

WATER RESEARCH COMMISSION

C O R P O R A T E P L A N

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WATER  
RESEARCH  
COMMISSION



## VISION

To have highly informed water decision-making through science and technology at all levels, in all stakeholder groups, and innovative water solutions through research and development for South Africa, Africa and the world.



## MISSION

To be a global water knowledge node and South Africa's premier water knowledge hub active across the Innovation Value Chain that:

- Informs policy and decision making;
- Creates new products, innovation and services for socio-economic development;
- Develops human capital in the water science sector;
- Empowers communities and reduces poverty;
- Supports the national transformation and redress project; and
- Develops sustainable solutions and deepens water research and development in South Africa, Africa and the developing world.



## VALUES

- A culture of learning and sharing
- Innovation and creativity
- Integrity and fairness
- A spirit of professionalism and service orientation
- Facilitating empowerment and social change
- Good governance



## [ Official Sign-off ]

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**It is hereby certified that this Corporate Plan:**

1. Was developed by the Water Research Commission under the guidance of the Water Research Commission Board
2. Takes into account all the relevant policies, legislation and other mandates for which the Water Research Commission is responsible
3. Accurately reflects the strategic outcome-oriented goals and objectives which the Water Research Commission will endeavour to achieve over the period 2018/19 – 2022/23



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Chief Executive Officer



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Chairperson of the WRC Board



# [ Table of Contents ]

Official Sign-off.....	i
List of Acronyms .....	iv
Executive Summary.....	1
<b>Part A: Strategic Overview.....</b>	<b>2</b>
<b>1 Introduction .....</b>	<b>3</b>
<b>2 Legislative and Other Mandates.....</b>	<b>6</b>
2.1 Constitutional Mandate.....	6
2.2 Legislative Mandate.....	6
2.3 Policy mandates .....	7
<b>3 Alignment of WRC Strategy and Activities.....</b>	<b>8</b>
3.1 National Water Resource Strategy 2 (NWRS-2).....	8
3.2 Contributing Towards Achieving Government Outcomes and National Development Plan (NDP) Objectives.....	8
3.3 Alignment with DWS Strategic Objectives and National Water & Sanitation Master Plan .....	10
3.4 Alignment with Millennium Development Goals and Sustainable Development Goals.....	12
<b>4 Situational Analysis .....</b>	<b>16</b>
4.1 Performance Environment .....	16
4.2 Organisational Environment.....	16
4.3 Description of the WRC's Corporate Planning Process .....	18
<b>5 Strategic Outcome-Oriented Goals of the Institution – The WRC's Knowledge Tree .....</b>	<b>19</b>



<b>Part B: Strategic Emphases</b> .....	<b>25</b>
<b>6 Research and Development</b> .....	<b>27</b>
6.1 Introduction.....	27
6.2 Scope.....	28
6.3 Priorities for R&D .....	29
<b>7 Key Strategic Area (KSA) Strategic Objectives</b> .....	<b>32</b>
7.1 Water Resources and Ecosystems .....	32
7.2 Water Use and Waste Management .....	35
7.3 Water Utilisation in Agriculture.....	36
<b>8 The WRC Lighthouses</b> .....	<b>40</b>
8.1 Climate Change .....	40
8.2 The Green Village And Economy Lighthouse (GV&E) .....	43
8.3 Water–Energy–Food Nexus .....	46
8.4 Water Sensitive Design .....	48
8.5 Water Quality and Health.....	49
8.6 Water ICT .....	51
8.7 Sustainable Water Behaviours .....	52
8.8 Water and Big Data.....	54
8.9 Water Scarcity and Extreme Weather Events .....	56
<b>9 Innovation and Impact</b> .....	<b>58</b>
9.1 Introduction.....	58
9.2 Knowledge Services .....	62
9.3 Marketing and Communication .....	65
9.4 Innovation and Business Development .....	69
<b>10 International Cooperation and Partnerships</b> .....	<b>77</b>
10.1 The 5-Year Framework.....	77
<b>11 Finance</b> .....	<b>80</b>
11.1 Executive Overview.....	80
11.2 SCM and Finance Planning Focus to support the WRC Strategy during CP18.....	80
<b>12 Corporate Services</b> .....	<b>83</b>
12.1 Introduction.....	83
12.2 Information Technology .....	84
12.3 Corporate Social Responsibility .....	86
12.4 Human Resources .....	90
12.5 Facilities .....	91
<b>13 Risk Management</b> .....	<b>93</b>
<b>14 Budget</b> .....	<b>94</b>
14.1 Budgets for 2018/19 to 2022/23.....	94
<b>Appendix 1: Key Performance Indicators Multi-Year Performance Plan</b> .....	<b>98</b>
<b>Appendix 2: Projects Initiated in 2018</b> .....	<b>102</b>
<b>Appendix 3: Materiality Framework in terms of Treasury Regulation 28.3.1</b> .....	<b>109</b>
<b>Appendix 4: WRC Risk Register</b> .....	<b>112</b>

## [ List of Acronyms ]

<b>BD&amp;I</b>	Business Development & Innovation
<b>CEO</b>	Chief Executive Officer
<b>CoGTA</b>	Cooperative Governance & Traditional Affairs
<b>CMA</b>	catchment management agency
<b>CP17</b>	WRC Corporate Plan 2017/18 – 2021/22
<b>CP18</b>	WRC Corporate Plan 2018/19 – 2022/23
<b>DAFF</b>	Department of Agriculture, Forestry and Fisheries
<b>DEA</b>	Department of Environmental Affairs
<b>DHS</b>	Department of Human Settlements
<b>DIRCO</b>	Department of International Relations and Cooperation
<b>DoH</b>	Department of Health
<b>DMR</b>	Department of Mineral Resources
<b>DRDLR</b>	Department of Rural Development and Land Reform
<b>DST</b>	Department of Science and Technology
<b>DTI</b>	Department of Trade and Industry
<b>DWS</b>	Department of Water and Sanitation
<b>GDP</b>	gross domestic product
<b>GWRC</b>	Global Water Research Coalition
<b>HCD</b>	human capital development
<b>HEI</b>	higher education institution
<b>ICD</b>	Institute for Communicable Diseases
<b>ICT</b>	Information & communications technology
<b>I&amp;I</b>	Innovation & Impact
<b>IP</b>	intellectual property
<b>IWRM</b>	integrated water resource management
<b>KSA</b>	Key Strategic Area
<b>MDG</b>	Millennium Development Goal
<b>MRC</b>	Medical Research Council
<b>NDP</b>	National Development Plan
<b>NHLS</b>	National Health Laboratory Services
<b>NWRS</b>	National Water Resource Strategy
<b>O&amp;M</b>	Operations & maintenance
<b>PDI</b>	previously disadvantaged individual
<b>R&amp;D</b>	research and development
<b>RDI</b>	research, development and innovation
<b>RPS</b>	Research Policy and Strategy Committee
<b>SADC</b>	Southern African Development Community
<b>SALGA</b>	South African Local Government Association
<b>SANBI</b>	South African National Biodiversity Institute
<b>SDG</b>	Sustainable Development Goal
<b>S&amp;T</b>	science and technology
<b>TIA</b>	Technology Innovation Agency
<b>WEF</b>	Water–energy–food
<b>WIN-SA</b>	Water Information Network South Africa
<b>WRA</b>	Water Research Act
<b>WRC</b>	Water Research Commission
<b>WSD</b>	Water sensitive design
<b>WSA</b>	water services authorities
<b>WSP</b>	water services providers
<b>WWF</b>	Worldwide Fund for Nature

# [ Executive Summary ]

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**The world as we know it is changing. The Water Research Commission's Corporate Plan 2018/19–2022/23 (CP18) has been developed with a strategy that adapts to the 'new normal', conditions at the end of the most recent El Niño event – globally the worst in 20 years and which plunged North America, Africa and Asia into some of the most challenging dry conditions in recent times, and South America into some of its most devastating floods.**

The World Economic Forum 2017 Global Risk Report shows, over the past decade, a cluster of environment-related risks, especially extreme weather events, failure of climate change mitigation and adaptation as well as the water crisis that has emerged as a consistent risk in the portfolio of global risks. These are interconnected with many other risks; however, the environmental concerns are more significant as the risks in this category have been assessed as being 'above average', in terms of both their impact and likelihood to occur.

In South Africa, we steadily, but very slowly, ease out of drought, with the Western Cape struggling through what has been called its worst drought in 100 years, and this also reflects the Southern Africa picture. At the same time South Africa has shown changing weather patterns with this part of the world becoming steadily drier over the past 20 to 50 years with milder wet seasons and increasingly severe dry seasons. The world had its hottest year in 2015, a few of its hottest months ever in 2016, and a continuing warming trend in 2017.

While this has been the pattern for the past decade globally and for the past three decades in Southern Africa, the public discourse is still that of waiting to return to a more familiar time. It is time to consider this as the 'new normal'. The best science we have available to us in the form of weather and climate prediction says that this is either the new normal – or a very long period of transition to a different weather and climate pattern, that may be even harsher on the back of global climate change.

## Adaptation to the 'new normal'

CP18 is textured in a solution-oriented vector and does not consolidate the data and information to mourn the new normal, but to work out a range of interventions to enable a sustainable development pathway in the new normal. This is characterised as follows;

- A new research agenda and a new way of doing that research, not just inter-sectorally and in a transdisciplinary manner, but predominantly in partnership with the practitioner and user communities.
- Bringing together the little pockets of knowledge and solutions in different parts of the world for greater impact through smart and generous international collaboration.
- Re-visiting the regulatory environment and current infrastructure paradigm.
- A strategy that enables sustainable development and ensuring universal access to basic services in the new normal will be characterised by creativity, innovation and a system amenable to dynamic adaptation and improvement.
- An internal strategy that adapts to a new normal by straddling the fine line between what has traditionally worked and what will work in the future, based on the needs, strengths and mind-set of the current and future workforce. Each new generation is progressively more Internet- and technology-focused, and more social-responsibility focused. With this in mind the world of work focuses on human resources, information technology, governance and facilities in an integrated approach. This approach will ensure that the WRC will move to the next level in terms of business success and employee satisfaction.
- An interactive, multidirectional exchange of knowledge and ideas that is reflected in the research dissemination approach.
- A financial strategy that creates an agile income stream and sound financial reporting and compliance.

The effective and sustainable management of the country's limited water resources is essential for community health, development and cohesion, as well as continued economic activity. Research and development, along with innovation, has long since been recognised by Government as holding the key towards ensuring a water-secure future for the country.





# PART A

## STRATEGIC OVERVIEW



# [ 1. Introduction ]

Access to sufficient water and adequate sanitation of an appropriate quality is necessary for life, human dignity, economic growth and for social development. This underpins the wellbeing and prosperity of South Africa and all of its people. For the South African water science community, the challenges are clear – translating research, development and innovation (RDI) into real solutions to address poverty, inequality and unemployment, while applying knowledge solutions to advance opportunities to enable economic growth, improve competitiveness and ensure prosperity.

The four core principles of the WRC's strategy focus on:

**1. Paradigm** | **2. Partnership** | **3. Positioning** | **4. People**



## PARADIGM

- Impact orientation (Knowledge Tree)
- Development focus (R d <-> r D)
- Narrowing the implementation journey
- Multiplier effect

The WRC has conducted water research for more than 45 years and many research outputs have been produced throughout those years. The WRC model of dissemination was to produce research and transfer knowledge to academics and practitioners, who would then convert the knowledge into solutions. However, this linear approach does not achieve the level of impact that is required in changing sector with severe water, skills and infrastructure challenges. National policies also call for knowledge and solutions to be accelerated to the communities.

A paradigm switch is thus, required to take research outputs into outcomes and impact for the broader society. Hence, the WRC has re-orientated its strategy to focus on impact using the knowledge tree objectives, shifted R&D to a Development focus in order to narrowing the implementation pathway by accelerating solutions to the market and enhancing uptake. The WRC has invested in partnership building to achieve these objectives and the multi-plier effect.



## PARTNERSHIP

- Across stakeholder groups
- Public and private
- Local and international
- Funding
- Implementation
- Development
- Research

The WRC is a small lever that turns many big wheels due to its mandate, flexibility and agility in the sector. This is a unique national role which no other organisation in water science and technology sector plays in South Africa.

The WRC continues to develop expert partnerships in the science and development space and has strengthened its efforts to build sustainable and beneficial relationships with strategic traditional and non-traditional partners to complement the WRC mandate on either side of the value chain for strategic water sector and societal impacts.

The WRC strategy is re-enforced with a business development focus to ensure projects can be scaled up with implementation partners for greater uptake and diffusion. Finally, a new emphasis has been placed on enhancing international partnerships.



## POSITIONING

- Relationship with Executing Authority and DWS
- Recognition as key development player
- Leadership in Science and Innovation landscape
- Water sector leadership
- Increasingly important partner in the international sphere

The WRC is positioned as the premier water knowledge hub in South Africa, and a strategic water hub partner to Africa and the globe.

As a knowledge hub it positions itself to provide knowledge and technology exchange to as many stakeholders and water sector partners. It is also aligned to national policies and therefore, is a key development partner to the sector and in terms of human capital development within the science and technology space.

Our position as the WRC both nationally and internationally is more meaningful when there is a strong relationship with Executive Authority and the Department of Water and Sanitation.



## PEOPLE

- Transforming and expanding the water R&D community
- Growing the new W&S cohort
- Building the youth cadres
- Community practitioners and entrepreneurs
- WRC leadership development
- Gender and youth foci

At the heart of the WRC strategy is people. Three of the 6 knowledge tree objectives are linked to growing and empowering both the science community through the development of students, researchers, entrepreneurs and innovators as well as the sector practitioners and society through the generation of new knowledge, products and services. The WRC will use its programmes and instruments to improve people's lives. This will be advanced by supporting transformation and expanding the water research and innovation community.

The WRC is making stride in growing the new Water and Sanitation cohort working in water and sanitation research and innovation. This will involve having more women and youth leading projects and participating in the WRC projects. To stimulate economic growth and development, the WRC continues to support SMMEs and entrepreneurship that operates in water and sanitation areas and innovation development for the creation of new products and services for new business development and an enhanced competitive edge.



The four core principles of the strategy are implemented through the following instruments:



### The WRC Knowledge Tree

This is an investment in the multiplier effect which aims to inform policy and decision-making, contribute to sustainable development solutions, develop products and services for the economy, actively contribute to human capital development, directly empower communities, and enable the national transformation project. Secondly, it speaks to the continuous improvement of a programmatic approach to choose a significant proportion of new projects in each funding cycle that build on the knowledge base of existing and previous funding cycles.



### Community involvement in the research which further diversifies the research philosophy

This moves the WRC from the classical independent-observer scientific approach to an action-research paradigm. This entails the broadening of our research scope to one that actively involves communities in the research project, and engages key partners to upscale and also maintain interventions post-project.



### The WRC Lighthouses

This is the concentration of research for accelerated knowledge and solution development. These are trans-disciplinary, multi-branch and inter-institutional mega-projects (platforms) that will examine priority water issues across the innovation value chain.



### Innovation and impact

The WRC will pursue elevations in several key impact areas through, among others, technology scanning, reverse engineering, and the pursuit of ready-to-use solutions in a plug-and-play mode.





## [ 2. Legislative and other mandates ]

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The WRC serves as the research and development partner of the sector leader, the Department of Water and Sanitation (DWS), and provides the sector with knowledge and capacity to ensure sustainable management of water resources and enhance water services.

### 2.1 Constitutional mandate

The WRC is bound by the Bill of Rights contained within the Constitution that is applicable to all laws. In the execution of its mandate, the WRC upholds several key principles of the Bill of Rights, most notably section 27.1.b that gives everyone the right to have sufficient access to water. The WRC regards the ready availability of water knowledge and understanding as critically important to the adoption of effective and innovative strategies for equitable water service provision, management and use. It also has the pivotal role of being the knowledge partner to the respective implementing agents in the realisation of the Bill of Rights.

Additionally, section 16 of the Constitution, which addresses freedom of expression, including the right to academic freedom and freedom of scientific research, also applies to the work of the WRC.

### 2.2 Legislative mandate

The WRC is governed by the Water Research Act (WRA), Act No. 34 of 1971, which outlines the purpose and mandated objectives of the organisation. The WRC also operates and accounts for its activities in accordance with the Public Finance Management Act (PFMA), Act No. 1 of 1999, and is listed as a national public entity in Schedule 3A of this Act.

The mandated objectives of the WRC are also in accordance with the requirements of the policies of the DWS for the Water Services Act (Act No. 108 of 1997) and the National Water Act (Act No. 36 of 1998). Key legislative frameworks and their applicability to the WRC are highlighted below.

#### Water Research Act (Act No. 34 of 1971 as amended)

The principal aim of the Water Research Act (WRA) is to provide for the promotion of research in connection with water affairs. The Act requires the establishment of the WRC and the Water Research Fund, and sets the framework

within which the WRC operates. It also provides for the establishment of the WRC as a Schedule 3A public entity, thereby requiring compliance with the PFMA Act (Act No. 1 of 1999) and Treasury Regulations.

The WRC's mandate, as set out in this Act, highlights the following functions to be carried out by the organisation:

- Promote co-ordination, co-operation and communication in the area of water research and development
- Establish water research needs and priorities
- Stimulate and fund water research according to priority
- Promote the effective transfer of information and technology
- Enhance knowledge and capacity building within the water sector

#### National Water Act (Act No. 36 of 1998)

The objective of the National Water Act (NWA) is to ensure that South Africa's water resources are protected, used, developed, conserved, managed, and controlled in a sustainable and equitable manner, for the benefit of all persons. The NWA also provides for the pricing strategy for water use charges, the primary mechanism for the calculation of a charge, payable by some or all raw water users, that is set for research purposes by the WRC. The role of the WRC is to align its funding priorities with those key national water challenges articulated in the NWA, and to help solve water-related problems which are critical to South Africa's sustainable development and economic growth.

#### Water Services Act (Act No. 108 of 1997)

The objective of the Water Services Act (WSA) is to provide for the right of access to basic water supply and basic sanitation by setting national standards and norms. Section 156, read in conjunction with Part B of Schedule 4 of the Constitution of the Republic of South Africa (Act No. 108 of 1996), vests in the Executive Authority the responsibility to support and strengthen the capacity of municipalities to manage their own affairs, to exercise their powers and to perform their functions. Again, the applicability of the WSA to the WRC rests in the WRC's duty to respond to water supply and sanitation needs with research and development that helps to address those needs.

### Review of the water-related legislation

The Department of Water and Sanitation is currently reviewing the National Water Act, 1998 (Act No. 36 of 1998), the Water Services Act, 1997 (Act No. 108 of 1997) and the Water Research Act, 1971 (Act No. 34 of 1971).

While the National Water Act provides a legal framework for the progressive realisation of the right to access to sufficient water, the Act is under review to ensure that there is equity in the allocation of water, to improve water resource management and to streamline regulatory processes. In turn, the Water Services Act is being reviewed to improve the provision of water services to ensure alignment with the provisions of the Municipal Systems Act, 2000 (Act No. 32 of 2000) and the Municipal Finance Management Act, 2003 (Act No. 56 of 2003).

The revised policy positions necessitate the consolidation of the NWA and WSA into one piece of legislation that will govern the entire water value chain covering water supply and sanitation services as well as water resource infrastructure. This consolidation will not only allow for managing water across the value chain but will also enhance cooperative governance and set clear institutional roles and responsibilities with commonly agreed targets for water delivery.

### Water Research Amendment Bill

Addressing current and future water knowledge gaps and the way in which these are currently prioritised in the South African context demands the evolution of the regulation and governance structures of any research institutions. The purpose of the Water Research Amendment Bill, 2013, is to:

- Amend the WRA so as to insert certain definitions and substitute others;
- Effect certain textual improvements and name changes;
- Provide for the appointment of members of the Board and the CEO in line with other public entities in the water sector and current practice of Corporate Governance;
- Regulate the governance of the Water Research Council (Water Research Commission in the current Act)

- Align the Act with applicable legislation, such as the NWA, WSA and the Public Finance Management Act, 1999; and to
- Provide for matters incidental hereto.

While the new clauses in the Amendment Bill do not legislate for a change in the relationship between the DWS as the shareholder department and the WRC as a public entity, the process of developing the draft Bill has created the discussion space enabling these two public sector partners to draw closer together and iron out the modalities of governance, cooperation and the complementarity of roles.

### 2.3 Policy mandates

The WRC will continue to support DWS in its call for mainstreaming of water and sanitation as the basis to enable and catalyse economic growth and sustainable development. The WRC is therefore actively involved in key DWS initiatives, including the legislative and policy review, and the institutional realignment programme, as well as the implementation of the National Water Resource Strategy 2 (NWRS-2). Specifically, the WRC's 5-year strategy is designed to support the further refinement and implementation of NWRS-2, together with the DWS and associated departmental plans for water services and sanitation. This is closely followed by the water-related components of the Presidential-led National Infrastructure Plan and its associated 18 Strategic Integrated Projects (SIPS), the Department of Environmental Affairs-led Climate Change Response Strategy and the Department of Science and Technology's 10-year Innovation Plan, as well as the broader South African sustainable development agenda. A third layer addresses the water-related components of the other core development strategies for these 5 years, for example, in the areas of local government, agriculture (including forestry), rural development, mineral resource development, the spatial development plans, and water-related enterprise development. The outcomes of our research projects provide scientific knowledge which informs initiatives such as the water pricing strategy and water infrastructure management.

## [ 3. Alignment of WRC strategy and activities ]

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### 3.1 National Water Resource Strategy 2 (NWRS-2)

The NWRS-2 calls for a much larger contribution from R&D to empower the implementation of the Strategy. In addition, the Strategy also engages the further development of water sciences in South Africa. One of the key deliverables that the NWRS-2 emphasises is the Sector Research and Innovation (R&I) Strategy.

In support of this, it is incumbent upon the WRC to coordinate and empower the implementation of the National Water and Sanitation R&D agenda. Some of the additional contributions that the NWRS-2 requires from the WRC include:

- Desalination of seawater
- Job creation
- Mining, energy and manufacturing industries
- Awareness and communication
- Research and development
- Scenarios, climate change modelling and water availability
- Hydraulic fracturing and coal-bed methane extraction

These areas call on the WRC to collaborate with the DWS and other Government departments such as the Department of Trade and Industry (DTI), Department of Economic Development (DED), Department of Environmental Affairs (DEA), Department of Human Settlements (DHS), and the Department of Mineral Resources (DMR), as well as other sector partners such as Eskom, Rand Water and Sasol, to develop appropriate technologies and support the development of relevant centres of excellence in several of the fields of research described above. In this regard, the WRC, together with the DST, has completed a consultative process and developed the Ten-Year Water Research, Development, and Innovation/Deployment Roadmap that provides a sector-defined, needs-driven research agenda that caters for the public sector (utilities, municipalities), private industry, agriculture, and environmental protection.

### 3.2 Contributing towards achieving Government Outcomes and National Development Plan (NDP) objectives

As a national public agency, the WRC actively strives to support the Government of South Africa in achieving its strategic outcomes, with particular reference to the NDP objectives as well as the Corporate Plan (Annual Performance Plan) of the DWS and the performance agreement of the Minister of Water and Sanitation.

The WRC also applies the outcome-based approach developed by Government and aims to support all Government Outcomes and Outputs through its research portfolio, with special emphasis given to Government Outcomes 6, 7, 9 and 10 (Table 1). Firstly, Outcome 6 addresses the need for an efficient, competitive and responsible economic infrastructure network. WRC-funded projects support water availability through examining and finding solutions for issues related to bulk water supply, and through supporting the development of appropriate regulations regarding water quantity, quality and usage. A second emphasis is Outcome 7, which focuses on vibrant, equitable and sustainable rural communities and food security for all. This is carried out through a number of projects addressing water utilisation in agriculture as well as projects focusing on informal settlements and peri-urban communities. Thirdly, Outcome 9 aims at establishing a responsive, accountable, effective and efficient local government system. The WRC supports this outcome through research focused on improving services, with special emphasis on the delivery of water and sanitation services. Finally, Outcome 10 addresses the protection and enhancement of the country's environmental assets and natural resources. This outcome is supported through research in aquatic ecosystem connectivity processes, sustainable utilisation, restoration, global change and biodiversity protection. The WRC workplan is geared to the improvement of the quality and quantity of South Africa's water resources through both its research projects as well as its innovation and technology development activities. Examples include technologies and strategies to reduce water loss in distribution systems, better sanitation solutions and improved wastewater treatment.



Table 1. Alignment with Government Outcomes and NDP objectives

WRC Knowledge Tree Goals	Alignment with Government Outcomes	Alignment with NDP Objectives
<p>Strategic Outcome-Oriented Goal 1</p>	Inform policy and decision-making	
<p>The WRC aims to commission appropriate evidence-based knowledge generated to guide decision-making, influencing the development of policy, practice or service provision, shaping legislation, altering behaviour, contributing to the understanding of policy issues, and reframing debates. Through the R&amp;D that it commissions it also aims to inform decision-making at all levels within government but also in non-governmental arenas. WRC projects also aim to improve basic services, with special emphasis on delivery of water and sanitation services.</p>	<ol style="list-style-type: none"> <li>1. Government Outcome 9: A responsive, accountable, effective and efficient local government system.</li> <li>2. Government Outcome 12: An efficient, effective and development oriented public service and an empowered, fair and inclusive citizenship.</li> </ol>	<p>Building a capable and developmental state objectives: Chapter 13</p>
<p>Strategic Outcome-Oriented Goal 2</p>	Develop innovative products and services for economic growth	
<p>The WRC capitalises on those projects that have potential to develop new intellectual property or to introduce innovations which create new or improved technologies, products and services that can be used in the economy. Effectively, this is the WRC's contribution to job creation and economic development through water and sanitation science innovations. Additionally, WRC projects support water availability by finding solutions to problems related to bulk water supply and assisting the development of appropriate regulations regarding water quantity, quality, and usage.</p>	<ol style="list-style-type: none"> <li>1. Government Outcome 4: Decent employment through inclusive economic growth.</li> <li>2. Government Outcome 6: An efficient, competitive and responsive economic infrastructure network.</li> </ol>	<p>Economy and employment objectives: Chapter 3</p> <p>Economic infrastructure objectives: Chapter 4</p>
<p>Strategic Outcome-Oriented Goal 3</p>	Enhance human capital development (HCD) in the water and science sectors	
<p>The WRC strives to have high student participation in its projects. Although the emphasis is on post-graduate degrees, inclusion of undergraduates has also been investigated. There is also a particular emphasis on previously-disadvantaged individuals (PDIs) and women. The WRC also aims to support institutional development through mentorship provided to new research leaders.</p>	<ol style="list-style-type: none"> <li>1. Government Outcome 1: Improved quality of basic education.</li> <li>2. Government Outcome 5: A skilled and capable workforce to support an inclusive growth path.</li> </ol>	<p>Improving education, training and innovation objectives: Chapter 9</p>
<p>Strategic Outcome-Oriented Goal 4</p>	Empower communities	
<p>The WRC places an emphasis on projects that: (a) include communities not only as end-users of research but as active participants in the research process from the project design phase; (b) have a direct impact on the livelihoods of communities through water-related interventions; and (c) build sufficient capacity to assist with the post-project sustainability of those interventions. Additionally, the WRC has projects addressing water utilisation in agriculture, as well as in informal settlements and peri-urban communities. The use of water by small-scale farmers (smallholders) and water allocation reform are being addressed. The WRC will continue to support the wise use of water for agriculture, and to reduce water demand from irrigation.</p>	<ol style="list-style-type: none"> <li>1. Government Outcome 6: Vibrant, equitable and sustainable rural communities with food security for all.</li> <li>2. Government Outcome 7: Sustainable human settlements and improved quality of household life.</li> </ol>	<p>Environmental sustainability and resilience objectives: Chapter 5</p> <p>Inclusive rural economy objectives: Chapter 6</p> <p>Transforming human settlements objectives: Chapter 8</p>

WRC Knowledge Tree Goals	Alignment with Government Outcomes	Alignment with NDP Objectives
<p>Strategic Outcome-Oriented Goal 5</p>	<p>Promote transformation and redress</p> <p>This goal focuses on growing PDI involvement/ leadership in projects, as well as helping to promote socio-economic development through the reduction of poverty and inequality in South Africa, particularly of marginalised groups such as women and youth.</p>	<p>1. Government Outcome 5: A skilled and capable workforce to support an inclusive growth path.</p> <p>2. Government Outcome 11: Create a better South Africa and contribute to a better and safer Africa and World.</p> <p>3. Government Outcome 12: An efficient, effective and development oriented public service and an empowered, fair and inclusive citizenship.</p> <p>Improving education, training and innovation objectives: Chapter 9</p> <p>Transforming human settlements objectives: Chapter 8</p> <p>Building a capable and developmental state objectives: Chapter 13</p> <p>Nation building and social cohesion objectives: Chapter 15</p>
<p>Strategic Outcome-Oriented Goal 6</p>	<p>Drive sustainable development solutions</p> <p>The WRC prioritises those projects that provide sustainable development solutions that have had positive effects on the environment, economy and society, including: protection of water resources, optimal water use, and equity between generations, equitable access, environmental integration and good governance. Additionally, this goal focuses on developing knowledge products that are fit-for-use to ensure the uptake of research. Examples include technologies and strategies to reduce water loss in distribution systems, better sanitation solutions and improved wastewater treatment. The WRC will continue to invest in studies on climate change and related energy issues. Biodiversity related to aquatic life and ensuring ecosystem health through monitoring tools development, as well as protection and restoration of aquatic resources, will continue to be supported.</p>	<p>1. Government Outcome 7: Vibrant, equitable and sustainable rural communities with food security for all.</p> <p>2. Government Outcome 8: Sustainable human settlements and improved quality of household life.</p> <p>3. Government Outcome 10: Environmental assets and natural resources that are well protected and continually enhanced.</p> <p>Environmental sustainability and resilience objectives: Chapter 5</p> <p>Inclusive rural economy objectives: Chapter 6</p> <p>Transforming human settlements objectives: Chapter 8</p>

### 3.3 Alignment with DWS strategic objectives and National Water & Sanitation Master Plan

The National Water & Sanitation Master Plan (NWSMP) presents a solid affirmation and commitment from DWS to support water-related research, development and innovation. This is with a view to ensuring that there is highly informed water decision-making through science and technology at all levels, in all stakeholder groups, and innovative water solutions through research and development for South Africa, and the African continent. The DWS will thus continue to support efforts that position the country and its institutions as a global water knowledge node active across the whole water and sanitation innovation value chain.

The DWS with its relevant institutions has to construct, plant, and maintain a true Knowledge Tree which bears many desired fruits, resulting in new sustainable development solutions, new products and services, empowering of communities especially youth and women, informed policy and decision making, etc. In fact, this plan constructs a roadmap assuring the commitment of the DWS in addressing the challenges of unemployment, poverty and inequality as stated in the National Development Plan (NDP) of South Africa. The RDI Chapter of the NWSMP is aligned with and linked to key strategic goals of the DWS as well as other Government priorities. Above all, the NWSMP is meant to advance and comply with the Constitution and all other relevant policies and legislations of South Africa.

The chapter thus provides:

- A brief comment on RDI gaps and opportunities
- An overview of the key activities and instruments that underpin the water RDI sector
- The key investment themes/clusters that should be prioritized
- Tracking progress
- An estimation of envisioned investment required
- An overview of the proposed implementation and partnership approach

The Water RDI Roadmap is a 10-year innovation plan (2016/17–2027/27) that provides strategic direction, a set of action plans and an implementation framework to guide, plan, coordinate and manage South Africa’s water RDI investment. The Roadmap is a partnership initiative between the DST, DWS and the WRC. The Roadmap is thus positioned as the implementation plan for Chapter 14 of the NWRS-2 and its current revision processes. It also provides the basis for the research chapter of the National Water and Sanitation Master Plan. The Roadmap has strong alignment to the Water Chapter in the Industrial Policy Action Plan released in 2017/18. The plan focuses

on tracking and driving a series of research, high-end skills development and innovation deployment activities focusing on a range of clusters/thematic areas, such as unlocking alternative sources of water; ecological and built infrastructure, or monitoring and metering.

Ultimately the plan aims to:

- Address water knowledge gaps
- Grow the water sector high-end skills base
- Facilitate faster and more effective deployment of context-appropriate solutions to market
- Provide evidence that guides policy and implementation
- Develop content that guides education and awareness campaigns
- Unlock new opportunities for business and industry
- Deepen insight on how best to balance protection and use of the environment
- Facilitate a learning culture in water sector institutions about the challenges, risks, opportunities and solutions related to the water sector

Table 2 outlines the WRC’s alignment with DWS strategic objectives.

Table 2. Alignment with DWS strategic objectives

DWS strategic objectives	WRC strategic objectives
<b>Sound cooperative governance and an actively engaged citizenry</b>	<ol style="list-style-type: none"> <li>1. To enhance the governance of water in South Africa through knowledge and practice derived through research</li> <li>2. To enhance human capital development through support of students in water research projects as well as the development of researchers</li> <li>3. To contribute to economic transformation by supporting SMMEs in water research, development and innovation</li> <li>4. Enhance the diversity of project leadership as part of the broader national transformation project to promote the ongoing transformation of the water R&amp;D sector</li> <li>5. Achieve efficient and effective institutional governance including a good audit report</li> <li>6. Enhance the relevance and presence of the WRC locally and globally by coordinating strategic local and international partnerships by establishing MoUs, knowledge-sharing agreements/understandings or strategic partnership agreements with knowledge-sharing institutions and/or strategic partners</li> <li>7. Strengthen the WRC’s strategic position regarding water research and development</li> </ol>
<b>Equitable access to reliable, sustainable and acceptable water resources and sanitation services</b>	<ol style="list-style-type: none"> <li>1. To increase knowledge on water and sanitation services by initiating new research projects</li> <li>2. To provide the country with supportive knowledge via completed projects</li> <li>3. To improve knowledge dissemination (number of final research reports and technical briefs published)</li> <li>4. To promote the uptake and communication of WRC research in the form of manuals, guidelines, and other supporting materials produced</li> <li>5. To engage the sector in knowledge-sharing events through public dialogues and workshops</li> </ol>
<b>Enhances and protects water resource across the value chain</b>	<ol style="list-style-type: none"> <li>1. To increase water science focusing on protection of water across the value chain by initiating new research projects</li> <li>2. To provide the country with supportive knowledge via completed projects</li> <li>3. To improve knowledge dissemination (number of final research reports and technical briefs published)</li> <li>4. To promote the uptake and communication of WRC research in the form of manuals, guidelines, and other supporting materials produced</li> <li>5. To engage the sector in knowledge-sharing events through public dialogues and workshops</li> </ol>



### 3.4 Alignment with Millennium Development Goals and Sustainable Development Goals






From food and energy security to human and environmental health, it is well recognised that water contributes to improvements in social well-being and inclusive growth. As the world grapples with increasing water scarcity, numerous international water bodies have identified water as a priority concern.

While recognising these priorities, the world has moved beyond the Millennium Development Goals (MDGs), towards a post-2015 development agenda. Water-related goals have moved past the mere provision of water supply and sanitation towards a more integrated approach that encompasses the supply of basic services, the sustainable management of water resources, improved water governance, water quality and wastewater management, and mitigation against water-related disasters.

The Rio+20 conference (the United Nations Conference on Sustainable Development), held in Rio de Janeiro in June 2012, galvanized a process to develop a new set of Sustainable Development Goals (SDGs) which will carry on the momentum generated by the MDGs and fit into a global development framework beyond 2015.

The WRC has been championing the research and development (R&D) initiatives, aligning them with the Sustainable Development Goals adopted by the United Nations (UN) in 2015. Alignment to the 17 SDGs is in the following ways (Table 3):

Table 3. WRC alignment to the Sustainable Development Goals

End poverty in all its forms everywhere	
	<p>The WRC has been at the forefront of championing the Water–Energy–Food Nexus through the Lighthouse initiatives that started 4 years ago. The Water–Energy–Food Nexus Lighthouse cuts across all of the key strategic areas within the WRC, comprising more than 25 projects. The majority of these projects address the interlinkages within the nexus, creating opportunities for the Water–Energy–Food Nexus to be championed in an integrated way.</p>
End hunger, achieve food security and improve nutrition and promote sustainable agriculture	
	<p>The WRC has a key strategic area (KSA) of Water Use in Agriculture that is aligned to this goal. Priority attention is therefore given to investment in research and development for knowledge creation and diffusion, as well as training for knowledge application and skills development of, in particular, homestead food gardeners and smallholder farmers. The focus for research, technology exchange and implementation, to exploit the benefits of research-based knowledge generated in this KSA, is purposefully directed towards overcoming poverty, hunger and malnutrition and promoting resilience amongst members of the rural and urban population.</p>
Ensure healthy lives and promote wellbeing for all at all ages	
	<p>The WRC is aligned to this goal through the establishment of The Water Quality and Health Lighthouse, which is a cross-cutter within the WRC research KSAs as it is applicable to the entire water value chain and covers aspects of water resources, sanitation, drinking water, health and hygiene. The key aim of this Lighthouse is to serve as a research concentration space where all related projects across KSAs can be drawn together to make an impact in the national water quality and health space.</p>

#### Ensure inclusive and equitable education and promote lifelong learning opportunities



The WRC indirectly aligns to this goal in the form of capacity building in the sector. Through its research contacts, the WRC has, on average, 400 students working on its projects. Through partnerships based on the RDI Roadmap, it has also been able to provide bursaries to Masters students for the past two years. . It will continue to seek partnerships that support education and the transfer of knowledge products to schools and the youth in society and within water sector institutions.

#### Achieve gender equality and empower all women and girls



The WRC has launched the Women in Water Empowerment Programme, an initiative of the Department of Water and Sanitation.. Women-owned enterprises in the water and sanitation industry are very scarce. Opportunities exist for women to work in the water and sanitation sector as consultants, contractors, suppliers and innovators. The newly-launched programme opens up opportunities for women participation in research and development, engineering, construction, and local community initiatives. Through its research the WRC will continue to shine a light on the challenges that women face in water and provide guidance to water sector stakeholders on how to address them.

#### Ensure availability and sustainable management of water and sanitation for all



The WRC has a Water Use and Waste Management KSA that focuses on water usage and wastewater management in the domestic, industrial and mining sectors. It aims to proactively and effectively lead and support the advancement of technology, science, management, and policies relevant to water supply, waste and effluent management, for these sectors. This area also focuses on:

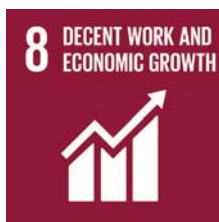
- Improving the management of water services in both rural and urban areas
- Developing appropriate technologies for improving the quality and quantity of our water supplies for both domestic use and industrial applications
- Developing new approaches to manage and enhance hygiene and sanitation practices
- Providing appropriate, innovative and integrated solutions to water and waste management in the industrial and mining sectors
- Developing innovative technologies and applications for improved treatment of wastewater and effluent and improved processes for enabling increased reuse thereof
- Improving health, economic and environmental conditions, while supporting the development of appropriate technologies and socially-focused management practices related to water and effluent management. The Water Resources and Ecosystem Management KSA also ensures that adequate research is undertaken to manage our water from source to tap sustainably. WRC projects support water availability by finding solutions to problems related to bulk water supply and assisting the development of appropriate regulations regarding water quantity, quality, and usage.

#### Ensure access to affordable, reliable sustainable and modern energy for all



In South Africa 95% of energy is derived from coal which is water intensive .The WRC has funded research investigating a mix of renewable energy generation tools energy efficiency and generation options, including biogas, and solar-powered treatment plants as examples. In addition, the WRC will continue to seek innovative solutions to provide off-grid solutions that can power water treatment and sanitation technologies.

#### Promote sustained inclusive and sustainable economic growth, full and productive employment and decent work for all



The WRC aligns to this goal by developing new products and services for economic development. The WRC capitalises on those projects that have potential to develop new intellectual property or to introduce innovations which create new or improved technologies, products and services that can be used in the economy. Effectively, this is the WRC's contribution to job creation and economic development through water and sanitation science innovations. Additionally, WRC projects support water availability by finding solutions to problems related to bulk water supply and assisting the development of appropriate regulations regarding water quantity, quality, and usage. The WRC will also support entrepreneurship programmes to encourage young professionals and entrepreneurs to become job creators by translating innovation into viable commercial products for sale to either communities or water sector institutions

**Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation**



The WRC, by effectively and smartly collaborating with the right public and private sector organisations:

1. Scales up sustainable solutions with strategic partners
2. Develops and facilitates the innovations to the stage where products and services are closer to the market and ready for uptake.
3. Strengthens human capital development opportunities for the sector

By partnering with Department of Trade and Industry, Department of Water and Sanitation and Department of Science and Technology, the WRC aims to stimulate manufacturing and industry development.

**Reduce inequalities within and among communities**



The WRC and its partners initiate projects that place emphasis on: (a) having a direct impact on the lives and livelihoods of communities through water-related interventions, and (b) building sufficient capacity to assist with the post-project sustainability of those interventions.

**Make cities and human settlements inclusive, safe, resilient and sustainable**



The Water Sensitive Design Lighthouse aligns to this goal by providing a critical mass of knowledge around the integration of planning activities for the adoption of more integrated and sustainable solutions using the water-sensitive design (settlements) lens for urban, peri-urban and rural environments.

**Ensure sustainable and consumption patterns**



The WRC supports the strategy that has the primary objective to increase national and household food security, improve livelihoods and increase efficient growth as well as equitable distribution of wealth on a farming, community and national level. This looks to the challenge of producing more food with the same or less water. The strategy further focuses on empowerment and capacity building for all farmers, especially women, with knowledge and practical skills for correct investment, marketing, production and financing. Within urban environments WRC research is directed at ensuring waste is converted into beneficial products, thereby closing the loop.

**Take urgent action to combat climate change and its impacts**



The WRC Climate Change Lighthouse has, since its inception, adopted a multi-sectoral and multi-level approach towards securing the water sector's contribution to enabling South Africa to characterize and prepare to deal effectively with a multiplicity of existing stresses brought by climate change, through research embedded with capacity building. This involved bringing to the fore a portfolio of research covering the following themes: impacts of climate change, adaptation to climate change and mitigation of climate change.

