



MONASH University

***Interrelating stakeholder views to promote collaborative protection
of the Crocodile and Sabie Rivers in the Inkomati River Catchment,
Mpumalanga Province, South Africa***

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Abstract

The National Freshwater Ecosystem Priority Area (NFEPA) Project completed in 2011 serves to highlight that priority rivers (River FEPAs) need to be conserved in South Africa to secure the long-term sustainability of freshwater resources. A primary mechanism for managing and conserving these River FEPAs is through South Africa's National Water Act, which promotes stakeholder involvement through Catchment Management Agencies (CMAs) to implement Integrated Water Resource Management within Water Management Areas (WMAs). The aim of this research is to interrelate stakeholder views to promote collaborative protection of the Sabie and Crocodile Rivers. These rivers flow from west to east through the Inkomati River Catchment (IRC) in the Inkomati-Usuthu WMA, are River FEPAs and support many water users. By exploring stakeholder views of the NFEPA project, relevant stakeholder platforms and stakeholder roles and relationships relating to river protection, this research promotes a better understanding of the implementation of national water policy at local level. A qualitative interpretivist research approach was adopted as it values people's experiences as being their reality. A social constructionist paradigm promoted exploration of the contextual meaning of these experiences and how they feed into broader social patterns. An intrinsic case study research design allowed in-depth analysis of stakeholder experiences through twelve, one-on-one, semi-structured interviews. The results reveal that the conservation stakeholders are applying the NFEPA Project, but awareness levels amongst other stakeholders is low. The stakeholders are interacting at a variety of stakeholder engagement platforms at different scales. The Inkomati-Usuthu CMA (IUCMA) co-ordinates the Crocodile River Forum (CRF) and the Sabie River Forum (SRF) meetings for resolving any social issues arising in the Crocodile River Catchment (CRC) and the Sabie River Catchment (SRC) respectively. The CRF meeting is an effective platform for stakeholder communication and conflict resolution, while the SRF meeting has yet to gain credibility amongst stakeholders. Both the CRF and SRF meetings are negatively impacted by power relations, lack of stakeholder capacity, diverse stakeholder interests and ineffective task implementation. Interview results indicate a lack of co-ordinated processes between stakeholder groups and stakeholder decision-making power. Recommendations are made on how stakeholders can collaborate to address the above challenges by improving the resilience of the local governance system. It is proposed that over time, an adaptive local governance system will promote formation of a collaborative stakeholder network capable of implementing sound water governance in accordance with IWRM and NFEPA principles. The results indicate that the CRC stakeholders are closer to achieving such collaboration than the SRC stakeholders. The high priority conservation status of the Sabie River together with water quality and availability challenges faced by stakeholders in the catchment highlight the national value and vulnerability of this river. Similar studies in other catchments should be encouraged. Catchments containing River FEPAs and water governance systems with low resilience (little central government support, low-levels of decision-making power amongst stakeholders, low levels of stakeholder cooperation and no functioning CMA) should be prioritized for government intervention and social facilitation efforts to improve their resilience.

Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

Signature:

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Date: *25/05/2018*

Acknowledgements

Ecclesiastes 4: 9-12

*"Two are better than one, because they have a good return for their labour:
If either of them falls down, one can help the other up.
But pity anyone who falls and has no one to help them up.
Also, if two lie down together, they will keep warm. But how can one keep warm alone?
Though one may be overpowered, two can defend themselves.
A cord of three strands is not quickly broken".*

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Finally, my love and appreciation go to Jesus Christ – the central strand of my life.

“The LORD is my strength and my shield; my heart trusts in him, and he helps me. My heart leaps for joy, and with my song I praise him.” Psalm 28:7

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ACRONYMS AND ABBREVIATIONS

CCMF	Crocodile Catchment Management Forum
CMA	Catchment Management Agency
CMF	Catchment Management Forum
CMLM	City of Mbombela Local Municipality
CMS	Catchment Management Strategy
COGTA	Department of Cooperative Governance and Traditional Affairs
CRC	Crocodile River Catchment
CRF	Crocodile River Forum
CROCOC	Crocodile River Operations Committee
CSIR	Council for Scientific and Industrial Research
DEA	Department of the Environment (Formerly DEAT)
DEAT	Department of Environmental Affairs and Tourism
DMR	Department of Mineral Resources
DoA	Department of Agriculture
DoH	Department of Health
DWA	Department of Water Affairs (Formerly DWAF)
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation (Formerly DWA)
FEPA	Freshwater Ecosystem Priority Area
HDI	Historically Disadvantaged Individual
ICMA	Inkomati Catchment Management Agency (Prior to 2 May 2014)
ICMS	Inkomati Catchment Management Strategy (2010)
IRC	Inkomati River Catchment
IUCMA	Inkomati Usuthu Catchment Management Agency (As of 2 May 2014)
IUCMS	Inkomati Usuthu Catchment Management Strategy
IUWMA	Inkomati Usuthu Water Management Area
IWMA	Inkomati Water Management Area
IWRM	Integrated Water Resource Management
KNP	Kruger National Park
MEA	Millennium Ecosystem Assessment (2005)
MTPA	Mpumalanga Tourism and Parks Association
NFEPA	National Freshwater Ecosystem Priority Area
NGO	Non-Governmental Organizations
NWA	National Water Act, Act No. 36 of 1998
NWRS	National Water Resource Strategy (2004)
NWRS 2	National Water Resource Strategy version 2 (2013)
RQIS	Resource Quality Information Services

RQO	Resource Quality Objectives
SAEON	South African Earth Observation Network
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SCMF	Sabie Catchment Management Forum
Sembcorp	Sembcorp Silulumanzi
SRF	Sabie River Forum
SRC	SRC
SRFA	Sabie River Farmers Association
SSNM	Savanna Science Networking Meeting
TA	Tribal Authority
TSB	TSB Sugar (Pty) Ltd.
VVELUW	Validation and Verification of Existing Lawful Use of Water
WAP	Water Allocation Plan
WAR	Water Allocation Reform
WMA	Water Management Area
WRC	Water Research Commission
WUA	Water User Association
WUL	Water Use License
WWTP	Waste Water Treatment Plant
WWTW	Waste Water Treatment Works

1. BACKGROUND

1.1. Introduction

Freshwater is critical to human wellbeing and can be substituted by nothing else. Human beings have always consumed freshwater and relied on freshwater ecosystems for a variety of goods and services (Shiklomanov, 2000). This valuable resource is both essential and finite, constituting only 2.5% of the water on earth. The majority of earth's freshwater resource is claimed by permanent snow cover and fresh groundwaters, while only 0.26% is easily accessible to humans in lakes, reservoirs and river systems (Shiklomanov, 2000). The Millennium Ecosystem Assessment published in 2005 (MEA) confirmed that freshwater ecosystems were amongst those most significantly modified globally by human activity. Freshwater ecosystems are rich in biodiversity and endemism (Revenga *et al.*, 2005). These stressed ecosystems support an extraordinarily high proportion of the world's biodiversity (Abell *et al.*, 2008), yet host the highest proportion of species threatened by extinction (MEA).

Water is one of South Africa's most limited resources. Social and economic needs have resulted in the widespread degradation of freshwater ecosystems (Driver *et al.*, 2011). Over half of South Africa's river, wetland and estuary ecosystem types are threatened (Nel and Driver, 2012). This crisis is expected to worsen in the future with a predicted escalation in water demand (DWAF, 2004) and an increase in aridity in many parts of the country in response to climate change (Schulze, 2005). South Africa is facing over-allocation of water in some river basins (by as much as 150%) and extensive pollution from industry (Turton, 2007). Given the close relationship between social, ecological and economic systems, "such widespread degradation of freshwater ecosystems inevitably compromises service delivery and results in costly management interventions and the loss of resilience to changing circumstances." (Driver *et al.*, 2011, p.3).

Despite being critical for human wellbeing, freshwater ecosystems have previously taken a backseat in conservation efforts globally relative to both terrestrial and marine conservation. Less than 20 years ago, researchers noted that "conserving freshwater biodiversity for its own sake" had limited support throughout the world (Dudgeon, 2000; Wishart *et al.*, 2000 in Abell *et al.*, 2007, p.49). There is a need for responsible stewardship of freshwater ecosystems as the ability of these systems to provide essential ecosystem services will be further compromised without wise conservation measures (Roux and Nel, 2013). In response to the alarming lack of emphasis on conservation of functionally intact freshwater ecosystems globally, Abell *et al.*, (2007) called for the development of an effective freshwater protected area strategy.

Since the early 2000s South Africa has established itself as one of the leaders globally in the relatively young field of freshwater conservation planning (Roux and Nel, 2013). The combined efforts of several national organisations, namely, the Council for Scientific and Industrial Research (CSIR), the South African National Biodiversity Institute (SANBI), the Department of Water Affairs (DWA) and the Department of Environmental Affairs (DEA) and various conservation and funding bodies culminated in the identification of spatially explicit priority areas for conserving rivers, wetlands and estuaries. The Freshwater Ecosystem Priority Areas (FEPAs) comprise 22% of South Africa's river length, 38% of wetland area and 41% of estuaries (Nel *et al.*, 2011b). Different categories of FEPAs have different management implications. These areas are known as Freshwater Ecosystem Priority Areas (FEPAs) and were formally published in 2011 (Nel *et al.*, 2011b).

By conserving some healthy rivers and wetlands in a catchment, not only are South Africa's freshwater biodiversity goals promoted, but the sustainable use of water resources in the catchment is enabled (Driver *et al.*, 2011). Delineation of the FEPAs provides guidance on "how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near natural condition," in order to promote the water resource protection goals presented in the National Water Act, Act 36 1998 (NWA) (Driver *et al.*, 2011, p.2). Ideally 20% of each river, wetland and estuary ecosystem type would receive some form of protection where natural resource managers are employed. Unfortunately, in reality, this is not the case. FEPAs comprise approximately 22% of South Africa's river length yet only 3% of the river length identified as FEPAs benefit from any formal protection and only 1% are protected by national parks (Roux *et al.*, 2015). In future, it has been suggested that protected area planners include FEPAs where possible, avoid using rivers as protected area boundaries, and include hydrological connectivity as a priority in order to improve freshwater conservation in South Africa (Nel *et al.*, 2009).

In conjunction with these improvements in protected area design, there should be an acknowledgement that the future of South Africa's freshwater relies heavily on the management of FEPAs outside of formal protected areas (Roux *et al.*, 2015). Systemic conservation governance characterized by conservation efforts that are interdependent, aligned and complementary across vertical and horizontal dimensions, is required to realise the success of top-down conservation targets (Roux *et al.*, 2015). In a vertical sense, effective systemic conservation governance relies on the adherence to national conservation policies at a local scale. In a horizontal sense, it is critical that there is regular interfacing between policy sectors (e.g. environmental, water and agricultural), private landowners and any other identified land-users to ensure that all parties are focussed on achieving common conservation goals (Roux *et al.*, 2008). Roux *et al.*, (2015) researched the gap between "national-scale

target setting and local scale ecological realities and management actions" in South Africa (Roux *et al.*, 2015, p.1) The findings of the research emphasize that systemic conservation governance requires extensive cooperation and co-ordination across the horizontal dimension, involving actors representing various sectors as well as private landowners.

Systematic conservation governance emphasizes the importance of co-operative strategies across several boundaries (e.g. policy sectors, land users, levels of government) in the future of freshwater conservation in South Africa (Roux *et al.*, 2013). The importance of co-operative strategies in freshwater conservation is reflected in the dramatic changes witnessed in the water resource management sector over the last twenty years. While Apartheid was characterized by a centralized government executing administrative and political power (Seekings, 1994), South Africa's post 1994 constitution embraces the principle of co-operative governance with the three spheres of government – national, provincial and local - respecting and supporting one another (RSA, 1996). The NWA introduced a shift in water resources management from a riparian system of land ownership to a system centred on the equitable, sustainable and economic development of water resources (NWRS).

A primary objective of the NWA is to promote stakeholder involvement and the transfer of powers and functions to local levels through Catchment Management Agencies (CMAs) in a management framework known as Integrated Water Resources Management (IWRM) (Colvin *et al.*, 2008). According to the NWA, a CMA is responsible for the protection, use, development, conservation, management and control of the water resources in its water management area. South Africa was divided up into 19 Water Management Areas (WMAs) according to hydrological boundaries as prescribed by the new legislation (Herrfahrdt-Pahle, 2010).

IWRM is defined as "a process which promotes the co-ordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of the vital ecosystems," (DWAF, 2004a, p.10). IWRM is not a new concept and has been promoted on and off since the 1950s, but regained global popularity after the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro (Biswas, 2008). Many countries have adopted IWRM in their water policy or law since 1992 (Hassing *et al.*, 2009). In South Africa, IWRM is presented formally in the NWA and implemented through the National Water Resource Strategy released by DWAF in 2004 (NWRS). An updated NWRS 2 was released in 2012.

This Chapter firstly introduces the background concepts relevant to the current research by exploring the NFEPA Project, IWRM and challenges to IWRM implementation. Thereafter,

these concepts are brought into focus by formulation of the problem statement by considering the challenges currently being experienced in South Africa with respect to river protection, specifically with respect to protection of the Crocodile and the Sabie Rivers. To address the problem statement, the research aim and objectives are outlined, followed by a description of the significance of the research.

1.2. The National Freshwater Ecosystem Priority Area (NFEPA) Project

During 2000 to 2006, a number of investigations into the state of freshwater ecosystems in South Africa revealed that, in line with global observations, these ecosystems were under threat and in a poor state relative to terrestrial and marine ecosystems [NWRS; State of the River Reports (Strydom *et al.*, 2006) and the National Spatial Biodiversity Assessment (Nel *et al.*, 2004)]. In 2005, a cross-sector engagement process was initiated which gave rise to a set of cross-sector policy objectives which underpinned a national vision for freshwater conservation (Roux *et al.*, 2006). This process involved a series of workshops hosting policy makers from the relevant government departments, aquatic scientists and conservation planners and resulted in a policy discussion document detailing a national goal for freshwater conservation in South Africa. This goal is “to conserve a sample of the full variety or diversity of inland water ecosystems that occur in South Africa, including all species as well as the habitats, landscapes, rivers and other water bodies in which they occur, together with the ecosystem processes responsible for generating and maintaining this diversity, for both present and future generations” (Roux *et al.*, 2006, p.36). This national goal was translated into operational cross-sector objectives (Roux *et al.*, 2006) as follows:

Objective 1 - Set and entrench quantitative conservation targets for freshwater ecosystems

Objective 2 - Plan for representation of freshwater ecosystems

Objective 3 - Plan for persistence of freshwater ecosystem processes

Objective 4 - Establish a portfolio of freshwater conservation areas

Objective 5 - Enable effective implementation

In 2011, the FEPAs were delineated through the combined efforts of several national organisations as described above (Nel *et al.*, 2011b). The NFEPA Project is relevant to Objectives 1, 2 and 3 and supports Objective 4 and 5 above (Driver *et al.*, 2011). The first objective is particularly relevant to the delineation of the FEPAs as it proposed a quantitative conservation target of at least 20% of each inland water ecosystem type (Roux *et al.*, 2006).

1.2.1. Technical and Social Dimensions of FEPA delineation

The FEPAs were delineated by incorporating principles of systematic conservation (Nel *et al.*, 2011b). Terrestrial conservation efforts have been streamlined by the development of systematic conservation planning since the 1970s. This systematic approach incorporates the principles of representation, quantitative target setting, persistence, efficiency, flexibility and transparency in the location and design of protected areas (Margules and Pressey, 2000). By applying systematic conservation planning principles developed for the conservation of terrestrial biomes, freshwater conservation planning has developed into a new and applied branch of conservation biology (Nel *et al.*, 2009 and Linke *et al.*, 2011).

The identification of the FEPAs involved both technical and social dimensions and incorporated the expertise of over 100 stakeholders (Roux and Nel, 2013). Relevant spatial data were entered into conservation planning software, collated and reviewed in order to inform FEPA selection during a series of workshops. Once the FEPAs had been identified, the selections were reviewed by aquatic ecologists and managers in further workshops. FEPA maps were compiled for each of the 19 Water Management Areas of South Africa, which are the administrative units delineated by the DWS (Roux and Nel, 2013). The scientifically-sound conservation plans used to determine the FEPAs were complemented throughout the project with attention to creating an implementation-enabling institutional environment by following three steps suggested by Roux and Nel (2013). Firstly, key interest groups and implementing agencies at national, provincial and water management area level were engaged throughout the process (as suggested by Margules and Pressey, 2000). Secondly, understanding and mapping the socio-economic dimensions of the FEPAs was taken into consideration. Thirdly, the FEPA project team engaged regularly with end-users to ensure that the terminology used and map designs produced would be relevant to the legal context of both water and biodiversity sectors.

1.2.2. Products of the NFEPA project

The final products of the NFEPA project included an Atlas of Freshwater Ecosystem Priority Areas (Nel *et al.*, 2011a), the NFEPA Technical Report (Nel *et al.*, 2011b), the Implementation Manual for Freshwater Ecosystem Priority Areas (Driver *et al.*, 2011) and the NFEPA DVD. A description of each of these documents is provided below as presented in the Implementation Manual for Freshwater Ecosystem Priority Areas (Driver *et al.*, 2011). These products aimed at providing South African policy makers with the necessary tools for protecting the country's freshwater systems (Roux and Nel, 2013).

- *Atlas of Freshwater Ecosystem Priority Areas*
Shows all maps developed by the NFEPA project, including FEPA maps per Water Management Area, national map products, and maps of input data layers. A brief explanation of each map is provided.
- *NFEPA Technical Report*
Describes the technical approach used to develop the maps, the stakeholder engagement process, the legal and policy analysis, and guiding concepts for institutional uptake.
- *Implementation Manual for Freshwater Ecosystem Priority Areas*
Explains how to use FEPA maps in different sectors, and provides freshwater ecosystem management guidelines for river FEPAs and wetland FEPAs.
- *NFEPA DVD*
Supplies GIS shapefiles and metadata, A3 jpegs of FEPA maps per Water Management Area, slide presentations of NFEA, and an open-source map viewer. The data is also available on SANBI's Biodiversity GIS website.

Different categories are shown on the FEPA maps for each Water Management Area. The following two categories are of importance to the current research (after Nel *et al.*, 2011):

- *River FEPA and associated sub-quaternary catchment*: Rivers that are currently in a good condition that contribute to biodiversity targets for river ecosystems and threatened or near threatened fish species. The entire sub-quaternary catchment has to be managed well to maintain or improve the ecological status of the river.
- *Fish Sanctuary and associated sub-quaternary catchment*: Rivers that provide freshwater habitats for threatened or near threatened freshwater fish indigenous to South Africa fall into this category. The fish sanctuaries in good ecological condition were identified as FEPAs, the remaining fish sanctuaries in relatively poor ecological condition are known as Fish Support Areas. In both cases, the sub-quaternary catchment requires management to protect the fish they contain, especially those fish sanctuaries containing critically endangered or endangered fish species.

1.2.3. Implementation of the NFEPA Project

The Implementation Manual for Freshwater Ecosystem Priority Areas (Driver *et al.*, 2011) provides freshwater ecosystem management guidelines for specific land-use activities associated with wetland FEPAs, river FEPAs and sub-quaternary catchment associated with river FEPAs and Upstream Management Areas. These land use activities are divided into three categories according to the stress they cause, including changes in water quality, changes in water quantity and changes in habitat and biota. The management guidelines for

each land use support overall management objectives and motivations. The overall management objectives for river FEPAs and the associated sub-quaternary catchments (extracted from Driver *et al.*, 2011) have been included in Appendix 1. As can be seen, activities relating to River FEPAs require careful management in order to preserve South Africa's valuable freshwater ecosystems. These management guidelines place additional pressure on natural resource managers as well as on water users in the river catchments. The co-ordinated involvement of these actors is critical in ensuring the sustainability of South Africa's future freshwater resource.

The FEPA maps themselves have no formal legal status, however, significant effort was invested during the NFEPA project to detail the many ways that the maps can be applied using a range of legal and policy tools (Driver *et al.*, 2011). Specific advice is provided by Driver *et al.*, (2011) on how to implement the FEPA maps using the NWA, the Biodiversity Act, the Protected Areas Act, the National Environmental Management Act, the Integrated Coastal Management Act, and the Municipal System Act. Other implementation mechanisms are discussed relating to mining, agriculture, aquaculture, freshwater ecosystems, national planning and provincial spatial biodiversity plans, business and biodiversity initiatives (Driver *et al.*, 2011).

FEPAs have recently been included in the NWRS 2 as part of the key strategic objectives for water resource protection. The NWRS 2 aims to "Protect and maintain existing freshwater ecosystem priority areas in good condition and well-functioning water resource ecosystems by managing riparian and wetland buffers and critical groundwater recharge areas," (NWRS 2, p.43). The FEPAs are also included within the strategic actions listed in the NWRS. The NWRS 2 (p.44) aims to "Maintain freshwater ecosystem priority areas in good condition. All NFEPAs, which identify priorities for conserving water ecosystems and supporting the sustainable use of water resources, are considered in the determination of Resources Directed Measures."

1.2.4. Major Actors in South African Freshwater Ecosystem Conservation

According to the Implementation Manual for Freshwater Ecosystem Priority Areas, the major departments and entities with a mandate for managing and conserving freshwater ecosystems in South Africa are listed below (after Driver *et al.*, 2011):

- The DWA [now the Department of Water and Sanitation (DWS)]
- The DEA [previously the Department of Environmental Affairs and Tourism (DEAT)]
- The SANBI
- SANParks

- Provincial conservation authorities
- CMAs

Particularly relevant to the current study are the roles and responsibilities of the DWS, SANParks, Provincial conservation authorities and CMAs (Appendix 2).

1.3. Integrated Water Resources Management

Governance is the mechanism for deliberate institutional reform and is defined as “the ability of a society to organise itself and manage its affairs for the greater collective good,” (Woodhill, 2010, p.48). A democracy should be identified by representation of the people and their ability to participate in all resource decisions (Kleingeld and Razzaque, 2014). IWRM embraces good governance, defined by Grover (2006) as “the range of political, organizational and administrative processes through which communities articulate interests, their input is absorbed, decisions are made and implemented and decision makers are held accountable in the development and management of water resources and delivery of water services,” (Grover, 2006 in Kleingeld and Razzaque, 2014, no page numbers). Since promulgation of the NWA there has been an increase in the number of non-state actors involved in water resource management, for example, emerging farmers, the epistemic community (other than law professionals) and consultants (Meissner *et al.*, 2013).

