An illustration of changing paradigms in water resource management in South Africa

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By

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Abstract

This research studies the characteristic features of shifting paradigms in South African Water legislation over the past hundred years and aligns these changes in legislation with established world views in water resource management. A comparative analysis is used to describe and compare how changes in South African water legislation over the past century have changed water resource management paradigm and *vice versa*. Three distinct legislative periods are explored within South African water law. The first period from 1912 to 1955 was dominated by the Irrigation and Conservation of Waters Act of 1912 which favoured the agri-industrial and minority landowners. The second period is recognised as the pre-modernism and industrial modernism as paradigms that are closely aligned to the earliest national water legislation. It is characterised by the advancement of the hydraulic mission and growing demand for water resources. The third phase is the National Water Act which transformed water resource management in South Africa. It represents a radical shift in legislation from the dominant paradigm in South Africa and provides one of strongest features indicating that legislation, along with political will, is the major driver and enabler in contributing towards change in water resource management. In South Africa, the paradigm shift in water resource management is the direct result of legislative influence driven by a quest to emphasise the need for social justice and equity in order to redress an unjust Apartheid system.

Acknowledgements

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Abbreviations

CMA Catchment Management Area

DWS Department of Water and Sanitation (previously the Department of Water Affairs, DWA)

GCWA Government Controlled Water Area

IWRM Integrated Water Resource Management

NWA National Water Act

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CHAPTER 1 INTRODUCTION

1.1 Introduction

In 2009 the United Nations Report on the Global Assessment of Water Statistics and Water Accounts indicated that 70% of all countries in the survey identified water scarcity and pollution as issues of the highest national importance, while 90% of the world's developing countries rated water scarcity and water pollution as their single most important issue (UNESCO, 2009). South Africa is ranked as the 30th driest nation on earth with a lower per capita availability of water than many drier countries with a higher ranking (DWA, 2010). Countries, such as Namibia, are ranked as drier but have better overall access to water. The uneven distribution of rainfall over South Africa is one factor responsible for a high water demand in large parts of the country that often exceeds supply (DWA, 2010) leaving parts of the country severely water stressed (NWRS, 2005). South Africa has an average annual rainfall of approximately 450mm, which is below the global average of 860mm annually (NWRS, 2005). Predictions have further indicated that South Africa may in future receive even less rainfall than is currently experienced due to the effects of climate change (Hewitson & Crane, 2006).

Climatic and development factors are compounded by South Africa's history of segregation and inequality. Under the Apartheid regime (from 1948 to 1994) black South Africans were oppressed, and without political rights, and largely relegated to rural areas and townships where access to water was limited. Poverty was endemic in these rural areas and characterised by despicable living conditions (Perret, 2002). Access to water in South Africa was controlled by those who had control over land. The 1913 Land Act ensured that the majority of the black population owned only 14% of the land, and this 14% consisted mostly of poor rural homelands and in conditions that perpetuated the cycle of poverty (Perret,

2002). It was not only the constraints of the ownership of land which unfairly favoured the white minority, water legislation and institutions favoured large white commercial farms over small labour intensive farms which were owned by blacks (Perret, 2002). Abrams asserts (1996) that rural citizens, comprising half the population, perceived water supply and sanitation as their highest priority in support of their livelihoods. The inequalities and prejudices of the previous regime still have consequences today - 20 years after democracy.

The shift in ideology in South Africa after 1994 resulted in major redress projects being undertaken to ensure the provision of services to all citizens. Reforms from 1994 ushered in many new laws to redress the injustices of the past. For example, the National Water Act (1998) is regarded as one of the most progressive and ambitious pieces of legislation (Tewari, 2009; Kidd, 2008). It encompasses equality, sustainability, efficiency and a sustainable approach to the management of water resources (Perret, 2002). Political change in South Africa had a profound impact, and a concomitant impact on water resource utilisation and management. It is this shift in societal and political consciousness that provides the contextual focus of this study – a descriptive account of the evolution of Water Resource Management (WRM) in South Africa beginning in the 20th century – followed by an investigation into the relationship between changes in WRM and water legislation within South African.

Worldwide Water Resource Management has undergone substantial shifts from an initial focus on technologically driven solutions to well defined problems, such as the need for more water in cities resulting from rapid urbanisation and the industrial revolution in the 19th and 20th centuries. In contemporary times the shift is towards a socially driven approach which seeks to integrate human needs in relation to the environment and

resources and hence the emerging concept of Integrated Water Resource Management (Pahl-Wostl, 2011). This shift has been recognised by many leading researchers including Turton et al (2006); Allan (1999); Tewari (2009); Turton and Meissner (2002) and Pahl-Wostl (2011).

1.2 Paradigms

Paradigms are an agreed way of thinking about the world and set out approaches to which specific communities investigate the world (Pahl-Worstl, 2010). Pahl-Worstl (2010) makes use of paradigms to identify, track and explain the changes experienced in Water Resource Management. Her research illustrates that the use of paradigms identify various world views held within the field of WRM. Paradigms not only address the question of what is being studied but how it is studied as well.

Some of the earliest understandings of paradigms are based on the work of Thomas Kuhn (1970) who is recognised as the most significant contributor to the early work on understanding paradigms and major ideological change within communities. Kuhn's book "The Structure of Scientific Revolutions" includes many context specific definitions of the idea of a paradigm. He conceived paradigms as "*the entire constellation of beliefs, values, techniques... shared by the members of a given community*" (pg. 175). Kuhn's work however focussed on research and the development of scientific disciplines whereas the research at hand deals with the development of ideas held by communities and the resulting legislative implications. The understanding of paradigms that provides more insight into this research endeavour is offered by Pahl-Worstl and highlights the all-encompassing nature of what paradigms are within communities, enabling the summary of practices, beliefs, techniques and values of communities at a given time. The use and understanding of paradigms as set

out by Pahl-Worstl is not unique, her interpretation and use of paradigms is shared by authors like Allan (2005) and Turton and Meissner (2002). While the works of Pahl-Worstl and Allan focus on the dominant paradigms of a period of time, Turton and Meissner (2002) have highlighted the changes or anomalies which lead to periods of transition. The use of research which focuses on dominant paradigms in conjunction with research which focusses on periods of transition between dominant paradigms, illustrates how beliefs and world views evolve over time (i.e. a paradigm is dominant within a community for a period of time after which events and anomalies lead to periods of transition which in turn usher in a new dominant paradigm) within communities.

The work performed by the researchers noted above (Turton and Meissner, Allan and Pahl-Worstl) has illustrated the existence of paradigms, and periods of transition between those paradigms, within Water Resource Management (WRM). Others (Tewari, 2009; du Plessis, 2010) have researched the shifts which have occurred in South African Water legislation since 1912. By considering both these areas of research it is hoped that the research at hand can illustrate how WRM paradigms and there shifting can be noted within South African Water Legislation. The assumption is that a relationship exists between changes found in WRM and those within South African water legislation.

In summary, a paradigm is a world view which encompasses the approach to a particular field of interest as well as an understanding and agreement of norms held by a particular '*community*' (interest group). By investigating the dominant paradigm of a '*community*' and the changing shifts which lead to the transitions between paradigms, it might be possible to appreciate a better understanding of the inner working and thinking shared by those within that community. Should the understanding and opinions of a community change, then these

shifts should be evident in the field of knowledge and practice within which the community functions. As new problems are encountered and new individuals join a community, then new ideas will be offered to address new problems. When a problem is encountered that cannot be addressed in the "usual" manner then the community often experiences a crisis. The assumption is that overcoming this crisis, often results in the introduction of new thinking, and a resultant transition.

1.3 South African legislative reform

The shifting political environment of South Africa is one that has been extensively documented (Heller, 2001; Ramphele and McDowell, 1991). The early 20th century was characterised by the institutionalisation of racial bias and segregation (Maylam, 2001; Bickford-Smith, 1995; Ross, 2008). Domination was established and secured by force through the passing of legislation which limited the rights of certain racial groups and with widespread implications, including reduced access to water resources for the majority of the population. Before 1994 South Africa was characterized by years of inequality and oppression by the white minority who imposed rule over the black majority. Thus pre-1994 legislation enforced injustice and gave entitlement to a small white minority. After the first democratic election in 1994, extensive and wide ranging reforms were set in motion to redress the legacies of the past. The starting point for new legislation and reform, because it was so extensive and important, only came about two years after the 1994 elections in the form of the Constitution (Act 108 of 1996) which formed the basis of all new legislation. The Constitution brought about the acceptance of societal norms, values and standards, never before included in national legislation (Kidd, 2008). The results (enactment of new legislation) of these changes will be further explored in the literature review section of this study.

1.4 Research Question

Previous research has identified dominant paradigms that were prevalent at a particular time as well as the shift and period of transition which lead to the introduction of new paradigms within WRM. The research at hand details these shifts and changes in paradigms and attempts to align them chronologically with water legislation, with the view to identifying the coincidence of patterns in political, industrial and societal aspects indicating if or how shifting paradigms can be noted within legislation and where these push or pull legislative and policy change. This leads to the research question: is there a coincidence or correlation in the changes in water resource paradigms and water legislation in South Africa?

The broad aim of this research, therefore, is to illustrate the shifting paradigms of water resource management in South African water legislation. This will be achieved by the following objectives:

- Identifying and explaining recognised paradigms that have typified South African water resource management over the past century;
- Identifying the periods of transition between these dominant paradigms and what brought them about;
- Identifying how these paradigms and transitions are aligned to changing South African water legislation (if at all) by examining their chronological sequence:
- Analysing relationships between the paradigm shifts within South African Water legislation and how these are aligned with paradigm shifts in water resource management in the country

1.5 Scope of the Research

The research will highlight the common shifts that have taken place in both legislation and water resource management, and will investigate and attempt to explain the relationship between these changing paradigms over the past century by making use of available evidence to identify the shifting of paradigms of WRM and possible alignment with water legislation. The primary sources of evidence include national water legislation and trends in water research over the past century. The first of these sources, national water legislation, will be used to outline the national perspective on water management, while the second source of evidence arises from previous research in water resource management in South Africa and from the global context. The research will attempt to identify and explain common patterns evident within both legislation and management.

1.6 Brief outline of the research

The chapters which follow will illustrate the research that has been undertaken in this project. The initial chapter briefly introduces the concept of paradigms and how they shift, it indicates the various facets of the current research and how it will be performed. Chapter two investigates the chosen paradigm frameworks and their relevance to the current study. This is followed by the exploration of the relevant South African water legislation. Finally these elements are brought together in order to identify the presence of the various paradigms and their shifts within the legislation.

The third chapter deals with the methodology of the research, why it was chosen, the study design and limitations. The fourth chapter will then include the discussion section of the

research. Here the existence of these paradigms and their shifting will be examined. This section offers an analytical discussion of the results obtained from the current research as well as previous work.

The final chapter includes a discussion of the findings as well as a summary of the research and its results and the context in which these results are understood.

CHAPTER 2 LITERATURE

2.1 Introduction

This chapter examines how the academic literature within WRM has developed an understanding of paradigms or phases based largely on the work of scholars such as Allan, Turton and Meissner, Masterman and Jean Cohen. The interpretation offered by these scholars show how the thinking and application of paradigms are relevant to the current study. Thereafter the discussion focuses on the three main Water Acts that were promulgated at various stages between 1912 and 1998. This literature highlights the core pieces of legislation that have shaped water resource management in South Africa.

2.2 Unpacking paradigms

Kuhn's interpretation of paradigms

Thomas Kuhn is regarded as the originator of the concept of paradigms (Dogan, 1998). Kuhn's work on paradigms is outlined in his book entitled *"The Structure of Scientific Revolutions"* which was the first attempt to define the concept of paradigms. Researchers agree that Kuhn's work revolutionised the manner in which people understand the process of change in the scientific world (London, 2008). Kuhn's work is considered a major leap in terms of how change is understood within academia, and it is the universal appeal of Kuhn's ideas that have allowed his theories to take hold in many disciplines ranging from the humanities, and social sciences through to engineering and mathematics (London, 2008).

Kuhn's book details the ideas which govern progress and how new concepts are formed in science. Paradigms not only serve to illustrate world views of a particular community but also function as a tool in preparing students for studying to become part of a scientific

community. Students and practitioners of the scientific community are exposed to the rules and standards of scientific practice which have been accepted as norms in their chosen disciplines (Phillips, 1973). It is these commitments and agreements to norms and standards that allow for a period of normal science to occur (where there is little change and many features of a discipline remain the same). The unified viewpoint that is experienced under a dominant paradigm is a period of consensus which is referred to as a period of "*normal*" science. However disciplines are not static, they are continuously affected by changes and discoveries, some of which cannot be explained or solved by the agreed methods and standards held by a community at that time (Phillips, 1973).

Kuhn focused on paradigms within the natural sciences to the exclusion of the possibilities within the social sciences. Stahl, Koschmann, & Suthers (2006) noted this difficulty by stating that due to the cultural and organisational factors shared by both disciplines (social sciences and the natural sciences), but suggested by inference that Kuhn's work could also be applied to the social sciences. By contrast, Westheus (1976: pg. 41) argued that when commenting on Kuhn's interpretations of paradigms, they (paradigms) are shaped by what social scientists regard as the "*most critical decision-making unit in a society*". In order to determine this "*most critical unit*", Westheus investigated sociological research and found that most survey research and studies of public opinion tended to take the individual person as the "*decision-making unit*". He concluded therefore that within social sciences, it is the individual that shapes the resultant paradigm, through experiments, and in turn informs the paradigms of social science. In the natural sciences, the "*Most critical decision-making unit*" can be seen as experimentation and repeatable results by these authoritative figures that influence resultant paradigms (Westheus, 1976). Kuhn (1962: pg. 175) notes paradigms as

"*beliefs, values and techniques of a given community*", therefore it can be said that paradigms represent the methods which communities use to overcome problems or approach issues. Kuhn sees paradigms as identification tools rather than tools that are used to arrive at a particular end. The result is that paradigms are used to establish a community's (or groups) views towards issues, rather than overcoming the issue. In the case of research, paradigms are used by researchers, as identifying tools to determine the position of communities towards issues. The identifying characteristics enable researchers to determine the path that communities have taken in order to arrive at a particular point and possibly predict where they will lead (Stahl, Koschmann, & Suthers, 2006). Such as has been utilised in the work of Seibrits and Winter (2013), where Kuhn's understanding of Paradigms have further been used in an attempt to propose the direction and predict the path of future scientific research.

