The Effects of Law Enforcement on Water Compliance: A Case of the Vaal Dam Catchment Area

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NOTICE 1

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DECLARATION

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Simon Mporetji, 2017

DEDICATION

This dissertation is also dedicated to my late Father, Njoni Samuel Mporetji, seen no more but always remembered.

Abstract

This study explored the influences of water law enforcement on compliance in the South African water sector, using the Vaal Dam catchment area as a case study. Generally, the term compliance refers to "conformance to a set of laws, regulations, policies, best practices, or service-level agreements" (Silveira, et al., 2012:525) .The focus of the study was on compliance with regards to the National Water Act, 1998 (Act 36 of 1998) and related legislation as well as other regulatory instruments like permits and licence conditions. Enforcement entails ensuring that actions are taken by the Department of Water Affairs (DWS) to achieve compliance within the regulated community to correct or terminate conditions that put at risk the environment or the public health.

The study was a qualitative enquiry, and primary data was collected using key informants from DWS and Local Government. Respondents were selected using a purposive sampling technique. Analysis was conducted using a thematic technique. The study found that ineffective law enforcement coincides with high levels of noncompliances. The major noncompliance identified was with regard to municipal waste water treatment works discharges. Given the challenge faced by DWS in enforcing the law in the face of principles like cooperative governance and Intergovernmental relations, the study recommended an approach of water governance to water management.

Key words

Vaal Dam, catchment, enforcement, compliance, Department and Sanitation, governance, Intergovernmental relations, cooperative governance

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List of Acronyms

CMAs	Catchment Management Agency
COD	Chemical Oxygen Demand
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation
EC	Electrical Conductivity
EDC	Endocrine Disrupting Compound
ELU	Exiting Lawful Use
EPA	Environmental Protection agency
GIS	Geographical Information System
IGR	Intergovernmental Relations
IHP	International Hydrological Programme
ISO	International Standard Organisation
MPhil	Master of Philosophy
NEMA	National Environmental Management Act
NWA	National Water Act
POP	Persistent Organic Pollutants
RSA	Republic of South Africa
SA	South Africa
SDC	Source Directed Controls

WDCS	Waste Discharge Charge System
WSI	Water Services Institution
WULA	Water Use Licence Application
WWTWs	Waste Water Treatment Works

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Chapter 1: Introduction

1.1.Background

The deterioration of water quality is one of the most important concerns regarding water resources in the 21st century (Davis and Rafik, 2003). As human populations grow, industrial and agricultural activities expand, leading to declining water quality globally (Glase, et al., 2008). As a result of increasing human population, sewage disposal has become a major problem (Owili, 2003). This is confirmed by studies which show that high levels of organic materials enriched with high concentrations of nutrients especially nitrogen and phosphorus constitute the most widespread pollutant at a global scale (Whiteside, 1983; WWAP, 2003). Worldwide, the major contributors of the problem of nutrient loading in rivers and lakes include dense settlements of Asia, Africa and South America (WWAP, 2003).

The United Nations' World Water Development Report states that Belgium was ranked number one in the year 2003, as having the dirtiest water in the world, resulting from large amounts of raw sewage being discharged into rivers (WWAP, 2003). The current situation however is that, India is recognized as having the worse sewage pollution of surface and ground water in the world (Presse, 2014). In fact, approximately 80% of sewage generated in Indian cities and towns flows into rivers untreated (Presse, 2014). In their article, Upadhyay et al, (2011), reports that pollution into the Yamuna River, a tributary of the Ganga River in India, has far outstripped the river's capacity to assimilate pollutants, thus the river has deteriorated into a sewage drain.

Likewise, sewage pollution is a growing concern in South Africa. While South Africa may not be listed in the top ten most hydrologically dirty countries in the world, several authors have indicated that increasing water resource pollution (as a result of raw sewage discharges into rivers) in this country require immediate intervention (Kleynhans, 2011; Raymer and Buckle, 2011; Turton, 2008; Momba *et al*., 2006). According to a report produced by Afriforum, millions of untreated or poorly treated effluents run into rivers in South Africa (Kleynhans, 2011). The South African situation is consistent with the global scale problem, where there has been a notable decline in water quality in almost all regions where there are intensive activities like agriculture as well as large urban and industrial areas (WWAP, 2003).

This background supports the narrative that, conditions and events in catchments are responsible for fresh water quality in terms of the physical, chemical and biological features (Fuggle & Rabie, 1992). While Howarth & McGillivray (2001) states that water quality changes may arise from natural factors, it has been established that the diverse human agency is largely responsible for the deviation of water quality from its natural state. The concern with water quality thus arises from water that is polluted by human influences (ibid:3). This therefore necessitated the need to set regulatory and control mechanisms to govern the actions of people (Barnard, 1999), to ensure water quality compliance.

In the development of a regulatory regime, the first level of control are moral rules which are set to guide the interactions of people and their environment. These provide mechanisms for voluntary compliance (Barnard, 1999), for instance adoption of environmental management systems (ISO 14001). When such moral based regulatory mechanisms fail, Barnard (1999) argues that there would be a shift to binding and enforceable regulatory mechanisms, thus a legal custom kicks in. These includes national legislation and international treaties for resource quality protection. This study makes an assumption that, at the heart of increasing deterioration of water quality in the South African, are intertwined challenges associated with compliance and law enforcement.

Generally, the term compliance refers to "*conformance to a set of laws, regulations, policies, best practices, or service-level agreements*" (Silveira, et al., 2012:525) .The focus of the study will be on water compliance with regards to the National Water Act, 1998 (Act 36 of 1998) and related legislation, in terms of water quality, including the physical, chemical and biological characteristics of the water. Enforcement entails ensuring that actions are taken by the Department of Water Affairs (DWS) to achieve compliance within the regulated community to correct or terminate conditions that put at risk the environment or the public health.

The focus of the study will be on water compliance with regards to the National Water Act, 1998 (Act 36 of 1998) and related legislation, in terms of water quality, including the physical, chemical and biological characteristics of the water. Enforcement on the other hand entails ensuring that actions are taken by the Department of Water Affairs (DWA) to achieve compliance within the regulated community to correct or terminate conditions that put at risk the environment or the public health. Generally, the concern with water quality and compliance arises from water that is

polluted by human influences (Howarth & McGillivray, 2001). Since in any society, water is a resource common to all, polluting sources must be effectively monitored. Water quality objectives, laws and various regulatory mechanisms must be developed to govern the actions of people (Barnard, 1999). In his article (*ibid, 1999*), confirms that setting scientifically sound resource quality objectives aligned with a strong regulatory regime is key for effective water resource management.

1.2. Rationale

In his article, Heyes (2000) asserts that literature provides evidence that the enforcement dimension of environmental regulation has been widely studied. Much of the work however, placed particular interest on air quality, coastal pollution and general environmental pollution. Effectively, what transpires within literature is that much of the research has not looked at the relationship between water law enforcement and compliance. This constitutes a knowledge gap, and thus, having identified this area, a prime motivation for this study is to contribute knowledge within the area of compliance and enforcement in the water sector.

It suffices to provide a background that further clarifies the motivation for the study within the context of the Vaal Dam catchment area. The Vaal Dam is a precious impoundment supporting South Africa's Economic hub, Gauteng Province as well as parts of Provinces like the Free State, Mpumalanga and the North West. More than 12 million people depend on this resource in terms of water supply for drinking, power generation processes and other human need activities. Silt deposits, intensive developments, and domestic and industrial waste water discharges within key tributaries of the Vaal Dam pose a significant threat to the quality and quantity of water in this impoundment. The current domestic effluent management as well as the practices of sediment and erosion control in the Vaal System, has enormous consequences on the quality of water in this resource. Added to this whole situation, is the challenge of rapid population growth with concomitant high levels of waste generation within the Vaal Dam catchment area.

Generally, there are enormous consequences related to the above challenges, including significant threats to biodiversity, disappearing riparian zones, increasing purification costs, as well as issues related to human and animal health. Reality dictates that risks would always be there, but given the importance of the Vaal Dam, it is crucial to maintain the water quality within acceptable levels of

prescribed standards and guidelines. This could be achieved through effective water law enforcement.

Since water quality standards vary from country to country, measuring and quantifying the extent of noncompliance globally would be a challenge.. An interesting argument along this line is that, every decision to use land is an indirect water use decision (Bossio, *et al.*, 2010). Various studies have confirmed that development leads to water quality degradation (Laws, 1993; Fuggle & Rabie, 1992; Howarth & McGillivray, 2001). While Howarth and McGillivray (2001) states that water quality changes may arise from natural factors, various studies indicates that, to larger extent, the diverse human agency is responsible for the deviation of water quality from its natural state.

The position taken in this study is that, while there are good water laws and policies' reflecting good water governance in South Africa, their implementation has been a big challenge. Inadequate implementation of the South African water law perpetuates non-compliances by Water Services Institutions (WSIs) and other water users and thus leads to poor chemical, physical and microbiological quality of water in South African streams, specifically the Vaal Dam catchment area. This study would further assume that enforcement is critical to ensuring positive outcomes of policy and legislative requirements for water. At the heart of increasing deterioration of water quality in the South African water sector as viewed through the situation in the Vaal Dam catchment area, are intertwined challenges associated with compliances and law enforcement.

1.3. Research aim and specific objectives

This study aimed to explore the influences of law enforcement on water compliance in the South African water sector using the Vaal Dam catchment area as a case study.

The following were the specific research objectives:

1) To understand South Africa's policy and legislative context for water;

2) To understand water compliance levels in the Vaal Dam catchment area;

3) To determine the level of law enforcement; and

4) To determine the level of monitoring of all licensed and unlicensed activities.

1.4. Limitations of the study

The natural characteristic of water is largely determined by physical chemical and microbiological factors, which are affected by the geographical, geological, ecological and the nature of human uses of water (Howarth & McGillivray, 2001). This constitutes an inherent uniqueness in freshwater systems, thus limiting the extent to which water quality data and findings can be generalised countrywide. The qualitative component of the study would be largely reliant on respondents' viewpoints, thus incorporating individual's subjective views in the results is inevitable. This would make replicating the study to be exceedingly difficult. In his article (Jick, 1979) echoes this line by arguing that qualitative methods are difficult to replicate. Another limiting factor is the fact that the study is bound by time and financial constraints.

1.5. Structure of the thesis

This thesis is organized into five chapters:

Chapter 1 presents the context of the study by highlighting the effects of law enforcement and compliance in the Vaal Dam region. The research issue and research question are introduced.

Chapter 2 presents a review of the literature to establish a theoretical foundation for the research and to position this in the context of water quality, law enforcement, compliance and water management in South Africa.

Chapter 3 describes and provides justification for the methodology utilised in the study and also introduces the study areas. It highlights the methods used and the techniques employed in data collection and analysis. Ethical issues and the limitations of the study are also discussed.

Chapter 4 presents the research results. These are based on interviews conducted in the Vaal Region basin with the participants and on literature pertinent to the topic.

Chapter 5 presents a combined discussion of the results and interprets them in the context of the literature and a conclusions and implications of the study.

Chapter conclusion

This introductory chapter presented a quick overview of relevant literature to set the tone for the study. The general trend is that there is a deterioration of water quality globally, resulting from factors such as population growth, urbanization and poor sanitation services. The situation in the Vaal catchment area is similar to what is happening around the world i.e. that contamination of water with sewage is a great challenge. In the South African context, position taken in this study is that, while there are good water laws and policies' reflecting good water governance, their implementation is a great challenge. The chapter described the rationale of the study as well as the aims and objectives. The chapter further included the study limitations and ended with a quick overview of chapters.

Chapter 2: Literature Review

2.1. Introduction

This chapter reviews relevant literature for the study titled, effects of Law enforcement on compliance: a case of the Vaal Dam catchment area. Literature is guided by research questions and the overall aim of the study. The aim of the study was to explore the influences of water law enforcement on compliance in the South African water sector, using the Vaal Dam catchment area as a case study. The study was designed with five objectives which are: 1) to understand South Africa's policy and legislative context for water; 2) to understand the compliance level in the Vaal Dam catchment area; 3) to determine the level of law enforcement; 4) and to determine the level of monitoring to all licensed and unlicensed activities. This chapter will provide detailed information to allow for a clear line of argument to be established during the analysis of results. Objective one will particularly be addressed in this chapter. While the remaining four objectives which are 2, 3, 4, and 5 would be alluded to as part of the literature, they would be addressed in detail in the results chapter, i.e. chapter 4.

2.2. Water protection and management

Water is a powerful symbol throughout the world, carrying with it ideas of baptism and new life, cleansing and healing and the promise of growth and prosperity (DWAF, 1997). It is the most important resource essential for sustaining all life forms. This resource is so vitally important that without it, all human activities would cease and hence all life forms would come to an end (DWAF, 1997). However, this valued resource is increasingly being threatened as human populations continue to grow and demand more water of high quality for domestic purposes and economic activities (Gangoo, 2003).

Protection of water resources is critical for human benefit and ecosystem health. In South African context policies, regulations and programs which aim to protect water resources have been developed (DWA, 2012). They provide the framework for the protection, use, development, conservation, management and control of country's water resources (DWA, 2012).

Environmental problems constitute one of the key challenges on the African continent in the 21st century (African Society, 2008). Researchers have showed that deterioration of water resources in

South Africa poses significant environmental challenges nationally and in local communities (Darkey and Donaldson, 2000). Water resources have become overexploited and over utilised due to man's need for modernity at the expense of the environment. Overexploitation of water resources brings nothing but disaster in the long run. When properly protected, water resources can have tremendous value in urban areas because they have the potential to mitigate pollution (Wetlands), storm water runoff and flooding problems (dams) that harm human life and property; provide places of refuge and recreation in the fast paced urban environment; aid protection of whole river basins and interconnected systems of habitat for fish and wildlife that cross jurisdictional boundaries; and, afford aesthetic, cultural, educational and economic benefits to life in urban areas and elsewhere (Larson, 2004).