Providing space for public participation is a key principle within IWRM. Indeed, public participation is considered, at least in theory, to be the cornerstone of South Africa’s newly formed participatory democracy (Razzaque and Kleingeld, 2014). The World Bank defines participation as, “a process in which stakeholders influence policy formulation, alternative designs, investment choices, and management decisions affecting their communities and establish the necessary sense of ownership,” (World Bank, 1993, p.16). South Africa’s water policy directly contains ‘guidelines’ for public participation procedure to consider and embrace all stakeholders, and particularly acknowledges the need for compensation of impoverished stakeholders (DWAF, 2004b; DWAF, 2007a).

1.3.1. Institutional Responsibilities

The NWA refers to a water resource management institution as a CMA, a Water User Association (WUA), a body responsible for international water management or any person who fulfils the functions of a water management institution in terms of the NWA. Figure 1 provides a conceptual diagram adapted from Weaver *et al.*, (2017) showing the different government levels of the various statutory and non-statutory water resource management institutions described in the NWRS. According to the NWRS, the implementation vehicle of the NWA, the Minister of Water Affairs and Forestry (the Minister) is responsible for all aspects

of water resources management in South Africa. All water management institutions are subject to the Minister's authority (NWRS).

Importantly, the NWA also defines a responsible authority, whose duties relate specifically to water use and specifically authorisation of water use by general authorisation or license. The NWA's authorisation of water use makes it clear that only the Minister, or a CMA to which the appropriate powers and duties have been assigned, may authorise the use of water (Chapter 1 and Schedule 3, NWA). Other water management institutions may not authorise water use.

The DWS is nationally tasked with water administration (Razzaque and Kleingeld, 2014) and is responsible for the implementation of the NWA. The DWS has a head office in Pretoria and regional offices in each of South Africa's nine provinces. The regional offices are responsible for managing the water resources in the water management areas until functional CMAs are established and approved by the DWS head office in Pretoria. (Brown 2011). As outlined in the NWRS, the DWS will slowly relinquish its roles as operator and developer to embrace its position as sector leader, policy-maker, co-ordinator and regulator. Until this occurs the DWS will guide the process of decentralisation by leading the creation of new institutions and assisting them in their tasks.

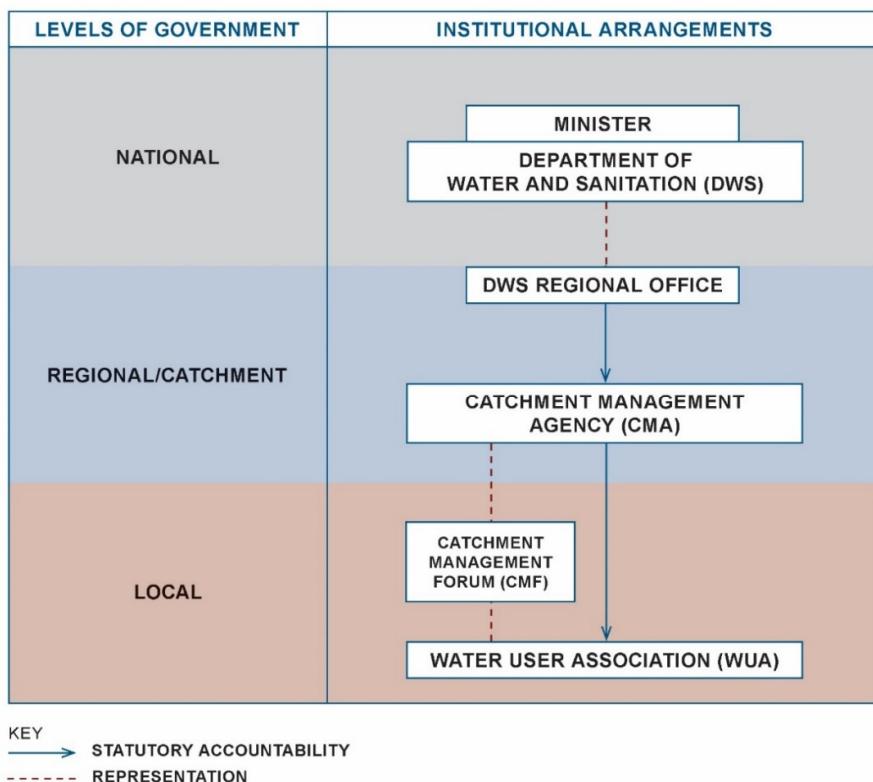


Figure 1 A conceptual diagram showing the different levels of government of South African water resource institutions described in the NWRS (Adapted from Weaver et al., 2017)

1.3.1.1. Catchment Management Agencies

South Africa's new water law dictates the establishment of 19 Water Management Areas (corresponding to hydrological boundaries) to be run by CMAs which are required to execute duties according to a CMS (du Toit *et al.*, 2011). The national government has supplied guideline documents to be followed by CMAs when forming their CMSs. These guidelines do not prescribe specific details of the CMS, but rather provide basic areas for inclusion for the operation of IWRM within the catchment (du Toit *et al.*, 2011). The CMAs are instructed in the NWRS to collaborate with local stakeholders to draft, implement and update (every five years) the CMSs. Section 9 (g) of Chapter 2 the NWA (no page numbers), states that a CMS must "enable the public to participate in managing the water resources within its water management area."

The NWA legislates public participation for the first time in water governance in South Africa. Communities and stakeholders participate in developing a CMS for their WMAs in a manner that aligns with the NWRS, yet remains locally relevant (Driver *et al.*, 2011). "These agencies must promote participation by water users and other stakeholders in all aspects of water resources management in their areas of operation," (NWRS, p.137).

The CMA is obligated to fulfil several initial functions outlined in Section 80 of the NWA, including:

- a) To investigate and advise interested persons on the protection, use, development, conservation, management and control of the water resources in its management area;
- b) To develop a Catchment Management Strategy (CMS);
- c) To co-ordinate the related activities of water users and of the water management institutions within its water management area;
- d) To promote the co-ordination of its implementation with the implementation of any applicable development plan established in terms of the Water Services Act, 1997 (Act no.108 of 1997); and
- e) To promote community participation in the protection, use, development, conservation, management and control of the water resources in its water management area.

In accordance with Sections 19 and 20 of the NWA, the CMA is responsible for:

- Prevention and remedying effects of pollution, and
- Control of emergency incidents in respect of water resource pollution or potential water resource pollution.

In terms of schedule 3 of the NWA, the DWS may assign the following functions to the CMA:

- Power to manage, monitor, conserve and protect water resources and to implement Catchment Management Strategies (CMSs);
- Catchment Management Agencies may make rules to regulate water use;
- Catchment Management Agencies may require establishment of management systems;
- Catchment Management Agencies may require alterations to water works; and
- Catchment Management Agencies may temporarily control, limit or prohibit use of water during periods of water shortage.

1.3.1.2. Water User Associations

The NWA outlines a departure from the traditional Irrigation Boards towards the more inclusive WUAs. Irrigation Boards under the Water Act of 1956 were typically organized around access to water, fees and votes according to the proportionality rule (Merrey *et al.*, 2009). The WUAs are open to all water users including farm workers and informal water users (Merrey *et al.*, 2009).

1.3.1.3. Stakeholder Forums

Despite not being specifically provided for by the NWA, the DWS strongly recommends the formation of stakeholder forums for successful water management. “....In the Department’s experience such voluntary bodies have proved to be of great value in initiatives leading to the creation of CMAs, and in addressing local water management issues. They have provided a focus for public consultation and for integrating the water-related activities of other non-governmental and community based organisations”, (NWRS, p.97). The Catchment Management Forum (CMF) is a non-statutory water management institution introduced in the NWA to assist in the establishment of statutory water management institutions (Boakye and Akpor, 2012). CMFs and Catchment Management Committees act as stakeholder platforms to promote collaborative strategic planning and priority setting in the WUA in line with the CMS (Du Toit *et al.*, 2011).

1.3.1.4. Hierarchy Theory

Hierarchy Theory involves the separation of a system into levels of organization within a hierarchical structure (Ahl and Allen, 1996 in McCloughlin and Thoms, 2015). The character of each level or holon is constrained by those holons directly above and impacted by those immediately below (McCloughlin and Thoms, 2015). A Strategic adaptive management Reflexive Learning Framework (SRLF) has been developed (McCloughlin and Thoms, 2015). In simple terms, the SRLF has a hierarchical structure displaying three levels of organization within adaptive resource management governance.

Applying this model to South Africa, the national level of governance in South Africa is referred to as SRLF Level-1, the Water Management Areas as SRLF Level-2 and the individual river catchments as SRLF – 3. In “top down” processes, policy requirements emerging from Level-1 typically influence the management approaches adopted by Level-2. These management approaches, in turn, constrain the types of management actions performed by Level-1. “Bottom up” processes are typically learning via feedback processes initiated within Level-3 entities. The information received via these feedback loops is collated up to parent Level-2 entities to inform Management Targets. In a similar fashion, this information is collated and presented to the parent Level-1 entity to inform Policy Targets (McLoughlin and Thoms, 2015).

Figure 1 shows the different government levels of the various statutory and non-statutory water resource management institutions relevant to the current study described in the NWRS. Each level of organization is a separate entity, but influenced by the levels above and below it (Parsons and Thoms, 2007 in McLoughlin and Thoms, 2015). The cross-scale influences between the different levels of organisation relevant to the current study are provided in DWAF (2001), shown in Figure 1 and discussed below.

Top-Down Processes

The Minister has significant influence over CMA operations. The delegation and assignment of powers to the CMAs is at his or her discretion. The performance of tasks will be audited by the Minister and he or she will intervene if the CMA is not performing adequately. The CMAs and the Minister can delegate water management functions to the WUA. The WUA can therefore play an important role in water management at a local level. The CMFs are non-statutory water management institutions not specifically mentioned in the NWA. To maintain a high level of stakeholder interest in these meetings, these forums will need to be empowered by the CMA to make a meaningful ongoing contribution to water management (DWAF, 2001).

Bottom-up Processes

WUA and CMA representation at the CMF meetings, as well as the compilation of detailed CMF meeting minutes, allow local level information to be collated and passed onto the higher levels within the organisational structure. CMA reports, including Business Plans and Annual Reports, allow information feedback from the CMA to the DWS. These reports are used by the DWS to audit the performance of the CMA in relation to its approved CMS (DWAF, 2001).

1.4. Challenges to IWRM Implementation

1.4.1. Entrenchment of Apartheid Practices

In 1998, the NWA ushered South Africa into a transition process from a command and control style of water resource governance to a more integrated and adaptive management approach. A recent study in the Olifants-Doorn WMA investigating drivers and barriers towards sustainable water and land management revealed that many commercial farmers in the Olifants-Doorn WMA act as if water is still attached to their private property (Knuppe and Meissner, 2016). Other barriers to the adaptive management of land and water resources in the Olifants-Doorn WMA include:

- a) A plethora of new legislative structures birthed through the NWA which have proven difficult to digest by both state and non-state actors. The NWA has proven complex to navigate and human and financial resources for its implementation are lacking.
- b) Capacity challenges within the DWS head office as well as regional offices and local government including lack of vital leadership skills and high staff turnover rates.

The intimate relationship between productive farming and access to water, together with the barriers faced with implementing the NWA, have hampered the transition in water governance triggered by the NWA in South Africa. Some stakeholders remain entrenched in previous Apartheid practices. A substantial investment into human resources and finances over time within South Africa's new water governance structures is required to promote the transition process from command and control practices to IWRM in the WMAs. (Knuppe and Meissner, 2016).

1.4.2. Complexity

Major changes in the political environment together with an increase in the number of actors involved in water resource management have contributed to a rise in the complexity of South Africa's water resource sector from a societal perspective (Lotz-Sisitka and Burt, 2006). Catchments themselves are complex linked social and ecological systems (Pollard and du Toit, 2008). Managing such "complexity on complexity" is plagued with difficulties as the natural and social aspects of social-ecological systems are interrelated in ways that confound attempts to predict their response to interventions (Cilliers *et al.*, 2013).

Conventional scientific methods including hypothesis testing by experimentation, data collection and decision-making from recorded outcomes do not address the wicked problems posed by complex systems (Berkes, 2017). Wicked problems are characterised by a high level of uncertainty, shifting goal posts and changing issues. These problems often fall into the

societal domain instead of the technical domain, where issues of values, equity and social justice have weight and the objective expert only provides limited input (Berkes, 2017).

In the face of a similar complex system navigating academic-service relationships in the field of nursing, Kinnaman and Bleich, (2004) note that a transformation of academic-service relationships is required to respond to complex problems. Solving these problems requires deeper working relationships or collaboration between the different elements within a system. The Bleich-Kinnaman Organizational Decision-making Model identifies four behavioural strategies to be applied in joint decision-making scenarios. The appropriate behavioural decision-making strategy is contingent on the degree of certainty that a *judgement* to carry out specific actions will resolve a specific problem plotted against the degree of *agreement* among participants regarding the outcome given the specific actions (Figure 2).



Figure 2 The Bleich-Kinnaman organizational decision-making model (Kinnaman and Bleich, 2004)

According to the above model:

- Tolerance behavior is effective in high certainty and high agreement scenarios. Tolerance involves only marginal routinized communication between organizations. Interaction is limited and does not involve conflict.
- Like tolerance behavior, co-ordination is recommended in high certainty and high agreement scenarios. Communication between organizations involves informing each other through established routine communication pathways.
- Cooperation is effective when either certainty or agreement about an organizational outcome is not high. In these scenarios, active, respectful negotiations are carried out within professional boundaries and cultural practices.

- Collaboration behavior is triggered by problems with low to moderate certainty and low to moderate agreement regarding the outcomes expected based on defined actions. Collaboration is recognized equal distribution of power, knowledge contribution and a focus on achieving the best outcome regardless of discipline, hierarchy or organizational distinctions.

Both toleration and coordination are effective in the “plan and control” section of Figure 2 and are problem solving behaviours that support single-loop learning (Kinnaman and Bleich, 2004). Single loop learning results in improvements being made to a system without modifying the underlying values of the system (Fabricius and Cundill, 2014). Cooperation and collaboration are behaviours recommended in the zone of complexity in Figure 2 and involve double-loop learning (Kinnaman and Bleich, 2004). Double loop learning promotes innovation, questions existing practices and explores alternatives (Fabricius and Cundill, 2014).

The challenges facing the stakeholders who participated in the current study are complex in nature owing to the fact that the Sabie and Crocodile River Catchments are interlinked social-ecological systems. The stakeholders are reacting to complex problems with uncertain outcomes and/or low to medium agreements about outcomes. Stakeholder cooperation and collaboration are therefore required, in order to make innovative collective decisions to promote protection of the Sabie and Crocodile Rivers. In agreement with Kinnaman and Bleich (2004), Berkes (2017) promotes adaptive collaborative approaches to address wicked problems typical of complex systems. Adaptation is a problem-solving process achieved through prioritizing communications, social learning, perspective sharing, negotiations and the development of adaptive collaborative strategies for making progress. There are different types of collaborative approaches applied in achieving adaptive governance including adaptive co-management (Berkes, 2017).

1.4.3. *Participatory Water Governance*

The “rapid and widespread proliferation of participatory and devolutionary approaches to natural resource management on a global scale,” (Brown, 2011, p.172) has ignited interest into research on how these global concepts are being translated within the South African political and social contexts (Brown 2011; Mackay and Ashton, 2004; Mirumachi and van Wyk, 2010). Research by Brown (2011) challenges several underlying assumptions with respect to the participatory paradigm in water governance in South Africa. Participatory and devolutionary approaches in water governance aim to legislate for a more equitable distribution of water for development and to increase access to water planning and management. Unfortunately, owing to fundamental weaknesses in the participatory model and underlying assumptions, these outcomes have not been attained (Brown, 2011).

Firstly, the assumption that local management is preferable to centralised government control which is commonly viewed as inefficient, corrupt and anti-redress is questioned. The departure from central leadership and traditional hierarchy in governance towards decision-making through active involvement of all stakeholders as equals has not been covered adequately in the literature (Brown, 2011). Indeed, Du Toit *et al.*, (2011) note that "A personal and group responsibility for water management that will lead to a future-focussed approach rather than polarised protection of vested interests is essentially an experiment in progress" in South Africa (Du Toit *et al.*, 2011, no page numbers).

Secondly, Brown (2011) asserts that the universality of participatory approaches regardless of context has not been supported by literature. Ostrom (2005) argues that "neither size nor heterogeneity are variables with a uniform effect on the likelihood of organising or sustaining self-governing enterprises," (Ostrom, 2005, p.253). However, closer inspection of Ostrom's research shows successful participatory efforts have been limited to the local level (Pimbert, 2004, and Singleton, 2002) and assumes a level of homogeneity amongst resource users. The latter is an important precursor to the equitable distribution of costs and benefits of collective action based on a common vision of management (Blaikie, 2006). The Catchment scale of river management supported by the NWA in South Africa "would inevitably result in the scaling up of participatory efforts, and the involvement of a potentially more diverse range of stakeholder interests than those in Ostrom's cases," (Brown, 2011, p.173).

Thirdly, the transformatory potential for institutional reform is challenged within the South African context. The assumption put forward by communicative theorists (Habermus, 1984; Innes, 1996 in Brown, 2011) that power differentials between groups can be "contained and managed through the creation of new spaces for communication and a written constitution" to allow for institutional reform within heterogeneous contexts is questioned (Brown, 2011, p.173). To the contrary, empirical research shows that power relations have impacted participatory development programmes negatively: marginal groups, specifically women and the very poor, were excluded and projects were often facilitated by the local elites (Cooke and Kothari, 2001; Argawal, 2001 in Brown, 2011).

Boakye and Akpor (2012) performed a study investigating stakeholder participation in water management in the Msunduzi Catchment of Kwazulu Natal. They noted that establishing institutional platforms as well as political advances in public participation does not necessarily translate into meaningful participation of stakeholders. Most policies and legislation on public participation processes in South Africa stop short of explaining how best public involvement can be achieved. Scant attention has been given to the capacity of participants or their feelings

about public participation processes (du Toit, (2005) and Faysse, (2004) in Boakye and Akpor, 2012).

1.4.4. Adaptive Governance

Adaptive governance enacted through adaptive co-management is society's response to dealing with unpredictable complex adaptive social-ecological systems. Adaptive co-management is defined as "a flexible, community-based system of resource management tailored to specific places and situations, and supported by and working with various organisations at difference scales," (Olsson *et al.*, 2004, p.75).

Global development in the 20th century relied heavily on technological innovation (Beck 1997), but the challenges of sustainability and social justice in the 21st century demand new emphasis on institutional innovation (Woodhill, 2010). According to Woodhill (2010), interaction and learning between citizens and government, business and civil society players requires various forms of multi-stakeholder engagement (Woodhill and Van Vugt, 2008) and social learning (Wals, 2007). Adaptive governance focuses on the broader social contexts that enable ecosystem-based management and is operationalized through adaptive co-management where the learning by doing component of adaptive management is combined with the multilevel linkage of co-management to co-ordinate user groups or communities, government agencies, and nongovernmental organizations in ecosystem-based management (Dietz *et al.*, 2003).

Cundill and Fabricius (2010) identify system attributes and key variables considered pivotal in monitoring the governance dimension of adaptive co-management. These attributes and their key variables are (as described by Cundill and Fabricius, 2010):

- *Social capital* refers to the ability of people to act collectively (Ostrom and Ahn, 2003). Social capital is enhanced by networks, bonds, norms and trust (Putnam 1995) and is crucial for self-organization within social systems (Folke *et al.*, 2005).
- *Adaptive capacity* refers to the flexibility of a system in response to changes (Armitage, 2005) and is closely linked to social capital as social capital influences the ability of groups to act collectively to a disturbance (Gunderson and Holling, 2002). Adaptive capacity is gauged by the learning characteristics of individuals, institutions and organizations in the face of uncertainty and change (Armitage, 2005).
- *Self-organization* is a process that supports adaptive co-management and requires platforms for social engagement, social networks to facilitate information flow, collaborative learning as well as monitoring and responses to environmental feedbacks and the ability to make sense of various sources of information (Olsson *et al.*, 2004).

- *Operational preconditions for adaptive governance* Dietz *et al.*, 2003 have identified five operational requirements for successful adaptive governance as follows:
 - a) Information about the resource being managed must be readily available. The information must be reliable and at an appropriate scale for the level of management.
 - b) Conflict resolution mechanisms must be in place to cater for diverse values, interests, perspectives and power inequalities:
 - c) Compliance and enforcement of rules must be apparent.
 - d) Adequate infrastructure must be in place as this impacts the degree to which resources can be used or managed.
 - e) People and organizations must be prepared for change.

These system attributes and key variables were tested in four localities in South Africa. Each outcome indicator was rated according to a five-point scale (5=strongly agree; 1=strongly disagree. The overall results of the study revealed that a major challenge to achieving adaptive co-management in practice was the creation of conditions that promote self-organization and cross-scale institutional linkages. A linkage can be defined as “a point of interaction or cooperation between two or more actors or collective bodies, such as organizations or units of government. These linkages can be established through institutions, which can include shared rules and strategies, or regularized patterns of interaction, creating functional interdependencies between different actors, or collective bodies,” (Young, 2002 in Heikkila *et al.*, 2011, p.122). Long term and well-funded social facilitation was suggested as critical to supporting adaptive co-management in South Africa (Cundill and Fabricius, 2010).

A recent South African case study by Biggs *et al.*, 2017, demonstrates the importance of creating cross-scale institutional linkages in successful water governance. Biggs *et al.*, 2017 document a case study describing a governance crisis in the Olifants River, South Africa. In the absence of a CMA, failure of effective cross-scale collaboration and co-constructed action resulted in the Olifants River drying up for 78 days and the curtailment of critical ecosystem services. During the time of the crisis, the cross-scale and multi-level (national to lower) governance was perceived as weak, almost dysfunctional, by SANParks. The establishment of the Inter-Departmental Liaison Committee on Inland Water Ecosystems (IDLC) in February 2007 was an outcome of the crisis. This committee ensures regular liaison between SANParks and Water Affairs, promoting cross-scale governance. This committee proved to be a valuable “stepping stone” to address the scale mismatch in governance of the Olifants River and “continues to remain as a legacy and basis from which other agencies and/or institutional arrangements can continue,” (Biggs *et al.*, 2017, p.182).

