DEVELOPMENT OF REGULATIONS TO ENTRENCH WATER EFFICIENT SANITATION SOLUTIONS IN BULK SERVICES

A report to the

Water Research Commission

by

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EXECUTIVE SUMMARY

Bulk services constraints

Water and sanitation services in municipalities are experiencing significant challenges pertaining to interruption of services and failure in the delivery of water services to its constituencies. Ineffective service delivery and dysfunctional infrastructure also translate to inability to approve and service new developments, whilst pressure on existing infrastructure (sewers and treatment facilities) and water resources are incrementally increasing.

Access to functioning and capacitated water and sanitation bulk services, stressed or over-abstracted water resources, as well as cumbersome institutional and environmental processes impact negatively on the development and investment in housing, business and industrial facilities.

Purpose of this project

This WRC study identified changes in the current regulatory framework that will:

- Prevent irresponsible greenfield development that place an additional burden on existing stressed systems or resources,
- Facilitate responsible greenfield development that rather enable good practices linked to localised water efficient solutions with low generation of faecal matter/sludge,
- Open a pathway to scale up the application of new localised water efficient solutions with low generation of faecal matter/sludge, which will hopefully transition to other areas of sanitation, in both greenfield and brownfield, which are becoming unsustainable and cost prohibitive to maintain and manage.

Outcomes and findings

Entrenching of water efficient sanitation solutions (WESS) has material potential to reduce or negate negative impacts and facilitate unlocking bulk-related projects through sectoral regulation and policy. Three approaches are considered:

- Approach 1 (short term option <5 years): Rapid adaption, amendment and strengthening of existing Department of Water and Sanitation (DWS) regulation to ensure that efficient water use, and where possible, off-grid services form part of the sanitation solutions being investigated for new greenfield developments;
- Approach 2 (medium term option 5-10 years): Further entrenching water efficient sanitation solutions in DWS regulation through more extensive changes to existing regulations and guidelines or developing new regulations that entrenches WESS as part of the sanitation solutions being investigated for all developments (brownfield and greenfield);
- Approach 3 (long term option >10 years): Entrenching water efficient sanitation solutions in sectoral regulation by amending or strengthening DWS- and non-DWS regulations, guidelines and standards or develop new regulatory documentation, e.g. SANS, to facilitate the enactment of WESS and

WESS-related concepts. This may require the involvement of various other departments and government agencies and should be seen as a long term option.

These routes include the strengthening of WESS in the existing regulatory process, including the proposed compulsory Water and Sanitation Services Norms and Standards (N&S), the standard water use licence (WUL)/IWUL application process, and leveraging the concepts through the Blue & Green Drop incentive-based regulation assessments.

Regulatory intervention that allows for innovative WESS would fast-track and unlock bulk-related development projects which are deadlocked in processes that disallow connections to existing municipal networks and WWTWs, whilst being unable to offer any alternative solution to developers of new greenfield or major redevelopment of brownfield areas. Projects that can benefit from WESS could include:

- A developer is enabled to invest in a greenfield development project, such as new sectional title/residential complexes and estates (including resort developments) or a major redevelopment (brownfield areas), despite constrained access to existing bulk infrastructure, by undertaking collection, transport and wastewater treatment services in-house, through employing WESS;
- Despite limited available water resources in an area, there is a potential for service extension through employing WESS, instead of waterborne sanitation;
- Alternative water efficient or dry sanitation system developments (without long term negative environmental impact), if facilitated and effectively accommodated in the national- or municipal environment, can encourage further development, e.g.:
    - A developer may be able to gain municipal approval for an alternative solution due to technology exposure or certification or approved Norms and Standards for such alternative solution;,
    - A developer, with municipal approval for alternative solution, is able to get authorisation for the WWTWs through NWA Act Section 21, due to availability of technology exposure or certification or approved Norms and Standards for such alternative solution;
    - A developer's proposed on-site WWTW, although not fully able to meet strict effluent quality standards (GA general- or special limits), may potentially obtain DWS approval for relaxation of specific effluent quality parameters, specifically if pollution impact is limited;
    - A process would be created for a municipality and/or developer to approach DWS during project conceptualisation phase to fast-track approval and licensing processes based on the projected water use, wastewater discharge or reuse, water services infrastructure and technologies proposed;.
- In a case where the local regulation or municipality continues to block or frustrate development where appropriate WESS has been offered, the developer would have a recourse to approach DWS directly.

This study did not focus on developing or describing punitive measures relating to the failure of enacting WESS at a municipal development level, but rather focused on entrenching and compelling WSAs, WSPs & WSIs (including greenfield developers as WSI operating as WSP), to:

- "conserve water" and achieve efficient water use, through measures such as being off-grid and or using water saving devices, water-efficient processes (recycling);

- ensure that planned developments will not form part of a stressed existing water service;
- investigate and prove, prior to opting for a connection to a waterborne system, that an "off-grid" sanitation option would be non-viable, more onerous/hazardous to the WSA and/or the environment before motivating.

Recommendations for immediate action

Specific changes to existing DWS regulations is recommended, focusing on:

- Changes to DWS's "Proposed Compulsory National Water and Sanitation Services Norms and Standards Jan-2024" to accommodate for WESS;
- Update of the BD & GD assessment criteria to incentive WSIs to quantify their infrastructure baseline (capacity, functionality and resource availability) and outline plans for alternative smart solution in bulk provision;
- Changes to the current WUL process and forms to:
    - Ensure that the WSI confirm their situation relating to their sewer network and wastewater treatment operational capacity,
    - Have WSI confirm that the WUL applicant's selected option supports their water and sanitation situation and is the most appropriate under the circumstances,
    - Have the WUL applicant prove effective water efficient and WCDM practices within their design, and or
    - Have the WUL applicant prove their selected sanitation option is a water-efficient sanitation solution,
    - Ensure that the developer, or the long term operational/management body, sign as a water service intermediary (operating as WSP), a Service Level Agreement with the WSA, confirming the system-specific conditions or criteria of required for compliant service provision;,
- Changes to WUL guideline documents to align with recommended requirements/changes as per the N&S guideline documents and BD/GD process, to include recourse to developers who are unable to proceed within the confines of the local municipal processes or are hampered by lengthy complex licensing processes.

Way forward

In the short term, DWS is to undertake the recommended amendments as per the focus areas for immediate entrenchment of WESS in bulk services.

In the longer term, DWS is to undertake further actions to strengthen, encourage and entrench WESS, including undertaking steps to ensure similar amendments in other DWS- and non-DWS policy, regulatory instruments, guidelines and related documentation. This includes concepts such as:

- DWS encouraging the review of existing SANS to ensure applicability to SA environment (e.g. The SANS 10400-Part Q and/or ISO 31800:2020 to allow for effective inclusion of the broader spectrum (non-pre-fabricated) of DWWT systems);

- DWS driving recommended amendments to SANS 10400 and the NBR in terms of improving sanitation water efficiency measures;
- DWS encouraging the development of additional, new regulatory instruments, such as SANS, to facilitate the enactment of WESS concepts (SANS 10400 part XB (efficient water usage in buildings));
- DWS developing WQ guidelines for non-potable uses, such as toilet and urinal flushing (non-closed loop), priming drain traps and even potentially cold water clothes washing, using the fuller spectrum of treated alternate water sources (including treated blackwater) – these need to define acceptable reuse options, conditions, and discharge standards;
- DWS driving enactment of a water efficiency labelling and standards (WELS) rating system for water efficient appliances and fixtures;
- DWS updating current Model By-laws to encourage water efficiency through inclusion and adoption of good practices from municipalities, such as CoCT & EWS, including for consideration of water efficient fittings and equipment, and regular revision of these guideline models (5-year basis).

With WESS entrenched in regulation through the recommended changes (e.g. in the Norms & Standards, WUL process & incentive-based regulation), existing punitive measures within the legislation, applicable to non-compliance of these regulations, may prove to be adequate. Should DWS wish to develop stronger and more specific non-compliance orientated punitive measures, it is recommended that DWS utilise legal specialists to develop the necessary legal punitive actions for non-compliance with WESS.

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ACRONYMS

Abbreviation	Description
AFTRA	Africa Federation of Teaching Regulatory Authorities
AMCOW	African Ministers' Council on Water
ASIDI	Accelerated Schools Infrastructure Delivery Initiative
B-BBEE	Broad-Black Based Economic Empowerment
BD	Blue Drop
BMGF	Bill and Melinda Gates Foundation
BTLE	Bluetooth Low Energy
CAB	Community Ablution Block
CAPEX	Capital expenditure
CapManEx	Capital Maintenance Expenditure
CBO	Community-based Organisation
CEMM	City of Ekurhuleni Metropolitan Municipality
CoCT	City of Cape Town
COEGA	The Coega Development Corporation
COGTA	Department of Cooperative Governance and Traditional Affairs
CoJ	City of Johannesburg
CSI	Corporate Social Investment
CSIR	Council for Scientific and Industrial Research
CTMM	City of Tshwane Metropolitan Municipality
DBE	Department of Basic Education (National)
DBSA	The Development Bank of South Africa
DEFF	Department of Environment, Forestry and Fisheries
DEWATS	Decentralised Wastewater Treatment Systems – It refers to a technical approach rather than merely a technology package.
DHS	Department of Human Settlement
DPR	Direct Potable Reuse (direct water reclamation)
DPW (DPWI)	Department of Public Works (and Infrastructure)
DSA system	Direct Sanitation Application system
DSI	Department of Science and Innovation
DST	Department of Science and Technology
DST	Dry Sanitation Toilet unit
DWS	Department of Water and Sanitation
DWWT	Decentralised Wastewater Treatment
DWWTS	Decentralised Wastewater Treatment System
ECDOE	Eastern Cape Department of Education
EEA	European Environment Agency
EFMS	Education Facilities Management System
EFTP	Engineering Field Testing Platform

EHPs	Environmental Health Practitioners
EIG	Education Infrastructure Grant
EMIS	Education Management Information System
EPA	American or US's Environmental Protection Agency
ESI	World Bank Economics of Sanitation Initiative
EWS	eThekwini Municipality's Water and Sanitation Department
FBS	Free Basic Services
FEDSAS	Federation of Governing Bodies of SA Schools
FSM	Faecal Sludge Management
G2RT	Generation 2 Reinvented Toilet
GBCSA	Green Building Council of South Africa
GD	Green Drop
GDD	Greywater Diversion Device (GDD)
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GL	General Limits ito DWS WQ limits
GNR.509 - June 2001	Government Notice R. 509: Water Services Act (108/1997): Regulations: Compulsory national standards and measures to conserve water. Published 8 June 2001
GoK	Government of Kenya
GPEDU	Gauteng Department of Education
gpf	gallons per flush
GPS	Global Positioning System
GTS	Greywater Treatment System
H&S	Health and Safety
HMI	Human Machine Interface
HSM	Health and safety manager
HSO	Health and safety officer
HTAP	Healthy Toilets are Possible!
IAPMO	International Association of Plumbing and Mechanical Officials
IAS	International Accreditation Service
IDT	The Independent Development Trust
imp gal	Imperial Gallon – Imperial gallon is about one-fifth or 20 per cent greater in volume than the American gallon
IOPSA	Institute of Plumbing SA
IoT	Internet of Things
IPAP	Industrial Policy Action Plan
IPR	Indirect Potable Reuse
IRC	International Reference Centre on Community Water Supply and Sanitation (aka International Water and Sanitation Centre)

ISO	International Organisation for Standardisation
ito	In terms of
IWUL	Integrated Water Use Licence
IY	Impilo Yabantu
JASWIC	Joint Acceptance Scheme for Water Services Installation Components
JMP	Joint Monitoring Programme
KPIs	Key Performance Indicators
KZN	KwaZulu-Natal
ℓ	litre and litres
ℓ/m	litres per minute
ℓ/s	litres per second
LITRP	Low-Income Toilet Replacement Programme
LOFLOs	Low-flow on-site sanitation systems
ℓpf	litres per flush
LPMD	Litres per measurement per day
LTCPs	Local technology and commercialisation partners
MaP	Maximum Performance
MAVT	Multi-Attribute Value Theory
MCDA	Multiple Criteria Decision Analysis
MDG	Millenium Development Goals
MHM	Menstrual Hygiene Management
MTSF	Medium Term Strategic Framework
N&S	Norms and Standards
NAPTOSA	National Professional Teachers' Organisation of South Africa
NASGB	National Association of School Governing Bodies
NBR	National Building Regulation
NBR & BS Act	National Building Regulations and Building Standards Act, No 103 of 1977
NDP	National Development Plan
NECT	The National Education Collaboration Trust
NEIMS	National Education Infrastructure Management System
NFC tags	Near Field Communication tags
NGO	Non-government Organisation
NGS	Next Generation Sanitation (also known as New Generation Sanitation)
NHBRC	National Home Builders Registration Council
NMBM	Nelson Mandela Bay Metropolitan Municipality
NPP	Non-price policies
NRCS	National Regulator for Compulsory Specifications
NRF	National Research Foundation (of South Africa)
NSF	National Science Foundation
NSS	Non-sewered sanitation
NSSS	Non-sewered sanitation systems

NTU	National Teachers Union
NWA	National Water Act, No 36 of 1998
NWP	Netherlands Water Partnership
Ø	Diameter
O&M	Operations and Maintenance
OPEX	Operational expenditure
PAT	Progress Assessment Tool
PAWTP	Packaged Aerated Wastewater Treatment Plant
PED	Provincial Education Department
PEU	Professional Educators' Union
PID	Partners in Development
PIRB	Plumbing Industry Registration Board
PLIFR	Pensioner and Low-Income Family Full Retrofit Programme
PMG	Parliament Monitoring Group
PMSU	Programme Management Services Unit
PP	Priced Policies
PRG	Pollution Research Group
QR code	Quick Response code
R&D	Research and Development
RDI	National Water Research, Development and Innovation Roadmap
SABS	South African Bureau of Standards
SACE	South African Council for Educators
SACPS	South African Product Certification Services Pty Ltd
SADC	Southern African Development Community
SADTU	South African Democratic Teachers Union
SAFE	Sanitation Appropriate for Education
SALGA	South African Local Government Association
SAMCO	Structural Assessment, Monitoring and Control
SANAS	South African National Accreditation Systems
SANiTi	Sanitation Transformation Initiative
SANS	South African National Standard
SAOU	Suid Afrikaanse Onderwysersunie
SAPA	South African Principals' Association
SASTEP	South African Sanitation Technology Demonstration Programme
SATAS	South African Technical Auditing Services (Pty) Ltd.
SCM	Supply Chain Management
SDG	Sustainable Development Goals
SFWS	Strategic Framework for Water Services
SGB	School Governing Body
SME	Small to Medium Enterprise
SMME	Small, Medium and Micro Enterprises

SOE	State-Owned Enterprise
SPI	Service Provider Interface
SST	Smart Sanitation Technology
STTCC	Sanitation Technology Technical Coordinating Committee
SWA-HLM	Sanitation and Water for All High-Level Meeting
T&E	Testing and Evaluation (facility)
TBC	Toilet Board Coalition
the dti	The Department of Trade and Industry (pre June 2019)
the dtic	Department of Trade, Industry and Competition (post June 2019)
TIPS	Trade & Industrial Policy Strategies
TSA	Three Star Approach
UD	Urine Diversion
UDDT	Urine-Diverting Dry Toilet
UJ-PEETS	University of Johannesburg – UJ Process, Energy & Environment Technology Station
US gal	American gallon
USD	United States Dollar
USF	University of South Florida
VIP	Ventilated Improved Pit Latrines
VUNA	Valorisation of Urine Nutrients
WADER	Water Technologies Demonstration Programme
WADI	Water Distribution
WASH	Water, Sanitation and Hygiene
WATSAN	Water and Sanitation
WCWDM	Water Conservation and Water Demand Management
WE&RF	Water Environment and Reuse Foundation
WEF	Water and Environmental Federation
WELS	Water Efficiency Labelling and Standards Scheme
WESS	Water Efficient Sanitation Solution
WET	Water and Environmental Technology
WHO	World Health Organisation
WinS	Water, Sanitation and Hygiene (WASH) in Schools
WPC	Water Performance Certificates (part of Green Building Policy)
WQRM	Water Quality Management Report
WRC	Water Research Commission
WRRF	Water Resources Research Foundation
WSD	Water Sensitive Design
WSI	Water Services Institution
WSUD	Water Sensitive Urban Design
WUL	Water Use Licence
WWF	World-Wide Fund for Nature (World Wildlife Fund)

WWTP/W	Wastewater Treatment Plant/Works

1 BACKGROUND

1.1 Introduction

Municipalities are experiencing significant challenges in the delivery of water and sanitation services, ranging from interrupted water supply, sewage spillages, failing assets to unrecovered revenue. The most recent Green Drop (2022) and Blue Drop (2023) reports confirmed that many municipal water networks and treatment facilities are not achieving the minimum compliance standards. Ineffective services mechanisms and dysfunctional infrastructure also translate to inability to service new developments, operate, and maintain existing infrastructure, and safeguard natural water resources. Climatic effects on resources and services management compound this already complex situation, whilst frustrating investment and leaving communities desponded without access to alternative services options.

Current programmes and interventions around municipal housing and engineering services aim mostly to restore existing functionality and capacity, without due consideration of the consequences associated with factors that restrict new developments, e.g. new housing schemes in low and high income areas, estate living, and industrial development. There are currently no regulations to encourage, incentivise or enable water efficient solutions which can respond to these constraints, and investors often cannot continue with planned developments due to the lack of policy or alternatives to install water services.

Sanitation solutions are generally considered to be 'smart' where systems require low to no water, are completely off-grid or non-sewered, or are decentralised. The concept of smart sanitation solutions has gained popularity as it could counter typical problems associated with overloaded systems, raw water supply, sewage treatment and reuse of waste-containing water, thereby unlocking pathways for new development initiatives. South Africa has demonstrated many front-end and back-end sanitation solutions, amongst others, through the WRC-SASTEP programme in partnership with DSIT, DWS, DBE and BMGF. Benefits associated with these technologies include water savings, SMME development along the services value chain, and sludge transformation into inert or valuable products (Mudombi & Montmasson-Clair, 2020).

One of the unique responses that South Africa has developed to respond to challenges in the water sector, is the concept of incentive-based regulation. Examples hereof are the Blue Drop, Green Drop and No Drop programmes which aim to induce changes in behaviour of individual institutions to facilitate continuous improvement and adoption of best practise management in drinking water, wastewater, and non-revenue water. Consequently, progressive improvement and excellent performance is recognised and rewarded, whilst poor performers are identified, and interventions/resources mobilised to correct the non-compliance.

In light of the above background, the scope of this study is to create a set of practical sanitation regulations which will prohibit unsuitable and unsustainable practice whilst enabling and incentivising the uptake and acceleration of water efficient sanitation solutions in overcoming the existing challenges and opportunities pertaining to new developments. It is hypothesised that such regulation will be best positioned if it entrench itself within the water use licensing, water conservation and demand management, and wastewater regulation environment, to ensure seamless implementation. The timing of the conceptualised sanitation regulation would be ideal noting the current proposed changes to the Water Services and National Water Acts.

1.2 Aim of the Study

The purpose of the project is to develop a set of sanitation regulations which will enable the uptake and acceleration of water efficient sanitation solutions (WESS). The regulations need to offer incentives to solving the challenges and opportunities (smart solutions) related to water efficiency, and off-grid, non-sewered or decentralised solutions. It is paramount that the (new) regulations do not add the burden of local government, but rather assist to relieve the constraints and provide smart alternative services solutions.

The strategic objectives of the project are:

- Capture global lessons and processes and the regulation of relevance to South Africa,
- Develop a framework for the regulations and its application,
- Undertake a high-level legal review of the recommended amendments to the regulations and its implications, as well as how it will interact with other regulations. (confirm if it is executable within the existing legislative framework).

The aims of the project are as follows:

- Undertake an investigation towards developing regulations under existing water legislation at national and local government level, which will enable DWS, municipalities, private partners and involved stakeholder to implement water efficient sanitation solutions,
- Develop a framework outlining the options and undertake a legal review of the options proposed to assess if they are practical and executable,
- Develop a position paper on the regulations.

The Department of Water and Sanitation (DWS) is responsible for setting and enforcing regulations such as the one under investigation in this report. DWS is seeking to develop and implement a regulatory framework whereby (current) unsuitable and unsustainable sanitation practices are prohibited and instead, provide an enabling environment to encourage and enable practical and alternative solutions by developers, investors, and municipalities themselves. Poor practice would typically entail practices such as preventing new greenfield developments from placing additional demand on existing wastewater systems that are already under capacity or by relying on overstressed natural water resources. The proposed framework would initially focus to prohibit unsustainable service delivery mechanisms ito greenfield (undeveloped area) rather than brownfield (previously developed area) developments by disallowing typical scenarios such as:

- New connections are installed to bulk sewers where the pipes, pumpstations and WWTWs are either dysfunctional or do not have the capacity to deal with the additional load. In such a case, DWS would regulate the manner in which new connections are made or alternatives offered in terms of non-sewered or decentralised systems.
- Water supply shortages and water scarce conditions are pertinent in certain regions of the country. In such cases, regulation would facilitate new developments to use sanitation technologies that have proven low water usage or circular systems.
- Sewage sludge contaminates the environment where treatment capacity, technology or discharge options are limited. In such cases, regulation would encourage the concept of circular economy to reuse or recover valuable nutrients from waste products.

In light of the above, the purpose of the regulatory framework is therefore to:

- Prevent irresponsible greenfield development that place an additional burden on existing stressed systems or resources,
- Facilitate responsible greenfield development that rather enable good practices linked to localised water efficient solutions with low generation of faecal matter/sludge,
- Open a pathway to scale up the application of new localised water efficient solutions with low generation of faecal matter/sludge, which will hopefully transition to other areas of sanitation, in both greenfield and brownfield developments, which are becoming unsustainable and cost prohibitive to maintain and manage.

1.3 Research Methodology

The project was undertaken in a phased approach, over a period of five months:

Phase 1: Project Inception

An initial project meeting between the research team, reference group, DWS and WRC project lead to confirm, clarify, and finalise the scope of work, methodology, deliverables, and workplan.

Phase 2: Desktop assessment

A literature review that comprises of the following actions:

- Conducting a desktop assessment of regulation elsewhere in the world to confirm their applicability or potential shortcomings in the South African environment,
- Identify existing South African legal and regulatory material that may be suitable to expand, adapt or change to accommodate smart sanitation solutions, i.e. water efficient sanitation solutions.
    - WRC *defines "smart sanitation solutions" as systems which require low to no water, are completely off-grid/non-sewered or are decentralised. Confirm applicability and or any changes to ensure an effective catch-all phrase for the envisaged water efficient water supply and wastewater services solutions in development.*

- Clarify the concept and terminology associated with 'smart sanitation' and identify synergies with- or gaps in existing regulations and proffer suitable recommendations.

The regulations desktop assessment needs to capture global lessons around regulatory concepts that would be of relevance to South Africa. In this context, regulations of interest would include those that would facilitate next generation sanitation (NGS) or non-sewered sanitation systems that would consider regulations regarding water efficient front end technology (pedestals); modular and innovative backend technologies (SANS 30500 compliance requirements); and the various centralised, decentralised, and on-site sludge treatment technologies. Known and demonstrated technologies would include: low flush systems; full reclamation toilet units; community ablution blocks; decentralised wastewater systems; and greywater treatment systems.

The literature review will also identify and investigate which regulations align best with smart sanitation solution uptake, such as water use license, waste discharge system, spatial development frameworks, water conservation and demand management and wastewater regulation. In addition, options related to the phasing or stepped expansion of water efficient sanitation solutions must be considered. In terms of the latter, the phasing envisaged could be based on a sector (e.g. wastewater/resource recovery) or initially on critical and selected applications across the sanitation spectrum.

Included in this section would be the proposed outline and structure of the proposed regulations that will be developed/expanded in the draft regulatory framework.

Phase 3: Development of a smart sanitation regulation framework

This phase comprises of the development of a draft framework of smart sanitation-related regulations, contextualised within existing water legislation and regulated by the DWS. The proposed changes in the National Water Act and Water Services Act will also be considered to ensure early alignment should these amendments take effect.

A key driver of the regulatory framework is to enable DWS and the sector to better understand the regulatory environment in which water efficient sanitation solutions can be offered and accelerated as alternatives in the sanitation services market. The framework will need to incorporate- and encourage change to improved management systems and user behaviour. Likewise, the regulatory framework could facilitate opportunities for stimulating the development of a new industry which will potentially meet several national objectives of job creation, SMME development, micro- and macro enterprise development, etc. while transforming existing challenges into opportunities by creating a circular economy for sanitation (TBC; Akinsete et al., 2019).

A critical aspect of the framework is the potential phasing or stepped expansion options of the concept to accommodate water efficient sanitation solutions in local government (implementation interface) and national government (regulatory authority). Incentive-based regulation has been accoladed as an

innovative and unique response to challenges in the water sector and should be investigated for its potential role in the uptake of smart sanitation and appropriate technologies via well-positioned regulations. Incentive-based regulation finds particular favour when the Regulator aim to induce changes in behaviour of individual institutions towards continuous improvement and adoption of best practise in wastewater collection and treatment systems. In addition, the framework may explore how smart sanitation uptake would stimulate secondary markets and innovative research partnerships.

The following approaches were taken as part of the framework development:

- Approach 1 (short term option <5 years): Rapid adaption & strengthening of existing DWS regulation by:
    - Identify quick changes to existing regulation that can be adapted, changed, or strengthened, to ensure that efficient water use, and where possible, off-grid services form part of the sanitation solutions being investigated for new greenfield developments.
- Approach 2 (medium term option 5-10 years): Entrenching water efficient sanitation solutions in DWS regulation by:
    - Following on 1 – Identify more extensive changes to existing regulations and guidelines or develop new regulations that entrenches WESS as part of the sanitation solutions being investigated for all developments (brownfield and greenfield).
- Approach 3 (long term option >10 years): Entrenching water efficient sanitation solutions in sectoral regulation by:
    - Following on 1 & 2 – Change or strengthen DWS and non-DWS regulations, guidelines and standards or develop new regulatory documentation, e.g. SANS, to facilitate the enactment of WESS and WESS-related concepts. This may require the involvement of various other departments and government agencies and should be seen as a long term option.

Phase 4: Legal review of the proposed regulations and its implications

This step involves a high level legal review and conditions to check if the proposed changes to the regulations are possible and aligned to relevant water, municipal and treasury legislation, and regulations. This phase would identify and make recommendations on potential changes to existing legislation and regulations that would accommodate smart, water efficient sanitation. The follow-through theme would be to consider how any changes would allow seamless implementation and incentives for smart sanitation uptake in the municipal industry.

The output from this phase will influence the development of the Smart Sanitation Regulatory Framework.

Phase 5: Engagement with relevant stakeholders

The draft framework will serve as a proof of concept to assess with a small, core team of practitioners to obtain their input towards converting the proposed regulatory framework into regulatory position paper. This engagement will be limited to 5 entities, who will be identified during the 1st phase. Engagement will be via directed email correspondence, online meetings and/or telephonic discussions.

Phase 6: Develop a (smart) Water Efficient Sanitation Solutions position paper

Based on the outcomes of the previous steps, the draft framework will be converted and consolidated into a position paper for water efficient sanitation solutions regulation. The format would likely include: Citation, Application, Interpretation, Objective, Scope of the regulations, and Phasing for enactment of regulation.

Phase 7: Delivery of final product

This final phase will comprise of a master report that contains all findings of the respective phases, which culminate into the primary output being the Water Efficient Sanitation Solutions Regulation Position Paper.

Deliverables

The key output from this study are:

1. Outline and structure of the proposed regulations,
2. Legal implications of the proposed regulations,
3. Engagement with relevant South African stakeholders,
4. Water Efficient Sanitation Solutions regulations position paper.

The above phases area condensed and depicted in the following project flow schematic:

1. Project inception

- Clarify aim, scope, method, deliverables

2. Desktop review

- Concept around smart sanitation solutions & technologies
- Global & local perspectives
- Legislative & regulatory environment related to smart sanitation

3. Regulatory framework

- Concept of smart sanitation, solution, technology
- Identify suite of legislation and regulations relevant to smart sanitation

4. Legal review

- Legal review of proposed regulations and its implications

5. Stakeholder engagement

- Test draft framework
- Selected municipalities, DWS, San R&D institutes

6. Regulation Position Paper

- Input from 1-5
- Draft Smart Sanitation Solutions Regulation Position Paper

7. Final Report

2 LITERATURE REVIEW

2.1 General Sanitation Services

The Bill and Melinda Gates Foundation (BMGF) report comments that based on interviews with municipality and national government officials, the following key factors need to be considered in the design of sanitation technologies (Pillay, 2018):

- The extent to which the technology enables the reduction of pathogens,
- The extent to which the technology enables the reduction of the demand on water given the limited water resources in South Africa,
- The effectiveness of the technology in controlling air and water pollution,
- Eco-friendliness in accordance with South Africa's emphasis on green technologies
- Water dependency,
- User-friendliness (and limiting user interaction) given the established household sanitation, habits and levels of education and literacy in most communities coupled with the pressures of economy, poverty, and health.

Current key factors influencing technology choices by municipalities include (Pillay, 2018):

- Site suitability, for example topography. Mountainous and rocky terrains are cited as a limitation in introducing water-borne systems in some of its communities, making decentralised system more appealing.
- Institutional factors such as the internal capacity of municipalities to fully discharge project design implementation, operation, and maintenance responsibilities.
- Environmental impact (on the ground and in water sources) of the proposed technologies. Critical aspects include:
    - Environmental Impact Assessment studies are required for construction of Wastewater Treatment Plants,
    - Any effluent from new technology needs to meet national DWS norms and standards as set out in the SANS regulations,
    - Environmental impact on the ground and in water sources [rivers, streams, etc] need to be assessed,
    - Where there are any mechanical/chemical processes and moving parts that may use oils/chemicals in any conversion of waste, these process oils/chemicals cannot contaminate the surrounding land and water. Pillay comments that Johannesburg Metro and Tshwane Metro municipalities have mini plants that convert waste to pellets/gas and these plants cannot be close to any river streams.
- Financial factors such as the construction costs especially where government grants are used as the only source without contribution from households.
- Socio-cultural factors may limit the types of technologies that are introduced. These include aspects such as discouragement of certain practices such as touching excreta and squatting, even with using alternative concepts. An example, due to stigma of dealing with excreta directly, household did not remove dry solids, even when introducing urine diversion newer

models, which don't have pits and are built upright with the toilet placed on top and easier access to the separated dry solids that can be removed manually with a shovel. Municipal incentives such as household on-selling the fertilised waste to farmers may or may not work in field due to this reluctance to deal with waste directly. Technology needs to afford the rural household the same convenience as the urban household.

- Socio-economic factors such as the type of housing structure. A sink/wooden structure is often not stable enough to add another structure such as a toilet onto it. There are still odour sensitivities from waste even if pits are a few meters away. Particularly in townships or informal communicates where land is scarce, and households are very crowed.
- Household affordability, specifically ito both capital contributions and maintenance.
- Operation and maintenance impacts the choice of technology. Municipalities tend to lean towards systems that are easy to operate and maintain, are not costly to operate and maintain, and have clear responsibility delineation between the household and the municipality

2.2 Smart Sanitation Solutions Defined

Different meanings are associated with the terms "smart sanitation", "smart sanitation economy", and "smart sanitation solutions", as indicated by the following:

"The Smart sanitation economy": (Neethling et al., 2022) (TBC, 2017)

> The "smart sanitation economy" refers to the digitisation of sanitation technologies, which will involve the collection of data from sanitation systems with the goal of improving and maintaining sanitation systems efficiently. Using technology to collect data can enable service providers to optimize their offerings and to detect maintenance needs in the system. It can also lead to advances in disease surveillance by public health officials.

"Smart sanitation & technologies"

> Appears to be described ito IoT, whereby it incorporates technologies such as mobile applications, blockchain, sensors, and big data, to improve daily living, as well as, improving efficiencies in the sanitation value chain. (Frost & Sullivan, 2020)
>
> The Toilet Board Coalition defines "Smart Sanitation" as a way to build resilience in cities, communities, and sectors by utilizing Fourth Industrial Revolution technologies to improve the collection and monitoring of wastewater for both individualised and aggregate-level preventative health surveillance. (Rary et al., 2020)

"Smart sanitation solutions": Regs ToR (TBC; Akinsete et al., 2019)

> Smart sanitation solutions (smart sanitation technology solutions) are systems which require low to no water, completely off-grid/non-sewered or are decentralised.
>
> Smart Sanitation is a new way of looking at sanitation designed for cost recovery, revenue generating business opportunities, and future system resilience.

The concept of "smart toilet economy" is an overarching concept relating to digital transformation which encompasses both "the toilet economy" and "the circular economy" concepts, which are concepts and technologies that are dealing with valorisation and recycle of water. The varied

interpretation of the terminology create potential for confusion as the general perspective is that "smart sanitation" refers mainly to a digital perspective or utilising 4th Industrial Revolution technologies in sanitation.

In addition, the Netherlands Water Partnership (NWP) "Booklet on Smart Sanitation Solutions" is one of the earliest forerunners of smart sanitation solutions and comments that such solution constitute an effective disease barrier, prevent environmental pollution, and optimise the use of resource in terms of nutrients, water, and energy. Such solutions should meet the needs of the user, must be simple to use, to maintain and repair, be possible to replicate and be affordable. Likewise, what may be considered "smart" in one area may not necessarily be "smart" when applied in a different area. As such the concept of "smart" references the concept that a technology should be adapted to local conditions and adaptable to a changing environment (NWP, 2006).