In the South African context, regulations and other measures that aim to protect water resources are currently in place and new ones have recently been proposed (DWA, 1998; DWA, 2012). However these regulations are usually opposed by residents and other stakeholders. People's different beliefs about the environment may lead to various attitudes and behaviors towards water resources. Such disparities eventually exert pressure into various elements of environment. A number of scholars and practitioners suggest that environmental problems can be effectively addressed when scientific knowledge is linked to local knowledge and public deliberation (Morton and Padgitt, 2005). Basically, ecosystem/environmental research and policy are incomplete without consideration of humans, as they are an inherent part of the systems.

Water resources are amongst other important and endangered natural capitals that are directly connected to humans and hence require high level of protection. However, the first step towards efficient water resource protection/management is to gain an understanding of humans' attitudes and other psychological aspects about these resources. Generally, without public acknowledgement of water resources issues and perceptions that there is some urgency to environmental degradation, it will be difficult to mobilise responses and change practices. Knowledge of human perceptions, attitudes and behavior relating to natural resources is critical to developing culturally acceptable and sustainable policies and programs (Nassauer et al. 2001). Such information is required to meet government standards for responsive public policy, and can improve the design and implementation of natural resource protection measures (Mitchell, 1989).

For the purpose of this study, water resources protection will refer to a series of inter-related components involving the implementation of programs and strategies aimed at minimizing exploitation of water resources (NRC, 2000). The quality and quantity of all water resources are important to aquatic ecosystems, human health, and economic stability (NRC, 1999). Aquatic ecosystems, public health and economic benefits of water resource protection are widely accepted in the water resources literature. Water resources protection also makes economic sense for at least three principal reasons. First, it is reported to be less expensive to protect a water source from contamination than it is to remediate after contamination (Leccese, 1998). Second, it has been shown to be more cost effective to invest in natural capital by protecting resources rather than to invest in physical capital, such as water treatment technologies (NRC, 2000). Third, According Barton and Ernst (2004), water resource protection is a first line of defense for good quality water and significantly reduces water treatment challenges and costs.

In general, protection of water resources involves determining what activities pose a risk to water resources, and implementing strategies that will ensure that the quality and quantity of these resources are not jeopardized. Many of the activities and strategies that are necessary for successful water resources protection are carried out by a number of agencies, organizations, and/or groups, including provincial and local government agencies, water management organizations, non-government organizations, and local citizens (McCormack, 2005). Some residents may exhibit positive attitudes and express significant support for these water resource protection efforts in general; however real-world evidence and previous studies indicate that significant opposition to particular water resource protection measures exists (Brinckman, 2002). Generally, people's different beliefs about the environment may lead to various attitudes and behaviors towards water resources. Therefore, it is very important to engage residents in pursuit for more effective ways to resolve water resources problems. This is the integrated approach which brings citizens and stakeholders into agenda setting, decision-making, monitoring, and enforcement activities.

A first step in creating effective measures to address water resources problems is to discover agreement as well as differing viewpoints amongst residents. Because water is visible and has so

many functions in almost every aspect of people's life, it is one component of the environment on which most people have some opinions or attitudes (Lundmark, 2007). For this reason, when water quality issues involve multiple parties, individuals or groups, it is essential to understand the relative value of water to different groups of people, their perceptions and knowledge about the problems, and furthermore their intrinsic attitudes and beliefs about human relationship to the environment (Fox, 1995). Study of environmental attitudes is critical because attitudes influence how people approach the natural environment. Underlying these attitudes are cultures, social norms, and paradigms that affect the way the whole society interact with nature (Lundmark, 2007). Understanding environmental attitudes can help all parties involved acknowledge differing ways of framing the functions and value of water resources and lead people to find common ground for concerted efforts to solving water problems (Lundmark, 2007).

2.3 Enforcement and compliance

The concepts of enforcement and compliance fall within the broader field of water management. Before zeroing-in on the main concepts of the study, this chapter would discuss historical developments in the field of water management globally and nationally. The age of water resources can be traced back to the age of planet earth itself. Throughout time what has been changing is the scale and manner in which water is used. Global trends of human inhabitation of land have been observed to take place around areas of fresh water abundance. In the olden days, before the 12^{th} century, there were few people around water resources. Ancient cities had rudimentary water supply infrastructure, with no running water. In Britain for instance, the supply and management of water infrastructure gained momentum between the 12^{th} and 14^{th} century. Globally, major social transformations took place some 10,000 years ago and were associated with development of food production mechanisms. Literature indicates that changes in water management are always associated with significant developments in social and economic organization.

Early technological developments like irrigation techniques, storage facilities and growing cities led to a growing demand of water, thus the need for water management. Growing cities were associated with a growing need for food production thus growing impacts on water resources. Mechanization of the 1800s century led to turn in population growth in cities. This was accompanied by an accelerated demand for water services. This led a significant transformation

from the natural state of rivers resulting from the introduction of industrial and domestic chemical pollutants into water resources. Complex challenges of pollution and increasing demands for water services sparked the need for an intergovernmental conference by the United Nations. Only later in the 90s the International Hydrological Programme (IHP) recognized the importance of understanding the social dimension of water management. Going forward various areas of actions were identified to engender a focus on the social aspect of water management at the local and regional level of governments

2.4. Water quality, pollution and the history of South African water management

While a number of definitions of water quality exist, The United Nations defines Water Quality as the ‘‘physical, chemical, and biological characteristics of water necessary to sustain desired water uses’’ (UNECE, 1996). The quality of water resources can be affected by both identifiable ‘point sources’ of pollution such as discharge of poorly treated effluent from sewage plants and surface run-offs directly into water sources, and also by ‘non-point’ sources that can only be traced to particular activities, such as farming, rather than specific locations. Water quality can vary due to seasonal or daily (day and night) difference, for example, temperature; DO and dissolved CO2 vary diurnally (DWAF, 1996b), while flow levels are more seasonally affected. Temperature and Dissolved Oxygen (DO) are system variables, which regulate essential processes within the aquatic ecosystems (Dallas H F, 1993).

The definition of pollution is fluid and varies slightly from literature to literature. From a regulatory perspective, the definition of pollution is tightly linked to that of contamination (Tarazona, 2014). This study adopts Tarazona (2014:1)’s approach which defines contamination as any anthropogenic release of substances into a medium, and “pollution as the level of contamination that produces adverse effects on the receiving environment”. In this regard, pollution is a phenomenon inherent to the presence of human beings on earth.

Thousands of years ago, human societies were nomadic, thus the effects of their pollution was limited (Rupert, 2016). A shift to more organized societies led to an increase in the scale of pollution and its impact on water resources and the environment (Matthews, 2007). In South Africa during pre-settlement times, water management was administered under African Customary Laws, which were simple common knowledge amongst individuals (Tewari, 2009). For the African

natives of South Africa, water and land were shared resources. One had no ownership of water or land, but only to share with fellow men, including those who were just passing (Rupert, 2016). Just like in other parts of the world, there were few people and water was abundant. Thus in pre-colonial South Africa, the concern with large scale pollution was nonexistent.

The year 1652 marked the arrival of settlers in South Africa. Soon after their arrival, access roads were built, river courses were diverted, systems of furrows were dug, and a dam was built to supply water for irrigation and drinking (Matthews, 2007). A few years after the arrival of settlers, water from a local stream was undrinkable as a result of people using it as a dump for household waste. As early as 1653 the first environmental 'legislation' - aimed at protecting water supplies from human fouling was formulated (Matthews, 2007). This early transformation to the landscape marked the beginning of significant anthropogenic influences on water resources in South Africa. As the settlement grew, the scaling up of water development projects for water supply to meet the demand was essential. This triggered the earliest supply driven water legislation aimed at facilitating the supply of water for cooking washing and livestock farming (Tewari, 2009).

In South Africa, the earliest legislation and management approaches to water were hinged on supply (Tewari, 2009). And indeed for many years water management has been based on a supply driven approach in South Africa. The above discussions demonstrated that at the early years of the arrival of settlers in South Africa, all the laws were designed to ensure that water is supplied to the farmers – this was about delivery and did not take into account how the water was being used. The approach was more on water resources. Today the approach has shifted to demand driven, in this cases users are more important. Thus the demand-driven perspective to water management focuses on users more than resources.

The standards for the performance of sewage treatment plants are laid down by the DWS. The most important indicator of performance is the quality (chemical and microbiological parameters) of the effluent from the works, before it is discharged into the watercourse or whatever other arrangement is agreed to in terms of the license or other form of authorisation from DWS for the works to operate (NWAct, 1998).

For a number of years a certain Gauteng catchments has been struggling to meet consistently the DWAF standards for effluent discharge from wastewater treatment works (CSIR, 2010). The situation became so critical (inter alia, threatening the integrity of water supply downstream of the Vaal dam) that DWAF has to issue a notice prohibiting contact sport and recreational activities within the catchment (DWAF, 2005a).

The pollution into the receiving stream was mainly associated with high nutrient load which lead to eutrophication and microbiological count of effluent discharged by sewage treatment plants (Du Preez, 2010). Eutrophication is the process whereby excessive growth of algae and other aquatic plants is encouraged as a result of the enrichment of water with plant nutrients, particularly nitrogen and phosphate forms (NO2-N, NO3-N, NH4-N and PO4-P). The accumulation of nutrients in excess of natural requirements results in nutrient enrichment – eutrophication – and this has important impacts on the composition and functioning of the natural aquatic biota (Oberholster P. B.-M., 2009a).

South Africa's climatic conditions, combined with various factors, have resulted in large-scale changes to aquatic ecosystems and subsequent eutrophication of rivers and water storage reservoirs. The microbial content of water represents one of the primary determinants of fitness for use. Human settlements, inadequate sanitation and waste removal practices, storm water wash-off and sewage spills are the major sources of deteriorating microbiological water quality in South Africa (Oberholster P. M.-M., 2010).

The spread of diseases such as cryptosporidiosis, dysentery, cholera and typhoid is caused by the use of water that is contaminated by fecal matter (Momba, 2004). Micro-organisms derived from faecal matter can also end up on fruit and crops through contaminated irrigation water. Polluted water makes swimmers sick and hurts coastal and catchment economies. Illnesses associated with polluted water include stomach flu, skin rashes, pinkeye, respiratory infections, meningitis, and hepatitis. In addition to the health risks from polluted water, economists have estimated that a typical swimming day is worth approximately $35 to each individual, so depending on the number of potential visitors to a resorts located along rivers, the "consumer surplus" loss on a day that a beach is closed or under advisory for water quality problems can be quite significant (Rabinovici, 2004).

Polluted waters may contain disease-causing organisms called pathogens. The most common types of pathogens are those associated with human and animal waste, including bacteria, viruses, and protozoa. For instance, giardiasis is caused by the protozoan *Giardia lambia* and *cryptosporidiosis* is caused by *cryptosporidium*, North America's leading reported intestinal parasite (Canada, 2004).

High count of these protozoa in excess 500 and 200 cells/ml respectively has been notified in barrage at Lochvaal (Du Preez., 2010). Swimmers in sewage polluted water can contract any illness that is spread by fecal contact, including stomach flu, respiratory infection, and ear and skin infections. Most swimming-related illnesses last from a few days to several weeks, but in some cases pathogens may cause severe, long-term illness or even death. Sensitive populations such as children, the elderly, or those with a weakened immune system are particularly at risk for long-term effects. For example, research has shown that children under the age of 9 have more reports of diarrhea and vomiting from exposure to waterborne pathogens than any other age group, with at least a twofold increase occurring over the summer swimming months (CDC, 2005)

On the basis of beach visitation rates and monitoring data, researchers have estimated that 689,000 to 4,003,000 instances of gastrointestinal illness and 693,000 instances of respiratory illness occurred each year between 2000 and 2004 at Southern California beaches (Brinks, 2008). Beachgoers can even contract illness without going in the water. A 2009 study found a positive association between beach sand contact and the risk of gastrointestinal illness at beaches with a nearby sewage treatment plant outfall (Heany et al., 2009). While these estimates are subject to a great deal of uncertainty, they provide insight into the potential for underreporting of beach-related illnesses. In South Africa there's no immediate available reported and documented information related to illness caused by poor water quality in resorts near rivers and streams.

Harmful algal blooms (HABs), often called red tides, area growing problem in surface waters where nutrient rich pollution can spur algal growth. Several species of phytoplankton produce potent toxins that can make people sick if they are exposed to contaminated water or if they eat contaminated fish or shellfish. These toxic organisms are a natural part of the phytoplankton community, but when conditions are right, they experience a rapid growth in numbers, resulting in a "bloom." HABs can last for days, weeks, or months and cause serious and potentially life threatening human illnesses that have a slew of symptoms, including diarrhea, nausea, vomiting,

abdominal cramping, chills, diminished temperature sensation, muscle aches, dizziness, anxiety, sweating, seizures, numbness and tingling of the mouth and digits, and paralysis, as well as cardiovascular and respiratory symptoms (Woods Hole Oceanographic Institution, 2013).

Efforts to deal with red tides have focused on mitigating the effects of these events, primarily through improved systems to monitor for these blooms, educate and communicate the risks to the general population, and learn more about the causes of harmful algal blooms and how they affect humans and aquatic life. Strong efforts need to be made to control nitrogen and phosphorus pollution from sources such as sewage systems, urban and suburban stormwater, septic tanks, and agricultural runoff to reduce the number of red tide events (Institution, 2001).

Beaches, rivers, and lakes constitute the top vacation destination in the United States. Americans take more than 900 million trips to coastal areas annually and spend approximately $44 billion during these trips (USEPA, 1996). The World Travel and Tourism Council report shows that in South Africa, tourism contributes 492000 direct jobs, constituting 3% of total employment. Its impact is far wider and the report states that tourism constitutes 6.9% of the country's total employment which is equivalent 1 148 000 jobs. Current data provided shows that DWAF has approximately 325 dams of which 110 (33%) dams are currently used for some recreational purposes with 215 (67%) dams not being utilised.

