Setting the scene for Water Sensitive Planning in South Africa: Considering the perspectives of planning professionals

A Lombard

orcid.org/0000-0001-8719-3834

Dissertation accepted in fulfilment of the requirements for the degree *Master of Science in Urban and Regional Planning* at the North-West University

Supervisor:	Prof EJ Cilliers
Co-supervisor:	Prof SS Cilliers

Graduation May 2021

25031287

PREFACE

This research (or parts thereof) was made possible by the financial contribution of the NRF (National Research Foundation) South Africa. Any opinion and conclusions or recommendations expressed in this research are those of the author and therefore the NRF does not accept any accountability in regard thereto.

Without the resources provided by the North-West University (Potchefstroom Campus), this dissertation would not have been possible. I would like to thank the Department of Natural Science and the Urban and Regional faculty. To all the lecturers who played a part in my education and to both my supervisor Prof E.J. Cilliers and co-supervisor Prof S.S. Cilliers. Thank you for your patience, guidance, and mentorship throughout this proses and I will forever be grateful for the time you invested in me. Furthermore, to Dr Erika Fourie who acted as my main statistical consultant and without whom none of the illustrated results would be possible.

Lastly, for all the support and belief received from my friends and family, thanks are not enough, and words cannot describe how truly blesses and thankful I am.

To everyone who watched me suffer, grow, and succeed we finally made it to the end.

ABSTRACT

Water is considered a vital resource for human survival. The management of water and water resource planning is increasingly being recognised, from a spatial planning perspective, as vital components within the broader sustainability discourse (Engel et al., 2017). Communities worldwide are facing enormous challenges regarding the management of water resources. Due to various reasons, such as increasing populations, struggling economies, water availability and the expensive supply thereof (ICLEI et al., 2012), water management is a complex process and includes various spheres of government and different role players. Climate change is deemed responsible for significant impacts on water availability in South Africa, the conservation and sustainable management of water should thus be regarded as an important investment in South Africa's future (Tewari, 2009:639). According to the Department of Water Affairs and Forestry (DWAF, 2004), there should be an equilibrium between the conservation of water resources and the delivery infrastructure, thus water demand and water conservation should be managed together to create an effective system.

This research reflected on the evolution of spatial planning and water management in South Africa to better understand the unique challenges South Africa faces, along with the transdisciplinary environment in which water planning and management are now embedded (Todes, 2009:414, van Wyk & Oranje, 2014:8). The urgent need for a comprehensive national water plan, aligned with broader spatial planning approaches, has become apparent. This research aims to provide a point of departure for a Water Sensitive Planning (WSP) approach, based on a theoretical investigation and perspectives of current, professional planners and to 'set the scene' for a national water plan. This research, therefore, reflected on WSP from a planning perspective and identified gaps relating to WSP in South Africa, specifically pertaining to the knowledge of professional planners in terms of effective management of water resources in South Africa.

The literature considered the evolution of spatial planning and water management on a global and South African scale to identify trends, solutions, and innovative approaches to South Africa's WSP challenges. The literature then proceeded to reflect on sustainability and governance to further contribute to the construction of a national WSP plan for South Africa and to understand the status quo of WSP. The empirical investigation considered the perspectives of a sample of current, professional planners, pertaining to South Africa's unique water-related challenges, along with possible solutions in quest of the development of a national water plan.

The research concluded that water security and investment in water management could prevent a global catastrophe, however, if policymakers and planners are to recognise the importance of

WSP (Zhuwakinyu & Creamer media, 2012:3) and recognise water as one of the most important resources on earth, the effective management of WSP may be possible. The consideration of transdisciplinary planning and lifelong learning was also highlighted as a key to achieve the above-mentioned goal. Based on the theoretical investigation, as well as the empirical investigation and perceptions of professional planners, this research recommended guidelines as a first step in creating a national water-sensitive plan for South Africa and aims to provide this perspective and pose a point of the departure, based on the viewpoints of professional planners, to structure a national water plan.

Key terms: Water Sensitive Planning, South Africa, Spatial planning, Transdisciplinary planning

OPSOMMING

Water word beskou as 'n lewensbelangrike bron vir menslike oorlewing. Die bestuur van water, en waterhulpbronbestuur word toemeemend herken as 'n belangrike komponent in terme van volhoubaarheid vanaf 'n ruimtelike beplanning perspekfief (Engel et al., 2017). Gemeenskappe wêreldwyd word deur enorme uitdagings gekonfronteer in terme van die bestuur van water hulpbronne, weens verskillende redes wat toenemend populasiegroei, sukkelende ekonomieë, die beskikbaarheid van water, asook die duur aanbod daarvan insluit (ICLEI et al., 2012). Waterbesuur is 'n komplekse proses en sluit verskillende vlakke van die regering en rolspelers in. In Suid-Afrika het klimaatverandering ook ’n beduidende impak op die beskikbaarheid van water tot gevolg gehad, wat die bewaring en volhoubaarheid van water onder die vergrootglas geplaas het, spesifiek ook in terme van investeringsmoontlikhede (Tewari, 2009:639). Volgens die Departement van Water Sake en Bosbou (DWAF, 2004), moet daar 'n ewewig tussen die bewaring van water hulpbronne en die afleweringsinfrastruktuur wees, dus moet die vraag na water en die behoud daarvan saam bestuur word, ten einde 'n effektiewe watersisteem te skep. Hierdie studie het gefokus op die evolusie van ruimtelike beplanning en waterbestuur, in ’n poging om Suid-Afrika se unieke uitdagings beter te verstaan, te same met die transdissiplinêre omgewing waarbinne waterbeplanning- en bestuur nou funksioneer (Todes, 2009:414, van Wyk & Oranje, 2014:8).

Die behoefte vir 'n insluitende nasionale water plan wat in lyn is met breë ruimtelike beplanningsbenaderings is duidelik en hierdie studie het gepoog om die vertrekpunt vir ’n water sensitiewe benadering daar te stel, gegrond op die teoretiese vertrekpunte, asook persepsies van huidige, professionele beplanners. Hierdie studie het dus gereflekteer op Water Sensitiewe Beplanning (WSB) vanuit 'n beplanningsperspektief ten einde die gapings wat veband hou met WSB in Suid-Afrika te identifiseer. Die perspektiewe van die streekproef van huidige, professionele beplanners is ook in ag geneem, veral in terme van die effektiewe bestuur van water hulpbronne in Suid-Afrika.

Die literatuurstudie het daarom die evolusie van ruimtelike beplanning en waterbestuur op 'n wêreldwye en Suid Afrikaanse vlak bestudeer, om neigings, oplossings en innoverende benaderings vir Suid-Afrika se WSB uitdagings te identifiseer. Die literatuurstudie het vervolgens volhoubaarheid en bestuur oorweeg in die soeke na ’n nasionale WSB plan vir Suid-Afrika. Die empiriese ondersoek het huidige, professionele beplanners se perspektief in ag geneem, spesifiek ten opsigte van Suid-Afrika se unieke waterverwante uitdagings en moontlike oplossings in die daarstel van ’n nasionale water sensitiewe plan vir Suid-Afrika.

Die studie se gevolgtrekking is dat water sekuriteit en investerig in die bestuur van water 'n globale katastrofie kan voorkom. As beleidmakers en beplanners egter nie die belangrikheid van WSB en die belangrikheid van water hulpbronne kan herken nie (Zhuwakinyu & Creamer media, 2012:3) sal die effektiewe bestuur van WSB nie moontlik wees nie. Die oorweging van transdissiplinêre beplanning en lewenslange leer is ook uitgewys as noodsaaklike maatreëls ten einde die bogenoemde doelwit te bereik. Gebaseer op die teoretiese fundering en empiriese onderstel, stel hierdie studie riglyne voor vir die ontwikkeling van ’n nasionale water sensitiewe plan vir Suid-Afrika.

Sleutel terme: Water Sensitiewe Beplanning, Suid-Afrika, Ruimtelike belpanning, Transdissiplinêre beplanning

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1 INTRODUCTION

1.1 Introduction

Water is a vital resource, not only for human survival but also for urban sustainability. It is estimated that approximately 43 countries and 700 million people are influenced by water scarcities (Kurunthachalam, 2014:1) and thus, the planning of water is of great importance. South Africa is considered a water-stressed country, but ironically has a high-water usage of approximately 273 litres per day per person, that is 64 litres higher than the global average water use per person (Mckenzie et al., 2013:1). Both the availability and the quality of water in South Africa is being impacted by the challenges of a growing economy, along with rapid urbanisation and limited infrastructure provision (Webb et al., 2009:1). It is estimated that 64% of South African households do not have access to water services and that 35% of municipal water is lost through leaks (Viljoen & van der Walt, 2018:1). Water Sensitive Planning (WSP) is the complete consideration of water resources from a transdisciplinary perspective in the built environment. In line with increasing transdisciplinary planning approaches, South Africa is compelled to consider WSP approaches as part of mainstream urban planning (van Wyk & Oranje, 2014:8). WSP is a method used to integrate sustainable development and water awareness into urban and regional planning (Carmon & Shamir, 2010:1) where water resources are actively considered by the spatial environment. This dissertation considers the perspectives of planning professionals in South Africa relating to urban spatial planning and WSP, to set the scene for an integrated approach towards WSP in South Africa.

As a result, this dissertation reflects on the evolution of global spatial planning trends followed by South Africa's spatial planning evolution, in an attempt to understand South Africa's unique urban layout and development trends from a planning perspective, and the possible challenges faced in the implementation of WSP approaches

This chapter introduces the research topic, followed by the problem statement of this research, the research aims and objectives, the method of investigation, delineation of the study area, and limitations of the research. Lastly, chapter divisions are provided to 'set the scene' for this research dissertation. Figure 1 illustrates the structure of the research as explained.

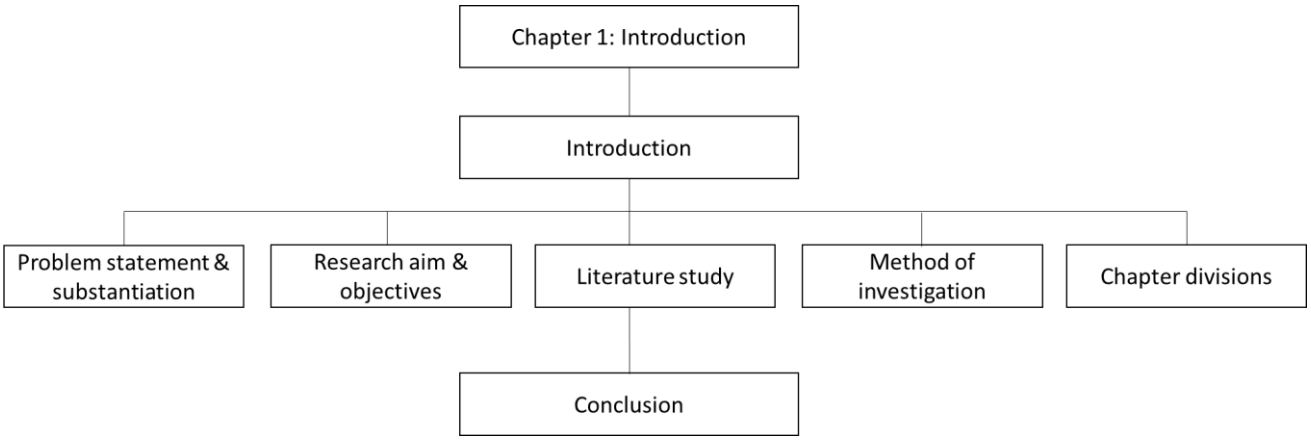


Figure 1: Breakdown of Chapter 1

1.2 Problem statement

Water is considered a vital resource for human survival. The management of water and water resource planning is increasingly being recognised, from a spatial planning perspective, as vital components within the broader sustainability discourse (Engel et al., 2017). Communities worldwide are facing enormous challenges regarding the management of water resources due to various reasons, such as increasing populations, struggling economies, water availability and the expensive supply thereof (ICLEI et al., 2012). Water management is a complex process and includes various spheres of government and different role players. Climate change is deemed responsible for significant impacts on water availability in South Africa; the conservation and sustainable management of water should thus be regarded as an important investment in South Africa's future (Tewari, 2009:639). South Africa's water-related challenges in the urban environment gain importance as drought and climate change increases. According to the Department of Water Affairs and Forestry (DWAF, 2004), there should be an equilibrium between the conservation of water resources and the delivery of infrastructure, thus water demand and water conservation should be managed together to create an effective system.

Spatial planning in South Africa originated as an abstract design approach with broad frameworks and international trends (Todes, 2009:414), but has recently progressed to incorporate transdisciplinary approaches (van Wyk & Oranje, 2014:8) which could contribute to an inclusive WSP approach. The recent water-related challenges in South Africa include drought due to climate change, vulnerable water systems, a rise in water demand, overexploitation of rivers and finally, water losses (Donnenfeld et al., 2018:2-3), therefore the need for a comprehensive national water plan, aligned with broader spatial planning approaches, has become apparent. There is also a need for a national approach to guide WSP in South Africa. As a point of departure, this research investigated the perspective of professional planners to structure a way forward for such a national WSP approach.

This research aimed to consider historical approaches of water planning and management and the benefits of integrated and transdisciplinary planning approaches to address the identified urban water challenges. This research suggests that historical approaches, such as top-down and current interdisciplinary approaches are outdated and unequipped to address modern urban water challenges. It is acknowledged however, that water management is a complex matter and various spheres of government are involved and affected; the recommendations that have been provided are done so from a spatial planning perspective and may vary from other profession's viewpoints.

In order to create a holistic national water plan for South Africa, (and to set the scene for such plan) it is important to understand the status quo of water planning in South Africa, the local challenges and opportunities relating to water planning and ultimately the planning professionals' (as custodians of water planning) perspectives towards WSP approaches. This research aimed to provide this perspective and pose a point of departure, based on the viewpoints of professional planners, to structure a national water plan for South Africa. The research proves that South Africa has several water-related legislative documents but none of these documents mention WSP or how the implement WSP.

1.3 Research aim and objectives

The primary aim of this research was to consider WSP in South Africa from the perspectives of urban planning professionals and to draw conclusions concerning the scope, challenges, and opportunities for the realisation of WSP in a national context.

Objectives of this research included:

- To consider the historical development of the planning profession and the importance of transdisciplinary planning approaches.
- To consider the notion of WSP and the opportunities for South Africa.
- To consider the perspectives of professional planners towards the status quo of WSP.
- To conclude on the importance and opportunities for WSP in South Africa based on the literature review and empirical investigation.
- To make planning recommendations to enhance WSP approaches in South Africa in quest of a national water plan.

1.4 Delineation of the study area

The research considered South Africa, a water-stressed country, along with the challenges and implementations of WSP as perceived by planning professionals.

1.5 Limitations

The research considered the scope, complexities and opportunities relating to WSP from the perspectives of planning professionals in South Africa. The empirical investigation captured the viewpoints of current planning professionals using a structured questionnaire. The data was statistically analysed and interpreted to inform on the local perspective towards WSP, but generalisation was drawn relating to WSP approaches beyond the local context. The data is limited to the number of participants who voluntarily completed the questionnaire and gave consent for use of data for this research purpose. This research acknowledges that water management is a complex process, including various spheres of government and different role players, but provides recommendations from a spatial planning perspective. This research offers a limited view, and it is acknowledged that more research needs to be conducted before WSP and a national water plan can be implemented but, this research is considered a point of departure to understand spatial planning and water management from a trans-disciplinary perspective, and to provide guidelines to develop an inclusive national water plan for South Africa.

1.6 Method of investigation

The method of investigation proceeded as follow:

1) Identify research topic
2) Considered aims and objectives
3) Write Chapter 1
4) Conduct research for literature review
5) Set up e-questionnaire (send e-questionnaire)
6) Refine literature review
7) Re-write literature review
8) Analyse statistics
9) Write Empirical
10) Refine statistics
11) Re-write Empirical
12) Conclude Chapter 6 & 7

This research employed a chronological investigation into the historical background relating to spatial planning and water planning, as well as the origins thereof in South Africa, to highlight the evolution of planning as a profession with specific reference to WSP approaches. Challenges relating to the spatial planning profession, both globally and in South Africa, were considered as part of a thematic investigation focusing on WSP objectives derived from the theoretical investigation.

The theoretical investigation was based on 14 core sources that were identified based on their reference to spatial planning and WSP challenges, both on a global and national scale. A thematic grouping approach was employed accordingly to identified broad themes of investigation. The first theme entailed “sustainability” and included literature on natural resources, sustainability, climate change and environmental considerations. It also considered challenges related to population growth, urbanisation, urban sprawl, and the impact thereof on broader spatial planning approaches. The second theme “governance” entailed literature on policies and multi-level governance, specifically relating to water management and the implementation of WSP.

It also included silo-planning approaches and other historical animosities that were identified as challenges relating to governance within planning. Historical animosities are defined as spatial inequalities caused by Apartheid. Table 1 summarises the sources and delineation of identified and grouped themes as employed in this research.

Table 1: Global spatial planning challenges

	Governance				Sustainability				
	Lack of policies	Historical animosities	Silo-planning	Regional planning authorities	Natural resources	Urbanisation/ Urban sprawl	Population growth	Climate change	Environmental consideration
Bran et al (2012:462-466)	X	X	X		X	X			
Mohamed (2013)						X	X	X	
Gregory et al. (s.a.:1- 17)							X		
The Chicago Council on global affairs (2015:1-12)	X					X			
Bouton et al. (2013)						X	X	X	
World Economic Forum (2016&201 9)						X	X	X	

Freire (2006:1-8)				X		X	X	X	X
Mahamud et al. (2016)	X		X			X			X
Goodstadt & Partidario 100-108	X		X			X		X	
Polidoro et al. (2012:101 0-1018)			X			X	X	X	X
Leinfelder & Vanempte n (2008:1-4)			X			X		X	X
Okeke (2015:153-178)			X	X	X				
Ding (2009:384-390)	X						X		X

For South Africa's spatial planning challenges, the theme of 'sustainability' was once again identified and included the lack of ecosystem services, sustainability, climate change and natural resources which included water supply and conservation. It also considered challenges related to population growth, urbanisation and urban sprawl and the impact thereof on broader spatial planning approaches. The second theme 'governance' also applies to South Africa and includes literature on policies relating to water management and the implementation of WSP. Silo-planning approaches and overcoming historical animosities such as the urban and rural divide and spatial inequalities were identified as challenges relating to governance within planning. Table 2 summarises the sources and delineation of identified and grouped themes as employed in the research.

Table 2: South Africa's spatial planning challenges

	Governance			Sustainability				
	Lack of policies	Silo-planning	Historical animosities	Lack of ecosystem services	Urbanisation & Urban sprawl	Population growth	Climate change	Natural resources (supply & demand
Todes & Turok (2018)	X		X	X	X			
du Plessis (2013:1-21)	X		X		X	X		
Joscelyn (2015:1-40)	X	X	X		X		X	X
State of South African Cities Report (2016:1-20	X	X	X				X	X
Situma (2002:1-13)	X	X	X		X			
SPLUMA Act 16 (2013)	X		X		X	X	X	X
Sustainable Development Goals (2017)			X			X	X	X
National Planning Commission (2012)	X	X	X		X	X		X
Department of Rural Development &	X	X	X	X			X	X

Land Reform (2014)								
Kotze et al. (2014:1-4)			X	X	X	X	X	X
Karuri-Sebina (2016)		X	X		X	X	X	X
Angelopulo (2017:65-92)	X		X		X			
Palmer et al. (2016:1-41)	X		X		X	X	X	X
WWF (2014:1-40	X		X		X	X	X	X

Table 3 focusses on the water planning challenges and objectives at both the global and local scale and again employed a theoretical investigation into the themes of
1) water quality, 2) water quantity, 3) water conservation, 4) governance and 5) planning. Table 3 illustrates global WSP challenges as identified through the above-mentioned themes.

Table 3: Global WSP challenges

	Water quality & Public health	Water quantities	Water conservation	Water planning	Water governance
Carmon & Shamir (2008:1-11)	X		X	X	
Wong & Brown (2009:673-683)		X			
Sharma et al. (2016:1- 15)	X	X		X	
Brown et al. (2016:1- 49)	X	X	X		
Coolet et al. (2013:1- 43)	X	X	X	X	X
Wong (2007:1-13)	X		X	X	X
USAID (2009:1-32)	X		X	X	
Jimenez-Crsneron (2015:10-20)	X	X	X	X	X
Abu-Zeid & Shiklomanov			X	X	X

(2003:1-152)					
Romano & Akhmouch (2019:1-9)		X	X	X	X
Fulazzaky (2014:2000-2020)	X	X	X	X	X
Khatri & Vairavamoarthy (2007:1-20)	X	X	X		X
Gourbesville (2008;284-289)		X	X		X
Tan et al. (2012:2-10)		X	X	X	X

South Africa's WSP challenges were once again identified under the themes of 1) water quality, 2) water quantity, 3) water conservation, 4) water governance, 5) water planning as illustrated in Table 4.

Table 4: South Africa's WSP challenges

	Water quality & Public health	Water quantity	Water conservation	Water planning	Water governance
Armitage et al. (2014:2- 23)		X		X	
Fisher-Jeffes et al. (2017:1-10)	X	X	X		X
Carden et al. (2016:51- 63)	X		X	X	X

Department of Rural Development & Land Reform (2014)	X	X	X		
Donnenfeld et al. (2018:1-24)	X		X	X	X
WWF 2016 (2-100)	X	X	X		
Weaver et al. (2017:398- 409)	X	X			X
Sershen et al. (2016:456 -466)	X		X		X
Muller et al. (2009:1-40)	X	X			X
World Cup Legacy Report	X	X	X	X	
Nkuna & Ngorima (2011:1-10)	X		X	X	X
USAID (2009:1-32)	X	X	X	X	
Jimenez-Cisneros (2015:10-20)	X	X	X	X	X

The empirical investigation captured the perspectives of a convenience sample of local professional planners regarding WSP for South Africa. The sample is considered convenient as local professionals whose information was available was contacted. An e-questionnaire was

distributed to the sample group, to capture the status quo of WSP in South Africa, their perspectives relating to the importance of WSP for South Africa, and finally identifying opportunities for future WSP approaches. Ethics consent for this research was given by the North-West University on 29 July 2019 (Annexure A, NWU-01165-19-A9) and the researcher did not have direct contact with the participants as the e-questionnaire was distributed through online portals where participation was voluntary. The questionnaire was initially constructed with basic research on water-related challenges in South Africa, thereafter the research evolved into increasingly complex water- related challenges, such as population growth, water governance, water planning, water supply and demand, and water quality, the dissertation thus evolved with the research.

A consent statement was included along with a statement of confidentiality. Consent was obtained by completion of the e-questionnaire. The data of the e-questionnaire was statistically analysed through cross-tabulation, Chi-square test and symmetric measures to present a quantitative view of the data derived from the survey. Ultimately, the empirical investigation informed conclusions and planning recommendations to set the scene for WSP in South Africa.

1.7 Structure of the research

The dissertation is structured as follows:

Chapter 1: Introduction.

Introduction and problem statement, Primary research questions, Aims and objectives of this research, Methodology, Delineation of the study area, Limitations of the research.
The current chapter serves as an introduction to the research and offers background on the methods and steps followed to conduct this research. The research aims and objectives were stated to remind the reader of the ultimate goal for this research. The consideration of WSP from the perspective of local professionals concludes this research with offered recommendations to possibly solve the challenges identified.

Chapter 2: The evolution of the spatial planning profession Globally and in South Africa.

The evolution of global and local spatial planning with the consideration of transdisciplinary approaches, land use management and WSP. Relevant spatial planning challenges were identified on a global and national level to compare trends and the future of spatial planning.

Chapter 3: The evolution of WSP.

WSP approaches were considered to highlight the linkages in the planning profession and

identify transdisciplinary planning approaches. The evolution of WSP on a global and national level with identified WSP challenges. The evolution of global WSP is mentioned to identify ideologies and trends for WSP, thus identifying future trends for WSP in South Africa. These challenges were then compared to identify future trends.

Chapter 4: Policy and legislation review related to WSP in South Africa.

Chapter 5: Results of the professional planner's view on WSP

The e-questionnaires conducted voluntarily with planning professionals are evaluated to consider the status quo of WSP, the implementation of WSP and finally exploring sustainable water planning solutions for future generations.

Chapter 6: Conclusions

Conclusions on planning professionals' views on WSP to offer sustainable recommendations as well as conclusions on South Africa's policy and legislation regarding WSP.

Chapter 7: Planning Recommendation, illustrating sustainable planning solutions to set the scene for the promotion of WSP in South Africa.

CHAPTER 2 THE EVOLUTION OF THE SPATIAL PLANNING PROFESSION

2.1 Introduction

Chapter 2 captures the evolution of the spatial planning profession on a global and local level to achieve the first objective for this research; to consider the historical development of the spatial planning profession and the importance of transdisciplinary planning approaches. This serves as an review of relevant literature to understand the notion of WSP as part of broader spatial planning approaches, and the aim of considering WSP for South Africa based on the perspective of local planning professionals. Through the evolution of spatial planning, current challenges could be identified, relating to the planning of water, to better understand the planning profession and the importance of the integration of the planning profession. Spatial planning trends and the evolution thereof is highlighted in this chapter to emphasize the importance of transdisciplinary approaches for the effective planning of water resources. The goal for Chapter 2 is to understand how South Africa's water crisis originated and effected the planning profession as an introductory section for WSP and the evolution thereof. Figure 2 illustrates the proceedings for this section.

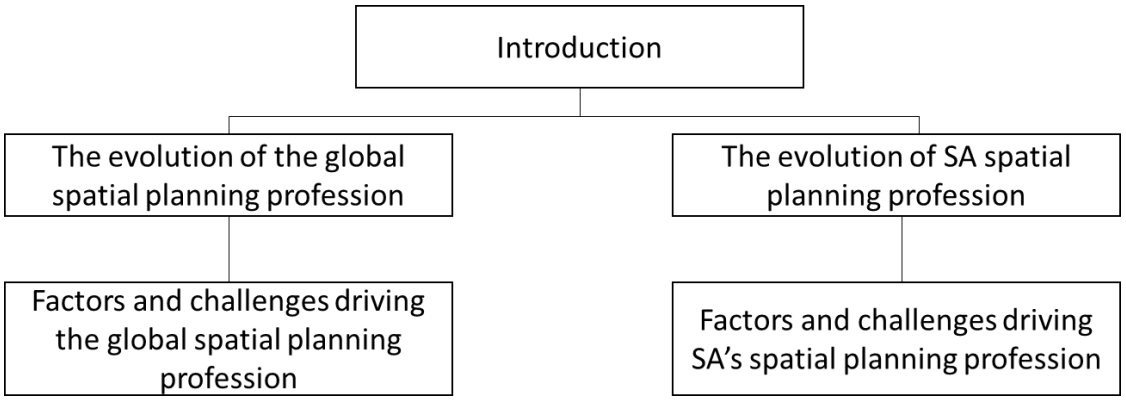


Figure 2: Breakdown of Chapter 2

2.2 The evolution of the global spatial planning profession

The following section depicts the global spatial planning profession's evolution, Figure 3 illustrates the evolution as explained accordingly. The highlighted boxes illustrate key historical events identified from the research below. The timeline was compared to the one of South Africa to illustrate development speed (cross-reference Figure 6).

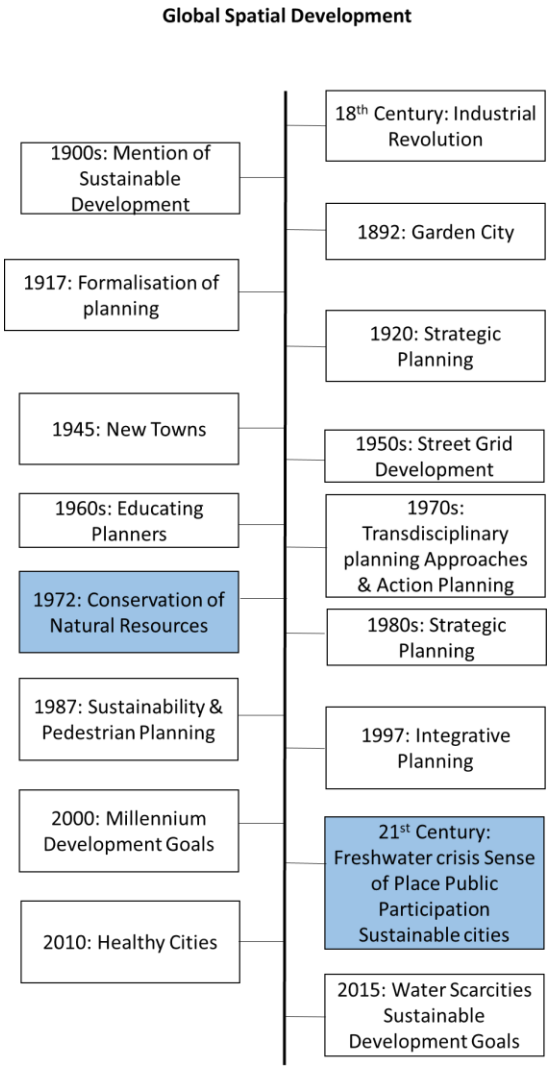


Figure 3: The evolution of global spatial planning

Planning can be defined as the consideration of future events and in that sense, humanity has been planning since rational thinking emerged; however, the formalisation of planning only came with the twentieth century in 1917 (Carron, 2010:9). The concept of different socio-economic groups living together originated in the 14th to 16th century with different religion or income classes grouped in one neighbourhood (Alshuwaikhat, 2015:15). The industrial revolution in the 18th century brought with it the notion of railways and roads; this shifted the spatial planning profession into the consideration of planning on a larger scale than previously implemented (Alshuwaikhat, 2015:15). In 1798 Thomas Robert Malthus wrote an article on projections of population growth and food production and thus the notion of sustainability was birthed (Bac, 2008:576).

In the early 1900s a biologist named Patrick Geddes suggested that regional planning might be the solution to large congested metropolitan areas, he further stated the notion of sustainability through the renewal of resources and an ecological balance in sub-regions (Duhl & Sanchez,

1999:4). Ebenezer Howard introduced The Garden City in 1892, urbanisation took place in England and the city, specifically industrial areas were placed under immense pressure (Savery, 2008:2). The Garden City aimed to improve health conditions for factory workers by combining city and country life thus considering sustainability. The characteristics are as follows; an appreciation for the natural environment, access to services and facilities and lastly opportunities for social interaction, safe housing, and community participation (Savery, 2008:2). The two major variables for the Garden City were identified as the number of jobs and the quality of housing, and a greenbelt was implemented for agricultural reasons and the prevention of urban sprawl (Alshuwaikhat, 2015:19-20).

Early in the 20th century, the neighbourhood unit was introduced by Perry, to improve the health and safety of people living in residential areas and this initiated the thought of urban lifestyle and the importance thereof (Alshuwaikhat, 2015:16). Europe implemented strategic planning in the 1920s and 1930s and it was thus considered the origin of strategic planning (Albrechts, 2001:734). 1920 substantiated the concept of social interaction and the role the city plays in community health (Duhl & Sanchez, 1999:4). Around 1945 after the Second World War, several countries adopted the idea of planning as a notion to recover from the devastation of the war (Carron, 2010:9). The conceptualisation of new towns came in 1946 and towns were now obligated to be surrounded by a green belt. However, some criticism was received around this notion and it was terminated (Duhl & Sanchez, 1999:4). In the 1950s the street grid system was used to develop growing cities and have been observed as early as 2600 BC (O'Grady, 2014:6). In mid-1960 the term regional planning gained importance in North America and Europe, the term suggests that a broad view of a country should be perceived rather than small independent cities (Acheampong, 2018:13). Regional planning also promotes integration and balance throughout the country. The 1960s brought with it a view on educational planning as a means to excel in human resource development, experts were trained but expectations on radical ideas were not met and were contradicting classic planning principles which were introduced in 1970 and strongly implemented by 1980 (Carron, 2010:9). Transdisciplinary planning approaches surfaced in 1970 with the urgency to solve global issues such as sustainability and climate change (Bernstein, 2015:1). Planners started communicating with one another about different issues to create efficiency in the problem-solving process.

In the early 1970s, the United States (US) considered the switch from traditional passive planning to action-oriented planning (strategic planning); this was because of emerging challenges (oil crisis, unstable economy etc.) that required a clear vision (Albrechts, 2001:734). A conference devoted to the environment in 1972 promoted the conservation of natural resources, such as water, and protecting the environment (Bac, 2008:576). The 1980s brought the increasing implementation of strategic planning with a series of articles in the US calling on the government

to implement this planning theory (Albrechts, 2001:734). Strategic planning was also implemented in the 1980s to increase cost efficiency and shift the focus to a result-driven model (Carron, 2010:8).

Strategic planning was identified as the need to create a strategy to solve a problem, this depends on the ability to create a vision (Albrechts, 2001:734). According to Albrechts (2006:1150), there is still no clear definition of strategic planning, but the concept can rather be adapted depending on the current issues faced at a given time. The characteristics that define strategic spatial planning as identified by Mäntysalo et al. (2015:173) are first; to shift from a rational planning approach to a visual planning approach. Strategic spatial planning processes are sustainable elements when focusing on long-term visions for current problematic situations. Secondly, strategic spatial planning includes the modification of blueprint planning to action planning; the focus of spatial planning is to generate productive change in the planning environment (Mäntysalo et al., 2015:173). Carron (2010:7) defined strategic planning's characteristics as the consideration of a bigger picture through the reflection of a changing environment and the achievement of a long-term goal with a clear vision. Strategic planning is said to consider the private sector and plan effectively for the planning profession's futures when the future may appear uncertain (Albrechts, 2001:734). Strategic planning shifts the focus from achieving the outcome to defining what the outcome should be; the theory thus considers future trends in current circumstances (Morley, 2007:3).

Sustainability and the consideration thereof became more apparent in 1987 when climate change and environmental conservations were important concepts that came to light and once again shifted spatial planning approaches into the consideration thereof (Saadatian et al., 2012:310). Sustainable Development was birthed on the notion of good citizens, conserving resources, and striving for equality. Sustainable development can roughly be divided into three eras; Pre- Stockholm, from Stockholm to World Commission on Environment and Development (WCED) and Post-WCED (Saadatian et al., 2012:311). Sustainability and Sustainable Development's evolution and trends have gained importance, and this might help to ensure that the 21st century will be a sustainable one (Bac, 2008:576). Integrative planning made its debut in 1997 and revolutionised the planning profession, the idea was that planners would incorporate multi- and transdisciplinary approaches to find sustainable solutions for challenging scenarios (Abukhater, 2007:67). Urbanisation and population growth increased, and major cities or metros were developed to accommodate the growing urban environment, while Green Infrastructure (GI) and sustainable planning approaches became increasingly evident in the 21st century, GI is the method in which challenges in the build environment are solved with nature.

In 2015 the Sustainable Development Goals (2030:6) were developed to ensure a sustainable

future the second goal was relevant to WSP and aims to guarantee no hunger. To accomplish this adequate water supply is necessary, which is identified as the sixth goal. Cities make up two per cent of the earth's surface and in 2010 the European Union (EU) stated the goal for planning today is to create healthy and safe cities with a guarantee of clean drinking water whilst considering the Sustainable Development Goals (EU 2010:10). The eleventh goal aims at creating sustainable cities and communities - this once again links to adequate water management to ensure the health and safety of communities. The demand for sustainability has risen with the increase in awareness of the environment and the limitations of natural resources. Nilsson & Ryden (s.a.:206) further state that the UN and EU have promoted sustainable spatial development over the last decade to protect the environment. Where sustainability was previously only mentioned it is now considered into agendas, regulations, and rules. Planning has thus shifted from a passive approach into an active approach in terms of sustainability. A major global crisis for the 21st century was identified as freshwater scarcities; this has a significant influence on the urban environment and how spatial planning is being implemented (Srinivasan et al., 2012:1). An emphasis on green public spaces has been adopted? to ensure a sense of place and a sustainable environment (European Union, 2010:14). In 2015 an emphasis was placed on water scarcity as a consequence of the fact that the United Nations Millennium Development Goals (MDGs) were not met, with one billion people still not receiving adequate water supply and more than two billion people lacking basic sanitation (Bigas et al., 2012:3).

In 2016 the World Economic Forum identified integrated planning approaches as a trending notion in the 21st century. The 21st century brought with it the trend of 'sense of place'; this refers to how the environment feels (e.g., pleasant, relaxed, safe) and is achieved through public participation. Public participation is the notion of public decision making, i.e., the community partakes in development decisions and is, in a way, responsible for their development (Cilliers & Timmermans, 2014:415-417). Current spatial planning approaches focus on the idea of creating a sustainable environment through smart growth. Subjects like sustainability, resilience, and conservation drive planning to not only consider current challenges but plan for future unknown difficulties (Bouton et al., 2013:4-5). Concepts that were previously introduced (e.g., sustainability and strategic planning) are now being refined and implemented in large scale spatial planning. According to the United Nations at the Framework Convention on Climate Change (2015:4) a goal was set for 2018 to address the impacts of global warming through an action plan created to discuss the growing common concern of climate change and ultimately offer recommendations to improve the situation.

2.2.1 Current challenges of the spatial planning reality

As mentioned in Chapter 1 two themes were identified with regard to current global spatial

planning challenges. The first of these themes is sustainability and includes climate change, natural resources, population growth, urbanisation, and urban sprawl. The second theme is governance which includes the lack of policy implementation, silo-planning and historical animosities (cross-reference Section 1.6 Table 1). Sustainable development was first mentioned in the 1900s and is considered vital in 2020. Factors such as climate change will always exist, but it could be mitigated through sustainable planning and proper governance. Through the consideration of sustainability and governance, the main challenges for global spatial planning challenges could be identified. Sustainability suggests the maintenance of something for future use and without proper governance, this could not be achieved.