It is proposed that the regulation replace the word 'smart'' with ''water efficient'' and adopt the following definition for "Water Efficient Sanitation Solutions" (WESS): Sanitation systems which require low to no water, completely off-grid/non-sewered or are decentralised and utilise technologies that include using water saving devices, water-efficient processes and beneficial use of waste products.

The terminology includes for off-grid and non-sewered sanitation systems, which aim to improve sanitation services without the high capital investment and water usage required for large reticulation services. The term also includes treatment package plants for decentralised waterborne sewage to bridge the gap between basic and improved sanitation and allow municipalities to achieve hygiene and sanitation for all (Neethling et al., 2022).

Finally, it is important to agree that "water efficient sanitation solutions" encompasses not just the smart sanitation technologies as alternatives to sewered waterborne systems, but also the facilitating factors that enact these solutions, such as:

- Easy and free access to regulatory standards and applicable guidelines, similar to CoCT concept of using QR Codes/tags to get quick access to their various guidelines and on-line application forms.
- Application of more achievable- or different environmental limits for smaller community systems. Such authorisations could be similar to the concept of General Authorisation, but with condition that such systems must be registered and confirmed by municipal and national systems. Registration could be on-line, with a given timeframe for inspection prior to continuing with development.
- Coupled with the above, is the need for clear guidelines and proven/approved/demonstrated technologies, so that the Regulator can be appeased regarding the impact of alternative solutions.
- Linked to the above, is the need for a certification process of proven technologies for manufacturing for use by municipalities and developers.
- To avoid the confusion around the terminology of ''smart sanitation'', an different special term can be used, such as "water savvy" or "Savi" sanitation as a more ''common sense''

approach for alternative and appropriate (smart) sanitation services. It can be linked to an avatar or concept such as “Savi Sani” similar to the “Green Drop”, etc. which can then form part of a WELS style accreditation concept.

- The above can form part of the incentives for manufactures, developers, owners, and operators of such technologies, to advertise the compliance and appropriate use of such concepts.

The regulations should look at opportunities within the water use license, water conservation and demand management and wastewater regulation environment to allow seamless implementation and incentives.

2.3 Global Perspective on Smart Sanitation

2.3.1 Global lessons and processes and the regulation of relevance to South Africa

NWP’s Booklet on Smart Sanitation Solutions identified the need to stimulate an informed demand for improved sanitation by offering people information about appropriate technologies and services. Sanitation facilities are only sustainable when people make their own choices and own contribution towards obtaining and maintaining them. People have to experience the toilet as an improvement in their daily life. It is critical that sanitation systems be embedded in the local institutional, financial-economic, social-cultural, legal-political, and environmental context (NWP, 2006). The booklet offers guidelines and principles when seeking to incorporate smart sanitation solution into regulation:

- Develop ownership by involving families and the private sector in design and planning,
- Be demand responsive by ensuring that the solution must be responding to actual needs,
- Build on existing practice, experience, and infrastructure (don’t re-invent the wheel),
- Be culturally sensitive by taking account of values, attitudes, and behaviour of the users,
- Be financially sustainable by making choices based on affordability and willingness to pay,
- Develop institutional support by considering existing institutional settings.

The five elements of a sanitation system, being the toilet, collection, transport, treatment, and use of excreta are all together vital for sustainable sanitation and thus create room for flexibility in design and choice in developing an appropriate solution adapted to local conditions (NWP, 2006). The five elements are:

1. **Toilet** designs are smart when hygienic safety is guaranteed, and excreta can be dealt with in a socio-culturally acceptable way. Toilets must be seen by the relevant population as safe and attractive to use, while construction and maintenance costs have to be affordable. Examples are:
    - Toilets that are marketed as using ultra-low-flush to micro-flush technologies, currently available in the commercial market for use in standard residential buildings, such as most of the NGS toilets, Arumloo, Zerho Waterless Toilet, EcoVac, GSAP Microflush toilet (align with pour-flush option), Eaziflush (Envirosan), EcoFlush

Toilet (urine diverting classic WC), Pour-flush (low-flush on-site waterborne) – PID and EWS/PRG, Earth Auger (dry sanitation, composting), Andy Loo (incinerating), LUSEC (composting), and Eco-Loo (dry sanitation, composting).

- The advanced toilet using built-in smart technology/digital technology, or technology capable of interacting and connecting with the user, often found in smart homes around the world and in high-tech regions such as Japan. Smart toilets sense how much water is needed and flush using just the right amount. The smaller flushes can use as little as 2.2 ℓpf and will have a variety of other luxury options available, such as air-dryers, self-cleaning feature, and built-in sensors to alert user of leaks. It must still prove to be a water-, energy- and treatment-efficient option.

2. Smart **collection** facilities make efficient use of limited space and function effectively over a long period. The collection system must safely contain human excreta awaiting transportation. Collection facilities typically needs ventilation and may include pre-treatment of excreta. Examples are:
    - Typically linked directly to treatment system chosen, e.g. when multi-use toilets connect to a limited sewer linked to on-site/decentralised treatment plant.
    - The system include collection of dried or wet products from composting toilet, urine diversion, etc., with either individual or combined collection facilities for the removal and/or transportation for different treatment options:
        - Urine from urine diversion toilets or urinals can be collected in plastic containers,
        - Oil drums, or more secure fault containers can be used for the collection of faeces,
        - Vaults and chambers if suitable, for example in areas with a hard subsurface and high ground water table.

3. Smart **transportation** considers transportation of excreta through means that are not dependent on large, cost-intensive infrastructure, which can provide source of income for small private entrepreneurs (usually only appropriate for small haul distances and small volumes) and that could possibly link with solid waste collection services. Examples are:
    - Various options are available for limited sewer networks or small bore systems (gravity) coupled with removal and transportation of the dried- and wet products from different toilet options.
    - Transportation from collection point to combined collection point or treatment facility, e.g. tricycles and push carts transport of containers containing urine or excreta or pedal or motorised carts and tricycles in areas with narrow access/streets.
    - Mechanical emptying systems for pits and (septic) tanks such as MAPET and Vacutug. These devices rely on informal or small scale, private operators to empty pits, creating local business opportunities.

4. Appropriate **treatment** systems are smart when they are designed based on the required characteristics of the end-product (for economic use) and when it considers the recovery of resources, notably nutrients, present in urine and excreta. However, conditions must be adhered to such as keeping excreta separate from greywater and stormwater, or keeping urine and faeces separate which provides options for more efficient recovery of resources. Examples are:
    - On-site septic tanks and waste treatment: e.g. Bubbler septic tank, Flush Tech on-site waste treatment and Smart San self-contained waterborne wastewater treatment,
    - Non-reticulated (reduced water, dry or 100% recycled): e.g. Enviro Loo recirculation toilet & treatment plant, USF NEWgenerator from WEC, and Zerho Waterless Toilet,
    - Reticulated (water using): such as Arumloo and DEWdrop; Envirosan's EOOS/Eazi-split; Prana Water & Sanitation/Zyclonic Aquonic Wastewater Treatment,
    - Could also include for more complex system such as G2RT,
    - Composting-based treatment systems and double vault dehydration systems, where excreta dry inside the vault as a result of sun radiation, natural evaporation, and ventilation,
    - DEWATs and planted soil filters.

5. Smart of use of products refers to the extraction or **use of waste materials and energy** from excreta or wastewater, through reuse, recycling, and recovery. The nutrients in excreta have a high fertilising value and can partly replace the demand for artificial fertiliser. Excreta can improve soil conditions and generate biogas. Biogas can be used in households for cooking and heating. It also includes excreta and/or wastewater disposal which considers the serious threat to public health and the environment posed by improper handling. Examples are:
    - Recycled use of treated water for toilet flushing and irrigation,
    - Decomposed excreta is rich in nutrients (NPK – nitrogen, phosphorous, and potassium) and organic material for beneficial uses such as:
        - Conserve phosphorous resources through recycling from sanitation and used as fertiliser (urine),
        - Compost as soil conditioner,
        - Small-scale biogas digesters provide fuel for domestic lighting, cooling, and cooking,
        - Larger-scale biogas plants may produce sufficient supplementary gas to fuel engines to generate limited electricity,
        - Greywater reuse decentralised systems are increasingly used in buildings (hotels, hospitals, schools) or industrial facilities world-wide.

Associated with the above, is the need for Regulations, Norms and Standards that contain health and safety mechanisms associated with the infrastructure and disposal or use of waste products.

2.3.1.1 Case study: Japan

In Japan, on-site individual buildings and block-wide wastewater recycling systems generated water for non-potable urban applications (toilet flushing in commercial buildings and apartment complexes) since 2003 (Funamizu & Onitsuka, 2008).

Japan adopted the Johkasou Law (known as "PAWTP Law") in 1983 to support the DEWATS concept. This law created a legal basis for the installation of manufactured Packaged Aerated Wastewater Treatment Plants (PAWTPs), whereby maintenance, inspection, and desludging were clearly defined. To ensure a practical approach, the responsibility, and duties of PAWTP users were specified and state certification systems were issued for both PAWTP installation workers (process controllers) and maintenance operators. Certain aspects of Japan's decentralised wastewater management system are found to be useful for wastewater management in developing countries (Hashimoto, 2019) including:

- ***Review effluent water quality standards and selection of decentralised wastewater management system***. This aspect allows for a realistic policy response for governments which allows for the continuation of anaerobic-type wastewater treatment facilities, under the condition that the maintenance, including sludge management, is substantially improved. At the same time, conversion to a packaged aerated WTP or a similar facility could be promoted for non-household users and high-income households, specifically where sewer connection are difficult. Accordingly, regulations concerning domestic wastewater, such as the effluent water quality standards, should differ, according to the type of user and apply stricter regulation to non-household users *(commercial or multi-residential)* in comparison to household users. If softer effluent quality limits are not set, the stricter standards end up as mere targets and not as achievable standards to be imposed.
- ***Qualification and training system for installation business of decentralised wastewater treatment facilities***. Japan uses a municipal construction surveyor to check new houses or building as part of the process of issuing building permits. The building permits system works only if the decentralised wastewater treatment facilities are standardised by the performance testing system. In developing countries this may be problematic, and a suitable policy response would be that government allows diverse decentralised treatment facilities, particularly those for household use, but that the quality of installation requires a suitable qualification and training system, modelled on that used in Japan.
- ***Introducing regular desludging system for decentralised wastewater treatment facilities.*** Other than issuing maintenance manuals for septic tanks, which advocate a recommended desludging frequency, Japan's regulatory framework does not allow the user to set the frequency of desludging, but rather follows a preventative desludging of PAWTPs. This is a legal obligation for the users, established as once a year, with the timing controlled by the desludging businesses approved by the municipalities. Any introduction of a regulated desludging system would have to consider how to engage middle-to-high-income households. It is possible that this option may prove too costly in South Africa, unless a mechanism is put in place, such as cross-subsidisation or incentive for beneficial use of sludge.

- ***Qualification system and training system for desludging business and process controllers.*** In many countries, including Japan, desludging works are performed by water and wastewater operators or sewer and drainage corporations. However, desludging of on-site facilities such as septic tanks and PAWTPs are performed by micro-, small, and medium-sized enterprises who are typically part of the informal sector. Some contractors are reported to perform poorly and engage in illegal activities such as dumping the collected sludge into rivers. The social status of desludging workers in developing countries is low and their income unstable due to an "on-call" usage system. To negate this, it is recommended that a government establishes a training system for desludging technicians. In addition, a system is required in which only the desludging vendors (e.g. utilising registration or certification process) are allowed to the desludging business under regulatory oversight, thereby cultivating their professionalism and raise their social position.
- ***Qualification system and examination system for operators of PAWTPS or similar facilities for non-household users.*** The Japanese approach recommends that technicians for PAWTPs or similar facilities attend a professional training course and pass an official examination, and that such a system also monitors skill levels. This recommendation is similar to Regulation 3630 of DWS and WISA's process for registration as Professional Process Controller. Coupled to this professionalisation drive, regulations must be strengthened to apply penalties on the non-household users who fail to contract qualified operators for treatment facilities. In South Africa, this can be incorporated in national regulations, municipal by-laws and also included via Green Drop process.
- ***Develop proper sludge treatment facilities.*** Japan has a 60 year history of developing sludge treatment facilities, and such sophisticated technologies may not be suitable for developing countries. However, the accumulated knowledge and experiences in on-site sludge treatment, pretreatment, solid-liquid separation, disposal of dried sludge, treatment of supernatant would be meaningful to countries who wish to follow same.

2.3.1.2 Case study: America, San Fransisco

The City and County of San Francisco adopted a "On-site Water Reuse for Commercial, Multi-Family, and Mixed-Use Development Ordinance" in 2012. Commonly known as the Non-potable Water Ordinance (NPO), it added Article 12C to the San Francisco Health Code, allowing for the collection, treatment, and use of alternate water sources for non-potable uses in buildings. The codes makes it mandatory to install and operate an on-site water reuse system for new development projects over a specific size, as well as further requirements for different project types, based on the required alternate water sources and non-potable end uses (SFPUC, 2022).

The San Francisco Public Utilities Commission (SFPUC) guideline comments that the most common types of alternate water sources collected and treated by buildings in San Francisco are rainwater, stormwater, foundation drainage, greywater, blackwater and condensate, produced by commercial, mixed-use, and multi-family residential buildings. These alternate water sources are treated and reused to meet the non-potable end uses. This can only occur in compliance with the prescribed Rules and Regulations Regarding the Operation of Alternate Water Source Systems (Rules and Regulations).

Typical uses of the treated alternate water sources include:

- Indoor uses:
    - Toilet and urinal flushing,
    - Priming drain traps,
    - Clothes washing (cold water).
- Outdoor uses:
    - Subsurface irrigation,
    - Drip or other surface non-spray irrigation,
    - Spray irrigation,
    - Decorative fountains and impoundments,
    - Cooling applications,
    - Dust control/street cleaning.

The City also requires commercial and residential developments of ≥1 ha to install and operate an on-site water reuse system. Each development type has different requirements ito 'Required Alternate Water Sources and Required Non-potable Uses'. Development projects are also required to follow the 10-step permitting process for successful implementation of an on-site system. The '10 Steps for Successful Implementation of an On-site Water Reuse System' entails compliance with various regulatory requirements of relevant departments within the City and County of San Francisco. The steps include:

1. Submit a Water Budget Application,
2. Submit a Non-potable Implementation Plan (district-scale projects only),
3. Submit Application for Permit to Operate, including an Engineering Report that motivates how the project's treatment system complies with the requirements for on-site water reuse systems by demonstrating:
    - Alternate water sources collected and treated for non-potable end uses,
    - Entity or entities involved in the design, treatment, operation, and maintenance of the on-site water reuse system,
    - Treatment processes used to meet required water quality criteria,
    - Demonstration of compliance with the pathogen log reduction targets,
    - Information on operating conditions and continuous online monitoring,
    - Cross-connection and backflow prevention measures,
    - Contingency plan and system bypass that will allow the system to divert to the sewer,
4. Obtain Encroachment Permit from SFPW (if applicable),
5. Obtain Plan Check Approval and then Complete System Construction,
6. Conduct a Cross-Connection Test with relevant department and Complete Post-Construction Inspection,
7. Submit Documentation for a Permit to Operate,
8. Obtain a Permit to Operate ,
9. Operate in Conditional Startup Mode ,
10. Operate in Final Use Mode with relevant department approval.

The City's guideline provides example On-site Water Reuse Treatment Trains to illustrate how unit processes can be used to meet the pathogen log reduction targets (LRTs) and other water quality requirements. Treatment train selection will depend on project-specific factors such as source water, space constraints, and end uses. Selecting of appropriate treatment processes include:

- Source water quality entering the treatment system,
- Water quality standards,
- Solids management,
- Site constraints including footprint and access,
- Energy usage,
- Economics (both capital and operating costs),
- Aesthetics (i.e. colour and odour),
- Ease (or complexity) of operation and maintenance,
- Reliability to ensure uptime and production.

In addition, guidance and resources are made available including for aspects such as:

- "Using Non-potable Water for Clothes Washing" and additional disinfection guidance,
- Case Studies of San Francisco On-site Water Reuse Systems,
- On-site Water Reuse System Resources List,
- San Francisco Department of Public Health Director's Rules and Regulations Regarding the Operation of Alternate Water Source Systems,
- San Francisco Health Code, Article 12A, Backflow Prevention,
- San Francisco Health Code, Article 12C, Non-potable Water Ordinance,
- San Francisco Public Utilities Commission Rules and Regulations Governing Water Service to Customers, Section G, Cross-Connection Control,
- Stormwater Management Requirements and Guidelines,
- Water Budget Applications for single buildings and district-scale projects,
- Water Use Calculators for single buildings and district-scale projects,
- Validated UV List,
- Implementing "OneWaterSF": On-site Reuse Factsheet.

2.3.2 ISO standards

Regulations vary significantly within countries and even municipalities. An International Standard assist users and regulators to conform to a product or service to ensure that manufacturers, implementers, and users feel more secure with their innovation, research, and development in sanitation systems. Similarly, it can facilitate cross-border trade.

Relevant ISO standards have been developed for Household Non-sewered Sanitation Systems, Community Scale Resource Oriented Sanitation Treatment Systems and Faecal Sludge Management ito activities related to drinking water and wastewater services. These ISO standards provide such assurance and guidance for water efficient sanitation solutions and are as follows:

2.3.2.1 *Household Non-sewered Sanitation System Standard*

ISO 30500 Standard: 'Non-sewered sanitation systems – prefabricated integrated treatment units' This standard is applicable to sanitation systems that are either manufactured as one package or manufactured as a set of prefabricated elements designed to be assembled in one location without further fabrication or modification that influences the system function. General safety and performance requirements for design and testing. TÜV SÜD, a global leader in product testing and certification and the American National Standards Institute (ANSI) were instrumental in drafting the ISO standard. ISO 30500 tests can be conducted by TÜV-SÜD in Singapore, who is also the certification body for this standard (Kelly, 2022). TÜV-SÜD have developed an online ISO 30500 certification readiness index which provides technology developers with a self-assessment of their technology and its readiness for certification against the standard. A critical aspect of it is to ascertain if the technology is a non-sewered sanitation system (NSSS) and fits within IS0 30500, and post questions around various thresholds and parameters which help assess if the technology complies with the standard (Kelly, 2022).

Ito South Africa, the ISO 30500 has been adopted into a local standard, the SANS 30500. The standard also specifies sustainability considerations for NSSS. TÜV-SÜD have also provided advice to South Africa on how to set up the certification scheme (Kelly, 2022).

The British adopted the "BS ISO 30500:2018 Non-sewered sanitation systems. Prefabricated integrated treatment units. General safety and performance requirements for design and testing". This standard does not include the following aspects (BS Standards, 2018):

- guidelines for selection, installation, operation and maintenance, and management of sanitation systems,
- transportation of treated output outside of the sanitation system (e.g. manual, truck or trunk) for further processing, reuse, or disposal,
- treatment processes taking place at another location separate from the front-end and back-end components,
- reuse and disposal of sanitation system output.

Other ISO standards of relevance include:

2.3.2.2 *Community Scale Resource Oriented Sanitation Treatment Systems Standard*

ISO 31800:2020: Faecal sludge treatment units – Energy independent, prefabricated, community-scale, resource recovery units – Safety and performance requirements

2.3.2.3 *Faecal Sludge Management Standards: Activities related to drinking water and wastewater services*

ISO 24521: Guidelines for the management of basic on-site domestic wastewater services

This International Standard provides guidance for the management of basic on-site domestic wastewater services, using appropriate technologies in their entirety at any level of development. It supplements and is intended to be used in conjunction with ISO 24511. It is applicable to both publicly and privately operated basic on-site domestic wastewater (black- and greywater) services, for one or more dwellings.

The guidelines includes the following:

- management of basic on-site domestic wastewater services from the operator's perspective, including maintenance techniques, training of personnel and risk considerations,
- management of basic on-site domestic wastewater services from the perspective of users,
- design and construction of basic on-site domestic wastewater systems,
- planning, operation and maintenance, and health and safety issues.

The following are outside the scope of this International Standard:

- limits of acceptability for wastewater discharged into a receiving body,
- analytical methods,
- management structure of sanitary waste/wastewater service activities of operation and management,
- content of contracts or subcontracts.

The guidelines state that basic on-site sanitation solutions should consider the following:

- effective disease barrier,
- prevention of environmental pollution,
- environmental requirements,
- optimisation of the use of resources in terms of nutrients, water, and energy,
- simplicity of construction, use, operation, maintenance, and repair,
- adherence to hygienic safety standards,
- affordability and willingness to pay,
- existing institutional support,
- existing best practice, experience, and infrastructure,
- development of ownership, involving landlords, users of all kinds, public water utilities and the private sector in design and planning,
- cultural sensitivity, considering values, attitudes, and the behaviour of the user.

Basic on-site domestic wastewater systems generally comprise of:

- user interface,
- collection and transport of sanitary waste/wastewater and residues removed from wastewater,
- treatment of sanitary waste/wastewater and residues removed from wastewater,
- disposal/reuse of treated effluent,
- disposal/reuse of treated residues.

ISO 24510: Activities relating to drinking water and wastewater services – Guidelines for the assessment and for the improvement of the service to users

ISO 24511: Guidelines for the management of wastewater utilities and for the assessment of wastewater services.

2.3.2.4 Asset Management for Water and Wastewater Utilities

ISO 55000:2014 – Asset management

- This International Standard provides an overview of asset management, its principles and terminology, and the expected benefits from adopting asset management. This standard is in the process of being replaced by SO/FDIS 55000 (Stage: 50.20).
- In South Africa, there may be a need to adapt a more water/sanitation asset-managed focussed version of the standard.

2.3.3 International perspectives summary

Key lessons for South Africa can be taken from the international community in regards of smart sanitation and regulation thereof.

Firstly, sanitation is considered smart, appropriate, and sustainable if it is embedded in the local institutional, financial-economic, social-cultural, legal-political, and environmental context.

The terminology can be confusing, and it is recommended that DWS adopt 'water efficient sanitation solutions", abbreviated as WESS, to accommodate the conflicting perceptions around smart technologies and to be inclusive of non-sewered, decentralised, off-grid, water efficient systems.

The five elements of a smart, albeit water efficient, sanitation system are:

1. Toilet designs are smart when hygienic safety is guaranteed, and excreta can be dealt with in a socio-culturally acceptable way. Toilets must be seen by the relevant population as safe and attractive to use, while construction and maintenance costs must be affordable.
2. Smart collection facilities make efficient use of limited space and can function effectively over a long period. The collection system must safely contain human excreta awaiting transportation. Collection facilities often need ventilation, and some include pre-treatment of excreta.
3. Smart transportation considers transportation of excreta through means that are not dependent on large, cost-intensive infrastructure, which can provide source of income for small private entrepreneurs (usually only appropriate for small haul distances and small volumes) and that can provide a potential to link with solid waste collection services (could require transfer facilities).
4. Appropriate treatment systems are smart when they are designed based on the required characteristics of the end-product (for economic use) and when it considers the recovery

of resources, notably nutrients, present in excreta. It does come with consequences which also need accounting for, such as keeping excreta separate from greywater and stormwater, or keeping urine and faeces separate which provides options for more efficient recovery of resources.

5. Smart use of products refers to the extraction and/or utilisation of materials and energy from excreta or wastewater, through reuse, recycling, and recovery. The nutrients in excreta have a high fertilising value and can partly replace the demand for artificial fertiliser. Excreta can improve soil conditions and generate biogas. Biogas can be used in households for cooking and heating. It also includes excreta and/or wastewater disposal which considers the serious threat to public health and the environment posed by improper handling.

Critical aspects that would impact on regulation include:

- Understanding accountability & responsibilities:
    - Any system or technology has operation and maintenance (O&M) requirements, including sludge management and periodic desludging,
    - Qualifications and skills requirements for design, implementation and O&M must be clearly defined,
    - Adequate institutional capacity is fundamental for oversight, regulation, and implementation of pollution control,
- Treatment of wastewater is not 'one size fits all', whereby local conditions call for local solutions and regulation needs to accommodate this notion:
    - Effluent quality standards must be clearly defined differentiated between various users and user types,
    - Decentralised wastewater treatment installations are proven technologies and able to comply with environmental discharge regulations. It has the potential to positively influence environmental health and personal behaviours in urban areas which are likely to remain unserved, in industrial, commercial, and affluent or poor housing areas, if appropriate systems are built in the right location with the required skillsets, O&M practice and budgets,
    - Communities are able to manage less technically complex decentralised wastewater treatment installations, such as DEWATS, which can accelerate services in poor communities. This is dependent on the number of users projected and providing there is shared responsibility with government for O&M.
- Economic incentives are powerful enablers for concepts like recycling,
- Legislation is meaningful where it encourage greener and circular approaches to urban wastewater treatment, enabling recovered resources to enter the market, whilst disallowing barriers that limit the use of such resources.

2.4 South African Perspective on Smart Sanitation

Sanitation is a complex and yet vulnerable field in itself, with multiple drivers impacting on sustainable sanitation service delivery, including: location with urban/peri-urban areas; access to connected

services; availability of water & alternative sources, electricity, geotechnical conditions, and space; and access to road and property access. These challenges and barriers can be categorised in South African literature and essentially fit into a few basic groupings as discussed below.

2.4.1 Municipal water reclamation and reuse as alternative water supply sources

The following terminologies and concepts are commonly used in the South African reuse domain (DWS, 2015):

- Direct reuse: Reuse of treated or untreated wastewater by directly transferring it from the site where it is produced to a different/separate facility for further use.
- Indirect reuse: Reuse of treated or untreated wastewater after it has been discharged into a natural surface water or groundwater body, from which water is taken for further use.
- Direct potable reuse: Treating the used water to a level which is fit for direct use by a second water user. The treated water is then supplied directly to the second user without going through a natural or manmade water body such as a stream, dam, or aquifer. Irrespective of the way in which water reuse is implemented, desalination technology such as Reverse Osmosis is typically required.
- Indirect potable reuse: Treating the used water and discharging the treated water to a natural or man-made stream, dam, aquifer, etc. before abstraction and use by a second downstream water user. Indirect reuse of water to potable levels therefore introduces a natural or man-made environmental barrier between the first water user and the second water user.
- Recycling: Utilisation of treated or untreated wastewater for the same process that generated it, i.e. it does not involve a change of user. For instance, recycling the effluents in a pulp and paper mill.
- Reclaimed water: Wastewater that has been treated to a level that is suitable for sustainable and safe reuse.
- Return flows: Treated and/or untreated wastewater that is discharged to a natural surface water or groundwater body after use.

Municipal water reclamation and reuse as alternative water supply sources to sustain development and economic growth in various regions of South Africa are generally understood to be (Swartz et al., 2022):

- Reclaimed water: Municipal wastewater that has been treated to specific water quality criteria so it can be beneficially reused. This is normally a higher quality than the quality of secondary treated effluent,
- Recycled water: Water generated from sewage, greywater or stormwater systems and treated to a standard that is appropriate for its intended use. In industry, recycled water can relate to cooling water recycling where there is minimum treatment).

Such water reclamation and reuse can be achieved through various mechanisms and technologies and there are existing examples of these such as Beaufort West (direct potable reuse (DPR)), Ballito (DPR),

George (indirect potable reuse (IPR)) and Mossel Bay (reuse for industrial purposes) (Swartz et al., 2022).

In 2015, Swartz comments as follows on direct reclamation of municipal wastewater (Swartz et al., 2015):

- DWS needs to adopt and implement standards for direct and indirect potable reuse (DPR & IPR) in South Africa as a high priority.
    - Direct reuse refers to the beneficial use of appropriate treated wastewater without interim storage in a surface water body or aquifer (conversion of wastewater directly into drinking water, irrigation water, process water or cooling water),
    - Indirect reuse refers to the beneficial use of appropriate treated wastewater with interim storage in a surface water body or aquifer (use of reclaimed water for irrigation or other non-potable applications after a period of storage),
- DWS should assist water service providers (municipalities and water boards) to have access to proficient scheme and plant managers, and skilled process controllers, by funding training programmes for scarce skills (such as membrane treatment plant operation),
- Standards for drinking water quality from IPR and DPR plants should be included in the SANS 241 as a separate section for water reclamation plants for producing drinking water,
- Regulation of IPR and DPR plants should be given specific attention, and included in, the Blue Drop and Green Drop program – for wastewater treatment plants supplying reuse plants with secondary or tertiary treated wastewater.

2.4.2 Non-sewered sanitation system & Decentralised Wastewater Treatment system & DEWATS

Non-sewered sanitation (NSS) or Non-sewered sanitation system (NSSS) is defined differently and is not equally clear, such as:

- DWS Norms and Standards (2024) defines "non-sewered sanitation system" to mean:
    - A system that is not connected to a networked sewer, and collects, conveys, and fully treats the specific input to allow for safe reuse or disposal of the generated solid output or effluent.
- International Organisation for Standardisation (ISO):
    - Non-networked sanitation (NSS) comprises any sanitation system treating human excreta that operates without connection to any sewer or drainage network.

Author observations from literature:

- Non-sewered/on-site systems do not appear to apply to treatment processes taking place at another location separate from that of the front-end and back-end components. It depends on the interpretation of the term “networked sewer” as either meaning part of a centralised wastewater collection and treatment system or if it excludes any form a sewer collection pipe as per ISO. It is critical that DWS define their interpretation.
- A NSS system, as identified in the SANS 30500, does not include any system that drains an area through a sewered network, even if such network is limited, neither does it make

allowances for a system built on site. SANS 30500 is only applicable to prefabricated integrated treatment units. It is applicable to sanitation systems that are either manufactured as one package, or, manufactured as a set of prefabricated elements designed to be assembled in one location without further fabrication or modification that influences the system function.

- DWS's definition is adequate for the present, however considering the limitation of the SANS 30500, there is a need in the long term to ensure a clause is added or the SANS is revised to allow for on-site built facilities rather than only pre-built package plants. Considering the limitation of the present construction management and lack of effective certification, a cautionary approach must be taken.

Decentralised Wastewater Treatment is defined as follows:

- EPA definition: (EPA, 2015): "Decentralised Wastewater Treatment" refers to " a variety of approaches for collection, treatment, and dispersal/reuse of wastewater for individual dwellings, industrial or institutional facilities, clusters of homes or businesses, and entire communities. These systems are a part of permanent infrastructure and can be managed as stand-alone facilities or be integrated with centralised sewage treatment systems. They provide a range of treatment options from simple, passive treatment with soil dispersal, commonly referred to as septic or on-site systems, to more complex and mechanised approaches such as advanced treatment units that collect and treat waste from multiple buildings and discharge to either surface waters or the soil. They are typically installed at or near the point where the wastewater is generated."
- GreenCape CoCT position paper: (Mpofu et al., 2023) identifies decentralised sewerage systems to follow common concepts:
    - Consists of appropriate infrastructure system for collection, treatment, and disposal of domestic wastewater from a combination of residential complexes, schools, and light commercial (excluding industrial and heavy commercial), retail centres and resting fuel service stations,
    - Treats "normal" domestic wastewater which includes human faeces and urine, menstrual blood, bile, flushing water/greywater, anal cleansing water, toilet paper, and other bodily fluids/solids,
    - Limited volume treatment and serves a limited extent waterborne sewered area, development, or settlement – being a collection of dwellings or a defined area approved by the water services authority,
    - The limited sewered network is not connected to the larger ("central") sewerage system,
    - It is not an on-site ("dry") sanitation system, such as ventilation improved pit (VIP) toilets, septic or conservancy tanks, which usually services a single house or building.
    - The system is acceptable and affordable to the users, safe (including for children), hygienic and easily accessible and does not have a detrimental impact on the environment.

Note: DEWATS: The DEWATS concept is an example of a specific technical approach to decentralised wastewater treatment.

Author observations from literature:

DWS does not at present define Decentralised Wastewater Treatment (DWWT) or Decentralised Wastewater Treatment Systems (DWWTS). Although the EPA definition provides for a wide range of sanitation options and would be a good definition to generally adopt, DWS will need to confirm if the term applies to systems that are:

- part of permanent infrastructure that are owned and managed as stand-alone facilities by the municipality and or its contracted WSI. …. and or
- part of privately owned permanent infrastructure that are managed as stand-alone facilities by the infrastructure owners, operating as a WSI with a SLA to the municipality. This stand-alone system is more in line the CoCT and EWS concept of a WWTW on private property…….and or
- be integrated with centralised sewage treatment systems (by the municipality or an contracted WSI) and be managed as part of their centralised wastewater treatment

Following on with this concept, DWS may need to either:

- Revise or add an additional category to ensure that the definition allows for the potential of a privately owned decentralised wastewater treatment system with a limited sewer network of multiple ablutions facilities to a single, stand-alone treatment works, e.g. residential housing estate or resort style facility, or,
- Confirm that Decentralised Wastewater Treatment can be used for both circumstances as stand-alone systems and linked to central system. This may then require that it be clarified in the regulation that for each instance, separate norms, standards, and management requirements may be applied, based on the nature of ownership and the concept of stand-alone or linked to a central system.