1.4.4.1. Polycentric Governance

Recently polycentric governance, a concept introduced in 1961 and used most notably in public administration literature (Ostrom, Tiebout and Warren, 1961 in Carlisle and Gruby, 2017), has emerged as a governance system well suited to deal with complex environmental problems at multiple scales (Morrison, 2017). Polycentric governance structures are characterised by multiple interacting centres of power with different purpose, organisation, spatial location and many degrees at different levels, (Pahl-Wostl *et al.*, 2012). Possibly the most quoted theoretical advantage of polycentric governance systems in the commons literature is that they have the potential to adapt to both existing and future social and ecological change better than more centralized forms of governance (Pahl-Wostl, 2009; Marshall, 2015 and Bixler 2014 in Carlisle and Gruby, 2017)

Complex-adaptive systems theory supports these claims as it has been discovered that complex-adaptive systems are able to adapt by modifying their rules and behaviour as experiences increase (Pahl-Wostl *et al.*, 2012). The capacity for adaption of polycentric governance systems “has been linked to the notion that they facilitate parallel efforts to experiment with different ideas and rule combinations which when combined with information transmission and learning, can lead to institutional innovation to cope with change,” (Imperial, 1999; Ostrom, 1999 in Carlisle and Gruby, 2017, p.10).

Carlisle and Gruby, (2017) propose a theoretical model for a functional polycentric governance system. The model proposes core institutional features that theoretically enhance the functionality of polycentric governance systems, including:

a) Multiple, overlapping decision-making centres with some degree of autonomy

Only those that exercise “considerable independence to make norms and rules within a specific domain,” (Ostrom, 1992, p.552 in Carlisle and Gruby, 2017) are considered to be decision-making centres. Other organisations that strongly influence policies or provide important technical or financial support are categorised as having a “critical supporting role.”

Polycentric governance draws on a complex arrangement of a variety of levels and types of organisations in a range of sectors of society. These organisations have overlapping functions and responsibilities. To facilitate this system of polycentric governance, private corporations, community based organizations and voluntary associations play a vital supporting role, despite the fact that they have not been assigned public roles in a formal manner.

b) Choosing to act in ways that take account of others through processes of cooperation, competition, conflict and conflict resolution

Through cooperation, competition, conflict and conflict resolution, decision-making centres develop self-organizing tendencies. Successful self-organizing tendencies will allow governance systems to adapt without input from a central body (Lebel *et al.*, 2006 in Carlisle and Gruby, 2017).

Self-organisation may also be supported by a level of competitiveness between decision-making bodies. However, intense competition can undermine cooperation and stall self-organization. Conflict resolution mechanisms are of value as conflict can promote learning and change as different interests, philosophies and perspectives are aired in the process of deliberation. Cooperative processes allow for collective capacity to increase or for functions to be outsourced to more capable decision-making centres or supporting actors. “Polycentricity allows considerable mixing and matching of consumption, provision and production units operating at different scales of aggregation,” (McGinnis, 1999, p.4).

Importantly Carlisle and Gruby (2017) point out that the effectiveness of a governance system depends upon its objectives (i.e. efficiency or equity) as well as the cultural and historical backdrop to the system. The presence of multiple, semiautonomous decision-making centres does not guarantee that sufficient co-ordination exists among the centres to allow the arrangement to function as a polycentric governance system (Marshall, 2015 and Pahl-Woestl and Knieper, 2014). In order for a polycentric governance system to successfully function, decision-making centres must take each other into account in competitive and cooperative relationships and are capable of resolving conflicts (Marshall, 2015 and Ostrom, 1961).

1.5. Problem Statement

The new water laws of South Africa, embracing equity, sustainability, a whole catchment approach to water management and co-operative governance have been commended for being some of the most progressive globally. Such progressive policy, however, requires progressive approaches to implementation (Colvin *et al.*, 2008). Biswas (2008) provides a critical analysis of IWRM and unveils the reality behind this popular concept: that despite much international support and financial investment, “the results of its application in a real world to improve water policy, programme and projects at macro- and meso - scales have left much to be desired,” (Biswas, 2008, p.5). Merrey (2008) points out that IWRM in developing countries has not been successfully implemented owing to a false assumption of the presence of basic water infrastructure. He also notes that a “blind spot” of IWRM is the lack of attention given to

the political dimension of water management. “IWRM in water scarce contexts is all about changes in allocation of water, an inherently political question...” (Merrey, 2008, p.901).

South Africa, as a water scarce developing nation has, perhaps not surprisingly, experienced challenges with respect to IWRM implementation. Despite high hopes by national levels of government for IWRM to be promoted through local level Catchment Management Agencies (CMAs), in reality this has not been the case (van Koppen and Schreiner, 2014). The establishment of CMAs has been slower than anticipated. The number of CMAs has been reduced from 19 to 9 owing to “the technical capacity required to staff CMAs, and the challenges such a large number of institutions poses to the DWA in regulating their performance,” (DWA, 2012). Currently only four CMAs are operating, namely the Inkomati-Usuthu, Breede-Gouritz, Limpopo-North West and the Pongola-Mzimkulu (Citizen Press Release, 2014).

Merrey *et al.*, (2009) note the challenges encountered when attempting to establish the CMA in the Olifants River Basin. A major consulting firm appointed by the then Department of Water Affairs and Forestry (DWAF) initiated the process of establishing the Olifants CMA in 1998. During consultations, DWAF and its consultants failed to overcome serious cultural barriers and political inequalities existing between stakeholders in the catchment. As a result, the process of formation of the Olifants CMA was halted by DWAF, who is now using its own authority to manage the basin (Merrey *et al.*, 2009). The Inkomati Catchment Management Agency (ICMA) was the first CMA established in South Africa under Government Notice No. 397 of 26 March 2004. According to Government Notice 330, the Inkomati Water Management Area (IWMA) was extended on the 2 May 2014 to include the Usuthu Catchment. Thereafter the IWMA became known as the Inkomati-Usuthu WMA (IUWMA) and the name of the ICMA was changed to be the Inkomati-Usuthu CMA (IUCMA).

In December 2015 the Minister withdrew some delegated functions previously awarded to the IUCMA (IUCMA Annual Report 2016/2017). The recalling of its authority within the IUWMA highlights a change of national water strategy and a move away from a decentralisation of power promoted by the NWA and the NWRS. These developments appear to indicate that “Institutional transformation through the CMAs is stalled....” in South Africa (Merrey *et al.*, 2009, p.59).

The identification of FEPAs in 2011 constituted the most comprehensive freshwater conservation plan for South Africa to date (Nel *et al.*, 2011b). The slow and impeded establishment of CMAs in South Africa has not gone unnoticed and concern has been expressed about the implementation of freshwater conservation targets on the ground. While several successful conservation efforts have been reported (Nel *et al.*, 2015), on the ground

protection of the FEPAs is often hampered by technical capacity deficits and administrative challenges in South Africa's water governance structures. It has been noted that, "in most developing countries, institutions are viewed as too weak or too young to adequately carry out IWRM and need therefore to be strengthened," (Razzaque and Kleingeld, 2014, no page numbers).

The current research seeks to gain insights into the protection of the Sabie and the Crocodile Rivers that flow into the Kruger National Park (KNP) and then into Mozambique. Both rivers occur within the IUWMA and are managed by the IUCMA. The KNP is South Africa's flagship national park and has been identified as playing a very important role in achieving national freshwater ecosystem goals. A substantial proportion of the river length (50%) in the KNP has been selected as FEPAs and over 10 river ecosystem types occur in this park (Roux *et al.*, 2013). The entire length of the Sabie River in South Africa has been selected as a River FEPA while the Crocodile River has been identified as a River FEPA in the upper and far upper reaches of the catchment (Nel *et al.*, 2011a).

In order to conserve a River FEPA, it is important to manage the network of streams and wetlands in the sub-quaternary catchment and upstream management area that drain into the river FEPA (Driver *et al.*, 2011). More and more SANParks freshwater management personnel are relating to stakeholders outside of the KNP and relying on South Africa's fledgling water governance structures in order to conserve the freshwater ecosystems inside the park (*pers comm.* SANParks KNP Employee, 2016). According to the NWA, the CMAs should be playing a leading role in implementing IWRM at the local scale by co-ordinating the related activities of water users and of the water management institutions within their water management area. (Driver *et al.*, 2011). The CMAs are also central to NFEPA implementation at the local scale as they have been tasked with ensuring that FEPAs are meaningfully reflected in the development and implementation of the Catchment Management Strategies (CMSs) as well as in the sub-water management area scale (Driver *et al.*, 2011).

At this time of global uncertainty concerning the practice of IWRM in developing nations, a qualitative approach researching stakeholder perspectives relating to the protection of the Sabie and Crocodile Rivers has been adopted. This research provides a critical contribution to informing the collaborative protection of the Sabie and Crocodile Rivers by stakeholders in the IUWMA. It is hoped that the findings of the research will assist natural resource managers and water officials at all levels of government (including policy makers) in improving implementation of IWRM and protection of South Africa's valuable water resources in the future.

1.6. Research Aim and Objectives

1.6.1. Aim

This study aims to interrelate stakeholder views to promote collaborative protection of the Crocodile and Sabie Rivers in the Inkomati River Catchment, Mpumalanga Province, South Africa.

1.6.2. Objectives:

To gain an understanding of stakeholder views with respect to:

- a) The National Freshwater Ecosystem Priority Area Project
- b) Stakeholder engagement platforms, specifically
 - i. which stakeholder engagement platforms are relevant to stakeholders in the Crocodile and Sabie River catchments, and
 - ii. the IUCMA Catchment Management Forum Meetings, specifically the Crocodile River Forum and the Sabie River Forum meetings.
- c) Stakeholder roles and relationships relevant to protection of the Crocodile and Sabie Rivers.

1.7. The Significance of this Research

During the NFEPA project, an intensive collective effort was invested in the delineation of the FEPAs for South Africa in 2011. Particular attention was paid to ensuring that implementation of the FEPA maps was possible through a range of legal policy and tools (Driver *et al.*, 2011). According to the Implementation Manual for FEPAs, the CMAs are responsible for ensuring that freshwater ecosystem priorities are meaningfully reflected in the development and implementation of the CMSs as well as at the sub-water management area scale.

Unfortunately, implementation of IWRM as laid out in the NWA has not proceeded as intended in South Africa. A full literature review of research on water resource management institutions spanning the time period 1997 to 2011 was carried out by Meissner *et al.*, (2013). This work revealed a predominance of studies on CMAs, particularly their institutionalisation and organisational functionality. Researchers have invested a great deal in determining how CMAs can operate effectively, but these studies have been mostly theoretical and not practical. There is a call for a shift in research focus to include other water resource institutions, the informal aspects of water resource governance and new theoretical developments (Meissner, *et al.*, 2013).

The current study deviates from previous research by having a more bottom-up and pragmatic approach that is based on stakeholder views of river protection in the IUPMA (Figure 3). A

stakeholder in the current study refers to an IWRM stakeholder as referred to by Jackson, (2014) and defined in the NWA, (Section 10 (2) c) as:

"any persons, or their representative organisations; 3) whose activities affect or might affect water resources within its water management area; and 4) who have an interest in the content, affect or implementation of the Catchment Management Strategy."

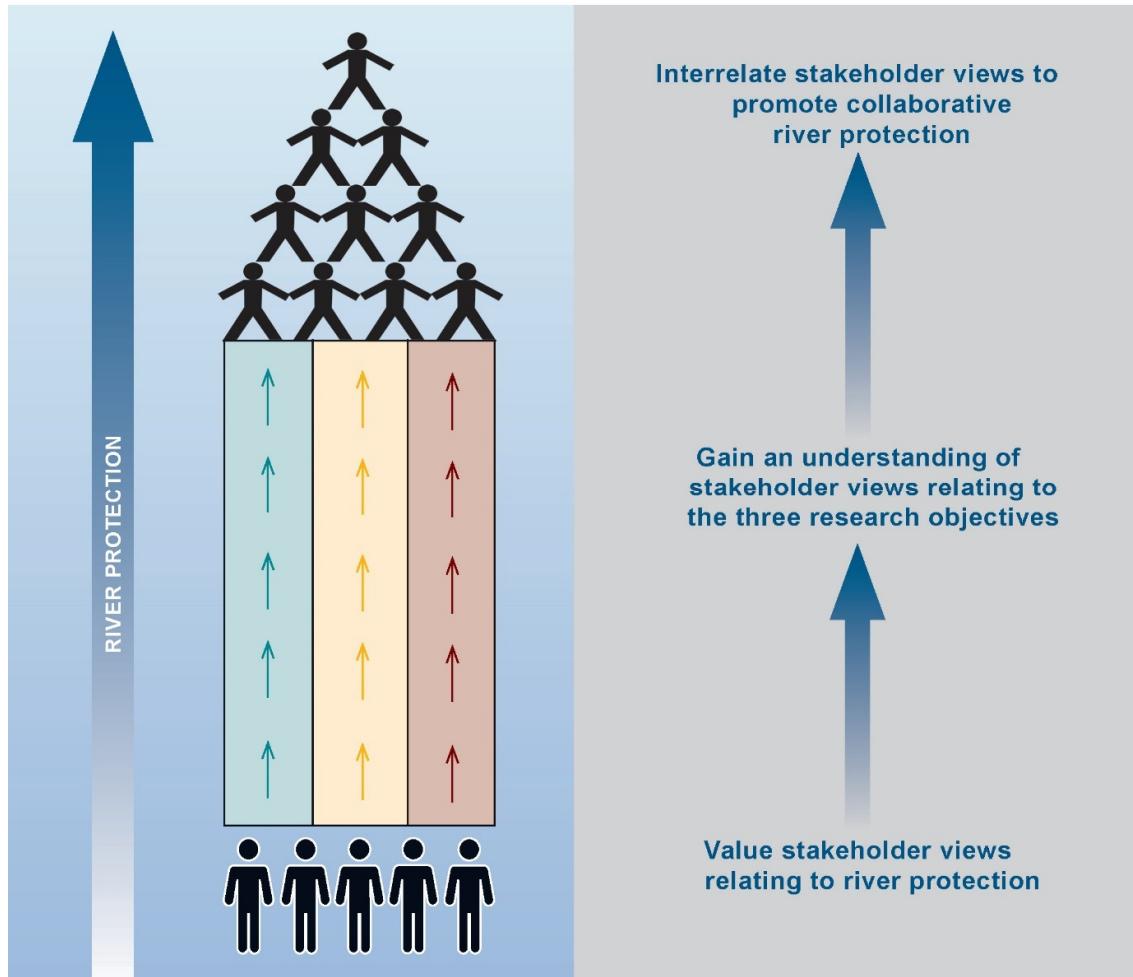


Figure 3 Conceptual diagram depicting the bottom-up research approach adopted

As depicted conceptually in Figure 3: by valuing, understanding and interrelating stakeholder views relating to river protection on the ground, this research aims to promote collaborative river protection in the future. It is hoped that the suggestions provided will serve as a practical guide to key national and regional-level water governance and conservation stakeholders on how to support collaborative protection of the Crocodile and Sabie Rivers and highlight the merits of the “bottom-up” research approach.

At a broader scale, by exploring stakeholder views with respect to river protection, this research promotes a better understanding of the implementation of South Africa’s national

water policy. The fact that the ICMA was the first CMA to be established in South Africa allows the researcher opportunity to share stakeholder views that may prove useful when setting up CMAs in other areas around the country. The IUCMA has to work closely with other stakeholders and will often rely on good stakeholder relationships to protect vulnerable freshwater resources. In other catchments where CMAs have not yet been established, understanding the roles of these other actors in the informal governance sector is even more important in river protection. By adopting a similar research approach, the challenges facing these stakeholders on the ground can be discerned and brought to the attention of key national and regional stakeholders.

2. STUDY AREA

This Chapter provides useful information on the study area pertaining to both the physical and social characteristics of the Inkomati River Catchment (IRC), specifically with respect to the Crocodile River Catchment (CRC) and the Sabie River Catchment (SRC). With respect to the physical characteristics relevant to the study, a description of the IRC is followed by information on land use and water resources, water use and water availability in the CRC and the SRC. Thereafter, the FEPAs status of the Crocodile and Sabie Rivers is discussed. The social aspects of the study area are investigated by introducing the key stakeholders including the conservation stakeholders, water governance stakeholders and the IRC stakeholders. The Chapter closes by providing a synopsis of previous research documented in the literature relating to challenges to stakeholder collaboration in the IRC.

2.1. The Inkomati River Catchment

The Sabie and Crocodile Rivers flow from west to east through the Inkomati River Catchment (IRC) in the IUWMA. The IUWMA is situated within the Mpumalanga Province in the northeast of South Africa as shown in Figure 4 (NWRS 2). The Inkomati Catchment Management Strategy (ICMS) was released in 2010 and provides useful information of the study area. The CMS is currently being reviewed and updated to include the Usuthu WMA and is due to be released in 2018 (*Pers comm*, IUCMA Community Co-ordinator, 2018).

For the purposes of the current research, the IUCMA will be referred to (except when referring to literature prior to 2014). Despite the extension of the IWMA to the IUWMA in 2014, the stakeholders on the ground still identify with the IRC or IWMA as their administrative region. For this reason, the current research refers to the IRC or the “catchment” as the water governance region relevant to stakeholders active in the IRC. In this chapter reference is made to the IWMA (when referring to the ICMS and the Atlas of FEPAs in South Africa).

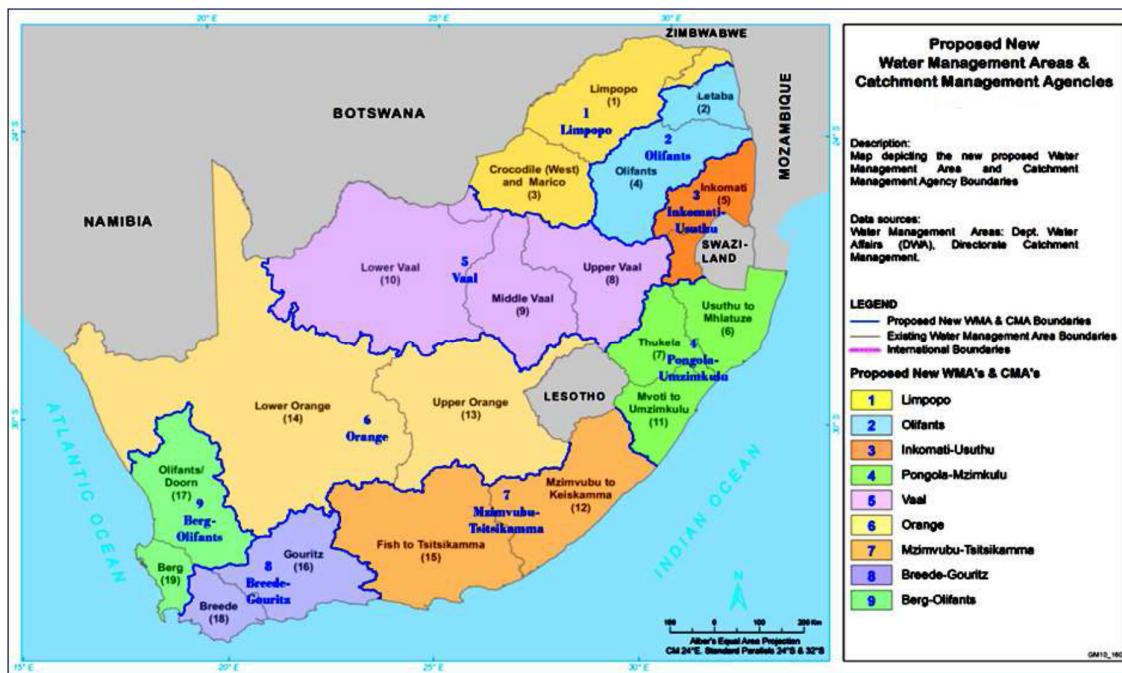


Figure 4: Position of the IUWMA in South Africa (NWRS 2)

The IRC in South Africa forms part of the Incomati International River Basin shared between South Africa, Mozambique and the Swaziland. The rivers in the IRC flow through Mozambique and into the Indian Ocean. These international linkages impose certain international obligations with respect to water quality and water quantity on the rivers (ICMS).

The IRC is one of the most important river catchments in South Africa (Kleynhans *et al.*, 2013) and has been divided into three sub-catchments: The Komati, Crocodile and Sabie-Sand River sub-catchments as shown in Figure 5 below (ICMS). Despite being at the sub-catchment scale, the current research (in accordance with the ICMS) refers to the Crocodile River Catchment (CRC) and the Sabie River Catchment (SRC).



Figure 5: The main river catchments in the IWMA (ICMS)

2.2. Land Use

2.2.1. The Crocodile River Catchment

The dominant land use activities in the CRC are agriculture, irrigation, forestry production and rural and urban settlements. Forestry activities are concentrated in the escarpment region to the west of Nelspruit and comprise 16.5% of the total area covered by the CRC (Crafford *et al.*, 2007). Approximately two thirds of the planted area are under *Pine* species with the remainder predominantly under *Eucalypt* species (Crafford *et al.*, 2007). Trout farming is occurring in the region of Dullstroom and Machadodorp. The middle section of the Crocodile River is characterised by the densely populated towns of Nelspruit, Kaapmuiden and Malelane which place both domestic and industrial demands on the river (ICMS).

Commercial farming for vegetables and sugar cane as well as tobacco cultivation, fruit orchards are active in this area. Mining is occurring near the Kaap River and the Sappi

Ngodwana Mill (producing paper-grade pulp from wood) is operating in the Elands River catchment. The Crocodile River forms the southern boundary of the KNP before flowing in the KNP. Commercial farming (for citrus and sugar cane) is occurring in this region and numerous tourist lodges line the banks of the Crocodile River. An increase in urban development and industrial activity has occurred in the middle reaches of the catchment (ICMS).

2.2.2. *The Sabie River Catchment*

The upper reaches of the SRC are characterised by forestry production, and are predominantly under *Pinus* and to a smaller extent, *Eucalyptus* species (Roux *et al.*, 2017). The small towns of Sabie, Graskop and Kiepersol are located in this region and land use activities include irrigation, agriculture (of bananas and madumbi), domestic and minor industrial activities (including sawmills) (ICMS). Trout farming has become a popular activity in the area. In the lower reaches of the Sabie and Sand Rivers many rural settlements have developed. These local communities undertake subsistence and small-scale farming of cattle and fruit (ICMS).

2.3. Water Resources, Water Use and Water Availability

2.3.1. *Water Resources*

2.3.1.1. *The Crocodile River Catchment*

The source of the Crocodile River is located near Dullstroom. The river then flows eastwards and is impounded by Kwena Dam before reaching Nelspruit. The river forms the southern boundary of the KNP after Matsulu and then flows into Mozambique and Komatipoort (ICMS).

The CRC has relatively high rainfall on average. Rainfall is variable across the catchment with a relatively high rainfall (1100mm/annum) recorded in the mountainous region west of Nelspruit compared to a relatively lower rainfall of (600mm/annum) recorded in the lower reaches of the CRC (ICMS). These rainfall trends across the catchment are reflected in the Mean Annual Runoff recorded (Table 1).