**Conserve and sustainably use the oceans, seas and marine resources for sustainable development**



The WRC indirectly aligns to this goal by funding research in this area that focuses on river health, rehabilitation and the treatment of wastewater that would ultimately reach the oceans through estuaries. The Green Economy Lighthouse further takes a global view on marine and coastal resources.



**Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and reverse land degradation and halt biodiversity loss**



The WRC's KSA on Water Resources and Ecosystems focuses on surface water, estuaries and aquifers, together with their related ecosystems, and how they are best managed.

**Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels**



The WRC indirectly aligns to this goal by driving sustainable development solutions.

- **Protection of water resources.** A specific highlight is the WRC's current research to build a body of knowledge around unconventional gas mining. One new project is looking at the potential impact of this technology on South Africa's water resources with a view to developing best-practice guidelines.
- **Optimal water use.** The WRC's projects in the field of water utilisation in agriculture address this directly, for example, projects determining the water footprints of selected field and forage crops. Other projects are developing sustainability indicators that can be used to manage groundwater use.
- **Equity between generations.** A significant initiative focuses on improving management of South Africa's wetlands of international importance (so-called Ramsar sites).
- **Current equitable access.** There is considerable emphasis on supporting the provision of safe drinking water. Projects have been wide-ranging, from improving our understanding of the concept of free basic water to transfer of knowledge to communities relating to rainwater harvesting.
- **Environmental integration.** The WRC Lighthouses, by their very nature, epitomise the WRC's acknowledgement of the need for integrated approaches.

**Strengthen the means of implementation and revitalise the goal partnerships for sustainable development**



To stretch the impact of the Water Research Fund the WRC has a strategy to increase the WRC's partnerships in various domains. These include research partnerships, implementation partnerships and innovation value chain partnerships.



## [ 4. Situational Analysis ]

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### 4.1 Performance environment

The WRC's performance environment is created on the premise that the crux of the water and sanitation challenge in South Africa is a capacity and capability challenge. The WRC addresses the three dimensions of this challenge, namely, new knowledge, human capital, and technological solutions. It will endeavour in its projects to create a high concentration of activities that support each of these dimensions. In so doing, the WRC funds and facilitates research in water-related innovation and disseminates such knowledge for the advancement of national water security. The recipients of this knowledge may be higher-education institutions (HEIs), science councils, or private agencies/contractors, as well as the various tiers of government.

While our increased efficiencies, innovation and partnerships will continue to maintain knowledge production levels, it is becoming increasingly difficult to meet two very basic challenges in the South African water and sanitation system. The first is the ability to address the increasingly complex nature of water problems such as non-revenue water and acid mine drainage. The second is the WRC's ability to both transform the South African R&D community through the development of researchers from the designated groups as well as to create further avenues for job creation and entrepreneurship development, which are all restricted by the limited availability of R&D funds.

At the same time, technological innovation, improvements in communication, increased collaboration and international partnerships have enhanced our ability as a South African water R&D community to conduct better research, to train students at higher levels, and to organise for better translation of research into products and services for the economy. These improvements, together with new resources, will guarantee our ability to make a significant difference to South Africa's water fortunes.

### 4.2 Organisational environment

The primary functions of the WRC have always been to fund and steer the water research agenda in South Africa,

and to effectively disseminate and communicate research findings. Administrative activities are carried out to ensure compliance with regulatory requirements and to provide an enabling environment for research management.

However, in recent years the WRC has been increasingly called upon to not only develop new knowledge in the water and sanitation science and technology domain, but also to support and further develop human capacity and skill as well as lead technology, product and industry development (Figure 1). This not only necessitated an expanded mandate but also a suitable organisational structure capable of handling these added responsibilities. The WRC has re-engineered its operations and structure to address challenges faced by the water and science sectors and the country.

As such, two core teams have been developed (Figure 2):

1. Research and Development – which focuses on the generation of new knowledge as well as the mechanisms needed to support this, including human capital development and skills development.
2. Impact and Innovation – which entails a redefined focus on technology, product and industry development, business development and innovation realisation on the one hand, and enabling mechanisms such as knowledge dissemination, communication and marketing on the other.

The following structure defines the internal governance framework:

- The Minister of Water and Sanitation is the Executive Authority of the WRC.
- The Department of Water and Sanitation is the shareholder representative.
- The WRC Board is the Accounting Authority of the WRC.
- The Chief Executive Officer (CEO) is the Accounting Officer and a member of the WRC Board.
- The Heads of Branches, which include the Group Executives, the Chief Financial Officer and the Executive Manager for Corporate Services, report directly to the CEO.

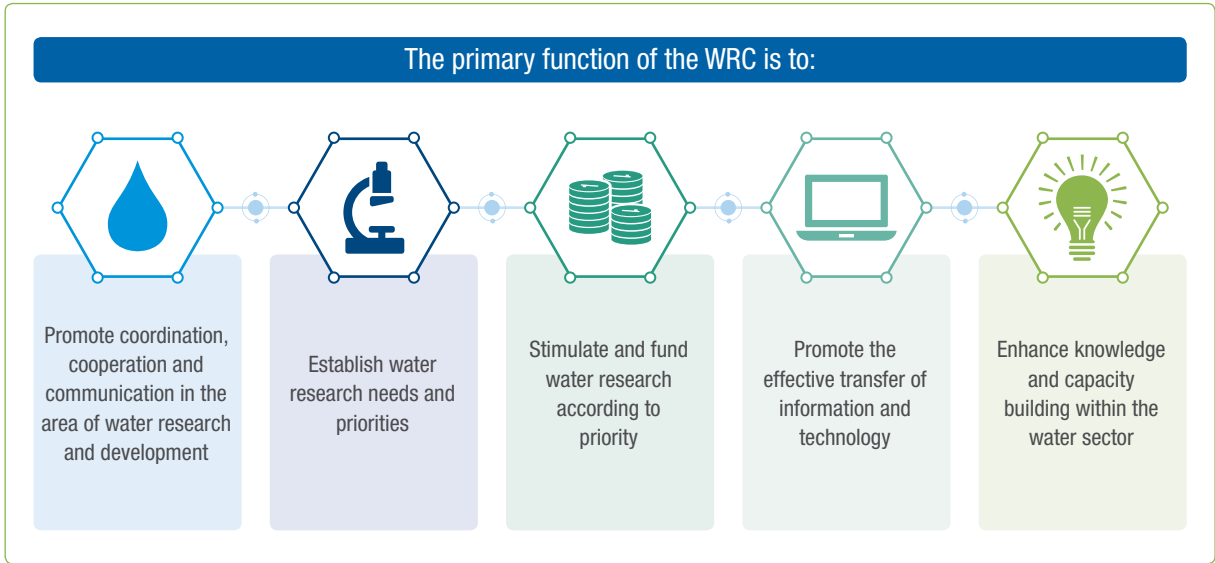


Figure 1. The WRC's primary function

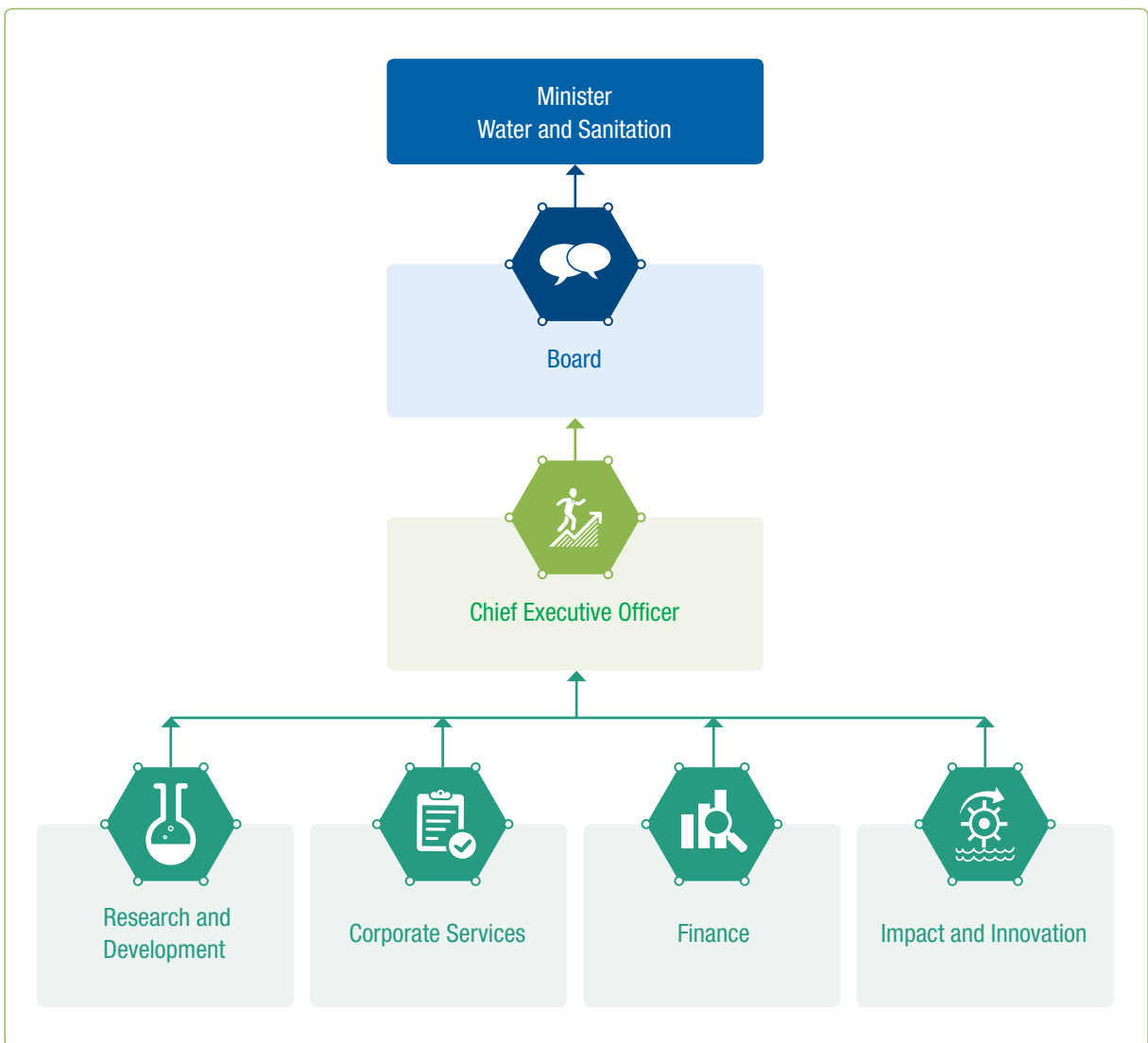


Figure 2. WRC organisational structure

### 4.3 Description of the WRC's corporate planning process

The process conducted to develop this Corporate Plan is characterised by three important elements. Firstly, it has been an ongoing and iterative process. Secondly, it has been consultative, incorporating discussions and considerations from the DWS and WRC stakeholders in various forums. Thirdly, it has employed both forecasting and back-casting approaches to the development of strategic objectives, involving an analysis of the WRC's current positioning in the sector as well as a reflection on

developments and potential developments in the external and organisational environment that could have an impact on the 5-year planning cycle. All of these processes have been under the guidance of the WRC Board.

The formal planning process continued from the developments in the previous year's iteration of the Corporate Plan for 2017/18. Other important inputs and events feeding into the corporate planning process are shown in Figure 3.

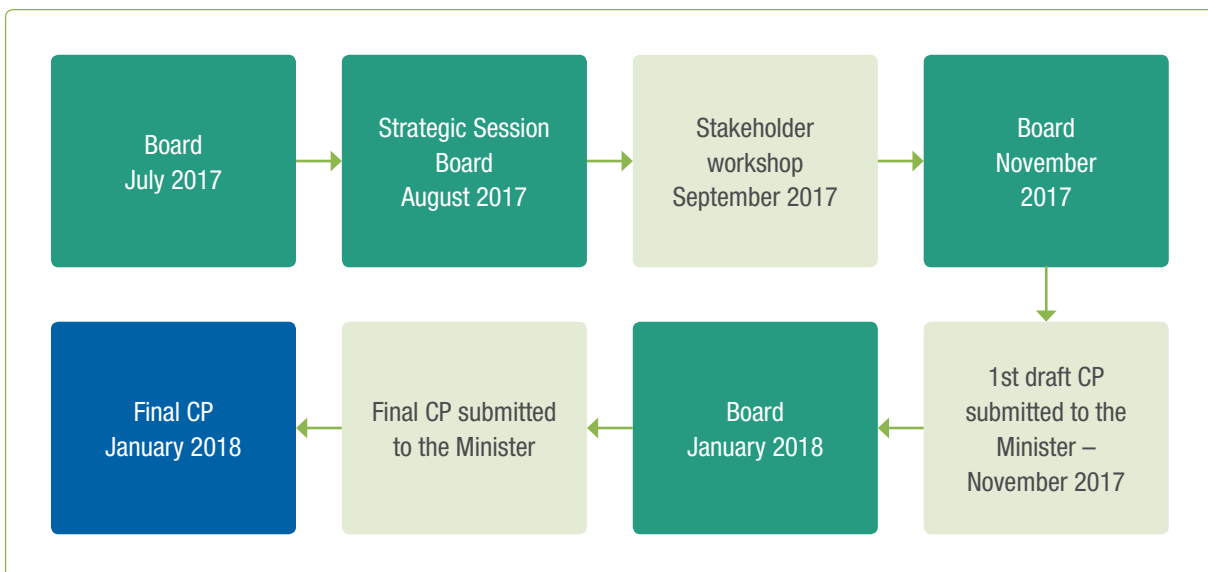


Figure 3. Corporate planning timeline



[ 5. Strategic outcome-oriented goals of the institution – The WRC’s knowledge tree ]

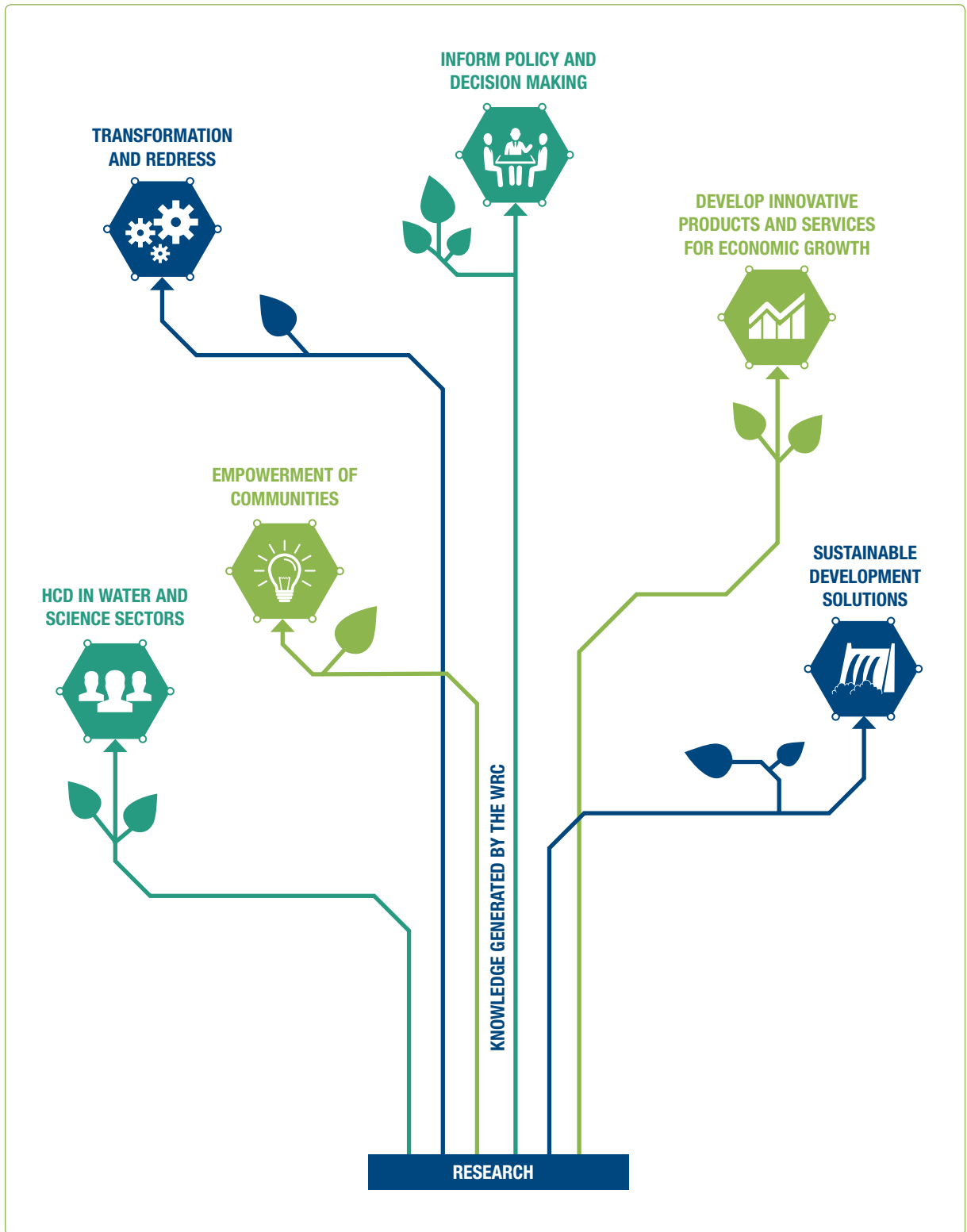


Figure 4. The WRC Knowledge Tree



Figure 5. The WRC's strategic outcome-oriented goals

Table 4. Strategic outcome-oriented goals depicted by the WRC Knowledge Tree

Strategic Outcome-oriented Goal 1	Inform policy and decision-making
<p><b>Goal statement</b></p>	<p>The WRC will reinforce its efforts to commission appropriate research projects to actively inform both policy development by Government partners and decision-making by all parties in the water sector. Particular effort will be made to: (a) provide appropriate evidence-based information to guide decision-making, (b) effectively communicate scientific findings to decision-makers, (c) provide advisory services to Parliamentary portfolio committees, the shareholder department and other decision-making bodies, and (d) provide a platform for dialogue on various issues involving the policy landscape.</p>
<p><b>Examples</b></p>	<ul style="list-style-type: none"> <li> <p><b>Integrated information system for canal water management:</b> Water loss control on irrigation schemes can be substantially improved by training water control officers, calibration or installation of water measurement devices and switching to computerised water information management systems. This is achievable with installation, operation and maintenance of WAS – the Water Administration System. The Water Administration System (WAS) has been developed, primarily through WRC funding, for increasing water loss control and thereby achieving water savings of 10 to 20% on irrigation schemes. WAS is already implemented on all major irrigation schemes in South Africa and further implementation is funded by the SWPN with the co-operation of DWS. Expanded implementation of WAS to an estimated additional 400 000 ha of irrigation schemes is possible with support of DWS, by accrediting the implementation of WAS on all irrigation schemes.</p> </li> <li> <p><b>Water and wastewater management by industries:</b> Several guidelines are developed via WRC projects and the guidelines are aimed at updating previous editions of National Surveys on aspects related to resource management in the various industries. The guidelines outline industrial operations, the degree to which various resources have been managed based on a set of indicators per unit of production (e.g. specific water intake, specific effluent, etc.), best practices adopted or currently under implementation and, finally, an outline of recommendations on probable improvements that can further enhance resource utilisation.</p> </li> <li> <p><b>Evaluation of the risks associated with the use of rooftop rainwater harvesting (RRWH) and groundwater for domestic use and livestock watering:</b> Rainwater harvesting is being practised in a number of areas, but the technology is not fully utilised, particularly in rural communities. Although there is a public perception that rooftop-harvested rainwater is safe to drink, the presence of potential pathogens, such as E. coli, Salmonella, Legionella, and Giardia, among others, have been reported in these water sources. The project evaluated and presented the risks associated with the use of RRWH for domestic use and in homestead food gardens, and with the use of groundwater for potable use and livestock watering. The final product has been published as two volumes. Volume 1 deals with microbial quality of rooftop rainwater while Volume 2 considers the chemical quality of groundwater for potable use and livestock watering.</p> </li> <li> <p><b>Vulnerability, adaptation to and coping with drought:</b> Vulnerability, adaptation to and coping with drought with development of drought risk indicators for future drought management in South Africa, as an input to the drought task team of the National Disaster Risk Management Centre, based on cases of commercial and subsistence rain-fed farming investigated in the Eastern Cape.</p> </li> </ul>



Strategic Outcome-Oriented Goal 2	Develop innovative products and services for economic growth
<b>Goal statement</b>	The WRC will capitalise on those projects that have potential to develop new intellectual property or to introduce innovations which create new or improved technologies, products and services to be used in the economy.
<b>Examples</b>	<ul style="list-style-type: none"> <li>• <b>The WEROP: Wave Energy Reverse Osmosis Pump to enhance water security:</b> This a South African invention that provides safe drinking water to coastal communities without the need for access to an electricity supply of any kind, or a water distribution grid. This technology makes use of wave energy for a variety of benefits including desalination and electricity production without consuming ANY electricity in the process. While there are many desalination plants in action, they all consume electricity from the national grid. The WEROP, designed and patented in South Africa by Impact-Free Water (IFW) uses wave energy to run itself, and produces potable water to SANS241 standards. By producing, rather than consuming electricity in the process of desalinating water, IFW has a solution that is truly impact-free on the environment and sustainable as long as there is water in the oceans. It will go a long way towards reducing South Africa's water crisis and, by diversifying the mix of water resources from which we draw domestic supplies, it will assist in our drought and climate change resilience and mitigation.</li> <li>• <b>Low-flush toilets:</b> A low-flush system was developed through the WRC. The toilet gives the user the same experience as a full-flush toilet but, critically, it can operate without the need for a cistern from where most leaks emanate in toilets, uses up to 3 litres to flush, and does not require complex sewers in rural areas. Over 800 of these units have been installed with new RDP houses fitted with a toilet inside the house – instead of outside – because the water seal limits smells. The system has been well-received by communities in which we have implemented this system and the South African Breweries (SAB) Foundation has recognised the technology with an award in the water and sanitation field. Around 300 temporary jobs were created and 90 people trained with masonry skills through the programme.</li> <li>• <b>Applying the franchising principle for water and sanitation services O&amp;M:</b> The franchising principle was used to train locals in their respective areas to conduct routine O&amp;M of water and sanitation infrastructure. The benefits of the model include access to franchisor business know-how for the local franchisee, a higher level of assistance and expertise, and ensuring quality assurance for the services provided.</li> </ul>

Strategic Outcome-Oriented Goal 3	Enhance human capital development (HCD)
<b>Goal statement</b>	The WRC will strive for high student participation in its projects, as well as partnering with higher education institutions (HEIs) to grow capacity in new and emerging disciplines, e.g., biomimicry.
<b>Examples</b>	<ul style="list-style-type: none"> <li>• <b>Student participation:</b> All WRC projects are encouraged to have a component of student participation where possible.</li> <li>• <b>Supporting new PDI project leaders:</b> A special programme of short-term projects is planned to encourage and empower previously-disadvantaged individuals to be project leaders.</li> <li>• <b>The WRC Empowerment Fund:</b> The WRC and DWS have partnered to implement the WRC Empowerment Fund to capacitate emerging project leaders and also to help develop various capacities for CMAs.</li> <li>• <b>Student bursaries:</b> The WRC has partnered with DST to offer student bursaries in scarce-skills areas such as biomimicry and environmental ecosystem services.</li> </ul>

Strategic Outcome-Oriented Goal 4	Empower communities
<b>Goal statement</b>	The WRC and its partners will increase emphasis on projects that (a) have a direct impact on the lives and livelihoods of communities through water-related interventions, and (b) build sufficient capacity to assist with the post-project sustainability of those interventions.
<b>Examples</b>	<ul style="list-style-type: none"> <li>• <b>Smart geyser technology and software which promote water and energy saving:</b> The technology is fitted on water systems in homes (houses) as well as industries to monitor both water use as well as water wastage. It also monitors energy use. The technology is controlled remotely by a cellphone or personal computer. The software enabled homeowners to be in charge of water and energy use in their homes or premises. The technology has been tested in many homes and it works well and is ready for commercialisation. The technology has been accepted by people who tested it and it has assisted in changing their wasteful behaviour in the use of water and energy as people has seen how much water and energy they use as compared to their neighbours.</li> <li>• <b>Risk management tools – WSP &amp; W2RAP:</b> WSP and W2RAP tools are risk management tools for identification and prioritization of risks associated with water and wastewater services, respectively. The tools are ready for implementation and have already been used by several municipalities for risk management training and for BD &amp; GD audit preparation.</li> </ul>



Strategic Outcome-Oriented Goal 5	Promote transformation and redress
<b>Goal statement</b>	This 5-year Corporate Plan has transformation and redress as a central driver, both within the organisation as well as in the project portfolio. The goal is necessarily cross-cutting in that it drives the 'human capital development' and 'empowerment of communities' goals.
<b>Examples</b>	<ul style="list-style-type: none"> <li>• <b>Policy instruments promoting transformation and water equity:</b> The WRC has funded work that has examined a range of policy instruments for pursuing objectives and targets related to water equity. These include water services policy instruments, customer accountability mechanisms, water licensing instruments, environmental water equity mechanisms and economic policy instruments. Each of these presents opportunities but also has challenges that need to be overcome to make them transformative instruments. It is here that research can assist.</li> <li>• <b>Improving household food security in rural communities:</b> Determining water use of indigenous grain and legume food crops in order to encourage production of these staple crops for improved household food security in rural communities, and as part of the research project train young researchers, enabling them to obtain Master and Doctoral degrees.</li> <li>• <b>Water legislation in South Africa:</b> A report has just been completed, titled 'Reviewing South Africa's water legislation and providing a framework for monitoring future progress'. This has the potential to inform the drafting of the National Water and Sanitation Bill. The report is being published but a Ministerial Brief will soon be available.</li> </ul>

Strategic Outcome-Oriented Goal 6	Drive sustainable development solutions
<b>Goal statement</b>	Sustainable development will remain a core principle driving all WRC projects and activities. Specific focus is placed on sustainable development solutions.
<b>Examples</b>	<ul style="list-style-type: none"> <li>• <b>A mobile application, Drop Drop, to promote water conservation:</b> This was developed in order to allow users to access information about their daily water usage, predicted estimate of their month-end water bill, water conservation methods, municipal contacts and information about water resources. This application was tested in a sample population consisting of households in the City of Cape Town Metropolitan Municipality. The study found that the water-related information generally increased water-related knowledge and conservation awareness of the sample population on leak detection, consumption monitoring and conservation measures. It was noted that the cumulative monthly water consumption of the participants in the treatment group was consistently lower than the cumulative consumption of participants in the control group during the study period. At the same time, the gap between cumulative consumption of the treatment group and that of the control group widened. This was attributed to intensified water conservation practice by participants in the treatment group, due to the water-related information provided by the Drop Drop mobile application.</li> <li>• <b>The Arumloo as a sustainable sanitation solution for South Africa:</b> The Arumloo represents another example of a smart technology. The toilet system was developed in partnership with the WRC and is capable of flushing on less than 2 litres of water (a third of a normal flush). The system has been tested under international standards for flush performance. A solar pasteurization system was developed through the WRC for treating collected rainwater and tested in Kayamandi informal settlement in Cape Town. Results obtained showed that the system was effective in treating collected rainwater to within drinking water standards.</li> <li>• <b>Optimisation of electricity and water use in agriculture:</b> Optimisation of electricity and water use for sustainable management of irrigation farming systems and to change design norms by optimising operating costs in relation to fixed costs as determined by capital equipment of pipes and electrical motors, in response to increasing electricity tariffs and changes in electricity rate structures.</li> </ul>

In terms of the achievement of the above-mentioned strategic outcome-oriented goals (Table 4; Figure 5) depicted by the WRC Knowledge Tree (Figure 4), the WRC manages a multi-year portfolio of projects numbering approximately 300 at any time (Table 5).

Table 5. Baseline summary for strategic outcome-oriented goals

Indicator	2015	2016	2017 (to start in April 2018)
<b>Number of projects approved</b>	<b>87/287</b>	<b>75/262</b>	<b>60/261</b>
<b>Budget of projects over cycle</b>	R122 120 771	R106 122 621	R50 712 178
<b>Total budget (1st year)</b>	R33 513 313	R29 320 276, 00	R13 565 698
<b>Projects with SMME as Lead</b>	22 (18%)	22 (31%)	17 (28%)
<b>Community Based Projects</b>	23 (26%)	14 (18%)	27 (45%)
<b>Youth Led Projects</b>	-	-	8 (13%)
<b>Number of PDI project Leaders</b>	57 (66%)	45 (63%)	35 (58%)
<b>Number of students (distinct) in proposals</b>	232	173	110
<b>HDI (Univ.) participation (contracting org - Lead)</b>	10 (22%)	11 (15%)	6 (10%)
<b>Female project leaders</b>	67%	28 (39%)	25 (41.7%)
<b>African project leaders</b>	44%	19 (26%)	18 (30%)
<b>Number of projects with international collaboration</b>	2 (2%)	1 (1%)	1 (1.7%)



# PART B

## STRATEGIC EMPHASES



Within the Government Outcomes and the WRC Knowledge Tree goals, the next 5 years will place special emphasis on a series of elements that aim to further strengthen the adaptation to the new normal.

These elements cut across the various units of the WRC and include the following key emphases (Figure 6).

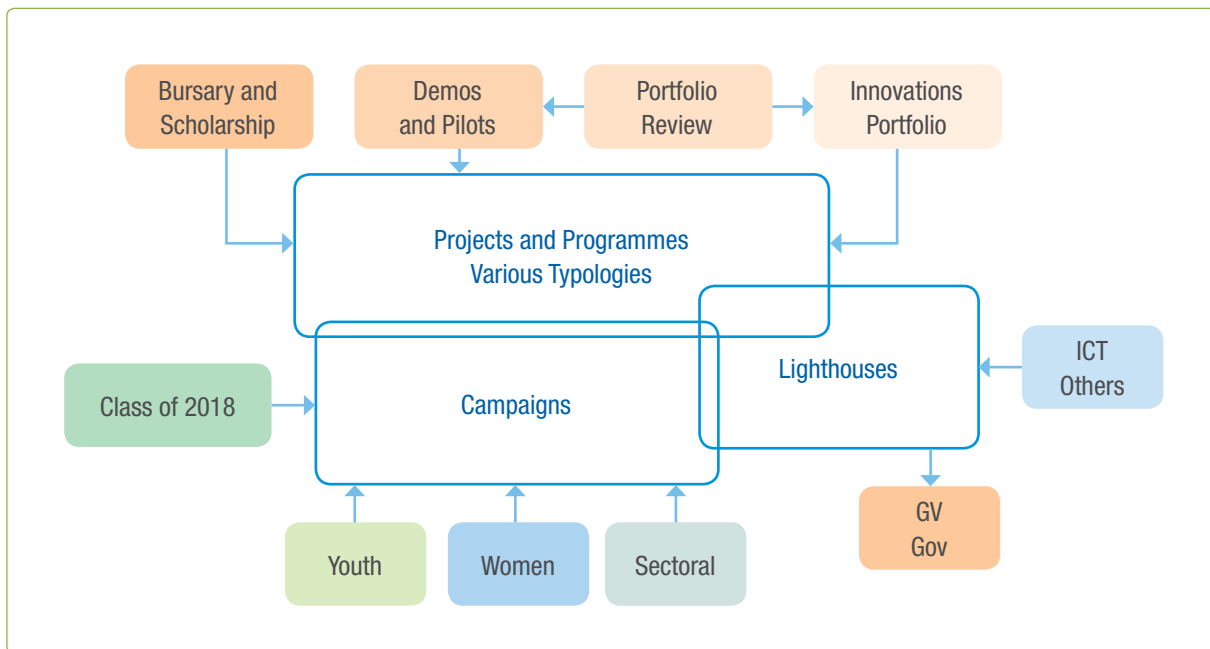


Figure 6. Key strategic instruments and elements





# [ 6. Research and Development ]

## 6.1 Introduction

The Research and Development (R&D) branch offers new knowledge in water and sanitation through research and development projects. The knowledge generated results in new or refined technologies and innovations which the WRC provides to the water sector to address specific needs and challenges. The branch is actively involved in human and institutional capacity development using research and development projects, research products and services. It supports other branches in the WRC with knowledge,

innovations and technologies that enable them to fulfil their functions, for instance, I&I and Corporate Services (Corporate Social Responsibility) get R&D support when they embark on knowledge dissemination and transfer, screening and evaluation of new technologies, negotiation of new water business development initiatives, assisting schools and needy communities, etc. The R&D branch has three key strategic areas (or departments), which are Water Resources and Ecosystems, Water Use and Wastewater Management, and Water Utilisation in Agriculture (Figure 7).

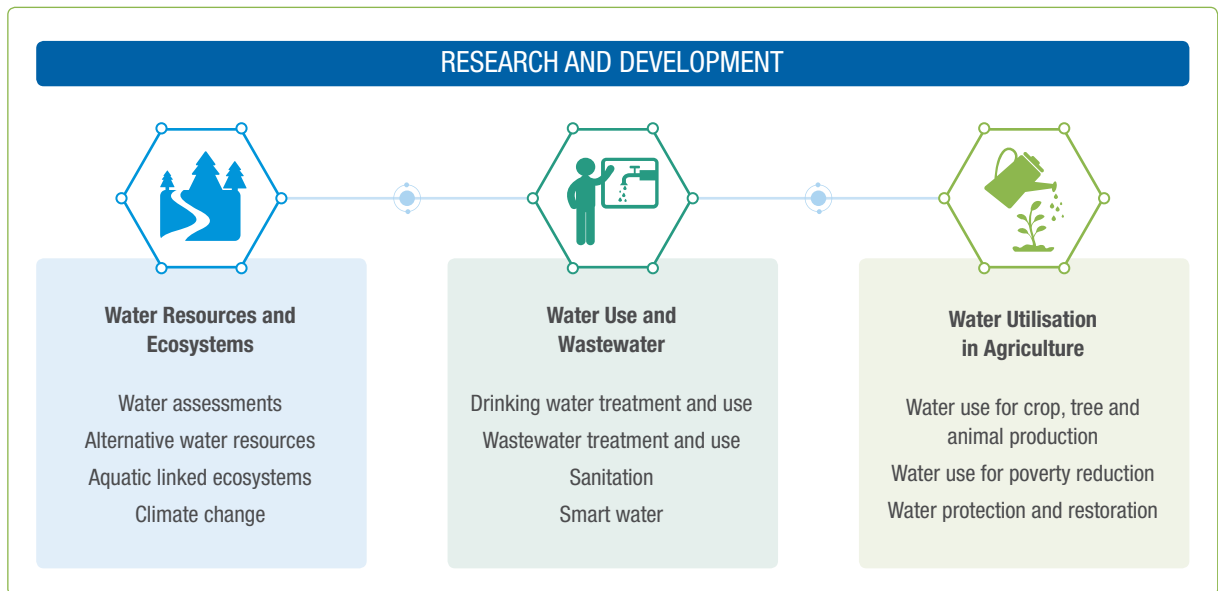


Figure 7. The three key strategic areas in the Research and Development branch of the WRC implemented from the 2016/17 financial year

## 6.2 Scope

The R&D branch in the WRC has considered both the macro- and micro-environment in developing the plan for 2018/19–2022/23. The R&D portfolio has to address both the challenges and opportunities in the water and related sectors. Some of the challenges are global in nature, whereas the majority can be viewed in a local context. Water scarcity or security has been identified as a major risk in attaining sustainable economic growth and development. In a water-scarce region such as ours (SADC), where countries share water resources and cultures, water scarcity threatens socio-economic development and environmental sustainability. The WRC will continue to support and encourage new research initiatives which adequately address these challenges and associated risks. Socio-economic challenges have been given a special focus from the previous funding cycle and this emphasis will continue in this cycle. As we embark on consolidating our strategy, evaluation and refining of our existing structures and instruments will be important to enable the WRC and the water sector to thrive in these challenging times. The R&D portfolios will continue to develop products and services geared to overcome the ‘cubed’ challenge (poverty, inequality, and unemployment). The branch will put emphasis on ensuring that knowledge solutions support growth (economic and social), the competitiveness of water-related industries and thus enterprises, and the continuous development of current and future water knowledge workers (especially researchers and students).

In addition, more emphasis will be directed, through R&D projects and other activities, toward influencing water-related behaviour and approaches to water use and management. The WRC will continue to generate knowledge that influences society and decision makers to be wise water resource users, while at the same time improving understanding of available innovation and the complexities of water management. The branch will pursue the generation and development of knowledge and tools to enable the water sector to overcome inefficiencies in the use of water resources, and promote those practices and technologies that will result in high water security or high availability and access to clean water. To attain the above, the R&D branch has begun to look at its research and development portfolios, with the intention to align them to what the WRC intends to achieve by 2035 and beyond. The competitiveness of the aspired products and services in relation to their value or relevance to the water and related sectors will be given special attention when selecting and allocating resources to projects/portfolios, as shown in Figure 8. The Knowledge Tree and the Lighthouses provide guidance on critical areas to focus on in addressing the cubed challenge. Figure 8 shows the possibilities we have to advance the organisation’s strategic focus/objectives, using budgetary allocations to promote a paradigm shift in research and development (from a big ‘R’ and small ‘d’ to small ‘r’ and big ‘D’).

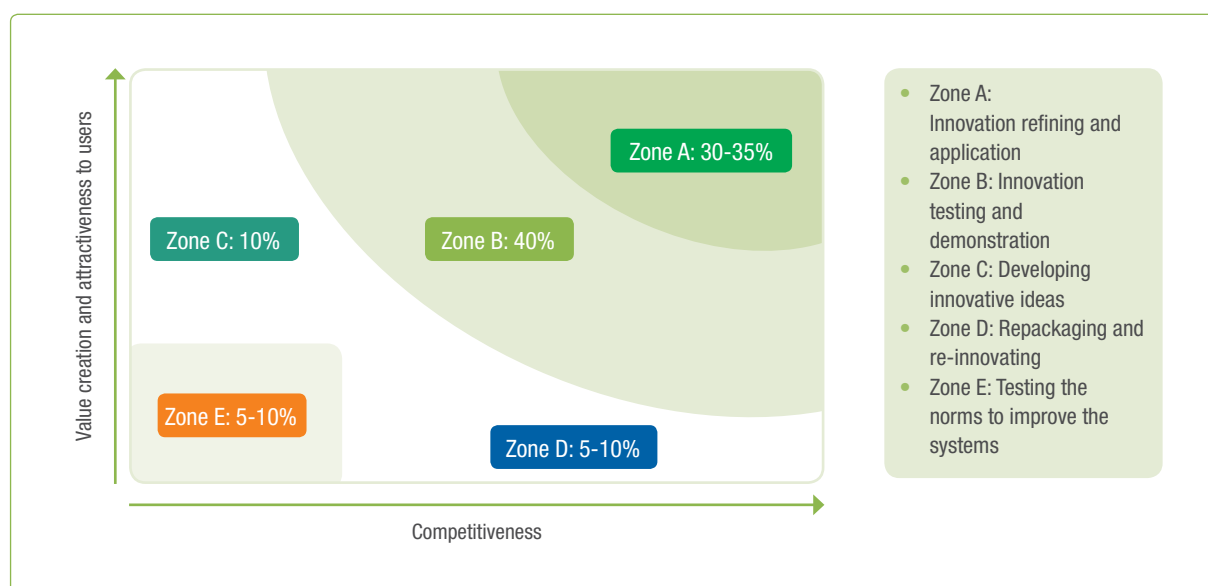


Figure 8. Investment plan for new projects in the Research and Development Branch



The branch will ensure that all innovative ideas are given a chance to be developed, explored scientifically, and tested. This will be made possible by ensuring that the R&D branch work closely with Innovation & Impact (I&I) and other branches in the WRC. All four P's in the WRC corporate strategy will be implemented in the operations and practices of our branch. The branch will continue to seek more relevant partnerships, addressing people's needs and ensuring that the WRC is properly positioned to fulfil its mandate.

### 6.3 Priorities for R&D

In the next 5-year cycle, the R&D branch will focus on consolidation of the corporate strategy. This will include paying special attention to and promoting knowledge and innovation production in five identified main priority areas (see Figure 9): supporting the **Implementation of the Water Research, Development and Innovation (RDI) Roadmap**; **improving operation and maintenance** in the sector, supporting efforts to develop and **expand the water industries** (family); ensuring the WRC is well positioned as a **global water-and-science leader**; and to support our country and Africa to **achieve the water-related SDGs**.

