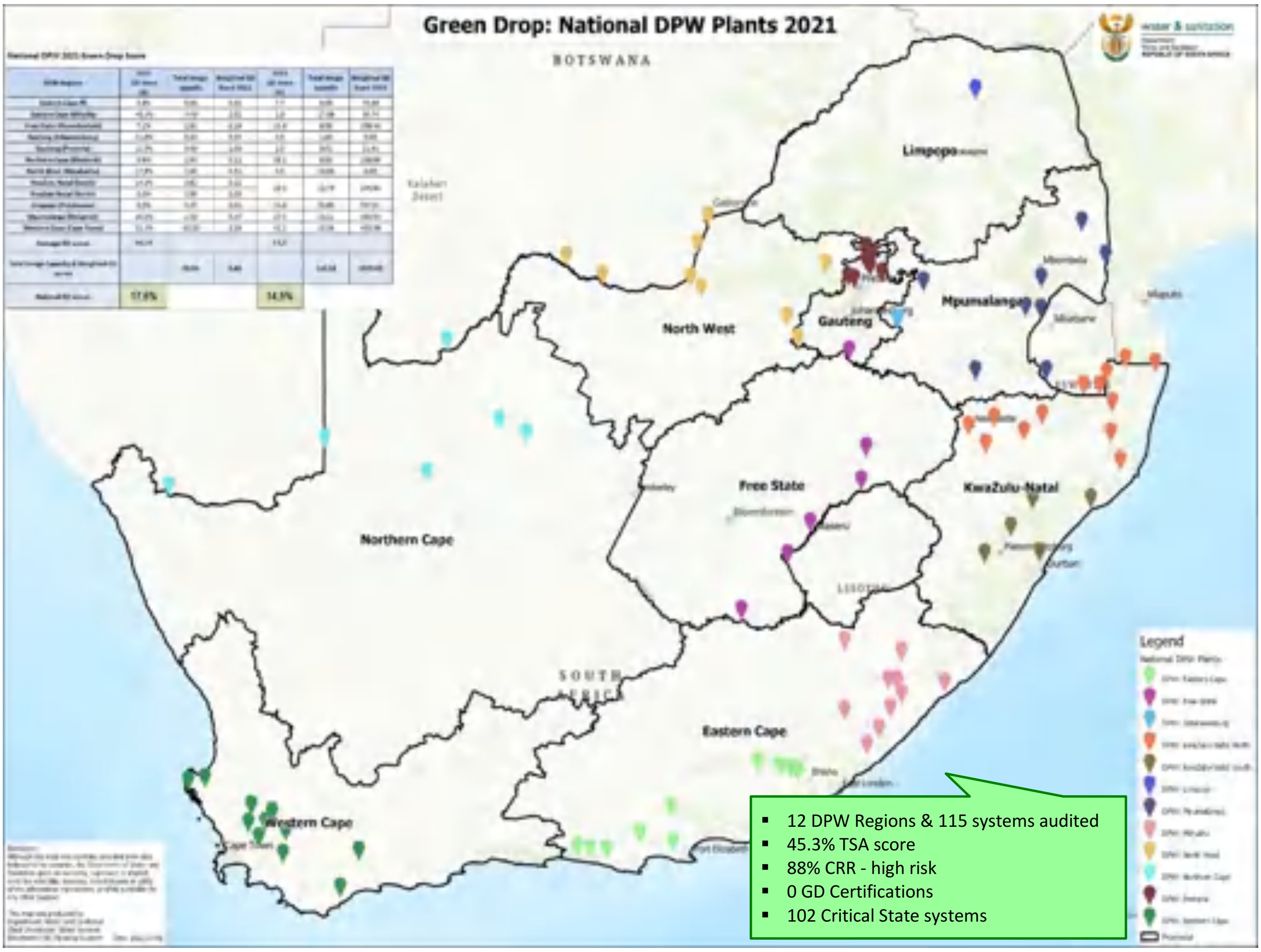
Tom Robbins coaches that *curiosity, especially intellectual inquisitiveness, is what separates the truly alive from those who are merely going through the motions.*

Some finger pointing, head scratching and explanation on the process flows and energy monitoring – what a lively discussion by James Beukes and his inquisitive team

Bergrivier Municipality.
Possibly the most desirable workplace in the world. Friendly, knowledgeable staff. An absolute pleasure to audit.
Thank you for your service and dedication, team.

Bitou Municipality continues to impress with consistent performance and a capable team. The excellent mixed liquor suspended solids is just one of many highlights of the Gansevallei WWTW. Excellence well deserved.

13. DEPARTMENT OF PUBLIC WORKS: WASTEWATER MANAGEMENT PERFORMANCE



Department of Public Works Synopsis

An audit attendance record of 100% affirms the DPW Regions commitment to the Green Drop national incentive-based regulatory programme.

The Regulator determined that no wastewater systems scored a minimum of 90% when measured against the Green Drop standards for the audited period and thus no DPW region qualified for the prestigious Green Drop Certification. This is consistent with no systems being awarded Green Drop Status in 2013 but is recognised for its inherent value to establish an accurate, current baseline from where improvement can be driven, and excellence be incentivised.

Five (5) of the 12 DPW Regions improved on their 2013 scores. The remainder of the DPW Regions regressed to lower Green Drop scores compared to 2013 baselines. The Eastern Cape Port Elizabeth Region is the best performing Region with a Green Drop score of 45%, supported by a good technical site assessment score of 81% for St Albans Prison. PE also achieved the best overall progress from an 8% GD score in 2013 to 45% in 2021. Western Cape and Johannesburg are in 2nd and 3rd positions but are marked by low Green Drop and TSA score. Unfortunately one hundred and two (102 of 115) systems were identified with critical score levels in the DPW, compared to 104 of 121 systems in 2013.

The full range of Green Drop KPAs require attention from all the DPW Regions, without any exceptions. It is recommended that the national DPW programme of 2018 be revitalised to turnaround wastewater services in DPW, building on the 2021 audit baseline.

It needs mention that DPW leadership commissioned a nation-wide project in 2017 to get DPW Regions ready for the next Green Drop audit. Most of the Green Drop information was prepared during this project, but not all Regions presented this information as evidence. Amongst others, Sludge Management Plans were prepared which contain the technology and design of the treatment facilities.

The provincial Risk Ratio for DPW treatment plants regressed from 80% in 2013 to 88% in 2021. The most prominent risks were observed on treatment level, and pointed to works that exceeded their design capacity, dysfunctional processes, and equipment (especially disinfection), and effluent and sludge non-compliance. Opportunities are presented in terms of reducing cost through process optimisation and improved energy efficiency, and beneficial use of sludge, nutrients, biogas, and other energy resources.

The Regulator is hopeful that the 2021 audits will set a baseline from where a positive trajectory for wastewater services and improved performance will follow. The DPW Regions are encouraged to start preparation for the 2023 Green Drop audit. The 2021 Green Drop status are summarised in Table 216, indicating no Green Drop Certifications, but several systems in critical state.

Table 216 - 2021 Green Drop Summary

DPW Region	2013 GD Score (%)	2021 GD Score (%)	2021 GD Certified ≥90%	2021 GD Contenders (89%)	2021 Critical State (<31%)
Eastern Cape PE	8	45↑			Bulembu SAPS Airport
Western Cape	42	22↓			10 of 11 plants
Gauteng Johannesburg	0	22↑			Devon
Mpumalanga	28	21↓			6 of 8 plants
North West	0	18↑			All 10 plants
Gauteng Pretoria	1	13↑			All 8 plants
Free State	14	7↓			All 6 plants
Northern Cape	18	6↓			All 6 plants
Eastern Cape Mthatha	2	4↑			All 16 plants
Limpopo	15	3↓			All 20 plants
KwaZulu Natal North	19	0↓			All 13 plants
KwaZulu Natal South		14↓			All 5 plants
Totals	-	-	0	0	102

The Department of Water and Sanitation acknowledges the excellence in wastewater management achieved for the Green Drop Audit year of 2021.

No Green Drop Certificates are awarded in any of the DPW Regions.

Background to Department of Public Works Wastewater Services

Incentive based regulation was an innovative and uniquely South African response to challenges in the water sector. The tragedies of Delmas (2005 and 2007) and Joe Gqabi (2007) showed that an alternative, proactive approach to regulation was required to improve the standards of drinking water and wastewater management. This was the genesis of the Blue Drop (Drinking Water) and Green Drop (Wastewater Quality) programmes in 2008.

Incentive-based regulation seeks to induce changes in behaviour of individuals and institutions to facilitate continuous improvement and adoption of best practice management of treatment systems. Consequently, progressive improvement and excellent performance is recognised and rewarded. It should however not be construed as a weaker form of regulation but rather an alternate approach, as it is underpinned by a strong legislative mandate in the Water Services Act.

The Green Drop and Blue Drop incentive-based regulation promotes transparency and accountability and allows DWS to measure, monitor and publish information about the quality of water services, based on legislative standards or industry good practice. It seeks to identify risks and to ensure responsible authorities implement control measures to prevent failure.

There are 12 DPW Regions in South Africa, delivering wastewater services through a sewer network comprising of 115 WWTWs, 73 network pump stations and 35.2 km outfall and main sewer pipelines. The sewer network excludes the pipelines of 8 DPW Regions who could not provide data. There is a total installed treatment capacity of 39.04 Ml/d, with all capacity residing in micro-, small, and medium-sized treatment plants. No large or macro-sized plants are used.

Table 217 - Summary of WWTW capacity and flow distribution according to plant sizes

	Micro Size Plants	Small Size Plants	Medium Size Plants	Unknown (NI)*	Total
	<0.5 Ml/day	0.5-2 Ml/day	2-10 Ml/day		
No of WWTW	64	27	4	26	115
Total Design Capacity (Ml/day)	7.67	20.37	11.00	26	39.04
Total Daily Inflow (Ml/day)	1.93	11.07	3.38	70	18.03
Use of Design Capacity (%)	25%	54%	31%	-	46%

** "Unknown" means the number of WWTWs with NI (No Information) on design capacity or daily inflow*

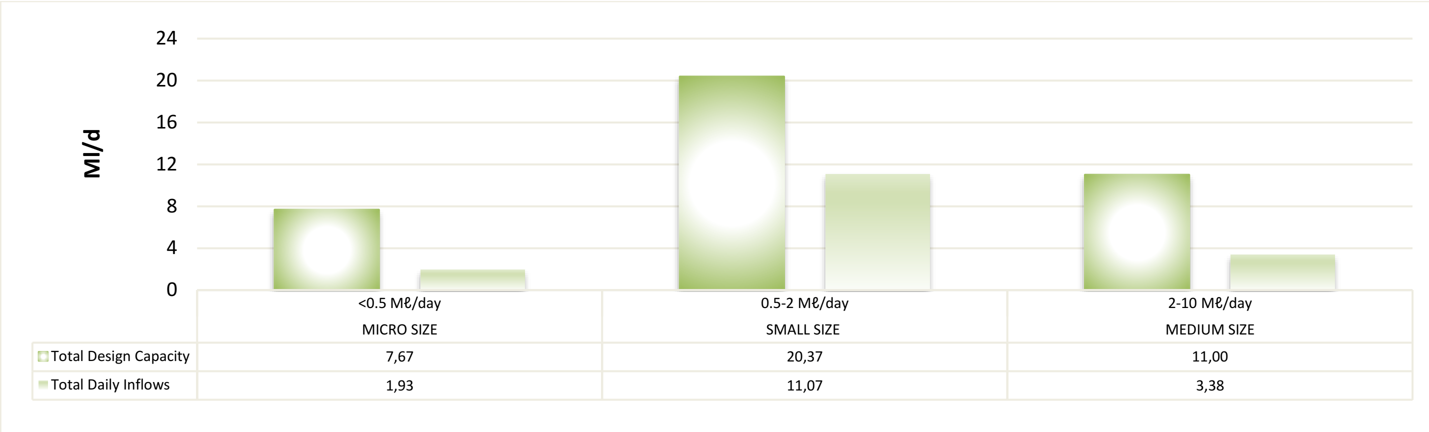


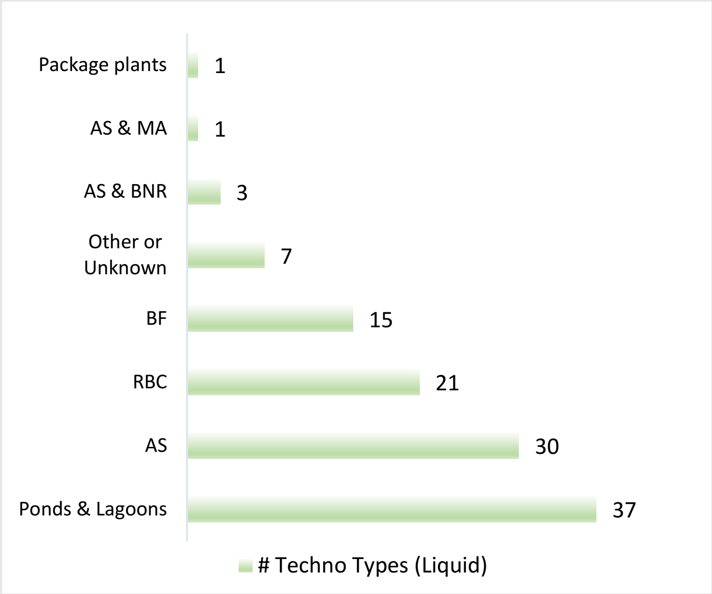
Figure 196 - Design capacities and operational inflow to WWTWs

Based on the current operational flow of 18.03 Ml/d, the treatment facilities are operating at 46% of their design capacity. The three largest flow contributors are the Western Cape, Eastern Cape, and Free State Regions with a total of 11.9 Ml/d. The 46% figure implies that there is 54% spare capacity to meet the medium-term demand. However, 70 of the 115 systems (61%) do not monitor their inflow. The spare capacity is therefore inaccurate and can only be confirmed once all WWTWs measure their inflow (Refer to Diagnostic 3). The spare capacity would also be compromised at systems in cases where treatment processes are non-operational due to dysfunctional equipment and/or structures. VROOM Cost Diagnostic 7 reports on the refurbishment requirements to restore such capacity and functionality. The "available" capacity translates to 21 Ml/day, which would be sufficient to service an additional 87,500 to 131,250 persons (Red Book, 2019: 40-60% of 400 l/c/d).

The audit data shows that 8 systems with known design capacities are hydraulically overloaded. This figure will be higher as there are 70 systems that are not measuring their inflows and hence it is not possible to determine whether these systems are hydraulically overloaded as well. The systems with known design capacities, that are hydraulically overloaded, are as follows:

- Eastern Cape Mthatha: 1 of 16 systems (Willowvale DCS)
- Free State: 1 of 6 systems (Goedemoed Correctional Centre)
- KZN South: 1 of 5 systems (New Hanover prison)
- Mpumalanga: 1 of 8 systems (Lebombo PoE)
- Western Cape: 4 of 11 systems (Voorberg, Brandvlei, Dwarsrivier and Drakenstein Prisons).

The predominant treatment technologies employed at WWTWs comprise of ponds/lagoons, activated sludge and variations, rotating biological contactors and biofilters (for effluent treatment), and solar drying beds for sludge treatment. The next audit will need to verify sludge treatment technologies, as insufficient information ("Other") is observed in this area.



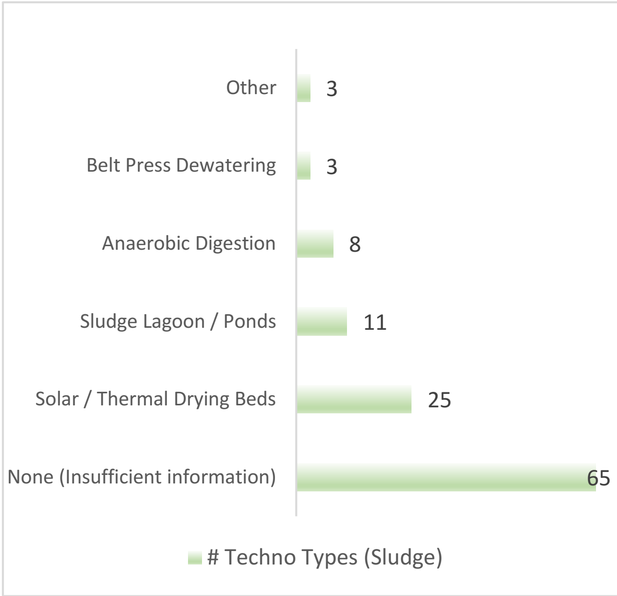


Figure 197 - Treatment technologies for wastewater effluent (a) and sludge (b)

Table 218 - Summary of Collection Network Pump Stations and Sewer Pipelines

DPW Region	# WWTWs	Pump Stations (#)	Sewer Pipelines (km)
Eastern Cape Mthatha	16	0	NI
Eastern Cape PE	11	6	29
Free State	6	7	NI
Gauteng Pretoria	8	4	NI
Gauteng Jhbg	1	1	NI
KwaZulu Natal North	13	17	0.2
KwaZulu Natal South	5	2	NI
Limpopo	20	0	NI
Mpumalanga	8	1	NI
North West	10	2	2
Northern Cape	6	10	NI
Western Cape	11	23	4
Totals	**115**	**73**	**35.2**

The sewer network consists of the sewer mains and pump stations as summarised in Table 218. The Western Cape Region appears to have the most pump stations (23 no.) followed by KwaZulu Natal North Region (17 no.) Only the Eastern Cape provided verifiable information on the length of sewer pipelines in the Region (29 km). Eight of the 12 Regions could not provide information on sewer pipelines, indicating asset management information limitations.

Department of Public Works Green Drop Analysis

The 100% response from the 12 DPW Regions audited during the 2021 Green Drop process demonstrates a commitment to wastewater services in the country.

Table 219 - Green Drop Comparative Analysis from 2009 to 2021

GREEN DROP COMPARATIVE ANALYSIS				
Performance Category	**2009 - 2011**	**2013**	**2021**	**Performance trend 2013 and 2021**
Incentive-based indicators				
DPW Regions assessed (#)	Not determined	12 (100%)	12 (100%)	→
Wastewater systems assessed (#)	Not determined	121	115	↓
Average Green Drop score	Not determined	13.9%	12.3%	↓
Green Drop scores ≥50% (#)	Not determined	5/121 (4%)	2/115 (2%)	↓
Green Drop scores <50% (#)	Not determined	116/121 (96%)	113/115 (98%)	↓
Green Drop Certifications (#)	Not determined	0	0	→
Technical Site Inspection Score (%)	Not determined	47.1%	45.3%	↓

NA = Not Applied NI = No Information *↑= improvement, ↓= regress, →= no change*

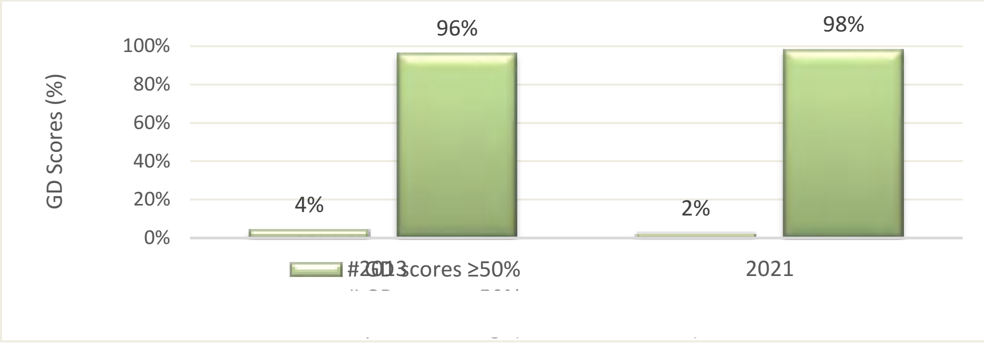


Figure 198 - GD trend analysis over the period 2013 to 2021, indicating the percentage GD scores above 50% (left bar) and below 50% (right bar)

The trend analysis indicates that:

- The number of systems audited has decreased from 121 systems in 2013, when the first assessments were undertaken, to 115 systems in 2021
- The GD average score decreased marginally from 14% in 2013 to 12% in 2021
- Similarly, the number of systems with GD scores of ≥50% decreased between from 5 (4%) in 2013 to 2 (2%) in 2021
- This trend was also mirrored in the TSA score, which had decreased marginally from 47% in 2013 to 45% in 2021
- This trend was balanced by the number of systems with GD score of ≤50% increasing from 96% in 2013 to 98% in 2021
- The Green Drop Certifications remained constant with 0 awards in 2013 and 0 awards in 2021.

The analysis for the period 2013 to 2021 indicates that the majority of the system scores are in the 0-31% (Critical Performance) space, with the 31-49% (Poor Performance) being the next largest category.

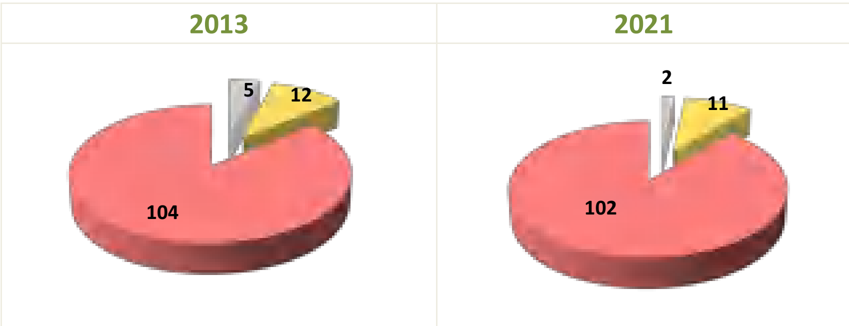


Figure 199 - No. WWTWs in the Green Drop score categories over the period 2013 to 2021 (graph legend to right)

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	

In summary, trends for the period 2013 to 2021 indicate as follows:

- Systems in a 'poor state' decreased from 12 systems in 2013 to 11 systems in 2021
- Systems in a 'critical state' decreased from 104 in 2013 to 102 systems in 2021
- Systems in the 'excellent and good state' remained constant with no systems in 2013 and 2021.

Department of Public Works Risk Analysis

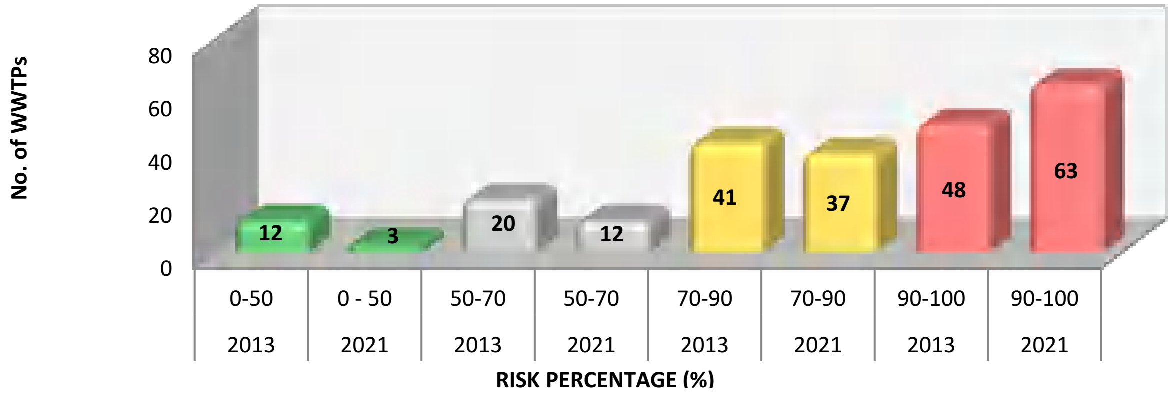
Green Drop risk analysis (CRR) focuses on the treatment function specifically. It considers 4 risk indicators, i.e. design capacity, operational flow, technical capacity, and effluent quality. The CRR values do not factor risks associated with sanitation- or wastewater network and collector systems.

Table 220 - Cumulative Risk Comparative Analysis from 2013 to 2021

Performance Category	2013	2021	Performance Trend
Highest CRR	17	17	→
Average CRR	13.6	15.0	↓
Lowest CRR	6	6	→
Design Rating (A)	1.0	1.0	→
Capacity Exceedance Rating (B)	4.5	4.2	↑
Effluent Failure Rating (C)	5.3	7.3	↓
Technical Skills Rating (D)	3.8	3.5	↑
CRR% Deviation	**80.0**	**88.0**	↓

↑= improvement, ↓= regress, →= no change

The concept of risk management has not been embedded within the DPW Regions. Table 220 shows a regressed CRR% deviation from 2013 (80%) to 2021 (88%) for the Regions overall, mostly as result of final effluent quality failures (C). The other risk indicator shows little- or even positive risk changes, i.e. no change in design capacity (A), risk improvement in design capacity exceedance (B) and improvement in the technical skills rating (D). Individual systems, however, shows more pertinent risk vulnerabilities, as highlighted under "***Regulator's Comment***" for each wastewater system. The CRR analysis in context of the Green Drop results suggests that further improvements should focus on 1) capacity exceedance at plants which are hydraulically overloaded or approaching its design lifespan, 2) effluent quality failures, especially for microbiological compliance, and 3) strengthening of technical skills and operational competency, especially related to sludge management.



90 – 100% Critical risk WWTPs	
70 - <90% High risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low risk WWTPs	

Figure 200 - WWTW Risk distribution and trends from 2013 to 2021; Colour legend

Trend analysis of the CRR ratings for the period 2013 to 2021 reveals that:

- The 2021 assessment cycle highlighted regressive shifts with a decrease in the number of low risk WWTWs (12 to 3), decrease in medium risk WWTWs (20 to 12), decrease in high risk WWTWs (47 to 37), followed by a marked increase in critical risk WWTWs (48 to 63)
- This is a highly concerning trend that would require urgent intervention by DPW leadership
- An overall regressive performance pattern is noted in most DPW works, which signal the benefit of repeat/regular audits to ensure continued improvement. Performance seems to decrease when there are significant time lapses or irregular interaction.

Regulatory Enforcement

Wastewater systems which failed to achieve the minimum Green Drop target of 31%, are placed under regulatory focus. The Regulator requires that the DPW Regions to submit a detailed corrective action plan within 60 days of publishing of this report. Without any exception, all DPW Regions and 102 wastewater systems received Green Drop scores below 31%. These systems are placed under **regulatory surveillance**, in accordance with the Water Services Act (108 0f 1997). In addition, these DPW Regions will be compelled to ringfence water services funding or grant allocations to rectify and restore wastewater collection and treatment shortcomings identified in this report.

Table 221 - WWTWs with <31% Green Drop scores

DPW Region	2021 GD Score	WWTWs with <31% score
Eastern Cape Port Elizabeth	45%	Bulembu SAPS Airport
Western Cape	22%	10 of 11 plants
Gauteng Johannesburg	22%	Devon
Mpumalanga	21%	6 of 8 plants
North West	18%	All 10 plants
KwaZulu Natal South	14%	All 5 plants
Gauteng Pretoria	13%	All 8 plants
Free State	7%	All 6 plants
Northern Cape	6%	All 6 plants
Eastern Cape Mthatha	4%	All 16 plants
Limpopo	3%	All 20 plants
KwaZulu Natal North	0%	All 13 plants

The following DPW Regions and their associated wastewater treatment plants are in high CRR risk positions, which means that some or all the risk indicators are in a precarious state, i.e. operational flow, technical capacity, and effluent quality. WWTWs in high risk and critical risk positions poses a serious risk to public health and the environment. The following DPW Regions will be required to assess their risk contributors and develop corrective measures to mitigate these risks.

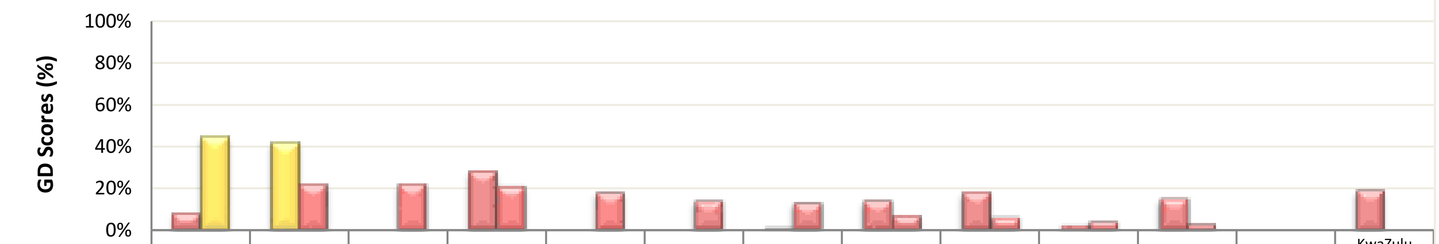
Table 222 - %CRR/CRR$_{max}$ scores and WWTWs in critical and high-risk space

DPW Region	2021 CRR/CRRmax % deviation	WWTWs in critical and high-risk space	
		Critical Risk (90-100%CRR)	High Risk (70-<90%CRR)
EC Port Elizabeth	64.2%		4 Plants
MP	70.6%		5 Plants
WC	73.0%	1 Plant	5 Plants
GP Johannesburg	77.0%		1 Plant
NC	83.0%		6 plants
FS	84.0%		6 Plants
EC Mthatha	91.2%	7 Plants	9 Plants
NW	92.0%	9 Plants	1 plant
KZN South	98.0%	5 Plants	
GP Pretoria	100.0%	8 Plants	
KZN North	100.0%	13 Plants	
LP	100.0%	20 Plants	

Good practice risk management requires that the W$_2$RAPs are informed by meaningful Process and Condition Assessments, supported by zealous implementation of corrective measures and ongoing monitoring of risk movement. All of the 12 DPW Regions have wastewater systems in the high and critical risk positions, 63 systems in critical risk positions and 37 plants in high-risk positions (100 of the 115 systems in total). It is evident that risk management has not sufficiently been embedded in any of the Regions, and would require a concerted effort, such as the revival of the national DPW programme of 2018.

Performance Barometer

The **Green Drop Performance Barometer** presents the individual Green Drop Scores, which essentially reflects the level of mastery that a Region has achieved in terms of its overall wastewater services business. The bar chart below indicates the GD scores for 2013 in comparison to GD 2021, from highest to lowest performing DPW Region. The Eastern Cape PE Region is commended for an improved GD score from 8% in 2013 to 45 % in 2021 and is also the only Region which improved its overall CRR risk status. The Western Cape Region regressed from 42% in 2013 to 22% in 2021. All the other DPW Regions remain in critical state.



	Eastern Cape PE	Western Cape	Gauteng Jhb	Mpumalanga	North West	KwaZulu Natal South	Gauteng Pta	Free State	Northern Cape	Eastern Cape Mthatha	Limpopo	KwaZulu Natal North	KwaZulu Natal Combined
	8%	42%	0%	28%	0%	0%	1%	14%	18%	2%	15%	0%	19%
	45%	22%	22%	21%	18%	14%	13%	7%	6%	4%	3%	0%	0%

Figure 201 - a) Green Drop scores 2013 (bar left) and 2021 (bar right), with colour legend inserted

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	

The **Cumulative Risk Log** expresses the level of risk that a Region poses in respect its wastewater treatment facility. It is based on the ***individual Cumulative Risk Ratios***. Figure 202 presents the cumulative risks in ascending order – with the low-risk DPW Regions on the left and critical risk DPW Regions to the far right. The analysis reveals that there are 5 DPW Regions in high-risk positions and 6 DPW Regions in critical risk positions. Only Eastern Cape is maintaining a good risk status, being in medium risk space.

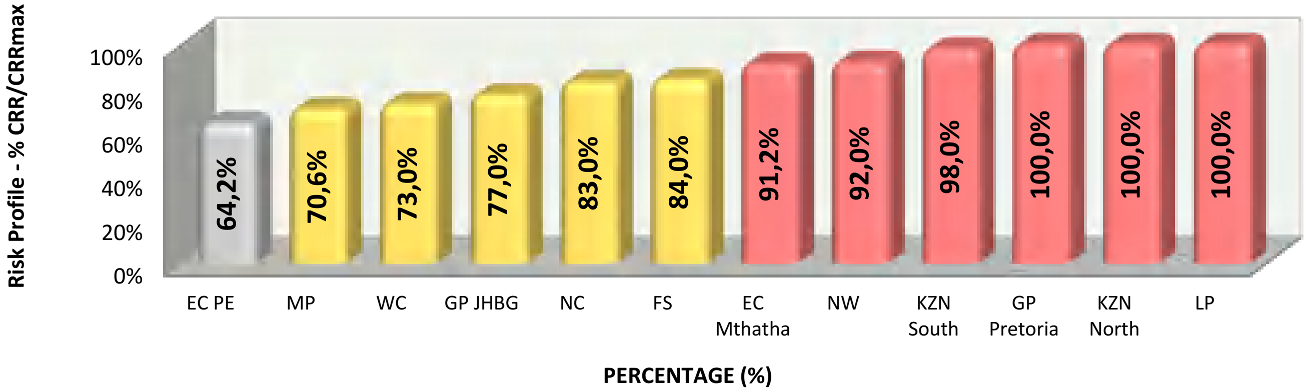


Figure 202 - %CRR/CRRmax Risk Performance Log 2021; Colour legend

90 – 100% Critical risk WWTPs	
70 - <90% High risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low risk WWTPs	

Department of Public Works Best Performers

Eastern Cape Port Elizabeth received the highest Green Drop score for all DPW Regions:
- ✓ 45% Green Drop Score
- ✓ 2013 Green Drop Score of 8%
- ✓ Improvement on the CRR risk profile from 87% in 2013 to 64% in 2021
- ✓ 7 of 11 systems in the low and medium risk positions
- ✓ Technical Site Assessment score of 81% (St Albans Prison)

Western Cape received the 2nd best Green Drop score:
- ✓ 22% Green Drop Score
- ✓ 5 of 11 systems in the low & medium risk positions
- ✓ TSA score of 49% (Drakenstein Prison)

Gauteng Johannesburg received the 3rd best Green Drop score:
- ✓ 22% Green Drop Score
- ✓ 1 system in high-risk position
- ✓ TSA score of 66% (Devon)

KPA Diagnostics

The Green Drop Audit process collects a vast amount of data that yield valuable insight on the state of the wastewater sector in each Region. These insights have been captured into 7 thematic areas or 'Diagnostics', as discussed below.