This data clearly shows that there may be considerable scope for the increase in recreational use on DWAF dams and rivers (DWAF, Project 8906, 2006). Recreational use may be linked, in many instances, to tourism development and since the majority of the country's dams are located in rural areas, the dams provide a natural focus point for rural local economic development (LED) and the simultaneous provision of infrastructure.

The ways in which polluted water puts revenues (generated tourism industry especially those located near water resources) at risk are many and varied. Polluted rivers result in a loss of utility for those who have planned to visit and swim in the water; that in turn impacts local economies in the form of lost tourist rand and the jobs they support. Clean and healthy rivers, on the other hand, can help a community thrive.

One study estimated economic losses as a result of closing a Lake Michigan beach due to pollution could be as high as $37,030 per day (ibd). Similarly, a Southern California study concluded that each year fecal contamination at Los Angeles and Orange County beaches caused between 627,800 and 1,479,200 excess gastrointestinal illnesses with a public health cost of $21 million to $51 million (Given., 2006).

Another example of the potential for economic harm from beach pollution is found in Florida. One analysis of southeast Florida estimated that there were more than 18 million "person-days" of visits to natural reefs in four counties, leading to $2.7 billion in spending and more than 40,000 full and part-time jobs (Johns, 2001). Yet coral reefs are adversely impacted by a combination of rising temperatures, increasing nutrients, and pathogen pollution from sources such as untreated or inadequately treated sewage. Fecal contamination from sewage in the Florida Keys is thought to be a major source of disease in coral (Nature, 2002).

Similar examples do exist in South Africa, especially the Hartebeespoort Dam which is over polluted with high nutrients load and release blue green algae (DWAF, 2003) (RW, 2012). The loss of the once profitable tobacco industry in the Brits Town (downstream of the Hartebeespoort dam) area due to the high chloride content of the water from the Hartebeespoort Dam, an example of the damaging effects of salinisation, shows how poor water quality from one area can impact on the economic sustainability of the next down-stream area (Roux S & De-LangeW, 2010). The impact of poor water at the Hartebeespoort Dam' s tourist attraction as well as property value has not been quantified.

2.5. The Governance approach

This study would make use of the notion of governance. Section 2.12 of this chapter would introduce, the idea of power and institutional context to provide an understanding of the relationship between water users and the law enforcement agency. The concept of governance in this chapter is used to provide an understanding of how role players in water management must interact to obtain desirable results as a collective. The concept of governance as applied in this chapter does not replace the idea of power in the theoretical framework section. There is actually a synergistic relationship between the two, as governance would entangle the complex relationship between water users and law the enforcement authority. Both enforcement and compliance are

aspects that could be understood from governance's perspective. The discussions that follow would cover the governance model adopted in this study, and would serve as a platform to contextualize the complex notion of water management. This would be followed by an inclusion of the nexus of power into the model.

This research assumes that the greatest pathology in the water sector in South Africa and globally is more the social fabric than the economic and the scientific or ecological aspects. The argument presented in this report would be hinged on the notions of governance and leadership and change in the water sector. The biggest scourge confronting contemporary resource management practitioners has to deal with change. For many years practitioners have attempted to make a shift to ensure that people focus on the human aspect of water resource management. The Rio conference and the Global water partnerships were some of the efforts adopted to embrace the human side of water resource management. Of late the concept of governance has been identified to help in unraveling the challenges of the water sector.

Governance is defined as "societal arrangements that are put in place to regulate, and facilitate the use of water resources. According to the global partnership on water relations, those societal arrangements refers to "the legal, policy and administrative arrangement that are put in place to ensure the wise use of water resources – avoiding degradation, equity in sharing, the marginal groups are able to also have access, to ensure that allocation of water nationally and internationally is in-line with internationally prescribed principles – by the global water partnership and other players in the sector"

Governance is synonymous with the term good governance or democracy. The idea behind this is that the introduction of this concept is to introduce new methods and processes of governing. For instance in the water sector there this drive to bring catchment management agencies on board, to empower water user associations – this is a new method of governing as opposed to a central control system. People are shifting away from this practice, government must continue to have a role but other actors must come on board and play an active role. Governance embodies the direction amongst social actors, this emphasises on interactions of actors within a particular domain rather than individual actors. It entails interactions amongst government, civil society and the private sector. In actual fact, the concept of governance encourages us to focus on the interaction

amongst these role players. Governance can be institutionalised at different levels of social interactions – much similar to polycentric governance.

Academics who study governance ask questions like how resources are being utilised, problems and opportunities and how problems are being analysed. These questions helps in differentiating characterising and analysing the distinction between what managers do - which is about implementation, their functions are more technical or operational, and governance is bout behaviours, especially in terms of what is acceptable and what is not acceptable. Governance concerns with what rules and sanctions apply to effect the patterns of use. The behaviour exhibited reflect the nature of the governance style that is in place. The way users behave is largely a response to or a result of the governance style. Governance style is very important in shaping and defining the behaviour of users.

2.6. Institutional capacity for water management: a governance approach

In the context of this study, institutional capacity refers to an ability to establish strong institutions to enable effective governance of water. Without institutionalisation, the idea of water governance would not be operationalized. This includes compliance monitoring as well as enforcement, which in this study, form aspects of water governance. Good water governance helps in building institutional capacity from local level upwards. In the water sector, SA has been struggling to build institutional capital, especially with regard to the establishment of Catchment Management Agencies (CMAs). Community based natural resource management has been about ensuring that the benefits of using resources. There are however some unintended consequences of this whereby communities closer to the resources have developed strong institutions like committees which can be used for furthering political agendas (Tewari, 2009). Without institutions and social capital there is no way we can achieve or work towards achieving a common goal. Governance also empowers stakeholders especially in terms of knowledge and ability to make decisions on matters that directly affect their lives. The idea of community participation has become a panacea in government, especially when problems need to be resolved. The realisation of late is that polycentric governance may be a more superior model to resolve problems. Communities must be included and marginalisation must be deconstructed. Their role must be clearly defined. Other players from different levels must be included.

2.7. The role of DWS and CMA's

The Department of Water and Sanitation has a legal mandate to establish catchment management agencies within all water management areas in South Africa. Good water governance helps in determining the appropriate tool for government in service delivery (Rogers & Hall, 2003). Up to now service delivery in South Africa to the local people is solely provided by local government. Good governance would assist in understanding the appropriate role for government (Rogers & Hall, 2003). For instance, what should be role and functions of regional DWS bodies and how does it differ from the role of a CMA. Applying the principles of good governance appropriately would assist in clarifying the roles and functions of different role players. Where decisions are made good governance would clarify by asking the right questions, who is making decisions, how were they arrived at, who participated, who controls information flow – this is important because information is critical in making critical decisions, and some stakeholders would withhold information so that decisions made would further their interests.

2.8. Water governance and human-natural resource interactions

The interaction of human beings and their natural resources can be well understood within the context of the idea of water governance. The themes under study, viz, enforcement and compliance, are related to how human beings interact with their water resources. Canadians are the forerunners or are at the forefront in the area of natural resource management and the idea of interactions between human resources and human interaction (Forster, 2015). They were looking at the interaction between science, governance and management. In Sweden, for instance researchers in the Resilient Centre at Stockholm have gained momentum in the area of human-natural resource interactions, which mush into governance. This is influencing the United Nations to incorporate governance issues, and currently the water division of the United Nations has a huge water governance programme, because of the influence of Stockholm researchers. The success of water governance and its inclusion in the United Nations demonstrate its relevance internationally and thus a good platform to explain the relationship between enforcement and compliance in this study.

2.9. A governance approach: Water management

In order to have a deeper understanding of the concepts of enforcement and compliance, this study adopts a governance approach. Governance is different from government. Government is based on the notion of a centralized organizational structure. Governance on the other hand comprises of a multitude of actors across levels (Rogers & Hall, 2003). These actors collaborate, interlink and work together towards achieving a common goal, as opposed to government. The definition of governance is very fluid and there are several definitions found within literature. The World Bank conceived the idea of good governance as a mechanism to shift from economic stabilization and the structural adjustment programmes that were being imposed on borrowing countries. Effectively the idea of good governance was developed by the World Bank to influence policies of the global South. As conceived by the World Bank, good governance entails a government based on transparency, democracy, openness of policies, the rule of law, absence of corruption and money laundering, etc. This view of governance still upholds the traditional idea of a centralized government and its associated bureaucratic machinery. This however does not define or even cover the scope of the idea of governance adopted in this study.

In the context of this study, governance is a network of organizations that cut across states, and go beyond traditional administrative jurisdictions of the state by linking the state, the private sector and civil society together in a very complex and a multi-actor configuration. For many years professionals in the water sector have attempted to make a shift to ensure that people focus on the human aspect of water resource management. Some of the ideas regarding this shift were distilled in the Rio conference and the Global water partnerships. What transpired within these events reflected efforts adopted to embrace the human side of water resource management. In order to unravel the human side of water resource management this study introduces the concept of socio-ecological systems. The approach of Water governance draws from this notion of socio-ecological systems, which according to Glase et al. (2008), defines a complex interaction between the bio-geo-physical component and the associated social elements. In the context of socio ecological systems - water management looks beyond the physical aspect of water and the environment.

2.10. The model of socio-ecological systems

The term socio-ecological system is used in water governance because of the strong linkages between people and natural resources. The concept of socio-ecological systems is inextricably linked to the concept of governance, and can actually be used as a governance model. Effectively the application of the concept of socio-ecological systems is done within the context of governance. In this concept, water management comprises of two systems that are inextricably linked. These are the social system or the human system and the natural system. The human system defines social institutions including people, Policies, laws and strategies as well as the manner in which these policies or laws are formulated, implemented and evaluated, including decision making processes related to outcomes of evaluations. The social system also comprises of resource users who require access and delivery of water services. For the purpose of this research, the natural system would represent water resources and the associated ecologies and processes.

The state of the social system is affected by the natural system, and *vice versa*. Linked to these two systems is the concept of public infrastructure. In this context, Public infrastructure goes beyond the physical infrastructure and includes the human infrastructure. The human infrastructure defines the non-physical aspects like policies, strategic plans, legal frameworks, which are meant to facilitate service delivery and the manner in which resources are utilized. The physical infrastructure denotes for instance dams, canals, reticulation systems etc., and is the operational component of public infrastructure. Within the social system there is also the public infrastructure providers – these are the people who provide the infrastructure. The laws, policies and strategies are applied by infrastructure providers to facilitate access to water services. In a traditional government setting, government would be the actual public services providers. Within the context of water governance, government is one of the players. Other players include but not limited to, Water user association, CMA, Water Boards, the private sector.

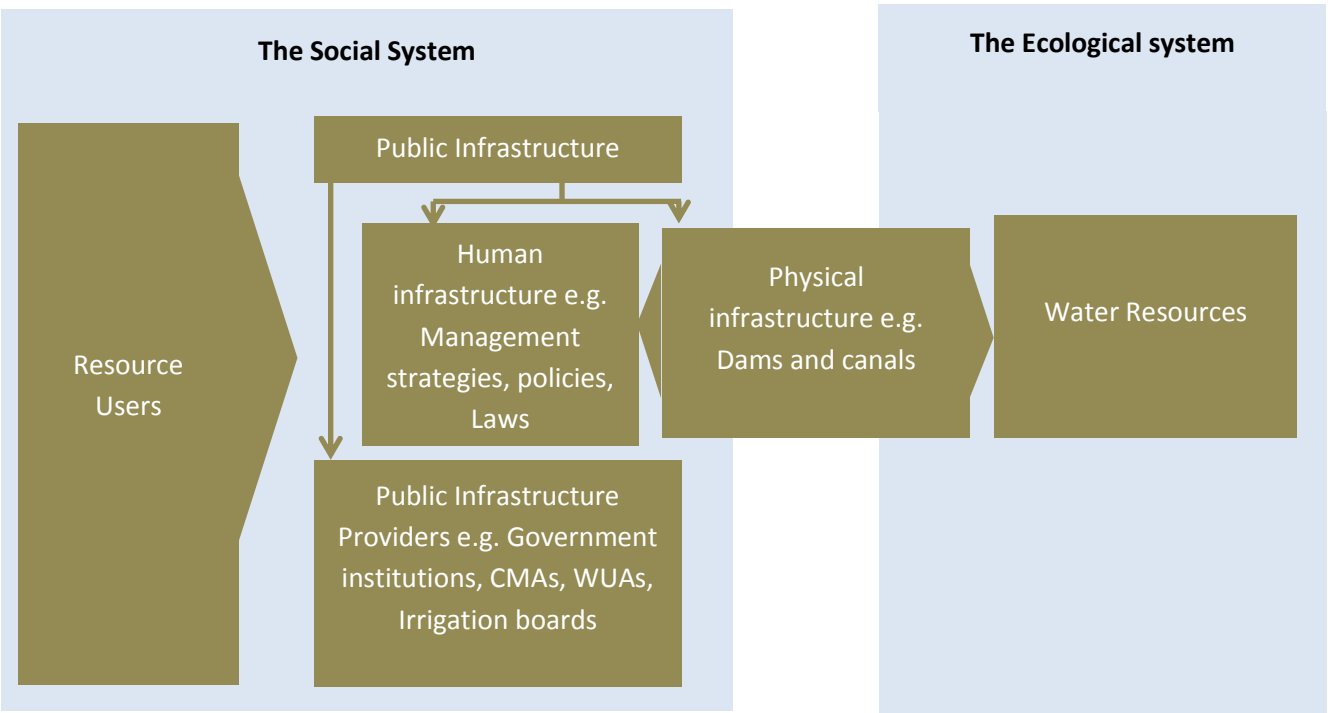

Figure 2: A diagram illustrating the socio ecological system: interactions between water resources and resource users

The laws, policies and strategies are applied by infrastructure providers to facilitate access to water services. In a traditional government setting, government would be the actual public services providers.