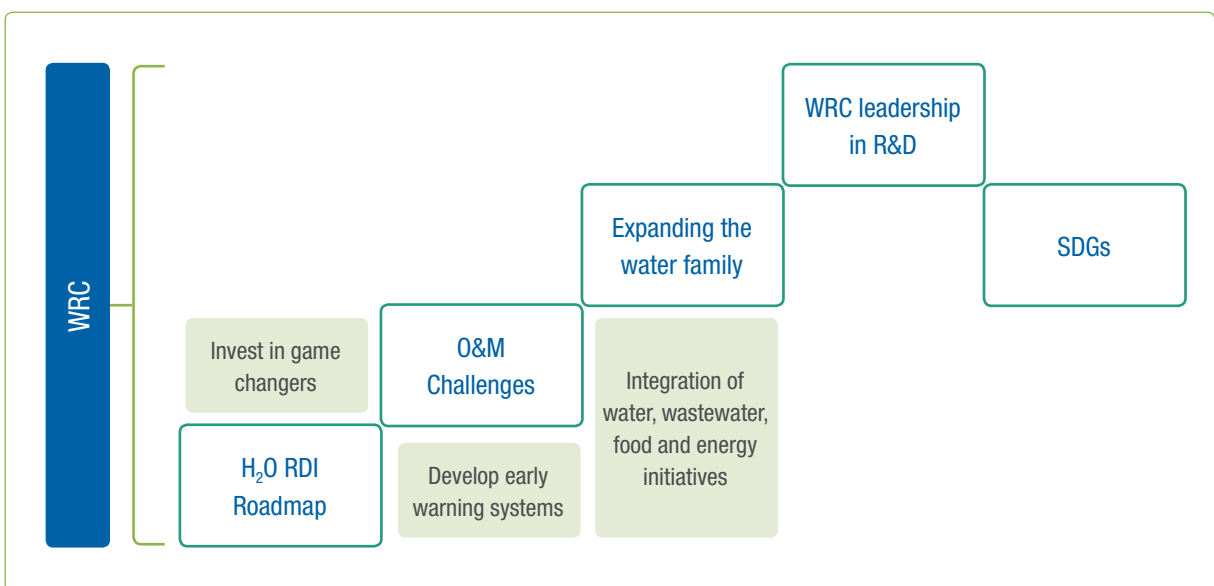


Figure 9. New priority areas to be focused on by the R&D branch

### Implementation of the Water Research, Development and Innovation (RDI) Roadmap

The Water RDI Roadmap is a programme initiated by the Department of Science and Technology (DST). The WRC was appointed by DST to develop the programme on the Department's behalf. The RDI Roadmap has been endorsed by the Science and Technology Parliamentary Portfolio Committee and has been adopted by DWS and included in the R&D chapter of the NWRS-2. The WRC, like all other institutions in the water and science sectors, regards the Water RDI Roadmap as an important project to be supported through the initiatives of the WRC. The R&D portfolio will address all seven key areas identified in the Roadmap. These include all issues relating to **water supply**, such as: increase ability to make use of more sources of water, including alternatives; improve governance, planning and management of supply and delivery; improve adequacy and performance of supply infrastructure; and run water as a financially sustainable 'business' by improving operational

performance. Regarding **water demand**, the RDI Roadmap identifies the following to be pertinent to South Africa: improve governance, planning, and management of demand and use; reduce losses and increase efficiency of productive use; and improve performance of pricing, monitoring, billing, metering and collection. The Water RDI Roadmap will be implemented or supported in the WRC in consideration of other identified critical areas such as prioritizing investment in the 'game-changers'; and developing and improving our early warning systems. There is a suite of Lighthouses that will effectively address the Water RDI Roadmap. In addition, the WRC has identified additional Lighthouses to ensure research concentration on issues that relate to people or society, i.e., Water Behaviour, Water and Big Data, Water ICT, and Water Scarcity and Extreme Weather Events. These Lighthouses and others are described in detail in subsequent sections. The Water RDI Roadmap guides the water sector and others to address the entire water value chain, as shown in Figure 10.

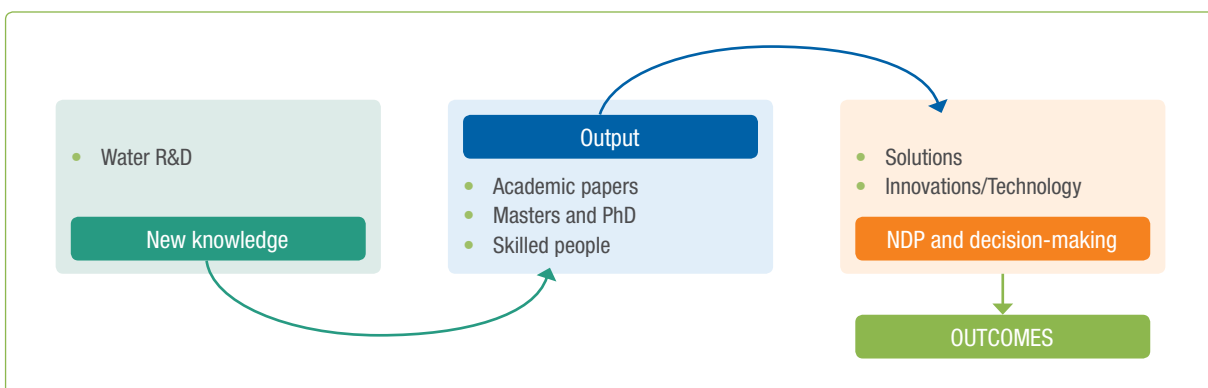


Figure 10. Water RDI and its contribution in the entire water value chain





### Improving operation and maintenance in the sector

WRC-funded projects will need to address identified operation and maintenance (O&M) challenges in the water sector. The R&D outputs of the WRC are aimed to inform policy, empower decision makers with credible world-class knowledge, and support training of water service providers/workers so that O&M challenges can be resolved resulting in all systems running efficiently and optimally. This will be advanced, among others, by producing tools and guidelines for use by practitioners and also materials that can be used for training. The WRC will continue to partner with other national and international agencies to start and implement R&D initiatives which address identified O&M challenges.

### Expand the water industries (family)

The WRC will continue to invest in and promote identified or developed 'game-changers' in the water and sanitation sector to promote sustainable socio-economic growth and development. The R&D branch has a unique role of ensuring the production of new knowledge and innovation required to advance this cause. New knowledge, tools and innovation will enable the establishment of new enterprises in the water and associated sectors. New knowledge and more water enterprises will assist in addressing the cubed challenge (poverty, unemployment, and inequality).

### Global water-and-science leadership

It is the desire of the WRC to be a global water node and a national/regional water hub. This requires us to be positioned appropriately in the local water sector and in the global arena

in water science and technology development. While the WRC is already a key global and regional player on water, CP17 emphasises the commitment of the R&D branch to implementation of the four P's (people, partnership, paradigm shift, positioning) as strategic tactics to advance its leadership in water and sanitation. The R&D branch will continue to identify and support research, development and innovation that can be uniquely identified with the WRC. The WRC is well positioned to lead in areas or matters that are unique to South Africa, Africa, and the developing world. We have shown that kind of leadership in the past by leading the world in research such as cloud seeding and fog harvesting, alternative sanitation, desalination, environmental flows or water requirements, irrigation water saving, and many others.

### Achieving the water and sanitation-related Sustainable Development Goals (SDGs)

The WRC will support the Government and Africa's initiatives geared towards achieving SDGs, especially those that relate to water, sanitation, and ecosystems. The WRC will continue to initiate relevant projects to address identified knowledge or innovation gaps in water and sanitation. More effort will be made to integrate initiatives about water, wastewater, sludge, food and energy research, to attain sustainable gains or benefits addressing SDGs. The R&D branch will work with I&I and DWS to ensure that available tools and materials are distributed and used by all relevant stakeholders to resolve water, sanitation, food, energy, and other environmental challenges in South Africa and Africa.



# [ 7. Key Strategic Area (KSA) strategic objectives ]

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## 7.1 Water Resources and Ecosystems

### Scope

This plan presents the new Key Strategic Area: Water Resources and Ecosystems, which is a combination of the former Water Resource Management and Water-Linked Ecosystems KSAs. New thrusts and programmes have been developed unifying the various components of the previous portfolios and redirecting them to enable the WRC to respond to current challenges and trends related to water resources and ecosystems. In addition, attention will be given to national, global and water sector related plans, roadmaps and goals. Inter- and intra-branch coordination and collaboration is encouraged to improve return on investment and to increase uptake of research and development outputs. The portfolio will be enriched with projects and activities that will stretch the KSA further across the research, development and innovation value chain. Innovation is a key growth driver in the form of new and improved products, processes and services, underpinned by a strong science and technology foundation.

Water resources include watercourses, surface water, estuaries and aquifers and, together with the related ecosystems, are best managed based on a hydro(geo)logical boundary, while taking into account administrative boundaries. Integrated water resource and ecosystem management calls for an improved understanding and quantitative description of the interactions between the different components of the hydrological cycle (atmosphere, surface and subsurface) and linked ecosystems. Water Resources and Ecosystems will focus on hydrological and ecosystem processes, management, and protection, through social, institutional, economic and technological interventions at the appropriate scales. Benefit derivation from our water resources and ecosystems will enable meeting a variety of outcomes, such as the WRC's Knowledge Tree and Government Outcomes, for the benefit of society, the economy and the environment. The discipline-specific approach to solving water challenges is important but on its own cannot address current environmental problems

and complexities. A coordinated approach that links various disciplines is important and achievable through the formation of strategic partnerships, positioning and coordination.

Product and process innovation are encouraged within the new KSA. Innovative and empowered institutional arrangements and responses will ensure the implementation of resilient coping, adaptation and mitigation measures. The use and development of water resource technologies will be encouraged to ensure cost-effective and reliable data and information collection, processing, storing and modelling of these systems. Technologies that will enable in-situ water quality remediation and treatment will also form part of the research portfolio.

### Strategic objectives

The strategic objectives (Table 6) have embedded in them all of the elements of the WRC's Knowledge Tree and at the same time aim to enhance the development focus to ensure higher resource security and improve livelihoods in and around water and related systems. Fostering research and implementation partnerships at all levels will ensure that we create not only a robust science system but also a customer base for our research, development and innovation outputs. High-impact, outcomes-based projects will form the basis of the portfolio while funding R&D projects that are complementary to existing products and solutions for maximum impact. Solutions exchange will be encouraged through a complementarity model as well as through process improvements with relevant stakeholders. The portfolio of projects will continue to build capacity at all levels and ensure that this capacity is maintained in the sector and beyond.

In order to improve water security, a competent portfolio that will diversify South Africa's water supply mix and develop processes and technologies that will enhance and embed resilience in water resource and ecosystem use and protection will be built.

Table 6. Water Resources and Ecosystems strategic objectives

Strategic objective	Description of strategic objective
To establish better governance models aimed at facilitating equitable, productive and sustainable use of water resources and ecosystem goods and services	Typical areas related to water management reforms and the related governance aspects that will be covered include: governance at the national level, water sector legal frameworks and broader institutional arrangements, transparency and accountability, civil society participation and the equitable provision of access and services. The sustainability of installed schemes ultimately depends on how we operate and manage these schemes or interventions. Governance is a crosscutting issue within the water sector but also needs strengthening across the energy, agricultural and mining sectors to ensure sustainability as well as integrating the activities of departments responsible for water (DWS, CoGTA, DAFF).
To improve our understanding of hydrological and ecosystem processes that will enable efficient management and decision-making	This Thrust focuses on developing a scientific understanding of the hydrological cycle and inter-linkages in order to promote systematic water assessment and planning. Sound water resource assessment and planning can only be achieved with reasonably accurate and consistently recorded and processed data and information.
To improve environmental and climate change resilience and disaster and risk mitigation through improved understanding of the atmospheric, water, land and people interactions	The Thrust will address research to improve our understanding of the connectivity between land, water, atmosphere and people. Any change induced to the environment through natural and anthropogenic means may have an impact on the biophysical and socio-economic environment, ultimately affecting resource use, and should be assessed to be able to quantify the risks, determine response and adaptive strategies while implementing IWRM. The Thrust will also focus on movement of people (migration), changing land use and response of aquatic ecosystems to these population dynamics.
Converting natural assets into societal, economic and environmental benefits whilst maintaining healthy trade-offs	This Thrust is focused on research, innovation and development which specifically address tested sustainable management tools necessary in natural systems decision-making, and guide sustainable utilisation of these systems for the provision of the benefits that people depend on. Central to this is the need to manage the social and economic requirements of society from natural ecosystems and the implementation of policy and legislation. Outputs from research should contribute to improving the lives of people while also contributing to improving the condition of water resources and the environment at large.
To provide innovative solutions for water and ecosystem degradation and depletion and its impact on public health	This Thrust will focus on research on water resources (rivers, dams, groundwater) and their quality in terms of chemical, biological and ecological health as well as flow and how it links to or affects quality. The health/quality of these resources have an effect on water users (domestic, recreation, ecological, traditional, religious, industrial, mining and raw water abstraction) and similarly the users have an impact on the resources. There is a need to focus on research and development as well as innovative tools for monitoring, modelling, and the prediction and early warning of impacts.
To provide applicable and marketable technological solutions that will enable improved management of water and land resources	Use of electronics, earth observations, early warnings, numerical models, remediation technologies, sampling and analysis technologies, as well as innovations critical in water resource protection will form a key component of this Thrust.



## Portfolio analysis

The portfolio will build on a rich research and development foundation that will draw from WRC and other research organisations' outputs. Key milestones have been the development of planning tools such as the WR2012 products and governance provisions for the sustainable management of water resources. There has been a steady decline in hydrological and related observed data and issues with the acquisition of long-term weather and climatic data. Water resource management and decision-making relies on up-to-date and spatio-temporally significant datasets. An understanding of the data and information landscape in South Africa and how to overcome the challenges associated with it has been a key focus area. The WRC is developing, out of these products, an innovation strategy to revive and enhance data and information collection (monitoring), management and usage. The revamped KSA portfolio will, in the short term, focus on improving our data and information systems. This can also be used to develop robust remote-sensing techniques and numerical models to assist decision-making with sparse datasets over larger areas. A new thrust will be created that will focus and concentrate technological developments that are implementable for improved management. Adaptation and coping mechanisms associated with extreme events also need robust and up-to-date data and information to ensure adequate management of water and land resources. Engendering key partnerships in this domain is a priority.

The diversification of the country's water supply mix from traditional surface water resources and rural groundwater supply schemes remains a key strategy for implementation through innovative solutions. Environmental change, especially climate change and variability, is a key challenge in managing water resources and the research portfolio is building towards developing coping and adaptation strategies through the understanding of weather and climate processes and patterns as well as the concomitant impact on water, land and socio-economics. A key focus will be to develop innovative real-time early warning systems and reporting tools that will enhance prediction and intervention capabilities at all levels. This work directly supports the following Lighthouses:

- 1) Water Scarcity and Extreme Weather Events;
- 2) Water and Big Data; and
- 3) Climate Change.

Water quality and water resource protection remain key challenges to sustainable water supply due to the impacts of, among others, environmental changes, rapid urbanisation and poor land-use planning. Understanding pollutant fate and behaviour remains a key focus as it allows for strategic, technological and non-technological/social interventions, to protect the environment and public health. The portfolio will also significantly contribute to the Water Quality and Health Lighthouse as well as the Water–Energy–Food Nexus Lighthouse, through the unconventional gas research headed by the WRC, for example.

Unlocking water resources and ecosystems for societal and economic benefit through enhancing the developmental focus of the portfolio will be a strategic deviation from the previous ecosystem portfolio. However, key research questions will still be pursued that will ensure that water-linked ecosystems are protected and that trade-offs are sustainably managed. The development of land and water can be made profitable, productive or useful if supported by proper strategies, tools and a good understanding of the environmental limits. Through the application of green and blue economy principles, a new economic growth paradigm is envisioned that is friendly to the Earth's ecosystems while contributing to poverty alleviation over multigenerational timescales. To this extent, a Lighthouse called Green Village and Economy will be continued in order to prioritize and concentrate green innovations aimed at making an impact on society and the economy through partnerships.





## 7.2 Water Use and Waste Management

### Scope

The **Water Use and Waste Management** KSA focuses mainly on water usage and wastewater management in the domestic, industrial and mining sectors. It aims to proactively and effectively lead and support the advancement of technology, science, management, and policies relevant to water supply, waste and effluent management, for these sectors. This KSA also supports studies on institutional and management issues, with special emphasis on the viability and efficient functioning of water service institutions. Research on infrastructure for both water supply and sanitation is included. A further focus is on water supply and treatment technology serving the domestic (urban, rural, large and small systems) as well as the industrial/commercial and mining sectors of our economy. This KSA encompasses waste and effluent as well as reuse, recycle and recovery technologies that can support the municipal, mining and industrial sectors and improve management in these sectors with the aim of improving productivity and supporting economic growth while minimising the negative effects of economic development on human and environmental health.

The provision and supply of water of adequate quality and quantity for economic and public health purposes remain continuous challenges. Water is a finite resource and, specifically in the context of South Africa, is becoming incrementally scarce. Managing water use and the waste released to the water environment is thus of paramount importance to ensure the sustainability of the resource and the activities relying on it. Water use and waste management in South Africa is consequently a key factor for social and economic growth, as well as for our environment. The entire way we think about and use water is thus an important factor in determining our future. In recent years, the focus of the KSA has been on supporting the implementation of various pieces of legislation that impact on the provision of sustainable water services. This support was in the form of unpacking and understanding key elements within legislation and the impact on the water services sector. The result has been a bias towards developing guidelines and tools to assist new and emerging municipalities and politicians to understand their responsibilities, which also included repackaging information of a technical nature. In the process, we have maintained a balance with dealing

with cutting-edge technological advances and have been concentrating on their application and commercialisation. Developing innovative processes and technologies for water purification, reuse and treatment of wastewater from domestic to industrial and mining activities has been and is of even greater importance to our country, especially in the light of problems related to the deteriorating quality of our water resources and the rising costs and reliability of energy. Considering the emerging challenges, research in the KSA will continue to focus on greater innovation and development of cutting-edge technologies to respond to the issues of poor O&M, competency and capacity constraints, reuse, energy efficiency, climate change constraints, emerging contaminants and the aspect of drinking water quality. The next 5 years will be about building better resilience, responses and earlier reactions to water security.

A key emphasis for the KSA over the next 5 years, 2018/19–2022/23, will be in accordance with the core WRC strategy to shift the attention of WRC activities and research into the domains of application/demonstration and uptake. We believe that the KSA is ideally placed to be a key feeder of innovative technologies and processes. In this regard the following key focus activities are planned:

- Initiating and ramping up the concept of ‘innovation challenges’; two of these initiatives are already in planning and execution, namely the WaterSmart Fund and Sanitation Innovation Fund
- Further integrate and enhance objectives of the WRC Lighthouses
- Increasing innovation and technology demonstration, and at places at scale; key activities which are in place in this domain include sanitation technologies, AMD, and drinking water solutions
- Supporting technology advice and guidance
- Linking innovation solutions to industrial and commercial pathways
- Increasing our attention to provide greater support towards O&M activities, which may also mean extending our processes to support training and capacity building

Through these processes and interventions, we envisage developing a more vibrant and responsive area which will be able to address both long-term research needs and short-term solution requirements. We hope to achieve the balance of this strategy through our programmes and thrusts.

## Strategic objectives

The primary objective of this KSA is to provide knowledge and innovation that ensures reliable, affordable and efficient water use and waste management services to enhance the quality of life, and contribute to economic growth and improved public health.

The secondary objectives are to:

- Improve the management of water services in both rural and urban areas
- Develop appropriate technologies for improving the quality and quantity of our water supplies for both domestic use and industrial applications
- Develop new approaches to manage and enhance hygiene and sanitation practices
- Provide appropriate, innovative and integrated solutions to water and waste management in the industrial and mining sectors
- Develop innovative technologies and applications for improved treatment of wastewater and effluent and improve processes for enabling increased reuse thereof
- Improve health, economic and environmental conditions, while supporting the development of appropriate technologies and socially-focused management practices related to water and effluent management

### 7.3 Water Utilisation in Agriculture

The strategic objectives directing the research and development activities in the portfolio of projects in the KSA: Water Utilisation in Agriculture are explicitly aligned to or in support of achieving the first four Sustainable Development Goals (SDG's) for the period 2015–2030. The report by the 2016 World Economic Forum highlights that two of the most interconnected risks are profound social instability and structural unemployment. According to the 2017 Global Risks Report, environmental risks influencing water use for food production are more prominent than before. Furthermore, in the strategic context of the R&D strategy of this KSA, it is shown that the top four interconnected SDG's guide the prioritisation of research to address sustainable production and reduce poverty, unemployment and inequality. Priority attention is therefore given to investment in research and development for knowledge creation and diffusion, as well as training for knowledge application and skills development of, in particular, homestead food gardeners and smallholder farmers. The focus for research, technology exchange and implementation, to exploit the benefits of research-based knowledge generated in this KSA, is purposefully directed

towards overcoming poverty, hunger and malnutrition and promoting resilience amongst members of the rural and urban population.

Within the next 5-year planning period of CP18, and in continuation of CP17, the strategic direction in this KSA will be determined by the innovation cycle to achieve application and exploitation of the available research output. For this purpose, increasing attention will be given to knowledge dissemination targeting a range of end users in agriculture. The actual impact of existing and new research output will be increased through public and private partnerships and establishing Africa-wide as well as international linkages. The strategic focus for research and development is on increasing the system of knowledge for efficient use of water for production of food, forage, fibre, and fuel crops; improving food security, reducing poverty and increasing the wealth of people dependent on water-based agriculture; and ensuring sustainable water resource use. The requirements of present and future generations of subsistence, emergent and commercial farmers are addressed through creation and application of water-efficient production technologies, practices, models and information systems within the following five interrelated sub-sectors of agriculture:

- Irrigated agriculture
- Rain-fed agriculture
- Woodlands and forestry
- Grasslands and livestock watering
- Aquaculture and fisheries

The challenge for applied research and development is contributing to finding sustainable solutions for water use in agriculture, with priority given to innovative new products which support economic development and inform decision-making for private business and public policies. In the process of undertaking these research and development projects, the composition of research teams endeavours to increase representivity of Black and female researchers. Post-graduate students are trained to improve the expertise of human capital and encourage young scientists to choose a career in water research, while on-farm and participatory action research leads to empowerment of individuals and groups in rural communities.

## Strategic objectives

In execution of the WRC's mandate and functions, the strategic objectives for research on and development of Water Utilisation in Agriculture are indicated in Table 7.

Table 7. Water Utilisation in Agriculture strategic objectives

Strategic objective	Description of strategic objective
To increase the biological, technical and economic efficiency and productivity of water use	The primary objective is to increase national and household food security, improve livelihoods of people and increase efficient growth as well as equitable distribution of wealth on a farming, community and national level. The major challenge is to produce more food with the same or less water. This requires empowerment and capacity building for all farmers, especially women, with knowledge and practical skills for correct investment, marketing, production and financing decisions and actions. In this process, hunger must be eradicated, poverty reduced, new small farming businesses established and existing profitable farming enterprises maintained. Over the long term, sustainable agricultural activities and employment opportunities in rural and urban areas must be achieved, which implies obtaining benefits for people who are presently using water for food production, without compromising future benefits in food value chains.
To reduce poverty through water-based agricultural activities	
To increase profitability of water-based farming systems	
To ensure sustainable water resource use through protection, restoration and reclamation activities	

### Portfolio analysis

Accordingly, a holistic systems approach is followed for knowledge creation and dissemination to enable people to utilise water in a sustainable way for food production and improved livelihoods. Research and development projects are managed within the innovation cycle to ensure that scientific research is applicable, and economically and socially beneficial. Key issues being addressed are the productivity of water use for crops and livestock, poverty reduction and wealth creation in rural areas and prevention of resource degradation. These efforts are aligned to the Vision for 2030 of the National Development Plan; the outputs for Outcomes 7 and 10 in the Programme of Action announced by the Presidency; core water strategies of the NWRS-2; measures in the framework for the New Growth Path; and the National Agricultural Research and Development Strategy. Recent reports by the FAO further emphasise that food production is essential to achieve better nutrition and health for improved human and economic performance.

Research and development work will continue to fill knowledge gaps that exist in the utilisation of water in agriculture, in relation to the following key priorities of the research portfolio:

- Increasing the productivity of rainwater and irrigation water for crop and livestock production
- Uplifting rural economies through commercial food production and reducing income inequalities
- Quantifying the water footprint and identifying employment opportunities in food value chains
- Eradicating hunger and reducing poverty
- Improving food security, nutrition and health
- Generating alternative sources of renewable energy
- Preventing soil and water degradation and pollution
- Adapting farming systems to climate change

### Focus for future knowledge investment

This KSA is actively working towards achieving a balance between projects in irrigated and rain-fed agriculture, agro-forestry and aquaculture, to promote farmer involvement in poor rural communities through participatory action research, and to take research projects further toward practical application of results with technology transfer activities. In order to promote development, increasing contributions are made to implement available research-based knowledge in co-operation with partners in the public and private sectors. Building on the baseline of completed and ongoing projects, the priority themes previously approved for research and technology exchange for development starting in 2018/19 are as follows: Irrigation and drainage management to reduce the impact of extreme events or mitigation of droughts and floods; water use and relations of pecan nut trees/orchards; assessment of the basis of water allocation (related to estimating water use for crop rotations) on selected water-stressed irrigation schemes in humid, semi-humid; semi-arid and arid areas; quantifying water use partitioning in order to increase efficiency of water use and potential water saving at farm level by combining technologies, e.g., nets and mulching for apple fruit production; assessment, enhancing/capacitating and enabling entrepreneurial involvement of women and youth in sustainable agricultural water management for food production, employment and establishing small business opportunities; further improvements to the risk-based approach for assessing irrigation water quality guidelines; development of a risk-based approach for assessing livestock watering and aquaculture water quality guidelines; evaluation of the management and impact of the quantity and quality of water for new agri-parks in selected provinces of South Africa; knowledge dissemination, technology exchange, training and demonstration of specified topics/

themes in agricultural water management to encourage uptake and implementation of water-research based knowledge; and knowledge dissemination of technologies and practices for improving water productivity of rain-fed cropping systems.

A stakeholder consultation workshop was held on 20 July 2017 and the following themes were identified as needs and prioritised for proposals of research and development projects starting from 2019/20: Assessment of impact and control of aquatic weeds in irrigation dams and canals; water use and water relations of different types of indigenous teas (rooibos, herbal, honey bush, etc.) in winter rainfall areas; assessment of rainwater harvesting from rooftops and storage for domestic, household, livestock and/or garden use and impact of water quality on human and environmental health; evaluating different techniques (e.g. canopy size reduction, deficit irrigation and partial root zone drying) for reducing citrus water use during drought periods and recovery time to optimal yields; assessment of the cumulative impact on quality and quantity of water resources of large-scale herbicide application for reducing bush encroachment in rangeland areas; investigation into the factors influencing under-utilisation of existing smallholder irrigation schemes and opportunities for improved future use; investigating the conjunctive use and management of surface and ground water for irrigation; water use of indigenous root and tuber food crops; review and assessment of sustainability of national-scale remotely-sensed ET estimates to quantify water use differences pertaining to commercial forestry in South Africa; determine water use of selected sub-tropical and deciduous fruit tree crops at industry/national level; application of drone technology for monitoring state of the crop to improve water use productivity with precision agriculture and improved irrigation scheduling; water-energy-food nexus as a sustainable approach for advancement of food and nutrition security or achieving SDGs 2,3 & 6 with specific attention to efficient energy use for food production; determine the impact of over-abstraction of aquifers through pumping and/or afforestation on crop cultivation and livestock grazing and watering as well as domestic water use on smallholder plots within groundwater-dependent ecosystems; technical and financial feasibility of alternative

energy sources (solar & wind) for irrigation; assessment and compilation of strategies and technologies for coping with significant drought in specific production areas and agro-climatic zones; technology exchange to encourage uptake and implementation of water-efficient water application technologies; review and development of guidelines for operating, maintaining and utilising water in small dams on farms and in communal areas with macro-rainwater-harvesting for agricultural production with special attention to drought mitigation; consolidation and update of existing crop factors and identification of missing crop factors into a national-scale database using existing field measurement results; promotion of rain-fed crops and associated best management practices through efficient water-use for food production to supplement irrigated crops; investigate the state of irrigation water losses and efficiency of irrigation water use for water supply to selected schemes, on schemes and on farm level for multi-purposes and single purpose water supply; strategy to unlock investment in ecological infrastructure and/or natural resource management in agriculture and mapping of areas where water can be released through change in land use.

The output of most of these projects will mainly contribute to the WRC Lighthouses on the Water–Energy–Food Nexus, Water Quality and Health, Water ICT, Water Scarcity and Extreme Weather Events, and Sustainable Water Behaviours.





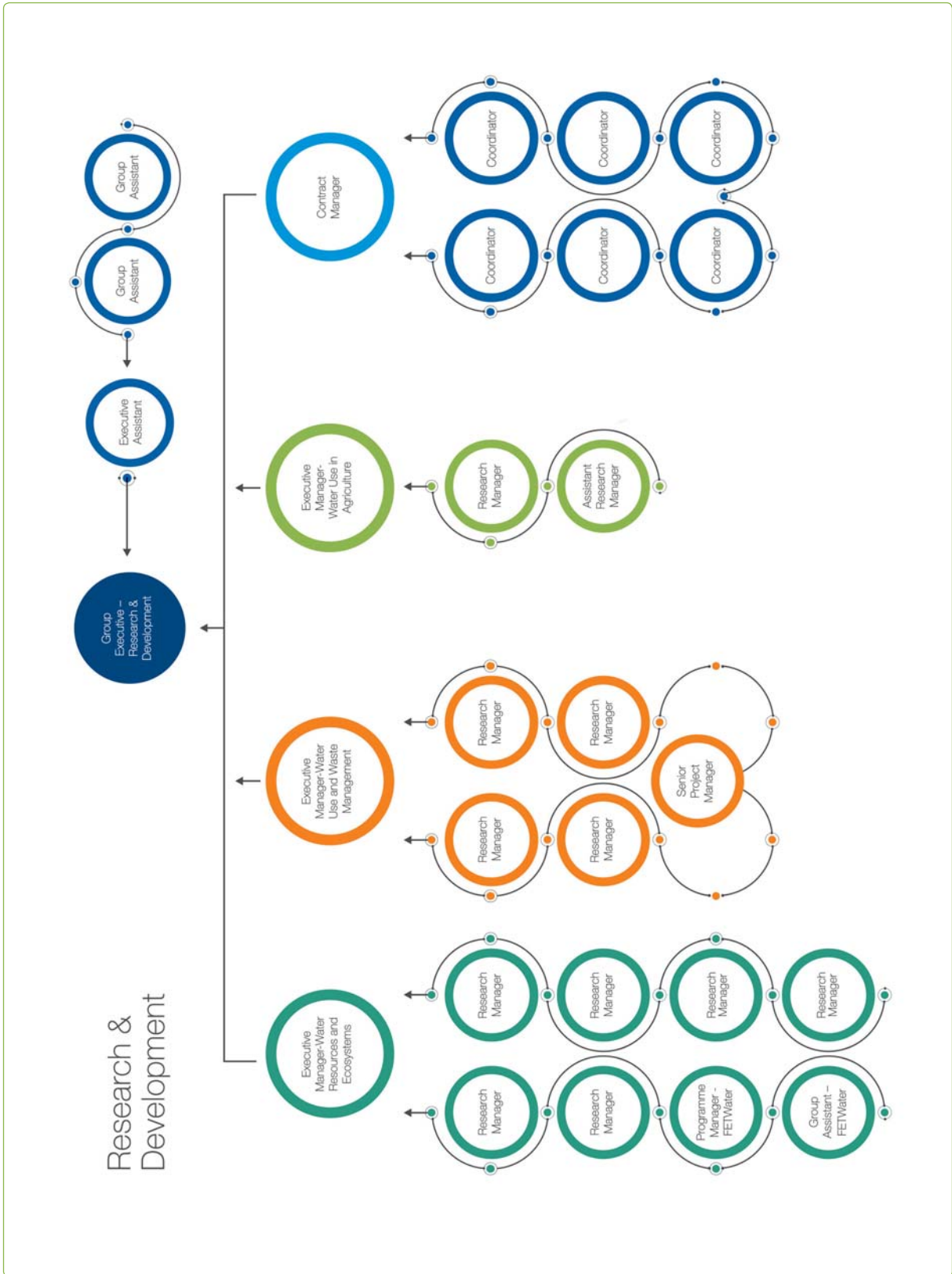


Figure 11. Research and Development Branch structure

# [ 8. The WRC Lighthouses ]

## 8.1 Climate Change



### Scope

The WRC Climate Change Lighthouse is undertaken through collaborative research on priority water-related climate issues with partnerships forged along the innovation value-chain to enhance water

research and development nationally and globally. The ultimate goal is to ensure empowerment of people for enhanced resilience, and development of the knowledge base for climate adaptation and decision support tools, together with guidance and a framework for sectoral response. Water is critical for development, economic growth and ‘a better life’ (SONA, 2015). It is a key factor for inter-sectoral linkages. Climate change impacts on water resources, and development cannot be undermined. Increased occurrence of extreme climatic events comes with negative implications for infrastructure, health, production and economic growth, amongst others. All of these have a negative influence on development.

Key issues of concern include extreme climate events (floods, droughts, landslides, heatwaves, wildfires, etc.), water quality and health, coastal zone management, water supply, groundwater recharge and the energy–water nexus. The role of this Lighthouse in climate-change response is embedded within adaptive capacity, resilience, improvement of early warning systems, reduced vulnerability and an improved ability to respond, coupled with proactive planning.

Implementation of this Lighthouse is cross-cutting in nature and requires a coordinated effort to address the consequences of a changing climate. Climate change capital (Figure 12) represents a cross-sectoral approach for implementation of the Climate Change Lighthouse. The approach will support a basic and applied research base for knowledge generation, innovation, capacity building and research for developmental impact. This will incorporate capacity development covering both research teams (and mentoring of upcoming scientists) and the recipients of the knowledge, interventions and innovations generated, including support for commercialisation of the generated technology.

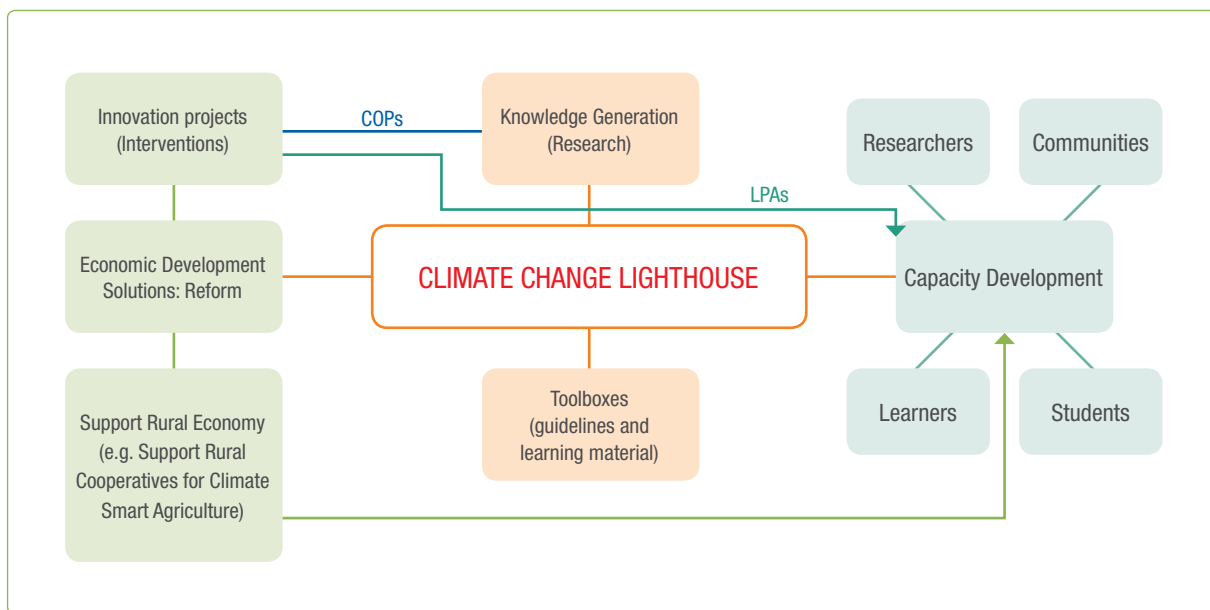


Figure 12. Climate change capital

Both national and international stakeholders are expected to contribute significantly in terms of knowledge creation, funding and strategic direction. The knowledge generated will upscale into adaptation intervention projects/actions and mitigation guidelines (Figure 13) in support of a climate-resilient economy. This will include sector and site-specific responses determined and guided by need, together with national policy perspectives (NDP/NCRP, Green Economy, and LTAS) and integration of climate response into IDPs and catchment planning. The outcome is expected to be a climate-resilient society with improved adaptive capacity contributing to climate-smart development that does not compromise economic and social development.

Since its inception this Lighthouse has adopted a multi-sectoral and multi-level approach towards securing the water sector's contribution to enabling South Africa to characterize and prepare to deal effectively with a multiplicity of existing stresses brought by climate change, through research embedded with capacity building. This involved bringing to the fore a portfolio of research covering the following themes:

- **Impacts of climate change:** A high priority was for the water sector, in partnership with other sectors, to research the development and support of appropriate institutions to refine and communicate climate-change

scenarios, projections, information and data together with identification and quantification of impacts.

- **Adaptation to climate change:** A water-sector specific research priority was for DWS-led collaborative research that would enable DWS and catchment management agencies to develop an integrated climate change adaptation response strategy, thereby mainstreaming adaptation within water resource management, nationally and regionally, with the overall aim of enhancing adaptive capacity.
- **Mitigation of climate change:** With relatively few exceptions, it was deemed that the water sector will not be responsible for taking the lead in mitigation-related research and development projects. However, the sector is clearly a stakeholder in other projects that have water use or water resource implications contributing to climate change mitigation. In such instances, the forging of inter-sectoral research partnerships with water sector participation is highly appropriate.

Over the past year, this Lighthouse has regained momentum by attracting the interest of stakeholders such as DWS, DEA, DAFF and catchment management agencies, amongst others, who are now actively participating in prioritizing strategic areas of research, participating in and evaluating progress of such research and its impact.

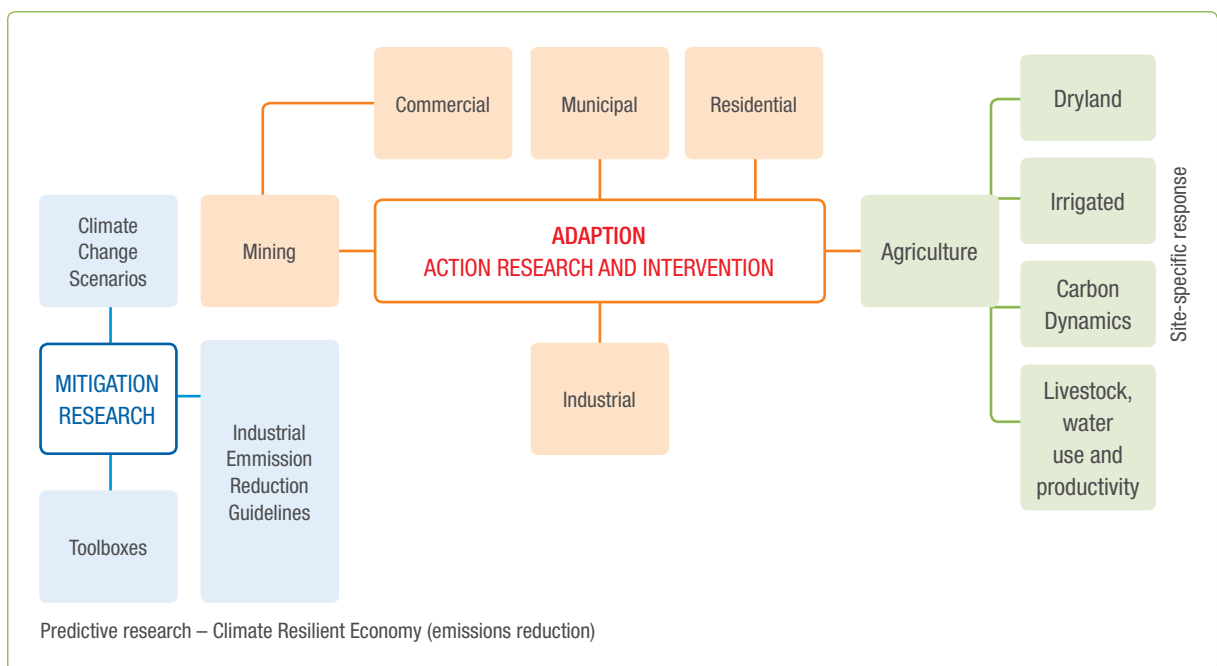


Figure 13. Representation of a climate-resilient society through coordinated cross-sectoral and water-linked climate change response

The Lighthouse’s research portfolio is composed of about 18 active research projects focusing on diverse fields: developing early warning systems for thunderstorms and floods for disaster management and aviation support, characterizing regionally extensive droughts and the influence of the ocean on inland climate with its impact on water resources, developing planning and decision support tools for climate hazards and predicting soil moisture–climate interactions under extreme events. The focus is also on determining the impact of climate change on aquatic ecology and defining the necessary response, which includes future impacts on fish distribution.

### Future plans

The WRC Climate Change Lighthouse is a primary vehicle to drive research and knowledge generation on climate change adaptation, response, characterization of change and risks/vulnerabilities and also to contribute to human capital development to improve sectoral adaptive capacity and future response. In the years that follow, the Lighthouse is expected to downscale its focus to the catchment and municipal scale, to translate the findings of research to an operational level, and to mainstream adaptive actions to enhance resilience and response to the impacts of climate change. The priority focal areas will include the following:

- Establishing new protocols for assessing vulnerability of existing infrastructure – models are needed that incorporate global climate science in order to improve their resilience

- Research on design of new water infrastructure for further development
- Develop climate change adaptation/mitigation guidelines focusing on the water sector to assist in mainstreaming climate change
- Develop cost/benefit models for adaptation approaches, evaluating these in a comprehensive way to justify adaptation choices, and valuing ecosystem services and the co-benefits of adaptation
- Research managing water quality and availability in the context of climate change impacts, focusing on things likely to occur as result of climate change
- Examine climate impacts on socio-economic impacts of water demand (e.g., municipal/industrial demand), focus not only on temperature and precipitation but also impacts on population shifts, migration, etc., that may drive water-intensive industry to relocate or change water use patterns (supply)
- Understand/identify indicators and thresholds of ecosystem services that affect water supply management (i.e., availability, infrastructure) (supply) at local scale
- Community-based innovation platforms and demonstrations for climate change response

It is, however, understood that climate change planning and response will over the long term be strategically adopted as part of business-as-usual in a quest to expand the interests of a climate-resilient economy and the realization of the Sustainable Development Goals.





## 8.2 The Green Village and Economy Lighthouse (Gv&E)



### The green economy

The 'green economy' is the economy that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. It is low-carbon, resource efficient and socially inclusive (UNEP, 2011). The recently hatched concept of the 'blue economy' is a subsidiary of the green economy, with a global focus on coastal and marine resources (UNEP, 2013). Due to the overlapping principles of sustainability, the WRC decided to pool these concepts under one umbrella, the Green Village and Economy Lighthouse (GV&E). Its purpose is to concentrate research where possible in selected catchments, catalyse action through appropriate green innovations, position the organization through leading dialogues and presentations (including international conferences), and to market and communicate innovative products in order to see implementation, most likely through partnerships. GV&E was established in 2013, with a main aim of research and pilot testing of green innovations for meeting basic needs and providing fundamental services to marginalized rural and peri-urban communities in focal catchments (pilot areas), on a sustainable basis and at an affordable investment cost.