Table 223 - Summary of the key diagnostic themes and reference to the respective Green Drop KPAs

Diagnostic #	Diagnostic Description	Diagnostic Reference
1	**Green Drop KPA Analysis**	KPAs A-E
2	**Technical Competence**	KPA A, B & Bonus
3	**Treatment Capacity**	KPA D
4	**Wastewater Monitoring and Compliance**	KPA B & D & Bonus
5	**Energy Efficiency**	KPA C & Bonus
6	**Technical Site Assessments**	TSA
7	**Operation, Maintenance and Refurbishment of Assets**	KPA C, D & Bonus

Diagnostic 1: Green Drop KPA Analysis

Aim: Analysis of technical skills, environmental plans, financial management, technical capacity, and regulatory compliance provides insight to the strengths and weaknesses that distinguish the DPWs wastewater industry.

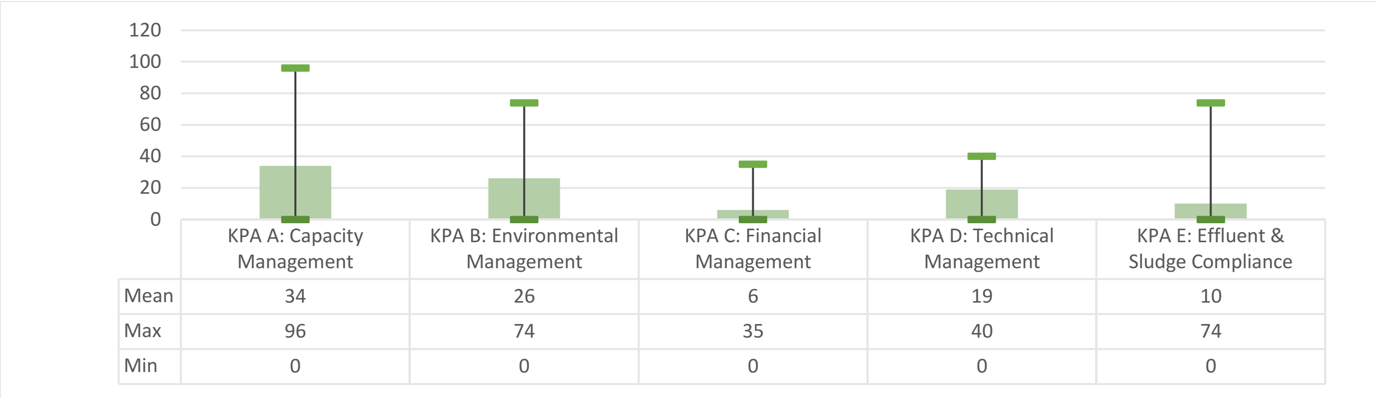
These insights in return, may inform appropriate interventions and strategies to improve the individual KPAs and ultimately, collective KPA performance.

Findings: The DPW Regions are characterised by a highly variable KPA profile. A good KPA profile typically depicts a high mean GD score, coupled with a low Standard Deviation (SD) between the outer parameters (min and max). Similarly, a well performing system is one which has most/all systems in the >80% bracket and no systems in the <31% bracket.

Table 224 - Green Drop scores KPA profiles (graph legend included)

KPA #	Key Performance Area	*Weight*	Minimum GD Score (%)	Maximum GD Score (%)	Mean GD Score (%)	# Systems <31%	# Systems >80%
A	Capacity Management	*15%*	0%	96%	34%	70 (61%)	11 (10%)
B	Environmental Management	*15%*	0%	74%	26%	72 (63%)	0 (0%)
C	Financial Management	*20%*	0%	35%	6%	115 (100%)	0 (0%)
D	Technical Management	*20%*	0%	40%	19%	100 (87%)	0 (0%)
E	Effluent and Sludge Compliance	*30%*	0%	74%	10%	105 (91%)	0 (0%)

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	



Note: The High and low lines represent the Min and Max range, and the shaded green represents the Mean

Figure 203 - Maximum, minimum, and mean Green Drop KPA scores

The KPA distribution indicates as follows:

- Capacity Management (KPA A) depicts the highest mean of 34%, the highest maximum of 96%, and the highest Standard Deviation (SD) of 96%. These results indicate some pockets of strengths pertaining to the registration of WWTWs, maintenance plans and records, maintenance teams, and registered, qualified staff (process controllers, supervisors, scientists, technicians, engineers)
- Financial Management (KPA C) received the lowest mean of 6%, indicating a deficiency in credible information pertaining to the budget drivers, O&M budgets and expenditure, operational cost (R/m^3), energy use and cost (R/kWh), and supply chain management and contract management
- This was followed by the Effluent and Sludge Compliance (KPA E) that received the next lowest mean of 10%, indicating vulnerability in data management, IRIS upload, effluent quality compliance, and sludge quality compliance.

The GD bracket performance distribution reiterates the above findings:

- ***KPA Score >80%:*** Capacity Management (KPA A) is by far the best performing KPA with 10% of systems achieving >80%. All the remaining KPAs achieved 0% of systems >80%
- ***KPA Score <31%:*** Financial Management (KPA C) represents the worst performing KPA with 100% of systems lying in the 0-31% bracket, followed by Effluent and Sludge Compliance (KPA E) with 91% and Technical Management (KPA D) with 87%.

Diagnostic 2: Technical Competence

Aim: This focus area assesses the human resources (technical) capacity to manage wastewater systems. Theory suggests that a direct correlation exists between human resources capacity (sufficient number of appropriately qualified staff) and a Region's performance- and operational capability. It is projected that high HR capacity would translate to compliant wastewater services and protection of scarce water resources.

Findings: According to regulations, wastewater plants are classified as Class A, B, C, D or E plants. Similarly, Process Controllers and Plant Supervisors are registered as Class I, II, III, IV, V or VI operators. High classed plants require a higher level of operators due to their complexity and strict regulatory standards. Technical compliance of PCs and Supervisors is determined against Green Drop standards, as defined by Reg. 2834 and draft Reg. 813 of the National Water Act 1998.

Note: "Compliant staff" means qualified and registered staff that meets the GD standard for a particular Class Works. "Staff shortfall" means staff that does not meet the GD standard for a particular Class of works (+1 for a shift) and/or staffing gaps exist at the respective WWTWs.

Table 225 - No. compliant versus shortfall in Supervisor and Process Controller staff

DPW Region	# WWTWs	Compliant staff		Staff Shortfall		Ratio*	2021 GD Score (%)
		Supervisor	PCs	Supervisor	PCs		
Eastern Cape Mthatha	16	0	0	3	16	0.0	4%
Eastern Cape Port Elizabeth	11	15	18	0	5	3.0	45%
Free State	6	0	3	2	13	0.5	7%
Gauteng Pretoria	8	0	2	3	12	0.3	13%
Gauteng Johannesburg	1	0	1	1	1	1.0	22%
KwaZulu Natal North	13	0	0	3	25	0.0	0%
KwaZulu Natal South	5	1	3	1	9	0.8	14%
Limpopo	20	0	0	6	37	0.0	3%
Mpumalanga	8	4	2	1	12	0.8	21%
North West	10	1	5	3	7	0.6	18%
Northern Cape	6	0	2	2	10	0.3	6%
Western Cape	11	1	2	3	18	0.3	22%
Totals	**115**	**22**	**38**	**28**	**165**		

** The single number Ratio is derived from the number of qualified staff divided by the number of WWTWs operated by this number of staff. E.g. for DPW-EC, 33 qualified staff is available to support 11 WWTW, thus 33/11 = 3 ratio*

Competent human resources are a vital enabler to ensure efficient and sustainable management of treatment processes and infrastructure. For the DPW, operational competencies are not on par with regulatory expectations, as illustrated by the high shortfalls against the Green Drop standards. This is possibly brought about by existing staff not being registered or qualified, but also by the high number of contractors that is not required to comply with regulatory standards. The latter could be addressed by including this requirement in the tender and procurement specification.

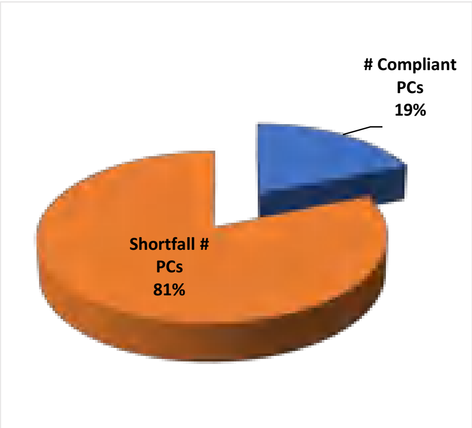


Figure 204 - Schematic illustration of compliant versus non-compliant Supervisors (a) and Process Controllers (b)

Plant Supervisors: The pie charts indicate that 44% (22 of 50) of Plant Supervisors complies with the Green Drop standard, with zero shortfall for the Eastern Cape PE Region. A 56% (28 of 50) shortfall is noted for Supervisors overall, with the highest shortfall observed for the Limpopo Region (6 no.) and 5 of the other DPW Regions with 3 no. each.

Process Controllers: Similarly, 19% (38 of 203) of the PC staff is compliant for the DPW Regions. There is an 81% (165 of 203) shortfall in PCs with the highest shortfall in the Regions for Limpopo (37 no.), followed by KwaZulu Natal North (25 no.), Western Cape (18 no.), and Eastern Cape Mthatha (16 no.).

Green Drop standards prescribes stricter standards for Class A and B plants with Level V and VI Supervisors and Process Controllers per shift, whereas Class C to E plants have reduced requirements and sharing of staff across works is acceptable. Furthermore, shifts have been introduced to ensure optimal operations while addressing security risks, particularly as it relates to vandalism. Telemetry also reduces the requirement for on-site staff during night shifts, but these relaxations will have to be done within the DWS regulatory guidelines.

It is anticipated, but has never been tested before, that a close correlation would exist between the competence of an operational team and the performance of a treatment plant, as measured by the GD score. The data indicates as follows:

- 1 of the 12 DPW Regions have good Supervisor/Process Controller ratios in place (≥3) – Eastern Cape PE
- All the DPW Regions have shortfalls in registered Process Controllers.

The results from the ratio analysis indicate high ratios for Eastern Cape PE only, and low ratios for the remaining Regions.

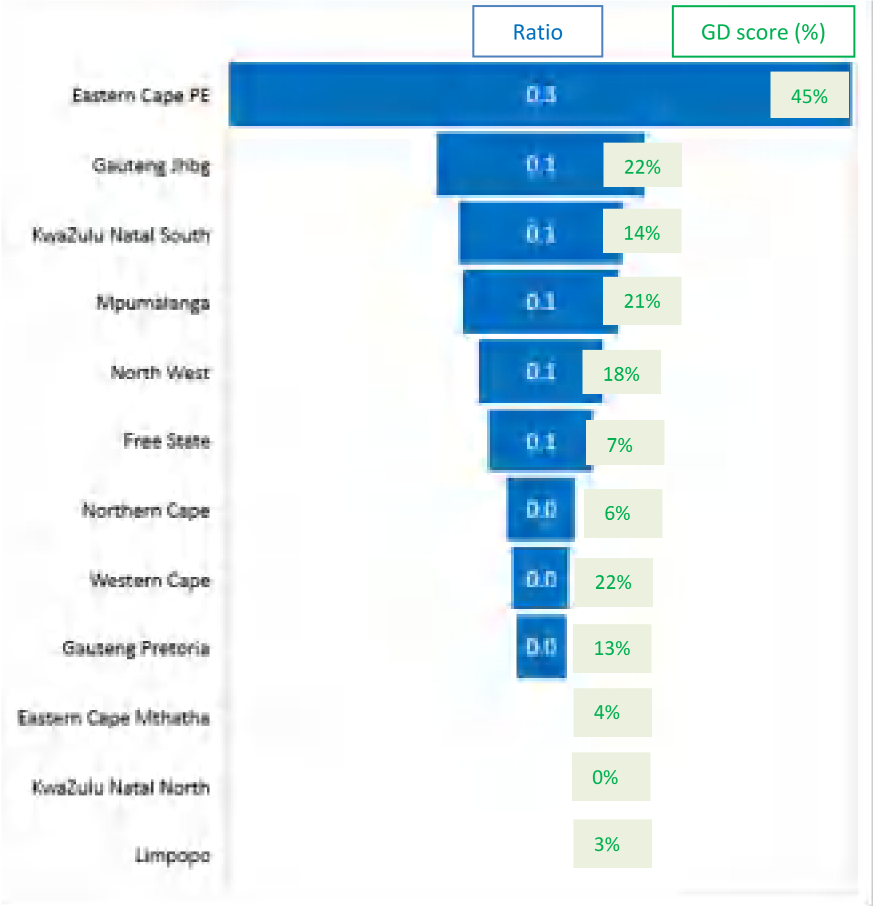


Figure 205 - Ratio of compliant operational staff to no. of WWTWs and Comparison of Ratios with GD scores

Overall, the comparative bar chart confirms a high correlation between Regions with high ratios and higher GD scores (Eastern Cape PE 45%, Gauteng Johannesburg 22%, Mpumalanga 21%, and North West 18%). Whereas lower ratios are associated with lower GD scores, i.e. Free State to Limpopo in Figure 205, with the only anomaly being that of the Western Cape.

In addition to operational capacity (above), good management practice also requires access to qualified engineers, technicians, technologists, scientists, and maintenance capability. Such competencies could reside in-house or accessible through term contracts and external specialists.

Table 226 - Summary of the maintenance capacity and no. of qualified and shortfall of Engineering, Technical and Scientific staff

DPW Region	# WWTW	Maintenance Arrangement	Qualified Technical Staff (#)				Technical Shortfall (#)	Qualified Scientists (#)	Scientists Shortfall (#)	Ratio*	2021 GD Score (%)
			Engineers	Technologists	Technicians	Total					
Eastern Cape Mthatha	16	No Capacity	0	0	0	0	2	0	1	0.0	4%
Eastern Cape Port Elizabeth	11	Inadequate Capacity; Internal Team (Only)	1	0	0	1	1	4	0	0.1	45%
Free State	6	Inadequate Capacity; Partially Capacitated	1	2	1	4	0	0	1	0.7	7%
Gauteng Pretoria	8	Partially Capacitated	0	0	0	0	2	1	0	0.0	13%
Gauteng Johannesburg	1	Internal + Term Contract	0	1	0	1	1	0	1	1.0	22%
KwaZulu Natal North	13	Internal + Specific Outsourcing	0	0	0	0	2	0	1	0.0	0%
KwaZulu Natal South	5	No capacity	0	0	1	1	1	0	1	0.2	14%
Limpopo	20	No Capacity	0	0	0	0	2	0	1	0.0	3%
Mpumalanga	8	Internal Team (Only); Internal + Term Contract	1	0	0	1	1	0	1	0.1	21%
North West	10	Internal + Term Contract; Internal Team (Only); Internal + Specific Outsourcing	1	0	0	1	1	1	0	0.1	18%
Northern Cape	6	Internal + Specific Outsourcing; No Capacity	0	0	0	0	1	1	0	0.0	6%
Western Cape	11	Inadequate Capacity; Partially Capacitated	0	0	0	0	0	3	0	0.0	22%
Totals	**115**		**4**	**3**	**2**	**9**	**14**	**10**	**7**		

** The Ratio depicts the number of qualified technical staff divided by the number of WWTWs that have access to the staff*

Note 1: "Qualified Technical Staff" means staff appointed in positions to support wastewater services, and who has the required qualifications. "Technical Shortfall" is calculated based on a minimum requirement of at least 2 Engineers/Technologists/Technicians and at least one 1 Scientist per DPW Region.

Note 2: "Qualified Scientists" means professional registered scientists (SACNASP) appointed in positions to support wastewater services. "Scientist's shortfall" means that the WSI does not have at least one qualified, SACNASP registered scientist in their employ or contracted.

The DPW has a low contingent of qualified maintenance staff for at least 5 of the 12 DPW Regions, with the current qualified maintenance staff forming a collective of in-house-, contracted- or outsourced personnel. The data for maintenance capacity and expertise indicates the following:

- 6 of 12 DPW Regions have in-house maintenance teams
- 3 of 12 DPW Regions have internal maintenance teams supplemented with term contracts
- 3 of 12 DPW Regions have internal maintenance teams supplement with specific outsourced services
- 8 of 12 DPW Regions range from no capacity to inadequate capacity to partially capacitated.

For qualified technical staff in the DPW Regions, the data indicates as follows:

- A total of 4 engineers, 3 technologists, 2 technicians (qualified) and 10 SACNASP registered scientists are assigned to the 12 DPW Regions, totalling 19 qualified staff for the DPW
- A total shortfall of 21 persons is identified, consisting of 14 technical staff and 7 scientists
- 10 of the 12 DPW Regions have some shortfall in qualified technical staff, with the exception of the Free State and Western Cape Regions
- Only 25% (3 of 12) of the DPW Regions have access to credible laboratories which complies with Green Drop standards. The DPW in-house laboratories are generally found to lack quality assurance and adequate analytical turnaround times.

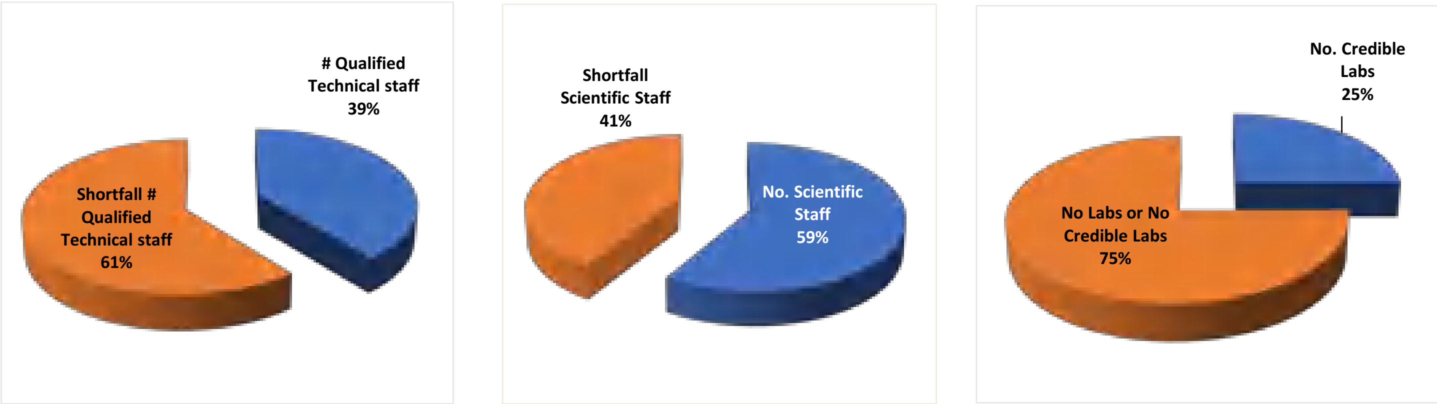


Figure 206 - Graphic illustration of the number and %: a) qualified engineering/technical staff; b) professional scientists; c) access to credible laboratory services that complies with Green Drop standards

Ratio analysis has been done to determine the number of qualified technical and scientific staff assigned per WWTW. It is expected, but never tested before, that a higher ratio would correspond with well-performing and maintained wastewater systems, as represented by the GD score.

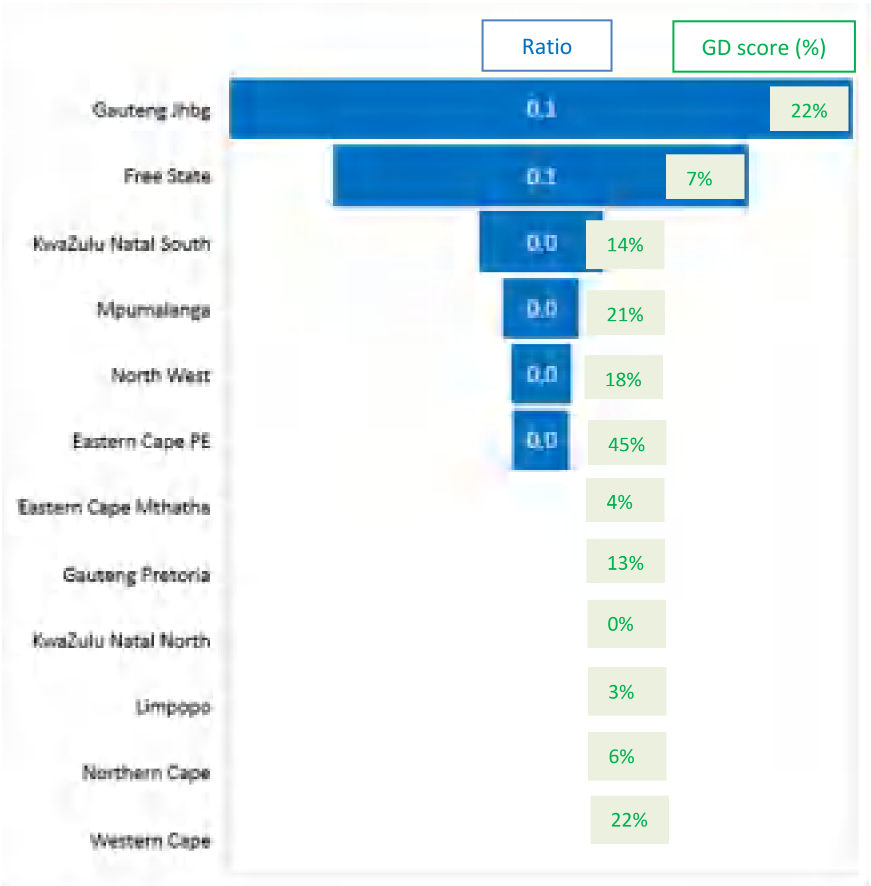


Figure 207 - Ratio of compliant technical staff to no. of WWTWs and Comparison of Ratios with GD scores

Figure 207 shows a close correlation for some of the DPW Regions with high ratios and high GD scores in the top half of Figure 207, with the anomaly being the Free State Region. Likewise, a correlation is observed between lower ratios and lower Green Drop scores in the bottom half of Figure 207, with the anomaly being the Western Cape Region. These results suggest that wastewater performance may be less sensitive towards engineering, technical and scientific staff, and more dependent on operational competencies (Superintendents and Process Controllers).

One manner of enhancing operational capacity is via dedicated training programmes. The Green Drop audit incentivise appropriate training of operational staff over a 2-year period prior to the audit date. The results are summarised as follows:

Table 227 - No. of WWTWs with operational staff sent on training over the past 2 years and vice versa

DPW Region	# WWTW staff attending training over past 2 years	# of WWTW without training over past 2 years
Eastern Cape Mthatha	0	16
Eastern Cape Port Elizabeth	11	0
Free State	0	6
Gauteng Pretoria	8	0
Gauteng Johannesburg	1	0
KwaZulu Natal North	0	13
KwaZulu Natal South	2	3
Limpopo	0	20
Mpumalanga	0	8
North West	0	10
Northern Cape	0	6
Western Cape	0	11
Totals	**22 (19%)**	**93 (81%)**

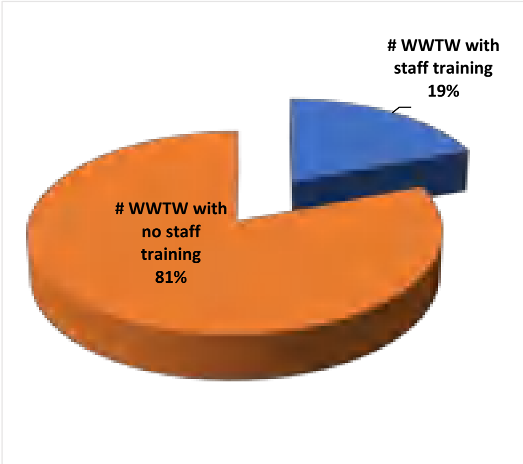


Figure 208 - %WWTWs that have trained operational staff over the past two years

The results confirmed that only 19% of WWTWs staff have had operational staff attend training over the past 2 years. This leaves a considerable gap in knowledge and skill and would require a concerted effort to strengthen the training initiatives of Supervisors and Process Controllers. Recent training events focussed primarily on chlorine handling and NQF, and need to be expanded to operation of technology, mathematic equations, sludge treatment and energy efficiency.

Diagnostic 3: Treatment Capacity

Aim: A capable treatment plant requires adequate design capacity and functional equipment to deliver a quality final water. If the plant capacity is exceeded by way of inflow volume or strength, a plant will not be capable to achieve its compliance standards. Capacity is typically exceeded when the demand exceeds the installed design capacity, or when processes or equipment is not operational or dysfunctional, or when the electrical supply cannot support the treatment infrastructure. This diagnostic assesses the status of plant capacity and operational flows to the plants.

Findings: Analysis of the hydraulic capacities and operational flows indicate a total design capacity of 39 Ml/d for the DPW Regions, with a total inflow of 18 Ml/day - considering that 70 systems are not measuring their inflows. Theoretically, this implies that 46% of the design capacity is used with 54% available to meet additional demand. However, the full 39 Ml/d day is not available as some infrastructure is dysfunctional, leaving 33.1 Ml/d available. The reduced capacity means that the DPW Regions are closer to its total available capacity than the data suggests. The consequence of insufficient capacity is that new housing and industrial developments would be impeded, which would counter local socio-economic initiatives. *It must be noted that many DPW Regions do not report or have knowledge of reduced capacity, and a higher figure can be expected.*

For the DPW Regions in general, most plants are operating within their design capacities, with the exception of some systems in the EC Mthatha, Free State, KZN South, Mpumalanga and Western Cape Regions. None of the DPW Regions reported a low percentage use of their overall capacity (<50%). Treatment systems with low percentage use may be affected by breakdown in sewer networks or pump stations whereby all sewage is not reaching the treatment works. The Green Drop audit requires a wastewater flow balance to identify and quantify possible losses from the network and/or ingress into the sewers. The DPW Regions do not have flow balances that follows the wastewater trail from consumer to treatment plant.

Table 228 - Summary of WWTWs design and available capacities, inflows, % use design capacities, and inflows measured per WWTW

DPW Region	# WWTWs	Design Capacity (Ml/d)	Available Capacity (Ml/d)	Operational Flow (Ml/d)	Variance (Ml/d)	% Use Design Capacity	Inflow measured #
Eastern Cape Mthatha	16	0.6	0.6	0.3	0.3	52%	10
Eastern Cape Port Elizabeth	11	4.5	4.4	3.5	1.0	78%	11
Free State	6	2.6	2.6	2.4	0.2	93%	6
Gauteng Pretoria	8	8.7	7.2	0.0	8.7	0%	NI
Gauteng Johannesburg	1	0.2	0.2	0.2	0.0	85%	1
KwaZulu Natal North	13	3.9	0.8	0.0	3.9	0%	NI
KwaZulu Natal South	5	0.8	0.6	0.0	0.8	0%	NI
Limpopo	20	0.4	0.4	0.0	0.4	0%	NI
Mpumalanga	8	2.3	2.3	1.5	0.8	65%	3

DPW Region	# WWTWs	Design Capacity (Ml/d)	Available Capacity (Ml/d)	Operational Flow (Ml/d)	Variance (Ml/d)	% Use Design Capacity	Inflow measured #
North West	10	2.9	2.9	0.1	2.9	2%	1
Northern Cape	6	1.9	1.0	1.7	0.3	87%	6
Western Cape	11	10.3	10.3	8.4	1.9	82%	7
Totals	**115**	**39**	**33.1**	**18**	**21**	**46%**	**45**

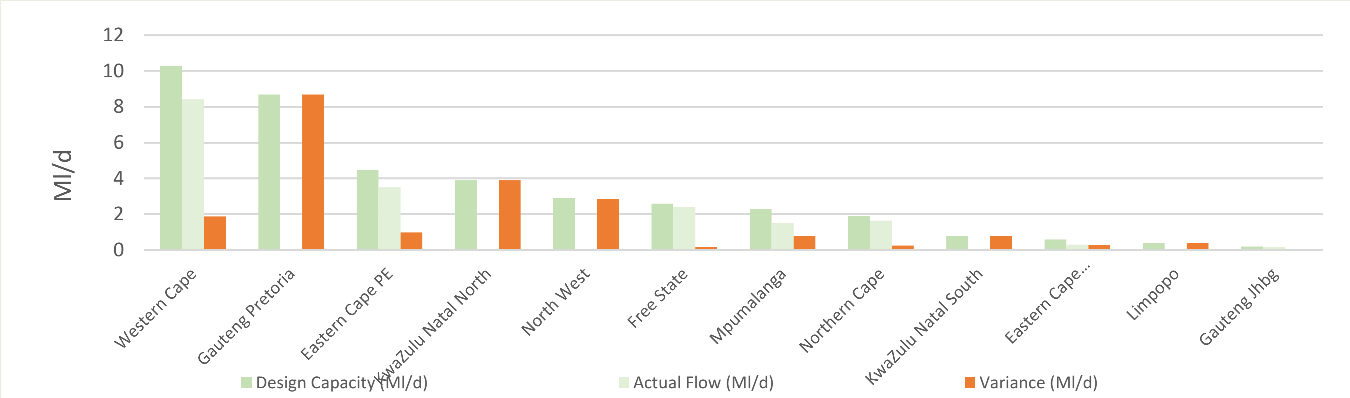


Figure 209 - Design capacity, actual flow, and variance in Ml/d for WWTWs

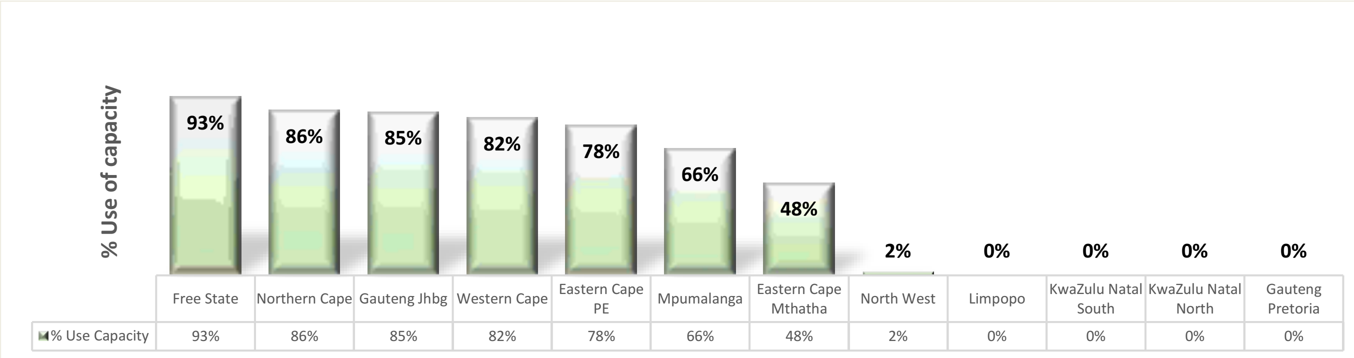


Figure 210 - % use of installed design capacity

The audit data shows that 8 systems with known design capacities are hydraulically overloaded. This figure will be higher as there are 70 systems that are not measuring their inflows and hence it is not possible to determine whether these systems are hydraulically overloaded as well. New housing and industrial developments in these drainage areas would not be able to proceed, without expansion of the capacity. The systems with known design capacities, that are hydraulically overloaded, are as follows:

- EC Mthatha: 1 of 16 systems (Willowvale DCS)
- Free State: 1 of 6 systems (Goedemoed Correctional Centre)
- KZN South: 1 of 5 systems (New Hanover prison)
- Mpumalanga: 1 of 8 systems (Lebombo PoE)
- Western Cape: 4 of 11 systems (Voorberg, Brandvlei, Dwarsrivier and Drakenstein Prisons).

Lastly, Water Use Authorisations mandate the DPW Regions to install and monitor flow meters, whilst GD requires the DPW Regions to report inflows on IRIS and to calibrate meters annually.

The audit results indicate that 39% (45 of 115) of DPW Regions monitor their inflow, with the balance of 61% (70 of 115) not monitoring their inflow (WWTWs linked to all the Regions apart from Eastern Cape PE, Free State, Gauteng Johannesburg, and Northern Cape). The majority of the DPW Regions do not calibrate or verify their flow meters on an annual basis, thereby failing to meet good practice standards.

Diagnostic 4: Wastewater Monitoring and Compliance

Aim "*To measure is to know*" and "*To know is to manage*". The primary objective of a wastewater treatment plant is to produce final effluent and biosolids to a safe standard. This standard cannot be measured or managed if operational- and compliance monitoring is lacking. This diagnostic assesses the monitoring status and final effluent compliance against each WWTW's mandatory standards.

Findings: For operational monitoring, a satisfactory level of 90% is applied as the benchmark, to give weight to the importance of monitoring. For compliance monitoring, the audit evaluates the sampling point, sampling frequency, final effluent quality, biomonitoring, heavy metals, and any specific condition that the DWS may have included in the water use licence. Final effluent quality compliance is calculated against the mandatory limits as listed under "Authorisation Status". A >90% compliance figure confirms high quality final effluent, whereas a <30% indicate poor effluent quality. The enforcement measures are summarised in the column to the far right and include NWA Notices and Directives issued, criminal cases opened, and court interdicts granted during the period 1 April 2019 to 30 June 2021.