2.2.1.1 International perspective on sustainability

The UN-Habitat was established to regulate sustainability and ultimately improve infrastructure and transportation planning (Okeke, 2015:153). Through sustainability infrastructure lifespan could be increased and implementing environmental considerations may prove valuable in the consideration of maintenance costs and thus spatial planning perspectives (Gregory et al., s.a.:15). The idea of sustainability in the context of? spatial planning highlights the importance of balancing the economy, environment and social aspects while conserving natural resources (Slave & Nedovic-Budic, 2016:1). Sustainability mitigates the notion of urban sprawl and negative urbanisation patterns as previously mentioned; spatial planning is thus related to sustainability through planning (Slave & Nedovic-Budic, 2016:1-2). In terms of environmental aspects, sustainability is being undermined by economic and social factors because they are prioritised (Bran et al., 2012:464). Spatial planning carries a great responsibility in the management of protected areas and links with sustainable processes to preserve ecosystems for future generations (Markovic & Babić, 2014:1-222).

When considering the effects of climate change from a planning perspective, the availability of natural resources, including water, influences the challenges of implementing and promoting sustainability. The effect of rising global temperatures is largely relevant due to human activity and is seen as the most important issue of the 21st century (Condon et al., 2009:4). Towards the end of the 1980s, the Urban Heat Island Effect became apparent with regard to land use allocations, different spatial patterns, and consumption behaviours influence on climate change (Yiannakou & Salata, 2017:1-2). With regard to the spatial planning profession, the challenges that emerged were the increase and decrease in demand for energy together with the effect of melting land-based ice on coastal areas due to a rise in sea levels (Condon et al., 2009:4-5). The consideration of Green Infrastructure (GI) was then implemented to mitigate the human effects on climate change (Yiannakou & Salata, 2017:2-3).

Rapid population growth, urbanisation and climate change were emerging challenges in the 21st

century (Bouton et al., 2013:3). In 2030 it is estimated that approximately 60% of the world's population will live in cities due to urbanisation and population growth (Bouton et al., 2013:3). The World Economic Forum (2016:9) stated that growing cities is a major challenge faced in spatial planning, and the creation of effective and sustainable cities is thus becoming more challenging and important. Current spatial planning challenges with regards to water planning include sustainable development, urbanisation, implementing and evaluating spatial plans and implementing trans-disciplinary approaches (Bran et al., 2012:462-467). The World Economic Forum (2019:5) identifies climate change as the second largest risk to world economy? according to global likelihood and impact.

Figure 4: Global Footprint – The 30 Most Populated Urban Agglomerations (as of 2014)

Source: European Union (2016:9)

The number of megacities worldwide has nearly tripled since 1990 and by 2030 approximately 41 cities will have a population of 10 million (European Union, 2016:9). Figure 4 illustrates the world population in 1990 and 2014 and projected populations in 2030 for the 30 most populated urban areas; the need for sustainable planning solutions is thus depicted. Urbanisation is the movement of people from rural areas to urban areas; this creates an increase in traffic congestion, a lack of basic services, inadequate energy, environmental decay, crime, and unplanned development to mention a few (European Union, 2016:10 & Pawan, 2016:111). As substantiated by Figure 4. Cities in Latin America and Europe have achieved a plateau in terms of urban population and thus urbanisation (McGranahan & Satterthwaite, 2014:5). Urbanisation has caused over lapping between urban and rural areas in terms of cultures and lifestyles, resulting in rural areas losing importance and value in a spatial sense (McGranahan & Satterthwaite, 2014:5- 6). The causes for urbanisation include, but are not limited to, industrialisation

(employment opportunities), social factors and modernisation (Pawan, 2016:110-111). Urbanisation may be classified as the leading cause of urban sprawl which is characterised as the rapid low-density growth of cities and may be the source of the increasing spatial planning complexities (Polidoro et al., 2012:1011).

2.2.1.2 International perspective on governance

There are numerous policies and legislative contexts set in place to regulate the planning of space; however, the lack of implementation is the identified challenge (Bran et al., 2012:465), and thus the challenge of governance is established. Current spatial plans consider environmental, social, and economic factors, but the absence of implementation leads to increasing spatial challenges and the creation of new and improved policies that are in turn not being implemented (Baftijari et al., 2007:1-3). The disregard for urban policies is observed from a spatial planning perspective (Polidoro et al., 2012:1012). Policies have the power to create healthy and safe living conditions; slum and informal development could be upgraded sustainably if policies were set in place to promote the notion (Corburn & Sverdlik, 2017:2).

Multidisciplinary approaches have only recently been accepted by practising planners and researchers in the spatial planning profession (Pinson, 2004:1). Spatial planning is a diverse field that crosses many professional boundaries and multidisciplinary approaches are of importance. Integration between disciplines might be the answer to finding sustainable solutions for spatial planning challenges; however, within the planning profession a divide has been created between the sciences and spiritual sciences (Pinson, 2004:2-4). Urban planning and architecture split from engineering, then urban planning disassociated itself from architecture. This created different disciples conducting their research on similar spatial planning issues (Pinson, 2004:4). As previously mentioned, the spatial planning profession has a responsibility to protect the natural environment, and this is achieved through following a multidisciplinary approach, where spatial planners and ecologists work hand in hand to achieve sustainability (Markovic & Babić, 2014:222). Figure 5 illustrates how a spatial planning professional team is assembled to consider spatial planning challenges faced. A transdisciplinary team is selected to consider different challenges and find the most sustainable solution to environmental and urban difficulties. Different activities are pointed out and correlating specialists are assigned to them, sociologist, ecologists, engineers, GIS specialists, architects and economists are a few of the included professionals (Markovic & Babić, 2014:222-224).

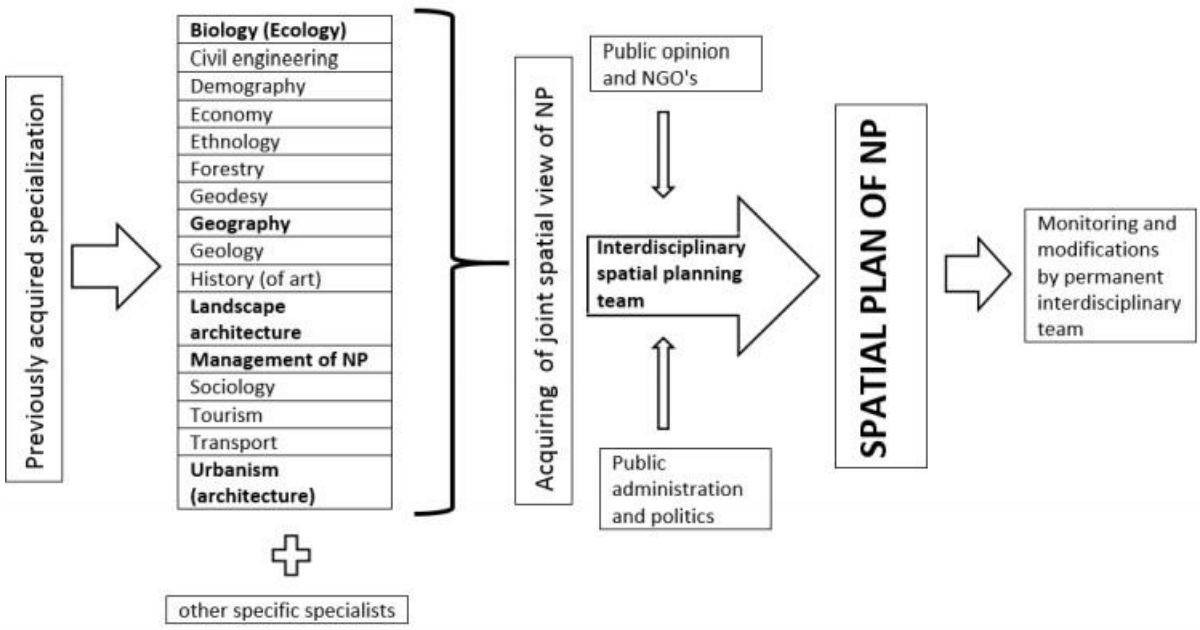


Figure 5: Organisation of the spatial planning professional team

Source: Markovic & Babić (2014:223)

Whilst innovative ideas and concepts are frequently introduced in the planning profession, the provision of policies to compel professionals to implement these ideas or solutions are lacking on a global scale (Polidoro et al., 2012:1010). Spatial planning is primarily implemented through spatial plans and is affected by other policies; spatial plans are set in place to regulate space and are considered as a continuing process (Segura & Pedrogal, 2017:1-3). The evaluation, monitoring and review of spatial plans are thus vital, however there are debates on deciding on an accurate evaluation method (Segura & Pedrogal, 2017:1-3).

The global population in 2016 marked at approximately 7.4 billion of which around 1 billion people live in slums (Hermanson, 2016:1). The challenge of informal development is largely amplified by the governance of a country or region. The notion of rural development and the provision of housing is a challenge faced by most cities; informal and rural development is considered to increase shelter and promote economic growth (Corburn & Sverdlik, 2017:1). In terms of developing rural areas, food security is of importance, as without proper infrastructure rural communities (that provide food) are under increased strain (Adisa, 2014:3). When considering developing countries, informal and slum developments become increasingly evident and the mitigation of growth in these environments has proven difficult; however, decentralisation and comprehensive planning are among the methods suggested to combat increasing slum developments (Enemark et al., 2018:2). Informal settlements are reported as the fastest growing developments and it is suggested that a larger population in informal areas contributes to higher forms of inequality (Hermanson, 2016:1).

Section 2.3 introduces the evolution of South Africa's spatial planning profession and the chapter concludes with a comparison of spatial planning challenges form a global and national perspective. South Africa's history and spatial planning are largely considered uneven and overcoming previous animosities are necessary to achieve equal urban development.

2.3 The evolution of South Africa's spatial planning profession

Figure 6 illustrates the evolution of South Africa's spatial planning to better understand the evolution of South Africa's spatial planning. The key events, highlighted in Figure 6, includes the 1994 election, debates in food security during 2008 and a rise in water management awareness in 2015 followed by a water crisis and drought in 2018. Through the investigation of South Africa's spatial planning trends, a better understanding of complex local WSP challenges may be achieved.

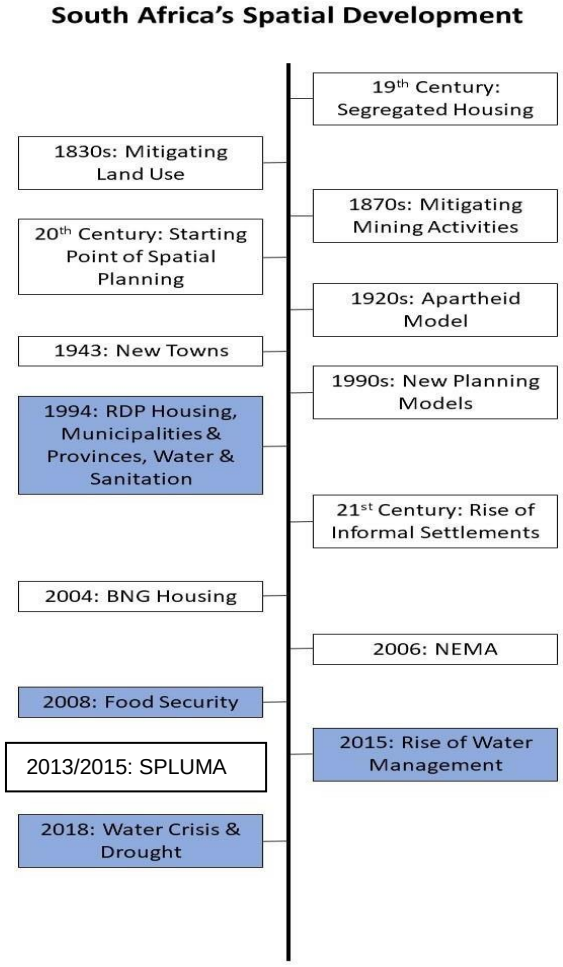


Figure 6: South Africa's spatial development evolution

South Africa was colonised between 1650 and 1700, western culture was introduced and with it capitalism. Then, in 1800 the British established a colony and as a result British American Law (Rohr, 2019:37). During the 19th century, South Africa`s industrial period started with the

discovery of diamonds and then gold (Berrisford et al., 2015:2), initiating segregated housing and the mining industry. The environmental impact of the mining industry resulted in low quality of life and highly toxic waste outputs. Mitigating land use in South Africa dates back to the 1830s (Wyk & Oranje, 2014:6), when the early measures of spatial planning in South Africa were inherited from Britain and included restrictive covenants together with official conditions intended to promote order and sense of place in small towns. Urbanisation in South Africa took place in coastal towns due to agriculture and segregation (Berrisford et al., 2015:2), due to economic development and racial quarrels citizens migrated to urban areas. In the 1870's South Africa implemented 15 Gold Laws to regulate mining activities in the Witwatersrand's goldfield areas; the laws included restrictions on Europeans to settle and mine in the area (Wyk & Oranje, 2014:6). The implementation of this law initiated economic exclusion and spatial separation based on race, the beginning of the 20th century introduced subdivision and privately-owned property. Segregation dates back long before the 1913 Land Act and the establishment of the South African Union and is a defining feature when considering South Africa's urban landscape (Hendler & Wolfson, 2003:3). Berrisford et al. (2015:2) state that the national population grew from 20% in 1913 to 35% in 1951, 48% in 1980 and 57% in 2001. The 20th century is thus identified as the starting point for the development of spatial planning. South African planning was thus initiated through the mining industry and rapid population growth, while the country focused on segregated development which involved the development of urban areas. As previously mentioned, the British Empire colonised parts of Africa, when a power struggle emerged between the British, Afrikaner settlers, and African tribes as the British wished to have control over the whole of Africa (Rohr, 2019,34). The Second Anglo-Boer War lasted from 1899 to 1902 and in 1910 South Africa gained independence. The arrival of white people in South Africa initiated a power struggle in the country which was won by the British and Dutch who introduced segregation and the notion of the homeland (Smith 2005:3). Figure 7 illustrates South Arica's homeland division and metropolitan areas; the homelands were thus separated from the Republic of South Africa (Smith, 2005:5). Pretoria, Witwatersrand, and Vereeniging were considered the economic heart of South Africa and referred to as the Transvaal. The Durban metropolitan area then developed and strong racial segregation was evident during this time (Smith, 2005:5- 6). The Apartheid model was then implemented to organise and improve social statuses (Berrisford et al., 2015:2).

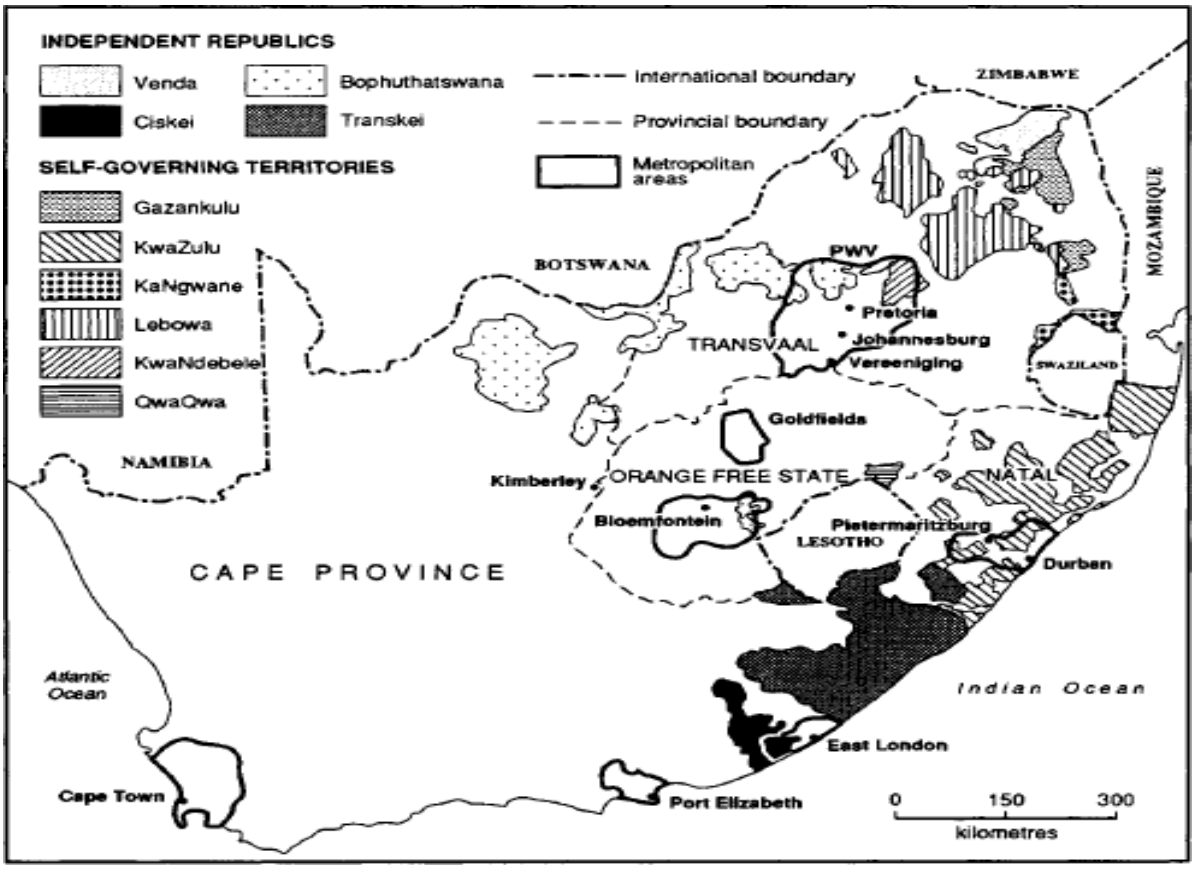


Figure 7: South Africa's homelands

Source: Smith (2005:3)

The Apartheid model required separate spatial planning legislation for different areas and in the 1920s planners influenced by Europe and Britain implemented spatial planning legislation in South Africa (Wyk & Oranje, 2014:7). Town planning schemes were thus introduced, and land use was partly regulated. According to Berrisford et al. (2015:3) planning urban spaces and implementing spatial planning was implemented as a strategy to improve the economy through labour. With the notion of town planning schemes, the African housing development was implemented; before the 1920s planners were not responsible for planning African housing (Hendler & Wolfson, 2003:4). In 1943 South Africa established the New Town notion in Vanderbijlpark and later in Stilfontein, Sasolburg, and Welkom (Brockett, 1996:164). Chronically South Africa's New Towns were developed approximately the same time as British new towns and were strongly influenced by the Garden City concept (Brockett 1996:164). Vanderbijlpark was the first industrial town in South Africa to be planned to the last detail before construction of any sort started and followed a segregated approach (Brockett, 1996:165).

South Africa entered the 1990's with a legacy of segregation and fragmented planning due to the Apartheid model, and it was then, among others, the planner's responsibility to reconstruct this impression and create a new and sustainable model (Donaldson, 2001:1). The reconstruction of

divided cities did not, however occur without challenges; the apartheid principals flowed harmoniously with spatial planning principles previously set in place while clashing with innovative thoughts for the future (Donaldson, 2001:1). The Apartheid model left on one side a modern developed area where urban sprawl was already visible, and on the other side an underdeveloped and unregulated urban environment (Hendler & Wolfson, 2003:12).

In 1994 South Africa transitioned into a democracy which encouraged improved spatial planning and land use management (van Wyk & Oranje, 2014:2). Before the democracy shift in South Africa, the country was focused on inequality which led to homelessness, and spatial planning aimed to address this issue through large-scale redevelopment and spatial transformation. In 1994 South Africa revised the concept of municipalities and provinces (Wyk & Oranje, 2014:7), and environmental aspects were partly considered with the conservation of nature reserves and good quality of life in white urban areas (Berrisford et al., 2015:4). The post- apartheid government implemented and funded over a million Reconstruction and Development Program (RDP) houses over 10 years in a programme that was initiated in 1994 (Hendler & Wolfson, 2003:12). Water provision and sanitation also became apparent in this time, with increasing consideration of the supply and demand on this resource (Department of water affairs and forestry, 2005:2).

2008, illustrates a significant uprising in the number of informal settlements in South Africa with rapid growth rates of up to 6% per annum (Hendler & Wolfson, 2003:24), this time further highlights a growing consideration of the environment and the consequences planning may have (Barrisford, 2011:256). In 2004, the Breaking New Ground (BNG) policy was formulated due to poverty and unemployment in many of the RDP projects; this new policy aimed to address locational disadvantages being faced by the poorer communities (Hendler & Wolfson, 2003:13). Spatial transformation, integrating communities of a different class, densification and enhanced public transportation was the focus of BNG housing and other innovative policies.

2006 brought the enforcement of the National Environmental Management Act (107 of 1998, NEMA). The act stated that environmental impact assessments be carried out before development could take place (Barrisford, 2011:252). The consideration of the environment and implementation of laws to protect it thus became apparent in the spatial planning profession. In 2008 food security emerged as an important factor due to the credit crisis and recession; the concept of implementing community gardens then surfaced and thus some environmental consideration was sparked (Hendler & Wolfson, 2003:19). In 2015 South Africa experienced below-average rainfall and decreasing dam levels, which initiated the consideration of water management in the spatial planning profession (Muller, 2017:1). Water supply and the effective and sustainable management of this valuable resource became increasingly important. South

Africa's current spatial planning considers the protection of the environment for the promotion of health and safety (Muller, 2017:2). Environmental conservation and biodiversity considerations have increased but are still undermined, with 57% of South Africa's river ecosystems and 65% of wetlands classified as threatened (Berrisford et al., 2015:4). Planning has shifted towards the incorporation of integrated planning approaches to resolve urban complexities. Cities are trans-disciplinary which means that different non-relating elements are combined to form a city and therefore cities require transdisciplinary planning practices (Abukhater, 2009:64-67). Plans and projects relating to the planning profession often take place on different scales which have implications on the decision-making process (Abukhater, 2009:67). Abukhater (2009:72) highlights the necessity for integrated planning approaches by stating the uniqueness of the planning profession and the need for practical planning implementation guidelines. Akindele & Asani (2017:149) state that there have been three post-world-war paradigm shifts in planning with town planning first seen as a subcategory of architecture. Planning then shifted to incorporate the consideration of the environment, economy, and social functions. Urban and regional planning once again shifted towards specialised planning, e.g., urban design and traffic planning (Akindele & Asani, 2017:150). Nilsson & Ryden (s.a.:206) state that sustainable development has become a major factor in the planning profession, and planning and management is, therefore, an important instrument in achieving sustainability.

In 2018, following South Africa's latest drought, the City of Cape Town implemented policies for the implementation of Water Sensitive Urban Design (WSUD) (Madonsela et al., 2019:1), strategies include the collection of rainwater and reusing wastewater and stormwater (Lottering et al., 2015:1). South Africa then considered the incorporation of an Environment Impact Assessment Report (EIA) and a Strategic Environmental Assessment (SEA) in the planning profession, to give planners the ability to foresee the impact of development on the environment; each large-scale plan or project is required to incorporate an EIA and SEA (Nilsson & Ryden, s.a.:216). Environmental Planning and Management (EPM) may be considered as a strategy or technique to incorporate the environment in a top-down planning approach. EPM's primary focus is to create a sustainable environment by managing natural resources and protecting the natural environment (Akindele & Asani, 2017:155). With the consideration of environmental impacts, smart cities were identified and acknowledge an ecologically friendly environment that incorporates integrated technology and transdisciplinary approaches. Smart cities are considered future solutions to planning principles. The notion of sustainability influenced a green planning paradigm and contributed to South Africa's participatory planning approach (Okeke, 2015:2). The Spatial Planning and Land Use Management Act (2013) is considered the guiding policy regarding spatial planning in the planning

profession, where the mention of water is limited to a basic right. The main focal point of this

research is WSP and it is evident that a national Water Sensitive Plan has not yet been developed.

2.3.1 Current challenges of the local spatial planning reality

The evolution of South Africa's spatial planning highlights the unique challenges the country faces regarding historical animosities and spatial layout. The main themes as identified in Chapter 1 (cross-reference Section 1.6 Table 2) are sustainability and governance. Sustainability includes climate change, natural resources, population growth, urbanisation, and urban sprawl as supported through the evolution of South Africa's spatial planning. Factors such as climate change and population growth cannot always be stopped but their effects could be mitigated through spatial planning. The second theme is governance and includes the lack of policy implementation with regard to water management and overcoming historical animosities. As mentioned, South Africa has a unique urban-rural divide because of how spatial planning was managed in the country. The following section explains these selected themes in detail.

2.3.1.1 A local perspective on sustainability

Climate change is largely due to human activity and in the case of South Africa a stable climate is not present, extreme drought is observed in one area while floods are observed in another (Jones et al., 2011:21-23, Kusangaya et al., 2013:48-50). Areas in the North West, for example, have an annual rainfall of approximately 200mm while eastern areas receive 500mm, this contributes to the unstable environment and this may only worsen with the effect of climate change (Jones et al., 2011:22-24). As a result of rising temperatures, evaporation is estimated to? increase by 40% and thus water availability will decrease by 10-30% in South Africa; it could thus be stated that if climate change continues water scarcity will increase (Kusangaya et al., 2013:48-51). With the resulting increase in water scarcity, spatial planning might have to adapt to accommodate this stress in the form of WSP. South Africa depends on the mining and burning of fossil flue to produce electricity, this contributes to climate change and creating a sustainable environment is increasingly difficult (Von Bormann & Gulati, 2014:5).

In 2004 Durban municipality implemented a Municipal Climate Protection Programme; the program implemented municipal adaption, community-based adaption and urban management implications such as the rise in sea levels, the urban heat island, water conservation and the management of stormwater runoff (Roberts et al., 2012). The urban-heat island is defined as ecosystem-based adaption (EBA), it involves the implementation of ecosystem services and biodiversity to assist the city (community) to acclimatise to climate change. EBA considers the urban environment on a detailed scale to implement unique infrastructure and comprehensive services suitable for the specific urban environment (Robert et al., 2012).

Over three million people do not have access to water in South Africa and with an increase in water stress, food security might become increasingly problematic (Jones et al., 2011:30). South Africa is a water-stressed country and water should, therefore, be managed to its full potential and rapidly increasing water demands in South Africa are not currently classified as sustainable (Webb et al., 2009:1). Water is not fully considered in the urban supply chain although it is considered as a vital resource for human survival (Goga & Pegram, 2014:4), an estimated 1.7% shortfall in water supply by 2025 and the fact that 98% of South Africa's total water supply is already allocated (Von Bormann & Gulati, 2014:5). Rand Water is considered as one of South Africa's essential water service providers, supplying 11 million people with clean water, however, with regards to sustainability, degrading infrastructure is a leading cause of bursts and leaks of pipelines (Webb et al., 2009:2-7).

With rapid population growth and urbanisation, degrading water quality and scarcities and thus degrading health, in overpopulated areas diseases such as cholera and malaria became increasingly evident (Jones et al., 2011:29-30). South Africa is currently utilising its water resources to supply municipalities, irrigation systems, electricity generation and fuel preparation. The importance of water is highlighted through food security and energy production (Von Bormann & Gulati, 2014:4). With rapid population growth comes rapid urbanisation and ultimately urban sprawl. Urban sprawl is a major issue faced by South African cities, RDP-housing is built on the periphery of cities, and in turn spatial planning approaches are influenced in these regions (Okeke, 2015:1).

As previously stated, South Africa initiated racial integration in the early 1990s, and RDP houses were then provided and urbanisation became more compelling and affordable (du Plessis, 2013:9). Wealthy citizens prefer to live on larger properties on the outskirts of cities or in gated communities because of this low-density development urban sprawl occurs (Yusuf & Allopi, 2010:416). South Africa is a developing country, and it is estimated that 50% of South Africa's population will live in cities by 2034. With a growing population of 51.8 million in 2011 (Ruhiiga, 2014:610), 60% of South Africa's population resides in metro cities (Johannesburg and Cape Town), uneven development is thus occurring, placing stress on cities and their ability to supply adequate water and sanitation (Turok & Borel-Saladin, 2014:3-4). Planning and compensating for urbanisation requires a consideration of the unique demography, as previously mentioned South Africa is experiencing urban sprawl due to locational disadvantages, this should be considered when planning developing cities and towns. Urbanisation in South Africa is largely due to job opportunities and better quality of live, high unemployment rates and a growing population forces people to migrate from rural to urban areas (Ruhiiga, 2014:610-612).

Mitigating urban sprawl is the consideration of growth and implementation of Smart growth thus,

identifying where growth should take place rather than if growth should take place (Song et al., 2002:9). The American Planning Association (2002) defines smart growth as “the planning, design, development and revitalization of cities, towns, suburbs and rural areas to create and promote social equity, a sense of place and community, and to preserve nature as well as cultural resources.” Smart growth together with local policies are not necessarily implemented to prevent urban sprawl but rather mitigate the phenomena to ensure cohesive development through spatial planning.

2.3.1.2 Local perspectives on governance

South Africa has limited data on the implementation of multidisciplinary and transdisciplinary approaches but rather focuses on integrating authorities in the decision-making process. Integrated development currently focuses on reducing carbon emissions and water incentives through The National Planning Commission (NPC) ensuring integrated decision-making (Goga & Pegram, 2014:1-5). The lack of policies and the implementation thereof is evident in South Africa, this research will thus proceed to evaluate South Africa’s legislative context and challenges faced, in the empirical investigation. The lack of investment regarding infrastructure, resource management and spatial plans demotes development in South Africa (Oranje & Merrifield, 2010:29-32). Regarding infrastructure development in South Africa inequal standards are placed in urban and informal areas; the government, however, has allocated funds towards housing projects and infrastructure improvement; although financing gaps are still observed (Hagerman, 2012:5-9).

Spatial transformation is emphasised in South Africa, through the improvement of desirable geographic areas and the stagnation of undesirable locations (Joseph et al., 2016:44), this implies that privileged communities are developed while underprivileged communities are underdeveloped. South Africa is still facing some spatial planning challenges due to Apartheid and historical planning approaches, spaces reflecting inequality are visible in the locations of townships and low-cost housing. A locational disadvantage is a key challenge faced in South Africa, integration is thus needed in metropolitan areas to improve economic efficiency and quality of life (Todes et al., 2010:416). As a result of South Africa’s history and dependence on the mining industry sustainability was not considered as a priority (Von Bormann & Gulati, 2014:3) however, South African companies have started implementing the notion of sustainable development and shifted their focus from profit-orientated to environmentally orientated as a result of intense condemnation for environmental and social problems (Groenewald & Powell, 2016:1-3). To achieve a sustainable and resilient environment new form of communication and a new agreement on fair and impartial access is needed (Von Bormann & Gulati, 2014:3).

South Africa has increased its efforts to integrate communities, but segregation is still visible with regard to township placements, and most of the working class are still living kilometres away from their work environment (Turok & Borel-Saladin 2014:1-3). Integration strategies include functional integration and socio-economic integration; functional integration require that 50% of urban activities be located within walking distance from residential areas, while social-economic integration considers financial and community aspects (du Plessis, 2013:9). In Johannesburg, one of South Africa's major cities, the middle-class and upper-middle-class have become increasingly integrated (Hendler & Wolfson, 2003:13), residing in gated communities or secure suburbs. Swilling (2010:230) argued that not only are townships that are being places on the peripheries of towns but also the lower-middle-class as seen in Cape Town. Property value and cost has drastically increased and living near the CBD has become unaffordable for most South Africans. The South African national government is strongly considering and implementing spatially rebalancing the country, this involves the promotion of economic equality in terms of location (Todes & Turok, 2018:4). Reconstruction strategies were ordered through the NDP to promote the redevelopment of informal areas and decrease the urban-rural divide (du Plessis, 2013:9). Locational disadvantage's negative effect is urban sprawl and is caused by the placement of informal beyond the urban periphery (Yusuf & Allopi, 2010).

South Africa has experienced a decrease in economic growth and tourism, and transportation is considered as the most critical issue with a significantly high cost (Kruger & Luke, 2015:2) partly because of locational disadvantages. South Africans are dependent on cars as a mode of transportation and this leads to higher land demands for roads and parking spaces, thus transportation and land use patterns are considered as interdependent (Yusuf & Allopi, 2010). In 2015 South Africa promoted a month car-free festival to encourage its citizens to consider different modes of transportation in the city of Johannesburg but this did not become an annual event (Kruger & Luke, 2015:2). South Africa mainly considers three modes of public transportation namely the Gautrain, taxi, and the traditional commuter railway (Walters, 2014:1). The advancement of railway development was highlighted in 2015 with the increasing development of the Gautrain to relieve traffic and stress placed on roads (Kruger & Luke, 2015:2). Over the past thirty decades South Africa's government has produced policies and strategies dedicated to the development of public transportation, unfortunately not much has changed, the lack of spatial consideration concerning public transportation proves challenging to the spatial planning profession (Walters, 2014:1).

2.4 Conclusion of Chapter 2

The objective of Chapter 2 was first to identify how South Africa's water crisis originated from a spatial planning perspective. Climate change was highlighted throughout the current chapter and could thus be identified as a culprit for South Africa's water crisis. Furthermore, the location of

South Africa's water sources might lead to an inefficient supply of water. A growing population paired with the previously implemented Apartheid model is also suggested as problematic. As previously mentioned, South Africa was dependant on its mining industry which consumed most of their water supply. From a spatial planning perspective urbanisation trends might also be an cause of South Africa's water crisis as cities are expanding further away from water sources which in turns leads to water losses.

The second part of the objective was to highlight the importance of transdisciplinary planning approaches. Firstly, the creation of garden cities promoted the integration of urban areas and that of rural areas, as a result, farmers (professionals) were forces to integrate with the public, research, and other professionals such as urban planners. Although Garden cities are not classified as transdisciplinary approaches it is a classic example. The notion of sustainability and social integration also promoted transdisciplinary as the public, professionals and research were forced to work together. Throughout the evolution of global and South Africa's spatial planning hints of transdisciplinary planning, approaches are observed, this substantiates the importance thereof. It could be said that transdisciplinary planning approaches lie at the heart of many spatial planning approaches such as sense of place, Smart Growth, urban design and assessments like EIA and SEA. A case study conducted in Switzerland about the utilisation of a piece of land without compromising its potential highlights the importance of transdisciplinary planning approaches (Stauffacher et al., 2008:412). The case study offers three major arguments for the implementation of transdisciplinary approaches: normative, instrumental, and substantive (Stauffacher et al., 2008:109). Normative suggests that people know their own needs, instrumental implies that community input will secure trust with regards to policy development while a substantive focus on educating the public (Stauffacher et al., 2008:409-410). Said case study concluded that an ideal design was found, through the implementation of a transdisciplinary planning approach, that is both practical for the community and the development of the region. The benefits of transdisciplinary approaches are the creation of partnerships between sectors, team building and building trust between the communities and the newly formed partnerships (Tejada et al., 2019).

The evolution of the global spatial planning profession and South Africa's planning profession are similar in the way that they evolved but the timeline and challenges differ slightly. This is illustrated in Table 5 below, while the consideration of water resources started in 1972 in a global sense, South Africa started considering the resource in 1994. The global and local spatial planning profession placed high importance on the water in the 21st century, this highlights the current importance of considering water and the management thereof in a spatial planning context. Similarities in spatial planning complexities and challenges were identified and may thus be considered as accurate and important in the spatial planning profession.

Table 5: Comparison of spatial planning timelines

Comparisons	Global SP	South Africa's SP
Major timeline events	18th Century: Industrial revolution 1917: Formalisation of planning 1972: Conservation of water resources 21st Century: Sense of place, public participation, and sustainable cities	19th Century: Segregated housing The 1920s: Apartheid model 1994: RDP housing, municipalities and provinces, water, and sanitation 2015: Rise of water management

Table 6 offers a comparison between global spatial planning challenges and South Africa's spatial planning challenges. The table was derived from the above identifies spatial planning challenges as illustrated in Table 1 and Table 2. Population growth, urbanisation and urban sprawl are all increasing on a global and South African scale. Globally natural resources are protected but still overused as resources such as water is a necessity. Sustainability and the protection of the natural environment are strongly observed in South Africa. This suggests that South Africa is considering global trends with regard to sustainability to contribute to 'saving' the earth. With regard to governance a lack of policy implementation is observed on both levels but so is an increase in innovation. Professionals are considering transdisciplinary planning while illustrating innovative planning solutions.

Table 6: Comparison of spatial planning challenges

Global spatial planning	South Africa's spatial planning
Sustainability: Population growth, urbanisation, urban sprawl, and climate change is increasing**.** Natural resources are protected but overused. Sustainability is implemented on a large scale (cross-reference Section 2.2.1.1).	**Sustainability:** Population growth, urbanisation, urban sprawl, and climate change is increasing. Natural resources are protected but overused. Sustainability is considered but not necessarily implemented. (cross-reference Section 2.3.1.1).

Governance: There is a lack of policy implementation, innovation is increasing (cross-reference Section 2.2.1.1).	**Governance:** There is a lack of policy implementation, struggling to overcome historical animosities, innovation is observed (cross-reference Section 2.3.1.2).

This section served as an introduction for global and local WSP and highlighted how the planning profession has evolved to consider natural resource. Chapter 3 will illustrate the evolution of WSP and its challenges, the second objective of considering the notion of WSP and evaluation of the opportunities for South Africa is then achieved. Local spatial planning has evolved from segregated planning into a more holistic approach, the integration between communities (and rural and urban areas) increases equality and the evolution of inclusive planning principles. Spatial planning thus influences how water is considered from a planning perspective; when the spatial planning challenges of an area is known water may be planned accordingly. This research aims to illustrate the link between spatial planning and WSP to ultimately offer local solutions and promote the consideration of WSP.