South Africa, similarly to other countries, is committed to eradicating poverty, ensuring water supply and sanitation, securing food and energy, and protecting ecological infrastructure, biodiversity and ecosystem resilience. Some of these commitments are expressed in the SDGs, the NDP, and various other strategies. The pressure from impacts of climate change and degradation of ecosystems must be considered alongside the needs of increasing numbers of people without jobs (latest estimated unemployment rate is 26% (Stats SA, 2013)). Even though the predictions are that 71.3% of people will be urbanized by 2030 (UN World Urbanization Prospectus, 2014), the challenges of escaping poverty, unemployment and inequality are not likely to disappear as long as the economic growth rate remains less than 5% per annum (SONA, 2009). About 12 million people live in abject poverty, while more than 50% of aquatic ecosystems (ecological infrastructure) are degraded, rendering them less capable of providing the services they are expected to offer. In an effort to move

from poverty to prosperity, through knowledge acquisition and enterprise development, the WRC has prioritized the triple challenges of poverty, unemployment and inequality in CP17. Transitioning to a green economy is one of the key imperatives of Government (though this is clouded with numerous challenges, including disintegrated policies, and low uptake by society and business), as highlighted in the NDP. It is further recognised that there can be no transition to a green economy without green technologies and technological innovation (ASSAf, 2014). The GV&E will, through a serious paradigm shift, narrow the gap between innovation and application, build partnerships towards co-funding and implementation, influencing innovation through positioning via dialogues, conferences, and community interventions while centralizing the people, especially the 'game-changers' (youth), key in 'disruptive' innovation and enterprise development. Gender plays a core role, particularly in rural and disadvantaged communities, hence a prominent effort will be directed towards woman emancipation/empowerment, along with that of the elderly and people living with disabilities.

### Progress made

The Lighthouse has made good progress since 2014, albeit with challenges. Currently it is focused on restoration efforts (landscape greening) at the uMzimvubu (Ntabelanga/Laleni), Okhombe and uMngeni pilot sites.

### Activities in uMzimvubu and Okhombe

The Okhombe and Ntabelanga study sites are covered under one GV&E project (K5 2423): 'Improving socio-economic conditions of Ntabelanga and Okhombe communities through integrated green innovations'. This project was triggered by a DWS water infrastructure project to construct two dams, Ntabelanga and Laleni, in a highly erosive catchment. The risk of dam siltation is very high due to extensive landscape degradation and erosion. The investment at risk is estimated to be above R16 billion. DEA/DST/WRC have already established a scientific group to develop a 10-year Ntabelanga Research and Investment Strategy. DEA invested more than R450 million for operationalizing restoration tools. This positioned the WRC very well as the project on restoration and curriculum development form part of this partnership. Four students (two MSc and two PhDs) benefited from this ongoing project. The Lower Sinxaku School has been brought into the efforts, with students piloting various plants (productive) and vetiver, which if successful will be the candidates for rehabilitation. The planting of trees will then be taken

further through the establishment of a nursery, creating much-needed jobs in the village. There is full support by the school principal and teachers, and the local chief. Women make up the majority of attendees at the workshops and of trained personnel on rehabilitation trials.

In Okhombe, the GV&E project is investigating a mix of renewable energy generation tools, including biogas, which was initiated through a Water Utilisation in Agriculture KSA project. Societies in Okhombe rely on harvesting firewood, with dire soil erosion consequences. It is critical that research on the mix of energy generation at affordable prices be conducted. Fifteen households are participating in renewable energy action research/testing, giving regular feedback at scheduled workshops (again dominated by women). If accepted by society and found to be efficient, there is a room for entrepreneurship development around the discovered energy mix. Through this research, biogas reliance and efficiency will be investigated. Currently, biogas cannot generate energy throughout the year. Through partnership, the GV&E attracted R1 million in co-funding leverage from DEA/NRM (MoU).

### Activities in uMngeni

The uMngeni River has continuously failed to meet the escalating water demands of its major cities, Durban and Pietermaritzburg, threatening tourism and the cities' contributions to GDP. In uMngeni, GV&E has managed to strongly influence the development of the 'ecological infrastructure' concept. Currently more than 20 organizations, including government departments, conservation authorities, WWF, SANBI, DEA (Green Fund/DBSA), uMngeni Water, academic institutions, local municipalities and eThekweni Metro, to mention a few, signed an MoU to improve the uMngeni's water security, through testing the concept of **ecological infrastructure**. GV&E, in partnership with Green Fund/DBSA supported research on the role of business in ecosystem integrity and identification of ecological infrastructure hotspots, as well as costing required rehabilitation (estimated at R201 million for a quarter of the uMngeni catchment). GV&E is supporting this, through WRC Project K5/2354, titled 'Demonstration of how healthy ecological infrastructure can be utilized to support society through green economy'. Amongst other key objectives are: costing the impacts of pollution on business and the cost of water purification, due to degraded ecological infrastructure; and building institutional frameworks and facilitating stewardship. Through this GV&E project, more than seven students (ranging from Hons. to

PhD) have benefited. The WRC currently hosts the Chair of the uMngeni Ecological Infrastructure Partnership-Research Sub-committee. This committee has produced a draft uMngeni Research and Implementation Strategy. Through partnership, especially with DEA/NRM, GV&E has been well marketed and continues to reach out.

There are several other projects that have been initiated for different green innovations, such as citizen science water quality biomonitoring tools (K5/2350), targeted at empowerment of communities and schools. This project has been conducted in partnership with WESSA Eco-schools, a DWS-funded programme. Even before the tools were fully developed (E. coli count, rainfall gauges, ambient temperature, flow plank, transparency tube, MiniSASS-App), the innovation had already collected awards, and been tested globally, e.g., in Florida, USA, Mexico, South Korea, India, Kenya, Namibia and Lesotho. The project has attracted R1 050 000 from DST ecological infrastructure funds (MoU), in support of refinement of the MiniSASS App and development of a community of practice, so-called citizen scientists. The concept of citizen science for water resources has spread rapidly from KZN, to the rest of the country, and globally. Presentations on community water resource management have been made in South Korea, Mexico and, most recently, Italy (June 2016). People are at the centre of any ecological infrastructure and restoration initiative. In many cases, there is community capacity building, awareness and training required in order to bring society on board. This project has positioned the WRC through more than 20 workshops/training events, including farmers, traditional leaders, school pupils, and communities. The river rehabilitation guidelines (K5/2270) were produced and now support the WSD Lighthouse as it is being trialled in new developments. The 'green liver' project (K5/2367, Water Use and Waste Management KSA), is nearing completion of Phase 1, laboratory testing, in which specific plants responsible for absorption of specific pollutants are being isolated. This is fundamental in optimizing wetland filtration efficiency when undergoing rehabilitation. The technology will be tested on real field pollutants if funds are secured. Project K5/2353 is focused on harvesting of salt in Limpopo wetlands. The plan is to develop this project to full business operation, led by women. Other projects on soil erosion in uMzimvubu, as well as Project K5/1955 on Okhombe biogas, strongly supported this Lighthouse. The following were directed calls meant to initiate enterprise development and business in wetlands. Project K8/1088 was focused on developing Typha fibres

into various boards that can be used to insulate houses, ceilings, etc. Project K8/1079 targeted the development of amadumbe in the Mbongolwane wetlands into chips, as well as the promotion of crafts. Finally, Project K8/1089 was focused on selecting plants with medicinal properties.

### Future plans

With the exception of the river rehabilitation guidelines, all other projects mentioned above are ongoing, till 2018/19. Besides the current projects, further directed calls were made towards generating further new knowledge dedicated to supporting the green economy as from 2017. These include eco-tourism and business, unlocking business in the blue economy (coastal and marine focus), and the insurance value of ecological infrastructure. There are many aquatic plants with medicinal properties; these will be considered and given detailed investigation. Value adding from natural resources gives a strong motivation to communities to conserve the ecological infrastructure and threatened biodiversity. Energy generation from alien and invasive plants, i.e., converting a challenge to an opportunity, will be explored. There is an urgent need to develop guidelines on integrating green innovation in business beyond the site, i.e., inclusive of the catchment

where business is based. This helps the business achieve its corporate responsibility and societal approval. There are various funding opportunities which will be explored through marketing our innovations, such as DTI, NT, GEF, and Green-Fund/DBSA. Partnership with organizations interested in the green economy agenda, such as Green-Matter and Green-Space, will be explored to facilitate uptake of GV&E products. The WRC has identified the need to establish a community of practice around the green economy and restoration as well as a website to facilitate sharing of ideas in SA, Africa and globally. DEA is very supportive of this and has already expressed interest in it.

### Constraints

There must be a dedicated effort to attract and fund youth as game changers, especially on technological aspects of GV&E and indeed broader innovation. Partnerships take time to build as they depend on trust, which develops over a long time. There is a limited risk appetite to fund projects at the stage between innovation and commercialisation (the so-called 'valley of death') in the innovation value chain. The WRC needs to take the lead in this area by expanding special funds, similar to the WaterSmart Fund, to cover Water Resources and Ecosystems innovation projects.





### 8.3 Water–Energy–Food Nexus



#### Overview

Based on the report recently released by the World Economic Forum (WEF), a quarter of the world's human population already live in regions that suffer from severe water scarcity for at least 6 months of the year. The WEF report rated water crises as the largest global risk in terms of potential negative impacts over the next decade. Moreover, the water crisis has a significant ripple effect on the ability to ensure energy and food security. Water scarcity, energy shortages and food insecurity are among the major challenges facing Southern Africa, including South Africa. The three elements (Water–Energy–Food) cannot be considered in isolation as water is the key resource to energy generation and food production. Notably, crop production is the largest regional consumer of freshwater resources and currently consumes a lot of energy. Water, energy and food are inextricably linked as energy is required to produce and distribute water and food, to pump water from groundwater or surface water sources, to power tractors and irrigation machinery, and to process and transport goods. Water, in turn, is required to generate energy. This interrelationship is referred to as the water–energy–food nexus (Figure 14).

A properly coordinated water–energy–food nexus approach stimulates economic growth, serves as a catalyst for development, alleviates poverty and also reduces unemployment, as has been highlighted by several developed countries. There is a need for South Africa to

drive the water–energy–food nexus and also narrow the policy gap between water, energy and food security. This is vital, particularly where choices have to be made between land-use for agriculture (often food production) and mining (economic benefits and job creation), where both are strategically essential. As such a choice has to be made that can result in both employment and food production.

The community of practice and policy makers should emphasise the need for an integrated (nexus) approach to water, energy and food. South Africa has limited options; as a country we need to adopt the Water–Energy–Food Nexus to address challenges such as: (a) rapid urbanisation, (b) threats posed by climatic variability and change, (c) challenges that affect water and energy planning for economic development. The WRC has been at the forefront of championing the Water–Energy–Food Nexus through the Lighthouse initiatives that started 4 years ago. The Water–Energy–Food Nexus Lighthouse cuts across all of the KSAs within the WRC, comprising more than 25 projects. The majority of these projects address the interlinkages within the nexus, creating opportunities for the Water–Energy–Food Nexus to be championed in an integrated way.

#### Achievements

The Water–Energy–Food Nexus activities have been shared and highlighted on different platforms as part of information dissemination. For instance, two popular articles were published in the *Water Wheel*. On 29 April 2015, a paper was presented at the World Bank Water–Energy Nexus Thirsty Workshop in Sandton, Johannesburg. This Lighthouse will continue in 2017/18 to disseminate relevant knowledge about water, energy and food.

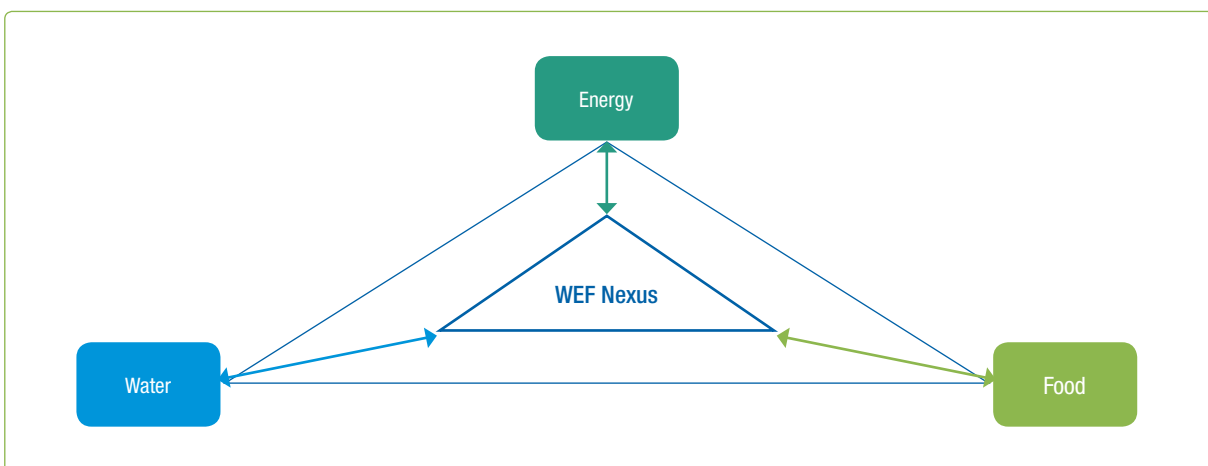


Figure 14. Water–Energy–Food Nexus



### Planned activities

Water, energy and food security are crucial for sustainable long-term economic growth and human wellbeing, and there are strong linkages between all three. Activities in one sector may influence or even constrain economic growth in the others. As has been highlighted several times, water scarcity, energy shortages and food insecurity are among the major challenges facing South Africa. The three cannot be considered in isolation as water is the key resource to energy generation and food production. Notably, in South Africa, the agricultural sector uses at least 62% of freshwater resources and currently consumes a lot of energy. Water, energy and food are therefore inextricably linked, and energy is required to produce food, pump and distribute water, power tractors and irrigation machinery, and to process and transport agricultural goods. This interrelationship is referred to as the water–energy–food (WEF) nexus. There are several initiatives planned for the following five years (2018 – 2023), including: (a) sharing and exchanging ideas on WEF across the globe; (b) establish the South African WEF nexus network; (c) conduct a state-of-the-art literature review on past, present and ongoing work on the WEF nexus focusing on current status, potential, challenges and opportunities for intersectoral WEF nexus planning, and paying attention to both technical and policy issues; (d) develop a programme/framework for linking the WEF Nexus to the Sustainable Development Goals (SDGs), placing particular emphasis on SDG 2, 6 and 7; (e) develop mechanisms for identifying local research champions for the

WEF nexus and development of a database of professionals working on the WEF nexus; (f) develop a national guideline and research agenda for prioritising WEF nexus research, development and innovation for South Africa – the agenda should align with international initiatives to allow South Africa to tap into global funding for the WEF nexus.

### Challenges

Challenges faced by the Water–Energy–Food Nexus Lighthouse are similar to those of other WRC Lighthouses. For example, there is a need to have a specific budget ring-fenced for the Lighthouse. There is an urgent need to move towards policy convergence as opposed to the current ‘silo’ approach which requires strategic engagement of the relevant departments at decision-making level. The WRC intends to coordinate this effort and requires support at political level. In this regard, a properly funded WEF nexus research programme, supported by projects across KSAs, and preferably those that promote implementation of innovation and involve different partners and stakeholders, needs to be developed. There is also a need for the WEF nexus to be linked directly with local, provincial and national policies, including the NDP. The contribution of the WEF nexus can be realised if research outcomes could influence future policies and strategies and at the same time support Sustainable Development Goals (SDGs) such as SDGs 2, 6, 7, 8 and 9, which all have targets related to WEF nexus activities. Currently this is not the case.



## 8.4 Water Sensitive Design



The current realities create a higher impetus to scale up the application of WSD in both rural and urban environments. We will continue to put greater emphasis towards training and capacity building, as well as demonstration projects with

municipalities and business. The Water Sensitive Design Lighthouse has been progressing well since 2013. The purpose of this Lighthouse has been to develop a critical mass of knowledge around the integration of planning activities for the adoption of more integrated and sustainable solutions using the water-sensitive design (settlements) lens for urban, peri-urban and rural environments.

Thus, in 2014 the Community of Practice programme (CoP) was initiated aimed at building awareness (Figure 15) and providing decision support by funding research and building capacity within the sector. In 2015, the WRC officially launched the concept to the broader planning community and water sector at the Khuluma Sizwe Series ‘Two Histories, One Future’ Dialogue, held in Johannesburg, at which the Framework and Guideline documents were shared. Under the CoP platform a total of 18 activities (dialogues, symposiums, seminars, conferences, etc.) are currently planned over the next 3 years (2018–2019) as part of the CoP awareness building and information sharing. However, this needs to be further strengthened and consolidated beyond 2019 through stronger partnerships and transformation of the

shared knowledge into demonstrations and implementation as a way of stimulating innovation for economic growth, thereby catalysing development to address challenges associated with poverty, unemployment and inequality.

On the research front, there has been continued support of feasibility and scenario-planning projects to build capacity and understanding of the principles through context-specific examples. The Lighthouse also set out to involve practitioners (water and spatial planners) from municipalities early in the process, and can report that the City of Cape Town and eThekweni Metros have water-sensitive design principles written into their spatial development and related policies, while the City of Johannesburg and City of Tshwane Metros are in the process of considering them. Through research, demonstration and engagement it is envisaged that these principles will be adopted, adapted and ultimately incorporated into planning, guidelines and policy. To date, outside the guidelines for sustainable drainage systems and water-sensitive urban drainage, two projects in support of water-sensitive design have been completed, with six projects currently progressing. The WRC will continue to support projects about water-sensitive design.

### Future plans

A major gap identified is the lack of water-sensitive design research capacity in South Africa and particularly of researchers dealing with the rural space. Moreover, the current CoP has been restricted to one region, the Western Cape. Thus, from 2017 until 2021 there is a need to support other research institutions interested in water-sensitive

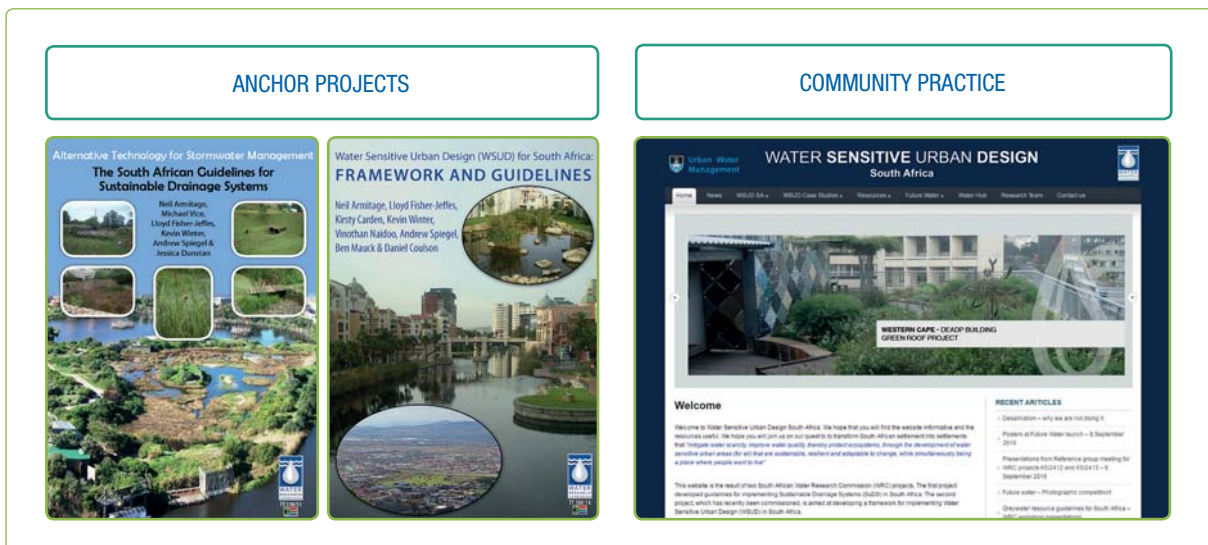


Figure 15. WSD awareness and communication activities

design in rural environments. In this regard, projects and pilots dealing with multi-functionality, diversification of the water mix, fit-for-use and the appropriate technologies will continue to be supported, encouraged and showcased through demonstrations and ultimately implementation. Furthermore, a key strategy will be to broaden the CoP footprint across the country in order to bring the focus to the rest of the country.

The DST Water Research Development and Innovation Roadmap and the Water Technology Demonstration Programme (Wader) will be key in driving partnerships for demonstrations and implementation. Hopefully, this will stimulate the necessary innovation for economic growth, an environment of competitiveness and prosperity that can be a catalyst to address challenges associated with poverty, unemployment and inequality.

## 8.5 Water Quality and Health



### Scope

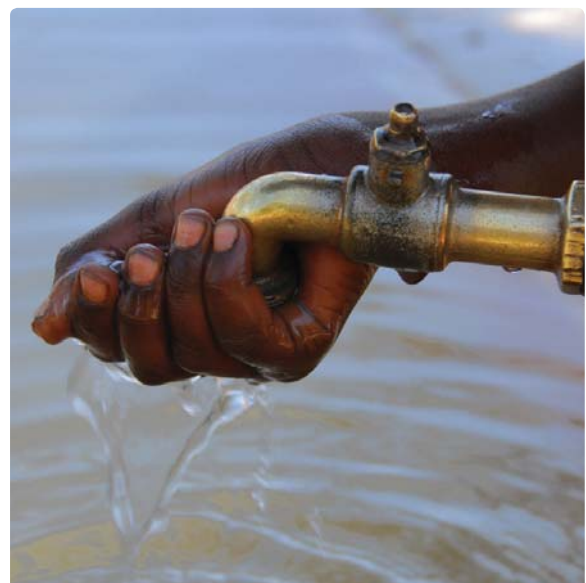
The Water Quality and Health Lighthouse is a cross-cutter within the WRC research KSAs as it is applicable to the entire water value chain and covers aspects of water resources, sanitation, drinking water, health and hygiene.

### Aims and objectives

The key aim of this Lighthouse is to serve as a research concentration space where all related projects across KSAs can be drawn together to make an impact in the national water quality and health space. The following objectives are to be met:

- Form **partnerships** with other research organisations addressing aspects relating to water quality and health (MRC, ARC, ICD, CSIR etc.);
  - Specific health partnership with the Department of Health (DoH) under environmental health, Institute for Communicable Diseases (ICD), National Health Laboratory Services (NHLS), CANSA, SA Renal Society, Medical Research Council (MRC) and Department of Environmental Affairs multi-stakeholder Committee on Chemicals Management (DEA\_MCCM)
  - The Government departments' partnership with CoGTA (SALGA), DoH, DEA, DAFF, DMR, DWS (CMAs and water boards)
- Establish and coordinate **communities of practice** (COP) in this field:
  - Focus on the specialist modelling COP focusing on water-land-ecosystems climate change prediction and early warning modelling

- Emerging and persistent contaminants COP focusing on the identification and prioritization of research needs in this area. This COP will also identify funding mechanisms and the lead department to take on specific aspects, including implementation, communication/reporting and funding
- Microbiological pathogen and waterborne diseases COP to focus on the identification and prioritization of research needs in this area. This COP will also identify funding mechanisms and the lead department to take on specific aspects, including implementation, communication/reporting and funding
- Guide the **research agenda** on water quality and health aspects
- **Communicate and disseminate** research findings in the right spaces through the relevant authorities
- Establish and maintain **international linkages** with GWRC, IMWI, FAO, NASAC (Network of African Science Academies)





## Knowledge dissemination

In this Lighthouse there will be a strong focus on knowledge and information sharing/dissemination. In this regard, there is a plan to do the following:

- WRC to take the lead in the reporting of water quality and health research findings to be shared with the relevant stakeholders and partners. This will be made possible by the development of an annual publication from the WRC on the Water Quality and Health Lighthouse research findings as well as a bi-annual research newsletter.
- WRC and partners to host an annual water quality and health mini-conference
- A national water quality and health dialogue/workshop focusing on pathogen and microbiological research to discuss the status quo of research and to develop a research strategy (as took place for chemicals research in 2016)
- A workshop is planned on the completed project: 'Investigation of the contamination of water resources by agricultural chemicals and the impact of environmental health: Volume 1: Risk assessment of agricultural chemicals to human and animal health'

## Future strategic focus

It is the vision of this Lighthouse through CP17 to strategically locate the Lighthouse within the greater South African space as a platform for:

- Increasing funding to the WRC where water quality and health research of national priority can be undertaken through partnerships, COPs and international linkages
- Use partnerships to enhance research funding sustainability and facilitate the implementation of research products, to improve impact
- Use the COPs and other stakeholder engagements to identify the long-term research strategy/action plan and to get better value by sharing of resources and creating the necessary skills and capacity
- Introduce and maintain an annual reporting mechanism/knowledge-sharing process through a newsletter, national dialogues, annual WRC publication and conference
- Undertake the national skills and capacity gap analysis (relating to laboratories, data management, models, early warning systems, ICT systems) that will support the national cause, including centres of excellence and laboratory services, as well as data management analysis centres





## 8.6 Water ICT



### Scope

This Lighthouse will incorporate the scope of the Water and Big Data Lighthouse to facilitate the integration of related concepts. Being a water-scarce country, the smart management of water resources in South Africa is

becoming important as the supply of clean, fresh water is steadily decreasing. In addition, the provision of related services remains an important national priority. It is apparent that many of the challenges faced by the water sector in South Africa require related foresight in order to design policies and strategies that exploit emerging and critical technologies for the benefit of sustainable development. Presently, there is already an established understanding on benefits of using information and communication technologies (ICTs) for development (ICT4D) across all sectors and all over the world. ICT has rapidly matured over the past half a century and the focus has shifted to application. Emergence of the mobile Internet (M-ICT) era has opened limitless opportunities for developing next-generation technologies as a result of the convergence of traditional ICT applications and the Internet. In the water sector, the integration of novel ICT-enabled products, tools and solutions has been identified as a key enabler for smart water management, consumption and governance.

With mobile technology penetration and adoption of mobile-to-web technologies in South Africa set to increase further by 2019, the water sector cannot miss out on this opportunity. This opportunity brings with it the potential to synergise with and contribute to the goals and objectives of the National ICT and Water Research, Development and Innovation (RDI) roadmaps. Thus, the main aim of the Water ICT Lighthouse is to serve as a platform for growing the knowledge and research base on the application of ICTs in the water sector, and to share current thinking and strategies of future technological development to advance development in the water sector. In this regard, the Water ICT Lighthouse, through the Wader platform, aims to:

- Coordinate related research, development and innovation activities, and increase access to and use of related knowledge and innovations
- Coordinate and facilitate engagements in ICT developments in the water sector
- Build relationships and establish collaborative partnerships with external organisations/individuals,

including drivers of innovations

- Strengthen the adoption of ICT-enabled solutions across all stakeholders (including public, government, private/non-governmental) and track progress towards supporting water sector objectives
- Strengthen capacity building in the sector and empower communities on the use of ICT

In recognition of the potential role of ICT in the water sector, the WRC has spearheaded a number of related projects on the development and use of ICT applications. So far, the work done at the WRC has demonstrated that ICT-enabled solutions have the potential to positively bring change in the way we manage our water resources and related services. Such projects have generated knowledge on the technological innovation concerned, demonstrated how it can be embedded into the sector for effective water management and services delivery; and provided recommendations on how it can be integrated into decision making and governance systems. Technologies such as satellite remote sensing, in combination with sensor and geographical information system (GIS) technologies, have been used as a smart tool for water resources management. For example, an integrated water quality management system (IWQMS) is being piloted in the Western Cape to obtain information in near-real-time about water quality, through web-enabled sensors and communication networks. The availability of the data on a timely basis is crucial for decision making in water resources management. There are future plans to develop this further into a water quality early warning system (EWS).

Smart metering technologies provide near-real-time information about water usage and such information can be used to shift consumer behaviour, detect leaks and have better control over water demand. The roll-out of smart water meters all over the country over the past 3 years is evidence that there is a sufficient knowledge base on the use of smart meters as an efficient solution to address the issues of water conservation and demand management, reduction of non-revenue water and improved customer service. The development of numerous mobile applications and platforms facilitates a two-way communication, and has changed the way water is governed and increased transparency in the sector. Examples in this category include: a municipal water supply reporting tool to improve water services delivery; miniSASS app – a simple tool which can be used by anyone to monitor the health of a river; and a number of decision support systems which enable the user

to make informed decisions on water resources planning and management.

Given the knowledge base that has been generated from these projects, interest in using ICT interventions in the water sector has increased immensely. However, despite solid evidence on the benefits of ICTs, the water sector has not geared itself up to make best use of the increasingly ubiquitous access to mobile technology. In addition, the lack of coordination in the water sector has hindered access to and use of big data to provide the needed intelligence for managing water resources and provision of related services. Thus, the short- to medium-term actions for the Lighthouse are as follows:

- Conduct a status quo and track the emergence of innovative ICT applications in the sector

- Document the relevant experiences of key ICT applications (both failures and good practices) in the water sector
- Identify opportunities, constraints and enablers for ICT adoption and scale-up in the water sector
- Facilitate stakeholder engagement, dialogues and knowledge dissemination, and bring together partners in such a way that breakthrough/sector-shifting technologies can emerge
- Linking the water sector to big data opportunities in order to facilitate a new wave of trend tracking, opportunity trawling and responsive management options
- Understand how to match ICT options to different cultures and ways of working in water sector institutions to ensure appropriate ICT support tools are designed

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## 8.7 Sustainable Water Behaviours



### Scope

Human behaviour, culture, perceptions, paradigms and choices sit at the heart of how the supply of water is managed and demands for water are negotiated. Thus, in the context of the growing

challenges of water scarcity, demand outstripping supply, high user expectations and required assurances, and climate variability, interventions are required beyond technical interventions. A focus on behaviour is thus crucial when managing supply and demand issues in the water sector. Behaviour is also important when considering water and its broader links to the green economy and wider sustainable development approaches.

Ensuring our long-term water supply requires the use of both supply-sided approaches such as water augmentation through water recycling, reuse and recycling, and demand-sided approaches such as water conservation. In an environment of high expectations and many promises, the conservation of water resources is a critical component of the effective and environmentally sustainable management of water supplies. It is anticipated that climate change will decrease the reliability of water supplies, due to reductions in rainfall and the increasing variability of rainfall events. The conservation of water resources will therefore

become increasingly imperative. Given the imperative of water conservation for environmental sustainability, the efficient use and management of water, and climate change mitigation, it is critical to understand what factors contribute to water conservation behaviour. Being aware of these factors will inform water managers, government and public policy officers of how best to encourage water-conserving behaviours, and thus reduce the need to augment existing water supplies. Despite the importance of increasing water-conserving behaviours, relatively limited research has been conducted to date.

A focus on behaviour necessitates a dual approach, looking at the professionals who are the drivers of planning, management, governance and implementation in the water sector, as well as having an outward-looking approach that looks towards users of water at the level of individuals, communities, industry, and the public sector. This outward-looking focus on behaviour also needs to interact with the political agendas and priorities and how water is prioritized in the context of competing demands in the broader national economy.

A behaviour focus looking inward at the professionals working and engaged with the water sector necessitates a focus on exploring issues around making use of alternative sources of water, rethinking our conceptualization around built and ecological supply infrastructure, and the behaviour shifts required to run water as a smart business from a

management perspective. Here the focus is on the levers that can unlock behavioural and paradigm shifts in the traditional ways of managing water. A close focus on training, re-learning, procurement and similar mechanisms is crucial here.

When looking outward towards the behaviour of the users of water the predominant focus has been on water conservation as a demand-side measure. This remains important. Equally important, however, are the behavioural shifts towards seeing water as a core driver of economy and business which stretches far beyond notions of conservation.

A significant body of work on factors contributing to positive attitudes toward water conservation exists. However, it is known that attitudes do not necessarily translate into actual behaviour. Over the past decade, utilities, governments, businesses, and non-profit organisations have come to realize that more than just financial considerations and information drive behaviour. Social, cultural and psychological factors also play a significant role in shaping consumers' decisions and behaviours around resource use. Stakeholders have consequently turned their interest to behavioural science, a multidisciplinary field that draws from psychology, sociology, public health, and behavioural economics to explain the complex mechanisms that shape human behaviour. In addition, a range of other social science disciplines, including political science, anthropology, linguistics, history and philosophy, help to interpret some of the broader contextual, cultural and historical factors

that drive preferences, paradigms and attitudes. When used strategically, these disciplines support the potential to drive down resource use, drive up profits, and generate measurable gains in conservation and efficiency.

Sustainable behaviour typically focuses on understanding long-term behaviours and, where transformative tipping points can be leveraged, applies behavioural theory and requires rigorous measurement of outcomes and impact. Focusing on behaviour, actions and preferences thus provides one of the key opportunities and sustainable interventions which can contribute to the acknowledgement and management of the water resources, their exploitation and efficient use by households, agriculture, mining, industry and the environment.

The scope of this Lighthouse will drive the building of research capacity, knowledge and innovative products which will support the sector and Government to traverse the pathway towards building a strong and responsive society and consumers, who will contribute to the sustainable management of our water resources. New approaches, supported by the use of evidence-based principles and applying proven behavioural strategies that align with the behaviours and cultures at multiple levels within the sector and that are best suited for achieving the objectives demonstrated. These new use behaviours can result in significant, persistent, and measurable reductions in resource consumption.





## 8.8 Water and Big Data



This Lighthouse will be incorporate the scope of the Water ICT Lighthouse to facilitate the integration of related concepts. Massive forces are refashioning the relationship between humans and water. Climate change,

floods, droughts, population growth and rapid urbanisation all present communities around the globe with new challenges. We need to get smarter about how we monitor and manage this precious resource we call water.

Where we were once only able to analyse data on an ad-hoc, hands-on basis through white boards, complex spreadsheets and business intelligence reports, the industry and global landscape have changed significantly. It has moved to a clearer reactive analysis incorporating a much higher volume of historical data with more complexity, and analysing it much more quickly. Knowing what to look for can also yield insights from real-time information streams. With this historical and real-time data at hand, we can begin to look forward (a crystal ball almost) with predictive and prescriptive analytics, creating real value. Merely comparing historical data to identify trends in usage, water flows, below-ground water movement, quality and quantity, then overlaying weather maps and measurements and forecasts, we could more accurately predict water usage, above- and below-ground water storage and flow, impact and much more.

Gartner defines big data as high-volume, high-velocity, and/or high-variety information assets that require new forms of processing to enable enhanced decision making, insight discovery and process optimisation.

The exponential increase of data being collected will only drive improvements in water research if that data is put to use (Figure 16). Big data becomes useful if it can be quickly converted into knowledge products. The analysis and meta-analysis by which such products are created requires that the appropriate hardware and software are available, for example, there is a new breed of software tools that can perform data mining and predictive analytics. In addition, distribution channels are needed to communicate the findings and predictions resulting from this analysis to the appropriate stakeholders. Whilst many of the components or software that support big-data analysis

and data virtualization can be deployed today, the missing ingredient for most companies will be the people necessary to do the work. It is important to assess the readiness of people for big data. Is there a willingness and skill set to transition to digital technologies in the research sector as well as within the various departments and utilities within the water sector in South Africa? Do we have the teams/structures that would be able to effectively respond when we receive alarms/information of high impact? We will need that human interaction – the people to maximise the value of that data – whether it's somebody telling the system what to do under certain circumstances or somebody that is directly acting because of the data they are receiving.

The water sector as a whole, by its very nature, generates significant volumes of data, which can and certainly should be harnessed and analysed to provide insight for improved management, reporting and decision-making ability. Utilising intelligent data analytics, based on past data combined with predictive flow modelling as well as real-time information on water levels, weather reports, water flows, and pressure and more, could assist us in significant event detection and/or prediction. This type of data analysis can create intelligent reporting and enhance our view on usage patterns, demand, quality issues and more. Big data is about taking previously disconnected data like water levels in a reservoir and pressure in the sewage mains – and linking them with other sources of information, such as meteorology, rainfall, and storm predictions. Data then becomes a predictive tool.

Within our customers' arenas (utility providers), operational processes and tools have increased and matured; so too has the amount of data being collected and the expectations of analytics capabilities evolved. Evolution and transformation are the words most often used to describe the journey being undertaken by today's utility providers across the globe. Big data and the analysis thereof is providing each utility with an opportunity to better manage their enterprise based on data-driven decisions.

A seismic shift could occur. Far beyond another technology evolution, a fundamental transformation could begin to occur, a cultural shift in which we as a research institution alter our thinking about big data and analytics and the ways in which both might be useful to our customers and fellow human beings. Throughout the water sector, technology-generated new data offers distinct opportunities for a holistically improved customer experience and relationship.



It is important to note that no matter how 'big', an incomplete or otherwise flawed set of data will not provide actionable information. The proper analytics (Figure 17) can be developed only with a clear understanding of the quality and quantity of available data.

Whilst the water sector might be generating and using more data today, we are not using this data as efficiently as possible and, as such, we are not realising the benefits of big data as quickly as possible. To adequately grasp the reins on the opportunities available to us will require a seismic shift in our culture. We need to pull down the historic data silos, and allow for a more open, holistic and collaborative environment to be formed in which data, in particular, is owned and used by the sector, rather than just specific departments, and our country, for input on a global scale.

To fully tap the well of new, actionable information available, it is imperative that we ask ourselves, what else can we do? How else can we achieve and provide value? How can we share our data, collate it and effectively leverage our analytics to drive bigger value of our input into the research sphere?

Questions that we will aim to answer:

- Will a Cloud-based software-as-a-service (SAAS) benefit our organisation?
- What will we measure/monitor?
- How will data capture and analysis transform the management of our most precious resource?
- What data is being collected (already exists) by sensors/monitors that we believe could add value to us?
- What data is not being collected by sensors/monitors that we believe could add value to us?

- What sensor-type devices do we need?
- Are there technologies already in the market that could benefit us?
- Is there a solution that we could implement that would provide instant visibility into all areas of the water network?
- What improvements could be made from the correct analyses of this data?
- Could real-time and historic analysis of the correct information enhance our ability to respond to current/predicted events?
- What analysis tools and smart systems need to sit on top of the data (once we have it/access to it) in order for us to correctly interpret it and employ it in decision making, reporting and dissemination?

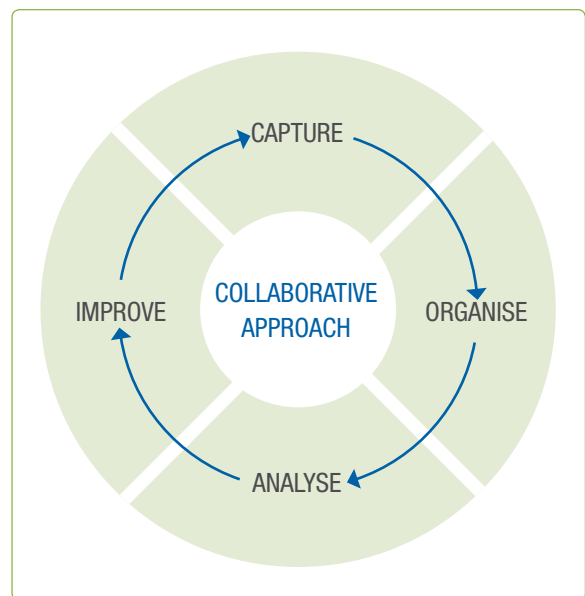


Figure 16. This closed-loop approach will help us create long-lasting analytical benefits

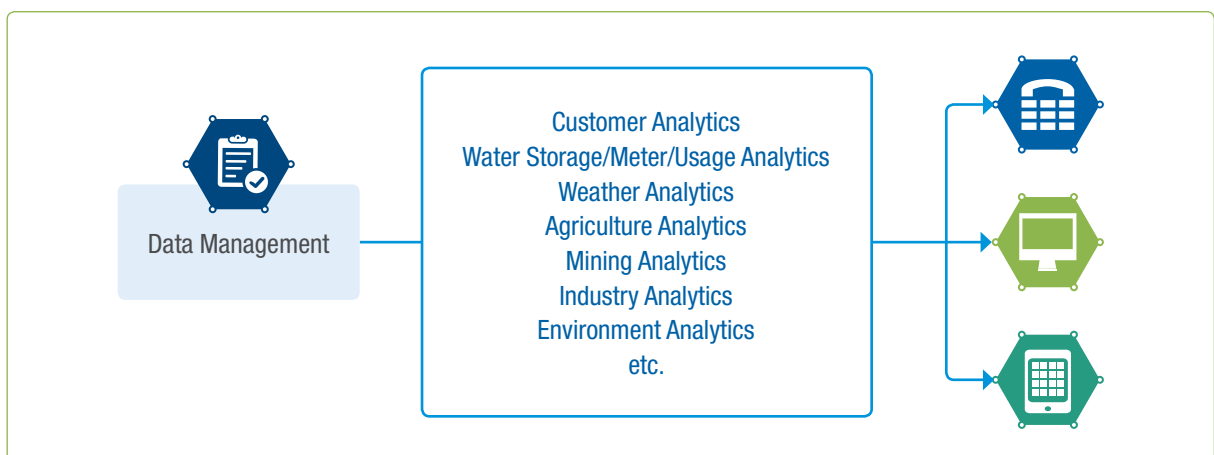


Figure 17 'Big data' analytics

- 'Big data' raises the issue of privacy: Who has what information? How secure is it? How do we collate the various sources of information and share it, securely?
- How will the role of big data in the water sector benefit from developments of big data in other sectors?

Integrating processes and technologies that collect more robust data will lead to a more strategic solution. The technology to improve our portfolio as an organization will only be as good as the managers and staff that support our efforts on a daily basis. It is envisaged that we would have to budget effectively for supporting the insights gained from implementing any big data analytics solution. A significant contributing factor for success when employing our big-data analytics solution is to ensure that there is vast, core

functionality that meets our business needs. The results of correctly sourced and analysed data promises enhanced decision making and a further improvement on enterprise-level water management, when the solution deployed is correctly aligned to our organisation's corporate plan.

One of our key goals would be to identify the impact of big data and advanced analytics when it comes to managing water on both a national and global level. The predictive ability provided by data analytics offers opportunities to optimise water consumption in every sector. Big data and predictive analytics could be a transformative cornerstone in water research. This Lighthouse will endeavour to ascertain to what extent this could be and what the next steps are?