Table 229 - Summary of the operational and compliance monitoring status

DPW Region	# WWTW	Operational monitoring (KPA B2)		Compliance monitoring (KPA B3)	
		Satisfactory [GD score >90%]	Not Satisfactory [GD score <90%]	Satisfactory [GD score >90%]	Not Satisfactory [GD score <90%]
Eastern Cape Mthatha	16	0	16	0	16
Eastern Cape Port Elizabeth	11	0	11	0	11
Free State	6	0	6	0	6
Gauteng Pretoria	8	0	8	0	8
Gauteng Johannesburg	1	0	1	0	1
KwaZulu Natal North	13	0	13	0	13
KwaZulu Natal South	5	0	5	0	5
Limpopo	20	0	20	0	20
Mpumalanga	8	0	8	2	6
North West	10	0	10	0	10
Northern Cape	6	0	6	0	6
Western Cape	11	0	11	0	11
Totals	**115**	**0 (0%)**	**115 (100%)**	**2 (2%)**	**113 (98%)**

The performance recorded in Table 229 stems from performance data as measured against the Green Drop Standard expressed in KPAs B2 and B3. The data shows an overall unsatisfactory monitoring regime for both operational (0% satisfaction) and compliance (2% satisfaction) sampling and analysis. The DPW Regions are not meeting the Green Drop standard and need to prioritise this aspect on a national basis.

This is a concerning observation. Compliance monitoring is a legal requirement and the only means to measure performance of a treatment facility. Operational monitoring is the cornerstone of day-to-day process adjustments and optimisation to ensure treatment is efficient and deliver quality effluent/sludge that meet design expectations. Sludge monitoring is also essential as poor sludge handling is the root cause of many WWTWs failing to meet final effluent standards. The results indicate that the DPW Regions on average, is not achieving regulatory- and industry standards.

Table 230 summarises the results of KPA E, which also carries the highest Green Drop scoring weight. Note that all averages shown as '0%' under Effluent Compliance, include actual 0% compliance plus systems with no information or insufficient data.

Table 230 - Summary of authorisation status, effluent compliance status, and directives/notices issued

DPW Region	Effluent Compliance										Enforce-ment Measures*
	Authorisation Status	Microbiological Compliance (%)			Chemical Compliance (%)			Physical Compliance (%)			
		Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	
Eastern Cape Mthatha	6 GA; 10 Not authorised	0%	0	16	0%	0	16	0%	0	16	0
Eastern Cape Port Elizabeth	11 GA	72%	3	1	23%	0	5	56%	2	1	0
Free State	2 GA; 4 Not authorised	0%	0	6	0%	0	6	0%	0	6	0
Gauteng Pretoria	1 WUL; 7 Not authorised	0%	0	8	31%	0	4	34%	0	3	0
Gauteng Johannesburg	1 GA	0%	0	1	0%	0	1	0%	0	1	0
KwaZulu Natal North	13 Unknown	0%	0	13	0%	0	13	0%	0	13	0

DPW Region	Effluent Compliance										Enforce-ment Measures*
	Authorisation Status	Microbiological Compliance (%)			Chemical Compliance (%)			Physical Compliance (%)			
		Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	
KwaZulu Natal South	1 Exempted; 4 Not authorised	0%	0	5	0%	0	5	0%	0	5	0
Limpopo	20 Unknown	0%	0	20	0%	0	20	0%	0	20	0
Mpumalanga	5 GA; 3 Not authorised	18%	1	6	50%	4	4	25%	2	6	0
North West	1 WUL; 7 GA; 2 Not authorised	0%	0	10	0%	0	10	0%	0	10	2
Northern Cape	1 GA; 5 Unknown	0%	0	6	0%	0	6	0%	0	6	0
Western Cape	3 WUL; 8 GA	84%	5	1	73%	2	2	69%	4	1	0
Totals		**14%**	**9**	**93**	**15%**	**6**	**92**	**15%**	**8**	**88**	**2**

* The enforcement measures (notices or directives issued) are taken over a two-year financial period from July 2019 to June 2021

On average, the DPW Regions did not fare well in terms of final effluent quality compliance, with 14% compliance with microbial effluent quality, 15% with chemical-, and 15% with physical effluent quality. For the microbiological compliance category, 9 of 115 systems achieved >90% and 93 of 115 systems fell below 30%.
For the chemical compliance category, 6 of 115 systems achieved >90% and 92 of 115 systems fell below 30%. For the physical compliance category, 8 of 115 systems achieved >90% and 88 of 115 systems fell below 30%.

A total of 2 Notices have been issued to the North West Region. These enforcement measures initiated by the Regulator would require leadership intervention and correction.

In terms of sludge compliance status, it is found that:

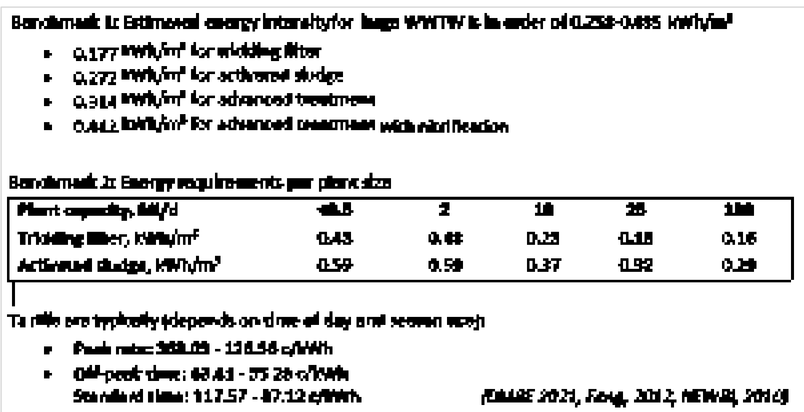
- 4 of the 115 plants (3%) classify their biosolids according to the WRC Sludge Guidelines in the Western Cape Region
- No plants monitor sludge streams
- 25 of 115 plants (22%) have 2017 Sludge Management Plans in place that are not being implemented
- 10 of 115 plants (9%) use sludge for agricultural purposes, landfill, commercial products, and thermal sludge practice.

In closing of this diagnostic, the data confirmed that only 3 of the DPW Regions have access to credible laboratories for compliance and operational analysis. These in-house or contracted laboratories have been verified to be accredited and/or have Proficiency Testing Schemes with suitable analytical methods and quality assurance. The DPW Regions are not meeting the regulatory expectation that all Regions have access to analytical services for compliance, operational and sludge monitoring.

Diagnostic 5: Energy Efficiency

Aim: The wastewater industry offers many opportunities to respond to climate change challenges by improving energy efficiency, reduce greenhouse gasses, and generate energy. The energy cost of sophisticated treatment technologies are in the order of 25-40% of the O&M budget (cited WRC 2021). This diagnostic investigates the status of energy efficiency management at a national and regional level with an aim to motivate for improved operational wastewater treatment efficiency.

Findings: The audit results suggest an overall low awareness of energy management in the DPW Regions. None of the DPW Regions conducted baseline energy audits or could report on electricity cost as R/kWh. No energy efficiency initiatives are in place. No system SPCs are calculated as part of good practice. No DPW Region could account for CO_2 equivalents associated with energy efficiency.


Benchmark 1: Estimated energy intensity for large WWTW is in order of [illegible] kWh/m³
- 0.177 kWh/m³ for trickling filter
- 0.272 kWh/m³ for activated sludge
- 0.314 kWh/m³ for advanced treatment
- 0.412 kWh/m³ for advanced treatment with nitrification

Benchmark 2: Energy requirements per plant size

Plant capacity, Ml/d	[illegible]	2	10	25	100
Trickling filter, kWh/m³	0.43	[illegible]	0.23	0.18	0.16
Activated sludge, kWh/m³	0.59	[illegible]	0.37	[illegible]	[illegible]

Tariffs are typically (depends on time of day and season etc)
- Peak rate: [illegible] c/kWh
- Off-peak time: [illegible] c/kWh
Standard time: 117.57 - [illegible] c/kWh (ESKOM 2021, [illegible])

The information suggests that the DPW Regions have not established a specific report to monitor energy as part of the wastewater business. Energy efficiency management is not embedded in the DPW Regions, and potential cost savings and environmental gains are forfeited.

Diagnostic 6: Technical Site Assessments

Aim: The Green Drop process makes provision for the desktop audit being followed by a Technical Site Assessment (TSA) to verify the desktop evidence. The assessment includes physical inspection of the sewer network, pump stations, and treatment facility, coupled with asset condition checks to determine an approximate cost to restore existing infrastructure to functional status (VROOM).

Findings: The results of the DPW Region TSAs are summarised in Table 231. A deviation of >10% between the GD and TSA score indicate a misalignment between the administrative aspects and the work on the ground. The Regulator regards a wastewater system with a TSA score of >80% as one that have an acceptable level of process control and functional equipment. 90% would represent an excellent plant that complies with most of the Green Drop TSA standards.

Table 231 - Summary of the WWTW Technical Site Assessments scores and hardware problems and %deviation between GD and TSA scores

DPW Region	TSA WWTW Name	WWTW GD Score (%)	% TSA	Key Hardware Problems	Difference between TSA & GD score
Gauteng Jhbg	Devon	22%	66%	1. Improvement needed mostly on the operation of the plant; 2. In particular monitoring of process units, flow monitoring, sludge withdrawal from settlers, anaerobic digesters, sand replacement in the drying beds	44%
Mpumalanga	Barberton CS	25%	47%	1. Primary settling tanks; 2. Biofilters; 3. Anaerobic digesters; 4. Sludge sump pump 5. Electrical infrastructure	22%
Free State	Maseru Bridge	9%	57%	1. Mechanical equipment - one mixer, clarifier, and RAS pumps offline; 2. RAS pumps offline for 1.5 years - no sludge recycling; 4. Installation of flow meter – prone to short circuiting during wet weather conditions	48%
Eastern Cape Mthatha	Mthatha DCS	4%	13%	1. Blocked inlet; 2. Ponds lining; 3. Pump electric cables; 4. Irrigating leaf crops with effluent that is not monitored	9%
Eastern Cape PE	St Albans Prison	42%	81%	1. Ageing infrastructure - mechanical and structural	39%
Limpopo	Beit Bridge POE	3%	58%	1. Flow meter to be calibrated; 2. Spare aerator motor to be repaired	55%
Gauteng Pretoria	Thaba Tshwane	15%	33%	1.Disinfection; 2. Hydraulic overloading, 3. Distribution box overflow; 4. Sludge and Effluent Pumps	18%
North West	Losperfontein CS	22%	29%	1. Pumpstation pumps and mechanics; 2. General maintenance and repairs; 3. PST not functional, 4. Digester not functional; 5. Disinfection	7%
KwaZulu Natal North	Ncome Prison	0%	29%	1. Contractual challenges in terms of operations and maintenance; 2. Most mechanical equipment is under strain and require immediate maintenance and repair; 3. Biofilter effluent distribution arms; 4. Damaged bridges and walkways on settlers; 5. Operation and monitoring lacking	29%
	Waterval Prison	0%	59%	NI	59%
KwaZulu Natal South	Sevontein Prison	16%	42%	1. Pump station mechanical screen and standby pump; 2. Inflow and outflow meters; 3. Aerator no. 1 in the Pasveer ditch; 4. 1 no. RAS pump, 1 no. irrigation pumps, sludge return pump, balancing tank pump, and WAS pumps including some leaking and dysfunctional valves; 5. Unresolved electrical issue with tripping of the outflow meter, and the blown electrics in the panel box that serves the irrigation pumps	28%
Western Cape	Drakenstein Prison	22%	49%	1. Sludge dry beds; 2. Sludge lagoons, 3. Grit removal; 4. Flow metering	27%
Northern Cape	Lohatla MB	5%	26%	1. Primary Dortmund tanks need to desludge and re-commissioned; 2. Primary sludge transfer pumping station electro-mechanical equipment to be reinstated; 3. Biofilter unit processes to be re-commissioned; 4. Humus tanks to be re-commissioned; 5. Rapid gravity filters and Chlorine disinfection need to be re-instated	21%
Totals	**13**				**9% to 55%**

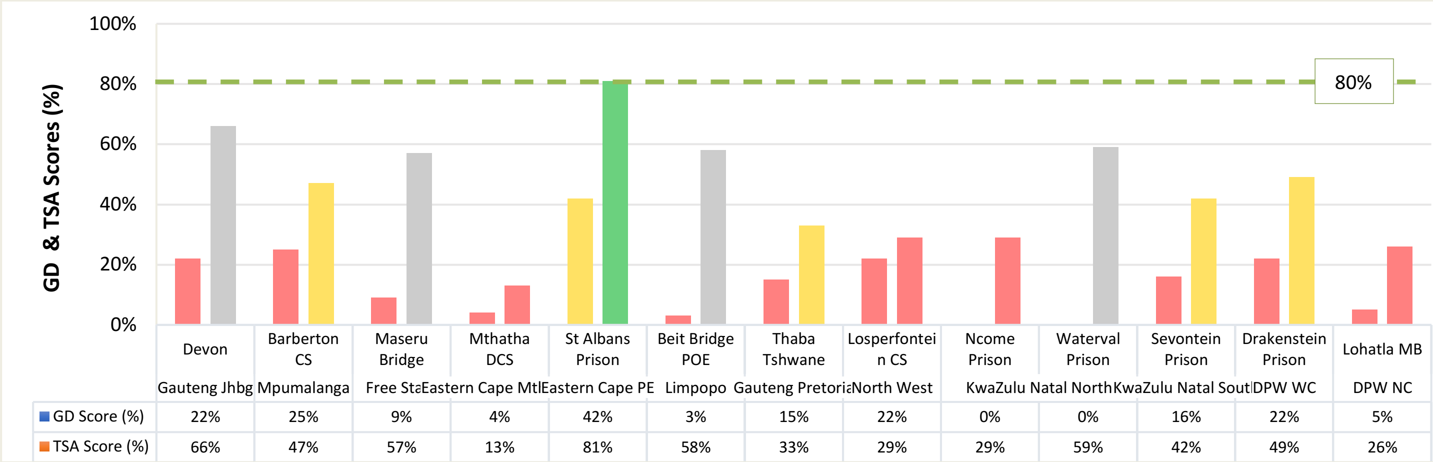


Figure 211 - GD score 2021 (bar left) and TSA score 2021 (bar right) comparison (colour legends as for GD – blue excellent; red critical)

A total of 13 site assessments were conducted, with 1 inspection per Region. Only one treatment works in Eastern Cape PE (81%) scored above 80%, which is generally regarded to be a satisfactory TSA score. Poor TSA scores indicate that treatment facilities fail to meet operational, asset functionality, and workplace safety standards.

An acceptably low difference between GD and TSA scores were observed for the Eastern Cape Mthatha (9%) and North West (7%) Regions. A low deviation implies that the wastewater management aspects correlate with the condition of processes and infrastructure in the field. Some focal points include:

- The Eastern Cape PE Region impressed with a very high TSA score of 81%, however, the GD score was low at 42%
- The Eastern Cape Mthatha and North West Regions had close matches to the GD scores of 9% and 7% respectively
- All the remaining DPW Regions had large deviations ranging from 21% to 59%, which emphasize that management, operation and functionality of the sewer network and treatment processes are well below standard.

The VROOM cost presents a ''very rough order of measurement" cost to return a WWTWs functionality to its original design. For The Region, a total budget of R174 million is estimated, with the bulk of the work going towards restoration of mechanical equipment (62%).

Table 232 - VROOM cost split for civil, mechanical, and electrical and total VROOM cost estimate

DPW Region	Civil cost estimate	Mechanical cost estimate	Electrical & C&I cost estimate	Total VROOM cost
Gauteng Jhbg	R37,324	R79,608	R7,068	R124,000
Mpumalanga	R723,152	R6,392,305	R1,812,343	R8,927,800
Free State	R38,656	R19,270,235	R19,328	R19,328,220
Eastern Cape Mthatha	R58,806	R0	R38,394	R97,200
Eastern Cape PE	R1,432,593	R2,312,670	R201,273	R3,946,536
Limpopo	R55,930	R602,070	R0	R658,000
Gauteng Pretoria	R3,807,096	R13,298,760	R8,970,144	R26,076,000
North West	R22,370,310	R50,623,183	R9,859,507	R82,853,000
KwaZulu Natal North	R5,565,722	R8,008,857	R881,842	R14,456,420
KwaZulu Natal South	R449,187	R776,540	R4,923	R1,230,650
Western Cape	R4,018,545	R6,886,683	R4,853,772	R15,759,000
Northern Cape	R97,952	R349,112	R55,255	R502,320
Totals	**R38,655,273**	**R108,600,023**	**R26,703,849**	**R173,959,146**
% Distribution	**22%**	**62%**	**16%**	**100%**

The key hardware problems are listed in Table 231, with predominant defects in aging civil infrastructure and electrical infrastructure and components, primary and secondary clarification, recycle and return flows, sludge handling, sludge and effluent pumps, and power backup. Mechanical defects, maintenance and repairs typically include dysfunctional aerators, pumps, mixers, screens, degritters, and disinfection equipment. Contractual oversight and challenges in O&M, monitoring, vandalism and theft, long procurement lead times, lack of management involvement, lack of maintenance, lack of budget, and sparce laboratory (scientific) support are the main reasons for dysfunctional assets.

Diagnostic 7: Operation, Maintenance and Refurbishment of Assets

Aim: In adequate financial resources are often cited as a root cause to dysfunctional or non-compliant wastewater systems. Knowledge and monitoring of fiscal spending are therefore a critical part of wastewater management. This diagnostic investigates the status of financial information as pertaining to O&M budgets and expenditure, asset figures, and capital funding.

Findings: A substantial amount of financial information was presented during the audit process. Unfortunately, the evidence was presented in different formats, levels of detail, or absent for some DPW Regions. It was observed that WSA teams with financial officials present during the audits typically performed better, and also had a good understanding of the wastewater challenges experienced by their technical peers. Discrepancies observed included: generic or non-ringfenced budgets, contract lump sums for Service Providers presented as budgets, outdated or incomplete asset registers, some cost drivers are lacking (mostly electricity), etc. The Regulator grouped data into different certainty levels, as can be summarised at the end of this Diagnostic.

It must be noted that there were limitations with the financial and asset information. Most of the DPW Regions did not submit current information or complete financial data sets.

The result of each financial portfolio is discussed hereunder.

Vroom Cost Analysis

The VROOM costs breakdown is discussed under the TSA Diagnostic but is further illustrated as follows.

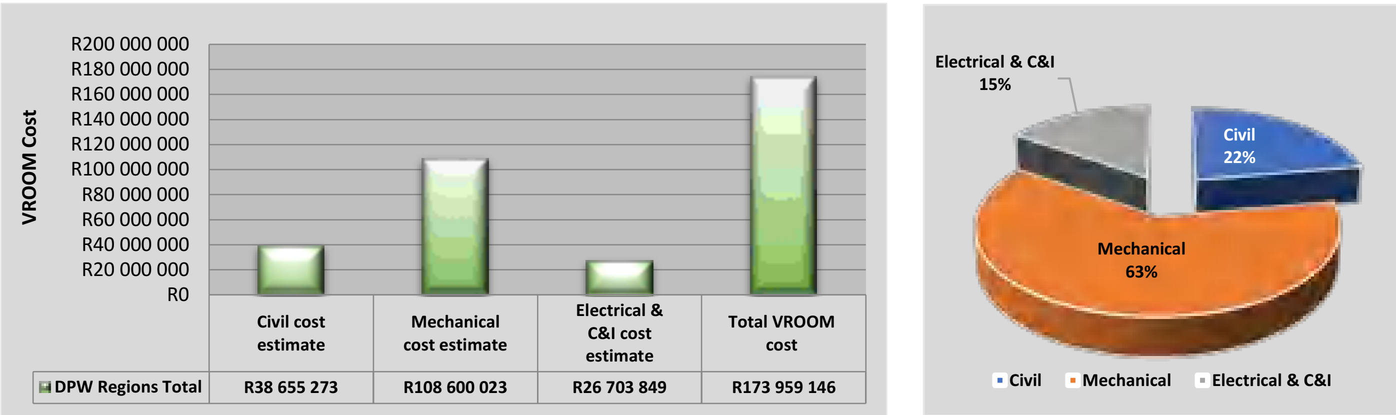


Figure 212 - Graphic illustration of the total cost estimated to restore functionality to existing assets (a), broken down to civil, mechanical, and electrical components

The total cost of R174 million is estimated to restore existing treatment works to their design capacity and functionality - made up by R109 million for mechanical repairs, R27 million for electrical repairs, and R39 million for civil structures.

Table 233 shows that a capital budget of R83 million has been secured over 1-3 years to address infrastructural needs, which does not adequately cover the R174 million VROOM refurbishment need and by implication, does not allow any surplus for other capital projects. The R174 million estimated VROOM cost constitutes 57.5% of the total asset value of R302.6 million. Furthermore, the WATCOST-SALGA figures provides for an annual 2.14% of the asset value required to maintain these assets. This constitutes an amount of R6.5 million required by the various WSA's annually to maintain the assets, while a once-off R174 million is required to restore existing assets.

Capital, O&M Budget and Actual, and Asset Value

The capital budgets, O&M budgets, O&M actual expenditure, and current asset values are summarised below.

Table 233 - Summary of the capital budgets, O&M budgets, O&M actual expenditure, and current asset values

DPW Region	Capital budget available	O&M budget (2020/21)	O&M expended (2020/21)	% Expended	Total Current Asset Value
Gauteng Jhbg	NI	NI	NI	NI	R11,800,000
Mpumalanga	R516,000	R2,658,000	R2,913,000	110%	R53,498,000
Free State	NI	R3,930,750	NI	NI	R37,956,800
Eastern Cape Mthatha	NI	NI	NI	NI	NI
Eastern Cape PE	R14,141,428	R5,736,960	R26,460,200	461%	NI

DPW Region	Capital budget available	O&M budget (2020/21)	O&M expended (2020/21)	% Expended	Total Current Asset Value
Limpopo	NI	NI	NI	NI	NI
Gauteng Pretoria	R68,420,790	NI	NI	NI	R27,616,000
North West	NI	NI	NI	NI	R67,183,520
KwaZulu Natal North	NI	NI	NI	NI	NI
KwaZulu Natal South	NI	NI	NI	NI	R57,645,100
Western Cape	NI	NI	NI	NI	NI
Northern Cape	NI	NI	NI	NI	R46,932,500
Totals	**R83,078,218**	**R12,325,710**	**R29,373,200**	**238%**	**R302,631,920**

The Green Drop process provides a bonus (incentive) in cases where Water Services Institutions provide evidence of capital projects with secured funding since this is deemed as a definitive means of addressing wastewater services inadequacies. This incentive encourages wastewater infrastructure investment. A total capital budget of R83 million has been reported for the refurbishment and upgrades of wastewater infrastructure for the DPW Regions over a 1-to-3-year fiscal period. The largest capital budget is observed for the Gauteng Pretoria Region (R68m).

For the 2020/21 fiscal year, the total O&M budget reported for the DPW Regions was R12.3 million, of which R29.4 million (238%) has been expended. Over-expenditure of 461% by the Eastern Cape Region and 110% for the Mpumalanga Region was observed. The provincial figures exclude 10 of the 12 DPW Regions who did not have financial or who had partial information.

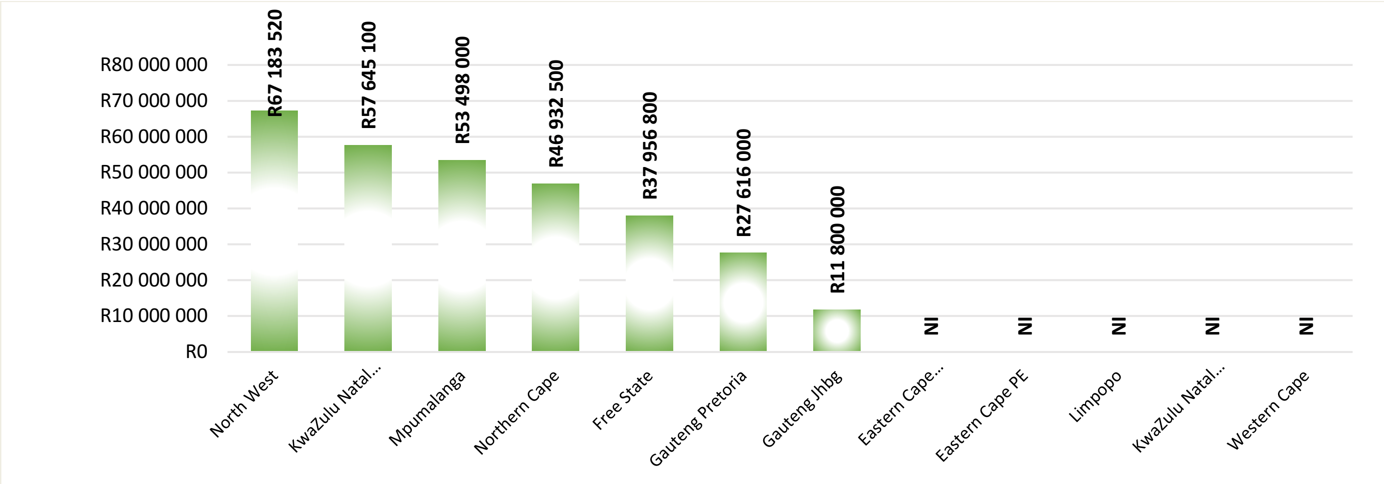


Figure 213 - Total current asset value reported by the DPW Regions

The total current asset value for wastewater infrastructure (networks, pump stations, treatment plants) is reportedly R303 million (excluding 5 DPW Regions with no information). The highest asset values are observed for the Regions North West (R67m), followed by KwaZulu Natal South (R58m) and Mpumalanga (R53m).

O&M Cost Benchmarking

By combining the SALGA and WRC WATCOST models, an estimation of the maintenance cost required per asset type can be done, i.e. civil, buildings, pipelines, mechanical, electrical, and instrumentation. The maintenance benchmark departs from the basis that 15.75% of the asset value is required to maintain these assets.

Table 234 - SALGA-WRC annual maintenance budget guideline and cost estimation

Description	% of Current Asset Value	Asset Value Estimate	Modified SALGA Maintenance Guideline	Annual Maintenance Budget Guideline
Current Asset Value estimate	**100%**	**R302,631,920**	**15.75%**	**R6,476,323**
Broken down into:				
1. Civil Structures	46%	R139,210,683	0.50%	R696,053
2, Buildings	3%	R9,078,958	1.50%	R136,184
3. Pipelines	6%	R18,157,915	0.75%	R136,184
4. Mechanical Equipment	35%	R105,921,172	4.00%	R4,236,847

Description	% of Current Asset Value	Asset Value Estimate	Modified SALGA Maintenance Guideline	Annual Maintenance Budget Guideline
5. Electrical Equipment	8%	R24,210,554	4.00%	R968,422
6. Instrumentation	2%	R6,052,638	5.00%	R302,632
Totals	**100%**	**R302,631,920**	**15.75%**	**R6,476,323**
			Minus 20% P&Gs and 10% Installation	**R1,942,897**
			Total	**R4,533,426**

The model estimates that R6.5 million (2.14%) is required per year to maintain the assets valued at R303 million. Notably, this maintenance estimate assumes that all assets are functional. The VROOM cost represent the monies needed to get assets functional, from which basis route maintenance could then focus on maintaining the assets.

Table 235 indicates the SALGA maintenance cost estimation in relation to the VROOM cost, O&M budget, and O&M actual expended.

Table 235 - O&M cost estimates by the SALGA and VROOM models versus actual budget and expenditure figures

Cost Reference	O&M Cost Estimate	Period
Modified SALGA	R6,476,323	Annually, estimation
O&M Budget	R12,325,710	Actual for 2020/21
O&M Spend	R29,373,200	Actual for 2020/21
VROOM	R173,959,146	Once off estimation

The cost dynamics can be summarised as follows:

- The SALGA estimations for O&M budgets are close to 50% of the actual reported budgets for the 2020/21 fiscal year. This is influenced by asset values not provided for by 5 of the DPW Regions
- The actual O&M budget does not seem adequate when compared with the SALGA guideline. This is influenced by full O&M budgets and actuals not provided for by 10 of the DPW Regions
- The VROOM cost represents an estimation of the refurbishment cost to restore WWTWs functionality and design capacity.

Production Cost

It is good business practice to monitor and manage the production costs of wastewater treatment in Rand/m^3 treated, and to compare such cost with industry norms. Published benchmarks is not currently available for typical treatment (production) costs, but significant cost increases are expected since 2013, given the variable input factors such as Covid, and cost of chemicals, transport, and electricity. From an economic perspective, it is valuable to compare production cost at time of budgeting versus actual production costs. However, due to scarce information, it is not possible to provide insight as to possible shortfalls from an economic perspective.

No production costs for wastewater treatment could be concluded, which leaves a significant gap in the financial portfolio of the DPW. Readers may view the results obtained for municipalities in Gauteng, KwaZulu Natal, Eastern Cape and Western Cape, to obtain a sense of typical production costs at South African wastewater treatment facilities.

The DPW Regions did not provide production costs for their respective systems. Production costs remain an invaluable parameter and carry economic value and benefit. Given the lack of data during the 2021 audit cycle, it would be imperative for Superintendents to determine and monitor production (treatment) cost as a parameter within the fiscal reporting framework going forward.

Data Certainty

Data certainty is expressed at different levels for the financial and asset figures reported within this Diagnostic. Certainty levels may differ from system to system, hence the repeat of some DPW Regions as the data provided for is variable or inconsistent or limited or non-existent (NI). DPW Regions that were identified under the category ''High Certainty", presented consistent and verifiable evidence in the form of budgets, expenditure, asset registers, and unit costs.

Table 236 - Levels of certainty associated with financial and asset information reported by the DPW Regions

Data Certainty	Description	DPW Region
No certainty	Absent data or no certainty in data presented - not ringfenced for WWTW & Network	Eastern Cape Mthatha, Limpopo, KwaZulu Natal North, Western Cape
Low certainty	Minor or little certainty in the data - partially ringfenced for WWTW only or data as extreme outliers	Gauteng Johannesburg, Free State, Gauteng Pretoria, KwaZulu Natal South, Northern Cape, Eastern Cape PE, North West
Reasonable/good certainty	Reasonable to good level of certainty in the data - ringfenced for WWTW and/or Network and data falls within/close to expected parameters	Mpumalanga
High certainty	High level of certainty in the data - ringfenced for WWTW and Network and data falls within expected parameters	None

13.1 Eastern Cape (Mthatha) Region

Water Service Institution	**DPW Mthatha: Eastern Cape**	
Water Service Provider	DPW Mthatha: Eastern Cape	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Blockages to inlet works 2. Maintenance defects 3. Electrical cables **VROOM Estimate:** - R97,200
2021 Green Drop Score	**4%↑**	
2013 Green Drop Score	**2%**	
2009-11 Green Drop Score	**NA**	

Key Performance Area	Unit	Cofimvaba DCS	Centane complex	Elliotdale DCS	Elliotdale SAPS
Green Drop Score (2021)		**7%**	**1%**	**6%**	**0%**
2013 Green Drop Score		1%	NA	1%	1%
2009 - 2011 Green Drop Score		NA	NA	NA	NA
System Design Capacity	Ml/d	0.04	NI	NI	0.08
Design Capacity Utilisation (%)		25%	NI	NI	19%
Resource Discharged into		To be verified	NI	Xhorha River	NI
Wastewater Risk Rating (CRR % of CRR_{max})		**Cofimvaba DCS**	**Centane complex**	**Elliotdale DCS**	**Elliotdale SAPS**
CRR (2011)		NA	NA	NA	NA
CRR (2013)	%	82.4%	NA	100.0%	41.2%
CRR (2021)	%	82.4%	100.0%	100.0%	82.4%

Key Performance Area	Unit	Engcobo DCS	Flagstaff DCS	Lusikisiki DCS	Maluti Military Base
Green Drop Score (2021)		**4%**	**7%**	**6%**	**1%**
2013 Green Drop Score		0%	1%	0%	0%
2009 - 2011 Green Drop Score		NA	NA	NA	NA
System Design Capacity	Ml/d	0.019	0.028	NI	NI
Design Capacity Utilisation (%)		79%	36%	NI	NI
Resource Discharged into		Open veld to river	Nearby stream	Nearby stream	NI
Wastewater Risk Rating (CRR % of CRR_{max})		**Engcobo DCS**	**Flagstaff DCS**	**Lusikisiki DCS**	**Maluti Military Base**
CRR (2011)		NA	NA	NA	NA
CRR (2013)	%	76.5%	100.0%	70.6%	70.6%
CRR (2021)	%	88.2%	82.4%	100.0%	100.0%

Key Performance Area	Unit	Mthatha DCS (Wellington)	Mthatha 14 SAI MB	Mt Fletcher DCS	Mqanduli DCS
Green Drop Score (2021)		**6%**	**7%**	**7%**	**7%**
2013 Green Drop Score 2021		0%	0%	0%	2%
2009 - 2011 Green Drop Score		NA	NA	NA	NA
System Design Capacity	Ml/d	NI	0.28	0.07	0.043
Design Capacity Utilisation (%)		NI	59%	81%	35%
Resource Discharged into		Mthatha River	To the open veld then small stream	NI	Nearby stream
Wastewater Risk Rating (CRR % of CRR_{max})		**Mthatha DCS (Wellington)**	**Mthatha 14 SAI MB**	**Mt Fletcher DCS**	**Mqanduli DCS**
CRR (2011)		**NA**	**NA**	**NA**	**NA**
CRR (2013)	%	100.0%	58.8%	82.4%	58.8%
CRR (2021)	%	100.0%	88.2%	88.2%	82.4%

Key Performance Area	Unit	Ngqamakwe DCS	Qunu Museum	Ntabankulu DCS	Willowvale DCS
Green Drop Score (2021)		**7%**	**2%**	**1%**	**5%**

Key Performance Area	Unit	Ngqamakwe DCS	Qunu Museum	Ntabankulu DCS	Willowvale DCS
2013 Green Drop Score		**3%**	**0%**	**2%**	**1%**
2009 - 2011 Green Drop Score		NA	NA	NA	NA
System Design Capacity	Ml/d	0.037	NI	0.038	0.013
Design Capacity Utilisation (%)		NI	NI	81%	115%
Resource Discharged into		Designed to irrigate	Nearby stream	Nearby stream	Nearby stream
Wastewater Risk Rating (CRR % of CRR_{max})		**Ngqamakwe DCS**	**Qunu Museum**	**Ntabankulu DCS**	**Willowvale DCS**
CRR (2011)		NA	NA	NA	NA
CRR (2013)	%	82.4%	88.2%	76.5%	100.0%
CRR (2021)	%	82.4%	100.0%	82.4%	100.0%

Technical Site Assessment: **Mthatha DCS (Wellington prison) WWTW 17%**

13.2 Eastern Cape (Port Elizabeth) Region

Water Service Institution	**DPW: Port Elizabeth**	
Water Service Provider	Zanamansi Water Solution	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Ageing infrastructure - mechanical and structural 2. Sewer network and treatment plant in very good condition. **VROOM Estimate:** - R3,946,536
2021 Green Drop Score	**45%↑**	
2013 Green Drop Score	**8%**	
2009-2011 Green Drop Score	**NA**	

Key Performance Area	**Unit**	**Middelsdrift Prison Piggery**	**Healdtown Police Station**	**Debe Nek Police Station**	**Die Blaar Housing Complex**
Green Drop Score (2021)		**40%**	**44%**	**38%**	**45%**
2013 Green Drop Score		**6%**	**8%**	**5%**	**6%**
2009-11 Green Drop Score		NA	NA	NA	NA
System Design Capacity	Ml/d	0.066	0.017	0.0127	0.015
Design Capacity Utilisation (%)		91%	88%	100%	100%
Resource Discharged into		Irrigation	Kat River	Irrigation	Irrigation
Wastewater Risk Rating (CRR% of CRR_{max})		**Middelsdrift Prison Piggery**	**Healdtown Police Station**	**Debe Nek Police Station**	**Die Blaar Housing Complex**
CRR (2011)	%	82.4%	47.1%	88.2%	58.7%
CRR (2013)	%	100.0%	75.9%	70.6%	70.6%
CRR (2021)	%	58.8%	64.7%	70.6%	70.6%

Key Performance Area	**Unit**	**Stormsriver Police Station**	**Kwaaibrandt Housing Complex**	**Patensie Prison**	**Kirkwood Prison**
Green Drop Score (2021)		**52%**	**43%**	**43%**	**46%**
2013 Green Drop Score		**6%**	**5%**	**12%**	**14%**
2009-2011 Green Drop Score		NA	NA	NA	NA
System Design Capacity	Ml/d	0.009	0.015	0.4	1.8
Design Capacity Utilisation (%)		100%	64%	100%	61%
Resource Discharged into		Storms River	Irrigation	Gamtoos River	Sunday
Wastewater Risk Rating (CRR% of CRR_{max})		**Stormsriver Police Station**	**Kwaaibrandt Housing Complex**	**Patensie Prison**	**Kirkwood Prison**
CRR (2011)	%	64.7%	47.1%	58.8%	58.8%
CRR (2013)	%	70.6%	70.6%	100.0%	100.0%
CRR (2021)	%	64.7%	70.6%	64.7%	64.7%

Key Performance Area	**Unit**	**Middelsdrift Prison**	**St Albans Prison**	**Bulembu SAPS Airport**
Green Drop Score (2021)		**55%**	**41%**	**30%**
2013 Green Drop Score		**6%**	**5%**	**3%**
2009- 2011 Green Drop Score		NA	NA	NA
System Design Capacity	Ml/d	0.6	1.5	0.05
Design Capacity Utilisation (%)		83%	90%	70%
Resource Discharged into		Kieskama River	Swartkops	Irrigation
Wastewater Risk Rating (CRR% of CRR_{max})		**Middelsdrift Prison**	**St Albans Prison**	**Bulembu SAPS Airport**
CRR (2011)	%	29.4%	64.7%	**NA**
CRR (2013)	%	100.0%	100.0%	100.0%
CRR (2021)	%	35.3%	64.7%	76.5%

Technical Site Assessment: **St Albans Prison WWTW 81%**

13.3 Free State Region

Water Service Institution	**DPW: Free State**
Water Service Provider	DPW: Free State

Municipal Green Drop Score	
2021 Green Drop Score	**7%↓**
2013 Green Drop Score	**14%**
2009-11 Green Drop Score	**NA**

VROOM Impression (Towards restoring functionality):

1. Civil structure at Maseru Bridge PoE in very good condition and very well maintained
2. Mechanical equipment needs attention - one mixer, clarifier, and RAS pumps offline
3. RAS pumps offline for 1.5 years - no sludge recycling
4. Installation of flow meter – prone to short circuiting during wet weather conditions.