While Kuhn's work has been heralded by many as revolutionary (London, 2008), not all of Kuhn's conclusions have remained devoid of criticism. Recent work has questioned Kuhn's idea that scientific paradigms are "*incommensurable*" and that shifts are therefore essentially irrational events. London (2008) noted that the Canadian philosopher, Paul Thagard likened a paradigm shift to the process of learning a second language, and that scientific revolutions contained enough continuity to propose that the process was not arbitrary, however *e*xploring these criticisms lies beyond the scope of this research.

Phillips (1973), one of Kuhn's most ardent critics, noted two major points. The first of these criticisms lies in Kuhn's conception of paradigms which remains unclear. This shortcoming is highlighted by Masterman (1970) who concluded that Kuhn uses "*paradigm*" in at least twenty-one different definitions in his original work. While it has been noted that these

definitions are not inconsistent and their interpretation weighs heavily on context, Masterman suggests that they fall into three main categories:

> *"metaphysical paradigms," or "metaparadigms," which concern such things as beliefs, myths, new ways of seeing, and other aspects which indicate what Masterman refers to as "a metaphysical notion or entity"; "sociological paradigms," which refer to concrete scientific achievements, universally recognized scientific achievements, and the like, and "artefact paradigms," or "construct paradigms"* (Masterman, 1970: pg. 65).

It is this intricate design that Masterman defines as Kuhn's primary short coming, which will be discussed in greater detail in the section below, that deals with paradigms in the social sciences.

2.3 Paradigms and transition in Water Resource Management

The shifting of paradigms takes place in the form of scientific revolutions in the "hard" sciences, and in these disciplines only one paradigm is seen as having dominance over the others. Yet in the social sciences there are multiple paradigms which exist simultaneously. It is the objective of this research to illustrate the shifts which have occurred in South African Water Resource Management. The current research is not alone in proposing that these that these paradigms exist, the following section of the research will investigate the work of other authors who have noted the existence of these paradigms and shifts. This review of the literature will explain the models noted in previous research as well as their criticisms and their applicability to the South African example.

The first and most notable source of previous research in the field of shifting paradigms in Water Resource Management is the work of Ohlsson and Turton (1999). Entitled “the turning of a screw”, the paper investigates adaptation to water scarcity. The concept was built on the existing knowledge of the progression of water management practices. The progression followed a three step process, namely identifying bottlenecks, finding appropriate social tools to meet the challenges, and finally dealing with the conflicts created by new ways of utilising the water resource. In an effort to simplify this progression they labelled these three steps based on their main style of management: Supply Management, Demand Management and Allocative Efficiency.

The first of their three development stages of water management focuses on supply management, where demand for water is increasing. The reaction is to advance the technology to meet the increasing demands for water. These technological advances are colloquially referred to as “heroic engineering” because efforts are centred on meeting needs. The reference to engineering is because the supply is met through physical engineering projects. These feats of “*heroic engineering*” would range from simple storage methods, like dams and reservoirs to water transport in the form of aqueducts and constructed canals and streams. As time and needs progressed, so did the need for more water which meant that more difficult efforts would be required such as inter-basin transfers, which takes water from an area of high availability and low need for water to areas which have a high need and low availability of the resource. However water is a finite resource and as such sourcing it from great distances can only serve needs for a limited time.

This leads to the second water management step of demand management. In this stage is characterised by effective use of water at every stage of the water use cycle. The ,management approach is to ensure that every drop is used, which may include the re-use of water so as to utilise each drop fully, for an example, the re-use of water which has been used for purposes such as dish washing in an irrigation system. This stage makes an attempt to improve the use of what is available rather than making more water available as in the case of heroic engineering and supply management.

The third and final stage described by Ohlsson and Turton is allocative efficiency, a stage that entails large scale restrictions of water in order to achieve more value from the water. The term 'value' involves the management of water so that it is used sparingly without waste. Water resources may be issued to areas of agriculture rather than areas of industry as the growing of crops to feed a community is more "valuable" than economic production. The allocative efficiency stage makes use of both social and administrative measures in order to get "more value per drop".

Although these steps have been described in a linear fashion, the completion of one stage does not indicate the beginning of another, rather they occur simultaneously. The dominant step at a particular time is seen as being the dominant paradigm at work. These steps are used in conjunction and together they are intended to ensure the sustainable usage of the water resource.

It is these three steps (Supply Management, Demand Management and Allocative Efficiency), identified by Ohlsson and Turton that identify the various paradigms. This conclusion is based on the manner in which each management step dominates the aims and methods of water resource management at its time of dominance, much like paradigms

influence the aims, objectives and worldview of communities. A practical example of this can be seen in the supply management stage. The approach is dominated by increasing supply rather than efficient usage, technological efforts (heroic engineering) are used in order to increase the supply rather than utilising what is available better.

Paradigms shifts explain how water is first treated as freely abundant resource that can be used without consequences. There is then a change to a management system which recognises the importance and fragility of useable water and thus changes the way of utilising and managing the resource to one of greater efficiency and smarter, sustainable usage. It is the presence of these paradigms (from supply and demand management to allocative efficiency) and their shifting that the current research explores in relation to changes in South African legislation.

Ohlsson and Turton focused on the oscillation between a perceived scarcity of the natural water resource, and a perceived scarcity of the social means required to overcome that original scarcity. All the while this progression leads towards ever increased amounts of social resources that can be applied to overcome the natural resource scarcity. Thus this brings forth the analogy of the turning of a screw. The use of this term and diagram make it easier to see the interaction between the spheres of natural resource management and the social challenges encountered.

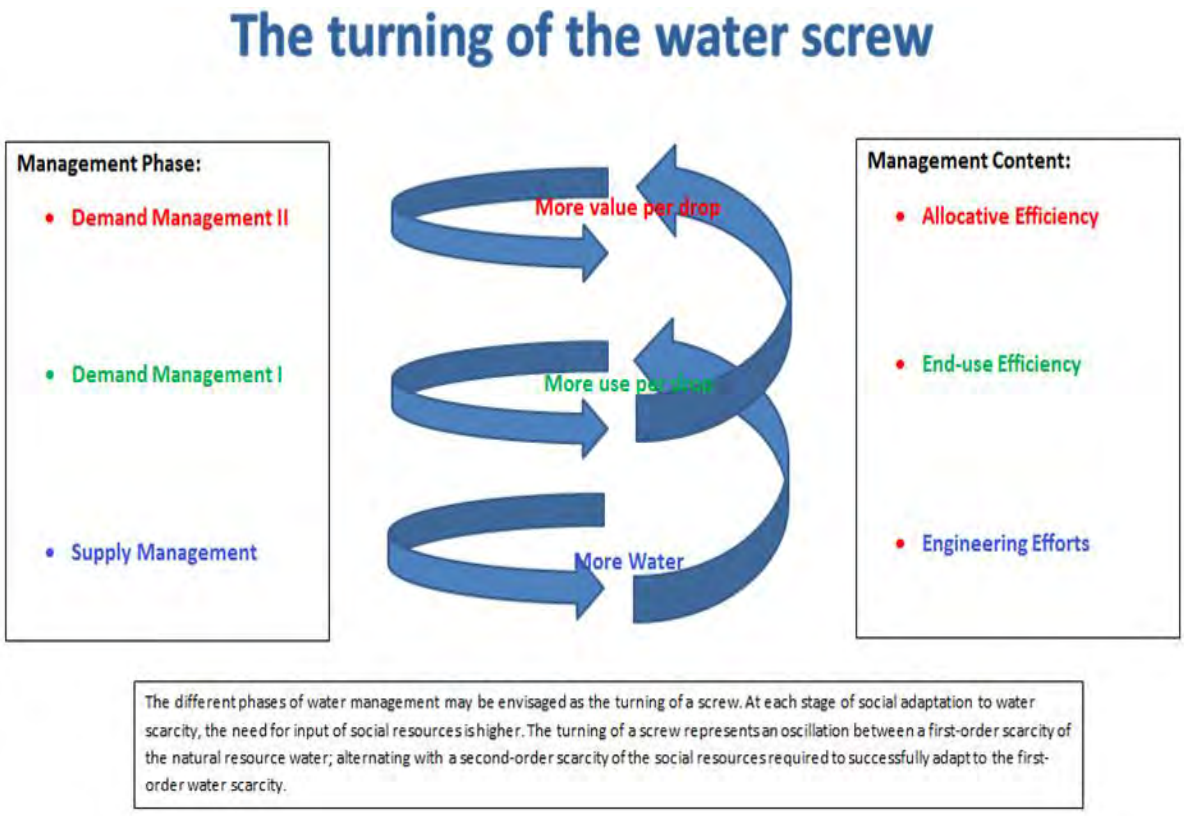

Figure 1. Turning of the Screw (Source: Ohlsson and Turton, 1999)

The purpose of Allan's (2005) research is to develop an analytical method which addresses the problem of water resource allocation. While Ohlsson and Turton drew attention to the social reactions and expectations required to overcome water challenges, Allan's research emphasised economic, legal and political factors at play. Allan bases his research on the work of previous authors, chiefly the conflict for water in North Africa, Jordan and the Middle-East as key examples to describe the various influences politics, economics and legislation have on water management.

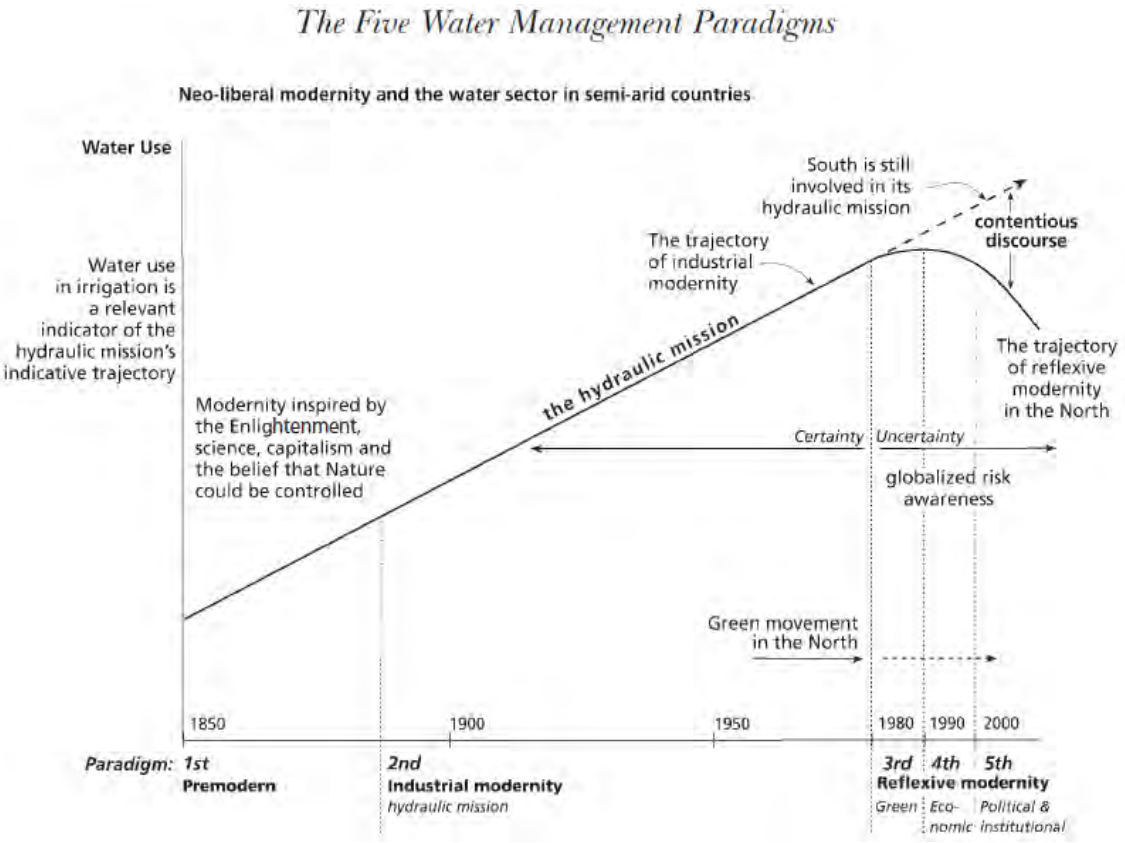

Figure 2. Five Water management Paradigms. (Source: Allan, 2005.)

Allan represents the transition of five water management paradigms. Each of the water management paradigms illustrated by Allan has a distinct focus. While each paradigm is represented linearly in a timeline, all of these paradigms are constantly at work with some being more prominent over the management system at a given time. The similarities that can be noted between Allan's diagram (Figure 2) and Ohlsson and Turton that are not coincidental since both of these diagrams represent the focus of water management paradigms over time. The first of the five paradigms is the pre-modern paradigm which is dominated by the increase in water usage in an era that predates the industrial era at a stage when the population growth is rising and their need for water is increasing. This

increase in the ‘hydraulic mission’ is testament to the ingenuity and engineering efforts taking place at the time.

The second paradigm, referred to by Allan (2005) is industrial modernity. Water use extends from agriculture and subsistence activities to the industrial boom. This era represents a ‘golden age’ where anything is believed to be possible and the consequences for actions is not immediately felt or understood. This is the longest domination of a paradigm and is followed by the third paradigm. This time period sees the introduction of the green movement, not only does it advocate for sustainable resource use it also identifies the faults and damage done by previous paradigms. With the rise in education begins the slow change in direction. Allan notes that this trend is only evident in northern countries. In Southern countries where development and infrastructure is not as advanced the hydraulic mission continues to intensify.

The fourth paradigm is characterised by a focus on economics. During this time period the expansion of economies (particularly in the north) is of paramount concern. Yet smart economic decisions are often backed with environmental advantages and this sees the consistent decline in the hydraulic mission. Again this trend remains mainly in the north while development in the south is still characterised by the hydraulic mission. The fifth and final paradigm is one dominated by political and institutional forces. Here the institutional arrangements are open to recognising the condition of the environment and are influenced by the growing call for environmentalism and sustainability from individuals. In this fifth paradigm the principles of Integrated Water Resource Management are prevalent and due to these principles the ‘hydraulic mission’ slows down. Allan notes that this is only the case in developed nations of the Northern hemisphere, while the Southern hemisphere remains

on the course of pursuing the hydraulic mission. Allan then introduces the concept of sustainability in the water sector through its representation as the triangle below. Each of the three sides is representative of a factor which influences sustainability. The triple bottom line is represented as the factors of the Economy, Society and the Environment.