## 8.9 Water Scarcity and Extreme Weather Events



### Scope

South Africa is a semi-arid to arid country with highly constrained freshwater resources which are unevenly distributed spatially and temporally. The country has been projected to experience

water scarcity by 2025 due to exponentially increasing water requirements on a finite and limited resource. The improved socio-economic conditions (and the rapidly growing population) and the changing climatic conditions are cited as the main factors that put pressure on this limited resource. Specifically, the extreme weather events such as recurring droughts and floods as a result of climate change are projected to worsen societal impacts and to aggravate water scarcity in South Africa. Currently, water scarcity and climate change are acknowledged as the topmost important global risks for society. The risks largely stem from the unsustainable use of the water and land environment and the extreme human influence on natural systems. Water-related shocks, such as droughts, floods and pollution incidents, combined with ill-preparedness

and low coping capacities, present high levels of risk for most of the world's poorest. Therefore, the main aims of this Lighthouse are to:

- Enhance the country's water security and resilience to current and future water scarcity
- Investigate through prediction and early warning systems the potential impacts of extreme weather events on water scarcity as well as to develop mitigation measures

With a semi-arid climate with limited water resources, South Africa has unique scientific requirements and challenges which are compounded by data limitations. The dynamics of South Africa's complex water systems and their response to extreme weather events and climate change are uncertain. The **objective** of this Lighthouse will be to harness the existing knowledge in order to develop novel approaches and tools that will advance our understanding and management of the water scarcity problem, both at the catchment and regional (national) level, and to mitigate the increasing vulnerability caused by extreme weather events. The main research questions will centre on 'managing the complex and dynamic water systems that require new understandings of hydrological process interactions and feedbacks across multiple scales, and the effects of human activities on the water environment'.

The projects of this Lighthouse will be built on the principle that water scarcity (and hence water security) is an explicitly universal objective. Therefore, while research is conducted at a catchment scale to find solutions suited to local contexts (and vice versa), it should be recognised that water scarcity is a global problem that often requires addressing at multiple scales, i.e., local to regional and global. Therefore, local and national as well as international partnerships will be essential in this Lighthouse's endeavour.

### Current understanding

Over the past 40 years South Africa has conducted a number of large-scale water resources assessment studies (e.g. WR90, WR2005, WR2012, etc.) that aim to address large-scale water resources management and development. However, these studies focus on fundamental aspects of hydrology with very little or no in-depth research on the impacts of human and environmental change to water resources and their associated feedbacks. Additionally, there are a number of recently completed and ongoing climate change and land-use projects to assess the potential impact of the projected change on water resources. Most of these projects are conducted under the Climate Change Lighthouse and a few KSAs. However, it is postulated that these projects do not comprehensively address the understanding of water resources availability, water scarcity and water threats that are caused by extreme weather events.

There are also ongoing research projects on water resources accounting which could prove useful in determining the water use by different land types, and this study complements the water accounts research currently being conducted for Statistics South Africa.

### Future perspectives

There are a number of exciting national and international developments that can aid in the advancement of water scarcity and extreme weather events research. These include:

- The growing global links and partnerships among the community of practice in global-scale models has led to a growing number of global datasets that reduce uncertainty in global modelling; thus the effects of

extreme weather events such as droughts can be addressed across local and global scales

- Significant advances in monitoring technologies, sensors, remotely-sensed data and data acquisition systems provide opportunities for generating new information and new knowledge at the spatial and temporal scales that have not been envisaged before
- Therefore, the main drivers of water scarcity such as the hydrological processes, climate variability (and change) and anthropogenic activities can be characterised and analysed from new perspectives

### Proposed modalities of action

#### Short to medium term

A comprehensive review of the state-of-the-art in water scarcity (and extreme weather events) research to synthesise the existing knowledge and to identify gaps both nationally and internationally, is planned. This work should provide a guide to the long-term research strategy for water scarcity and extreme weather events.

#### Medium to long term

The synthesis report will provide a strategy on the medium-to long-term research vision for this Lighthouse. Chief among the key issues to receive priority is the establishment of the hydrology data facility to collate and coordinate hydrology datasets in all its facets.



# [ 9. Innovation and Impact ]

## 9.1 Introduction

The complexity of water challenges facing the nation mean that the water sector needs game changers and needs them urgently. Growth in population and the economy, along with urbanization and land-use changes, are threatening both water quality and the ability to meet water demand. Looking to the future, climate change is expected to further stress water systems in large parts of the country. Water infrastructure, by some measures the oldest and most fragile part of the country’s built environment, has decayed. Current conversations around water challenges are painting a challenging picture for the future of water. Therefore, there is need to focus more on generating innovative solutions and be able to urgently take those solutions to application.

Solutions to the country’s growing water challenges lie, in part, with the development and adoption of new innovative technologies, and development of new products and services leading to the creation of new industries.

But current investment in water innovation is extremely low, especially investment by the astute promoters of innovation—such as venture capital and corporate research and development. This low investment may explain the low levels of innovative output, as measured by patent filings and adoption and dissemination of new innovations.

The recent drought has further demonstrated to us that unless we take innovations to application, we shall continue to be challenged.

The WRC has taken a strategic decision to address this challenge, and responded by establishing a new branch, Innovation and Impact. This branch seeks to address the above issues by focusing on the following (Figure 18):

- Positioning the WRC as a premier knowledge hub, leading the sector in terms of disseminating appropriately packaged knowledge products including multimedia and interactive solutions. Taking things further we will embark on integrating knowledge generated by other

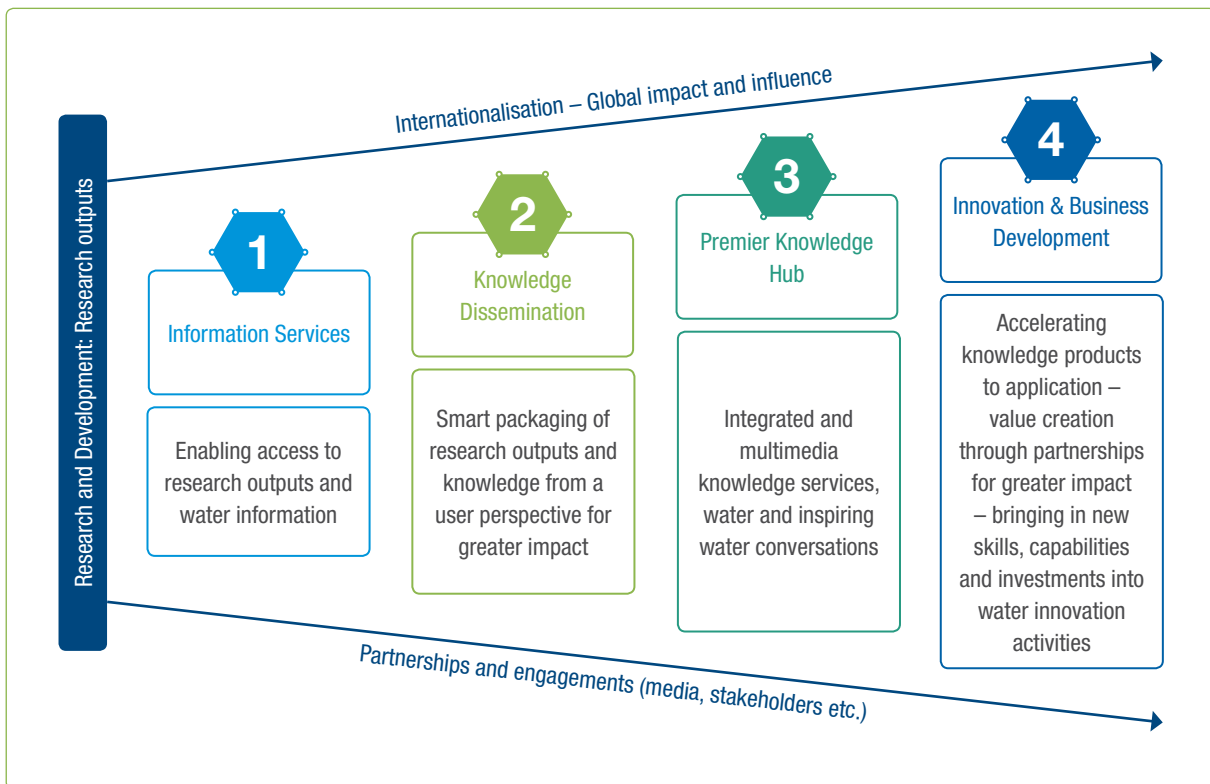


Figure 18. The 2018/19–2022/23 Strategy will see the WRC moving quickly from Areas 1 and 2 to areas 3 and 4, whilst retaining critical elements in Areas 1 and 2



bodies, making available and accessible credible water data and information, hence improving the general uptake and use of water management knowledge by the relevant sectors of the population.

- Inspiring water conversations, ensuring that water and water-related knowledge permeates through all sectors of our population leading to better understanding of water management issues hence behavioural changes; positioning the WRC and its personnel as the credible water conversation leader in all media channels
- To create a robust and vibrant innovation ecosystem that allows the WRC to play a lead and co-ordinating role with strategic sector partners in accelerating technologies to the 'market'
- Creating an environment whereby professionals and non-professionals can contribute and channel their knowledge and innovative skills to solving water problems from a multidisciplinary point of view
- To draw various stakeholders to engage in water conversations and tell their water stories

### Organising for maximum impact

Research impact has traditionally been defined at the WRC as 'the demonstrable contribution that excellent research makes to society and the economy'. Research impact encompasses all the ways that research-related products and skills benefit individuals, organisations and nations. These include: improved global economic performance (and specifically the economic competitiveness of South Africa), increasing the effectiveness of public services and policy, and enhancing quality of life and public health. A defining characteristic of impact is that it must be **demonstrable**. It is not enough just to focus on activities and outputs that promote research impact, such as organising a conference or publishing a report. We must be able to provide evidence of research impact, for example, that it has been taken up and used by policy makers and practitioners, and has led to improvements in service delivery or business. Above all, research must be of the highest quality: we cannot have impact without excellence.

The primary reason for the renewed focus on achieving impact is that, as a public entity, we form part of a Government that strives to improve the lives of its citizens. As such, we have a role to play in achieving Government Objectives. Additionally, we are increasing our emphasis on the need for evidence of economic and social returns from our investment in research. Demonstrable impact

helps to verify that research is important – that it is worth investing in and using. Evaluating our impact also enables us to see what works and why. These lessons can then be implemented both by the WRC and our future researchers.

High-quality research has the potential to enhance social and economic wellbeing across all sections of society. By ensuring that decisions on policy and practice are informed by evidence, research can help to:

- Improve the effectiveness and sustainability of public, private and third sector organisations
- Improve social welfare and cohesion
- Increase economic prosperity, wealth, and job creation
- Enhance cultural enrichment and quality of life

To maximise the impact of our research, we need to engage with our key user groups. This can provide substantial benefits for the quality of our own research, including:

- **Feedback** to help shape our research agenda and improve methodologies
- **Relevance**, ensuring our research is meaningful, timely and useful
- **Human capacity development**, recruiting participants, for example, for Reference Groups or surveys
- **Recognition**, developing new skills and raising our profile

We aim to achieve maximised research impact, and this can include socio-economic impact, academic impact, or both. Socio-economic impact is the demonstrable contribution that excellent research makes to society and the economy, of benefit to individuals, organisations and the nation. Academic impact is the contribution that excellent research makes to advances across and within disciplines, including significant advances in understanding, method, theory, and application. The impact of research can be **instrumental** (i.e. influencing the development of policy, practice or service provision, shaping legislation, altering behaviour), **conceptual** (contributing to the understanding of policy issues, reframing debates), or **capacity building** (through organisational and personal skill development).

To plan impact effectively we need to:

- Identify our key partners and stakeholders, for example, other researchers, public sector, business/industry
- Identify how they will benefit from our research – types of impact might include: improving social welfare and/or public services, influencing policy, contributing to industrial competitiveness

- Identify how we will ensure they have the opportunity to benefit, for example, through organising public events, conferences, interaction with the media, sharing of intellectual property
- Creating platforms to receive stakeholder concerns and needs, that can determine research questions

### Knowledge dissemination

The dissemination of research findings is defined here simply as the process of sharing information and knowledge. Knowledge dissemination should address the challenge of improving accessibility of research findings to those we are trying to reach and ensure the physical availability of research output materials to a larger proportion of our target audience. Research dissemination should also seek to make research findings comprehensible to those who receive them. At the WRC, dissemination of research findings will be positioned as follows:

- Highly acknowledged and given priority as essential means of maximising the impact of research on development
- As an intrinsic element of all good research practice, especially in the water discipline
- Preventing knowledge becoming sticky to where it has been generated and effectively lost
- As providing value to research projects, increasing the impact of the research for potentially wider application
- As promoting the public profile of the WRC whilst strengthening its research profile

### Towards a premier knowledge hub

The conventional model that the WRC has been applying for quite some time is the linear knowledge transfer model. This model adopts the approach where information is seen to flow from the information provider, via a chosen media (publications and reports) to the information user. This model assumes that the dissemination is a one-way, top-down flow of information from research experts to a passive audience. Recent developments at the WRC have demonstrated that information flow is a far more complex process – it is an interactive, multidirectional exchange of knowledge and ideas and that should be reflected in the research dissemination approached promoted in this strategy.

### Maximising impact through inspiring water conversations

Advancing and inspiring water conversations within the water sector in South Africa defines the strategic approach of the Water Research Commission, building upon the insight and results and examples gleaned from research. This approach also builds upon the attributes of interpersonal conversation: intimacy, interactivity, inclusion, and intentionality. This approach also indicates a slight departure from traditional to sector conversations.

Critical elements of sector conversations include the following: exchange of comments and questions between a group of people which results with open and fluid exchange of knowledge (such as dialogues), as compared to seemingly closed and directive exchange. For decades now, organisations used to achieve scale and efficiency mainly through print and broadcast, in particular – operated in one direction only. But new channels have disrupted that one-way structure. Social technology gives sector leaders the means to foster a genuinely interactive culture (Figure 19) – values, norms, and behaviours that create a welcoming space for dialogue.

The other attribute is inclusion. At best, sector conversation enables participants to share ownership of the substance of their discussion. As a consequence, they can put their own ideas – and, indeed, their hearts and souls – into the conversational arena, and this is critical for the water sector. Such an approach would also promote brand ambassadors and thought leaders within the sector. For the WRC to develop and promote thought leadership and storytelling is a smart and quick way to bolster the WRC's reputation and relevance.

### Defining the 'new normal': water innovation

The ultimate goal of the South African water sector is to provide the public with reliable and safe water supplies and to dispose of wastewater safely and in compliance with national water quality regulations. However, a number of challenges have rendered the achievement of this goal rather difficult. On the other hand, this has opened up opportunities for a variety of new technologies. The country is taking great strides in shifting focus from supply enhancement to demand management.

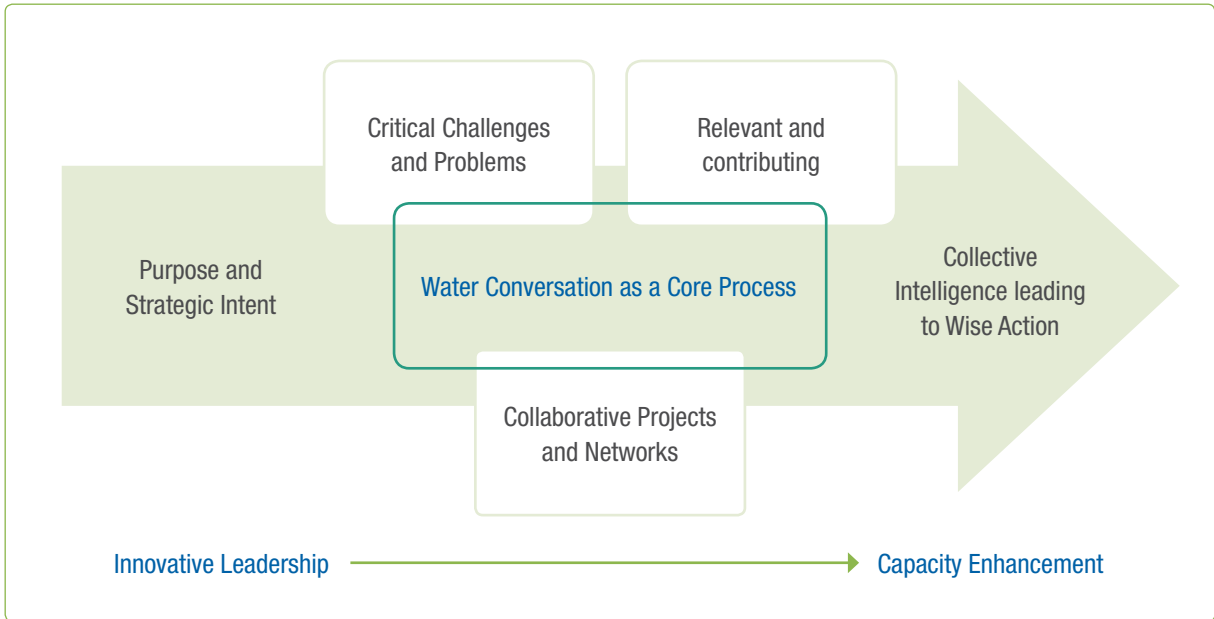


Figure 19. Thinking together for impact

Current practice has demonstrated that innovative technologies, coupled with incentives and education, can greatly reduce water use. As a result, there is increasing interest in technologies that are more water efficient and in technologies that can help encourage greater conservation among consumers. These innovative technologies will generally fall under the following categories:

- **Supply enhancement.** A need to focus on technologies that are more drought resistant such as water reclamation, water desalination, and technologies that allow localized resource enhancement such as rainwater harvesting, fog harvesting, etc.
- **Demand management.** Focus on technologies that encourage or enable water use efficiency (achieving the same with less water) and reducing water consumptive activities, decrease the costs and pollution associated with wastewater disposal, water-smart irrigation, technologies that encourage behavioural change, etc.
- **Governance improvement.** Technologies that will help tackle inefficiencies in the water governance system, such as smart metering, leak management, and better understanding of customer behaviour.

And the innovative technologies may be classified as follows:

- **Technologies to explore alternative sources.** Technologies with the potential of producing water from non-traditional water sources such as desalination, acid mine drainage, rainwater or stormwater capture, and reuse of wastewater.
- **Smart water technologies.** Technologies that integrate information technology into water accounting and management, such as leak detection, smart water meters, and Internet-based water-use solutions and software. These innovative solutions enable water service providers to enhance supply and curb demand simultaneously.
- **Technologies promoting water use efficiency and conservation.** Technologies that enable short- and long-term demand management in various sectors, such as irrigation sensors, low-flow plumbing, and water-efficient appliances.
- **Water purification technologies.** All the technologies that are used to purify, filter, disinfect, and produce water of different quality for different beneficial uses.
- **Groundwater.** Technologies that enable water infiltration and groundwater banking and recovery.

While the water sector offers many opportunities to innovate and deploy new technologies, in practice the sector has barely tapped the potential those technologies offer. Various hurdles currently inhibit the development, testing, adoption, and diffusion of new water technologies. Other sectors of the economy have experienced various levels of success when it comes to addressing the need for new technology – yet very little of this cross-sectoral learning actually occurs in the water sector. Various barriers have inhibited fundamental change in recent decades in the basic technologies. Addressing the coming challenges will require new approaches. In this document, we put forth a new strategy to increase innovation and speed-up the deployment of new technologies in the water sector.

### Global impact and stature

The WRC recognises that water scarcity is one of the most important and complex challenges facing SA, the continent and the world today, and will continue to be the case for the future, especially for SA should the national water use and water resources management policies and operations continue as is. As the majority funder of water research in the country, it is of crucial importance that the WRC establish international partnerships and facilitate collaborations between South Africa and leading teams in the continent and the world. This will help to position South Africa as a leading knowledge partner, resolve South Africa and Africa's water challenges, and make a substantial contribution to the generation of global knowledge and technological solutions.

Since its establishment, the WRC has built fruitful international partnerships across different stakeholder groups, and undertaken a wide range of international activities that helped to raise awareness and build a good reputation for the WRC, the SA water sector in the continent and internationally. The activities include, (a) promotion of SA's expertise, (b) facilitating South Africa's access to international programmes, projects and funding (c) facilitating South Africa's participation in strategic conferences and workshops and (d) serving on international policy and technical steering committees and working groups that shape the global and regional water agendas.

The Impact and Innovation Branch is organised into four units each focusing on specific activities to implement the WRC strategy whilst working together.

## 9.2 Knowledge Services

The reach and spread of water knowledge, critical for sustainable water management, is the key role of Knowledge Services. Hence, for the next 5 years it will focus on raising the strategic profile of the WRC as a premier knowledge hub nationally and internationally. It will also provide the necessary dissemination function to relevant stakeholders for research outputs and impact, and strategically positions the WRC within the local and international water sectors through its dissemination, marketing and branding initiatives.

The strategic focus for knowledge services in this planning cycle is to continue with the coordination of the WRC's knowledge dissemination, information services and research capacity enhancement activities, and use these to position the WRC as the premier water knowledge hub.

The WRC will continue pursuing this goal via the following processes:

- Advance, or extract value from our research and development activities and those of our partners, generate content and develop knowledge products
- Produce, manage, distribute and store information and knowledge resources, provide assistance, and share solutions
- Know, engage and develop our customers to receive the knowledge products and contribute to the generation of knowledge products
- Initiate and roll-out new initiatives leading to making water knowledge more accessible to the 'man-on-the-street'

Additionally, the WRC will introduce new initiatives to harvest new knowledge during the course of a research project through initiating conversations at project level and special publications that integrate and tell a story on water as indicated below. This should also be supplemented by the introduction of new knowledge services and products (Figure 20).



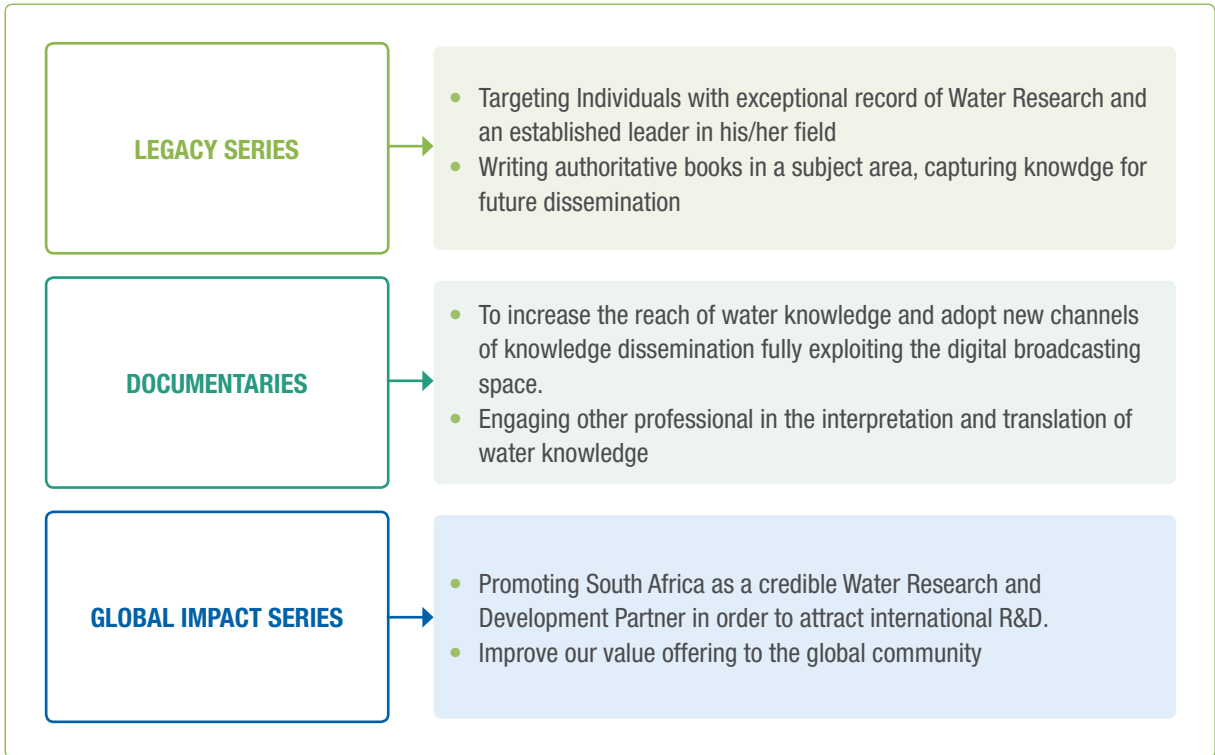


Figure 20. Future knowledge services products



## Knowledge Services programmes

This division will define itself through the management and service-delivery approach that converges **information management and publications, knowledge dissemination, and research capacity development and strategic learning**.

### 1. Knowledge dissemination

The focus of this unit is in dissemination, as in 'make it happen', an active process to communicate results to potential users by targeting, tailoring and packaging the message (usable intelligence) for a particular target audience. It also includes a process of extracting the main messages or key implications derived from research results and communicating them to targeted groups of decision makers and other stakeholders in a way that encourages them to factor the research implications into their work – 'smart packaging for impact'.

#### Areas of competence:

- Developing and implementing a user-driven dissemination strategy
- Developing researcher/knowledge user networks
- Targeting, tailoring and packaging messages for particular target audiences
- Design, layout and packaging of all knowledge products for greater impact
- Developing knowledge user networks and/or communities of practice
- Production (content, graphics, and layout) of the Water Wheel, brochures, technical, policy and ministerial briefs, Knowledge Review, Water SA, technology transfer reports, WIN-SA publications, field notes, posters, infographics, etc.
- Developing multi-media products from research findings
- Develop targeted products for schools, rural communities, etc.

### 2. Information services and publications

The focus of this unit will be to: serve data, information and knowledge to customers or users, nationally and internationally; continuously improve access to the knowledge resources by various categories of users; collect data, information and knowledge from its contributors,

produce it, manage it, store it and manage access; manage data, information and knowledge as a critical resource for the WRC, embracing 'lean and keen' principles.

#### Areas of competence:

- Printing management, including uploading of documents
- Access to information and knowledge products by the general users
- Information services (Information Centre)
- Management and storage of all WRC publications
- Management of information for internal use
- Document management: internal and external

### 3. Research capacity building and strategic learning

This focuses on: raising the level of knowledge among the general public, users and scientific communities on the significance of water research and its findings to the future of South Africa; designing and delivering innovative knowledge-based products, activities and services tailored to meet the capacity-building needs of the broad development community; designing capacity-building guidelines and programmes for various stakeholders; and designing and implementing strategies and initiatives to ensure that the water needs of South Africa (including research) have a supply of a diverse pool of water professionals. Also, as innovative approaches to knowledge exchange and dissemination grow and evolve, increasing focus will be placed on developing indicators to evaluate these processes and their impact on relevant short, medium and long-term outcomes.

#### Areas of focus:

- Research student development and support
- Research capacity development initiatives
- Special publications and story-telling
- Research analytics and studies to inform future research direction
- Specific activities tailored to raise the level of knowledge of water issues by different sectors of the population
- Compiling and disseminating relevant capacity-building tools and learning materials
- Ensuring that WRC knowledge services are reaching all sectors of the population

### 9.3 Marketing and Communication

The national profile of the WRC as a credible knowledge broker and a premier knowledge hub still needs to be widely communicated. New and fresh strategies are required to achieve this goal. Real impact of the WRC activities can only be experienced if people and communities are better able to access the wealth of information and solutions within the WRC. Therefore, the nation and the global community have to know about the WRC and what the WRC can offer them. Thus, there is still a critical need for the WRC to massively raise its public profile through well-planned interventions.

Marketing and Communication, in the next 5 years, will focus on the improvement of the public and political profile of the WRC by enhancing the credibility and relevance of the WRC and water knowledge through strategic positioning and strengthening of stakeholder relations, public engagement, media engagement, parliamentary liaison, strategic communication, events management and marketing initiatives and programmes. This includes engagement with relevant stakeholders and national programmes and partners for impact. This unit will also be responsible for the Annual Report and other corporate reports and plans.

The WRC marketing and communication strategy should therefore seek to achieve, in general, the following:

- Achievement of the WRC's overall organizational objectives
- Enabling the WRC to engage effectively with stakeholders
- Demonstrating the success of the work and investments of the WRC
- Ensuring that people understand the role played or the work of the WRC
- Using the generated knowledge to influence or change behaviour and perceptions where necessary
- Marketing and Communication will develop and implement various mini-strategies to pursue the following;
- Inspiring water conversations nationally – which may be considered as a 'push' strategy, engaging the nation in water discussions and imparting critical water management knowledge
- Partnership with other national and private initiatives to promote water solutions and the WRC brand
- Promoting WRC professionals so that their knowledge and skills can benefit communities
- Effective and efficient use of various media channels, including social
- Redefining the events space to support the above initiatives





This work will be carried out through three units as follows:

### 1. Marketing and event management

Event management (project management) entails the creation and development of large-scale events such as workshops, conferences, summits, ceremonies, formal parties, or conventions. It involves studying the brand, identifying the target audience, identifying partners and contributors, devising the event concept, planning the logistics and coordinating the technical aspects before actually launching the event.

Marketing Management will develop strategies, approaches and programmes to generate interest in our knowledge services, products and brand, improve customer opinions of our products and services, and increase the WRC's perceived relevance. The strategies will include creative new plans and ways to deliver our message to the customer.

#### Activities:

- Position the WRC as a premier knowledge resource for all water-related issues, locally and internationally
- Develop, coordinate and implement the WRC's Marketing Policy and Strategy
- Develop the WRC corporate identity (CI) to support targeted marketing campaigns
- Establish the WRC at the forefront of knowledge creation and knowledge dissemination
- Develop the brand strategy for the WRC and lead its implementation
- Assist the business development unit to market new technologies and demonstrations for greater value and impact
- Manage and coordinate the WRC knowledge dissemination and knowledge sharing events
- Planning, implementation and follow-up for all special events (national, ministerial) and annual receptions
- Manage event logistics, publicity, including public relations, advertising and collateral material design, production and distribution in collaboration with the communications unit

### 2. Communications and media relations

For the WRC, this will involve the systematic planning, implementing, monitoring, and revision of all of the channels of communication internally, and between the WRC and external partners, managing the flow of information, including online communication. Media relations involves working with the media for the purpose of informing the public of the WRC's mission, policies, achievement, and scientific water knowledge in a positive, consistent and credible manner.

Typically, this means coordinating directly with the people responsible for producing the news and features in the mass media. The goal of media relations is to maximize positive coverage in the mass media without paying for it directly through advertising, and additionally, the preparation of internal staff members for media engagement.

#### Activities:

- Support the political profile of the WRC by enhancing the credibility and relevance of the WRC through strategic positioning and strengthening stakeholder relations
- Develop, coordinate and implement the WRC's Media and Communication Strategy (ensuring that all activities related to the media, parliamentary liaison, conference exhibitions, sponsorships, awards, advertisements, press releases, corporate videos, social media, and multi-media presentations is part of the communication portfolio's plans).
- Meet regularly with KSAs to assess KSA-specific communication
- Broaden social networking to benefit the organisation
- Continuous engagement with research managers to ensure proper engagement with the media

### 3. Stakeholder liaison

One of the WRC's priorities is to ensure that its products and services do reach a wide range of stakeholders. One of the programmes that will once again bring massive gains to our stakeholders is the Water Information Network South Africa (WIN-SA).

As a programme, WIN-SA aims to capture the innovative work of people tackling real service delivery challenges. It also aims to stimulate learning and sharing around these challenges to support creative solutions. Most importantly, WIN-SA strengthens peer-to-peer learning within the water sector.

WIN-SA will operate based on the following key strategic objectives;

- Repackage and disseminate existing appropriate knowledge for target audiences
- Increase access and use of practical appropriate information and knowledge for improved water services sector performance
- Create a culture of learning and sharing amongst sector stakeholders using social innovation methodologies
- Partner with relevant organisations to transfer the information to more water sector institutions using the multiplier effect



## Mapping of stakeholders

Table 8 looks at how our different products and services are reaching the different groups of stakeholders:

Table 8. Products and services targeting different stakeholder groups

AUDIENCE	RESEARCH REPORTS	BRIEFS	DIALOGUES	WORKSHOPS	CONFERENCES	SUMMITS/ SYMPOSIA	SOCIAL MEDIA	PRINT MEDIA	BROADCAST MEDIA	WEBSITE	ROADSHOWS	TECH DEMOS	Water SA	WATER WHEEL	WIN – SA PUBLICATIONS	SPECIAL PUBLICATIONS	STAKEHOLDER REPORT	ANNUAL REPORT	KNOWLEDGE REVIEW	CAREER GUIDANCE	SCHOOL MATERIAL AILL PHASES	TENDER BRIEFS	
Ministers	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						✓	✓	✓	✓				
Premiers					✓	✓	✓	✓	✓	✓													
Portfolio committees	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓				
Top management in Government	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓				
Government officials	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓				
Board members	✓	✓	✓	✓	✓	✓	✓							✓		✓	✓	✓	✓				
Local government	✓	✓	✓	✓	✓	✓				✓				✓	✓	✓	✓	✓	✓				
Municipalities	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓	✓	✓	✓				
Civic orgs.	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓								
NGOs	✓		✓	✓	✓	✓	✓	✓	✓	✓				✓	✓								
CBOs	✓		✓	✓	✓	✓	✓	✓	✓					✓	✓								
NPOs	✓		✓	✓	✓	✓	✓							✓	✓								
Consultants	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓
Private co.	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓									
CMAAs	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓				
Water utilities	✓		✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓				
Water boards	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓			✓									
Universities	✓		✓	✓	✓	✓	✓						✓	✓	✓	✓		✓	✓			✓	
Schools	✓											✓		✓							✓	✓	
Youth associations	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓						✓	✓	
State-owned entities (SOEs)	✓		✓	✓										✓									
Colleges of agriculture	✓		✓	✓	✓	✓								✓									
Mining companies	✓		✓	✓	✓	✓								✓									
Religious groups	✓	✓												✓									
Political parties														✓	✓								
Traditional leadership			✓	✓										✓	✓								
Unions														✓	✓								
Water user associations	✓	✓	✓	✓	✓									✓	✓	✓							
Science councils	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Women-owned enterprises	✓	✓	✓	✓												✓							
People living with disabilities																							

AUDIENCE	RESEARCH REPORTS	BRIEFS	DIALOGUES	WORKSHOPS	CONFERENCES	SUMMITS/ SYMPOSIA	SOCIAL MEDIA	PRINT MEDIA	BROADCAST MEDIA	WEBSITE	ROADSHOWS	TECH DEMOS	Water SA	WATER WHEEL	WIN – SA PUBLICATIONS	SPECIAL PUBLICATIONS	STAKEHOLDER REPORT	ANNUAL REPORT	KNOWLEDGE REVIEW	CAREER GUIDANCE	SCHOOL MATERIAL ALL PHASES	TENDER BRIEFS	
Retired civic groups	✓	✓	✓	✓												✓							
River watch community groups	✓																						
	✓	✓	✓												✓			✓					
Farming community / Small scale farmers	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Farming Community / cooperatives	✓	✓																					
Farming Community/ Commercial farmers	✓	✓														✓							
Water tech developers	✓	✓																					
Private investors																							
Big corporates & banks																							
Households																✓							
International water institutes	✓	✓																					
Regional water clusters	✓	✓																					
River basin organisations	✓	✓	✓																				
Gender machinery	✓	✓	✓																				
Suppliers																							✓
SMMEs	✓	✓																					✓
Donor organisations	✓	✓	✓																				
Media	✓	✓	✓																				
Hospitals and clinics	✓	✓	✓																				
Churches	✓	✓	✓																				
Traditionalists	✓		✓																				
Regional offices (depts.)	✓	✓	✓	✓	✓	✓												✓					
Laboratories	✓	✓	✓		✓																		
International community (embassies, science orgs etc.)	✓	✓	✓	✓	✓	✓																	
Emerging farmers	✓	✓																					
Retail sector	✓	✓	✓															✓					

## 9.4 Innovation and Business Development

The WRC vision and strategic shifts over the past 5 years have resulted in the emergence of many attractive value propositions for both local and international partners. By effectively and smartly collaborating with the right public and private sector organisations, the WRC can:

- Influence policy and decision-making across all water sector institutions and via cross-sectoral partnerships
- Scale up sustainable solutions with strategic partners
- Develop and facilitate the innovations to the stage where products and services are closer to the market and ready for uptake
- Strengthen human capital development opportunities for the sector

This also recognizes the power of building the right networks of ecosystem partners on either side of the WRC water value chain, and empowering them with the relevant knowledge, skills, and opportunities. This model offers a unique opportunity to create a multiplier effect (Figure 21) which will accelerate diffusion of water knowledge, products, and services to policy-makers, practitioners, professionals, NGO's, entrepreneurs, and communities.

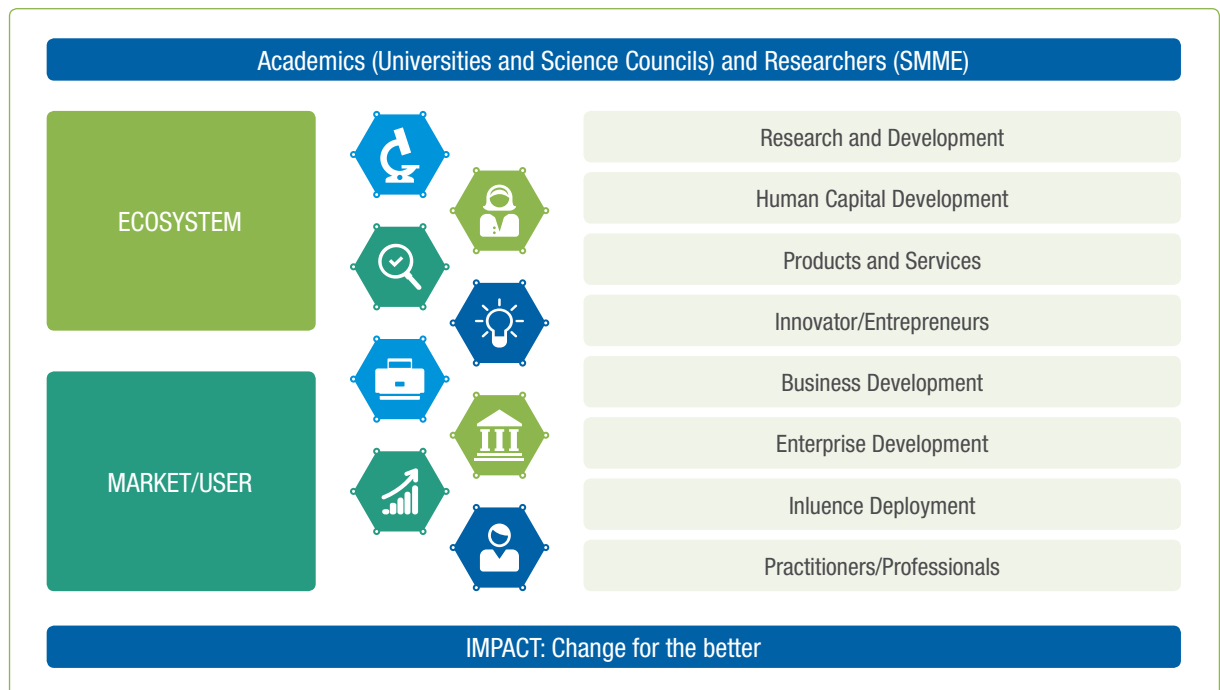


Figure 21. Using multiplier effect to create impact for the WRC and the water sector and its cohort of researchers, entrepreneurs and professionals

At the heart of the Business Development and Innovations strategy is the recognition that South Africa is faced with the triple challenge of poverty, unemployment, and inequality. Therefore, one of the primary directives is to use knowledge-based capital and the innovations that are developed to create opportunities for new businesses to enter the water sector, thereby transforming the sector (Figure 22) through inclusivity of women, youth and previously disadvantaged individuals in opportunities of entrepreneurship, research, consultancy, and practice. Knowledge transferred to researchers, consultants and practitioners are fairly well entrenched in various WRC activities such as material development, workshops and conferences. However, support of entrepreneurs and enterprise development support calls for the development of an enterprise development strategy focused on pipeline development in support of the broader ecosystem of partners and sustainable water practices and solutions. In addition, the BD&I team will strive to create programmes and funding with relevant partners to improve technical skills for emerging professionals who work in public sector institutions.

To ensure that the WRC achieves its vision of creating knowledge that positively impacts on the lives of millions of South Africans either directly or indirectly through the water sector and R&D cohort, the Business Development and Innovation KSA has organised to accelerate research, innovation, and human capital development by focusing on the following five pillars (Figure 23):

- **Operational efficiency and flexibility:** Create both internal and external enablers to effectively implement the corporate plan by adopting a model of operational flexibility that allows the organisation to pilot and test opportunities that support the national system of innovation and the water sector
- **Connectivity:** Grow the capabilities of the WRC as a collaborative connector organisation with local, national, and global partners and stimulate and influence support for the broader ecosystem development, support and alignment
- **Innovation intelligence & support:** Develop demand-driven and relevant innovation service mechanisms to support the acceleration of innovations through the value chain and work with partners to develop a vibrant



Figure 22. Business Development strengthening the role of the WRC as a transformative partner

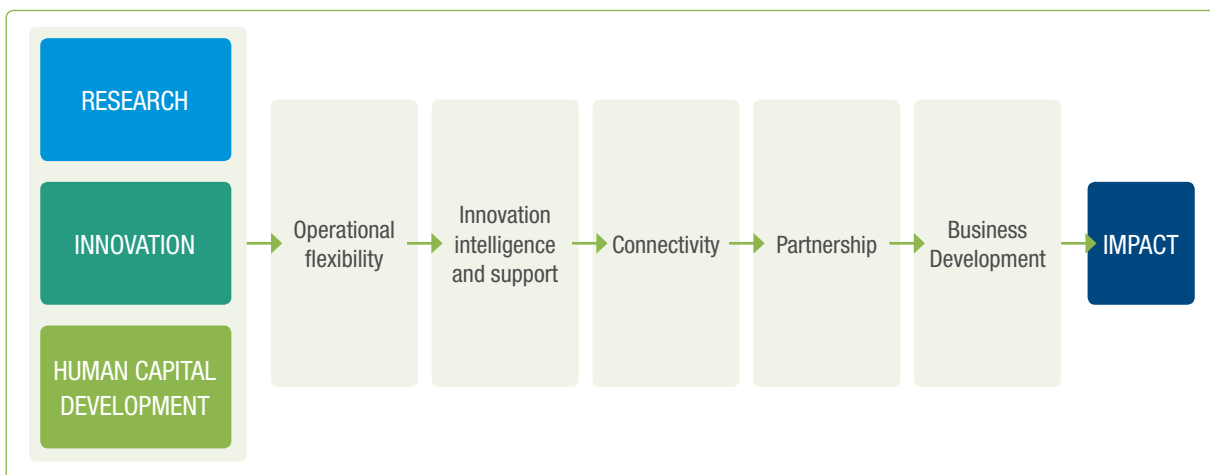


Figure 23. Creating impact from publicly-funded research and private sector initiatives



ecosystem of innovators, entrepreneurs, enterprises, investors, and funders

- **Partnership:** Develop long-term beneficial relationships with strategic traditional and non-traditional partners to complement the WRC mandate on either side of the value chain for strategic water sector outcomes. BD&I will focus on building partnering capabilities across the WRC that are able to cross institutional and sectoral boundaries to achieve systemic impact. It will raise the strategic nature of current partnerships to achieve greater impact in prioritised areas.
- **Business development:** Create long-term value for the WRC and the water sector through the creation of new services, products, programmes, and platforms, which includes the securing of funds and investment for testing innovative R&D solutions at scale.