CHAPTER 3 THE EVOLUTION OF WSP

3.1 Introduction

WSP is perceived as a tactic to achieve sustainable development through the integration of water resources and urban and regional planning (Carmon & Shamir, 2010:1). WSP encourages sustainable development and public participation. WSP is a sub-section of WSUD and promotes the integration of the urban water cycle while protecting the environment (Armitage et al., 2014:5).

As previously stated, the consideration of global and local spatial planning served as an introduction to WSP and the challenges faced in implementing this planning method. Chapter 3 includes an explanation and timeline of WSP on a global and local scale and thus includes the evolution of South Africa's WSP to achieve the second objective of this research: To consider the notion of WSP and the opportunities for South Africa. This serves, in conclusion, to understand WSP in South Africa and highlight lacking aspects in the planning profession regarding water management. The goal of this chapter is to understand the origins and driving factors of WSP in the planning profession globally and locally as an introduction to the empirical research to be conducted for this research. WSP in South Africa might be driven by international trends as it is a new approach and the consideration thereof is thus necessary. Figure 8 explains the proceedings as mentioned.

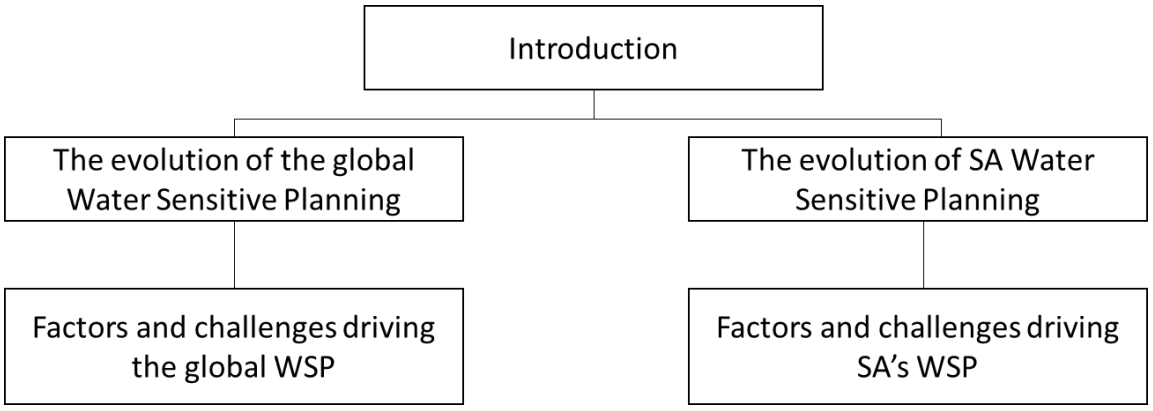


Figure 8: Breakdown of Chapter 3

3.2 The evolution of WSP

Figure 9 illustrates a timeline of major events in the evolution of global WSP, the diagram highlights key events that lead to current WSP and water management trends. As will be further discussed, the acknowledgement of a global dark period in the 1980s relating to water management is included to better understand why the notion is not as evolved. The highlighted selection is identified as a major breaking point in global WSP and will be used in conclusion to compare South Africa's

evolution. The evolution of global WSP is included to better understand WSP and the applications thereof.

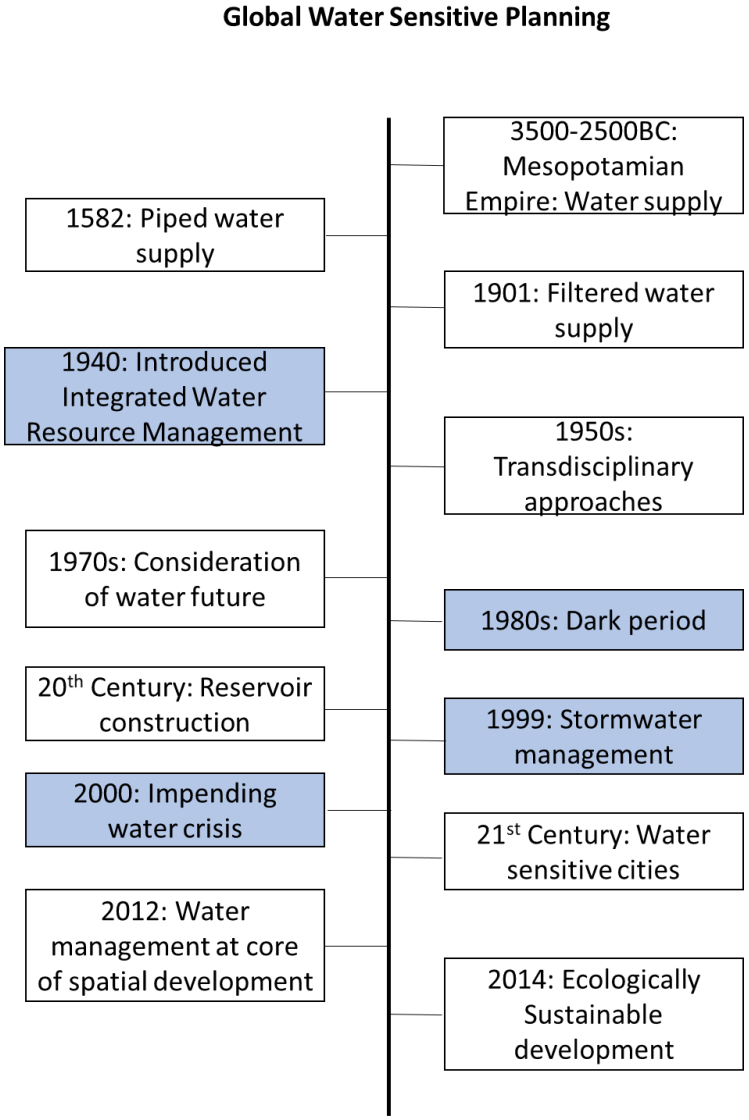


Figure 9: Global WSP Evolution

6000 to 7000 years ago rural villages developed into towns, the early human civilisations known as the Mesopotamian Empire (3500-2500 BC) were confronted with the challenge of supplying adequate water quality and therefore settled near rivers, when the supply bodies became inadequate civilisations would migrate (Cassardo & Jones, 2011:620, Lofrano & Brown, 2010:5256). The Neolithic age brought with it the first successful efforts to manage water through the construction of dams and irrigation (Angelakis & Zheng, 2015:456). Agriculture was developed and the need became greater to manage the supply of water (Cassardo & Jones, 2011:620). The Roman period introduced stormwater management and the increased consideration of water supply (Lofrano & Brown, 2010:5256-5257). Urban water supply and sanitation thus made its

debut in the Bronze age and the first records of water management were from 2725-2671 BC (Lofrano & Brown, 2010:5256-5257, Angelakis & Zheng 2015:456). Large scale hydro-projects were observed 700-200 BC because of population growth, higher irrigation demands and enhancement of power, these projects included the construction of dams and canals (Angelakis & Zheng, 2015:456). Integrated Water Resource Management (IWRM) dates back centuries with the industrialisation and management of water noted in Spain in the 10th century (Rahaman & Varis, 2005:15), but was only named and formalised later. The Spanish used a form of IWRM to transport their water with the help of bridges and pipes but the formalisation of IWRM occurred in 1992.

In 1582 piped delivery supply was introduced by a privately-owned company (Tynar, 2012:3). During the turn of the 19th century piped water supply was evident in London, the water, however, was unfiltered and of low pressure, by 1901 95% of the population received filtered piped water supply at high pressure (Tynar, 2012:2). The early 1990s was identified as the starting point of water governance at the Dublin Conference and throughout the 20th-century water, governance developed rapidly on a regional and local scale (Cooley et al., 2013:10). At the Dublin Conference, increasing water scarcities and the use of water was discussed along with the need for a holistic approach towards water management.

In 1940 the early concept of IWRM was presented in Tennessee Valley (Rahaman & Varis, 2005:15). During the 1950s the notion of transdisciplinary approaches to water management was introduced by creating an intellectual space where engineers, scientists and water managers could share information and findings to find sustainable solutions for emerging water challenges (Cooley et al., 2013:12). Germany implemented improved IWRM notions in 1960 through multidisciplinary integrated planning approaches (Rahaman & Varis, 2005:15). The concept of binding numerical values to water to display the quality thereof was implemented in 1965 and the importance of water quality increased (Lumb et al., 2011:11). In the 1970s the notion of water balance and estimations of future water withdrawals were developed and published by distributing water withdrawals into grid boxes with population and irrigation distributions and contributing factors (Oki & Kanae, 2006:1069).

The 1980s brought with it a dark period for water management with its disappearance from political agendas during this timeframe, but in 1990 the situation improved as a result of several conferences for creating awareness on water management (Rahaman & Varis, 2005:15). The emphasis on the importance of freshwater was placed in 1992 at the Earth Summit and relevance on the topic increased in popularity (UNEP, 2016:1). The impacts of large dam constructions on an environmental and social level were identified in the late 1970s and yield in development was observed (Cooley et al., 2013:11). During the 20th century, the construction of reservoirs

increased rapidly, and by the 1980s 30 000 reservoirs were constructed worldwide with a combined volume of approximately 1 million m3 (Shiklomanov et al., 2003:7). In the 1990s Water Sensitive Urban Design (WSUD) was introduced in Australia and evolved from stormwater management as main focus to include the protection of the environment and water quality in the early 2000s (Fletcher et al., 2015:526). 1992 highlighted the need for improved water management and the first academic mention Integrated Water Resource Management (IWRM) was recorded (Cooley et al., 2013:11). Institutions were not equipped to implement IWRM at the time, but academics agreed that IWRM is the future with regards to water management (Rohr, 2019:46). In 1997 to 1998 the book Long-Term Vision for Water, Life and Environment in the 21st Century, was planned and prepared to create awareness around water as a resource (Cosgrove & Rijsberman, 2000:4). In 1999 stormwater quality management was introduced but the notion was not considered mandatory, sustainable approaches thus made headway and were considered important to the new generation of water professionals and thus WSP approaches (Wong, 2007:8).

Traditionally and before the 21st-century water management considered controlling water and predictability, however, a growing population and urban pollution have increased the difficulty of managing and predicting water in current times (Brown et al., 2016:6). The development of Water Sensitive Cities was introduced as a form of managing urban water sustainably, the implementation of this notion may prove challenging but is also deemed necessary (Brown et al., 2016:7). The 21st century introduced a tripled population and the use of water multiplied six-fold, water use for human activity includes but is not limited to residential use and industries. Generation ndustries, however, uses twice as much water as household in the cooling process of the production of electricity (Cosgrove & Rijsberman, 2000:2).

In 2001 the lack of water related staregy implementation and policy development was identified, action programs were suggested to improve implementation and sustainability and water objectives were then merged (Rahaman & Varis, 2005:17). In 2000 the world was facing an impending water crisis with many countries already confronting water challenges, 1 billion people lacking access to drinking water and half of the world's wetlands were destroyed (Cosgrove & Rijsberman, 2000:1-4). Water governance was identified as the highest priority for action in 2000 and thus the Water Development Report was established (Cooley et al., 2013:10). The year 2000 was bestowed the theme of 'plan to action', privatisation was opposed by several planning professionals and government presence was demanded (Rahaman & Varis, 2005:17). WSUD increased in relevance in 2000 with innovations in the field of water management (Wong, 2007:1). According to Armitage et al. (2014:3), planning professionals are often site focused and may not consider the broader system, WSUD was thus considered as a

transdisciplinary approach and WSUD projects are conducted on a variety of scales. WSP and WSUD are currently dealt with separately by different professionals, however, the WSUD approach requires a simultaneous consideration which in turn promotes transdisciplinary approaches (Armitage et al., 2014:8).

Carmon & Shamir (2010:2) identified the evolution of WSP in the planning profession as creating common goals and means, integrating research approaches and methods, interdisciplinary approaches, integrating levels of planning and integrating research and implementation aspects. Little to no integration between disciplines and research approaches were identified, this caused a setback in identifying sustainable solutions seeing that each profession was creating their own research. Stormwater infrastructure were previously designed to mitigate flood risk through drainage management, however over the last 30 years Ecologically Sustainable Development (ESD) was introduced and professionals realised that there was a need to manage the urban water cycle, water was now implemented in city designs and innovative concepts to reduce runoff and improve rainwater harvesting (Tjandraatmadja et al., 2014:1, Wong, 2007:1).

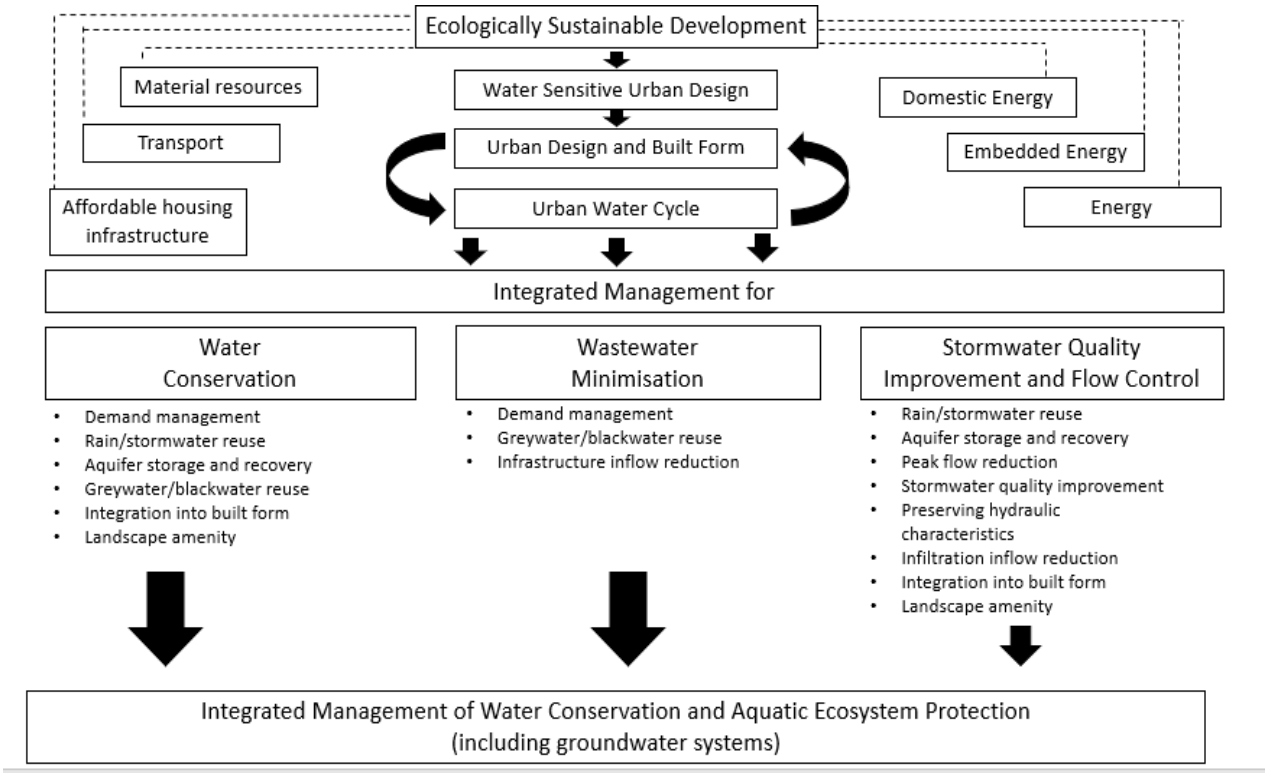


Figure 10: Ecologically sustainable development

Source: Tjandraatmadja et al. (2014:1)

Ecologically Sustainable Development is an integration of WSUD and water cycle management, Figure 10 as developed by Tjandraatmadja et al. (2014:3), depicts the interaction among the built environment, water cycle management, energy flow and material to create a framework for

sustainable water conservation. The planning profession has evolved from little consideration of conservation and stormwater management to the realisation of its importance in the planning environment (Lottering et al. 2015).

Carmon & Shamir (2010:1) identified the goals of WSP as the improvement of the planned environment, reducing the negative impact of stormwater, supplementing water resources and improving their quality, and cost-effectively conserving the environment while promoting public participation. WSP thus incorporates environmental, social, and economic goals in synergy and aims to achieve a healthy and sustainable urban environment. These principles were implemented to protect urban food supply and human health, but current water systems are being placed under pressure by increasing population and urbanisation, ageing infrastructure, climate change and capacity constraints (Sharma et al., 2016:1). According to Sharma et al. (2016:1) large-scale centralised water, stormwater and wastewater systems have been implemented for 100 years.

3.2.1 Current challenges of global WSP approaches

WSUD and WSP consider the implementation of water conservation and stormwater management on local, precinct and regional scale. The challenges of managing water sustainably and in a sensitive manner includes the consideration of water conservation and stormwater management. Table 7 highlights the implementation of water systems in the planning environment (Wong, 2007:5). Through the integration of the three water systems in the urban environment, water supply, wastewater and stormwater, integration of WSP and urban design could be achieved (Wong, 2007:3).

Table 7: Implementation of water systems in the planning environment on different scales

Precinct	Local	Regional
Planning		
• Local street layout.	• Allotment density and layout.	• Major road layout. • Public open space and multi-use corridors.
Water Conservation		
• Stormwater storage/pond. • Aquifer storage and recovery.	• Rainwater tank.	• Stormwater storage/pond.

		• Aquifer storage and recovery.
Stormwater Quality		
• Precinct-wide infiltration basins. • Porous pavement. • Sand filters. • Bio-retention swales. • Bio-retention basin. • Vegetated swales. • Urban forest. • Constructed wetlands.	• On-site retention (infiltration). • Porous pavement. • Sand filters. • Bio-retention planters. • Rain garden. • Vegetated buffer.	• Riparian buffer. • Natural channels. • Urban forest. • Constructed wetlands.
Stormwater Detention		
• Retarding basins. • Ponds.	• On-site detention.	• Retarding basins. • Lakes.

Source: Wong (2007:5), Oki & Kanae (2006:1068), Carden et al. (2018), Rohr (2019:26)

Population growth, urbanisation and industrialisation are considered to increase water demand and should, therefore, be considered WSP challenges (Rohr, 2019:26). Challenges identified in the water sector include water availability (supply), water quality, water scarcities and climate change (Cooley et al., 2013:4-9, Wong, 2007:1). The research acknowledges that the mentioned challenges are not the only challenges relating to global WSP. A methodology is provided in Chapter 1 explaining the thought process in acquiring these challenges (cross-reference Section 1.6). Compiling all the known global WSP challenges would prove impossible as each country has unique difficulties, Table 3 is constructed to provide a general idea most countries could face to understand the notion of WSP (cross-reference Section 1.6 Table 3). This process might result in identifying overlying trends that might assist South Africa in its quest for achieving WSP. The identified thematic challenges include water quality, water quantity, water conservation, governance, and planning.

3.2.1.1 International perspective on water quality

Annually approximately 3-4 billion people die of water-borne diseases (Cosgrove & Rijsberman, 2000:6), growing pressure on the world's water resources has resulted in degrading water quality and thus increasing the cost of water treatment (Cooley et al., 2013:1). The impacts of

rapid population growth, urbanisation and industrialisation were identified as degrading water quality throughout the globe, water demand thus increased, and water supply became increasingly challenging (Cosgrove & Rijsberman, 2000:4 & Vörösmarty et al., 2000:284). As previously mentioned, the importance of freshwater was highlighted in 1992, water quality, however, only received the same recognition twenty years later in 2012 (UNEP, 2016:1). The notion of creating a water quality index (WQI) was introduced in 1965 but received a diminutive acknowledgement by professionals, the WQI gained importance and is now used in environmental assessments (Lumb, 2011:12). Water quality is directly linked to the health of humans, 70 to 90% of the total population in some regions rely on surface water as their main source of water, ingesting of contaminated water may lead to serious health issues and in some cases death (UNEP, 2016:3). The causes of water pollution include, but are not limited to, rainfall, runoff, leaching and temperature from the Earth's core, human activity naturally contributed to water population through the expulsion of waste products (UNEP, 2016:4).

3.2.1.2 International perspective on water quantity

The availability of water on Earth is approximately 1.386 million cubic kilometres, however, primary human activity such as households, agriculture, recreational and environmental activities entail the use of freshwater (Cassardo & Jones, 2011:621). Primary freshwater on earth is stored in glaciers and ice sheets and it is estimated that 3.0 million km3 of freshwater is stored in Antarctica (Shiklomanov et al., 2003:14). An evaluation on freshwater availability stated that between 1960 and 1997 a 60% decline is evident on freshwater worldwide per capita (Cassardo & Jones, 2011:622). Uneven distribution of the world's freshwater is a key characteristic of freshwater availability, and therefore a supply-side or engineering approach was followed through accommodating humans by supplying water to desirable areas (Cosgrove & Rijsberman, 2000:6). Earth is commonly referred to as the 'Blue Planet' and the lack of water availability is thus ironic. Appropriate water management should be considered for the protection of water as a vulnerable resource (Oki & Kanae, 2006:1068). Water used for human consumption is divided as follows; agriculture 70%, industries 20% and 10% direct consumption (Zhuwakinyu & Creamer media, 2012:5), food and energy production can, therefore, be identified as vital for human survival and this cannot be accomplished without adequate water availability.

Water demand is defined as the the ratio of water that is withdrawn, a local water stress index is identified through the ratio which the population interacts with sustainable water supply (Vörösmarty et al., 2000:284). Figure 11 illustrates the level of water stress each country will face by 2025, areas of the low population will naturally face less water stress than higher populated areas, half of the world's population will reside in countries experiencing water stress (Cosgrove & Rijsberman, 2000:28, Vörösmarty et al., 2000:284).

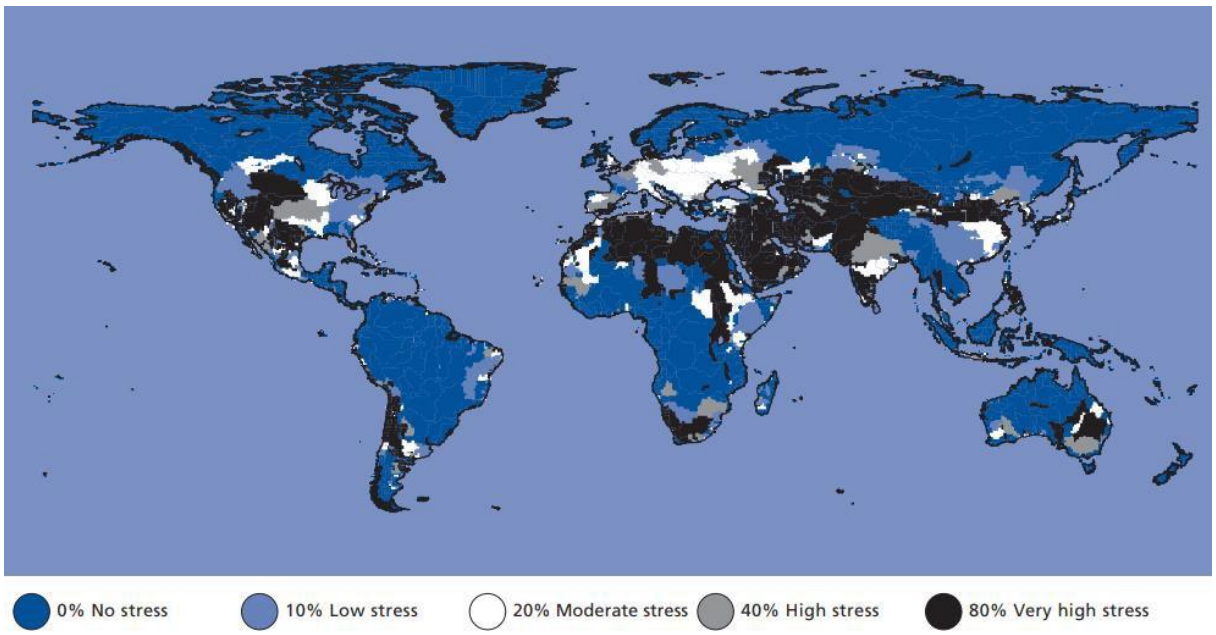


Figure 11: Water stress map in 2025

Source: Cosgrove & Rijsberman (2000:28)

Water demand on an industrial and domestic level is determined by the population and thus increases with the population (Vörösmarty et al., 2000:284). Water availability contributes greatly to the production of food and energy but on a global scale the world is not water-secure and water demand has already surpassed the supply thereof in many countries (Zhuwakinyu & Creamer media, 2012:3).

3.2.1.3 International perspective on water conservation

Freshwater is identified as green or blue water; green water is primarily identified as rainwater while blue water is considered as surface runoff and groundwater (Cosgrove & Rijsberman, 2000:6). An estimated 10% of blue water (renewable freshwater resource) accounts for the maximum availability of the total renewable freshwater that is extracted by humans per year and due to evaporation approximately 30% of the available resource is used (Oki & Kanae, 2006:1068). A 10% and 30% use of availability may be considered insignificant and water scarcities unlikely, but high variability and uneven spatial distribution increase the vulnerability of water resources and it is thus considered impractical to use 100% of the available resource (Oki & Kanae, 2006:1068-1069). Water losses through infrastructure is a common challenge faced by many countries, water is lost through leaks and bursts, and this greatly contributes to water scarcities. The notion of sustainability and Sustainable Drainage System (SuDs) suggests rainwater harvesting and the implementation of swales and buffers to mitigate and utilize stormwater and runoff in an attempt to conserve water. As stated in the evolution of WSP the conservation of water through sustainability is gaining importance but is not implemented worldwide.

3.2.1.4 International governance of water planning approaches

Professionals such as engineers, planners, the government etc. consider WSP and related? challenges individually, this creates slow progress in the innovative field of WSP. The responsibility of WSP is disregarded, and this contributes to professionals placing little focus on the development of areas from a water-related perspective. Multi-Level governance of water is necessary, water and water planning characteristics stretch from private to public stakeholders (OECD, 2014:1). Figure 12 illustrates a multi-level governance framework and, ultimately a method identifying and bridging gaps in the governance of water.

Figure 12: Multi-level governance

Source: OECD (2014:2)

When responsibility is taken for the governance of water, WSP may gain momentum and implementation. The responsibility of water planning shifts from governmental management to private management. Private professional carry little weight regarding the decision-making process. The lack of communication between the spheres of government and professionals are considered as a silo-approach.

3.2.1.5 International perspective on water planning

Stormwater management is considered as a WSP challenge because of its relation to runoff and the management thereof in the urban environment. Stormwater has a complex relationship with the urban environment, and they are considered naturally incompatible. In the

consideration of natural stormwater infrastructures such as rivers and wetlands, the urban development area is decreased (Rohr, 2019:26). Urban development is restricted, and a choice should then be made between the protection of natural stormwater agents or the development of cities and urban areas. In developed counties, stormwater is traditionally managed to combine rainwater and sewage into one pipe to be treated (Rohr, 2019:27). This results in unnecessary treatment and high volumes of generalised treatment. The obvious solution would be to implement separate sewage systems, but challenges are still present. Separate systems divide stormwater or runoff into one pipe and sewage into another, but stormwater is then released into the natural environment without any treatment (Rohr, 2019:27). This might not seem problematic but depending on where the stormwater originated from high levels of natural and unnatural pollutants may be present.

As previously mentioned, a goal for WSUD is the management and re-use of wastewater and stormwater, this implies that stormwater management is considered a challenge in the consideration of WSP and a different approach is needed (Lottering et al., 2015). Flood protection and creating water-friendly and sustainable urban environment are goals when considering WSP. Over the last two decades new stormwater approaches have been developed in several countries without communications between the countries, all these countries incorporated sustainability as the primary goal, although the motivations for these approaches vary in almost every case (Carmon & Shamir, 2010:1). Australia is identified as an innovator in the field of stormwater management but Carmon & Shamir (2010:2) state that landscape architects, drainage engineers and planners have contributed to stormwater solutions, but largely in their fields and only recently started to partially integrate their research. The management of stormwater contributes greatly to flood control and innovative countries such as Australia have an extensive history in renewing and reusing stormwater (Porse, 2013:31), stormwater management assists in the conservation and recycling of water resources. Sustainable stormwater management ultimately regulates streamflow, groundwater, and water quality (Pocone Northeast Resource Conservation and Development Council, s.a.:7), WSP could benefit from increased water availability and flow as previously stated. WSP considers all forms of water resources that affect the urban environment, stormwater management and thus runoff are perceived as an important part of urban areas and the management thereof may support WSP in achieving sustainability. Surface runoff was traditionally considered undesirable and the primary goal was a hasty removal and aversion of surface water (Boller, 2004:55). Stormwater management is primarily implemented to promote public health and reach economic and environmental sustainability in urban areas (Porse, 2013:29). Stormwater impacts natural streams and urban ecosystems through runoff, stormwater management thus prioritises flood risks and water pollution, while modern urban water management highlights the importance of

integrated approaches to ensure social and environmental sustainability (Walsh et al., 2016:1).

Identified and tested approaches include compact development, low impact development, increasing housing densities and limiting imperviousness (Carmon & Shamir, 2010:2). From the 20th-century stormwater management has been implemented through, treatment facilities, storm drains and basins, currently, innovative approaches and technologies are implemented to manage runoff and the pollution thereof (Porse, 2013:29). Combined sewer systems were previously thought the answer to managing stormwater effectively, through the separation of wastewater. The reuse of wastewater and stormwater is currently implemented to manage stormwater efficiently (Boller, 2004:55). The Pocono Northeast Resource Conservation and Development Council (s.a.:5) states that stormwater management largely manages runoff, runoff usually flows into the nearest river, lake, or wetland, however, as development increases so does the amount of runoff, in urban areas this may prove to be problematic. The European Commission (2013) defines Green Infrastructure as: “a strategically planned network of high quality, natural and semi-natural areas with other environmental features, which is designed and managed to deliver a wide range of ecosystem services and protect biodiversity in both rural and urban settings.” The challenge of planning water in an eco-friendly and sustainable manner is one not frequently discussed, this research aims to highlight the importance of innovation and new perspectives. GI is not only implemented for the achievement of WSP but while identifying WSP challenges, as previously stated, it is suggested that the lack of GI implementation contributes towards the lack of WSUD and WSP in an urban environment.

GI has a combination of social, environmental, and economic goals that require an adjustable framework for planning, evaluating, and implementing (Chini et al., 2017:1). Is it suggested that GI could improve urban planning because it considers an all-inclusive approach to complex social-ecological systems (Harens & Pauleit, 2014:516). Cities are constantly growing, evolving and adapting, as a result of population growth and urbanisation, cities have struggled to maintain their sustainability and thus planning with the consideration of water. Connectivity and multifunctionality are fundamentals when considering GI, multifunctionality means that socio-economic and ecological factors are taken into consideration and not left to chance (Harnes & Pauleit, 2014:518). The challenge is the implementation of GI planning and reaping the benefits thereof especially regarding WSP.

GI considers the conservation value, growth management and infrastructure planning of a space which offers a more comprehensive approach to open space planning (Lafortezza et al., 2013:1) and long-term value. There are multiple definitions for GI, but all agree on the that it is a system (Chini et al., 2017:3), definitions may also vary depending on the focus point of a study. GI could be used as a solution in key water management challenges such as water supply management, water quality regulation and moderation of extreme events (Bertule et al., 2014:14- 15). GI not only considers open spaces such as parks but identifies a function such as recreation as well as the service it provides (Harens & Pauleit, 2014:519). As previously stated, GI planning also considers the economic aspect and value of spaces of infrastructure, this results in an all- round beneficial factor to consider in the strive for effective WSP.

GI in terms of WSP has a focus of considering ecosystem-services in development. Ecosystem-services are thought to improve the multifunctionality already created by GI and is thus suggested that GI and ecosystem-services be integrated to create the most effective framework (Harens & Pauleit, 2014:525). Urban areas are implementing GI to mimic a natural environment through the implementation of green roofs, restoring, conserving, and enhancing the natural environment (e.g., trees and wetlands), GI could be considered as a WSP challenge as a result of their interdependent relationship (Kramer, 2014:1). These concepts aim to manage water efficiently, there are, however, few implementations on a large or regional scale. Bertule et al. (2014:15) argue that the management of wetlands and the reconnection of rivers to their dams might improve regional WSP and ultimately address the challenge of implementing GI for the promotion of WSP. Examples of GI include but are not limited to green walls, natural areas, green roofs, wildlife, amphibian and riparian and could also be merged with planning when ecological corridors and wildlife overpasses are considered (Civic & Siuta, 2014:8-9).

3.3 The evolution of South Africa's WSP

Through the consideration of global WSP, trends were identified to better understand South Africa's method regarding WSP. As previously stated, South Africa's spatial planning trends and challenges were identified as an introduction to this section, through the understanding of South Africa's implementation of spatial planning similar challenges may arise regarding WSP. This section is offered as an outline of WSP theory in South Africa to provide information of the local challenges faced, these challenges are then compared with the perspectives of local planning professionals in the empirical investigation to ultimately offer recommendations regarding the implementation of WSP in South Africa.

Figure 13 illustrates South Africa's WSP evolution as explained below, key events are highlighted for an improved understanding of South Africa's unique development. The aim is to compare the

global evolution of WSP to the national evolution to identify the leading party and trendsetters. Although South Africa is a unique country it could still benefit from the experiences of others.

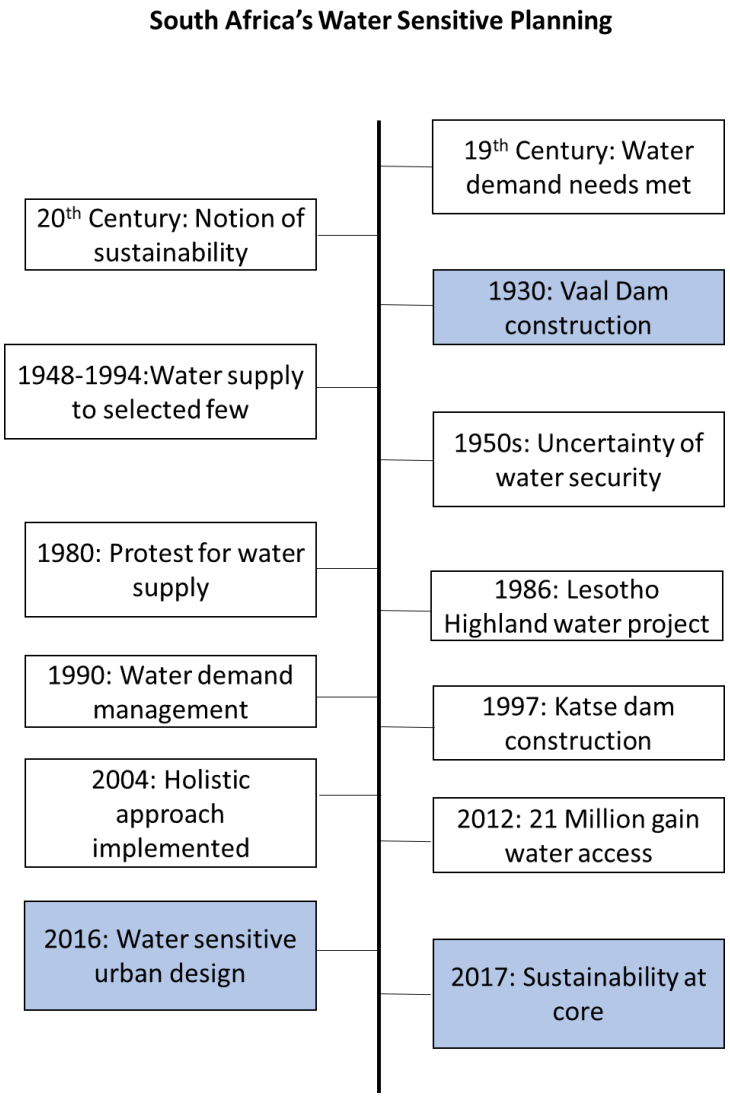


Figure 13: The evolution of South Africa's WSP

In 1800 the British established a colony in South Africa, land was allocated accordingly, and natural rights were attached to these lands. This means that landowners also owned the natural resources on that land e.g., rivers and dams (Rohr, 2019:34). A Special Water Court was founded to manage water resources and sanitation through the allocation thereof to representatives in towns and cities (Rohr, 2019:34).

South Africa possesses a variety of discrepancies in rainfall patterns and quantities; therefore, the management and storage of water have been placed on high regards from colonial times (Earle at al. 2005:3). During the 1900s and even before that Southern Africa have met their demand needs through dependency on rainfall for irrigation and livestock needs (Claasen,

2013:326). The twentieth century brought with it international trends of sustainability and South Africa introduced a modern approach to agriculture, water demands increased (Claasen, 2013:326), and the Great Depression in 1930 emphasised the need for large scale infrastructure development. The Vaal Dam and Vaalharts Government Water Scheme were developed to provide industries and farms with water for food and development security (Earle et al., 2005:8). Water was used to stimulate economic growth through its role in the mining and agricultural sectors and thus responsible for a large portion of South Africa's development in the 20th century (Earle et al., 2005:5).

From 1948 to 1994 under apartheid regime water policies were written to advance the needs of a selected few, a small portion of the population was identified as advantaged and in 1994 after the first democratic election took place South Africa was left with 12-14 million people without adequate water provision (Earle at al., 2005:3). The previously disadvantaged portion of the population was situated in homelands with water shortages, the consideration of water management and managing the supply and demand of water increased in relevance and importance after the majority of the population suffered as a result (Earle at al., 2005:3).