Fig 3. Sustainability & discursive politics

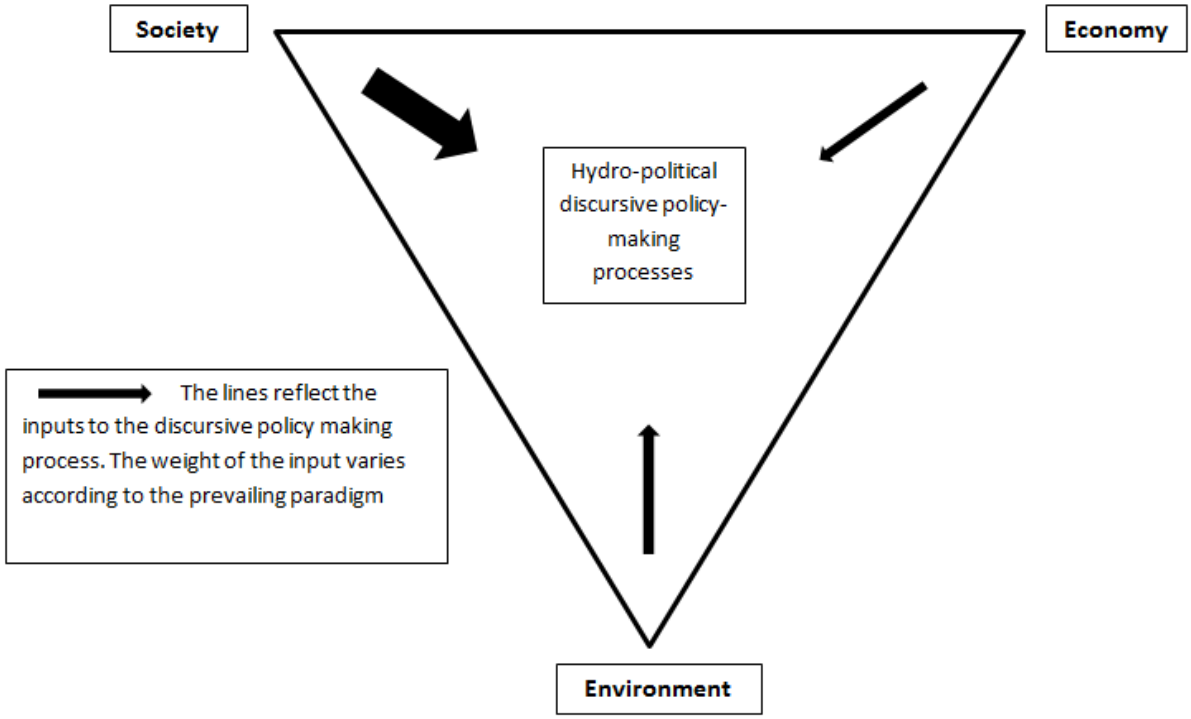

Figure 3. The three forces of influence in the water sector. (Source: Allan, 2005).

While the initial diagram (Figure 3) explains how each of the corners equally represent the influencing factors of the environment the economy and society, the following figure shows how each of the five paradigms have been influenced by those same factors however note that dominance is attributed to different sectors during each paradigm.

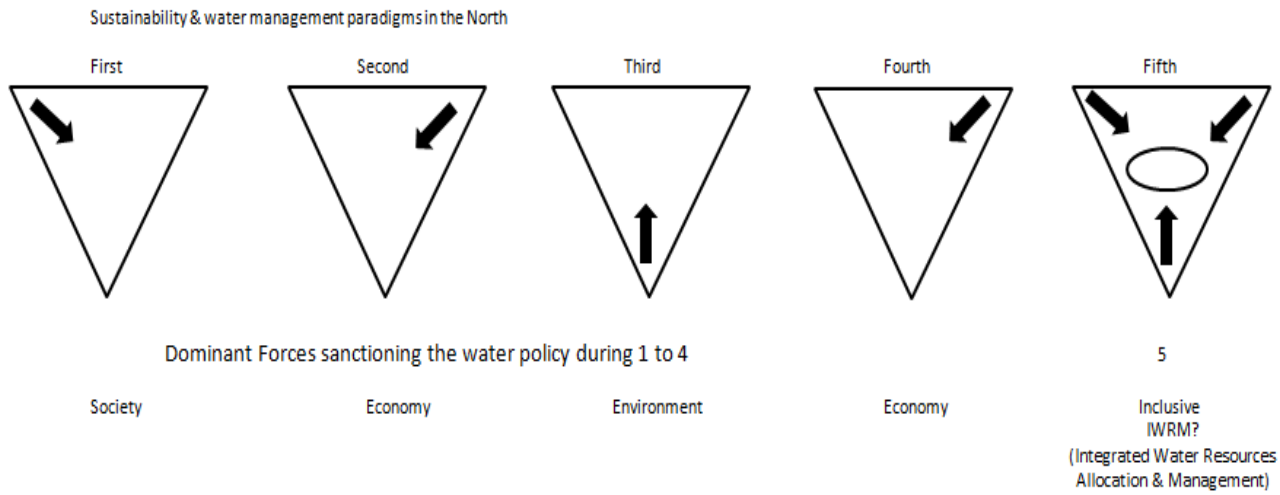

Figure 4. The dominant factors in each paradigm. (Source: Allan, 2005).

As has been noted above, the work of Turton and Meissner (2002) has focussed not so much on the paradigms which are dominant at the time but rather at the periods of transition which occur between these periods of "*normal science*". The second reason that this work is of seminal importance to this research is that it has specifically focussed on the South African context, highlighting the South African paradigms in WRM.

Turton and Meissner (2002) have focussed on how the relationship between stakeholders (i.e. the end user/public, government and NGO's) influences what paradigms are dominant at the time as well as the effects this relationship has during periods of transition. Turton and Meissner refer to this interaction between role players as the hydrosocial contract, this contract is dynamic in nature and as the relations between role players within this contract change it can facilitate a transition in the contract itself. The authors base their theoretical model on an advancing and growing city which starts off in a condition of water abundance. While this condition is prevalent water is in good supply and very little effort is required in order to harness it. During this time the relationship between water user and water is a

personal one and the extent of water usage is determined by the individual. This period of time is referred to by the authors as the initial period of water abundance.

However due to the dynamic nature of the contract the status quo is not maintained, as the city begins to grow so does the demand for water, where during the condition of water abundance water is used chiefly for the individual, advancements see the uses for water increase to sectors such as industry or mining along with a burgeoning working population which also demands access to water. Soon the once sufficient supply may become polluted, over utilised and in short supply, this brings forth an anomaly or problem which needs to be solved, more water is needed. Turton and Meissner note the prevailing condition of water abundance giving way to a prevailing condition of water scarcity. It is this transition that is referred to as the "*first transition*", which sees significant differences in four areas of the hydrosocial contract.

(1) The relationship between end user and water is significantly changed, where water was sought for personal consumption the main users of water have changed to industry, (2) Water is now allocated often in a predetermined amount via community infrastructure (i.e. water pipes) and from an authoritative regulatory body. (3) Next it is the perception of water that undergoes a substantial change, where it was once an abundant free resource it is now viewed as a commodity. (4) Lastly is the birth of the hydraulic mission, a term shared with many other researchers in this field (Ohlsson and Turton, 1999; Reisner, 1993; Allan, 2005), this hydraulic mission refers to the birth of an era which has a need for water that is so strong and so dire that it is seen as a literal mission that government must fulfil. The hydraulic mission seeks to satisfy the need for water by any means necessary, the means used are often obtained from engineers who become a discursive elite as they are seen as

miracle workers (Reisner, 1993) because they can supply water to areas where none is available.

With the incessant demand for water ever growing the heroic engineering of these engineers become more and more complex and their consequences ever more far reaching. This supply side management is a stark change from what was experienced under the first prevailing conditions. The increasingly complicated and costly feats of heroic engineering perform their purpose and effectively change the prevailing conditions of water scarcity into conditions of a water deficit. And once again it is evident that a second transition period is underway.

Along with a water deficit the cost of heroic engineering becomes evident to the end user and to natural environmental features or attractions come under threat (i.e. the creation of dams in cultural or spiritual areas). NGOs drive a social consciousness which determines the cost of heroic engineering and if the cost is too high the ideas are not seen as suitable, this can be referred to as the demand management phase. During this time it not only the idea of social consciousness that determines what kind of heroic engineering is suitable but also political conditions. It is easy to see how the prevailing conditions noted by Turton and Meissner reflect the definition of a paradigm and the periods of transition can as likely be seen as anomalies which need to be addressed in order for the prevailing paradigm to take hold.

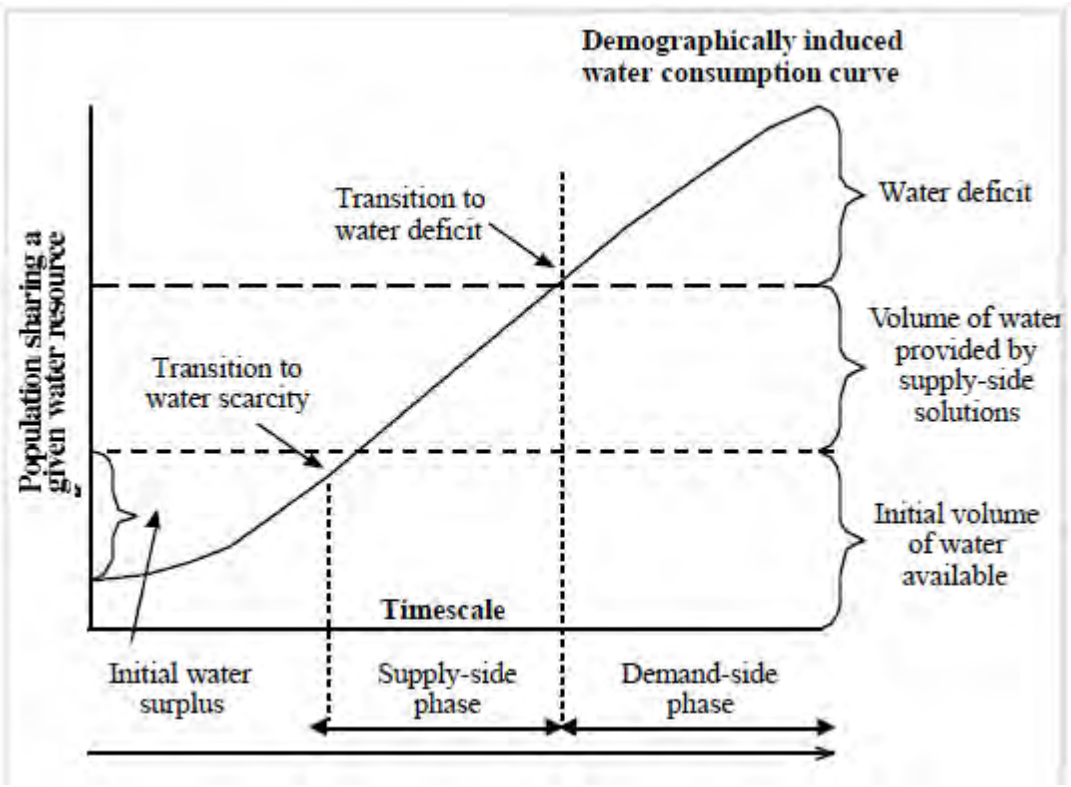

Figure 4. Graphical representation of Turton and Meissner's periods of transition and prevailing conditions. (Source Turton and Meissner, 2002).

When looking at the graphical representations of both Allan and Turton and Meissner it is evident that both theories illustrate the same progress of WRM. Even though Allan's theories have been implemented in the Northern hemisphere while the work of Turton and Meissner is rooted in the South African context, the common ground shared by both illustrate a common growth pattern within the field of WRM. Both bodies of work refer to a prevailing worldview which is evident within the community, in Allan's work it is termed a paradigm while according to Turton and Meissner it is called a Prevailing condition. Both studies also indicate that these periods are interspersed with periods of upheaval which result in a change in the communities understanding or way of functioning.

While the research above has focussed on general paradigms within water management, the next section to be investigated is relevant to the current research as it studied the "emergence, persistence and change of policy paradigms" in Israel over a period of nearly fifty years as is being investigated in the current research.

Menahem (2001) investigated how policy networks and the social interaction have contributed to the founding of governmental policy. This research takes an in-depth look into how government policies are influenced by the networks. Menahem's investigation dates back to the foundation of the Israeli state in 1948, its autonomy and its steady decline. The water policy is found to be deeply intertwined with agricultural policy and formed part of the process of nation building, thus showing the direct links to political parties and state policy. The dominant Zionist ideology of the area at the time ensured the national importance of agriculture (Eisenstadt, 1967).

Three periods of development are identified by Menahem each with its own paradigms which were deemed to be present. These periods of development were also categorized according to the approach of the policy, be it anticipatory or reactionary. The paradigms alluded to by Menehem were expressed through the legislation regarding water resources. The legislation was created through the combination of the policy network, and the nature of water policies of the time (Menahem, 2001). This close interrelation between policy, law, and paradigms are of keen interest to the research at hand. What can be seen in this research is the relationship identified between the water sector and the agricultural sector noting that many who were in the agricultural sector had a role in government and as such the interests of the policy network was in favour of agriculture. The period between 1948

and 1967 showed an anticipatory nature of the networks by planning for future irrigation systems, crop types and the status of the land.

The period between 1967 and 1990 is characterized in Menahem's research as having an institutionalized network and having very strong agricultural priorities. The political situation of Israel at the time is noted as being the reason for the strong institutionalised focus. This period was characterised by ever growing gap between demand and sustainable yields, growing under the assumption that more water could be discovered or that further resources could be created through desalination. These ideas led to a water crisis in the area resulting in forced change and adaptation to conditions and the turn towards sustainability.

The final period of Menahem's research is characterised by conflict due to scarce resources. Crops unlike in the periods previously were changed to those that were better suited for growth with diminished water supplies along with deteriorating water quality. These changes in the water conditions necessitated legislative change as well. The most relevant of these was the separation of water and agricultural policies, and the instatement of actual water experts in political positions.

Through the classification of these water development periods the research was able to distinguish what forces determined the change within the national policy. The research did however note that the findings expressed by the policy analysis were not in accordance to those which had been expressed in the research of Hall.

2.4 South African Water Legislation

The discussion continues with an exploration of the overarching "umbrella" Acts which controlled water management over the past 100 years in South African. Although this

research considers legislation which has been enacted over the past century, it is essential to first document the origins and principles of South African water law which preceded them.