Table 1 Natural Surface Water Runoff in the CRC (ICMS)

Catchment	MAR (million m³/annum)
Upper Crocodile and Elands	467.3
Middle Crocodile	359.4
Kaap	204.2
Lower Crocodile	106.6
Sub-Total	1137.5

According to the Inkomati Water Availability Assessment (IWAA) completed in 2009, the Kwena Dam has a substantially greater capacity and supply area than the other dams in the CRC (Table 2).

Table 2 Details of the major dams in the CRC (IWAA)

Dam	Full Supply Capacity (million m ³)	Full Supply Area (km ²)
Kwena	158.9	12.5
Ngodwana	10	1
Witklip	12.7	1.9
Klipkopjes	11.9	2.3
Longmere	4.3	1
Primkop	2	0.4

2.3.1.2. The Sabie River Catchment

The Sabie-Sand River catchment can be divided into the Sabie and Sand River catchments. The Sabie River source is located close to the town of Sabie, while the Sand River originates west of Bushbuck Ridge. The Sabie and Sand Rivers merge near Skukuza in the KNP before flowing into Mozambique and joining the Incomati River (ICMS).

Rainfall is highly variable in the SRC ranging from above 1 300mm/annum on the Transvaal Drakensberg Escarpment to 400mm/annum in the lower eastern region of the catchment (ICMS). These rainfall trends across the catchment are reflected in the Mean Annual Runoff recorded (Table 3).

Table 3 Natural Surface Water Runoff in the SRC (ICMS)

Catchment	MAR (million m ³ /annum)
Upper Sabie	467.3
Sand	359.4
Lower Sabie	204.2
Sub-Total	1137.5

Table 4 shows that the Nyaka Dam is by far the most significant flow regulating feature within the SRC.

Table 4 Details of the major dams in the SRC (IWAA)

Dam	Full Supply Category	Full Supply Area
Inyaka	125	8.1
Maritsane	2	0.1
Da Gama	13.6	1.3
Kasteel	1.2	0.1
Edinburgh	3.3	1.0
Orinoco	1.9	0.2

2.3.2. Water Use

The water demands by sector are shown in Figures 6, 7 and 8 show, for the IWMA, the CRC and the SRC respectively. It is clear that apart from water removed for maintenance of the Reserve, irrigation, followed by forestry are the two most significant water users in the IWMA (Figure 6).

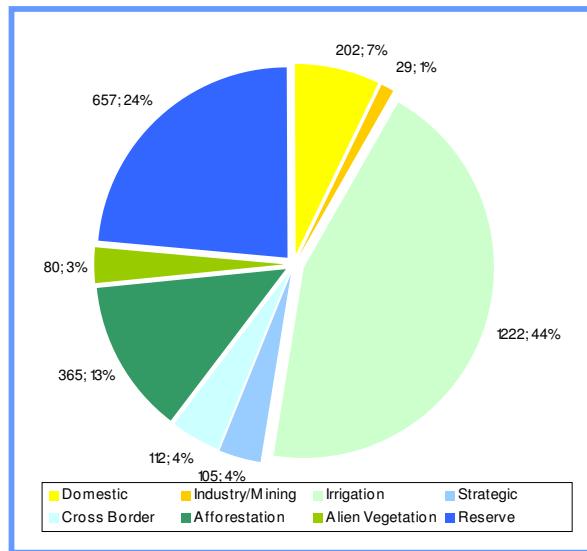


Figure 6 IWMA Water Demands (ICMS)

Figure 7 shows that the water demands in the CRC follow a similar trend as those for the IWMA. After water has been removed for the Reserve, irrigation followed by forestry are the next most significant water users in the Crocodile System. The demand from domestic requirements and industry are also relatively higher in the Crocodile System than seen in the overall catchment.

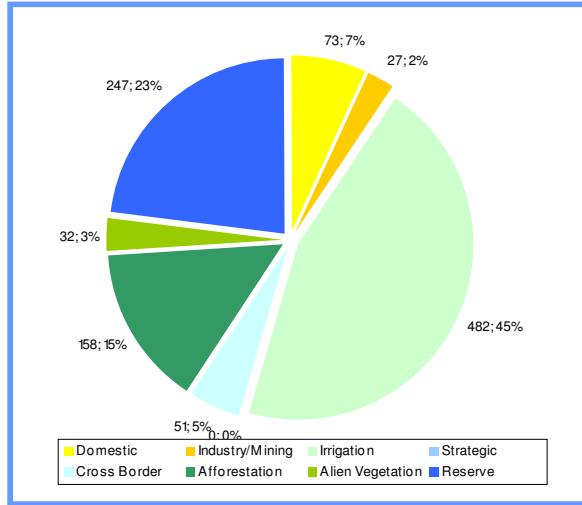


Figure 7 CRC Water Demands (ICMS)

Figure 8 shows that the water demands in the SRC differ from the rest of the IWMA with relatively lower demand recorded from irrigation, but higher demand recorded from Reserve, domestic and forestry demands (ICMS).

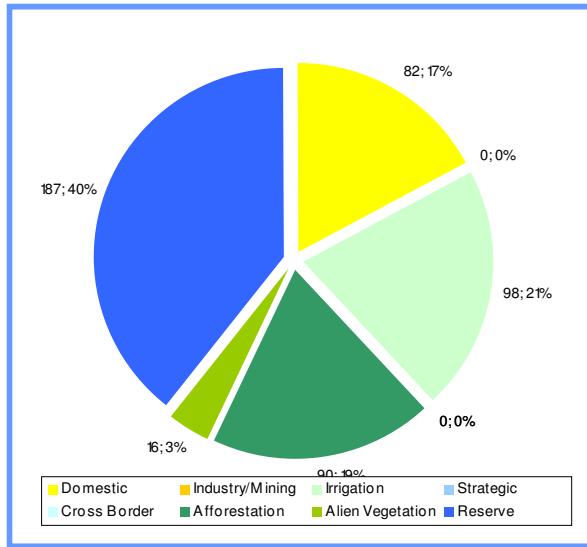


Figure 8 SRC Water Demands (ICMS)

2.3.3. Water Availability

2.3.3.1.1. The IRC

The IRC is a water-stressed catchment and no new water is available for allocation (ICMS). Figure 9 shows water availability against demand for the IWMA and the Komati, Crocodile and Sabie Catchments. Water demand is greater than availability in every catchment.

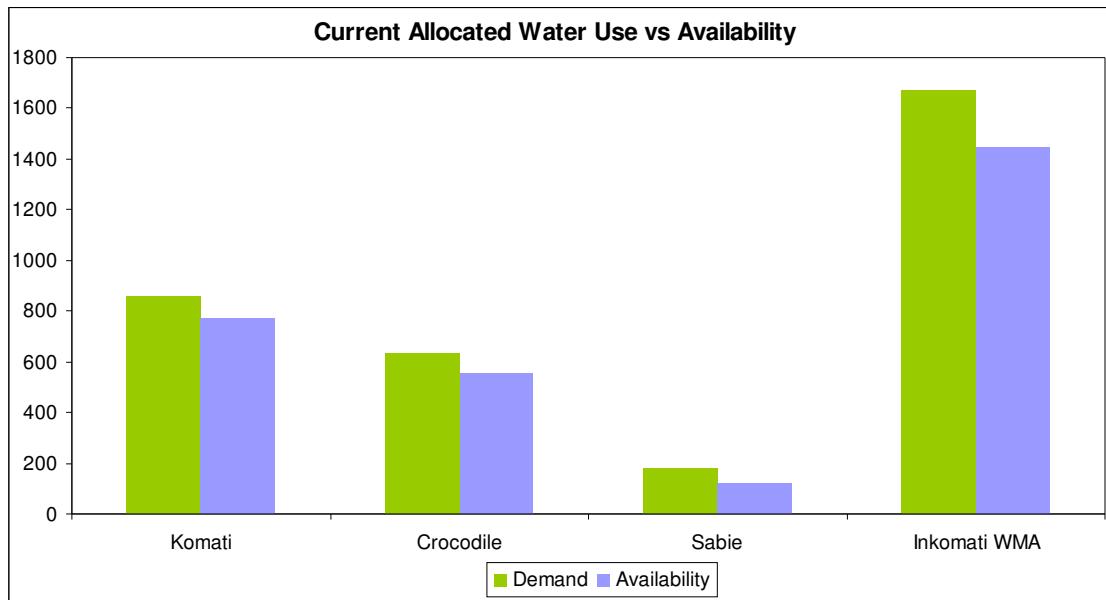


Figure 9 Current allocated water use vs availability in the IWMA (ICMS)

2.3.3.1.2. The CRC

Quantifying the available water resource in the CRC is a complex problem. The operating rules for Kwena Dam alleviate this challenge by providing the assurance of supply to all users under the assumed rules (Table 5). The operating rules therefore have great influence on water availability. The IWAA highlights that, according to the Kwena Dam operating rules, water users in the CRC are required to first make use of run-of-river flows before releases from the Kwena Dam are made. Downstream water users are, therefore, highly dependent on the responsible management of river abstractions by upstream users and the sound operation of Kwena Dam in the CRC (ICMS).

The water balance for the main stem of the Crocodile River is provided in Table 5 below.

Table 5 Crocodile River Water Balance for the main stem of the river (ICMS)

Water Use Sector	Demand (million m³ /annum)	Supply (million m³ /annum)	Assurance of Supply(%)
Irrigation	400	344	100
Domestic	48	46.6	95
Industrial	23.5	23.4	98.6
Cross Border Flows	28	28	100
Total	517.5	460.3	

2.3.3.1.3. The SRC

The Nyaka Dam was constructed with the primary aim of ensuring sustainable flow through the KNP (IWAA). The ICMS highlights that there is less water available in the SRC than previously thought (Table 6). This issue emphasizes the importance of implementing the operating rules for the Nyaka Dam efficiently to increase water availability in the SRC (ICMS). Despite the development of a complex operating procedure for the Nyaka dam, the operating rules were yet to be fully implemented at the time the IWAA was completed in 2009. The Nyaka Dam was operating at far less than its maximum capacity and hence the need to operate the dam efficiently had not yet arisen. In addition, the lack of competent staff was a further limitation to the operation of the dam (IWAA).

The water balance for the Sabie River is provided in Table 6 below.

Table 6 Sabie River Water Balance (ICMS)

Water Use Sector	Demand (million m ³ /annum)	Supply (million m ³ /annum)	Assurance of Supply (%)
Irrigation	85.3	75.5	80
Domestic	4	4	100
Industrial	0	0	N/A
Transfers Out	14.5	14.5	100
Cross Border Flows	0	0	N/A
Total	103.8	939	

2.3.3.2. *The Water Allocation Plan*

The IUCMA is in the process of completing a Water Allocation Plan (WAP) which aims to bring about Water Allocation Reform (WAR) in the IUWMA. The WAP will be finalised once the Validation and Verification of Existing Lawful Use of Water (VVELUW) has been completed for the IUWMA (*pers comm.* SANParks KNP Employee, 2017b).

2.4. FEPA Status of the Sabie and Crocodile Rivers

Figure 10 below shows the FEPA map for the IWMA (Nel et al., 2011a).

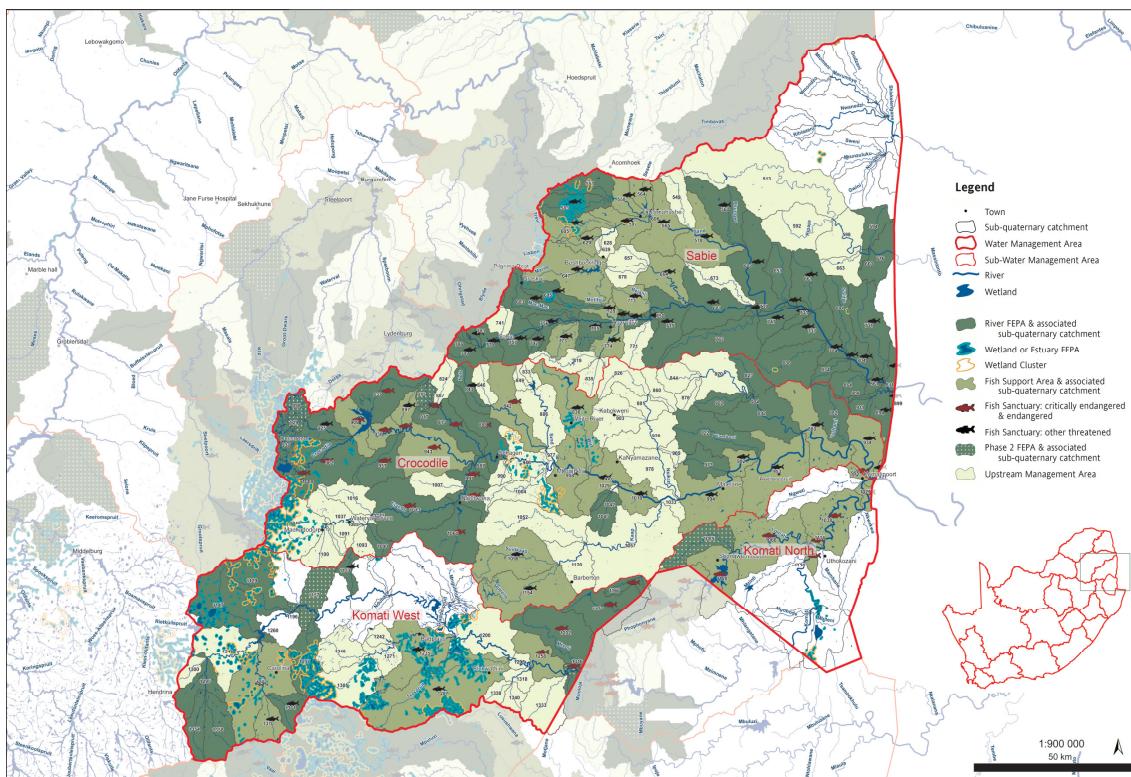


Figure 10 The FEPA map for the IWMA (Nel et al., 2011)

As can be seen the entire length of the Sabie River in South Africa has been marked as a River FEPA as has the lower and far upper reaches of the Sand River. Fish sanctuaries (for threatened fish species) have been indicated along the length of the Sabie River and, to a lesser extent, along the Sand River. The Crocodile River has been marked as a River FEPA in the upper and far upper reaches of the catchment. Fish sanctuaries (for critically endangered and endangered fish species) are indicated in this area. The remainder of the river (not marked as River FEPA) has been marked as Fish Support Areas. In these areas fish sanctuaries for threatened fish species have been shown.

2.5. Key Stakeholders

2.5.1. Conservation stakeholders

The key conservation stakeholders active in the IRC are the Department of Environmental Affairs (DEA), the Mpumalanga Tourism and Parks Association (MTPA) and SANParks.

The Crocodile and Sabie Rivers are important perennial rivers flowing from the escarpment through the southern portion of the KNP into Mozambique. SANParks has had a long history

of involvement with stakeholders in the catchment owing to the location of the southern portion of the KNP in the catchment. As an integral conservation stakeholder, SANParks' KNP has influenced river protection efforts in the catchment (Pollard *et al.*, 2011).

2.5.1.1. South African National Parks (SANParks)

The KNP was initially founded to protect the dwindling wildlife of the South African Lowveld and the first formal protection measures involved urgent response to sudden issues. This preservationist approach led to a style of management by intervention in the mid-1940s until the 1990s (Freitag *et al.*, 2014). As mentioned previously, the 1990s heralded major water policy changes in South Africa which were to have a direct influence on the KNP. The ideas of managing the catchment and considering stakeholders' interests were embraced in a more holistic attitude towards water management (Roux and Foxcroft, 2011). These linkages were immediately relevant to the KNP where all the major river systems originate on the escarpment and then flow eastwards through several land-use types before entering the KNP and ultimately into Mozambique (Pollard *et al.*, 2011).

Since 1994, stakeholder involvement, transparency and accountability have been drivers within the KNP management to achieve equity and sustainability of natural resources. At the same time, a growing awareness of the challenges involved in natural resource management led to the questioning of some of the assumptions made by the "command and control" style of management (Pollard *et al.*, 2011). Research interest in adaptive management grew as variability was highlighted as the key characteristic of semi-arid systems (Davies *et al.*, 1995). Adaptive management has been defined by Meffe *et al.*, (2002, p.97) as "The process of treating resource management as an experiment such that practicality of trial and error is added to the rigour and explicitness of the scientific experiment, producing learning that is both relevant and valid".

Strategic Adaptive Management (SAM) was developed within the KNP in 1995, initially in the context of managing rivers and their catchment areas (Biggs and Rogers 2003; Rogers and Bestbier 1997; Rogers and Biggs 1999 in Roux and Foxcroft, 2011). Water resources and river catchments have been described as STEEP systems in the literature. The STEEP acronym refers to the web of Social, Technical, Ecological, Economic and Political processes and characteristics that are typical of these complex social-ecological systems (Berkes and Folke 1998; Berkes *et al.*, 2003 in Jackson, 2014). SAM is a methodology developed within a local South African context for managing and operating complex systems incorporating the social/technical and management/science challenges often encountered (Rogers and Bestbier, 1997; Biggs and Rogers, 2003 in Jackson, 2014). Along with adaptive planning and management should be the use of feedback loops in successful SAM. According to Pollard *et*

al., (2011), feedback loops should be responsive multi-feedback loops which provide the basis for learning reflection and response to an evolving context. Two critical challenges of managing natural resources were embraced by SAM, namely, social-ecological complexity and the existence of multiple stakeholders with varying values, perceptions and expectations (Roux and Foxcroft, 2011).

The SAM framework defined during the final phase (1997-1999) of the KNP Rivers Research Programme consisted of the formulation of a vision, underpinned by a series of objectives (ranked according to priority), leading to the identification of specific end-points to inform and guide management (Rogers and Bestbier, 1997 in McLoughlin *et al.*, 2011). When these end points, referred to as the upper and lower Thresholds of Potential Concern (TPCs), are exceeded an investigation ensues to understand the reason why (Biggs and Rogers, 2003). The investigation may result in a management intervention or revision of the TPC (Biggs and Rogers, 2003). A focussed monitoring programme to check the TPCs regularly is a fundamental requirement of SAM (Rogers and Bestbier 1997, Rogers and O'Keefe 2003 in McLoughlin *et al.*, 2010). In summary, SAM is designed to be strategic (purposeful action in response to set thresholds), adaptive (learning while doing) and participatory (promoting engagement and importance of stakeholders) (Grant *et al.*, 2008 in Roux and Foxcroft,).

The KNP monitors both river flows and water quality and submits results to the DWS (*pers comm*, SANParks employee, 2017a). A State of the Rivers Report is released annually by the KNP. This report provides the Ecostatus of the freshwater resource in the five perennial KNP rivers. The Ecostatus is an integrated index, taking into account river drivers (hydrology, geomorphology and physio-chemical) and river responses (fish, macroinvertebrate and riparian vegetation) (Petersen *et al.*, 2014). In order to determine the Ecostatus of each river, the indices are determined for the Driver and Response components varying from A to F, where A represents conditions close to natural and F representing a critically modified condition (Table 7) (Kleynhans and Louw, 2007, in Petersen *et al.*, 2014).

Table 7: Ecological categories for eco-status components (Kleynhans and Louw, 2007)

Ecological Category	Description	Score (% of Total)
A=Excellent	Unmodified, natural	90-100
B=Good	Largely natural with few modifications	80-89
C=Fair	Moderately modified	60-79
D=Poor	Largely modified	40-59
E	Seriously modified	20-39
F	Critically/extremely modified	0-19

The State of the Rivers Report used to be based on surveys carried out as part of the implementation of the River Health Programme (RHP). The RHP was initiated in 1994 by the DWAF to undertake biomonitoring surveys of rivers throughout South Africa (Petersen *et al.*, 2014). The River Health Programme ended in 2016. Since then SANParks has continued to conduct bio-monitoring surveys in the 5 perennial rivers in the KNP. Every 10 years the KNP releases a Kruger Park Management Plan According to the Park management plan process (available at https://www.sanparks.org/conservation/park_man). This document addresses the future management of the KNP protected area and river management is considered as part of this process (SANParks, 2008).

Recently the classes of water resources and Resources Quality Objectives (RQOs) were gazetted in Government Notice 40531 for the IWMA (DWS, 2016). This consultative process was co-ordinated by the DWS and resulted in nationally recognized management objectives for these rivers (Petersen *et al.*, 2014). Future State of the Rivers Reports and Kruger Park Management Plans will incorporate RQO compliance instead of alignment to TPCs (*pers comm.* SANParks KNP Employee, 2016).

2.5.2. Water Governance Stakeholders

Key water governance stakeholders in the IWMA include: the regional office of the DWS and the regional office of the DEAT in Mbombela; the IUCMA; the various municipalities; the WUAs and the Irrigation Boards (ICMS).

The Ehlanzeni District Municipality extends into the study area. The Bushbuck Ridge Local Municipality area includes: Acornhoek, Bushbuck Ridge and Tulamahashe, while the City of Mbombela Local Municipality (CMLM) area includes: Nelspruit; Barberton; Hazyview; Kabokweni; Ngodwana; White River and other communities in Southern Nsikaziv (ICMS).

The Elandsriver and Upper Komati WUAs have been established in the IWMA. Neither of these WUAs are operating successfully. The Irrigation Boards are still operating in accordance with the 1956 Water Act. There are 26 Irrigation Boards operating in Irrigation Districts throughout the IWMA (ICMS). The main Irrigation Boards in the study area are listed below.

Irrigation Boards in the CRC: The Elands Valley Irrigation Board; Sand River Irrigation Board; Kaap River Major Irrigation Board and White River Valley Conservation Board.

Irrigation Boards in the SRC: The Sabie River Irrigation Board and the White Waters Major Irrigation Board.

2.5.2.1. The ICMA

The initial functions have been assigned to the IUCMA as described in Section 4.2.1.1 of this document (ICMS). The ICMA adopted an IWRM framework (Figure 11) recommended in the Guidelines for the development of Catchment Management Strategies: toward equity, efficiency and sustainability of water resources management (DWAF, 2007b). The framework promotes a practical approach to the implementation of IWRM legislation and policy (Jackson, 2014) and has been lauded as “the most recent and state of the art thinking for the implementation of IWRM in South Africa,” (Jackson, 2014, p.2). The framework incorporates Strategic Adaptive Management and a series of strategies designed to promote sustainability (DWAF, 2007b; Pollard and du Toit, 2008).