In the 1950s water demand management was implemented through the Orange-Fish river transfer scheme as an effort to warrant water security in South Africa (Earle et al., 2005:7). In 1956 the Water Act No 54 of 1956 was created to replace the Irrigation and Conservation of Water Act created in 1912 (Rohr, 2019:40). In 1970 water availability gained importance and a warning was issued to highlight the consequences of water shortages (Rohr, 2019:41). Water Demand Management (WDM) was introduced through water conservation in urban areas by managing pressure control and leaks, implementing individual metering, and reducing urban plot sizes (Rhor, 2019:41). Water was regarded as a form of power and influence and could thus be used to manipulate the community (Earle at al., 2005:3), and during the 1980s and 1990s black South Africans protested the limited supply and quality of water received in rural areas. But in 1994 with the enlightenment of democracy water services were mandatory for all South Africans (Earle at al. 2005:3-4, Claasen, 2013:328). The political unrest in South Africa along with the most intense drought South Africa has ever faced intensified the effects of water shortages. In 1986 the Lesotho Highlands Water Project was implemented, and South Africa shifted a focus towards water conservation and securing water resources for future generations (Earle et al. 2005:7). The Katse Dam was constructed in 1997 and the Mohale Dam in 2002 (both part of the Lesotho Highlands scheme) to ensure the supply of water to Johannesburg, which was rapidly expanding (Claasen, 2013:326). It was then discovered that the construction of dams damaged ecosystems to a large extent and dam construction was no longer the focus of water management (Rohr, 2019:40).

Monitoring the quality of water in South Africa was introduced in 1998, gathering information on water resources gained importance and the need for sustainable water management became increasingly evident (Stats SA, 2005:1). In the 1990s a global paradigm shifts in water resource management took place, the engineering supply solutions were replaced with demand management to create sustainable solutions for current issues (Claasen, 2013:327). In 1997 the Water Service Act 108 of 1997 was constructed and confirmed the Constitution's desire to provide everyone with clean drinking water and placed the responsibility on local governments to provide water according to their jurisdiction (Rohr, 2019:50). Local Government was defined as Water Services Authorities and a Water Services Development Plan was presented that combined environmental, technical, financial, social, and institutional planning (Rohr, 2019:50). The National Water Act was introduced with effect in 1999, the act aimed to incorporate IWRM at its core and emphasised the relationship between the environment and water resource management (Rohr, 2019:50-51). In 2009 municipalities' concerns about water quality grew and providing improved water quality gained importance, and between 1994 and 2012 approximately 21 million people gained access to improved water sources (Rivett et al., 2013:409).

The Department of Water Affairs and Forestry (2004) stated that effective water management should be achieved from a holistic perspective, the process for creating IWRM then started in South Africa, quite a long time after it was globally acknowledged. Water is a basic human right and one of the most vulnerable resources, not only in South Africa but worldwide. To mitigate the growing water availability concern, IUWM is implemented in urban areas and works hand in hand with WSUD approaches (Sharma et al., 2016:1). The WSUD approach first gained attention in South Africa with the publications of the SA-focused WSUD Framework and Guidelines in 2014 and aims to mitigate water management challenges through the integration of stakeholders and the new paradigm of WSP (Carden et al., 2016:51). Tjandraatmadja et al. (2014:1) define WSUD as an approach to urban planning and design that integrates the management of the total water cycle into the development and land use process. WSUD combines urban design and urban planning to promote water sensitivity to achieve the goal of water sensitive cities (Fisher- Jeffes et al. 2017:5). As with GI, there is a multitude of definitions and views associated with WSUD, but it is generally agreed that development should consider water sustainability (Armitage et al. 2013:3). Uncommonly the WSUD framework was developed from an integrated perspective through a series of Learning Alliances (Armitage et al. 2013:4). It is suggested that WSUD can only be achieved by embracing innovation in technology. WSUD may lead to water conservation, flood control, healthy living environments, improved stormwater quality and landscape amenities, according to Sharma et al. (2016:1) these systems may either be combined into the centralised system or be implemented as a stand-alone system. WSUD

aims to integrate the management of all water sources (groundwater, surface runoff, rainwater, wastewater and drinking water) and mitigate all urban streams, storage facilities and the treatment of wastewater (Tjandraatmadja et al. 2014:1). Fletcher et al. (2015:259) introduce the notion of a Water Sensitive City (WSC) which follows Australian innovation towards WSUD. South Africa's unique contextualisation may require some alteration to WSUD but with appropriate modelling tools and strategies, this goal may be achieved (Armitage et al., 2014:1). As stated in the previous section, water availability is decreasing because of the influence of human activity on climate change (Earle et al., 2005:5) and the need for WSP is increasingly urgent.

The realisation that not only urban areas could benefit from water sensitivity WSUD evolved into WSD (Water Sensitive Design) (Carden et al., 2018:4). WSD suggests that all areas could benefit from the consideration of water and how it is managed. WSD is a system-based approach that endorses the development of b GI and includes, Alternative Water Resources (AWR), Water Demand Management/Water Conservation (WDM/WC) and Sustainable Drainage Systems (SuDS) approaches (Carden et al., 2016:52-53). South Africa implements WDM to mitigate the lack of physical water resources in the country, large scale projects were implemented to ensure water security and supply adequate and sustainable water (Earle et al., 2005:7). South Africa focused on sustainability and integration as challenges continue to emerge in the quest for WSP.

El Nino is the effect that causes surface water in the Pacific Ocean to rise in temperature since 2015 this effect has intensified and is the reason for South Africa's drought (Brink, 2016:3). Drought may cause significant spatial planning challenges, day-zero without water for the city of Cape Town was predicted for the 12th of April 2018 (Masante et al., 2018), there is little the spatial planning profession could do after a disaster has been declared but future planning and precaution may result in saving cities in the future. The need for a holistic national water plan is thus highlighted to prevent future disaster through spatial planning, the cause of drought is due to climate change, but the cause of a disaster might be due to spatial planning.

3.3.1 Current challenges of South Africa's WSP approach

South Africa is a water-scarce country and supplying water to its cities is one of the country's greatest challenges, furthermore, if South Africa aims to avert a water crisis, existing systems may have to be managed efficiently, in terms of quantity and quality (Armitage et al., 2014:1). South Africa has unique geography where water sources are not necessarily located near major cities and towns, it is thus apparent that alternative supply systems be set in place to accommodate this phenomenon (Carmon & Shamir, 2010:1). South Africa is a developing

country with rapid urbanisation and compound water management challenges, both in access to water-based services and resource shortages with negative impacts on the quality of ground and surface water (Carden et al., 2016:51). South Africa faces challenges such as the availability of water and the quality thereof, the economic aspects of these challenges directly link with the supply of water (Carden et al., 2018:5). Table 8 highlights the unique challenges faced by South Africa in the implementation of WSUD, most challenges stem from South Africa's history and the implications of Apartheid. Table 8 is offered in support of the selected challenges for this research and aims to highlight South Africa's unique situation.

Table 8: Challenges faced in the implementation of WSUD in South Africa

Challenge	Description
Supply infrastructure	Poor integration and communication: Stormwater fall under the roads department and water supply are separate from the wastewater.
Stakeholders equity	Support in creating approaches, dignity, ownership, and respect: Challenging to supply 'green' infrastructure to the previously disadvantaged where there is a lack of basic services.
Health aspects	Risk of spreading waterborne diseases.
Adaptability & uncertainty	Skill constraints: uncertainties regarding politics, climate change, water demand patterns and population growth.
Mitigation	Managing environmental impacts.
Ecosystem goods & services	South Africa faces many challenges and job creation, and affordable housing is prioritised above ecosystem services and food provision.

Source: Armitage et al. (2014:3)

WSUD integrates land use development and the water cycle to add environmental and economic value to urban areas (Carden et al., 2018:5). WSUD increases the availability of water by offering alternative sources by implementing Green-Blue corridors this also ensures water security (Carden et al., 2018:5). Bule-Green corridors are considered as parks, wetlands, rivers and canals to mention a few. The driving factors for WSD include 1) Economic incentives 2) Green Building Ratings 3) Legislative approval 4) Sensitive environments 5) Existing infrastructure and zones and 6) Institutional champions (Carden et al., 2018:9) While taking the challenges South Africa faces into account, Armitage et al. (2014:5) created a framework to implement Water Sensitive Settlements (WSS) in South Africa. Figure 14 below illustrates this framework and highlights the needs and solutions for South Africa. South Africa's history is considered together with what needs to be done and the road ahead for the creation of WWS. The need for separate water treatment is depicted together with the need for an integrated approach to WSP. WSP considers sustainable development and integrates water into urban and regional planning (Carmon & Shamir, 2010:1) which contributes to the implementation of WSS.

South Africa's spatial planning and water history regarding the notion of Apartheid has been depicted in the sections above, a clear understanding of inequality and lack of service regarding water was highlighted. Figure 14 illustrates that South Africa is currently under stress regarding water quality (public health) and water scarcities, the need for an integrated and effectively managed water systems also arises. The goals of WSP in South Africa as identified by Figure 14 consists of equality in water provision and multifunctional infrastructure to increase the efficiency of water resources in South Africa.

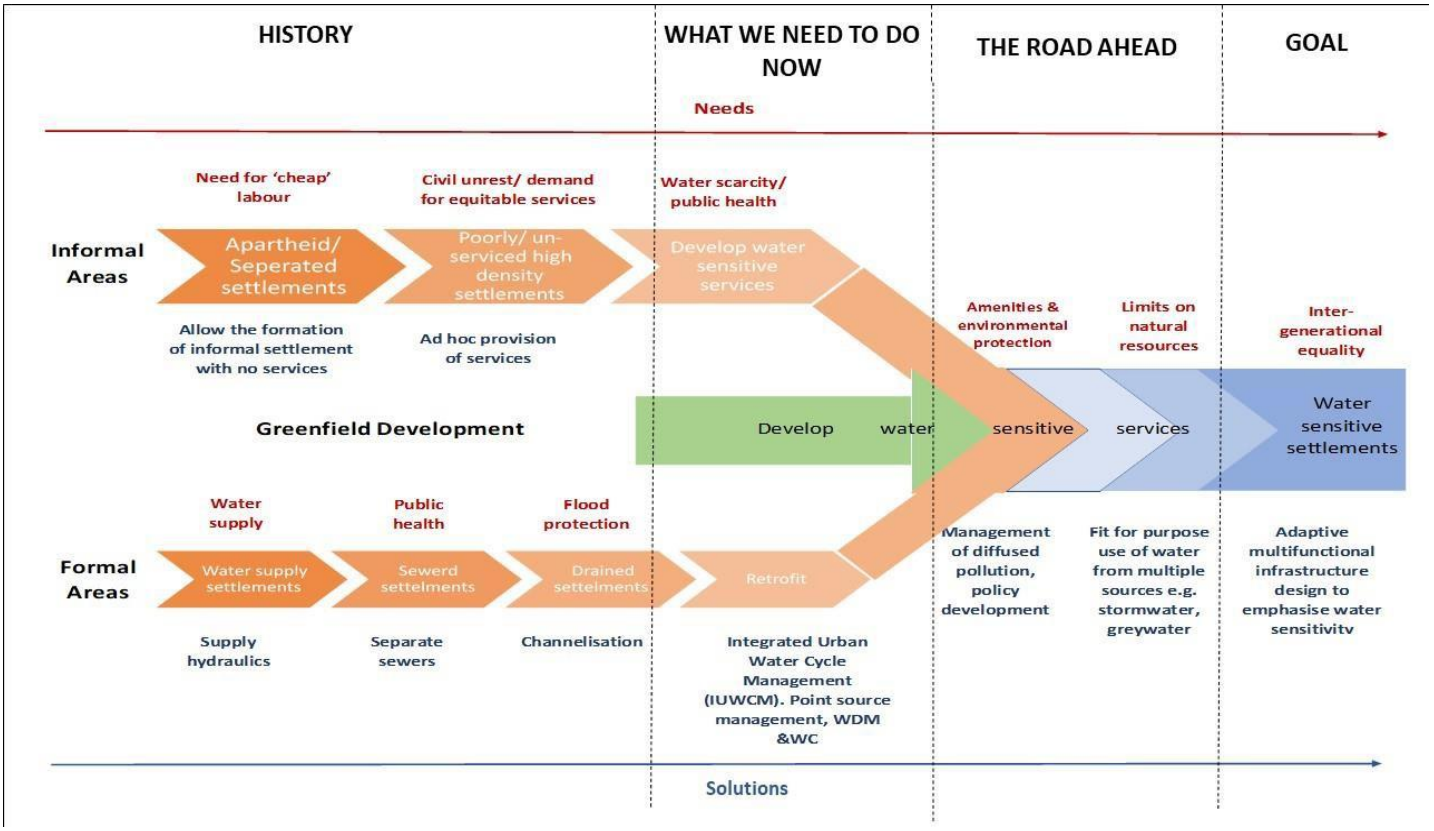


Figure 14: Framework for Water Sensitive Settlements in RSA

Source: Armitage et al. (2014:5)

Table 4 illustrates South Africa's WSP challenges, the table was compiled with the help of several sources stating challenges relating to local WSP. A complete methodology is provided in Chapter 1 (cross-reference Section 1.6 Table 4). As previously mentioned, the research acknowledges that the derived challenges are not the only WSP challenges South Africa faces. The above-mentioned challenges were gathered from scientific sources to define the core of South Africa's WSP challenges and include water quality, water quantity, water conservation, the governance of water and water planning

3.3.1.1 Local perspective on water quality

Access to safe drinking water is a basic right in South Africa, the term water security thus became more evident, and form part of the Millennial Development Goals (Sershen et al., 2016:456). South Africa's water quality has recently been highlighted in the media, the consideration of polluted stormwater is identified as a major threat to South Africa's urban water systems (Fisher-Jeffes & Armitage, 2013:429). In 2010 South Africa's water quality was said to be degrading due to population growth, mining, urbanisation, and power generation (Zhuwakinyu & Creamer media, 2012:8).

South Africa's leading water quality issue in surface water was identified as disease-causing organisms in water bodies because of overpopulated and under-serviced human settlements (Stats SA, 2005:10). The main culprits for water pollution in South Africa are speculated to include rapid population growth, current and historical mining activity and urbanisation (acid mine drainage), these factors may also contribute to the availability and quality of the water supplied in South Africa (Musigaf & Tom, 2014:72, Sershen et al., 2016:457). Bulk water pollution is of serious concern in South Africa, surface water is also threatened by inflow water pollution from industrial and domestic use (Sershen et al., 2016:457). The South African government has implemented and supplied several documents and policies to improve water access and quality, especially in rural areas, but municipalities fail to implement suggested actions and communities are thus placed at a disadvantage (Rivett et al., 2013:409).

South Africa is identified as a country with high rainfall fluctuations and high dependency on rainfall catchment, freshwater quality has witnessed a decline especially in rural areas where entire ecosystems are being disturbed (Musigaf & Tom, 2014:72). A Green Drop monitoring system was introduced in South Africa to regulate the quality of effluent from wastewater treatment works into rivers. In 2013 an estimated 13% of wastewater treatment plants implemented water-saving plans (Sershen et al., 2016:458).

3.3.1.2 Local perspective on water quantity

Climate change is deemed responsible for significant impacts on water availability in South Africa, the conservation and sustainable management of water should thus be regarded as an important investment in South Africa's future (Tewari, 2009:639). According to the Department of

Water Affairs and Forestry (2004), equilibrium should be met with the conservation of water resources together with the delivery infrastructure thus, water demand and water conservation should be managed together to create an effective system. The global water demand is approximately 173 l/d/c (daily litre per capita) while South Africa's water demand ranges? from 235 l/d/c to 260 l/d/c (Carden, 2018:6).

A total of 450 million tonnes of water is supplied by South Africa annually, and 70% thereof is supplied to the mining industry (Musigaf & Tom, 2014:72). South Africa's water distribution network consists of local municipalities that supply small urban and rural areas while larger municipalities supply metropolitan areas and consist of 297 municipalities which increases the complexities with regards to management and implementation of strategies (Bhagwan et al., 2014:2). A report in 2011 proposed that South Africa's bulk water infrastructure be upgraded or replaced to ensure a decline in water losses (Sershen et al., 2016:457). South Africa is utilising their natural resources to great extent with overexploitation of approximately 60% of rivers and only one-third of South Africa's rivers are therefore in good condition (Donnenfeld et al., 2018:2). Figure 15 illustrates South African rivers categorised by average flow; this substantiates that South Africa's rives are in dire need of conservation. A total of 146 of rivers have extremely low flow and only 63 rivers have high flow highlighting the severity of South Africa's water conservation and management. High population growth, urbanisation and industrialisation increase the municipalities challenge of providing adequate water supply. Natural systems such as rivers are then placed under pressure and water supply abilities are questioned (Earle et al., 2005:3).

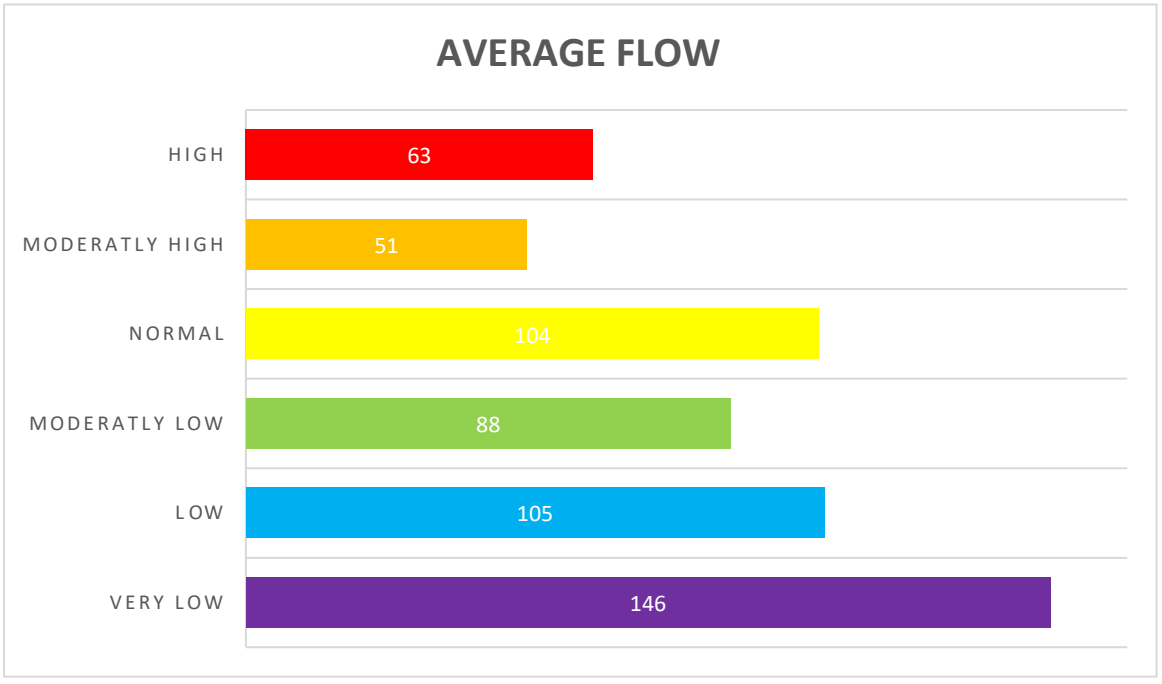


Figure 15: Number of rivers in South Africa characterised by average flow

Source: Donnenfeld et al. (2018:3)

Water demand is a key factor in the discussion of water conservation and WSP, the water demand is constantly increasing due to urbanisation and population growth (Donnenfeld et al., 2018:5). In 2011 it was estimated that roughly 3.3% of South Africans do not have any access to water infrastructure, while 7.2% have moderate access to water infrastructure (de Ridder & Mothupi, 2018:2). South Africa's water supply consists of approximately four major rivers that supply 70% of South Africa's water (these rivers are also shared by neighbouring countries) with ever-increasing water demand (de Ridder & Mothupi, 2018:2).

3.3.1.3 A local perspective on water conservation

Water is a necessity for all living organisms, harvesting rainwater and managing stormwater are two of the ways to conserve water in urban areas (Kurunthachalam, 2014:1-2). This dissertation focuses on the conservation of water on an urban and regional level with specific reference to South Africa. Water losses and infrastructure management are the main culprits in terms of South Africa's water management challenges. An estimated 20 to 30 per cent of South Africa's rainwater is converted to runoff, and thus identified as the lowest runoff to rainwater conversion in the world (Earle et al., 2005:6). The exploitation of rivers, dam levels and climate change are also identified as challenges in the conservation of South African water resources (Donnenfeld et al., 2018:2). One of South Africa's challenges regarding water scarcities is the realisation that groundwater is not used to its full potential, approximately 15% total water consumption is obtained from groundwater and it is mainly rural communities which largely benefit from groundwater (WWF, 2016:9).

South Africa has been identified as a water-stressed country, because of rapid population growth and the climate vulnerability of the country, water demand is not closing the supply gap (Bhagwan et al., 2014:2). South Africa experienced a drought from 2014 to 2016, this initiated a focus on conservation and highlighted the importance of water in South Africa's legislative context (Donnenfeld et al., 2018:2). The drought, however, was not the only cause of South Africa's water scarcities, but rather emphasized existing inadequacies in Water Management (WM) (Donnenfeld et al., 2018:2). Climate change was deemed responsible for significant impacts on water availability in South Africa, the conservation and sustainable management of water should thus be regarded as an important investment in South Africa's future (Tewari, 2009:639). According to the Department of Water Affairs and Forestry (2004), equilibrium should be met with the conservation of water resources together with the delivery infrastructure thus, water demand and water conservation should be managed together to create an effective system.

Several of South Africa's water pipelines are over 100 years old, which leads to 65% water losses in some urban areas through leaks (Lombard, 2016:33). South African municipalities are primarily considering price over sustainability (Southern Africa Stainless Steel Development Association, 2017:2), by implementing a long-term vision South Africa might realise that sustainability and quality of life go hand in hand. South Africa's lack of technology leads to outdated pressure control systems, that contributed to water losses through pipe bursts and leaks (Lombard, 2016:33). The previous president J.G. Zuma stated that South Africa is not a water-rich country and a target has been set to halve water losses by 2014 (Mckenzie et al., 2012:4) but water losses and allocations were, however not disclosed. An estimated 40% of South Africa's wastewater is untreated (Donnenfeld et al., 2018:1), which contributes to South Africa's inefficient use of water and the lack of water-wise decisions on a governmental level. The WWF (2016:16) created a framework for ensuring a sustainable water future for South Africa. They suggest that decreasing degradation, utilising groundwater, investment in the future, ecological infrastructure, planning Waterwise, catchment agencies and invasive alien plant species clearing are methods needed to be implemented; Figure 16 depicts the strategy.

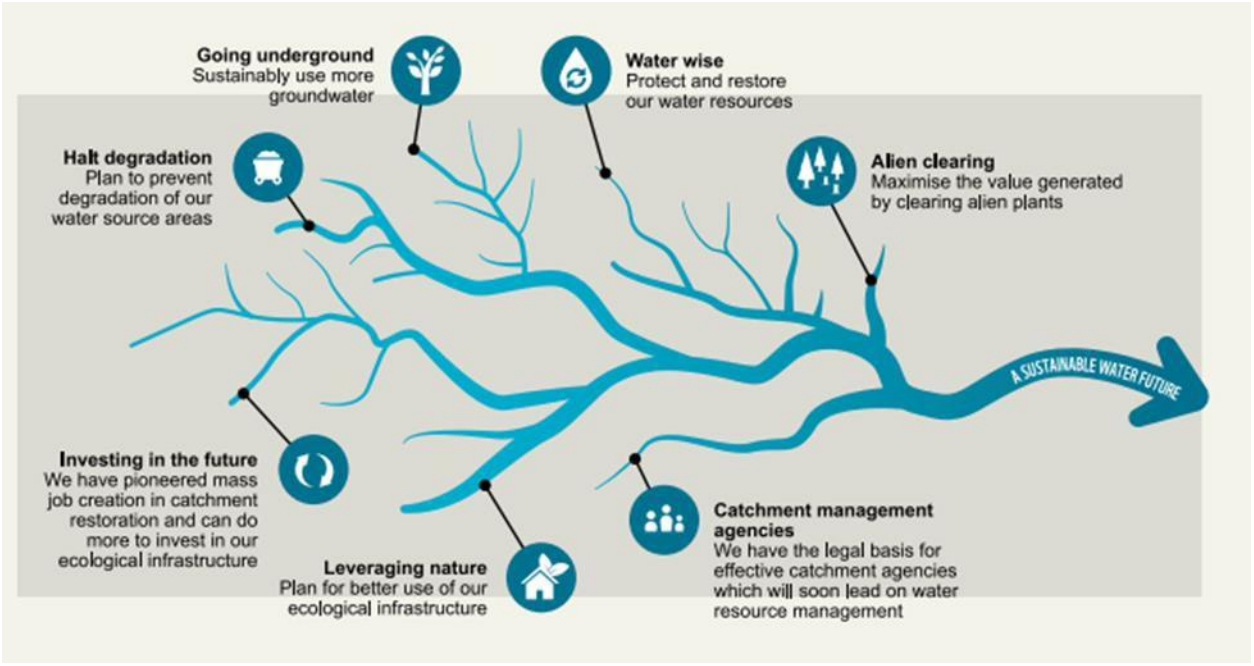


Figure 16: A sustainable water future

Source: WWF (2016:16)

3.3.1.4 Local governance of water planning approaches

The Department of Water Affairs (DWA) governs South Africa's water sector and is responsible for policy development and providing funding for the sector (DWA, 2013:1). Water governance in South Africa largely focused on supply management, technical solutions and subsidised infrastructure before 1994. Landowners were permitted to use all water resources on the property and informal areas were thus left lacking water provision as a result, after the election, several policies were set in place to equalise water supply (Herrfahrdt-Pa¨hle:2010:114).

The DWA does not carry this responsibility alone but relies on water services authorities and water services providers. In larger areas, municipalities take on the responsibility of purifying water and municipalities are then held responsible for the sustainability of their jurisdiction (DWA, 2013:3). The governance of water is not provincial bound and water management boundaries are allocated according to the source of supply, that increases the difficulties in planning water on a national and provincial scale (Herrfahrdt-Pa¨hle:2010:115). South Africa's water is governed by the Water Service Act of 1997 and the National Water Act (NWA) of 1998, the following section of this research examines South Africa's legislative context in greater detail (WWF, 2016:7). The DWA (2013:1) states that these Acts provide South Africa with effective water management. Increased difficulties in water governance and the argument of responsibility for the management of water complicates the implementation of WSP.

3.3.1.5 A local perspective on water planning

South Africa has unique rainfall patters and implementing sustainable stormwater management includes the consideration of runoff and water losses, engineering experts speculate that little to no stormwater should be lost to achieve efficiency (Lombard, 2016:35). The conservation and management of water contribute to the sustainable management of stormwater and water quality. In South Africa municipalities carry the responsibility of managing stormwater through municipal rates, this creates funding challenges (Fisher-Jeffes & Armitage, 2013:429). As a result of ongoing water scarcity in South Africa, stress is placed on existing water systems and the need for an alternative water supply system has become apparent (Fisher-Jeffes et al., 2017:1). Stormwater could be considered as an alternative water supply system, if stormwater is managed effectively it could be reused and water losses might decrease. According to Fisher-Jeffes et al., (2017:1), stormwater harvesting improves water security and is considered a sustainable method for maintaining parks, wetlands, and dams as stormwater is used instead of fresh water supplies.

Stormwater forms part of the urban water cycle and should, therefore, be considered as a WSP challenge, the challenges of managing water in an urban area contribute greatly to the notion of

WSP (Fisher-Jeffes & Armitage, 2013:429). South Africa's large informal areas increase the difficulties in managing stormwater and community-based infrastructure is set in place to accommodate stormwater and the resulting floods (Adegun, 2014:1). The purpose of stormwater management as identified by the Red Book is to improve quality of life, protect the natural environment, to protect the health and safety of the community form floods, to conserve water through management, and to create sustainability and resilience in communities (CSIR, 2005:8). The Red Book (2018) states that climate change increases the challenges of stormwater management and the urban drainage system, but stormwater management was only mentioned four times throughout the document. As previously mentioned, interdisciplinary teams are needed to create a sustainable outcome (CSIR, 2005:8), planning's purpose in stormwater management is to facilitate accomplishments. South Africa changed stormwater management to a tax bases structure that is implemented to support the management of stormwater (Fisher-Jeffes & Armitage, 2013:429).

South Africa's annual risk for flooding is approximately 83.3% and the population affected in urban areas is high due to geographical location and economic factors (Mckenzie et al., 2012:4). The Department of Environment Affairs (2016:32) argues that a rise in rainfall results in a rise in stormwater when stormwater is not managed effectively floods become increasingly common. With the consideration of stormwater management, WSP might contribute to a sustainable future. South Africa's informal settlements? are not necessarily equipped with stormwater infrastructure, this places these areas under greater risk for floods (ActionAid, 2006:2). Informal settlements are thus not only placed under risk, but runoff and excess water resources are lost and polluted (Adegun, 2014:2). Localised flooding is a result of little to no stormwater management and infrastructure and occurs because of compacted ground, few to no-drains and blocked drains (ActionAid, 2016:3). The implementation of WSP thus becomes increasingly important? in South Africa's informal areas because of lacking infrastructure and public participation.

As previously stated, GI is considered a driving factor of WSP, highlighting the importance of ecosystem services and sustainability regarding the planning of a vulnerable resource. Environmental depletion is considered a challenge from a WSP perspective bearing in mind lowering dam levels and the condition of water sources. As previously stated, environmental depletion and the lack of GI promotes degrading water quality. Environmental depletion may lead to groundwater pollution because of agricultural runoff and sewerage outfalls (Tyagi et al., 2014:1493), this increases difficulties in WSP and the recycling of water. The implementation and consideration of GI from a WSP viewpoint should be considered to promote ease in the application of WPS. The loss of ecosystem services and environmental depletion are challenges

faced in the planning community, with a focus on WSP these factors may stand in the way of effective and sustainable water management.

GI has gained importance in South Africa and thus more funds are allocated for the implementation of GI (Cilliers, 2019:4). GI produces ecosystem service and is generally implemented in an urban environment to increase ecosystem consideration and improve quality of life and sense of place (Culwick et al., 2016:8). Theoretically, GI promises efficient infrastructure as well as social, economic, and environmental benefits, in South Africa however current implementations are lacking (Culwick et al., 2016:12). South Africa aims that the new generation of planners finds the implementation of GI as important as the theory thereof. South Africa shifted focus towards a green economy approach implemented in the Western Cape Province, with water management and GI as a priority, with challenges of climate change GI is considered essential for the development and sustainability of the region (Pienaar et al., 2017:78). A green economy considered the combined benefit of adequate and sustainable water supply and GI, the investment thereof may be substantial, but the benefits greatly overrule the cost (Pienaar et al., 2017:79).

A study conducted on the implementation of GI identified 40% of individuals working in the private sector do not implement GI as a part of spatial planning (Cilliers, 2019:4). It is thus considered evident that planners in South Africa have low consideration of GI even though sustainability and the consideration thereof is a highlighted trend in South Africa. GI is implemented on a small scale in several of South Africa's major cities and forms part of sustainable spatial planning. Guidelines and policies are set in place to promote the implementation of GI. But as previously stated GI might consist of higher costs and budgeting for luxury (as GI is considered) versus necessity, is a trending argument (Culwick et al., 2016:10).

3.4 Conclusion of Chapter 3

The objective of Chapter 3 was first to understand the notion of WSP. Through the evolution of global WSP, it was discovered that the early solutions to water-related difficulties were to migrate towards the water sources. This, however, is not a sustainable solution and the construction of dams, rivers, and canals were implemented. Transdisciplinary planning initiated WSP through notions such as ESD, WSC, IWRM, WSUD, and WSD. All these approaches contributed to the development of WSP and are researched to find the most sustainable product. Secondly, Chapter 3 aimed to identify opportunities for South Africa and is it suggested that the most important is the opportunity to learn from global past experiences. South Africa could observe the implantation of WSP and adapt strategies for ultimate success. The opportunity of knowledge is of great importance.

In conclusion, Table 9 and Table 10 were created, with the research gathered in Chapter 3, to illustrate the comparison of the global evolution of WSP and that of the national evolution of WSP. When considering the timelines in Chapter 3 it could be said that South Africa did not initially follow global WSP trends on a broad perspective. When the challenges were compared similarities began to emerge, considering South Africa as a third world country innovation and improvement of water awareness is gaining momentum. As observed from this and the previous chapters spatial planning and WSP share similar challenges, this might be because the two concepts share similar implementation traits, such as the consideration of GI and integrated approaches. It might thus be clear that one concept is dependent on the other. When spatial planning and its challenges are understood, WSP could follow the same trends and be implemented in an integrated manner. A cohesive approach may be needed for spatial planning and WSP to be implemented efficiently.

Table 9: Comparison of major timeline events

Comparisons	Global WSP	South Africa's WSP
Major timeline events	1940: IWRM	1930: Vaal Dam construction
	1980: Dark period	2011: Drought
	1999: Stormwater management	2016: WSUD
	2000: Impending water crisis	2017: Sustainability at the core

South Africa constructed the Vaal Dam in 1930, the next water-related phenomenon occurred 81 years later when South Africa underwent a drought in 2011. Thereafter WSUD and sustainability made headway. In contrast global WSP kicked off in 1940 with IWRM followed by the realisation that water is a scarce resource and consists of difficult challenges. As previously stated, sustainability is particularly important and currently at the core of global and national planning. Table 10 illustrates the challenges selected for local and global WSP and were identified through the literature.

Table 10: Comparison between WSP challenges

Global WSP challenges	South Africa's WSP challenges
Water Quality: The quality of water has gained importance and awareness about health risks relating to water quality is highlighted. Water quality in third	**Water Quality:** Good quality water, however; in rural areas, the quality of water is not on a high standard. And water pollution is a

world countries are generally good, but water pollution remains present (cross-reference Section 3.2.1.1).	challenge. Water quality is degrading due to population growth. (cross-reference Section 3.3.1.1)
Water Quantity: Water demand is surpassing the supply thereof. As a result of a growing population, there is an increase in water demand. Water demand is 173 l/d/c. (cross-reference Section 3.2.1.2)	**Water Quantity:** Water demand is surpassing the supply thereof. As a result of a growing population, there is an increase in water demand. Demand increased from 235 l/d/c to 260 l/d/c (cross-reference Section 3.3.1.2).
Water Conservation: Water is considered scarce in some part of the globe because of climate change, but the conservation of water is gaining importance (cross-reference Section 3.2.1.3).	**Water Conservation:** As a result of South Africa's drought water conservation has gain importance and trend are being implemented to conserve water (cross-reference Section 3.3.1.3).
Governance of water planning approaches: Silo-planning is implemented to some extent and thus the governance of water might be an undetermined responsibility. But innovation regarding water governance is explored and implemented around the globe. (cross-reference Section 3.2.1.4)	**Governance of water planning approaches:** The governance of water is being questioned but ultimate traditional planning and governance are generally implemented (cross-reference Section 3.3.1.4).
Water Planning: Innovation in the field is observed with the focus on conserving and recycling water. The consideration of ecosystem depletion and sustainability are gaining importance and innovation in the field is observed. (cross-reference Section 3.2.1.5)	**Water Planning:** Management with regards to floods are lacking in informal and rural areas. In parts of South Africa, dense urban areas are grieved by the lack of stormwater management. South Africa is increasing considering ecosystem services and is actively preventing environmental depletion. (cross-reference Section 3.3.1.5)

When comparing South Africa and global WSP some similarities emerge such as the increasing importance of GI and the general good quality of water provided in South Africa. Water scarcities

are observed around the world and South Africa is no different in that regard. However, when considering the innovation in stormwater management and questions regarding water governance, global trend surpasses South Africa's current state. South Africa's water challenges lie in landscape difficulties and the location of reliable water sources. It is suggested that South Africa is following global trends with regards to questioning water governance to find a suitable solution for the identified challenges. Furthermore, global stormwater management and water recycling innovations inspire South African planners to find appropriate solutions to unique difficulties. Through the evolution of global WSP innovation is inspired which might be interpreted as a trend. This section aimed to highlight international and national WSP trends and the evolution thereof to better understand South Africa's challenges and to ultimately offer recommendations based on the knowledge of professional planners in South Africa.

The following chapter depicts policy and legislation relating to WSP in South Africa and on a global level. As previously stated, the lack of policies and the implementation thereof is considered a challenge on a global and local scale. The theoretical investigation in this, and previous, chapters serve as an introduction to the empirical investigation and an improved understanding of local WSP challenges. The challenges identified in the literature review were used in the e-questionnaire to gather knowledge from practising planners. The dissertation evolved as research continued and the literature was used to confirm the legitimacy of the selected challenges. The data was analysed and compared to that of the literature and from there, recommendations are offered based on the conclusion of both the literature and practising planners.

CHAPTER 4 POLICY AND LEGISLATIVE REVIEW PERTAINING TO WSP

4.1 Introduction

In this chapter, the policy and legislative context relating to global and national WSP is discussed to highlight the need for an inclusive national water plan for South Africa. Global and national WSP as discussed in previous Chapters are lacking not only in research but also in implementation (cross-reference Section 1.6 Table 3 & Table 4). Awareness regarding climate change and water scarcities are continuously increasing but WSP and active consideration of water planning is scarce. Global water trends are therefore mentioned to evaluate future inclinations of the planning profession's consideration of WSP. The section further explores South Africa's legislative context regarding water resources and water planning, the limited knowledge regarding water planning in South Africa is analysed to emphasise the need for a holistic national water plan.