The Innovation and Business Development unit is currently involved in supporting the following four strategic areas to enhance partnerships, business development and impact:

- **Sectoral co-ordination and alignment:** The National Water RDI Roadmap
- **National innovation platform:**
  - Wader: Water Technologies Demonstration Programme
  - Water 'Tech Transfer' Office
- **Water industrialisation:** Support of the Industrial Policy Action Plan
- **Water cohort transformation:** Enterprise development support via programmes such as Women in Water Empowerment Programmes and Imvelisi Green Entrepreneurs (targeting Youth Development)

### Sectoral co-ordination and alignment

#### The National Water Research, Development and Innovation (RDI) Roadmap

The Water RDI Roadmap is a partnership initiative between the DST, DWS, and the WRC. It is the key implementation instrument behind the Research and Development chapters of the NWRS-2 and the National Water and Sanitation Master Plan. The Roadmap is also closely linked to the priorities of the Industrial Policy Action Plan 2017–2021.

The National Water Research, Development, and Innovation (RDI) Roadmap is a sector-wide plan to focus interventions in water research, high-end skills and innovation. This includes development, testing, demonstration, positioning and deployment of new solutions, know-how and technologies. The Roadmap helps to position South Africa for a water-

secure future by ensuring that we are equipped with knowledge, solutions and skills to respond to a future water sector demand gap of 17% by 2030.

The coordinating, monitoring and evaluation function of the Roadmap is conducted by the Portfolio Management Unit (PMU), which is housed at the WRC. The PMU provides:

- Policy leadership and support by positioning the Roadmap to align to and influence key policy processes such as the NWRS-2, Water Master Plan and Industrial Policy Action Plan
- Runs a suite of catalytic intelligence projects focusing on understanding the water innovation ecosystem (e.g. unlocking RDI Finance opportunities, mapping the state of water RDI)
- Signals and frames a range of national RDI priorities through scoping and engagement activities

The WRC investment portfolio is highly aligned to the investment priorities of the Roadmap. Of the 212 active projects in 2016/17, 208 were aligned to the clusters of the Roadmap. Of the approximately R160 million spent on projects in 2016/17, 96% of this investment was aligned to Roadmap clusters such as alternate sources, infrastructure, efficiency and governance, planning and management (Figure 24, 25). The same applies to the portfolio of students supported by the WRC in 2016/17.



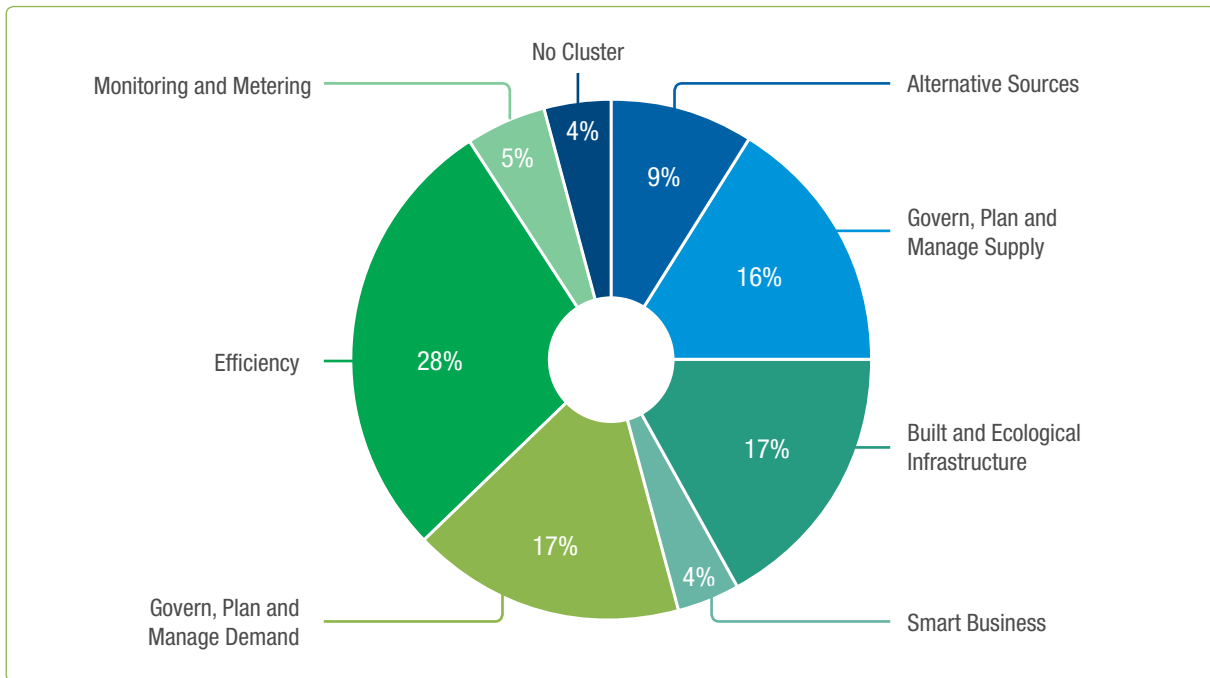


Figure 24. Investment towards water security in water RDI

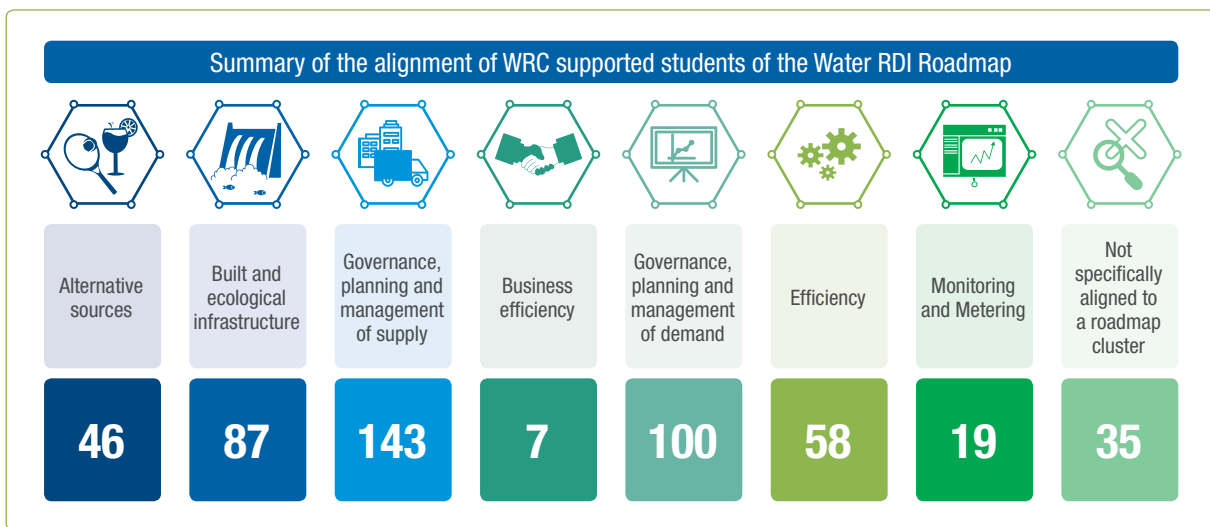


Figure 25. WRC portfolio alignment to sector needs focusing on the 7 clusters

In order to implement the aspiration, the RDI Roadmap signals will require a range of traditional and non-traditional RDI players to come on board to co-create, develop and deploy different initiatives. These initiatives will be branded by the various partners that take the lead on them. In the 2017/18 Corporate Plan the WRC primarily contributed to the Roadmap through the alignment of its research call and student support processes. In the 2018/22 Corporate Plan the WRC will maintain these inputs but also support a range of the priority initiatives that emerged from the Roadmap prioritization process and will align and partner with

additional water sector and National System of Innovation organisations. The PMU will also seek additional funds to support more research in the following areas: economics of water and pro-poor societal issues. It will support business and partnership development for strategic initiatives such as the Industrial Policy Action Plan (IPAP), SANITI, and the creation or piloting of a South African Hydrological Centre. It will seek funds and alignment from sectoral partners to support new chairs, centres of excellence and professional service centres or develop hybrid models with partners to accelerate skills and knowledge transfer in the water sector.

## National water innovation platform

### The Water Technologies Demonstration Programme (Wader)

The Water Technologies Demonstration Programme (Wader) is a partnership between the DST and the WRC that was launched in 2014 following a consultative process with the sector. Wader was set up as an instrument that will help to streamline the water innovation space with a focus on technology demonstration and assessment.

Wader is not mandated to take a product or technology to the market but rather to create an enabling environment for acceleration of technologies into the market through partnerships. The role of Wader is thus as a technical broker in the sector and to provide platform opportunities for innovators to display their technologies. It does not play a direct role around how a start-up or small-, micro-, or medium-enterprise (SMME) interacts with other partners and investors to full commercialization of its technology (Figure 26), but partners with other entities like the Innovation Hub and various other incubators to facilitate support for entrepreneurs and their business development. The WRC hosts Wader, as part of its broader strategy of realizing impact in the water sector, engaging with strategic public and private sector partners to close the innovation, funding and investment chasm that SMMEs and entrepreneurs are faced with.

The Wader PMU has enhanced the programme by managing the following four critical objectives:

- Ensure operational effectiveness and efficiency
- Develop demand-driven services for sector

- Co-ordinate and enhance Wader as a platform through strategic partnerships
- Contribute to societal impact

### Operational effectiveness and efficiency

It is important to evaluate and develop the necessary plans, processes and systems that will ensure that the PMU is consistent, effective, and efficient in its day-to-day operations. Thus, Wader PMU has developed and operationalised the following:

- Annual plan revisions
- Innovation calls
- Framework for pitch sessions from innovators to users/funders
- Expert panel for technical evaluations
- Advisory protocol (with relevant templates)
- Marketing and communication plans

In CP18 Wader will analyse the value of aligning its process to the WRC call processes in order to connect innovation opportunities from the WRC pipeline with water sector partners, to strengthen a demand-driven approach and broker opportunities for co-funding and/or demonstrating in the field. This may require an institutional realignment of timelines, processes and budgets and therefore requires careful consideration.

### Services offered

Wader has developed several services for the sector and has been evaluating its adoption by technical sector partners. Table 9 maps the different services offered and the activities associated with the offering.

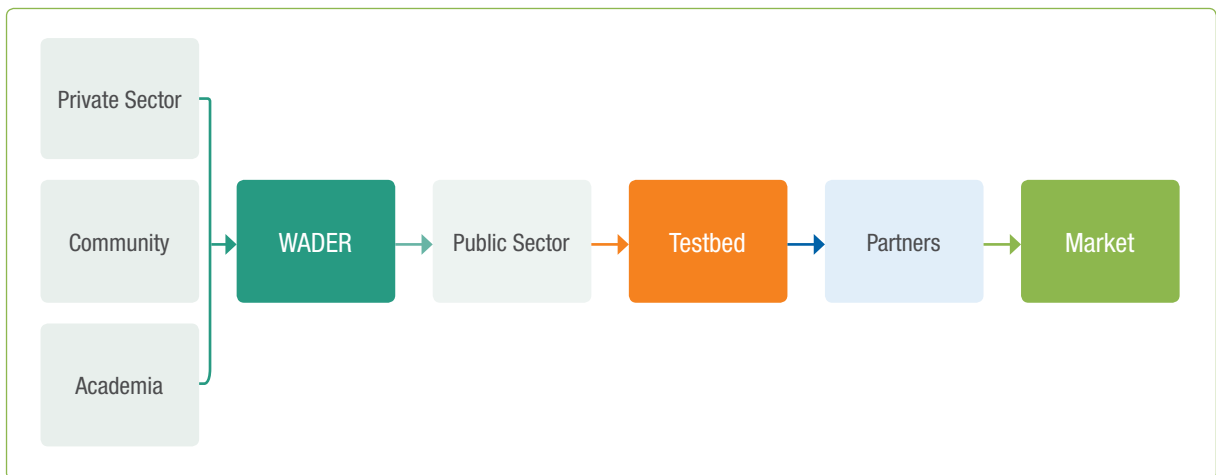


Figure 26. Wader's role in the Water Innovation value chain

Table 9. Wader service offerings

Service offering	Specific activities
1. Demonstration	<ul style="list-style-type: none"> <li>Offers a scan-and-sort function</li> <li>Offers some funds for demonstrations but requires more robust partnerships to increase the funding pool</li> </ul>
2. Access to information	<ul style="list-style-type: none"> <li>Development of Wader website with regular updates</li> <li>Development of databases of technologies and innovators/entrepreneurs</li> </ul>
3. Credible technical information	Offers expert independent panel to evaluate new and emerging technologies/tools
4. Networking and Brokering role	Allow peer-to-peer networking opportunities with entrepreneurs/innovators via events
5. Matchmaking	Brokers opportunities between innovators, funders, organisations and municipalities
6. Growth of SMMEs & ED	Based on feedback from tech pitching sessions Wader connects innovators with economic development partners and innovation hubs/incubators
7. Technical advice	Offers an advisory on a scientific basis for private sector–driven technologies
8. Drives innovation in priority areas	Link to Water RDI

In CP18 Wader will introduce two new information offerings for the sector. These include:

- Validation framework for evaluations to standardize approaches for different types of technologies
- Testbed map of opportunities

#### Co-ordinate and enhance Wader as a platform through strategic partnerships

Wader currently has three types of partnerships, viz: innovation partnerships, strategic local sectoral partnership, and strategic global partnerships. Innovation partnerships include various entities such as:

- Technology Innovation Agency
- Industrial Development Corporation
- Innovation Hub
- Various municipalities and water boards

Currently, the Water RDI PMU and the Wader PMU are engaged in framing a series of sectoral innovation and knowledge platforms with the South African Local Government Association (SALGA). In CP17 SALGA aligned its Innovation and Technology Strategy to the Water RDI Roadmap needs and an initial design of various platforms to support water sector institutions (WSIs) such as water services authorities (WSAs) and water services providers (WSPs). CP18 will aim to operationalise the five platforms.

The WRC, with Wader as the enabling platform has set up a strategic global partnership with the Water Environment and Reuse Foundation (WE&RF) of the United States of America. This partnership has enabled Wader to make use of information from the Leaders Innovation Forum

for Technology (LIFT) program of WERF. This has been extremely useful for Wader to set its processes in place for drawing in innovative technologies. In 2017 the co-hub was launched to facilitate technology information exchange, i.e., access to the range of technologies available through online access and webinars. The co-hub offers the advantage of identification of promising technologies for demonstration either in a South African or US environment. CP18 will strengthen the exchange of information across the LIFT weblinks by selecting relevant South African technologies to be viewed for uptake by US utilities, and vice versa. A long-term goal of the co-hub partnership is to facilitate an exchange programme for utility staff in both countries to visit other utilities to strengthen skills and competencies and to gain exposure to best practice and innovation.

#### Contribute to societal impact

Wader connects with both established and new researchers and innovators in the water sector. Through its calls and events, Wader will seek to encourage entrepreneurs from previously disadvantaged groups to participate in providing water solutions, and thus seek opportunities to:

- Increase the pool of Black and female innovators (transformation, race and gender will be key focus areas)
- Broker co-funding investment from local and global partnerships to enable the successful testing of valuable technologies for the water sector
- Through technology demonstrations, support emerging SMMEs, new skills, and testing solutions in relevant environments with the potential to be manufactured and/or assembled locally



### National water technology transfer support

The newly-established Technology Transfer Office provides a level of specialist skills and experience in IP management and commercial and technology transfer matters (Figure 27). The role of the Office will be to develop and maintain a leadership profile for the WRC in intellectual property and technology transfer matters in the South African water community. The WRC must translate the knowledge, experience and insight of its employees, programmes and offerings into solutions that have demonstrable impact on society. This implies that the WRC’s core capability must transform from purely developing new knowledge, to consistently translating new knowledge into impact via a process of intellectual asset management.

In this context, the TTO will lead in the effective identification, disclosure, protection and management of discoveries and inventions and other IP, to be able to make deliberate choices as to how to benefit society and the economy with this intellectual property. The TTO will build a high-quality IP portfolio to optimise opportunities for technology transfer (both commercially and for social impact), attract R&D and licensing income, and enhance the WRC’s research reputation.

In the short term, it is proposed that the first step towards achieving the main objective, of positioning the WRC as a leader in the South African and water community, will be to implement good IP and commercialisation management. The key objectives for the WRC in terms of transferring technology are as follows:

- Enhance the WRC’s ability to demonstrate impact through value creation from innovations

- Improve financial sustainability through diversified income streams
- Optimise return on investment
- Establish and strengthen a culture of innovation
- Translate the knowledge, experience and insight of employees, programmes and offerings into solutions having demonstrable impact on society
- Establish a clear and practical process for innovation, i.e., creating, securing, protecting and exploiting the WRC’s intellectual assets

The focus is on intangible asset management referring to the management of IP through the processes of identification, protection and exploitation of IP.

The newly-formed unit will evaluate the following service offerings in CP18. Based on demand and value it will then institutionalise those services which offer the greatest value to the WRC and sector partners and innovators.



Figure 27. Services to be provided by the Water ‘Tech Transfer’ Office

### Water industrialisation

In CP17, the WRC contributed to a water and sanitation chapter in the IPAP 2017–2022 and will continue to support partners in achieving the aims of chapter. The chapter prioritizes four major programmes:

- Water Industrialisation Implementation Plan
- Innovative Desalination and Water Manufacturing Programme
- Next Generation Sanitation Cluster Programme
- Modular and Advanced Wastewater Capability Build Programme

The inclusion of the IPAP chapter is now uniquely positioned to lead the water industrialisation strategy since the major players, such as the DTI, DWS and DST, are supportive of the ‘new’ water industry opportunities which can offer new markets to new commercial players and innovatively structure policy and investment incentives towards such initiatives. However, to industrialise the water space with the ‘next generation water and sanitation products and technologies’, aimed at both water sector institutions, industry, households and businesses, requires that the innovation value chain is completed to achieve high-quality technologies with the correct commercial partners to take them forward. CP18 will ensure that the WRC participates with all key stakeholders to make this a success.

### Water cohort transformation

While the WRC recognizes the unequal society that we live in, it also recognizes the power that knowledge solutions can offer to previously disadvantaged groups if appropriate opportunities are afforded to women, youth and Black professionals and entrepreneurs. Thus, the BD&I team will continue to support programmes that elevate entrepreneurship and enterprise development. Support will continue to be given to:

1. Women in Water Empowerment Programme (funded by the DWS and Implemented by the WRC)
2. Imvelisi Enviropreneur Programme where WRC has provided in-kind and technical advisory support to young entrepreneurs who are passionate about green technologies and businesses



# [ 10. International Cooperation and Partnerships ]

The WRC International Cooperation and Partnerships strategy aims to establish new and strengthen existing partnerships that will extend the WRC footprint, especially in the African continent, and derive maximum value for the WRC, the SA water sector and continent. The international partnerships will be guided by five objectives of:

- Global positioning of the WRC as a competitive and key development player and a leader on water and sanitation knowledge-based solutions
- Influencing and contributing to the global and continental water agenda
- Securing international resources for the WRC, SA and the continental water sector
- Contributing to strengthening capacity on the continent
- Facilitating impact-driven research, innovation and value-adding engagements

The strategy will provide guidance and a framework for common principles and a clear WRC value proposition for international partnerships. The implementation of the strategy will be an integrated process and effort by the Research and Development (R&D) and Innovation and Impact (I&I) branches. The strategy will guide the proactive identification of internal, systemic, and international risks that could inhibit successful implementation of the WRC international partnerships, prevent the risks from occurring or establish mitigation actions. Below are some of the high potential risks that will be addressed over the short and long term:

- **Internal:** Lack of WRC prioritisation, and a framework to drive African cooperation and partnerships, internal alignment and integration of international strategy implementation within the branches, and co-funding to leverage international investment.
- **Systemic:** Lack of national strategy, joint planning and a unified approach for South Africa's engagement with the continent and multilateral fora/platforms which may lead to losing leverage and benefit associated with the platforms. The national strategy should be led by the Department of International Relations and Cooperation (DIRCO) supported by the relevant line departments, state-owned entities and other water stakeholders.
- **Continent:** Lack of African agenda established and driven solely by African Member States, dependency

on donor funding, and low intra-African collaboration and partnerships.

- **International:** Building and maintaining South Africa and the continent's global competitiveness (technical expertise, policy, technological and innovation), diminishing development and international research funding, lack of prioritisation of water and sanitation in global agendas.

## 10.1 The 5-year framework

The WRC will embark on a new approach to strengthen and improve its international partnerships for the next 5 years starting in the 2018/19 financial year. The approach will focus on strategic, impact-driven and value-adding international engagements guided by a carefully considered framework. The WRC will put more effort and resources towards establishing African water flagship programmes, to leverage maximum benefit from the existing partnerships, and to create dependencies on the WRC to provide leadership in water RDI knowledge-based solutions.

The international partnerships will be driven by four pillars and will incorporate a range of activities specifically designed to derive maximum benefit and value from each partnership, as highlighted in Figure 28.

The short-term goals for the implementation of the international strategy in 2018/19 are as follows:

- Establish the international value proposition and marketing material together with Communications and Marketing and Knowledge Services teams
- Commission a study to conduct a comprehensive mapping of water RDI landscapes, priorities and funding opportunities in the different regions of the world
- Revise the current international strategy, also adding the Africa game plan
- Examine the feasibility and value of being a global connector, like Stockholm as the World Water Week lead convener, but for the African continent
- Identify opportunities for the WRC to join existing or new continental programmes/projects
- Influence prioritization of water and sanitation as key programmes for the Indian Ocean Rim Association (IORA) and Southern African Development Community (SADC), capitalizing on South Africa's chairmanship

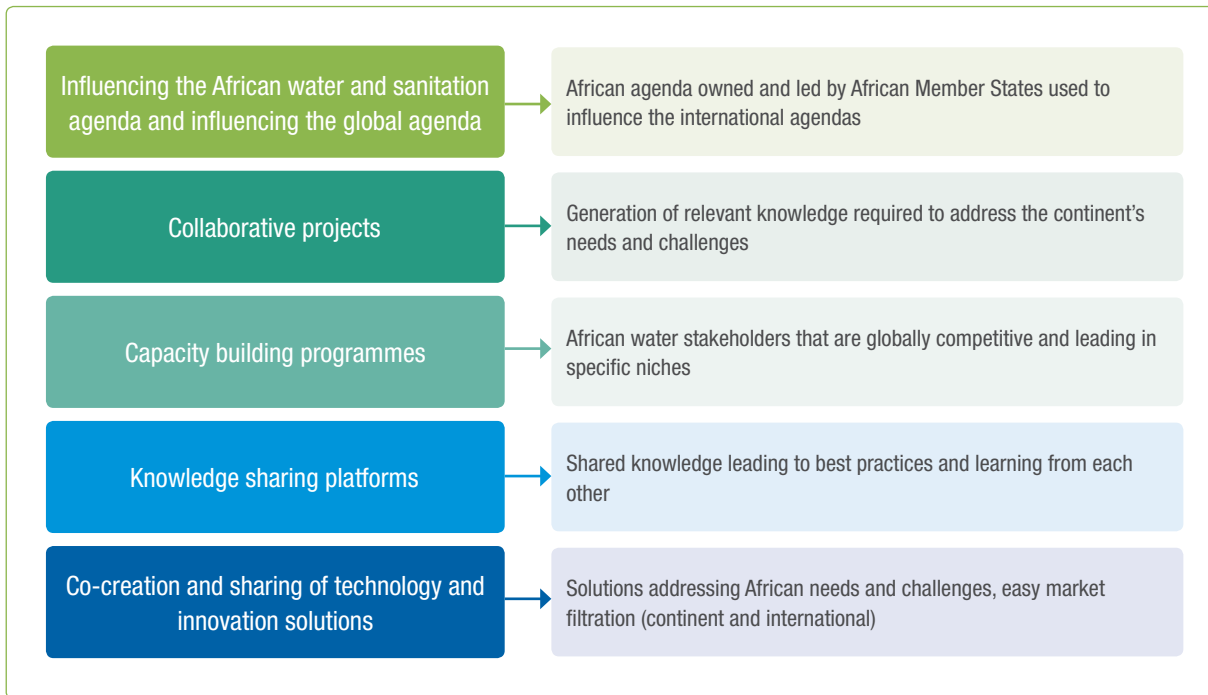


Figure 28. WRC International cooperation and partnerships pillars

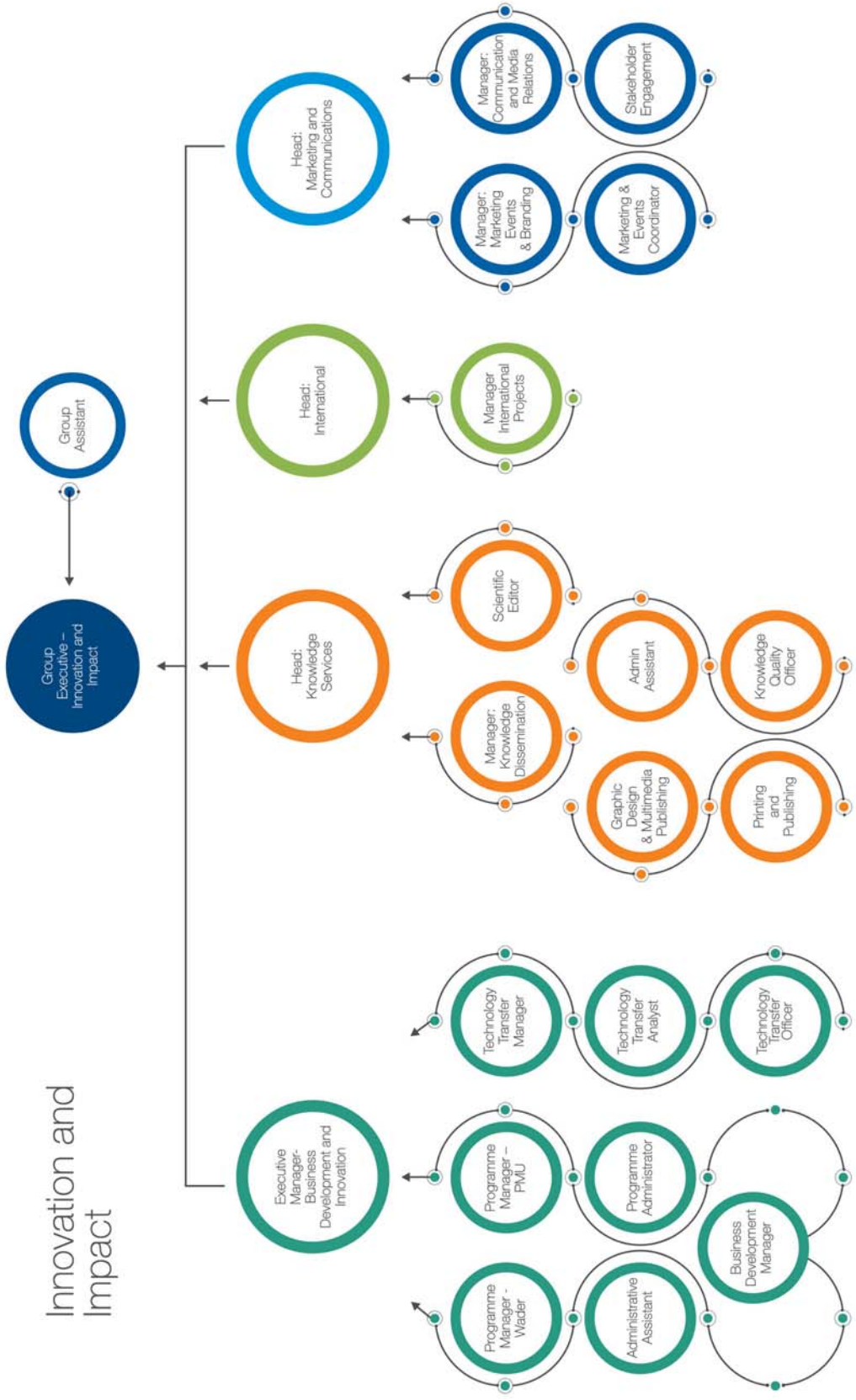
The long-term goals for the implementation of the international strategy in 2017–2020 are as follows:

- Positioning the WRC as a preferred African partner
  - Key competitive player (technical know-how)
  - Water and sanitation knowledge and key development player
  - Co-convener of international strategic events (explore hosting the SIWI-like African-led conference)
- Leverage international resources
  - Management and implementation of long-term water and sanitation programmes in the continent
  - African regional water flagship programmes (regional) with joint funding from local, regional and international partners and investors
  - Implementation of capacity building programmes for the continent (knowledge sharing, technology transfer and solution co-development)
- WRC used as an effective and efficient water and sanitation knowledge hub for the continent
  - Partnerships with leading institutions to provide training on the continent
- Increased water and sanitation programmes influenced by the WRC’s strategic continental and global agenda
  - Prioritisation and allocation of resources for water and sanitation (IBSA, IORA, SADC etc.)
  - Alignment of the global agenda to the African agenda





# Innovation and Impact



# [ 11. Finance ]

## 11.1 Executive overview

Over the CP18 period the Finance Branch will maintain its ongoing focus on financial reporting and compliance as this is an important element related to the WRC retaining and building on its clean audit status, which also provides our partners and key stakeholders further assurance of the entity's financial soundness.

During the CP18 planning period the Finance Branch will shift towards becoming a more strategic partner to the WRC operations by moving from being primarily engaged in administration to being driven by improved efficiencies and effectiveness within the WRC Supply Chain Management (SCM) function and the financial planning and management areas (Figure 29). The Branch focus will be geared towards providing the WRC with the required financial planning, structuring and support tools to facilitate and empower the organisation to understand its funding requirements and funding sources that will enable it to realise its research, development and impact vision and strategic objectives. The Finance Branch will play a key role in ensuring the WRC remains financially sound and sustainable. During this period skills development and empowerment of the team, and refining of business processes and IT systems deployed within the finance domain will be fundamental to ensuring the successful attainment of the finance goals and objectives contained in CP18.

The key strategic focus areas, more fully described below, include:

- Improved efficiencies and effectiveness within the WRC Supply Chain Management (SCM) function to ensure improved turnaround times
- Enhancing the financial planning capabilities which will contribute towards creating an appropriately funded and financially stable operating environment

## 11.2 SCM and Finance planning focus to support the WRC Strategy during CP18

### Enhancing the effectiveness and efficiency of the SCM function

SCM is responsible for the sourcing and procurement of all goods and services that are non-research related. This function has the potential of significantly impacting on the effectiveness of the overall WRC business operations. We recognise that over the next five years there is an expectation that the WRC must concentrate on greater impact and this means a move from the traditional research work towards demonstrations and piloting of the research. What this means is that there will be an increased demand for more sophistication with respect to SCM, specifically, the sourcing of materials and possibly other associated professional services that are related to setting up demonstration plants and pilots which often requires dealing with international suppliers and service providers.

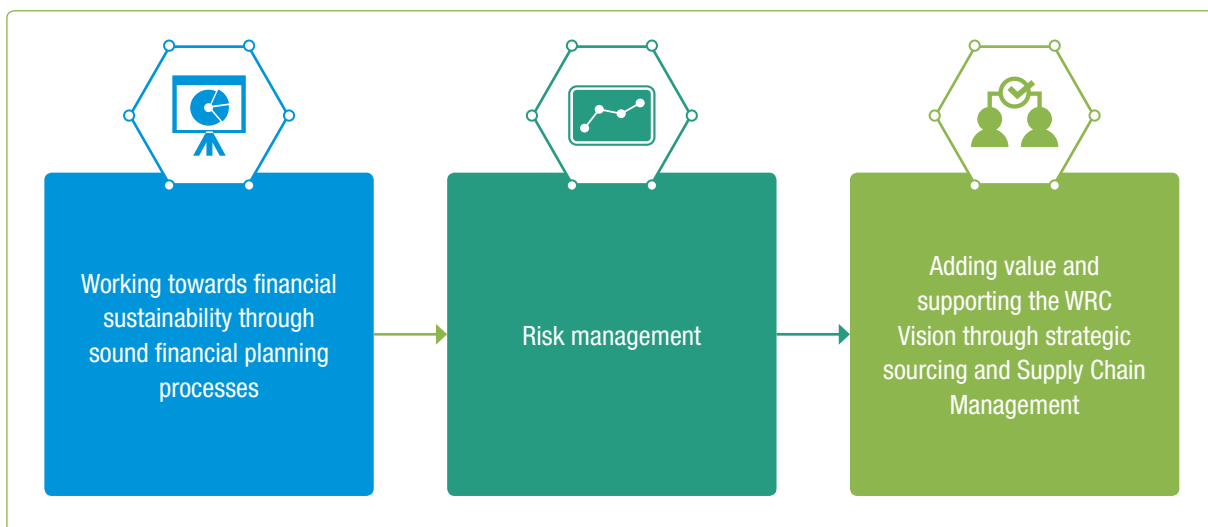


Figure 29. Finance and Supply Chain Management planning focus

This will be a new area of operation for the SCM function and will require the following:

- Ongoing skills development and empowerment of the SCM team
- Refining the SCM business processes and making these less cumbersome without compromising the legislative requirements and compliance with the various SCM prescripts
- Where appropriate, ongoing refinement and customisation of the IT systems and technologies that are deployed within the SCM environment

For the traditional goods and services such as travelling, printing, IT and other services we will select an appropriate sourcing and procurement strategy and this will include:

- Awarding multi-year contracts for specific goods and services to appropriate service providers after following the required procurement and tender frameworks, rather than obtaining quotes for each and every purchase, which is not only inefficient but often more costly. The contract approach will allow the WRC to obtain better and more competitive pricing and will also make the procurement process more efficient whilst still complying with the required prescripts.
- Where appropriate pre-qualifying service providers for certain goods and services and in the process accrediting these potential suppliers by following the permissible SCM processes and prescripts. This means that where procurement is urgent the pre-qualified service providers could then simply be approached to provide proposals and quotations and this will reduce

response times without compromising the service standards nor the legislative requirements.

- Where appropriate and advantageous the WRC will consider sourcing goods and services utilising existing contracts from other State organs if this is favourable. The potential for inadvertently also attracting irregular expenditure is recognised and will be factored into the decision when the need arises.
- As the WRC business evolves this will be accompanied by changes in its procurement and SCM requirements and the Finance Branch will ensure that there is an ongoing analysis and adaptation of the SCM function and processes within the boundaries of the prescripts

Whilst the SCM unit plays a key role with regard to WRC SCM legislative compliance we recognise that for it to remain relevant it must also have a client service orientation. The engagement with various stakeholders and recipients of the SCM services will therefore be paramount during the design, development and implementation of the various elements required to build a more responsive and effective SCM function. In this regard, a number of SCM work sessions will be held as an integral part of working towards achieving the above SCM strategic goals.

### Enhancing the financial planning business processes and systems

Figure 30 provides an overview of the key financial planning and budgeting elements that are coordinated by the Finance Branch.

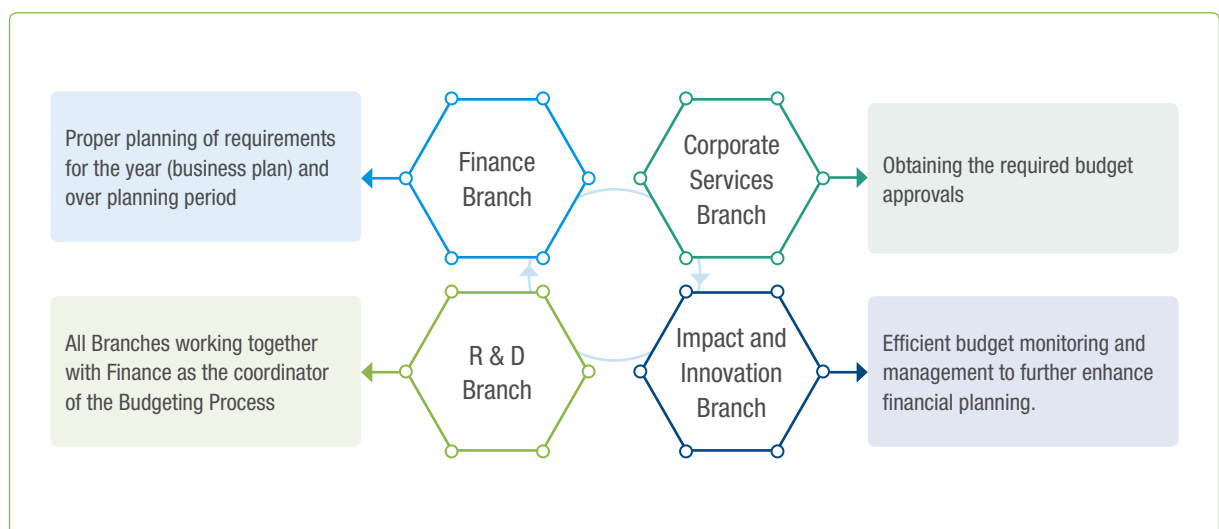


Figure 30. Key financial planning and budgeting elements

Over the planning period the areas of focus that will support the WRC goals with respect to financial sustainability include:

**Increased focus on the coordination of the budget planning and formulation processes to ensure:**

- Enhanced focus on key financial performance indicators
- That revenue generation activities relating to leverage and levy income are planned and prioritised
- Cost containment and cost-saving measures are fully explored and implemented
- Formalised engagement and discussions between the various WRC branches which will result in joint ownership of the financial outcomes in terms of the budgets and financial projections. The result will be more realistic and informed financial planning.

**Increased focus on cost control and expenditure monitoring processes to be enhanced and this to include:**

- Having dedicated monthly and quarterly WRC financial performance work sessions where revenue and expenditure progress against targets and budgets are analysed and discussed
- Ensuring corrective measures are devised where financial performance is not on target for specific areas
- Following up on the progress in relation to corrective measures taken

The current WRC funding model means that there are no guarantees regarding availability of funds and, like other research institutions, we are faced with the ongoing uncertainty related to the various phases of the economic and business cycles. In addition, the WRC research and development projects are generally underpinned by multi-year contracts; we also have a fixed overhead cost structure related to staff, office and other infrastructure. Thus, in essence the balancing of revenue and cost is a critical business imperative. The WRC funding matters that will be considered during the planning period include:

- MoUs – funding agreements
  - Contracts will be carefully scrutinised to ensure that the financial impact is clearly understood
  - Management fees will be considered for inclusion as part of the standard terms and conditions for leverage-funded projects
  - Contracts should provide for operational expenditure to be financed by the project
- Business development focus on securing new sources of leverage funding
- Risk mitigation potential associated with possible trading via an operating subsidiary that could pursue less risk-averse opportunities without placing the WRC core business at risk

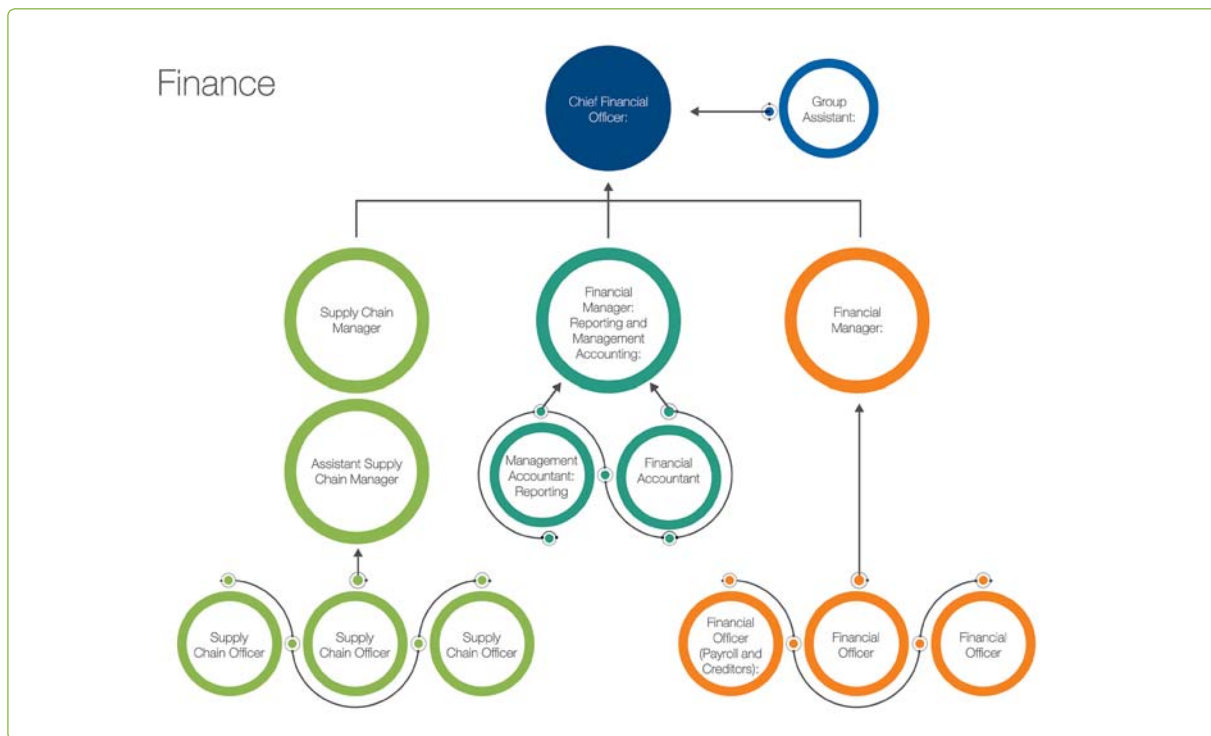


Figure 31. WRC Finance Branch



# [ 12. Corporate Services ]

## 12.1 Introduction

The WRC's workplace is being defined by technology and the employees that are using it, corporate social responsibility, good governance and the physical work environment.