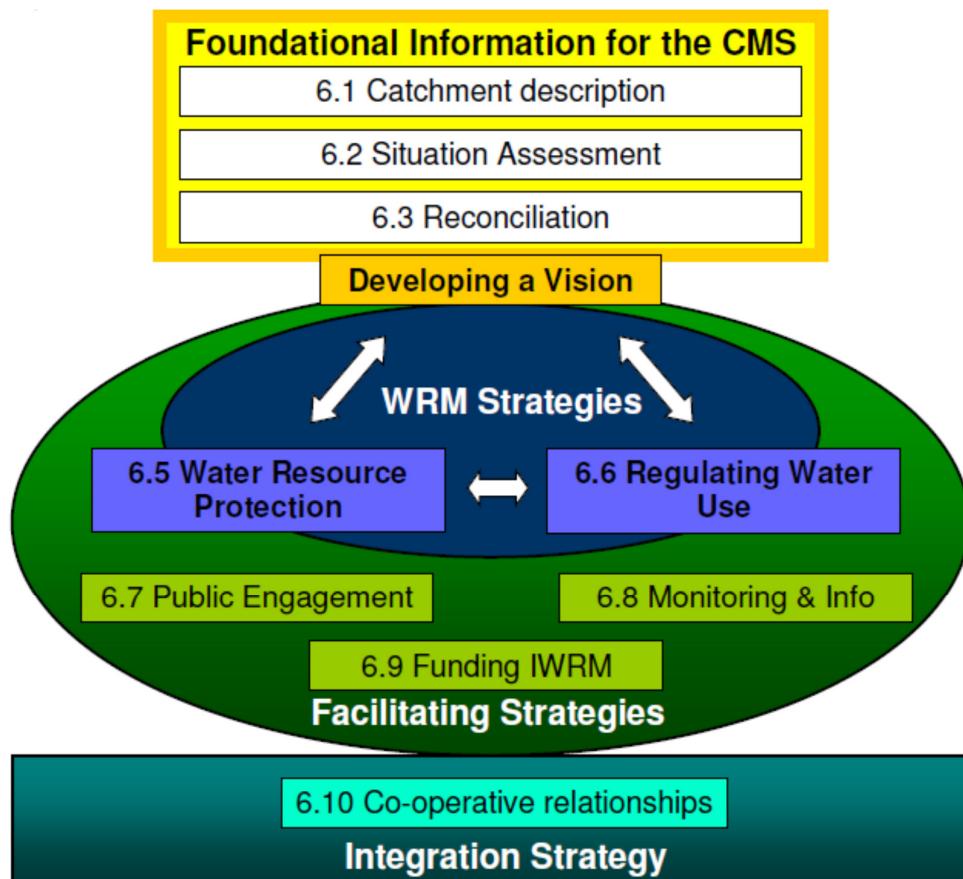


Figure 11: An IWRM Framework used for development of the ICMS (DWAF, 2007b)

The vision of the ICMA as stated in the ICMS (p.121) is:

“We share the Inkomati water resources, and responsibility for their management, amongst ourselves and with our neighbours. Our decision-making environment, including delegated functions, enables collaborative action towards equity, sustainability and efficiency in a continually evolving socio-economic system. We

manage the resource adaptively, co-operatively and progressively to achieve social, economic and environmental justice, and promote healthy living.”

In line with the NWA, the ICMS promotes public participation in managing the water resources within its water management area. Public engagement has been included in the CMS as a facilitating sub-strategy and co-operative governance as an integration strategy. These two strategies work hand-in-hand to promote an implementation system for participatory IWRM. It is acknowledged in the CMS (p.154) that “IWRM cannot be achieved by any single organisation or structure, but must be achieved through collaborative system of organisations and individuals working together towards a common set of objectives”.

2.5.2.1.1. The Stakeholder Engagement Sub-Strategy

The ICMA co-ordinates all stakeholder engagement in the catchment (ICMS). The ICMS Stakeholder Engagement Sub-Strategy below (extracted from the ICMS, p156 - 159) outlines how the ICMA, in collaboration with stakeholders, plans to enact various strategic actions, including:

Achieving Equity

- *Achieving equity involves the creation of CMFs as “pragmatic and workable structures and processes for participatory IWRM decision-making.” The CMFs are the vehicles through which CMA plan to ensure collective responsibility of all stakeholders with respect to decision-making and accountability thereof. The Forum meetings will provide a space for regular stakeholder collaboration for the co-ordination and evaluation of IWRM activities. Feedback will be provided on Strategic Action Programmes and stakeholders will ensure that the Forum remains relevant to their needs.*
- *Capacity building and empowerment programmes will be developed. The education needs of previously disadvantaged groups is catered for by proposing capacity building and empowerment programmes as a critical part of participation.*
- *The slow process of establishing Water Use Associations or transforming Irrigation Boards into Water User Associations will be revised and implemented urgently. This process must be inclusive, involving stakeholders in the decision-making process.*

Managing Flow

The establishment and maintenance of appropriate river operations committees will be undertaken to ensure that specific technical decisions are made and operationalized. These committees will also clearly define roles, responsibilities and accountabilities to

stakeholders' value criteria and other specified structures and operations. Particularly, the operations committee will focus on ensuring a transparent and inclusive process is followed for the reserve determination and implementation.

Managing Water Quality

The determination and implementation of the Resource Quality Objectives and the Reserve will be inclusive and transparent.

Generating and Managing Knowledge

Social co-learning systems and co-generation of knowledge will be incorporated into the IWRM decision-making processes.

Achieving Compliance and Enforcement

- *Paradigm shifts will be facilitated by awareness and education campaigns that are targeted at specific stakeholder groups that are not compliant.*
- *Enforcement needs and potential control methods will be identified in collaboration with stakeholders throughout the catchment.*

Generating Revenue

Decisions relating to how IWRM revenue will be generated will be inclusive and transparent.

The “CMSs are, from a practical point of view, the strategic vehicle used by CMAs and their stakeholders to enable action in catchments,” (du Toit *et al.*, 2011, no page numbers). Involvement of stakeholders in the above Stakeholder Engagement Strategies is critical for their successful implementation.

Listed amongst the threats to achieving this vision and particularly relevant to the current research are the following points (ICMS):

- A general sense of public dissatisfaction and apathy has been observed and linked to the poor progress in implementation of IWRM.
- A lack of cooperative governance at national, provincial and local levels has hampered the management of water resources
- The CMA that is challenged with respect to finances, staff and authority is seen as an obstacle to the implementation of the IWRM in the IWMA.

The primary objective of the ICMS, highlighted in the “Visioning” Chapter, is to achieve full delegation of authority to the ICMA to ensure that effective IWRM can occur in the catchment. There is an urgency in the catchment to develop a system of stakeholder engagement and

co-operative governance (both enabled by efficient IWRM) to highlight the importance of water across local and regional government structures (ICMS).

2.5.2.1.2. Co-operative Governance Strategy

It is acknowledged in the ICMS (p.184) that “IWRM can only be implemented collaboratively, through a system of organisations and individuals working together towards a common set of objectives”. The CMS identifies that the ICMA needs to consolidate its role as the central co-ordinating body within the catchment for all activities that affect water resources by continuing to prioritize informal and formal relationships with organisations. A Memorandum of Agreement with the DWA is highlighted as an urgent priority for the ICMA. This agreement was under revision at the time the CMS was released and outlines the avenues for future cooperation between the ICMA and the DWA and the assignment and delegations of functions and related human, financial and other resources to the ICMA.

The strategic actions underpinning the co-operative governance strategy (extracted from the ICMS), include:

Managing Flow

- *Promote co-ordinated river operations both at the local sub-catchment scale, for example the Crocodile River Operations project, and at the international scale in accordance with the international agreements to which South Africa is a signatory.*
- *Facilitate awareness campaigns and practical initiatives across sectors to decrease water losses and increase water use efficiencies by launching water education programmes with the DWA and other agencies.*

Managing Water Quality

- *Institute a cooperative system to ensure that spatial/developmental planning explicitly considers water resources and their long term sustainability. The ICMA plans to focus on raising the profile of water resources within the catchment to ensure that development is conducted in a controlled and well-considered manner. The ICMA will collaborate with the DWA, Department of Agriculture (DoA), Department of Land Affairs and Environment and the local municipalities in this endeavour. The Mpumalanga Provincial Growth and Development Strategy and municipal Integrated Development Plans will be encouraged to prioritize consideration of their impacts that planned developments may have on the sustainability of the water resource on the other water users.*
- *Establish a clear system for timely and effective management of pollution incidents*

- *Facilitate awareness campaigns and practical initiatives across sectors to decrease water quality degradation, for example, offering support to various initiatives aimed at improving water quality in the catchment initiated by the municipalities, the Netherlands project, the Department of the Environment and the DoA.*

Generating and Managing Knowledge

- *Build knowledge sharing/research networks nationally and internationally. The transferral of research findings, knowledge, experiences and skills by establishing networks between the ICMA and its stakeholders will be encouraged. There are many programmes, initiatives and studies currently underway that will provide useful information to the ICMA for planning and managing the resources together with the stakeholders.*
- *Consolidate data and information sharing networks to meet operational and monitoring requirements. Regional and national monitoring networks for water quality will be the responsibility of the DWA. "There are numerous DWA water quality monitoring points in the IWMA. These are monitored on a monthly basis by DWA and feed into the DWA Water Management System (ICMS)."*

Achieving Compliance and Enforcement

- *Investigate different enforcement needs and potential methods across the catchment.*
- *Develop and implement an innovative, practical and transparent system for identifying and dealing with transgressors.*

2.5.2.1.3. Implementation of IWRM in the IRC

In response to the IWRM framework proposed in the ICMS, the IUCMA has implemented the following strategic actions as part of the Stakeholder Engagement Sub-Strategy:

- Formation of the CMFs (*Achieving Equity Strategic Action*). Relevant to this research are the Crocodile Catchment Management Forum (CCMF) and the Sabie Catchment Management Forum (SCMF). Importantly, the stakeholders refer to the CCMF as the Crocodile River Forum (CRF) and the SCMF as the Sabie River Forum (SRF). To ensure that this research is relevant to stakeholders active in the IRC, the terms CRF and SRF are used to refer to the CCMF and SCMF respectively in this document.
- Formation of the Crocodile River Operations Committee (the CROCOC) (*Managing Flow Strategic Action*).

- Publication of classes of water resources and RQOs in Government Notice 40531 for the IWMA after a stakeholder consultation process (*Managing Water Quality Strategic Action*).

2.5.2.1.4. Incorporation of the NFEPA Project in the ICMS

The NFEPA project has been incorporated in the ICMS as follows: The ICMS considers the NFEPAs within the Catchment Description Chapter. Here it is stated that “SANBI, the South African Biodiversity Institute, is managing the above project to identify the priority areas of riverine and wetland biodiversity protection. The IRC has been identified as a sub-regional level fish hotspot, with a high biodiversity relative to other WMAs in South Africa. It is thus important that these priority areas are incorporated into the planning of all related institutions. The ICMA must coordinate this planning through the Co-operative Governance Sub-strategy,” (ICMS, p.55).

The “Visioning” chapter in the ICMS also makes reference to the NFEPAs under the Co-operative Governance objective (p.124). The objective aims to: “Urgently develop a system of co-operative governance and stakeholder engagement that gives water a high profile across local and regional government structures”. Several points describe the system proposed, including: The system must “Incorporate the National Freshwater Ecosystem Priority Conservation Areas Framework.” The Sustainability objective (p.125) in the same chapter states, “A process for implementing the Reserve must be put in place and must include full integration of the National Freshwater Ecosystem Priorities.” This objective is repeated in the Resource Protection Chapter where it is reiterated that Reserve implementation must be linked to FEPA outcomes and that it must be ensure they are taken into account of in other planning organisations. A map showing the FEPAs in the IWMA has been included in this chapter.

Finally, one of the key issues arising from the situation assessment and the visioning process was that the focus of the resource protection sub-strategy should achieve “The protection of water resources (vulnerable aquifers and wetlands) from water quality impacts through the National Freshwater Ecosystem Priority Areas,” by co-operative governance with the DWA and stakeholders (ICMS, p.131).

2.5.3. IRC Stakeholders

A broad range of stakeholders are active water users in the IRC. The IUCMA has a stakeholder database called the Water Users Registration Database which provides the contact details of all the stakeholders in the different catchments within their water use area. This database is available for the Sabie and Crocodile River Catchments by request from the IUCMA.

2.6. Challenges to stakeholder collaboration in the IRC

Previous research into stakeholder relations and activities in the IRC have highlighted challenges to stakeholder collaboration.

During the time period 2005 to 2009, a collaboration between DWAF and the Environment Agency (England and Wales) known as the Watercourse Project was carried out (Colvin *et al.*, 2008). This project focussed on capacity building in three sites, including the ICMA, and was divided into two phases. The first phase ran from April 2005 to March 2007 and focussed on the need to develop a set of principles and practices which prioritized learning, reflexivity and adaptation. It was found that participants of the project responded well to the action and social learning approaches as well as to the collaborative approach. The second phase of the project focussed on water governance and was launched as the new flagship project for the UK-South Africa sustainable Development Dialogues. Two key areas of focus emerged from the second phase of the watercourse project, namely, how to build capacity for a co-operative (multi-stakeholder) approach to water governance and how to build capacity for an adaptive approach to water governance. A multiple stakeholder dialogue based on Future Search principles was rolled out in a series of five sub-catchment workshops (Colvin *et al.*, 2008).

These workshops were well attended by emerging farmers, community development workers, community-based organisations and some government departments, however, (with the exception of the Crocodile River Workshop) poor attendance was noted by large business users, commercial farmers, local municipalities and water boards. It was noted that “the bias was therefore generally towards attendees representing groups not already enjoying water allocation,” (Colvin *et al.*, 2008, p.685) The main Future Search Workshop was held in October 2007 for three days and similar patterns in stakeholder representation were noted. A shared stakeholder vision emerged after the workshop that was a product of a participative process and available to be used to shape the ICMS vision (Colvin *et al.*, 2008).

After engaging across the ICMA stakeholder network during the project, several issues were highlighted to the board and senior management team of the ICMA, including: The researchers noted that there was little overall sense of coordination or common narrative amongst the different stakeholder workshops occurring throughout the catchment; there were considerable differences in the style of these workshops with some being done “to stakeholders” and others “with stakeholders” and, finally, this resulted in stress on the ICMA institutional development team who are responsible for co-ordinating these activities and also created potential for “stakeholder fatigue” and confusion. The issue that stood out as the most challenging to address for the members of the Future Search Team was the issue of non-attendance/engagement of some stakeholder groups. The main reason for this was thought to be that

those responsible for recruiting key sectors to the stakeholder events, including members of the ICMA governing board, failed to fully understand the importance of their role in the process (Colvin *et al.*, 2008).

2.7. Challenges to stakeholder collaboration in the SRC

Mirumachi and van Wyk (2010) examine stakeholder interaction at the local and international level of water governance in South Africa. The SRC was used for the local case study where business, a conservation agency, an irrigation group and a scientific organisation took part in a dialogue for improved decision making. In the past both cooperation (Weeks *et al.*, 1996 in Mirumachi and van Wyk, 2010) and conflict (van Wilgen *et al.*, 2003 in Mirumachi and van Wyk, 2010) have been demonstrated amongst water users in the catchment in response to hydrological variability (particularly drought). Ironically, the volunteer fora that historically supported co-operative relationships amongst subsets of the community in the SRC disintegrated after introduction of the NWA. The perception at the time was that the water policy reform heralded by the NWA made their role redundant under the new legislative framework (Sherwill *et al.*, 2007 in Mirumachi and van Wyk, 2010).

The study carried out by Mirumachi and van Wyk, 2010 involved a research organisation and three stakeholder groups. The research organisation assisted stakeholders in structuring their issues, facilitating discussions and supplied some resources required to support their actions. The three groups included: a private forest and saw milling company in the upper reaches of the SRC; an irrigation group in the middle of the catchment and a parastatal conservation agency responsible for management for the KNP in the lower reaches of the catchment (van Wyk *et al.*, 2006b in Mirumachi and van Wyk, 2010).

All three groups had in common negative experiences in past co-operative attempts. Empowerment differentials (in terms of resources, knowledge, skills, confidence and capacity between stakeholder groups) were seen by all three groups as a threat to cooperation potential in the catchment. Another challenge was maintaining momentum in cooperative strategies once they had been established (van Wyk *et al.*, 2006b in Mirumachi and van Wyk, 2010). As a result of these disappointments the stakeholders were motivated to achieve more robust collective decisions through empowerment and capacity enhancement. However, the three stakeholder groups were dependent on DWAF to endorse their increased interaction with other stakeholder groups. Despite attempts to alleviate power disparity, expose interdependence and identify risks, the stakeholder groups ultimately “chose to stall their process towards the end of the project due to lack of confidence that the regulatory body at the national scale (DWAF) would endorse their voluntary investment in the process” (van Wyk *et al.*, 2006b in Mirumachi and van Wyk, 2010, p.31). The risk perceived was that great energy

invested into local water management activities could potentially be wasted if the activities were found not to be in alignment with regulatory policy.

3. RESEARCH APPROACH AND METHODOLOGY

A qualitative interpretivist research paradigm steered the current research. Firstly, this Chapter expands on the decision to select a qualitative interpretivist approach, thereafter, the background and perspective of the researcher is elucidated upon. The Research Design Section motivates for why an intrinsic case study research design was selected and provides information on how the participants were selected, the semi-structured interviews conducted and the secondary data collected. The details of the interpretive data analysis process are provided in the Data Analysis Section, followed by discussions on the trustworthiness and limitations of the research. The chapter closes with a description of the ethical considerations taken into account throughout the study.

3.1. Research Paradigm

A qualitative approach has been adopted in the current research to allow a deeper understanding of the challenges faced by stakeholders in the IRC with respect to river protection.

“Quantitative research makes sense in situations where we know in advance what the important variables are, and are able to devise reasonable ways of controlling or measuring them. But what about situations in which it is difficult to say what the variables are, or how to measure them? In such cases, we need to engage in the kinds of open-ended, inductive exploration made possible by qualitative research,”
(Terre Blanche *et al.*, 2006, p.272).

Qualitative research methods that attempt to describe and interpret people's feelings and experiences in human terms (Terre Blanche *et al.*, 2006) provide a useful tool in discerning key issues affecting stakeholders at the catchment level. An interpretivist approach was chosen as it values people's experiences as being their reality (ontology), makes sense of people's experiences by interacting with them and listening attentively to what they are saying (epistemology) and makes use of qualitative research techniques to collect and analyse information (methodology) (Terre Blanche *et al.*, 2006).

More specifically, the interpretivist paradigm assumes a relativist ontology, a subjectivist epistemology and a naturalist methodology (Kivungu and Kuyini, 2017). The assumption of a relativist ontology implies that the situation being studied has multiple realities which can be explored and understood through human interactions between the researcher and the subjects of the research (Chalmers, Manley and Wasserman, 2005). The assumption of a subjective epistemology implies that the researcher interprets the data applying his/her own thinking and processes the data informed by interacting with participants (Kivungu and Kuyini,

2017). The assumption of a naturalist methodology implies that the researcher sources information gathered through interviews, discourses, text messages and reflective sessions, with the researcher being a participant observer (Carl and Kemmis, 1986).

A purely interpretivist approach would focus solely on the subjective understandings and experiences of individuals or groups (Terre Blanche *et al.*, 2006), while the goal of constructionists is to understand the world of lived experience from the perspective of those who live in it (du Plooy-Cilliers, 2014). This approach attempts to “get into the head of the subjects being studied,” in order to understand what the subject is thinking or the meaning he/she is making of the context (Kivunga and Kuyini, 2017, p.33). An important part of the current research process is to understand the viewpoints of different stakeholders in the catchment in order to promote stakeholder co-ordination in river protection. By showing how stakeholder experiences feed into broader social patterns, a social constructionist paradigm was adopted (Terre Blanche *et al.*, 2006).

3.2. Researcher Background and Perspective

The researcher is the principal instrument of analysis and can never fall back on a set of technical procedures or definitions (Terre Blanche *et al.*, 2006, p.328). Despite having a scientific background, the researcher is aware that certain challenges being faced by South Africa’s water sector require researchers to make use of qualitative research approaches. The qualitative approach is particularly suitable for studying the implementation of policies on the ground. As noted by Starman (2013, p.29), “Case studies have been largely used in the social sciences and have been found to be especially valuable in practice-oriented fields.”

Throughout the research process (commencing in March 2016 and concluding in May 2018), the researcher has attempted to gain a deeper understanding of the social sciences and the qualitative research methods available to the social science researcher. Several different meetings and seminars were attended by the researcher throughout the research process in an effort to improve her qualitative research skills and to bridge the gap between science and implementation (Table 8). In 2016, a seminar on *Interview Styles and Techniques* presented by Dr Ruth Albertyn was attended before commencing interviews in the field. Towards the end of 2017, the Garden Route Interface Symposium was attended after the interviews had been completed. Participation in this meeting improved the researcher’s understanding of the interface between science and practice and how the two fields are intricately related.

The Savanna Science Networking Meetings (SSNMs) are held annually in Skukuza and are a platform where academics present the latest research relating to the KNP and other savanna regions around the world. The researcher attended certain days of the SSNMs held in 2016

and 2017. The researcher attended the days where research pertaining to freshwater management and socio-ecological systems was presented. These meetings provided the researcher with relevant information relating to the study area as well as a platform to network with people with both management (natural resource managers) and scientific (savanna science academics) knowledge of the area.

Table 8: Research Interview and Meeting Record

Dates of Excursion Phase of Interviews	Number of Interviews	Description
14-17 March 2016 (Phase 1)	1	<ul style="list-style-type: none"> Conducted an initial start-up interview with SANParks personnel and attended the SSNM.
25 July 2016		<ul style="list-style-type: none"> Attended a seminar on <i>Interview Styles and Techniques</i> presented by Dr Ruth Albertyn
21 August - 26 August 2016 (Completed Phase 1 Interviews and commenced Phase 2 Interviews).	5	<ul style="list-style-type: none"> Attended the SRF meeting the 22nd August 2016. Presented the project proposal at the CRF meeting on the 26th August 2016. Accompanied SANParks personnel on a field trip to the Sabie River on the 24th August 2016. Conducted 2 Phase 1 Interviews and 3 Phase 2 Interviews
15 -17 February.2017 (Phase 2 interviews were completed)	6	<ul style="list-style-type: none"> Attended the CRF meeting on the 17th February 2017. Completed 6 Phase 2 Interviews.
13 th to the 15 th March 2017		<ul style="list-style-type: none"> Attended the SSNM and followed up with SANParks personnel on a few outstanding issues
19 – 20 September 2017		<ul style="list-style-type: none"> Attended the Garden Route Interface Symposium

3.3. Research Design

3.3.1. *Intrinsic Case Study Design*

In order to gain an understanding of the key issues challenging stakeholder protection of rivers in South Africa, a case study research design was selected.