Water rights under African customary law (pre-colonial era)

The first peoples in South Africa were nomadic people. These people lived as hunter gatherer societies, making use of water as they needed and not having a significant influence on the resource. Common law at the time gave water the status of a common resource. As these nomadic peoples were joined by communities which were of an agricultural nature the ownership of water as a resource was brought into contention. While water disputes were few those that did occur were settled by the leaders and elders of tribes. The utilisation of water in this time is very low, in comparison with modern standards, and it is only utilised where it is found therefore those who want to make use of it must be located close to it. The arrival of settlers in 1652 brought with them foreign laws and customs that was forced upon the local people and defined law differently to the local understanding.

The Colonial era

The arrival of the 1652 Dutch settlers to South Africa brought the first major shift in water legislation. This shift encompassed the change from customary African laws which saw water as a shared commodity to a Roman-Dutch system which had at its heart the principle of *dominus flumnius*, this principle gave the government the right to control water within the country. This era, based on roman laws, saw water as a commodity that could not be privately owned (Pienaar and Van der Skyf, 2007). While the law classified water as a public

commodity which could not be owned, there was a different understanding of the banks which neighboured the water system (riparian). This land was able to be privately owned yet the owner of the land could not restrict members of the public from accessing the water which his land neighboured. In this period there was a clear distinction drawn between the source of water and the water which flowed in streams. Water which flowed in navigable streams was seen as belonging to the public, and as such available for their use. However if the stream was non-navigable or flowed from a spring sourced on private land that water was deemed as under the control of the owner of the land from where it originated. This complex system of onerous water distinction resulted in many disputes over the resource and its utilization (Tewari, 2009).

This Roman-Dutch system was the dominant system from 1652 until 1873 which signalled the change in colonial power in South Africa from Dutch to English rule, and as such a change in legislation. This brought with it a change in principles for water law, paramount among the changing principles came the change of the rights of riparian (along the river) land owners. Riparian land owners had the right to utilise the water of a river flowing over or alongside their properties. Along with this right came their right to the control over water from springs on their land as it had been under the Roman-Dutch system. This change in system resulted in a negligible role for government in the allocation and development of water resources, from there all out control of water which had been the case under the Roman-Dutch system (Pienaar, 1998). This system (English Law) remained in power until the proclamation of the 1912 Water Conservation Act.

Water Conservation Act 8 of 1912

The promulgation of the 1912 Water Conservation Act under British rule brought with it a change in one major principle. This act allowed for the distinction between public and private water, whereas before water was seen as a public commodity. The distinction of different types of water was based on the idea that water flowing over or alongside land was entitled to be used as private water, and as such under the control of the owners of the adjacent land. However it contained a stipulation which entitled the owners of land down-stream to water rights as well. It was stipulated that these lower lying land owners should also be allowed access to the water flowing in the river. Therefore water could not be stored and diverted so as to disadvantage users downstream (Pienaar, 1998). Water running in public streams was then deemed to be public water and the use thereof was available to all as regulated by the Act. The differentiation between private and public water, meant that water which flowed over or adjacent to private land, deemed to be private water, had no ownership yet riparian land owners had access and rights to use this water. Whereas water which then had its source on public land, deemed to be public water, was accessible to all but was owned by the state. Resulting in private water having no distinct owner and public water belonging to all (Tewari, 2009). This convoluted distinction of private and public water, while simplified, was maintained in the Water Act 54 of 1956.

Water Act 54 of 1956

The 1956 Water Act, while retaining the distinction between public and private water, did not explain who the owner of private water was, yet the ownership of public water was given to the state. Even though it did not explain the ownership of private water it maintained that exclusive utilisation rights belonged to the land owners of the source from

where the water came and those who owned land adjacent to the stream. The rights to public water however were controlled by the government, riparian land owners were then allowed access to sufficient quantities of surplus water for domestic use, watering of cattle and cultivation (1956 water act and Pienaar, 1998). In terms of the 1956 Water Act, riparian owners had the right to use public water in public streams, but the use-rights were controlled and regulated by the state. The right of private owners to use water in rural areas (farms) which had its source on the land or flowed over the land was a direct consequence of their land ownership. Although there was no finality over the ownership of water the use of water was derived from and linked to the ownership of land. This act allowed the access to water yet the use of this water was controlled by the state (Thompson, 2006).

National Water Act 36 of 1998

The advent of democracy in South Africa brought with it yet another change in water legislation, while democracy came about in 1994 changes to the water act were not enacted until 1998. The reason for this delay period was due to many factors paramount of these was the need for research and consultation. The new Water Act needed to cater for a large portion of the population which had previously been excluded. Black, formerly disadvantaged citizens, now needed to be catered for equally to their white counterparts. As has been stated above previous water legislation had been based on European laws (Roman-Dutch and English law). As all the previous legislation had come from areas (Europe) which have abundant access to water, the legislation often did not cater to the South African context which was much drier and needed to accommodate for extensive water shortages.

The first and most significant change that the National Water Act brought to South African water legislation was the substituting of the differentiation of public and private water. The 1998 act recognised water as being a natural resource which belongs to all citizens of the country. The act then has three main facets which distinctly differentiate it from its predecessors, namely the Public Trust Doctrine, the Socio-Economic effects catered for within the act and the licensing of the use of water.

Public Trust Doctrine

The Act states that as a natural resource, water belongs to all the people of South Africa, but its use is controlled by government and kept in trust. The Act gives government a fiduciary role towards the people of South Africa, this ground breaking premise had not previously been used in South African legislation. This relationship between state and people results in the state holding property subject to the public trust solely as representative of the nation for the benefit of the nation, not the state treasury or the leading political party. This appointment of the state as trustee ensures that it is not at its discretion to deal with the resource or ownership of the resource, but rather its obligation to Act towards the benefit of 'all people'. The theory of the public trust doctrine specifically summarises the state's duty to regulate the sustainable use of the nation's water resource and is reflected in the sections of the Act that deals with the allocation of water.

Socio economic effects of the Act

The socio-economic effect of the act can be divided into two distinct areas of focus, namely the accessibility to water for the whole population and the environmental management aspect of the Act. The Act has as one of its core principles that everyone is entitled to

sufficient water for domestic services, this principle is unique to South African legislation as it is not evident in many pieces of international legislation including the International Covenant on Economic, Social and Cultural Rights of 1966; African Charter on Human and Peoples' Rights of 1981. The right given in the act is enshrined in section 27(1) (b) of the constitution noting that *"everyone has the right to have access to sufficient food and water"* and enforced by Section 27(2) "the state must take reasonable legislative and other measures, within its available resources, to achieve the progressive realisation of these rights". 'Basic water supply' is defined in section 2 of the Compulsory National Standards and Measures to Conserve Water Regulations of 2001 as "25 litres per person per day accessible within 200 metres". This stipulation creates great logistical and infrastructural pressure on the state to provide for these needs. This basic water supply entitled 6.000 litres of water per household per month should be freely available (DWA, 2012).

The environmental management aspect of the Act (NWA, 1998) is set out in section 2 which states that there is "protection of the environment by managing water resources". Section 3 (2) of the act stipulates that the Minister of Water Affairs and Forestry must, in the allocation of water use rights, see to environmental protection. Due to the inclusion of these sections the water authority may require that a water user must apply for a license if polluted water is to be released in a water source, if the water is polluted in any other way or water is used in such a way that the quality of the water is detrimentally affected. The Act further states in section 43 that "*water restrictions are instituted in instances where excessive use of water resources takes place*" (NWA, 1998). These stipulations bring forth the final aspect to be detailed about the act the right to use water through licensing.

Use rights by licensing

While the Act clearly defines all manner of the practical application of the principles which underlie the public trust doctrine, they are too numerous to mention here. These practical applications require the state to consider the public interest in all water allocations. It is also clear that all water use rights exercised on authority of the Act are allocated and exercised within the scope of the public trust doctrine. This means that while recipients of water use rights may use those rights to their advantage, the water use rights are impinged on with the public trust and subject to the public's pre-existing title. If the public interest demands a retraction or curtailment of these rights, the individual's interests in these rights will be secondary to those of the public (Pienaar, 1998).

This chapter has highlighted the extensive research that has already been performed in the chosen area of study. The work of Allan; Turton and Ohlsson and Turton and Meissner have all proposed the existence of paradigms in WRM and in the South African context in particular. Rather than disputing the nature of paradigms this research is interested in the shifting which takes place between paradigms as highlighted by Turton and Meissner's transitions. The research will therefore focus on the work of both Allan as well as that of Turton and Meissner. The research of both international and local frameworks for WRM paradigms has resulted in almost identical graphical representations, the accounts, results and prediction of both studies enables this research to assert that paradigms do exist within the area of Water resource management. Although each piece of work has assigned differing designations the research has shown that dominant paradigms and prevailing conditions are in essence the same phenomenon. Likewise periods of transition and shifting

paradigm are also the same phenomenon. Finally this chapter has explored the three umbrella acts which have been selected for use in this research.

CHAPTER 3 METHODOLOGY

3.1 Introduction

This research uses secondary sources from academic literature and national legislation on water in order to identify and illustrate shifts in water resource management paradigms in South African legislation. The approach uses descriptive analysis methods in order to achieve the requirements of the research within the constraint of a desktop study.

Much has been written about water resource paradigms from the macro/worldwide perspective. The work of Ohlson and Turton (1999) and Allan (2005) have investigated paradigms from a top down viewpoint by exploring how paradigms can be identified and how they behave in a theoretical context. Menahem (2001) has investigating paradigms at a country specific level, by illustrating how paradigms could be identified during a time of substantive legislative change in Israel. Turton and Meissner have investigated the existence of the hydro-social contract which exists and how periods of transition have perforated the dominant paradigms which prevail at a given time. This study has then furthered this trend of intensifying the research, and investigated water management paradigms and their transition in relation to the South African context from 1912 until 1998. This study utilises the three legislative changes in water law since 1912 as a basis for identifying and tracking key elements and thinking in general water resource paradigms to examine how political, economic and social changes in the country, as demonstrated through shifting legislation, are recognised in these paradigms. In this sense the legislation is used to compare and contrast changing paradigms in order to situate these general paradigms and the periods of transition within the changing SA context.

3.2 Identification and approach

This study illustrates paradigms, as proposed by the research in water resource management, in an attempt to identify and compare the shifts in water resource paradigms with the changes which have been experienced in South African legislation. It is hypothesized that the radical shifts in South African legislation, like the formulation of the Constitution and the principles that it enshrines in the subsequent Water Act, have driven or have been driven by a paradigm change in Water Resource Management. The research therefore entails the identification and illustration of paradigms within water resource management, and from that proposes that these shifts can be noted within water legislation. The current study and the work of Turton and Meissner (2002) share a close correlation but will diverge in that the study at hand will attempt to identify the proposed paradigms changes within Water Resource Management and illustrate these within South African water legislation.

The research of Hall (1993) and Menahem (2001) used distinctive approaches in order to make sense of their findings. Hall made use of the social learning approach in order to interrogate his findings while Menahem utilised a policy network approach. As this research aims to investigate water resource legislation, it is appropriate for a water resources management framework approach to be taken. In an attempt to simplify the research process the study has chosen to utilise a process which already achieves the desired requirements of identifying, tracking and unpacking paradigms. The approach which has been identified is that used by the work of Allan (2005) and that used by Turton and Meissner (2002), this was selected because the initial work of identifying and illustrating paradigms within WRM has been done. Given that strikingly similar results have been

yielded from both studies this research is not required to perform this once again. Further the authors have already placed their framework within the South African context allowing for simple interpretation. As has been noted above the research undertaken by Allan (2005), which investigated WRM paradigms within the Northern Hemisphere, emphasised the dominance of prevailing paradigms and the policy implications thereof, much like the aims of the current research. It is in its location that the current research deviates from the work of Allan. While Allan's research is based on the northern hemisphere, the current research will be focused on the southern hemisphere. This north-south divide will provide for interesting comparison in the discussion section of the research and allow for the identification of patterns, similarities and contrasts. Turton and Meissner (2002) in turn focussed on the South African context but emphasised the shifting of these dominant paradigms due to periods of transition.

3.3 Research design

The research design is based on the interpretation and analysis of legislation, with particular attention on three principle Acts that have shaped water resource legislation in South Africa. These Acts were selected with the intention of identifying Water Resource Management paradigms within the legislation as a whole. The research then explores these emerging paradigms in water resource management giving attention to the academic debate in both local and international literature.

In the performance of this research, two forms of analysis will be utilised, namely descriptive and comparative analysis. The Descriptive analysis will take the form of describing specific sections of each Act and their viewpoints or interpretation of particular matters. The purpose of this is to illustrate and thus align the intention of the legislation

with that of the proposed paradigm. The use of a descriptive analysis will enable the characteristics of each dominant paradigm evident within the legislation to be highlighted and properly identified. These descriptive accounts will then form the basis of the comparative analysis which will illustrate how the legislation has "shifted" through each new enactment. The legislation and the shifts highlighted by the descriptive analysis will then be compared with those paradigms and shifts which have been found to be evident in research of water resource management. The similarities and contrasts which emerge between each act will also be explored so as to form a holistic understanding of what has changed and what has been retained through the period of transition.

3.4 Methods

The methods seek to address the objectives posed at the outset of the study and are as follows

- Identify and illustrate paradigms that characterised water resource management over the past century in general;
- Identifying how these paradigms are aligned to changing South African water legislation (if at all) by examining the chronological sequence in conjunction with the political, industrial and social context of the time;
- Analysing the possible relationships between the paradigm shifts within South African Water legislation and how these are aligned with paradigm shifts in water resource management in the country.

The method of investigation and analysis to be used by the research will consists of two phases each of which addresses specific objectives of the research as outlined above. The initial phase will make use of descriptive analysis and will illustrate and describe the SA water legislation that has been selected for investigation in this study. The descriptive analysis will then continue by describing and unpacking the paradigms which are present in South African water management according to Allan and Turton and Meissner. The second phase of analysis (comparative analysis) will utilise the results gained in the descriptive analysis process to compare the South African legislative shifts with the paradigms identified in the field of Water Resource Management.

3.5 Descriptive Analysis

As has been mentioned previously the Acts selected for investigation in this study have been chosen because of their over-arching nature (they are the umbrella Acts for water management). The short-coming of this is that each act is extensive and detailed, due to the time constraints imposed on the study the research has only selected specific items within the legislation on which the description and comparison analysis process will be based.