An suitable definition for Decentralised Wastewater Treatment may be an adapted form of the EPA definition to allow for the separation of ownership concept:

> *"Decentralised Wastewater Treatment refers to various approaches for collection, treatment, and dispersal/reuse of wastewater for individual dwellings, industrial or institutional facilities, clusters of homes or businesses, and entire communities. They provide a range of treatment options from simple, passive treatment with soil dispersal, commonly referred to as septic or on-site systems, to more complex and mechanised approaches such as advanced treatment units that collect and treat waste from multiple buildings and discharge to either surface waters or the soil. They are typically installed at or near the point where the wastewater is generated. These systems, when owned by the municipality, and or its contracted WSI, as a part of their permanent infrastructure, can be managed as stand-alone facilities or be integrated with centralised sewage treatment systems. These systems, when privately owned permanent infrastructure, will need to be managed as stand-alone facilities by the infrastructure owners, operating as a WSI with a SLA to the municipality."*

It is recommended that DWS:

- **Keep the DWS Norms and Standards 2024 definition for "non-sewered sanitation system"**
- **Define and add Decentralised Wastewater Treatment to the revised Norms and Standards.**

2.4.3 Challenges facing sustainable management and operation of WWTWs

The Harding research group comments that wastewater quality indicators need to be known in order to reuse, recycle, or recover as resources, but are generally poorly reported (Harding et al., 2020). It is widely agreed and published that poorly managed municipal wastewater treatment works are major contributors to the poor water resource quality of SA rivers, with some of the underlying factors being (Noqhamza, 2021) (Vosloo et al., 2019):

- Lack of resources (human and financial) and technical skills,
- High staff turnover,
- Lack of stakeholder engagements,
- Delay in issuing of licenses,
- Co-operation among officials within various directorates of DWS,
- Insufficient support from national sphere of government to local government funding for the ageing of the current infrastructure.

The Green Drop National and Provincial Reports 2022 report and diagnose the state of wastewater in South Africa in comprehensive detail (2022, 2023). It suffices to state that the same fate that faces large centralised municipal works, would also apply to water efficient sanitation solutions if not addressed and regulated with these challenges in mind.

2.4.4 Understanding the barriers and enabling factors in regulation to uptake of water efficient sanitation systems:

Sanitation innovation is hampered by a number of factors, such as (Neethling et al., 2022):

- lack of standardisation and guidance in the selection of appropriate technology/solutions,
- lack of understanding of the systems,
- unscrupulous service providers who sell substandard or inappropriate solutions,
- lack of applicable standards; conflicting sanitation policies and regulations,
- lack of willingness to try or mistrust of new technologies due to past experiences,
- lack of clear tender specifications and guidelines with respect to procuring non-traditional sanitation technologies,
- Many municipalities lack the technical capacity to understand new systems being proposed, leading to either implementation of inappropriate solutions or refusal to consider any alternative solutions. Municipalities require clear guidelines to pursue any new technologies,
- Tender specifications are not written with an understanding of these new systems, leading to manufacturers of innovative sanitation systems frequently being unable to tender for municipal sanitation contracts,

- Historically across South Africa, policies have enhanced a binary paradigm of flushing systems connected to full sewerage networks being the norm in urban areas and dry, on-site systems being the norm in rural and peri-urban areas,
- Later policies, post 2016, include for alternative technologies and support innovative solutions, but does not make it a requirement as part of the solution investigation.

The deployment of alternative options, such as decentralised sanitation, provides solutions which offers more climate resilience by distributing risks, diversifying technologies, and building redundancy into larger systems. A regulatory environment which defines, guides, encourages and regulates water efficient sanitation solutions is seen as a meaningful alternative to unblock existing municipal barriers where existing infrastructure, funds and skills are under pressure and thereby hampering or halting new developments and services expansion.

2.4.5 National Sanitation Policy (2016)

South Africa's institutional framework for sanitation innovation is being formalised to close current gaps. Any successful pitching of new sanitation technologies must clearly unpack the different institutions involved and engage these before engaging with municipalities. The four most important role players are DWS, DST, SALGA, and Agrément Board (Pillay, 2018).

Although the 2016 National Sanitation Policy does not refence "smart sanitation" it does comment as follows on appropriate sanitation technology (DWS, 2016):

- Limited water resource availability should inform appropriate technology selection,
- Implementation of alternative, appropriate technology will be within social, environmental, and economic constraints. Settlement and geographic situation will also be considered,
- Appropriate sanitation technology must encompass waste management systems,
- Decentralised sanitation systems are encouraged,
- A formal process for certification and accreditation of appropriate sanitation technologies will be developed,
- The Minister will, in concurrence with National Treasury, provide incentives to encourage utilisation of resource efficient sanitation infrastructure in human settlement areas,
- The Minister will have developed regulations for new development to use greywater in waterborne sanitation systems, minimising impacts on water resources.

2.4.6 Active use of SANS 30500

The ISO 30500 has been adopted into a local standard, SANS 30500, in South Africa. The standard specifies sustainability considerations for NSSS and enjoyed guidance by TÜV-SÜD regarding the establishment of a certification scheme (Kelly, 2022).

Infrastructure News comments that many NSSS exist worldwide, but that no technology had been certified against ISO 30500 by end 2022. Likewise, despite a high level of South African representation

on the ISO 30500's international panel and SA adopting the standard as SANS 30500 in 2019, the setting up of a certification scheme not realised (Kelly, 2022). In the article, Dr Preyan Arumugam-Nanoolal, highlighted the following factors:

- the stringent requirements of the standard as well as the costs associated with testing,
- testing laboratories would need to be SANAS 17025 accredited, which is expensive to get obtain and maintain,
- SANAS accredited do not typically have capacity for testing NSSS and currently do not see the business case as there is very little demand for NSSS testing,
- laboratories which have capacity to measure most of the parameters required for NSSS testing reside at universities and research institutions and are not SANAS accredited,
- Linked to this is the lack of critical mass ito having enough technologies needing to be certified to justify the cost embedded into becoming a third-party certifier of SANS 30500. In other words: "...market acceptance of NSSS is driven by SANS 30500 certified products and SANS 30500 certification will likely only happen once there is a large volume of technologies which are certification ready."

Author observations from literature:

- To overcome some of the challenges listed, an online system could assist technology developers to determine their certification-readiness, without excessive costs involved and avoiding repeated submission of prospective NSSS technology for certification. Such system will guide technology developers in creating NSSS that meet the criteria of SANS 30500.
- South Africa, through a UKZN -Agrément partnership, plans have been tabled to develop this certification scheme.
- The DWS Sanitation Technology Technical Coordinating Committee (STTCC) is facilitating the development of a process to assess and validate appropriate sanitation technologies and aid in their certification and accreditation, and to guide the adoption and commercialisation of these technologies on a national basis.
- At a local and implementation level, municipalities will ultimately have to make the decision as to the technology being implemented.
- The SANS 30500 coupled with a certification scheme, could create confidence and assurance in governments, regulators, private investors, and end-users that the non-sewered facilities they use are safe, reliable, good quality and managed by competent operation and maintenance staff.
- Simultaneously, it facilitates the development of a local circular economy with the transformation of human wastes into valuable resources, thereby driven a responsive climate and environmental plan.

A current WRC project, "Coordination for the SANS 30500 Testing and Certification (Mark Scheme) Pilot" is underway and being undertaken by WASH R&D Centre and Khanyisa Projects with the project timeframe being April 2022 to March 2024. The purpose of this project is (WashCentre UKZN , n.d.):

- Develop a cost-effective mark scheme for the certification of NSSS against SANS 30500,
- Identify in-country laboratories with the capacity to provide testing against the entire standard,

- Test at least one Class 1 and one Class 2 NSSS under the proposed mark scheme in order to identify any other barriers to NSSS systems achieving certification in South Africa,
- Provide potential solutions going forward.

2.4.7 Greywater Systems

Greywater is defined as untreated household wastewater from baths, showers, kitchen and hand-wash basins and laundry, i.e. all non-toilet uses. The reuse and recycling of greywater through safe management, can assist in relieving pressure on freshwater supplies (DWS, 2016). Adequate regulation is seen to be a significant enabler to prevent incorrect storage, use and disposal of greywater which holds various health risks, including mosquito breeding from ponding of greywater, contamination of drinking water supplies and odours from stagnant water. The 2016 Sanitation Policy commented that policies at that time did not contain a policy position on greywater. There is also no specific reference to greywater in the National Water Act (NWA) No. 36 of 1998 (Republic of South Africa. 1998) although some sections concern itself with water resource management (DWS, 2016). This position has subsequently changed with the issuing of the 2017 Norms and Standard for Domestic Water and Sanitation services, and the 2024 revised (proposed) version Norms and Standard Part B, which deals with the discharged water quality ito domestic effluent management, and reference to greywater management following the WRC's 2018 'Guidelines for Greywater Use and Management in South Africa' (Carden et al., 2018), seeking to support the wider adoption of domestic greywater use in South Africa.

The guideline identified the classes of greywater, ito "light" (being Class I & Class II) and "dark" (being Class III) and sub-list the various classes into (Carden et al., 2018):

- Class Ia: Bathroom greywater – greywater sourced from showers,
- Class Ib: Bathroom greywater – greywater sourced from basins & baths,
- Class II: Laundry greywater – greywater sourced from laundry basins and washing machines,
- Class III: Laundry greywater – greywater sourced from kitchen sinks and dish washing machines.

The guideline does not deal with Class III greywater, due to the alkalinity and high organic concentration (fats, oils, grease, etc.) of the water. Similarly, due to high pollutant levels, greywater use is not recommended in informal settlements, as it is closer to "black" water, unless it is first directed to an on-site treatment process. Greywater reuse should be "fit-for-purpose" and considers toilet flushing and irrigation the more appropriate applications, on condition that human contact can be limited. Untreated greywater thus may be more appropriate to sub-surface irrigation, whereas treated greywater can be used more effectively in larger building structures, such as offices, public building, hotels, etc. In these situations, the greywater can be collected and treated under supervision and then used for irrigation, toilet flushing etc. (Carden et al., 2018).

In South Africa, untreated use of greywater in a domestic environment, without storage (apart from temporary holding or surge tank), is usually achieved through the use of a Greywater Diversion Device (GDD) and for sub-surface irrigation.

The guideline also describes the use of a Greywater Treatment System (GTS) which collects and treats greywater through a range of different treatment processes available, depending on the ultimate reuse. A cautionary approach is advised regarding the cost implication, social acceptability, O&M requirement prior to adopting this technology.

The guideline indicates that the most extensive content on management and use of greywater is found in the following regulations (Carden et al., 2018):

- Revision of General Authorisations in terms of section 39. (GN 665 of 6 September 2013: Government Gazette No. 36820),
- Regulations Relating to Compulsory National Standards and Measures to Conserve Water (GNR.509 of 8 June 2001),
- National Sanitation Policy (GN 70 of 12 February 2016: Government Gazette No 39688),
- National Environmental Health Norms and Standards for Premises and Acceptable Monitoring Standards for Environmental Health Practitioners (GN 1229 of 24 December 2015: Government Gazette No 39561).

2.4.8 Package Plants (including DEWATS)

2.4.8.1 Industry perspective

WRC published 2 reports on 'Self-regulation of the Small wastewater treatment (SWWTW) Industry'' (2015), which includes value information on package plants.

- Volume 1 deals with the development of proposed framework of standards, a conceptual model for a test facility and an accreditation system for each "new" technology provided by suppliers. It introduces a framework of standards which could be adapted for use in South Africa, and discusses their strengths and weaknesses, together with the feasibility of scaling them up for use on larger Works. It drew from the then current industry know-how as well as Australian, European and the United States NSF standards used internationally (Gaydon, 2015a). The report comments that it examined the then current South African legislative standards for discharge of treated effluent to the environment, the corresponding monitoring requirements, and the then current General Authorisation Discharge Requirements. Recommendations were made ito:
    - WQ for lawn irrigation,
    - Defining satisfactory compliance, which included a method of calculation and the percentage compliance,
    - A categorisation framework for SWWTW sizes following a three-tier system. This was after consultation with the industry body SEWPACKSA and the WISA SWWTW Division,
    - A SWWTW Treatment Efficiency Testing Standard was formulated inclusive of proposed process design standards, and proposed as a national standard and would obviate the need for various municipalities to publish their own individual standards or by-laws,

    - Providing a brief evaluation of the concept of a SWWTW evaluation facility making recommendations with respect to the requirements, funding of the facility and its operation.
- Volume 2 proposes a "Green Droplet" Accreditation System (Gaydon, 2015b), which examines the development of the Green Droplet System for SWWTW, a concept mooted by eThekwini Water and Sanitation (EWS) with a view to self-regulation of small plants under their jurisdiction. Self-regulation would encourage the various stakeholders (owner, designer, supplier, operator, regulator) to take the right actions proactively while understanding their role in the chain of accountability to minimise risk to environment, health, and reputation. The system proposed is a simplified and graded system applicable to different Categories of SWWTWs. It also identifies the drivers required to be institutionalised as being:
    - Acknowledgement that the Green Droplet System aims to protect the environment and should be seen in a positive light,
    - Implementation will need to be conducted with enthusiasm and the process seen as a positive action, rather than a bureaucratic requirement,
    - The system should lead to positive recognition, incentives, and rewards,
    - The system should be carefully set out in the supporting paperwork to ensure that it is simple and easily understood to prevent confusion and frustration during implementation.

Note: the above report refers to General Authorisation (GA – GN 1191 of 1999), which has subsequently been replaced by the 2013 revised GA for controlled activity wastewater irrigation (Government Gazette Vol 578 No 36820 Government Notice No 665 of September 2013). The discharge Standard General Limit Values were changed with ammonia amendment to 6 mg N/ℓ, and the current limit amended to 3 mg N/ℓ. This would imply that SWWTW may not necessarily be able to achieve GA limits as this limit would require a sophisticated and energy-intensive technology.

2.4.8.2 Municipal perspective

The Water Institute of Southern Africa (WISA) has a Small Wastewater Treatment Works Division (SWWTWD) which supports sustainable performance, collaboration, management, and governance within the Small Wastewater treatment works (SWWTW) community aimed at achieving Green Drop compliant performance, community ownership attitude and nurturing a winning network of partners and build mutual loyalty within the division (WISA, 2024) (Dlamini, 2022).

The WISA SWWTWD has identified the following challenges (Dlamini, 2022):

- No standard legislation or policy governing Package Plants/SWWTW, requiring each municipality to develop its own,
- Some systems failing due to installation flaws since there's no or minimal assessments regarding the experience and track record of the technology supplier and insufficient understanding of product description, servicing requirements, and user operation and of use,

- Operational challenges include:
    - Bad odours and poor effluent quality due to lack of maintenance and process control,
    - No alternative power source to mitigate load shedding interruptions,
    - Inadequate training of plant operators or no plant operators to attend to the daily tasks,
    - Vandalism and theft,
    - Insufficient budget allocation (both CAPEX and OPEX).

A key principle and solution in decentralised treatment would be to devolve the level of the application so that wastewater can be treated at affordable costs, cutting the cost of pumping long distances, and promoting local reuse of treated wastewater. The DEWATS concept is an example of a specific technical approach to decentralised wastewater treatment.

Previous section 2.4.2 discussed the key attributes of a decentralised sewerage system (Mpofu et al., 2023).

2.4.9 Ecological Sanitation (Eco-Sanitation)

Eco-sanitation is the incorporation of alternative water and sanitation system in the design and operation of housing development (Dowling, 2007).

The Lynedoch EcoVillage, managed by the Lynedoch Home Owners Association (LHOA), is an example of an eco-estate where LHOA is responsible for operation, maintenance of services and infrastructure in accordance with functions and powers as delegated by the Stellenbosch Municipality. It includes a combination of mixed residential (medium to low income), light commercial, community and educational facilities. The system has certain attributes that could be replicated to other developments (Dowling, 2007):

- Water & stormwater management:
    - The dual water supply for recycling of water for toilet flushing and irrigation, water saving devices (taps, shower heads & dual flush systems), stormwater run-off reduction and rainwater harvesting.
    - The potable water supply is via the municipal supply system, but there is a dual piping system to allow for the recycled water to be used for flushing and irrigation at a household level.
- Household effluent management: Provision is made for both grey- and blackwater treatment by two different system and all water stays on overall premises.
    - The community, commercial and public building's effluent (grey & blackwater) is treated via a multistage biological treatment process (Biolytix system, an organic soil ecosystem of peat, beetles, microorganisms, and earthworms) including a sand filter and UV radiation. The outflow of this is used for irrigation.
    - Residential effluent is treated via shared septic tanks coupled with a small bore sewer system. The septic tank outflow, via the small bore system, is transported to a

vertically constructed wetland for secondary treatment. Initially the wetland outflow went via membrane filter (powered by windmill and solar panels), but ultimately it will be pumped to a polishing dam from where it is recycled into the residences as flush water. Sludge removal is every 18-24 months.

Operational and design issues of concern relate to:

- Biological treatment system
    - Blackwater exceeds greywater in the non-residential buildings and system and actual system overloaded ito design criteria,
    - WQ compliance relating groundwater pollution and Health and Safety aspects for the biological treatment system, specifically ito effective pathogen removal, High COD & phosphates,
    - Ineffective sand filtration and UV radiation processes,
    - Cross utilisation of the wetland systems (using the wetland for both systems) can achieve compliance but will reduce wastewater product recycling value ito reuse of nutrients through irrigation.
- Wetland system
    - Effective denitrification needs to be achieved and thus it is essential to ensure that the right or effective plant material are used,
    - Effective mechanisms for phosphate removal need to be ensure as part of design,
    - Critical to ensure correct loading which can be achieved if full residential development occurs, but as a phased development occurs resulting in underloading, such phased loading may also need to be brought into the design of the wetland system, possibly through a modular approach.

The above case proved effective from a financial perspective (Capex & Opex), water conservation & demand management perspective and ultimately ito water quality and environmental compliance. The case carries positive lessons to other potential developments and informs a regulatory approach where certain circumstances are presented (Dowling, 2007):

- Where connection of a development to a centralised bulk servitude system impossible,
- Where a development takes place over the existing infrastructure which cannot meet the design aims and capacity of the development,
- Where centralised systems cannot keep up with development,
- Where a community development project wishes to use recycled resources,
- Where ownership is established such as in a closed development.

2.4.10 Water Services Intermediaries and Water Services Providers

A water services intermediary can be defined as "*any person who is obliged to provide water services to another in terms of a contract where the obligation to provide water services is incidental to the main object of that contract*", whereas as a Water Services Providers (WSPs) can be any organisation contracted by a WSA to provide water services on behalf of that WSA to consumers within that WSA. This is usually in the form of a Service Level Agreement (SLA).

The Service Level Agreement (SLA) between a municipality (the WSA) and their water and or sanitation WSP must clearly define the role of the WSA as regulator of the services provided by the WSP and in specific the roles ito the operational and maintenance functions required to ensure ongoing supply of services and its compliance to all applicable legislation and norms and standards promulgated in terms of these. Further provisions in the SLA include service level and quality to consumers, as well as effluent quality. DWS have developed a Model Water Services Contract which guides the drafting of a SLA between the WSA and WSI (DWAF, 2012).

An intermediary may be operating and maintaining a plant and will then require the same regulatory functions as WSPs, even though there will not be a direct contract between the municipality and the operating agent (intermediary). There is a strong case to be made for a WSI or WSP operating a decentralised treatment facility on behalf- or instead of a municipality.

At present, municipalities decide whether to manage operators of DWWT plants as WSPs, allowing for more direct oversight, or as intermediaries and thus accepting a certain amount of risk. It may be necessary to either strengthen national regulation regarding WSIs accountability related to sanitation services provision and management, or to revisit the WSP concept to allow for national generic SLA guidelines which municipalities can access.

An Implementation Guide can facilitate DWWT plants, specifically if developed to consider (Mpofu et al., 2023):

- Requirement of an application for a DWWT or a package plant,
- The municipal contribution vs the developer's contribution, which could be zero in cases where the developer funds the installation of a DWWT,
- Installation and operational requirements addressing principles such as:
    - O&M for long term sustainability, with appropriate institutional, skills, financial and contractual arrangements,
    - Each installation and arrangements must be measured, managed, and regulated on its own merits,
    - National, provincial, and local policy and legislative requirement compliance, including:
        - Effluent standards,
        - Operational requirements and standards, such as Load variation; Backup systems (such as pumps & alternative electricity supply); Operational failure (incl. poor-quality effluent); Management and control of odour, noise & Psychoda flies, Visual intrusion; Public health and safety; and Waste (sludge) disposal,
        - Environmental requirements,
        - Applicable ISO and South African national standards (SANS), including 35000, 25421, 10400X and 10400XA.
    - Financial sustainability,

    - Ensure effective regulation through development and adoption of appropriate policy, by-laws, application and approval procedures, and compliance monitoring and enforcement capacity (financial, human and systems).
- Guidance ito monitoring and reporting requirements for operators including parameters, standards and frequency of monitoring and reporting as well as additional aspects such as regularity of site visits and of independent verification of monitoring results against WSP reported results.

2.5 Water Efficient Sanitation: Norms, Standards & Regulatory Aspects

Water efficient and smart sanitation concepts are found in several legislation:

- Constitution of the Republic of South Africa Act, 1996,
- National Environmental Management Act, No 107 of 1998,
- National Water Act, No 36 of 1998,
- Water Services Act, No 108 of 1997,
- Environment Conservation Act (ECA), No 73 of 1989,
- Occupational Health and Safety Act No 85 of 1993,

Regulatory aspects pertaining to water efficient sanitation are discussed in more detail hereunder.

2.5.1 DWS's National Norms and Standards for Domestic Water and Sanitation Services Version 3/Final (2017)

The 2017 DWS 'National Norms and Standards for Domestic Water and Sanitation Services' updates the previous version by considering the complexities and unique challenges faced in different parts of the country (i.e. rural, urban, peri-urban). The version addresses equitable water services provision to households, accounting for availability of water resources, financial challenges, geographical issues, servicing of vulnerable groups, and addressing the backlog (Neethling et al., 2022).

The term "water efficient sanitation" does not appear in the document, however, it puts forward a case to advocate and investigate water reuse and recycling ito the following:

- Reduction in demand of fresh water through investigating and advocating water-wise landscaping, rainwater harvesting, and water-efficient appliances and fixtures, and implementing use patterns and manufacturing processes with lower water needs than conventional methods,
- Likewise, the safe management and recycling or reuse of greywater, specifically ito of activities such as flushing of toilets should also be viewed as a "smart sanitation solution".

The document further refers to reclaimed water as being wastewater (including blackwater) that has been treated by a centralised wastewater treatment plant for potable or non-potable reuse. DWS need to consider in the next update the adoption of the WESS terminology and definition and takes a

position on wastewater (including blackwater) treatment by a decentralised wastewater treatment plant for potable or non-potable reuse.

2.5.2 DWS's Proposed Compulsory National Water and Sanitation Services Norms and Standards (2024) (DWS, 2024)

The draft 'Compulsory National Standards for Water Supply and Sanitation Services and Regulation' presents standards related to interim and basic sanitation services and emergency sanitation services, as well as the quality of water discharged into water services or water resources systems. It also covers standards around greywater, sewer collection, wastewater treatment, and faecal sludge management; quantity and quality of industrial wastewater collected into sewerage systems; quantity and quality of wastewater discharged into water resources; and control of objectionable substances (www.gov.za, 2024).

Similarly to the previous version, the term "smart sanitation" does not appear in the document, however, the document does refer to:
In Part A – provision of water services:

- The need for a WSI to provide appropriate sanitation technologies, which may differ based on the settlement density. In a dense settlement, innovative/emerging sanitation solutions can be provided that are off-grid (non-sewered), use little or no water and involve on-site treatment of human waste, but must ensure that the user level of service experienced is the same as those for conventional water-borne sewers systems,

- WSIs needing to undertake WQ monitoring and reporting obligations more similar to that of a WSP, ito drinking water provision,
- The WSA's accountabilities in providing interim sanitation services which must meet basic standards, be culturally sensitive and appropriate,
- Basic sanitation service which must ensure that excreta and wastewater is safely contained throughout the sanitation chain,
- Faecal sludge management as part of the sanitation service (but does not reference recycled wastewater or reuse of sludge),
- Define the use of waterborne sewered systems in areas of dense formal settlement by WSIs, and making allowance for innovative or emerging solutions, such as non-sewered solutions that use little or no water and involve on-site treatment of human waste. In the medium and low dense settlement areas, similar provision is made for solutions with lower cost wastewater treatment solutions,
- Requirement that new innovative or emerging solutions or non-sewered solutions must adhere to the requirements of SANS 30500 for Non-Sewered Sanitation Systems,
- Requirement that all new settlements and developments must use water efficient sanitation solutions,
- Requirement that faecal sludge treatment plants must adhere to "ISO 31800" for faecal sludge treatment units – this is a critical document for on-site treatment units,
- Confirms the WSI's operator and worker requirements and community participation.

In Part B – the discharged water quality ito domestic effluent management:

- Greywater management must be undertaken following the WRC's 2018 Guidelines for Greywater use and management in South Africa,
- Sewer collection, wastewater treatment & faecal sludge management, specifically for the WSI's accountability ito Wastewater Risk Abatement planning (W_2RAP) and WHO Sanitation Safety Plans,
- Sludge management, including collection and removal and regularity of inspections and treatment process audits.

In Part C – covering the efficient and sustainable use of water:

- The focus is more on water conservation and water demand management (WCWDM) with limited comment on the use of alternative water sources,
- Recycling options are not covered.

In Part D – Construction & Functioning of Water Service Works & Consumer Installations:

- Covers mainly the need for water and wastewater balances and determination of water losses,
- Confirms the need to conform to SANS 10252: Water Supply and Drainage for Buildings and SANS 10254: The installation of fixed electric storage water heating systems,
- The conformance requirement earlier to adhere to "ISO 31800" makes substantial allowance for on-site installations, their construction and operation.

In Part E – Nature, operation, sustainability, operational efficiency, and economic viability of water services provides for:

- Human resources planning & competencies,
- Management of disruptive electrical supply on water services including wastewater systems,
- O&M of Wastewater treatment systems identifies generic requirements for Wastewater treatment systems operation, auditing, budgeting, and costing, etc. No specific comment as to on-site installations,

Author observation from literature:

- The closest link and reference to WESS would be the adherence requirement to "ISO 31800".

2.5.3 The National Water Resources Strategy (NWRS3) (2023)

The DWS's NWRS2 highlights the need to reduce water losses and increase water use efficiency; promote water saving through incentive-based programmes which includes using smart technology. NWRS2 states that conventional waterborne sanitation, using potable standard water to flush human faeces, is an inefficient resource use system. Similarly, inadequate, or poor sanitation from areas of human settlement is one of the main sources of pollution having a negative impact on water quality and groundwater. The NWRS2 annex a strategy for water reuse called the 'National Strategy for Water Reuse', with comment that the strategy be incorporated into the activities of WSAs.

The NWRS-3 comprises the following overarching goals (DWS, 2023):

- Water must be protected, used, developed, managed, and controlled sustainably and equitably,
- Water and sanitation must support development and the elimination of poverty and inequality, and contribute to the economy and job creation

NWRS-2 comments on the existing initiatives on WCWDM by municipalities, noting the need to intensify water conservation and curtail demand within the local government sphere. The strategy gain traction with many metropolitan and other municipalities reducing their water losses and improving water use efficiency. Interventions include pressure management, retrofitting and removal of wasteful devices, improved management, sectorisation, metering, billing, development of by-laws, tariff reviews, mains replacement, leak detection and repair, awareness campaigns, asset management, operation and management, pressure management, and wastewater reuse.

The NWRS-3 identifies strategic objectives for reducing water demand and list the following actions to be taken (DWS, 2023):

- Align the water use authorisation process with WCWDM priorities and encourage interventions to improve water use efficiency by ensuring that WCWDM conditions are included in the Water Use Authorisations,
- Encourage Water User Associations (WUAs) and end users to understand the need to modernise their water conveyance systems and irrigation equipment, and that the Department must modernise its water conveyance systems,
- Achieve a change of attitude and behaviour in terms of how water is treated and conserved, by promoting efficient use of water amongst consumers, customers and by promoting the use of water saving technologies by consumers and customers,
- Promoting the reuse, reducing, recycling and recovery of wastewater,
- Exploring the feasibility of different direct wastewater and water return-flow reuse options, which includes municipal wastewater reuse and other options.

2.5.4 SANS 30500 – Non-Sewered Sanitation

SANS 30500:2019 defines non-sewered sanitation systems as an installation that "treats human faeces and urine, menstrual blood, bile, flushing water, anal cleansing water, toilet paper, other bodily fluids/solids and in some systems, additional input as defined by the manufacturer. The outputs substances of such a system include solids and effluent, as well as noise, air, and odour emissions."

The standard requires general safety and performance requirements for design and testing and promotes the implementation of sanitation systems where increased sustainability is desired, or where traditional sanitary sewer systems are unavailable or impractical and thus, to ensure human health and safety as well as protection of the environment.

SANS 30500 certification is only applicable to:

- Sanitation systems that are either manufactured as one package, or manufactured as a set of prefabricated elements designed to be assembled in one location without further fabrication or modification that influences the system function. It is thus not applicable to sanitation systems constructed in situ.
    - ***Author observation***: There may be a need to revise or clarify in-situ built, non-prefabricated designed unit.
- Treatment units that operate in non-sewered and off-grid environments and that do not require major sewer infrastructure. It does appear that it can apply to treatment processes taking place at another location, separate from that of the frontend and backend components.
    - ***Author observation***: There may be a need to revise or clarify the "off-grid" reference to allow for a limited sewer network of multiple ablutions facilities to a single, stand-alone treatment works, e.g. residential housing estate or resort style facility.
    - The standard provides for a DWWT system – it could be advantageous to consider this aspect in legislation, possibly in SANS 25421.

SANS 30500 confirms that it does not consider the following listed aspects, which implies that additional provision is needed to ensure that it is referenced in legislation.

- Guidelines for selection, installation, operation and maintenance, and management of sanitation systems,
- Transportation of treated output outside of the sanitation system (e.g. manual transport, transportation by truck or trunk pipes) for further processing, reuse, or disposal as well as requirements for transfer facility,
- Reuse and disposal of sanitation system output.

2.5.5 SANS 10400-Part Q

SANS 10400-Part Q deals with the sanitary waste and the healthy handling and treatment of effluent when there is no water-borne sewage system available in a particular area. Health is the major factor when it comes to effluent and any pathogens, pollutants or contaminants must not affect the user of any sanitary waste means of disposal.

In specific, Part Q refers to all the parts of the system that could be used from Closets, Chemical toilets to VIP (Ventilated improved pit) toilets. The sanitary construction guidelines are specific on size and location and minimisation of odours and attraction of flies. Sanitary conservancy tanks have become the rule in many municipalities and there are specific guidelines on the installation and siting.

Similarly to SANS 30500, the standard does not make provision for a DWWT system. There is thus a need to ensure that decentralised treatment is considered in legislation.

The local authority has the overriding say on what is and what is not permitted in any area over which it has jurisdiction.

2.5.6 SANS 24521 Guidelines for the management of basic on-site domestic wastewater services

South Africa has adopted the "SANS 24521:2020 Ed 1 Activities relating to drinking water and wastewater services – Guidelines for the management of basic on site domestic wastewater services" which provides guidance for the management of basic on-site domestic wastewater services. This national standard is the identical implementation of ISO 24521:2016 and is adopted with the permission of International Organisation Standardisation.

The standard comments that management of on-site domestic wastewater services of all types and at all levels of technology, require an understanding of the biological processes at work, the factors that can inhibit those processes and the means of ensuring those processes are functioning. It also involves a general understanding by the wider community served of the benefits of sanitation system use and management.

The SANS also applies to both publicly and privately operated basic on-site domestic wastewater (black- and greywater) services, for one or more dwellings and provides guidance on:

- Management of basic on-site domestic wastewater services from the operator's perspective, including maintenance techniques, training of personnel and risk considerations,
- Management of basic on-site domestic wastewater services from the perspective of users,
- Design and construction of basic on-site domestic wastewater systems,
- Planning, operation and maintenance, and health and safety issues.

The SANS also confirms that basic on-site sanitation solutions include consideration for a number of aspects as discussed under previous section 2.3.2.3.

This SANS confirms that the requirements of ISO 24511:2007 apply to various aspects, including public health protection, sustainability of basic on-site domestic wastewater systems and sustainable development. ISO 24511 provides guidelines for the management of wastewater utilities and for the assessment of wastewater services.

The SANS encourages the reuse of reclaimed water (treated effluent), but states that prior to granting approval, the relevant authority should establish that the extent of treatment, the method of application and the reuse purpose for reclaimed water, to ensure that it does not create public health risks and adverse environmental impacts. It also comments that reuse should only be permitted for:

- Non-potable (not for human consumption) purposes,
- Systems that do not have a negative effect on the environment,
- If safeguards are included to ensure that failing on-site domestic wastewater systems do not cause accumulation of wastewater on the ground, its percolation into ground water or its flow into waterways that are close to the failing system.

The SANS does also support the effective reuse of water as flushing water, especially where it is in short supply and ito water that has been used for washing hands and/or anal areas, where possible,

(e.g. toilets where the top of the water tank forms a sink). The guide further comments on the disposal and reuse of treated wastewater and sludge and provides examples of intensive and extensive treatment options.