Simons (2009, p.21) defines a case study as “an in-depth exploration from multiple perspectives of the complexity and uniqueness of a particular project, policy, institution, program or system in a ‘real life’ context.”

The “real life” case explored in the current study can be expressed as ‘protection of rivers by stakeholders in the Inkomati River Catchment, Mpumalanga Province, South Africa.’ During

the study, stakeholder views were collected in a variety of ways and interrelated to better understand how collaborative stakeholder protection of the Crocodile and Sabie Rivers can be supported. Such intensive study of a particular case in its natural setting and with consideration to its complexity and context is known as an Intrinsic Case Study (Punch, 2014).

The IRC in Mpumalanga province South Africa was selected as the site for the case study as it provides several key elements considered favourable for the current research:

- The Sabie and Crocodile Rivers flow from west to east through the catchment before entering Mozambique. These rivers have been identified as priority freshwater conservation targets (Nel *et al.*, 2011a), are two out of five perennial rivers flowing through the KNP, provide important water resources for a broad range of activities in the catchment and have international significance (ICMS).
- There is a high level of stakeholder interest in the Sabie and Crocodile Rivers:
 - SANParks has played a central role in influencing institutional arrangements (Biggs *et al.*, 2008) and has undertaken, or at times, initiated engagement in wider water management actions such as catchment strategy development, international agreement revision, water quality monitoring and even legal action (Pollard *et al.*, 2011).
 - The ICMA was the first CMA to be established in South Africa in March 2004 (ICMS) and is well-positioned to provide in-depth information relating to the challenges experienced in implementing IWRM at catchment level.
 - A broad range of stakeholders are active water-users in the catchment.
- Regular IUCMA CMFs provide further insights into the key issues facing stakeholders in the catchment.

3.3.2. Selection of Participants

In qualitative research if sampling of a certain group of people is deliberate, then it is known as purposive sampling (Punch, 2014). Expert and Snowball purposive sampling were employed during two phases of interviewing (Table 8).

3.3.2.1. Phase 1 – Expert Purposive Sampling

Expert purposive sampling involves approaching people who are acknowledged as specialists in a field of relevance to the research being undertaken (Etiken *et al.*, 2015). Dr Dirk Roux (Senior Freshwater Conservation Scientist at SANParks and Research Supervisor) was well-positioned to introduce the researcher to key personnel responsible for freshwater management at SANParks KNP. As SANParks is a key stakeholder in the IRC, interviews with

the freshwater management team provided an important entry point to identifying and engaging with key stakeholders in the catchment.

The first phase of interviews with SANParks personnel included three separate interviews. The first interview was conducted in March 2016 and coincided with the SSNM held annually in Skukuza. This initial interview with SANParks served to orientate the researcher in terms of identifying the key stakeholders operating in the catchment and important background information to the study was shared. Two subsequent interviews with SANParks personnel were conducted on successive days in August 2016. Owing to demanding workloads and busy schedules, interviews were conducted with SANParks personnel in cars while driving to attend different CMF meetings and on the way to a field trip in the catchment. These two interviews provided information as guided by the open-ended interview questions supplied in Table 9 below. Important contacts of key stakeholders in the catchment were also provided. The researcher had the opportunity to attend a field trip together with the South African Institute for Aquatic Biodiversity to sample fish species in the Sabie River on the 24th August 2016. At times, during the research process, the researcher emailed the SANParks KNP employees with queries to gain clarity on certain issues discussed in the interviews.

3.3.2.2. Phase 2 – Snowball Purposive Sampling

Snowball sampling “makes use of referrals to increase the sample size” (du Plooy *et al.*, 2014, p.143). The members of the Phase 1 interviews with the SANParks freshwater management team provided valuable contact details and introductions (in some cases) to key stakeholders that they relate to with respect to the Crocodile and Sabie Rivers in the catchment. These Phase 1 interviews provided the researcher with a useful entry point to access the relevant stakeholders in the catchment. Further snowball sampling occurred as the key contacts provided by SANParks were interviewed and referred the researcher to other key stakeholders in the catchment. These Phase 2 interviews were held during two separate three day trips in early 2017. In some instances, the people identified in organisations were not available for interviews. Where possible, colleagues of theirs were interviewed instead. These interviews were held at different venues including the different stakeholder organisations, at venues suggested by the stakeholders or after the CMF meetings for convenience.

3.3.3. Semi-structured Interviews

In qualitative research interviews provide a useful tool to access people’s perspectives in order to understand them (Punch, 2014).

“In order to understand other persons’ construction of reality, we would do well to ask them....and to ask them in such a way that they can tell us in their terms (rather

than those imposed rigidly and a priori by ourselves) and in a depth which addresses the rich context that is the substance of their meanings" (Jones, 1985 in Punch, 2014, p.144).

To gain an in-depth understanding of the different stakeholder views concerning river protection in the IRC, it was necessary to conduct one-on-one, semi-structured interviews. All the interviews were conducted in person, except for one interview which was conducted on Skype (owing to a lack of time availability in the stakeholder's schedule). It is estimated that the interviews lasted between 45 minutes to 1 hour.

In total, 12 semi-structured interviews were conducted during the current research. On arrival for each interview, the researcher introduced herself politely and outlined the purpose of the study. The interview candidate was presented with a Monash University Consent Form and Project Explanatory Statement (Appendices 3 and 4). Once the interview candidate had consented to the interview, the voice recorder was turned on and the interview began. An effort was made to keep the interview style relaxed and flexible, allowing the researcher to change the focus where required.

Open-ended questions were asked which provided the interviewee with scope to express his/her opinions and insights (Bryman, 2004). The pre-determined questions outlined in Table 9 below follow the objectives of the study and provided a guide to the general themes of the interview. The interviewer attempted to cover the research objectives during each interview. The language and wording of the different research questions differed from interview to interview owing to the different stakeholder backgrounds (Saunders *et al.*, 2012). In some cases, prompts and probes were used to better understand the interviewee's perspective (David and Sutton, 2011). At the end of each interview, the researcher assured the participant of his or her confidentiality.

Table 9: Pre-determined Interview Questions

Pre-determined Interview Questions
1) Are you aware of the NFEPA Project? If so, in what way is the NFEPA project relevant to you?
2) What stakeholder engagement platforms or meetings do you attend regularly and why?
3) What is your opinion of the CRF and/or the SRF meetings?
4) Do you (or does your organization) do anything regularly to protect the Sabie and/or Crocodile Rivers?
5) Who are the key stakeholders involved in protection of the Sabie and/or Crocodile Rivers?
6) Who do you relate to in a river management crisis?

3.3.4. Secondary data collection

3.3.4.1. Minutes of the Catchment Forum Meetings

A request was made towards the end of 2016/beginning of 2017 by email from the researcher to the community coordinators responsible for compiling the CMF meeting minutes to provide the researcher with recent previous copies of these documents for the Sabie and Crocodile CMF meetings. Four sets of electronic copies of CRF meeting Minutes (24 June 2016, 26 August 2016, 21 October 2016, 25 November 2016) were received within a week of this request being made by email. The community co-ordinator routinely sends out the CRF meeting minutes to stakeholders on the stakeholder's database therefore the researcher has a record of subsequent meeting minutes. The minutes for the 17 February 2017 CRF meeting were also included for review (Appendix 5) as the researcher attended this meeting.

The SRF meeting minutes took approximately 3 months to receive. The reason given was that the co-ordinator had limited data bundle and was unable to email the documents. Eventually copies of the documents were handed to a colleague at a SRF meeting who then delivered the documents to the co-ordinator at the IUCMA in Mbombela. The documents were scanned by the co-ordinator at the IUCMA Mbombela offices and sent through electronically to the researcher. Unfortunately, the documents were not scanned in order and the pages were not numbered which made compiling them a challenge. Ultimately, only the SRF meeting minutes for the 27 February 2017 were compiled from the pages scanned and sent to the researcher for review (see Appendix 6). It was noted that, in contrast to the CRF, the SRF meeting minutes are not circulated routinely to stakeholders by email.

3.3.4.2. CRC Management Forum Reflection Survey

Towards the end of 2016, the chairman of the CRF carried out a Survey amongst meeting attendees. Thirty questionnaire cards were filled out anonymously by attendees to the CRF meeting.

On each card, the following questions were asked:

- What has been our best achievement in 2016?
- What do you think is the Croc Forum's biggest single problem or challenge to achieve the objective to protect the river?
- How must we fix this? (the above identified problem)?

The chairman of the CRF kindly supplied the Survey responses for inclusion in the current research (Appendix 7).

3.3.4.3. General Meeting Observations

The researcher attended one SRF meeting on the 22 August 2016 and two CRF meetings on the 26 August 2016 and the 17 February 2017 respectively. The researcher engaged in marginal participation as defined in Grinnel (1993), as the researcher is not a regular attendee of the meetings and came to the meeting as an outsider. The researcher was permitted to give a presentation of the proposed research at the CRF meeting on the 26th August 2016. Unstructured meeting observations were made at the SRF meeting on the 22 August 2016 and the CRF meeting on the 17 February 2017. Unstructured meeting observations are generally used in the naturalistic approach to research and are limited to fairly broad patterns of target problems and are easily affected by the biases of the observer (Grinnell, 1993).

3.4. Data Analysis

Data analysis was guided by "Steps in Interpretive Data Analysis" (Terre Blache *et al.*, 2006, p.322-326).

3.4.1. Step 1: Familiarisation and immersion

As suggested by Terre Blanche *et al.*, (2006), this step started early in the research process. As key stakeholders were contacted and interviews scheduled, a preliminary understanding of the meaning of the data was already beginning to form. By the time data collection was complete, the analysis of the data was already occurring. Transcription of interviews into digital format and reviewing of meeting minutes and meeting observations were followed by brainstorming, drawing diagrams and making summaries. This process of data familiarisation and immersion served to allow the researcher to make later decisions regarding which interpretations would likely be supported by the data and which would not.

3.4.2. Step 2: Inducing themes

During this step, main themes were identified from the data as described by Terre Blanche *et al.*, (2006). Naturally, themes linked to the research objectives were identified, and then beyond those themes, other background or underlying subthemes were induced from specific descriptions. These subthemes were arranged and rearranged under different themes. It was a priority that the emerging themes and subthemes were relevant to the current research.

3.4.3. Step 3: Coding

Interview transcripts and reflections survey responses were coded by highlighting identified themes and subthemes with bright colours. In reality, the steps of inducing themes and coding the interview transcripts blended together as observed by Terre Blanche *et al.*, (2006). This process was seen as flexible as themes and subthemes changed during the process of coding.

3.4.4. Step 4: Elaboration

Once the themes and subthemes were collected together, it was possible to use the data to elaborate or explore them closely. During this process sub-issues were identified and themes and subthemes were reshuffled. After a process of coding, elaborating and re-coding a point was reached where no further sub-issues arose and the themes and subthemes were finalised.

3.4.5. Step 5: Interpretation and checking

During this step, written reporting of the case study was carried out and the themes identified were presented to respond to the overall aim of the report.

3.4.6. Contextualised Comparison

As shown above, the five steps in interpretive data analysis suggested by Terre Blanche *et al.*, (2006) were followed broadly to analyse the qualitative data collected in an ordered way. Punch *et al.*, (2014) emphasizes the role of comparison in identifying abstract concepts and coding during qualitative studies. Starman (2013, p.36) also refers to “contextualized comparison,” involving “detailed consideration of contextual factors” and searching for “analytically equivalent phenomena even if they are expressed in different terms and contexts,” to increase conceptual validity in qualitative research studies.

Where possible, comparison was used as a tool in the current research to highlight more abstract concepts (Punch 2014). These higher order concepts (Punch *et al.*, 2014) that developed from comparisons were considered critical to understanding how the different themes identified during the data analysis process fed into broader social contexts.

3.5. Trustworthiness

According to Lauckner *et al.*, (2012), trustworthiness is based upon credibility (the extent that the findings accurately describe the phenomenon studied), dependability (the ability of the study to account for variability over time), confirmability (the extent that the research process is clearly described and can be followed by another) and transferability (the extent to which the findings of the study can be applied to other similar situations (Krefting, 1991, in Lauckner *et al.*, 2012).

Several strategies that promote the trustworthiness were followed during the proposed research as suggested by Lauckner *et al.*, (2012).

- *Multiple sources and methods* - the researcher collected different data from a range of different sources throughout the research process (interviews, meeting minutes, reflection survey cards and general observations).
- *Analyst triangulation* – Research supervisors reviewed sections of interview transcripts in order to interrogate coding decisions.
- *Data Storage* – A Research Database was created on the Researcher's computer which promoted the organized storage of all information gathered during the research process. Interview transcripts, meeting minutes, reflection surveys, notes taken and voice recorder files were also stored in this database.

The strategies described above contribute to improving the credibility and dependability of the research. With respect to transferability and confirmability, the case study, if performed well, will combine both.

Creswell, (2007) lists the following criteria for evaluating case study research:

- Is there a clear identification of the “case” or “cases” in the study?
- Is the “case” (or are the “cases”) used to understand a research issue or used because the “case” has (or “cases” have) intrinsic merit?
- Is there a clear description of the “case”?
- Are themes identified for the “case”?
- Are assertions or generalizations made from the “case” analysis?
- Is the researcher reflexive or self-disclosing about his or her position in the study?

The researcher reflected on these questions throughout the research process to ensure that each question was addressed and the overall trustworthiness of the research enhanced as a result. It is noted in Baxter and Jack (2008, p.548), that Stake (1995) uses the term intrinsic and suggests that researchers who have a genuine interest in the case should use this

approach when the intent is to better understand the case. “It is not undertaken primarily because the case represents other cases or because it illustrates a particular trait or problem, but because in all its particularity and ordinariness, the case itself is of interest.”

The contextual nature of an intrinsic case study means that it is generally not applicable to other cases. The implementation focus of the current study increases its usefulness. The challenges highlighted here are not unique to the IRC and it is thought that the study will be considered useful in other contexts.

3.6. Project Limitations

Qualitative research incorporates multiple realities and has no statistical basis (Rahman, 2016). It has been found that policy-makers award low credibility to the results from qualitative research and prefer to use quantitative research when research is called upon (Sallee and Flood, 2012). “Qualitative research is often overlooked in conversations about incorporating research in practice,” (Sallee and Flood ,2012, p.139). Despite the obvious limitations such as the issue of generalizability of smaller sample sizes (Harry and Lipsky, 2014); the complexities of data interpretation and analysis (Richards and Richards, 1994) and the relative length of time associated with qualitative research, three strengths of qualitative research have been identified by Sallee and Flood (2012). These strengths include: a) focus on context, b) use of emergent design and c) use of thick description.

In terms of context, qualitative researchers have the opportunity to develop an understanding of context and behaviour of individuals in certain settings because they collect data in the field (Creswell, 2007 in Sallee and Flood, 2012). In terms of emergent design, qualitative methods provide flexibility for researchers to respond to changes on the ground to ensure that data capture is meaningful. The use of thick description supplies rich narratives which capture everyday experiences which otherwise would remain hidden under the scrutiny of quantitative analysis (Sallee and Flood, 2012).

During the current research several limitations are noted as listed in Table 10. Where possible, these have been mitigated as shown, to provide a rich, in-depth qualitative case study displaying focus on context, emergent design and the use of thick description. These attributes make the research compelling to practitioners and policymakers alike who may be searching practical solutions to pressing problems (Sallee and Flood, 2012).

Table 10: Project Limitations and Mitigation Strategies

Limitation	Mitigation Strategy
Sample Size (A total of 12 interviews were carried out).	The sample size reflects the qualitative nature of the research. By conducting in-depth interviews with SANParks and key stakeholders in the IRC, this research provides unique stakeholder perspectives into river protection. The goal of the research was not to provide a 'representative' sample' or to make generalisations.
Restricted access to key contacts	In some instances, it was not possible to interview the people identified by SANParks. Where possible, the researcher was referred to other people in the same organisation (by other key stakeholders during interviews). In one instance a stakeholder was not available to attend an interview in person owing to a busy schedule. In this instance, a Skype interview was conducted.
Contextual nature of the research	The limitation of an intrinsic case study approach is that it is contextual in nature, and generally not applicable to other cases. The implementation focus of the current study increases its usefulness. The challenges highlighted here are not unique to the IRC and it is thought that the study will be considered useful in other contexts.
Ineffective organization of data	It was challenging to compile the SRF meeting minutes received by email as the pages were not scanned in order and the pages were not numbered.
Distance from stakeholders and delays due to administrative constraints	The distance and inaccessibility of the Bushbuck Ridge IUCMA Office during the study was a limitation. The researcher was advised not to travel to the Bushbuck Ridge Offices alone due to safety concerns. Limited data bundle available to the administrative staff at the Bushbuck Ridge IUCMA office delayed the electronic delivery of documents to the research via email.
Skype interview network problems	The intermittent cellphone network coverage during the Skype interview hampered communication. Numerous attempts were made before the meeting could be conducted.
Defensive attitude of participants	At times the interview participants adopted a defensive attitude when questioned about their involvement in river protection on the ground. The researcher was sensitive to such attitudes and encouraged the participant to relax and only share information they were comfortable with sharing.
Logistical constraints	The identified organisations were a far distance from where the researcher lives. An effort was made to schedule the interviews with different identified organizations in close physical proximity to one another during the same field visits. Certain interviews were held after the SRF and CRF meetings for convenience.

3.7. Ethical Considerations

"What we do as researchers and the quality of work we produce often affect other people and we therefore have a responsibility to the bigger community that we serve to act with honesty and integrity so that everyone can have and maintain confidence in the research process," (du Plooy *et al.*, 2014, p. 273).

The researcher followed all Monash University South Africa's protocols for ethics consideration. The required clearance was received from the Monash University Human

Research Ethics Committee (MUREC) (Appendix 8) prior to commencing with fieldwork, (CF16/201-2016000092). At all times, every effort was made to ensure that the participants involved in this research study were informed of the purposes of the study and how the results will be used.

The Research Proposal was presented at the CRF meeting on the 26th August 2016. Participation was voluntary and the issues of consent, privacy and confidentiality were respected during the study and explained to the participants. Before interviews commenced the interview candidates were presented with a Monash University Consent Form and Project Explanatory Statement (Appendices 3 and 4). The interview candidate was reminded that the interview was going to be recorded (as stated in the Consent Form) before the interview commenced. The researcher intends to return to the CRF meeting during 2018 to present the findings of the research (if permitted to do so).

4. RESULTS

The results in this Chapter are presented in accordance with the research objectives as outlined in Table 11. The table also provides information pertaining to the information source for each results section. The first objective, namely, “to gain an understanding of stakeholder views with respect to the NFEPA project,” was explored during interviews and the results are presented in Section 4.1.1.1., entitled “Awareness and application of the NFEPA Project amongst stakeholders.”

The second objective is addressed in two parts:

- i. “To gain an understanding of stakeholder views with respect to stakeholder engagement platforms relevant to stakeholders in the CRC and the SRC,” was investigated during interviews and the results are presented in four different sections: International; regional; catchment scale and sub-catchment scale stakeholder engagement platforms in Sections 4.2.1.1. to 4.2.1.4. respectively.
- ii. “To gain an understanding of stakeholder views with respect to the IUCMA Catchment Management Forum Meetings, specifically the CRF and the SRF meetings”. This objective was achieved by gathering information from a variety of different sources related to the CRF and SRF meetings and the results reflect this. Stakeholder views relating to the CRF meeting were sourced from interview results (Section 4.3.1.1), reflection survey results (Section 4.3.1.2.), CRF meeting minutes (Section 4.3.1.3) and CRF meeting observations (Section 4.3.1.4). Stakeholder views relating to the SRF meeting were gathered from interview results (Section 4.3.2.1), SRF meeting minutes (Section 4.3.2.2.) and SRF meeting observations (Section 4.3.2.3).

The third objective, “to gain an understanding of stakeholder views with respect to stakeholder roles and relationships relevant to protection of the Crocodile and Sabie Rivers,” was explored during interviews and the results are presented in two sections, namely Section 4.4.1.1 entitled, “Catchment scale roles and relationships in river protection,” and Section 4.4.1.2 entitled “Sub-catchment scale stakeholder roles and relationships in river protection.” These sections are lengthy as the interviews were successful in providing a great deal of rich information pertaining to stakeholder roles and relationships in the catchment. Summary Tables 16 and 17 are provided at the beginning of Sections 4.4.1.1 and 4.4.1.2. respectively to guide the reader through the information presented.

Table 11 Results Synthesis

Objectives To gain an understanding of stakeholder views with respect to		Page References	Information Source	Results
a)	4.1. The NFEPA Project	76-77	4.1 Interview Results	4.1.1.1 Awareness and application of the NFEPA Project amongst stakeholders
b) (i)	4.2 Stakeholder engagement platforms relevant to stakeholders in the CRC and the SRC	78-81	4.2.1 Interview Results	4.2.1.1. International stakeholder engagement platforms 4.2.1.2. Regional stakeholder engagement platforms 4.2.1.3 Catchment scale stakeholder engagement platforms 4.2.1.4 Sub-catchment scale stakeholder engagement platforms
	4.3. The IUCMA Catchment Management Forum Meetings, specifically the CRF and the SRF meetings	81-90		
b) (ii)	4.3.1. The CRF Meeting	81-87	4.3.1.1 Interview Results 4.3.1.2 Reflection Survey 4.3.1.3 CRF Meeting Minutes 4.3.1.4 CRF Meeting Observations	
	4.3.2 The SRF Meeting	87-90	4.3.2.1 Interview Results 4.3.2.2 SRF Meeting Minutes 4.3.2.3 SRF Meeting Observations	
c)	4.4 Stakeholder roles and relationships relevant to protection of the Crocodile and Sabie Rivers	90-110	4.4.1 Interview Results	4.4.1.1 Catchment scale stakeholder roles and relationships in river protection 4.4.1.2. Sub-catchment scale stakeholder roles and relationships in river protection

4.1. Stakeholder views on the NFEPA Project

4.1.1. Interview Results

4.1.1.1. Awareness and application of the NFEPA Project amongst stakeholders

The key conservation stakeholders are aware of the NFEPA project and have experience applying it in the IRC. The NFEPA Project has been used to demarcate control areas for the introduction of trout into the Crocodile River in accordance with the National Environmental Management Biodiversity Act, Act 10 of 2004 (NEMBA), to respond to Water Use License (WUL) Applications and in developing Spatial Development Frameworks. At this stage the NFEPA project has not been integrated into everyday interaction or decision making as it is seen as a relatively new concept.