In the mid-1980s South Africa experienced the most severe drought in its history and it was suggested that the supply of water be increased to accommodate the growing demand (Rohr, 2019:42). The Department of Water Affairs (DWA) identified four issues with relation to South Africa's approach towards water resources 1) Several of South Africa's laws are derived from Europe and do not necessarily fully apply to local challenges 2) The management of water resource quality and quantity was not fully addressed 3) While the usage of water could be regulated during the drought it could not be regulated thereafter 4) The need for rivers to be classified as integrated systems and controlled in a catchment-orientated way (Rohr, 2019:42).

As previously stated, South Africa underwent a complex history in terms of equality, the water sector was no different and some areas are still considered water-poor (Goldin, 2008:195). South Africa is a water-stressed country and innovative technology and strategies have been discussed to educate the public on water conservation, the government, however, should take responsibility for the sustainability of the country through equally innovative policy implementation and effective WSP (Donnenfeld et al., 2018:2-3). The previous chapters supported the idea that there is a lack of implementation of South African policies and several sources in Table 1-4 identify the lack of policy implementation as a challenge with regards to WSP (cross-reference Section 1.6).

4.2 Policy and legislative review related to global WSP

In 2000 water governance was pinpointed as a priority of action at the Second Water Forum in The Hague (Cooley et al., 2013:10). Early water-related development considered dam

construction to ensure water security and flood protection, legislative context developed around this phenomenon. Furthermore, rivers and water bodies were used to define state borders, this caused segregation in terms of water communication between states and municipalities (Caponera, 1980:3). The conflict between states emerged as a result of share water resources and degrading quantity and quality of water from one state basin to its neighbouring basin, local communication concerning water resources were not considered constructive but rather identified as possessive (Earle et al., 2016:59). Local governance lacked integration because of the global understanding of water sources, the consideration of WSP developed at a later stage after the development of basic water resource governance.

Agenda 21 is a document created on sustainable development by the United Nations, the Agenda was created to address current challenges and suggest sustainable solutions (UN, 1992). Agenda 21 was released in 1992 and the main concern is achieving sustainability. Agenda 21 (1992) states that IWRM is promoted and that local communities be involved in the decision-making process regarding policymaking; integration of water planning is strongly considered (UN, 1992:197). Agenda 21 also considers the development of policies and highlights the full utilisation of assessment information, trends, and water resource situations (UN-water, 1992:201-204) It is thus clear that this is an important document to consider. Public participation is highlighted through Agenda 21 and promoted the participation of woman and youth (UN-water, 1992:211), to ultimately support a sustainable future. WSP is not mentioned but can be derived from the water management and sustainability aspects stated, this is true for several policies but to achieve effective WSP clear guidelines should be available.

The cost of new water is constantly increasing and contributes to water scarcities, water supplies are wasted, groundwater is depleting, soil irrigation and quality are decreasing, and vulnerability of water ecosystems are observed on a global scale; this contributes to the challenges of implementing global WSP legislation (Rosegrant et al., s.a.:164). A vision for the sustainable development of water resources is identified through the contribution of the public and private sector together with civil society. A legal framework ensures water access for the whole population and binds local municipalities to provide clean water; thus, protecting the population’s basic human right (IMPRESSUM, 2015:8).

The Millennium Development Goals (MDG) identifies the assurance of environmental sustainability as the seventh goal, the provision of clean drinking water, with the consideration of sustainability, is highlighted (UN-water, 2015:7). The MDG was then reconsidered and sustainability gain importance, the Sustainable Development Goals (SDG’s) were developed with the MDG as consideration and identified the provision of clean water and sanitation as their sixth goal, the second goal is zero hunger, which could not be achieved without the proper provision

of water services (UNDP, s.a.:1). In terms of legislative context, the SDGs are global ideas set in place of guideline purposes however, the focus is placed on climate change and water scarcities, WSP is not profoundly considered but awareness is created around a sustainable water vision. Integrated transdisciplinary approaches are promoted through the statement of increased global communication and cooperation in the SDG's (UNDP, s.a.:8). The New Urban Agenda (2017) highlights the importance of integration and sustainability relating to WSP. The realisation that third and first world countries might have different challenges are highlighted throughout the document. The protection and conservation of water resources are deemed important together with the effective management of stormwater. Table 11 illustrates the selected global frameworks relating to WSP.

Table 11: Policy and legislation relating to global WSP

Date	Name	Guide	Relation to water planning
1992	Agenda 21	Agenda	• States IWRM and public participation. • Focus is on sustainability and integrating planning.
2000	Millennium Development Goals	Framework	• Identifies the insurance of environmental sustainability as the seventh goal, the provision of clean drinking water, with the consideration of sustainability.
2015	Sustainable Development Goals	Framework	• Goal six identifies water resource complexities and offers variable solutions.
2017	New Urban Agenda	Agenda	• Aims to provide safe drinking water. • Protect and conserve water resources. • Mentions IWRM and mitigating water losses. • Aims to achieve sustainable water management, stormwater management and water recycling.

Global water legislation concludes to water as a basic human right, the UN states that national policies should be set in place and implemented on a local level by municipalities to ensure that

the population's basic rights are not obstructed (UN-water, 2013:20-22). WSP is a relatively new concept in the planning profession, and thus clear legislation considering WSP proved difficult, speculation on solving the global water crisis suggests that the answers lie on a local level and not necessarily on a global scale.

Derivatives of water management and sustainability were used to compile this section and may prove that awareness and implementation of WSP are lacking. However, global water trends include the consideration of water losses (Deloitte, 2012:2) and the integration of water challenges in strategic planning (World Business Council for Sustainable Development, 2005:2-14). Trends related to water planning were identified in Namibia as transdisciplinary approaches, conservation, and policymaking (Scott et al., 2018:1-3).

4.3 Policy and legislation review related to WSP in South Africa

In 1971 the Water Research Commission (WRC) was established, water supply and wastewater treatment were considered a focal point, after the political shift in South Africa many newly formed municipalities undertook the responsibility of water supply and treatment and it became apparent that rural and poor communities required more attention (WRC, 2014:44). The Worldwide Fund for Nature (WWF) (2017:10-16) identifies South Africa's water trends as; considering water maintenance to reduce water losses, strong water governance, creating a water conscious country, managing supply and demand, and lastly creating a water-smart economy. The two legislations that govern South Africa's water are the Water Service Act of 1997 and the National Water Act (NWA) 1998 (WWF, 2016:7), Table 12 provides a list of policy and legislative context used by South Africa in their quest to manage water effectively. Considering the 22-year gap between 1997, (when the first legislative document regarding water management emerged) and 2019 (when a severe water crisis was observed in South Africa) updated legislation may be necessary. The National Water Resource Strategy (NWRS) introduced in 2004 and updated in 2013 shifted the focus of water management towards efficiency and is therefore also considered an important document relating to WSP. For South Africa to restore its water security, significant political will and financial investment are needed (Donnenfeld et al., 2018:1), between 2014 and 2018 the country underwent severe drought and water debates catalysed South Africa's concern regarding water security and the survival of the urban environment.

Table 12: Policy and legislation relating to WSP in South Africa

Date	Name	Guide	Level	Relation to water planning
1994	White Paper on Water Supply and Sanitation Policy	Policy	National	• Reconstruction and development of water supply. • Water supply and sanitation services.
1996	Constitution of the Republic of South Africa (Act 108 of 1996)	Legislation	National	• Right to sufficient water. • Right, that environment is not harmful to health or wellbeing. • Ecologically sustainable development.
1997	White Paper on National Water Policies for South Africa	Policy	National	• The policy refines water ownership and allocation. The national government will act as a public trustee.
1997	Water Services Act (Act 108 of 1997)	Legislation	National	• Currently under revision. • Provision of potable water supply. • Requires Water Service Authorities (municipalities) to consider public delivery options first.
1998	National Water Act (Act 36 of 1998)	Legislation	National	• Nation's water is protected, developed & managed. • Equality, efficiency & sustainability is promoted. • Integrated water management. • Establishment of water catchment agencies. • Reserve water for aquatic ecosystems and basic services. • Recognition of international allocations.

1998	National Environmental Management Act (Act 107 of 1998)	Legislation	National	• Water quality and the prevention of pollution. • General allocation of water resources.
2003	Strategic Framework for Water Services	Framework	National	• Align and integrate the planning of water resources & water supplies. • Mention of bulk infrastructure. • Promotes an integrated water resource management approach.
2013	Spatial Planning and Land Use Act (No. 16 of 2013)	Legislation	National	• The management of water is not a focal point in this document. • The conservation of water is mentioned.
2015	Sustainable Development Goals	Framework	International	• Goal six identifies water resource complexities and offers variable solutions.
2018	Draft National Water and Sanitation Master Plan	Framework	National	• Reducing water demand and increasing supply. • Redistributing water. • Effective water management. • Regulating the water sector. • Improving raw water quality.

Frameworks are considered the least binding and are developed by individuals and are offered to governing bodies to further create legislative context. Policies are guidelines created by individuals or companies and are also not legally binding but are designed to offer some guidance. Legislations are law binding documents approved by the government and are punishable if ignored. Table 12 mentions some of South Africa's most used policies, frameworks, and legislation to evaluate South Africa's adequacy and reference towards WSP.

South Africa's consideration of water resources is adequate but water planning and WSP are derived concepts, this implies that South Africa does not implement WSP as previously defined. Awareness regarding water conservation and challenges are identified in South Africa's legislative context as depicted in Table 12 above but guidelines on water planning are limited to conserving water resources and improving quality and quantity. The thematic identified gaps regarding the policies and legislation in Table 12 are 1) Environmental consideration 2) Sustainability 3) Consequent guidelines 4) Transdisciplinary approaches 5) WSP. While water resources are mentioned in these documents the term WSP is seldomly used.

4.4 Conclusion of Chapter 4

This section considered global WSP legislation and trends followed by South Africa's context on WSP, the overall conclusion is that policymakers and economic planners may not place water on a high enough regard to improving water investments such as treatment, collection and overall use of water resources (Zhuwakinyu & Creamer media, 2012:3). Trends such as sustainability and conservation were observed on a local and global scale but the notion of WSP with regards to legislation is lacking on both levels of consideration. As previously stated, the WRC aims to assist municipalities in addressing water challenges such as water provision and wastewater treatment (WRC, 2014:44), awareness relating to water planning was creative but implementation regarding legislative context failed. The research conducted in this dissertation concludes that adequate policy and legislative documents are set in place for the implementation of WSP and the sustainable management thereof. The challenge arises in the implementation of these legislative documents rather than the existence thereof. As previously stated, the necessity of a holistic national water plan for South Africa is highlighted throughout the dissertation and is still the conclusion offered. WSP is an innovative concept and implementation and guidelines may be limited. Trends such as sustainability and conservation were observed on a national and global scale but the specific notion of WSP with regards to legislation is lacking on both levels of consideration. Chapter 5 depicts the empirical investigation and achieves the third objective of this research through the consideration of the professional planner's perspectives on the status quo of WSP in South Africa.

CHAPTER 5 EMPIRICAL INVESTIGATION: PROFESSIONAL PERSPECTIVE PERTAINING TO WSP

5.1 Introduction

This chapter captures the methodology employed to gather data for the required empirical investigation and presents the results of the professional planners' perspectives towards the status quo of WSP in South Africa. These results are offered to complete the third aim of this research: To consider the perspectives of professional planners towards the status quo and the consideration of the importance and opportunities for WSP in South Africa. The empirical investigation captured the perspectives of a convenience sample (planning professionals that were willing to participate and accessible) of local professional planners regarding WSP for South Africa to identify the status quo of WSP in South Africa. The perspectives of planners in the professional environment are vital in identifying current thought patterns to ultimately offer valuable recommendations for the creation of a holistic national water plan for South Africa.

5.2 Research methodology

This research aims to consider WSP in South Africa from the perspectives of planning professionals and to draw conclusions regarding the scope, challenges, and opportunities for the realisation of WSP in a local context. With the initial research framework, an e-questionnaire (Annexure C) was drafted to investigate the professional planners' work sector and experience, their knowledge regarding WSP was questioned followed by their experience with WSP and the level of importance thereof. A convenience sample of local professional planners was identified and accordingly, their perspectives regarding WSP in South Africa was captured through the e-questionnaire.

The e-questionnaire was sent to 200 professional and junior planners of which 31 planners responded the e-questionnaire was sent to LinkedIn groups and the reach is unidentifiable. The data of 30 planners were used because an outlier was discarded, only one professional responded from the educational sector and was thus excluded. The small sample size is acknowledged, and this is recognised as a limitation in Chapter 1 (cross- reference Section 1.4). The willingness of professional planners to participate in research might be highlighted here. The statistical analysis of the e-questionnaires includes the responses of 30 professional planners. The first section of the questionnaire captured the profile of the respondents in terms of the work sector and experience. All the respondents are working in the private sector and this is also considered a limitation (cross-reference Section 1.5) and suggests that the data might be one-sided in the professionals' opinions on the matter of WSP. The questionnaire was sent to

42 professionals in the tertiary education sector, 47 professionals in government departments and 88 professionals in the private sector. The questionnaire was primarily sent to private professionals because their contact details were easily provided. Private professionals

implement planning trends in, not only urban design but larger-scale developments, and this might be useful to identify the importance and implementation of WSP in South Africa. The opinions of private planners may result in a 'hands-on' evaluation of WSP in South Africa.

The e-questionnaire was distributed to the sample group, to capture the status quo of WSP in South Africa, their perspectives relating to the importance of WSP in South Africa, and finally identifying opportunities for future WSP approaches. Annexure C illustrates the complete e-questionnaire sent out to the potential participants. The researcher did not have direct contact with the participants as the e-questionnaire was distributed through online portals where participation was voluntary. Ethical consent for this research was granted by the North-West University, Scientific Committee of Urban and Regional Planning within the Faculty of Natural and Agricultural Sciences (cross-reference Annexure A). A consent statement was included along with a statement of confidentiality. Consent was obtained by completion of the e-questionnaire. The data of the e-questionnaire was statistically analysed to present a quantitative view of the data derived from the survey.

A rating system for global water challenges as perceived from professional planners was included in the questionnaire. Global water challenges included are water quality, water demand, water supply, water conservation, stormwater management and GI planning. The e-questionnaire was constructed based on the literature review which identified the core issues to be investigated (cross-reference Section 3.2). The question of the alignment between spatial planning and water management to address the identified water-related challenges was offered to explore the professional planners' view on the implementation of WSP in South Africa. The data of the e-questionnaire was accordingly statistically analysed as illustrated in Annexure D. Cross-tabulation with the inclusion of a Chi-square test was used to analyse and interpret the data (cross-reference Annexure D). In some cases, the association was violated, and the linear-by-linear association was interpreted instead of the Pearson Chi-square. These values determine the statistical significance of the correlation and will ultimately state the value of the data and sample size. Furthermore, the data was analysed to provide percentages of the participant's answers such as what percentage participants worked in which sector (education, private, municipal). For the question of work experience, the participants were asked to select intervals of their work experience; one is less than three years, two- between three and seven years and three, more than seven years. The participants were then asked to define WSP and a Likert scale was used to define the data where zero and one were used for a relative understanding of WSP, two for a basic definition, three for a semi-inclusive definition and four for an inclusive definition. A relative

definition would be if participants indicated that WSP is Water Sensitive Planning where a basic definition acknowledged the acronym and included the consideration of water when planning.

Semi-inclusive would include the component of land-use management and the integration of planning land-use management and water sensitivity; while an inclusive definition included the goals of WSP in managing stormwater, catchment areas and the integration of WSP in the planning community. The planners were asked to rate their knowledge of WSP on a Likert scale from one to five; one being little to no knowledge and five identified as expert knowledge. Participants' experience with WSP were then questioned using a rating basis where one is no experience and five is expert experience.

Table 17 was created through a comparison method, the data for global challenges were compared with those of local challenges. If there was at least a 10% difference in rating of the global and local challenges the data was highlighted to illustrate how strongly South African planner's perspectives are on the similarities of global WSP challenges and local WSP challenges. The results were then interpreted and explained accordingly in the following section. The question of how spatial planning and water management could align to address the mentioned challenges were included to identify the planner's perspective and possible planning solutions for the provided challenges (cross-reference Annexure B). The answers were colour coded according to themes and include a legend. A colour code was used to highlight the key solution of each participant answer for convenience. Stormwater management, runoff, and water catchment agencies, wastewater and water recycling were allocated the same colour as they share a theme of excess water. IWRM, WSUD, integration, and transdisciplinary planning were grouped while water governance and policy implementation shared a theme. Sustainability, GI, and protection of the natural environment emerged as a group while maintenance of infrastructure and the creation of new policies were individually grouped. Although the sample size is small, this research might contribute to identifying specific knowledge gaps within the planning profession. Ultimately, the empirical investigation shapes conclusions and planning recommendations to set the scene for WSP in South Africa.

5.3 Empirical research results: Professional Planner survey

The survey included ten questions to consider the perspective of professional planners towards the status quo of WSP. This information, together with the literature review, was used in Chapter six to conclude on the importance and opportunities for WSP in South Africa. The section below offers the results for each question stated in the e-questionnaire together with crosstabulations to analyse the participating planners' views on WSP.

5.3.1 Work experience

The participants were asked to indicate their work experience (cross-reference Annexure C Question 2). The majority (83.3%) of the participants selected option number one (less than three years), which indicates that most of the planners are new to the field and are expected to have knowledge of innovative concepts such as WSP. Figure 17 illustrates that 83.3% of participants have less than three years of experience 6.7% have between three and seven years of experience while 10% have more than seven years of experience.

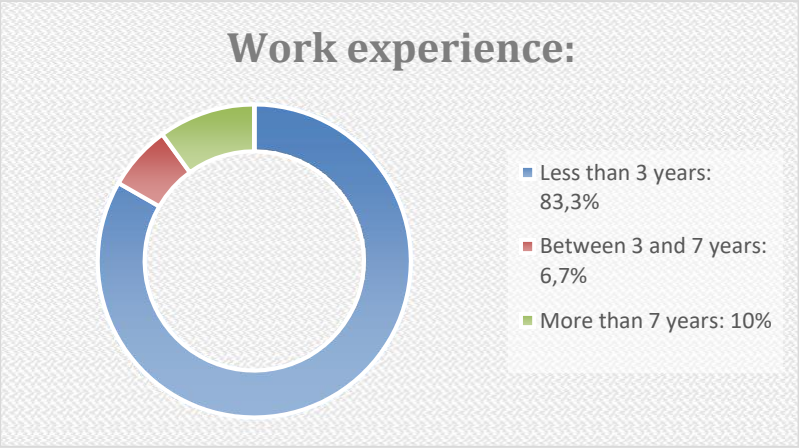


Figure 17: Work experience

In 2017 the University of the Western Cape and the University of Cape Town collaborated to evaluate water sensitive design principles for future cities where most of the researchers were students (University of the Western Cape, 2017). It could thus be argued that the new generation of planners is being educated on matters such as WSP. It is also useful to gather the perspectives of new planners to identify future trends in the planning profession. If younger planners have knowledge of WSP it might be an indication that the trend is more likely to be implemented in the future.

5.3.2 Defining WSP

The professionals were asked to define WSP (cross-reference Annexure C Question 3). None of the participants defined WSP as comprehensively as identified in the literature review namely "Water-sensitive planning (WSP) is an approach to sustainable development that integrates water considerations into urban and regional planning (Camron & Shamir, 2010)". Depending on if professionals mentioned sustainability, integration and planning the definition was considered comprehensive. WSP is an advocate for sustainable developments and aims to improve the planned environment through the enhancement of water resources, water quality and the protection of the natural environment while considering social, economic, and environmental

aspects (Cameron & Shamir, 2010). And it is thus apparent that knowledge regarding WSP is lacking in the planning profession. Figure 18

illustrates that 30% of professionals identified WSP with a relative understanding while 33.3% possessed a basic understanding, 26.7% identified WSP with a semi-inclusive definition and 10% identified WSP with an inclusive definition.

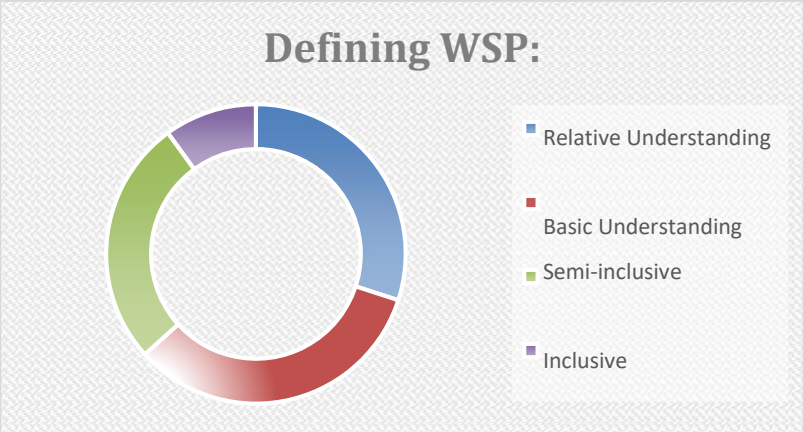


Figure 18: Defining WSP

None of the planners could provide an expert definition for WSP. It is thus apparent that more than half of the professionals could not accurately define WSP. The results imply that young professional planners have a less than a basic understanding of WSP. The participant's definitions include the consideration of water resources and water supply and demand.

5.3.3 Knowledge of WSP

The professionals were then asked to rate their knowledge of WSP (cross-reference Annexure C Question 4). Figure 19 below illustrates the data gathered. 6.7% of participants indicated to have no knowledge of WSP, 33.3% thought to have little knowledge, 43.5% indicated they have moderate knowledge and 16.7% of planners stated to have had near expert knowledge of WSP. The gap in WSP with regards to the professional environment is substantial.

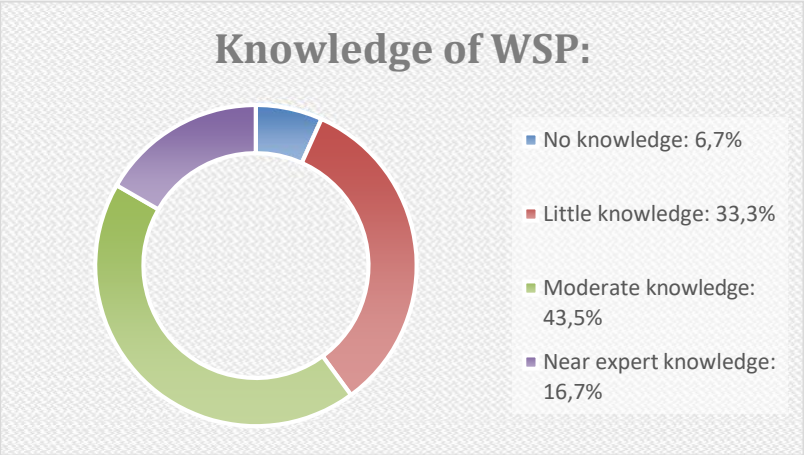


Figure 19: Knowledge of WSP

5.3.4 Experience with WSP

Participants' experience with WSP was then questioned using a rating basis where one is no experience and five is an expert experience (cross-reference Annexure C Question 5). Once again, no participants identified their experience on an expert level and Figure 20 illustrates that 33.3% of professionals have no experience, 30% have little experience, 33.3% have moderate experience and 3% have near expert experience.

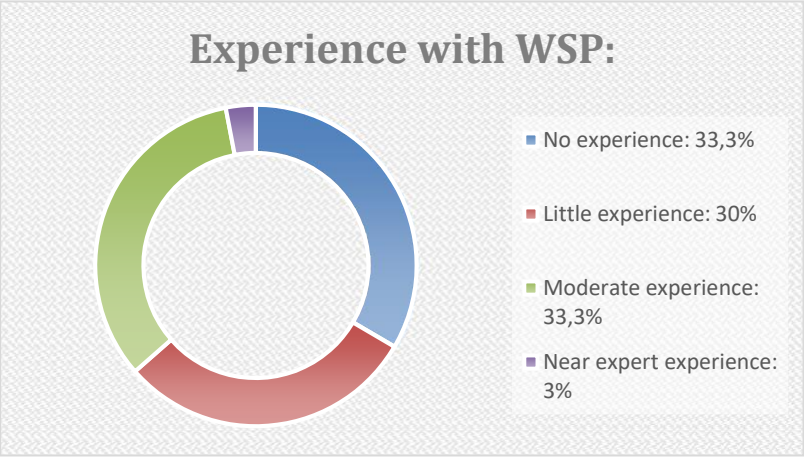


Figure 20: Experience with WSP

It is important to note that through the questionnaire none of the participants classified themselves as WSP experts. This does not mean that the participant's opinions are irrelevant but rather that a unique perspective is offered with regards to the gaps of WSP in alignment with spatial planning.

Correlation between experience with WSP and knowledge of WSP were considered through a cross-tabulation (cross-reference Annexure D). Knowledge of WSP was grouped to include:

1) No knowledge 2) Little knowledge 3) Moderate 4) Near expert knowledge.

The experience was grouped to include:

1) No experience 2) Little experience 3) Moderate 4) Near expert experience

as highlighted in Table 13.

Table 13: Cross-tabulation of experience with WSP and knowledge of WSP

			Knowledge coded		Total
			1&2	3&4	
Experience coded	1	Count	7	3	10
		% within Experience coded	70.0%	30.0%	100.0%
	2	Count	4	5	9
		% within Experience coded	44.4%	55.6%	100.0%
	3&4	Count	1	10	11
		% within Experience coded	9.1%	99.9%	100.0%
Total		Count	12	18	30
		% within Experience coded	40.0%	60.0%	100.0%

70% of participants with no experience with WSP processed little to no knowledge of WSP, while 55.6% of participants with little experience of WSP has moderate to near expert knowledge of WSP. Participants with moderate to near expert experience with WSP processed a 90.9% of moderate to near expert knowledge of WSP, it is thus evident that there is a correlation between work experience and knowledge of WSP, as work experience of participants increases so does the percentage of knowledge regarding WSP.

The p is identified in Figure 21 below, if the p (approximate significance) is smaller than 0.05 (5%) it is an indication that there is a statistically significant association between the factors (cross-reference Annexure D). The p-value indicates the effect size:

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.203[a]	2	0,017
Likelihood Ratio	9,096	2	0,011
Linear-by-Linear Association	7,869	1	0,005
N of Valid Cases	30		

Figure 21: Chi-Square Test

The p is identified as 0.017 (1.7%) and is smaller than 0.05 this confirms that there is a correlation between experience with WSP and knowledge thereof. The Phi-value then explains the significant association, as it was proven that there is an association between the two factors. As mentioned above the phi-value is 0.523 this further suggests that there is a significant association or large effect. Thus, experience with WSP is interdependent to the knowledge of WSP. As illustrated in Table 14 below (cross-reference Annexure D).

Table 14: Symmetric measures

		Value	Approximate Significance
Nominal by Nominal	Phi	0.523	0.017
	Cramer's V	0.523	0.017
N of Valid Cases		30	

$\sim 0.1\ practical\ non-significant\ assosiation\ or\ small\ effect$

$\sim 0.3\ practical\ visible\ significant\ association\ or\ meduim\ effect$

$\sim 0.5\ practical\ significant\ association\ or\ large\ effect$

5.3.5 Importance of WSP

The importance of WSP was then rated by the participants and in Figure 22 below it is highlighted that 43.3% of the participants rated WSP as extremely important and 41.9% rated WSP as moderately important (cross-reference Annexure C Question 6).

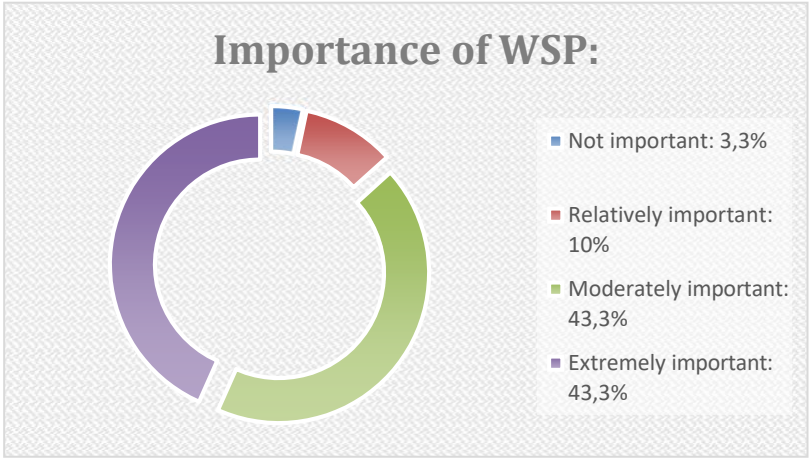


Figure 22: Importance of WSP

The results suggest that WSP is of importance to the participating planners but as previously stated it is not implemented and knowledge of WSP in lacking in the professional environment. The data was once again correlated to illustrate the relationship between work experience and the importance of WSP as illustrated in Table 15 below (cross-reference Annexure D). Work experience was grouped to include:

1) Less than three years of experience 2) Three years' experience 3) Seven years' experience 4) More than seven years' experience

The importance of WSP was once again grouped to include:

1) Low importance 2) Relevant importance 3) Moderate importance 4) Extreme importance

Table 15: Cross-tabulation of work experience and the importance of WSP

			Importance coded			Total
			1-3	4	5	
% wit in Work Experience coded	1	Count	3	12	10	25
		% within Work Experience coded	12.0%	48.0%	40.0%	100.0%
	2&3	Count	1	1	3	5
		% within Work Experience coded	20.0%	20.0%	60.0%	100.0%
Total		Count	4	13	13	30
		% within Work Experience coded	13.3%	43.3%	43.3%	100.0%

48% of professionals with less than three years of experience rated WSP with moderate importance while 40% rated WSP with extreme importance. 60% of participants with more than three years of experience rated WSP as extremely important. It is thus evident that there is a correlation between work experience and knowledge of WSP, as the experience of participants increases so does the percentage allocated to importance increase.

The p is identified in Figure 23 below, if the p (approximate significance) is smaller than 0.05 it is an indication that there is a statistically significant association between the factors (cross-reference Annexure D). The phi-value indicates the effect size:

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.338[a]	2	0,512
Likelihood Ratio	1,439	2	0,487
Linear-by-Linear Association	0,004	1	0,950
N of Valid Cases	30		

Figure 23: Chi-Square Test

P is identified as 0.512 this is higher than 0.05 and is thus not statistically significant, this suggests that WSP is moderate to extremely important regardless of the amount of work experience a single participant has. The data confirms the importance of WSP, and the p-value does not need

to be interpreted.

5.3.6 Global WSP challenges

The professionals then rated the importance of global and national challenges relating to WSP challenges (cross-reference Annexure B Question 7). The research acknowledges that South African planners might not have adequate knowledge of global WSP challenges but as the research is titled the perspective of professional planners, the aim was to compare South African professional planner's perspectives on global and national difficulties. These challenges as previously mentioned include water quality, supply and demand, water conservation, stormwater management and GI planning (cross-reference Section 3.2.1). This question aimed to compare local perspectives and evaluate if South African planners think that South Africa faces similar international challenges. Table 16 below captures the results of the rated global WSP challenges as per planner's perspective.

Table 16: Global WSP challenges

Importance	Water quality	Water supply & demand	Water conservation	Stormwater management	GI planning
No	-	-	-	-	-
Low	3.3%	-	-	-	-
Relative	26.7%	26.7%	16.7%	30%	23.3%
Moderate	26.7%	23.3%	33.3%	46.7%	43.3%
Extreme	43.3%	50%	50%	23.3%	33.3%

As seen in Table 16 planners did not rate any of the challenges as primarily unimportant, most planners rated the challenges with extreme importance. This might suggest that the WSP challenges selected for this questionnaire are of relevance because the participants could choose not to select any of the challenges. The mentioned challenges are not the only water-related challenges South Africa faces as mentioned in Chapter 3 (cross-reference Section 3.3.1) but rather represents compact concepts that might be of value for further consideration. Water quality together with supply and demand and water conservation are identified with extreme importance, while stormwater management and GI are allocated moderate importance. Water conservation was identified as the most important challenge while water supply and demand are considered as second important. Water quality is suggested to be least important according to the planners, this might be because South Africa generally supplies good quality water.

5.3.7 South Africa's WSP Challenges

Table 17 below captures the results of South Africa's rated WSP challenges as per planner's perspective (cross-reference Annexure C Question 8). Once again, most planners allocated challenges with an extremely important rating. Several planners, in contrast with global WSP challenges, rated the challenges with a low level of importance. Water quality, supply and demand and water conservation were again rated as extremely important while stormwater management is considered as moderately important. With regards to GI, planners rated it equally as relatively important and extremely important. Once again water conservation is identified as most pressing and this might be because of global water scarcities. In comparison to South Africa, global water quality is considered the third most important and this might be because of the connotation with other third world countries and their struggle with water quality.

Table 17: South Africa's WSP challenges

Importance	Water quality	Water supply & demand	Water conservation	Stormwater management	GI planning
No	3.3%	-	-	-	-
Low	3.3%	3.3%	-	3.3%	3.3%
Relative	13.3%	13.3%	16.7%	30%	33.3%
Moderate	30%	23.3%	30%	36.7%	30%
Extreme	50%	60%	53.3%	30%	33.3%

Table 18 illustrates a comparison of global WSP data and South Africa's WSP data. This table was constructed to highlight and compare how the planners rated the challenges on a global and national level, the methodology is explained above. Some disagreements regarding water supply and demand are observed but it was ultimately considered as extremely important and more so on a national level. General cohesiveness was observed regarding water conservation, the challenges were identified as extremely important and slightly in favour of a local context. Stormwater management and GI were identified as moderately important and leaned towards the global scale. Table 18 illustrates the participating planner's perspective on the relation of global and local challenges and to examine if international trends could be followed to address some of South Africa's water-related challenges.

Table 18: Comparison of global and national data

	Water Quality		Water Supply Demand		Water Conservation		Stormwater		GI	
	Global	**Local**	**Global**	**Local**	**Global**	**Local**	**Global**	**Local**	**Global**	**Local**
No	-	3.3%	-	-	-	-	-	-	-	-
Low	3.3%	3.3%	-	3.3%	-	-	-	3.3%	-	3.3%
Relative	**26.7%**	**13.3%**	**26.7%**	**13.3%**	16.7%	16.7%	30%	30%	**23.3%**	**33.3%**
Moderate	27%	30%	23.3%	23.3%	33.3%	30%	**46.7%**	**36.7%**	**43.3%**	**30%**
Extreme	**43.3%**	**50%**	**50%**	**60%**	50%	53.%	**23.3%**	**30%**	33.3%	33.3%

5.3.8 Alignment of spatial planning and water management

The question of how spatial planning and water management could align to address the above-mentioned challenges were included to identify the planner's perspective and possible solutions (cross-reference Annexure C Question 9). Annexure B captures the participant's answers, and six general themes were identified.

1) Stormwater management, runoff, wastewater, water recycling, and Water Catchment Agencies (WCA):

The planners emphasised that stormwater is not managed effectively, and suggested water catchment areas be created to mitigate runoff and reduce the risk of floods. The participants also raised concerns about wastewater and water recycling, stating that water should be treated and reintroduced into the water supply cycle.

2) Water governance:

The participants stated that the alignment between spatial planning and water management is reliant on adequate water governance. Water custodians should be appointed and the consideration of water resources with regards to planning should always be considered. Policies and legislative documents should carry weight and be deemed as mandatory.

3) Maintenance of infrastructure:

The participants emphasised the need to maintain water infrastructure to mitigate leaks and bursts. Several planners suggested that water pressure in urban areas be lowered to reduce water losses and place less strain on infrastructure.

4) Sustainability, GI, protecting the natural environment:

Sustainability and the protection of the natural environment has been key concepts in South Africa for several years. As a result, the participants placed great focus on the fact that spatial planning should align with water management to create a sustainable environment. The implementation of GI in urban areas could mitigate runoff and water could be conserved through bioswales and greywater tanks.

5) Create new policies:

Several participants suggested that to align spatial planning and water management new policies should be set in place. Although this research suggests the creation of a new national water plan it also found that new policies are not necessarily needed, but that the implementation of policies is the problem.

6) Integrated and transdisciplinary planning, WSUD, IWRM

Effective water management could be achieved by implementing integrated planning approaches. The participants highlighted that WSUD and IWRM should be considered and implemented in all urban developments. Creating a transdisciplinary team could result in the alignment of spatial planning and water management.

It is acknowledged that none of the participants are experts in WSP and that their knowledge is limited. But these gaps confirm the information in the literature review (cross-reference Section 3.3.1 & Section 1.6 Table 4) and could, therefore, be deemed relevant.

5.3.9 Custodians of WSP

The professionals were then asked whom they think the custodians of WSP should be and Figure 24 below illustrates the results (cross-reference Annexure C Question 10). Participants could select multiple answers, and this may influence the data percentages. The results indicate that urban planners should be the custodians of WSP in South Africa. This suggests that selected urban planners in South Africa think their profession be held responsible for the management of water.