Other aspects covered by this SANS include:

- Management of basic on-site domestic wastewater systems, including for independent management of the functioning of the system, financial sustainability, asset, risk & environmental management,
- Planning & construction, which also highlights that water reuse, as well as efficiency of the technology (ito collection, evacuation, treatment, water & energy requirements), should be included in the design planning,
- Operation & maintenance, including developing operational-, maintenance- and waste collection- & transportation plans and instructions,
- Health and safety issues.

The Annexures provides a summary of user interface examples of basic on-site wastewater technologies, including comment on 8 aspects, namely: types of technologies, water and energy requirements, treatment ito passive or non-passive, recycling/reuse potential, advantages, disadvantages, and outputs. The technologies covered and which have further discussion include:

- Simple ventilated/unventilated pit latrine,
- Ventilated improved pit latrine/fossa alternatives,
- Dry toilet (including urine diverting dry toilet, composting toilet and other basic dry toilet models and their variations),
- Pour flush toilet,
- Waterless urinal,
- Cistern flush toilet,
- Washing facilities, e.g. greywater sink,
- Soak-away, e.g. for greywater.

The SANS comments as flows in passive versus non-passive treatment:

- Passive" treatment of the wastewater causes the waste to be degraded through naturally occurring organisms without the use of additional equipment to generate the organisms but may include the use of additives,
- The capability of a design to provide non-passive treatment may depend on the topography of the site,
- Non-passive treatment uses external energy and includes additional equipment to treat the wastewater by moving the wastewater to other treatment stages with pumps or using compressors to introduce air into the wastewater.

The Annexure also provides a similar summary of collection and transportation examples of basic on-site wastewater technologies including comment on the 8 aspect categories. The technologies covered and which have further discussion include:

- Collection: ranges from Jerrycan/other tank, Vaults & Chambers, Human powered and motorised (pump or vacuum) emptying to Transfer stations (underground holding tank),
- Transportation: ranging from cart, tricycle or any other human-powered multiple-wheeled vehicles to trucks and Vacuum tankers.

Similarly, the various treatment examples provided as a summary with the 8 aspects followed by a short descriptive discussion, which include:

- Septic tank system with adequate filtration, if discharged,
- Ponds (anaerobic, facultative, aerobic, maturation),
- Constructed wetland,
- Land treatment (slow filtration, rapid filtration, and overland flow),
- Biological treatment units, based usually on attached growth (such as trickling filters or rotating biological contactors) or suspended growth biological processes, such as low-rate activated sludge,
- Up-flow anaerobic sludge blanket reactor (UASB),
- Sedimentation/thickening ponds,
- Unplanted drying beds,
- Planted drying beds,
- Co-composting (where composting is required with other available organic waste),
- Anaerobic biogas reactor.

Lastly, the SANS Annexures also provide a summative discussion on disposal/reuse examples of basic on-site wastewater technologies that covers energy recovery, effluent disposal, and land application.

2.5.7 SANS 10400X and SANS 10400XA

Part X deals with environmental sustainability, and Part XA deals with energy usage in buildings. The requirements of this new national standard covers hot water supply; energy usage and building envelope; design assumptions and building envelope requirements. The standard also defines the different climatic zones of South Africa.

Of relevance to WESS, is the stipulation that all buildings (include DWWTW), as well as alterations and additions, where plans need to be drawn up and submitted (besides garages and storage areas) must be designed and constructed in an energy efficient way to contribute to the reduction of greenhouse gases.

Although provision is made in SANS 10400-X and XA for sustainable buildings and energy efficiency in buildings, no similar provision has been made for water efficiency in buildings. A previous WRC study recommended that in SANS 10400-XA, the concept of encouraging water efficiency in buildings (including flushing systems) should form a separate and additional part to Part X, e.g. Part XB Efficient Water Usage in Buildings (Merwe-Botha & Quilling, 2023).

2.5.8 ISO 31800:2020 (ISO, 2020)

The ISO 31800:2020 'Faecal sludge treatment units – Energy independent, prefabricated, community-scale, resource recovery units – Safety and performance requirements', is a Community Scale Resource Oriented Sanitation Treatment Systems Standard. It specifies requirements and test methods to ensure performance, safety, operability, and maintainability of community-scale resource recovery faecal sludge treatment units (herein addressed as treatment units) that serve approximately, but not limited to, 1 000 to 100 000 people. This document applies to treatment units that (ISO, 2020):

- Primarily treat faecal sludge,
- Are able to operate in non-sewered and off-grid environments,
- Are prefabricated,
- Exhibit resource recovery capability (e.g. recovering energy, reusable water, soil amendment products), and are capable of being energy neutral or energy net positive.

This standard does not apply to treatment units requiring major sewer infrastructure. The standard also excludes guidelines for selection, installation, operation and maintenance, and management of these faecal sludge treatment units, and neither incorporates nor substitutes for manufacturers' instructions and user manuals.

The standard states that the treatment units shall be designed and manufactured in accordance with the International System of units (SI) defined in ISO 80000 (all parts) and IEC 80000 (all parts). Other requirement for the manufacturer are the undertaking of hazard and operability study (HAZOP) following IEC 61882, and a risk assessment following either ISO 12100 or IEC 31010. Treatment units shall be designed for a serviceable life of not less than 20 years, assuming operation and maintenance are conducted according to the manufacturer's specifications.

The standard further describes in detail the following aspects and requirements:

- Treatment unit input and Specification of input parameters and ranges,
- Requirements for handling of faecal sludge as a fuel ito Reception and storage of faecal sludge, faecal sludge feeding system and Drying facilities,
- Energy balance and resource recovery,
- Performance requirements ito:
    - Technical process availability such as Mean time between failure (MTBF), Mean time to repair (MTTR) & Preventive maintenance time (TMT),
    - Process reliability ito Process stability, Start reliability, and start time & Shut-off reliability and shut-off time (including probability of failure on demand (PFD)).
- Safety and functional requirements,
- Operability & Maintainability,
- Outputs ito solid and effluent limits, air emissions, odour control, noise & testing,
- Product literature and content that must be made available, these include for:
    - Input & Performance claims,
    - Unit boundaries,

- Energy dependence ,
- Environmental sustainability ,
- Consumables,
- Greenhouse gas (GHG) emissions,
- Characteristics of resource recovered products,
- Maintenance and operator documentation.

Author observations from literature:

Considering the regulatory inclination towards a WESS approach, there is a need to adopt the following ISO standards as SANS ito the South African environment:

- Community Scale Resource Oriented Sanitation Treatment Systems Standard
  - ISO 31800:2020 - Faecal sludge treatment units - Energy independent, prefabricated, community-scale, resource recovery units - Safety and performance requirements.
- Faecal Sludge Management Standards: Activities related to drinking water and wastewater services
  - ISO 24510 - Activities relating to drinking water and wastewater services – Guidelines for the assessment and for the improvement of the service to users
  - ISO 24511 - Guidelines for the management of wastewater utilities and for the assessment of wastewater services.

2.6 Water-efficient Sanitation from a Municipal Perspective

Author observations from literature:

Existing literature indicate that municipal by-laws follows the following trends with regard to water efficient sanitation solutions (Merwe-Botha & Quilling, 2023):

- Few of the smaller municipalities and a limited number of metro municipalities have made specific provision or directives to water efficient sanitation solutions or technologies. The existing measures are mostly related to defining water efficient measures (6 ℓ or less flushing), particularly in relation to water fittings such as toilets flushing systems.
- Most of the metros have specific directives, e.g. CoCT, whereas others ascribed to environmentally sustainable policies and “Green” principles without actively defining the extent of the technologies. Of note is NMBM, which has a directive that stipulate that all water services fittings need to be included on the JASWIC List of Accepted Water Components.

Many municipalities adopted the Model By-laws with no/limited personalisation or additional specification. Using this document as lever, the following is recommended:

- Update the Models By-laws to encourage water efficiency, including for water efficient fittings and equipment, potentially identifying a range of water efficient option, e.g. low-flush, ultra-flush to pour-flush, etc.,
- Provide a generic/national Schedule of Approved Pipes and Fittings, which municipalities can change as per their supply chain management processes and relevance to their area,

- Charging for schedules will discourage people accessing it, specifically if needing to check on water efficient fittings and equipment. This information should be freely available in pdf format from municipalities websites with a period applicability indicated to ensure that the latest version is being accessed.

The section following provides some insight as to the current status of municipal regulation in terms of alternative water use and non-sewered sanitation.

2.6.1 City of Cape Town

The 2018 Water By-laws require that water conservation criteria be incorporated into a development (CoCT, 2018). This implies that:

- New developments must ensure that any equipment or plant connected to the water installation uses water in an efficient manner,
- New developments must install water conservation and demand management systems, or alternative water systems, and these must be approved by the City before development proceeds. (The full details of any proposed water conservation and demand management system or alternative water systems such as a greywater system, air conditioner or bleed-off for flushing toilets, irrigation, swimming pool top-up or top-up for non-domestic purposes must accompany the building plans),
- Pipes and water fittings in a water installation must bear:
  - the standardisation mark of the SABS in respect of the relevant SANS specification issued by the bureau; and
  - a certification mark issued by the SABS to certify that the pipe or water fitting complies with a SABS mark specification, or a provisional specification issued by the SABS, provided that no certification marks must be issued for a period exceeding two years.
- Parks and sports fields use alternative water sources such as harvested stormwater, treated effluent or borehole water for irrigation purposes before using potable water. Licensing procedures to be followed as required by the water source (e.g. borehole) and intended use.

Ito alternative water use and NSS (Mpofu et al., 2023), CoCT promotes the responsible use of alternative water sources. Guidelines have been developed as part of the City's water resilience drive. Alternative water can be used to flush toilets and for a few other uses, with required permission and quality.

CoCT Perspective: The approval, authorisation and licensing needed for different sources of alternative water include

Table 2.1: The approval, authorisation and licensing needed for different sources of alternative water from a CoCT perspective

Alternative Water Source	From National DWS	From CoCT
Greywater	N/A	• Approval for installation
Treated effluent – from City	Registration as a water user	• Approval for installation

CoCT thus allows for the use of treated effluent, as per their Treated Effluent By-law (CoCT, 2010 (amended in 2015)). The City identifies treated effluent as recycled sewerage water that is sourced from the treated effluent supply system of the City. The water is piped via a separate network of pipes and can be used for irrigation and industrial purposes. It can also be collected on a large-scale in tankers from the collection points on a permit-based system granted by the City. It must NOT be used for drinking water. The City supplies treated effluent to high water users, which can include complexes, businesses, and apartment blocks where there is a level of control management. There is a formal application process and very specific criteria that need to be met in order to use this option.

Discharge of used alternative water or any effluent generated must be directed to the correct place. Any discharge or overflow from your alternative water system containing harmful chemicals or substances should be directed to the sewer system for treatment/neutralisation at the City's wastewater treatment works, provided that it is within the prescribed limits stipulated in the City's Wastewater and Industrial Effluent By-law.

The City has also defined specific design criteria for treated effluent installations, which includes for:

- A consumer must ensure that— (a) treated effluent installations comply with SANS 10252:2004 Part 1, or as it may be amended (SANS 10252: Water Supply (Part 1) and Drainage. for Buildings (Part 2)); and (b) no interconnection between treated effluent and potable water supplies exist,
- Compulsory diagram drawing of the intended installation, showing location of Reduced Pressure Zone (RPZ) backflow preventer (The required level of backflow prevention as outlined in SANS 1808-15,
- Permission or a license from the National Department of Water and Sanitation (where required),
- Pipework is correctly colour coded, as per SANS 10140-3:2003; and
- Appropriate signage, as per SANS 1186-1:2008, is displayed.

In addition, CoCT may grant permission for the treatment of blackwater on site, using a package plant for reuse. The City comments that does not encourage this option due to the extreme hazardousness of raw domestic wastewater or even partially treated domestic wastewater to both human and ecological health. Furthermore, the proximity of the package plants to people within the developments/sites may pose serious health risks. Such application are judged on merit, upon serious consideration by the City. Requests would be entertained in situations that would benefit (and the extent thereof) rather than compromise the City in term of its obligations, for example:

- Proposed developments being in a remote area outside the City's potable water and wastewater network perimeter,

- In an area where new water and wastewater services are not planned in the foreseeable future,
- Existing municipal wastewater treatment works that do not have adequate capacity,
- Reuse of the treated effluent for water conservation reasons.

The City comments that these installations require considerable management, technical expertise, monitoring, and reporting, and would have to comply with Environmental Impact Assessment (EIA) processes, Green Drop requirements and other relevant water standards. Developers wishing to apply, must follow the "Application to operate as a water services intermediary (WSI)" process available on the City's website. (http://www.capetown.gov.za/City-Connect/Apply/Municipal-services/Water-and-sanitation/apply-to-install-and-use-an-alternative-water-system).

The CoCT website also comment that application as a water services intermediary (WSI) is necessary if intending to go "off the municipal water grid" or wanting to operate as a water services intermediary in order to provide drinking-quality water for:

- Domestic/household purposes,
- Residential complexes, business organisation, commercial farms, etc,
- Those living, working, or visiting your property, you have to follow the application process.

In some cases, an intermediary may be operating and maintaining the works, and this will require the same regulatory functions as for WSPs, even though there will not be a direct contract between the City and the operator (Mpofu et al., 2023).

CoCT promotes the installation of greywater systems in new developments for garden and landscaping irrigation (where appropriate) and toilet flushing. The City's Water and Sanitation Department has published a brochure for further information on the safe use of greywater. Also see the full and summary versions of the Guidelines for Alternative Water Installations and Risks of Groundwater14 leaflet.

2.6.2 City of Johannesburg

CoJ had identified a potential increase in demand for the installation of alternative water source supply technologies (referred to as "off-grid solutions"). These solutions often take the form of on-site (package) treatment plant(s) that obtain water from sources such as boreholes, collected on-site raw sewage, rainwater harvesting, etc. and purifying that water to potable standards for consumption within the boundaries of that property. This has resulted in the drafting of an Off-Grid Water Services Policy in 2022 (CoJ_EISD, 2022).

The policy comments that although it is international best practice not to use the high-value clean potable water for toilet and urinal flushing, dual connections of potable water (for drinking purpose use) and the non-potable/recycled water (for sanitation purpose) is not common practice in South Africa. The use of alternative water source is managed through a written contract, entered into between the City and the customer who installs an off-grid/alternative water source solution. The

policy, however, also comments that an alternative water source supply is limited to 20% of the customer's overall current water demand and will be limited to supplementary use for alternative fit-for-purpose water uses such as connecting to rest rooms, irrigation systems, and cooling systems. Therefore, the city will not support off-grid solutions that completely disconnect from the Council's water supply services (CoJ_EISD, 2022). It is to be noted that this could deter the development of DWWT and more structured and multi-user non-sewered sanitation systems.

Similar to CoCT, CoJ allows for the use of treated effluent, as defined as wastewater which has been treated and provided from the treated effluent supply system of the City. CoJ's Treated Effluent By-law (CoJ, 2017) defines the design criteria for treated effluent installations, which at minimum requires a compliance to SANS 10252:2004 Part 1 and it amendments, and in cases with dual potable water connection, the installation of a Reduced Pressure Zone Backflow Preventer (RPZ) in accordance with SANS 10252-1:2004 Part 1 in all the potable water supply points entering the premises, downstream of his or her isolating valve which is situated downstream of the water meter. Similarly to CoCT, there is also no comment about the use of "own" treated effluent in the By-Laws. It is to be noted that this could deter the development of DWWT and more structured and multi-user non-sewered sanitation systems.

The CoJ Water Services By-laws make provision for on-site sanitation technologies such as septic tank and treatment plant, French drains, conservancy tanks and VIPs. The By-laws does allow other plant for the treatment, disposal, or storage of sewage, but it does require prior written Council approval. Likewise, in the case of a communal sewer, a collective agreement must be signed by the group of consumers accepting responsibility for the maintenance and repair of the communal sewer. All on-site sanitation services must be in accordance with the specifications of the Council and in compliance with all other legislation prior to conclusion of the agreement (e.g. EIA regulations, NEMA, etc.). In approving an application for the installation of infrastructure, the Council may specify the type of on-site sanitation services to be installed.

CoJ's By-laws also require all sewer drainage-related infrastructure to comply with:

- SANS Code 10400-2010 Part P, Drainage or as amended
- Pipes or fittings need to:
    - bear the SANS standardisation mark in respect of the relevant and the latest SANS specification issued; and
    - bear a certification mark Issued by a SANS accredited certification body to certify that the pipe and or water fitting fully complies with SANS criteria; and
    - be accepted by Joint Acceptance Scheme For Water Services Installation Components (JASWIC) and listed by this committee that the pipe and or water fitting fully complies with the relevant SANS criteria. The current schedule referred to can be retrieved on www.jaswic.co.za website.

2.6.3 eThekwini Municipality

The eThekwini Municipality Sewage Disposal By-law (EWS, 2016) provides for different mechanisms of sanitation and for the management and regulation of sewage. The developer is allowed to investigate the provision of a suitable on-site privately owned sewage disposal system, subject to the home owner‘s association fulfilling its obligations as water services provider or water services intermediary.

However, services to informal settlements must be provided by means of either an ablution block connected to the municipal waterborne sewerage reticulation system; or where no connection to the municipal waterborne sewerage reticulation system is available a toilet block where each toilet must be equipped with its own VIP pit which must be emptied as and when required (EWS, 2016). This does thus not necessarily allow for a WESS concept or smart options.

The by-laws are specific in that privately-owned sewage treatment plant may only be installed on premises with the prior permission of an authorised official, which will only be granted in exceptional circumstances. It also includes privately-owned low volume domestic sewage treatment plant, which may only be installed on domestic premises. In terms of a privately-owned low volume domestic sewage treatment plant on domestic premises, the following conditions apply (EWS, 2016):

- The plant must comply with the eThekwini guideline document: Package Plants for The Treatment of Domestic Wastewater, as published and amended from time to time,
- The developer must appoint a professional engineer at the commencement of the project and such professional engineer:
    - is responsible for the design and selection of the plant,
    - must supervise the construction, installation, and commissioning of the plant,
    - is responsible for the operational control, monitoring, and maintenance of the plant for a period of 5 years in terms of a service contract to the satisfaction of an authorised official,
- The developer must lodge a financial guarantee with the Municipality in an amount equal to 1,5 times the total cost of the plant for a period of 5 years,
- The municipality may prescribe additional requirements,
- If the discharge does not comply with the General Limit Values as set by the Department of Water and Sanitation General Authorisations in terms of Section 39 of the National Water Act, the owner of such plant may be instructed to discharge into an approved municipal facility on such conditions as an authorised official may prescribe,
- If the plant fails to meet the discharge standards set by the Department, the owner of the plant may be instructed to remove and replace the plant at his or her own cost.

The Water By-laws make provision for the use of non-potable water for irrigation purposes and may not be used for domestic or any other purpose which, in the opinion of the municipality, may give rise to a health hazard. Very specific safety and signage requirement apply (EWS, 2023). No comment appear to be made with regard to reuse of treated black- or greywater for toilet flushing purposes.

3 POSITIONING WATER EFFICIENT SANITATION SOLUTIONS (WESS) IN REGULATION

3.1 Incentivising Water Efficient Sanitation Regulation in Bulk Water Services

The Department of Water and Sanitation, in its role of national regulator, seeks to develop a regulatory framework to achieve the active discouragement of current municipal practices related to approving new developments or turning away applications for development where water and sanitation bulk infrastructure is under-capacity, both avenues which deter service delivery. This includes preventing new greenfield developments from creating further stresses to an existing strained networks and wastewater treatment systems, and ito requiring additional demand from existing stressed water resources.

DWS regulation thus needs to look at:

- Providing the Department with the means to enforce development to employ water efficient sanitation solutions that could potentially include concepts such as:
    - non-sewered & off-grid treatment solution systems coupled to efficient water use solutions, and
    - alternative water supply (allowing for direct and indirect potable reuse, recycling & reclaimed water), in areas where current sanitation systems are failing and have no water to expand.
- Facilitating or encouraging new developments that seek to pursue off-grid solutions, due to lack of, limited or dysfunctional water supply and or sanitation bulk services,
- Facilitating or encouraging new developments that see to use sanitation technologies that incorporate low water usage, specifically in areas where there are water supply shortages or water scarcity (e.g. Gauteng & eThekwini).

To achieve these objectives, it is necessary to review DWS regulatory documentation in order to:

- Identify which documents at present make provision for or refer to new developments (greenfield) ito water efficient water supply and wastewater services demands,
- Comment on what the potential changes to the regulation/s in order to:
    - Facilitate or encourage new developments wanting to go off gird due to no water and sanitation bulk services,
    - Provide DWS with the means to entrench water efficient water supply and wastewater services development, specifically non-sewered off-grid treatment systems and alternative water supply sources and efficient water use, in areas where current municipal systems are failing or unable to meet the required water demand.

Critical concepts are considered to be:

- The regulation needs to be a DWS regulation and not a municipal regulation, but to be enacted through municipal and local regulation, policy or processes,

- Wastewater product reuse, specifically collection and transportation off-site has historically been problematic and should be the focus of the intended WESS regulation. The current focus should ideally be on localised solutions with low generation of faecal matter/sludge,
- The regulation must be technology agnostic and is about enabling good practices linked to localised water efficient solutions with low generation of faecal matter/sludge,
- The regulation must encourage the provision of adequate and sustainable OPEX by having effective SLAs which require the WSI to indicate the manner and projection in which the proposed and planned system will be financially justifiable, coupled with sustainable operation and maintenance.

The purpose of the regulatory framework is to open a pathway to scale up the application of these smart solutions which will hopefully transition to other areas of sanitation such having to deal with VIP and other technologies which are becoming unsustainable, cost prohibitive to maintain and manage.

3.2 Review of DWS regulatory documents

The following DWS regulatory documents comment on service demands in stressed water supply and wastewater services and/or alternative water use and non-sewered sanitation. It includes, but is not limited, to the following legislation:

- National Water Act (NWA), No 36 of 1998,
- Water Services Act, No 108 of 1997,
- DWS's National Norms And Standards For Domestic Water And Sanitation Services Version 3- Final (DWS, 2017),
- DWS's Proposed Compulsory National Water and Sanitation Services Norms and Standards Jan-2024 (DWS, 2024),
- National Sanitation Policy of 2016,
- DWS Approved National Water Resource Strategy Third Edition (NWRS3) 2023.

Relevant comment as to applicability or changes in relation to entrench water efficient sanitation solutions are bulleted, in italics and highlighted in blue. This will form the basis of the envisaged draft regulatory framework.

3.2.1 National Water Act (NWA), No 36 of 1998

Chapter 4 deals with the use of water and that DWS represents the National Government, thereby having an overall responsibility and authority over water resource management, including the equitable allocation and beneficial use of water in the public interest, a person can only be entitled to use water if the use is permissible under the Act. As such, it defines lawful water use, the condition under which it can occur, as well as other controlled activities, including wastewater discharge and or management. The Act makes provision for efficient and beneficial use of water in the public interest, prior to issuing a general authorisation or licence.

This Act in Chapter 4 "Part 8: Compulsory licences for water use in respect of specific resource" establishes a procedure for a responsible authority to undertake compulsory licensing of any aspect of water use in respect of one or more water resources within a specific geographic area. It includes requirements for a responsible authority to prepare schedules for allocating quantities of water to existing and new users. The procedure is intended to be used in areas which are, or are soon likely to be, under "water stress" (for example, where the demands for water are approaching or exceed the available supply, where water quality problems are imminent or already exist, or where the water resource quality is under threat), or where it is necessary to review prevailing water use to achieve equity of access to water. It comments on the potential for additional information and environmental authorisation. It further comments that in determining the quantities of water to be allocated to users, the responsible authority must consider all applications received, and draw up a schedule detailing how the available water will be allocated among the applicants. In drawing up an allocation schedule, the responsible authority must comply with the plans, strategies and criteria set out elsewhere in the Act and must give special consideration to certain categories of applicants. A responsible authority need not allocate all the available water in a water resource and may reserve some of the water for future needs.

This section thus does allow for the concept of water stressed and the potential of enforcing an authority to show how this will be used and/or allocated, through a licence… although not stated (as yet) it could be a place to include the need to show efficient water use and allow for alternative options including recycled or greywater usage. If this notion is applied to the WSP or WSA or agency accountable for the allocation (and provision?) of the resource use, it would imply access to the resource (e.g. via water supply from bulk supplier or municipality?) and thus enforcing an compulsory licence at municipal planning level and strengthening- or using Section 43 (1)(a) to(c) to ensure efficient use of water as per above comment.

Under the definitions, it is specifically stated that the term "conservation" in relation to a water resource means the efficient use and saving of water, achieved through measures such as water saving devices, water-efficient processes, water demand management and water rationing.
Under Section 26 "Regulation on water use", provision is made for a number of conditions or prescriptions under which water use may occur, these include for:

- 26(1)(a): manner or extent of water use,
- 26(1)(d): prescribing the outcome or effect which must be achieved by the installation and operation of any waterwork,
- 26(1)(e): regulating the design, construction, installation, operation, and maintenance of any waterwork, where it is necessary or desirable to monitor any water use or to protect a water resource.

This section thus allows for the concept of DWS being prescriptive in the use of water and related water works. It would however be necessary to identify how DWS can use this concept and where it needs to be brought in to ensure that a municipality require greenfield developments, specifically in water stressed areas (including a municipal area that is close to the limit of their allocation of water) to show how they will "conserve water" and achieve

efficient water use, through measures such as using water saving devices, water-efficient processes (recycling).

3.2.2 Water Services Act, No 108 of 1997

The main objectives of the Act includes provision for:

- A regulatory framework for water services institutions and water services intermediaries - 2(d),
- The accountability of water services providers - 2(i),
- The promotion of effective water resource management and conservation - 2(j).

This Act also provides for a regulatory framework for water services institutions and water services intermediaries, including an instruction that a WSP must set conditions for provision of water services that include measures to promote WCWDM.

The Act does not provide further clarification of what this entails, other than such existing and proposed water conservation, recycling and environmental protection measures need to be identified in the WSDP.

Under Section 19 "Contracts and joint ventures with water services providers" there is the potential under 19(5)(b) - "compulsory provisions to be included in such a contract", for the Minister, as part of the prescriptions for a such a contract, to include that the municipality (as WSA and/or as WSP) needs to show how they will require greenfield developments, specifically in water stressed areas (can also refer to a municipal area that is close to the limit of their allocation of water) to show how they will "conserve water" and achieve efficient water use, through measures such as using water saving devices, water-efficient processes (recycling).

Section 19(7) makes allowance for the Minister to provide model contracts which can be used as guide for contacts between a WSA and WSP. This would also be an instance where inclusion can be made that the greenfield developer, as WSP (or WSI operating as WSP), needs to show how they will "conserve water" and achieve efficient water use, through measures such as being off-grid and or using water saving devices, water-efficient processes (recycling).

DWS have developed such model Service Level Agreement contracts (Model Water Services Contract, (DWAF, 2012)*) - these aspects will be highlighted in that section.*

The Act instructs that a WSA needs to monitor the performance of WSPs and WSIs within its area of jurisdiction to ensure that they comply with the set standards and norms and standards for tariffs, Provision is also made for the setting of additional standards by WSAs for WSIs to adhere to and comply with.

Chapter II of the Act permits DWS to prescribe compulsory national standards relating to the provision of water services. Section 9(d), in specific, provides for the application of these norms and standards

to the nature, operation, sustainability, operational efficiency and economic viability of water services and 9(f), as to how these apply to the construction and functioning of water services works and consumer installations. This chapter of the Act further recognises that these norms and standards may differentiate between different users and different geographic areas, accounting for other factors such as socio-economic and physical attributes of each area. The Act further confirms that one of the aspects that DWS must consider in the prescription of these standards is the operational efficiency and economic viability of water services.

This section provides more than adequately for DWS to ensure that through their norms and standards, WSAs, WSPs & WSIs (including greenfield developers as WSI operating as WSP), need to show how:

- *They will "conserve water" and achieve efficient water use, through measures such as being off-grid and or using water saving devices, water-efficient processes (recycling),*
- *Require prove that their planned system will not form part of a stressed existing water service,*
- *That "off-grid" sanitation options have been investigated and were found to be non-viable or more onerous/hazardous to the WSA and/or the environment before motivating or opting for a connection to a waterborne system.*

It becomes important that DWS, through their national and regional interaction with WSAs, WSPs & WSIs, ensure that they apply these concepts when they interpret the norms and standards to a specific area. This may thus, rather than capturing in legislation, more likely require improved awareness creation and interpretation of detailed area assessments by DWS staff and management (e.g. using Blue Drop & Green Drop assessments or commentary) of a WSI's systems ito being stressed or not, and requesting the applicant/s to provide improved information on "conserving water" and proof of investigating "off-grid" sanitation options, prior to them supporting approval of WULAs or grant funded projects.

3.2.3 DWS's National Norms and Standards for Domestic Water and Sanitation Services Version 3- Final (DWS, 2017)

The National Norms and Standards document states that:

- It is the culmination of the review and revision of the international and national norms and standards for water and sanitation services, and
- It sets out and describes the national norms and standards for levels of water services, including sanitation, which applicable from 2017 onwards until revised.

Under the following definitions, relevant concepts pertaining to WESS are of note:

- *Appropriate sanitation service*: Refers to a service that effectively protects and preserves public health and the natural environment whilst being acceptable, affordable, manageable, and adaptable in responding to the demand, the socio-cultural needs, the users' ability to

afford continued operation, and the available organisational/institutional and technical capacities.

- *Appropriate technology*: Refers to conventional, alternative, and intermediate infrastructure/device, tools and processes that are suited to the specific time and place, and which meet context-specific criteria and key characteristics. This means the sustainable application or operation of a technology (process, tool and/or device) to meet national imperatives within the local institutional, financial, social, cultural, ethical, economic, and environmental requirements and constraints experienced by the authority or consumer responsible for the technology.
- *Greywater* is defined as water from baths, showers, and hand basins. Wastewater from kitchen sinks, dishwashers and washing machines (except if environmentally friendly detergents are used) is excluded due to its high solids content and the negative impact of softeners and other undesirable chemicals on the environment. Greywater is different from reclaimed water.
- *Reclaimed water* is wastewater (including blackwater) that has been treated by a centralised wastewater treatment plant for potable or non-potable reuse.

Critical guiding principles for a WSA related to its duties of providing water and sanitation services, are:

1) Equity in access,
2) Acceptability, safety, and hygiene,
3) Economy and affordability,
4) Effectiveness and efficiency,
5) Reliability,
6) Appropriateness, including in the choice of infrastructure/systems,
7) Protection and conservation of the environment,
8) Monitoring and regulation for effectiveness and appropriateness.

The document consist of 4 parts, being:

- Part 1 focuses on water components of water services,
- Part 2 focuses on the sanitation and wastewater components of water services,
- Part 3 summarises the monitoring and reporting responsibilities,
- Part 4 concludes with a proposed plan of action in implementing the norms and standards for water and sanitation services.

Under Part 1: Water supply, there are 2 specific sections of note ito cross-cutting norms and standards for water services, being:

- **Norms and Standards (N&S) for Water reuse and recycling (Section 4.5)**
    - The formal supporting strategy for water reuse, called the 'National Strategy for Water Reuse' (in NWRS2) was to be incorporated into the activities of the WSAs.
        - *DWS need to confirm if this has happened formally and how, as this may form a critical part of monitoring the entrenchment of WESS.*

- To achieve social acceptability, a participatory approach to the development of greywater reuse norms and standards, as well as technologies, needs to be followed, so that the water needs and concerns of the consumers are addressed.
    - *This may require a strengthening comment clause or something ito the greenfield development, WESS and the use of "WELS" application technology, describing how the developer plans to or have catered for it.*
- Increasing water reuse can assist in providing more resilience to managing the insecurity of water supply as a result of climate change. It rests with the DWS and with water services providers to take water reuse into the future and to open up this avenue as a water source by amending their by-laws, creating the awareness and the demand for greywater reuse, and supporting those who want to implement greywater reuse and recycling.

This is the "gap" where DWS and WSAs have to ensure entrenchment of WESS – they may need some rethinking as to "only the use of greywater" and rather include for specific alternate water sources (greywater just being one of it).

- **N&S for level of service ito self-supply level of water services (Section 5.8)**
    - The document comments that "self-supply" happens when people dig their own wells or construct water harvesting systems at household level or in small groups.
    - Self-supply level of water services is aimed at supporting people who are meeting their own need for domestic water supply largely or wholly through own investment and can be individual households, or small groups of households.
    - The document remarks that the WSA shall advocate augmenting water use with alternative water sources, such as groundwater (springs, wells, boreholes), rainwater harvesting and stormwater harvesting.
    - Furthermore, that Guidelines shall be provided to self-supply households regarding treatment and purification of alternative water sources for domestic and personal use.

At present, this document does not openly advocate recycling treated wastewater, either as toilet and urinal flushing water or as part of a closed-loop-system, as being part of alternate water source supply. It may be necessary that this aspect is brought forward and recognised as part of alternate non-potable water source supply.

    - The municipal By-laws shall be revised to allow for self-supply.

At present, this may only be happening in or be provided for in limited municipalities and Metros and their By-laws, and one possible way to entrench it would be through its inclusion in the DWS Generic Model By-laws.