VROOM Estimate:

- R19,328,220

Key Performance Area	Unit	22 Field Engineer Regiment Bethlehem	Caledonspoort Port of Entry	Goedemoed Correctional centre	Groenpunt Correctional Centre
Green Drop Score (2021)		**9%**	**12%**	**2%**	**8%**
2013 Green Drop Score		**18%**	**1%**	**8%**	**20%**
2009 - 2011 Green Drop Score		NA	NA	NA	NA
System Design Capacity	Ml/d	0.1496	0.0353	0.6904	1.5016
Design Capacity Utilisation (%)		47%	37%	109%	97%
Resource Discharged into		Jordan River	Caledonspoort River	Orange River	Vaal River
Wastewater Risk Rating (CRR% of CRR_{max})		**22 Field Engineer Regiment Bethlehem**	**Caledonspoort Port of Entry**	**Goedemoed Correctional centre**	**Groenpunt Correctional Centre**
CRR (2011)	%	**NA**	**NA**	**NA**	**NA**
CRR (2013)	%	64.7%	82.4%	76.5%	64.7%
CRR (2021)	%	82.4%	82.4%	88.2%	88.2%

Key Performance Area	Unit	Maseru Bridge	Van Rooyenshek Port of Entry
Green Drop Score (2021)		**9%**	**13%**
2013 Green Drop Score		**18%**	NA
2009 - 2011 Green Drop Score		NA	NA
System Design Capacity	Ml/d	0.1291	0.113
Design Capacity Utilisation (%)		93%	9%
Resource Discharged into		Caledon River	Soak away system - discharge to groundwater
Wastewater Risk Rating (CRR% of CRR_{max})		**Maseru Bridge**	**Van Rooyenshek Port of Entry**
CRR (2011)	%	NA	NA
CRR (2013)	%	64.7%	NA
CRR (2021)	%	88.2%	76.5%

Technical Site Assessment: **Maseru Bridge Port of Entry WWTW 57%**

13.4 Gauteng (Johannesburg) Region

Water Service Institution	**DPW: Johannesburg**	
Water Service Provider	Blessing Engineering Services	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Infrastructure in satisfactory condition 2. Improvement needed mostly on the operation of the plant 3. In particular monitoring of process units, flow monitoring, sludge withdrawal from settlers, anaerobic digesters, sand replacement in the drying beds. **VROOM Estimate:** - R124,000
2021 Green Drop Score	**22% ↑**	
2013 Green Drop Score	**0%**	
2009 - 2011 Green Drop Score	**NA**	

Key Performance Area	**Unit**	**Devon**
Green Drop Score (2021)		**22%**
2013 Green Drop Score		**0%**
2009 - 2011 Green Drop Score		NA
System Design Capacity	Ml/d	0.2
Capacity Utilisation (%)		85%
Resource Discharged into		Irrigation
Wastewater Risk Rating (CRR% of CRR_{max})		**Devon**
CRR (2011)	%	**100.0%**
CRR (2013)	%	**100.0%**
CRR (2021)	%	**76.5%**

Technical Site Assessment: **Devon WWTW 66%**

13.5 Gauteng (Pretoria) Region

Water Service Institution	**DPW: Pretoria**	
Water Service Providers	DPW: Pretoria	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Disinfection 2. Hydraulic overloading 3. Distribution box overflow 4. Sludge and Effluent Pumps **VROOM Estimate:** - R26,076,000
2021 Green Drop Score	**12%↑**	
2013 Green Drop Score	**1%**	
2009-2011 Green Drop Score	**NA**	

Key Performance Area	Unit	Boekenhouts-kloof 1 MB	Boekenhouts-kloof 2 MB	Central Advanced Training	Zonderwater Prison
Green Drop Score (2021)		**11%**	**2%**	**13%**	**10%**
2013 Green Drop Score		**0%**	**0%**	**0%**	**0%**
2009 - 2011 Green Drop Score		NA	NA	NA	NA
System Design Capacity	Ml/d	0.045	NI	0.045	2
Design Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Evaporation dam	Evaporation dam	Tributary of Hartebeespoort Dam	Irrigation crops
Wastewater Risk Rating (CRR % of CRR_{max})		**Boekenhouts-kloof 1 MB**	**Boekenhouts-kloof 2 MB**	**Central Advanced Training**	**Zonderwater Prison**
CRR (2011)	%	64.7%	NA	70.6%	76.5%
CRR (2013)	%	82.4%	NA	58.8%	88.2%
CRR (2021)	%	100.0%	100.0%	100.0%	100.0%

Key Performance Area	Unit	Ditholo Military Base	Roodeplaat Dog School	Thaba Tshwane	Wallmansdahl Military Base
Green Drop Score (2021)		**13%**	**13%**	**15%**	**11%**
2013 Green Drop Score		**0%**	**0%**	**0%**	**0%**
2009 - 2011 Green Drop Score		NA	NA	NA	NA
System Design Capacity	Ml/d	0.09	0.512	3	3
Design Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Veld discharge	Pienaars River	Irrigation – crops and golf course	Evaporation ponds
Wastewater Risk Rating (CRR % of CRR_{max})		**Ditholo Military Base**	**Roodeplaat Dog School**	**Thaba Tshwane**	**Wallmansdahl Military Base**
CRR (2011)	%	58.8%	82.4%	58.8%	58.3%
CRR (2013)	%	88.2%	88.2%	88.2%	70.6%
CRR (2021)	%	100.0%	100.0%	94.1%	100.0%

Technical Site Assessment: **Thaba Tshwane WWTW 33%**

13.6 KwaZulu Natal (North) Region

Water Service Institution	**DPW: KZN North**	
Water Service Provider	DPW: KZN North	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Contractual challenges in terms of operations and maintenance 2. Acceptable civil infrastructure in place but most mechanical equipment is under strain and require immediate maintenance and repair 3. Biofilter effluent distribution arms 4. Damaged bridges and walkways on settlers 5. Operation and monitoring lacking. **VROOM Estimate:** - R14,456,420
2021 Green Drop Score	**0%↓**	
2013 Green Drop Score	**19%**	
2009-11 Green Drop Score	**NA**	

Key Performance Area	Unit	Onverwacht Border Post	Mtubatuba SANDF	Esibayeni SAPS	Ubombo SAPS
Green Drop Score (2021)		**0%**	**0%**	**0%**	**0%**
2013 Green Drop Score		**34%**	**18%**	**5%**	**13%**
2009 - 2011 Green Drop Score		NA	NA	NA	NA
System Design Capacity	Ml/d	0.02	0.7	0.1	0.1
Design Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Land Irrigation	Wetland	Unknown	Artificial Wetland
Wastewater Risk Rating (CRR% of CRR_{max})		**Onverwacht Border Post**	**Mtubatuba SANDF**	**Esibayeni SAPS**	**Ubombo SAPS**
CRR (2011)	%	67.7%	58.8%	**NA**	88.2%
CRR (2013)	%	82.4%	88.2%	100.0%	100.0%
CRR (2021)	%	100%	100%	100%	100%

Key Performance Area	Unit	Golela Border Post	Ingwavuma SAPS	Ndumo SANDF	Emanguzi SAPS
Green Drop Score (2021)		**0%**	**0%**	**0%**	**0%**
2013 Green Drop Score		**16%**	**5%**	**8%**	**7%**
2009 - 2011 Green Drop Score		NA	NA	NA	NA
System Design Capacity	Ml/d	0.1	0.1	0.1	0.06
Design Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Artificial Wetland	Artificial Wetland	Artificial Wetland	French Drain
Wastewater Risk Rating (CRR% of CRR_{max})		**Golela Border Post**	**Ingwavuma SAPS**	**Ndumo SANDF**	**Emanguzi SAPS**
CRR (2011)	%	58.8%	NA	94.1%	NA
CRR (2013)	%	100.0%	100.0%	100.0%	88.2%
CRR (2021)	%	100%	100%	100%	100%

Key Performance Area	Unit	Glencoe Prison	Hlobane SAPS	Ncome Prison	Waterval Prison
Green Drop Score (2021)		**0%**	**0%**	**0%**	**0%**
2013 Green Drop Score		**38%**	**15%**	**27%**	**23%**
2009 - 2011 Green Drop Score		NA	NA	NA	NA
System Design Capacity	Ml/d	0.52	0.02	0.88	1
Design Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Buffalo River via unknown stream	Artificial Wetland	Blood River via Endlhevenu stream	Buffalo River
Wastewater Risk Rating (CRR% of CRR_{max})		**Glencoe Prison**	**Hlobane SAPS**	**Ncome Prison**	**Waterval Prison**
CRR (2011)	%	47.1%	64.7%	64.7%	47.1%

Key Performance Area	Unit	Glencoe Prison	Hlobane SAPS	Ncome Prison	Waterval Prison
CRR (2013)	%	64.7%	70.6%	82.4%	82.4%
CRR (2021)	%	100%	100%	94.1%	100%

Key Performance Area	Unit	Ekuseni Youth Centre
Green Drop Score (2021)		**0%**
2013 Green Drop Score		17%
2009 - 2011 Green Drop Score		NA
System Design Capacity	Ml/d	0.16
Design Capacity Utilisation (%)		NI
Resource Discharged into		Unknown
Wastewater Risk Rating (CRR% of CRR_{max})		Ekuseni Youth Centre
CRR (2011)	%	58.8%
CRR (2013)	%	70.6%
CRR (2021)	%	100%

Technical Site Assessment: **Waterval Prison 59%; Ncome Prison 29%**

13.7 KwaZulu Natal (South) Region

Water Service Institution	**DPW: KZN South**	
Water Service Providers	uMzinyathi DM (Kranskop Prison)	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Pump station mechanical screen and standby pump 2. Inflow and outflow meters 3. Aerator no. 1 in the Pasveer ditch 4. 1 no. RAS pump, 1 no. irrigation pumps, sludge return pump, balancing tank pump, and WAS pumps including some leaking and dysfunctional valves 5. Electrical issue with tripping of the outflow meter, and blown electrics in the panel box that serves the irrigation pumps **VROOM Estimate:** - R1,230,650
2021 Green Drop Score	**14%↓**	
2013 Green Drop Score	**28%**	
2011 Green Drop Score	**6%**	
2009 Green Drop Score	**NA**	

Key Performance Area	**unit**	**Kranskop Prison**	**Mthunzini Prison**	**New Hanover Prison**	**Sevontein Prison**
Green Drop Score (2021)		**12%**	**13%**	**7%**	**16%**
2013 Green Drop Score		**12%**	**30%**	**24%**	**28%**
2009 -2011 Green Drop Score		NA	NA	NA	NA
System Design Capacity	Ml/d	0.1	0.1	0.067	0.5
Design Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Mandeleni to Tugela	Umalalazi	Injasuthu to Sterkspruit	Msunduzi via stream
Wastewater Risk Rating (CRR% of CRR_{max})		**Kranskop Prison**	**Mthunzini Prison**	**New Hanover Prison**	**Sevontein Prison**
CRR (2011)	%	NA	NA	NA	NA
CRR (2013)	%	35.0%	35.0%	41.0%	59.0%
CRR (2021)	%	100%	94.1%	100.0%	94.1%

Key Performance Area	**Unit**	**Wartburg SAPS**
Green Drop Score (2021)		**11%**
2013 Green Drop Score		**21%**
2009 -2011 Green Drop Score		NA
System Design Capacity	Ml/d	0.048
Design Capacity Utilisation (%)		NI
Resource Discharged into		Irrigation to farmer (off-flow to Nhlambamasoka stream, tributary to Umgeni River)
Wastewater Risk Rating (CRR% of CRR_{max})		**Wartburg SAPS**
CRR (2011)	%	NA
CRR (2013)	%	47.0%
CRR (2021)	%	100%

Technical Site Assessment: **Sevontein Prison WWTW** **42%**

13.8 Limpopo Region

Water Service Institution	**DPW: Limpopo**	
Water Service Provider	DPW: Limpopo	
Institution Green Drop Score		**Vroom Impression (Towards restoring functionality):** 1. Flow meter to be calibrated 2. Spare aerator motor to be repaired **VROOM Estimate:** - R658,000
2021 Green Drop Score	**3% ↓**	
2013 Green Drop Score	**18%**	
2009-11 Green Drop Score	**NA**	

Key Performance Area	Unit	Acornhoek SAPS	Beit Bridge PoE	Hoedspruit MB	Hoedspruit Boston
Green Drop Score (2021)		**0%**	**3%**	**0%**	**0%**
2013 Green Drop Score		**7%**	**20%**	**3%**	**5%**
2009-2011 Green Drop Score		NA	NA	NA	NA
Design Capacity	NI	NI	0.4	NI	NI
Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		NI	Limpopo River	NI	NI
Wastewater Risk Rating (CRR% of CRR_{max})		**Acornhoek SAPS**	**Beit Bridge PoE**	**Hoedspruit MB**	**Hoedspruit Boston**
CRR (2011)		NA	NA	NA	NA
CRR (2013)		100.0%	88.2%	100.0%	100.0%
CRR (2021)		100.0%	100.0%	100.0%	100.0%

Key Performance Area	Unit	Hoedspruit MB - BVVA	Hoedspruit MB - HQ	Hoedspruit MB - 85SQ	Hoedspruit MB - 19SQ
Green Drop Score (2021)		**0%**	**0%**	**0%**	**0%**
2013 Green Drop Score		**20%**	**27%**	**27%**	**20%**
2009-2011 Green Drop Score		NA	NA	NA	NA
Design Capacity	Ml/d	NI	NI	NI	NI
Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		NI	NI	NI	NI
Wastewater Risk Rating (CRR% of CRR_{max})		**Hoedspruit MB - BVVA**	**Hoedspruit MB - HQ**	**Hoedspruit MB - 85SQ**	**Hoedspruit MB - 19SQ**
CRR (2011)		NA	NA	NA	NA
CRR (2013)		100.0%	76.5%	70.6%	94.1%
CRR (2021)		100.0%	100.0%	100.0%	100.0%

Key Performance Area	Unit	Hoedspruit Military - 400SQ	Hoedspruit Military - 514SQ	Hoedspruit 7 SU	Leboeng SAPS
Green Drop Score (2021)		**0%**	**0%**	**0%**	**0%**
2013 Green Drop Score		**20%**	**20%**	NA	**23%**
2009-2011 Green Drop Score		NA	NA	NA	NA
Design Capacity	Ml/d	NI	NI	NI	NI
Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		NI	NI	NI	NI
Wastewater Risk Rating (CRR% of CRR_{max})		**Hoedspruit Military - 400SQ**	**Hoedspruit Military - 514SQ**	**Hoedspruit 7 SU**	**Leboeng SAPS**
CRR (2011)		**NA**	**NA**	**NA**	**NA**
CRR (2013)		94.1%	94.1%	**NA**	70.6%

Key Performance Area	Unit	Hoedspruit Military - 400SQ	Hoedspruit Military - 514SQ	Hoedspruit 7 SU	Leboeng SAPS
CRR (2021)		100.0%	100.0%	100.0%	100.0%

Key Performance Area	Unit	Makhado Airforce	Matatshe CS	Naboomspruit Military	Soekmekaar Magistrate
Green Drop Score (2021)		**0%**	**0%**	**0%**	**0%**
2013 Green Drop Score		**20%**	**11%**	**5%**	**22%**
2009-2011 Green Drop Score		NA	NA	NA	NA
Design Capacity	Ml/d	NI	NI	NI	NI
Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		NI	NI	NI	NI
Wastewater Risk Rating (CRR% of CRR_{max})		**Makhado Airforce**	**Matatshe CS**	**Naboomspruit Military**	**Soekmekaar Magistrate**
CRR (2011)		**NA**	**NA**	**NA**	**NA**
CRR (2013)		94.1%	88.2%	100.0%	94.1%
CRR (2021)		100.0%	100.0%	100.0%	100.0%

Key Performance Area	Unit	Vuwane Military	Verdrag	Masemola SAPS	Gilead SAPS
Green Drop Score (2021)		**0%**	**0%**	**0%**	**0%**
2013 Green Drop Score		**8%**	NA	NA	NA
2009-2011 Green Drop Score		NA	NA	NA	NA
Design Capacity	Ml/d	NI	NI	NI	NI
Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		NI	NI	NI	NI
Wastewater Risk Rating (CRR% of CRR_{max})		**Vuwane Military**	**Verdrag**	**Masemola SAPS**	**Gilead SAPS**
CRR (2011)		NA	NA	NA	NA
CRR (2013)		100.0%	NA	NA	NA
CRR (2021)		100.0%	100.0%	100.0%	100.0%

Key Performance Area	Unit	Siloam	Shilubane	Plantjan PoE	Zanzibar PoE
Green Drop Score (2021)		**0%**	**0%**	**0%**	**0%**
2013 Green Drop Score		NA	NA	NA	NA
2009-2011 Green Drop Score		NA	NA	NA	NA
Design Capacity	Ml/d	NI	NI	NI	NI
Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		NI	NI	NI	NI
Wastewater Risk Rating (CRR% of CRR_{max})		**Siloam**	**Shilubane**	**Plantjan PoE**	**Zanzibar PoE**
CRR (2011)		NA	NA	NA	NA
CRR (2013)		**NA**	**NA**	**NA**	**NA**
CRR (2021)		100.0%	100.0%	100.0%	100.0%

Technical Site Assessment: **Beit Bridge PoE WWTW** **58%**

13.9 Mpumalanga Region

Water Service Institution	**DPW: Mpumalanga**	
Water Service Providers	Virtual Consulting and Magwa Construction (Mahamba) Superway until end March 2021 Lubisi Consulting (Oshoek) Multinet (Lebombo)	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Primary settling tanks 2. Biofilters 3. Anaerobic digesters 4. Sludge sump pump and general electrical infrastructure require attention **VROOM Estimate:** - R8,927,800
2021 Green Drop Score	**20%↓**	
2013 Green Drop Score	**28%**	
2009-11 Green Drop Score	**NA**	

Key Performance Area	Unit	Barberton CS	Daggakraal SAPS	Lebombo PoE	Mahamba PoE
Green Drop Score (2021)		**25%**	**9%**	**17%**	**40%**
2013 Green Drop Score		**48%**	**0%**	**21%**	**35%**
2009-2011 Green Drop Score		NA	NA	NA	NA
Design Capacity	Ml/d	1.184	0.01	0.1	0.076
Capacity Utilisation (%)		59%	NI	200%	NI
Resource Discharged into		Irrigation	Welspruit	Komati River	Mozana stream
Wastewater Risk Rating (CRR% of CRR$_{max}$)		**Barberton CS**	**Daggakraal SAPS**	**Lebombo PoE**	**Mahamba PoE**
CRR (2011)	%	58.8%	100.0%	82.4%	70.6%
CRR (2013)	%	35.3%	70.6%	58.8%	52.9%
CRR (2021)	%	76.5%	70.6%	88.2%	52.9%

Key Performance Area	unit	Oshoek PoE	Sandriver MB	Witbank DCS	Zonstraal MB
Green Drop Score (2021)		**34%**	**30%**	**7%**	**17%**
2013 Green Drop Score		**55%**	**1%**	**14%**	**21%**
2009-2011 Green Drop Score		NA	NA	NA	NA
Design Capacity	Ml/d	0.17	0.057	0.631	0.0495
Capacity Utilisation (%)		NI	NI	95%	NI
Resource Discharged into		Komati River	No discharge	Irrigation	Luvuthu River
Wastewater Risk Rating (CRR% of CRR$_{max}$)		**Oshoek Port of Entry**	**Sandriver Military Base**	**Witbank DCS**	**Zonstraal Military Base**
CRR (2011)	%	52.9%	82.4%	100.0%	1.0%
CRR (2013)	%	47.1%	76.5%	64.7%	1.0%
CRR (2021)	%	88.2%	47.1%	76.5%	64.7%

Technical Site Assessment: **Barberton Correction Services WWTW 47%**

13.10 North West Region

Water Service Institution	**DPW: North West**		
Water Service Providers	Ascul Construction CC WaterLab Services Virtual Consulting Engineers Magwa Construction		
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Pumpstation pumps and mechanical equipment 2. Maintenance and repairs defects 3. Primary settling tank ineffective 4. Anaerobic digester 5. Chemical Disinfection dysfunctional **VROOM Estimate** - R14 456 420	
2021 Green Drop Score	**18% ↑**		
2013 Green Drop Score	**0%**		
2009-11 Green Drop Score	**NA**		

Key Performance Area	Unit	Bray Port of Entry	Boshoek SAPS	Klipdrift MB	Losperfontein CS
Green Drop Score (2021)		**23%**	**21%**	**6%**	**22%**
2013 Green Drop Score		**0%**	**0%**	**0%**	**0%**
2009-2011 Green Drop Score		NA	NA	NA	NA
System Design Capacity	Ml/d	NI	NI	NI	NI
Design Capacity Utilisation (%)		NI	NI	NI	NI
Resource Discharged into		Molopo River	NI	NI	NI
Wastewater Risk Rating (CRR% of CRR_{max})		**Bray Port of Entry**	**Boshoek SAPS**	**Klipdrift MB**	**Losperfontein CS**
CRR (2011)	%	70.6%	70.6%	100.0%	64.7%
CRR (2013)	%	100.0%	100.0%	100.0%	100.0%
CRR (2021)	%	94.1%	94.1%	94.1%	94.1%

Key Performance Area	Unit	Molopo MB	Ramatlabama	Rooigrond CS
Green Drop Score (2021)		**11%**	**25%**	**20%**
2013 Green Drop Score		**0%**	**0%**	**0%**
2009-2011 Green Drop Score		NA	NA	NA
System Design Capacity	Ml/d	0,7	0,2	0,4
Design Capacity Utilisation (%)		NI	NI	NI
Resource Discharged into		NI	NI	NI
Wastewater Risk Rating (CRR% of CRR_{max})		**Molopo MB**	**Ramatlabama**	**Rooigrond CS**
CRR (2011)	%	58.8%	100.0%	70.6%
CRR (2013)	%	100.0%	100.0%	100.0%
CRR (2021)	%	94.1%	94.1%	94.1%

Key Performance Area	Unit	Swartkopfontein BC	Welgegend	Skilpad BC
Green Drop Score (2021)		**29%**	**15%**	**29%**
2013 Green Drop Score		**0%**	**0%**	**0%**
2009-2011 Green Drop Score		NA	NA	NA
System Design Capacity	Ml/d	0,03	0,03	0,19
Design Capacity Utilisation (%)		NI	NI	NI
Resource Discharged into		NI	Mooi River	NI
Wastewater Risk Rating (CRR% of CRR_{max})		**Swartkopfontein BC**	**Welgegend**	**Skilpad BC**
CRR (2011)	%	52.9%	64.7%	82.4%
CRR (2013)	%	100.0%	100.0%	100.0%

Key Performance Area	Unit	Swartkopfontein BC	Welgegend	Skilpad BC
CRR (2021)	%	94.1%	94.1%	76.5%

Technical Site Assessment: **Losperfontein WWTW: 29%**

13.11 Northern Cape Region

Water Service Institution	**DPW: Northern Cape**	
Water Service Provider	DPW: Northern Cape	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Primary Dortmund tanks to be desludge and re-commissioned 2. Primary sludge transfer pumping station electric and mechanical equipment to be reinstated 3. Biofilter to be re-commissioned 4. Humus tanks to be re-commissioned 5. Rapid gravity filters and Chlorine disinfection need to be re-instated **VROOM Estimate:** - R502,320
2021 Green Drop Score	**6%↓**	
2013 Green Drop Score	**18%**	
2009-11 Green Drop Score	**NA**	

Key Performance Area	Unit	Lohatla MB	Louisvale MB	Middelputs PE	Nakop PE
Green Drop Score (2021)		**5%**	**4%**	**10%**	**6%**
2013 Green Drop Score		**4%**	**4%**	**1%**	**29%**
2009 Green Drop Score		NA	NA	NA	NA
Design Capacity	Ml/d	0.82	0.26	0.01	0.022
Design Capacity Utilisation (%)		98%	38%	100%	100%
Resource Discharged into		No Discharge	No Discharge	Recycle	No Discharge
Wastewater Risk Rating (CRR% of CRR_{max})		**Lohatla MB**	**Louisvale MB**	**Middelputs PE**	**Nakop PE**
CRR (2011)		94.1%	94.1%	100.0%	100.0%
CRR (2013)		76.7%	100.0%	100.0%	100.0%
CRR (2021)		82.4%	70.6%	88.2%	88.2%

Key Performance Area	Unit	Olifantshoek RS	Vioolsdrift PE
Green Drop Score (2021)		**7%**	**6%**
2013 Green Drop Score		**33%**	**39%**
2009-2011 Green Drop Score		NA	NA
Design Capacity	Ml/d	0.7	0.12
Design Capacity Utilisation (%)		86%	100%
Resource Discharged into		Land discharge	Conservancy Tank
Wastewater Risk Rating (CRR% of CRR_{max})		**Olifantshoek RS**	**Vioolsdrift PE**
CRR (2011)		NA	NA
CRR (2013)		NA	NA
CRR (2021)		82.4%	88.2%

Technical Site Assessment: Lothala WWTW **26%**

13.12 Western Cape Region

Water Service Institution	**DPW: Western Cape**	
Water Service Provider	Overberg Water	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Sludge dry beds 2. Sludge lagoons 3. Grit removal 4. Flow metering. **VROOM Estimate:** - R15,759,000
2021 Green Drop Score	**22%↓**	
2013 Green Drop Score	**42%**	
2009- 2011 Green Drop Score	**NA**	

Key Performance Area	**Unit**	**Voorberg Prison**	**Paardeberg Prison**	**Dwarsrivier Prison**	**Brandvlei Prison**
Green Drop Score (2021)		**15%**	**21%**	**24%**	**20%**
2013 Green Drop Score		**53%**	**50%**	**52%**	**9%**
2009-2011 Green Drop Score		NA	NA	NA	NA
System Design Capacity	Ml/d	1	0.102	0.09	1.23
Design Capacity Utilisation (%)		150%	NI	104%	151%
Resource Discharged into		Vier-en-Twintig River	Berg River	Breede River	Collection tank for irrigation
Wastewater Risk Rating (CRR% of CRR_{max})		**Voorberg Prison**	**Paardeberg Prison**	**Dwarsrivier Prison**	**Brandvlei Prison**
CRR (2011)	%	47.0%	59.0%	59.0%	65.0%
CRR (2013)	%	47.0%	41.0%	47.0%	71.0%
CRR (2021)	%	94.1%	76.5%	76.5%	64.7%

Key Performance Area	**Unit**	**Buffeljagsrivier Prison**	**Drakenstein Prison**	**Helderstroom Prison**	**Saldanha Naval Military Academy**
Green Drop Score (2021)		**37%**	**22%**	**28%**	**21%**
2013 Green Drop Score		**5%**	**5%**	**31%**	**14%**
2009-2011 Green Drop Score		NA	NA	NA	NA
System Design Capacity	Ml/d	0,25	3	2	1
Design Capacity Utilisation (%)		51%	51%	113%	63%
Resource Discharged into		Buffeljagsrivier	Buffeljagsrivier	Berg River	Sonderend River
Wastewater Risk Rating (CRR% of CRR_{max})		**Buffeljagsrivier Prison**	**Buffeljagsrivier Prison**	**Drakenstein Prison**	**Helderstroom Prison**
CRR (2011)	%	82.0%	53.0%	53.0%	59.0%
CRR (2013)	%	59.0%	59.0%	59.0%	82.0%
CRR (2021)	%	47.1%	64.7%	64.7%	88.2%

Key Performance Area	**Unit**	**Test Flight & Development Centre**	**Langebaanweg Air Force Base**	**Riebeeck West Prison**
Green Drop Score (2021)		**21%**	**22%**	**17%**
2013 Green Drop Score		**17%**	**9%**	**15%**
2009-2011 Green Drop Score		NA	NA	NA
System Design Capacity	Ml/d	0.078	0.58	0.97
Design Capacity Utilisation (%)		NI	36%	NI
Resource Discharged into		Evaporation ponds	Berg River, Sout River	Berg River
Wastewater Risk Rating (CRR% of CRR_{max})		**Test Flight & Development Centre**	**Langebaanweg Air Force Base**	**Riebeeck West Prison**

Key Performance Area	Unit	Test Flight & Development Centre	Langebaanweg Air Force Base	Riebeeck West Prison
CRR (2011)	%	71.0%	88.0%	65.0%
CRR (2013)	%	59.0%	59.0%	47.0%
CRR (2021)	%	88.2%	76.5%	58.8%

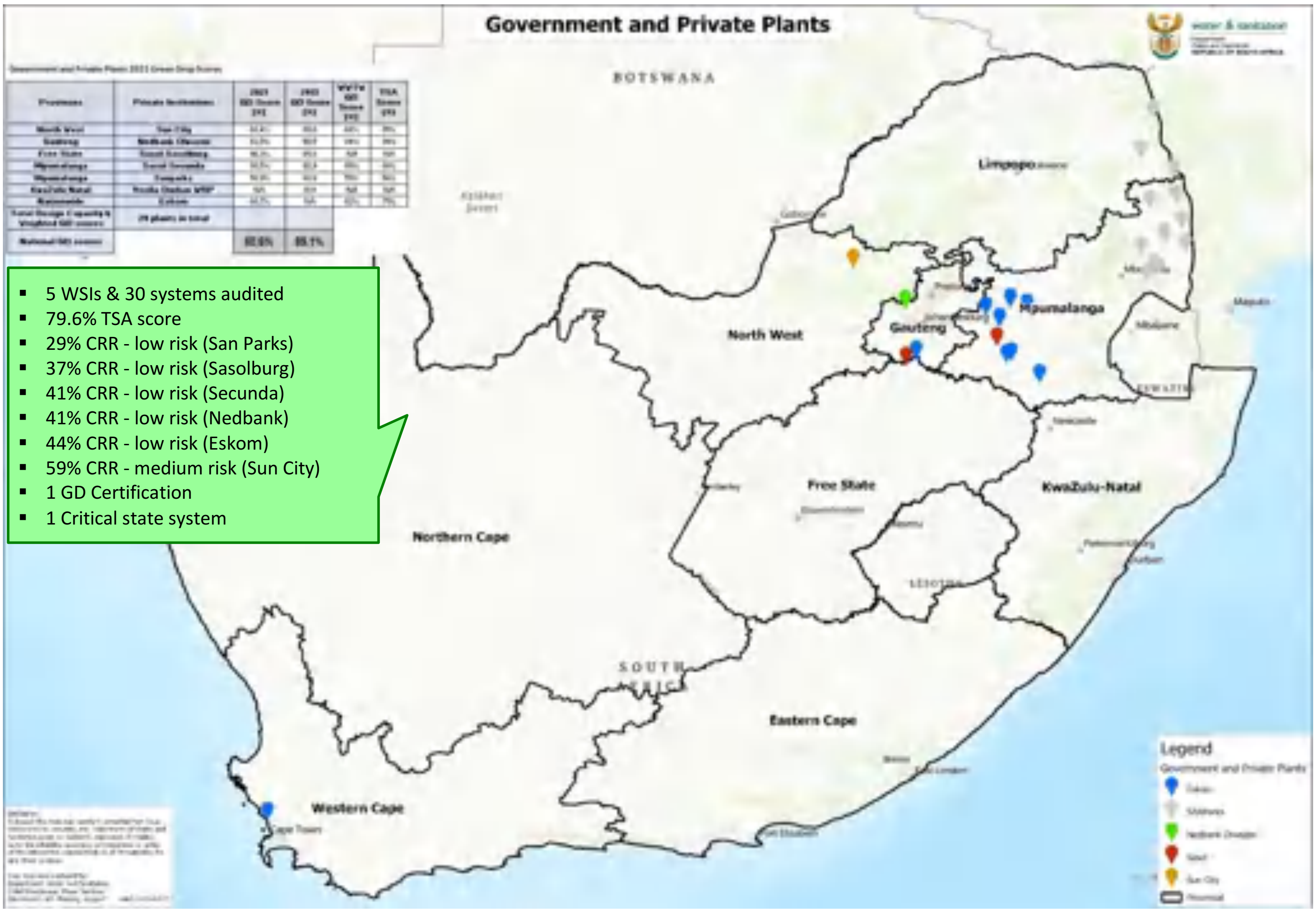
Technical Site Assessment: **Drakenstein Prison WWTW 50%**

Despite dysfunctional equipment at the DPW Barberton Correctional Services WWTP, the staff climbed through the safety railing in order to manually push the arms on the primary sedimentation tanks, understanding the importance of scum removal. The arms on the trickling filters were also not functional and in order to get some flow distribution and wetting of the whole filter area, staff manually moved these arms along. Remarkable. DPW management take note.