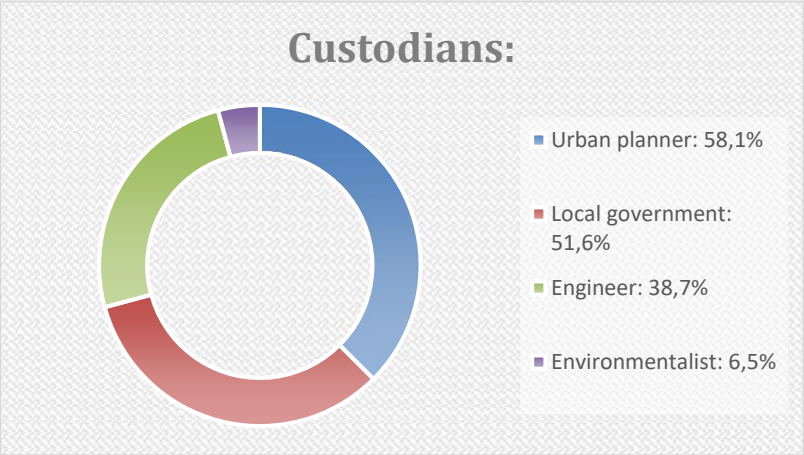


Figure 24: WSP custodians

As a result of the sample size, it cannot be generalised that all the professional planners in South Africa suggest that they be held responsible as custodians. But the results might indicate that a portion of planners suggest that the planning profession is suited to manage WSP in South Africa. This contributes to the dissertation on WSP and the attempt to set an inclusive scene for national water plan in South Africa.

5.4 Conclusion of Chapter 5

Chapter 5 intended to achieve the third aim of this research: To consider the perspectives of professional planners towards the status quo; and the consideration of the importance and opportunities for WSP in South Africa. The selected challenges included in the e-questionnaire proved relevant in the consideration of WSP from a spatial planning perspective. Global challenges and South Africa's challenges share similarities and may contribute to the credibility of this research. Through the literature review and specifically Chapter 3 the main thematic challenges were identified as water quality, water quantity, water conservation, water governance and water-related planning which included stormwater management and GI. The participating planners identified water quality, water supply and demand, water conservation, stormwater management and GI as extremely relevant WSP challenges in South Africa. Although the participants did not regard themselves as experts in WSP the link between theory and practice is relevant. As the theory suggests and the participants confirmed, transdisciplinary planning is the future (Abukhate 2007:67, Abukhate 2009:64-67, Armitage et al., 2014:8, Berstein 2015:1, Cooley et al., 2013:12, Scott et al., 2018:1-3, Stauffecher et al., 2008:109, Tejada et al., 2019, Van Wyk & Oranje 2014:8). Through the integration of disciplines, approaches and theories for a national water plan could be identified. Chapter 3 suggests that municipalities should not solely be responsible for the management of water and the participants agreed by nominating urban planners as water planning custodians. Regarding the alignment of spatial planning and WSP,

the theory suggested the themes of sustainability and governance to which the participants agreed. The opportunities identified through the empirical investigation includes the protection of the natural environment through Water Catchment Agencies' (WCA), stormwater management and GI. The opportunity for mitigating water losses through infrastructure management and governance was also identified.

CHAPTER 6 CONCLUSIONS

6.1 Introduction

Conclusions presented in this chapter are drawn from the literature and empirical investigation (cross-reference Chapter 2 & Chapter 3) captured in the previous chapters and aligned with the research objectives stated in Chapter 1 (cross-reference Section 1.3). This research aimed to consider WSP in South Africa from the perspectives of planning professionals to offer planning recommendations and serves as a conclusion to the research conducted and illustrates the importance of this research to the planning community. It identifies specific consideration to be implemented when planning for WSP in South Africa. In Chapter 1 (cross-reference Section 1.2) while discussing the problem statement of this research it became evident that transdisciplinary approaches are increasingly being considered in the planning profession. The importance of transdisciplinary planning is thus highlighted throughout the dissertation. Opportunities for WSP in South Africa were identified by the professional planners (cross-reference Section 5.3.8) and the literature, as previously mentioned South Africa is a water-stressed country and could benefit from WSP. South Africa requires a holistic national water plan, and this is highlighted in this chapter along with possible methods as to how to achieve such a plan.

6.2 Research conclusions

The primary aim of this research was to consider WSP in South Africa from the perspectives of planning professionals and to draw conclusions about the scope, challenges, and opportunities for the realisation of WSP in a national context. The main conclusions drawn from this research are -

6.3 Conclusion 1: Transdisciplinary planning approaches will play an increasingly important role in future planning endeavours.

Transdisciplinary planning is at the core of many revolutionary concepts, even before it was formally defined. Garden Cities incorporate the notion of transdisciplinary planning through the integration of urban and rural areas. Landowners or farmers integrated with urban areas and urban planners thus achieving social, economic, and environmental integration (cross-reference Section 2.2). Thereafter the notion of sustainability gained importance and that too promoted transdisciplinary planning, indicating that researchers, environmentalists, and the public worked together to promote awareness and create a sustainable environment. Once again unknowingly achieving transdisciplinary planning (cross-reference Section 2.2). Sense of place and public participation was then defined, and a key aspect of transdisciplinary planning became

mandatory, the introduction of NEMA, Smart Growth and urban design (cross-reference Section 2.3) all considered transdisciplinary planning approaches in some way.

In Section 2.3 it was determined that South Africa historical development influenced the planning profession in several ways. During South Africa's industrial evolution segregated housing was introduced and this affected the way South Africa implemented and developed planning approaches. The implementation of the Apartheid Model and homelands (cross-reference Section 2.3) is also an indication of how South Africa's planning profession was affected through its unique history. Overcoming historical animosities was identified as a spatial planning challenge for South Africa in Chapter 1 (cross-reference Section 1.6 Table 2) and Table 2 substantiates the concern. Locational disadvantages and how planning approaches are implemented in different locations contributed to the conclusion that historical development affected the planning profession (cross-reference Section 2.3).

In 1970 transdisciplinary approaches surfaced to combat challenges such as climate change and sustainability (cross-reference Section 2.2.1.1). Section 2.3.1 (cross-reference Section 2.3.1) identifies silo-planning as a spatial planning challenge and mentions the lack in data regarding transdisciplinary approaches, this might suggest that there are future opportunities regarding the research and implementation of transdisciplinary approaches. The importance of a transdisciplinary team is illustrated in Section 2.2.1 (cross-reference Section 2.2.1 Figure 5), the collaboration of specialists might guarantee the sustainability of future planning endeavours. Transdisciplinary planning suggests the collaboration of people from outside academia and the knowledge and experience of science/professionals (Stauffacher et al., 2008:420).

Transdisciplinary planning featured in many mainstream planning approaches and it could thus be concluded that transdisciplinary planning will continue to play a role in future planning approaches (cross-reference Section 2.2.1.1). It was previously observed that transdisciplinary planning is not only implied but evolved into a major consideration in the planning community. A conclusion derived from the empirical investigation suggests that transdisciplinary planning be implemented to achieve WSP (cross-reference Annexure B). WSUD and IWRM can only be achieved through transdisciplinary planning approaches (cross-reference Section 5.3.8) and interdisciplinary approaches (e.g., Environmental, social, technical, social and, economical) (Carden et al., 2018:7).

6.4 Conclusion 2: There are various opportunities for South African planners to include WSP as part of mainstream Urban Planning.

The opportunities for implementing WSP in South Africa are endless but depends on how the available knowledge on WSP is applied. Through observing global implementation and learning from global innovator's mistakes South Africa can identify the best course of action for the local implementation of WSP. As mentioned throughout this research the notion of sustainability is gaining importance and could be considered as an essential element in the planning industry (cross-reference Section 2.2.1.1 & Section 2.3.1.1). It is thus suggested that there are various implementation opportunities at different levels in South Africa for WSP. On a local scale, planning, water conservation, and stormwater quality could be improved (cross-reference Section 3.2.1 Table 7). Opportunities for the implementation of urban agriculture are highlighted while water could be conserved through rainwater tanks. Stormwater quality is improved through rain gardens, vegetated buffers, bio-retention planters, and on-site retention (Carden et al., 2018:4) (cross-reference Section 3.2.1 Table 7). Opportunities to implement WSP on a precinct level include stormwater storage, infiltration basins, urban forestry, and the construction of wetlands. While on a regional scale multi-use corridors and public open spaces are considered as major planning opportunities (cross-reference Section 3.2.1 Table 7). Other opportunities include GI, Low Impact Development, Best Management Practice, WSUD, IWRM, urban water management, and decentralised rainwater (Rohr, 2019:87-88).

South Africa has only actively been implementing WSUD for 6 years and it is considered a relatively new concept (cross-reference Section 3.3). The majority of planning professionals are not aware of the long-term benefits of WSUD and WSD (Carden et al., 2018:7), but research is making headway and innovation is promoted. The implementation of WSD in South Africa requires monitoring, careful design, green spaces, the participation of stakeholders, the inclusion of ecological infrastructure, and the translation of research into policies (Carden et al., 2018:10). The first step towards implementing WSP is the promotion of WSD through educating the public and planning professionals (cross-reference Section 3.3.1).

As a result of one South Africa's droughts, WSP has gained importance and the need for effective water management has become apparent (cross-reference Section 3.3). Chapter 3 includes WSP challenges and with challenges comes the opportunity to discover sustainable planning solutions, it is thus apparent that South Africa has various opportunities to include WSP into the planning profession (cross-reference Section 3.3.1). The participants of the e-questionnaire stated that urban planners should be the custodians of WSP, this implies that professionals in the industry prefer to include WSP into urban planning (cross-reference Section 5.3.9). The planners were asked to define WSP, based on the literature review and the research thereof the

definitions were rated (cross-reference Section 5.3.2). The results suggest that most planners defined WSP with relative understanding or a basic definition. This suggests a lack of detailed knowledge and understanding of WSP in South Africa which creates the opportunity to develop WSP into the urban planning profession. The opportunities for WSP as part of mainstream urban planning were derived from the participants (cross-reference Annexure B) is illustrated in Table 19.

Table 19: Opportunities of WSP as part of mainstream urban planning in South Africa

Opportunities of WSP as part of mainstream urban planning in South Africa	Examples
Managing city catchment areas (Cross-reference Annexure B).	Monitor and compare water losses (cross-reference Section 3.1.2). Implementing rainwater tanks, bio-retention swales, natural channels (cross-reference Section 3.2.1 Table 7). Integrated Urban Water Cycle Management (cross-reference Section 3.3.1 Figure 14).
Improve water governance (Cross-reference Annexure B & Chapter 4).	Implement transdisciplinary approaches. Seek consulting experts for each project (cross-reference Section 3.3.1.5). Appoint water governance custodian (cross-reference Annexure B). Consider the natural environment; wetlands and canals (cross-reference Section 3.2.1 Table 7).
Promote the integration of water management (cross-reference Annexure B & Chapter 3).	Encourage research and innovative suggestions in the planning community. Develop water-sensitive services (services such as water supply that considers water conservation); adaptive multifunctional designs that promote water sensitivity (cross-reference Figure 14).

	Collaboration with environmentalists to create urban farms, bio-swales, and wetlands (cross-reference Section 3.2.1 Table 7).
Improving sustainability through WSUD and thus green infrastructure planning (cross-reference Annexure B & Chapter 3).	Implement and promote green designs. Create company standards in which GI is compulsory (cross-reference Chapter 4). Implement rainwater tanks, on-site infiltration, rain gardens, and vegetation buffers (cross- reference Section 3.2.1 Table 7).
Improve the management of wastewater, stormwater, and runoff (cross-reference Annexure B & Chapter 3).	Educate rural communities and consider stormwater, wastewater, and runoff in new developments. Implement effective separate sewer systems, recycle water and canalisation (cross-reference Section 3.3.1 Figure 14)**.** Create vegetation buffers, on-site infiltration, and rain gardens (cross-reference Section 3.2.1 Table). Improving the resilience of water supply through stormwater and the utilisation of stormwater (Rohr, 2019:86-87). Point source management (cross-reference Section 3.3.1 Figure 14).
Assist in the development of a national water plan.	Identify gaps in the planning community. Participate in research. Support innovation through implementation. Consider WSP and spatial planning challenges (cross-reference Chapter 2 & 3). Appoint a water custodian (cross-reference Annexure B). Considered different levels of implementation (cross-reference Section 3.2.1 Table 7).

Overall promotion of public participation and transdisciplinary approaches (cross-reference Section 3.3.1.5).	Seek advice from community members on new projects and give back to the community through skill development (cross-reference Section 3.3.14). Seek advice from experts in different fields (cross-reference Section 3.2.1.5).

6.5 Conclusion 3: Professional planners emphasised the importance and opportunities for WSP in South Africa.

The perspective of planning professionals on the topic of WSP is visible throughout the research on a global and local scale but is manifested on a local scale in the results of the e-questionnaire. All the participants work in the private sector, this was not done deliberately (although more questionnaires were sent to them) but rather illustrates an honest representation of planners that were willing to participate (cross-reference Section 5.3). Most planners also had less than three years of work experience (cross-reference Section 5.3.1 Figure 17); the results of this investigation portrayed the perceptions of young planners working in the private sector. This research might illustrate the future trends for South African planners and set the scene for South Africa's planning profession in the future. The participating planners could reshape the planning profession and this dissertation might highlight prospects and thinking patterns such as the consideration of water resources, GI, and water sensitivity.

The planners were asked to define WSP and based on the literature review and the research thereof the definitions were rated. The results suggest that many planners defined WSP with relative understanding or a basic definition. This suggests a lack of knowledge and understanding of WSP in South Africa (cross-reference Section 5.3.2 Figure 18).

Most participants ranked with little and moderate experience and knowledge of WSP (cross-reference Section 5.3.4 Figure 21), a cross-tabulation was then conducted to determine the influence of WSP experience has on the knowledge of WSP (cross-reference Section 5.3.4 Table 13). The results suggest that the higher a planner's experience with WSP was the more knowledge they had about WSP. This result seems obvious, but it suggests that the planners that have experience with WSP did adequate research and gained knowledge regarding WSP and the implementation thereof. This might also suggest that WSP is not a known concept regardless of experience. The literature review suggests the same result as the amount of research available on WSP is limited. WSP is moderate to extremely important for participating South African planners regardless of their work experience (cross-reference Section 5.3.5 Figure 22).

Initially, South Africa's WSP challenges were identified as water quality, water supply and demand, water conservation, stormwater management and green infrastructure planning; these challenges were included in the e-questionnaire and sent out to planners for evaluation. The participating planners rated the selected challenges and identified water quality, water supply and demand and water conservation as the main WSP challenges in South Africa. The literature identified water quality, water quantity, water conservation, water governance and water planning as challenges (cross-reference Table 1-4). The empirical investigation and literature review thus agreed that water- quality, availability and conservation are the main concerns when dealing with WSP in South Africa (cross-reference Section 5.3.7 Table 17).

The literature suggests that water availability is the most important global challenges as it was discussed the most in the research reviewed (cross-reference Section 1.6 Table 2). The literature then deems population growth and urbanisation, water scarcities and water governance as extremely important while the participants favour stormwater management and water quality (cross-reference Section 1.6 Table 2 & Chapter 3 & 5). This seems appropriate as South Africa is a third world country which means that water quality, to mitigate disease, and stormwater management, to mitigate floods, are of great importance (Carden et al., 2018:7). The major overlying challenges are thus identified as water availability, population growth, and urbanisation, this statement is derived from the literature review and the empirical investigation. It was previously mentioned that the challenges were selected with a broad view to identifying the core challenges of WSP and not only location-based challenges (cross-reference Section 1.2). It is then agreed that the availability of water is of utmost importance and thus the conservation thereof. To create the framework for a national plan, a transdisciplinary approach should be followed where researchers, professionals and public representatives come together to discuss the best course of action (cross-reference Section 3.2.15).

The alignment between spatial planning and the challenges for WSP in South Africa is illustrated in Annexure B, as identified by the participants. Participants suggested that water governance be improved through maintenance and operation, that integrated water management might prove useful (cross-reference Section 6.4 Table 19). Water governance includes the appointment of water custodian, the custodian would then be responsible for policy creation and implementation as well as the promotion of sustainability and WSP. By combining spatial planning and WSP with consideration of the different challenges a solution might be reached. The planners also highlighted the need to layout stormwater systems and the inclusion of international trends. Sustainability and the consideration thereof were considered important and thus links with the consideration of integrated management and planning strategies (cross-reference Annexure B). The literature agrees with these viewpoints as previously mentioned in the evolution of South Africa's spatial planning and WSP (cross-reference Section

2.3). The opportunities as illustrated in Table 19 are derived not only from the e-questionnaire (cross-reference Annexure B) but also the literature (cross-reference Section 3.3). This suggests that the participating planners emphasise that there are opportunities for WSP in South Africa but that they are also regarded as important.

With regards to the custodians of WSP, the participants selected that urban planners be held responsible, as they could select from multiple options. This selection highlighted that they have thought to include integration between planners, the local government, and engineers. In some cases, environmentalists were also included (cross-reference Section 5.3.9 Figure 24). In the literature review a transdisciplinary approach or team was favoured with regards to the management of water (cross-reference Section 3.2.1.5 & Section 3.3.1.5). The argument of water custodian is an old one and each professional group feels that they are best suited for the job. From a spatial planning perspective, it makes sense that the planner be held responsible as the responsibility of creating a sustainable future lies ahead (cross-reference Section 5.3.9). The key point with regards to the governance of water is maintenance and management (cross-reference Section 3.3.1.4). Water losses through leaks and bursts are increasing and as previously stated water availability is the most pressing WSP challenge (cross-reference Section 3.3.1).

The limited inclusion of WSP in mainstream urban planning is suggested through the knowledge (cross-reference Section 5.3.3) and experience planning professionals have with WSP (cross-reference Section 5.3.4) The results illustrate that the majority participating planning professionals in South Africa have little experience and moderate knowledge of WSP. When consulting the literature this statement might hold some value, there is limited research of WSP in South Africa (cross-reference Section 2.3) and it could be argued that it resulted in limited implementation. WSP is not only the implementation of GI but also the integration of water-catchment areas and water awareness (cross-reference Section 1.6).

The participants of the e-questionnaire were asked to rate the importance of WSP, and the results identified WSP as moderately to extremely important (cross-reference Section 5.3.5 Figure 22). A cross-tabulation was conducted to evaluate the effect of the planner's work experience with how they rated WSP's importance. The results suggest medium meaningfulness, and this implies that WSP is moderate to extremely important for participating South African planners, regardless of their work experience (cross-reference Section 5.3.). The professional planners proceeded to align the WSP challenges with spatial planning thus highlighting that there are opportunities for WSP in South Africa (cross-reference Annexure B). The literature suggests that WSP is extremely important on a global and national scale (cross-reference Chapter 3) and could be used to mitigate water losses and improve water quality. WSP and WSC might be the future of sustainability and should be treated as such (cross-reference Section 2.2.1.1 & Section

2.3.1.1). Current and future cities could benefit from implementing a WSP approach and it is thus concluded that WSP and the opportunities it provides is of extreme importance.

6.6 Conclusion 4: WSP approaches are fundamental in creating a national water plan for South Africa

South Arica's National Water Act (Act 36 of 1998) includes several of the concerns incorporated in this dissertation (cross-reference Section 4.3 Table 12), however, the concept of WSP was only introduced in South Africa in 2014 (by way of the WSUD framework and guidelines - cross-reference Section 3.1) and is considered a relatively new concept. By considering spatial planning (cross-reference Section 2.3.1) and WSP (cross-reference Section 3.3.1) challenges an integrated national plan may be possible.

Challenges that will guide the development of a national water plan include, but are not limited to water availability, water quality, public health, water scarcities and conservation, water governance and transdisciplinary planning, water planning and environmental depletion (cross-reference Section 3.2.1 Table 7 & Section 1.6 Table 2). The main focus of the suggested national water plan would be WSP. Through the literature review, it was found that there are several national WSP challenges, through the consideration of these challenges the fundamentals of a national water plan may be identified (cross-reference Section 3.2). The challenges of a concept, in this case, WSP, is considered as fundamental for South Africa's national water plan. By reflecting on the challenges of WSP in South Africa guidelines emerge for the creation of an effective national water plan. Table 20 illustrates how WSP challenges could be considered fundamental when considering such a plan.

Table 20: WSP challenges as fundamental for SA national water plan

South Africa's WSP challenges	Examples
Water Quantity: **Water demand is surpassing the supply thereof (cross-reference Section 3.3.1).**	Monitor water losses and implement pressure control. Improve maintenance to avoid water losses through leaks and bursts (cross-reference Section 3.3.1).
Water Quality: **Good quality water, however; in rural areas, the quality of water is not of a high standard (cross-reference Section 3.3.1).**	Implement equality with regards to water supply and quality (cross-reference Section 3.2). Educate communities on identifying clean water sources and provide sources if needed.
Water Conservation: **As a result of one of South Africa's drought water conservation has gained importance**	Educate communities on water conservation. Consider shorter supply distances to minimise water losses (cross-reference Section 3.3.1).

and trends are being implemented to conserve water (cross-reference Section 3.3.1).	Implement green spaces and infrastructure in the urban environment.
Water Governance: **Implementation of necessary infrastructure may be lacking (cross-reference Section 3.3.1).**	Identify a custodian for water and grant the necessary authority. Considered transdisciplinary teams by involving community members in the decision making proses.
Water Planning: **Management with regards to floods are lacking in informal and rural areas. In parts of South Africa, dense urban areas are grieved by the lack of management (cross-reference Section 3.3.1).** **South Africa is increasing considering ecosystem services and is actively preventing environmental depletion (cross-reference Section 3.3.1).**	Educate rural communities in the art of managing stormwater through trenches. Implement a compulsory stormwater evaluation for developments. The implementation of green spaces and other GI infrastructure should be mandatory (cross-reference Section 3.3.1). Promote the protection of the natural environment and ecosystem services (Carden et al., 2018:11). Mandatory GI and transdisciplinary teams that include experts in the environmental and social fields.

6.7 Conclusion of Chapter 6

Chapter 6 captured the four major conclusions of this research and it is thus apparent that there is enough evidence to show that South Africa requires a holistic national water plan. The consideration of transdisciplinary planning approaches and the importance and opportunities for WSP in South Africa could be used as a point of departure for such a national water plan. The evaluation of the professional planners' opinions suggests that there is a demand for the alignment of WSP and spatial planning and the result might be a national water plan (cross-reference Annexure B). Chapter 6 suggests that transdisciplinary planning has always been an underlying approach but is gaining importance in the planning profession. WSP might gain momentum because of this, the new generation of planners are focused on sustainability and innovation. Chapter 6 proved that there are many opportunities for the implementation of WSP and that the participating planners have an interest in the topic. Chapter 7 illustrates the methods of achieving a national water plan for South Africa based on the conclusions mentioned above.

CHAPTER 7 PLANNING RECOMMENDATIONS

7.1 Introduction

This chapter captures the planning recommendations drawn from this research to enhance WSP approaches in South Africa in quest of a national water plan. As previously stated, there are a few highlighted challenges regarding WSP in South Africa (cross-reference Section 1.6 Table 4). As previously mentioned in Chapter 5 (cross-reference Section 5.2), the research was limited to a small sample selection, but the participants proved to be a newer generation of planners. This might result in a unique consideration of planning recommendations and the future of the planning profession in South Africa. This does not take away the limitation of the small sample size but merely provides a unique viewpoint. The following recommendations are based on this research and it is acknowledged that there are other solutions to the mentioned challenges.

7.2 Recommendation 1: Transdisciplinary planning approaches should be emphasised as part of mainstream Urban Planning, especially relating to land use and water management.

The literature investigation highlighted the importance of transdisciplinary approaches and in Chapter 6 (cross-reference Section 6.4 Table 19) it was shown that transdisciplinary planning approaches will play an increasingly important role in future planning endeavours. It is therefore evident why transdisciplinary planning is included as a planning recommendation in this research. Through creating awareness and promoting skill-sharing among professionals it might be possible to increase the sustainability and efficiency of projects. When considering sustainability through urban planning several complex challenges emerge, it is theorised that the implementation of transdisciplinary approaches might address these problems (Kviberg, 2008:11-12). Transdisciplinary planning should ultimately narrow the gap between research and implementation. Transdisciplinary planning combines expertise from science and non-academia to create sustainable planning solutions and this is achieved through public participation (Stauffacher et al., 2008).

Transdisciplinary approaches complement various professions through the identification of similarities (Kviberg, 2008:12), and through skill-sharing, challenges might be resolved more effectively and possibly more sustainably. When considering water management, the environment, economy, and social aspects should be considered (Kviberg, 2008:12) and while urban planners have knowledge about these concepts, they are by no means experts in each field. Thus, to find the most sustainable planning solutions, transdisciplinary planning should be implemented. Through the implementation of public participation, the public might accept

conflicting decisions with increasing ease (Stauffacher et al., 2008). Including researchers and non-academics into the decision-making process, partnerships are created between parties who would otherwise not been involved (Tejard et al., 2019). Furthermore, team building, and communication is promoted, and trust is established (Tejard et al. 2019). By combining insights from researchers and people from outside academia unique problem-solving skills come to light (Stauffercher et al., 2008 & Tejard et al., 2019). It is thus recommended that transdisciplinary planning be implemented as part of mainstream urban planning, especially relating to land use and water management through public participation and the integration of researchers and practical departments. The transdisciplinary team should include non-scientific community members and various experts such as anthropologists, environmentalists, economists, and urban planners, urban ecologists that are engineering orientated to identify all the challenges and reach the best conclusion. This could be achieved through legislation that identifies transdisciplinary approaches as mandatory. It is recommended that guidelines be set in place that requires a transdisciplinary team e.g., professionals, academics, and the public. Public participation and space aware residents are promoted but the inclusion of academics is not necessarily considered or suggested. As previously stated, rural community members could greatly contribute and learn from stormwater management (cross-reference Section 6.6 Table 20). The participating planners identified transdisciplinary planning as a gap with regards to WSP and the planning environment. This section addressed a way to implement WSP in the planning profession and thus considering the participating planners' concerns.

7.3 Recommendation 2: WSP should be considered on both local and national scale to enhance the opportunities thereof for South Africa

Through the opportunities identified in Chapter 6 (cross-reference Section 6.4 Table 19) recommendations are made. It is suggested that water catchment areas should be managed effectively, this is achieved firstly through the establishment of water catchment agencies for each water management area (Herrfahrdt-Pähle, 2010:10). Water catchment agencies (WCA) are accountable for the protection, conservation, use, development, and management of water resources (Herrfahrdt-Pähle, 2010:10) and if water WCA are monitored and implemented, it might be possible to manage water catchment areas effectively. Secondly, water management areas should be divided into correlating water catchment areas (Herrfahrdt-Pähle, 2010:11) so that water sources and water demand areas overlap, this will ensure shorter transporting distances and thus decreasing water losses.

Another opportunity identified is improving issues in water governance. As previously stated, South Africa has sufficient legislative context regarding the management of water and apart from creating a national water plan South Africa should rather adjust existing laws and policies

regarding water management (cross-reference Section 4.2). Concerns regarding the implementation of legislative context regarding water resources were questioned in Chapter 5 (cross-reference Section 5.3.9. Updating the current national water plan, as mentioned in Chapter 4, is also suggested (cross-reference Annexure B). Promoting communication between governing sectors might also contribute to addressing water governance challenges. Chapter 4 highlighted gaps in South Africa's legislative context regarding WSP, little to no guidelines are offered with regards to the implementation of WSP and revision of water legislation are suggested (cross-reference Section 2.4).

Through the implementation of multilevel governance an understanding of how authorities implement policies is offered (Corfee-Morlot et al., 2009:25). It can thus be determined on which scale WSP approaches are best implemented and therefore gaps and opportunities could be identified. Implementing national WSP trends might result in the implementation of effective WSP on a local scale as well. Multilevel governance could also prove useful in identifying the relationship between cities (Corfee-Morlot et al., 2009:25), regions and the nation. These opportunities are identified to enhance WSP in South Africa and to set the scene for a national water plan and this might encourage local authorities to implement WSP approaches. Considering WSP on a national scale allows urban planners to form assessments on larger scales, the water source and supply chain could be analysed to identify related challenges. National WSP embodies the local concept and is therefore intertwined, national consideration is conceptualised (Herold, 2008:227-229). Implementing a holistic approach to WSP might result in enhanced opportunities for South Africa.

IWRM also emerged as an opportunity, as previously stated IWRM considers a spatial planning approach. The modelling of IWRM studies the interaction humans have with their environment (Badham et al., 2019) and this is a suggested recommendation to improve the integration of water resource management. IWRM modelling suggests the cooperation of the project managers and stakeholders to improve the quality and effectiveness of IWRM (Badham et al., 2019). As previously mentioned, the consideration of transdisciplinary planning approaches might be beneficial for the integration of IWRM. IWRM was identified as a gap in Annexure B and the implementation thereof was addressed in this section (cross-reference Section 3.2 & Annexure E).

Implementing WSUD to increase the sustainability of urban areas was suggested by the professional planners in the e-questionnaire (cross-reference Annexure B & Section 3.2), WSUD utilises water resources responsibly and innovatively through the construction of wetlands, education programs, controlling stormwater runoff, and implementing regulations to name a few

(Beza et al., 2018:369). As previously stated, it was determined that urban planners be the custodians of WSP with transdisciplinary decision-making as its core (cross-reference Section 5.3.9). It is recommended that urban planners, governments, and communities be held responsible for the implementation and upkeep of WSP in South Africa. It is recommended that governing water spheres communicate with one another and that local challenges be deemed equally as important as national issues. As mentioned above the implementation of WSUD does not only benefit local communities but might reduce nation-wide water stress depending on the scale of implementation (cross-reference Section 3.3.1).

The participating planners expressed concern regarding the creation of new policies, this was debunked in Chapter 4 (cross-reference Section 4.2) where it was found that South Africa has adequate policies and legislation, however, these documents are not implemented. The participants further identified a gap in the governance of water which was addressed in this section.

7.4 Recommendation 3: Professional planners should be sensitised towards the opportunities, benefits, and status quo relating to WSP approaches in a quest to enhance WSP in South Africa

As identified through the e-questionnaire, professional planners considered WSP important, but a large portion of the participants had little experience with WSP. It could thus be suggested that WSP is not greatly implemented in the participant's professional environment. If professions are aware of the opportunities and benefits WSP offers, WSP approaches might be increasingly considered (cross-reference Section 6.4). As previously stated, sustainability is a key consideration in the planning community and through the education of professional planners, WSP could also reach this status (cross-reference Section 2.3.1.1 & Section 3.3.1.3). Through the implementation of lifelong learning, curiosity is created and professional might have the ability to adapt better to change and innovation (Laal, 2012:4271). Lifelong learning is achieved by creating awareness through specialised conferences and seminars to educate professional planners on WSP or by implementing a specialised subject during the education phase.

As previously stated, South Africa is facing a water crisis and urban planners might play a role in the solution of managing water effectively. By promoting and implementing education in the planning profession, opportunities and innovative concepts might be implemented and understood better by professional communities (Laal, 2012:4270) (cross-reference Section 6.4 Table 19). It is therefore suggested that planning professionals should be sensitised towards the opportunities and benefits of WSP through lifelong learning. Through the promotion of Continued

Professional Development (CPD) points by the South African Council for Planners (SACPLAN) this might be achieved.

7.5 Recommendation 4: WSP approaches should be emphasised in South Africa in quest of a national water plan

There are a few highlighted challenges regarding WSP in South Africa (cross-reference Section 1.6 Table 4), the following challenges are selected for recommendations: Water quality, water quantity, water conservation, water governance and water planning. The selected challenges were derived from the literate review with consideration of all the listed challenges included in the e-questionnaire (cross-reference Section 5.3.7 Table 17). The challenges are also derived from the information given when participants were asked how spatial planning and WSP could align to address the provided challenges (cross-reference Annexure B). This section aims to illustrate that WSP approaches should be emphasised in South Africa through analysing water quality, water conservation, water planning, water governance and sustainability.

7.5.1 Water quality

Water quality is considered a challenge in the implementation of WSP and should, therefore, be considered in South Africa's WSP approaches. Table 19, as previously mentioned, illustrates the identified recommendations for water quality challenges (cross-reference Section 6.4 Table 19). The participant planners offered no insight into the aspect of water quality and public health but touched on wastewater treatment and recycling water (cross-reference Annexure B).

Ecological wastewater treatments include land treatment, wetlands, high-rate algae ponds, and aquaculture fishponds (Polprasent et al., 2015:3-4). Planners should consider the inclusion of wastewater treatments on a developing site and this may result in the improvement of water quality in the development of rural areas. By implementing a wastewater treatment plant on-site, the community might be educated and will cooperate in skill development for future opportunities. Watershed conservation is also considered a solution to poor water qualities, this is achieved through the conservation of the natural environment such as wetlands and creating awareness through private companies (Tellman et al., 2018). The participants in the empirical investigation identified water recycling, sustainability, wastewater treatment, and the protection of the environment as gaps with regards to WSP in South Africa (cross-reference Annexure B). The section above illustrates how these factors can be implemented to achieve sustainable WSP by addressing water quality issues.

7.5.2 Water quantity

Water availability is considered a WSP challenge as well as an approach, the availability of water is a crucial component when considering the management of water and ultimately WSP. Water availability includes water supply and demand as identified in the e-questionnaire, several planners mentioned the lack of inadequate supply of water and water losses because of poor infrastructure management. This challenge is thus inclusive in all aspects of this research and the following section aims to offer planning recommendations to improve water availability.

Water supply challenges might occur because of decreasing water availability, freshwater resources are being depleted and one solution might be to implement desalination of saltwater (Fisher, 2019). Water conservation and harvesting rainwater might increase availability freshwater resources on earth (Fisher, 2019) and promoting sustainability and the effects of climate change may also influence the conservation of natural water resources. Including rainwater and stormwater harvesting implementation into the IDP and SDF might increase urban water availability (cross-reference Chapter 2 & 3).

Reservoirs are considered a sustainable solution for water availability difficulties; reservoirs are built to store water for urban areas or in the event of a dry spell and for agricultural purposes (Fisher, 2019). The consideration of storage losses is of importance and the detection of water losses through leaks and evaporation may seem futile but accounts for a large portion of South Africa's water losses (Mukheibir, 2010). Maintaining and monitoring water losses may prove as one of the best solutions for water availability in South Africa.

Water demand in South Africa is much higher than the supply thereof (cross-reference Section3.3.1.2). However, the adequate supply of water includes the decrease of water losses through leaks and bursts (Lombard, 2017). Some solutions to reduce water losses include the improvement of internal coordination, improving metering, leak reduction through control, pressure measurement, detection and repair and lastly improving overall infrastructure management (Mukheibir, 2010:3-4). With regards to urban and regional planning water availability solution includes consideration and awareness, water supply is not necessarily a planner's responsibility but the ability to consider water resources and supply methods may result in a more sustainable urban environment. Infrastructure management and pressure control are major factors when considering water availability. Individual metering and a reduction of stand plot sizes could reduce leaks and bursts and thus improve the availability of water in urban areas. The participants in the empirical investigation identified infrastructure maintenance as a gap with regards to the effective management of WSP. By harvesting rainwater, greywater and, stormwater the municipal water demand could be reduced and thus providing less expensive water in the

long run (Carden et al., 2018:9).

7.5.3 Water conservation

Water conservation is considered a WSP challenge and should, therefore, be considered in the quest for creating a national water plan for South Africa. Table 19 illustrates the identified recommendations for water conservation from a spatial planning perspective as described below (cross-reference Section 6.4 Table 19). The current status quo of water conservation is improving, awareness is created with regards to water conservation and thus a conscious effort is observed to conserve water in certain parts of South Africa.

Water conservation and climate change are derived from the literature review (cross-reference Section 3.3.1.3), and the answers provided by the planners who participated in the e-questionnaire (cross-reference Section 5.3.7 Table 17). As previously stated, urban and regional planners should be concerned about water losses and plan future development with the consideration of water sources, availability, and supply distance (cross-reference Section 3.3.1.2). As derived from the planner's perspective of spatial planning and WSP challenges, integration of sustainability and expertise are necessary to conserve water (cross-reference Annexure B). Integrated urban water systems may result in a satisfactory clean water supply (Novotny, 2008:1), by integrating water systems water is recycled and used to its full potential.

Water conservation can be defined as reducing water losses or consumption, using water efficiently and managing water adequately (Kumari & Singh, 2016:76). Conservation strategies include rainwater harvesting, improving irrigation, and desalination (Kumari & Singh, 2016:77-78). The environment, economy and social aspect should be in balance for water systems to be considered sustainable (Novotny, 2008:1). By implementing green development and smart growth, water and the natural environment could be conserved. Public education and community participation are also considered a method for conserving water in urban and rural areas (Kumari & Singh, 2016:79). As previously mentioned, the implementation of GI and transdisciplinary approaches was identified as gaps and throughout this Chapter, methods of implementation are discussed to implement WSP and create a national water plan for South Africa.

7.5.4 Governance of water planning approaches

Water governance is derived from the literature review and the participating planner's opinion on the alignment of spatial planning and WSP to address the presented challenges (cross-reference Section 3.3.1.4). Several planners suggested that water governance could be the main solution

to the identified WSP challenges (cross-reference Annexure B). The construction of a national water plan that considered water availability, ecosystems, and water-intensive services is suggested (Kumari & Singh, 2016:78). The need for a national water plan for South Africa has been highlighted throughout this research, such a plan may result in the adequate guidelines for implementing WSP in South Africa. Such a national plan should compensate for all the mentioned challenges and implications South Africa faces (cross-reference Section 3.3.1.4). Water demand should be decreased and supply increased while the environment is protected (Viljoen & van der Walt 2018:3). Core concepts for a national water plan should ideally include the regulation of water and clear and effective instructions to do so (Viljoen & van der Walt, 2018:3). Table 21 below illustrates policies and legislation relating to water in South Africa as well as the identified gaps and suggested recommendations.