The deterioration of water quality is one of the most important concerns regarding water resources in the 21st century (Davis and Rafik, 2003). As human populations grow, industrial and agricultural activities expand, causing changes to the hydrological cycle, leading to declining water quality globally (Glase, et al., 2008). As a result of increasing human population, sewage disposal has become a major problem (Owili, 2003). This is confirmed by other studies which shows that high levels of organic materials enriched with high concentrations of nutrients especially nitrogen and phosphorus constitute the most widespread pollutant at a global scale (Whiteside, 1983; WWAP, 2003). Excessive amounts of both nitrogen and phosphorus in rivers and lakes stimulates

accelerated growth of aquatic plants and algae, leading to a condition referred to as eutrophication (Li, et al., 2011). Worldwide, eutrophication has been identified and listed in the world's major water quality issues (WWAP, 2003).

The major contributors of the problem of eutrophication in rivers and lakes include dense settlements of Asia, Africa and South America (WWAP, 2003). To narrow this further down, the United Nations' World Water Development Report states that Belgium was ranked number one in the year 2003, as having the dirtiest water in the world, resulting from large amounts of raw sewage being discharged into rivers (WWAP, 2003). The current situation however is that, India is recognized as having the worse sewage pollution of surface and ground water in the world (Presse, 2014). In fact, approximately 80% of sewage generated in Indian cities and towns flows into rivers untreated (Presse, 2014). In their article, Upadhyay et al, (2011), reports that pollution into the Yamuna River, a tributary of the Ganga River in India, has far outstripped the River's capacity to assimilate pollutants, thus the river has deteriorated into a sewage drain.

2.11. South Africa's regulatory approaches and policy instruments for water

To understand compliance and how it is influenced by legislation, this stage warrants an interogation of South Africa's a broader legislative and regulatory regime for water. South Africa uses a combination of regulatory tools including:

- Self regulatiory management instruments – these include for instance the adoption of international standards like ISO 1400 which is a system for environmental management.
- Regulatory management instruments – these include the use of formal legislation including the issuing of water use licenses, landfill permits, registration of any water use as prescribed by the law etc.
- Market based management instruments – these includes application of systems like the waste discharge charge system (WDCS). This is a system for charging users for discharging waste into state water resources.

In South Africa, the Constitution is the supreme law, and there are two key clauses relating to water which are, Section 26 which provides for the right of access to water; and Section 24, which

provides for the rights to a healthy environment and to have the environment protected (Constitution, 1996). This latter clause gives a mandate to the National Water Act, Act No. 36 of 1998. The National Water Act was passed as a legislative framework to manage, control, protect, develop and *inter alia*, to give effect to the rights as enshrined in the constitution (DWAF, 1998). According to the National Water Act (Section 19), it is a criminal offence to discharge polluting substances or act in ways that may pollute or contaminate water resources. In this regard, the national water act provides for source directed controls in the form of five water use entitlements, which are water use license, General Authorisation, Section 22(3), Schedule1 and existing lawful water use. These are regulatory measures for controlling impacts on resources. It is therefore illegal to use water in any manner unless that water use is authorised interms of any of these entitlements.

The National Water Act furthermore provides for resource directed measures which defines the desired level of protection for water resources. These include resource management classes, the determination of the reserve and resource quality objectives. In order to ensure compliance and improvement to resource status, the Department of Water and Sanitaion must ensure that monitoring occurs on a continual basis. In the context of this study, policy implementation and law enforcement would be assesed in terms of the combined application of resource directed measures and source directed controls.

For implementation purpose, the National Water Act provides a tier system for water resource management institutions in South Africa. The first tier is DWS through the Minister of Water and Sanitation and is responsible for developing the National Water Resource Strategy (de la Harpe et al., 2001). In this tier the Minister is the Public trustee. The second tier is Catchment Management Agency (CMA), which must develop a catchment management strategy and the third one is the Water User Association. This tier system ensures a sort of decentralisation in the implementation of the Water Act. This decentralisation reflects a shift from the conventional practices where national government was the sole player in water managament and resource protection. Decentralisation allows for effective stakeholder involvement in public water resource management and decision making (Tortajada, 2010). Nevertheless, the broader water policy implementation in South Africa is still provided by national government because the process of decentralisation is very slow. The establichment of CMAs has been running at a snail's pace, thus perhaps constituting amongst other things an enforcement bottle neck.

2.12. Theoretical framework

A theoretical framework provides a philosophical conceptualisation of a phenomenon under study (Have, 2004; Creswell, 2007). This philosophical conceptualisation involve the use of inquiry paradigms or world views in search of the truth (Patton, 2002; Lewis & Ritchie, 2003). Creswell (2007) asserts that such paradigms are theoritical constructs used as platforms upon which, or lenses through which phenomena are veiwed and understood. In understanding the complex challenges of compliance and law enforcement in the South African water sector, this study would make use of the notion of power. This is drawn into the study to provide an understanding of how power relations affect challenges of compliance and enforcement.

Before introducing the inquiry paradigm, it suffices to first introduce the notion of socio-ecological systems. According to Glaser (2006) the term socio-ecological systems defines a complex interaction between the bio-geo-physical component and the associated social elements in a basin. This means that people and the associated laws, policies and strategies as well as processes of their formulation, implementaion and evaluation are inextricably linked to water resources.

In their article *Glase, et al* (2012) argues that the human-nature interaction is measured using natural science instruments. By so doing human beings therefore construct their own truth or reality about the human-nature interaction (Glase M. , Krause, Ratter, & Welp, 2012). In this study, such reality would be derived from water quality data and the resulting analysis including field observation, as well as an identification of the complex social, political and economic processes and mechanisms that give rise to persistance challenges of non-compliance. From this understanding, this study would place human-water resources interaction at the centre of all issues forming the nexus of compliance and enforcement

2.12.1. Institutional context: Power

Max Webber defines power as the probability of an individual or a group to carry out their will even when opposed (Marshall, 1997). From the legacy of the enlightment social thinkers of the eighteenth century, a whole library of scholars emerged, who interpreted or critiqued how the notion of power was conceived and construed to be. Some of the key tenets of the Enlightenment

legacy included statements like “knowledge is power” and “the more rationality, the better” (Flyvbjerg, 1998). In his book, Flyvbjerg (1998) cites Friedrich Nietzsche who asserts that power creates social, physical, economic and ecological realities. This means that power gives any interpretation of reality authority.

For Karl Marx, power is a possession, a quantum possessed by authoritative institutions, and is oppressively exercised on the working class and the powerless (Bălan, 2010). This veiw of power was however, strongly negated by Mitchel Foucault, who according to Seidman (2004), asserted that power is everywhere, and is dissipated by relationships between individuals, communities, agencies etc.

From a Foucauldian stand point, the relationship between these role players in a catchment is about power and processes or mechanisms about how this power is distributed (IFDA, 2009). Players are further linked together by long term political, environmental, social, cultural and economic objectives. Furthermore to their linkage, is an interplay of history, changes, influences, negotiations resources as well as a precedence of who “set the rules of the game” (ibid:1). These background non-physical aspects will have a pervasive influence on legal interventions to address challenges of compliance in the Vaal Dam catchment area.

The first step would be an extensive desktop review of journal articles and policy documents. In addition to desktop review more information about compliance would be obtained through site visits and interaction with officials from selected municipalities and DWA officials. A semi-structured interview schedule would be drafted for use as a research instrument to understand the subject under study. Key informants in this study would be enforcement officials as well as officials within identified WSIs experiencing persistent compliance challenges. Where possible, interviews would be conducted face to face, and more questionnaires would be sent to respondents via email, while others would be done telephonically

2.13. Chapter conclusion

The literature reviewed in this chapter dealt with broad water management issues. Areas covered included water protection and management; aspects of compliance and enforcement; South Africa's regulatory approaches and policy instruments for water and the notion of socio-ecological systems. In order to have a deeper understanding of the concepts of enforcement and compliance, this chapter adopted a governance approach. This was described in detail to allow for a clear line of arguments in the latter chapters. The chapter also presented the theoretical framework, which was hinged on the foucauldian's perspective of power and the institutional context of power. These would be used as platforms explore the influences of water law on compliance

Chapter 3: Methodology and Research Area

3.1. Study Methods

This study was primarily a qualitative based enquiry, but primary data was collected by making use of both quantitative and qualitative instruments. Creswell (1998) asserts that a qualitative enquiry uses qualitative instruments to study a human or social problem. Any research where results, data analysis and conclusions are drwan without using statistical procedures, follow a qualitative paradigm (Stauss & Corbin, 1990). This study would be based on a single case, which is the Vaal Dam catchment area (see discussion on the study area below). Secondary data will be collected through the use of relevant published Journal articles, books, internet websites, newspaper articles, and any riliable grey literature.

In order for the researcher to advance the aim of this research, a qualitative research approach methodology was applied as part of the the study. According to (Mack et al, 2005) qualitative research shares the following characteristics:

- Effective in obtaining culturally specific information about the values, opinions, behaviors, and social contexts of particular populations.
- Seeks to understand a given research problem or topic from the perspectives of the local population it involves.
- Systematically uses a predefined set of procedures to answer the question through collection of evidence
- Produces findings that were not determined in advance
- Produces findings that are applicable beyond the immediate boundaries of the study

Qualitative methods are also effective in identifying intangible factors, such as social norms, socioeconomic status, gender roles, ethnicity, and religion, whose role in the research issue may not be readily apparent. Although findings from qualitative data can often be extended to people with characteristics similar to those in the study population, gaining a rich and complex understanding of a specific social context or phenomenon typically takes precedence over eliciting data that can be generalized to other geographical areas or populations. (Mack et al, 2005). The

most used methods for qualitative research are participant observation, in-depth interviews, and focus groups. Participant observation is appropriate for collecting data on naturally occurring behaviors in their usual contexts.

Table 1: Presentation of participants in the study

Theme	**Department of Water and Sanitation**					**Municipality**
Description of respondents	**Respondent 1**	**Respondent 2**	**Respondent 3**	**Respondent 4**	**Respondent 5**	**Respondent 6**
Position in the organisation	Middle Management	Junior Management	Official	Middle Management	Official	Middle management
Catchment involvement	Vaal Dam and Wilge	Vaal Dam	Vaal Dam, Grootdraai, Waterval and Wilge	Vaal Dam and Waterval	Vaal Dam	Vaal Dam and Wilge

The researcher in this study collected data and information by conducting field based research and using one on one open-ended interviews with the selected participants, refer to table 1 for the full results of the study. According to Creswell (2007), there are various forms of interview design that can be developed to obtain thick, rich data utilising a qualitative investigational perspective (Creswell, 1998,2007).

In-depth interviews are optimal for collecting data on individuals' personal histories, perspectives, and experiences, particularly when sensitive topics are being explored. Focus groups are effective in eliciting data on the cultural norms of a group and in generating broad overviews of issues of concern to the cultural groups or subgroups represented. (Mack et al, 2005).

To fulfill the aim of this study which examines the perceptions of a specific population in relation to the water quality of the river and its impact on tourism, the researcher used In-depth interviews (other literature termed as Standardized Open –ended Interview (Turner, 2010) as the primary data method. Six (6) participants were interviewed in this study, the participants were selcted from different backgrounds but had similar interests in the subnject matter. The selected participants participate in all four catchments in the Vaal Dam. In this kind of interviews participants are always asked identical questions, but the questions are worded so that responses are open-ended

(Gall D & Borg, 2003). Although the data provided by participants is often rich and thick with qualitative data, it could have been a more cumbersome process for the researcher to sift through the narrative responses in order to fully and accurately reflect an overall perspective of all interview responses through the coding process.

3.2. Sampling strategy

Primary data was collected by making use of key informants (Gate Keepers) selected from the Department of Water Affairs, and relevant Local Municipality. Participants were then selected by following a purposive sampling technique. Bryman and Burgess (1999) states that a purposive sampling technique is a nonsampling method and makes use of key informants in collecting primary qualitative data. Schwandt (1997) defines key informants as people who are familiar with the subject under study, and would therefore provide valuable information. In this study sample size was not very crucial, as the need would be to gather information about perceptions, ideas, or thoughts of people, which cannot be quantified (Creswell, 1998). In addition to this data, more information about enforcement and compliance would be obtained through site visits to selected areas within the catchment.

In order to collect qualitative information, a semi-structured interview schedule was drafted for use as a research instrument to understand the effects of Law enforcement on compliance. Key Informants in this study were government officials and senior staff members from the department of Water and Sanitation (DWS) and a single local Authority. Officials from local municipalities were also sent questionnaires via email. Data was collected by sending Questionnaires to respondents via email, while others would be done telephonically.

3.3. Recruitment of participants and Interviews

Schurink (2000) suggests that participants with the right expertice and insight should be selected to participate. In this study, participants would be selected from the catchment forums that are held quarterly in the four subcatchments of the Vaal Dam. There was a personal introduction as well as an explanatory statement of the study given to each potential participant. (See Appendix) Participants were encouraged to be part of the study, and were reminded that they have the right knowledge and insight to make valuable inputs. A consent form was used to otain their consent (See Appendix). There was a six months time period allocated for both recruitment and interveiws of participants in this study.

3.4. Data Analysis

Data was analysed using the thematic analysis technique. In cases where a recording device was used, ideas were transcribed, and either be paraphrased or recorded as direct quotations (Spradley, 1979). From the information, patterns of ideas and behaviour identified and listed under specific themes. Leininger (1985) argues that themes are ideas that when viewed alone, may not have any substantive meaning. By putting themes together, a collective experience is pieced together, thus allowing conclusions to be drawn.