Under Part 2: sanitation services, the specific sections of note are:

- **N&S relating to Pollution risk management (Section 6.2)**
    - Greywater management (Sect 6.2.3) requires safe disposal of greywater and identifies 4 appropriate methods, being casual tipping, garden irrigation, soakaways, and piped systems (solids-free sewer).
        - *It does not make allowance for recycling as toilet flushing water, as being part of alternate non-potable water source supply. It may be necessary that this recycling is brought forward in this section and is recognised as part of acceptable alternate non-potable water source supply options. Additional conditions on safe management and handling will need to be referenced at the same time.*
    - Wastewater and sludge management (Sect 6.2.4), ito reuse comments that the beneficial use of sludge shall be encouraged to ensure sustainable sludge management. The WRC "Guidelines for the Utilisation and Disposal of Wastewater Sludge Volumes 1 to 5" is identified as the acceptable guidelines to be used.
    - Effluent management (Sect 6.2.5) comments that off-site wastewater treatment is considered a specialised subject and where the introduction of a treatment works is considered, specialist consultants shall be involved.
        - *There may be more effective or extensive description required to qualify who, what and how, specifically ito a greenfield development's non-municipal service provider.*
        - *Standards for discharge and effluent quality already prescribed in WUL process, may need to look at relaxation potential to General Limits (GL) or even adjusted GLs.*

- **N&S relating to Wastewater, greywater, and nutrient reuse (Section 6.3),**
  This section caters for the adoption of wastewater and greywater reuse strategies to reduce the pressure on the potable water resources and to create a balance between available resources and demands.
    - *Wastewater reuse (Sect 6.3.1)*: Guidance as per the International water quality guidelines for wastewater reuse as issued by the World Health Organisation (WHO) in 2006. It also includes for the following conditional reuse options: (a) In urban areas for flushing toilets, (b) Agricultural irrigation, (c) Environmental reuse – wetland restoration, stream augmentation, groundwater recharge, (d) Industrial use – cooling water and (e) Indirect potable use.
        - *Although this section allows reuse, there may be a need for stronger insistence on investigation of these options in greenfield development.*
    - *Greywater reuse (Sect 6.3.2)*: Greywater reuse shall be contained within the boundaries of the property/yard of the user and investment in further research and development regarding greywater reuse is required. For example, decentralised systems for wastewater reclamation are increasingly used in collective buildings (hotels, hospitals, schools) or industrial facilities world-wide.

        - *This section needs strengthening to move away from just requiring further research to actual implementation, e.g. include for on-site individual buildings and block-wide wastewater recycling systems generated water for non-potable urban applications (toilet flushing in commercial buildings and apartment complexes) and may provide the necessary location for further applicable N&S on greywater reuse.*
    - *Nutrient management and reuse (Sect 6.3.3)*: Important comments are that:
        - South Africa does not currently have legislation or effective policy regarding nutrient reuse from human excreta,
        - Reuse of nutrients can only become a mainstream practice through cooperation between different levels of stakeholders, and by understanding that a closed-loop approach offers advantages for all,
        - Local government shall play a key role as facilitator and regulator, finding ways to promote innovation while holding service providers accountable and achieving a degree of protection to public health and the environment.
        - *In order for DWS to entrench WESS and move toward on-site sanitation management, it is critical to develop the necessary legislative and policy support, guidance documentation, and norms and standards and to distribute and make it readily available. Local government cannot facilitate effectively unless effective support is provided by DWS.*

- **N&S regarding operation and maintenance responsibilities indicate (Section 6.4)**
    - Services providers and authorities shall have clear By-laws regarding the operation and maintenance of sanitation infrastructure and facilities.
    - Responsibilities shall be clearly defined, and maintenance personnel shall have the tools and skills to do their job effectively in ensuring effective maintenance.
        - *To entrench WESS, DWS need to review their model By-laws and model service level agreements to ensure that they effectively accommodate providing clear guidance and identifying clear requirements, related to the operation and maintenance of sanitation infrastructure facilities for greenfield developments with WESS, such as on-site sanitation- & NSS systems, as well as decentralised wastewater treatment systems.*

- **N&S for levels of sanitation services for Full sanitation services ito (Section 7.3),**
    - *On-site sanitation services (Sect 7.3.1)*: This makes allowance for localised wastewater treatment facilities close to the source of waste generation, including package plants, but which are not connected to a reticulated system (municipal network). Wastewater management and effluent disposal are to follow existing WRC sludge guidelines which also makes allowance for beneficial use of sludge. Other activities encouraged are greywater & nutrient reuse. Local municipalities' Environmental Health Practitioners (EHPs) to undertake the necessary monitoring of H&S and environment impact. The need to ensure the appropriateness of the type of sanitation infrastructure/facility is also confirmed.

- *This section appears to provide adequately for full sanitation service levels in a greenfield development of on-site sanitation & NSS systems.*

- **N&S for Sanitation services to private land (Section 9)**
  This section confirms that WSAs need to ensure basic sanitation service levels on privately owned land, which includes greenfield developments such as sectional title/residential complexes & estates. It also states that ownership of sanitation assets provided on private land may pass into the hands of the person owning the land in the following circumstances: 1) where an "on-site" sanitation facility is provided to a household; and 2) where assets are required for services to consumers served by a water services intermediary who owns the land on which the consumers reside and where that intermediary has made an appropriate contribution to financing the cost of the assets. The section comments mainly on ensuring basic sanitation service levels and is quite specific in this regard but does not appear to discount higher level of sanitation service. The section also instructs that sanitation services shall ensure appropriate wastewater disposal and appropriate sludge disposal. These include comment that a properly built and functioning sewer system is the most appropriate wastewater and sludge disposal option in urban areas, and soakaway pits or infiltration trenches must be used other situations.
    - *This section needs to be reviewed to allow for appropriate sanitation systems, inclusive of properly built and functioning sewer systems, even in non-urban areas (including greenfield developments such as sectional title/residential complexes & estates including resort developments). It should not be prescriptive on only the use of soakaway pits or infiltration trenches in such non-urban developments.*

  The section also clearly states that, in situations that are not deemed to be free basic services, the land owner is fully responsible for the capital, operation, maintenance and refurbishment actions and costs pertaining to sanitation services. This implies that in the event of such greenfield developments (e.g. sectional title/residential complexes and estates including resort developments), the land owner/s (via management body) stay fully accountable for the capital, operation, maintenance and refurbishment actions and costs pertaining to sanitation services, including sustainable financial asset management, although they may transfer operational responsibly to a contracted service provider. The section also confirms the need to ensure the appropriateness of the type of sanitation infrastructure/facility.
    - *This section needs to be reviewed to ensure effective clarity and inclusion of land owner/s (and their management bodies, e.g. Body Corporates, etc.) of greenfield developments such as sectional title/residential complexes & estates including resort developments.*
    - *There may also be a need to ensure clarity on the transfer operational responsibly, but not legal accountability, ito a contracted service provider and prescriptive condition or clauses that should form part of such of a SLA between the parties (possibly an additional section)*

- *What is not covered and should be included for, is the need for a WSI SLA between the land owner/s (and or their management bodies) and the WSA ito of water and or sanitation service provision.*

3.2.4 DWS's Proposed Compulsory National Water and Sanitation Services Norms and Standards Jan-2024 (DWS, 2024)

This document, which had been published for comment, does not comment if it is to repeal or overwrite the 2017 DWS's National Norms and Standards for Domestic Water and Sanitation Services Version 3- Final.

There are 5 parts to these Norms and Standards, being:

- Part A: Provision of water services,
- Part B: The quality of water discharged into any water services or water resource system,
- Part C: The efficient and sustainable use of water,
- Part D: Construction and functioning of water services works and consumer installations,
- Part E: The nature, operation, sustainability, operational efficiency, and economic viability of water services.

The draft Compulsory National Standards for Water Supply and Sanitation Services and Regulation cover standards relating to interim and basic sanitation services and emergency sanitation services, as well as the quality of water discharged into water services or water resources systems, including standards surrounding greywater, sewer collection, wastewater treatment, and faecal sludge management; the quantity and quality of industrial wastewater collected into sewerage systems; the quantity and quality of wastewater discharged into water resources; and the control of objectionable substances (www.gov.za, 2024).

At present the N&S only defines "non-sewered sanitation system" to mean a system that is not connected to a networked sewer, and collects, conveys, and fully treats the specific input to allow for safe reuse or disposal of the generated solid output or effluent. There does not appear to be any reference to decentralised wastewater treatment systems.

- *There is a need to ensure that there is effective clarity and definition with regard to the following concepts within the document:*
  - *Non-sewered sanitation (NSS) or Non-sewered sanitation system (NSSS),*
  - *Decentralised Wastewater Treatment (DWWT) or Decentralised Wastewater Treatment Systems (DWWTS).*

It is recommended that DWS keep the existing Norms and Standards 2024 definition for "non-sewered sanitation system" and ensure definition for Decentralised Wastewater Treatment is added to DWS revised Norms and Standards.

- *A possible definition for Decentralised Wastewater Treatment would be to use the EPA definition in an adapted form to allow for the separation of ownership concept:*
  - ***"Decentralised Wastewater Treatment** refers to various approaches for collection, treatment, and dispersal/reuse of wastewater for individual dwellings, industrial or institutional facilities, clusters of homes or businesses, and entire communities. They provide a range of treatment options from simple, passive treatment with soil dispersal, commonly referred to as septic or on-site systems, to more complex and mechanised approaches such as advanced treatment units that collect and treat waste from multiple buildings and discharge to either surface waters or the soil. They are typically installed at or near the point where the wastewater is generated. These systems, when owned by the municipality, and or its contracted WSI, as a part of their permanent infrastructure, can be managed as stand-alone facilities or be integrated with centralised sewage treatment systems. These systems, when privately owned permanent infrastructure, will need to be managed as stand-alone facilities by the infrastructure owners, operating as a WSI with a SLA to the municipality."*

Other terminology that may need to be included and which may require effective clarity and definition in this document are:

- *"On-site wastewater services" can be either on the scale of a single-family unit or on a community scale, even though the latter may require a collection system of some type, but one which is not part of a formalised municipal network,*
- *"Off-grid" options can include on-site sanitation options such as Non-sewered Sanitation Systems (NSSS) as well as Decentralised Wastewater Treatment Systems (DWWTS) which is not part of a formalised municipal network.*

In terms of entrenching WESS through referencing efficient water use and off-grid sanitation services, and the provision of such in the regulation, there are several such conceptual references in this document.

In Part A – provision of water services, specifically under "basic sanitation service" (Clause 7), the aspects discussed below, are of note.

- The need for a WSI to provide appropriate sanitation technologies, which may differ based on the settlement density, as referenced in Clauses 7(6) & 7(7):
  - In a dense settlement, innovative/emerging sanitation solutions can be provided that are off-grid (non-sewered), use little or no water and involve on-site treatment of human waste, but must ensure that the user level of service experienced is the same as those for conventional water-borne sewers systems. This is specifically for areas where there may not be adequate capacity in the sewer and WWTW system.

- In medium dense settlement areas, the preferred option is water borne, if there is adequate capacity in the sewer and WWTW system, although there is provision for equivalent solutions with lower water cost wastewater treatment solutions.
- In low density settlement areas, the preferred option is non-sewered solutions.
    - *From this it is clear that, in areas where there is inadequate capacity in the sewer and WWTW system, allowance has been made for the consideration of innovative or emerging solutions, such as non-sewered solutions that use little or no water and involve on-site treatment of human waste. In the medium and low dense settlement areas, similar provision is made for solutions with lower cost wastewater treatment solutions. This section needs to be adapted to include for WESS and in specific "off-grid solutions, including on-site wastewater services, off-grid or non-sewered solutions". In addition, this section may need further strengthening and clarity via an instruction in that it could states that WSIs must consider the use of such innovative or emerging solutions instead of waterborne sewered systems in areas of dense formal and medium settlement where there is inadequate capacity in the sewer system and or the WWTW.*

- Clause 7(8) requires that new, innovative or emerging solutions or non-sewered solutions must adhere to the requirements of SANS 30500 for Non-Sewered Sanitation Systems,
    - As mentioned previously:
        - *The SANS needs to clarify that it does include any system that drains an area through a limited sewered network to an off-grid or stand-alone treatment unit within the larger development boundary,*
        - *SANS 30500 certification is only applicable to non-sewered and off-grid systems, and thus does not initially appear to apply to treatment processes taking place at another location separate from that of the frontend and backend components. In particular it does not make provision for a DWWT system. There is a need to:*
            - *Clarify that basic on-site wastewater services can be either on the scale of a single family unit or on a community scale, even though the latter requires collection systems of some type,*
            - *Ensure that this is considered in legislation by referencing the "SANS 24521:2020 Ed 1 Activities relating to drinking water and wastewater services-Guidelines for the management of basic on site domestic wastewater services".*

- Clause 7(9) requires that all new settlements and developments must use water efficient sanitation solutions.
        - *There is thus inclusion and even instruction for a concept of enforcing development to motivate how they are accommodating to this requirement.*

Other requirements that could impact include:

- WSIs needing to undertake water quality monitoring and reporting obligations more similar to that of a WSP, ito water services provision,
- The WSA's accountabilities in providing interim sanitation services which must meet basic standards, be culturally sensitive and appropriate,
- Basic sanitation service which must ensure that excreta and wastewater is safely contained throughout the sanitation chain (Clause 7(2)),
- It defines how faecal sludge management must be undertaken as part of the sanitation service but does not reference recycled wastewater or reuse of sludge,
- It requires that faecal sludge treatment plants must adhere to "ISO 31800" for faecal sludge treatment units – this is a critical document for on-site treatment units (Clause 7(11)), but it does require changes to fully accommodate WESS,
- Confirms the WSI's operator & worker requirements and community participation.

In Part B – the discharged water quality ito domestic effluent management is covered and includes the following aspects related to WESS:

- Greywater management (Clause 10), if a WSI is planning on separating, collecting, and using greywater, effective greywater management must be undertaken following the WRC's 2018 Guidelines for Greywater use and management in South Africa, as well as Wastewater Risk Abatement planning (W_2RAP),
- Sewer collection, wastewater treatment & faecal sludge management (Clause 11(1) to 11(4)), identifies specifically for the WSI's accountability aspects such as planning for and implementation of plans relating to Wastewater Risk Abatement planning (W_2RAP) and climate resilient sanitation safety planning following the WHO Sanitation Safety Plans,
- Sludge management requirements/accountabilities of WSIs and related procedures, including collection and removal and regularity of inspections and treatment process audits are identified and discussed in this section.

In Part C – covering the efficient and sustainable use of water:

- The focus is more on water conservation and water demand management (WCWDM) from a municipal perspective with limited comment on the use of alternative water sources (recycling option not covered) by non-municipal entities.
    - *Clause 15(7): Relates to a Council's approved WCWDM Strategy and Business Plan which could possibly be extended to include that municipalities and WSIs need to require greenfield developments, such as sectional title/residential complexes and estates including resort developments, to indicate the manner and extent in which WCWDM, through efficient water use and off-grid sanitation, has been accounted for in their selected technology options upon submission of building/development plans for approval.*

In Part D – Construction & Functioning of Water Service Works & Consumer Installations, the following is noted:

- It covers mainly the need for Water and wastewater balanced and determination of water losses by a WSI,
- It confirms the need to conform to SANS 10252: water Supply and Drainage for Buildings and SANS 10254: The installation of fixed electric storage water heating systems.
    - *There may be a need to include either under the concept of consumer installation, the potential for consumer installed on-site or off-grid treatment options or to create a new clause to deal with it. The conformance requirement earlier, to adhere to "ISO 31800", does make substantial allowance for on-site installations , their construction and operation, but does not necessarily allow a DWWT system.*

Thus, from the above comment, the most conclusive involvement and directive with regard to WESS would be the adherence requirement to "ISO 31800". It does however not appear consider a broader and more complex option, e.g. of a limited sewer network of multiple ablutions facilities to a single, stand-alone treatment works (non-prefabricated), as found in developments such as residential housing estates or resort style facilities or a DWWT system.

- *There is thus a need to provide for the potential of a limited sewer network of multiple ablutions facilities to a single, stand-alone treatment works non-prefabricated), as found in developments such as residential housing estates or resort style facilities or a DWWT system and reference it back to the need to conform to SANS 25421 in this regard.*

In Part E – Nature, operation, sustainability, operational efficiency and economic viability of water services, provision is made for:

- Human resources planning & competencies,
- Management of disruptive electrical supply on water services including wastewater systems,
- O&M of wastewater treatment systems – it identifies generic requirements for wastewater treatment systems operation, auditing, budgeting, and costing, etc. No specific comments are made pertaining to on-site installations.

3.2.5 DWS's Water and Sanitation Services Policy on Privately Owned Land (DWS, 2022)

The 2016 National Sanitation Policy (DWS, 2016) definition of 'privately owned land' includes greenfield developments such as sectional title/residential complexes and estates, and resort developments. The policy's scope focusses on defining both DWS's and sector's obligations in regulating and supporting the provision of water services to residents living on privately owned land and taking advantage of water services intermediary approach in the provision of those services and establishes basic principles to be applied in achieving access to water-related infrastructure, the establishment of institutional arrangements, financial and internal and external coordination mechanisms, and implementation responsibilities. The policy seek to achieve sustainable and equitable water supply and sanitation provision for previously disadvantaged residents living on privately owned land.

There is direct reference relating to concept of smart sanitation through efficient water use and off-grid sanitation, as per the following comments:

- Water supply service levels
    - *Water-dependent sanitation* systems should be discouraged in areas where water supplies are limited or unreliable.
        - *DWS can possibly strengthen this aspect by including reference to situations where the municipality is unable to provide services due to existing stressed networks and treatment systems, but where there still is a need such services due to the provision of residential housing.(in other words it is not just resource availability, but also link to limited or unreliable infrastructure and sustainable services).*
    - *Alignment to water conservation and demand management strategies*, the development and widespread use of "water-saving" water supply and sanitation appropriate technologies is promoted as a services solution.
    - *Reliability:* It is imperative that only proven technologies and designs should be adopted in the provision of water services. In particular, innovative, and proprietary systems must be tested against performance criteria and independently evaluated in terms of operational requirements, value-for money and customer acceptability and satisfaction. This must be done before they become part of a service delivery programme. To this end, the government will identify appropriately qualified and objective bodies (such as the WRC, CSIR, etc.) to conduct such evaluations against agreed criteria.
        - *Adequate allowance is made for the concept of WESS through efficient water use and off-grid sanitation. However, until there is an effective and functioning certification process, DWS need to strengthen the technical aspect by referencing accepted concepts and raise the potential of a limited sewer network of multiple ablutions facilities to a single, stand-alone treatment works. The need for the "WELS" style product certification should be adopted.*
    - *Upgrading:* As water supply and sanitation improvement is a process, it is desirable to consider infrastructure upgrading (e.g. borehole to yard connection or VIP to septic tank) sequences, where this is likely in the foreseeable future. Designs should be done accordingly within cost constraints and in some cases infrastructure up-grading (e.g. installing a reticulation network at a later stage) should be considered at the planning stage.
        - *The regulatory documentation correctly indicates a stronger drive to less complex sanitation system, but there may be a need to provide clear comment on the appropriateness of WESS (ito efficient water use and off-grid sanitation), which includes more formalised treatment works/mechanisms and reuse, in circumstances where it is appropriate and sustainable ito a private WSI.*
- *Economically and Financially Sustainable Water and Sanitation Services* on Privately Owned Land:

- Refence is made that there are no dedicated funding programmes by water services institutions, including water services authorities, which are earmarked to provide water services to residents residing on privately owned land,
- In addition, it is commented that there under-recovery of the total economic, and financial cost of water services by WSAs has resulted in water tariffs that do not capture the total cost of water services,
    - *DWS, Treasury and municipal services grant fund agencies need to relook this aspect, to make allowance for funding that facilitates appropriate smart sanitation through efficient water use and off-grid sanitation and where there is either a product reuse or treated wastewater recycle component that can offsetting cost or achieve resource savings, 'i.e. the greater good concept'.*
    - *Should this effected, then regulatory sections such as this, should then reference the availability of government grant funding, via municipal services grant funds, to facilitate water services development for the population living on private land and not having access to effective & dignified sanitation.*

Under "Roles and Responsibilities", the document makes provision for the concept of Private Landowner acting as a Water Services Intermediary, where these entities are encouraged to enter into a contract with the water services authority.

- *DWS should strengthen this aspect by changing it to requiring a SLA between the Private Landowner and the WSA. The contract should also adhere to the DWS Norms and Standards appropriate to a WSI function.*

3.2.6 The 2016 National Sanitation Policy (DWS, 2016)

Literature highlights that South Africa's institutional framework for sanitation innovation is being formalised to close current gaps, and that any successful pitching of new sanitation technologies must unpack the different institutions involved and engage these before engaging with municipalities. The four most important role players are DWS, DST, SALGA, and Agrément Board (Pillay, 2018).

Of concern is that "DEWATS" is used for Decentralised Wastewater Treatment, but this concept is an example of a specific technical approach to decentralised wastewater treatment (DWWT) and does not encompass the whole of it.

- *DWS need to be specific when using acronyms to rather use Decentralised Wastewater Treatment (DWWT). This is also more aligned to uses such as "Wastewater Treatment Works (WWTW)".*

There is provision within the policy to support the proverbial 'out-regulation' of poor practices ito resource dependent and efficient water supply and sanitation systems. Chapter 7 Sustainable Sanitation Services includes these under the following sections:

- Section 7.1 Position 24: Appropriate Sanitation Technologies, in specific Section 7.1.3 Policy Positions, highlights:
    - Limited water resource availability should inform appropriate technology selection,
    - Implementation of alternative, appropriate technology will be within social, environmental, and economic constraints. Settlement and geographic situation will also be considered,
    - Appropriate sanitation technology must encompass waste management systems.
    - Decentralised sanitation systems are encouraged,
    - A formal process for certification and accreditation of appropriate sanitation technologies will be developed,
    - The Minister will, in concurrence with National Treasury, provide incentives to encourage utilisation of resource efficient sanitation infrastructure in human settlement areas,
    - The Minister will have developed regulations for new development to use greywater in waterborne sanitation systems, minimising impacts on water resources.
- Section 7.2 Position 25: Greywater management in sanitation service provision, in specific Section 7.2.3 Policy Positions, highlights:
    - Greywater recycling by decentralised and centralised systems is encouraged,
    - The Minister will provide norms and standards for greywater management,
    - Use and management of greywater in a safe and sustainable manner is required. Greywater management within property boundaries is the responsibility of the property owner, while greywater management outside property boundaries is a WSA responsibility,
    - DWS will provide guidelines for greywater management.
- Section 7.3 Position 26: Reuse, recycle, recover and reclamation in the sanitations sector, in specific Section 7.3.3 Policy Positions, highlights:
    - Sanitation provision must emphasise the need for the conservation of water resources and the use of appropriate technologies which are environmentally sustainable,
    - Sanitation services should be provided based on the principles of minimising the use and impacts on natural resources,
    - The return of treated wastewater to a source other than the water resource requires special motivation. This will require a water use authorisation,
    - Recycle and reuse of treated wastewater for non-potable applications in human settlement areas should be implemented wherever possible,
    - Where appropriate, priority must be given to sanitation technologies which minimise use of natural resources.

3.2.7 DWS Approved National Water Resource Strategy Third Edition (NWRS3) 2023 (DWS, 2023)

The major focus of the NWRS-3 is the protection and equitable and sustainable access and use of water by all South Africans while sustaining the country's water resource. The NWRS-3 identifies under

the various strategic objectives for reducing water demand, that DWS needs to ensure that all sectors use water efficiently and effectively. Actions identified include (DWS, 2023):

- Aligning the water use authorisation process with WCWDM priorities and encourage interventions to improve water use efficiency by ensuring that WCWDM conditions are included in the Water Use Authorisations,
- Encouraging the WUAs and end users to understand the need to modernise their water conveyance systems and irrigation equipment, and that the Department must modernise its water conveyance systems,
- Needing to achieve a change of attitude and behaviour in terms of how water is treated and conserved, by promoting efficient use of water amongst consumers, customers and by promoting the use of water saving technologies by consumers and customers,
- Promoting the reuse, reducing, recycling and recovery of wastewater,
- Exploring the feasibility of different direct wastewater and water return-flow reuse options, which includes municipal wastewater reuse and other options.

Under Chapter 3 Principles, Principle 2 is focussed on utilising resources efficiently and effectively and as such DWS seeks:

- To ensure value for money in everything it does,
- To provide high quality services, cost effectively and with the least possible wastage,
- To pursue all programmes to the full,
- To proactively focus on turning ideas into cutting edge [*innovative*], best in class and "outside the box" approaches and solutions.

If revising this document in future it is recommended to potentially add an additional sub-principle:

- *"To entrench WESS and open a pathway for resource efficient solutions ito water supply and sanitation systems, where the term "resource" applies to water as well as effluent/sludge."*

In Chapter 4 Reducing Water Demand, provision is made for WESS through effective WCWDM, but there are still aspects that weaken it based on comments such as:

- WCWDM is still not treated as a priority hence there is still lack of proper planning, implementation, reporting and regulation,
- The challenges raised relate to Water & Sanitation Services Institutions & Local Government,
- Regulations are needed to set compliance monitoring and enforcement targets that would make compliance compulsory.

In terms of the Strategic objectives, there are effective provisions to support entrenching WESS ito resource efficient water supply and sanitation systems:

- Strategic Objective 2 – includes for promoting efficient use of water and use of water saving technologies by consumers and customers,
- Strategic Objective 3 – includes for ensuring the implementation of WCWDM best practices in new developments,

- Strategic Objective 4 – includes for ensuring that WCWDM conditions are included in the Water Use Authorisations,
- Strategic Objective 5 – includes for promoting reuse, reducing, recycling and recovery of wastewater.

Chapter 7 Managing Effective Water & Sanitation Services, provides for measures that support entrenching WESS ito resource efficient water supply and sanitation systems, as reflected in:

- Guiding Principle 6 – comments that the right to basic water supply and sanitation services comes with a corresponding responsibility, namely, to use water and sanitation services responsibly and with due care. This would thus also apply to ensuring the use of resource efficient water supply and sanitation systems.
- Principle 11 – the choice of technology, where a trade-off must be made between effectiveness, affordability, capacity to operate and maintain, life-cycle costs, consumer acceptability and environmental impact in choosing the appropriate technology.
- Principle 12 – water demand management is necessary to ensure efficient and effective water and sanitation services delivery, and should be given as much attention as supply expansion in services and water resources planning.
- Strategic Objective 2 – includes for:
    - revisiting levels of service for water supply and sanitation services against issues of affordability,
    - ensuring appropriate effective technologies and water use efficiency,
    - ensuring safely managed on-site sanitation services throughout the sanitation service chain (collection, transportation, treatment, disposal and/or end use),
    - ensuring adherence to all Water and Sanitation Policy norms and standards.

Chapter 8 Regulating the Water & Sanitation Sector also contain effective provisions to support entrenching WESS ito resource efficient water supply and sanitation systems, included in comments such as:

- The development of a non-sewered sanitation regulation programme is also required in light of the SDG requirement to safely manage faecal sludge from on-site sanitation technologies like VIPs, septic tanks, and conservancy tanks, etc.,
- Guiding principle of minimal regulation – Regulatory intervention should be the minimum necessary to deal with the matter being addressed and should avoid unnecessary administrative burdens on regulatory and regulated bodies as well as on the water user.
    - *This support the concept of "regulating out" rather than "regulating in".*

Similarly to previous chapters, Chapter 9 Managing Water & Sanitation Under a Changing Climate, also support entrenching WESS ito resource efficient water supply and sanitation systems, but is specifically aligned to the concept of planning for a changing future using a no-regrets and low-regrets approaches through supporting low water usage and or circular systems (water smart and efficient).

Based on all the above supporting aspects in the Strategy, one manner to initiated WESS entrenchment is to regulate that a WSA must require all new greenfield developments, through their water services connection

application and/or WARMS registration and/or their WUL application, to include a "Technical Report", where the applicant motivates the WESS appropriateness of the selected water supply and sanitation treatment options ito:

- *infrastructure impact ito available sewer network and WWTW (needing to connect or go off-grid in the situation of a stressed sewer network and or stressed WWTW,*
- *treatment process and disposal methods ito of the environment and the environmental impacts,*
- *alternative options of treatment and disposal investigated,*
- *why the proposed/existing option was chosen, and*
- *to provide proof that water efficient solutions have been used in the greenfield design and developed, inclusive of the sanitation system and wastewater treatment process.*

3.2.8 DWA's Model Water Service Contract Between WSA & WSI (DWAF, 2012)

This document, developed by the Department of Water Affairs (DWA), provides a guideline for developing a water service agreement between a WSA and a Water Services Intermediary (WSI) that ensures that water services are accessible and provided in a manner which is efficient, equitable and sustainable. This model contract is specifically geared to facilitate better cooperation between WSAs and private land owners during the negotiation of the individual water services agreements and thus will serve to further clarify and define the respective roles and responsibilities of each institution.

The contract assumes that at least the following matters, where applicable, will have been addressed during the different phases specified in the Cooperative Governance Agreement:

- The promulgation of By-laws in compliance with but not limited to Section 21 of the Act,
- The adoption of Credit Control and Debt Collection and tariff policies that include an indigent policy,
- Ensuring that all permits, licenses, exemptions, permissions, and approvals that may be necessary in respect of the provisioning of water services are in place.

Section 7 of the contract deals with the provision of water services ito water supply and sanitation service standards, as well as water quality standards to be achieved ito of the effluent (SANS 241). Although Section 9 includes for the droughts, water conservation and water demand management, it mainly focusses on the WSI ability to impose a surcharge upon consumers.

- *An additional paragraph or clause may be added to this section which require greenfield developments, specifically in water stressed areas including municipal areas which is close to the limit of their allocation of water, to apply WESS concepts in their water use and sanitation design solution, specifically through measures such as using water saving devices, water-efficient processes (recycling).*

Section 10.2 Legal Compliance (specifically Clause 10.2.2) requires that in respect of the environment, the WSI acknowledges that South Africa is a semi-arid country and that managing the supply of water services and demand therefore requires advanced planning for drought and water shortages. Clause 10.2.3 requires that the WSI shall fully comply with all environmental Regulatory Provisions and the environmental aspects of the water services development plan adopted by the WSA. Neither of these clauses however define or identify how the WSI needs to accommodate for such situations.

- *It is recommended that an additional paragraph or clause is added to this section which require greenfield developments, specifically in water stressed areas (can also refer to a municipal area who is close to the limit of their allocation of water) to prove how they will "conserve water" and achieve efficient water use, through WESS measures such as using water saving devices, water-efficient processes (recycling). This can be done through the provision of a localised WCWDM plan for their specific water use and sanitation design solution, referencing the measures employed such as using water saving devices, water-efficient processes (recycling).*

Section F: Liability, Breach, Termination and Vis Major Clause 19. Liability, in Clause 19.1, ensures that on the transfer operational responsibly of water service provision, the legal accountability, ito a contracted service provider to the WSI, stays with the WSI. This implies that in the event of such greenfield developments (e.g. sectional title/residential complexes & estates including resort developments), the land owner/s (via management body) stay fully accountable for the capital, operation, maintenance and refurbishment actions and costs pertaining to sanitation services, including sustainable financial asset management, although they may transfer operational responsibly to a contracted service provider

Other aspects of relevance ito Section 10 are:

- Clause 10.1 Operations and maintenance reference is made to the responsibilities ito maintenance, but no material comment is made ito the need to ensure that operational conditions ito staffing and procedures are addressed appropriately,
    - *It is recommended that an additional sub- clause is added to this section which requires adherence to the DWS Norms and Standards appropriate to a WSI function, and in specific to appropriate staffing and operation and maintenance procedures.*
- Sub-Clause 10.1.3 confirms that the WSI is responsible for maintaining the water services system and responsible for all costs associated with such assets including maintenance costs, insurance, licensing and running costs.
    - *It is recommended that this clause be strengthened to require that the WSI provide clear indication as to the manner in which their planned system will be financially sustainable and adequate OPEX provision has been allowed for.*

Section 17 Monitoring confirms the right of the WSA to undertake relevant performance monitoring and would thus include for undertaking any audit where the WSI is required to prove or support the original concept of effective water use and sustainable management of sanitation services.

3.2.9 DWAF Model Water Services By-laws (DWAF, 2005)

The section following references the DWAF Model Water Services By-laws portion which formed part of the DWAF Model By-Laws Pack as issued in June 2005. The pack consisted of two model by-laws, being:

- Model Credit Control and Debt Collection,
- By-laws Model Water Services By-laws.

Under the definitions, the term "on-site sanitation services" is identified to mean any sanitation services other than water borne sewerage disposal through a sewerage disposal system.

- *This definition may need to be reviewed and adjusted to ensure that it also includes for systems with limited and or small bore sewer systems linked to an on-site treatment facility.*

Chapter 3 (Clause 76) identifies the service levels as supplied by the municipality and in Clause 76(3)(c) provision is made for a metered pressured water connection, but it also includes an individual connection to the municipality's sanitation system.