Table 21: Water governance recommendations

Name	Gaps	Recommendations
White Paper on Water Supply and Sanitation Policy (1994)	• Consideration of conservation. • Guidelines on how to implement effective water management/planning. • Environmental consideration. • Lacks transdisciplinary approaches. • Lacks integrated planning.	• Annual conferences that promote environmental awareness and conservation for professional planners. • The promotion of WSP through grants and bursaries. • Educating professionals through compulsory transdisciplinary planning on an annual basis.
Constitution of the Republic of South Africa (Act 108 of 1996)	• Sustainable water planning methods are not present. • Mandatory guidelines on water supply are lacking. • Transdisciplinary approaches & Integrated planning was not identified.	• Annual conferences on WSP methods and implementation strategies. • Educating professionals through compulsory on transdisciplinary planning on an annual basis.

White Paper on National Water Policy for South Africa (1997)	• Little environmental consideration. • Water sensitivity is not mentioned. • Mandatory water supply guidelines should be visible. • Transdisciplinary approaches & Integrated planning were not identified.	• Mandatory conferences on environmental consideration. • Compulsory WSP courses completed annually. • Educating professionals through compulsory on transdisciplinary planning on an annual basis.
Water Services Act (Act 108 of 1997)	• No Environmental consideration. • Mandatory water supply guidelines are not presented. • Water sensitivity, WSP, WSUD is not mentioned. • Transdisciplinary approaches & Integrated water planning was not identified.	• Annual compulsory WSP seminars and short courses. • Educating professionals through compulsory on transdisciplinary planning on an annual basis.
National Water Act (Act 36 of 1998)	• Guidelines on water sensitive supply & transdisciplinary approaches are not highlighted.	• Annual compulsory WSP seminars and short courses. • Educating professionals through compulsory on transdisciplinary planning on an annual basis.
National Environmental Management Act (Act 107 of 1998)	• WSP & Transdisciplinary approaches are not mentioned.	• Annual compulsory WSP seminars and short courses. • Educating professionals through compulsory on transdisciplinary planning on an annual basis.
Strategic Framework for Water Services (2003)	• Transdisciplinary approaches & WSP guidelines are not mentioned. The framework was updated and minor mentions of sustainability was noted.	• Annual compulsory WSP seminars and short courses. • Educating professionals through compulsory on transdisciplinary planning on an annual basis.

Spatial Planning and Land Use Act (No. 16 of 2013)	• Transdisciplinary approaches. • WSP guidelines. • Water sensitive supply guidelines. • Conservation and environmental consideration. Are all not considered.	• Annual compulsory WSP seminars and short courses. • Educating professionals through compulsory on transdisciplinary planning on an annual basis. • Annual conferences on environmental protection.
Millennium Development Goals (2015)	• Transdisciplinary approaches. • Integrated management. • WSP guidelines. • Environmental consideration. **Are not considered**	• Annual compulsory WSP seminars and short courses. • Educating professionals through compulsory on transdisciplinary planning on an annual basis. • Promotion of WSP research through grants and bursaries.
Draft for National Water and Sanitation Master Plan (2018)	• Transdisciplinary planning. • WSP guidelines. • Environmental consideration. • Pressure control. • Maintenance on infrastructure. • Guidelines for effective water supply. • Public health and water quality. • Countermeasures for the effect of urbanisation. • Reducing supply distances. • Employing water custodians. • Guidelines on the management of stormwater and wastewater.	• Annual compulsory WSP seminars and short courses. • Educating professionals through compulsory on transdisciplinary planning on an annual basis. • Promotion of WSP research through grants and bursaries. • Water quality control through regular documentation. • Monitoring urban development through council meetings. • Vote on water custodians. • Compulsory conferences on stormwater and wastewater.

Source: Cross-reference Chapter 4

A consistent approach for WSP should be implemented on all spheres of government and therefore a consistent approach should be developed that accommodates both local and national levels (Carden et al., 2018:11).

7.5.5 Water planning

Stormwater management is included in the literature and the e-questionnaire (cross-reference 3.3.1.5 & Section 5.3.7 Table 17), the aspect of flooding was specifically derived from the literature. Flooding in urban areas can be reduced through the sustainable management of stormwater and SuDS, this could be achieved by mimicking the natural environment (e.g., swales and wetlands) and implementing ecological engineering (Novotny, 2008:8-10). Solutions to stormwater management challenges include the implementation of GI, rainwater catchments, green spaces, green rooftops, and permeable pavements to name a few (O'Neill & Cairns, 2016:20). Local stormwater management strategies include infiltration trenches and swales while regional strategies incorporate wetlands, retention ponds and detention ponds (Armitage et al., 2013:6-7). South Africa not only experiences stormwater challenges in urban areas but also in rural areas, identified strategies for rural areas include creating water channels, harvesting rainwater, harvesting stormwater and vegetation (Adegun, 2014:4, Fisher-Jeffes et all., 2017). Most rural areas have little to no vegetation (lawns and gardens) and this contributes towards the promotion of floods in these areas. Implementing sidewalks and pavements may also decrease the risks of floods, with regards to rural communities and public participation may be the only means to manage stormwater (Adegun, 2014:6). Education is thus of extreme importance, if rural community members are properly educated on how to manage stormwater, safety might increase as well as a decrease in water losses. Stormwater management and runoff were identified as a gap in the planning profession with regards to WSP (cross-reference Section 7.6.4 Table 21). By harvesting stormwater water security and flooding can be improved (Fisher-Jeffs et al., 2017:3-4), the importance of GI is thus highlighted.

GI planning was derived from the initial research; participating planners rated GI as the least important challenge, but the component of ecosystem services and environmental depletion was not included. As previously stated, the literature review identified GI as a WSP challenge from several sources and thus it was included in the dissertation (cross-reference Section 1.6). Stormwater management, water conservation, and water availability all mentioned GI as an important solution component and thus the challenge of implementation emerges. GI might influence water quality through natural treatment while rainwater harvesting may increase water supply (O'Neill & Cairns, 2016:25). Urban ecosystem services considered include provisioning (e.g., freshwater), cultural (e.g., recreation) and regulating (e.g., water purification and climate regulation) (Gómez-Baggethun et al., 2013:179). These ecosystem services were selected because of their relevance to this research. By implementing and considering the optimization of ecosystem services in urban planning, the effects of climate change might decrease, and the provision of an aesthetic and environmentally pleasing urban environment is created. Ecosystem services can be implemented through the consideration of natural infiltration, green spaces,

environmental protection, implementing buffers, and public participation (Woodurf & BenDor, 2016). Through regulating policies and preserving the ecosystem the environment is protected and the importance of ecosystem services is realized (Woodurf & BedDor, 2016). It was previously mentioned GI planning includes examples such as rainwater harvesting, swales, and the consideration of green open spaces (cross-reference Section 3.3.1.4). Clear objectives should be set to ensure that new infrastructure and developments include GI and ultimately WSP (Carden et al., 2018:11).

7.7 Recommendation 5: More research is needed to understand the challenges and opportunities of WSP approaches from a transdisciplinary perspective.

The results of the e-questionnaire showed that the participating planners do not have adequate knowledge of WSP (cross-reference Section 5.3.2 & Section 2.2.2), which identifies the urgent need to bridge this gap via transdisciplinary planning approaches. This will strengthen an educational approach and provide better support for planners to engage with WSP as part of broader spatial planning approaches. Given the small empirical research sample, generalisations could not be drawn from this research, but it did provide a point of departure to further discuss the issues identified from this research, specifically in terms of lack of knowledge, the interface between the disciplines of spatial planning and water management and point of departure for creating a comprehensive water planning framework for South Africa (cross-reference Section 5.2). The lack of knowledge and interface between spatial planning and water management is discussed in the following section to create points of departure for a holistic national water plan in South Africa. Table 22 is offered to summarise the recommendations for such a national water plan followed by the conclusion of this research.

7.7.1 Addressing limited knowledge pertaining to WSP

In an attempt to address the current limited knowledge pertaining to WSP, especially from a trans-disciplinary perspective, it is recommended that educational platforms be revised to include at least, to some extent, the realities pertaining to WSP and the impact thereof within multi-disciplines. Educators, and all professional planning bodies, would need to enforce such a revised teaching-learning approach to equip students and future planners (cross-reference Section 6.4 Table 19) with tools to implement WSP. WSP should be acknowledged as a planning challenge and not only the local authority's responsibility, Continuous Professional Development (CPD) as envisioned by the South African Council for Planners (SACPLAN) could also include WSP as part of broader sustainability thinking and include compulsory seminars and workshops as part of life- long learning and knowledge.

The importance and value of participatory planning in relation to WSP objectives should also be

enhanced. When public participation is promoted, skill-sharing takes place and the lack of knowledge decreases (cross-reference Section 2.3). Community members often have a unique understanding of the challenges faced in a particular area, in spending so much time observing one problem members of the community could contribute fitting solutions (cross-reference Section 6.6 Table 20). In promoting transdisciplinary planning approaches, the objectives of WSP could be more reachable, especially when ownership is highlighted, and communities understand the value chain. Chapter six mentioned the lack of WSP research from a transdisciplinary perspective and that the gap between research and implementation should be eliminated (cross-reference Section 6.4). Results from this research illustrate that there is a demand for even more research regarding WSP approaches from a transdisciplinary perspective. Carden et al. (2018:11) suggest that research should be supported and that skills could be developed through capacity building initiatives. Table 4 illustrates some of South Africa's WSP challenges and commonalities were drawn for this research, it is thus evident that more case study-based research should be

conducted to understand South Africa's WSP challenges. When the challenges of WSP is understood then the opportunities will be increasingly relevant. The implementation of transdisciplinary approaches has been discussed throughout the research and the benefits of considering WSP from a transdisciplinary perspective are summarized as:

- Increasing water supply through alternative sources.
- Improving sustainability and water conservation.
- Increased environmental consideration.
- A holistic approach to WSP.
- Community involvement which improves water quality and stormwater management.
- A decrease in floods and runoff.
- Consideration and implementation of legislation.
- The consideration of water supply infrastructure and a reduction in water losses.

7.7.2 WSP approaches in South Africa should be enhanced in quest of a national water plan.

Integrating the spatial planning discipline with that of the water management discipline could be achieved through transdisciplinary planning, which has been discussed fully, and by implementing multi-level governance. Enhancing communication between professional planners, urban ecologists and water engineers and municipalities are the greatest recommendations. When communication between disciplines is strong teamwork increases and thus problem-solving skills (cross-reference Section 6.4 Table 19). Water catchment areas should be managed by monitoring water losses, and IWRM. By implementing multifunctional designs, the interface between spatial

planning and water management could be enhanced.

7.7.3 Proposed national water framework for South Africa

The provided planning recommendations suggest an integration between water governance and planning professionals to ultimately create cohesion and a holistic national water plan (cross-reference Annexure B & Section 6.4 Table 19). Throughout this Chapter, the status quo of WSP was observed through the selected challenges and reveals that WSP is gaining importance in the planning community. Considering the social aspects of WSP it could be said that public participation and community involvement are at the heart of WSP (cross-reference Section 2.3 & Section 6.6 & Section 7.3). There is a vast number of opportunities for WSP in South Africa and the ultimate recommendation for WSP would be to create awareness around water resources and the challenges with regards to implementation. By implementing WSP as the main component in planning approaches this could be achieved. The quest for a holistic national water plan is ambitious but it is recommended that South Africa approaches WSP through the consideration of water availability, water quality, water conservation, stormwater management, water governance, and GI. If these factors are considered from a transdisciplinary perspective a holistic national water plan is possible. To conclude and offer a point of departure for a holistic national water plan for South Africa Table 22 is constructed.

Table 22: Point of departure for a South African national water plan

	Theoretical perspective included in the literature review	The perspective of stakeholders as obtained through Empirical investigation	Opportunities identified based on this research
Water Quality	Overall good potable water quality. Pollution in rural and urban areas. (cross-reference Section 3.3.11)	Identified as an extremely important challenge by planners (cross-reference Section 5.3.7 Table 17).	Public participation and education to raise awareness of water pollution (cross-reference Section 2.3 & Section 6.6 Table 20 & Section 7.3).
Water Quantity	Demand is surpassing supply. As a result of South Africa's unique terrain, water needs to be transferred further which can causes	Identified as an extremely important challenge by planners. Concerns for the availability of water and the increasing demand. (cross-reference Section	Maintain infrastructure (cross-reference Section 3.3.1.2 & Section 7.6.1). Encourage research and innovation (cross-reference Section 6.4 Table 19 & Section 6.6 Table 20). Effective stormwater management

	water losses. (cross-reference Section 3.3.1.2)	5.3.7 Table 17).	(Stormwater, rainwater, and greywater harvesting) (Fisher-Jeffes et al., 2017:3). Broader WSD approaches. (cross-reference Section 7.6.1 & Section 7.6.3) Lowering water pressure in urban areas (cross- reference Section 7.6.1).
Water Conservation	The conservation of water is gaining importance (cross-reference Section 3.3.1.3).	Conservation is gaining importance as the realisation of South Africa's water scarcities set in (cross-reference Section 5.3.7 Table 17).	Encourage public participation (cross-reference Section 2.3 & Section 6.6 & Section 7.3). Rainwater and stormwater harvesting (cross-reference Section 7.6.1 & Section 7.6.3). Implementing GI (cross-reference Section 7.5.6). Public education to create awareness about water losses (cross-reference Section 6.6 Table 20).
Water Governance	Traditional approaches are implemented. Lack of policy implementation. Struggling to overcome historical animosities/ WSP should be included in all policies, legislation, and approaches. (cross-reference Section3.3.1.4)	The planners suggest that there is not a custodian for water management and that responsibility and blame are shifted. Lack of policy implementation. Lack of integration between disciplines and spheres of government. (cross-reference Section 4.2 & Section 7.6.4 Table 21)	Implement point source management (cross-reference Section 7.6.1). Encourage transdisciplinary planning (cross-reference Section 3.3.1.5). Appoint an urban planner as water custodian (cross-reference Section 5.3.9). Improve communication and implementation between professionals (cross-reference Section 7.6.4 Table 21). Policies should align guidelines and challenges (Carden et al., 2018:4). Implement NEMA and educate professional. WSP should be mentioned in all policies, legislation, and approaches. (cross-reference Section 4.2)

Water Planning	Little focus is placed on informal/rural areas. Stormwater is not managed effectively. Public participation is essential. Systems should be monitored. (cross-reference Section3.3.1.5).	A lack of stormwater management and runoff. Water recycling is not taking place. The consideration of green designs is increasing. WSP is overlooked. Supply infrastructure is not maintained. (cross-reference Annexure B & Section 6.4 Table 19).	Implement transdisciplinary planning (cross-reference Section 3.3.1.5). Considered IWRM to promote sustainability (cross-reference Section 3.2 & Section 7.4 & Section 7.6.3). Implement WCA to lower water costs and floods (cross-reference Section 7.4). Manage stormwater through the implementation of GI (cross-reference Section 7.5.6 & Section 7.6.1 & Section 7.6.3). Maintain infrastructure and monitor water losses through the lowering of pressure systems (cross-reference Section 3.3.1.2 & Section 7.6.1).
Water Sustainability	In theory, it is important, but implementation is lacking. Population growth and urbanisation are increasing while natural resources are overexploited. (cross-reference Section 2.3.1.1)	A high consideration of sustainability is observed.	Promote green designs through life-long learning (cross-reference Section 6.6 Table 20 & Section 7.5). Encourage transdisciplinary planning (cross-reference Section 3.2.1.5). Protect wetlands and natural environment through education and policies (cross-reference Section 4.2 & Section 7.5.6). Promote urban farms (cross-reference Section 7.5.6). Conserve natural resources through rainwater, stormwater, and greywater harvesting (cross-

reference Section 7.6.1 & Section 7.6.3).

Water quality can be improved through public participation and education to raise awareness of water pollution. Educating the community on the dangers of water pollution could contribute to the improvement of water quality. Recycling stormwater and wastewater can also improve South Africa's water quality, to improve public health, water quality must first be improved. Providing save clean drinking water for all is stated in South Africa's Constitution and by achieving this water pollution might decrease as a result. Improved water quality could also be achieved through the provision of adequate service delivery and infrastructure.

Water quantities are decreasing because water demand is surpassing the supply thereof. If the infrastructure is maintained, water losses will decrease, and water quantities will increase; this could be achieved by lowering water pressure and through policy implementation and encouraging innovation. Through encouraging research and innovation alternative water supply sources can be discovered and implemented. Rainwater, stormwater, and greywater harvesting are considered alternative supply sources and will improve the quantity of available water. South Africa's rivers are being overexploited (cross-reference Section 3.3.1.2 Figure 15), and this compromises the availability of water in South Africa. The extreme water scarcities South Africa faces also contributes to the lack of available water resources and therefore climate change should be mitigated through GI. WSUD could improve the availability of water because alternative water sources are used (e.g., rainwater harvesting, swales, reservoirs, green corridors, water recycling), thus finding sustainable alternatives.

The conservation of water requires public participation, by creating awareness of water losses conservation might be possible. Stormwater and rainwater harvesting are means to conserve water resources as alternative sources are used and municipal water demand decreases. Implementing GI (e.g., bioswales and rain gardens) also contributes to the conservation of water resources. Sustainable planning approaches such as IWRM, WSD and WSP could also contribute to the conservation of water resources.

The governance of water should include transdisciplinary planning and improved communication between professionals. All policies, legislation, approaches should include WSP and challenges should align with guidelines. Point source management should be implemented to monitor water losses, degrading infrastructure, and water levels. Communication between professionals and

spheres of government is encouraged to create cohesion regarding policy implementation and suggested trends.

Water planning includes a variety of components, transdisciplinary planning is required to achieve effective water planning. If urban planners are appointed as custodians water losses should be monitored and reported. Innovation and continued research are needed to accomplish the effective management of water. Life-long learning and the promotion of seminars are required to improve water planning approaches.

Sustainability can be achieved through the promotion of green designs and life-long learning. Appointing a transdisciplinary team to a project can result in a higher level of sustainability, the natural environment for example is more likely to be protected if an ecologist is a part of the team. GI is encouraged through rainwater, stormwater, and greywater harvesting along with blue-green corridors. Sustainability can also be achieved through public participation and creating awareness about the importance of the natural environment and resources. The implementation of green and blue corridors is suggested to improve the supply of water, lower water losses and promote overall sustainability.

7.8 Conclusion of Chapter 7

Figure 25 illustrates a plan for the implementation of a national water plan for South Africa. The overlying component is identified as transdisciplinary planning and should be implemented in education, the professional environment, governance, and sustainability. A theoretical framework for WSP would ideally initiate in the education phase. The education phase includes the incorporation of WSP in university curricula and to update curricula annually to consider new trends. Students should be encouraged to employ life-long learning. The professional environment should encourage research and innovation through educational seminars (i.e., continuing professional development). Planners should monitor water losses and maintain infrastructure(thus implementing water resource management) to mitigate water losses and improve water supply and demand. Public participation is needed to implement transdisciplinary planning and improve WSP. With regards to governance, it is suggested that WSP be incorporated into all approaches, policies, and legislation and that the guidelines of WSP align with the challenges thereof. The enforcement of legislative context is necessary together with that of public participation. The strategy for sustainability includes the harvesting of stormwater, rainwater, and greywater. Water should be recycled to improve water supply through alternative source supply. Green and blue corridors should be implemented for the same reason and thus sustainability is improved. When considering a national water plan it is important to reduce water demand and increase water supply while protecting the ecosystem (Viljoen & van der Walt

2018:3). Figure 25 below illustrates the above-mentioned strategy. Through the combination of research, and professional experience the quest for a holistic national water plan could be achieved. And by laying the groundwork through education the awareness of WSP could be enhanced.

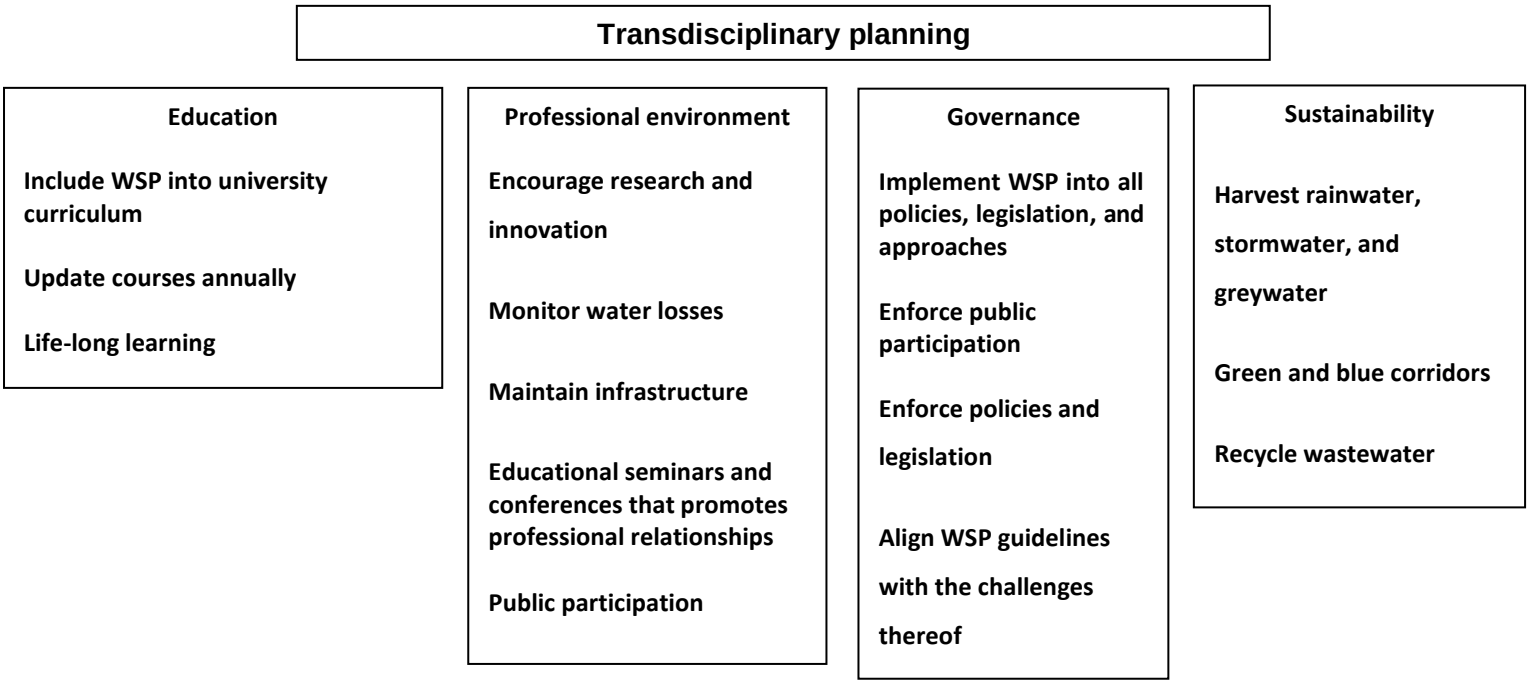


Figure 25: Implementing WSP

This research aimed to consider WSP in South Africa from the perspectives of planning professionals and to draw conclusions regarding the scope, challenges, and opportunities for the realisation of WSP in a national context. Chapter two considered South Africa's WSP evolution and illustrated that although WSP is a relatively new concept, the consideration of water has always featured in the South African context. Chapter five considered the perspectives of professional planners in South Africa and it was concluded that there is knowledge of WSP, but the implementation thereof might be lacking. Although the professionals did not have a lot of work experience the data captures the perspectives of the new generation of planners. The opportunities for WSP in South Africa are illustrated in Chapter six and Chapter seven concludes with recommendations to contribute to the realisation of WSP in a national context. It is recommended that South Africa creates a national water plan with Table 22 and Figure 25 as a guideline and appoint a transdisciplinary team of role players that includes professional planners, local and national authorities, and the community.

Bibliography

Abukhater, A. 2009. Rethinking planning theory and practice: A glimmer of light for prospects of integrated planning to combat complex urban realities. Theoretical and Empirical Researches in Urban Management. 2(11):64-79.

Abu-Zeid, M. & Shiklomanov, I.A. 2003. Water resources as a challenge for the twenty-first century. *World Meteorological Organisation* 959:1-140.

Adegun, O.B. 2014. Coping with stormwater in a Johannesburg, South Africa informal settlement. Municipal Engineer, DOI: 10.1680/muen.13.00030.

Acheampong, R.A. 2018. The Concept of Spatial Planning and the Planning System. [In the Book: Spatial Planning inGhana, Chap 2]. 10.1007/978-3-030-02011-8_2.

ActionAid. 2006. Climate change, urban flooding and the rights of the urban poor in Africa. Key findings from six African cities. *ActionAid international.*

Adisa, R.S. 2014. Rural development in the twenty-first century as a global necessity. Department of Agricultural Extension and Rural Development, University of Ilorin, Ilorin Nigeria.

Ahern, J., Cilliers, S. & Niemela, J. 2014. The concept of ecosystem services in adaptive urban planning and design: A framework for supporting innovation. Landscape and urban planning, 125(2014):254-259.

Akindele, O.A. & Asani, M.A. 2017. Paradigm shift in town planning: Applications and implications for Nigeria. Impact journal. 5(9):147-160.

Albrechts, L. 2006. Shifts in strategic spatial planning? Some evidence from Europe and Australia. Environment and planning. 38:1146-1170.

Albrechts, L. 2001. How to Proceed from Image and discourse to action: As applied to the Flemish diamond. Urban studies. 38(4):733-745.

Angelakis, A.N. & Zheng, X.Y. 2015. Evolution of water supply, sanitation, wastewater and stormwater technologies globally. *Water* 2015(7):455-463.

Angelopulo, G. 2017. A competitive assessment of Southern Africa's leading cities- National, continental and global perspectives. *Strategic review for Southern Africa* 39(1):65-92.

Armitage, N., Fisher-Jeffes, L., Carden, K., Winter, K., Naidoo, V., Spiegel, A., Mauck, B. & Coulson, D. 2014. Water sensitive urban design (WSUD) for South Africa: Framework and guidelines. Water research commission. 588(14):1-34.

Armitage, N., Vice, N., Fisher-Jeffes, L., Winter, K., Spiegel, A. & Dunstan, J. 2013. Alternative technology for stormwater management. The South African guidelines for sustainable drainage systems. Report to the Water Research Commission by the University of Cape Town. Report no . TT 558/12. ISBN 978-1-4312-0413-7

Bâc, D.P. 2008. A history of the concept of sustainable development: Literature review. University of Oradea, Faculty of Economics, 1st – 3rd Universitatii St. Oradea, dbac@uoradea.ro p.576-580.

Badham, J., Elsawah, S., Guillaume, J.H.A., Hamilton, S.H., Hunt, R.J., Jakeman, A.J., Pierce, S.A., Snow, V.O., Babbar-Sebens, M., Fu, B., Gober, P., Hill, M.C., Iwanaga, T., Loucks, D.P., Merritt, W.S., Peckham, S.D., Richmond, A.K., Zare, F., Ames, D., Bammer, G., 2019. Effective modelling for Integrated Water Resource Management: A guide to contextual practices by phases and steps and future opportunities. Environmental Modelling & Software 116, 40-56. https://doi.org/10.1016/j.envsoft.2019.02.013

Behdad, P.E. 2006. Adaptive Reuse Program City of Los Angeles. 2 ed. City of Los Angeles.

Department of Water Affairs (DWA). 2013. Strategic overview of the water sector in South Africa. Version 1.5.

Berrisford, S., Hendler, P., Joseph, S., King, N., Lester, N., Luthango, M.B., Magni. P., Mkhize, M. & Napier, M. 2015. The urban land paper series. Vol. 1. New York, Wunderhorn, Heidelberg. Archipelago Books.

Berrisford, S. 2011. Unravelling Apartheid spatial planning legislation in South Africa: A Case Study. Durban Forum. 22:247-263.

Bernstein, J.H. 2015. Transdisciplinary: A review of Its origins, development, and current issues. Journal of Research Practice. 11(1):1-20.

Bertule, M., Lloyd, G.J., Korsgaard, L., Dallton, J., Welling, R., Barchiesi, S., Smith, M., Opperman, J., Gray, E., Gartner, T., Mulligan, J. & Cole, R. 2014. Ecosystem-based management approaches for water-related infrastructure projects. Green infrastructure: Guide for water management. 5-68.

Beza, B., Zeunert, J. & Hanson, F. 2018. The Role of WSUD in Contributing to Sustainable Urban Settings. 10.1016/B978-0-12-812843-5.00018-6.

Bhagwan, J., Wegelin, W., Mckenzie, R. & Wensley, A. 2014. Counting the lost drops: South Africa's study into non-revenue water. Water practice and technology. (9)4:1-9.

Boller, M. 2004. Towards sustainable urban stormwater management. *Water Science and Technology: Water supply* 4(1):55-65.

Bouton, S., Cis, D., Mendonca, L., Pohl, H., Remes, J., Ritchie, H. & Woetzel, J. 2013. How to make a city great. 1st ed. McKinsey&Company.

Bran, F., Popa, D. & Popa, C. 2012. Spatial planning: Challenges and European approaches. Proceedings of the 6th international management conference. Approaches in organisational management, Romania. p.462-467.

Brink, E. 2016. Dust to dust. Solidarity Research Institute. https://navorsing.solidariteit.co.za/wp-content/uploads/sites/19/2016/01/2016-01-28_SRI_Drought-Report.pdf. Date of access: 10 Dec. 2018.

Brockett, L. 1996. The history of planning south African new towns: Political influences and social principles adopted. Department of Town and Regional Planning, University of Witwatersrand.

Carden, K., Ellis, D. & Armitage, N.P. 2016. Water sensitive cities in South Africa: developing a community of practice. WIT Transactions on the built environment. (165):51-62.

Carden, K., Armitage, N., Fisher-Jeffes, L., Winter, K., Mauck, B., Sanya, T., Bhikha, P., Mallett, G., Kanyerere, T & Gxokwe, S. 2018. Challenges and opportunities for implementing water sensitive design in South Africa. WRC Project report K5/2412, Pretoria

Carmon, N. & Shamir, U. 2010. Water-sensitive planning: integrating water considerations into urban and regional planning. Water and environmental journal. 1-11.

Carron. 2010. Strategic Planning: Concept and rationale. Eugène Delacroix, Paris. International Institute for Educational Planning.

Cassaedo, C. & Jones, J.A.A. 2011. Managing water in a changing world. *Water* 2011(3):618-628.

Chini, C.M., Canning, J.F., Schreiber, K.L., Peschel, J.M. & Stillwell, A.S. 2017. The Green Experiment: Cities, Green Stormwater Infrastructure, and Sustainability. Sustainability. 9(105):1-21.

Cilliers, E.J. & Timmermans, W. 2014. The importance of creative participatory planning in the public place-making process. Environment and Planning B: Planning and Design 2014 41:413-429.

Civic, K. and Siuta, M. (2014) Green Infrastructure – Training manual for trainers. ECNC, Tilburg, the Netherlands and CEEweb for Biodiversity, Budapest, Hungary. Copyright © 2014 ECNC and CEEweb

Claasen, M. 2013. Integrated resource management in South Africa. *International journal of Water Governs* 1(2013):326-338.

Condon, P.M., Cavens, D. & Miller, N. 2009. Urban planning tools for climate change mitigation. Lincoln institute of land policy. Cambridge.

Corburn, J. & Sverdlik, A. 2017. Slum upgrading and health equity. *International Journal of Environmental Research and Public Health,* 14(342):1-12.

Corfee-Morlot, J., Kamal-Chaoui, L., Donovan, M.G., Cochran, I., Robert, A. & Teasdale, P. 2009. “Cities, Climate Change and Multilevel Governance”, OECD Environmental Working Papers N° 14, 2009, OECD publishing, © OECD

Cooley, H., Ajami, N., Ha, M., Srinivasan, V., Morrison, J., Donnally, K. & Christian-Smith, J. 2013. Global water governance in the 21st century. California, Pacific Institute.

Cosgrove, W. & Rijsberman, F. 2000. World water vision. 1st ed. Washington, DC. Earthscan Publications Ltd.

Davies, C., MacFarlane, R., McGloin, C. & Roe, M. s.a. Green Infrastructure planning guide. http://www.greeninfrastructure.eu/images/GREEN_INFRASTRUCTURE_PLANNING_GUIDE.pdf Date of access: 30 June 2018.

DEA (Department of Environmental Affairs). 2016. Climate change adaptation perspective of disaster risk reduction management in South Africa-Provincial modelling of drought, flood and sea level rise impacts and a description of adaptation responses (ed Munzhedzi, S.M., Khavhagali, V.P., Midgley, G.M., de Adreu, P., Scorgie, S., Braud., M. & Abdul, Z.) Long-term adaption scenarios Flagship Research Programme. Pretoria.

de Ridder, E.T. & Mothupi, J.M. 2018. Projecting water demand in South Africa. 1-9.

Ding, C. 2009. Policy and planning challenges to promote efficient urban spatial development during the emerging rapid transformation in China. *Sustainability*: 1:384-408; DOI10.3390/su1030384

Du Plessis, D.J. 2013. A critical reflection on urban spatial planning practises and outcomes in Post-Apartheid South Africa. *Springer:* DOI 10.1007/s12132-013-9201-5

Donnenfeld, Z., Crookes, C. & Hedden, S. 2018. A delicate balance: Water security in South Africa. South Africa, Institute for Security Studies (ISS). 1-24.

Duhl, L.J. & Sanchez, A.K. 1999. Healthy cities and the city planning process: A background document on links between health and urban planning. World Health Organization 1-36.

European Commission 2013. Building a Green Infrastructure for Europe. European Union, Belgium doi: 10.2779/54125

Enemark, S., Mclaren, D. & Mclaren, R. 2008. Preventing informal development – through means of sustainable land use control. Integrating Generations FIG Working Week 2008 Stockholm, Sweden.

Engel, J., Jokiel, D., Kraljevic, A. & Geiger, M. 2011. Big cities. Big water. Big challenges. Water in an urbanising world. 1st ed. Germany, Berlin, WWF.

European Union. 2010. Making our cities attractive and sustainable. Belgium. European Commission.

European Union. 2016. Inspiring future cities & urban services shaping the future of urban development & services initiative. Switzerland. World economic forum.

Everett, G., Lamond, J. & Lawson, E. (2015) Green infrastructure and urban water management. Handbook on Green Infrastructure: Planning, Design and Implementation. 50-66.

Fisher, M.R. 2019. Environmental biology. Creative Commons Attribution 4.0 International License. Pressbook. https://openoregon.pressbooks.pub/envirobiology/front-matter/introduction/ Date of access: 4 March 2020.

Fisher-Jeffes, L. & Armitage, N.P. 2013. Charging for stormwater in South Africa. Water SA, 39(3):429-436.

Fisher-Jeffes, L., Carden, K. & Armitage, N. 2017a. A water sensitive urban design framework for South Africa. *Town and Regional Planning*, 71. *http://dx.doi.org/10.18820/2415-0495/trp71i1.1*

Fisher-Jeffes L, Carden K, Armitage NP, Winter K 2017. Stormwater harvesting: improving water security in South Africa's urban areas. S Afr J Sci 113: #2016-0153

Fletcher et al is a good reference for this - Fletcher, T.D., Shuster, W., Hunt, W.F., Ashley, R., Butler, D., Arthur, S., Trowsdale, S., Barraud, S., Semadeni-Davies, A., Bertrand-Krajewski, J.L. and Mikkelsen, P.S., 2015. SUDS, LID, BMPs, WSUD and more–The evolution and application of terminology surrounding urban drainage. Urban Water Journal, 12(7), pp.525-542.

Folifac, F.A. 2007. National water policies and water services at the extremes: what challenges must be faced in bridging the gap? Learning from the South African Experiences. *African water journal*, 1(1):2-19.

Fulazzaky, M.A. 2014. Challenges of integrating water resource management in Indonesia. *Water*, (6):2000-2020

Goga, S. and Pegram, G. 2014. Water, energy and food: A review of integrated planning in South Africa. Understanding the Food Energy Water Nexus. WWF-SA, South Africa.

Gourbesville, P. 2008. Challenges for integrated water resource management. *Physics and chemistry of the earth* 33:284-289, DOI:10.1016/j.pce.2008.02.002

Government Gazette, 3012. Act no. 16 of 2013. Spatial planning and land use management Act. Cape Town 578:36730

Gregory, D., Mansfield, C., Richardson, M., Harvy, A. & Collins, Z. s.a. Global city challenges.The creative and socio economy solution. the British council.

Groenewald, D. & Powell, J. 2016. Relationship between sustainable development initiatives and improved company financial performance: A South African perspective. Acta Commercial 16(1):1-14.

Hagerman, E. 2012. Challenges to regional infrastructure development. Paper funded by and prepared for the Development Bank of Southern Africa. www.tips.org.za

Hendler, P. & Wolfson, T. 2013. The planning and the “unplanning” of urban space 1913 to 2013: privatised urban development and the role of municipal governments. Paper presented at the Conference on ‘Land Divided: Land and South African Society in 2013, in Comparative Perspective’, University of Cape Town, 24 – 27 March 2013.

Hansen, Rieke & Pauleit, Stephan. (2014). From Multifunctionality to Multiple Ecosystem Services? A Conceptual Framework for Multifunctionality in Green Infrastructure Planning for Urban Areas. AMBIO. 43. 10.1007/s13280-014-0510-2.

Herrfahrdt-Pähle, Elke: Introducing catchment management : the case of South Africa / Elke HerrfahrdtPähle. – Bonn : DIE, 2010. – (Discussion Paper / Deutsches Institut für Entwicklungspolitik ; 3) ISBN 978-3-88985-479-7

Hermanson, J.A. 2016. Slums, informal settlements and inclusive growth in cities: examples from Morocco and Columbia. Washington, DC

Herod, A. 2008. Scale: The local and the global. https://www.researchgate.net/publication/247445656_Scale_The_local_and_the_global Date of access: 28 March 2020.