3.4.1 Coding

According to du Plooy-Cilliers et al (2014), coding is a way of organising data into manageable pieces. This will allow examination of the data and decision-making on how to break the data down. The first coding frame is often a multi-leveled process that requires several successive sorting of all cases under examination (Berg, 2001). Investigators begin with a general sorting of cases into some specified special class. In many ways, this first frame is similar to what Strauss (1987) describes as axial coding. According to Strauss (1987) axial coding occurs after open-coding is completed and consists of intensive coding around one category. The researcher coded the transcripts line by line as well as word by word. Then they were labeled based on similarities in terms of meanings. The codes with commonalities were then grouped together.

The assigned code or category serves as an identifier whenever you find a meaningful segment in the data. The researcher analysed the data from the interviews under broad themes and these were related to the questions asked during the interview process. The researcher then organised the data into categories and sub-categories by reading across all the transcripts. An analytical memo that contained the broad themes and headings was produced and finally extensive direct quotations from the participants were used to allowing for some thick description.

3.5. Validity and Reliability of the Study

Validity can be described using a wide- range of terms in qualitative studies. This concept is not a single, fixed or universal concept, but rather a contingent construct, inescapably grounded in the processes and intentions of particular research methodologies and projects (Winter, 2000). Issues related to validity in qualitative research have been addressed for more than half a century (Atkinson et al., 2003). Patton (2001) considers that validity and reliability are two factors about which any qualitative researcher should be concerned when designing a study, analysing results and judging the quality of the study. To try and ensure the validity of their research, qualitative researchers routinely employ: member-checking; triangulation; thick description; peer reviews; and external audits to try and ensure the validity of their research (Creswell and Miller, 2010).

Reliability and validity are conceptualized as trustworthiness, rigor and quality in qualitative paradigm. In qualitative paradigms, the terms: 'credibility' 'neutrality' or 'conformability', 'consistency' or 'dependability' and 'applicability' or 'transferability' are essential criteria for quality of research (Lincoln and Guba, 1985; du Plooy-Cilliers et al.,2014). Trustworthiness is crucial to ensuring reliability in qualitative research, while also establishing good quality studies through reliability and validity in qualitative research. Seale (1999) states that, "The trustworthiness of a research report lies at the heart of issues conventionally discussed as validity and reliability" (Seale, 1999). The bullets below show the criteria that the study employed to ensure that trustworthiness is achieved.

- Credibility - this concept looks at the congruency between the study findings and reality. Indeed the findings of this study are very much related to what is happening on the ground.
- Transferability - this concept focus on applying study results on other contexts. Since the study was qualitative, application of the study results to other contexts would be minimal. Adjustments would need to be done if the results of this study are to be applied to other contexts
- Dependability - this concept asks the question whether the same results would be obtained if the study is to be repeated again. The phenomena understudy are dynamic and may pose particular challenges if one is applying the results even in the same contexts.
- Conformability - this concept deals with the use of instruments that do not depend on human technocracy. Unfortunately this study used instruments (semi-structured questionnaire) which was designed by the researcher and therefore, would also reflect the researcher's bias.

Triangulation is a procedure used to try and achieve validity: the researcher's search for convergence among multiple and different sources of information to form themes or categories in a study. This is a step taken by researchers, employing only the researcher's perceptive, and it is a systematic process of sorting through the data to find common themes or categories by eliminating overlapping areas (Creswell and Miller, 2010). According to Mathison (1988), triangulation has arisen as an important methodological issue in naturalistic and qualitative approaches to evaluation to control bias and establishing valid propositions. Qualitative methodology often applies triangulation as a means of establishing credibility; including triangulation of investigators, theory, technique or sources (Denzin, 1978). The interviews, observation and document analysis were validated against each other to establish validity. Through this association, achieving validity and reliability of research from the qualitative researcher's perspective is increased and it eliminates bias and increases the researcher's truthfulness of a proposition about the social phenomenon (Denzin, 1978).

A peer review involves someone, who is familiar with the research or the phenomenon being explored, reviewing the data and research process. Seeking the assistance of peer review allows the researchers to add credibility to a study (Creswell and Miller,

2010). Peer review of the study was also employed for this study to establish credibility.

During this study the researcher used thick, descriptive statements that sought to produce for the readers the feelings that they would have experienced, or could experience, in the study. Hence, credibility is then established by the readers who read a narrative account and are transported into a setting or situation (Denzin, 1978). Rich description also enables readers to make decisions about the applicability of the findings to other settings or similar contexts (Creswell and Miller, 2010).

3.6. Ethical considerations

What transpires within literature is that it is the responsibility of the researcher to ensure that those who participate in a study are not harmed; their privacy is maintained, and an informed consent is provided (Miller *et al*., 2012; Holloway & Wheeler, 1995). Information gathering in a qualitative enquiry involves a multitude of both moral and ethical issues. This background gives a hint that there are many ethical questions that a researcher who deals with human subject would be exposed to. An ability to uphold a good conduct and in interacting with diverse people in the data collection phase would be an index of good ethical grounding. Schurink (2000) advices that, it would not be easy to identify all ethical dilemmas at the outset. While this is factual, Miller *et al* (2012), states that, unless ethical dilemmas are identified and measures are put in place to address them, they may potentially alter research design and data collection. At the outset, this study would observe and sought to address ethical dilemmas as per the ethical conduct outlined in (Miller *et al*, 2012), which are as follows:

3.7. Do no harm

Those involved in a research must not be exposed to situations that put them at risk of bodily or psychological harm. This will be dependent on research design and execution. In this study the researcher would ensure that participants are not exposed to anything that would harm them. (Stauss & Corbin, 1990; Resnik, 2015).

3.8 Privacy and Anonymity

This principle advises that the researcher should conceal any identifying information. This applies to information that may make either an individual or an institution identifiable by a third party. In this study, identifying information would be removed from collected data. Consent would be sought however, from participants where there are compelling reasons to publish information that may identify them (Resnik, 2015).

3.9 Confidentiality

Information collected from participants would be treated with confidentiality. Participants would be assured that any recordings including voice clips would be destroyed after they have been transcribed and incorporated into a research report. This study would not collect information from minors and any other persons with vulnerable conditions (Resnik, 2015).

3.10 Informed Consent

Individuals participating in this study would be informed about the nature of the study by making use of an information sheet. This would be further explained by the researcher to provide additional clarity. Participants would therefore make informed choices of whether or not to participate. A consent form for allowing the use of any recording device would be drafted and such consent would be sought from participants. Furthermore, participants would be informed that participation is voluntary, and they can choose to withdraw from participating at any time without feeling prejudiced in any manner (Resnik, 2015).

3.11 Rapport and Friendship

In order to allow a participants to be free to disclose the much needed information, the researcher in this study would build a rapport. This would require an environment that is trustworthy, though without feigning any friendship with participants (Resnik, 2015).

3.12 Intrusiveness.

In this study, the researcher would avoid being intrusive in any manner. This means that the researcher will not intrude on participants' time, personal space, and personal lives. In order to avoid intrusion the researcher would make reasonable estimates of the time needed to spend with

each participant (de la Harpe, Ferreira, & Potter, 2001). To avoid or minimise intrusion on the three areas i.e. time, space, and personal lives, the following would be done:

- Intrusion on time: reasonable time estimates would be set and discussed with prospective participants
- Intrusion on personal space: if this is an issue for any individual, a neutral venue would be chosen for the interview.
- Intrusion on personal live: the researcher would avoid making any conversation personal with participants.

3.13 Researcher's identity

The researcher in this study would identify himself as an MPhil Student at Monash University (South African Campus, conducting a study on "the influence of enforcement on compliance in the South African water sector".

Appropriate steps were taken overall by the researcher to adhere to strict ethical guidelines in order to uphold participants' privacy, confidentiality, dignity, rights and anonymity. Ethical clearance for this research was sought and obtained from the Monash University Human Research Ethics' Committee (MUHREC) before I could proceed with the collection of data from the study area (See Appendix). The study conducted was classified as a low-risk research, which means that questions asked were minimally sensitive and posed minimal to no risk to participants.

3.14. The Study area

One the key features of the Vaal Dam catchement area is the Vaal Dam reservoir, located south of Johannesburg near Vereeniging. This catchment area extends over an area of approximately 38 500 Km^2, and cuts across three Provices namely; Gauteng, Mpumalanga, and Free State. The Vaal Dam catchment area is part of a broader Vaal system, which comprises three sections, which are, the Upper, Middle and Lower Vaal. This study is based in the Upper Vaal section of the system, and comprises of four sub-catchments, which are, the Grootdraai, Waterval, Wilge and the Vaal Dam reservoir. The Vaal Dam catchment area encapsulates all river systems in the Upper Vaal that lie upstream of and drains into the Vaal Dam, refer to Map 1. The following

discussion provides an overview of the four sub-catchments in the Upper Vaal catchment area

Figure1: Map of the Vaal Dam catchment area, showing the four sub-catchments

3.14.1. Waterval catchment

The Waterval is the most affected catchment of all the sub-catchments in the Vaal Dam catchment area, situated in Mpumalanga Province. Human activities such as mining, industry, agriculture, rural and urban settlements are currently responsible for the deterioration of the

water quality in the Waterval River system. Problem areas in the Waterval River catchment include the town of Secunda, (Sasol-synfuel and Sasol Coal mines), Evander and the township of Embalenhle. Major discharges into the catchment includes Secunda WWTW, Evander WWTW, Embalenhle WWTW, Sasol Mining, Harmony Gold Mines, and Sasol Synfuels.

Secunda Sewage Works is operated and maintained by Sasol Synfuels and treats domestic sewage from the Sasol Synfuels factory and the Town of Secunda. Purified effluent is discharged into the Klipspruit. Both Evander and Embalenhle sewage works are operated and maintained by Govan Mbeki Local Municipality. Embalenhle WWTW discharges into the Trichardtsrpuit and Evander WWTW discharges into the Winkelhaakspruit.

3.14.2. Grootdraai Dam catchment

This catchment is named after the Grootdraai Dam, situated in the upper reaches of the Vaal River less than 10km upstream of the Town of Standerton in Mpumalanga Province. The Dam was completed in 1982 and was built primarily to support the water needs of the SASOL I, II and III plants at Secunda, ESKOM's, Tutuka Power Station as well as the Matla, Duvha, Kendal and Kriel power stations located on the coal fields in the adjacent Olifants River Basin. Major discharges into the catchment includes five WWTW which are: Ermelo Municipal Sewage Works, Bethal Municipal Sewage Works, Tutuka Power, Station Tutukani Sewage Works, Majuba Power Station Sewage Works, and New Denmark Colliery South Shaft Sewage Works. More water quality influences are from collieries which includes New Denmark Colliery, Golfview Colliery, X-strata (Spitzkop and Tselentis), and Delta/Mashala.

3.14.3. Wilge river catchment

The Wilge River catchment area is located in the aastern parts of the Free State Province, and is sub-divided into six management units which are Jordaanspruit, Ash River, Liebenbergsvlei, Elands River, Upper Wilge and the Middle Wilge. Major discharges into this catchment include wastewater treatment works of Qwaqwa, Tsiame, Harrismith, and Bethlehem. By comparison

with other subcatchments, the Wilge catchment area is less industrialised. The few industries in this catchment discharge into municipal sewage treatment works.

Jordaanspruit runs through the town of Bethlehem and the Ash River management unit receives water from the Leotho Highlands Project, a transfer Scheme at the Town of Clarens. The Elands River management run through the Qwaqwa area, and is largely affected by QwaQwa sewage works, which is operated and maintained by Maluti a Phofung Local Municipality. The Liebenbergsvlei River is a tributory of the Wilge River and constitute a management area where few anthropogenic activities takes place. The Middle Wilge River management unit runs downstream the farm area of Waaiwater near the Town of Warden through to the Town of Frankfort.

The Upper Wilge management unit starts at Sterkfontein which is situated in the very upper reaches of the Vaal Dam catchment on the Nuwejaarspruit, a few kilometres from the edge of the Drakensberg Escarpment. Sterkfontein Dam receives its water via the Tugela-Vaal Project which is a pumped storage scheme involving the net transfer of up to 630 million m^3 of water from KwaZulu-Natal. The water from KwaZulu-Natal is stored in Sterkfontein Dam and released into the Vaal Dam via theNuwejaar and Wilge Rivers when ever the need arises.

3.14.4. Vaal Dam reservoir

The Vaal Dam Reservoir catchment consists of both the Klip River sub-catchment (in the Eastern Free State), which drains the town of Memel; and the Vaal Dam area. This catchment is affected by anthropogenic activities such as wastewater treatment works and agricultural activities. It is not an industry or mining-intensive area, but there are few industrial activities occurring in the Town of Standerton. The few industries in this catchment discharge their effluents into municipal sewer systems. Major discharges into the catchment includes the wastewater treatment works of Standerton.

3.15. Chapter conclusion

This chapter presented the methodology followed in this study. The study was a qualitative enquiry. Data was analysed using a thematic technique, and was coded to ensure better breakdown for effective management purposes during analysis. Qualitative data would latter in the study be triangulated with quantitative data to understand the level of compliance. The study intruced ethocal considerations as well as the study area to provide a clear understanding the land uses within the Vaal dam catchment area.

Chapter 4: Findings of the study

4.1. Introduction

This chapter presents the findings and analysis of the case study of the Vaal Dam catchment area. The findings are guided by the overall aim of the study and research questions. The aim of the study was to explore the influences of law enforcement on water compliance in the South African water sector, using the Vaal Dam catchment area as a case study. The study was designed with four objectives which are: 1) to understand South Africa's policy and legislative context for water; 2) to understand water compliance levels in the Vaal Dam catchment area; 3) to determine the level of law enforcement; and 4) to determine the level of monitoring of all licensed and unlicensed activities. Objective one was addressed elsewhere in the study. This chapter addresses the remaining three objectives which are 2, 3, and 4. The major finding is that there is a negative feedback between water compliance and enforcement. Non-compliance incidences are high in the catchment, particularly for municipal WWTWs. The analysis found that the level of law enforcement was inadequate to deter identified non-compliances in the catchment.