We refer to it (the NFEPA Management Guidelines) fairly often and we use it in our conservation plans. Our GIS land-use planner is using it- we are all using it. There is no other thing for us to use. We are even using it now with the NEMBA issue. Trout is an Alien Invasive Species Category 2. When it is introduced to a system, controls have to be put in place. The Federation of South African Fly Fishermen wanted to go to court. It ended up in DEA - a big story. Then we had to demarcate areas and so what did we do - we used the NFEPA. (Interview 8)

When we have to comment on a classification or a WUL, then we raise that not only does the river flow into the KNP - it is also a FEPA. So it provides added leverage to protect the freshwater resource. If we are working with municipalities or whoever else developing Spatial Development Frameworks, the NFEPA would be a key component of that dialogue. (Interview 5)

You wouldn't use the NFEPA in everyday interaction or decision-making as it is a relatively new concept. (Interview 5)

The conservation stakeholders expressed that at this stage the NFEPA Project constitutes a broad scale conservation tool that needs refinement at the local scale to become more relevant. The lack of up-to-date local NFEPA information has resulted in a forestry company using the project to justify its activities near a river. Although the MTPA conducts bio-monitoring surveys in the Sabie and Crocodile Rivers, this information is not being used to update the NFEPA Project at this stage.

The NFEPA maps were made with a broad-scale mind-set as it was impossible for them to go and sample every area and what they lack is on-the-ground expertise. I think a lot of people and organisations need to buy into it to improve it and refine it into something really great. (Interview 6)

My problem with NFEPA is that there are major gaps where we haven't got enough information. In one case forestry misused the NFEPA project. They said, "we are carrying on with our planting and our planting distances because the river is not an NFEPA area." So I went there and I did the survey and found 14 species, of which three are IUCN red data. (Interview 8)

When I was involved with the NFEPA project, they promised us they were going to update the NFEPAs regularly, but that hasn't been happening. The MTPA could never take an NFEPA and incorporate it into their models. The format is wrong. NFEPA has never been incorporated into the RIFDEN model. (Interview 8)

Apart from the conservation stakeholders, it was found that awareness and understanding of the NFEPA project amongst stakeholders was low. A Bushbuck Ridge resident expressed surprise that the Sabie River has been identified as a River FEPA and yet nothing has been done to curtail the large scale monoculture plantations upstream in the Sabie River.

I'm surprised that they talk about protecting this catchment along the Sabie – what are they doing? This place is overplanted with industrial timber plantations – the *Eucalyptus* - that uses more water than destroys our wetlands, destroys our grasslands and destroys our downstream water flow. (Interview 4)

Those stakeholders that were aware of the project provided brief replies when questioned about it. One stakeholder observed that no mention has been made of the NFEPA project at any of the CMF meetings attended.

I haven't used it (the project) yet. (Interview 12)

No, I don't use that document and I won't be able to assist you there at all. (Interview 9)

I am aware of that (project). (Interview 2)

I can't think of anyone ever mentioning NFEPAs at the forum meetings. (Interview 5)

Stakeholders expressed the view that other criteria are more relevant in river management than the NFEPAs, for example the Reserve Determination, Management Class and the RQOs. The stakeholders expressed that the NFEPA project lacks legal status which limits its application.

In general, KNP doesn't manage for FEPA, but they manage for the Reserve. A Reserve is a requirement in the NWA. In general, there is an emphasis on Reserve Determination and Management Class. (Interview 1)

Yes, I know about it (the NFEPA Project). I don't think it really filters through. I think the RQOs are something that everyone takes note of, and also from a licence point of view - that's one of the things that we need to include. Whereas yours obviously (the NFEPA project) at this stage, because it's not a legal document as such, it's a nice to have almost, to look at. (Interview 10).

My thing with NFEPA is that it's the only tool we've got that we can use at present. Unfortunately, it's not law. (Interview 8)

It is an important document, but it's not legally binding. (Interview 5)

4.2. Stakeholder views on Stakeholder Engagement Platforms

4.2.1. Interview Results

The following stakeholder engagement platforms were identified by the key stakeholders in interviews as relevant to river protection:

4.2.1.1. International Stakeholder Engagement Platforms

4.2.1.1.1. The Kingfisher Project

The Kingfisher Project is an international, multi-stakeholder meeting organized by a team from The Netherlands. The Dutch are world experts in legal agreements relating to worldwide water issues. Key representatives from the water sectors of Swaziland, Mozambique and South Africa attend. The meeting provides a platform to discuss the water sector challenges faced by the different countries.

We discussed everything relating to water from all three countries – their challenges and issues, the winners and losers. It was attended by 140 people and there were another 30 from The Netherlands (engineers, designing software planners). (Interview 12)

4.2.1.1.2. Trans-boundary Conference with Mozambique and Swaziland

A Transboundary Forum is held on an annual basis. This conference provides a platform where all the stakeholders from the water industry from South Africa, Mozambique and Swaziland meet to discuss water related issues.

Anyone can attend the Transboundary Conference. (Interview 10)

4.2.1.2. Regional Stakeholder Engagement Platforms

4.2.1.2.1. The DWS Strategy Meetings and Workshops

The DWS regularly organizes strategy meetings such as the Groundwater Strategies, Water Quality Management Strategies, Reconciliation Strategies and Reserve Determination Strategies. Climate Change Adaptation Workshops are also organized.

It is not mandatory for stakeholders to supply information at these strategies and workshops, but an effort is made to do so as it promotes good relations and protection of the water resource within the Catchment. Owing to time and logistical constraints it is not always possible to attend these strategies and workshops, but these meetings are prioritized and attended where possible. (Interview 5)

4.2.1.2.2. The Inter-Departmental Liaison Committee on Inland Water Ecosystems (IDLC)

The IDLC meeting occurs bi-annually and is chaired by the DWS, together with SANParks. This meeting promotes communication between all government departments with a freshwater conservation mandate. It was initially established as a DWS/SANParks meeting on low flow management issues and has since expanded to include a broader range of

stakeholders. Attendees include: SANBI; the DWS; the CMAs; the South African Earth Observation Network (SAEON); the CSIR and sometimes Non-Governmental Organizations (NGOs) attend.

You can raise issues of particular concern because you might get some high level output from that meeting. It's not run according to an agenda necessarily, its more an information sharing session. (Interview 5)

4.2.1.2.3. Water Research Commission (WRC) Reference Groups

WRC Reference Groups are attended by some conservation stakeholders in the catchment if they are of particular interest or if the stakeholders are assigned to the Steering Committee for a meeting.

4.2.1.3. Catchment Scale Stakeholder Engagement Forums

4.2.1.3.1. The Forum of Forums Meeting

The IUCMA has established a joint committee which represents the different catchments under its jurisdiction. This overall forum meeting for all the rivers in the catchment is held every three months

It's a new forum we've established, to bring to the top level what is happening in all the other rivers. (Interview 12)

4.2.1.3.2. The RQO Consultation Process

Consultation of stakeholders occurred during the RQO definition process in the IRC. This process was organized by the DWS and involved a broad range of stakeholders, some of whom formed part of the steering committee. The steering committee was permitted to give input into the process and played an important role in ensuring the relevant shareholders were present. The stakeholders expressed different views of the RQO definition process:

I think that the steering committee was quite good with in the way in which they got everyone involved. I think everyone that participated almost owns a little bit of the RQOs because we were actively involved in the system. I think the RQOs are something that everyone takes note of. (Interview 10)

We weren't happy with the process. The new RQOs came out for the Inkombati. Now we provided information and we told them that we don't agree with a lot of these things and they just didn't say anything - they just published them so now its cast in stone - we can't change those things. In the Sabie particularly, I'm very concerned. (Interview 8)

4.2.1.3.3. Women in Water Conference

Two years ago the IUCMA hosted a Women in Water Conference. This platform provided an opportunity for women to get together in the catchment and for the IUCMA to become aware of water-related challenges facing women.

Who is the one working most with the water? It is the women. They've got the most challenges - they're the ones who need to go and fetch the water. So it is important to get the women's eye on things, especially from a rural point of view. (Interview 10)

4.2.1.4. Sub-Catchment Scale Stakeholder Engagement Platforms

4.2.1.4.1. Integrated Water Resources Management Workshops

The IUCMA has a Division called the Institution and Participation (I&P) Division which runs IWRM Workshops in communities in the IRC. During the workshops, community members are educated about the quality of the local water resource, pollution, and what they can do to protect the resource. To date these community education efforts have been more input than output-based: IUCMA representatives arrive in a community, run an IWRM workshop, co-ordinate a clean-up campaign and then leave. When they return to the area at a later date, the IUCMA representatives find that the water resource situation has not changed since their last workshop. The community co-ordinator at the Bushbuck Ridge Office is heavily involved in IWRM workshops. The IUCMA is now planning on trying new and innovative ways of involving volunteer groups in preventing pollution in the communities.

We are going to introduce a stipend system - have a group of volunteers that are in charge of managing pollution in the resource, so that as time goes by and they prove to be competent and reliable, you register them as a waste management NGO. From then on they can access grants that will ensure they become a sustainable business. (Interview 2)

4.2.1.4.2. Adopt-A-River Meetings

Adopt-A-River groups conduct river clean-up activities in the vicinity of their villages along tributaries of the Sabie River. Meetings are held from time to time with other Adopt- a-River teams both upstream and downstream the river. The issues discussed at Adopt-A-River meetings depend on the challenges experienced in that particular region. In Bushbuck Ridge, for example, there is a potable water problem and the group plays an important role in warning the people not to drink directly from the streams.

The tributaries are prioritized because the communities in the villages pollute the tributaries which in turn pollutes the river. It is therefore logical to focus on tributary clean-ups. (Interview 7)

That (the information discussed at meetings) depends on the serious challenges in that particular region. In Bushbuck Ridge, for example, we have a potable water problem and whenever we are doing this research we always tell people that they mustn't be driven by thirst and go and drink from the streams. The average person in the community is not aware of *E. coli* at all. (Interview 4)

4.2.1.4.3. Media Platforms

There is an effort being made by a stakeholder in the catchment to allow the IUCMA to engage with a larger audience via the local radio station and the television. The local radio station is

providing a free 20 minute per week slot so that stakeholders can engage in conversation around the Crocodile River. A weekly seven-minute television slot is also available to keep stakeholders updated on the status of various projects relating to the Crocodile River.

We are going to have live calls into the station. My vision is to intermingle the different cultures – black and white, English and Afrikaans. There are 19 000 people listening to this radio station. (Interview 12)

4.2.1.4.4. School Competition (CRC)

For the past nine years, a stakeholder has been working with the Department of Education to organize an innovation school competition in the CRC. School children in Grades 10 and 11 are invited to design a Water Purification Plant. The teachers are trained in the basics of water purification and the costs involved, so that they can guide the children in their classes.

I began this project to make school children aware about water purification. Each child then interacts with his or her family at home in the different communities. (Interview 12)

4.3. Stakeholder views on the IUCMA Catchment Management Forum Meetings

4.3.1. *The CRF Meeting*

4.3.1.1. *Interview Results*

4.3.1.1.1. The difference between the CFM meetings and the Crocodile River Operations Committee CROCOC Meetings

The IUCMA has set up two different types of stakeholder engagement platforms within the IRC: The CMF and the CROCOC meetings. The CMF meetings are stakeholder platforms for resolving the diverse social issues experienced by stakeholders within the river catchments. The CRF and the SRF meetings are the CMFs held bi-monthly by the IUCMA to focus on the social issues in the Crocodile and Sabie River Catchments respectively. The CROCOC is a technical meeting formed 9 years ago and held quarterly to apply the river operating rules to the Crocodile River. Decisions are made at this meeting regarding the volume of water to be released from dams in the system. More recently the operating rules for the Sabie River have been included at the CROCOC meetings.

The CMFs are grass roots level organisations of stakeholders where they voice all their concerns. The issues are very broad, ranging from litter and diapers being thrown into the rivers, to water shortages and pollution. (Interview 5)

The CROCOC is more a technical meeting where they decide the planning and the water release and the water retention - the day-to-day, week-to-week water releases - they are not concerned with social issues. Demographics and social issues are discussed at the CMF meetings. (Interview 12)

The main purpose of the CROCOC is to apply the river operating rules – rules used to release water during droughts from dams for the purposes of irrigation and domestic use downstream. (Interview 9)

4.3.1.1.2. The CRF Meeting

The CRF meeting was commended for providing a forum where stakeholders feel comfortable with discussing any issues with authorities. These issues are discussed until “a way forward” has been agreed upon.

At the CRF meeting, everyone feels free to raise any issue. So they can challenge us, we can challenge them as the authority. Then we can move forward from there and see what is the best way forward. (Interview 10)

The stakeholders expressed that there is a lack of stakeholder representation at the CRF meeting. It was expressed that there is a need for influential people in the community to attend the CRF meetings. Specifically, it was mentioned that there is a lack of municipality representation and that the Department of Human Settlements should attend. Representation of stakeholders at the CRF meetings has decreased over time, possibly owing to feelings of intimidation and lack of capacity amongst stakeholders. In order to address this, the IUCMA intends to meet with key poorly-represented stakeholders (like the Irrigation Boards and the municipalities), outside of the CRF meetings to ensure that the stakeholders receive support in solving any issues highlighted at the CRF meetings. It is hoped that this support will allow stakeholders to feel more empowered when they attend the meetings.

Sometimes you look at the stakeholders that are in this Forum, there are not enough. Those stakeholders that are not in, some of them they make important decisions of who stays where. If you have people already staying in the wetland, there is nothing much that we can do to stop the pollution. What we need is to have the Human Settlement form part of this Forum because they also do their thing and design, so it will affect whatever water and sanitation that is to come. We need to do the planning at the same time. (Interview 11)

.....I think that the most concerning point is the lack of municipalities attending. (Interview 10)

When these CRF meetings started they were well-represented. Over time numbers have decreased because the communication language is English and the business of the day is lashing down at the municipalities. The meetings are such a short space of time and people are there to present. All the other work needs to happen in the background - where we can come to consensus on how as a sector they are going to sort out their challenges. This way when we are sitting at the Forum everybody is more comfortable, everybody is empowered. (Interview 2)

Key stakeholders expressed that attending the CFM meetings costs them time and productivity in other areas. The time spent attending meetings needs to be balanced with maintaining technical expertise in their positions. It was expressed by one stakeholder that the meetings are, “a waste of my time.” The CROCOC meetings are prioritized by the conservation

stakeholders and the Irrigation Boards above the CMF meetings as important river operations decisions are made at the CROCOC meetings.

Owing to time constraints and logistics, I focus on the meetings where decisions are made, which means I prioritize the Operations Committees above the CMFs. The Irrigation Boards are represented at the Operational Committees as these are decision-making. (Interview 5)

I mean I don't even normally attend. I mean it's not at my level. I just don't have the time to sit at these meetings, they are a waste of my time. (Interview 8)

They (the Irrigation Boards) are sitting on the CROCOC. They are farmers, they don't have time to attend the CRF. They call the CRF meeting a talk show. (Interview 12)

4.3.1.2. CRF Meeting Reflection Survey for 2016

Responses from the CRF Meeting Reflection Survey have been grouped into themes as shown in Tables 12 and 13 below.

Table 12: Summary of stakeholder reflections of the best achievement of the CRF Meeting in 2016

Themes	The best achievement in 2016 was:
Stakeholder Involvement/Representation	
Stakeholders expressed that they were satisfied with stakeholder attendance and collaboration at the CRF meeting from relevant stakeholders in the catchment.	<p>“Satisfactory attendance of key clients.”</p> <p>“Good attendance and knowledge sharing.”</p> <p>“Very good collaboration of all sector partners”.</p>
Some stakeholders expressed that there had been an improvement of stakeholder representation at the CRF meeting in 2016.	<p>“Getting increased attendance of SH representation.”</p> <p>“Getting certain municipalities on board – Bravo!”</p> <p>“Getting more stakeholders involved from the different industries.”</p>
Water Resource Protection/Enforcement	
Several stakeholders expressed success in achieving water resource protection and enforcement in the catchment.	<p>“More enforcement achieved.”</p> <p>“Ability to preserve our river system.”</p> <p>“More issues are being identified and resolved. The CMF meeting is growing.”</p> <p>“Being heard by authorities.”</p> <p>“Actions to solve problem.”</p>
Specific examples where issues were resolved were provided.	<p>“Illegal mining in NoordKaap addressed”</p> <p>“Fixing the problem at Hillsview.”</p> <p>“Avoiding the Drought disaster as Kwena Dam.”</p>
Capacity Building, Empowerment & Awareness	
Stakeholders expressed that capacity building, empowerment and awareness increased in the catchment in 2016.	<p>“Educate and empower the stakeholder with knowledge of water management in the catchment.”</p> <p>“Raising awareness of sewage spills.”</p>

Themes	The best achievement in 2016 was:
Specifically, the war on leaks project contributed capacity building and empowerment.	"Implementation of the war on leaks project with a total of 1081 unemployed youth trained in the province."
Running of the Meeting/ Meeting Effectiveness	
Various aspects of the meeting were praised by stakeholders.	"Well-structured minutes, good communication." "Consistency of reporting." "Review of agenda – meeting all interests of water users." "Being the best forum of the country, out of 19 CMAs."

Table 13: Summary of stakeholder reflections of the biggest challenge to achieving river protection in 2016 and how this should be fixed

Themes	What do you think is the Croc Forum's biggest single problem or challenge to achieve the objective to protect the river?	How must we fix this? (the above identified problem)?
Stakeholder Involvement/Representation		
The stakeholders expressed that not all the relevant parties attended the CRF meeting in 2016. Specifically, it was noted that the decision-makers at the municipalities, Department of Mineral Resources (DMR), DEA, Historically Disadvantaged Individuals (HDIs), Tribal Authorities (TAs) and farmers were poorly represented at the meeting.	"Not all water sector partners represented." "Responsible people (decision makers of municipalities) not attending the forum." "Not all stakeholders are represented, for example, the DMR." "Some of the stakeholders like Environmental Affairs not participating." "Non-attendance by HDIs. Zero attendance of TAs (Chiefs)." "Involvement of the farmers."	"Visit the different partners individually and encourage them to attend the forum." "Promote forum with municipal managers." "Invite DMR to form part of the forum." ? "Robust programme to woo them to attend." "Extend invitations to farmers."
Water Resource Protection/Enforcement		
Many respondents identified failure to resolve pollution caused by municipal waste treatment works and pump stations as the biggest challenge in the catchment. Specifically, the Kabokweni sewer pump is mentioned.	"Water pollution, especially from the municipal WWTW." The biggest problem is that no progress in terms of improvement of problematic water pumps especially in Kabokweni. "Pollution from non-functional treatments and pump stations."	"Enforcement by the IUCMA." Capacity building is highly supported, so that the SAPS will be able to understand our business and take action when cases are reported. "Direct engagements with the authorities both at local and provincial spheres of government to deal with poor infrastructure maintenance and rehabilitation."

Themes	What do you think is the Croc Forum's biggest single problem or challenge to achieve the objective to protect the river?	How must we fix this? (the above identified problem)?
	"Kabokweni sewer pump stations not sorted."	??
	"Waste Water Treatment Works (WWTWs), illegal dumping of wastes into the stream and manhole overflows."	"As one body, CRF, we can over overlook on the problems/challenges (put them as risk that will have danger to lives)."
Other issues requiring attention in terms of enforcement were River sand mining and drought/climate change.	"River sand mining."	Collaborate strategically in relevant departments – security, justice, health, traditional leaders, COGTA, DMR, DAFF, Civil Society, DoH, DEA and SAPS.
	"Drought/Climate change."	Align operating rules with Climate/Drought strategies. Assess illegal water use.
Lack of enforcement issues	"Almost becoming talk shop."	Increase power of the croc forum with media and SAPS.
	"The forum has no legal power to or status to further objectives."	Not in our power to fix.
	"The forum does not have funding to achieve objectives."	Funding – levies- but is this our responsibility? There are agencies to fix this. I believe it is the forum's responsibility to highlight issues and foster cooperation. Not to fix things.
	"To follow through with reported actions and get results from IUCMA/SAPS etc. "	We have the policies and the manpower, but we lack the implementation.
	"Dealing with some environmental offences."	
Capacity Building, Empowerment & Awareness		
Capacity building in the areas of education and awareness were identified by stakeholders as challenges in the catchment	"Water quality-civilians need education and awareness on nappy disposal."	Collaborate strategically in relevant departments – security, justice, health, traditional leaders, the Department of Cooperative Governance and Traditional Affairs (COGTA), DMR, DAFF, Civil Society, Department of Health (DoH), DEA and SAPS.
	Promotion/educating our communities on environmental (resource) management.	Promote some environmental awareness, especially to our local communities.

4.3.1.3. Review of CRF Meeting Minutes

The minutes of the CRF meeting for 26 August 2016, 21 October 2016, 25 November 2016 and 17 February 2017 (Appendix 5) were reviewed. Table 14 below provides a summary of the fixed items on the CRF Agenda.

Table 14: Fixed items on the agenda of the CRF meeting (August 2016 to February 2017)

ITEM	DETAILS
<i>Opening and Welcome</i>	
<i>Introductions and Apologies</i>	<ul style="list-style-type: none"> Apologies from stakeholders are noted here.
<i>Adoption of the Agenda</i>	<ul style="list-style-type: none"> The agenda is adopted and any additional items are noted, for example: stakeholder presentations added
<i>Minutes of previous minutes</i>	<ul style="list-style-type: none"> Minor alterations made to the previous meeting minutes are noted.
<i>Matters arising from the previous meeting minutes</i>	<ul style="list-style-type: none"> A brief summary is provided of the major issues identified in the previous meeting. Progress made on any of the issues is reported.
<i>Report back on water quality status</i>	<ul style="list-style-type: none"> Water quality monitoring results are presented by the IUCMA. The results for <i>E.coli</i>; EC; PO₄ and As are presented as either compliant or exceeding the RQO limits at specific sites along the main stem of the river. Pollution Incidents are reported. Questions or comments are raised and noted.
<i>Feedback on municipal WWTWs</i>	<ul style="list-style-type: none"> The City of Mbombela and Nkomazi local municipalities and Sembcorp present on any issues with their WWTWs. Questions or comments are raised and noted.
<i>Hydrological Status</i>	<ul style="list-style-type: none"> The hydrological status of the CRC is presented by the IUCMA. The dam releases; dam levels and rainfall status in the catchment are presented. Questions or comments are raised and noted.
<i>Feedback from any relevant workshops or conferences</i>	<ul style="list-style-type: none"> Stakeholder present feedback from workshops/conferences for example: The REMCO 2016 Conference; The Climate Change Adaptation Strategy and Implementation Strategy; the Waste Management and Classification Workshop and feedback from Bio-monitoring Surveys.
<i>Announcements</i>	<ul style="list-style-type: none"> Any Announcements from the Forum Chairman or the IUCMA are noted
<i>Date of next meeting</i>	
<i>Closure, lunch and departure</i>	

4.3.1.4. CRF Meeting Observations

The researcher attended the CRF meeting on the 17 February 2017. General observations made are noted below:

The CRF meeting was held at the Mbombela Stadium. The meeting started 5 minutes late and was professionally chaired. An attendee list was passed around for participants to sign. Several presentations were provided and attendees were permitted to ask questions. The stakeholders brought up the issue of the broken valve at Kwena Dam. They expressed that the issue was urgently requiring attention. The IUCMA executive manager responded to the stakeholders. The stakeholders remained unhappy and asked if the minister was aware of the issue. If the delay in fixing the valve was financial, then a stakeholder expressed he could provide the necessary funds to fix the valve.