The Internet of Everything (IoE) is enabling new forms of connectivity, changing communications and fostering new ways of working. With the plethora of devices, apps and solutions now available and growing at a phenomenal rate, to remain relevant and competitive, the WRC must move with the times, while striking a balance between current and future employee and business needs.

The Internet of Everything, enabling people globally to be connected wherever they are and whatever they are doing, has led to the rise of 'Supertaskers' – members of Generation X and Y who have honed their skills of completing several tasks efficiently and simultaneously. The dynamic is changing and the lines between work and home life are blurring as technology enables employee to make the most out of what used to be wasted hours sitting

in a traffic jam or a doctor's waiting room. This flexibility minimizes downtime during load shedding, which can often be a challenge in South Africa, as staff can work from anywhere they find power and a Wi-Fi connection.

For the workplace, this means the emergence of a generation of workers with the potential to be highly productive. It also suggests the need to ensure that employees are given the variety of tasks they need to tap into this skill and lead to their fulfilment. It will therefore be essential to create a working environment that engages and encourages this way of thinking.

Together with ICT, another important aspect of the world of work is corporate social responsibility. This is a business management practice that incorporates social and environmental concerns into regular business activities. It encompasses many objectives ranging from the ethical treatment of employees and members of the supply chain, to safe and healthy ingredients, to environmentally-friendly/sustainable product manufacturing.

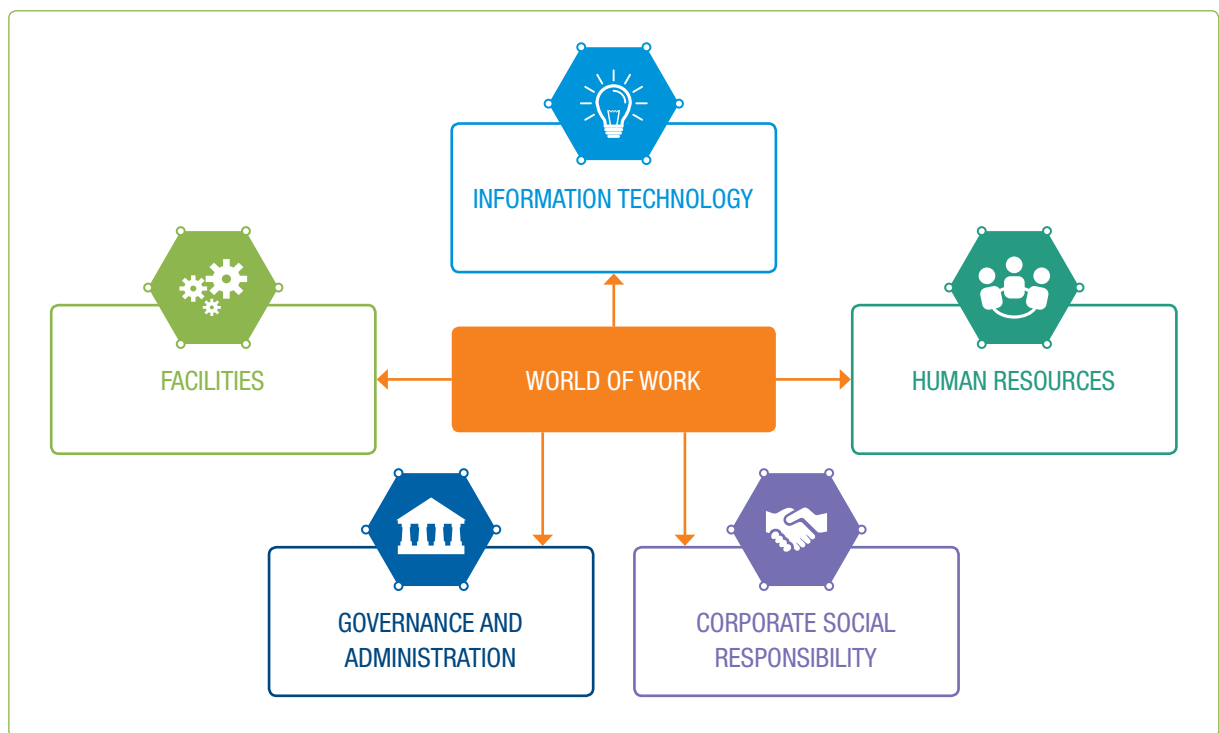


Figure 32. WRC Corporate Services

As consumers, employees expect a high level of corporate social responsibility, and not meeting those expectations can be a major turnoff.

Essentially, the WRC's Corporate Services Strategy straddles the fine line between what has traditionally worked and what will work in the future, based on the needs, strengths and mind-set of the future workforce. Each new generation is progressively more Internet- and technology-focused, and also more social-responsibility focused. With this in mind the world of work must focus on human resources, information technology, governance and Facilities in an integrated approach (Figure 32). This approach will ensure that the WRC will move to the next level in terms of business success and employee satisfaction.

## 12.2 Information Technology

The IT Strategy is based on the following three principles:

- **IT as an enabler of business functions (business intelligence).** IT systems that are developed and implemented to improve traditional business functions in order to improve the financial accuracy and reporting aspects of fund and project management.
- **IT as a facilitator to new impact areas.** The use of different types of media can reach different demographics. IT will play the role of facilitator because it acts as a go-between between the business itself and the new impact area.
- **IT to provide agility.** The economy, events, trends and circumstance play a part in the WRC's impact and growth. Agility is a measure of the WRC's ability to adapt and even embrace change. Technology plays a decisive role in modern business. Examples of technology that enable agile responses are: Cloud services, remote access, as-a-service products and mobility products.

The IT Strategy has five themes, which are:

- Advancing the WRC – targeted investment in key strategic areas
- Effective information stewardship – recognizing the growing importance of capturing, storing and providing secure, effective access to a growing inventory of information
- WRC operational excellence – providing common structural solutions in support of sustainable excellence and the various departmental initiatives
- IT complexity reduction – reducing the burden of maintaining and evolving existing services to release resources that deliver new advances

- IT functional excellence – continuing to build effective processes, approaches and structures in how IT delivers projects and services

The general approach for IT finances, governance and organization is proposed to be strengthened through:

- **Finances**
  - Driving IT complexity reduction to release resources to be available for new initiatives and innovation
  - Increasing central oversight of IT spend, including management of all major IT capital investments – with critical review of ongoing spend
- **IT governance**
  - Include service governance in our KPIs
  - Assess and address gaps in overall IT governance
  - Encourage and steer risk-taking IT service innovation initiatives
- **Organisation**
  - Periodic reskilling of IT resources to deliver the IT Strategy
  - Supporting a review of IT services and engagement structures across Corporate Services

### Our view of the future

The strategic vision can be viewed in overview using these three lenses:

#### LENS 1: Research vision for IT

IT provision should enhance and facilitate the WRC's world-class research. This goal is described with respect to three main areas:

- **Communication.** IT should facilitate communication within the WRC, with other institutions in the national and international context, with business and with the general public. This requires tools for collaborative working, fostering a sense of the WRC academic and research community through technology, and using data requests intelligently to understand the needs of students, researchers and the users of research outputs.
- **Infrastructure.** Researchers should be able to exploit near-state-of-the-art IT infrastructure for high-performance computing and have access to in-house expertise to make projects viable. IT provision and support should ensure excellent value for money to the benefit of both external users and our institution. IT infrastructure should reflect the changing ways in which researchers work, supporting virtualization and untethered working.

- **Data.** The WRC needs to be proactive in the ‘big data’ era, providing the means to access and share datasets, as well as ensuring security and resilience in data storage. IT should provide the means to both protect and exploit the institution’s electronic assets.

The WRC is committed to delivering a distinctive and high-quality user experience. IT can support this significantly through:

- Higher quality interactions – where services are seamless, highly accessible (mobile), and deliver comprehensive solutions, including interactions with our in-house staff, our external researchers and general consumers
- Facilitating more responsive, inclusive and tuned collaboration environments, supporting communities both within and outside the WRC
- Fostering ongoing innovation and focused development of new services
- Supporting researchers and consumers through a full relationship lifecycle

### LENS 2: Professional services vision for IT

Business systems within the WRC are necessarily complex because they have to both underpin the core business of research and also support the WRC’s legislative and compliance agenda.

In the past, business systems were largely developed in isolation from the researcher, user or consumer community and this led to a proliferation of local applications resulting in duplication and inefficiency. More recently it has resulted in the need for major reconfigurations to existing systems to allow greater access and functionality.

The vision for the institution is therefore to move forward to a more integrated and simplified provision which promotes and facilitates collaborative working and provides data across the WRC that is fit for purpose, accessible, portable, agile, robust, accurate, timely, scalable and secure and provides comprehensive reporting solutions.

This will be achieved by turning off legacy systems, investing in integrated systems and ensuring appropriate interconnection between applications through the use of middleware solutions, to be underpinned by a comprehensive business-wide training programme. Broadly the direction is to follow an approach of ‘best in class overall’ rather than ‘best in class for each specific requirement’.

### LENS 3: End-user/researcher vision for IT

The WRC is committed to delivering a distinctive and high-quality user/researcher/consumer experience. IT can support this through:

- Higher quality interactions – where services are seamless, highly accessible and deliver comprehensive solutions (including interaction with people/users who are not based in our offices)

### IT strategy themes

The IT Strategy to deliver against these future visions is encapsulated in five themes:

- **Advancing the WRC.** It is key to the Strategic Framework goals that energy and focus is directed towards the key areas for development and delivery. This IT theme is to deliver game-changing advances in how IT supports the key areas of academic research, knowledge dissemination and a distinctive, high-quality user experience. It will do this through a market-focused approach coupled with collaborative innovation for each of these three areas.
- **Effective information stewardship.** It is critical that greater focus with systems and procedural support is established in capturing, storing and providing effective secure access to a wide range of assimilated information sets. This will ensure (i) legal compliance, balanced with (ii) cost effective and responsive service provision, and (iii) practical procedures and guidelines to assist WRC staff and administrators to manage information most effectively.
- **Operational excellence.** In a number of areas, there are significant opportunities to improve how departments and functions operate across the WRC. This theme focuses on underlying infrastructure step-change enhancements, carbon reduction initiatives, and staff skills developments which can directly contribute to such improvements.
- **IT complexity reduction.** Recognizing the current economic realities together with an existing IT provision capability which is already fully committed, it is necessary to adopt new approaches for IT delivery. A key driver of the current IT provision is technical complexity. Therefore, delivering a step-change reduction in IT complexity can facilitate a repurposing of resources to help deliver the overall IT Strategy, particularly in the areas of data centre hardware platforms and application architecture.
- **IT functional excellence.** As a core function for an information-driven institution with high aspirations, IT needs to be striving for ‘best in sector’ provision of IT services and projects.

## 12.3 Corporate Social Responsibility

Corporate social responsibility is the commitment by the WRC to behave ethically and contribute to economic development while improving the quality of life of its employees as well as the community and the environment in which it operates.

The principal goal of the strategy is to establish the directives necessary to achieve respect for the employees and environment, and to contribute to society.

The specific **objectives** of the strategy are as follows:

- Minimise impact to the environment through waste and pollution reduction
- Enhance the wellbeing of employees
- Ensure empowerment and improvement of the communities in which the WRC operates

These objectives are detailed in the following **strategic focus areas/thrusts**:

- Community
- Employee wellness
- Environment

### Community

The WRC will contribute to communities through sustainable interventions that will result in a direct improvement in the lives and livelihoods of communities (Table 10).

- Programme 1: Community involvement in research projects. Build capacity through knowledge transfer and training
- Programme 2: Use of innovations/technology from research projects in the community

### Employee wellness

The WRC's performance is directly influenced by the health and wellbeing of its employees. In today's dynamic environment it is critical for the WRC to step forward and invest in its human capital as a competitive advantage, and with this comes a need to nurture the wellness of its employees.

**Scope:** To improve the health and wellbeing of the WRC's employees through education and activities that will support positive lifestyle change thereby resulting in improved employee productivity and morale, and health-care cost savings for the employee and the organisation.

The fundamental **objectives** of this strategy are to:

- Improve the health and wellbeing of WRC employees
- Improve the quality of work-life
- Reduce the use of health care
- Enhance productivity

The Employee Wellness Strategy will focus on three areas of wellness (Table 11):

- Programme 1: Health Management
- Programme 2: Wellness Management
- Programme 3: Socio-Economic Wellness

### Programme 1: Health Management

**Scope:** Health management is the integrated management of health risks for chronic illness, occupational injuries and diseases, mental diseases and disability. Health management activities are efforts to promote and maintain the general health of employees through prevention, intervention, awareness, education, risk assessment and support in order to reduce the impact and effect

Table 10: Corporate Social Responsibility implementation plan

	Output indicators	Outcome indicators
<b>Programme 1:</b> Community Involvement in research projects  <b>Programme 2:</b> Use of Innovations/technology from research projects in the community	<ul style="list-style-type: none"> <li>• To select projects that have community involvement</li> <li>• Use of innovations/ technology for research projects</li> </ul>	<ul style="list-style-type: none"> <li>• Build capacity through knowledge transfer and training</li> <li>• Enhance infrastructure in the community that will result in an improved quality of life</li> </ul>
	<b>Activities for Programmes 1 &amp; 2:</b> <ul style="list-style-type: none"> <li>• Proposal submitted detailing community involvement in the research project</li> <li>• The implementation of the innovation/technology from the research project in the community</li> </ul>	



of communicable and non-communicable diseases and injuries on the productivity and quality of life of employees.

Target areas for intervention:

- Body mass index
- Waist circumference
- Blood pressure
- Cholesterol
- Glucose
- Chronic diseases of lifestyle

### Programme 2: Wellness Management

Wellness management is the promotion of the physical, social and emotional wellness of individuals. This is achieved by creating an organisational climate and culture that is conducive to wellness and work-life balance. Wellness management strives to meet the health and wellness needs of WRC employees through preventative and curative measures, by customizing those aspects that are most relevant and fit the dynamic environment of the WRC.

Target areas for intervention:

- Smoking status
- Alcohol consumption
- Nutritional intake
- Physical activity
- Mental health

### Programme 3: Socio-Economic Wellness

The current economic pressures such as the rise in interest rates, high cost of living and economic uncertainty are major contributing factors in influencing the psycho-social wellness of employees. Many of the presenting problems, such as stress, depression, interpersonal and work-related problems, are actually caused by financial difficulties employees are experiencing. In this respect the WRC will seek financial-related interventions that assist employees.

Target areas for intervention:

- Financial planning
- Debt counselling



Table 11. Employee wellness programmes and indicators

<b>Programme 1:</b> Health management	<b>Output indicators</b>	<b>Outcome indicators</b>
	<ul style="list-style-type: none"> <li>To provide wellness screening to employees</li> <li>To provide health-related information</li> </ul>	<ul style="list-style-type: none"> <li>WRC employees know their health status</li> <li>Employees become aware of health risks enabling early detection and treatment</li> </ul>
	<b>Activities for Programme 1:</b>	
	<ul style="list-style-type: none"> <li>Fitness screening of all employees</li> <li>Nutrition screening of all employees</li> <li>Know-the-disease campaign</li> </ul>	
<b>Programme 2:</b> Wellness management	<b>Output indicators</b>	<b>Outcome indicators</b>
	<ul style="list-style-type: none"> <li>To promote individual physical wellness of employees in order to promote fitness and healthy lifestyle</li> </ul>	<ul style="list-style-type: none"> <li>Majority of employees with a Body Mass Index of 18.5–24.9</li> <li>Majority of employees with waist circumference less than 88 cm for women and 102 cm for men</li> <li>Majority of employees with blood pressure within acceptable range</li> <li>Majority of employees with cholesterol within acceptable range</li> <li>Majority of employees with glucose level within acceptable range</li> <li>Majority of employees on non-smoking status</li> <li>Majority of employees with an alcohol consumption level within range</li> <li>Majority of employees with acceptable nutritional intake</li> <li>Majority of employees with acceptable physical activity</li> </ul>
	<b>Activities for Programme 2:</b>	
	<ul style="list-style-type: none"> <li>Increase physical activity initiatives</li> <li>Nutrition education programmes</li> <li>Healthy eating plans (healthy meal options)</li> <li>Work–life balance initiatives</li> </ul>	
<b>Programme 3:</b> Socio-Economic Wellness	<b>Output indicators</b>	<b>Outcome indicators</b>
	<ul style="list-style-type: none"> <li>To promote individual socio-economic wellness of employees in order to decrease the related effects to employee health</li> </ul>	<ul style="list-style-type: none"> <li>Employees who are informed of financial matters that impact on their socio- economic wellness</li> <li>Employees who are equipped to deal with debt issues</li> </ul>
	<b>Activities for Programme 3:</b>	
	<ul style="list-style-type: none"> <li>Financial planning workshops</li> <li>Debt counselling workshops</li> </ul>	

## Environment

The WRC acknowledges that the environment is a fundamental aspect of social responsibility. The business activity of the WRC has an impact to a greater or lesser degree on the environment.

To reduce the impact of the WRC activities on the environment and ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.

The environment strategic focus area is targeted via two programmes (Table 12):

- Programme 1: Waste and pollution reduction
- Programme 2: Green ICT

## Programme 1: Waste and Pollution Reduction

To raise awareness of the impact of excessive consumption on the environment. Waste and pollution reduction will be achieved through intensive recycling programmes. One of the main objectives of recycling is to reduce the amount of garbage that gets sent to landfills.

## Programme 2: Green ICT

Scope: The alignment of WRC IT initiatives with measures that address environmental and sustainability issues. These include designing, manufacturing, using and disposing of computer systems efficiently and effectively with minimal or no impact on the environment.

Table 12. Environment programmes and indicators

	Output indicators	Outcome indicators
<b>Programme 1:</b> Waste and Pollution Reduction	<ul style="list-style-type: none"> <li>• To recycle waste from the WRC activities</li> <li>• To purchase products manufactured from recycled goods</li> <li>• To reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote the recyclability or biodegradability of products</li> </ul>	<ul style="list-style-type: none"> <li>• Reduction in landfill</li> <li>• Reduction of pollution from landfill leachate</li> <li>• Reduction in the depletion of natural resources by the re-use of materials</li> <li>• Reduction of energy consumption by the reuse of materials</li> <li>• Support to the economy as recycling creates jobs</li> <li>• Reduce energy consumption</li> <li>• Ensure that hazardous waste is disposed of in a way that does not harm the environment</li> </ul>
	<b>Activities</b>	
	<ul style="list-style-type: none"> <li>• Provision of recycling bins</li> <li>• Recycling campaign to increase collection of waste</li> <li>• Remove active screensavers:               <ul style="list-style-type: none"> <li>- Monitors left running with active screensavers can consume the same amount of energy as when the screen is in full use</li> </ul> </li> <li>• Switch monitors to standby after 10 minutes of inactivity (no active screensavers)</li> <li>• Shut down computers after office hours:               <ul style="list-style-type: none"> <li>- Ensure that all users shut down their computers once they are done working so that their computers do not utilise unnecessary energy when not being used.</li> </ul> </li> <li>• Ensure re-use of equipment that is no longer required. If re-use is not possible recycle or ensure green disposal:               <ul style="list-style-type: none"> <li>- A lot of energy is consumed in the manufacture, delivery and disposal of equipment. By extending the life of a product it will save energy and materials (at the manufacturing stage) as well as purchase and disposal costs. The WRC is also committed to ensuring that recycling or disposal of all waste or retired products, is done in an environmentally friendly way.</li> </ul> </li> <li>• Recycle toners and paper</li> <li>• Set default green printing including duplex and grey-scale by default</li> <li>• Optimise power-saving mode on printers</li> </ul>	

## 12.4 Human Resources

Changing employee expectations, new technologies, increasing globalization and a need for agility in the face of a turbulent business environment mean that tomorrow's workplace will be barely recognizable from today. With the WRC operating in a complex environment, we are already experiencing:

- An increasingly competitive market for talent compounded by significant demographic changes
- Shortage of technical and leadership skills
- Constant change brought upon by a broader stakeholder economic, political and social environment – this requires ongoing examination of the alignment of WRC priorities with national interests

For the WRC to keep pace with the changing environment its Human Resources Strategy focuses on the following three principles:

- **Agility.** A workforce that is agile and responsive, with the soft and hard skills and competencies that reflect the changing needs of the WRC – this implies identification of workforce requirements and solutions, and empowering talent with the skills, tools, systems and support needed to work more effectively, and be more adaptable.
- **High performance.** A high-calibre, motivated workforce that works in partnerships internally and externally, with an emphasis on results, innovation, solution-driven collaboration, and team performance
- **Shared responsibility.** The WRC is 'everyone's business'. Employees at all levels of the organisation must work together and be accountable to each other to improve our ability to deliver on the WRC's mission.

## Human Resources strategic objectives

### 1. Employee flexibility and workplace complexity

The WRC is increasingly composed of an ever-shifting, complex environment of a global network of partners, business partners and outsourcing providers. As talent stretches beyond the confines of the company, Human resources (HR) teams may have to pay as much attention to people outside of the organisation as to those inside.

### 2. Employees and technology

The use of technology to integrate talent management into the fabric of everyday business. HR IT will become a vital component of the WRC characterised by social media, Cloud computing, mobility, and 'big data'.

### 3. Talent management

With a mismatch between areas of supply and demand of jobs, the WRC will be composed of a highly diverse workforce. HR will need to adopt new recruitment strategies to effectively match talent with task across the business. The skills gap is also widening and HR will increasingly need to ensure that the WRC has the right people. HR to develop initiatives to be able to quickly tap skills when and where they are needed.

### 4. HR drives the agile WRC

The world is becoming increasingly unpredictable and organisations that can adapt to changing business conditions will outperform. HR will fundamentally reshape itself to enable a new organisation designed around nimble and responsive talent.

### 5. WRC's talent management that meets the science of human behaviour

As new discoveries into human behaviour are emerging – the WRC will be investing in organizational development





strategies that will begin to arm it with the tools and insights to achieve better performance from the workforce.

#### **6. The use of social media to enhance communication and employee engagement**

Social media is pervading the workplace and making it easier for employees to exchange information and ideas online. HR will play a vital role in helping build effective organisational cultures that support this, as well as incentives and processes for knowledge sharing, innovation and engagement.

#### **7. HR navigating risk and privacy in a more complex world**

As the Internet continues to break down information barriers, HR will now be adopting risk management strategies covering everything from protecting confidential information and data, to risks associated with weak hiring or turnover of talent.

#### **8. HR to deliver seamless employee experiences**

HR will evolve from being a clearly-defined, stand-alone function to one that collaborates closely with other parts of the business, such as IT, strategy and marketing, to deliver well-rounded HR and talent management processes.

#### **9. Tapping skills anywhere, anytime**

These trends are happening now and will only get more real and impactful. A very different set of HR and talent management practices will be required, which are better suited to a highly volatile, global and knowledge-oriented age.

The implementation of the principles of agility, high performance and shared responsibility would require the following:

1. That the WRC embeds a revised HR service delivery model and standardised processes across the business
2. Ensure the right talent in the right place at the right time to enable WRC 's growth and innovation strategy
3. Design and deliver the WRC's employee value proposition to drive employee engagement as well as cultural and organisational transformation

### **Governance and administration**

In order to continually improve our role in supporting and enhancing the mandate of the WRC, Corporate Services also has the objectives to:

1. To establish unified business processes in order to create a unified administration

2. To enable the integration of the WRD's processes into the governance and management of the organisation
3. To keep the WRC's governance structure under review to ensure that it is fit for purpose, i.e., it provides a flexible and responsive legislative and decision-making framework for the organisation
4. Review of legislation
5. Shorten lines of decision-making
6. Distinguish between decision-making, consultation and communication; bring greater transparency to the decision-making process

### **12.5 Facilities**

Facilities at the WRC is responsible for creating an optimal environment for the organisation's primary functions, taking an integrated view of the business infrastructure, and using this to deliver satisfaction and best value through support for and enhancement of the core business. Thus, facilities management can be described as something that will:

- Deliver effective and responsive services
- Enable changes in the use of space in the future
- 'Sweat the assets', i.e., make them highly cost effective
- Create competitive advantage for the organisation's core business
- Enhance the organisation's culture and image
- Ensure that the work environment enhances stakeholder satisfaction

Managing facilities efficiently and effectively is achieved by a robust strategy that is developed within the context of the WRC's Corporate Plan and space/accommodation strategy. These involve development of strategic objectives and a plan for facilities management, with proper reference to the overall Corporate Plan and space/accommodation strategy within which it is contained, and which considers the needs of the organisation, differentiating between core and non-core business activities.

#### **Facilities strategic objectives**

- Identify and establish effective and manageable processes for meeting those needs
- Establish the appropriate resource needs for providing services, whether obtained internally or externally
- Identify the source of the means to finance the strategy and its practical implications

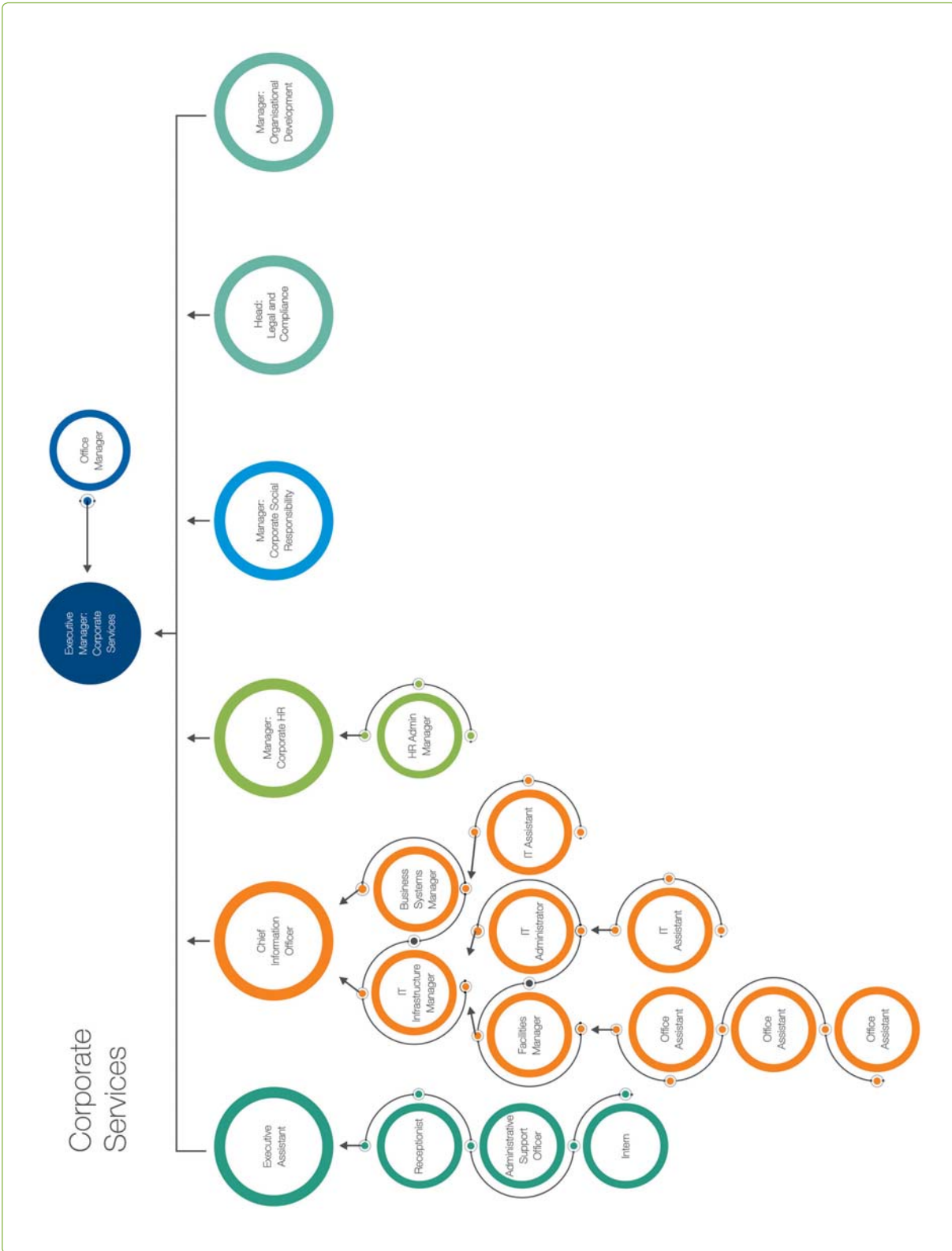


Figure 33. WRC Corporate Services

## [ 13. Risk Management ]

The WRC's risk management framework is made up of a risk assessment which identifies internal and external risks to the WRC and details an implementation plan for their mitigation. Executive Management and the Board undertake the risk assessment annually in November. After completion of the assessment and approval by the Board, quarterly reviews of the document evaluate the progress against the plan and identify any new risks.

The WRC Board and management team identified 12 risks as outlined in Table 13.

Table 13. Summary of WRC Risk Register

Risk name	Link to strategic objective
Inadequate availability, continuity and growth of adequate research expertise to deal with complexity in the water sector, both institutionally and externally	<ul style="list-style-type: none"> <li>To support human capacity building in the water sector</li> <li>To enhance knowledge across the water knowledge and innovation cycle</li> <li>To support community empowerment</li> </ul>
Financial sustainability	<ul style="list-style-type: none"> <li>Financial sustainability &amp; corporate wellbeing</li> <li>To develop new products and services (new innovations)</li> <li>To develop sustainable solutions</li> </ul>
Constraints in keeping up with changes and trends in water research, development, innovation, implementation and impact	<ul style="list-style-type: none"> <li>To enhance knowledge across the water knowledge and innovation cycle</li> <li>To develop sustainable solutions</li> <li>To inform policy and decision making</li> <li>To develop new products and services (new innovations)</li> <li>To support community empowerment</li> </ul>
Insufficient uptake of research, solutions and technology	<ul style="list-style-type: none"> <li>To enhance knowledge across the water knowledge and innovation cycle</li> <li>To develop sustainable solutions</li> <li>To inform policy and decision making</li> <li>To develop new products and services (new innovations)</li> <li>To support community empowerment</li> </ul>
The role of the WRC in research, development and innovation within SADC, Africa and globally	<ul style="list-style-type: none"> <li>To develop sustainable solutions</li> <li>Financial sustainability &amp; corporate wellbeing</li> </ul>
Inability to recover in the event of a disaster	<ul style="list-style-type: none"> <li>Financial sustainability &amp; corporate wellbeing</li> </ul>
Fraud and corruption	<ul style="list-style-type: none"> <li>Financial sustainability &amp; corporate wellbeing</li> </ul>
Losing competitive edge	<ul style="list-style-type: none"> <li>Financial sustainability &amp; corporate wellbeing</li> </ul>
Uncertainty within the tertiary education environment	<ul style="list-style-type: none"> <li>To enhance knowledge across the water knowledge and innovation cycle</li> </ul>
Uncertainty within the tertiary education environment	<ul style="list-style-type: none"> <li>To support human capacity building in the water sector</li> <li>To enhance knowledge across the water knowledge and innovation cycle</li> <li>To support community empowerment</li> </ul>

## [ 14. Budget ]

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In the WRC's budget estimates over the 5-year review period we have taken a conservative approach when estimating WRC income growth. This is based on the emerging trend of a general reduction in water consumption volumes due to a number of factors, including drought. The WRC aims to have a substantial impact on the sector through improved technologies and efficiency measures. Research undertaken in water conservation and demand management are critical in the sector where water losses are exceptionally high. Furthermore, the WRC undertakes pilot studies and demonstrations in order to ensure that theoretical solutions are tested. Due to the scientific nature of the research, the cost of equipment required is impacted by scientific inflation, which is much higher than the general inflation rates.

The WRC's aim over the review period is to emphasize and strengthen the WRC's research funding and research support activities while striving to improve internal processes. The budget reflects the WRC's commitment to improve its internal processes that support its core process of knowledge creation, sharing, dissemination and transfer. Therefore, the budget reflects a change in the ratio between the WRC's investment in research & development funding, innovation and impact, and other support costs (human resource and infrastructure costs).

### 14.1 Budgets for 2018/19 to 2022/23

Tables 14–19 below provide a detailed analysis of income and expenditure trends projected in the WRC's budget over the five-year period 2018/19 to 2022/23. The key revenue and cost drivers and assumptions include the following–

In general, the inflation projections utilised for the period 2018/19 to 2022/23 are in accordance with the 2018 MTEF

Technical guidelines issued by National Treasury in June 2017, which are as follows:

- 2018/19 financial year: 5.7 %
- 2019/20 financial year: 5.6 %
- 2020/21 financial year: 5.5 %

The National Treasury inflation estimate of 5.5% for 2020/21 has been carried through in the WRC budget estimates for the 2021/22 and 2022/23 financial years.

The revenue projections for water research levies over the five-year period (2018/19–2022/23) has been increased year-on-year by 10%. This was based on the request of the WRC, at the National Consultation on Water Research Levy for financial year 2018/19, for a levy increase of 10% in order to ensure that the WRC achieves optimum impact, which received overwhelming support from the stakeholders. The interest received and leverage income stream projections have been increased year-on-year in line with inflation expectations over the remaining five-year period (2018/19–2022/23). In general, the estimates for expenditure have been increased year-on-year, in line with the inflation expectations over the five-year period (2018/19–2022/23); where applicable, however, specific inflation rates are applied as defined in agreements entered into by the WRC, such as costs associated with leases and the replacement of these assets as and when required, or the expected cost-of-living and performance-based increases. Research and Development expenditure is based on the expected realisation of the project deliverables in respect of research project contracts entered into by the WRC. A research ratio of 62% has been maintained over the planning period.



Table 14. Financial summary starting from the 2015/2016 financial year

DESCRIPTION	2015/16	2016/17	2017/18
Levies	200,031,249	207,322,204	218,862,899
Interest Received	9,239,503	8,908,922	6,838,454
Leverage	60,964,552	82,795,007	74,031,823
Other	3,084,489	1,084,593	6,454,436
Disinvestment of investment	-	19,997,276	-
<b>TOTAL INCOME</b>	<b>273,319,793</b>	<b>320,108,002</b>	<b>306,187,611</b>
Fixed Costs	6,035,568	11,360,673	11,604,798
Running Costs	10,013,932	10,112,039	9,615,673
Human Resource Costs	52,216,686	65,253,786	78,923,828
Research & Development Funding	201,047,393	213,306,351	199,927,785
Corporate Expenditure	1,821,448	1,964,144	2,709,756
Capital Expenditure	656,616	15,864,882	2,613,500
TOTAL EXPENDITURE	271,791,643	317,861,875	305,395,340
<b>TOTAL EXPENDITURE</b>	<b>326,030,999</b>	<b>354,914,310</b>	<b>386,465,760</b>

A trend analysis of the above financial years was performed and the results utilised as part of the inputs to formulate the budget for the five-year period, 2018/2019 to 2022/2023. In addition to this, the WRC needs for the five years have been considered to ensure that the sufficient resources are available.

Table 15. Summary of the budget for the five-year period

DESCRIPTION	2018/19	2019/20	2020/21	2021/22	2022/23
Levies	239,711,905	263,683,096	290,051,406	319,056,546	350,962,201
Interest Received	7,758,331	8,192,797	8,643,401	9,118,788	9,620,322
Leverage	78,251,637	82,711,981	87,426,564	98,210,906	110,555,523
Other	309,125	326,436	344,390	363,332	383,315
<b>TOTAL INCOME</b>	<b>326,030,999</b>	<b>354,914,310</b>	<b>386,465,760</b>	<b>426,749,572</b>	<b>471,521,360</b>
Fixed Costs	12,348,419	13,257,688	14,281,910	15,397,224	16,602,021
Running Costs	12,141,088	11,829,524	12,053,145	11,665,705	11,870,611
Human Resource Costs	92,253,879	104,086,511	118,203,333	133,207,001	146,650,974
Research & Development Funding	204,222,042	218,480,456	237,958,927	262,312,463	292,012,304
Corporate Expenditure	3,282,424	3,620,494	3,809,901	3,991,162	4,204,860
Capital Expenditure	1,783,146	3,639,638	158,544	176,016	180,591
<b>TOTAL EXPENDITURE</b>	<b>326,030,999</b>	<b>354,914,310</b>	<b>386,465,760</b>	<b>426,749,572</b>	<b>471,521,360</b>

Table 17. Research & development funding per Key Strategic Area

DESCRIPTION	2018/19	2019/20	2020/21	2021/22	2022/23
Water Resource Management & Water-Linked Ecosystem KSA 1 & 2	38,743,471	37,778,219	34,256,471	41,010,373	45,521,520
Water Use and Waste Management KSA 3	40,684,274	32,753,192	48,464,159	64,987,288	72,255,515
Water Utilization in Agriculture KSA 4	38,322,530	46,170,032	47,433,718	36,496,380	40,502,902
Innovation and Impact	23,586,255	24,146,106	23,378,016	24,607,517	26,676,843
Leverage-funded projects contributing to R & D and I & I *	62,885,512	77,632,906	84,426,564	95,210,906	107,055,523
<b>Total</b>	<b>204,222,042</b>	<b>218,480,456</b>	<b>237,958,927</b>	<b>262,312,463</b>	<b>292,012,304</b>

Table 18. Research & development funding per Key Strategic Area (%)

DESCRIPTION	2018/19	2019/20	2020/21	2021/22	2022/23
Water Resource Management & Water Linked Ecosystem KSA 1 & 2	19%	17%	14%	16%	16%
Water Use and Waste Management KSA 3	20%	15%	20%	25%	25%
Water Utilization in Agriculture KSA 4	19%	21%	20%	14%	14%
Innovation and Impact	12%	11%	10%	9%	9%
Leverage funded projects contributing to R & D and I & I *	31%	36%	35%	36%	37%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

\* The Other Leverage-Funded Projects, as reflected in Table 17 and Table 18, represent the FETWater, Bill & Melinda Gates Foundation, DST GATES, DST GBS, Wader, Empowerment Programme, IPRDP, Acqueau, African Development Bank, and DST PMU leverage-funded projects for the remainder of the contract period. It further includes all future prospects/expectations for entering into new leverage-funded projects which will either focus on research and development or innovation and impact.

Table 19. Research & development funding per Operating Branch

DESCRIPTION	2018/19	2019/20	2020/21	2021/22	2022/23
Research and Development (R & D)	117,750,275	116,701,444	130,154,348	142,494,040	158,279,938
Innovation and Impact (I & I)	23,586,255	24,146,106	23,378,016	24,607,517	26,676,843
Leverage-funded projects contributing to R & D and I & I	62,885,512	77,632,906	84,426,564	95,210,906	107,055,523
<b>Total</b>	<b>204,222,042</b>	<b>218,480,456</b>	<b>237,958,927</b>	<b>262,312,463</b>	<b>292,012,304</b>

Table 20. Research & development funding per Operating Branch (%)

DESCRIPTION	2018/19	2019/20	2020/21	2021/22	2022/23
Research and Development (R & D)	58%	53%	55%	54%	54%
Innovation and Impact (I & I)	12%	11%	10%	9%	9%
Leverage-funded projects contributing to R & D and I & I	31%	36%	35%	36%	37%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

The Leverage-Funded Projects contributing to R & D and I & I, as reflected in Table 19 and Table 20, represents the FETWater, Bill & Melinda Gates Foundation, DST GATES, DST GBS, Wader, Empowerment Programme, IPRDP, Acqueau, African Development Bank, and DST PMU leverage-funded projects for the remainder of the contract period. It further includes all future prospects/expectations for entering into new leverage-funded projects which will either focus on research and development or innovation and impact.

## APPENDIX 1: KEY PERFORMANCE INDICATORS MULTI-YEAR PERFORMANCE PLAN

The WRC's Annual Performance Plan indicator set is a lifecycle approach to measuring performance that integrates strategy, people, resources, processes and measurements to improve decision-making, transparency and accountability. The management of performance allows the WRC to learn from experiences, reflect on what has worked and what has not and adapt to the changing environment. In using the streamed lined indicator set, the WRC is able to monitor and report on results through the development and provision of integrated financial and non-financial information. This information will be used for both internal management purposes and for external accountability to the Minister of Water and Sanitation, Parliament, the Public.