- *This concept may need to be adjusted to ensure that it can also be applied to a metered pressured water connection (supplied by municipality), without a municipal sewer connection. In other words where the water and drainage installations are maintained by the customer and where the sanitation treatment (for reuse, recycling & reclaiming) is deemed "off-grid" or the broader definition of "on-site" as commented above previously and does not connect to the municipality's sanitation system.*

Chapter 4 references the condition for supply of water services and consists of 9 parts (Clauses 77 to 109). Specific sections that are applicable to appropriate smart sanitation through efficient water use, alternative water supply (reuse, recycling and reclaimed) and wastewater off-grid treatment options include:

- Part 1: Connection to Water Supply System (Clauses 77 to 80),
    - Clause 77 refers to provision of a water supply connection and Sub Clause (2), in specific, refers to extending, modifying, or upgrading the existing water supply network to accommodate for a new consumer/s, potentially at the new consumer/s expense (contribution portion to be determined by municipality).
        - *This Clause could be strengthened to ensure, specifically in stressed water supply service networks, that the new bulk/multi-user consumer must be required to include WESS concepts in their design and selected technology options. The manner and extent of efficient water use (including reuse, recycling and or reclaiming of wastewater via off-grid treatment) must be*

indicated. This information must either be in the application for connection or upon submission of building/development plans for approval.

- Part 2: Standards (Clauses 81 to 85) refers back to the minimum standards set for the provision of water supply services in terms of section 9 of the Act,
    - *No specific changes envisaged to this section, if the earlier comments relating to the changes required in the Norms and Standards are addressed appropriately.*
- Part 3: Measurement (Clauses 86 to 89) – No specific changes envisaged to this section,
- Part 4: Audit (Clauses 90),
    - *No specific changes envisaged to this section if the earlier comments relating to ensuring effective SLA are addressed appropriately. The audit undertaken can then prove or support the original concept of effective water use and sustainable management of sanitation services.*
- Part 5: Installation Work (Clauses 91 to 97),
    - *No changes envisaged to this section, if the earlier comments relating to the changes required in the Norms and Standards and the need for an effective SLA (which will need to define the O&M conditions ito staffing and procedures) are addressed appropriately.*
    - *It may be necessary to ensure reference to the relevant and/or revised SANS or ISOs, applicable to WESS (efficient water use including recycling and or off-grid sanitation), are included in this section.*
- Part 6: Communal Water Supply Services (Clauses 98) – No specific changes envisaged to this section, although it allows for communal water supply services through a communal installation designed to provide a controlled volume of water to several consumers,
    - *DWS to confirm if the "controlled volume" also refers to a limited supply volume where any additional requirement must be sourced from alternative water supply sources. If this is the case it may be necessary to indicate its inclusion.*
- Part 7: Temporary Water Supply Services (Clauses 99) – Not relevant,
- Part 8: Boreholes (Clauses 100) – No specific changes envisaged to this section,
- Part 9: Fire Services Connections (Clauses 101 to 109) – No specific changes envisaged to this section.

Chapter 5 references the conditions for supply of sanitation services and consists of 9 parts (Clauses 110 to 151). Specific sections that are or could be applicable to appropriate WESS and alternative water supply (ito reuse, recycling and reclaimed) through wastewater off-grid sanitation treatment options include the following:

- Part 1: Connection to Sanitation System (Clauses 110 to 115) –- This section makes allowance for the use of on-site sanitation services, as obtained in accordance with Clause 98,
    - Of note is Clause 111 (2) Provision of Connecting Sewer, which specifically refers to extending, modifying, or upgrading the existing water supply network to

accommodate for a new consumer/s, potentially at the new consumer/s expense (contribution portion to be determined by municipality).

- *The above nation may need to be strengthen ito of either an additional sub-clause or a new clause that specifically comments that, in areas with an existing stressed sewer network and or stressed WWTWs, or area with no immediate future network opportunity, the municipality may require the owner of premises (or greenfield developer) to undertake on-site or off-grid sanitation services. It is to be noted that Clause 130 Installation of On-Site Sanitation Services, reference the concept of provision own on-site services when it is not reasonably possible or cost effective for the municipality to install a connecting sewer.*
- *This new clause could be strengthened to include for the concept of ensuring that the new consumer must be required to indicate the manner and extent that WCWDM solutions be addressed in their design and selected technology options, including concepts of efficient water use ito through reuse, recycling and/reclaiming wastewater via off-grid treatment. The consumer will need to provide proof of and motivation, either in their application for connection and or upon submission of building/development plans for approval.*

- Part 2: Standards (Clause 116) refers back to the minimum standards set for the provision of sanitation services in terms of section 9 of the Act,
    - *No specific changes envisaged to this section, if the earlier comments relating to the changes required in the Norms and Standards are addressed adequately.*
- Part 3: Methods for Determining Charges (Clauses 117 to 121) – No specific changes envisaged to this section,
- Part 4: Drainage Installations (Clauses 121 to 129) – No specific changes envisaged to this section,
    - *It may be necessary, ito Clause 124 Technical Requirements for Drainage Installations, to ensure effective reference to the relevant and or revised SANS or ISOs, applicable drainage related to efficient reuse, recycling and or reclaiming of wastewater via off-grid treatment.*
- Part 5: On-Site Sanitation Services and Associated Services (Clauses 130 to 136),
    - Clause 130 Installation of On-Site Sanitation Services, which references the concept of provision own on-site sanitation services when it is not reasonably possible or cost effective for the municipality to install a connecting sewer.
        - *There may a need to strengthen the above argument ito of either an additional sub-clause or a new clause, that specifically includes for areas with an existing stressed sewer network and or stressed wastewater treatment works, or area with no immediate future network opportunity.*
    - In Clauses 131 to 134, specific conditions relating to on-site sanitation systems are discussed and Clause 132 includes specific references to septic tanks and treatment plants.

        - *No specific changes are envisaged to this section as it makes allowance for a treatment plant with no specification of the definitive number of dwellings it needs to serve. It does however, require that any such other on-site sewage treatment plant must dispose of its effluent in manner that satisfies the municipality.*
        - *This section prescribes aspects such as the minimum size, capacity, and volume of septic tanks, which possibly needs adjustment in future should the selected and certified treatment technology require otherwise to allow for effective wastewater reuse, etc.*
- Part 6: Industrial Effluent (Clauses 137 to 141) – Not relevant to this study,
- Part 7: Sewage Delivered by Road Haulage (Clauses 141 to 144) – No specific changes envisaged to this section,
- Part 8: Other Sanitation Services (Clauses 145 to 146) – No specific changes envisaged to this section,
- Part 9: Installation Work (Clauses 147 to 151),
        - *No major specific changes envisaged to this section, if the earlier changes required in the Norms and Standards and SLA related to O&M definitions and conditions ito staffing and procedures, are addressed.*
        - *Reference may be needed to the relevant and/or revised SANS or ISOs, applicable to efficient water use (including recycling and or off-grid sanitation).*
    - Clause 151 Water Demand Management refers mainly to flushing urinals needing to be user-activated and that cisterns, and related pan designed to operate with such cistern, may not exceed 9 litres. In addition, all cisterns not intended for public use, are to be fitted with flushing devices allowing interruptible or multiple flushes, provided that such flushing device shall not be required in cisterns with a capacity of 4,5 litres or less.
        - *Provision needs to be made for closed-looped sanitation systems, which may require a different flush volume to function effectively.*

In Clause 152 of Chapter 6 Water Services Intermediaries, reference is made to the potential of a municipality requiring the registration of water services intermediaries or classes of water services intermediaries to register with the municipality in a manner as specified via a public notice.

- *The clause may be strengthened by changes ito requiring the registration (not ''potentially'' requiring) of all water services intermediaries or classes of water services intermediaries with the municipality.*
- *The above notion may be strengthened by either an additional sub-clause, or a new clause that specifically includes for requiring a SLA between the WSI and the municipality as WSA. It should refer to need to ensure that the contract contains the required adherence to the DWS Norms and Standards appropriate to a WSI function.*

Chapter 7 deals with Unauthorised Water Services, and the following Clauses are of note:

- In Clause 163, reference is made to the allowance for Use of Water from Sources Other than the Water Supply System, but it is conditional on a number of factors, these being:
    - That prior approval is required from the Engineer (municipality as WSA),
    - Depending on specific use, provision of evidence of either compliance to the requirements of SANS 241: Drinking Water, or that the use of such water does not or will not constitute a danger to health.
        - *This aspect is very relevant to any sanitation treatment system that includes direct and indirect potable reuse, recycling & reclaimed wastewater and it may be necessary to add a comment to such effect as a sub-clause.*
- In Clause 164 of this chapter, reference is made to the allowance for Use of On-Site Sanitation Services Not Connected to the Sanitation System and identifies some of the requirement to be met, these being:
    - that prior approval is required from the Engineer (municipality as WSA),
    - provision of evidence that the sanitation facility is not likely to have a detrimental effect on heath or the environment.
        - *No specific changes envisaged to this section.*

Generic additional recommendations:

- *The Model By-laws may need to change to accommodate easier acceptance of "WESS'' as embodying ''smart sanitation solutions" ito of use of own alternative water (domestic recycled water) not just the municipal supplied option,*
- *With WSI registrations ito By-laws and Norms and Regulations, there may be a need include a clause regarding requirement of "pre-commissioning compliance inspection" of system and effective monitoring thereafter, to ensure compliance with all statutes prior to the problem developing.*

3.2.10 Aide Memoir for the preparation of a water quality management report (Boyd, 2003)

The guideline is to assist local authorities and owners of sewage treatment works who are applying for a licence in terms of section 27(1) of the National Water Act 1998 (Act No 36 of 1998) in drawing up a Water Quality Management Report (WQMR). The guide defines the WQRM report aims as:

- Meeting the requirements of the NWA,
- Meeting the requirements of the Department of Water Affairs and Forestry's water quality management policies and strategies,
- Providing a single document that will satisfy the various authorities concerned with the regulation of the environmental impacts of waste and its disposal,
- Giving reasons for the need for, and the overall benefits of the proposed project,
- Describing the relevant baseline environmental conditions applicable to the waste disposal practice,
- Briefly describing the activities so that an assessment can be made of the significant impacts that the project or activities are likely to have on the environment,

- Describing how the negative environmental impacts will be managed and how the positive impacts will be maximised,
- Setting out the applicant's management criteria that will be used to manage the waste disposal practice,
- Ensuring that all licences are issued expediently should the application be approved of.

The guide identifies the report as having 11 Parts, of which the following would be of relevance to a resource efficient water supply and WESS:

- Part 3: Water Supply – this section, under water sources, includes for alternative water source aspects such as recycled waste (external source, e.g. sewage waste),
- Part 4: Description of Reticulation system requires identification of the type of sewer system, nature of the sewerage, the envisaged hydraulic and organic loading,
- Part 5: Description of Sewage Treatment works and Classification: this section requires some motivation as to selection choices followed ito components of system, disposal methods, etc.,
- Part 7: Management Systems and Pollution Prevention Methods. This section does require a motivation or indication as to why the specific technology has been selected (would include for on-site or off-grid option),
    - Section 7.6 motivates the appropriateness of the options ito selected or alternative treatment process and disposal methods and their environmental impacts, supported by investigations and why the proposed/existing option was chosen.
        - *This concept can be expanded to include for the infrastructure impact in a stressed sewer network and stressed WWTW, and to provide proof of water efficient solutions being utilised in the design and treatment process.*
        - *This motivation component could possibly form part of the standard WUL application by a greenfield developer to an existing network and WWTW of a WSI.*

3.2.11 WULA forms

Most of the WULA forms only become relevant after the selection of a technology options has been made and, in most cases, "Technical Reports" are to justify the choice of technology options. For example, the DW765 form indicates as follows for irrigating with wastewater:

> *"DW765 Section 21(e) of the National Water Act: Engaging in a controlled activity in terms of section 37 or 38 of the NWA Irrigation of any land with waste or water containing waste generated through any industrial activity or by a waterwork Currently, the following are controlled activities:*
>
> - *Irrigating with wastewater,*
> - *Modification of atmospheric precipitation (cloud seeding),*
> - *power generation which alters the flow regime of a water resource; and intentional recharge of underground water with wastewater,*

- *A common controlled activity is irrigation with wastewater, typically from a water treatment works. This can be a productive use of water if a crop is grown with the wastewater,*
- *Hydrological fracturing, unconventional gas.*

Supporting technical information to be provided with the technical report:
Submit the following "technical reports" with supporting appendices if the purpose of "Engaging in a controlled activity in terms of section 37 or 38 of the NWA" is for:

- *Aide Memoir - if the purpose is irrigation of any land with waste or water containing waste generated through any industrial activity is for wastewater treatment works,*
- *Integrated Water and Wastewater Management Plan (IWWMP) - if the purpose of Irrigation of any land with waste or water containing waste generated through any industrial activity or by a waterwork is for industry or mining use,*
- *Power generation business plan - if the purpose of Irrigation of any land with waste or water containing waste generated through any industrial activity or by a waterwork is for power generation,*
- *Geohydrological report - if the controlled activity is intentional recharging of an aquifer with any waste or water containing waste."*

The concept of WESS could be linked to the above WULA forms by:

- *Requiring an earlier "Technical Report", where the WUL applicant motivates the appropriateness of the selected sanitation/treatment options ito:*
  - *infrastructure impact ito available sewer network and WWTW (needing to connect or go off-grid in the situation of a stressed sewer network and or stressed WWTW,*
  - *treatment process and disposal methods ito of the environment and the environmental impacts,*
  - *alternative options of treatment and disposal investigated and*
  - *why the proposed/existing option was chosen.*
- *This aligns with the earlier comment made regarding "Aide Memoir" and in specific to section Part 7: Management Systems and Pollution Prevention Methods: Section 7.6.*
- *The decision DWS need to take is whether this concept becomes a standard and general clause/requirement to all WUL forms.*

4 REGULATORY FRAMEWORK

4.1 Context

Water and sanitation services in municipalities are experiencing significant challenges resulting in interruption of failing service delivery in many municipalities. Ineffective service delivery and dysfunctional infrastructure also translate to inability to service new developments and put pressure on existing infrastructure (sewers and treatment facilities) and water resources.

Current programs and interventions aimed at municipal housing and engineering services aim mostly to restore existing functionality and capacity, without considering the factors that restrict new developments, e.g. new housing schemes in low- and high-income areas, estate living, and industrial development or factors that allow service connections where bulk infrastructure does not have sufficient capacity, e.g. water and sewer networks and pumpstations, and where water resources are already stressed or the demand exceeding the availability.

At present there are no regulations which actively discourage or prohibit poor practices or actively encourage, incentivise, or enable water efficient solutions which can respond to these constraints. The absence of rules, policy or guidelines means that investors often discard planned developments or delay such plans perpetually, without the aid of a process that would provide of smart alternatives to install water and sanitation services.

A regulatory framework is therefore needed to facilitate the formulation of regulations aiming to:

- Prevent irresponsible greenfield development or major redevelopment of brownfield areas, that place an additional burden on existing stressed systems or resources,
- Facilitate responsible greenfield and brownfield development that rather enables good practices linked to localised water efficient solutions with low generation of faecal matter/sludge,
- Open a pathway to scale up the application of new localised water efficient solutions with low generation of faecal matter/sludge, which will hopefully transition to other areas of sanitation, in both greenfield and brownfield developments, which are becoming unsustainable and cost prohibitive to maintain and manage.

4.2 Approach

As commented in Section 3.2, the existing legislation in term of the Acts, already makes provision for enforcing aspects such as “conserve water” and “achieve efficient water use”. What is required is to link these concepts to the term or concept of WESS in Regulation. To achieve this outcome, three approaches can considered:

- Approach 1 (short term option <5 years): Rapid adaption & strengthening of existing DWS regulation by:
    - Identify quick changes to existing regulation that can be adapted, changed, or strengthened, to ensure that efficient water use, and where possible, off-grid

services form part of the sanitation solutions being investigated for new greenfield developments.

- Approach 2 (medium term option 5-10 years): Entrenching water efficient sanitation solutions in DWS regulation by:
    - Following on 1 – Identify more extensive changes to existing regulations and guidelines or develop new regulations that entrenches WESS as part of the sanitation solutions being investigated for all developments (brownfield and greenfield).
- Approach 3 (long term option >10 years): Entrenching water efficient sanitation solutions in sectoral regulation by:
    - Following on 1 & 2 – Change or strengthen DWS and non-DWS regulations, guidelines and standards or develop new regulatory documentation, e.g. SANS, to facilitate the enactment of WESS and WESS-related concepts. This may require the involvement of various other departments and government agencies and should be seen as a long term option.

4.3 Approach 1 (Short term option): Rapid Adaption & Strengthening of Existing regulation

Rapid adaptions or changes and or strengthening of existing DWS regulations are necessary to urgently establish and initiate the concepts of WESS without complicating the process and accelerating short term implementation goals. This approach aims to:

- Prevent irresponsible greenfield development that place an additional burden on existing stressed systems or resources,
- Facilitate responsible greenfield development that rather enable good practices linked to localised water efficient solutions with low generation of faecal matter/sludge,
- Open a pathway to scale up the application of new localised water efficient solutions with low generation of faecal matter/sludge, which will hopefully transition to other areas of sanitation, in both greenfield and brownfield developments, which are becoming unsustainable and cost prohibitive to maintain and manage.

To achieve this quickly, the ideal would be to bring about these changes in existing regulatory documentation that are currently in the process of being revised and or where minimal changes to an existing regulatory tool can be made to amplify the entrenchment of the concepts.

It is recommended that the following existing regulation either be changed or strengthened, to ensure that WESS, specifically ito efficient water use and off-grid sanitation services, form part of the sanitation solutions for new greenfield developments.

4.3.1 DWS's Proposed Compulsory National Water and Sanitation Services Norms and Standards Jan-2024

The NWA (Act 36 of 1998 makes provision for enforcing aspects such as "conserve water" and "achieve efficient water use" through compulsory licences in water stressed areas where WSA are to produce

schedules for allocating quantities of water to existing and new users. Section 26 "Regulation on water use", prescribes the manner in which water may be used. If read in conjunction with the definition for "conservation" of the resource, this allows for the concept of DWS being prescriptive in the use of water and related water works. It would however be necessary to identify how DWS can use this concept and where it needs to be brought in to ensure that a municipality require greenfield developments, specifically in water stressed areas (including a municipal area that is close to the limit of their allocation of water) to show how they will "conserve water" and achieve efficient water use, through measures such as using water saving devices, water-efficient processes (recycling). The ideal for this would be through the Norms and Standards and WUL processes.

DWS is proposing a new Compulsory National Water and Sanitation Services Norms and Standards and as such thus presents the best opportunity to initiate the change. The following changes are recommended in regard to the draft Compulsory National Standards for Water Supply and Sanitation Services and Regulation.

Under the Definitions Section to ensure that there is effective clarity and definition, the following concepts within the document need adjustments:

- **"Water Efficient Sanitation Solutions" (WESS),**
    - Include and define the collective term (catch-all phrase) of Water Efficient Sanitation Solutions" (WESS) which can be defined as:
        - *"Sanitation systems which require low to no water, completely off-grid, non-sewered or are decentralised and utilise technologies that include using water saving devices, water-efficient processes and beneficial use of waste products*.",
- **"Off-grid**" options,
    - Must be shown to include on-site sanitation options such as Non-sewered Sanitation Systems (NSSS) as well as Decentralised Wastewater Treatment Systems (DWWTS),
- **"On-site Wastewater Services",**
    - Current definition mainly identifies it as effluent being treated and disposed of on the same property where it is generated and refers to pits, etc., but <u>does not clarify</u> that this could also include a larger area, such as at a community scale development or residential complex/housing estate and or resort-style development,
    - <u>The definition must show that it is applicable to both situations</u>; on the scale of a single-family unit or on a community scale, even though the latter may require a collection and transportation system of some type (these do not part of a formalised municipal network). When water is used, conventional drainage systems (gravity sewers) and non-conventional drainage systems (settled sewage or simplified sewer systems) can be applicable.
- **Non-sewered Sanitation (NSS) or Non-sewered Sanitation System (NSSS**),
    - Mean a system that is not connected to a networked sewer, and collects, conveys, and fully treats the specific input to allow for safe reuse or disposal of the generated solid output or effluent.

- **Decentralised Wastewater Treatment (DWWT) or Decentralised Wastewater Treatment System (DWWTS),**
    - There is no current definition included, thus consider the EPA definition in an adapted format that allows for the separation of ownership ito municipal vs private:
        - "*Decentralised Wastewater Treatment refers to various approaches for collection, treatment, and dispersal/reuse of wastewater for individual dwellings, industrial or institutional facilities, clusters of homes or businesses, and entire communities. They provide a range of treatment options from simple, passive treatment with soil dispersal, commonly referred to as septic or on-site systems, to more complex and mechanized approaches such as advanced treatment units that collect and treat waste from multiple buildings and discharge to either surface waters or the soil. They are typically installed at or near the point where the wastewater is generated. These systems, when owned by the municipality, and or its contracted WSI, as a part of their permanent infrastructure, can be managed as stand-alone facilities or be integrated with centralised sewage treatment systems. These systems, when privately owned permanent infrastructure, will need to be managed as stand-alone facilities by the infrastructure owners, operating as a WSI with a SLA to the municipality*."
- DWS need to translate these definitions to all regulatory documentation to ensure a consistent use and understanding of the defined concepts.

Under Part A, specifically under **"Basic sanitation service" (Clause 7),** the following changes are recommended:

- Sub-Clauses 7(6) & 7(7), refers to the **need to provide appropriate sanitation technologies for high, medium, and low density formal settlements**, indicating that provision is made for the consideration of innovative or emerging solutions, such as off-grid (non-sewered) solutions,
    - This section needs to be adapted to include for **"off-grid solutions, including on-site wastewater services, off-grid or non-sewered solutions"** that use little or no water and involve on-site treatment of human waste, particularly in areas where there is inadequate capacity in the sewer and WWTW system.
    - This section may need further strengthening and clarity via an instruction that requires adherence, through the words **"must consider"** rather than just encouraging a concept using the word **"can be".** As such it is recommend adding a statement, to either Sub-Clause 7(6) or 7(7) that states:
        - "*WSIs must consider the use of such innovative or emerging solutions instead of waterborne sewered systems in areas of dense formal and medium settlement where there is resource scarcity and or inadequate capacity in the sewer system and or the WWTW*."
- Sub-Clause 7(8) indicates that new innovative or emerging solutions or non-sewered solutions must adhere to the requirements of SANS 30500 for Non-Sewered Sanitation Systems,

- As mentioned, this SANS does not include any system that drains an area through a sewered network, even if such network is limited, and thus excludes DWWT systems. To potentially allow for DWWT systems, it is recommended that this clause be adapted to include refence to this, as follows:
  - "Whenever a Water Services Institution is providing new innovative off-grid sanitation systems, such must adhere to the requirements of the SANS 30500 for Non-Sewered Sanitation Systems or the "SANS 24521:2020 Guidelines for the management of basic on site domestic wastewater services", whichever is applicable."

In Part C – covering the efficient and sustainable use of water, and in specific Clause 15(7) relating to the need for a Council approved WCWDM Strategy & Business Plan, the following changes are recommended:

- It is recommended that additional sub-regulations be added with a specific focus of ensuring efficient and sustainable use of water. These Clauses 15(8) and 15(9) to states that:
  - "Clause 15(8) – In water resource scarce of water services stressed areas, WSAs must require greenfield developments such as sectional title/residential complexes & estates including resort developments, or major brownfield redevelopments, prior to planning approval, to indicate the manner and extent in which water conservation and water demand management (WCWDM) and Water efficient sanitation solutions (WESS) has been accommodated and accounted for in their selected technology options, in term of efficient water use and off-grid sanitation. Failure to do so may negatively impact on the approval by DWS for requests for increases in water use allocations requested by the WSA."
  - "Clause 15(9) – In water resource scarce of water services stressed areas, a municipality desirous to undertake a large scale development (greenfield or brownfield) need first to liaise with DWS and inform them of the envisaged specific water-use related aspects of the planned development. This should include information on the extent of development, quantity of erven and population served, planned volume of water use (demand), estimated volume alternative water resources available or generated (run-off & stormwater), reclamation potential and estimated volume (if applicable), estimated wastewater/effluent generated quality of effluent and application of the extent in which water efficient sanitation solutions (WESS) principles have been applied".

Although "Part D" refers to "Construction & Functioning of Water Service Works & Consumer Installations" and thus there may be a need to include, either under it or to create a new clause to deal with the potential for consumer installed on-site or off-grid treatment options. This may however be adequately covered under the revised Sub-Clause 7(8) above.

4.3.2 Changes as part of BD & GD Assessment process: (Short to medium term option)

WSIs need to take cognisance of Water Efficient Sanitation Solutions (WESS). This implies that they need to recognise, understand and acknowledge their current municipal network and WWTW situation ito capacity, functionality and resource availability. This is even more critical for a municipality which has water resource constraints or where the existing systems are already stressed and or dysfunctional, as they will be unable to extend their services, undertake or support the undertaking of major redevelopment of brownfield areas and or development of greenfield developments. Water Efficient Sanitation Solutions (WESS) is a means to further unlock services extensions and or bulk-related blocked projects.

The existing incentive-based BD & GD Assessment process presents the ideal vehicle to highlight, facilitate and capture their network and systems statuses. This can be achieved by creating an opportunity in BD & GD Assessment processes (including PATs) to confirm the current WSI's or municipal's system status ito the following:

- Under system capacity create tick box facilities to confirm status of system ito:
    - the existing municipal network is considered:
        - stressed ito capacity (maintenance or operational-related causes) >90%,
        - dysfunctional ito capacity (maintenance or operational-related causes) >100%,
    - the existing municipal treatment works is considered:
        - stressed ito capacity (maintenance or operational-related causes) >90%,
        - dysfunctional ito capacity (maintenance or operational-related causes) >100%,
- Under WCDM create tick box facilities to confirm status of system ito:
    - Falling within a water resource stressed area (Yes or No)
- Under Bonus Points, create potential for WSI to score points if they:
    - Have provision in their By-Laws for "off-grid sanitation solutions", including on-site wastewater services, off-grid or non-sewered solutions" that use little or no water and involve on-site treatment of human waste (Water Efficient Sanitation Solutions (WESS))
    - Identify that Future bonus points would be if they require greenfield developments (e.g. such as sectional title/residential complexes/housing estates & resort developments, prior to plan approval, to indicate the manner and extent in which water conservation and water demand management (WCWDM) has been accommodated and accounted for in their selected technology options, in term of efficient water use and off-grid sanitation

4.4 Approach 2 (Medium term option): Entrenching water efficient sanitation solutions (WESS) in DWS Regulation

Water efficient sanitation solution (WESS) can be entrenched by identifying more extensive changes to existing DWS regulatory documentation and guidelines, or by developing new regulations. Such changes will ensure that efficient water use and off-grid sanitation services, as part of the sanitation solution, are being investigated for all developments (brownfield and greenfield).

It is recommended that the following regulatory documents be adapted, changed, strengthened or created to enact the uptake of WESS.

4.4.1 WULA forms and processes

Historically, in water resource constrained areas or areas where the WSA/WSI's existing systems are already stressed and or dysfunctional, many major redevelopment of brownfield areas and or extensive greenfield development projects have been deferred (blocked) until new infrastructure capacity has been ensured. Only in limited situations, have the WSIs advised the developer to undertake the necessary sanitation management in-house, most often where the WSIs have developed their own existing guidelines.

With a stronger national focus on water efficient sanitation solutions (WESS) in regulation, WSAs with such constrained situations, may now be encouraged to require of such greenfield developers or brownfield re-developers to:

- Ito water resource management, prove effective water efficient and WCDM practices within their design, and or
- Ito sanitation, establish their own on-site wastewater management.

Developers undertaking their own on-site wastewater management may either require a GA or a WUL. Limited changes to the current WUL process will also be necessary to effectively facilitate the unlocking of bulk-related blocked projects at a regional and municipal level. Most of these changes will relate to:

- ensuring that the WSI can confirm their sewer network and wastewater treatment management situation,
- advise that the WUL applicant's selected option supports their situation and is the most appropriate under the circumstances,
- the WUL applicant can prove effective water efficient and WCDM practices within their design, and or
- the WUL applicant can prove theirs is a water efficient sanitation solution.
- The need to ensure that the developer or the long term management body, who will be acting as a local WSP, sign a Service Level Agreements between the WSA and the developer water service intermediary (operating as WSP) for complaint provision of such services.

The above can be initiated and begin to be achieved by making the initial changes to existing WUL guideline documentation, the actual application documentation and by ensuring that the WSA's By-laws and Service Level Agreements for private provision of services, do adequately accommodate for such a concept.

4.4.1.1 "Aide Memoir" for the preparation of a water quality management report (Boyd, 2003)

The extent to which this document is still actively in use in the sector needs to be confirmed, noting that it is still referenced in most of the WUL forms and guideline documentation. As such the reissue of the revised aide is recommended.

Part 7: Management Systems and Pollution Prevention Methods, of the guide identifies the requirement for a motivation or indication as to why the specific technology has been selected (would include for on-site or off-grid option).

- Section 7.6 provides for motivate the appropriateness of the selected options ito treatment process and disposal methods ito of the environment and the environmental impacts, alternative options of treatment and disposal investigated and why the proposed/existing option was chosen. It is recommended that this concept be further expanded to also include for comment regarding the infrastructure impact on a stressed sewer network and stressed WWTW and the need to provide proof of water efficient solutions being utilised in the design and treatment process. It is recommended that additional sub-clauses, as questions, be included before existing sub-clause 7.6.1 to state the following:
    - New 7.6.1 - Is a municipal connection to an existing network or treatment system required ito water and or sewerage? If yes, confirm the following:
        - Is the existing network and or treatment works, considered stressed nor dysfunctional?
        - Identify if the development falls within or outside of an existing area of water scarcity in terms of resource and potable supply availability.
    - New 7.6.2 Motivate why the additional development requirements will not lead to unacceptable stressing of either resources or system (ito network and or treatment capacity).

4.4.1.2 WULA application

It is recommended that DWS entrenches WESS as part of the standard WUL (or IWUL) application process. This is specifically relevant for greenfield developments such as sectional title/residential complexes and estates, including resort development requiring new connection to an existing network and WWTW of a municipality, as well as for the undertaking of major redevelopment of brownfield areas, requiring a substantial increase in water supply demand and effluent discharge.

Considering that most of the WULA forms only become relevant after the selection of a technology option has been, it is reasonable that "Technical Report" is required to justify the choice of technology and show that it would not negatively impact on the environment. The condition/content of the "Technical Report" is typically identified by DWS during the "Pre-application" process.

It is recommended that all WUL applications must also require an agreement with the relevant WSA as the manner in which provide water services will be provided. This can either be by means of a formal agreement (draft SLA) or a letter of consent from the municipality. It is recommended that DWS provide some specific conditions as to the content of this agreement or letter to ensure that the WSA confirm the following aspects, in terms of the relevant application:

- The existing network and or treatment works associated with the application is not stressed nor dysfunctional – additional supporting evidence would be the most recent Blue and Green Drop rating,
- Identify if the development falls within or outside of an existing area of water scarcity in terms of resource and potable supply availability,
- The additional development will not lead to unacceptable stressing of either resources or systems, related to the sewer or water network or treatment capacity,

- If falling within a stressed area, the application must confirm technology solutions and whether it (does not) constitute a water intensive new water and/or sanitation bulk service development – this statement needs to be evidenced by a motivation such as a supporting "Technical Report",
- The "Technical Report" needs to motivate the appropriateness of the selected sanitation treatment options ito:
    - Infrastructure impact ito available sewer network and WWTW – needing to connect or go off-grid in the situation of a stressed sewer network and or stressed WWTW,
    - Treatment process and disposal methods ito of the environment and environmental impacts,
    - Alternative options of treatment and disposal investigated, and
    - Why the proposed/existing option was chosen,
    - What the expected water, effluent, sludge quality would be.

The decision DWS will need to make is if this concept becomes a standard and general clause/requirement to all WUL forms, by creating a facility on the forms, that require the WSI to formally confirm the following:

- If the system is part of a water resource stressed area, (Yes or No)
- If the existing network and/or treatment works are considered to be stressed or dysfunctional, the BD or GD score account for such (as mentioned in Section 4.3.2) – (short to medium term options),
    - If the WSI confirms a stressed sewer network and stressed WWTW, require the WSI to provide information/evidence regarding the proposed infrastructure impact on their system,
- Support as to the appropriateness of the selected options ito treatment process and disposal methods ito their existing network and or treatment works, (Yes or No).

This aligns with the earlier comment made regarding "Aide Memoir" and in specific to section Part 7: Management Systems and Pollution Prevention Methods: Section 7.6.

It is envisaged that the situation could arise where some large scale developments may be unable to receive a municipal water services connection and may also unable to get the necessary WUL support from the WSA to use an acceptable alternative WESS systems (i.e. off-grid, decentralised or on-site). The latter could be due to a lack of understanding or reluctance for such alternative wastewater systems by the municipality. DWS need to provide a recourse to such developers which allow the developer or investor to directly approach DWS to discuss and confirm ways in which they could still apply for the necessary WUL. In identifying the recourse, DWS may need to ensure additional operational criteria as part of the licence, e.g. a SLA between DWS and the developer, agreement to be participate and comply with the BD and GD regulatory assessment process as well as ensuring compliance with aspects such as providing monthly report back via the IRIS system.