3.6 Analysis of legislation

Access to water is a consistent theme not only within all three acts under investigation but also in the evolution of South African water law (du Plessis, 2010; Smith and Hanson, 2003 and Stein, 2005). In the first phase the relevant acts will be described in terms of their provisions and their approach with regards to access to water. Access to water will further include whom the act assigns the ownership of water too and by what means it does so. The justification as to why these provisions have been included in the Acts. Smith and Hanson

(2003); du Plessis (2010); Stein (2005); Kidd (2008) and Thompson (2006) have noted that there are two approaches which comprise the access to water debate, these include the ownership of water and riparian land as well as the user rights of water. It is thought that these areas of focus will allow for appropriate comparison between legislation. As each piece of legislation has evolved there are inconsistencies and new additions which do not correspond with the older legislation. These changes in legislation are numerous and significant yet only selected additions and omissions will be investigated due to research constraints. These include, but are not exclusive to the water reserve, the right of the environment and the concept of reconciliation. These areas of special interest will also be investigated in greater detail so as to form an understanding of the thinking which was prevalent at the time.

3.7 Analysis of Theory

Turton and Meissner (2002) noted that paradigms or prevailing conditions were interrupted by periods of transition and that the transition (paradigm shift) was illustrated by noting four significant differences in the hydrosocial contract post and prior to the period of transition. The areas where particular change can be noted were that of (1) the relationship between the user and water; (2) Sanctioned discourse; (3) the hydraulic mission and (4) the driving phase. Aside from these four areas of change within the hydrosocial contact the initial mechanism which signifies that a period of transition is underway is the occurrence of a trigger event. This is an event that has a significant impact on the environment as a whole and has far reaching effects in terms of economic, political and societal consequences. (1) The relationship between the end-user and water signifies significant change in the hydrosocial contract as it determines how water is valued. The value of water can vary

significantly as it can be seen as a scarce commodity or a free resource. (2) Sanctioned discourse differs prior to and post transition, the discourse literally sanctions who is in charge of water and how it will be managed. Here an elite is group is usually formed to decide the management of water. (3) The hydraulic mission refers to the rationale held by the sanctioned discourse, and determines goals that will be worked towards. Finally the (4) driving phase refers to the phase which is dominant at the time i.e. supply or demand side phases. By noting the difference in these areas of change within the hydrosocial contract the research at hand will attempt to illustrate the presence of a period of transition.

3.8 Comparative analysis

The second step is an analysis based on Allan's approach to water management paradigms. The positioning of the paradigms (and legislation) will allow inferences to be made from the framework. Through the completion of the third step the second objective of the research will be fulfilled. The final step of the methodology addresses the third and final objective of the research, here the analysis drawn from the research will be substantiated and the linkages between the paradigms in the legislation will be drawn with paradigms in water management. Finally, once the identification and placement of the paradigms (and as a result the legislation) has been completed the research will then discuss and analyse the relationships, if any, which have been noted between the legislative changes and the change in WRM paradigms. The relationships and notable findings will provide recommendations for future research.

3.9 Limitations

Due to the extensive nature of the legislations which are dealt with in this research it was decided not to compare each act in its entirety. Therefore, through support from previous research, only certain sections of each act have been selected for comparison. This was done so as to allow for concise comparison. While water legislation in South Africa encompasses many more acts and policies than those identified in this research the selection of each piece of legislation has been done because they are all ”umbrella acts” for water legislation in the country. Each Act determined how the supplementary legislation regulated and enforced water management at the time. The second limitation of the research lies in the interpretive method in which legislation has been compared and investigated. Although the methods selected are open to interpretation they have been selected because of their success in previous studies as has been illustrated in Menahem (2001) and Turton and Meissner (2002), it is further proposed that even with the interpretive nature of the study the methods which have been followed have been executed in a logical manner.

Chapter 4 Analysis

4.1 Introduction

The analysis of the research at hand will be presented in two stages: a descriptive stage, followed by a comparative analysis stage. The initial stage describes and illustrates paradigms in water resource management as have been depicted by Turton and Meissner (2002) and Allan (2005). In an effort to remain concise the full description of the research performed by Turton and Meissner (2002) and Allan (2005) will not be retraced here, the findings of these studies will rather be summarised so as to highlight the paradigms and periods of transition explored within them. The chapter will then investigate the legislation highlighting the changes similarities and areas of special interest within each piece of legislation. Next the extent to which South African Water legislation provides evidence of those paradigms and periods of transition building on the work of previous authors will be illustrated. The second stage of the research uses comparative analysis to investigate the possible relationships between paradigm shifts within South African Water legislation and how these are aligned with paradigm shifts in water resource management.

4.2 WRM paradigms according to Allan

Allan noted five paradigms each of which evolves and is built on the understanding and management style from the previous paradigm, yet each paradigm depicts a distinctly different theme. Allan's paradigms were formulated by including inputs from legal, economic and political factors on a global scale. The global perspective, of this framework, describes how both northern and southern hemisphere countries have embraced Water Resource Management paradigms over time. Where this research and Allan's differ lies in

the scale of the context. The current research is only interested in how the South African case study fits with the general global outlook depicted by Allan.

The first of the five paradigms, referred to as the pre-modern paradigm, is dominated by the increase in water usage in an era that predates the industrial era. Allan describes this stage as one of rising population growth and increasing water demand. The increasing need is fulfilled through “engineering” practices in building dams for storage and the development of aqueducts to transport water to where it is needed. This increase in the ‘hydraulic mission’ reflects the ingenuity and engineering efforts that took place at the time. While the increase in demand for water is high it is not yet so high that the natural resources available in an area cannot cater for the needs. Stored water enabled substantial social and economic growth and advancement, and an increasing demand for water. Advancement and progress initiates a second paradigm.

The paradigm of industrial modernity, strengthens the hydraulic mission (i.e. catering to water needs through technological methods). The Industrial Age results in an exponential demand for water. Where water was only used for agriculture and subsistence, it now becomes a vital part of the industrial boom. This era represents a ‘golden age’ where anything is believed to be possible and the consequences for actions is not immediately felt or understood. This paradigm and the previous one, dominate in time, the water resources paradigm thesis, with both paradigms displaying a drive for development along with an expanding demand for water. The difference lies in the purpose for water use and the volume of demand. Whereas the pre-modern paradigm required water for subsistence and personal use, the Industrial era paradigm demanded it for manufacturing and large scale uses.

The third paradigm is referred to as the green movement. It is in this paradigm that the emphasis begins to shift from supply and demand. The Pre-modern and the Industrial paradigms focussed on growth through any means necessary, whereas the green movement is concerned with sustainable use of water resource. This paradigm is characterised sustainable resource and also a critique of the current 'business as usual' approach stating that an unrestricted hydraulic mission and reliance on technology to provide more water is unsustainable. Attention now shifts to demand management to curtail the need for a large amount of water, as is depicted in Figure 2, where the demand for water eventually results in responsible use and a reduction in water demand. Allan notes this shift is largely restricted to northern hemisphere countries whereas in southern hemisphere countries the hydraulic mission continues to intensify.

Allan's fourth paradigm presents an economic focus. During this period the expansion of economies (particularly in the north) is of paramount concern. Smart economic decisions can bring about a consistent decline in the need for new water resources and a decline in the hydraulic mission. Again this trend remains mainly in the north while development in the south still spearheads the growing demand for water and the hydraulic mission. This paradigm, along with the previous one, is characterised by the knowledge that water resources are limited but there is still uncertainty about the limitations and how the needs of the future will be realised. The threat of limited resources is a global one. In the South the overwhelming demand is to provide more water for a growing population.

The fifth and final paradigm is dominated by political and institutional concerns (Allan, 2005). Sustainable water usage is observed as an integral part of the national agenda. While northern countries expand and develop they experience the dominance of different and

changing paradigms, the South, however, remains paralysed within the second paradigm by continuing to pursue the hydraulic mission.

Although the research of Allan and Turton and Meissner tend to follow the same trend, their focus differs in that while Allan has investigated the dominant paradigms of particular ages, Turton and Meissner have rather investigated the transitions between periods of dominant paradigms, or prevalent conditions as the authors refer to it.

4.3 Turton and Meissner's periods of transition

In their research Turton and Meissner (2002) have chosen to focus on the relevance of the hydrosocial contract, which is the unwritten relationship between that exists between government and the public. This contract is established at the stage when individuals are no longer able to cater to their own water needs. While investigating the hydrosocial contract the authors have noted that there are periods of transition which exist between prevailing conditions. The authors thus propose that within the South African context two periods of transition have occurred. The first period of transition is to have occurred at the confluence of a number of circumstances the increased need for water from a rapidly growing society; the already limited supply of potable water that was available and the incidence of a drought are to have brought about the first period of transition.

The periods of transition refer to transitions between the types of hydrosocial contracts which exist, the Hobbsian and the Lockean, so named because of the attributes they possess which align them with the writings of John Locke and Thomas Hobbes. The Hobbsian Hydrosocial contract entails the uneven relationship between government and the public while the Lockean depicts the more equal relationship of Government, the Public and Civil

society (i.e. Non-governmental Organisations). It is these two forms of the hydrosocial contract which depict the change in world view/ paradigms.

In this research the focus is on two inter-related concepts within three National Water Acts, these being access to water and the right to use water. These concepts have been selected because they are embedded in South African history and legislation, and the system of racial bias in particular found in the denial of land and rights as a riparian user and bias towards the agriculturist sector. The Acts which have been selected also contain areas of special interest to the research and these will also be described in the section which follows.

4.4 Access to water and use in South African legislation

Each National Water Act will first be described in terms of its approach and the provisions within with attention to access to and use of water. The research compares the Acts by highlighting similarities and differences that can be identified within them.

The Irrigation and Conservation of Waters Act 8 of 1912

In 1910 the Union of South Africa was formed bringing the Boer territories of the Orange Free-State and the Transvaal together with the British provinces of Natal and the Cape (Thompson, 2006). This union meant that the water laws of the four territories were subsumed into one Act under the Union of South Africa (Tewari, 2009). The national Act was based on the existing water law of the Cape Colonies which were under British rule and therefore subject to English law at the time. This legislation formed the basis of all subsequent South African Water Law that followed (Tewari, 2009). The Act established the Department of Irrigation which administered and enforced the Act and as Thompson (2006)

notes, “promoted the development of land, mainly for irrigation” thus expanding the production of agri-industries (i.e. fruit, liquor and food production).

The enactment of the 1912 Irrigation Act ended the practice whereby the State was viewed as having *Dominus Fluminis* and replaced it with the riparian principle. *Dominus Fluminis* is defined as the dominion over the flow which meant that all flowing water was under the control of the State (Muvik, 2012). While the State previously had “dominion” over flowing water, the introduction of the riparian principle meant that water was now *Res Publicae* (belonging to the public), a concept that only applied to perennial rivers. Underground water and non-navigable water was however remained *Res in commercio* which meant water belonged to whoever abstracted it (i.e. farmers). Under the practice of *Dominus Fluminis* water belonged to no one, but its use was controlled by the state. This principle originated from the Roman Dutch laws which applied to Holland, a country with larger surface water resources than South Africa, but the differing climatic conditions of South Africa meant that surface water was not always available.

The 1912 Act divided flowing water into public and private water. Public water was known as water which flowed in a defined channel and could be used on two or more pieces of land which bordered the river. All water that was not seen as public water was then private water and was to be used as the land owner determined (Thompson, 2006). While the Roman Dutch common law saw this public water as being used for general common use entitling all persons to the use of that water. The 1912 Act then replaced this understanding that public water was to now used for common use, that of irrigation (clearly benefiting agricultural/irrigation users over others).

The 1912 Irrigation Act made a distinction between normal and surplus flow. Normal flow was defined as "*The actual, viable and natural flow which could be utilized for irrigation on riparian land under a system of direct irrigation without storage*" (Section 10 (1), 1912 irrigation act). Surplus flow was then conversely defined as "*That which was not normal flow*" (Section 10(3), Irrigation Act of 1912). The distinction between the two was necessary to enforce the principle of reasonable use. Traditions of English law (on which the Act was based) introduced the concept of reasonable use which meant that while each riparian user was allowed the use of surface flow, none were to use it in such a way that it would interfere with the same right of downstream users. Therefore all riparian land owners were entitled to use the normal flow of the river, i.e. users upstream could not use more than the normal flow of the river as it would infringe on the rights of users downstream, unless when surplus flow could be used and stored freely (Thompson, 2006).

The 1912 Act repealed the Roman Dutch principle of *Dominus Fluminis* and replaced it with the riparian principle which became a basis for determining the access to and right to use water. This principle meant that riparian land owners, i.e. persons who owned land adjacent to a river were entitled to the use of and access to the water which flowed on it (Muvik, 2012). This principle disregarded the idea of state control of flowing water, aside from its right to navigation (Tewari, 2009).

While the Roman-Dutch principle of *Res Communes* held that everyone was entitled to the use of water, the English riparian principle ensured that only a closed community (only riparian land owners) had rights to access and water use (Muvik, 2012). These riparian land owners were often commercial agriculturalists and the legislation entitled them to the use of water, while the Irrigation Act highly favoured the sector (agriculture). The rights of non-

riparian water users were clearly an afterthought as numerous (approximately 40) special water related pieces of legislation were enacted after the Irrigation Act of 1912 to serve the purpose of providing water and in reaching a settlement in water disputes (Thompson, 2006). Although the Act itself did not make a distinction between race groups, the 1913 Native Land Act ensured that the black majority was only allowed to own land in designated areas, often agriculturally poor and only made up a small fraction of South Africa land area. The combination of these two Acts therefore meant that the majority of black South Africans did not legally have a right to access and utilize water in their own country (Thompson, 2006, Kidd 2008 and Tewari, 2009).

Water Act 54 of 1956

The boom in industry and the discovery of valuable mineral resources in South Africa increased the pace of development in the country. The 1912 Irrigation Act could no longer cater for the needs of the booming new industry and the growing urban population in areas of water scarcity. These factors meant that the water legislation in South Africa needed to change in order to accommodate the changing circumstances. The Water Act 54 of 1956 repealed the Irrigation Act of 1912 (Kidd, 2008). The 1956 Water Act modernized the approach to water resource management, bringing with it many changes such as the inclusion of industry into the list of water users and along with that the legislated regulation of water quality (Thompson, 2008).

The Act retained the riparian rights which had been cemented in the previous Act. The 1913 Land Act prevented the ownership of land by black South Africans and thus the Act of 1956 ensured that the access to water use remained within the white minority who were the main riparian land owners (Kidd, 2008). The 1956 Water Act also retained the distinction

between private and public water. Private water was defined as "*All water which rises or falls naturally on any land or naturally drains or is led onto one or more pieces of land where that water is not capable of common use for irrigation purposes*" (Section 1, Water Act of 1956). The owner of land on which this water was found had exclusive use to this water (Section 5(1), 1956 Water Act) but was not permitted to pollute it (Section 23, Water Act of 1956).