Despite several logistic and security challenges with this works on the Zimbabwean border, the service provider to DPW was able to keep the plant and surrounding at a high ergonomic standard and functional. This plant set the standard for what can be achieved by DPW irrespective challenges experienced.

Top: DPW team at the Drakenstein Correctional Services. A good audit attendance was observed – this team shows high promise.
Below: Devon Correctional Central – a friendly team, committed contractor, terrain is neat and well-kept signage of good standard. This plant has the potential to reach Green Drop Certification in 2023.

14. GOVERNMENT- AND PRIVATE SYSTEMS: WASTEWATER MANAGEMENT PERFORMANCE



Government and Private Institutions Synopsis

An audit attendance record of 100% affirms the commitment by Government and Private Institutions to the Green Drop national incentive-based regulatory programme. The Regulator welcomes the first-time participation of Eskom in the Green Drop national incentive-based regulatory programme.

The Regulator determined that 1 wastewater system scored a minimum of 90% when measured against the Green Drop standards for the audited period and thus qualified for the prestigious Green Drop Certification. This compares lower than the 4 systems being awarded Green Drop Status in 2013 but is recognised for its inherent value to establish an accurate, current baseline from where improvement can be driven, and excellence be incentivised.

Only Sasolburg improved on their 2013 score. The remainder of the Government and Private Institutions regressed to lower Green Drop scores compared to 2013 baselines. Sasolburg is the best performing Private Institution in this category, by achieving an excellent Green Drop score of 96%, supported by a technical site score of 88%. Sasolburg further impressed with the best overall progress from an 86% GD score in 2013 to a 96% GD score in 2021. Sasol Secunda achieved the 2nd place with an 89% GD- and 88% TSA score, followed by Olwazini with an 84% GD- and outstanding 94% TSA score, which is also the highest site score in this category. Only one system (1 of 30) was identified to have a high-risk score level, compared to none in 2013.

The overall Green Drop performance in this category is characterised by particular strengths in management and technical capacity, combined with risk management practices that are well embedded in the wastewater business. The predominant KPA that requires attention include technical management, effluent and sludge compliance monitoring, effluent quality, and financial data.

The Risk Ratio for treatment plants improved from 2013 to 2021 for Sasol Sasolburg and San Parks but regressed for Nedbank and Sun City. No risk trend is established for Eskom since this was a first-time audit. Notably, all WWTWs remain in the low-risk positions, except for Sun City that moved into a medium risk position. For some of the Eskom and San park systems, the most prominent risks were observed on treatment level, and pointed to systems that exceeded their design capacity, and effluent non-compliance. Opportunities are presented in terms of reducing cost through process optimisation and improved energy efficiency, and beneficial use of sludge, nutrients, biogas, and other energy resources.

The Regulator is hopeful that the 2021 audits will set a baseline from where a positive trajectory for wastewater services and improved performance will follow. The Government and Private Institutions are encouraged to start preparation for the 2023 Green Drop audit. The 2021 Green Drop status are summarised in Table 237, indicating one Green Drop Certification and 1 system in critical state.

Table 237 - 2021 Green Drop Summary

Government and private institutions	2013 GD Score (%)	2021 GD Score (%)	2021 GD Certified ≥90%	2021 GD Contenders (89%)	2021 Critical State (<31%)
Veolia	91	NA			
Sasol Sasolburg	86	96↑	Sasolburg		
Sasol Secunda	93	89↓			
Nedbank Olwazini	99	84↓			
Sun City	90	68↓			
Eskom	NA	61			Kendal
San Parks	67	57↓			
Totals	-	-	1	0	1

The Department of Water and Sanitation acknowledges the excellence in wastewater management achieved for the Green Drop Audit year of 2021.

One Green Drop Certificate is awarded to Sasol Sasolburg.

Government and private institutions	Green Drop Certified Systems
Sasol	Sasolburg

Background to Government and Privately Owned Wastewater Systems

Incentive based regulation was an innovative and uniquely South African response to challenges in the water sector. The tragedies of Delmas (2005 and 2007) and Joe Gqabi (2007) showed that an alternative, proactive approach to regulation was required to improve the standards of drinking water and wastewater management. This was the genesis of the Blue Drop (Drinking Water) and Green Drop (Wastewater Quality) programmes in 2008.

Incentive-based regulation seeks to induce changes in behaviour of individuals and institutions to facilitate continuous improvement and adoption of best practice management of treatment systems. Consequently, progressive improvement and excellent performance is recognised and rewarded. It should however not be construed as a weaker form of regulation but rather an alternate approach, as it is underpinned by a strong legislative mandate in the Water Services Act.

The Green Drop and Blue Drop incentive-based regulation promotes transparency and accountability and allows DWS to measure, monitor and publish information about the quality of water services, based on legislative standards or industry good practice. It seeks to identify risks and to ensure responsible authorities implement control measures to prevent failure.

There are 5 Government and Private Institutions that participated in the Green Drop audits of 2021. Collectively, these systems deliver wastewater services through a sewer network comprising of 30 WWTWs, 161 network pump stations and 122 km outfall and main sewer pipelines. The sewer network excludes the pipelines of Nedbank Olwazini who did not provide data. There is a total installed treatment capacity of 91.1 Ml/d, with all this capacity residing in the micro to macro-sized treatment plants, with two large and macro-sized treatment plants linked to Sasol.

Table 238 - Summary of WWTW capacity and flow distribution according to plant sizes

	Micro Size Plants	Small Size Plants	Medium Size Plants	Large Size Plants	Macro Size Plants	Unknown (NI)*	Total
	<0.5 Ml/day	0.5-2 Ml/day	2-10 Ml/day	10-25 Ml/day	>25 Ml/day		
No. of WWTW	16 (53%)	6 (20%)	5 (17%)	1 (3.3%)	1 (3.3%)	1 (3.3%)	30
Total Design Capacity (Ml/day)	1.73	10.01	17.16	19	43.2	1	91.1
Total Daily Inflow (Ml/day)	0.84	6.21	6.41	12.4	28.37	None	54.3
Use of Design Capacity (%)	49%	62%	37%	65%	66%	-	59.5%

* *"Unknown" means the number of WWTWs with NI (No Information) on design capacity or daily inflow*

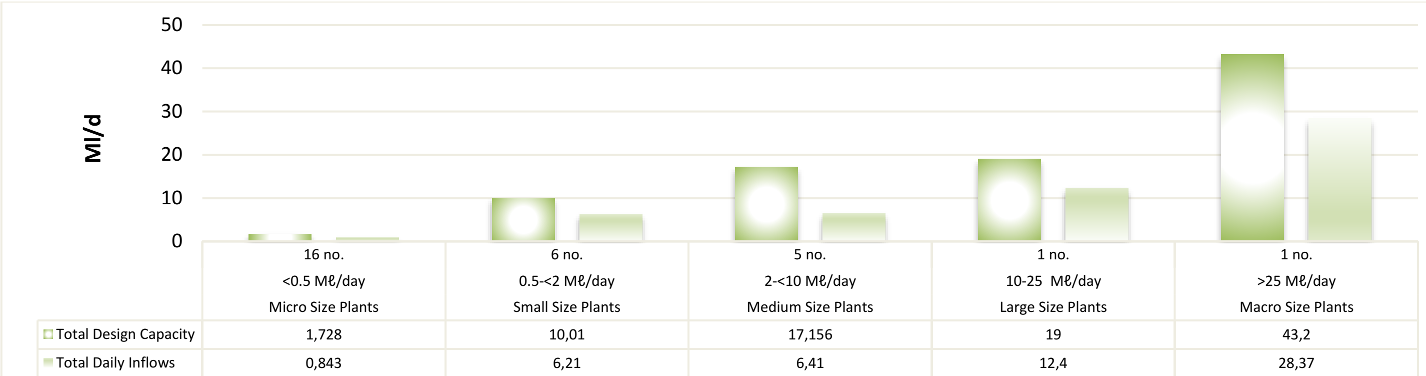


Figure 214 - Design capacities and operational inflow to WWTWs

Based on the current operational flow of 54.3 Ml/d, the treatment facilities are operating at close to 60% of their design capacity. The largest flow contributors are Sasol Sasolburg and Sasol Secunda with a total of 40.8 Ml/d. The spare capacity would be compromised at systems where some of the processes are non-operational due to dysfunctional equipment and/or structures. The VROOM Cost Diagnostic #6 reports on the refurbishment requirements to restore such capacity and functionality. The "available" capacity translates to 36.8 Ml/day, which would be sufficient to service an additional 153,333 to 230,000 persons (Red Book, 2019: 40-60% of 400 l/c/d).

Three (3) of the 13 treatment plants for San Parks are found to be hydraulically overloaded - Tshokwane, Orpen and Malelane. However, flow meters are not in place to verify the inflow, and all operational flows have been calculated based on per capital use of the facilities.

The predominant treatment technologies employed at the WWTWs comprise of ponds/lagoons, biological contactors, and filters, activated sludge plants for effluent treatment, and solar drying beds and anaerobic digesters for sludge treatment. The next audit will need to verify sludge treatment technologies, as insufficient information ("Other") is observed in this area.

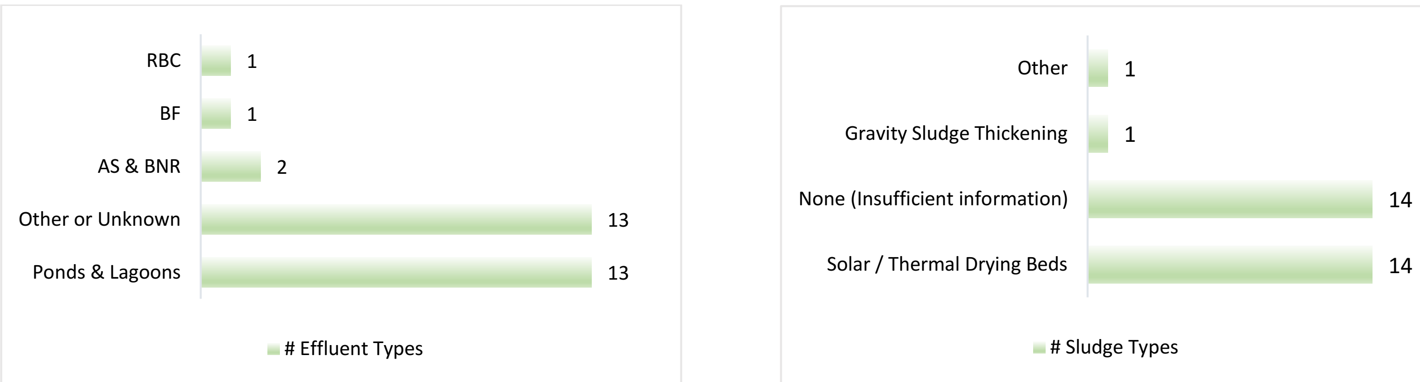


Figure 215 - Treatment technologies for wastewater effluent (a) and sludge (b)

Table 239 - Summary of Collection Network Pump Stations and Sewer Pipelines

Government and Private Institutions	# WWTWs	Pump Stations (#)	Sewer Pipelines (km)
Eskom	13	37	37
Nedbank Olwazini Gauteng	1	0	NI
San Parks	13	25	13
Sasol Secunda and Sasolburg	2	96	65
Sun City	1	3	7
Totals	**30**	**161**	**122**

The sewer network consists of the sewer mains and pump stations as summarised in Table 239. Sasol and Eskom appear to have the most pump stations with 96 and 37, and 65 km and 37 km sewer pipelines respectively. The sewer network excludes the pipelines of Nedbank Olwazini who did not provide data but is considered to be negligible due to a smallish terrain size.

Government and Private Institutions Green Drop Analysis

The 100% response from the 5 Government and private institutions audited during the 2021 Green Drop process demonstrates a commitment to wastewater services in the country. Eskom participating in the Green Drop programme for the first time. The Veolia plant was not assessed in 2021. A total of 30 systems were audited in 2021 compared to 18 systems in 2013. Audited institutions remarked positively on the value of benchmarking with other organisations in South Africa, to ensure continuous improvement and raising the performance bar after each assessment.

Table 240 - Green Drop Comparative Analysis from 2009 to 2021

GREEN DROP COMPARATIVE ANALYSIS					
Performance Category	**2009**	**2011**	**2013**	**2021**	**Trend 2013 and 2021**
Incentive-based indicators					
Government and private institutions assessed (#)	1 (100%)	3 (100%)	5 (100%)	5 (100%)	→
Wastewater systems assessed (#)	2	3	18	30	↑
Average Green Drop score	72%	89.8%	72.8%	60.1%	↓
Green Drop scores ≥50% (#)	2/2 (100%)	3/3 (100%)	17/18 (94%)	21/30 (70%)	↓
Green Drop scores <50% (#)	0/2 (0%)	0/3 (0%)	1/18 (6%)	9/30 (30%)	↓
Green Drop Certifications (#)	0	2	4	1	↓
Technical Site Inspection Score (%)	88%	NA	80.7%	79.6%	→

NA = Not Applied NI = No Information ↑= improvement, ↓= regress, →= no change

Theoretically, it would not be advisable to compare the results of 2013 with 2021, as to many new players entered the audit cycle, thereby breaking the trend analysis for a particular set of systems. However, trend analysis remains valuable to gauge how non-municipal sector, as collective, fares in terms of their overall risk management.

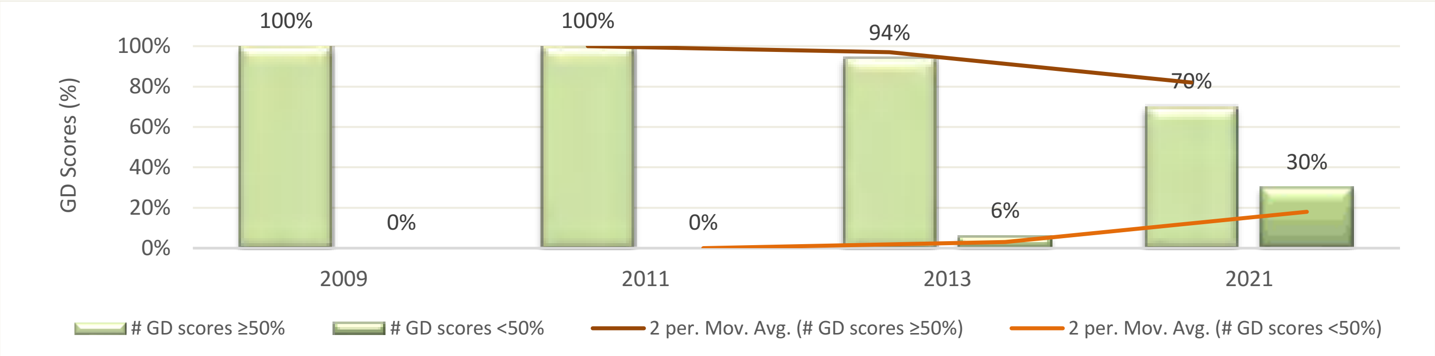


Figure 216 - Green Drop trend analysis over the period 2009 to 2021, indicating the percentage GD scores above and below 50%

The applicable elements of the trend analysis indicates that:

- The number of systems audited has steadily increased from 2 systems in 2009 to 30 systems in 2021 – a commendable pattern and demand for audits is noticed
- The Green Drop Certifications decreased from 4 awards in 2013 to 1 award in 2021.

The analysis for the period 2013 to 2021, indicates that 1 system score is in the 0-<31% (Critical Performance state), 8 systems scores are in the 31-<50% (Poor Performance space), and with 16 system scores in the 50-<80% (Average Performance category).

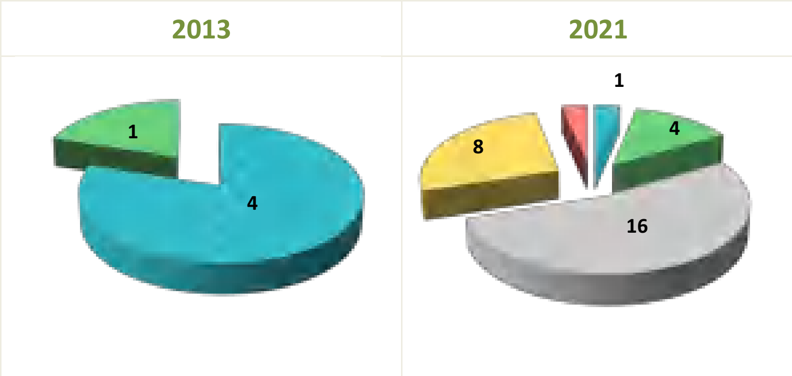


Figure 217 - No. WWTWs in the Green Drop score categories over the period 2013 to 2021 (graph legend to right)

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	

In summary, the trends for the period 2013 to 2021 indicate as follows, noting that new systems entered the audit cycle and that direct comparison of 2013 and 2021 is not possible. However, as a collective, these observations are meaningful and set a baseline for the 2023 audits, whilst given comparative value for the 2021 national picture:

- Systems in a 'poor state' increased from 0 systems in 2013 to 8 systems in 2021
- Systems in a 'critical state' increased from 0 systems in 2013 to 1 system in 2021
- Systems in the 'excellent and good state' remained constant with 5 systems in 2013 and 2021 but the systems in good state increased from 1 to 4 and the systems in excellent state decreased from 4 to 1.

Government and Private Institutions Risk Analysis

Green Drop risk analysis (CRR) focuses on the treatment function specifically. It considers 4 risk indicators, i.e. design capacity, operational flow, technical capacity, and effluent quality. The CRR values do not factor risks associated with sanitation- or wastewater network and collector systems.

Table 241 - Cumulative Risk Comparative Analysis from 2013 to 2021

Performance Category	Sasol Sasolburg			Sasol Secunda			Nedbank			Sun City			San Parks			Eskom
	2013	2021	Trend	2013	2021	Trend	2013	2021	Trend	2013	2021	Trend	2013	2021	Trend	2021
Average CRR	12	10	↑	9	9	→	5	7	↓	8	13	↓	6	5	↑	8
Design Rating (A)	3	3	→	2	2	→	1	1	→	2	2	→	1	1	→	1
Capacity Exceedance Rating (B)	3	3	→	3	3	→	3	3	→	3	2	↑	3	3	→	2
Effluent Failure Rating (C)	0	0	→	1	0	↑	0	2	↓	1	8	↓	2	1	↑	4
Technical Skills Rating (D)	3	1	↑	2	3	↓	2	2	→	1	1	→	2	1	↑	1
CRR% Deviation	**44**	**37**	↑	**41**	**41**	→	**29**	**41**	↓	**36**	**59**	↓	**37**	**29**	↑	**44**

↑= improvement, ↓= regress, →= no change

The concept of risk management seems to be well embedded within the participating Government and Private Institutions. Table 241 indicates a CRR% deviation movement from 2013 to 2021, which suggests good risk mitigation. Little to no risk change is noted in design capacity (A), capacity exceedance rating (B) with the exception of Sun City, whilst an overall risk improvement is noted in the technical skills rating (D) for Sasolburg and San Parks but a decrease for Secunda. An increase in the final effluent quality failures rating (C) for Nedbank and Sun City is noted, but a risk decrease for Secunda and San Parks.

The most marked deviation was for Sun City that moved from a low-risk position to a medium risk position. Only one system in Eskom indicates specific risk categories, as described under "***Regulator's Comment***".

Where applicable to some systems, further improvements can be made by focussing on 1) capacity exceedance at systems which are hydraulically overloaded or approaching its design lifespan, 2) effluent quality failures, especially for microbiological compliance, and 3) strengthening of technical skills and operational competency, especially related to sludge management.

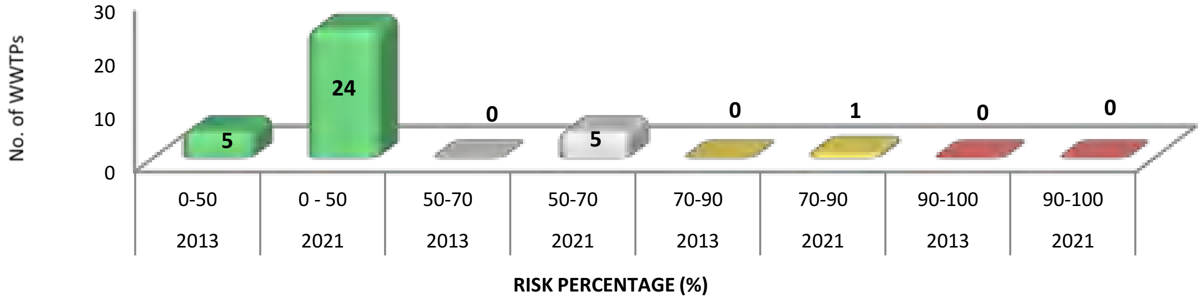


Figure 218 - a) WWTW Risk distribution and trends from 2013 to 2021; b) Colour legend

90 – 100% Critical risk WWTPs	
70 - <90% High risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low risk WWTPs	

In conclusion, trend analysis of the CRR ratings for the period 2013 to 2021 reveals that the 2021 assessment cycle enjoyed a favourable pattern of increased low risk WWTWs (5 to 24), medium risk WWTWs (0 to 5) and high risk WWTWs (0 to 1), with no system in critical risk positions.

Regulatory Enforcement

Wastewater systems which failed to achieve the minimum Green Drop target of 31%, are placed under regulatory focus. The Regulator requires that the Government and private institutions to submit a detailed corrective action plan within 60 days of publishing of this report. Only one Eskom wastewater system received a Green Drop score below 31%, and so is placed under **regulatory surveillance**, in accordance with the Water Services Act (108 0f 1997). Eskom is compelled to ringfence water services funding to rectify/restore this wastewater treatment system and its shortcomings as is identified in this report.

Table 242 - WWTWs with <31% Green Drop scores

Government and private institutions	2021 GD Score	WWTWs with <31% score
Eskom	**17%**	Kendal

Similar to the Green Drop audit result, the Kendal WWTW is also in a high CRR risk position, which means that some or all of the risk indicators are in an undesired state, i.e. operational flow, technical capacity, and effluent quality. WWTWs in high risk and critical risk positions poses a serious risk to public health and the environment. Eskom is required to assess Kendal's risk contributors and develop corrective measures to mitigate these risks.

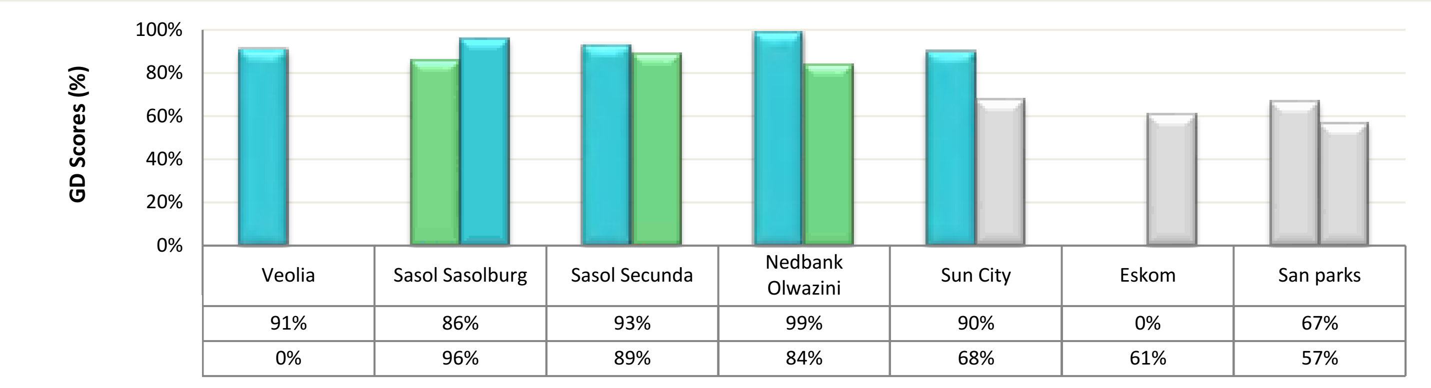
Table 243 - %CRR/CRR$_{max}$ scores and WWTWs in critical and high-risk space

Government and private institutions	2021 Average CRR/CRRmax % deviation	WWTWs in critical and high-risk space	
		Critical Risk (90-100%CRR)	**High Risk (70-<90%CRR)**
Eskom	82.4%		Kendal

Good practice risk management requires that the W$_2$RAPs are informed by meaningful Process and Condition Assessments, supported by zealous implementation of corrective measures and ongoing monitoring of risk movement.

Performance Barometer

The **Green Drop Performance Barometer** presents the individual Green Drop Scores, which essentially reflects the level of mastery that a Government and private institution has achieved in terms of its overall wastewater services business. The bar chart below indicates the GD scores for 2013 in comparison to GD 2021, from highest to lowest performing Government and private institutions. Sasolburg is commended for an improved GD score from a good performance of 86% in 2013 to an excellent performance of 96% in 2021. Secunda and Nedbank move from an excellent performance in 2013 to a good performance in 2021. Sun City regressed from an excellent performance of 90% in 2013 to an average performance of 68% in 2021.



	Veolia	Sasol Sasolburg	Sasol Secunda	Nedbank Olwazini	Sun City	Eskom	San parks
	91%	86%	93%	99%	90%	0%	67%
	0%	96%	89%	84%	68%	61%	57%

Figure 219 - a) Green Drop scores 2013 (bar left) and 2021 (bar right), with colour legend inserted

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	

The **Cumulative Risk Log** expresses the level of risk that a region poses in respect its wastewater treatment facility. It is based on the ***individual Cumulative Risk Ratios***. Figure 220 presents the cumulative risks in ascending order – with the low-risk Government and Private Institutions on the left and critical risk Government and private institutions to the far right. The analysis reveals that there are no Government or Private Institutions in high or critical risk positions. This is a commendable profile, and the participating organisations are applauded for upholding wastewater treatment in a low-risk space.

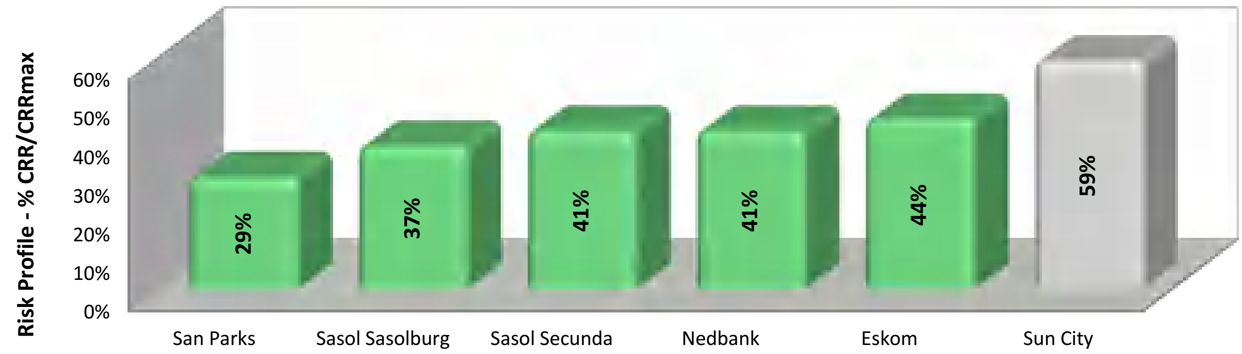


Figure 220 - a) %CRR/CRRmax Risk Performance Log 2021; b) Colour legend

90 – 100% Critical risk WWTPs	
70 - <90% High risk WWTPs	
50-<70% Medium risk WWTPs	
<50% Low risk WWTPs	

Government and Private Institutions Performers

Sasol Sasolburg is the **BEST PERFORMING** private institution, based on the following record of excellence:
- ✓ 96% Green Drop Score
- ✓ 2013 Green Drop Score of 86%
- ✓ Improvement on the CRR risk profile from 44% in 2013 to 37% in 2021
- ✓ 1 system in low-risk position
- ✓ No Technical Site Assessment undertaken

Sasol Secunda is the 2nd best scoring private institution:
- ✓ 89% Green Drop Score
- ✓ 1 system in low-risk position
- ✓ TSA score of 88%

Nedbank Olwazini is the 3rd best scoring private institution:
- ✓ 84% Green Drop Score
- ✓ 1 system in low-risk position
- ✓ TSA score of 94%

KPA Diagnostics

The GD Audit process collects a vast amount of data that yield valuable insight on the state of the wastewater sector in selected Government and Private Institutions. These insights have been captured into 7 thematic areas or 'Diagnostics', as discussed below.

Table 244 - Summary of the key diagnostic themes and reference to the respective Green Drop KPAs

Diagnostic #	Diagnostic Description	Diagnostic Reference
1	**Green Drop KPA Analysis**	KPAs A-E
2	**Technical Competence**	KPA A, B & Bonus
3	**Treatment Capacity**	KPA D
4	**Wastewater Monitoring and Compliance**	KPA B & D & Bonus
5	**Energy Efficiency**	KPA C & Bonus
6	**Technical Site Assessments**	TSA
7	**Operation, Maintenance and Refurbishment of Assets**	KPA C, D & Bonus

Diagnostic 1: Green Drop KPA Analysis

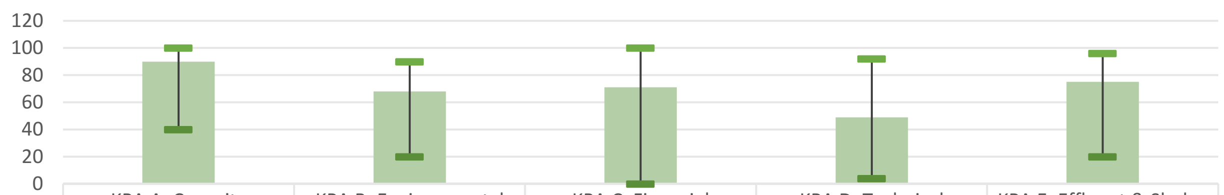
Aim: Analysis of technical skills, environmental plans, financial management, technical capacity, and regulatory compliance provides insight to the strengths and weaknesses that distinguish the Government- and Private Institutions wastewater industry. These insights in return, may inform appropriate interventions and strategies to improve the individual KPAs and ultimately, collective KPA performance.

Findings: The Government- and Private Institutions are characterised by a highly variable KPA profile. A good KPA profile typically depicts a high mean GD score, coupled with a low Standard Deviation (SD) between the outer parameters (min and max). Similarly, a well performing system is one which has most/all systems in the >80% bracket and no systems in the <31% bracket.