The analysis of qualitative data was supported by quantitative data which provide an overview of the water quality status of the Vaal Dam. Observations included physical observable characteristics or patterns of what was actually happening in the catchment. The results also included looking at the efficacy of legislative and regulatory mechanisms and institutions. The results are presented as quotations or extracts from the respondents' responses. Selected themes echoed the thrust of the main objective of the study to ensure that research questions were addressed.

4.2. Understanding water compliance levels in the Vaal Dam catchment area

Before presenting qualitative results of water compliance levels in the Vaal Dam catchment area, it is important to provide a concise description of the concept and attributes of compliance in the South African context. In an ideal situation, water compliance would describe a state where all members of a regulated community adhere to legislative requirements and standards applicable to all their activities. In South Africa, the National Water Act, Act 36 of 1998 defines source directed controls (SDCs), which are entitlements issued by DWS as authorizations for water

users to use water. These are authorizations meant to manage and control impacts or pollution from source. In terms of the NWA, Act 36 of 1998, there are five entitlements which are:

- Authorisation under schedue1, which require no extra conditions [Section 22(1)(a)(i) and schedule 1 : NWA 36: 1998)
- Generally authorised – either notice for impacts that a small enough not to require a license, are regional specific and vary on the basis on the nature of an activity [Section 22(1)(a)(iii): NWA, Act 36 of 1998 – regulations 398 and 399 (Government Notice 26187]
- Authorisation under a water use license [Section 22(1)(b): NWA, Act 36 of 1998]
- Authorisation under an existing lawful use (ELU) - a lawful authorisation that was in existence before the promulgation of the National water Act, Act 36 of 1998 [Section 22(1)(a)(ii) and Section 32 NWA Act 36 of 1998]
- Dispense with requirements for a license – this happens when the South African Minister of the Department of Water and Sanitation is satisfied that the water use would be covered under the requirements of other laws, in which case authorisation would be dispensed. [Section 22(c) and 22(3) : NWA, Act 36 of 1998]

Water compliance in the Vaal Dam catchment area would be achieved when water users conform to conditions of authorizations applicable to them. From this understanding, it suffices to assume that, if compliance to SDCs is achieved, then water quality status in the catchment would comply with the limits set in the in-stream water quality guidelines and resource quality objectives. These are numerical limits set by DWS to ensure adequate protection of water resources, and inform the conditions under which water use authorisations are issued. None-compliance of in-stream water quality to guidelines and standards would indirectly mean that water users do not comply with water use authorizations and other legislative requirements applicable to them.

For years, results from Rand Water's existing water quality monitoring programme and that of DWS have indicated that water quality was deteriorating in the catchment. The deterioration would be linked to failure of water users to conform to water use conditions applicable to them. Major discharges in the catchments include abattoirs, mines (gold and coal), dairy industries, sewage works and small organic and inorganic chemical industries. Most industries are small and

those that discharge have contractual agreements with local authorities to discharge onto sewage lines. Therefore, major discharges in the catchment are from waste water treatment works. Compliance in this context measures the performance of waste water treatment facilities against conditions of their legal authorisations.

The qualitative data presented in this chapter includes perspectives and comments of respondents supplied in their personal capacities and not in official capacities. According to the respondents involved in this study, there is a general trend of non-compliance by water users in the catchment, especially in the area of sewage treatment works. Respondents also indicated that abattoirs and industries discharging into water resources do not comply According to one of the respondents;

> *"…industries and abattoirs discharging directly onto rivers are not functioning properly".... the treatment process is bypassed in WWTWs. Most WWTWs processes are not functioning properly. This results in partially treated effluent being discharged into water resource, thus resulting in contamination*" (R1- DWS).

In fact, most respondents identified municipal sewage works as being the major problem regarding user compliance to required standards. This is a result of old and dilapidated sewage treatment systems, most of which are poorly operated.

Non-compliances are also exacerbated by a combination of unfettered industrial activities, decades of acid mine drainage, and poor management of informal settlements. This is confirmed by a respondent who said that

> "*Non-complying sewage treatment works, mining activities exercising limited operational care and/ or with inadequate closure plans in place pose the greater compliance threat. Diffuse impacts, inter alia, associated with agricultural activities, urban runoff and atmospheric deposition, are also activities that, probably, pose the biggest threat to water quality. Emerging sources of pollution, such as nanoparticles, persistent organic pollutants (POPs), endocrine disrupting compounds (EDCs) and others require additional research and monitoring"*(R2-DWS).

The evidence of noncomplying sewage works includes physically observable characteristics including a green colour, especially between October and January, indicating a possibility of eutrophication. Eutrophication, also called algal blooms is the proliferation of phytoplankton in a water body and is associated with artificial enrichment of water with plant nutrients like Nitrates and phosphates. Another parameter associated with impacts from noncomplying WWTWs include high microbiological loading into water resources. Generally respondents confirmed that;

> "*Bacteriological loading, including total coliforms and E-coli from the results discussed at the forum meetings from most of the WWTW were not complying*". Another respondent indicated that high bacterial loads come from "*sewage systems that are not functioning well and industrial pollution incidents as well as storm water runoff. Contamination of water resources with bacteria is also further ascribed to poor management of informal settlements*" (R6-DWS).

The current level of non-compliance and contamination of water resources in the Vaal Dam catchment area is leading to a situation where the available source water is under serious threat. One respondent mentioned that the high bacteriological loading in the catchment is a result of 95% of WWTW discharging untreated effluent into water resources. Discharging untreated sewage is a noncompliance and leads to microbiological parameters like *E.coli* and *Faecal Coli* forms going above limit. Respondents also identified parameters such as Salinity, Nutrients, biological, COD, Metals, Radioactivity, and Siltation as being above the limits of what has being determined to be the required standards for compliance. More information from existing catchment forums indicated that on-going sewage spills in the Vaal River and its tributaries have been a serious problem for decades. Given the level of noncompliance, it is important to present some water quality data to provide an indication of the water quality status of the Vaal Dam catchment area.

4.3. Water Quality Status of the Vaal Dam Catchment area

Qualitative data was analysed to provide further evidence for the level of noncompliance presented above. Parameters selected are informed by the major polluting activity in the catchment. Water quality data would provide information about the compliance level of applicable in-stream water quality guidelines in the Vaal Dam. In-stream water quality status is

directly linked to user compliance to standards or permits applicable to their activities. Water quality status can be used as a surrogate for the level of user compliance to regulatory requirements.

The bulk of this study is based on qualitative data obtained from respondents. However, as mentioned earlier, this part is presented to support qualitative data on the level of compliance in the catchment. For the purpose of this chapter, five parameters were selected based on the major contaminants around the Dam as well as activities upstream. From a water quality's perspective, the major challenges in the Vaal Dam catchment area are associated with nutrients, salinity and dissolved organics. Thus selected parameters are Nitrates, Phosphates, Sulphates Chemical Oxygen Demand (COD) and Electrical Conductivity (EC). A brief description of each parameter is provided below:

4.3.1. Nitrates

In a water body, nitrates are the most oxidized and stable form of nitrogen, largely used as nutrient by plants to stimulate and accelerate growth. Thus excessive amounts of nitrate in a water body may result in proliferation of phytoplankton or a condition called eutrophication.

4.3.2. Phosphates

Phosphates, generally found in the form of ortho-Phosphate, are considered to be the limiting nutrient for plant growth in freshwater systems. Only small quantities occur naturally mainly from geological sources. Like Nitrates, high phosphates levels generally occur in conjunction with algal blooms or eutrophication.

4.3.3. Sulphates

Sulphates are found in almost all natural water bodies. In any water resource, Sulphate concentrations vary depending on the natural rock formation through which the water flows. Ores of some heavy metals like Iron sulphides provide a natural source of Sulphates.

4.3.4. Chemical Oxygen Demand (COD)

COD is a measure of dissolved organic carbon in a fresh water body. It is used as a proxy for the presence of organic compounds in surface water. A variety of sources contribute COD in water resource systems including domestic and industrial waste water discharges, dairy product production, abattoirs, pharmaceutical companies, nutrient supplement and animal feed productions.

4.3.5. Electrical Conductivity (EC)

Conductivity is a physical parameter and defines the measurement of the ability of water to conduct an electric current. The higher the content of dissolved ions in the water, the more current the water can carry, and thus the higher the conductivity. It is also used as an alternative measure of total dissolved solids.

4.4. Water quality results: percentage compliance to instream water quality guideline

The results are presented as percentage compliance to in-stream water quality guidelines (refer to figure 4.1.). The dire situation and pollution issues in the catchments have been reported in the catchment forums as well as to DWS officials through various pollution incident reports. Catchment forums minutes indicate that despite all reported pollution incidents, problems still occur. Figure 4.1 depicts water quality status in terms of five selected parameters, Nitrates, Phosphates, Sulphates Chemical Oxygen Demand (COD) and Electrical Conductivity (EC). From the figure a significantly high levels of Nitrates non-compliances is observed in all sub catchments. These results are supported by other studies (Whiteside, 1983; WWAP, 2003) which shows that high levels of organic materials enriched with high concentrations of nutrients especially nitrogen and phosphorus constitute the most widespread pollutant at a global scale. This statement is also echoed in the above figure, showing high noncompliance levels of chemical oxygen demand in two sub catchments. Excessive amounts of both nitrogen and phosphorus in rivers and lakes stimulates accelerated growth of aquatic plants and algae, leading to a condition referred to as eutrophication (Li, et al., 2011). Worldwide, eutrophication has been identified and listed in the world's major water quality issues (WWAP, 2003).

According to figure 4.1., high noncompliance levels in Nitrates are observed in the Grootdraai and Waterval catchments, 69% and 100% respectively. Phosphates are the highest in the Waterval, perched at 69%. COD noncompliances are higher in the Waterval and Grootdraai catchment, both 93% and 52% respectively. In the same catchments, Electrical Conductivity is the highest with 87% in the Waterval and 46% in the Grootdraai. In the Vaal Dam, non-compliances are associated with both COD and Nitrates, and are 58% and 41%. These results mirror the nature of land uses and the levels of non-compliance by water users in all the four sub catchments in the Vaal Dam catchment area. The results also indicate that the two busiest catchments in the broader Vaal Dam catchment area are Waterval and Grootdraai catchment.

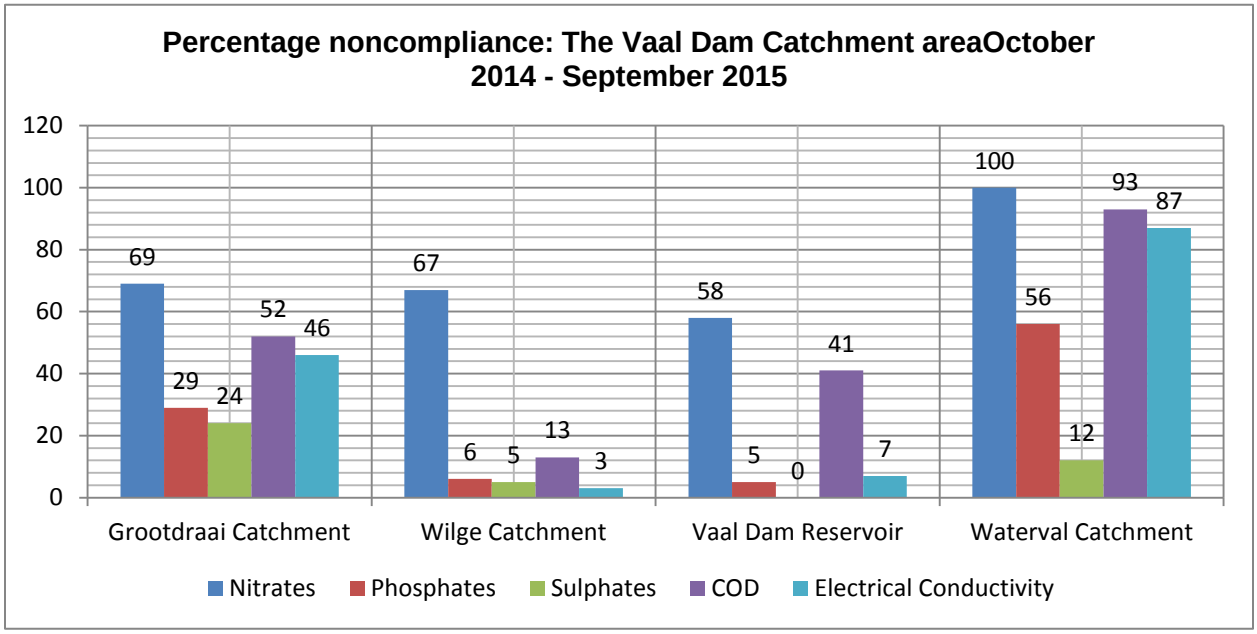

Figure 4.1. Percentage noncompliance: The Vaal Dam Catchment area, October 2014 - September 2016

The results presented under this theme have demostrated that the ongoing discharge of sewage into water resources is the major noncompliance. For this reason, the major finding in this section is that the level of noncompliance in the Vaal Dam catchment area is high. This was confirmed by water quality status results presented in terms of percentage noncompliances to instreeam water quality guideleines.

4.5. Determining the levels of monitoring to licensed and unlicensed activities

In the context of water resource management, the intentions of monitoring can be summed up by a statement by Peter Drucker, who in his book titled, the effective executive, said that one can't manage what they can't measure (Druker, 2002). Monitoring involves continuous data collection using various methods. The reasons for collecting such data vary significantly (EPA, 2015). Some of the reasons for monitoring include the need to collect: (EPA, 2015)

- Information needed to identify changes and trends occurring in a water body over time,
- Data needed for problem identification,
- Information required for strategies or policy formulation,
- Information required to see if policies and laws are achieving objectives as planned,
- Information needed to develop protocols and emergency control measures.

The fourth bullet above, points to a direct linkage between monitoring and compliance. This is because, in the context of water resource management, the need to see if policies and laws are achieving objectives as planned is akin to assessing compliance. The discussion that follows would describe compliance and its attributes.