4.4.1.3 DWA's Model Water Service Contract Between WSA & WSI

This document was developed in 2012 and it was recommended to be reviewed to include the following aspects:

- In Section 9, which includes droughts and WCWDM, it is recommended that an additional paragraph or clause is added to this section which requires greenfield developments, specifically in water stressed areas (can also refer to a municipal area who is close to the limit of their allocation of water) to ensure that the concepts of "conserving water" and "achieve efficient water use" is included in their water use and sanitation design solution, through measures such as using water saving devices, water-efficient processes (recycling). For example:
    - "In water stressed areas, which can also refer to a municipal area which is close to the limit of their allocation of water and or where the existing water and wastewater services infrastructure us stressed ito of capacity, the WSI must ensure that the concepts of "conserving water" and "achieve efficient water use" is included in their water use and sanitation design solution, through measures such as using water saving devices, water-efficient processes (recycling)."
- In Section 10.1 Operations and Maintenance, reference is made to the responsibilities ito maintenance, but no material comment is made regarding the need for operational conditions ito staffing and procedures. It is recommended that an additional sub- clause is added to this section which requires adherence to the DWS Norms and Standards appropriate to a WSI function, and in specific to appropriate staffing and O&M procedures.
    - "10.1.5 The WSI shall conform to the relevant regulatory provisions, including the DWS Norms and Standards appropriate to a WSI function, and in specific to appropriate staffing and operation and maintenance procedures."
- Sub-Clause 10.1.3 confirms that the WSI is responsible for maintaining the water services system and for all costs associated with such assets including maintenance costs, insurance, licensing and running costs. It is recommended that this clause be strengthened to require the WSI to provide clear indication as to the manner in which the planned system will be financially sustainable and that adequate OPEX provision has been allowed for.
    - "10.1.3 The WSI shall be responsible for maintaining the water services system and shall be responsible for all costs associated with such assets including maintenance costs, insurance, licensing and running costs. To this end, the WSI shall annually provide to the WSA clear and measurable indication as to the manner in which their planned system will be financially sustainable and that adequate OPEX provision has been allowed for."
- Section 10.2 Legal Compliance and specifically Clauses 10.2.2 and 10.2.3 do not clearly define or identify how the WSI needs to comply with all environmental Regulatory Provisions of the WSDP. It is recommended that an additional clause is added to this section which requires greenfield developments, specifically in water stressed areas or where the municipal area is close to the limit of their allocation of water, to prove how water will be conserved and water efficient use be achieved, through WESS measures such as using water saving devices, water-efficient processes (recycling, etc.). This can be done through the

provision of a localised WCWDM plan for the specific water use and sanitation design solution, referencing the measures employed such as using water saving devices and water-efficient processes.

- "In water stressed areas and/or municipal areas which are close to the limit of their allocation of water and or where the existing water and wastewater services infrastructure is stressed or close to its design capacity, the WSI must prove how water will be conserved, and water use efficiency will be achieved. This will be in the form of providing the WSA with a localised WCWDM plan for the specific water use and sanitation design solution, referencing the measures employed such as using water saving devices, water-efficient processes (recycling, etc.)."

4.4.2 DWAF Model Water Services By-laws (DWAF, 2005)

It is recommended that the 2005 Model Water Services By-laws are reviewed to ensure that efficient water use, and where possible, off-grid sanitation services form part of the sanitation solutions being investigated, not only for new greenfield developments, but where necessary and appropriate for all developments. Such a review should include for the following aspects:

- Updating the Models By-laws to encourage water efficiency, including for water efficient fittings and equipment, potentially identifying a range of water efficient option, e.g. low-flush, ultra-flush to pour-flush, etc.,
- Adopt good practices from municipalities, such as CoCT & EWS, into nation-wide By-laws to include aspects such as:
  - Encouraging consumers to flush toilets with greywater, rainwater, or other non-drinking water,
  - Incentives for low-flush toilets, alternative water source including greywater for reuse, etc.,
    - For urban areas specifically, the cities will incentivise and regulate the installation of low-flush toilets and water-saving urinals as a standard feature in their rated residential properties, offices, and commercial sites;
  - Banning use of automatic cistern or tipping tanks for flushing a urinal, specifically in public facilities,
  - New toilet installation must be fitted with a close coupled or low-level cistern; all new toilets must be fitted with a dual flush mechanism consisting of a maximum of 3 ℓ per flush on the low-flush setting and a maximum of 6 ℓ per flush on the high-flush setting, alternatively,
  - All cisterns not intended for public use, must be fitted with flushing devices allowing interruptible or multiple flushes, provided that such flushing device is not required in cisterns with a capacity of 4.5 ℓ or less,
- Provide a generic/national Schedule of Approved Pipes and Fittings, which municipalities can change as per their SCM processes and relevance to their area (possibly be achievable by updating the JASWIC List of Accepted Water Components),
- Synergised design requirements between municipal design departments,

    - By-laws typically cover water supply, leaving a disconnect between building control departments and water supply departments. (Example: clear a WC pan with 1,5 ℓ water versus ensuring the discharge reaches the sewer without causing blockages, etc.). Therefore, By-laws must consider the need for synergised design requirements between municipal design departments, i.e. Building Control Departments and Water Supply and Sanitation;
- Efficiency Standards should be incorporated into municipal policies and By-laws,
- Free, easy, and readily accessible regulatory information,
    - Charging for Schedules discourages users from accessing it, specifically if needing to check on water efficient fittings and equipment – it is strongly recommended that such information be freely available (pdf format) from the municipalities website with a period applicability indicated to ensure that the latest version is being accessed.

Specific changes to accommodate for WESS by ensuring that efficient water use, and where possible, off-grid sanitation services, form part of the sanitation solutions being investigated for new greenfield developments, include:

- Under the Definitions section, identify the term "on-site sanitation services" to mean any sanitation services other than water borne sewerage disposal through a sewerage disposal system. This definition must be adjusted to includes for systems with limited and or small bore sewer system linked to an on-site treatment facility. Similarly ensure that "off-grid" is also included in the definitions. Consider the following descriptions:
    - **"On-site wastewater services"** can be either on the scale of a single-family unit or on a community scale, even though the latter may require a collection and transportation system of some type, but one which is not part of a formalised municipal network. When water is used, conventional drainage systems (gravity sewers) and non-conventional drainage systems (settled sewage or simplified sewer systems) can be applicable,
    - **"Off-grid**" options can include on-site sanitation options such as Non-sewered Sanitation Systems (NSSS), as well as Decentralised Wastewater Treatment Systems (DWWTS).
- In Chapter 3, Clause 76 identifies the service levels as supplied by the municipality. Clause 76 (3)(c) provides for a metered pressured water connection, but it also includes for an individual connection to the municipality's sanitation system. There is no provision to ensure that it also can be applied to just a metered pressured water connection (supplied by municipality) that does not require a sanitation network connection. It is recommended that an additional concept is included as a further Clause:
    - <u>Clause 76 (3)(d)</u> <u>a metered pressured water connection (supplied by municipality)</u>, without an individual connection to the municipality's sanitation system—
        - installed against payment of the relevant connection charges,
        - where the customer maintains the water and drainage installations,

        - where the sanitation treatment (for reuse, recycling & reclaiming) is deemed "off-grid" or the broader definition of "on-site" and does not connect back to the municipality's sanitation system.
- Chapter 4 Part 1: Connection to Water Supply System, Clause 77, refers to provision of a water supply connection and Sub Clause (2), specifically, refers to extending, modifying, or upgrading of the existing water supply network to accommodate for a new consumer/s (potentially at the new consumer/s expense with the contribution portion to be determined by the municipality).
    - It is recommended that this Clause be strengthened to include for WESS by requiring, specifically in stressed water supply service networks, that the new consumer must include effective WCWDM solutions in the design and selected technology options. The manner and extent to which WESS is incorporated through efficient water use (including through reuse, recycling and or reclaiming of wastewater via off-grid sanitation treatment) must be provided. The consumer will need to provide such proof and motivation, either in their application for connection and or upon submission of building/development plans for approval. To facilitate this, consider adding another subclause after 2 and before 3 which states:
        - "Where application is made for water supply services in a WSA area that has been identified as having a stressed water supply service network or treatment system or being in a stressed water resource area, the new consumer must indicate the manner and extent that their design and selected technology options represent efficient water use ito WCWDM and WESS (including for reuse, recycling and or reclaiming of wastewater via off-grid sanitation treatment)."
- In Chapter 4 Part 5: Installation Work (Clauses 91 to 97), it may be necessary to provide reference to the relevant and/or revised SANS or ISO standard applicable to WESS – being efficient water use including recycling and or off-grid sanitation.
- Chapter 4 Part 6: Communal Water Supply Services (Clause 98), allows for communal water supply services through a communal installation, designed to provide a controlled volume of water to several consumers.
    - The term "controlled volume" needs to be clarified if it also refers to a limited supply volume, where any additional requirement must be sourced from alternative water supply sources. If this is the case it may be necessary to indicate its inclusion in this clause.
- Chapter 5 references the condition for supply of sanitation services. "Part 1: Connection to Sanitation System" allows for the use of on-site sanitation services in accordance with Clause 98. Of note is Clause 111(2) Provision of Connecting Sewer, which specifically refers to extending, modifying, or upgrading the existing water supply network to accommodate for a new consumer, potentially at the new consumer's expense (contribution portion to be determined by the municipality).
    - It is recommended to strengthen the above argument ito of either an additional sub-clause or a new clause:

        - "*In areas with an existing stressed sewer network and or stressed wastewater treatment works, or area with no immediate future network opportunity or capacity, the municipality may require the owner of premises (or greenfield developer) to undertake on-site or off-grid sanitation services.* "

- In Chapter 5 Part 4: Drainage Installations, the following are recommended:
    - In Clause 124 Technical Requirements for Drainage Installations, reference must be made to the relevant and or revised SANS or ISO standards for applicable drainage related to efficient reuse, recycling and or reclaiming of wastewater, via off-grid sanitation and treatment.
- In Part 5: On-Site Sanitation Services and Associated Services,
    - Clause 130 "Installation of On-Site Sanitation Services", references the concept of provision of own on-site sanitation services, as specified by the municipality, when it is not reasonably possible or cost effective for the municipality to install a connecting sewer.
        - The clause needs to be strengthened to also includes for municipal areas with an existing stressed sewer network and or stressed wastewater treatment works, or area with no immediate future network opportunity. In addition, this clause must accommodate for a WESS approach. The recommended change is thus:
        - "*If an agreement for on-site sanitation services in respect of premises has been concluded, or if it is not reasonably possible (inclusive of resource scarcity and or operational reasons) or cost effective for the municipality to install a connecting sewer, the owner must install WESS services, as specified by the municipality, on the site unless…*
    - Clauses 131 to 134 discuss specific condition relating to on-site sanitation systems, and Clause 132 makes specific reference to septic tanks and treatment plants, and allows for a treatment plant with no specification of the definitive number of dwellings it needs to serve, but does however require that any such other on-site sewage treatment plant must dispose of its effluent in a manner that satisfies the municipality.
        - The section prescribes aspects such as the minimum size, capacity, and volume of septic tanks, and these may need adjustment in future should the selected and certified treatment technology require otherwise to allow for effective WESS approach ito wastewater reuse, etc.
- In Chapter 5 Part 9: Installation Work (Clauses 147 to 151), reference to the relevant or revised SANS or ISO standards, applicable to WESS approach, is necessary, to include the concepts of efficient water use (including recycling and or off-grid sanitation).
    - Clause 151 Water Demand Management refers mainly to flushing urinals needing to be user-activated and that cisterns, and related pan designed to operate with such cistern, may not exceed 9 litres. In addition, all cisterns not intended for public use, are to be fitted with flushing devices allowing interruptible or multiple flushes,

provided that such flushing device shall not be required in cisterns with a capacity of 4,5 litres or less.

- It is necessary to provide for- or make reference to closed-looped sanitation systems, which may require a different flush volume to function effectively.

- In Clause 152 of Chapter 6 Water Services Intermediaries, reference is made that a municipality may require the registration of water services intermediaries or classes of water services intermediaries to register with the municipality.
  - The clause may be strengthened by changing it to ''requiring the registration'' (not ''potentially'' requiring) of all water services intermediaries or classes of water services intermediaries with the municipality.
    - "The municipality *will require* water services intermediaries or classes of…"
  - Above argument may be strengthened via either an additional sub-clause or a new clause, that specifically includes for Requiring a SLA between the WSI and the municipality as WSA. It should also include reference to the need to ensure that the contract contains the required adherence to the DWS Norms and Standards appropriate to a WSI function.
    - "*Such WSI registration will include the completion of a service level agreement between the WSI and the municipality as WSA, which will include adherence to the DWS Norms and Standards appropriate to a WSI function."*

A generic recommendation is that the revised or future Model By-laws need to accommodate easier acceptance of the WESS concept, i.e. "smart sanitation solutions" ito of use of own alternative water (domestic recycled water) and not just the municipal supplied option.

4.4.3 Water Services Act, No 108 of 1997

Chapter II of the Act refers to DWS being able to prescribe compulsory national standards relating to the provision of water services. In addition, Section 9 (d), in specific, provides for the application of these norms and standards to the nature, operation, sustainability, operational efficiency and economic viability of water services and 9 (f), as to how these apply to the construction and functioning of water services works and consumer installations.

Furthermore, Section 19 "Contracts and joint ventures with water services providers" under 19(5)(b) – "Compulsory provisions to be included in such a contract", allows for the Minister, as part of the prescriptions for a such contract, to include that the municipality (as WSA and/or WSP) demonstrate how they will require greenfield developments, specifically in water stressed areas or municipal areas that is close to the limit of their water allocation, to show how they will "conserve water" and accommodate for WESS, e.g. through measures such as using water saving devices, water-efficient processes (recycling), etc. Section 19(7) makes allowance for the Minister to provide model contracts which can be used as guide for contacts between a WSA and WSP. This would also be an instance where inclusion can be made that the greenfield developer, as WSP (or WSI operating as WSP), needs to show how they will "conserve water" and achieve efficient water use, through measures such as being off-grid and or using water saving devices, water-efficient processes (recycling). DWS have

developed such model Service Level Agreement contracts (Model Water Services Contract, (DWAF, 2012)).

This Act, in conjunction with its instruments such as the revised compulsory norms and standards (revised as per earlier recommendations), makes more than adequate provision for DWS to ensure that WSAs, WSPs and WSIs (including greenfield developers as WSI operating as WSP), need to show how:

- They will "conserve water" and achieve efficient water use, through measures such as being off-grid and or using water saving devices, water-efficient processes (recycling),
- Can require that they need to prove that their planned system will not form part of a stressed existing water service,
- That "off-grid" sanitation options have been investigated and were found to be non-viable or more onerous/hazardous to the WSA and or the environment than creating a connection to a waterborne system.

DWS must ensure that through their national and regional interaction with WSAs, WSPs and WSIs, these concepts are applied when interpreting the norms and standards to a specific area. This may thus, rather than capturing in legislation, more likely require improved awareness creation and interpretation of detailed area assessments by DWS staff and management (e.g. using Blue Drop & Green Drop regulatory comments) of a WSI's systems ito being stressed or not and requiring the applicant/s to provide improved information on "conserving water" and proof of investigating "off-grid" sanitation options, prior to supporting approval of WULAs or grant funded projects.

4.4.3.1 The 2016 National Sanitation Policy

Under Acronyms, "DEWATS" is used for Decentralised Wastewater Treatment. It needs to be noted that "DEWATS" is an example of a specific technical approach to decentralised wastewater treatment (DWWT) but does not encompass the whole of it.

- It is recommended that DWS must be specific with their acronyms and rather standardise on the term ''Decentralised Wastewater Treatment (DWWT)". This is also more aligned to uses such as "Wastewater Treatment Works (WWTW)".

4.4.3.2 New Guidelines

A further concept relating to WESS that requires investigation, is the effective use of treated alternate water sources. At present, the types of alternatives with the highest potential to be collected and treated by buildings include rainwater, stormwater, foundation drainage, greywater and blackwater generated by commercial, mixed-use, and multi-family residential buildings. Lesser known options would be condensate or mist. The most common water uses associated with these relate to non-potable end uses such as outdoor uses, which includes for irrigation (sub-surface, drip irrigation and limited spray irrigation), decorative fountains and impoundments, industrial uses such as cooling applications and dust control or street cleaning.

The proposed 2024 DWS Norms and Standard (Part B – discharged water quality ito domestic effluent management) provides guidance on greywater management in accordance with the WRC's 2018 Guidelines for Greywater Use and Management in South Africa. The guidelines aim to provide the necessary support for the wider adoption of domestic greywater management and use in South Africa.

4.4.3.2.1 WQ guidelines for flushing with treated effluent (New):

The concept of using treated alternate water sources, primary such as rainwater, stormwater, foundation drainage and or treated greywater for toilet flushing, present real opportunities as alternate resource/s, in addition to the use of treated blackwater in a closed loop system. Initially, DWS may consider the development of appropriate and relevant WQ guidelines for toilet and urinal flushing with treated effluent from the above mentioned alternate water sources, inclusive of treated blackwater in closed loop flushing. These need to define acceptable reuse options, conditions, and treatment standards for the reused for non-potable purposes (toilet flushing) that can qualify as GA. The WRC SASTEP unit has a wealth of information on technology options and technical evaluation thereof that could contribute to such output.

4.5 Approach 3 (Long term option): Entrenching water efficient sanitation solutions in sectoral regulation

This approach is a continuation of the first two approaches and focussed on several DWS and non-DWS regulatory documentation and guidelines that could be changed or strengthened and encourages the development of additional, new regulatory documentation, such as SANS, to facilitate the enactment of WESS concepts. This will likely require the involvement of various other departments and government agencies and should be seen as a long term option.

The regulatory changes required to facilitate the acceptance or institutionalising of WESS in sectoral regulation are commented in the sections following.

4.5.1 Regulating for Low Flush & Water Efficient Toilets and Water Efficient Sanitation System

Low flush & water efficient toilets form part of entrenching WESS in the sector, but require specific changes in the SANS 10400 (National Building Regulations) to provide for such technologies.

4.5.1.1 Changes to SANS 10400 (National Building Regulations)

4.5.1.1.1 SANS 10400-Part Q to be revised

The SANS 10400-Part Q deals with the sanitary waste, healthy handling, and treatment of effluent when there is no water-borne sewage system available in a particular area. It does not make provision for a DWWT system, although to a certain extent DWWT systems are considered in legislation ito ISO 31800:2020, but only for pre-fabricated systems. DWS, in conjunction with SABS, will need to confirm

the most appropriate standard to allow for effective inclusion of the broader spectrum of DWWT systems.

This SANS needs to be amended to include cross reference to the relevant SANS which caters for decentralised wastewater treatment systems, either a SANS 31800 or similar standard.

4.5.1.1.2 New part: SANS 10400 Part XB (Efficient Water Usage in Buildings)

Water efficient toilets, including low flush toilets, need to be considered in regulation. Similar to SANS 10400- XA which looks at Energy Usage in Buildings, the concept of encouraging water efficiency in buildings (including flushing systems) should form a separate and additional part to Part X, e.g. Part XB. As such, there is a need for a "SANS 10400 Part XB – Efficient Water Usage In Buildings" to encourage and entrench water efficiency in buildings, including aspects such as water efficient flushing systems and toilet systems (Merwe-Botha & Quilling, 2023). These regulations can then be further defined by either updating the existing SANS, or by providing additional SANS.

It is recommended that the SANS 10400 (National Building Regulations) as a whole be revisited, due to the changes required for water efficient toilets and DWWT ito 10400-Part Q and for a new "Part XB Efficient Water Usage in Buildings", to entrench the concept of encouraging water efficiency in buildings (including flushing systems).

4.5.1.1.3 Amendments to SANS 10400 and the NBR

These changes in the SANS will protect municipalities and the user from insurance and performance claims and risks. If a technology is only prescribed in By-laws, then the municipalities carry the risk and responsibility regarding quality and performance of the technology, which is financially unfeasible. Also, it could lead to discrepancies in standards and performance criteria across municipalities, thereby reducing the efficacy of the low-flush concept.

It is thus recommended that in terms of improving water efficiency measures, which impact on WESS, the PID recommendations are enacted in terms of the need for an amendment to SANS 10400 and the NBR. Included with these recommendations is the need for discussion between plumbing industry stakeholders and government before ratification. The table following summarises the recommended amendments to SANS 10400 and NBR in terms of improving water efficiency measures (Still et al., 2008).

Table4.1: Recommended amendments to SANS 10400 and the NBR in terms of improving sanitation water efficiency measures

Item Description	Specification regarding water efficiency	Notes
Cistern and pan – single flush	No cistern and pan for a new building should require more than 9 ℓ to clear	More efficient systems requiring 6 ℓ or less should be encouraged using a labelling system
Cistern and pan – dual flush	No cistern and pan with a dual flush mechanism should require more than 6 ℓ to clear on the full flush setting	
Cistern and pan – Interruptible flush	Cisterns and pans with interruptible flush mechanisms are an acceptable alternative to low-flush and dual flush options	The pan should be able to clear with not more than 9 ℓ
Urinal	Automatic flushing urinals should be illegal. Urinal flushing should be user activated (either manually or with sensors), and should use no more than 2 ℓ of water per flush	
Waterless toilets	Information regarding well tested designs of waterless toilet should be made available and these should be allowed for within the building codes	
Waterless urinals	Information regarding well tested designs of waterless urinal should be made available and these should be allowed for within the building codes.	
Greywater recycling systems	National standards for domestic greywater recycling systems should be developed and certified designs should be promoted.	

A critical recommendation relates to greywater recycling systems and the need to develop national standards for domestic greywater recycling, including the promotion of certified designs. The WRC's 2018 Guidelines for Greywater Use and Management in South Africa (Carden et al., 2018) provides valuable input to such national standards, highlighting support for the wider adoption of domestic greywater management and use in South Africa. The guideline does not include guidance with regard to Class III (laundry greywater), due to the alkalinity and high organic concentration (fats, oils, grease, etc.) of the water. This is an aspect that will need to be resolved or effectively clarified in future Norms and Standards.

4.5.1.2 New required regulation: ISO 31800:2020

ISO 31800 does not appear to have formally been adopted as a SANS as yet, although it is referenced in South African regulatory documentation as an applicable ISO standard. This standard needs to be formally adopted as a SANS , with amendments where necessary to ensure the following:

- Appropriateness to the South African socio-political, regulatory, and physical environments,
- Greater inclusivity, not only covering pre-fabricated treatment units but to also allow for on-site designed and built systems,
- Include the relevant cross referencing to the appropriate standards which allows for on-site designed and built systems.

4.5.2 WQ guidelines for further use of treated alternate water sources (New)

Following on from the earlier concept using treated alternate water sources, DWS need to consider extending the development of WQ guidelines for non-potable uses, such as toilet and urinal flushing (non-closed loop), priming drain traps and even potentially cold water clothes washing, using the fuller spectrum of treated alternate water sources (including treated blackwater). These need to define acceptable reuse options, conditions, and discharge standards.

Concepts to consider in these guidelines and regulatory documentation would include:

- Creating the potential for Municipal by-laws requiring new developments (commercial and residential) over as specific size, e.g. 1 ha or more, to install and operate an on-site water reuse system.
- From a regulatory perspective, guidance is required as to the relevant permission process (e.g. integrated WUL) to be followed which could include for existing concepts such as the relevant Technical Report that motivates how the project's treatment system complies with the requirements for on-site water reuse systems. It should include elements such as:
    - Confirming the types of available alternate water sources to be collected and treated for non-potable end uses,
    - Identify the entities involved in the design, treatment, operation and maintenance of the on-site water reuse system (WSA/WSI SLA),
    - Treatment processes used to meet required water quality criteria,
    - Demonstration of compliance with the WQ requirements, in specific aspects such as pathogen reduction,
    - Information on operating conditions and continuous online monitoring (smart metering),
    - Cross-connection and backflow prevention measures,
    - Contingency plan and system W_2RAP to manage an incident event.
- Developing guidelines for selecting appropriate treatment processes to consider aspects such as:
    - Source (raw) water quality entering the treatment system,
    - Water quality standards to be achieved per technology option/treatment process,
    - Solids (sludge) management,
    - Site constraints including footprint and access,
    - Energy usage (benchmark options),
    - Economic guidance (both ito capital and operating costs),
    - Aesthetics (i.e. colour and odour),
    - Ease (or complexity) of operation and maintenance,
    - Reliability to ensure uptime and production.
- Developing relevant standards and installation guides relevant to engineers, plumbers, O&M managers and regulatory managers.

4.5.3 Further Actions

Institutional recommendations (medium to long term option) include DWS encouraging a stronger focus and inclusion of appropriate Water efficient Sanitation systems (WESS), including off-grid sanitation systems and Decentralised Wastewater Treatment (DWWT) in tertiary education related to water and wastewater treatment design.

Recommendations related to the Value Added Chain that fit with the WESS concept, include alignment between the Dept of Human Settlements' Guidelines for Human Settlement Planning and Design, the various municipal design requirements, and the NBR, by enacting the following:

- The “Red Book” and municipal norms and standards need to follow national building regulations,
- Certification of sanitation technologies must be consistent and achieved through another means than SANS (due to delays), e.g. an Agrément SA certificate or alternative entity should a national rating and labelling system is accepted,
- Clear ratios must be established to guide different conditions (urban, rural, high density, etc.) and their technology implications,
- New technology systems must adhere to the applicable norms and standards in terms of design, and follow approved certification processes,
- Likewise, synergy is needed across municipalities in the implementation and enforcement of building regulation and water services.

4.5.3.1 Incentive-based Regulation: Water Efficiency Labelling and Standards (WELS) rating system (longer term option)

In addition to the recommended changes to the NRB, **legislation is required to allow the enactment** of a Water Efficiency Labelling and Standards (WELS) rating system for water efficient appliances and fixtures This may require either an individualised standard, similar to the “Australian Standard 6400:2016 Water efficient products – rating and labelling”, or the concept of WELS can be incorporated into the recommended SANS 10400- Part XB Efficient water usage in buildings. The WELS Standard must detail the criteria for:

- Testing,
- Rating, and
- Labelling products and display (star rating, water consumption, flow rates).

It is further recommended that the current SA range of product-specific standards that set technical specification for plumbing and drainage products and additional requirements for product testing, performance, labelling, and display are revised to accommodate a WELS system in terms of:

- Showers,
- Tap equipment,
- Flow controllers,
- Toilets, including for WC Pans, WC flushing devices, cistern inlet, outlet valves and technical specifications for flushing valves for water closets and urinals – for use with mains supply and with break tank supply,
- Urinal equipment, including technical specification for urinal flushing cisterns,
- Washing machines, and
- Dishwashers.

4.6 Further Considerations In Regulating Alternative Water Use And Non-Sewered Sanitation at Local Government Level

Decisions that need to be considered when entrenching alternative water use and DDWT at a local government level regulatory system, specifically when dealing with individual DDWT applications/installations, have already been identified by municipalities (Mpofu et al., 2023), whereby municipalities investigated these aspects for their own circumstances. It would thus make sense to take cognisance of these and include them in the national process. These considerations include the following:

- Time limits on term of operation – Some municipalities work on a five-year O&M contract, which could be considered as too temporary. Appropriate time frames must be defined for each application/installation based on the envisaged concept of ownership and operation, or work on a revision or application review cycle which should be aligned with the CAPEX and envisaged operational lifespan (ISO 31800 refers to 20 years – may need initial 10 years and then 5 year intervals).
- Contractual (SLA) arrangement – Any DWWT will require a contract/SLA. The municipality must decide whether it wants to enter into WSP contract with the operator or oversee it as an intermediary. A direct WSP contract will have more direct accountability to the municipality, but also requires more direct responsibility of the municipality. National guidance ito of basic generic SLA, which takes this aspect into account, can assist and guide municipalities in adopting "WESS" options in a responsible and sustainable manner.
- Emergency/failure (retention guarantee) – A bank guarantee may be required by the municipalities in case of failure. Such guarantee must reflect the risk associated with the specific installation or may be more generic such as 1.5 times the cost of the total installation.
- Preferred technologies – Consider having pre-approved or identifying preferentiality for certain types of technologies or installations (such a proven technologies). However, each individual application must still be assessed on its individual merits. It should be noted SANS 30500 certification is only applicable to non-sewered/on-site systems, thus not applying to DWWT.
- Property ownership – The implementation guide is for Developers, Professionals, Property Owners, and Treatment Plant suppliers seeking approval from the City (Section 1 of Proposed Implementation Guide). Additionally, the City may also plan to install, own and operate any such works itself, or appoint an operating agent (WSP), in which case it would be on municipal owned land.
- Installation and operational skills requirement – A professionally registered engineer or technologist must submit the application and oversee implementation, as well as the installation, requiring registered plumbers' and electricians' certification. The Institute of Plumbing South Africa (IOPSA) indicated (workshop 08 December 2020) that currently no standard skills for installation of DWWT have been defined within the plumbing industry and that IOPSA can assist with the development of such skills definition and training program in

association with the relevant Sector Education and Training Authority (SETA) based on existing international best practice.

- Effluent reuse and quality compliance – Municipalities should encourage reuse options since it will reduce the demand on the municipal supply systems. Effluent standards would still need to comply with at least the irrigation limits, or the general limit (for <2 Mℓ/day effluent discharged), or any water use licence limits (for >2 Mℓ/day).
- Applicability to informal settlements or low-cost housing developments – DWWT could be an alternative solution to centralised sewage collection and treatment for informal and/or low-cost settlements, if implemented suitably, as can be seen from international experience (particularly Indonesia). Secondary objectives could also be attained such as local job creation through community-based O&M. This model could be refined and replicated once a few DWWTs have been implemented successfully.
- Wastewater sludge management – All systems have wastewater sludge to be disposed of safely or beneficially, and should be a requirement coupled with appropriate access to relevant machinery and O&M procedures.

Essential aspects that will require clarification in regulation or in By-laws pertaining to alternative water use and NSS, including package plants, are:

- **Package plants** – A formalised procedure for installation of wastewater package plants need to provide for all process activities for developments in a remote area; or where no municipal sewer connection will be available for the foreseeable future; or due to municipal treatment capacity constraints hindering development. At present the planned revised norms and regulations refer only to ISO 31800 (2020) which is specific to prefabricated units. Regulations may need adjustment or further investigation to establish requirements for non-prefabricated units.
- **Future development or expansion options** need to be considered, specifically managing increasing wastewater discharge. i.e. what happen if the development or informal settlement grows and thus creates an increased demand? According to ISO 31800 (2020), lifespan on units needs to be at least 20 years, thus must be a mandatory part of the plan.
- **Alternative water installations** treating greywater and/or blackwater need to be included, as well as the fate of excess discharge water not being recycled (e.g. need to conform to specific catchment wastewater discharge WUL or GA standards).
- **The ideal concept around water use authorisation** (WUA) or water use "licence" authorisation (WULA) need to be confirmed in order to prevent a situation that demands a WUL where not necessary. Many of the water uses, depending on the existing development size criteria, may be authorised under GA: wastewater discharge standards and reuse. *It is critical that DWS consider practical means to facilitate water use authorisations for WESS typologies, in cooperation with DFFE.*
- Environmental Impact Assessment (EIA) – The National Environmental Management Act: EIA Regulations of 2014 (GNR 326) and the 3 Listing Notices (GNR 324, 325 and 327) were amended on the 7th of April 2017. A number of activities requiring authorisation may be applicable to non-sewered on-site treatment systems and or package plant installation and

require environmental authorisation prior to commencement. This will require clearer and more definitive guidelines or exemptions:

  - GNR 327 Listing Notice 1 Basic Assessment Process required will most probably come into play for most of the WESS that are applicable to larger complexes, resorts, or informal settlements, ito activity 15 (footprint larger than 50 m^2), 25 (only if effluent treatment capacity if >2 Ml & <15 Ml). This may be cost prohibitive.
  - GNR 325 Listing Notice 2 Scoping and EIA required, most probably will not be activated for effluent, polluted water, wastewater, or sewage, if such facilities have a daily throughput capacity of ≤2 000 m^3, but it may need some formal comment ito what dispensation is applicable or and under what conditions.
  - GNR 324 Listing Notice 3 Basic Assessment process for specific activities in identified sensitive areas – highly unlikely to get dispensation, but how is this to be managed ito of an informal settlement? Is dispensation possible for say closed-looped system?

- What Environmental approval process or approach to be followed if no EIA authorisation is applicable, should applicant work according to By-laws (e.g. compulsorily requirement for developers to approach DEA&DP for the EIA basic assessment, use and online questionnaire concept for limited screening) or should there be National Guideline?.