Table 245 - Green Drop scores KPA profiles (graph legend included)

KPA #	Key Performance Area	*Weight*	Minimum GD Score (%)	Maximum GD Score (%)	Mean GD Score (%)	# Systems <31%	# Systems ≥80%
A	Capacity Management	*15%*	40%	100%	90%	0 (0%)	27 (90%)
B	Environmental Management	*15%*	20%	90%	68%	2 (7%)	4 (13%)
C	Financial Management	*20%*	0%	100%	71%	4 (13%)	3 (10%)
D	Technical Management	*20%*	4%	92%	49%	17 (57%)	1 (3%)
E	Effluent and Sludge Compliance	*30%*	20%	96%	75%	5 (17%)	10 (33%)

90 – 100% Excellent	
80-<90% Good	
50-<80% Average	
30-<50% Poor	
0-<31% Critical state	



	KPA A: Capacity Management	KPA B: Environmental Management	KPA C: Financial Management	KPA D: Technical Management	KPA E: Effluent & Sludge Compliance
Mean	90	68	71	49	75
Max	100	90	100	92	96
Min	40	20	0	4	20

Note: The High and low lines represent the Min and Max range, and the shaded green represents the Mean (arithmetical average)

Figure 221 - Maximum, minimum, and mean Green Drop KPA scores

The KPA distribution indicates as follows:

- Capacity Management (KPA A) depicts the highest mean of 90%, the highest minimum of 40%, and the lowest Standard Deviation (SD) of 60%. These results indicate the greatest's strengths pertaining to the registration of WWTWs, maintenance plans and records, maintenance teams, and registered, qualified staff (process controllers, supervisors, scientists, technicians, engineers)
- Technical Management (KPA D) received the lowest mean of 49%, indicating some vulnerabilities in basic design information, inflow, outflow, meter reading credibility, process and condition assessments, site inspection reports, asset registers, asset values, bylaws, and enforcement
- This was followed by the Environmental Management (KPA B) that received the next lowest mean of 68%, indicating some deficiency in risk abatement plans, operations and compliance monitoring, sludge management compliance and laboratory credibility.

The GD bracket performance distribution reiterates the above findings:

- ***KPA Score >80%:*** Capacity Management (KPA A) is by far the best performing KPA with 90% of systems achieving >80%. This was followed by Effluent and Sludge Compliance (KPA E) with 33% of systems achieving >80%
- ***KPA Score <31%:*** Technical Management (KPA D) represents the worst performing KPA with 57% of systems lying in the 0-31% bracket, followed by Effluent & Sludge Compliance (KPA E) with 17% and Financial Management (KPA C) with 13%.

Diagnostic 2: Technical Competence

Aim: This focus area assesses the human resources (technical) capacity to manage wastewater systems. Theory suggests a correlation between human resources capacity (sufficient number of appropriately qualified staff) and the Government- and Private Institutions performance- and operational capability. It is projected that high HR capacity would translate to compliant wastewater services and protection of scarce water resources.

Findings: According to regulations, wastewater plants are classified as Class A, B, C, D or E plants. Similarly, Process Controllers and Plant Supervisors are registered as Class I, II, III, IV, V or VI operators. High classed plants requires a higher level of operators due to their complexity and strict regulatory standards. Technical compliance of PCs and Supervisors is determined against Green Drop standards, as defined by Reg. 2834 and draft Reg. 813 of the National Water Act 1998.

Note: "Compliant staff" means qualified and registered staff that meets the GD standard for a particular Class Works. "Staff shortfall" means staff that does not meet the GD standard for a particular Class of works (+1 for a shift) and/or staffing gaps exist at the respective WWTWs.

Table 246 - No. compliant versus shortfall in Supervisor and Process Controller staff

Government- and Private Institutions	# WWTWs	# Compliant staff		# Staff Shortfall		Ratio*	2021 GD Score (%)
		Supervisor	PCs	Supervisor	PCs		
Eskom	13	17	47	0	4	4.9	61%
Nedbank	1	1	0	0	1	1.0	84%
San Parks	13	1	1	1	6	0.2	57%
Sasol Secunda	1	0	0	1	3	0.0	89%
Sasol Sasolburg	1	2	6	0	0	8.0	96%
Sun City	1	1	2	0	0	3.0	68%
Totals	**30**	**22**	**56**	**2**	**14**		

** The single number Ratio is derived from the number of qualified staff divided by the number of WWTWs operated by this number of staff. E.g. for Eskom, 64 qualified staff is available to support 13 WWTW, thus 64/13 = 4.9 ratio*

Competent human resources is a vital enabler to ensure efficient and sustainable management of treatment processes and infrastructure. For the Government- and Private Institutions, operational competencies are mostly satisfying the regulatory expectations, as illustrated by the very low shortfalls against the Green Drop standards. Sasol Secunda is the only exception to this category of systems, with no compliant staff in place.

Plant Supervisors: The pie charts indicate that 92% (22 of 24) of Plant Supervisors complies with the Green Drop standard, with zero shortfall for all except San Parks and Sasol Secunda. An 8% (2 of 24) shortfall is noted for Supervisors overall.

Process Controllers: Similarly, 80% (56 of 70) of the PC staff is compliant for the Government- and Private Institutions. There is an 20% (14 of 70) shortfall in PCs with San Parks (6 no.), Eskom (4 no.) and Sasol Secunda (3 no.).

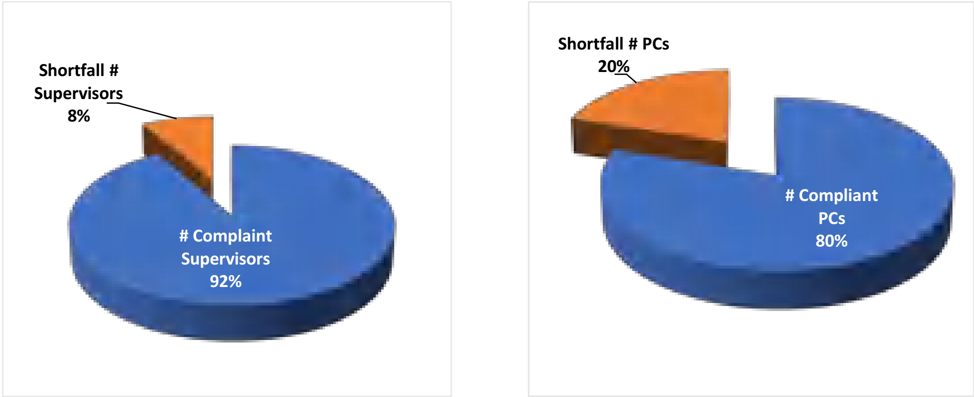


Figure 222 - Schematic illustration of compliant versus non-compliant Supervisors (a) and Process Controllers (b)

Green Drop standards prescribes stricter standards for Class A and B plants with Level V and VI Supervisors and Process Controllers per shift, whereas Class C to E plants have reduced requirements and sharing of staff across works is acceptable. Furthermore, shifts have been introduced to ensure optimal operations while addressing security risks, particularly as it relates to vandalism. Telemetry also reduces the requirement for on-site staff during night shifts, but these relaxations will have to be done within the DWS regulatory guidelines.

It is anticipated, but never tested before, that a close correlation would exist between the competence of an operational team and the performance of a treatment plant, as measured by the GD score. The results from the ratio analysis indicate high ratios for Sasolburg, Eskom and Sun City, and low ratios for the remaining institutions (Figure 223).

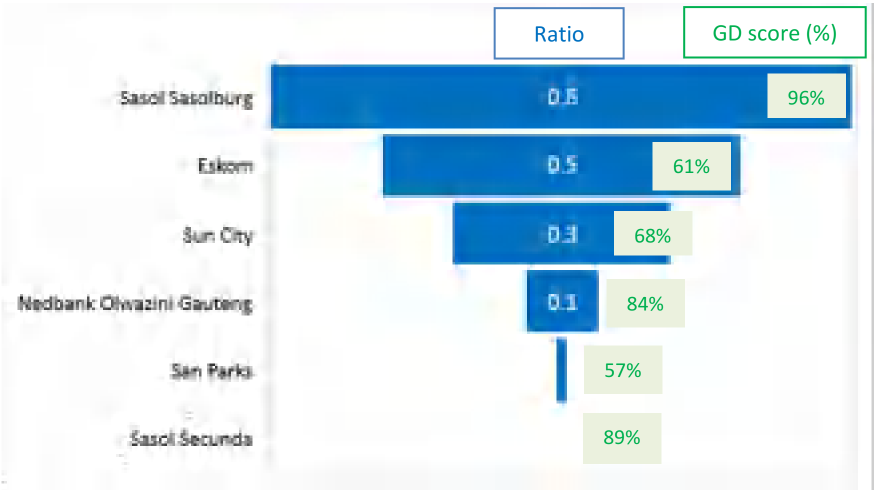


Figure 223 - Ratio of compliant operational staff to no. of WWTWs and Comparison of Ratios with GD scores

Overall, the comparative bar chart confirms a correlation with high ratios and higher GD scores for Sasolburg, Eskom and Sun City and San Parks but there is an anomaly with Nedbank and Sasol Secunda who had high GD scores but have low ratios especially for the latter having a shortfall in supervisory staff.

In addition to operational capacity, good management practice also requires access to qualified engineers, technicians, technologists, scientists, and maintenance capability. Such competencies could reside in-house or accessible through term contracts and external specialists.

Table 247 - Summary of the maintenance capacity and no. of qualified and shortfall of Engineering, Technical and Scientific staff

Government- and Private Institutions	# WWTW	Maintenance Arrangement	Qualified Technical Staff (#) Engineers	Technologists	Technicians	Total	Technical Shortfall (#)	Qualified Scientists (#)	Scientists Shortfall (#)	Ratio*	2021 GD Score (%)
Eskom	13	Internal + Specific Outsourcing; Internal Team (Only)	20	8	32	60	0	21	0	4.6	61%
Nedbank Olwazini	1	Internal + Specific Outsourcing	0	0	1	1	1	1	0	1.0	84%
San Parks	13	Internal Team (Only)	0	2	6	8	0	0	1	0.6	57%
Sasol Secunda	1	Internal + Specific Outsourcing; Internal Team (Only)	10	0	1	11	0	1	0	11.0	89%
Sasol Sasolburg	1	Internal + Term Contract	4	0	0	4	0	1	0	4.0	96%
Sun City	1	Internal + Specific Outsourcing; Internal Team (Only)	0	0	2	2	0	2	0	2.0	68%
Totals	**30**		**34**	**10**	**42**	**86**	**1**	**26**	**1**		

* *The Ratio depicts the number of qualified technical staff divided by the number of WWTWs that have access to the staff*

Note 1: "Qualified Technical Staff" means staff appointed in positions to support wastewater services, and who has the required qualifications. "Technical Shortfall" is calculated based on a minimum requirement of at least 2 Engineers/Technologists/Technicians and at least one 1 Scientist per Government- and Private Institutions.

Note 2: "Qualified Scientists" means professional registered scientists (SACNASP) appointed in positions to support wastewater services. "Scientist's shortfall" means that the WSI does not have at least one qualified, SACNASP registered scientist in their employ or contracted.

There is a very good contingent of qualified maintenance staff for all the Government- and Private Institutions, with the current qualified maintenance staff from a collective of inhouse, contracted or outsourced personnel. The data for maintenance capacity and expertise indicates the following:

- All the institutions have in-house maintenance teams
- Sasolburg has an internal maintenance team supplemented with term contracts
- All the other institutions have internal maintenance teams, supplement with specific outsourced services, apart from San Parks.

For qualified technical staff, the data indicates as follows:

- A total of 34 engineers, 10 technologists, 42 technicians (qualified) and 26 SACNASP registered scientists are assigned to the audited institutions, totalling 86 qualified staff
- A total shortfall of 2 persons is identified, consisting of 1 technical staff and 1 scientist
- Only Nedbank Olwazini has some shortfall in qualified technical staff
- 67% of the institutions have access to credible laboratories which complies with Green Drop standards, with the gap being the Sun City and San Parks laboratories.

Figure 224 - Graphic illustration of the number and %: a) qualified engineering/technical staff; b) professional scientists; c) access to credible laboratory services that complies with Green Drop standards

Ratio analysis has been done to determine the number of qualified technical and scientific staff assigned per WWTW. It is expected, but has never been tested before, that a higher ratio would correspond with well-performing and maintained wastewater systems, as represented by the GD score. The results from the ratio analysis indicate:

- High ratios were determined for Sasol Secunda, Eskom, and Sasolburg
- Positive ratios were determined for Sun City and Nedbank
- Low ratio was determined for San Parks' Kruger National Parks.

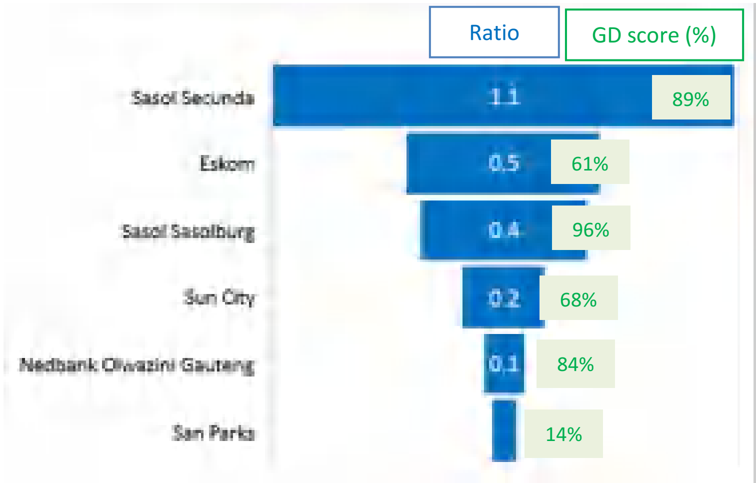


Figure 225 - Ratio of compliant technical staff to no. of WWTWs and Comparison of Ratios with GD scores

A close correlation is noted between high ratios and high GD scores, the anomaly being Nedbank with one technical staff shortfall. Likewise, a correlation is observed between lower ratios and lower Green Drop scores with San Parks. These results suggest that wastewater performance is also sensitive towards engineering, technical and scientific staff as is with the operational competencies (Superintendents and PCs).

One manner of enhancing operational capacity is via dedicated training programmes. The Green Drop audit incentivise appropriate training of operational staff over a 2-year period prior to the audit date. The results are summarised in the schematics following:

Table 248 - No. of WWTWs with operational staff sent on training over the past 2 years and vice versa

Government- and Private Institutions	# WWTW staff attending training over past 2 years	# of WWTW without training over past 2 years
Eskom	13	0
Nedbank	1	0
San Parks	13	0
Sasol	2	0
Sun City	1	0
Totals	**30 (100%)**	**0 (0%)**

Figure 226 - %WWTWs that have trained operational staff over the past two years

The results indicate that all WWTWs had operational staff attend training over the past 2 years. This is excellent results and testify to vigorous investment in human resources and operational skills. Training of the staff should continue along a similar vein, but the training should be expanded to include operation of technology, sludge treatment and energy efficiency.

Diagnostic 3: Treatment Capacity

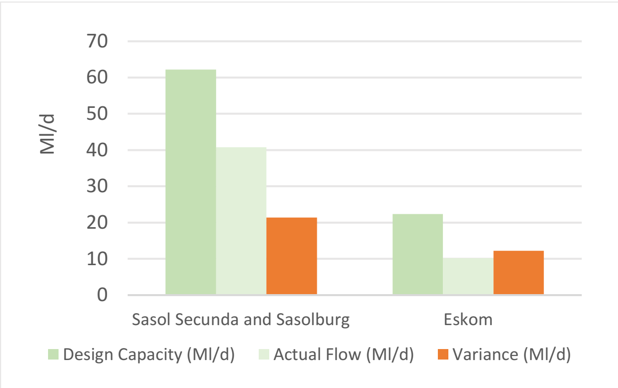
Aim: A capable treatment plant requires adequate design capacity and functional equipment to deliver a quality final water. If the plant capacity is exceeded by way of inflow volume or strength, a plant will not be capable to achieve its compliance standards. Capacity is typically exceeded when the demand exceeds the installed design capacity, or when processes or equipment is not operational or dysfunctional, or when the electrical supply cannot support the treatment infrastructure. This diagnostic assesses the status of plant capacity and operational flows to the plants.

Findings: Analysis of the hydraulic capacities and operational flows indicate a total design capacity of 91.1 Ml/d for the collective of institutions, with a total inflow of 54.3 Ml/day. Theoretically, this implies that 60% of the design capacity is used with 40% available to meet additional demand. The full 91.1 Ml/d day is available.

In general, most plants are operating within their design capacities, with the exception of 3 systems in San Parks. Most of the institutions reported a low percentage use of their overall capacity (<50%). Treatment systems with low percentage use may be affected by breakdown in sewer networks or pump stations whereby all sewage is not reaching the treatment. In the case of San Parks, the impact of Covid also resulted in tourists not visiting the Kruger Park which would result in low flows.
The Green Drop audit requires a wastewater flow balance to identify and quantify possible losses from the network and/or ingress into the sewers. Most of the institutions have flow balances that follows the wastewater trail from consumer to treatment plant – this is very good practice and set an example for the wastewater industry in South Africa.

Table 249 - Summary of WWTWs design and available capacities, inflows, % use design capacities, and inflows measured per WWTW

Government- and Private Institutions	# WWTWs	Design Capacity (Ml/d)	Available Capacity (Ml/d)	Operational Flow (Ml/d)	Variance (Ml/d)	% Use Design Capacity	Inflow measured #
Eskom	13	22.4	22.4	10.2	12.2	45%	13
Nedbank	1	0.063	0.063	0.04	0.06	63%	1
San Parks	13	1.3	1.3	0.7	0.6	52%	13
Sasol	2	62.2	62.2	40.8	21.4	66%	2
Sun City	1	5.1	5.1	2.6	2.5	50%	1
Totals	**30**	**91.1**	**91.1**	**54.2**	**36.8**	**60%**	**30**



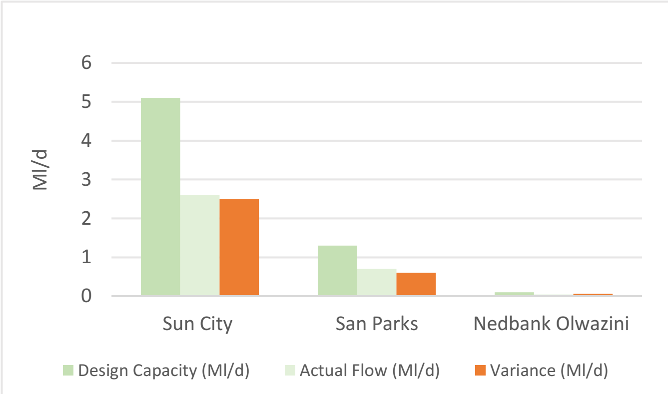


Figure 227 - Design capacity, actual flow, and variance in Ml/d for smaller and larger WWTWs

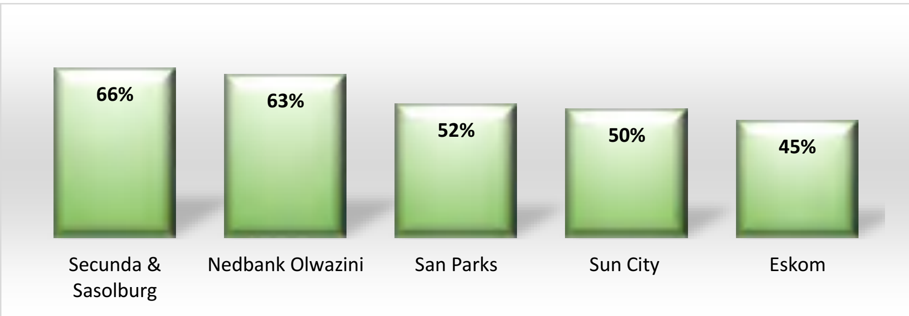


Figure 228 - % use of installed design capacity

The data shows that 3 of the 30 treatment plants are hydraulically overloaded as follows:

- San Parks: 3 of 13 systems (Tshokwane, Orpen and Malelane).

Water Use Authorisations mandate all institutions to install and monitor flow meters, whilst GD requires the Government and private institutions to report inflows on IRIS and to calibrate meters annually. The audit results indicate that 100% (30 of 30) systems monitor their inflow. Most of the institutions calibrate or verify their flow meters on an annual basis, thereby complying with good practice standards.

Diagnostic 4: Wastewater Monitoring and Compliance

Aim: "*To measure is to know*" and "*To know is to manage*". The primary objective of a wastewater treatment plant is to produce final effluent and biosolids to a safe standard. This standard cannot be measured or managed if operational- and compliance monitoring is lacking. This diagnostic assesses the monitoring status and final effluent compliance against each WWTW's mandatory standards.

Findings: For operational monitoring, a satisfactory level of 90% is applied as the benchmark, to give weight to the importance of monitoring. For compliance monitoring, the audit evaluates the sampling point, sampling frequency, final effluent quality, biomonitoring, heavy metals, and any specific condition that the DWS may have included in the water use licence. Final effluent quality compliance is calculated against the mandatory limits as listed under "Authorisation Status". A >90% compliance figure confirms high quality final effluent, whereas a <30% indicate poor effluent quality. The enforcement measures are summarised in the column to the far right and include NWA Notices and Directives issued, criminal cases opened, and court interdicts granted during the period 1 April 2019 to 30 June 2021.

Table 250 - Summary of the operational and compliance monitoring status

Government- and Private Institutions	# WWTW	Operational monitoring (KPA B2)		Compliance monitoring (KPA B3)	
		Satisfactory [GD score >90%]	Not Satisfactory [GD score <90%]	Satisfactory [GD score >90%]	Not Satisfactory [GD score <90%]
Eskom	13	3	10	7	6
Nedbank	1	0	1	1	0
San Parks	13	0	13	0	13
Sasol	2	0	2	2	0
Sun City	1	0	1	1	0
Totals	**30**	**3 (10%)**	**27 (90%)**	**11 (37%)**	**19 (63%)**

The performance recorded in Table 250 stems from performance data as measured against the Green Drop Standard expressed in KPAs B2 and B3. Table 249 indicates an overall unsatisfactory monitoring regime for both operational- and compliance sampling and analysis (90% and 63% dissatisfaction, respectively). This is a concerning observation. Only 3 of the 30 plants are on par with good practice for operational monitoring of raw sewage and the respective units responsible for the processing effluent and sludge. The Government- and Private Institutions are not meeting the Green Drop standard.

Compliance monitoring is not only a legal requirement, but also the only means to measure (and correct) performance of a treatment facility. Operational monitoring is the cornerstone of day-to-day process adjustments and optimisation to ensure treatment is efficient and deliver quality effluent/sludge that meet design expectations. Sludge monitoring is also essential as poor sludge handling is the root cause of many WWTWs failing to meet final effluent standards. Except for the privates on compliance monitoring, the results indicate that the Government for both and private institutions for operational monitoring, are not achieving regulatory- and industry standards.

Table 251 summarises the results of KPA E, which also carries the highest Green Drop scoring weight. Note that all averages shown as '0%' under Effluent Compliance, include actual 0% compliance plus systems with no information or insufficient data.

Table 251 - Summary of authorisation status, effluent compliance status, and directives/notices issued

Government- and Private Institutions	Authorisation Status	Effluent Compliance									Enforce-ment Measures*
		Microbiological Compliance (%)			Chemical Compliance (%)			Physical Compliance (%)			
		Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	Ave. (%)	# WWTWs >90%	# WWTWs <30%	
Eskom	10 WUL, 1 GA; 1 Exempted; 1 Permit	72%	8	3	54%	3	4	60%	3	4	0
Nedbank	1 GA	100%	1	0	100%	0	1	93%	1	0	0
San Parks	13 GA	77%	9	0	94%	13	0	86%	11	0	0
Sasol	2 WUL	100%	2	0	100%	2	0	100%	0	0	0
Sun City	1 WUL	0%	0	1	0%	0	1	0%	0	0	0
Totals		**70%**	**20**	**4**	**70%**	**18**	**6**	**68%**	**15**	**4**	**0**

* The enforcement measures (notices or directives issued) are taken over a two-year financial period from July 2019 to June 2021

On average, the institutions fared reasonably in terms of final effluent quality compliance, with 70% compliance with microbial effluent quality, 70% with chemical-, and 68% with physical effluent quality. For the microbiological compliance category, 20 of 30 systems achieved >90% and 4 of 30 systems fell below 30%. For the chemical compliance category, 18 of 30 systems achieved >90% and 6 of 30 systems fell below 30%. For the physical compliance category, 15 of 30 systems achieved >90% and 4 of 30 systems fell below 30%.

No Notices/ Directives have been issued to any of the Government- and Private Institutions.

In terms of sludge compliance status, it is found that:

- 6 of 30 (20%) plants classify their biosolids according to the WRC Sludge Guidelines – Eskom (4), Sasolburg & Secunda (2)
- 5 of 30 (17%) plants monitor sludge streams – Eskom (5)
- No plants have Sludge Management Plans in place
- 11 of 30 (37%) plants use sludge for landfill and thermal sludge practice.

In closing of this diagnostic, the data confirmed that 67% of the audited institutions have access to credible laboratories for compliance and operational analysis. These in-house or contracted laboratories have been verified to be accredited and/or have Proficiency Testing Schemes with suitable analytical methods and quality assurance. Most of the Government- and Private Institutions are meeting the regulatory expectation that have access to analytical services for compliance, operational and sludge monitoring.

Diagnostic 5: Energy Efficiency

Aim: The wastewater industry offers many opportunities to respond to climate change challenges by improving energy efficiency, reduce greenhouse gasses, and generate energy. The energy cost of sophisticated treatment technologies are in the order of 25-40% of the O&M budget (cited WRC 2021). This diagnostic investigates the status of energy efficiency management at privately owned and State-owned Enterprises, with an aim to motivate for improved operational wastewater treatment efficiency across all sectors.

Findings: The audit results suggest a fair level of awareness in energy management at all institutions. Only Eskom conducted some baseline energy audits, but all the other institutions provided some information on their actual SPC, energy tariff and energy cost. No energy efficiency initiatives are in place.

Benchmark 1: Estimated energy intensity for large WWTW is in order of [illegible] kWh/m³

- 0.177 kWh/m³ for trickling filter
- 0.272 kWh/m³ for activated sludge
- 0.314 kWh/m³ for advanced treatment
- 0.412 kWh/m³ for advanced treatment with nitrification

Benchmark 2: Energy requirements per plant size

Plant capacity, Ml/d	[illegible]	2	10	[illegible]	[illegible]
Trickling filter, kWh/m³	0.43	[illegible]	0.23	0.18	0.16
Activated sludge, kWh/m³	0.59	[illegible]	0.37	[illegible]	[illegible]

Tariffs are typically depends on time of day and season [illegible]

- Peak rate: [illegible] c/kWh
- Off-peak time: [illegible] c/kWh
  Standard time: 117.57 - [illegible] c/kWh

([illegible] 2021, [illegible] 2012, [illegible])

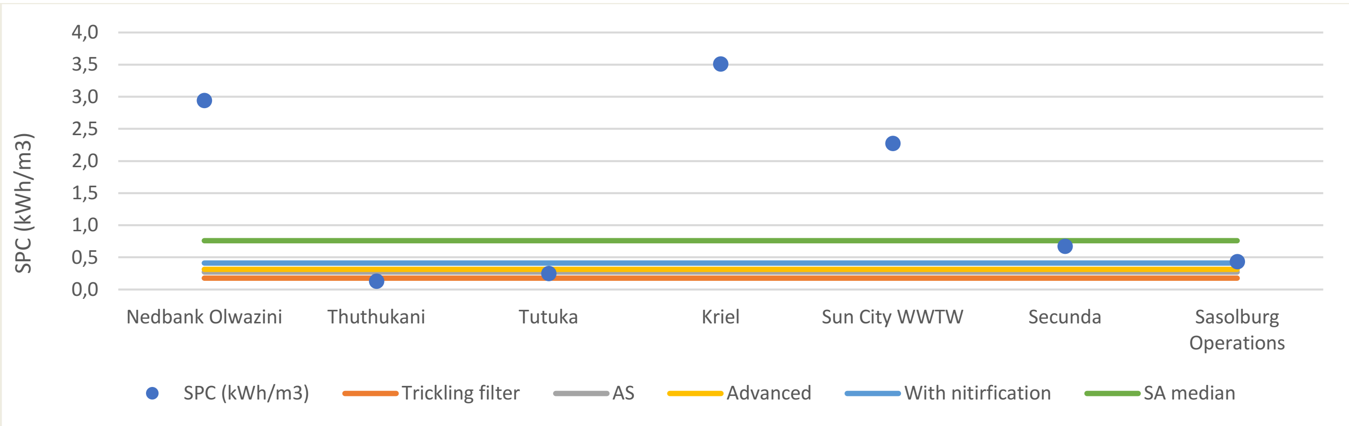


Figure 229 - Specific Power Production per DPW WWTW (kWh/m³) in order of increased design capacity, and compared to international technology benchmarks

In terms of energy management, the data depicts the following:

- Eskom conducted energy audits for 3 systems in the past 24 months
- SPCs were provided for by Eskom (5 of 13 systems), Nedbank, Sasolburg and Secunda, and Sun City as part of good practice except for San Parks

- No Government and private institutions could account for CO_2 equivalents associated with energy efficiency
- Both Eskom's systems (Tutuka and Thuthukani) fall below the industry benchmarks
- Eskom, San Parks, Sasolburg, Secunda and Sun City had partial to full knowledge of their energy tariffs (R/kWh) and energy cost (R/m^3).

The information suggests that the Government And Private Institutions have established some specific report to monitor energy as part of the wastewater business, and potential cost savings and environmental gains can be realised.

Diagnostic 6: Technical Site Assessments

Aim: The Green Drop process makes provision for the desktop audit being followed by a Technical Site Assessment (TSA) to verify the desktop evidence. The assessment includes physical inspection of the sewer network, pump stations, and treatment facility, coupled with asset condition checks to determine an approximate cost to restore existing infrastructure to functional status (VROOM).

Findings: The results of the Government and private institutions TSAs are summarised in Table 252. A deviation of >10% between the GD and TSA score indicate a misalignment between the administrative aspects and the work on the ground. The Regulator regards a wastewater system with a TSA score of >80% as one that have an acceptable level of process control and functional equipment. 90% would represent an excellent plant that complies with most of the Green Drop TSA standards.

Table 252 - Summary of the WWTW Technical Site Assessments scores and hardware problems and %deviation between GD and TSA scores

Government and private institutions	TSA WWTW Name	WWTW GD Score (%)	% TSA	Key Hardware Problems	Difference between TSA & GD score
Sasol	Secunda	89%	88%	Only some corrosion and paint needed in areas, no major hardware issues	1%
Eskom	Matla	82%	75%	1. Sewer pump stations; 2. Corrosion of concrete; 3. Secondary settling; 4. Sludge handling	7%
Nedbank	Olwazini	84%	94%	No dysfunctional hardware identified	10%
San Parks	Skukuza	59%	56%	1. Repair and strengthen fences; 2. Repair and desludge wetland/pond walls 3. Reed control on wetlands	3%
Sun City	Sun City	68%	85%	1.Cracks in concrete wall of UV chamber; 2. Irrigation pump on final effluent	17%
Totals	**5**				**1% to 17%**

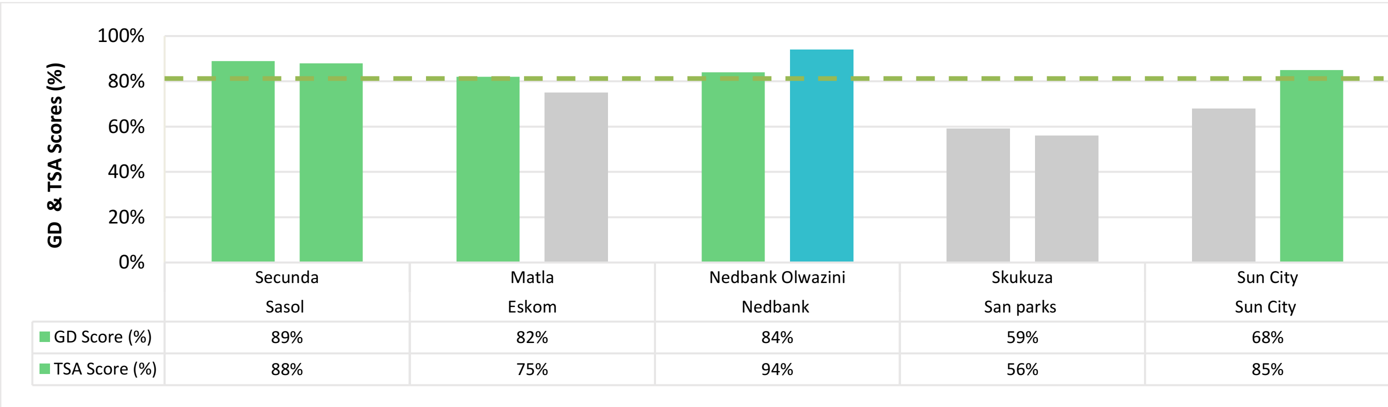


Figure 230 - GD score 2021 (bar left) and TSA score 2021 (bar right) comparison (colour legends as for GD – blue excellent; red critical)

A total of 5 site assessments were conducted, with 1 inspection per institution. Three systems scored above 80%, Secunda (88%), Nedbank (94%) and Sun City (85%), which is regarded as a satisfactory TSA score. High TSA scores (>50%) typically indicate that treatment facilities meet operational, asset functionality, and workplace safety standards. No unacceptably low percentage deviation TSA scores were observed for any of the systems. A low percentage deviation implies that the wastewater administration correlate with the condition of processes and infrastructure in the field. Some focal points include:

- Sasol Secunda and Nedbank Olwazini impressed with a very high TSA scores and GD score >80% followed closely by Eskom with a TSA score of 82% and a GD score of 75%
- All institutions had close matches between the GD and TSA scores with difference % ranging from 1% to 17% respectively, the highest deviation by Sun City. The statistics reflect positively on the operation and functionality of the sewer network and treatment processes.

The VROOM cost presents a ''very rough order of measurement" cost to return a WWTWs functionality to its original design. For the Government and private institutions, a total budget of R13 million is estimated, with the bulk of the work going towards restoration of civil infrastructure (80%).

Table 253 - VROOM cost split for civil, mechanical, and electrical and total VROOM cost estimate

Government and private institutions	Civil cost estimate	Mechanical cost estimate	Electrical & C&I cost estimate	Total VROOM cost
Sasol Sasolburg & Secunda	R373,200	R870,800	R0	R1,244,000
Eskom	R5,236,010	R1,240,791	R19,489	R6,496,290
Nedbank	R0	R0	R0	R0
San Parks	R4,642,194	R196,080	R63,726	R4,902,000
Sun City	R70,007	R238,393	R0	R308,400
Totals	**R10,321,411**	**R2,546,064**	**R83,215**	**R12,950,690**
% Distribution	**79.7%**	**19.7%**	**0.6%**	**100%**

The key hardware problems are listed in Table 252, noting civil infrastructure refurbishment and repair (corrosion control, walls, fences, painting sealing cracks), sludge handling, sewer pump station, secondary settling. Mechanical defects, maintenance and repairs typically include pumps.