Having discussed water compliance levels in previous section with the support of an account of the water quality status, it suffices to look at the monitoring of such activities and their out-puts. In South Africa, ongoing monitoring is very crucial for effective resource management and protection. As far as monitoring is concerned, respondents have indicated that DWS does monitoring for both authorised and unauthorised activities or water uses. This is supported by the following responses:

- *"… DWS does send someone for inspections and advise on matters that need attention* (R4-DWS).
- *"… monitoring is done through auditing by checking if the water uses are still the same and if they are discharging with the water standard after monitoring"*(R2-DWS).
- *"…in addition to regular internal and external audits, as required by most licenses, to be conducted by - and on behalf of license holders, a ranking in terms of priority is done on an annual basis by the DWS, where after compliance monitoring action is*

scheduled accordingly. Compliance monitoring can invoke compliance enforcement" (R1-DWS).

Another responded indicated that;

"…on monthly basis there is water sampling where the final effluent discharged to water resource is taken and submitted to laboratory for analysis to check the status of the water quality. By attending to pollution incidents when reported and by conducting the audit" (R3-DWS).

Monitoring is important for decision making, policy formulation as well as enforcement. Without monitoring compliance cannot be measured, the outcomes of policy implementation and the law would not be measured, and therefore the purpose for water resource management would be outright failure.

As mentioned above, DWS also monitors unauthorised activities. Unauthorised activities are water use activities that take place without the necessary authorisation in terms of the National Water Act. By right, such activities would be identified as illegal, but nevertheless, they need to be monitored to achieve the goal for effective water resource management and protection. As pupated by respondents in table six below, respondents' perspective on whether such activities are monitored and how they are monitored include,

"…they do it through the verification and validation of water uses, where they check on the map or by using GIS method. After that is where they are going to visit a place for investigation". Some indicated that "*when it comes to the DWS's attention, either through public assistance or through inspection conducted by departmental officials, further action, including compliance enforcement and monitoring is taken*". Indeed "*it would be difficult in a case where the department is not aware of any unauthorised water use activity*"(R1-DWS).

A respondent also mentioned that "*DWS monitors unauthorized activities by conducting regular inspections on all activities in the catchment. This does not need an appointment with water uses*". The general view though is that, unauthorised activities are monitored in the same way as authorised once. Mechanism of monitoring unauthorised activities includes verification and

validation of water uses, through public assistance or, inspection conducted by departmental official as well as through investigations.

The national water act provides that no one is authorized to use water without the necessary authorisation. Authorised activities are those activities that are authorized in terms of the National Water Act. According to respondents, there are various ways of monitoring authorised activities including inspections, auditing, investigations as well as taking water samples and making follow ups. In addition to these, a ranking in terms of priority of water is done on an annual basis by the DWS, where after compliance monitoring action is scheduled accordingly. According to respondents the Department (DWS) does monitor water uses that have been authorised in terms of the law and there are mechanisms and processes followed in doing that. This is in line with the initial discussion on monitoring in the beginning of the chapter

4.6. Determining the level of law enforcement

Enforcement defines actions taken by government to attain compliance within the regulated community to correct or halt situations where compliance is not achieved. Enforcement actions have to be taken and be used as deterrent for nonconformance. In the context of water resource management enforcement would ensure improvement in the quality of water resources, as well as fairness to water users who willingly comply. The route to achieve compliance may follow a coercive or conciliation and compromise (DWA, 1998). In terms of the NWA, Act 36 of 1998, enforcement actions are achieved by the using the following tools:

- Command and control – these include legal prescriptions and requirements to compel compliance. They include water use authorisation discussed in the previous section and the suctions of not conforming to their conditions
- Criminal measures – these are contraventions clearly spelt out in environmental laws and permits
- Administrative measures – in terms of the NWA, these include directives and notices issued by DWS to water users who fail to comply with regulations and other measure applicable to them. DWS can also withdraw authorisation when nonconformance persist.

- Economic measures – these are rewards afforded to water users to encourage them to comply. They include tax benefits and the waste discharge charge systems under the NWA
- Voluntary instruments – these are voluntary self-regulation measures like environmental management systems to ensure effective management of water and the environment.

In essence, the indicators for enforcement are: records of notices issued to water users; record of directives, records of Criminal case numbers as well as Court interdict letters sent the attorneys regarding identified problems. Under normal effective law enforcement DWS should have records of site inspections, records of investigations where noncompliance is suspected or observed, as well as court cases in extreme cases where noncompliance has been determined. This study however depended on people's perceptions and such records are held by the department as clarified information.

Respondents' perspectives regarding the level of law enforcement in the Vaal Dam catchment area have been captured under different themes, which were consolidated under the above subheading for ease of reading and understanding. It is a common legislative requirement in modern states to obtain a permit or some form of authorization to discharge pollutants into surface waters (RSA, 1998; EPA, 2007; Malawi, 1978; Australia, 1973). The impact of wastewater discharges into water ways attracts greater interest. Impacts are more severe for semi-arid areas such as South Africa. Thus there is a need to conduct details impact assessments and ensure that appropriate and adequate control measures are in place. In the case of South Africa one of the control measures to reduce impacts of waste water discharges is a water use license. When facilities are operated and managed properly to meet the requirements of license conditions, waste water discharges could be important and in fact could contribute positively to water way health and environmental quality.

Over and above the broader legislative and constitutional requirements, water users are required to comply with permits/license conditions applicable to them. Conditions and limits set within permits/license are targeted for law enforcement. This study found that generally, the issuing of water use licenses is an effective process with good intentions of ensuring that all water users are known and their activities are properly managed. The issuing of water use licenses is part of a

broad regulatory process, and licenses are used as tools to drive compliance monitoring. A respondent indicated that;

> "*The intention of the regulatory process, as per the NWA 36:1998, which includes licensing, is believed to be sound and very necessary. However, on the implementation-side, the general performance can probably be improved substantially. It should also be acknowledged that the regulatory process forms part of a larger water resource management "effort" that ideally includes the application of fiscal instruments (e.g. pricing policy and Waste Discharge Charge System), Resource Directed Measures (i.e. operationalizing of the Reserve, Resource Quality Objectives and Resource Classification through appropriate source control measures), catchment planning etc.*" (R1-DWS).

This view coincides with an assumption that law enforcement in the water sector is generally meager. The water law is an effective tool, but it is not effectively implemented or enforced.

Some respondents indicated that DWS would run an enforcement mechanism to ensure that water users conform to license conditions;

> *"…the department is trying the best they can in terms of enforcement by issuing the notices and directives to water users that are not complying*". They also do it through "…*through routine compliance monitoring inspection and compliance audits*". Some were of the view that "*DWS successfully enforces the National Water Act in the Catchment, as they are issuing notices and directives to water users who do not comply. They are also opening criminal cases and taking water users to court. Most of the court cases are withdrawn due to some loop holes in the water Act*."(R5 – DWS)

The views presented by the responded are that law enforcement is adequate and include a mix of administrative and criminal measure.

There are however, respondents who argued that law enforcement is affected by principles like cooperative governance and Intergovernmental relations (IGR), enforcement is very ineffective, or happens to a lesser extent;

> *"…due to cooperative governance. The process of regulating government departments from litigating and taking each other to courts makes enforcement a lengthy process and*

ineffective". Another similar principle, IGR, "*…forces spheres of government and organs s state to also resolve conflicts through other measure rather than taking each other to courts. Even when the municipalities are doing wrong, DWS has to come up with ways of assisting them in their non-compliance…" (R6-LM).*

This thus renders enforcement efforts very ineffective.

Under the theme 'level of law enforcement, there is an important assumption that, effective law enforcement is a deterrent for noncompliance. For legal activities, the targets for enforcement and compliance are conditions including numerical limits sets in permits/licenses. The results present contrasting views regarding enforcement of the NWA. While some respondents indicated that the department enforces the law through the issuing of notices and directives as well as through routine compliance monitoring inspection and compliance audits, other opted to differ. There were those who said that the implementation of the law is ineffective and needed improvement. There were yet respondents who held views that local authorities would opt not to comply because the deterrent mechanism of the DWS would be buffered by the principles of cooperative governance and Intergovernmental Relations (IGR). Given these contrasting views one has to adjudicate as to which views portrays a realistic picture of the level of enforcement in the catchment.

It was mentioned in previous discussions that the major non-compliance incidences are associated with municipal sewage discharges into water resources. This was also confirmed by compliance percentages of water quality results for parameters related to sewage discharges, where non-compliance incidences were significantly high. Considering that municipal sewage plants are the major discharges, in terms of volumes of waste water being discharged into water resources, a conclusion is that they would attract enforcement actions from relevant authorities when non-compliance incidences are identified. Since non-compliance incidences persist as shown the previous theme, it means that the law is either not enforced effectively, or its deterrent effect is ineffective. This analysis agrees with the views of the respondent who identified the two principles of IGR and cooperative governance as the major contributors to the inefficacy of enforcement efforts by relevant authorities. In terms of enforcement actions, DWS has always issued pre-directives and directives. It never went further to include criminal cases, as the

process would have to comply with the requirements of IGR and Cooperative governance, thus becoming too lengthy and costly for government.

4.7. Chapter Conclusion

This chapter has presented qualitative data in efforts to explore the influences of water law enforcement on compliance in the South African water sector, using the Vaal Dam catchment area as a case study. The approach was to use the study objectives as the main themes to allow for a clear and effective analysis. It was shown that indeed noncompliance incidents are high in the Vaal Dam catchment area, particularly for municipal waste water treatment works. The results provided an understanding of monitoring and how it is done for both legal and illegal activities. Monitoring is inextricably links to the concept of compliance. Subsequent to the result on compliance, enforcement results were presented. While some respondents indicated that the NWA was implemented, and therefore enforcement was adequate, some were of the view that enforcement was very ineffective. There were also differentials in the way the law was applied to private sector companies in comparison to local government. This has implications to compliance as the yard stick for compliance is the same but, but has different deterrent effects.

Chapter 5: Discussion and Conclusion

5.1. Introduction

This chapter presents discussions and conclusions for the study titled, effects of Law enforcement on compliance: a case of the Vaal Dam catchment area. Both law enforcement and compliance are aspects that fall within the broader area of water management, and have been defined in chapter 2, literature review. In chapter 2, a governance approach to understanding water management was adopted to provider a trailer to better understand how compliance and enforcement can be achieved effectively. The notion of governance was understood using a model of socio-ecological systems, which is used because of the strong linkages between people and natural resources the method adopted was qualitative, and respondents were recruited following a purposive sampling technique. The findings of the study were that ineffective law enforcement fails to deter noncompliances by water users.

5.2. The challenges of water quality noncompliances

Water resources provide both the physical habitats for aquatic organisms and several services for human being and terrestrial organisms. Noncompliances have been defined as failures of water users to conform to standards and legislative requirements applicable to them. Municipal waste water treatment works which were identified as major noncomplying water use in the catchment pose serious public health risks owing the potential contamination of drinking water with pathogens.

5.3. The role of the water law enforcement agency

In South Africa, all water resources have been placed under the trusteeship of the Department of Water and Sanitation (the national office and the associated regional (provincial) offices). It is DWS that is responsible for ensuring and coordinating the protection of water resources. In the context of compliance and enforcement the goal of DWS with the regard to the protection of water resources should be more on compliance than enforcement. Since the source of noncompliance challenges of in municipal sewage works are known, it is important to target them. The study has shown that some of the problematic areas leading to noncompliances includes old and derelict water treatment facilities, equipment deficiencies, leaks, overloads and poor operations. While in a case where these are sources of the problem a rigid enforcement

regime may not yield compliance, it is important that the department provide capacity and support to local authorities to get their sanitation facilities to function effectively. In cases where failures result from poor cooperation as indicated in the result, enforcement actions must be instituted to arrest on-going situations of noncompliance.

Comparative analysis of the levels of compliance and enforcement shows that there is a negative feed-back between the two. The level of compliance is low for the major polluting activity in the catchment, which are municipal waste water treatment works discharges. The evidence of noncomplying sewage works includes physically observable characteristics including a green colour in the warmers months, and is associated with eutrophication. Results also shows that DWS does monitoring to both legal and illegal; activities. This means that compliance assessments for targeted activities are done. The challenge in relation to this is that even though noncompliances are identified, analysis determined the level of law enforcement to be ineffective to yield adequate deterrent effects.

5.4. The role of local government

The role of local government in relation to the protection of water resources has to be looked at through the lens of constitutional and legislative requirements. The constitution requires that the state must ensure an environment that is not harmful to the health and wellbeing of the people of South Africa. It further impose a duty on government to ensure a progressive realisation of this right through legislative and other means within the boundaries of available resources. Because local government is part of the state, their failure to comply with standards and licence conditions applicable to them amounts to a contravention of the constitution. The South African Water legislation is administered at both the provincial and national level, but not at local level. Amongst other reasons, the required level of technical understanding may be lacking at the local government level. It is important however that municipalities are afforded the requisite capacity to be able to understand the constitution and the National Water Act to take part in ensuring effective implementation of this statute. This would ensure that decision making which affect the state of water resources and compliance at local levels are informed by sound understanding the their environment and legislative aftermath.

5.6. The role of cooperative governance and intergovernmental relations

Chapter three of the South Africa constitution provides for the principle of cooperative governance. Section 41. (1) of the SA Constitution states that ;

"*all spheres of government and all organs of state within each sphere must fostering friendly relations; assisting and supporting one another; informing one another of, and consulting one another on, matters of common interest; co-ordinating their actions and legislation with one another; adhering to agreed procedures; and avoiding legal proceedings against one another*" (RSA, 1996).