Private water was not entitled to be sold or used on any land other than the land where it was found or on land belonging to a municipal institution of local authority unless authorized by the Minister of Water Affairs (Section 5(3)c, Water Act of 1956). Public water applied to water flowing in a defined channel and suitable for irrigation on two or more piece of riparian land, much the same as the definition in the previous Act (Kidd, 2008). The right to use public water was divided into three subcategories: Agricultural, Urban and Industrial purposes. These purposes were still based in the rights of riparian land owners in that they were allowed to use "their public water" for the first two purposes in a manner that was controlled by the state (Kidd, 2008). Persons who were however not riparian land owners were finally allowed to use public water for certain purposes. These included drinking, washing, cooking and the watering of stock. The Act also stated that any use of public water, which amounted to wastage, was prohibited (Thompson, 2006).

The Act allowed the minister to determine areas which were high in water scarcity which could be designated as Government Controlled Water Areas (GCWA). As such the water in these areas could be used by those riparian owners who previously had access to them but only under the government's direction and appropriation. This largely attenuated the value of the riparian rights of water users in these areas. Within the GCWA, water was controlled

through the use of permits which detailed and authorised how much of the water could be used by riparian land owners. The control of public water within GCWA's was done to regulate the use of water in the public interest. Any use of water within GCWA's was controlled through the use of entitlements which were granted by the Minister (Thompson, 2006). Control of urban users was exercised through water courts while the use of water by industry was controlled by local authorities and did not require court permission (Tewari, 2009). The Act further went on to illustrate the uses of water by industry (Section 5 & 12, 1956 Water Act) and the legislative framework which supported this practice, clearly illustrating the partiality shown by the Act towards this sector.

The Water Act of 1956 changed the focus of water legislation, where it had been agriculture, the Act now focused on the urban and industrial uses of water (Tewari 2009, Kidd 2008 and Thompson 2006). Although it changed many principles, the Act retained the rights of riparian land owners but revived the state as *Dominus Fluminis*. The combination of riparian rights and state control resulted in a hybrid of the pre-existing water principles.

The National Water Act 36 of 1998

In 1994 the Republic of South Africa held its first democratic election and parted from its racially discriminative history. It took another four years before new water legislation was promulgated. The Water Act of 1998 was rooted in the Constitution of South Africa which emphasised the sustainable use of environmental resources and redressing of past injustices. While the water legislation of the past was itself not racially biased, it excluded the majority while empowering the rights of riparian landowners. The new Water Act ensured that all were given equal access and rights to water. Section 2 of the Act (1998) recognises that basic human needs must be met while not disadvantaging future

generations and pursuing equity, social and economic development, the public interest, demand for water and the biological and the ecological obligations. These inclusions signal an end to the importance of the riparian principle in that land ownership was no longer a prerequisite for the rights to access and use water. The *Dominus Fluminis* is also disregarded in that the state no longer has dominion over water but rather that it has the responsibility to ensure proper management of the resource in the public interest, in essence the state became the legal custodian of water (Kidd, 2008).

The right to access took away the previous distinctions between private and public water as had been enacted by the previous legislation and stated that water was a natural resource belonging to all people of the country. This premise is backed up in the preamble and section three of the Act which deals with the public trust doctrine. Where the 1912 and the 1956 Act focused on certain elements in society (i.e. ensuring the provision of water to agriculture and industry) the 1998 included all aspects of society as was required by the Constitution (1996). There are four main inclusions of the 1998 Act that the research has explored in order to emphasise the shift in focus described above, these four inclusions are the Public Trust Doctrine, Socio- Economic and Environmental Management Aspects and finally the use of water through licensing.

Public Trust Doctrine

The initiation of the public trust doctrine was a big shift from the historic Roman Dutch influence that was prevalent in South African law. This doctrine introduced a new Anglo American understanding that "water is a common property belonging to all" (Pienaar and Van der Skyf, 2007). This doctrine entrusts the state with a fiduciary role as a trustee in charge of this resource and the nation (all people) as the beneficiary. According to this

principle the state holds this property (water resources) in trust for the people in their "best interests". The state is the democratically elected representative and therefore obliged to act in the nation's best interests (Pienaar and Van der Skyf, 2007).

Socio economic

The second shift is the attention to socio-economic aspects in two main perspectives. The first of these is the accessibility of water for the whole population. Section 2, 4 (1) and schedule 1 of the Act (1998) states that everyone is entitled to sufficient water for domestic purposes. These sections equate the South African legislation with international practices of the time. The African Charter on People's Rights and the International Covenant on Economic, Social and Cultural rights both state that countries are to look after their people's needs but none specifically mentions access to water. South African Legislation however endeavours to go further than international standards through the constitution (Section 27) which provides the right that everyone has access to sufficient food and water. The Compulsory National Standards and Measures to Conserve Water Regulations (2001) then details the extent of the noted rights such as to obtain at least 25 litres per person per day be accessible within 200 meters of the individual's dwelling place (Pienaar and Van der Skyf, 2007). These standards are legislated in the Act and require the State to ensure them as trustee.

Environmental Management

Section 2 of the Act (1998) details the protection of the environment by managing water resources, although the previous Acts (1912 and 1956) refer to water not being used in a wasteful manner (1912) and that water should not be polluted (1956), although a section

which clearly outlines and defines how this should be done. Section 3 of the Act (1998) makes it a ministerial duty to allocate water rights in order to ensure environmental protection thus clearly stating the importance of the environment as seen by the Act (1998). This duty is fulfilled in section 21 of the Act (1998) in the use of water licensing for pollution or the deterioration in the quality of water and the restrictions which are in place if water is excessively used (Kidd, 2008).

Use rights by licensing

The Act through section 21, details the various uses of water into 7 broad categories, they are namely;

- Abstracting water from a water resource (s21 (a))
- Storing water (s21 (b))
- All aspects of waste disposal which impact water resources

(s21 (f) and (g) and (h))

- Removing, discharging or disposing of water found underground

(s21 (i))

- Making changes to the physical structure of watercourses

(s21(c) and (j))

- Some activities such as stream flow reduction activities

(s36, s37 (1), s38 (1))

- Water for recreational use (s21 (k)).

The Act regulates the use of water and allows for authorisation in three ways. Schedule 1 is the general authorisations and water use licenses which refer to a list of activities which

deal with small quantity use mostly for domestic purposes. The Act then escalates the licensing to a general use licence which conditionally allows limited water use without a licence (Tewari, 2009). The use of the general use licence is mainly confined to geographical areas where water is a scarce resource, and its concession is based on the accordance with other legal restrictions (Movik, 2012). Finally, the use of water which exceeds that of schedule one uses, as well as the conditions contained in a general use licence, requires the authorisation of a water use licence (Tewari, 2009). These licences are regulated in that they can be allocated for more than 40 years and are subject to review every five years so as to retain relevance with the prevailing resource conditions.

These four selections from the Water Act (1998) illustrate that the focus of the Act is no longer one industry or for one purpose, rather they illustrate that the 1998 Act emphasises inclusion rather than exclusion. The act can therefore be said to cater for all possible sectors within society in order to benefit the country at large.

4.5 Areas of special interest in each Act

The Irrigation and Conservation of Waters Act

Broad definitions of normal and surplus flow found in the 1912 Irrigation Act resulted in many disagreements and in different interpretations. In an attempt to address these issues the Act established water boards and courts to settle disputes between neighbouring land owners (Tewari, 2009). An interesting observation is that the water courts were mainly utilized to settle disputes over the over-use of water infringing on downstream users instead of the over-all control of the resource, meaning that riparian landowners were able to use and misuse the resources as they saw fit (Thompson, 2006).

While South Africa at the time was in the midst of deep oppression and racial segregation, there is no indication that this context is reflected in the legislation. The Act does not mention segregation or the proportion of resources for certain races. Thompson (2006) has also noted that rather than the Irrigation Act of 1912 being racially biased, it was biased towards land owners thus reflecting its oppressive nature. The 1913 Land Act had controlled those who owned land and reserved that right for whites, therefore resulting in an Act that in its self was not racially biased but further enforced the racial segregation which at the time.

The 1956 Water Act

The 1956 Water Act came closer to harmoniously ensuring equitable distribution of water between industrial and competing water users (Tewari, 2009). The 1956 Act introduced the idea of managing water quality. Due to rapid expansion and of the establishment of small towns and industries, effluent became a major problem and required the proper disposal and treatment of waste before being discharged into watercourses. The standards by which the water was regulated were also continuously updated.

The 1998 National Water Act

The Reserve

The concept of the reserve consists of two main components: the first is the human needs reserve, which is the idea that a certain amount of water should remain in the system to provide for all citizens basic needs (Movik, 2012). While the constitution legislates for minimum amount of water for sustenance, the reserve only allows the right to the basic domestic minimum (Movik, 2012). The second component is the ecological reserve, much

like the human needs reserve also allocates a minimum amount of water that is the minimum required to maintain environmental sustainability.

Existing lawful use

The 1998 National Water Act is not without criticism. One of the most controversial was that of 'existing lawful use'. This phrase was debated at length for nearly two years prior to the enactment of the National Water Act (1998). In terms of the 1912 Irrigation Act and the 1956 National Water Act, white farmers were given rights to use water, these rights were termed "*existing lawful water use rights*" (Movik, 2012). The National Water Act (1998) defined these rights as provisions to aid the transition from the riparian principle to the administrative principle. Movik (2012) explains their purpose through an interview held with DWAF (Department of Water Affairs and Forestry) officials:

> "*even though the existing users had greatly benefitted from skewed land ownership and the associated access to water through riparian rights, their uses were allowed to carry over because the economy depends on that kind of use*." (Movik, 2012: pg. 40).

In an interview with another official (the Chief Operating Officer of DWAF), Movik noted that "*The primary reason for retaining existing lawful uses was that they* (the Department) *would be exposed to allegations of expropriation if they did not do so*" (Movik, 2012 pg. 40).

DWAF citied that rather than practical or capacity problems, the reason for introducing existing lawful uses was due to the sustaining the economy and avoiding charges of expropriation. Schreiner and van Koppen (2002) have noted that should these existing lawful uses be converted to water use licenses (as envisaged by the legislation) they will

entrench the existing skewed power relations between white riparian land owners and black non-riparian land owners, which is in direct opposition to the objective of equity in the act (National Water Act, 1998).

The areas of special interest within the three pieces of legislation which have been highlighted above give further backing to the idea that each act had a specific area of society which it favoured. The water courts brought about by the 1912 Act allowed riparian landowners (mostly farmers) who had disagreements a platform from which to settle disagreements in court. Thompson (2006) notes that these courts ensured that water users (particularly in the agricultural sector) could expediently and efficiently ensure their access to the resource, further emphasising the focus of this industry within the Act. The introduction of water quality standards by the 1956 Act ensured industries that required particular water standards could effectively use the resource. Finally the areas of special interest that have been highlighted in the 1998 Water Act illustrate its multi-disciplinary nature and its ability to cater for all sectors of society, further the provision that the needs of all including the environment are found within the Act speak to the principles of integrated water resource management.

4.6 Paradigms and transitional phases within the Legislation

Allan's research, while not explicit in its identification as to the characteristics for paradigms depict the evolution of Water Resource Management well. It is because of this secondary attribute of Allan's research that it finds it place within this study, framing the understanding of how paradigms shift. While the attributing of specific paradigms to pieces of legislation may be lacking, the research has attempted to align its understanding of each paradigm with the characteristics evident within the legislation.

The 1912 Irrigation Act limits access and use of water to those who own land adjacent to rivers. This premise ensured that riparian land owners made up a closed community of powerful individuals who in essence have the basis of control of water in the country as they are assigned these use rights. Many of the riparian landowners are situated along rivers because they are in the business of agriculture (Tewari, 2009). By placing the basis of control of the water resource with those in the agricultural sector this Act clearly aligns itself with the agricultural sector. The 1912 legislation is so heavily biased towards the agricultural sector that it is difficult for other industries to develop let alone flourish, this is noted due to the passing of approximately 40 secondary acts. These Acts were used to allow non-riparian land owners access rights to use water, due to the total disregard of the Act for water users other than those who were riparian land owners. Thus making it difficult for sectors such as industry to grow and making conditions suitable for the expansion of agriculture (Thompson, 2006).The Act clearly makes its intentions know within its purpose statement. The act serves to codify the water legislation of the Union of South Africa after its recent formation (Thompson, 2006). It also undoubtedly notes the provision of irrigation as its purpose within its title, predisposing the legislation to having an agricultural focus.

Little mention is made within the Act for the uses of water outside those for agriculture and domestic use. During this period in time agriculture is still one of largest contributors to the country's Gross Domestic Product, and in order to ensure that the largest sector is able to prosper the legislation at the time must be drafted with an eye towards the agricultural sector. As has been shown above, the 1912 Act was dominated by a focus on the agricultural sector. Before this legislation was enacted there was a formation of the Union of South Africa, made up of the four territories and water within the Union was administered

under the Cape province's existing water legislation during the interim (between the formation of the union, in 1910, and the enactment of the 1912 irrigation act) (Tewari, 2009). However because this legislation was suited to the Cape's climactic conditions it had little practical relevance in the other territories. The mismatch between legislation and climatic conditions can be seen as an anomaly which contributed to the build-up and subsequent need for a paradigm shift. The Agricultural paradigm of the 1912 Irrigation Act could not account for the exponential growth of the industrial sector and the associated urban influx (Thompson, Muvik and Tewari), necessitating a paradigm shift which is signified by the enacting of the 1956 Water Act to cater for the needs of society at large.

Whereas the 1912 Act did not elaborate on the uses of water, the 1956 Act stated that water could be used more than simply for agriculture and domestic use (Section 8 and 9). The Act allowed for the industrial use of water through permits that placed control in the hands of government. The Act seems to expect the increased use of water by industry as it includes a clause (section 21) which regulates the use and disposal of water used by industry, agriculture is still at the forefront in terms of contributors towards the national GDP but it is well assisted by a growing industrial sector. Many authors (Thompson, Tewari, Stein, Kidd and Pienaar and Van der Schyff) have noted that the purpose for the 1956 Water Act was due to the inability of the Irrigation and Conservation of Waters Act (1912) to appropriately cater for the needs of the growing industrial sector. The 1956 Act made use of Government Controlled Water Area's (GCWA) in order to micro-manage the implementation of this Act. These GWCA's were areas where the Minister considered it necessary to implement strict controls around the use of water and the administration of

licences. The development of these areas encouraged the development of industrial zones in an attempt to further development of the sector.