Diagnostic 7: Operation, Maintenance and Refurbishment of Assets

Aim: Insufficient financial resources are often cited as a root cause to dysfunctional or non-compliant wastewater systems. Knowledge and monitoring of fiscal spending are therefore a critical part of wastewater management. This diagnostic investigates the status of financial information as pertaining to O&M budgets and expenditure, asset figures, and capital funding.

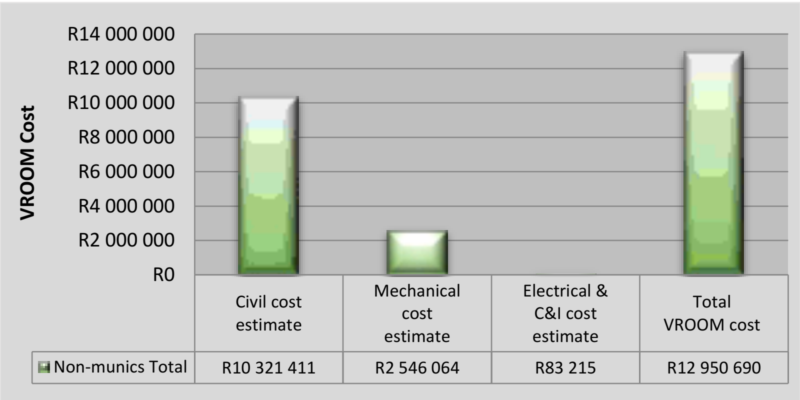
Findings: A substantial amount of financial information was presented during the audit process. Unfortunately, the evidence was presented in different formats, levels of detail, or absent for some Government and private institutions. It was observed that the Government and private institutions teams with financial officials present during the audits typically performed better, and also had a good understanding of the wastewater challenges experienced by their technical peers. Discrepancies observed included: generic or non-ringfenced budgets, contract lump sums for Service Providers presented as budgets, outdated or incomplete asset registers, some cost drivers are lacking (mostly electricity), etc. The Regulator grouped data into different certainty levels, as can be summarised at the end of this Diagnostic.

It must be noted that there were almost no limitations with the financial and asset information. Most of the Government and Privates submitted current information or complete financial data sets.

The result of each financial portfolio is discussed hereunder.

Vroom Cost Analysis

The VROOM costs breakdown is discussed under the TSA Diagnostic but is further illustrated as follows.



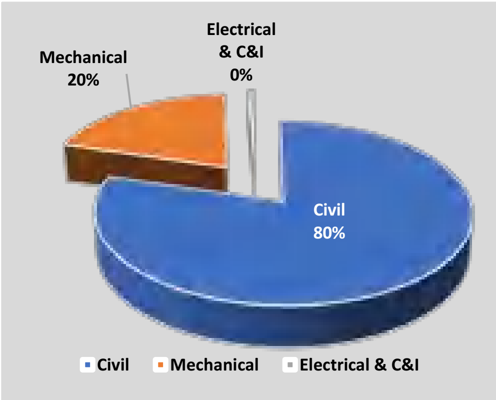


Figure 231 - Graphic illustration of the total cost estimated to restore functionality to existing assets (a), broken down to civil, mechanical, and electrical components

The total cost of R13 million is estimated to restore existing treatment works to their design capacity and functionality - consisting of R2.55 million for mechanical repairs, R83.3 million for electrical repairs, and R10.3 million for civil structures.

Table 254 indicates that a capital budget of R114.5 million has been secured over 1-3 years to address infrastructural needs, which does covers the R13 million VROOM refurbishment need and by implication, allows surplus for other capital projects. The R13 million estimated VROOM cost constitutes 11% of the total asset value of R115.7 million. Furthermore, the WATCOST-SALGA figures provides for an annual 2.14% of the asset value required to maintain these assets. This constitutes an amount of R2.5 million required by the various WSA's annually to maintain the assets, while a once-off R13 million is required to restore existing assets.

Capital, O&M Budget and Actual, and Asset Value

The capital budgets, O&M budgets, O&M actual expenditure, and current asset values are summarised below.

Table 254 - Summary of the capital budgets, O&M budgets, O&M actual expenditure, and current asset values

Government and private institutions	Capital budget available	O&M budget (2020/21)	O&M expended (2020/21)	% Expended	Total Current Asset Value
Sasol Sasolburg & Secunda	R15,935,000	R50,196,370	R50,157,260	100%	R94,899,740
Eskom	R76,043,640	R33,790,000	R15,460,000	46%	R16,573,300
Nedbank	R0	R763,000	R635,000	83%	R3,552,300
San Parks	R16,712,000	R7,941,400	R3,323,330	42%	R708,870
Sun City	R5,800,000	R3,612,820	R3,555,150	98%	R0
Totals	**R114,490,640**	**R96,303,590**	**R73,130,740**	**76%**	**R115,734,210**

The Green Drop process provides a bonus (incentive) in cases where Water Services Institutions provide evidence of capital projects with secured funding since this is deemed as a definitive means of addressing wastewater services inadequacies. This incentive encourages wastewater infrastructure investment. A total capital budget of R114.5 million has been reported for the refurbishment and upgrades of wastewater infrastructure for the Government and private institutions over a 1-to-3-year fiscal period. The largest capital budget is observed for Eskom (R76m).

For the 2020/21 fiscal year, the total O&M budget reported for the Government and private institutions was R96 million, of which R73 million (76%) has been expended. Over-expenditure was not observed. Under expenditure was observed for Eskom (46%) and San Parks (42%).

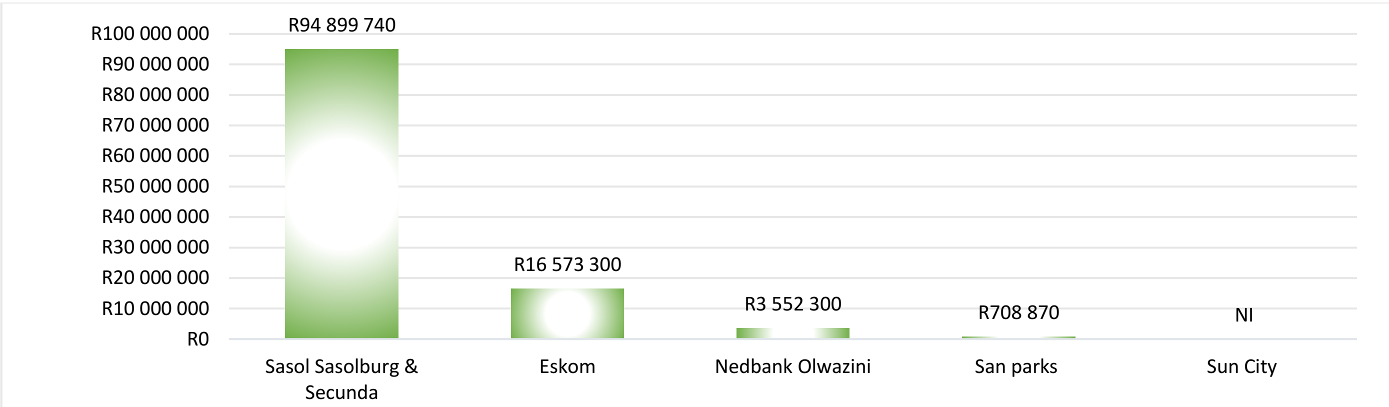


Figure 232 - Total current asset value reported by the Government and private institutions

The total current asset value for wastewater infrastructure (networks, pump stations, treatment plants) is reportedly R116 million (excluding Sun City with no information). The highest asset values are observed for Sasolburg and Secunda (R95m), followed by Eskom (R16.6m).

O&M Cost Benchmarking

By combining the SALGA and WRC WATCOST models, an estimation of the maintenance cost required per asset type can be done, i.e. civil, buildings, pipelines, mechanical, electrical, and instrumentation. The maintenance benchmark departs from the basis that 15.75% of the asset value is required to maintain these assets.

Table 255 - SALGA-WRC annual maintenance budget guideline and cost estimation

Description	% of Current Asset Value	Asset Value Estimate	Modified SALGA Maintenance Guideline	Annual Maintenance Budget Guideline
Current Asset Value estimate	**100%**	**R115,734,210**	**15.75%**	**R2,476,712**
Broken down into:				
1. Civil Structures	46%	R53,237,737	0.50%	R266,189
2, Buildings	3%	R3,472,026	1.50%	R52,080
3. Pipelines	6%	R6,944,053	0.75%	R52,080
4. Mechanical Equipment	35%	R40,506,974	4.00%	R1,620,279
5. Electrical Equipment	8%	R9,258,737	4.00%	R370,349
6. Instrumentation	2%	R2,314,684	5.00%	R115,734
Totals	**100%**	**R115,734,210**	**15.75%**	**R2,476,712**
			Minus 20% P&Gs and 10% Installation	**R743,014**
			Total	**R1,733,698**

The model estimates that R2.5 million (2.14%) is required per year to maintain the assets valued at R116 million. Notably, this maintenance estimate assumes that all assets are functional. The VROOM cost represents the monies needed to get assets functional, from which basis route maintenance could then focus on maintaining the assets.

Table 256 indicates the SALGA maintenance cost estimation in relation to the VROOM cost, O&M budget, and O&M actual expended.

Table 256 - O&M cost estimates by the SALGA and VROOM models versus actual budget and expenditure figures

Cost Reference	O&M Cost Estimate	Period
Modified SALGA	R2,476,712	Annually, estimation
O&M Budget	R96,303,590	Actual for 2020/21
O&M Spend	R73,130,740	Actual for 2020/21
VROOM	R12,950,690	Once off estimation

The cost dynamics can be summarised as follows:

- The SALGA estimations for O&M budgets are 2.6% of the actual reported budgets for the 2020/21 fiscal year
- The actual O&M budget is adequate when compared with the SALGA guideline
- The VROOM cost represents an estimation of the refurbishment cost to restore WWTWs functionality and design capacity.

Production Cost

It is good business practice to monitor and manage the production costs of wastewater treatment in Rand/m^3 treated, and to compare such cost with industry norms. Published benchmarks is not currently available for typical treatment (production) costs, but significant cost increases are expected since 2013, given the variable input factors such as Covid, and cost of chemicals, transport, and electricity. From an economic perspective, it is valuable to compare production cost at time of budgeting versus actual production costs. However, due to scarce information, it is not possible to provide insight as to possible shortfalls from an economic perspective.

Based on the limited data sets, no specific trend can be established between the cost to treat wastewater and the operational flow. Three sets of data were assessed:

- Secunda and Sasolburg budgeted for a production cost of R23.84/m^3 compared with actual cost of R1.10/m^3
- Eskom budgeted for a production cost of R376.11/m^3 compared with actual cost of R1.92/m^3
- Sun City budgeted for R7.37/m^3 compared with actual cost of R1.38/m^3.

The main factors that influence production costs would be staff, which is a fixed cost, and energy, chemical and repairs/maintenance costs, which is a variable cost which depends on the operational status of a plant. Some shortcomings were found as to availability or accuracy of the production costs.

Data Certainty

Data certainty is expressed at different levels for the financial and asset figures reported within this Diagnostic. Certainty levels may differ from system to system, hence the repeat of some Government and private institutions as the data provided for is variable or inconsistent or limited or non-existent (NI). Government and private institutions that were identified under the category ''High Certainty", presented consistent and verifiable evidence in the form of budgets, expenditure, asset registers, and unit costs.

Table 257 - Levels of certainty associated with financial and asset information reported by the Government and private institutions

Data Certainty	Description	Government and private institutions
No certainty	Absent data or no certainty in data presented - not ringfenced for WWTW & Network	None
Low certainty	Minor or little certainty in the data - partially ringfenced for WWTW only or data as extreme outliers	Sun City, Nedbank Olwazini, San Parks
Reasonable/good certainty	Reasonable to good level of certainty in the data - ringfenced for WWTW and/or Network and data falls within/close to expected parameters	Eskom, San Parks, Sun City, Nedbank Olwazini
High certainty	High level of certainty in the data - ringfenced for WWTW and Network and data falls within expected parameters	Sasol Sasolburg & Secunda

14.1 Sun City Resort

Water Service Institution	**Sun International - Sun City Resort**	
Water Service Provider	Tsebo Facilities Management	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Cracks in concrete wall of UV chamber 2. Irrigation pump on final effluent **VROOM Estimate:** - R308,400
2021 Green Drop Score	**68%↓**	
2013 Green Drop Score	**90%**	
2011 Green Drop Score	**90%**	
2009 Green Drop Score	**NA**	

Key Performance Area	**Unit**	**Sun City**
Green Drop Score (2021)		**68%**
2013 Green Drop Score		**90%**
2011 Green Drop Score		**90%**
2009 Green Drop Score		NA
Design Capacity	Ml/d	5.14
Capacity Utilisation (%)		50%
Resource Discharged into		Elands River
Wastewater Risk Rating (CRR% of CRR_{max})		**Sun City**
CRR (2011)	%	30.8%
CRR (2013)	%	36.4%
CRR (2021)	%	59.1%

Technical Site Assessment: **Sun International (Sun City Resort) WWTW 85%**

14.2 Nedbank Olwazini

Water Service Institution	**Nedbank**	
Water Service Provider	Nedbank Olwazini	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** No dysfunctional hardware identified. **VROOM Estimate:** - NIL
2021 Green Drop Score	**84%↓**	
2013 Green Drop Score	**99%**	
2011 Green Drop Score	**93%**	
2009 Green Drop Score	**NA**	

Green Drop Score (2021)		**84%**
2013 Green Drop Score		**99%**
2011 Green Drop Score		**93%**
2009 Green Drop Score		NA
System Design Capacity	Ml/d	0.063
Design Capacity Utilisation (%)		63%
Resource Discharged into		Irrigation
Wastewater Risk Rating (CRR % of CRR_{max})		**Nedbank Olwazini**
CRR (2011)	%	29.4%
CRR (2013)	%	29.4%
CRR (2021)	%	41.2%

Technical Site Assessment: **Nedbank Olwazini WWTW 94%**

14.3 Sasol Operations – Secunda and Sasolburg

Water Service Institution	**Sasol Operations**		
Water Service Provider	Metsimaholo Local Municipality		
Municipal Green Drop Score			**VROOM Impression:** Only some corrosion and paint needed in areas, no major hardware issues **VROOM Estimate:** - R1,244,000
2021 Green Drop Score	**94%**		
2013 Green Drop Score	**86% (Sasolburg)**	**93% (Secunda)**	
2011 Green Drop Score	**63%**	**81%**	

Key Performance Area	Unit	Secunda Operations	Sasolburg Operations
Green Drop Score (2021)		**89%**	**96%**
2013 Green Drop Score		**93%**	**86%**
2011 Green Drop Score		**81%**	**63%**
System Design Capacity	**Ml/d**	19	43.2
Capacity Utilisation (% ADWF ito Design Capacity)		65%	66%
Resource Discharged into		Trichardspruit via a channel	Vaal River and Taaiboschspruit
Wastewater Risk Rating (CRR % of CRR_{max})		**Secunda Operations**	**Sasolburg Operations**
CRR (2011)	**%**	13.0%	23.0%
CRR (2013)	**%**	40.9%	44.4%
CRR (2021)	**%**	40.9%	37.0%

Technical Site Assessment: ***Sasol Secunda Operations WWTW 88%***

14.4 San Parks – Department of Forestry, Fisheries and Environment

Water Service Institution	**San Parks: Kruger National Park**	
Water Service Provider	San Parks: Kruger National Park	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Repair and strengthen fences 2. Repair and desludge wetland/pond walls 3. Reed control on wetlands **VROOM Estimate:** - R4,902,000
2021 Green Drop Score	**57%↓**	
2013 Green Drop Score	**71%**	
2009-11 Green Drop Score	**NA**	

Key Performance Areas	**Unit**	**Letaba**	**Olifants**	**Pretoriuskop**	**Punda Maria**
Green Drop Score (2021)		**63%**	**53%**	**54%**	**58%**
2009-11 Green Drop Score		NA	NA	NA	NA
2013 Green Drop Score		**73%**	**76%**	**70%**	**76%**
Design Capacity	Ml/d	0.15	0.07	0.07	0.04
Capacity Utilisation (%)		47%	83%	83%	48%
Resource Discharged into		Nhlangaini to Lethaba River	Olifants River	Fayispruit to Beamiet to Crocodile River	Sisha Maritenga Spruit
Wastewater Risk Rating (CRR% of CRR_{max})		**Letaba**	**Olifants**	**Pretoriuskop**	**Punda Maria**
CRR (2013)	%	23.5%	23.5%	29.4%	29.4%
CRR (2021)	%	17.6%	41.2%	41.2%	17.6%

Key Performance Area	**Unit**	**Skukuza**	**Tshokwane**	**Shingwedzi**	**Satara**
Green Drop Score (2021)		**58%**	**47%**	**49%**	**59%**
2009-11 Green Drop Score		NA	NA	NA	NA
2013 Green Drop Score		**75%**	**69%**	**74%**	**59%**
Design Capacity	Ml/d	0.42	0.01	0.06	0.16
Capacity Utilisation (%)		33%	230%	38%	58%
Resource Discharged into		Sabie River	N'Waswitsonso River	Shingwedzi River	Shitsakana River
Wastewater Risk Rating (CRR% of CRR_{max})		**Skukuza**	**Tshokwane**	**Shingwedzi**	**Satara**
CRR (2013)	%	29.4%	47.1%	29.4%	58.8%
CRR (2021)	%	29.4%	52.9%	17.6%	23.5%

Key Performance Area	**Unit**	**Lower Sabie**	**Orpen**	**Berg en Dal**	**WPS**
A. Capacity Management	15%	92.5%	92.5%	92.5%	92.5%
Green Drop Score (2021)		**49%**	**49%**	**59%**	**54%**
2009-11 Green Drop Score		**NA**	**NA**	**NA**	**NA**
2013 Green Drop Score		**41%**	**55%**	**72%**	**53%**
Design Capacity	Ml/d	0.11	0.02	0.13	0.04
Capacity Utilisation (%)		63%	115%	52%	23%
Resource Discharged into		Sabie River	Thimbavathi River	Matjulu River	Sand River
Wastewater Risk Rating (CRR% of CRR_{max})		**Lower Sabie**	**Orpen**	**Berg en Dal**	**WPS**
CRR (2013)	%	64.7%	41.2%	23.5%	41.2%
CRR (2021)	%	23.5%	29.4%	23.5%	17.6%

Key Performance Area	Unit	Malelane
Green Drop Score (2021)		**49%**
2009-11 Green Drop Score		**NA**
2013 Green Drop Score		76%
Design Capacity	Ml/d	0.01
Capacity Utilisation (%)		63%
Resource Discharged into		Crocodile River
Wastewater Risk Rating (CRR% of CRR_{max})		**Malelane**
CRR (2013)	%	35.3%
CRR (2021)	%	35.3%

Technical Site Assessment: **Skukuza WWTW 56%**

14.5 Eskom – State Owned Enterprise

Water Service Institution	**ESKOM**	
Water Service Provider	ESKOM	
Municipal Green Drop Score		**VROOM Impression (Towards restoring functionality):** 1. Sewer pump stations 2. Corrosion of concrete 3. Secondary settling 4. Sludge handling **VROOM Estimate:** - R6,496,290
2021 Green Drop Score	**61%**	
2009-13 Green Drop Score	**NA**	

Key Performance Area	Unit	Matla	Camden	Matimba (Nelsonskop)	Arnot
Green Drop Score (2021)		**81%**	**44%**	**66%**	**77%**
2009-2013 Green Drop Score		NA	NA	NA	NA
Design Capacity	Ml/d	1.11	0.9	2.736	3.4
Capacity Utilisation (%)		52%	2%	23%	52%
Resource Discharged into		Reuse	Reuse	Irrigation	Recycle
Wastewater Risk Rating (CRR% of CRR_{max})		**Matla**	**Camden**	**Matimba (Nelsonskop)**	**Arnot**
CRR (2011) - (2013)	%	NA	NA	NA	NA
CRR (2021)	%	23.5%	58.8%	35.3%	29.4%

Key Performance Area	Unit	Hendrina	Kendal	Kriel	Tutuka
Green Drop Score (2021)		**43%**	**17%**	**59%**	**76%**
2009-2013 Green Drop Score		NA	NA	NA	NA
Design Capacity	Ml/d	2.4	NI	2	2
Capacity Utilisation (%)		40%	NI	48%	50%
Resource Discharged into		Recycle	Reuse	Reuse	Leeuwspruit
Wastewater Risk Rating (CRR% of CRR_{max})		**Hendrina**	**Kendal**	**Kriel**	**Tutuka**
CRR (2011) - (2013)	%	NA	NA	NA	NA
CRR (2021)	%	64.7%	82.4%	41.2%	35.3%

Key Performance Area	Unit	Majuba	Duvha	Lethabo	Koeberg
Green Drop Score (2021)		**31%**	**64%**	**59%**	**65%**
CRR (2011) - (2013)		**NA**	**NA**	**NA**	**NA**
System Design Capacity	Ml/d	3.48	0.3	2	0.075
Capacity Utilisation (%)		13%	33%	10%	37%
Resource Discharged into		Reuse	Reuse	Reuse	Coastal Discharge
Wastewater Risk Rating (CRR% of CRR_{max})		**Majuba**	**Duvha**	**Lethabo**	**Koeberg**
CRR (2011) - (2013)	%	**NA**	**NA**	**NA**	**NA**
CRR (2021)	%	64.7%	41.2%	35.3%	29.4%

Key Performance Area	Unit	Thuthukani
Green Drop Score (2021)		**82%**
2009- 2013 Green Drop Score		**NA**
System Design Capacity	Ml/d	2
Capacity Utilisation (%)		75%

Key Performance Area	Unit	Thuthukani
Resource Discharged into		Leeuwspruit
Wastewater Risk Rating (CRR% of CRR_{max})		Thuthukani
CRR (2011) - (2013)	%	NA
CRR (2021)	%	29.4%

Technical Site Assessment: **Matla WWTW 75%**

Top: The Sun City team. The audit event was remarkable for various reasons - a professional opening, efficient operations, short turnaround times, and detailed wastewater balance. This is one of the plant with the best signage in South Africa. The Regulator would like to see the laboratory working to its full potential.

Left: Linford Molaba, Vongani Ngobeni and Dr Eddie Riddell of the Kruger National Park showing off the Skukuza oxidation ponds. The W_2RAP process is used to prioritise risk of elephants damaging the fences and reedbeds.

The Eskom team participated for the 1st time to a Green Drop audit. Evidence was well prepared and delivered by knowledgeable teams across South Africa. Good clarification practices and infrastructure ensure quality effluent for reuse.

Simon Makhavhu and his team impressed. This is a well organised, highly competent team who works together in a practical and visionary manner. The insert photo shows how the Process Controller demonstrates the clarifier operation.

15. CONCLUSION

The Green Drop results reveal vulnerabilities and deficiencies that are overarching on regional and institutional level, even though the magnitude thereof differs on institutional and system level. Specific trends and themes are observed to confirm a national picture and to guide the sector to address these in a systematic, possibly programmatic, approach to affect wide-scale impact.

Regulatory Concerns

The Regulator noted some concerning issues during the audit process, which have not been prevalent in previous years:

- Several institutions have invested in infrastructure upgrades, extensions, and refurbishments via capital funding. However, these systems were still found to fail the regulatory standards (mostly not meeting effluent quality limits), and/or fail accepted engineering and workmanship standards, and/or in certain cases, have not been commissioned in part or in full. Such cases have been identified during the Green Drop 2021 audits, and the Regulator will engage the project owner. It is, however, imperative that donor and funding agencies implement monitoring processes to determine if the design and construction process follows the workplan, and to verify the quality of workmanship.
- Infrastructure is upgraded whilst the full system is taken out of commission, allowing untreated wastewater to bypass the plant directly to the water body. In some cases, contractors are not being paid, and pull out from the project without commissioning the refurbished systems, resulting in a prolonged continuance of untreated effluent being discharged to the environment. A Directive will be issued to Grant Managers to the effect that 1) no capital project should be approved without a contingency/interim plan to ensure the plant remain operational and that 2) implementation of such capital projects should occur on the accepted project implementation philosophy that plants remain operable during upgrades.
- Vandalism and theft of electrical cables, equipment and civil structures results in system being inoperable for extended periods. Few WSIs have anti-vandalism strategies or contingency plans or means available to replace and secure infrastructure.
- Significant investments are made in wastewater infrastructure without adequate planning regarding operations and maintenance requirements. This will also be discussed with Grant Management and relevant Water Services Authorities.

Diagnostic 1: Green Drop KPA analysis

The analyses of Green Drop KPAs reveal considerable weaknesses in effluent and sludge compliance (KPA A). The norm that prevailed was that of poor compliance with mostly microbiological, but also chemical and physical effluent quality limits, as well as unclassified biosolids that being applied without consideration of the safety and impact of the application. The Regulator will address these weaknesses through the appropriate regulatory means:

- Strengthening of operational monitoring of all relevant process units, and comparing unit processes to their original design specifications – this will improve final effluent and sludge qualities
- Identify and correct process unit bottlenecks through process audits and plant capability modelling – this will identify weaknesses in the reticulation and treatment value chain to inform capital projects
- Incorporate process audit findings in the W_2RAP to ensure a coordinated response and an informed basis to identify, prioritise and resources risks – this will provide capital and operational priorities.

Most WSIs battled to present good information related to Financial Management (KPA C), with sparce information on budgets, expenditure, cost drivers and wastewater treatment production costs. These vulnerabilities will be addressed through regulatory channels:

- WSIs will be required to adopt an integrated approach to wastewater management (which will reflect in the preparation for Green Drop Audits), to involve financial staff in the audit process and utilising appropriate cost drivers and benchmarks to inform wastewater budgets
- Strengthening of municipal engineering, contracts management and oversight capacity in respect of the implementation of technical/process project elements – this is especially pertinent for the DPW systems but also in the municipal sector
- Infrastructure upgrade projects must ensure that treatment continues whilst upgrades take place, without decommissioning an entire treatment facility.

Diagnostic 2: Technical competence

Many of the larger municipalities fared well in terms of technical competencies, whereas most smaller municipalities showed shortfall in technical skills. These vulnerabilities will be addressed via:

- WSIs will be required to update and maintain the registration of all Supervisors and Process Controllers on the IRIS system to ensure compliance with Green Drop Standards
- DWS will work with sector partners to combine IRIS registration of Superintendents and Process Controllers with a practical competence test, to ascertain that operational staff are registered who has the required competence to operate

the specified treatment technology and upskill operators on new knowledge such as energy efficiency and production costs of WWTWs
- WSIs will be required to strengthen recruitment processes to ensure that registered, qualified, competent staff is appointed that has experience in the particular technologies to be operated – this aspect will receive increased regulatory focus
- The Regulator will require WSIs to put mentor programmes in place whereby qualified, experienced professionals serve as mentors and coach junior staff, and hold them to the highest standard of wastewater service
- Incentivise professional development for process controllers, supervisors, and water unit managers. This should be informed should be informed by Workplace Skills Plans and Skills Development Programmes. Registration as Professional Process Controller (PrPC) at WISA is also encouraged to facilitate professionalisation of wastewater operators and managers
- Developing partnerships with professional training/engineering/science/research institutes to strengthen technical skills and to upskill existing skills, especially in the application of microbiology, chemistry, laboratory results, process adjustments, mathematical calculations, design knowledge, and energy assessment.

Diagnostic 3: Treatment capacity

Several wastewater systems are operating close to or beyond their hydraulic capacity, whilst a high number of WSIs do not know the design capacity or flow to their WWTWs. WSIs are thereby limited in their ability to plan to meet medium-term demand projections, or to confirm if spare capacity is available. This would present a serious impairment to economic growth initiatives. A programmatic approach will be followed to address these risks by targeting:

- Conduct assessments to verify the available plant capacity (hydraulic and organic). This could also be done as part of the recommendation for Process Audits and be combined with future growth projects and demand for wastewater reticulation and treatment capacity
- Strengthen the regulatory requirement for the measurement of operational flows to all WWTWs – this is crucial to confirm available capacity in order to support new housing and business development
- Prioritising the refurbishment or restoring of infrastructure to their original design capacity and functionality
- Accelerate water loss reduction programmes to drastically reduce the loss of potable water to sewer systems
- Identify new infrastructure and upgrade requirements to meet the 10-year demand.
- Water use authorisations demand wastewater volumes to be measured. The Regulator will focus on these requirements more strictly in future.

Diagnostic 4: Wastewater monitoring and compliance

Severe deficiencies were found in the monitoring of operational and compliance parameters were found at most institutions. Some of the compliance related issues will be addressed by the interventions listed under Diagnostic 1, others may include:

- The next Green Drop audit will confirm sludge treatment technologies and operating procedures. As an example, anaerobic digestion, which makes up the bulk of sludge treatment (and reuse opportunities), is poorly monitored and operated at most WWTWS. A provincial programme for upskilling of Plant Supervisors and Process Controllers in sludge handling and biosolids standards will assist to bridge this gap and reintroduce good practice in sludge management
- WSIs must urgently correct failures in the disinfection process which leads to poor microbiological quality effluent that is discharged to rivers, dams and oceans. This single hazard carries risk of epidemic proportions. Operational know-how needs to be improved on biological nutrient removal processes, which is a root cause for disinfection being absent or ineffective.
- National risks such as potential shortages in chemicals (e.g. chlorine) must be planned for as part of the risk management process and W_2RAP document.

Final effluent quality also a direct and long-term impact on the water quality of natural water courses, i.e. rivers, dams, and groundwater. As many WSIs fail to meet final effluent quality standards, remedial action will have to reach beyond the point of discharge and extend to restoring the water resources itself. The Regulator will focus on:

- Strict regulatory enforcement of final effluent quality standards
- Require WSIs to expand impact monitoring to ascertain the status of the natural resource via up- and downstream water qualities, ground water and soil analysis, biomonitoring, and toxicology
- Intensify regulation of bylaw implementation to ensure that hazardous industrial effluent does not impact on the plants capability to produce a high-quality final effluent and stable biosolids
- Incentivise the adoption of a multi-disciplinary team approach to wastewater management in WSIs. These s should include technical, financial, legal, and human resources to ensure compliance with the respective Water Acts of South Africa.

Diagnostic 5: Energy efficiency

A low level of awareness on energy efficiency and conservation exists at most WSIs. The majority of WSIs do not monitor their SPCs, and those who do monitor SPC, exceed the industry and technology benchmarks. This means that many opportunities are forfeited to improve energy efficiency, reduce cost and mitigate CO_2 footprint. First order interventions should be to work in partnerships with relevant public and private partners to:

- Develop internal capacity to conduct energy audits, which will assist to identify baseline energy use and cost, and identify energy efficiency improvement and energy generation opportunities
- Incorporate energy (electricity) as a cost item in the operational budget and the monthly year-to-date expenditure reports for each of the wastewater treatment plants individually. This information should be used to report the energy (kW/m^3) and cost (R/m^3) associated with treatment
- Incorporate electricity monitoring as part of the daily recording regime in the field, including energy consumption and demand tariffs and usage, SPC and compare with benchmarks in the same plant size and technology category
- Ensure that all plant extensions, upgrades, and refurbishment projects specify energy conservation and savings as an output of the project, supported by reduced CO_2 equivalents
- Systematically start to replace all energy intensive equipment with energy efficient hardware and technologies.

Diagnostic 6: Technical Site Assessments

The TSA showed a highly variable result with respect of process and asset functionality for WWTs across the country. While some wastewater systems were excellent others failed in all respects, with many plants being abandoned due to vandalism and other challenges. Regulatory interventions will involve:

- Prioritise anti-vandalism and anti-theft strategies
- Require strengthening of preventative repairs and maintenance programmes, budgets, and competence
- Require streamlining of procurement processes and internal planning for spare parts and chemicals such as chlorine
- Prioritise refurbishment of existing asset functionality by addressing the respective VROOM asset types, i.e. civils, mechanical, and electrical components
- Require minimum turnaround times to ensure fast turnover on repairs and replacement activities
- Implement more regular site inspections and condition assessments by DWS regional staff. WSIs re required to conduct independent assessments every 6-12 months, by a subject expert person
- Incentivise the update and improvement of quality asset registers to contain asset condition, remaining useful life and replacement cost, and use this information as part of the budget process
- Work with sector partners to strengthen Councillor induction programmes, and arrange field visits for Councillors, financial- and municipal managers to observe the typical risks and practicalities of wastewater management to supported informed decisions at executive and policy levels.

Diagnostic 7: Operation, Maintenance and Refurbishment of Assets

The majority of institutions could not present completed and verifiable evidence in the form of budgets, expenditure, asset values, and production cost (Rand/m^3 treated). The Regulator will work with financial sector partners to:

- Ringfence budget and expenditure for wastewater systems is imperative to formulate budgets, monitor expenditure and determine production costs – this will result in cost optimisation with the objective of achieving industry targets in Rand/m^3 treated
- Regular meeting of technical and financial management to review the status of budget and expenditure for wastewater services
- Monitoring and reporting of production cost on a monthly basis, and comparing with industry targets
- Preparation for the Green Drop audit and participation by the financial officials to be a compulsory requirement enforced by municipal managers
- Engage fund managers and WSIs in cases highlighted in this Report where vast amounts of capital funds (mostly grants) have been expended without positive outcomes or impact. Funding agents will be required to put measures in place to track such incidents timely and intervene earlier in the project lifecycle.