This principle is closely linked to Intergovernmental relations (IGR) which defines the cooperation and alignment of government department and organs in dealing with conflicts. This means that before the department of water and sanitation can take municipalities to court, they are required in terms of cooperative governance to exhaust all other conflict resolution measures. This principle imposes a duty on DWS to provide support and other measures before resorting to courts. Cooperation from the side of local government would be that they are required to timeously notify the department about the noncompliance, and take necessary actions to reduce the risks the environment and the public health.

This was illustrated in this study through the principles of cooperative governance and intergovernmental relations (IGR). For this reason municipal WWTWs could get away with persistence noncompliances. This study concludes that implementers of the NWA should be made to understand the impact of enforcement on water user behavior. The DWS should embark on awareness campaigns to educate water users about water legislation and its enforcement. Implementation can only be improved with capacitated enforcement officials and cooperation from local government, with commitments to reduce noncompliances of their sanitation systems. Current management and principles like intergovernmental relations and cooperative governances have, in many instances, crippled local government, now potentially also threatening service delivery, as they seem to discourage accountability. These principles need to be reviewed in order to engender improvement in the relationship between law enforcement efforts and compliance of municipal sewage works.

5.7. The role of governance in improving enforcement and compliance

Water Governance refers to multiple level decisions making beyond government. It is synonymous with the term good governance or democracy. The idea behind governance is that the introduction of this concept may introduce new methods and processes of governing. For instance in the water sector, there this drive to bring catchment management agencies on board, to empower local water user to take part in decision making. This is actually a new method of governing as opposed to a central control system. People are shifting away from the practice of government, to include other role players to take part in water management. In this context, in the case of the Vaal Dam, catchment area, government would continue to have a role but other actors would come on board and play active roles. This means that the decision to enforce the law as well as resource protection would be arrived at through a process of consensus seeking with multiple role players. When following this, the likelihood of nursing persistent noncompliance would be reduced significantly. Water users would also find an incentive to comply because they would have been part of decision making

5.8. Recommendations

Regarding the challenges of noncompliances by municipal WWTW and the failure of the current enforcement regime to yield desirable results, this study recommends that a different approach to water management be adopted. The challenge in both the regulator and the use is more of management than the failures of infrastructure and budgeting. A governance approach is suggested in this regard. A governance approach would help in determining the appropriate tool for government in service delivery. Up to now service delivery in South Africa is solely provided by local government, and resource protection facilitated by DWS. Governance would assist in understanding the appropriate role for DWS in water management. For instance, what should be role and functions of regional DWS bodies and would it differ from the role of a CMA. Applying the principles of governance appropriately would assist in clarifying the roles and functions of different role players as well. Law enforcement would not be left to be run by a single agency. The environmental and water management issues are complex and cannot be handled by one discipline. It is important to make efforts to include as many disciplines as possible to ensure that best decisions on the vision required for water resource protection is adopted. From governance's perspective, political scientists who will put particular focus on

interactions of stake holders, natural scientists, geographers, and engineers who will put particular focus on the physical infrastructure must be broad together to deal with issues of compliance and enforcement to ensure that desirable results are attained.

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Appendix A: Interview Schedule for Key Informant

INTERVIEW SCHEDULE FOR KEY INFORMANT

Project: Effects of Law enforcement on compliance: a case of the Vaal Dam catchment area, South Africa

Place of interview: _____Date _____

Consent form signed: YES_____ NO _____

Years in the water sector: .....

Name of organisation: ……..

Position in the organisation:

Senior Management	
Middle Management	
Junior Management	
Official	

Which catchment are you involved in:

Vaal Dam Reservoir	
Waterval Catchment	
Wilge catchment	
Grootdraai Catchment	

Compliance

1. Based on your experience in the catchment, is the water quality deteriorating or improving? Elaborate.

_____

_____

_____

2. Which are the key activities posing a threat to water quality in the catchment?

_____

_____

_____

3. Based on your knowledge, skills and expertise in water resource management in the Vaal Dam catchment area, which of the following constitute the major water quality problems? Elaborate

1. Salinity	2. Nutrients	3. bacteriological loading
Other, please specify		

_____

_____

_____

Law enforcement

4. In your view, is the National Water Act clear in terms of activities that are legal and those that are not in order to effectively protect water resources?

_____

_____

_____

5. Do you believe the issuing of water use license (WUL) is an effective process? Elaborate

_____

_____

_____

6. If not, does it contribute to noncompliances by water users - elaborate

_____

_____

_____

7. Does acquiring a water use licence enhance compliance or does it contribute to continual noncompliances?

_____

_____

_____

8. Do you think Department of Water and Sanitation (DWS) successfully enforces the National Water Act in addressing challenges in the catchment?

_____

_____

_____

Monitoring

9. Which activities require water use authorisation in the catchment?

_____

_____

_____

10. Is monitoring of authorised activities done by DWS, if yes, how is it done?

_____

_____

_____

11. How is monitoring of unauthorised activities done by DWS

_____

_____

_____

12. Is the implementation of the Act (NWA) identify gaps in terms of protecting water resources and the environment? If yes could you elaborate

_____

_____

_____

13. Who do you think is the most appropriate organisation to manage water resources in the catchment

_____

_____

_____

14. What needs to be done?

_____

_____

_____

Appendix B: Questionnaire

QUESTIONNAIRE

Project: Effects of Law enforcement on compliance: a case of the Vaal Dam catchment area, South Africa

Gender:	**Male**		**Female**	

Years in the water sector: .....

Position in the organisation:

Senior Management	
Middle Management	
Junior Management	
Official	

Which catchment are you involved in:

Vaal Dam Reservoir	
Waterval Catchment	
Wilge catchment	
Grootdraai Catchment	

Compliance

Based on your experience in the Vaal Dam catchment area, please indicate on a 5-point scale where 1 - Strongly Agree, 2 – Agree, 3 – not clear, 4 – Disagree and 5 - Strongly Disagree, rate of the following statements:

Example:

The National Water Act (NWA) is an effective tool for protecting water resources	**Strongly Agree**	**Agree**	**Not Clear**	**Disagree**	**Strongly Disagree**
	~~*1*~~	***2***	***3***	***4***	***5***

	Strongly Agree	Agree	Not Clear	Disagree	Strongly Disagree
1. Current water quality status in the Vaal Dam catchment in terms of applied standards/ guidelines is good	1	2	3	4	5
2. Water quality compliance level is good	1	2	3	4	5
3. Pollution problems are effectively addressed	1	2	3	4	5
4. Stakeholder attendance at catchment forums is good	1	2	3	4	5
5. Participation of forum stakeholders assist in addressing problems	1	2	3	4	5

Law Enforcement

	Strongly Agree	Agree	Not Clear	Disagree	Strongly Disagree
6. I understand the process and purpose of water use authorisation	1	2	3	4	5
7. Water users for purposes other than the reserve need to apply for water use authorisation	1	2	3	4	5
8. Current water users for purposes other than the reserve in the Vaal	1	2	3	4	5

Dam Catchment area do indeed possess water use authorisation	

Monitoring

	Strongly Agree	Agree	Not Clear	Disagree	Strongly Disagree
9. Authorised water users are monitored by Department of Water and Sanitation (DWS)	1	2	3	4	5
10. Unauthorised water users are monitored by DWS.	1	2	3	4	5
11. **Authorised** water users comply with control measures binding on them.	1	2	3	4	5
12. **Unauthorised** water users comply with control measures binding on them	1	2	3	4	5
13. Indicate the control measure applied by DWS for question 12 above					
14. DWS works with Department of Agriculture to prevent pollution of water resources from farming practices	1	2	3	4	5
15. DWS monitor farming practices in the catchment to prevent their impacts on water resources	1	2	3	4	5

Appendix C: Explanatory Statement

EXPLANATORY STATEMENT

Project: Effects of Law enforcement on compliance: a case of the Vaal Dam catchment area, South Africa

Chief Investigator's name:

Associate Professor Bimo Nkhata
Monash South Africa Water Node
Phone: [redacted]
email: [redacted]

Student's name:

Simon Mporetji
Phone : [redacted]
email: [redacted]

You are invited to take part in this study. Please read this Explanatory Statement in full before deciding whether or not to participate in this research. If you would like further information regarding any aspect of this project, you are encouraged to contact the researchers via the phone numbers or email addresses listed above.

What does the research involve?

The aim of this study is to explore the influences of water law enforcement on compliance in the South African water sector, using the Vaal Dam catchment area as a case study.

You will be asked to participate in a survey questionnaire which takes 15 - 20 minutes to complete. Your responses are confidential and once submitted will be anonymous.

Why were you chosen for this research?

The Vaal Dam catchment area has been chosen as a case study in this research project, and you have been identified as a stakeholder in the catchment, hence are urged to participate.

Consenting to participate in the project and withdrawing from the research

Participating in this study is voluntary and you are under no obligation to participate. If you would like to participate please read and complete the consent form and return it to the researcher. You have the right to withdraw from participation at any stage of the survey however once you have submitted your questionnaire you cannot withdraw your answers, as the questionnaires are anonymous. This means your responses will be unidentifiable amongst the other responses.

Possible benefits and risks to participants

There are no physical or psychological risks associated with this research. You are assured that your specific responses will not be identifiable, and the nature of the information the study requires is not sensitive.

Confidentiality

If you indicate your willingness to participate in this study by signing the consent form, any data collected will be anonymous. In the final report, if the findings are to be published or presented all data will be completely anonymous and only your organization will be identifiable.

Storage of data

Data collected will be stored in accordance with Monash University regulations, kept on University premises, in a locked filing cabinet for 5 years. A report of the study may be submitted for publication, but individual participants will not be identifiable in such a report.

Use of data for other purposes

As this study aims to understand participation law enforcement and compliance, findings may be shared with organizations involved in this study. However all data provided will be completely anonymous and no one will be named or identified in any way unless per their own request.

Results

If you would like to be informed of the aggregate research finding, please contact me, Simon Mporetji, [redacted]

Complaints

Should you have any concerns or complaints about the conduct of the project, you are welcome to contact the Research Coordinator at Monash South Africa:

Hester Stols

Office of the Academic President

Monash South Africa

[redacted]

Email: [redacted]

Thank you

Associate Professor Bimo Nkhata

Appendix D: Request to interview employees for a Masters Research Project

Phone: [redacted]

MEMORANDUM

To :

Att :

From : Simon Mporetji

Subject : Request to interview employees for a Masters Research Project

Date : 09 July 2015

Background

I currently work as a Water Quality Advisor within the Scientific Services Division in Rand Water. I am also studying a Master's Degree with Monash University – South African Campus in Integrated Water Management.

Request

This study aims to explore the influences of water law enforcement on compliance in the South African water sector, using the Vaal Dam catchment area as a case study. Data collection is expected to commence in September this year 2015.

Before commencing data collection, the University require that consent be sought from organisations whose employees have been identified as potential respondents. Such consent must be put on a letter head. I, therefore, request to interview employees within Dihlabeng Local Municipality. Attached along with this letter is a detailed explanatory statement providing more information about the study and its intended outputs.

Ethical obligations

I undertake and commit to the following without reservation.

1. To keep the information provided by employees with the sternest possible confidentiality.
2. To protect the participants and the Organisation from potential detriment and/or prejudice.
3. To make the report available to the Organisation upon completion.

Yours Sincerely

Mr Mabitleng Simon Mporetji

Signature_____ Date

Appendix E: Consent form for Key Informant

CONSENT FORM – Key Informant

Project: Effects of Law enforcement on compliance: a case of the Vaal Dam catchment area, South Africa.

Chief Investigator: Associate Professor Bimo Nkhata

Student Investigator: Simon Mporetji

I have been asked to take part in the Monash University research project specified above. I have read and understood the Explanatory Statement and I hereby consent to participate in this project.

I consent to the following:	**YES**	**NO**
Taking part in an interview	☐	☐
Audio recording during the interview	☐	☐
Completing a questionnaire	☐	☐
The data that I provide during this research may be used by the researcher in reports, publications, presentations and future research projects	☐	☐

Name of Participant

Participant Signature

Appendix F: Ethical Clearance Certificate

MONASH University
Monash University Human Research Ethics Committee (MUHREC)
Research Office

Human Ethics Certificate of Approval

This is to certify that the project below was considered by the Monash University Human Research Ethics Committee. The Committee was satisfied that the proposal meets the requirements of the *National Statement on Ethical Conduct in Human Research* and has granted approval.

Project Number:	CF15/2778 - 2015001132
Project Title:	Effects of Law enforcement on compliance: a case of the Vaal Dam catchment area
Chief Investigator:	Assoc Prof Bimo Nkhata
Approved:	**From:** 3 September 2015 **To:** 3 September 2020

Terms of approval - ***Failure to comply with the terms below is in breach of your approval and the Australian Code for the Responsible Conduct of Research.***

1. The Chief investigator is responsible for ensuring that permission letters are obtained, if relevant, before any data collection can occur at the specified organisation.
2. Approval is only valid whilst you hold a position at Monash University.
3. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval and to ensure the project is conducted as approved by MUHREC.
4. You should notify MUHREC immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.
5. The Explanatory Statement must be on Monash University letterhead and the Monash University complaints clause must include your project number.
6. **Amendments to the approved project (including changes in personnel):** Require the submission of a Request for Amendment form to MUHREC and must not begin without written approval from MUHREC. Substantial variations may require a new application.
7. **Future correspondence:** Please quote the project number and project title above in any further correspondence.
8. **Annual reports:** Continued approval of this project is dependent on the submission of an Annual Report. This is determined by the date of your letter of approval.
9. **Final report:** A Final Report should be provided at the conclusion of the project. MUHREC should be notified if the project is discontinued before the expected date of completion.
10. **Monitoring:** Projects may be subject to an audit or any other form of monitoring by MUHREC at any time.
11. **Retention and storage of data:** The Chief Investigator is responsible for the storage and retention of original data pertaining to a project for a minimum period of five years.

[redacted]

Professor Nip Thomson
Chair, MUHREC

cc: Mr Mabitleng Simon Mporetji

Monash University, Room 111, Chancellery Building E
[redacted]