### 1. Impact Portfolio

Objective	Indicator	Target for 2017/18	Target for 2018/19	Target for 2019/20	Target for 2021/22	Target for 2022/23
<b>Strategic Goal: To develop innovative products and services for economic growth</b>						
To capitalise on projects that develop intellectual property or to introduce innovations which create new or improved technologies, products and services used in the economy	The number of innovations, products and services that have been supported and/or implemented/ demonstrated / piloted.	New indicator	12	16	17	18
<b>Strategic Goal: To drive sustainable development solutions</b>						
To ensure that the WRC increasingly drives sustainable solutions for the Water Sector by hosting events that promote robust engagement around critical emerging water management issues	The number of WRC Dialogues	18	18	20	22	24
To promote the uptake and application of sustainable solutions by the water sector through broader engagements	The number of conferences/summits with the WRC as a host	New Indicator	2	3	2	3
<b>Strategic Goal: To inform policy and decision making</b>						
To influence policy- and decision-makers with research-based knowledge	The number of policy briefs produced and distributed to relevant government departments and other entities	14	12	13	13	13
	The number of ministerial briefs produced by the WRC and received by the Minister's Office	14	14	15	15	15
	The number of working papers produced that support decision-makers with research-based knowledge	New indicator	6	8	10	10
	The number of Parliamentary briefs produced and disseminated	New indicator	8	8	9	10



## 2. Partnerships

Objective	Indicator	Target for 2017/18	Target for 2018/19	Target for 2019/20	Target for 2021/22	Target for 2022/23
<b>Strategic Goal: To promote transformation and redress</b>						
To enhance the profile of project partnership as part of the national transformation project to promote the ongoing transformation of water research and development	To develop an inclusive strategy assists the tertiary institutions to add value to their activities in the water domain	New indicator	Approved strategy by Executive in Q4	n/a	n/a	n/a
To better enable researchers to participate in WRC funding instruments and specialised contracts	The number of WRC 101 workshops held in the financial year	New indicator	6	6	6	6
<b>Strategic Goal: To develop innovative products and services for economic growth</b>						
To ensure that the WRC invests in projects that results in the multiplier effect by partnering with strategic traditional and non-traditional partners to complement the WRC's mandate on either side of the value chain for water sector and societal impact	The number of workshops held in partnerships with other institutions	New indicator	20	22	22	22
	The number of partnership agreements signed with partnering institutions	New indicator	4	5	6	6

## 3. Research, Development and Innovation Portfolio

Objective	Indicator	Target for 2017/18	Target for 2018/19	Target for 2019/20	Target for 2021/22	Target for 2022/23
<b>Strategic Goal: To enhance knowledge across the water knowledge and innovation cycle</b>						
To enhance knowledge through new research RDI projects initiated	The number of new research projects initiated in the 2018/19 financial year	80	80	90	90	90
To maintain a portfolio of RDI projects that enhances water knowledge and the innovation cycle	The total number of RDI projects managed by the WRC	New indicator	250	350	350	350
To complete and finalise RDI projects scheduled in the financial year	The number of research projects that have been completed in the financial year	84	80	84	85	85
<b>Strategic Goal: To enhance knowledge across the water knowledge and innovation cycle</b>						
Growing a more inclusive water and sanitation science community of practice	The total number of project leaders on WRC managed projects that are female	New indicator	80 (32%)	85	85	90
	The total number of projects leaders on initiated projects that are female	New indicator	26 (33%)	26	27	28
	The total number of project leaders on WRC managed projects that are black and male	New indicator	85 (34%)	85	87	90
	The total number of project leaders on initiated projects that are black males	New indicator	20 (25%)	25	30	30
	The total number of female and black project leaders on initiated projects	New indicator	50 (63%)	55	65	60
	The total number of project leaders on initiated projects that are female and black	New indicator	120 (148%)	120	125	130

Objective	Indicator	Target for 2017/18	Target for 2018/19	Target for 2019/20	Target for 2021/22	Target for 2022/23
	<ul style="list-style-type: none"> <li>The number of students supported on all WRC managed research projects.</li> </ul>	300	300	300	200	310
	<ul style="list-style-type: none"> <li>Distributed as follows: <ul style="list-style-type: none"> <li>- Postdocs, PHDs &amp; Masters</li> <li>- Honours and others</li> </ul> </li> </ul>	210 (70%)	210	210	210	215
		90 (30%)	80	70	70	70
<b>Strategic Goal: To develop innovative products and services for economic growth</b>						
To increase the number of new innovations/products and services produced from WRC research	The number of innovations/products and services produced from WRC research	23	24	24	24	24

#### 4. Financial Portfolio

Objective	Indicator	Target for 2017/18	Target for 2018/19	Target for 2019/20	Target for 2021/22	Target for 2022/23
<b>Strategic Goal: To maintain financial and income sustainability</b>						
To maintain income financial sustainability	The total amount of leverage income	R71 697 923	R78 251 637	R82 711 981	R87 426 564	R98 210 906
	Initiate contracts with other organisation's that increase leverage funding	4	4	5	6	6
To diversify the income streams of the WRC	Development of Diversification Income Strategy to maintain financial sustainability	New indicator	Approved strategy	n/a	n/a	n/a
To improve the response to internal audit results	The percentage of the internal audit findings fully addressed	100% of findings resolved	100% of findings resolved	100% of findings resolved	100% of findings resolved	100% of findings resolved
To improve the response to the external audit results	The achievement of an unqualified audit report vs a qualified audit report	Unqualified audit report to be achieved	Unqualified audit report to be achieved	Unqualified audit report to be achieved	Unqualified audit report to be achieved	Unqualified audit report to be achieved
	The percentage of external audit findings fully addressed	100% of audit findings resolved	100% of audit findings resolved	100% of audit findings resolved	100% of audit findings resolved	100% of audit findings resolved

## 5. Human Resources and Corporate Wellbeing Portfolio

Objective	Indicator	Target for 2017/18	Target for 2018/19	Target for 2019/20	Target for 2021/22	Target for 2022/23
<b>Strategic Goal: To enhance social responsibility and corporate responsibility</b>						
To ensure social and corporate responsibility	The total number of active research and non-research community based projects	New indicator	106	108	108	108
	The total number of initiated community-based research projects	24	27	28	28	28
	The total number of SMMEs supported on WRC managed research projects	New indicator	120	68	68	68
	The total number of SMMEs supported on WRC managed initiated research projects	27	20	22	22	22
To promote transformation and redress and cultivate a high performance organisational culture	To increase employee engagement by conducting surveys that establishes the gap between current reality (what employees are experiencing) and the vision (what organisational culture employees want to experience)	New indicator	Current reality and vision surveys completed	n/a	n/a	n/a
	<ul style="list-style-type: none"> <li>To maintain or increase the percentage of black, female and employees with a disability at the WRC</li> <li>Measured by <ul style="list-style-type: none"> <li>- The total number of black number of employees</li> <li>-The total number of female employees</li> <li>- The total number of employees with a disability</li> </ul> </li> </ul>	New indicator	86% 58% 1.32%	6% 58% 1.32%	86% 58% 5%	86% 58% 5%
To develop strategies to support business leadership of the organisation	Develop an IT governance strategy	New indicator	Annual target	n/a	n/a	n/a
	Implement a leadership and organisational development strategy	New indicator	Annual target	n/a	n/a	n/a
	Maintain number of staff with Masters	New indicator	20	26	26	26
	Main number of staff with PhDs	New indicator	14	16	16	16
	The total number of employees in receipt of a study grant for the financial year	New indicator	7	10	10	10
	The total number of training courses held in-house	10	15	20	20	20
	The total number of external training courses attended	25	15	20	20	20

APPENDIX 2: LIST OF RESEARCH PROJECTS TO BE INITIATED IN THE 2018/ 2019 FINANCIAL YEAR

No.	Proposal No.	KSA	Open/ Directed	Research Manager	Project Title	Lead Organisation	First Year Budget (2018/19)	Total Budget	Project Duration
1	1005405	1&2	OPEN	Mr B Madikizela	Developing and testing a tool water sharing and Ecological Reserve monitoring in agricultural catchments of South Africa	Freshwater Research Centre	R 304 600,00	R 1 092 400,00	3
2	1005324	1&2	OPEN	Dr S Adams	Constraining the residence time of groundwater in the TMG aquifer system through 3H/3He and 85Kr dating and its implications for water supply management.	University of Stellenbosch	R 125 000,00	R 325 000,00	2
3	1005361	1&2	OPEN	Dr S Adams	Impact of heuweltjie distribution and density on the presence of saline groundwater along the west coast of South Africa	University of Stellenbosch	R 95 000,00	R 269 000,00	3
4	1005494	1&2	OPEN	Dr S Adams	Vadose zone hydrology: Complexity and anthropogenic influences	University of Pretoria	R 200 000,00	R 700 000,00	3
5	1005615	1&2	OPEN	Dr S Adams	Mobile App for hydro census and groundwater monitoring	University of North West	R 200 000,00	R 450 000,00	2
6	1005486	1&2	OPEN	Dr B Petja	The predictability of rainfall producing synoptic weather systems at the medium range forecasting time scale over South Africa	University of Pretoria	R 57 200,00	R 493 200,00	3
7	1005411	1&2	OPEN	Dr B Petja	An investigation of the historical and projected occurrence of the South African mid-summer drought and its implications for the agro-water budget	SAWS	R 100 000,00	R 620 000,00	3
8	1005532	1&2	OPEN	Dr B Petja	Determining climate change aspects on the ecosystem resilience of headwater wetlands in two catchments, Swaziland and South Africa (WET-RESILIENCE shortened project title).	ARC	R 100 000,00	R 500 000,00	3
9	1005544	1&2	OPEN	Dr B Petja	Causes of the 2015-2017 drought over the Western Cape, South Africa	ARC	R 100 000,00	R 100 000,00	1



No.	Proposal No.	KSA	Open/ Directed	Research Manager	Project Title	Lead Organisation	First Year Budget (2018/19)	Total Budget	Project Duration
10	1005412	1&2	DIRECTED	Dr B Petja	A national assessment of potential climate change impacts on the hydrological yield of different hydro-climate zones of South Africa	CWRR	R 1 000 000,00	R 2 500 000,00	3
11	1005424	1&2	DIRECTED	Dr B Petja	Impacts of climate change in determining the ecological reserve	IWR	R 500 000,00	R 500 000,00	1
12	1005520	1&2	OPEN	Dr B Petja	Using land-use changes to mitigate impacts of future droughts on water yields in South Africa	University of Cape Town	R 300 000,00	R 1 500 000,00	3
13	1005423	1&2	OPEN	Dr B Petja	Multi-platform remote sensing tools for peat fire detection and monitoring	ARC	R 150 000,00	R 330 000,00	2
14	1005438	1&2	OPEN	Mr J Dini	Trace study of water PhDs in South Africa	Quantitative Evidence Research Consultancy	R 250 000,00	R 600 000,00	2
15	1005416	1&2	OPEN	Mr J Dini	Water issues in ethical perspective: A pilot study in the Phillipi Horticultural Area (PHA)	University of Stellenbosch	R 200 000,00	R 400 000,00	2
16	1005454	1&2	OPEN	Mr Y van Wyk	The management and regulation of saline groundwater	University of the Western Cape	R 720 000,00	R 900 000,00	2
17	1005511	1&2	OPEN	Mr J Dini	Water efficiency, system resilience, social cohesion and water governance in South Africa.	INR NPC	R 100 000,00	R 200 000,00	2
18	1005588	1&2	OPEN	Mr J Dini	Research into alignment, scaling and resourcing of citizen based water quality monitoring to realising the DWS integrated water quality management strategy	Duzi-uMngeni Conservation Trust	R 150 000,00	R 1 242 800,00	4
19	1005507	1&2	OPEN	Mr W Nomqphu	Improving understanding of surface water - groundwater interactions from headwaters to lowlands for catchment scale sustainable water resources management	University of the Western Cape	R 200 000,00	R 1 500 000,00	4
20	1005475	1&2	OPEN	Mr W Nomqphu	Quantification of the spatio-temporal variability in land productivity in the Mzimvubu catchment	Rhodes University	R 50 000,00	R 150 000,00	3
21	1005304	1&2	OPEN	Dr E Ubomba-Jaswa	Fine-scale salinity modelling of the Great Fish/Sundays rivers.	Rhodes University	R 160 000,00	R 300 000,00	2

No.	Proposal No.	KSA	Open/ Directed	Research Manager	Project Title	Lead Organisation	First Year Budget (2018/19)	Total Budget	Project Duration
22	1005351	1&2	OPEN	Dr E Ubomba-Jaswa	Characterization and identification of catalytic versatile pesticide degrading cytochrome P450 monooxygenase from filamentous fungi towards creating transgenic plants (maize and cotton) for phytoremediation of toxic pesticides.	Mangosuthu University of Technology	R 160 000,00	R 400 000,00	2
23	1005326	3	OPEN	Dr N Kalebaila	Domestic Grey Water utilisation - A potential source and means of transfer of antibiotic resistance genes in the environment?	University of the Western Cape	R 300 000,00	R 900 000,00	4
24	1005371	3	OPEN	Dr N Kalebaila	Endocrine disrupting effects of public swimming pool water	University of North West	R 150 000,00	R 300 000,00	2
25	1005404	3	OPEN	Mr JN Bhagwan	Better leakage management through data integration	University of Cape Town	R 100 000,00	R 700 000,00	3
26	1005419	3	OPEN	Dr N Kalebaila	A communication strategy for water re-use in South Africa	University of Limpopo	R185 200,00	R574 600,00	3
27	1005462	3	OPEN	Dr N Kalebaila	Enablement of Desalination and Reuse of water: Bulk water supply economics, opportunity cost and cost of unserved water supply considerations	EScience Associates (Pty) Ltd	R 200 000,00	R 1 000 000,00	4
28	1005473	3	OPEN	Dr N Kalebaila	The investigation of direct wastewater reuse as a sustainable potable water source for inland water supply at Umgeni Water	Umgeni Water	R 200 000,00	R 1 000 000,00	5
29	1005530	3	OPEN	Dr N Kalebaila	Indigenous plant-based bio-adsorbent nanomaterials technology for water purification	University of Venda	R 150 000,00	R 300 000,00	2
30	1005327	3	OPEN	Dr JN Zvimba	Updating the current South African sludge guideline volume 2: validation of the recommendations from model simulation results through field studies across agroecological zones and evaluation of Emerging contaminant transfer to human food chain from crops grown in sludge amended land	University of Pretoria	R 50 000,00	R 1 100 000,00	4

No.	Proposal No.	KSA	Open/ Directed	Research Manager	Project Title	Lead Organisation	First Year Budget (2018/19)	Total Budget	Project Duration
31	1005349	3	OPEN	Dr S Pillay	A nature inspired approach for producing bio-bricks from urine (project extension)	University of Cape Town	R 150 000,00	R 300 000,00	2
32	1005439	3	OPEN	Dr JN Zvimba	The Role of Emerging Innovative Wastewater Sludge to Energy Technologies in Transitioning to a Circular Economy in the Water Sector: A South African Study case	TruSense Consulting Services	R 440 000,00	R 1 300 000,00	4
33	1005456	3	OPEN	Dr JN Zvimba	Including the Fate of Chemical Precipitants and Other Products of Waste Resource Recovery Facilities in their Strategic Design and Operation	University of Cape Town	R 200 000,00	R 750 000,00	4
34	1005482	3	OPEN	Dr S Pillay	Economic Demand Feasibility Study for Human Excreta Derived Faecal Products	Congretype Pty Ltd	R 250 000,00	R 500 000,00	2
35	1005516	3	OPEN	Dr S Pillay	Long-term monitoring and assessment of pour flush technology in South African	Partners in Development (Pty) Ltd	R 255 500,00	R 495 500,00	2
36	1005528	3	OPEN	Dr JN Zvimba	Development of an oleophobic (low-fouling) microfiltration module for decentralised sanitation applications	University of Stellenbosch	R 150 000,00	R 300 000,00	2
37	1005566	3	OPEN	Mr JN Bhagwan	Liveable neighbourhood with water as foremost priority: Redesigning an existing neighbourhood using Water Sensitive Design	University of Cape Town	R 100 000,00	R 1 200 000,00	4
38	1005556	3	Directed	Dr S Pillay	Country-wide Shit-Flow Diagram: Establishing National Excreta Flows in South Africa	Emanti Management Pty Ltd	R 305 650,00	R 992 250,00	3
39	1005392	3	OPEN	Dr Jo Burgess	Beneficiation of ochres and sludge generated from mine water treatment plants	University of Witwatersrand Chemistry	R 100 000,00	R 1 420 000,00	4
40	1005305	3	OPEN	Dr Jo Burgess	Integrated biological system for concurrent wastewater treatment, solids reduction and resource recovery from tannery wastewater	Cape Peninsula University of Technology	R 440 000,00	R 1 823 500,00	4
41	1005417	3	OPEN	Dr Jo Burgess	Optimizing the HDS Process for Maximum Value Recovery from AMD	UCT Civil Eng	R 100 000,00	R 1 705 681,00	4

No.	Proposal No.	KSA	Open/ Directed	Research Manager	Project Title	Lead Organisation	First Year Budget (2018/19)	Total Budget	Project Duration
42	1005418	3	OPEN	Dr Jo Burgess	Integrating ARD Prevention and Mine Waste Minimisation through the circular economy: Fabricated soils from Coal Waste	UCT Chem Eng	R 100 000,00	R 1 988 083,00	4
43	1005459	3	OPEN	Dr Jo Burgess	A WIN solution for mine waste clean-up. The remediation of mine contaminated sites, the recovery of metals, prevention of water pollution and job creation	KLM Consulting Services	R 200 000,00	R 330 000,00	2
44	1005466	3	OPEN	Dr Jo Burgess	Integrating quantitative mineral textural measurements into ARD characterisation protocol for improved accuracy in characterisation and prediction	University of Cape Town	R 195 138,64	R 436 794,84	2
45	1005471	3	Directed	Dr Jo Burgess	Natsurv 16: Water and wastewater management in the power generating industry (Edition 2)	VitaOne8	R 250 000,00	R 1 130 000,00	3
46	1005538	3	Directed	Dr Jo Burgess	Natsurv 19: Water and wastewater management in the fruit and vegetable processing industry (Edition 2)	Chris Swartz Water Utilisation Engineers CSWUE	R 250 000,00	R 1 130 000,00	3
47	1005576	3	OPEN	Dr Jo Burgess	The use of Schiff base ligands attached to protected superparamagnetic nanoparticles for the separation of one base metal ion from others	Stellenbosch University Chemistry & Polymer Science	R 105 000,00	R 280 000,00	3
48	1005580	3	OPEN	Dr Jo Burgess	Updating current strategies for estimating a source term for a tailings storage facility	NWU Centre for Water Science and Management	R 195 600,00	R 244 500,00	2
49	1005536	3	OPEN	Dr N Kalebaila	A survey of disinfection challenges relating to hydraulic contacting for small waterworks in South Africa	Umgeni Water	R 150 000,00	R 300 000,00	2
50	1005344	3	Open	Mr JN Bhagwan	Pressure management using pumps	CSIR	R 50 000,00	R 300 000,00	2

No.	Proposal No.	KSA	Open/ Directed	Research Manager	Project Title	Lead Organisation	First Year Budget (2018/19)	Total Budget	Project Duration
51	1005303	4	DIRECTED	Dr S Mpandeli	Quantifying water use of mature Pecan nut trees and orchards in selected irrigation areas of Northern Cape	University of Pretoria	R 300 000,00	R 4 000 000,00	5
52	1005339	4	DIRECTED	Dr S Mpandeli	Investigating the potential of fixed and draped netting technology for increasing water use productivity and water savings in full bearing apple orchards under micro-irrigation	University of Stellenbosch	R 300 000,00	R 1 499 970,00	4
53	1005370	4	OPEN	Dr S Mpandeli	Development of women and youth self-sustainable enterprises within the small holder farming sector in Limpopo	Khanimambo Innovative Solutions	R 305 170,00	R 1 892 500,00	4
54	1005382	4	OPEN	Dr G Backeberg	Evaluation of the management and impact of the quantity and quality of water for new agri-parks in selected provinces of South Africa	University of Pretoria	R 329 500,00	R 1 092 200,00	3
55	1005426	4	OPEN	Dr G Backeberg	Development and testing of a smart-phone application for predicting near real time water requirements fruit tree orchards	CSIR	R 280 700,00	R 780 700,00	3
56	1005435	4	OPEN	Dr G Backeberg	Developing a smart phone app for small scale fish farmers and government aquaculture extension officers to deliver an existing WRC manual for small scale farmers	Rhodes University	R 246 230,00	R 765 800,00	3
57	1005476	4	OPEN	Dr G Backeberg	Enhancements to the site-specific, risk based DSS for assessing irrigation water quality	University of Pretoria	R 280 700,00	R 930 000,00	3
58	1005531	4	OPEN	Dr S Mpandeli	Uptake of knowledge, technology and practices for improving water productivity in rain-fed cropping systems	University of the Free State	R 224 500,00	R 452 700,00	2



No.	Proposal No.	KSA	Open/ Directed	Research Manager	Project Title	Lead Organisation	First Year Budget (2018/19)	Total Budget	Project Duration
59	1005579	4	OPEN	Dr G Backeberg	Development of a risk based approach for assessing livestock watering and aquaculture water quality guidelines	Golder Associates	R 330 000,00	R1 100 000,00	3
60	1005629	4	OPEN	Dr G Backeberg	Assessment of the basis of water allocation on selected water stressed irrigation schemes in humid, semi-humid and arid areas through the application of SAPWAT4	PICWAT	R 230 000,00	R 475 000,00	2

**APPENDIX 3: DRAFT WATER RESEARCH COMMISSION**  
**Materiality Framework in Terms of Treasury Regulation 28.3.1**

**1. Definitions**

<b>Accounting Authority</b>	Board of Directors
<b>Executive Authority</b>	Minister of Water and Sanitation
<b>Entity</b>	Water Research Commission
<b>PFMA</b>	Public Finance Management Act (Act 1 of 1999 as amended by Act 29 of 1999)
<b>Treasury Regulations</b>	Public Finance Management Act, 1999: amendment of Treasury Regulations in Terms of Section 76 as published in Government Gazette No. 7372.

**2. Introduction**

In terms of Treasury Regulation 28.3.1, the accounting authority must develop and agree a framework of acceptable levels of materiality and significance with the relevant executive authority.

**3. Framework**

<b>Fiduciary duties of the accounting authority (PFMA section 50)</b>	<b>Quantitative (Amount)</b>	<b>Qualitative (Nature)</b>
(1) The accounting authority must: (c) On request, disclose to the executive authority responsible for that public entity or the legislature to which the public entity is accountable, all material facts, including those reasonably discoverable, which in any way influence the decisions or actions of the executive authority or that legislature.	Any fact discovered of which the amount exceeds the determined materiality figure as calculated in Annexure A.	1. Any item or event of which specific disclosure is required by law. 2. Any fact discovered of which its omission or misstatement, in the Board's opinion, could influence the decisions or actions of the executive authority or legislature.

<b>Annual Report and Financial Statement (PFMA section 55)</b>	<b>Quantitative (Amount)</b>	<b>Qualitative (Nature)</b>
(2) The annual report and financial statements referred to in subsection (1) (d) must – (a) Fairly present the state of affairs of the public entity, its business, its financial results, its performance against predetermined objectives and its financial position as at the end of the financial year concerned; (b) Include particulars of – i. Any material losses through criminal conduct and any irregular expenditure and fruitless and wasteful expenditure that occurred during the financial year; ii. Any criminal or disciplinary steps taken as a consequence of such losses or irregular expenditure or fruitless and wasteful expenditure; iii. Any losses recovered or written off; iv. Any financial assistance received from the state and commitments made by the state on its behalf; and v. Any other matters that may be prescribed.	1. Losses through criminal conduct – any loss identified. 2. Losses through irregular / fruitless / wasteful expenditure – if the combined total exceeds the planning materiality figure used by the external auditors for the year under review.	Any identified loss through criminal conduct.

Annual Report and Financial Statement (PFMA section 54)	Quantitative (Amount)	Qualitative (Nature)
<p>(3) Before a public entity concludes any of the following transactions, the accounting authority for the public entity must promptly and in writing inform the relevant treasury of the transaction and submit relevant particulars of the transaction to its executive authority for approval of the transaction:</p> <p>(a) Participation in a significant partnership, trust, unincorporated joint venture or similar arrangement;</p> <p>(b) Acquisition or disposal of a significant shareholding in a company;</p> <p>(c) Acquisition or disposal of a significant asset;</p> <p>(d) Commencement or cessation of a significant business activity.</p>	<p>Any fact discovered of which the amount exceeds the determined materiality figure as calculated in Annexure A.</p> <p>Not applicable</p> <p>Not applicable</p> <p>Not applicable</p> <p>Not applicable</p>	<p>Any participation, outside of the approved strategic plan and budget.</p> <p>Any acquisition or disposal, outside of the approved strategic plan and budget.</p> <p>1. Any asset that would increase or decrease the overall operational functions of the WRC, outside of the approved strategic plan and budget.</p> <p>2. Disposal of the major part of the assets of the WRC. Any business activity that would increase or decrease the overall operational functions of the WRC, outside of the approved strategic plan and budget.</p>

### 13.4 Authorisation

This framework was approved by the Board on \_\_\_\_\_.

\_\_\_\_\_  
**Chairperson of the Board**

## Determination of Materiality

### 1. Materiality Basis

Materiality bases	% Used	2015/16 Actual (R)	Materiality (R)
Gross Income	0.625%	306,320,583	1,914,504
Gross Expenditure	0.625%	312,783,527	1,954,897
Total Assets	1.250%	243,033,963	3,037,925
Net Surplus for the Year	6.250%	(6,462,944)	(403,934)

### 2. Materiality basis selected and the reasons therefore

Gross income consists of levies, leverage income and investment and other revenue. This has shown steady growth over the past 3 years. Net profit/(loss) is derived from gross income and gross expenditure.

The WRC is not a capital-intensive business and therefore total assets would not be considered an appropriate basis for calculating materiality.

Because of the uneven pattern in gross expenditure and net profit/(loss), gross income is regarded as the most appropriate basis for the calculation of materiality and also a good proxy for the scale of WRC business operations.

### 3. Justification of percentage used

The audited figures as at the 31st of March 2017 have been used as this constitutes the most reliable, verifiable and objective information available to use.

### 4. Materiality figure

The most appropriate indicator for the purposes of setting materiality is Gross Income. For this reason, materiality has been selected at 0.625% of Gross Income which amounts to R 1,914,504. In the previous financial year, materiality was set at R 1,724,638. The increase in the materiality figure (11%) is considered to be reasonable given the fact that the WRC's internal control environment has improved consistently over the past three years, as evidenced by the clean audit report received for the 2016/17 financial year. This reduces the WRC's risk for material misstatement, thus increasing the materiality figure.

APPENDIX 4: WRC RISK REGISTER 2018/19 FINANCIAL YEAR

Link to strategic objective	Risk name	Root causes of the risk	Potential consequences of the risk	Potential Impact (worst case scenario)	Likelihood of risk occurring if no management controls are in place
<p><b>1</b></p> <ul style="list-style-type: none"> <li>To support human capacity building in the water sector</li> <li>To enhance knowledge across the water knowledge and innovation cycle</li> <li>To support community empowerment</li> </ul>	Inadequate availability, continuity and growth of adequate research expertise to deal with complexity in the water sector, both institutionally and externally	<ul style="list-style-type: none"> <li>Insufficient skills and competencies in the country i.e. Critical skills gap</li> <li>Inadequate capability and capacity of partners, systems and processes available to ensure the development of skills, human capacity, capability and knowledge uptake in the water sector.</li> <li>Low number of graduates and post graduate production in SA</li> <li>Limited career and research training opportunities</li> <li>Current funding model for HEI (higher education institution) is inadequate</li> <li>Insufficient number of appropriately supervised projects</li> <li>Lack of a multi-sectorial research coordination.</li> <li>Lack of collaboration between vested parties.</li> </ul>	<ul style="list-style-type: none"> <li>Insufficient capacity to either identify or take advantage of opportunities</li> <li>Under-performance in the areas of emerging water management challenges</li> <li>Poor research and inadequate research outputs to service the water sector</li> <li>Harm to reputation</li> <li>Research outputs not dealing with the complexity and trans-disciplinary nature of water problems</li> <li>Not meeting stakeholders needs</li> </ul>	Serious	Almost certain
<p><b>2</b></p> <ul style="list-style-type: none"> <li>Financial sustainability &amp; corporate well-being</li> <li>To develop new products and services (new innovations)</li> <li>To develop sustainable solutions</li> </ul>	Financial sustainability	<ul style="list-style-type: none"> <li>Limited income streams (insufficient funding and diversity of income)</li> <li>Weaknesses in the administration of research levies at collection level</li> <li>Competition from public and private sector</li> <li>Levy increase is below scientific research average inflation</li> <li>Lower consumption due to drought resulting in reduction in levy income</li> <li>Reduction in funding - no guarantee of renewal of MOA with DWS in the future</li> <li>Loss of leverage income due to the complexity of projects and successful roll out</li> <li>General funding stagnant due to economic downturn</li> <li>Resistance from municipalities in implementation of WRC technologies (lack of buy in or knowledge to operate)</li> </ul>	<ul style="list-style-type: none"> <li>Reduction in research outputs</li> <li>Negative impact on stakeholder trust relationships due to cash flow and funding challenges</li> <li>Limited ability to grow the research portfolio</li> <li>Reduction in level of levy income</li> <li>Challenges in managing cash flow</li> <li>Insufficient budget to implement the strategic plan and operation of WRC</li> </ul>	Critical	Likely



	Inherent risk exposure with no management controls in place	Current business processes / controls in place to manage identified risks	Risk owner	Perceived control effectiveness	Priority due to residual risk exposure	Likelihood of risk occurring if controls are in place	Mitigating action plans to further address the residual risk exposure
	High	<ul style="list-style-type: none"> <li>Partnerships and collaboration with other organisations that have the capability.</li> <li>Capacity building as part of research contracts and research prioritisation in particular post graduate student support to develop skills in the water sector. (The 400 students supported by WRC are focused on water research)</li> <li>Engagement and strengthening of relationships with research partners to facilitate implementations</li> <li>Support publication and exposure of students and training material and marketing research careers (through schools, universities etc.)</li> <li>Lobby for increased research funds through DWS and DST and other players.</li> <li>Strengthening of the lighthouse programme, social sciences inter disciplinarily programme and other trans-disciplinarily research programmes to address to complexity in the water sector</li> <li>Technical, policy and ministerial briefs to ensure faster exposure to research outcomes.</li> <li>Periodic strategic review of research portfolio</li> <li>Strengthening and monitoring of the Knowledge Tree objectives.</li> </ul>	CEO	Satisfactory	Priority 3	Likely	Undertake a “Critical Skills Project” -Analysis of critical research skills - Create a Centre of water excellence -Skills audit The critical skills project include the hydrologists scarce skills projects
	High	<ul style="list-style-type: none"> <li>Renewed MOA (memorandum of agreement) of monthly payments with DWS up to 2022</li> <li>Escalation provisions for funding</li> <li>Governed by legislation, government gazette</li> <li>Agreements with levy agencies (RW and UW)</li> <li>Strategy to diversify funding by means of leverage income</li> <li>Regular interaction with shareholder (Department of Water and Sanitation) and stakeholders on funding issues</li> <li>Prioritisation of available funds</li> <li>Stretching of resources</li> <li>Regular meetings with funders</li> <li>Adherence to legislation (collection of income - WRA)</li> </ul>	CEO	Weak	Priority 1	Likely	Development of a Finance Diversification strategy

Link to strategic objective	Risk name	Root causes of the risk	Potential consequences of the risk	Potential Impact (worst case scenario)	Likelihood of risk occurring if no management controls are in place	
<p><b>3</b></p> <ul style="list-style-type: none"> <li>To enhance knowledge across the water knowledge and innovation cycle</li> <li>To develop sustainable solutions</li> <li>To inform policy and decision making</li> <li>To develop new products and services (new innovations)</li> <li>To support community empowerment</li> </ul>	<p>Constraints in keeping up with changes and trends in water research, development, innovation, implementation and impact</p>	<ul style="list-style-type: none"> <li>Inadequate capability and mechanisms of end users to utilise research output and implement findings</li> <li>Lack of long term planning</li> <li>Inadequacy of funding and insufficient investment in research</li> <li>Small size of the water research community of practice especially the HDI and PDI and insufficient researchers doing cutting edge research</li> </ul>	<ul style="list-style-type: none"> <li>Inability to take advantage of developments and contribute to improved water management and development outcomes in the country</li> <li>Possible reduction in funding</li> <li>Inappropriate research outputs</li> <li>Reputational damage/ credibility decline</li> <li>Deterioration of stakeholder relationships due to needs not being met</li> <li>Limited impact on research, development and innovation</li> </ul>	<p>Critical</p>	<p>Likely</p>	
<p><b>4</b></p> <ul style="list-style-type: none"> <li>To enhance knowledge across the water knowledge and innovation cycle</li> <li>To develop sustainable solutions</li> <li>To inform policy and decision making</li> <li>To develop new products and services (new innovations)</li> <li>To support community empowerment</li> </ul>	<p>Insufficient uptake of research, solutions and technology</p>	<ul style="list-style-type: none"> <li>Institutions not clearly identified at beginning of research process and not involved in development of research questions and results</li> <li>Insufficient communication between researchers across disciplines as well as researchers and the end users to facilitate the uptake of research</li> <li>Limited engagement with the sector nationally and internationally</li> <li>Mismatched information Architecture</li> <li>Lack of responsiveness from the sector</li> <li>Lack of appetite for knowledge based research, solutions and technology</li> <li>Lack of incentives</li> <li>Insufficient technical knowledge and support to maintain new innovations and systems</li> <li>Resistance to review and/ or implement water saving technologies</li> <li>Lack of knowledge from decision makers</li> <li>Relevance of research not adequately assessed</li> </ul>	<ul style="list-style-type: none"> <li>Inability to take advantage of developments and contribute to improved water management and development outcomes in the country</li> <li>No or little new knowledge created</li> <li>Poor uptake on implementation of results</li> <li>Limited impact on research, development and innovation</li> </ul>	<p>Critical</p>	<p>Likely</p>	

Inherent risk exposure with no management controls in place	Current business processes / controls in place to manage identified risks	Risk owner	Perceived control effectiveness	Priority due to residual risk exposure	Likelihood of risk occurring if controls are in place	Mitigating action plans to further address the residual risk exposure
High	<ul style="list-style-type: none"> <li>• Involvement of end users and stakeholders in design and rollout of research projects to enhance knowledge</li> <li>• Engaging partners in cutting edge technology and research (TIA, SASOL,SALGA)</li> <li>• Packaging of research to various stakeholders</li> <li>• Capacity building as part of research contracts and research prioritisation (including post docs)</li> <li>• Support publication and exposure of students and training material by means of a development programme for individuals</li> <li>• Innovation and Impact branch created in the WRC to bring business development and innovation into the Research and Development space.</li> </ul>	CEO	Satisfactory	Priority 4	Possible	
High	<ul style="list-style-type: none"> <li>• Development of policy and ministerial briefs to influence decision making and development of manuals, guidelines and support tools, e.g. dialogues, symposiums and conferences for implementation and development</li> <li>• Direct support for IP development and commercialisation</li> <li>• Incorporation of research uptake and interventions into WRC research proposal template and CP and periodic strategic review of research portfolio</li> <li>• Innovation and Impact branch created in the WRC to bring business development and innovation into the Research and Development space</li> <li>• Risk mitigation through demonstrations and standards</li> </ul>	CEO	Good	Priority 4	Possible	

Link to strategic objective	Risk name	Root causes of the risk	Potential consequences of the risk	Potential Impact (worst case scenario)	Likelihood of risk occurring if no management controls are in place	
<p><b>5</b></p> <ul style="list-style-type: none"> <li>To develop sustainable solutions</li> <li>Financial sustainability &amp; corporate well being</li> </ul>	<p>The role of the WRC in research, development and innovation within SADC, Africa and Globally</p>	<ul style="list-style-type: none"> <li>Insufficient interaction with the international community, especially other African countries.</li> <li>Inadequate dissemination of research findings and marketing of WRC internationally</li> <li>Limited financial instruments to support African research partnership</li> <li>Budgetary constraints to promote the profile of the WRC</li> <li>More focus on research as primary mandate of the WRC which leads to insufficient business development and innovation</li> <li>Limited global partnership profile of the South African technology, Science and Technology sector.</li> <li>Governance systems changes (change in protocol for approval of international travel)</li> </ul>	<ul style="list-style-type: none"> <li>Limited credibility in the international water research field</li> <li>Reduction in ability to attract donor and other funding</li> <li>Negative impact on possible partnerships with international or non South-African research institutions</li> <li>Limited potential to lead on African solutions</li> <li>Insufficient research output (output might not consider other relevant practices)</li> <li>Difficult for WRC to create African footprint</li> <li>WRC can be regarded as a poor contribution to the national system of innovation, i.e. limited market ready products (derived from research and subsequent development and innovation).</li> </ul>	<p>Critical</p>	<p>Likely</p>	

	Inherent risk exposure with no management controls in place	Current business processes / controls in place to manage identified risks	Risk owner	Perceived control effectiveness	Priority due to residual risk exposure	Likelihood of risk occurring if controls are in place	Mitigating action plans to further address the residual risk exposure
	High	<ul style="list-style-type: none"> <li>Establishment of the international unit within the WRC</li> <li>Improve the implementation of the WRC international strategy</li> <li>Participation in international conferences and events etc.</li> <li>Involvement in global, African and SADC level projects .</li> <li>Interaction with stakeholders on SADC, Africa and global involvement</li> <li>Conducting Southern Africa wide projects with donor partners and new donor funded relationships in Southern Africa</li> <li>Contracts in place with researchers to acknowledge the WRC.</li> <li>Innovation and Impact unit established in the WRC to focus on business development and innovation</li> <li>Development of Region wide projects</li> <li>Attend certain meetings through Videoconferences</li> </ul>	CEO	Weak	Priority 1	Likely	<p>Continuous monitoring of the risk</p> <p>Engagement with the director general to change approval protocol</p>



Link to strategic objective	Risk name	Root causes of the risk	Potential consequences of the risk	Potential Impact (worst case scenario)	Likelihood of risk occurring if no management controls are in place
6 Financial sustainability & corporate well being	Inability to recover quickly in the event of a disaster	<ul style="list-style-type: none"> <li>• Theft of computer hardware</li> <li>• Power and water supply failure</li> <li>• Fire, flood, hacking, negligence</li> <li>• IT Viruses</li> <li>• Hacking into the WRC information system</li> <li>• Loss of hard copy information</li> <li>• Poor security control (logical access and physical control)</li> <li>• Failure of support services (Eskom, Post Office)</li> </ul>	<ul style="list-style-type: none"> <li>• Delays and disruptions in operations</li> <li>• Possible loss of life / injury on duty</li> <li>• Financial loss</li> <li>• Loss of research results (reports/ loss of knowledge base - intellectual property)</li> <li>• Harm to reputation</li> <li>• Possible rework resulting in increased cost</li> <li>• Legal implications</li> </ul>	Critical	Possible
7 Financial sustainability & corporate well being	Fraud and corruption	<ul style="list-style-type: none"> <li>• Ineffectiveness of fraud and corruption prevention systems</li> <li>• Possible unethical behaviour</li> <li>• Non adherence to policy and procedures</li> <li>• Effectiveness of management oversight</li> <li>• Opportunists (bribes, corruption, collusion)</li> <li>• Increase in cyber crime and inadequate cyber security</li> </ul>	<ul style="list-style-type: none"> <li>• Financial loss</li> <li>• Operational inefficiencies</li> <li>• Harm to reputation</li> <li>• Inability to meet set performance delivery targets</li> <li>• Increased pressure from stakeholders</li> <li>• Loss of research results (reports/ loss of knowledge base - intellectual property)</li> </ul>	Critical	Likely
8 To enhance knowledge across the water knowledge and innovation cycle	Losing competitive edge	<ul style="list-style-type: none"> <li>• External changes Internal restructuring</li> <li>• Rapid growth</li> <li>• Not properly understanding the environment</li> <li>• Other institutions entering the environment</li> </ul>	<ul style="list-style-type: none"> <li>• Reputational damage</li> <li>• Loss of leverage funding</li> <li>• Loss of research partnerships and collaborations</li> </ul>	Serious	Almost certain
9 <ul style="list-style-type: none"> <li>• To support human capacity building in the water sector</li> <li>• To enhance knowledge across the water knowledge and innovation cycle</li> <li>• To support community empowerment</li> </ul>	Uncertainty within the tertiary education environment	<ul style="list-style-type: none"> <li>• Tertiary education environment is volatile</li> <li>• The future education environment is uncertain</li> <li>• Research subsidy may be diverted to pay for student fees</li> </ul>	<ul style="list-style-type: none"> <li>• Research portfolio at risk</li> <li>• The future of the researcher base is at risk</li> </ul>	Serious	Likely

Inherent risk exposure with no management controls in place	Current business processes / controls in place to manage identified risks	Risk owner	Perceived control effectiveness	Priority due to residual risk exposure	Likelihood of risk occurring if controls are in place	Mitigating action plans to further address the residual risk exposure
Moderate	<ul style="list-style-type: none"> <li>WRC continuity plan in place for all are areas (virtual operation - multiple locations and sites)</li> <li>Offsite backups of core systems and data, Disaster Recovery site and plans</li> <li>Uninterrupted Water and Power Supply</li> <li>Anti-virus software (renewed annually and daily updates) and Firewalls</li> <li>Insurance</li> <li>Emergency response teams</li> <li>Evacuation plans and procedures</li> <li>Fully functional private network (van)</li> <li>Logical and physical access controls</li> <li>Fire proof strong room for research contracts (Offsite)</li> <li>Digitisation of documentation</li> <li>3G and cell phone enablement</li> <li>24 hour security with armed response</li> <li>Outsource courier service provider</li> <li>Annual simulation testing</li> </ul>	Executive Manager Corporate Services	Good	Priority 5	Likely	
High	<ul style="list-style-type: none"> <li>Financial and management (reconciliatory, supervisory, etc.) controls</li> <li>Monitoring daily cash balance</li> <li>Segregation of duties</li> <li>Audit trails</li> <li>Delegation of authority</li> <li>Change controls</li> <li>Fraud prevention plan implemented and work shopped annually</li> <li>24 hour Fraud hotline</li> <li>Whistle blowing policy implemented</li> <li>Code of Ethics</li> <li>Establishment of a SCM unit</li> <li>Management of Intellectual property</li> </ul>	CFO	Satisfactory	Priority 3	Likely	
High	<ul style="list-style-type: none"> <li>Environmental scanning</li> <li>Recruitment policies/practices</li> <li>External reviews</li> <li>International engagement processes</li> <li>Local partnership strategy</li> <li>WRC staff development and retention</li> <li>WRC positioning strategy</li> </ul>	CEO	Satisfactory	Priority 3	Rare	
Moderate	<ul style="list-style-type: none"> <li>Fair number of project are offsite</li> <li>Flexibility in projects ( project timetables etc. has a set)</li> <li>Diversified research capacity</li> <li>Develop a tertiary education support plan</li> </ul>	Group Executive: Impact and Innovation  Group Executive: Research and Development	Satisfactory	Priority 4	Likely	Early movement of projects (if required)  Work with partners to move current resources to areas most needed





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