The Way Forward

As a way forward towards sustainable improvement of the South African wastewater sector, the following actions will be taken:

i. The Department of Water and Sanitation as Regulator of the water sector will use this Green Drop Report as the performance base-line for the municipal wastewater fraternity, to inform appropriate regulatory intervention with the objective to facilitate improvement. This will include the development of a **Water Services Improvement Programme**, which will include the 10-point plan towards informing sustainable intervention with the objective of ensuring a turnaround in the Municipal Water Services sector.

   The results of this report demands that wastewater services be a primary focus area of the said programme in targeted areas. Green Drop Performance trends will be used to determine repetitive poor performance (which have led to significant environmental damage over a period of time), to inform a more drastic approach towards **ensure turn around**. This could include facilitating long term intervention by either a capacitated water board or any other suitable mode of sanitation services support.

ii. National Government will ensure that grant funding allocated to the water sector will be allocated with the objective of **restoring functionality of existing wastewater infrastructure** according to the findings of this report. The determination of the very rough order of estimates (VROOM) was done to give an estimation of the capital requirement for the functionality restoration drive. This will be effected with the support from National Treasury.

iii. The Regulator will improve **the implementation of Section 19** of the National Water Act (Act 36 of 1998) to ensure that directives are issued with timeframes for implementation. Failure to respond will trigger remedial action be taken at cost of the non-complying entity or municipality. The Department will take steps to improve its capacity to more effective in this duty. There are engagements with the Department of Cooperative Governance as well as National Treasury to explore ways of utilising conditional grants for the purpose of remedial intervention.

iv. The Department welcomes the participation of ESKOM, SASOL and other private sector partners in the Green Drop Process, and will take guide from this to ensure that a **more inclusive regulatory process** be explored for the next audit season. The Green Drop Certification programme will thus become mandatory for all wastewater treatment systems, including the private sector.

All Water Services Institutions are hereby encouraged to commence immediately with the preparation for the next Green Drop audit process.

I don't know where we should take this company, but I do know that if I start with the right people, ask them the right questions, and engage them in vigorous debate, we will find a way to make this company great."

Jim Collins

16. GREEN DROP CERTIFICATION and AWARDS

2022 GREEN DROP CHAMPIONS

> ***Excellent teams don't believe in excellence -- only in constant improvement and constant change."***
> *Tom Peters*

The following organisations, teams, and individuals are acknowledged for outstanding performance or best progress in the following categories:

GREEN DROP AWARDS and RECOGNITION	
GD Certifications to Municipalities	Western Cape Municipalities (12 total): ✓ Witzenberg LM (Ceres 100%, Op die berg 98%, Tulbach 97% – 3 no. WWTWs) ✓ Bitou LM (Plettenberg-Bitou 93%, Kurland 91% – 2 no. WWTWs) ✓ Drakenstein LM (Hermon 92% – 1 no. WWTW) ✓ City of Cape Town Metro (Green Point Outfall 93.5%, Houtbay 93.5%, Philadelphia 96%, Wesfleur Domestic 100% – 4 no. WWTWs) ✓ Saldanha Bay (Hopefield 96% – 1 no. WWTW) ✓ Mossel Bay LM (Herbertsdale 91% – 1 no. WWTW) Gauteng [7 total]: ✓ City of Ekurhuleni Metro (Rondebult 95%, Herbert Bickley 94%, JP Marais 98%, Esther Park 95%, Carl Grundling 95%, Daveyton 99% – 6 no. WWTWs) ✓ Lesedi LM (Ratanda 92% – 1 no. WWTW) KwaZulu Natal [3 total]: ✓ iLembe DM (Frasers 95%, Shakaskraal 92.5% – 2 no. WWTWs) ✓ uMgungundlovu (Cool Air 91% – 1 no. WWTWs)

GREEN DROP AWARDS and RECOGNITION	
GD Contenders to Municipalities [All 89% GD scores]	Western Cape [21 total]: ✓ Drakenstein LM (Paarl, Wellington, Saron, Gouda, Kliprug-Pearl Valley-Val de Vie – 5 no. WWTWs) ✓ City of Cape Town metro (Athlone, Macassar-Strand, Kraaifontein, Mitchells Plain, Borcherd's Quarry, Potsdam-Milnerton, Melkbosstrand, Fisentekraal – 8 no. WWTWs) ✓ Mossel Bay LM (Mossel Bay-Hartenbos – 1 no. WWTW) ✓ Overstrand LM (Gansbaai, Stanford, Hermanus, Darling – 4 no. WWTWs) ✓ Swartland LM (Riebeeck Valley, Malmesbury-Abbotsdale – 2 no. WWTWs) ✓ Breede Valley LM (Worcester – 1 no. WWTW) Gauteng [5 total]: ✓ City of Ekurhuleni Metro (Tsakane, Hartebeesfontein, Welgedacht, Benoni, Rynfield – 5 no. WWTWs) KwaZulu Natal [1 total]: ✓ Harry Gwala (Ixopo – 1 no. WWTW) Mpumalanga [3 total]: ✓ Steve Tshwete LM (KwaZamokuhle-Hendrina, Blinkpan-Mine village, Komati – 3 no. WWTWs)
GD Certifications to Privates	Free State [1 total]: ✓ Sasol Sasolburg – 96%

RECOGNITION OF TEAMS & INSTITUTIONS

Awards	Criteria	Winner	2nd runner up	3rd runner up
Best Performing Municipalities	%GD score - WSI	Witzenberg LM (96%) - Western Cape	Bitou LM (93%) - Western Cape	Drakenstein LM, Overstrand LM, Swartland LM (All 89%) – Western Cape
Best Performing Systems	%GD score - system	Wesfleur Domestic (Atlantis) (99.7%) City of Cape Town - Western Cape	Ceres (99.6%) Witzenberg LM - Western Cape	Daveyton (98.8%) City of Ekurhuleni - Gauteng
Best Technical Site Assessment score	% TSA score	Riebeeck Valley (97%) Swartland LM - Western Cape	Wesfleur Industrial (96%) - City of Cape Town - Western Cape; JP Marais (96%) - City of Ekurhuleni - Gauteng	Wellington (95%) - Drakenstein LM - Western Cape
Best Progress from 2013 - 2021	Highest % GD score increase 2013 – 2021	Stellenbosch LM - Western Cape (40% to 84%)	Nkomazi LM - Mpumalanga (32% to 75%)	Emalahleni LM – Mpumalanga (16% to 45%)
Best Provincial Risk Managers	Lowest CRR% WSI - EC	Buffalo City LM	Nelson Mandela Bay	Amathole DM
	Gauteng	Ekurhuleni Metro	Midvaal LM	City of Johannesburg

RECOGNITION OF TEAMS & INSTITUTIONS				
	Northern Cape	Siyathemba LM	Dawid Kruiper LM	Hantam LM
	Free State	Tokologo LM	Letsemeng LM	Dihlabeng LM
	North West	JB Marks LM	Rustenburg LM	Matlosana LM
	Mpumalanga	Steve Tshwete LM	Nkomazi LM	Emalahleni LM
	Western Cape	Bitou LM	George LM	Drakenstein LM
	KwaZulu Natal	uMgungundlovu DM	Newcastle LM Msunduzi LM	iLembe DM
	Limpopo	Polokwane LM	Capricorn DM	Bela Bela LM
Best Risk Positions	Lowest CRR systems	Cinsta East, Amathole DM, EC Kei Mouth, Amathole DM, EC Appelbosch Hospital, uMgungundlovu DM, KZN Coolair, uMgungundlovu DM, KZN Lynnfield Park, Msunduzi LM, KZN Millerspoint, City of Cape Town, WC Herbertsdale, Mossel Bay LM, WC	Rondebult, City of Ekurhuleni, GP	Bedford, Amathole DM, EC Kaysers Beach, Buffalo City LM, EC Engcobo, Chris Hani DM, EC Ratanda, Lesedi LM, GP Kilbarchin-Ngagane, Newcastle LM, KZN Camperdown, uMgungundlovu DM, KZN Rietspruit, Emalahleni LM, MP Kurland, Bitou LM, WC Hermon, Drakenstein LM, WC Herolds Bay, George LM, WC Belvidere, Knysna LM, WC Brandwag, Mossel Bay LM, WC Hopefield, Saldanha Bay LM, WC Kalbaskraal, Swartland LM, WC Riebeek valley, Swartland LM, WC
Awards - DPW	**Criteria**	**Winner**	**2nd runner up**	**3rd runner up**
Highest Scoring Region	%GD score - Region	DPW Eastern Cape PE (45%)	DPW Western Cape (22%); DPW Gauteng JHB (22%)	DPW Mpumalanga (21%)
Highest Scoring Systems	%GD score - system	Middeldrift Prison (55%), DPW Eastern Cape PE	Storms River Police Station (52%), DPW Eastern Cape PE	Kirkwood Prison (46%), DPW Eastern Cape PE
Highest Technical Site Assessment score	% TSA score	St Albans Prison (81%), DPW Eastern Cape PE		
Best Progress from 2013 - 2021	Highest % GD score increase 2013 - 2021	DPW Eastern Cape PE (8% to 45%)	DPW Gauteng Jhb (0% to 22%)	DPW North West (0% to 18%)
Best Regional Risk Managers	Lowest CRR% WSI	DPW Eastern Cape PE	DPW Mpumalanga	DPW Western Cape
Best Risk Positions	Lowest CRR systems	Middelsdrift Prison, PE	Sandriver Military Base, Nelspruit Buffeljagsrivier Prison, Cape Town	Mahamba Port of Entry, Nelspruit

RECOGNITION OF TEAMS & INSTITUTIONS

Awards - Government and Privates	Criteria	Winner	2nd runner up	3rd runner up
Best Performing Institution	%GD score - Gov/Priv	Sasol Sasolburg (96%) - Free State	Sasol Synfuels (89%) - Mpumalanga	Nedbank Olwazini (84%) - Gauteng
Best Performing Systems	%GD score - system	Sasol Sasolburg (96%) - Free State	Sasol Synfuels (89%) - Mpumalanga	Nedbank Olwazini (84%) - Gauteng
Best Technical Site Assessment score	% TSA score	Nedbank Olwazini (94%) - Gauteng	Sasol Synfuels Secunda (88%) - Mpumalanga	Sun City (85%) - North West
Best Progress from 2013 - 2021	Highest % GD score increase 2013 - 2021	Sasol Sasolburg (86% to 96%)	None	None
Best Risk Managers	Lowest CRR% - WSA	San Parks	Sasol Sasolburg	* Sasol Synfuels Secunda * Nedbank Olwazini
Best Risk Positions	Lowest CRR systems	Letaba, Punda Maria, Shingwedzi, WPS – All San Parks	* Matla – Eskom * Satara, Lower Sabie, Berg en Dal – All San Parks	* Arnot, Koeberg, Thuthukani – All Eskom * Skukuza, Orpen – All San Parks

RECOGNITION OF INDIVIDUALS and GREEN DROP CHAMPIONS

Recognition	Name and Designation	Award
City of Johannesburg: Bushkoppies	Khensane Tsebe - Plant Supervisor	An outstanding manager who creates an enabling environment for Process Controllers through support and team spirit
City of Tshwane: All Systems	Kerneels Esterhuyse - Acting Director Wastewater Treatment	A true Green Drop Champion known for his knowledge, proficiency and getting things done
Sasol: Sasolburg	Simon Dzivhu Makhavhu - Area Manager Production: Water & Waste Utilities, Sasolburg Operations, SASOL	An outstanding team leader, instilling Green Drop excellence standards in Sasol
Sasol: Secunda	Anton Laubscher - Area Manager Production: Area Manager Production. Water and Ash - Secunda Operations, SASOL	An excellent team leader who drives performance through technical skill and enthusiasm
Ngwathe LM: All Systems	Marius Steenkamp - Supervisor Parys WWTW	An indispensable all-rounder who strives to keep systems running under challenging circumstances
uThukela DM: All Systems	Ms Cindy Coetzee – Head of Laboratory	A true Green Drop Champion and indispensable all-rounder who goes the extra mile under challenging circumstances
Umgeni Water, uMgungundlovu DM, Msunduzi LM	Sameera Majam - Scientist Water Quality management Green Drop team at Umgeni Water	A true Green Drop Champion who represents her organisation and the wastewater team in an excellent manner
Siza Water & iLembe DM	Jacobus Duvenhage - Process and Quality Supervisor Chenelle Coopusamy - Process and Quality Assistant Supervisor Raynund Ganesh - Water Quality Manager	A mentor-mentee team with outstanding team leading qualities, instilling Green Drop excellence standards at Siza Water

RECOGNITION OF INDIVIDUALS and GREEN DROP CHAMPIONS		
Kopanong LM: All Systems	Mr Marshall Madolo - Acting Technical Director	A true Green Drop Champion who organises, plan and drives high standards in the organisation and gear his team towards excellence
Drakenstein LM: All Systems	Mr. Geoffrey Bredenkamp and Mr Jurie Jumart	True Green Drop Champions who is the epitome of pride and excellence in wastewater management - true professionals
eThekwini Metro: All Systems	Lusapho Tshangela – Senior Engineer and Selina Govender - Pharmacist	True Green Drop Champions with excellent organising, IRIS and auditee skills
Nkomazi LM: All Systems	Dudu Sifunda - Manager Water & Sanitation	An excellent team leader who drives performance through efficiency, technical skill and diligence
ESKOM: All Systems	Felicia Sono - Chief Environmental Advisor, Environmental Management, Water Centre of Excellence, Generation Division	An efficient team leader, instilling Green Drop standards and gearing for excellence in Eskom's future
Silulumanzi & Mbombela LM: Kingstonvale, Kanyamanzane & Matsulu	Jo Anne Human - Governance and Risk Manager	An excellent team leader who drives performance through efficiency, technical skill and diligence
Silulumanzi & Mbombela LM: Kingstonvale, Kanyamanzane & Matsulu	Elize Keyser - Laboratory Supervisor	A capable scientist who supports her field team with analytical efficiency and quality laboratory services
JB Marks LM: All Systems	Liandi Bothma: Microbiologist	A diligent scientist who supports her field team with IRIS expertise, analytical efficiency and true dedication to wastewater services
Buffalo City : All Systems	Mkhuseli Nongogo – District Engineer	An outstanding team leader with in-dept knowledge of wastewater treatment - team player and solution driven
Nelson Mandela Bay Metro: All Systems	Sicelo (Selby) Thabethe – Senior Superintendent	An energetic and knowledgeable Process Controller who inspires through mentorship and true dedication to his profession and his team - a true Green Drop Champion
Govan Mbeki LM: Bethal WWTW	Mr Moropane - Plant Superintendent	An indispensable all-rounder who strives to keep systems running under challenging circumstances
Dawid Kruiper LM: All Systems	Leoné Sago - Control Technician: Water Production, Sewerage Treatment and Sanitation	A motivated, enthusiastic wastewater professional with excellent technical know-how
Hantam LM: All Systems	Cheslyn Barnes-September - Technician: Water & Sanitation	A motivated, enthusiastic wastewater professional with excellent technical know-how
DPW - Western Cape: All Systems	Ashia Petersen - Control Scientific Technician, Water Management	A motivated, enthusiastic wastewater professional with excellent technical know-how
Thembelihle LM: All Systems	Stephen Marufu - Technical Manager	A Green Drop Champion and Gentlemen - excellence in mentoring, knowledge and respect for his peers and the profession
Sol Plaatje LM: All Systems	Sabelo Mkhize - Senior Manager, Water Services Authority and Compliance	A Green Drop expert in own right - striving to keep systems running under challenging circumstances
Emthanjeni LM: All Systems	Jason Barth – Technician	A Green Drop expert in own right - stiving to keep systems running under challenging circumstances
Kareeberg LM: All Systems	Albertus van Schalkwyk – Operational Manager	A hard-working, innovative professional who strives for excellent in his everyday work ethic and positive approach to duty and his team

RECOGNITION OF INDIVIDUALS and GREEN DROP CHAMPIONS		
Dikgatlong LM: All Systems	Desmond Makaleni - Technical Manager	A newcomer to Green Drop with technical knowhow and morale builder
DPW – Mpumalanga: All Systems	Puseletso Mohlala - Water and wastewater supervisor	A Green Drop expert and superb organiser - striving to keep IRIS and systems organised under challenging circumstances
Midvaal LM: All Systems	Sandra Ratshili - Acting Technician: Purification	A dedicated Green Dropper and superb organiser - striving to keep IRIS and systems organised - dedicated and efficient
Bushbuckridge LM: All Systems	Angelinah Mashego - Process Laboratory Supervisor	A dedicated Green Dropper and committed to the future of the organisation - indispensable support to operations and planned laboratory services

"It always seems impossible until it's done."
Nelson Mandela

Jim Collins remarked that *greatness is not a function of circumstance. Greatness is largely a matter of conscious choice, and discipline.*
Welll done Stellenbosch – you have shown all these qualities and came such a far way since 2013. What a fun moment.

The effectiveness of a well-run and maintained works can be further enhanced with little aspects, such as beautification of the work environment with low maintenance plants. Makes for a pleasant work environment. Nice idea Mzunduzi LM and Umgeni team.

ANNEXURE A: CALCULATIONS TABLE

PARAMETER	DESCRIPTION	CALCULATION	REFERENCE
Green Drop Scores	A GD % is awarded to an individual WWTW based on audit results considered against 5 KPAs. The individual audit scores aggregate as a single (weighted) GD audit score for the WSI. The score is weighted against the design capacities of the individual WWTWs.	1) System GD score (%) = Sum (Audit scores x KPA sub weights) for each of the 5 KPAs Example: KPA sub weight = 15% of 100% for all 5 KPAs; KPA A sub-weights are 20% each for sub-KPAs A1 to A5 as per GD Requirements in the scorecard KPA A = (100% x 0.2) + (100% x 0.2) +(90% x 0.2) + (100% x 0.2) + (100% x 0.2) = 98% Contribution of KPA A to the overall GD score = (98% x 0.15) = 14.7% (out of 15%) 2) WSI GD score (%) = Sum ((System design capacity / Total design capacity) x System GD score) Example (WSA - 2 Systems): WSA GD score = ((200 Ml/d / 255 Ml/d) x 66.4%) + ((55 Ml/d / 255 Ml/d) x 86.6% = 70.7%	Introductory Provincial and National Chapters
Cumulative Risk Rating	CRR and %CRR/CRRmax The CRR value is based on 4 (weighted) risk indicators, i.e. the design capacity, ADWF, # final effluent failures and technical skills status at each WWTW. The risk weights are summarised in the section following this table. The %CRR/CRRmax provides the variance of a CRR value against the maximum CRR value that could potentially be reached if all 4 risk indicators are in critical state	1) CRR = (A x B) + C + D) where A = Design capacity rating, B = Capacity exceedance rating, C = Final effluent failures rating, D = Technical skills rating Example: CRR = (2 x 3) + 6 + 2 = 14 ; CRR max = (2 x 5) + 8 + 4 = 22 ; %CRR/CRRmax = (14/22) x 100 = 63.6% 2) WSA %CRR/CRRmax = Mean (arithmetical average) %CRR/CRRmax calculated for each WSA Example (3 systems): WSA %CRR/CRRmax = Mean(64.9% + 40.6% + 59.1%) / 3 = 54.9%	Introductory Provincial and National Chapters
Technical Site Assessments	The TSA % reflects the physical condition of the sewer collector network, pumping stations, treatment plant and point of discharge. The intention of the TSA is to verify the evidence and findings presented during the GD audit through the physical inspections of randomly selected sites	Multiple TSA scores per WSA: Combined TSA score = System design capacity divided by total TSA design capacity and multiplied by TSA score Example (2 TSA scores) = (200 Ml/d / 350 Ml/d) x 71% + (150 Ml/d / 350 Ml/d) x 59% = 66%	GD scorecards
	TSA and GD score comparison	% Deviation (TSA & GD score) = % score difference Example: TSA score = 44% and GD score = 38% = 6% deviation or difference	Diagnostic 6
Green Drop KPA Analysis	Mean GD score (&) for KPA A to E	Mean (arithmetical average) = Mean (Range of values) Example: Mean (32% + 68% + 94%) / 3 = 65%	Diagnostic 1
Technical Competence	Ratios to do a comparative analysis "Qualified Technical Staff" - staff appointed in positions to support wastewater services, and who has the required qualifications. "Technical shortfall" means the number of staff who are in technical support positions. "Qualified Scientists" - professional registered scientists (SACNASP) appointed in positions to support wastewater services. "Scientist's shortfall" means the number of scientists in scientific positions that are professional registered and qualified in technical support positions but not qualified. "Shortfall" is calculated based on a minimum requirement of at least 2 Engineers/Technologists/Technicians and at least one 1 Scientist per WSI.	Ratio - A : B (2 elements) or A : B : C (3 elements) etc Example 1: WWTW staff - No. Supervisors : No PC = 1 : 3 (based on 2 shifts) Example 2: If WSI has no qualified technical staff, the shortfall would be 2 qualified technical staff; Similarly, If WSI has 1 qualified technical staff, the shortfall would be 1 qualified technical staff Example 3: If WSI has no qualified scientific staff, the shortfall would be 1 qualified scientist; Similarly, If WSI has 1 qualified scientist, the shortfall would be zero	Diagnostic 2

PARAMETER	DESCRIPTION	CALCULATION	REFERENCE
Treatment Capacity	Future average wastewater flows (minimum and maximum options) based on future population growths using 2021 Statistical figure of 2.5%	Red Book: Water consumption (q) = 400 l/c/day; wastewater flow (qw) = 60-80% of water consumption. Anticipated flow Qw = P*q*qw (P-population) Example: 219.4 Ml/d spare capacity. 40-60% goes to plant: 0.4*219.4-160l/c/d to 240 l/c/d; Available capacity can service: 219.4 x 1,000,000/160 = 1,371,250 persons (for 40% flow) and 219.4 x 1,000,000/240 = 914,166 persons (for 60% flow)	Diagnostic 3
Wastewater Monitoring and Compliance	%Mean of each of the 3 no. final effluent categories (Microbiological, Chemical and Physical)	1) Mean (arithmetical average) = Mean (Range of values) Example: Mean (24% + 71% + 91%) / 3 = 62% 2) % Compliance = #Compliant samples / Total #Samples tested *100 Example: %Compliance = 42 samples comply with 75mg/l COD / 50 samples tested = 84% compliance for COD	Diagnostic 4
Energy Efficiency	Median used for Actual SPC and Energy Cost (R/m³) due to asymmetrical/ skewed data sets and because of outliers that do not represent credible figures or values	Median = +Median (Range of values) Example (Actual SPC in kW/m³): Median = (1.02 + 1418 + 0.51 + 0.36) = 0.77	Diagnostic 5
	Typical industry benchmark figures (range as per the wastewater technology types (effluent) per WSI) and Energy Unit Cost/Tariff (R/kWh) (From: WRC 2021 Energy Report)	Range = Range (A to B) or Range (A to C), etc Example (Industry benchmarks for type of WW technology in kWh/m³) where WSI has Activated Sludge & BNR and Biofilters: Range (BF & AS BNR) = 0.177-0.412	
Operation & Maintenance & Refurbishment of Assets	O&M Cost Benchmarking using: - WRC WATCOST model: calculated breakdown of assets into civil, buildings, pipelines, mechanical, electrical, instrumentation. - SALGA model: calculate annual maintenance cost per asset type based on benchmark of 15.75% of asset value -Production cost by a specific WWTW to treat inflow expressed in R/m³ -Shortfall is the gap between the budgeted production cost budgeted and actual cost expressed in R/m³	1) Current asset value (100% = Civil structures (46%) + Buildings (3%) + Pipelines (6%) + Mechanical equipment (35%) + Electrical equipment (8%) + Instrumentation (2%) 2) Modified SALGA maintenance guideline: 15.5% = Civil structures (0.5%) + Buildings (1.5%) + Pipelines (0.75%) + Mechanical equipment (4%) + Electrical equipment (4%) + Instrumentation (5%) Example (Civil structures) = (0.46 x R20,000,000) X 0.005) = R46,000 3) System O&M cost = System Expenditure (R) / Operational Flow (Ml/d) * 1000 Example: R13,1m / 9.6 Ml/d *1000 = R1.36/m³ 4) Shortfall = Budget Cost – Actual Cost Example: R3,90/m³ - R1.36/m³ = R2.54	Diagnostic 7
	Median used for O&M Budget (R/m³), O&M Actual (R/m³) and Shortfall (R/m³) *Note: asymmetrical/skewed data sets, outliers, data credible issues*	Median = +Median (Range of values) Example: (O&M Budget (R/m³)): Median = (2.03 + 13,476.00 + 6.98 + 7.77 + 3.67) = 6.98	
VROOM	Estimation of cost required to restore existing infrastructure to its original design capacity and operational functionality by addressing civil, mechanical, and electrical failures or defects. The cost is derived from an algorithm that uses the GD Inspector's impression of the condition of the hardware, coupled with the system-specific design capacity and GD score to derive an aggregated score for all systems within the WSI. The aggregated score is based on an algorithm that uses the refurbishment cost estimate of 1-2 systems and extrapolates it according to the other systems size and GD scores to arrive at a VROOM estimation cost	With reference to the earlier 'TSAs' parameter: The following is extracted from the TSA scorecard and inserted into the WSA Summary Dashboard of the GD scorecard: (1) VROOM cost ratio in R million per Ml/d (2) % cost estimates for Civil and Mechanical Estimated refurbishment requirement = VROOM cost ratio (R million per Ml/d) x total WSA systems design capacity x 10^6 Example: VROOM Cost = R1.87 (from TSA scorecard) x 1058 Ml/d (Total design capacity from WSI Information Sheet) x 10^6 = R1,978,460,000	GD scorecards Diagnostic 7

CRR Risk Weighting: Risk is defined and calculated by the following formulae:

Cumulative Risk Rating (CRR) = (A x B) + C + D

Where:
A = Hydraulic design capacity of the treatment plant in Ml/day
B = Operational flow as % of the installed design capacity
C = Number of non-compliant effluent quality parameters at point of discharge to receiving water body
D = Number of technical skills gaps (supervision, operation, maintenance) in terms of Reg. 2834 & Draft Reg. 813.

Each risk element carries a different weight in proportion to the severity of the risk element (refer to Annexure A):

	A: Design Capacity (Ml/d)	WF
Design Capacity Rating	> 400	7
	201 to 400	6
	101 to 200	5
	51 to 100	4
	21 to 50	3
	20 to 5	2
	<5	1

	C: Technical Skills Compliance	WF
Technical Skills Rating	Superintendent + Process Controllers + Maintenance Team	1
	Superintendent + Maintenance Team but no Process Controllers	2
	Process Controllers + Maintenance Team but no Superintendent	
	Process Controllers + Superintendent but no Maintenance Team	
	Superintendent but no Maintenance Team & no Process Controllers	3
	Process Controllers but no Maintenance Team & no Superintendent	
	Maintenance Team but no Superintendent & no Process Controllers	
	No Superintendent + No Process Controllers + No Maintenance Team	4

	B: Design Capacity Exceedance (%)	WF
Capacity Exceedance Rating	> 151 %	5
	101 - 150 %	4
	51 - 100 %	3
	1 - 50 %	2
	0 - 10 %	1
	< 0 %	0

D: No of Non-Compliant Parameters	WF
Effluent Failure Rating	8
	7
	6
	5
	4
	3
	2
	1
	0

Risk indicator D for effluent quality (8x):
- Microbiological: Faecal coliform or *Escherichia coli*
- Physical: pH, EC, SS
- Chemical: COD, NH_3-N, NO_3-N, O-PO_4

ANNEXURE B: GUIDE TO READING THE REPORT CARD

The following is an example of a typical report card that appears in the Green Drop Report 2022. Results are provided in colour coded format – each colour has a specific meaning and performance reference.

Water Service Institution	**Name**
Water Service Provider/s	Name

WSI Green Drop Score	
2021 Green Drop Score	**82%↑**
2013 Green Drop Score	**64%**
2011 Green Drop Score	**45%**
2009 Green Drop Score	**26%**

The WSI Green Drop score is a **Performance Indicator** of the overall wastewater business of the organisation. See colour legends below.
Arrows: Depict the current Green Drop status of the plant. A ↑ arrow shows improvement, ↓ shows digress, → shows unchanged situation

VROOM Impression: List of dysfunctional hardware **VROOM Estimation:** Extrapolated Rand value to restore functionality	**Breakdown of VROOM**		
	Civil	0%	R0
	Mechanical	71%	R4,270,280
	Electrical	29%	R1,769,720

Estimated refurbishment cost and key hardware defects are listed. The VROOM breakdown is summarised in the Provincial Summary under the 'Cost Diagnostic".

Key Performance Area	**Weight**	**System X**
A. Capacity Management	15%	100%
B. Environmental Management	15%	86%
C. Financial Management	30%	72%
D. Technical Management	20%	76%
E. Effluent & Sludge Compliance	30%	70%
F. Bonus		78%
G. Penalties		0%
H. Disqualifiers		None
Green Drop Score (2021)		**82%**
2013 Green Drop Score		**64%**
2011 Green Drop Score		**45%**
2009 Green Drop Score		**26%**
System Design Capacity	Ml/d	28
Design Capacity Utilisation (%)		77%
Resource Discharged into		Mhlongo River
Microbiological Compliance	%	91%
Chemical Compliance	%	96%
Physical Compliance	%	100%
Wastewater Risk Rating (CRR% of CRR_{max})		**System X**
CRR (2011)	%	76%
CRR (2013)	%	63%
CRR (2021)	%	45%

Note: Design capacity refers to Average Dry Weather Flow (ADWF)

Colour codes	**Appropriate action by institution**
90-100%	Excellent situation, need to maintain via continued improvement
80-<90%	Good status, improve where gaps identified to shift to 'excellent'
50-<80%	Average performance, ample room for improvement
31-<50%	Very poor performance, need targeted turnaround interventions
0-<31%	Critical state, need urgent intervention for all aspects of the wastewater services business

A system is disqualified from GD Certification if it defaulted to respond to a Notice/Directive

The final Green Drop score - same colour legends as above

Operational flow as calculated as % of the design capacity (ADWF)*

Effluent quality compliance compared to mandatory limits as audited under KPA E. A system is disqualified from Green Drop Certification if microbiological and/or chemical compliance <90%

CRR% indicates the risk of each treatment plant. A higher value reflects a high-risk state (undesirable). A lower value reflects a lower risk state.

CRR% Deviation	
	90 – 100% Critical risk WWTP
	70 - <90% High Risk WWTP
	50-<70% Medium risk WWTP
	<50% Low Risk WWTP

ANNEXURE C: ACRONYMS

ACRONYMS	DESCRIPTION	ACRONYMS	DESCRIPTION
AD	Anaerobic Digester	**Ml**	Mega litre
ADWF	Average Dry Weather Flow	**Ml/d**	Mega litres per day
AS(P)	Activated Sludge (Plant)	**NA**	Not Assessed or Not Applied
BF	Biofilter	**NEWRI**	Nanyang Environment & Water Research Institute
BNR	Biological Nutrient Reactor	**NI**	No information
CFO / CEO	Chief Financial / Executive Officer	**NQF**	National Qualifications Framework
C:N:P	Carbon Nitrogen Phosphorus ratio	**O&M**	Operation and Maintenance
CO_2 eq	Carbon Dioxide equivalent	**PA**	Process Audit
CoJ	City of Johannesburg	**PC**	Process Controller
CoCT	City of Cape Town	**PST**	Primary Settling Tank
COT	City of Tshwane	**RAS**	Return Activated Sludge
COD	Chemical Oxygen Demand	**RBC**	Rotating Biological Contactor
CRR	Cumulative Risk Rating	**RBIG**	Regional Bulk Infrastructure Grant
CS	Correctional Services	**RR**	Risk Register
DAF	Diffused Air Flotation	**SACNASP**	South African Council for Natural Scientific Professions
DCS	Department of Correctional Services	**SAHRC**	South African Human Rights Commission
DFFE	Department of Forestry, Fisheries and Environment	**SALGA**	South African Local Government Association
DM	District Municipality	**SBR**	Sequence Batch Reactor
DMRE	Department of Mineral Resources & Energy	**SLA**	Service Level Agreement
DO	Dissolved Oxygen	**SMP**	Sludge Management Plan
DPW	Department of Public Works	**SOE**	State Owned Enterprise
DWS	Department of Water and Sanitation	**SPC**	Specific Power Consumption
EA	Extended aeration	**SS**	Suspended Solids
EPWP	Expanded Public Works Programme	**SSC/SST**	Secondary Sludge Clarifier / Settler
GA	General Authorisation	**SVI**	Sludge Volume Index
GD	Green Drop	**TSA**	Technical Site Assessment
GDC	Green Drop Certification	**USDG**	Urban Settlements Development Grant
GWSA	Green Water Services Audit	**VROOM**	Very Rough Order Of Measurement
IMP	Incident Management Protocol	**W_2RAP**	Wastewater Risk Abatement Plan
IRIS	Integrated Regulatory Information System	**WF**	Weighting Factor
KPA	Key Performance Area	**WRC**	Water Research Commission
kl	kilo litre	**WSA**	Water Services Authority
km	kilo metre	**WSP**	Water Services Provider
kWh	kilo Watt hour	**WSI**	Water Services Institution
LM	Local Municipality	**WSIG**	Water Services Infrastructure Grant
MA	Mechanical Aeration	**WUL**	Water Use Licence
MB	Military Base	**WWTP/W**	Wastewater Treatment Plant/Works
MBR	Membrane Biological Reactor		
PROVINCES/REGIONS			
EC	Eastern Cape	**NW**	North West
FS	Free State	**NC**	Northern Cape
GP	Gauteng	**KZN**	KwaZulu Natal
LP	Limpopo	**WC**	Western Cape
MP	Mpumalanga		

ANNEXURE D: LIST OF TABLES

ANNEXURE E: LIST OF FIGURES

eThekwini Metro, Umbilo WWTW. The pristine nature of the works and infrastructure blends in with the conservation area, which the municipality ensure on a daily basis – 91% TSA score.
Well done to this City.

Drakenstein continues to impress. The Wellington WWTW aeration and works in general affirm how a plant should be operated. The evenness of the aeration draws the Regulator to this picture – well done with your Green Drop Excellence.