Herrfahrdt-Pahle, E. 2010. South African water governance between administrative and hydrological boundaries 2(2010):111-127, DOI: 10.3763/cdev.2010.0038

ICLEI-Africa, Josefsson J, Stephen V and Fairhurst, L. 2012. Building Climate Resilience. Retrofitting as an Adaptation option for the City of Cape Town, South Africa. Cape Town.

Jimenez-Cisneros, B. 2015. Responding to the challenges of water security: the Eighth Phase of the International Hydrological Programme, 2014–2021, DOI:10.5194/piahs-366-10-2015

Joseph, S.L, Bickford, G. & Magni, P. 2016. State of South African cities report ’16. South African CitiesNetwork. 1-416.

Jones, L., Martin, P., Pereznieto, P. & Standley, S. 2011. Exploring the impact of climate change on children in South Africa. Department of Environmental Affairs and UNICEF.

Kumari, M. & Singh, J. 2016. Water conservation: Strategies and solutions. *International Journal of Advanced Research and Review*. 1:75-79. https://www.researchgate.net/publication/312525328

Kemp, D., Leonard, R., Koth, K. & Walton, A. 2016. Water sensitive urban design: An investigation of current systems, implementation drivers, community perception and potential to supplement urban water services. Water. 8(272):1-15.

Khatri, K.B. & Vairavamoorthy, K. 2007. Challenges for urban water supply and sanitation in the developing countries. Discussion Draft Paper for the session on Urbanisation The Netherlands

Kramer, M.G. 2014. Enhancing sustainable communities with green infrastructure: A guide to help communities better manage stormwater while achieving other environmental, public health, social, and economic benefits. 1-57.

Kruger, S. & Luke, R. 2015. Current issues in the transport and supply-chain environment in South Africa. Journal of Transport and Supply Chain Management 9(1):1-3.

Kurunthachalam, S.K. 2014. Water conservation and sustainability: An utmost importance. Hydrology: Current research. 5(2):1-3.

Kusangaya, S., Warburton, M.L., van Garderen, E.A. & Jewitt, G.P.W. 2013. Impacts of climate change on Southern Africa: A review. Physical and Chemistry of the Earth 67(69):47-54.

Kviberg, K. 2008. Value and price: a transdisciplinary approach to urban water management. *WIT Transactions on Ecology and the Environment* 108:11-21. doi:10.2495/EEIA080021

Lafortezza, R., Davies, C., Sanesi, G. & Konijnendijk, C.C. 2013. Green Infrastructure as a tool to support spatial planning in European urban regions. iForest http://www.sisef.it/iforest/contents/?id=ifor0723-006 Date of access: 29 June 2018.

Leinfelder, H. & Vanempten, E. 2008. SPATIAL PLANNING CHALLENGES – IMPRESSIONS. Ghent University-Centre for Mobility and Spatial Planning,
2 Katholieke Universiteit Leuven, Department of Architecture, Urbanism and Spatial Planninghttps://www.researchgate.net/publication/228460644

Lofrano, G. & Brown, J. 2010. Wastewater management through the ages: A history of mankind. *Science of the total Environment* 408(22):5254-5264.

Lombard, A. 2016. How to save a city: Considering water provision complexities from a spatial planning perspective. Potchefstroom: NWU (mini-dissertation).
Mäntysalo, R., Kangasoja, J.K. & Kanninen, V. 2015. The paradox of strategic spatial planning: A theoretical outline with a view on Finland, Planning Theory & Practice 16(2):169-183.

Lumb, A., Sharma, T.C. & Bibeault, J. 2011. A Review of genesis and evolution of Water Quality Index (WQI) and some future directions. *Springer* 3:11-24.

Marković, I. & Babić, I. 2014. Importance of interdisciplinary spatial planning of national parks: Case study of Croatia. Journal of US-China Public Administration 11(3):221-231.

Masante, D., McCormick, N., Vogt, J., Carmona-Moreno, C. & Cardano, I. 2018. Drought and water crisis in Southern Africa, European Commission, Ispra, 2018.

McGranahan, G. & Satterthwaite, D. 2014. Urbanisation concepts and trends. 2de ed. International Encyclopedia of Social and Behavioural Science.

Mckenzie, R., Siqalaba, Z.N. & Wegelin, W.A. 2013. The State of Non-Revenue Water in South Africa (2012). The Water Wheel. 12(1):1-8.

Mohamed, E.S. 2013. Global challenges and local actions in the Built Environment Sustainable urban development challenges: a global perspective. UN-Habitat. Gothenburg, Sweden

Mukheibir, P. 2010. Less water losses: An integrated approach for small water supply systems. Presented at Ozwater10, Brisbane 8-10 March 2010. https://www.researchgate.net/publication/262676555

Muller. M., Schreiner, B., Smith, L., van Koppen, B., Sally, H., Aliber, M., Cousins, B., Tapela, B., van der Merwe-Botha, M., Karar, E. & Pieterse, K. 2009. Water security in South Africa. Development Planning Division Working Paper Series No. 12, DBSA: Midrand

Musigafi, M.C.C. & Tom, T. 2014. Freshwater pollution: A human-related threat to freshwater security in South Africa. *Journal of Public policy and Governance* 1(2):72-81.

Nilsson, K.L. & Ryden, L. s.a. Spatial planning and management. Planning, management and assessment. 18:205-315.

Novotny, V. 2008. Sustainable urban water management. *Water and urban development paradigm* The Netherlands. DOI: 10.1201/9780203884102.pt1

Nukuna, Z.W. & Ngorima, E. 2011. Challenges for water service delivery and its impact on South Africa's rural communities: The case of Thabonkulu, the small rural community in South Africa. 1st YWP conference, Kampala December 2011, Pretoria, Gauteng.
OECD, 2014. OECD Principles on Water Governance. Adopted by the OECD Regional Development Policy Committee on 11 May 2015. Centre for Entrepreneurship, SMEs, Regions and Cities.

O'Grady, T. 2014. Spatial institutions in urban economies: How cities grids affect density and development. Harvard University. (Thesis - PhD).

Okeke, D. 2015. Sustainable planning as basisfor guiding sustainable land use management. WIT Transactions on State of the Art in Science and Engineering 86:153-183. doi:10.2495/978-1-84566-077-2/007

Okeke, D. C. 2015. African Approaches to Spatial and Green Planning. Agriculture, Forestry and Fisheries. Special Issue: Planning for Sustainable Communities: Green-Spaces in Rural Areas. 4(4-1):6-13.

Oki, T. & Kanae, S. 2006. Global hydraulic cycle and world water resource. *Science* 313:1068-1071.

O'Neill, S.J. & Cairns, S. 2016. New solutions for sustainable stormwater management in Canada. Report September 2016. Sustainable Prosperity https://institute.smartprosperity.ca/sites/default/files/stormwaterreport.pdf

Oranje, M. & Merrifield, A. 2010. National spatial development planning in South Africa 1930-2010: An introductory comparative analysis. *SSB/TRF/MDM* University of Pretoria, Pretoria, South Africa.

Palmer, I., Graham, N., Swilling, M., Robinson, B., Eales, K., Fisher-Jeffes, L., Kasner, S. & Skeen, J. 2016. South Africa's urban infrastructure challenge. Contribution to the Integrated Urban Development Framework. httpwww.cogta.gov.zacgta_2016wp contentuploads201605IUDF-INFRASTRUCTURE-PAPER.pdf

Pawan, P. 2016. Urbanisation and its causes and effects: A review. International Journal of Research and Scientific Innovation (IJRSI) 3(11):2321-2705.

Pinson, D. 2004. Urban planning: An 'undisciplined' discipline? Futures, Elsevier, 2004, Transdisciplinary. 36 (4), p. 503-513.

Polidoro, M., de Lollo, J.A. & Barros, M.V.F. 2012. Urban sprawl and the challenges for urban planners. Journal of Environmental Protection 2012(3):1010-1019.
Porse, E.C. 2013. Stormwater governance and future cities. *Water* 5:29-32.

Polprasert, C., Pussayanavin, T. & Kottatep, T. 2015. Urban development and water sustainability. *Water and urban initiative working paper series* United nations university 1:1-6 https://collections.unu.edu/eserv/UNU:2850/WUI_WP1.pdf

Department of Human Settlement. 2019. Red Book. The Neighbourhood Planning and Design Guide Creating Sustainable Human Settlements. Pretoria. ISBN: 978-0-6399283-2-6

Rahaman, M.M., & Varis, O. 2005.Integrated water resource management: Evolution, prospects and future challenges. *Spring* 1(1):15-21.

Rivett, U., Champanis, M. & Wilson-Jones, T. 2013. Monitoring drinking water quality in South Africa: Designing information systems for local needs. *Water SA* 39(3):409-414.

Rogerson, J.M., Kotze, N. & Rogerson, C.M. 2014. Addressing South Africa's urban challenges. *Urban Izziv:* 22:1-5; DOI: 10.5379/urbani-izziv-en-2014-25-supplement-000

Rhor, H.E. 2019. Evidence based water sensitive planning: Securing water sustainability through innovative spatial planning tools. North-West University PhD orcid.org 0000-0003-4944-2398

Romano, O. & Akhmouch, A. 2019. Water governance in cities: current trends and future challenges. Water 11(500):1-9 DOI:10.3390/w11030500

Ruhiiga, T.M. 2014. Urbanisation in South Africa: a critical review op policy, planning and practice. Suppl on Population Issues in South Africa 28(1):610-622.

Saadatian, O., Mat, S., Lim, C., Daneshmand, S. &Sopian, K. 2012. The birth of sustainable development. International Journal of Energy and Environment 3(6):310-317.

Segura, S. & Pedrogal, B. 2017. Monitoring and evaluation framework for spatial plans: A Spanish case study. Sustainability 9(1706):1-19.

Sershen, Rodda, N., Stenstorm, T.A., Schmidt, S., Dent, M., Bux, F., Hanke, N., Bickley, C.A. & Fennemore, C. 2016. Water security in South Africa: perception on public expectation and municipal obligation, governance and water re-use. *Water SA* 42(3):456-465.

Sharma, A.k., Pezzaniti, D., Myers, B., Cook, S., Tjandraatmadja, G., Chacko, P., Chavoshi, S.,

Shiklomanov, I.A., Babkin, V.I., Penkova, N.V., Zaretskaya, I.P. & Yunitsyna, V.P. 2003. World water resources at the beginning of the twenty-first century. The press syndicate of the university of Cambridge: Cambridge, United Kingdom.

Situma, L. 2002. Challenges of transport planning and spatial development in the easter cape province. 21st Annual South African Transport Conference *Towards Building Capacity and Accelerating Delivery* ISBN: 0-620-28855-8

Slaev, A.D. & Nedovic-Budic, Z. 2016. The challenges of implementing sustainable development: The case of Sofia's Master Plan. *Sustainability* 9(15):1-19.

Smith, D.M. 2005. The Apartheid city and beyond. Urbanisation and social changes in South Africa. 5th ed. Johannesburg: Witwatersrand University Press.
Southern Africa Stainless Steel Development Association (sassda). 2017. SA millions in water losses. https://sassda.co.za/wp-content/uploads/2016/11/23-May_Baydu.co_.za_SA-MILLIONS-IN-WATER-LOSSES.pdf Date of access: 31 July 2018.

Song, J., Rajamani, J., Jung, J., Handy, S., Paterson, R., Bhat, C. & Kockelman K. 2002. Techniques for mitigating urban sprawl: Goals characteristics, and suitable factors. Repart no. 4420-1.

Stats SA. 2017. Sustainable Development Goals Baseline Report 2017. Published by Statistics South Africa, Private Bag X44, Pretoria 0001ISBN: 978-0-621-45888-6

Statistica South Africa. 2005. Natural Resource Account, Water quality for South Africa 2000. Statistica South Africa, Pretoria.

Stauffacher, M., Flu¨eler, T., Kru¨tli, P. & Scholz, R.W. 2008. Analytic and Dynamic Approaches to Collaboration: A Transdisciplinary Case Study on Sustainable Landscape Development in a Swiss Prealpine Region. *Springer Science* 2008(21):409-422. DOI 10.1007/s11213-008-9107-7

Swilling, M. 2010. Dealing with Sustainability, in Pieterse, E Counter Currents – Experiments in Sustainability in the Cape Town Region, Jacana

Tan, P., Bowmer, K.H. & Mackenzie, J. 2012. Deliberative tools for meeting the challenges of water planning in Australia. *Journal of Hydrology* 474(2012): 2-10 doi:10.1016/j.jhydrol.2012.02.032

Tejada, G., Cracco, M., Bouleau, C.R., Bolay, J. & Hostettler, S. 2019. Testing Analytical Frameworks in Transdisciplinary Research for Sustainable Development. *Sustainability* 11(16):4343. doi.org/10.3390/su11164343

Tellman B, McDonald RI, Goldstein JH, Vogl AL, Flörke M, Shemie D, et al. 2018 Opportunities for natural infrastructure to improve urban water security in Latin America. PLoS ONE 13(12): e0209470. https://doi.org/10.1371/journal.pone.0209470

Tewari, D.D. 2009. A detailed analysis of evolution of water rights in South Africa: An account of three and a half centuries 1652 ad to present. *Water SA* 35(5)693-710.

The Chicago Council on Global Affairs. 2015. Global urban challenges: The roll research universities. Printed in the United States of America. The Chicago Council on Global Affairs, 332 South Michigan Avenue, Suite 1100, Chicago IL, 60604, or visit The Chicago Council's Web site at www.thechicagocouncil.org.

The University of the Wester Cape. 2017. Evaluating water sensitive design principals for cities of the future. https://www.uwc.ac.za/Faculties/NS/Water_Studies/Pages/evaluating-water-sensitive-group.aspx#Schools Date of access: 23 July 2020

Tjandraatmadja, G., Cook, S., Sharma., Chacko, P., Myeres, B. & Pezzaniti, D. 2014. Water sensitive urban design implements and potential: Contributions to the SA urban water blueprint Goyder institute for water research technical report series No. 14/16, Adelaide, South Australia.

Todes, A., Karam, A., Klug, N. & Malaza, N. 2009. Byond mastering planning? New approaches to spatial planning in Ekurhuleni, South Africa. Habitat International, 32(2010):414-420.

Todes, A. & Turok, I. 2018. Spatial inequalities and policies in South Africa: Place-based or people-centred? Progress in Planning 123(2018):1-31.

Turok, I. & Borel-Saladin, J.M. 2014. Is urbanisation in South Africa on a sustainable trajectory? Development Southern Africa 9:1-21.

Tyagi, S., Garg, N. & Paudel, R. 2014. Environmental deration: causes and consequences. *European Reshearcher* 81(8-2):1491-1498 DOI: 10.13187/er.2014.81.1491

Tynar, N. 2012. Nineteen century water supply: Processes of innovation and improvement. *The review of Australian economics,* 1-37.

UNEP 2016. A Snapshot of the World's Water Quality: Towards a global assessment. United Nations Environment Programme, Nairobi, Kenya. 162-189

United Nations. 2016. New Urban Agenda. Habitat III ISBN: 978-921-132731-1

USAID 2009. Addressing water challenges in the developing world: A framework for action.

Van Wyk, J. & Oranje, M. 2014. The post-1994 South African spatial planning system and Bill of Rights: A meaningful and mutually beneficial fit? (1-21).

Viljoun, G. & van der Walt, K. 2018. South Africa's water crisis – An interdisciplinary approach. Tydskrif vir Geesteswaternskap. 58. 483-500. 10.17159/2224-7912/2018/v58n3a3.

Von Bormann, T. and Gulati, M. 2014. The Food Energy Water Nexus: Understanding South Africa's most urgent sustainability challenge. WWF-SA, South Africa.

Vörösmarty, C.J., Green, P., Salisbury, S. & Lammers, R.B. 2000. Global water resource: Vulnerability from climate change and population growth. *Science* 298:284-288.

Walters, J. 2014. Public transport policy implementation in South Africa: Quo vadis? Journal of Transport and Supply Chain Management 8(1):1-10.

Walsh, C.J., Booth, D.B., Burns, M.J., Fletcher, T.D., Hale, R.L., Hoang, L.N., Livingston, G., Rippy, M.A., Roy, A.H., Scoggins, M. & Wallace, A. 2016. Principals of urban stormwater management to protect stream ecosystems. *Freshwater Science* 35:1-14.

Wendt, W. 2015. Adaptive Planning - Needs and strategies for indicator based adaptive planning. CUPUM, 155(1-16).

Weaver, M.J.T., Keeffe, J.O., Hamer, N. & Palmer, C.G. 2017. Water service delivery challenges in a small South African municipality: Identifying and exploring key elements and

relationships in a complex social-ecological system. *Water SA* 43(3):398-408. doi.org/10.4314/wsa.v43i3.04

Wong, T.H.F. & Brown, R.R. 2009. The water sensitive city: principles for practice. Water science and technology. 60(3):673-682. doi: 10.2166/wst.2009.436

Wong, T.H.F. 2007. Water sensitive urban design: The journey thus far. *Environment design guide* 1-10.

Woodruff, S.C. & BenDor, T.K. 2016. Ecosystem services in urban planning: Comparative paradigms and guidelines for high quality plans. *Landscape and Urban Planning* 152:90-100 http://dx.doi.org/10.1016/j.landurbplan.2016.04.003 0169-2046/

World Economic Form. 2019. The Global Risk Report 2019 14th edition. ISBN: 978-1-944835-15-6

Wright, C.Y., Norval, M. & Alberts, P.N. 2015. Climate change, public health and COP21 – A South African perspective. *South African Meddical Journal:* 105(12):997-998 DOI: 10.7196/SAMJ.2015.v105i12.10232

United Nations. 2015. Framework convention on climate change. Conference of the Parties Twenty-first session Paris, 30 November to 11 December 2015. 1/CP.16, 2/CP.18, 1/CP.19 and 1/CP.20, FCCC/CP/2015/L.9/Rev.1

Yiannakou, A. & Salata, K.D. 2017. Adaption to climate change through spatial planning in compact urban areas: A case study in the city of Thessaloniki. Sustainability 9(271):1-18.

Yusuf, M.P. & Allopi, D. 2010. The impact of urban sprawl on the inhabitants of the Ethekwini Municipality and the provision of infrastructure. Proceedings of the 29th Southern Africa Transportation Conference. Pretoria South Africa. 978-1-920017-47-7

Zhuwakinya, M. & Creamer Media. 2012. Water 2012: A review of South Africa's water sector.

Powertech, Johannesburg, South Africa.

ANNEXURES

Annexure A: Code of conduct

CODE OF CONDUCT FOR RESEARCHERS

This code of conduct is applicable to all NWU researchers. As a researcher of the North-West University (NWU), I subscribe to the rules of the NWU Institutional Research Ethics Regulatory Committee (IRERC), all applicable policies of the NWU as well as all national and international laws and regulations applicable to my field of study. Furthermore, I commit myself to abide by the ethical principles and responsibilities as set out in the Singapore statement on Research Integrity (22 September 2010), in any and all research endeavours that I undertake as a researcher of the NWU.

The four major principles of research integrity to which I will adhere and that will guide my research are:

 Honesty in all aspects of research

 Accountability in the conduct of research

 Professional courtesy and fairness in working with others

 Good stewardship of research on behalf of others

Consequently, I will also adhere to the following ethical responsibilities:

1. I will take responsibility for the originality and trustworthiness of my research.

2. I will stay abreast of and adhere to all institutional, national, and international laws, regulations, and policies applicable and related to my research.

3. I will always employ appropriate research methods, base my conclusions on critical analysis of the evidence and report my findings and interpretations fully and objectively.

4. I will keep clear and accurate records of all research that I have conducted in a manner that will allow verification and replication of my work by others, if applicable.

5. I will, where applicable, share my data and findings openly and promptly, in line with external funding rules. This will be done as soon as possible after I have had an opportunity to establish priority and ownership claims.

6. I will take responsibility for my own contributions to publications, funding applications, reports and other representations of my research. I will also and only include authors who meet valid authorship criteria.

7. I will acknowledge the names and roles of those who made significant contributions to my research in publications, including writers, funders, sponsors, and others, but do not meet authorship criteria.

8. In my peer reviews, I will provide fair, prompt, and rigorous evaluations and I will respect confidentiality when I review others' work.

9. I will disclose all conflicts of interest (financial and other) that could compromise the trustworthiness of my work in research proposals, publications, public communications, and in review activities.

10. When I publicly address a community in the spirit of academic freedom, I will in all stages base my professional comments on research findings (if applicable) and my expertise. I will distinguish between professional comments and opinions based on personal views.

11. Should any irresponsible research practices and/or research misconduct become known to me or brought under my attention, I will report such irresponsible research activities to the appropriate authorities.

12. I will respond to irresponsible research practices or conduct, by taking prompt actions as set out in the procedures of the university. I will also protect those who report misconduct in good faith, to the best of my abilities.

13. I will endeavour to create and sustain an environment that encourages research integrity through education of students, research teams and peers, as well as abide by policies, and reasonable standards for advancement.

14. I will always weigh societal benefits against the risks inherent in my work.

Name:	Signature:	Date
Amelia Lombard	A.Lombard	2019/07/25

Annexure B: Question 7

Legend

	Stormwater management, runoff and water catchment agencies, wastewater, and water recycling		Water governance
	Sustainability, GI, and protection of the natural environment		Maintenance of infrastructure
	Create new policies		Integration and transdisciplinary planning. IWRM, WSUD

Spatial planning has a strong bearing concerning water management. The management of watershed areas is hinged upon how spatial planning approves compatible developments within catchment areas. Development with water catchments not only influences the qual ity of water but also its availability and its management.
Spatial planning should precede water management. Effective water management also revolves around issues of water governance, which is a quite broad area. There is increasing need to sensitise built environment professionals on the need to conserve water through intensive integrated water management, however, water engineers and environmentalist should not only consider themselves as the custodians of water management by frustrating potential developments.
At the level of urban design (refer to WRC guidelines for WSUD) coupled with community and industry involvement.
Spatial planning should not be conducted without a water management analysis. Water management is one of the most important aspects to ensure spatial planning to be sustainable.
Spatial Planning should indicate the extent to which water management is implemented with referral to dams, rivers, marshes and even the layout of stormwater drains within a town/city. Furthermore, spatial development may indicate the development needs for water management systems within rural and urban areas to ensure optimal development and planning of water systems that are essential for everyday life.
Incorporate both these elements wants and needs within new developments

Better implementation of water planning and conservation strategies
This should be done by requesting comments from the Department of Water and Sanitation (DWS) and Environmental Affairs and Development Planning (EA&DP) throughout the planning process. Water specialist such as freshwater, hydrogeologists, geohydrological and geotechnical studies should inform the planning process of water sensitive developments.
These assessments are required to inform the Basic Assessment process in terms of the National Environmental Management Act (NEMA) Environmental Impact Assessment (EIA) regulations (GN326 of 2017) and the Water Use Authorisation application in terms of Section 21 of the NWA (1998).
Water management systems/infrastructures should form a greater part in spatial planning to ensure that this life-sustaining resource is managed in such a way to ensure min wastage of the resource especially within cities with lager 'non-absorbent' areas where runoff/stormwater is lost to rivers. Water management should be integrated into our wider planning schemes.
Strict conformity and application to said policy and legislation in both the private and public sectors.
Proactive integrated planning with relevant specialist and role players.
Storm-water management, -conservation and-recycling plans for township-establishment and extension to be done in alignment with services planning.
South African municipalities and legislation have not implemented water management to the best of their abilities yet. Water management is not seen as an important matter when looking at Spatial Planning. There is a lack of communication between different Departments at municipalities, lack of incorporation between water management policies and Spatial Planning policies. There is no benefit or justice for owners in developing a water sensitive environment that will benefit the whole area, for example when developers incorporate water management infrastructure, ideas and solutions into their new developments it is seen as for their benefit. The municipalities (spatial planning) should incorporate a policy encouraging water management and provide benefit to these developments. These benefits and solutions should be incorporated into spatial planning policies to encourage better water management. There is still a massive gap in South Africa when it comes to water management and spatial planning is just one of a few policies that should align their guidelines to these challenges.
Spatial planning can use water management to create more sustainable and Eco-friendly cities, this will lead to reduce global warming and hopefully increase vegetation and food production.

There are many challenges faced today where the lack of spatial planning ends up wasting water instead of using it in the day to day activities within communities.
Spatial planning and Water management could be aligned by including a wide variety of professionals within the development team, to create water catchment areas and greenbelts instead of drainage systems. To use different building materials that are environmentally friendly. Create more open spaces in newly developed areas and to make people aware. The catchment of rainwater should be implemented to use in gardens and as greywater.
Sustainable water supply that has good quality. Stormwater has a big influence on water quality. Therefore, green infrastructure planning and spatial planning plays a big role in purifying and regulating the flow of stormwater.
Legislation
By planning and making rules and regulations to be followed all aspects can be improved but only if the law is carried out
By combining the two in terms of using spatial planning to plan for the water management to interact with each other
Take a page out of international memos
Departments such as Water & Sanitation and Roads & Stormwater (National to Local) must be part of the planning team of strategic spatial planning documents such as Spatial Development Frameworks, to ensure water management policies and plans are in-line to these documents and vice versa.
Incorporate it within the Land Use Management Schemes of municipalities, to force new developments to adopt sustainable water management techniques.
Large amounts of water could be diverted into retention ponds, and be filtered afterwards to be used for future purposes
It must be made a compulsory requirement that Environmental Management Plans should address how water quality, demand and conservation will be integrated into a proposed development
More emphasis required in local legislation, ie Planning By-Laws, to enforce alignment with EA's and EMP's.

Adjust the SDF in such a way that it takes WSP into account. Indicate on the SDF where water sensitive areas are, as well as possible future developments for WSP.
Better management of water resources such as groundwater, boreholes, storing sites dams etc) and operation and maintenance
I do not have enough knowledge to propose this. truly something I will have to investigate as a professional planner.
Better protection of resources and conservation of water will put less strain on the environment
Spatial Planning may be informed by the locality and availability of quality water sources. For instance: If an industrial area is proposed (with the possibility of noxious trade) it should not be within proximity of good quality water resources.
Good policy implementation
By creating filter systems that act as neutral purification system

Annexure C: E-questionnaire

https://docs.google.com/forms/d/14YLdJcY_Eh93JjaIozfN2L2DSYsIX1IwJGzBObc8OmY/prefill

Planners perspective on Water Sensitive Planning

Faculty of Natural and Agricultural Sciences
Unit for Environmental Sciences and Management, Urban and Regional Planning

URBAN AND REGIONAL PLANNING PROJECT INFORMATION SHEET

Informed consent for participation in the research "Setting the scene for water sensitive planning in South Africa: Considering the perspective of planning professionals" by "Miss A Lombard" (25031287) as part a Dissertation submitted for the degree Magister Scientiae in Urban and Regional Planning at the North-West University.

Purpose of the research:
To consider Water Sensitive Planning for South Africa, based on the perspectives of local planning professionals.

Research entity:
Urban and Regional Planning, Unit for Environmental Sciences and Management, North-West University.

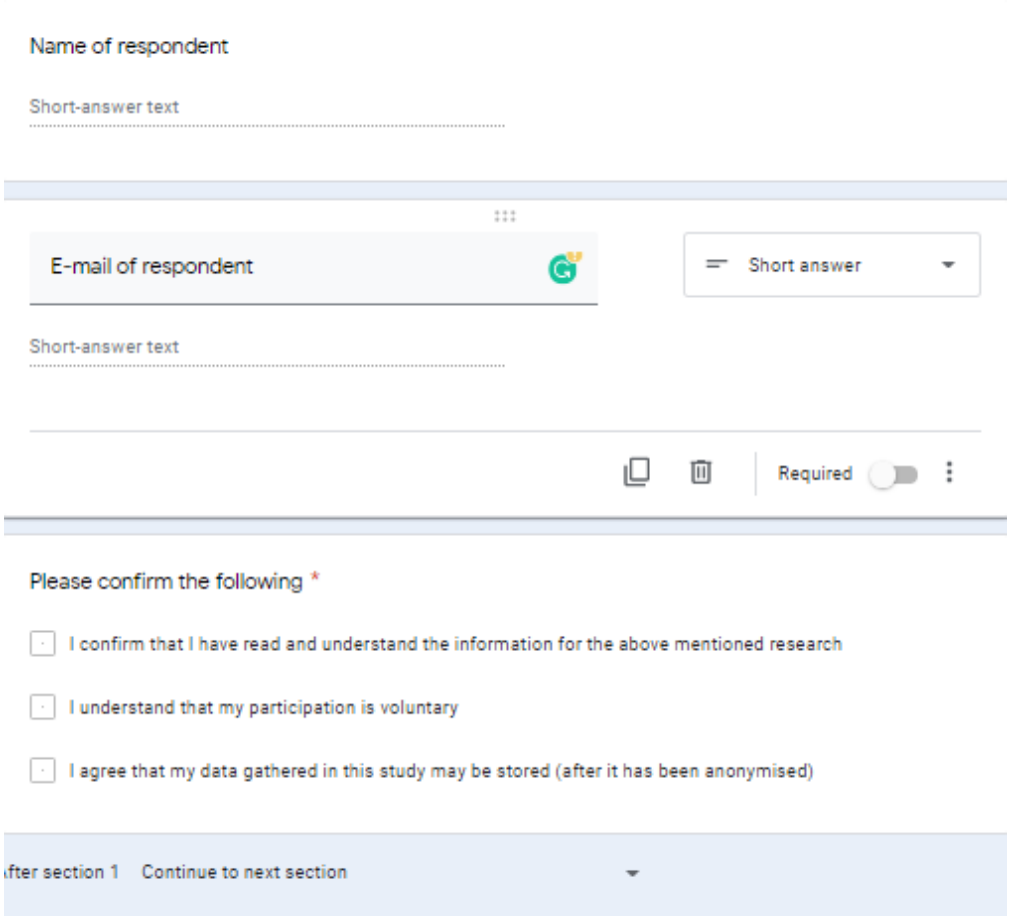
Superviser:
Prof EJ Cilliers (juanee.cilliers@nwu.ac.za)

Researcher:
Miss A Lombard (lombardamelia.al@gmail.com)

Privacy statements:

Anonymity statement: Responses will never be linked to individuals.
Confidentiality statement: Only researchers involved in this study will see responses
Submission information: E-questionnaire with online submission

Email address *


Name of respondent
Short-answer text
E-mail of respondent
Short answer
Short-answer text
Required
Please confirm the following *
I confirm that I have read and understand the information for the above mentioned research
I understand that my participation is voluntary
I agree that my data gathered in this study may be stored (after it has been anonymised)
fter section 1
Continue to next section

The unanswered questions..

Description (optional)

1. Please indicate in which sector you work *

- [ ] Government (National)
- [ ] Government (Provincial)
- [ ] Government (Local)
- [ ] Educational
- [ ] Local
- [ ] Private
- [ ] Other...

2. Please indicate your experience in the sector you work *

- [ ] Less than 3 years
- [ ] Between 7 and 3 years
- [ ] More than 7 years

3. Define WSP

Long-answer text

4. Please rank your knowledge of Water Sensitive Planning (WSP) *

	1	2	3	4	5	
No knowledge	○	○	○	○	○	Expert knowledge

5. Rank your experience relating to WSP *

	1	2	3	4	5	
Little experience	○	○	○	○	○	Expert experience

6. Please rank the importance of WSP in the planning profession *

	1	2	3	4	5	
Low importance	○	○	○	○	○	High importance

7. Rank the importance of the following global challenges in terms of the spatial planning agenda *

	Low relevance 1	2	3	4	5 Extreme relev...
Water Quality	☐	☐	☐	☐	☐
Water demand ...	☐	☐	☐	☐	☐
Water conserva...	☐	☐	☐	☐	☐
Stormwater ma...	☐	☐	☐	☐	☐
Green Infrastru...	☐	☐	☐	☐	☐

8. Rank the importance of the following South African challenges in terms of the spatial planning agenda *

	Low relevance 1	2	3	4	5 Extreme relev...
Water quality	☐	☐	☐	☐	☐
Water demand ...	☐	☐	☐	☐	☐
Water conserva...	☐	☐	☐	☐	☐
Stormwater ma...	☐	☐	☐	☐	☐
Green infrastru...	☐	☐	☐	☐	☐

9. How could spatial planning and water management align to address the challenges? *

Long-answer text

10. Who do you think should be the custodian of water planning in South Africa? *

- ☐ Urban planners
- ☐ Local government
- ☐ Engineers
- ☐ Other...

Annexure D: Stats

Frequency Table

1, Work sector

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	6.00	30	100,0	100,0	100,0

2. Work experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	25	83,3	83,3	83,3
	2.00	2	6,7	6,7	90,0
	3.00	3	10,0	10,0	100,0
	Total	30	100,0	100,0	

3. Define WSP

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	9	30,0	30,0	30,0
	1.00	10	33,3	33,3	63,3
	2.00	8	26,7	26,7	90,0
	3.00	3	10,0	10,0	100,0
	Total	30	100,0	100,0	

4. Knowladge of WSP

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	2	6,7	6,7	6,7
	2.00	10	33,3	33,3	40,0
	3.00	13	43,3	43,3	83,3
	4.00	5	16,7	16,7	100,0
	Total	30	100,0	100,0	

5. Experience with WSP

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	10	33,3	33,3	33,3
	2.00	9	30,0	30,0	63,3
	3.00	10	33,3	33,3	96,7
	4.00	1	3,3	3,3	100,0
	Total	30	100,0	100,0	

6. Importance of WSP

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	1	3,3	3,3	3,3
	3.00	3	10,0	10,0	13,3
	4.00	13	43,3	43,3	56,7
	5.00	13	43,3	43,3	100,0
	Total	30	100,0	100,0	

7a. Importane of global water quality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2.00	1	3,3	3,3	3,3
	3.00	8	26,7	26,7	30,0
	4.00	8	26,7	26,7	56,7
	5.00	13	43,3	43,3	100,0
	Total	30	100,0	100,0	

7b. Importance of global water depand and supply

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3.00	8	26,7	26,7	26,7
	4.00	7	23,3	23,3	50,0
	5.00	15	50,0	50,0	100,0
	Total	30	100,0	100,0	

7c. Importane of global water conservation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3.00	5	16,7	16,7	16,7
	4.00	10	33,3	33,3	50,0
	5.00	15	50,0	50,0	100,0
	Total	30	100,0	100,0	

7d. Importance of global stormwater management

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3.00	9	30,0	30,0	30,0
	4.00	14	46,7	46,7	76,7
	5.00	7	23,3	23,3	100,0
	Total	30	100,0	100,0	

7e. Importance of global green infrastructure planning

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3.00	7	23,3	23,3	23,3
	4.00	13	43,3	43,3	66,7
	5.00	10	33,3	33,3	100,0
	Total	30	100,0	100,0	

8a. Importance of SA water quality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	1	3,3	3,3	3,3
	2.00	1	3,3	3,3	6,7
	3.00	4	13,3	13,3	20,0
	4.00	9	30,0	30,0	50,0
	5.00	15	50,0	50,0	100,0
	Total	30	100,0	100,0	

8b. Importancs of SA water supply and demand

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2.00	1	3,3	3,3	3,3
	3.00	4	13,3	13,3	16,7
	4.00	7	23,3	23,3	40,0
	5.00	18	60,0	60,0	100,0
	Total	30	100,0	100,0	

8c. Importance of SA water conservation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3.00	5	16,7	16,7	16,7
	4.00	9	30,0	30,0	46,7
	5.00	16	53,3	53,3	100,0
	Total	30	100,0	100,0	

8d. Importance of SA stormwater management

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2.00	1	3,3	3,3	3,3
	3.00	9	30,0	30,0	33,3
	4.00	11	36,7	36,7	70,0
	5.00	9	30,0	30,0	100,0
	Total	30	100,0	100,0	

8e. Importance of SA greeen infrastructure planning

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2.00	1	3,3	3,3	3,3
	3.00	10	33,3	33,3	36,7
	4.00	9	30,0	30,0	66,7
	5.00	10	33,3	33,3	100,0
	Total	30	100,0	100,0	

10. Who do you think is the castodian for water planning in SA: Urban planner

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	13	43,3	43,3	43,3
	1.00	17	56,7	56,7	100,0
	Total	30	100,0	100,0	

10. Who do you think is the castodian for water planning in SA: Local government

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	14	46,7	46,7	46,7
	1.00	16	53,3	53,3	100,0
	Total	30	100,0	100,0	

10. Who do you think is the castodian for water planning in SA: Engineers

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	19	63,3	63,3	63,3
	1.00	11	36,7	36,7	100,0
	Total	30	100,0	100,0	

10. Who do you think is the castodian for water planning in SA: Environmentalist

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	28	93,3	93,3	93,3
	1.00	2	6,7	6,7	100,0
	Total	30	100,0	100,0	

Experience_coded * Knowledge_coded Crosstabulation

			Knowledge_coded		
			1 & 2	3 & 4	Total
Experience_coded	1	Count	7	3	10
		% within Experience_coded	70,0%	30,0%	100,0%
	2	Count	4	5	9
		% within Experience_coded	44,4%	55,6%	100,0%
	3 & 4	Count	1	10	11
		% within Experience_coded	9,1%	90,9%	100,0%
Total		Count	12	18	30
		% within Experience_coded	40,0%	60,0%	100,0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.203[a]	2	0,017
Likelihood Ratio	9,096	2	0,011
Linear-by-Linear Association	7,869	1	0,005
N of Valid Cases	30		

a. 3 cells (50.0%) have expected count less than 5. The minimum expected count is 3.60.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	0,523	0,017
	Cramer's V	0,523	0,017
N of Valid Cases		30	