Where water use had little variation in the previous pieces of legislation, the 1998 NWA gives a detailed account as to the various uses of water (Chapter 4). The 1998 Act equates the rights of all to access and use water (section 2). While the Act governs the use of water it makes allowances for individuals to use small amounts of water these allowances are contained in Schedule 1 of the Act (National Water Act of 1998). The Act is bounded by its purpose which is set out in section 2. Here the guiding principles of equity (2(b)), redress (2(c)) and social development (2(e)) clearly show the dominance of a paradigm which places social needs at the forefront. The influence of the ecological paradigm is also clear within this legislation. Through the presence of the principles of sustainability (2(d)), protection (2(g)) and preventing pollution (2(h)) of the environment the principles of integrated water resource management dominant. The 1998 Act has a distinctly integrated approach to management and implementation. The Act makes use of various disciplines to inform decision making and as well as the determining of Catchment management Areas (CMA), these areas are location specific as each catchment is different and as such requires the use of varying management. This integrated approach shows a tendency toward sustainability and the catering to the ecological needs of areas as well as the social needs which must be addressed according to the requirements of the constitution.

Each Act is seen to assign power to different sectors of society, the 1912 act favoured agriculture; while the 1956 Act catered to the needs of agriculture while favouring the growing industrial sectors; and finally the 1998 Act endeavoured to see to the needs of all thus placing the power in the hands of the state in an attempt to properly manage the

resource. Due to the changing ideological view points and political agendas which took place in the early 90's within South Africa the wholesale amendment of legislation was required through the enactment of the Constitution (1996). The Constitution assigned rights which could not be accounted for by the 1956 Water Act. The principle of the public trust doctrine, the equal rights of all to access water and the ecological and social rights which the constitution demanded are identified as some of the anomalies which influenced the occurrence of a paradigm shift.

The findings which have been explored above illustrate the presence of dominant focuses within the legislation rather than directly illustrating paradigms. However through interpretation and analysis the dominant paradigms can be linked to the focuses shown above. Within the 1912 Irrigation Act there is a clear focus on irrigation (agriculture) and the riparian principle. This research proposes that this is evidence of the dominance of the pre-modern paradigm. The evidence to support this lies in that this period was dominated by supply and demand, the agricultural sector during this time had the greatest demand for water and as such the power of control of water was given to this sector. The utilisation of engineering methods to supply water to areas which were water scarce showed the attitude to provide water to where it is required at all costs, which is the most significant attribute of the pre-modern era. These reasons along with the growing water demand experienced by the country and the growing population align this period with the pre-industrial paradigm.

The 1956 Water Act highlights a distinct focus on the industrial sector. The Acts drafting came out of the need for an Act which would support the growing industrial sector, (Thompson, 2006 and Kidd, 2008) the Act also recognised the rights of non-riparian land owners to access water. Further the Act recognised that water had many more uses than

simply domestic and agricultural. The population boom and the migration of people towards cities all signified the “golden era” that is highlighted within the Industrial paradigm. The exponential growth of cities and industry resulted in the need for new legislation further aligning the Act with the attributes of this paradigm.

The analysis of paradigms within the 1998 Water Act is the most demanding, its purpose and design which are set out in Section 2 show it has a Socio-ecological focus. The Act and its principles owe much of their inclusion to the formulation of the South African Constitution (1996). Cognisance of the effects on the environment and the inclusion of sustainable usage are evident of the Green movement. However the multi-disciplinary design of the Act and various other principles which are evident in Integrated Water Resource management propose that Allan’s political and institutional paradigm may already be present. It has further been noted that while the findings of the research concur with those of Allan’s depiction of Southern Hemisphere countries (in that the hydraulic mission and demand for water is increasing), South Africa is in the unique position in that while it includes the institutional and legislated attributes of the political and institutional paradigm it still has to cater for millions of people who have been disadvantaged by a racially biased political system. Due to this the country has to continue with its hydraulic mission continuously in search of more and more supplies of water in order to cater for its growing need.

By utilizing Allan’s framework the research has been able to show how 3 of his 5 water management paradigms are evident within the legislation, however because Allan (2005) does not theorise his approach it is difficult to say without any doubt that these paradigms

are evident within the legislation. In order to support this proposal the work of Turton and Meissner (2002) has been included in this research.

Where Allan (2005) focussed on the dominant paradigms present, Turton and Meissner (2002) investigated the periods of transition between prevalent conditions (paradigms). Due to Turton and Meissner's South African context, the presence of the periods of transition have already been confirmed within the literature. The first transition according to the work of Turton and Meissner is noted as a period in history when water scarcity is has been encountered by a community. It further notes that this scarcity may be worsened by the presence of a major drought, and the pollution of existing water sources through unchecked mining activities. The case study used in the research is that of the WitwatersRand in Johannesberg, with a focus on the period of time from the discovery of gold in 1886 and the shortage of potable water till about 1903. A period of transition is usually initiated due to the confluence of factors, like the situation of Witwatersrand in the Case study. The massive influx of people to the area due to the discovery of gold and the lack of potable water and sanitation resulted in a typhoid outbreak, this according to Turton and Meissner (2002) ushered in the first period of transition.

As has been stated previously Turton and Meissner (2002) noted that the presence of a period of transition can be noted by illustrating four significant differences in the hydrosocial contract on either side of a period of transition. The first of these differences lies in the relationship between the end-user and water in how it is valued. Before the confluence of factors in the Witwatersrand from 1886 to 1903 the area had an abundance of water, hence its name (white water ridge), during and after the period which follows water becomes ever more important in the area. As the drought worsens, sickness spreads

and and influx of people migrate towards the area, clean potable water becomes more and more important, changing its value from a resource that was freely available to a commodity that is highly valued (Turton and Meissner, 2002). The second change in the hydrosocial contract is that of the sanctioned discourse. In the Witwatersrand, and Johannesberg as a whole, water is very scarce during the period of transition, in order to satisfy the growing need for water the services of engineers are required to transfer water from neighbouring basins. This hydraulic mission creates an elite group who can determine the use and management of water. The third attribute of a period of transition is that of the hydraulic mission. As stated before the lack of water in the Johannesberg area results in the formulation of an hydraulic mission which caters to the immense new need for water in the area by individuals and industry. The outlook at this stage is one of eternal optimism and the idea that getting water is simply a matter of the monetary expenditure. Much like the Sanctioned discourse that has been created by this period of transition the rationale of the hydraulic mission did not exist prior accounting for a significant difference between the status of these attributes before and after the period of transition (Turton and Meissner, 2002)

The final attribute is that of a driving phase, before no need existed for a driving phase as water was used on a subsistence basis, after the period of transition this has been replaced by a strong supply phase attitude in keeping with the hydraulic mission present at the time (Turton and Meissner, 2002). The Hydrosocial contract which develops from this period of transition is also believed to have significant Hobbsian features (Turton and Meissner, 2002).

Although the first period of transition, according to turton and Meissner (2002) occurs before the enacting of the 1912 irrigation act this research sees the two as being directly linked. This can be said because the period of transition is just that, a period. It may cover a length of time. Further given that new legislation had to drafted in order enact the new legislation a long period of transition can be expected.

The second period of transition according to Turton and Meissner (2002) occurs during a period where a water deficit prevails. The main feature of this period of transition is attributed to the birth of a new social conscience. The early 90's in South Africa was about with social and political change (du Plessis, 2010), years of racial segregation and favouring towards the minority had resulted in stark inequalities between the races.

The four attributes taken from Turton and Meissner (2002) will once again be applied in order to determine the applicability of period of transition in accordance with the paradigm framework proposed by this research. The initial attribute of the relationship and value of water is satisfied as the period introduces the majority of the nation to services and rights that had not been afforded to them. Water is transformed from a daily chore to a legislated right. Even though many are not able to enjoy this right immediately, a large portion of the country does experience it.

The attribute of a change in sanctioned discourse is also seen during this period. The allocation and management of water no longer lies solely with the white, male engineer. It is shared by a number of disciplines in order to cater for a range of new uses that need to be fulfilled, including that of the ecological reserve (Turton and Meissner, 2002). Along with the political changes being introduced at this time there is a social change that is also occurring in that users are no longer willing to sacrifice environmental factors in order to

develop the hydraulic mission, thus depicting a significant difference before and after the period of transition.

Finally the attribute and a driving phase is somewhat changed, while there is a significant move toward ecological integrity and demand side management South Africa again lies with the burdens of the past. In many areas supply is still the leading driving phase. This is due to the real need of many citizens to access basic services such as water.

4.7 Relevance to academic work

The work of Allan (2005) was used as a hypothesis for the types of paradigms that would be found within the South African legislation. While Allan's research put forth the idea of paradigms which had the focus of the post-modern paradigm, industrial modernity and green movement etc. This research found that while the initial two paradigms were evident in the South African legislation the third paradigm found did not conform as easily having attributes belonging to both the green movement and the political and institutional paradigm while still increasing its hydraulic mission in search of greater resources.

The 1912 Irrigation Act has been attributed with having an agricultural paradigm. This focus can be seen through the use of the riparian principle which greatly benefitted commercial farmers here the water supply was first provided to those who had the greatest demand. This focus can be attributed to the major role that agriculture played in the economy at the time. The use of principles such as reasonable use and the determination of normal and surplus flow (normal flow being that which can be utilised for irrigation of crops) shows the legislations partiality towards the agricultural sector and as shown above the dominance of the pre-modern paradigms.

The 1956 Water Act has been ascribed as having the Industrial sector as its focus while still being in the supply outlook like the 1912 legislation. The presence of the industrial paradigm is due to the introduction of specific sections within the legislation which dealt with Industrial water use. The 1956 Water Act for the first time allowed non-riparian landowners to have access and use of water. The Act introduced the inclusion of water quality into the legislation, this according to Thompson (2006) can be attributed to the need of industry to have a minimum water standard. During this time period industry and mining were the biggest contributors to the growth of the economy and again the legislation followed suit in order to provide legislative benefits to those in these sectors. Tewari, Kidd and Thompson have similarly come to the same determination that this piece of legislation has a strong industrial focus.

Finally the 1998 Act has evidence of both a green movement and political and institutional paradigm. The legislation, with its basis in the constitution, is clearly under the influence of a political and institutional paradigm given the inclusion of IWRM principles, while at the same time answering the attributes of the green movement. Section 2 of the Act states that the objectives are for the benefit of the environment and in the best interest of the people through sustainable usage of resources.

Although the paradigms do not expressly fit into the work of Allan, they do come very close, it is thought that the reason that the framework does not match in its totality is due to the phenomenon that it (Allan's framework) is premised in the northern hemisphere context and given the segregated history it is expected that the majority of the country is still stuck in the development phase while other sections are privileged enough to be experiencing the benefits of the green paradigm. Throughout the history (the past century) of South African

water legislation there has been an underlying dominance of development and distribution. The 1912 Act endeavoured to supply agricultural land with water in areas which were not appropriately suited for farming. The 1956 legislation had special distinctions which ensured that industries and mining activities, which were water intensive but were found in water scarce areas, received water of a high quality. Finally the 1998 Act aimed to distribute and supply those who previously did not have access to water with sufficient water. Ohlsson and Turton along with Allan have identified the need for development and distribution as the hydraulic mission, and as in accordance with Allan's diagram (Figure 2) developing countries (like South Africa) are projected to continue with the pursuit of the hydraulic mission even after developed countries have turned away from it and are under the influence of the green movement paradigm. While South Africa may be said to currently be under the influence of the green movement it does not totally conform to the characteristics set out by Allan. This is due to the segregated history of South Africa, where many have been excluded from accessing water due to their skin colour. South Africa must continue to pursue the aim of distribution and allocation in order to right the wrongs of the past and to ensure its goal of equality while at the same time ensuring responsible and sustainable use of its water resources.

The use of Turton and Meissner (2002) as a support structure to reaffirm the presence of the proposed paradigms within the legislation performed well. However given that the Allan's (2005) framework accounted for more periods of transition than those detailed by Turton and Meissner (2002) requires further investigation.

Chapter 5 Conclusions and recommendations

5.1 Summary

The research made use of previous studies in order to illustrate paradigms in water management and through the assistance of similar studies (Menahem, 1998) formed a method for investigating the selected phenomenon. The research made use of other academic research in an attempt to hypothesise an end result which did not materialise completely as had been envisioned.

By investigating the legislation through an evidence based approach it was clear that dominant areas of focus were evident during each legislative time period. These areas of focus, through analysis and comparison, could be linked to dominant paradigms which were evident in each piece of legislation. These paradigms, although similar, did not completely fit according to those which had been hypothesized according to the work of Allan (2005). Those paradigms which were found to be dominant in the legislation have been summarised below.

The Irrigation Act of 1912 had at its core a focus on the agricultural sector. The main focus of the Act was in the expanding of agricultural resources and the allocation of water rights to these water users. The research has shown that access to and the use of water was limited, by the riparian principle, to land owners who were adjacent to rivers. In essence the majority of the water in the country was utilised by a closed group of individuals, riparian land owners, with the most common activity on this riparian land being agriculture. The influence of the riparian principle shifted the control of water from the government, as had been common practice when the State had the *Dominus Fluminis*, to agriculturalists. This

period was dominated by supply and demand, the agricultural sector during this time had the greatest demand for water and as such the power of control of water was given to this sector. The utilisation of engineering methods to supply water to areas which were water scarce showed the attitude to provide water to where it is required at all costs, which is the most significant attribute of the pre-modern era. These reasons along with the growing water demand experienced by the country and the growing population align this period with the pre-modern paradigm

While this legislative period is dominated by the presence of the pre-modern paradigm it must be remembered that in the social sciences multiple paradigms are present simultaneously. The other paradigm that has shown significance is that of the industrial modernity paradigm. This may be due to the common characteristics of these similar paradigms, they both encompass an era of exponential growth both in terms of population, demands on water resources and industrial developments. Through the advancement of agriculture in new areas the increase in infrastructure accompanied it, all the time pushing the hydraulic mission to make more and more of the resource available. During this time a closed group of individuals were given control of such a valuable resource because of the economic benefits they brought to the country. At the time agriculture was one of the dominant economic drivers and as such every attempt would have been made to ensure its prosperity. Although minerals had been discovered in the interior by this time they had not yet become the central focus due to a lack of industrialization and a limited market. An underlying trend that can be noted in this legislation is that of development, even though the paradigm at play seemed to focus development within the agricultural sector there is a clear drive towards development and advancement as a whole.