5 SYNTHESIS REPORT

5.1 Key sanitation issues delaying infrastructure development

The key problems reported and experienced from a sanitation perspective can be summarised as:

- Access to bulk:
    - Insufficient capacity of existing sewer networks and wastewater treatment works (WWTW) to accommodate new water and sewer connections,
    - Limitations in bulk infrastructure networks hinder new system extensions and unfeasible due to cost and WWTW access,
    - Site suitability, e.g. mountainous and rocky terrains are cited as a limitation in introducing water-borne systems in some communities, which makes a strong case for decentralised systems.
- Institutional factors:
    - Constraints in municipal capacity to:
        - Effectively execute project design implementation, operation, and maintenance responsibilities, which leads to dysfunctional network and treatment systems,
        - Effectively regulate alternative sanitation options, e.g. package plants, which results in alternate technologies being directly prohibited or not contemplated or allowed for (not mentioned in By-laws),
    - Reluctance to change due to perceived operation and maintenance (O&M) impacts related to the choice of technology. Municipalities tend to lean towards systems that are easy to operate and maintain (not costly to operate and maintain), and have clear responsibility delineation between the household/consumer and the municipality in terms of technology use and O&M. Municipalities are thus also disinclined to change due to a lack of understanding of what water efficient system requirements entail in terms of their responsibility versus the household/consumer's responsibility,
    - Low awareness and exposure of water efficient technologies amongst officials, planners, and design and process consultants contributes to a reluctance to change due to lack of understanding of water efficient system requirements and positive impacts,
    - Lack of readily accredited or certified water efficient treatment technologies and systems in the market place,
- Certain water resources are already under stress, and further development would create a situation where the demand exceeds the available supply of potable water, compounded by high water losses/unauthorised use in system (DWS No Drop Report, 2023),
- Many systems are not effectively designed to manage the impact of climate change in terms of drought or floods,
- Complex and lengthy authorisation processes, as well as the lack of understanding or interpreting of guidelines regarding the requirements, roles and responsibilities,

- Delays in processing of applications or fast tracking new greenfield development or major brownfield redevelopment, that does not necessarily negatively impact on water services infrastructure,
- Cumbersome environmental approval requirements and impacts of alternative and or water efficient sanitation technologies include:
    - Environmental Impact Assessment studies are required for construction of WWTWs,
    - Final effluent quality needs to meet national DWS norms and standards as set out in the SANS regulations,
    - Environmental impact on the ground and in water sources (rivers, streams, etc.) need to be assessed,
    - Any mechanical/chemical processes and moving parts that use oils/chemicals in any conversion of waste, these process oils/chemicals cannot contaminate the surrounding land and water, e.g. mini plants that convert waste to pellets/gas cannot be close to any river streams.

The above challenges delay and disincentivise services extension and bulk infrastructure investment and related projects. By entrenching water efficient sanitation solutions in sectoral regulation and policy, these impacts can be reduced or negated to facilitate unlocking bulk-related projects. Typical scenarios would include:

- A developer wants to invest in a greenfield development project, such as new sectional title/residential complexes and estates (including resort developments development) or a major redevelopment (brownfield areas) where the existing system is already stressed, but is constrained by access to bulk infrastructure to connect, transport and treat wastewater,
- Local water resources are limited or over-abstracted in a certain area, which curbs the potential for further waterborne sanitation as part of service extension,
- Alternative water efficient or dry sanitation system developments (without apparent long term negative environmental impact) are not facilitated, contemplated or accommodated in the national or municipal environment to encourage further development, with the following consequences:
    - A developer is unable to get municipal approval for an alternative solution due to lack of technology exposure or certification or approved Norms & Standards for such alternative solution,
    - A developer has municipal approval for an alternative solution but is unable to get authorisation for the WWTWs through NWA Act Section 21, due to lack of technology exposure or certification or approved Norms & Standards for such alternative solution,
    - A developer's proposed on-site WWTW is not able to meet strict effluent quality standards (GA general- or special limits), potentially needing DWS approval for relaxation of specific effluent quality parameters, specifically if pollution impact is limited.

5.2 Unlocking bulk-related blocked projects

DWS is desirous to find practical ways to entrench Water Efficient Sanitation Solutions (WESS) as part of the existing regulatory process, specifically pertaining to the proposed N&S, the standard WUL/IWUL application process, and ideally, also leveraging the concepts through the Blue & Green Drop incentive-based regulation assessments. These routes are viewed to be instrumental in fast-tracking bulk-related blocked greenfield development projects which are deadlocked in processes that disallow connections to existing municipality networks and WWTW, whilst unable to offer any alternative solutions to developers of new greenfield or major redevelopment of brownfield areas.

Section 4 of the WRC master report: "*Regulatory Framework: Entrenching Water Efficient Sanitation Solutions (WESS) in Bulk Services*" provides a detailed conceptual and activity based overview. The section following summarises only the most critical and urgent national actions that hold potential to unlock bulk-related blocked projects.

5.2.1 Changes to: Norms and Standards

- **Changes to DWS's Proposed Compulsory National Water and Sanitation Services Norms and Standards (Notice No. 4246 published in *Government Gazette* No. 49979, 12 January 2024)**:
    - Under the Definitions Section: Ensure effective clarity and definition regarding water efficient technologies and systems, **include or amend as follows**:
        - Include a definition of "Water Efficient Sanitation Solutions" (WESS) which could be:
            - "*Sanitation systems which require low to no water, completely off-grid, non-sewered or are decentralised and utilise technologies that include using water saving devices, water-efficient processes and beneficial use of waste products*.",
        - Include a definition of "Off-grid sanitation systems", to include on-site sanitation options such as Non-sewered Sanitation Systems (NSSS) and Decentralised Wastewater Treatment Systems (DWWTS),
        - Amend the definition of "On-site wastewater services" to clarify that on-site sanitation services can apply at a single household level or on a community scale. The latter may require a collection and transportation system of some type, but these do not part of a formalised municipal network. When water is used, conventional drainage systems (gravity sewers) and non-conventional drainage systems (settled sewage or simplified sewer systems) can be applicable,
        - Ensure that there is effective clarity and definition with regard the concepts of Non-sewered sanitation (NSS) and Decentralised Wastewater Treatment (DWWT) within the document. Currently there is no definition for DWWT:
            - Non-sewered sanitation (NSS) or Non-sewered sanitation system (NSSS), – keep definition as is:

        - "Non-sewered Sanitation (NSS) & Non-sewered Sanitation Systems (NSSS)" refers to a system that is not connected to a networked sewer, and collects, conveys, and fully treats the specific input to allow for safe reuse or disposal of the generated solid output or effluent,
    - Include a definition of "Decentralised Wastewater Treatment" (DWWT). The EPA definition in an adapted format could be considered, which contemplates both municipal and private ownership:
        - The definition of "Decentralised Wastewater Treatment" should clarify that it refers to various approaches for collection, treatment, and dispersal/reuse of wastewater for individual dwellings, industrial or institutional facilities, clusters of homes or businesses, and entire communities. They provide a range of treatment options from simple, passive treatment with soil dispersal, commonly referred to as septic or on-site systems, to more complex and mechanized approaches such as advanced treatment units that collect and treat waste from multiple buildings and discharge to either surface water or the soil. They are typically installed at or near the point where the wastewater is generated. These systems, when owned by the municipality, and or its contracted WSI, as a part of their permanent infrastructure, can be managed as stand-alone facilities or be integrated with centralised sewage treatment systems. These systems, when privately owned permanent infrastructure, will need to be managed as stand-alone facilities by the infrastructure owners, operating as a WSI with a Service Level Agreement with the municipality.

- Under Part A (Provision of Water Services), under "Basic sanitation service" (regulation 7)
    - Amend sub-regulations 7(6) and 7(7) to require the WSI to consider the use of such innovative or emerging solutions, instead of waterborne sewered systems, in areas of dense formal and medium settlement where there is resource scarcity and or inadequate capacity in the sewer system and or the WWTW, as follows:
        - Amend wording to include provision for "off-grid solutions, including on-site wastewater services, off-grid or non-sewered solutions" that use little or no water and involve on-site treatment of human waste, particularly in areas where there is inadequate capacity in the sewer and WWTW system,

- Add a statement, to either sub-regulation 7(6) or 7(7) that obliges Water Services Institutions

  to consider the use of such innovative or emerging solutions instead of waterborne sewered systems in areas of dense formal and medium settlement where there is resource scarcity and or inadequate capacity in the sewer system and or the WWTW.
- Clarify that new innovative off-grid sanitation systems must adhere to the requirements of the SANS 30500 for Non-Sewered Sanitation Systems or the "SANS 24521:2020 Guidelines for the management of basic on site domestic wastewater services", whichever is applicable, to allow for systems that drain an area through a sewered network, even if such network is limited, such as DWWT systems, (short to medium term options). Amend sub-regulation 7(8) to include that

  whenever a Water Services Institution is providing new innovative off-grid sanitation systems, such systems must adhere to the requirements of the SANS 30500 for Non-Sewered Sanitation Systems or the SANS 24521:2020 Guidelines for the management of basic on site domestic wastewater services, whichever is applicable.

- Under Part C (The Efficient and Sustainable Use of Water), after sub-regulation 15(7) which deals with the need for a Council approved WCWDM Strategy and Business Plan, include for two new sub-regulations relating to the efficient and sustainable use of water:

  Clause 15(8) that states that in water resource scarce or water services stressed areas, Water Service Authorities must require greenfield developments, such as sectional title/residential complexes and estates, including resort developments, or major brownfield redevelopments, prior to planning approval, to indicate the manner and extent to which WCWDM and WESS has been accommodated and accounted for in their selected technology options, in term of efficient water use and off-grid sanitation. Failure to do so may negatively impact on the approval by DWS for requests for increases in water use allocations requested by the WSA.

  Clause 15(9) that states that a municipality desirous to undertake a large scale development (greenfield or brownfield) need first to liaise with DWS and inform them of the envisaged specific water-use related aspects of the planned development. This should include information on the extent of development, quantity of erven and population served, planned volume of water use (demand), estimated volume alternative water resources available or generated (run-off & stormwater), reclamation potential and estimated volume (if applicable), estimated wastewater/effluent generated quality of effluent and application of the extent in which water efficient sanitation solutions (WESS) principles have been applied.

Note: The above changes immediately entrench water efficient sanitation into regulation, thus allowing DWS to enforce such consideration to unlocking bulk-related blocked projects at a regional and municipal level.

Other regulatory actions to further strengthen WESS are:

- Include similar requirements/changes in policy-related documentation (short to medium term options),
- Entrench water efficient sanitation solutions in DWS and non-DWS regulatory instruments, polices and guidelines (medium to long term options):
    - Through ensuring the necessary changes and or strengthening of sections within these instruments are undertaken,
    - By encouraging the review of existing SANS to ensure applicability to the SA environment (e.g. The SANS 10400-Part Q and or ISO 31800:2020 to allow for effective inclusion of the broader spectrum (non-pre-fabricated) of DWWT systems),
    - By driving recommended amendments to SANS 10400 and the NBR in terms of improving sanitation water efficiency measures,
    - By encouraging the development of additional, new regulatory instruments, such as SANS, to facilitate the implementation of WESS concepts (SANS 10400 Part XB (Efficient Water Usage in Buildings)),
    - By encouraging the development of WQ guidelines for non-potable uses, such as toilet and urinal flushing (non-closed loop), priming drain traps and even potentially cold water clothes washing, using the fuller spectrum of treated alternate water sources (including treated blackwater). These need to define acceptable reuse options, conditions, and discharge standards,
- Update current Model By-laws to encourage water efficiency (short to medium term options):
    - Include provisions for water efficient fittings and equipment, potentially identifying a range of water efficient option, e.g. low-flush, ultra-flush to pour-flush, etc. (short to medium term options),
    - Adopt good practices from municipalities, such as CoCT & EWS, into nation-wide By-laws, (short to medium term options),
    - Similarly revise these guideline models on a 5-year basis for such inclusions (long term ongoing options).

5.2.2 Changes to: Incentive-based Regulation

5.2.2.1 Short to medium term option: Incentivising WESS through the Blue/Green Drop assessments

Water services institutions are not sufficiently acquainted with the concepts of WESS as a means to unlock or facilitate services extension and bulk-related blocked projects. Municipalities and their providers need to acknowledge and quantify constraints to current municipal network and WWTW capacity, functionality and resource availability. This becomes even more critical for a municipality which faces immediate water resource constraints and/or under-capacitated or dysfunctional

infrastructure, compounded by the lack of By-laws, processes, systems and policy that consider alternative services options. In such cases, major redevelopment of brownfield areas and/or development of greenfield developments is halted without considering the negative impact on housing, access to services, job creation and overall SDG objectives.

The DWS's incentive-based Blue and Green Drop (BD/GD) assessment process is known for its ability to incentivise progress and performance, whilst collecting credible information pertaining to the municipal state and quantum of water and wastewater services. This same process presents a non-complex opportunity to extend its criteria to facilitate WESS as part of the audit by considering the following:

- Create an audit check under 'System Capacity' to confirm the status of the system pertaining to:
  - The existing municipal network, where this aspect can be linked and strengthened in the BD/GD and the Assessors comment related to O&M, repairs and breaks, reservoir conditions, etc.:
    - Stressed in terms of capacity (maintenance or operational-related causes – the TSA assessment will also provide an indication of how the sewer networks, pumpstations and reservoir sites are being managed) if it scores >90%,
    - Dysfunctional in terms of capacity (maintenance or operational-related causes) if it scores >100%,
  - The existing municipal treatment works is an existing audit check, but can be linked to the process where a WUL application is appraised by the DWS office:
    - Stressed in terms of capacity (maintenance or operational-related causes) if it scores >90%,
    - Dysfunctional in terms of capacity (maintenance or operational-related causes) if it scores >100%,
- Under water conservation and water demand management (WCDM) an audit check needs to be created to confirm the status of the water supply system in terms of:
  - Falling within a water resource stressed area (Yes or No)
- Under Bonuses, create an incentive for the WSA/WSP to score positively if:
  - The By-Laws audit sub-criteria allow for "off-grid sanitation solutions", including on-site wastewater services, off-grid or non-sewered solutions that use little or no water and involve on-site treatment of human waste (WESS)
- New or future bonus points could be created for concepts such as:
  - A municipal policy which requires greenfield developments (e.g. such as sectional title/residential complexes/housing estates and resort developments, prior to planning approval and in term of efficient water use and off-grid sanitation, to indicate the manner and extent in which WCWDM has been accommodated and accounted for in their selected technology options, and/or,

- A municipal policy/Standard Procedure/Good Practice for approval of municipal building plans where WESS is considered or in terms of pre-approved technologies (e.g. package plants or on-site systems), including processes aimed at fast tracking such cases for building plan approval/support ito WULA.

5.2.2.2 Longer term option: Water Efficiency Labelling and Standards (WELS) rating system

In addition to the recommended changes to the NRB, the enactment of a Water Efficiency Labelling and Standards (WELS) rating system for water efficient appliances and fixtures would strengthen a case for WESS. This may require either an individualised standard, similar to the "Australian Standard 6400:2016 Water efficient products – rating and labelling", or the concept of WELS can be incorporated into the recommended SANS 10400- Part XB Efficient water usage in buildings. Three criteria are proposed to allow for rapid development and rollout:

- Testing,
- Rating, and
- Labelling products and display of star rating (water consumption, flow rates)

5.2.3 Changes to: Water Use Licence/Authorisation

Historically, many projects have been deferred (blocked) until such time that new infrastructure capacity has been ensured, after which the standard development technicalities, bulk levy contributions and connection processes follow. By requiring WSIs to recognise and quantify their infrastructure baseline (capacity, functionality and resource availability) ahead of development applications, municipalities would be better equipped to make decisions pertaining to extending services OR offering a process to apply for alternative services options for brownfield or greenfield developments. A stronger national focus on WESS in regulation will enable constrained municipalities to engage proactively with private investors and developers in terms of:

- Water resource management, prove effective water efficient and WCDM practices within their design,
- Sanitation, offer water efficient or next-generation toilet designs, establish decentralised, on-site wastewater management within a responsible environmental framework, and
- Put monitoring and evaluation (M&E) and reporting mechanisms in place for the agreed service.

In the event of the developer undertaking their own on-site wastewater management, the National Water Act provides for either a GA or a WUL. Although the National Water Act provides sufficient detail and short turnaround times pertaining to such applications, the reality on the ground is somewhat different and becomes one of the obstacles to roll out alternative water and sanitation solutions.

5.2.3.1 Short term changes to the current WUL process

Changes to the current WUL process will be necessary to facilitate the unlocking of bulk-related blocked projects at a regional and municipal level. Most of these changes will relate to:

- Ensuring that the WSI can confirm the situation relating to their sewer network and wastewater treatment operational capacity,
- Having the WSI confirm that the WUL applicant's selected option supports their water and sanitation situation and is the most appropriate under the circumstances,
- Having the WUL applicant prove effective water efficient and WCDM practices within their design, and/or
- Having the WUL applicant prove their selected sanitation option is a water efficient sanitation solution,
- The need to ensure that the developer, or the long term operational/management body, sign a Service Level Agreement with the WSA as a water service intermediary (operating as WSP), confirming the system specific conditions or criteria of required for compliant service provision.

The above requirements can immediately be initiated during the pre-application meeting between the applicant and the regional DWS WUL official. The most crucial changes to the WUL process include:

- Either on the DWS WUL form create a facility, or by means of a motivation letter of support accompanying the WUL application, require that the WSI confirms the following:
    - If the system is in a water resource stressed area, as identified in consultation with DWS or as per the revised BD or GD assessment response/process, or other means,
    - If the existing network and treatment works is considered stressed or dysfunctional as per the revised BD or GD assessment or other means:
        - If the WSI confirms a stressed sewer network and stressed WWTW, require the WSI to comment regarding the proposed infrastructure impact on their system,
    - WSI's support as to the appropriateness of the selected options in terms of treatment process and disposal methods in relation to the existing network and or treatment works,
- Require WUL applicants (as part of their Technical Report which accompanies the WULA) to:
    - Provide comment, specifically in resource- or network and treatment infrastructure stressed areas, regarding the proposed infrastructure's impact on either the stressed sewer network and/or stressed WWTW and to motivate/prove their case for water efficient solutions being utilised in their design and treatment process,
    - Motivate the appropriateness of the selected treatment and disposal options relating to the environmental impact, and why the proposed/existing option was chosen.
    - The "Technical Report" needs to motivate the appropriateness of the selected sanitation treatment options in terms of:

        - Infrastructure impact on the available sewer network and WWTW – needing to connect or go off-grid in the case of a stressed sewer network and or stressed WWTW,
        - Treatment process and disposal methods with respect to the environment and environmental impacts,
        - Alternative options of treatment and disposal investigated, and
        - Why the proposed/existing option was chosen (affordability by user, skill, O&M, energy, etc.),
        - What the expected water, effluent, sludge quality would be.

It is envisaged that situation could arise where some large scale developments may be unable to receive a municipal water services connection and may also unable to get the necessary WUL support from the WSA to use an acceptable alternative WESS systems (i.e. off-grid, decentralised or on-site). The latter could be due to a lack of understanding or reluctance for such alternative wastewater systems by the municipality.

- DWS need to provide recourse for such developers to directly approach them to discuss and confirm ways in which they could still apply for the necessary WUL. In identifying the recourse DWS may need to ensure additional operational criteria as part of the licence, e.g. a SLA between DWS and the developer, agreement to be participate and comply with the BD/GD regulatory assessment process as well as ensuring compliance with aspects such as providing monthly report back via the IRIS system.

5.2.3.2 Medium term changes to the current WUL process

- Amend WUL guideline instruments to align with recommended changes for WESS, such as the "Aide Memoir", specifically pertaining to Section Part 7.6: Management Systems and Pollution Prevention Methods,
- Entrench the concept of WSIs needing to know their catchment and system status, and bring it in as a standard/general clause in all WUL forms, by creating a log facility that require the WSI to confirm the following:
    - If their system is part of a water resource stressed area (Yes or No) – this provides an indication (e.g. to DWS official) if there is a need to specifically ensure inclusion of WESS. If ticked as "yes" and there is no "WESS info" included, the application form should be declined from going further,
    - If their existing network and or treatment works, is considered stressed or dysfunctional, it is recommended that the revised BD or GD score (as mentioned in Section 4.3.2) – (short to medium term options),
        - If the WSI confirms a stressed sewer network and stressed WWTW, require the WSI to comment regarding the proposed infrastructure impact on their system,
    - Support as to the appropriateness of the selected options regarding treatment process and disposal methods and their impact on the existing network and or

treatment works (Yes or No), where “appropriateness” is defined by the municipality as guided by technology guidelines, Agrément certification, etc. The WSI needs to consider the appropriateness of the option selected by the WULA applicant, be it for a connection to their network or use of technology, e.g. avoid leading to more stresses. This allows for both waterborne and off-grid/on-site options to be supported but does require the WSI to take cognisance of the impact for record purposes.

- DWS need to consider the facts from the field, being that few to none of the existing WWTWs or package plants meet the stricter GA or irrigation standards, and thus consider implementing a special GA with reduced effluent quality standards by relaxation of specific effluent parameter limits. These limits could be considered for non-stressed catchments, or for technologies where the pollution impact is limited, or where the Water Resource Quality Objectives support reasonable contributions.

5.3 Changes to: SANS 10400 (National Building Regulations)

Changes to the SANS 10400 (National Building Regulations) to strengthen WESS include:

5.3.1 Revising SANS 10400-Part Q

The SANS 10400-Part Q deals with the sanitary waste, healthy handling, and treatment of effluent when there is no water-borne sewage system available in a particular area. It does not make provision for a DWWT system, although to a certain extent DWWT systems are considered in legislation ito ISO 31800:2020, but only for pre-fabricated systems. DWS, in conjunction with SABS, will need to confirm the most appropriate standard to allow for effective inclusion of the broader spectrum of DWWT systems.

This SANS needs to be amended to include cross reference to the relevant SANS which caters for decentralised wastewater treatment systems, either a SANS 31800 or similar standard.

5.3.2 New part: SANS 10400 Part XB (Efficient Water Usage in Buildings)

Water efficient toilets, including low flush toilets, need to be considered in regulation. Similar to SANS 10400- XA which looks at Energy Usage in Buildings, the concept of encouraging water efficiency in buildings (including flushing systems) should form a separate and additional part to Part X, e.g. Part XB. As such, there is a need for a “SANS 10400 Part XB – Efficient Water Usage In Buildings” to encourage and entrench water efficiency in buildings, including aspects such as water efficient flushing systems and toilet systems (Merwe-Botha & Quilling, 2023). These regulations can then be further defined by either updating the existing SANS, or by providing additional SANS.

It is recommended that the SANS 10400 (National Building Regulations) as a whole be revisited, due to the changes required for water efficient toilets and DWWT ito 10400-Part Q and for a new “Part XB

Efficient Water Usage in Buildings", to entrench the concept of encouraging water efficiency in buildings (including flushing systems).

5.4 Punitive or ameliorating measures around WESS enforcement

The study did not focus on developing or describing punitive measures relating to the failure of enacting WESS at a municipal development level, but rather focussed on entrenching and where necessary compelling WSAs, WSPs & WSIs (including greenfield developers as WSI operating as WSP), to:

- "Conserve water" and achieve efficient water use through off-grid measures or using water saving devices, water-efficient processes (recycling), etc.,
- Ensure that planned developments will not form part of a stressed or dysfunctional existing water service,
- Investigate and prove, prior to opting for a connection to a waterborne system, that an "off-grid" sanitation options would be non-viable, more onerous/hazardous to the WSA and/or the environment before motivating.

With WESS entrenched in regulation through the recommended changes (e.g. in the Norms & Standards, WUL process & incentive-based regulation), the existing punitive measures, applicable to non-compliance to these regulation, as identified through legislation, may prove to be adequate. Should DWS wish to develop stronger and more specific non-compliance orientated punitive measures, it is recommended that they utilise legal specialists for such specificality in terms of developing the necessary legal punitive actions for non-compliance with WESS.

Some measures to encourage compliance with WESS could include the following:

- WUL process: Disallow any furthering of a WUL application in the event of either:
    - The municipality failing to confirm their situation relating to their sewer network and wastewater treatment operational capacity, the impact of the planned system and that the WUL applicant's selected option supports their water and sanitation situation and is the most appropriate under the circumstances. (motivation letter or letter of support by WSI)
    - The applicant fails to proof WESS inclusion in the design and implementation of the planned system. (Technical report show casing the required confirmation criteria within).
- Section 19 of the WSA (Act 108 of 1997) allows for the requirement and prescription of a Service Level Agreement contracts between a WSA and WSP (including private developer operating as WSP).
    - Disallow any furthering of a WUL application if a SLA is not considered and maintain such standing until such time as it is included as part of the WULA. DWS will need to ensure that the model SLA make provision in terms of clearly defining roles and responsibilities, measurable KPIs and have adequate safeguards for the WSA, consumers and the WSP in the event of mismanagement by the various parties.

6 LEGAL REVIEW OF THE REGULATIONS AND ITS IMPLICATIONS

A high level legal review was conducted on the options and recommendations proposed by the research team in the Synthesis Report (Chapter 5) to assess if they are legally correct, practical and executable. The review was undertaken by an attorney specialising in public sector law. The review outcomes indicated the following:

- The recommended options as described in the Synthesis Report were assessed under a high level legal review to identify any apparent conflicts with existing relevant water sectoral or municipal legislation.
- The high level legal review concluded that the recommended options appear to be executable within the existing legislative framework.
- The high level legal review has not identified any legislative conflict between the recommended options and existing relevant water sectoral or municipal legislation.

Key Findings:

- Wording of the proposed change to the 2024 N&S document (DWS, 2024) provides a description of what the recommended change must achieve. The final wording of any changes to the N&S need to be carefully drafted as it will be legislative drafting.
- A legislative drafting expert must be involved in legislative drafting.
- The 2024 N&S does not mention the repeal of the 2017 N&S. DWS needs to confirm if the 2017 N&S document was formally promulgated under the WSA (108 of 1997). If not, then it does not have to be 'repealed'. With the promulgation of the 2024 N&S, it will automatically supersede the 2017 N&S. It is noted that the 2024 N&S will repeal the 'Compulsory National Standards and Measures to Conserve Water', issued in June 2001, and are still in force (see Regulation 26 of the 2024 N&S) (DWS, 2024).
- Proposed changes to N&S at Part C – the recommended option of wording relates to obliging the developer to notify the WSA about water conservation measures, etc. Caution will need to be applied with the final wording to ensure that it would not appear that DWS is dictating to a municipality when it can/cannot approve plans in its capacity as planning authority.

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Appendixes

A1: Relevant South African policies and regulations

- Proposed Compulsory National Water and Sanitation Services Norms and Standards
- Part 3 (Emergency Housing Programme) of The National Housing Code, Volume 4 (Department of Human Settlement (2009)
- Guidelines for Greywater Use and Management in South Africa, Water Research Commission Report No. TT 746/17, March 2018
- Wastewater Risk Abatement Plan, a W_2RAP Guideline, Water Research Commission Report TT 489/11, June 2011
- Guideline for the Preparation of an IWA Water Balance to Determine Non-Revenue Water and Water Losses (Department of Water and Sanitation 2014)
- Water-Borne Sanitation Operations and Maintenance Guide, Water Research Commission Report TT 482/11, March 2011
- Maintenance Management Standard for Immovable Assets May 2017 (www.publicworks.gov.za)
- Water Services Infrastructure Asset Management Strategy (Department of Water and Sanitation 2011)
- Self-Regulation of the Package Plant/SWWTW Industry Volume 1 (Report No.TT 620/14) and Volume 2 (Report No. TT 621/14)
- National Norms and Standards for Domestic Water and Sanitation Services (Ver3, 2017)
- Guidelines for Compulsory National Standards and Norms and Standards for Water Services Tariffs
- Hazardous Biological Agents Regulations (2001)
- Draft Regulation 813 of 23 October 2013 or Regulation of 2834 27 December 1985
- National Sanitation Policy (2016)
- National Water Act (36 of 1998)
- Draft National Water Resources Strategy Edition Three (NWRS-3 2022)
- Water Services Act (108 of 1997)
- National Road Traffic Act (93 of 1996)
- National Environmental Management Act (107 of 1998)
    - GNR 326 EIA Regulations (7 April 2017)
    - GNR 327 Listing Notice 1 (7 April 2017)
    - GNR 325 Listing Notice 2 (7 April 2017)
    - GNR 324 Listing Notice 3 (7 April 2017)
- SANS 10140- 3:2003; SANS 1186-1:2008; SANS 10400-S:2011; SANS 30500:2019; AND SANS 1808-15:2020

Electronic copies of the following documents published by DWS, can be found, and downloaded from https://ws.dws.gov.za/iris/documents.aspx)

A2: ANSI Sanitation Standards

https://sanitation.ansi.org/

American National Standards Institute (ANSI)

Household Non-sewered Sanitation System Standard

- ISO 30500 Standard:
  Non-sewered sanitation systems – Prefabricated integrated treatment units – General safety and performance requirements for design and testing

Community Scale Resource Oriented Sanitation Treatment Systems Standard

- ISO 31800:2020
  Faecal sludge treatment units – Energy independent, prefabricated, community-scale, resource recovery units – Safety and performance requirements

Faecal Sludge Management Standards: (Activities related to drinking water and wastewater services)

- ISO 24521
  Guidelines for the management of basic on-site domestic wastewater services
- ISO 24510
  Activities relating to drinking water and wastewater services – Guidelines for the assessment and for the improvement of the service to users
- ISO 24511
  Guidelines for the management of wastewater utilities and for the assessment of wastewater services

A3: Japan's PAWTP Law (DEWATS management)

Critical points relating to DEWATS or PAWTPs: (Hashimoto, 2019)

- "Ensure Good Performance of Decentralised Wastewater Treatment Plants:
  In Japan, decentralised wastewater treatment plants are standardised. Legally, the PAWTP is the only standard decentralised wastewater treatment plant in Japan. A corporate body that intends to manufacture PAWTPs must receive government approval, which is issued when these proposed plants meets the prescribed design standard. If a manufacturer intends to manufacture a new, non-standardised type of PAWTP, it must be evaluated by a designated institution."
- Ensure Proper Installation of Decentralised Wastewater Treatment Plants
  In Japan, those building a new house or building must submit a certification application prior to the start of construction to the municipality and seek confirmation by the district construction surveyor deployed by the municipality. Usually, this application is made by the house building company on behalf of the house owner. To the building certification application, the type of PAWTP to be installed, together with a copy of the government approval letter, must be attached. If these are satisfactory, the district construction surveyor issues a building permit.

PAWTP installation businesses are subject to registration with the prefectural governor that has jurisdiction over the area where they intend to conduct business, and they must assign an installation worker certified by the Japan Education Center for Environmental Sanitation in each place of business.

- Ensure Proper Sludge Management, Indispensable for Decentralised Wastewater Management:
  As mentioned previously, the owner or user of a PAWTP installed in a house or building is, under the PAWTP Law, designated as the "PAWTP (Johkasou) Manager". The Law mandates these managers to desludged their PAWTP once a year, work that can be entrusted to a PAWTP Desludging Vendor.
- Regulate Desludging Vendors to Ensure Proper Operations while Providing Job Opportunities and Social Status
  All the PAWTP desludging businesses in Japan need to obtain the approval of the local mayor. This approval may be for a limited period and is issued if the desludging equipment and the applicant capability conform to the standards prescribed by the Ministry of the Environment (MOE). The applicant must also show no record of violating the PAWTP Law during the 2 years preceding the application.
  In order to protect the desludging workers from the anticipated unemployment because of the diffusion of sewerage systems, municipalities are obligated to support their job transfer according to the Act on Special Measures Concerning Streamlining of Domestic Waste Disposal Business incidental to Improvement of Sewerage (1975).
- Ensure Proper Operation and Maintenance of Decentralised Wastewater Treatment Systems for Commercial Buildings
  The PAWTP Law requires adherence to the maintenance frequency specified by the MOE, which is once every 4 months for small-scale PAWTPs (e.g. a household type), and more frequently for medium- and large-scale PAWTPs, according to the type of treatment process. For example, in case of activated sludge treatment processes, the required frequency is once a week, while for the contact aeration process with screen and flow equalisation chambers or flow equalisation tanks, the required frequency is every two weeks.

A4: UK Sanitation Standards

Small Sewage Treatment Plants: BS EN12566
Capacity Dependent Upon Requirements
Please note: When installing a new sewage treatment plant, you must check with "British Water Flows and Loads 4 guidance" to ensure that it meets sizing requirements. Your treatment system must be able to handle the largest amount of sewage that it will need to treat.

Regulating Agencies
For England and Wales, visit the Environment Agency's and Natural Resources Wales' website to read the General binding rules: small sewage discharge to a surface water.

Different rules apply for Northern Ireland and Scotland, check with the following authorities for further details: the Scottish Environment Protection Agency or Department of Agriculture, Environment and Rural Affairs if your property is located in Northern Ireland.

For small sewage treatment plants, the standard is BS EN12566. This standard consists of seven main parts:

- Part 1: Prefabricated septic tanks – requirements and best practices for these units.
- Part 2: Soil infiltration systems – discusses the design parameters, building specifications and implementation.
- Type 3: Packaged and/or assembled domestic sewage treatment plants – the requisites and testing techniques used to gauge packaged sewage treatment plants that are necessary to treat sewage to the required quality.
- Part 4: Septic tanks assembled in situ from prefabricated kits – the standards and measurement sizes, including resistance to water leaks, pipe dimensions and grading of conformity.
- Part 5: Pre-treated effluent filtration systems – a guide discussing design parameters, building information and component requisites for treating effluent.
- Type 6: Prefabricated treatment units for septic tank effluent – the requirements, testing practices and grading of conformity for prefabricated secondary treatment units.
- Part 7: Prefabricated tertiary treatment units – the requirements, testing practices and grading of conformity for a packaged and/or site assembled tertiary treatment unit.

Additional Rule

Additional rules for systems installed and in use on or after January 1, 2015 -These regulations apply to if: activity was started a new discharge from a small sewage treatment plant on or after January 1, 2015, or had a discharge to the ground before January 1, 2015, which now needs to change to discharge to surface water (or the other way around):

- Public sewers
- Planning approval
- Sensitive areas
- Surface water flow
- Partial drainage fields (For drainage fields, the standard is BS 6297:2007)