As a result of the booming mining industry, there was a corresponding exponential growth in the industrial and urban sectors. The massive country wide growth meant that there was a need for updated water legislation in order to cater to the many new demands for water and the expanding population, so began the second legislative period with the 1956 Water Act. This period was characterized by a substantial industrial focus. The legislation introduced the concept of non-riparian land owners being able to access and to use water resources. The legislation had specially adapted clauses like those which dealt with water pollution in an attempt to favour the development of a strong industrial sector.

This period took the control of the water resource back from the closed group of farmers and designated control in a joint manner, through the use of both the riparian principle and the administrative principle of Government controlled water areas. Riparian land owners still had access to water but in designated areas the government had the final word regarding how much could be used, when and for what purposes. Again these findings are supported by the results obtained in Menahem's research (2001). The industrial modernity paradigm was dominant and once again due to the large role that it (Industry) played in the economy. Prolific population growth and uninhibited development represent the "golden age" characteristic of the industrial modernity paradigm. Much like the previous legislative period there was a dominant paradigm which was accompanied by a significant development focus. Here the industrial infrastructure of the nation was greatly developed and with it all the associated development.

The final period saw even greater growth than had preceded the 1956 Act, and along with drastic ideological and political changes the need for new water legislation was again evident. The growth of civic movements and sustainable responsibility were all factors

which set out the arrival of the 1998 National Water Act. The greatest force for change in the instatement of this legislation was the Constitution (1996). As the overarching legal document all legislation was required to conform to it including the National Water Act. The principles set out in the Constitution mirror those of section 2 of the 1998 National Water Act. The Constitution entitled all persons to equality no matter their race. This brought about the social interactive forces which can be attributed to the strong social aspect of the act. Along with the social focus came the Constitutions insistence in recognising the role of the environment and that it too had rights. It is this Socio-ecological focus that aligns this period with the green movement, the third of Allan's paradigms. This Act took away the right of only a select few, riparian land owners, and replaced it with the right of everyone to have access to this precious resource. An interesting note here is where the other two paradigms were dominant mostly because they had such a great influence on the economy the green movement paradigm has very little if any positive economic feedback. The research did however find that while the green movement was epitomised by the Act, it also contained many principles which can be seen in Integrated Water Resource Management which is a vital component of Allan's final political and institutional paradigm. Again the development focus is ever-present within the Act but where the other legislation was interested in distribution and provision of services to a select few, this development paradigm was of a reactionary nature and provided for all persons. The Act, in accordance with the constitution, attempts to right the wrongs of the past and to provide services for all. This three in one focus of the 1998 National Water Act signifies an exception to Allan's framework, here a single piece of legislation floats between multiple paradigms and depicts characteristics of both Southern Hemisphere and Northern Hemisphere countries. This

unique combination can again be attributed to the unfortunate racially segregated history of the country.

When the results gained from this study did not completely conform to framework ascribed from Allan (2005), a secondary desktop source was introduced. The work of Turton and Meissner had already confirmed the initial aim of the research to identify paradigms and periods of transition within water legislation. The combination of these pieces of research resulted in stronger evidence to assert that these paradigms and periods of transition could be illustrated in the legislation, yet the work of work of turton and Meissner also did not completely conform to that of the proposed framework.

5.2 Research limitations

While the research has endeavoured to explore all facets as accurately as possible the short term nature of this research project was not suited to appropriately study the phenomenon of shifting paradigms within legislation, and it in no way intends to put forth the idea that the explanations provided are finite and complete. The research was only ever intended to be a descriptive and exploratory exercise which leaves substantial room for the pursuit of further study.

5.3 Conclusion

The research has defined three legislative periods within South African water law. Each period has been under the control of a national water act. Each of which displayed a dominant paradigm. These three legislative periods and their dominant paradigms are as follows. The first period 1912-1955 was administered under the Irrigation and Conservation of Waters Act of 1912. This Act showed signs of the presence of the Pre-modern paradigm

and had at its heart the riparian principle. The second period 1956-1997 fell under the jurisdiction of the 1956 National Water Act. Here the dominant paradigm was that of industrial modernity, the legislation was based on a hybrid system of riparian rights with government administrative controls. The final period is that which is still in practice, the 1998 National Water Act was governed by not one but three possible paradigms given the all-encompassing nature of the legislation which is in effect. Here anthropological needs are seen as equal to environmental needs, and the need for advancement is matched by the need for equality and the redress of past indiscretions. The legislation is currently still under the control of an administrative principle but has the guiding goal of equality and allocation as its rudder. Even though these dominant paradigms have drastically shaped the legislation which characterised them, there is one focus that although not the most dominant remained constant throughout and that is the constant drive for development. While the nature of the development itself has constantly changed, from expansion to equality, its presence is continuous.

Movik (2012) noted that particularly in the South African example issues of social change often influence and result in legislative change. The 1912 Act was preceded by the forming of the Union of South Africa and the 1956 Act was preceded by the change in leadership from the British to the Afrikaaner nationalist's in 1948, the 1998 Water Act was also preceded by dramatic governmental change from the apartheid system to the democratic system currently led by the ANC.

The paradigms which have shifted in South African legislation can be aligned with the findings of Allan, yet the final paradigm is one that does not neatly conform to the attributes set out in his theory. Rather it represents the unique mind set of the South African situation,

a distinct drive towards development and advancing while being cognisant of the effects our actions have on their surroundings and amending of the negative effects that have resulted from previous decisions. The use of Turton and Meissner (2002) as a supporting document which confirmed the presence of these paradigms and periods of transition in the legislation was a significant addition to the research.

The work of Turton and Meissner (2002) has allowed the research to develop much clearer time frames. From this it is clear to see that paradigms enjoy dominance and then it is due to a combination of factors that a period of transition (paradigm shift) is experienced. The political social and environmental aspect clearly play a significant role in that paradigms are changed first and then research follows suit.

To answer the question posed in the introductory chapter, is there a relationship between changing south African water legislation and the shifting paradigms of Water resource management? Yes. The evidence has shown that the first two paradigms (pre-modernism and industrial modernism) are dominant in the first two pieces of legislation. These support the advancement of the hydraulic mission and a growing demand on water resources. Much like has been illustrated in the work of Allan. The third and final piece of legislation is unique in that it does not conform to the framework of Allan, the unique circumstance which formed the legislation has resulted in its unique multi-paradigm nature. It can be seen that the paradigms investigated by this research are resultant from political, social and economic interventions and changes from the community as a whole. It can therefore be said that the dominant paradigms drive the change in legislation which is often only felt years after the social, political and economic environment has changed. Meaning that if sustainable

management of water resources is a goal one of the key factors required to make this happen is a significant change in the world view so that legislation can be effected.

References

Abrams, L.J. 1996. *Water policy development in South Africa*. Available online http://www.africanwater.org [Accessed 13 September 2014].

Allan, J. A. 2005. Water in the Environment/Socio-Economic Development Discourse: Sustainability, Changing Management Paradigms and Policy Responses in a Global System, *Government and Opposition*. Blackwell Publishing, Oxford.

Bickford-Smith, V. 1995. South African Urban History, Racial Segregation and the Unique Case of Cape Town, *Journal of Southern African Studies*, 21(1), p.63-78.

Cohen, J. L. 1985. Stratergy or identity: New theoretical paradigms and contemporary social movements, *Social Research*, 52(4), p.663-716.

Constitution of the Republic of South Africa, Act 108 of 1996

Department of Water Affairs and Forestry. 2005. National Water Resource Strategy. Available online http://www.dwaf.gov.za/Documents/Policies/NWRS/Default.htm [Accessed 22 October 2012].

Department of Water Affairs and Forestry. 2007. *Consolidated water sector report: Third quarter 2007/2008*, Available online http://www.dwaf.gov.za/Masibambane/documents/monitoring-evaluation/ConsWSReport07Q3Vol1.pdf [Accessed 19 October 2012].

Department of Water affairs and Forestry, 2012. *National Water Resource Strategy 2*, Available online http://www.dwaf.gov.za/nwrs/NWRS2012.aspx [Accessed October 2012].

Dogan, M. and Higley, J. 1998. *Elites, crises, and the origins of regimes*, United States of America: Rowman & Littlefield publishers.

du Plessis, A. 2010. A government in deep water? Some thoughts on the state's duties in relation to water arising from South Africa's Bill of Rights, *Reciel*, 19 (3), p. 316-327.

Effrat, A. 1972. Power to the paradigms: an editorial introduction, *Sociological Inquiry* 3:33.

Eisenstadt, S. N. 1967. *Israeli Society,* New York: Basic Books,

Friedrichs, R. 1970. A sociology of sociology. *Journal of the History of the Behavioural Sciences,* 7(2). p.429.

Galwin, T., Kennelley, J. and Krause, T. 1995. Shifting paradigms for sustainable development: Implications for management theory and research, *The academy of management review*, 20 (4), p.874-907.

Hall, P. 1993. Policy paradigms, social learning and the state: The case of economic policy making in Britain, *Comparative Politics*, 25 (3), p. 275-296.

Hamann, R., Booth, L., and O'Riordan, T., 2000. South African environmental policy on the move, *South African Geographical Journal*, 82(2), p. 11-22.

Heller, P. 2001. Moving the State: The Politics of Democratic Decentralization in Kerala, South Africa, and Porto Alegre, *Politics and Society*, Available online http://www.en.ipea.gov.br/74F1B6D1-2073-4C01-A66B-A32C150FAD35/FinalDownload/DownloadId-7990ED411853DA292D75C06181872EDF/74F1B6D1-2073-4C01-A66B-A32C150FAD35/participacao/images/pdfs/participacao/heller.pdf [Accessed on 16 July 2014].

Hewitson, B. and Crane, R. 2006. Consensus between gcm climate change projections with empirical downscaling: precipitation downscaling over South Africa, *International Journal of Climatology*, 26, p. 1313-1337.

Horgan, J. 1991. Comment from representative of Scientific America, as noted in London, 1996.

Irrigation and Conservation of Waters Act No. 8 of 1912.

Kidd, M. 2008. *Environmental Law*, Cape Town: Juta and Co. Ltd.

Koschmann, T. 1996. Paradigm shifts and instructional technology, *Book Chapters,* Paper 4, Available online http://opensiuc.lib.siu.edu/meded_books/4 [Accessed on 4 August 2012].

Kuhn, T.S. 1962. *The structure of scientific revolutions*, First Edition, Chicago: University of Chicago Press.

Kuhn, T.S. 1970. *The structure of scientific revolutions*, Second Edition, Chicago: University of Chicago Press.

London, S. 1996. Book review of *"The structure of scientific revolutions*", Available online http://www.scottlondon.com/reviews/kuhn.html [Accessed 11, December 2012].

Ramphele, M. and McDowell, C. 1991. *Restoring the land: environment and change in post-apartheid South Africa.* Panos.

Maylam, P. 2001. *South Africa's Racial Past: The History and Historiography of Racism, Segregation, and Apartheid*, Ashgate.

Masterman, M. 1970. *The nature of a paradigm*. in Imre Lakatos and Alan Musgrave (eds.), Criticism and the Growth of Knowledge. p. 59-89.

Menahem, G. 2001. Water policy in Israel 1948-2000: Policy paradigms, policy paradims, policy networks and public policy, Israel Affairs, 7 (4) p.21-44.

Movik, S. 2012. *Fluid Rights: Water allocation reform in South Africa,* Cape Town: HSRC Press.

National Water Act No. 36 of 1998.

Ohlsson, L. and Turton, A. 1999. *The turning of a screw: Social resource scarcity as a bottle neck in adaptation of water scarcity*, Available online: http://www.soas.ac.uk/water/publications/papers/file38362.pdf [Accessed 25 July 2012].

Pahl-Wostl, C. and Kranz, N. 2010. *Water Governance in Times of Change*, Special Issue of Environmental Science and Policy. 13 (7).

Pahl-Wostl, C., Jeffrey, P., Isendahl, I. and Brugnach, M. 2011. Maturing the new water management paradigm: progressing from aspiration to practice, *Water Resources Management,* 25. p. 837-856.

Patterson, M. and Williams, D. 1998. Paradigms and problems: The practice of social science in natural resource management, *Society and Natural Resources*, 11,p. 279-295.

Perret, S. 2002. Water policies and smallholding irrigation schemes in South Africa: a History and new institutional challenges, *Water policy,* 4(3), p.283-300.

Phillips, D.L. 1973. Paradigms, Falsification and Sociology, Acta Sociologica, 16 (1), p. 13-30

Pienaar, G. J. and van der Schyff, E. 2007. Reform of water rights in South Africa, *Law Environment and Development Journal*, 3 (2), p.179-194.

Ritzer, G. 1975. A multiple paradigm science, *The American Sociologist*, 10 (3), p. 156-167.

Ross, R. 2006. *A concise history of South Africa*, Cambridge University Press.

Sabatier, P. A. 1988. An advocacy coalition framework of policy change and the role of policy orientated learning therin, *Policy Sciences,* 21 (2), p. 129-168.

Schreiner, B. and B. Van Koppen. 2002., Catchment management agencies for poverty eradication in South Africa, Phys. Chem. *Earth*, 27 p.969-976

Smith, L. and Hanson, S. 2003. Access to water for the urban poor in Cape Town: Where equity meets cost recovery, *Urban Studies*, 40(8), p. 1517-1548.

Stahl, G. Koschmann, T. and Suthers, D. 2006. Computer-supported collaborative learning: An historical perspective. *Cambridge handbook of the learning sciences*.

Stein, R. 2005. Water law in a democratic South Africa: A country case study examining the introduction of a public rights system, *Texas Law Review*, 83, p. 2167-2183.

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

Thompson, H. 2006. *Water Law: A practical approach to resource management and the provision of services,* Cape Town: Juta and Co. Ltd.

Turton, A. 2006. The Future of Africa's Water. *In Vaalco Supplement, 2006* Pretoria: Vaal River Catchment Association. p. 64.

UNESCO, 2009. World Water Assessment Programme. *Water in a Changing World*. The United Nations World Water Development Report 3.

Uys, M. 2008. Water law of South Africa: 1912-1998, Water research commission report: KV 203/08.

Water Act No. 54 of 1956

Westhues, K. 1976. Class and organization as paradigms in social scince, *The American Sociologist*, 11 (1), p.38-49.

World Bank, 2010. World Development Indicators, Available online http://data.worldbank.org/data-catalog/world-development-indicators/wdi-2010 [Accessed November 2012]

Wray, K. B. 2011. *Kuhn's evolutionary social epistemology*, United Kingdom: Cambridge University Press.

Wray, K. B. 2011. Kuhn and the Discovery of Paradigms. *Philosophy of the Social Sciences*, 41(3), p. 380-397