When comparing the CMF meetings in the catchment, a stakeholder observed that the SRF meeting is very distinct from the CRF meeting.

With the exception of the KNP as a governance institution in both catchments, everything else is quite different. The CRC is far more progressed - It probably also has something to do with the economic viability of that Catchment - it has Nelspruit and large townships.
(Interview 5)

4.3.2. The SRF Meeting

4.3.2.1. Interview Results

Stakeholders expressed concern over poor representation of community stakeholders at the SRF meeting. It was suggested that people either can't afford to attend (as they are not paid to attend and their transport costs are not reimbursed) or they are simply not aware of the meetings. A suggestion was made that the SRF meetings be held in the villages in the SRC allowing more people to attend and the opportunity for them to voice local challenges. Another concern expressed was that the commercial farmers upstream of Hazyview do not attend the SRF meeting.

We can't talk of good water management if we don't bring anything from the indigenous knowledge water conservation base. (Interview 4)

We need to find a way to restructure the Forum in such a manner so that there is fair representation of all parties involved and a fair definition of tasks. (Interview 7)

I have never seen any people from the plantations attend and that is a serious concern.
(Interview 4)

I think (the commercial farmers) are invited, but I'm yet to see them. I think perhaps in the old days before I was working here and attending the Forums, they may have, but certainly over the past two years I haven't seen any direct interaction between commercial agriculture and these guys, which I think is a shame. (Interview 5).

The commercial farmers were attending the meetings initially, three to four years back. The officials from the IUCMA say that they do invite the commercial farmers. The Forum has to find a way of engaging these commercial farmers and other parties who should be attending but aren't. (Interview 7)

There is a sense of frustration amongst the SRC Stakeholders that the SRF meetings are "all talk and no action". There is concern that issues brought to the SRF meeting are not adequately addressed. It was suggested that task teams should be formed to address the issues raised with the relevant people assigned to each team. The teams would be required to provide feedback on the issue at the next meeting.

In a situation where people allocate themselves dwelling sites nearby the river. By law I think that is not allowed. Under such circumstances we should have a task team which would include representatives from the Tribal Authority (TA). In South Africa, in terms of land or site allocation - that is a task of the TA. So by creating a task team inclusive of the TA, it would be able to attend to such issues. Then there are issues of littering. Instead of people taking rubbish to the dumpsites they litter. We may have a task team looking at that. Every task team would be required to provide feedback at each meeting. (Interview 7)

It seems like it's a talk show. They talk about an awareness campaign now, but this meeting has been running for years, but still there is nothing tangible to say...here we achieved this or here we've achieved that or here we have mobilised the community in this way. (Interview 3).

The stakeholders expressed that improvements could be made to the way that the meetings are run. The meetings should start punctually. The meeting Agenda and copies of presentations should be made available to meeting attendees before the meeting. People should be given the opportunity to have their queries voiced and noted.

I don't think the farmers have been well briefed in terms of what to expect from the Forum. In the SRC, the Terms of Reference are not always circulated to everyone. (Interview 11).

Some people were cut off from asking questions. Now we don't know what they had to say. Now some of the relevant questions may have been left out. They promised to discuss these questions at the next meeting, but I don't think that is great as that person is here today, they may not be at the next meeting. (Interview 3)

4.3.2.2. Review of SRF Meeting Minutes

Owing to the poor recovery of SRF meeting minutes, only limited information was available for review. The broad outline of the SRF Meeting is provided from the minutes of the meeting held on the 27th February 2017 (Appendix 6) in Table 15 below:

Table 15: Minutes of SRF Meeting (27 February 2017):

ITEM	DETAILS
<i>Arrival and Registration</i>	
<i>Opening</i>	
<i>Welcome</i>	
<i>Apologies</i>	<ul style="list-style-type: none"> • Apologies from stakeholders are noted here.
<i>Presentations by the municipalities and hospitals on water quality, waste management; emissions and state of the Waste Water Treatment Plants (WWTPs) in the SRC.</i>	<ul style="list-style-type: none"> • No presentations were made by the municipalities. • A brief report back from Matikwane hospital highlighting challenges faced and Mapulaneng hospital providing information on waste management and potable water supply.
<i>Lima rural development</i>	<ul style="list-style-type: none"> • A presentation explaining that Lima rural development are based at Bushbuckridge and offer support to farmers.
<i>Revenue management</i>	<ul style="list-style-type: none"> • IUCMA presented the 2017/2018 approved tariffs.
<i>Water Quality</i>	<ul style="list-style-type: none"> • Broad observations from water quality monitoring results presented. "He indicated that all monitoring points are not complying because of illegal discharges and illegal dumping." • It was noted that EC and PO₄ were complying, but that 2015 to early 2016 was not complying.
<i>Water Quantity</i>	<ul style="list-style-type: none"> • The dam levels for the Inyaka and Degama dams were provided. • It was commented that the recent rains led to improved levels in these dams. "We don't have enough water yet we need to conserve the little that we are having".

4.3.2.3. SRF Meeting Observations

The researcher attended the SRF meeting on the 22 August 2016. General observations made are noted below:

The SRF meeting was held at the Numbi Hotel in Hazyview. The meeting started about 20 minutes late. An attendee list was passed around for participants to sign. The Chairman of the meeting was unable to make the meeting so the meeting was chaired by the chairman of the Sabie River Emerging Farmer Association. The meeting was well-run by the Chairman. Several presentations were made. Attendees expressed disappointment that the Bushbuck Ridge Local Municipality was unable to attend the meeting and had sent a representative instead. Disappointment was also expressed when they were told that certain questions could not be addressed at the meeting because the relevant person was absent. They were asked to bring their questions again to the next meeting.

A stakeholder provided the following description of the SRF meeting during an interview:

The SRF meeting now has typical fixed points on the Agenda, for example water quality feedback from the CMA; feedback from the main water users. The Forum is particularly made up of emerging farmers or historically disadvantaged farmers. The dialogue is very centred towards their sorts of concerns, nothing big/macro, but local level issues. (Interview 5)

4.4. Stakeholder views on stakeholder roles and relationships in river protection

4.4.1. Catchment scale stakeholder roles and relationships in river protection

4.4.1.1. Interview Results

Table 16 provides a guide to the reader of the results presented in this section.

Table 16 Summary of results relating to catchment scale stakeholder roles and relationships

Research Objective	Results
	<p>4.4.1.1.1. Roles of key stakeholders in river management</p> <p>The IUCMA SANParks The MTPA The Municipalities The Irrigation Boards</p>
	<p>4.4.1.1.2. Stakeholder collaboration in river management</p> <p><u>Water Quality Monitoring</u></p> <ul style="list-style-type: none"> • SANParks and the DWS • SANParks and the MTPA • The IUCMA and Rhodes University <p><u>River Flow Monitoring</u></p> <ul style="list-style-type: none"> • Conservation stakeholders • The Irrigation Boards and the IUCMA • SANParks, the DWS, the IUCMA, the Irrigation Boards and the CROCOC
	<p>4.1.1.3. Roles of key stakeholders in enforcement of river protection</p> <p><u>The IUCMA</u></p> <ul style="list-style-type: none"> • Enforcement of water quality compliance • Enforcement of water quantity compliance • Establishment of the IUCMA Compliance, Monitoring and Enforcement Department <p><u>Interactions between the IUCMA and other key stakeholders in the Catchment</u></p> <ul style="list-style-type: none"> • Withdrawal by the DWS of authority previously delegated to the IUCMA • Issues encountered with enforcing water quality standards on local government. • Collaboration between the IUCMA, the DWS and COGTA to address enforcement challenges in the catchment. • The relationship between the IUCMA and the DWS

4.4.1.1.1. Roles of key stakeholders in river management

Interview results provide insights into the roles that the different key stakeholders (the IUCMA, SANParks, the MTPA, the Municipalities and the Irrigation Boards) play in river management in the IRC.

The IUCMA

The IUCMA conducts water quality and water quantity monitoring in the catchment in accordance with the ICMS. In general, it appears that in the past management of the Crocodile River has received more attention than the Sabie River.

The ICMS outlines the main strategic plan for the whole WMA in respect to the full water protection spectrum, including both water quality and water quantity management. (Interview 9)

In terms of management, the Sabie River is like the “little sister” to the Crocodile River. Systems developed in the Crocodile River usually filter down to the Sabie River over time. (Interview 5)

The focus of the IUCMA is on the management of the Crocodile River as it is the economic driver of the lowveld and there is strong international interest in the river owing to trans-boundary issues that arise. (Interview 8)

SANParks

SANParks performs water quality monitoring and bio-monitoring in the KNP. The SANPark’s freshwater ecologist performs *in situ* water quality analysis which provides a snapshot picture annually of the water quality of the Sabie and Crocodile Rivers. SANParks technical department also collects river water quality data as part of the KNP’s WUL Requirements. In addition, SANParks has recently commenced their own broad spectrum water analysis as an early warning screening method for water supply issues to staff and tourist camps.

The MTPA

The MTPA manage all the provincial nature reserves in the catchment. They issue Aquatic Conservation-Fishing permits outside the KNP. The MTPA are also involved in mining regulation within the catchment.

If there is a mining concern that’s associated with the water resources, the MTPA will be expected to comment and maybe even provide some kind of injunction on that process. They’re good on the terrestrial perspective with respect to mining – they have a useful diversity planning decision support system or dashboard on the internet. (Interview 5).

Bio-monitoring surveys are performed by the MTPA aquatic scientists on a catchment scale with some surveys extending into Mozambique. The MTPA is commissioned by the IUCMA to conduct Ecostatus Studies of the major rivers in the IRC. A minimum of 50 bio-monitoring sites are surveyed per river and reported on. Water quality is also reported on. Water quantity is not measured. Different bio-monitoring data including fish, macroinvertebrates and riparian

vegetation are captured digitally and fed into the RIFDEN computer model. The Integrated Ecological Status of each river is calculated using this model.

The River Ecostatus Reports are subjected to a peer review process, are finalised and placed on the IUCMA website. They work on a four-year rotation, so they start with the Sabie in year one and in year two do the next river and so forth. The Sabie River Ecostatus Report is currently in draft form (at the beginning of 2017). After the Sabie River, the Crocodile River will be next. (Interview 8)

The Municipalities

The municipalities are responsible for treating wastewater in the catchment. The municipalities must ensure that the water returning to the water source complies to water quality standards stipulated in their WULs.

Like any occupier of land, that municipality, when they work with their WWTWs, have the duty to ensure that the quality of the water going back to the source is in compliance with their WUL. And then of course municipalities have the general duty of environmental health to comply with. (Interview 9)

The Irrigation Boards

The IRC is heavily irrigated according to water allocations handed out under the previous Water Act of 1956, therefore the Irrigation Boards are still operating successfully. Two WUAs were established in the catchment, but they are not operating successfully. One of the reasons, provided by a stakeholder, that the Irrigation Boards haven't transformed into WUAs is because of the high number of irrigators operating in the Irrigation Districts. In other catchments where irrigation is only one of a variety of water users in the Irrigation Districts, WUAs have been successfully established.

There was a time given that all Irrigation Boards had to transform into WUAs. One of the reasons why it didn't work in our area - when you look at the Irrigation Districts - it was mostly only irrigators. And how can you now involve other water users within that area not using the water? It doesn't make sense to have a non-water user sitting in your water association. He doesn't have an interest there. (Interview 9)

Under the Water Act 54 of 1956, water allocations for farming were calculated and recorded in Schedules of Rateable Areas and the Minister could assign the management of water to an Irrigation Board. In this way the Minister transferred responsibility and accountability for the management of water allocations to the Irrigation Boards in the IRC. Therefore, the Irrigation Boards control, manage and administer their allocation of water amongst the farmers in each Irrigation Board within the catchment. Accordingly, the Irrigation Boards report directly to the Minister and not to the IUCMA. It appears that the Irrigation Boards have even been given control over the water use required by other industries in some cases.

They (the Irrigation Boards) do the total management of the water resource within their Irrigation District. It's their duty in terms of the assigned power that they received in

terms of Section 89 of the old Act. And they have infrastructures to allocate the water and, of course, and part of that is by implication, they must also make sure that the quality of the water is sufficient for irrigation. (Interview 9)

Most of our Irrigation Boards cover the same areas as Government Control Areas, so even to control that water for the other industries was then given to the Irrigation Boards. (Interview 9)

4.4.1.1.2. Stakeholder Collaboration in River Management

The interview results reveal that key stakeholders in the IRC collaborate to perform certain water management functions.

Water Quality Monitoring

SANParks and the DWS

SANParks conducts a water quality programme in collaboration with the DWS whereby a SANParks biotechnician submits water samples every month to the DWS at Roodeplaat as part of the Resource Quality Information Services (RQIS) programme. In this way SANParks contributes to the national dataset and downloads this data for their own reporting and a water quality record is maintained.

SANParks and the MTPA

The MTPA has a close relationship with SANParks as they are involved with bio-monitoring KNP's rivers.

Well we are working together until a certain stage. All of us. The MTPA work closely with SANParks. The MTPA do their monitoring for them in the rivers. SANParks only operate in the KNP, but the MTPA operate at a catchment scale starting at the top. (Interview 8)

The IUCMA and Rhodes University

Real-time water quality management is being initiated through the THRIP project, a collaboration between Rhodes University and the IUCMA. This real-time water quality management will obviously benefit all the users and enable them to manage the loads in the river according to the available quantity.

The THRIP project is particularly focussed on the Crocodile River and not on the Sabie River as yet. (Interview 5)

River flow monitoring

Conservation stakeholders

The conservation stakeholders have been managing the flow of these rivers in the KNP to maintain the Ecological Reserve as prescribed by the NWA.

We have pushed for environmental flows and the KNP has pushed for it as well - I mean I'm pushing for water because it's to the benefit of the entire system. (Interview 8)

The Irrigation Boards and the IUCMA

A hydrological model based on a baseline value has been designed and is implemented in the Crocodile River¹. The Irrigation Board reports to the IUCMA on the status of the hydrological model. The Irrigation Board Water Manager audits the water use of all the abstractors along the Crocodile River and reports if water should be released into the system or not.

SANPark, the DWS, the IUCMA, the Irrigation Boards and the CROCOC

The DWS has river flow gauges along the Sabie and the Crocodile Rivers. SANParks simply access the DWS real-time online data sources for accurate river flow monitoring data. SANParks performs flow verification on the gauge plate readings: a SANParks Biotechnician monitors river flow along the Crocodile and Sabie Rivers and sends gauge plate readings from the different DWS monitoring points to the CMA and the DWS so that they can calibrate their instruments on a regular basis.

Recently photographs of the gauge plates have been sent via a WhatsApp group. This has led to an improvement in monitoring results generated. (Interview 1)

If a deviation in the flow results relative to the flow forecasted by the hydrological model is noted, the SANParks Biotechnician raises the alarm and informs the water manager of the Irrigation Board. The manager contacts the River Operations and Information Manager at the IUCMA who then calls a meeting of the CROCOC Committee. The level of deviation from predicted flow is ranked as high, medium or low and the appropriate corrective management action is initiated by the necessary stakeholders. Although the CROCOC was initially formed as a communication platform for water quantity changes in the Crocodile River, the Sabie River has recently also been included.

4.4.1.1.3. Roles of key stakeholders in enforcement of river protection

The IUCMA

The IUCMA plays a key enforcement role in the catchment.

The water resource within the Crocodile and Sabie Rivers is protected by the IUCMA. (Interview 5)

I think the first who is participating in the protection is the IUCMA. (Interview 11)

It is our mandate (the IUCMA) to protect the river so we would be using the various instruments that are available. We will use the instruments such as the licenses for resource protection. For example, with licensing, we are able to know who is abstracting,

¹ At the time interviews were conducted for this research the Reserve for the IRC had not been gazetted. The proposed Reserve Determination for the water resources of the IRC were recently published for public comment according to the Government Gazette 41237, released on 10 November 2017.

who is discharging. Then we make the recommendations in terms of the licensing conditions. (Interview 2)

The IUCMA has grown in staff over time. It is noteworthy that there appear to be far less staff at the ICUMA satellite office in Bushbuck Ridge in the Sabie-Sand River Catchment than at the IUCMA offices in Mbombela.

When I started here (at the IUCMA offices in Mbombela), we were 92 people. We are now much more. We do have a satellite office at Bushbuckridge -with a minimum of 10 employees - we have a Control Environmental Officer, two Environmental Officers, we have two Community Officers. (Interview 9)

Enforcement of water quality compliance

In terms of Section 19 of the NWA, the IUCMA is authorised to issue directives in response to pollution of water resources in the catchment. If a person should fail to comply or comply inadequately with a directive given, then the CMA may take the measures it considers necessary to remedy the situation. Every quarter the IUCMA report on the water resource pollution instances and issue directives which are then followed up. The bio-monitoring information supplied by the MTPA to the IUCMA alert them to any biological changes in the rivers in response to water quality and quantity.

If a problem is detected in the bio-monitoring results in the Crocodile River, then the first point of contact is the IUCMA. The IUCMA react promptly when an issue is reported. The IUCMA and then DWS are the enforcers. We (the MTPA) are the scientists and we are just going to supply the information. (Interview 8)

Section 19, Sub-Section 3, of the NWA states a CMA, (not the DWS or the Minister), a CMA may direct any person who fails to take the measures required under Sub-Section 1 to commence taking specific measures before a given date and to diligently continue those measures or continue them before a given date. (Interview 9)

Enforcement of water quantity compliance

In terms of Chapter 4 of the NWA which refers to water use, reference is made to the “responsible authority” with respect to issuing of general authorisations and licenses. The Minister, not the IUCMA, is the responsible authority in terms of enforcing water quantity compliance in the catchment. The IUCMA is, by administrative agreement, involved in assisting with processing the WULs, but the final decision is taken by the Minister in Pretoria.

This is a very technical point in law- who should sign a water use authorisation? It must be the Minister in person. Those things are not assigned to us, although we are by administrative agreement, we are assisting with the processing of WUL Applications, but the decision is taken at Pretoria, not here. (Interview 9)

The establishment of the IUCMA Compliance, Monitoring and Enforcement Department

At the time of interviewing the IUCMA was in the process of establishing an independent department called Compliance, Monitoring and Enforcement. This unit will be headed up by a manager and will be responsible for the full spectrum of duties with respect to water quality

regulation. In terms of water quantity regulation, the IUCMA will conduct inspections, even provide a full audit of compliance, but if there is non-compliance detected, then the matter will be handed over to the Compliance, Monitoring and Enforcement unit at the DWS.

So in respect of Sections 19 and 20 of our water quality, we can finalise everything, but when it comes to compliance with WULs, the quantity part, then they (the Compliance, Monitoring and Enforcement Division at the IUCMA) will do the inspection, they will do even a full audit on the compliance, but if there's no non-compliance then it is unfortunate that at this point in time we have to hand it over to the Compliance, Monitoring and Enforcement unit at the Department. (Interview 9)

Interactions between the IUCMA and other key stakeholders in the Catchment

Withdrawal by the DWS of authority previously delegated to the IUCMA

In the past the CMA used to perform the full programme of regulation with respect to water quantity, they used to issue directives and take remedial action, but this authority has recently been withdrawn. The withdrawing of authority from the IUCMA with respect to water quantity regulation in the catchment has hampered progress in certain instances.

Recently the Minister revoked some of the authority previously awarded to the IUCMA. The IUCMA is continuing to function and do what it can, but there are now challenges in getting things acted upon in the catchment, particularly in the SRC where sand mining is occurring. Getting a result from these kind of issues has been a bit of a problem over the last couple of months because of that grey area on the delegations. I think that grey area has created a bit of uncertainty between the two organisations. Which is leading to a bit of a problem. For us, it's a risk – it obviously is a risk for the IUCMA – in the long term – we view it as a particular risk. We know that when the IUCMA has the delegation – especially when it comes to water resource protection – it only got that delegation two years ago - to revoke that is a bit of a threat to the status of the catchment. But look they are carrying on doing what they can. (Interview 5)

Issues encountered with enforcing water quality standards on local government

The issuing of directives has been effective in dealing with pollution violations by the private sector such as mining and other industries. Enforcing water quality standards on the public sector, for example local government, has been problematic.

It is very difficult when you are talking about the public sector, specifically when you are talking about the local government. If the WWTPs are not working optimally and there are those kinds of discharges, then it requires a lot of money and sometimes the capacity thing, sometimes it's an operational and maintenance issue - so there we have had a little bit of a problem. (Interview 2)

Collaboration between the IUCMA, the DWS and COGTA to address enforcement challenges in the Catchment

The IUCMA is collaborating with the regional office of the DWS and COGTA to address the biggest challenges faced in the catchment. The IUCMA is putting aside a small budget to assist with temporary solutions to minimize pollution from failing WWTPs while the plants are being fixed or new plants are being constructed. Examples of these measures would be to

construct sedimentation dams, initiate clean-ups, things that are not very expensive and that can still serve a purpose later when the WWTP is working.

In terms of inter-governmental relations, you can't take another department to court, you can't take a municipality to court. You should indicate that you have exhausted all means possible so that's notices and directives. Now we have realigned ourselves together with the Regional Office and the provincial COGTA to say let us understand where our biggest challenges are. The IUCMA is starting to put aside a small budget to assist with temporary solutions/measures to ensure that pollution from WWTPs is reduced in the next 3 to 5 years while new plants are being constructed. We are trying to show the Department that we can be their implementing agent in some of these projects. (Interview 2)

The relationship between the IUCMA and the DWS

The Regional Office of the DWS oversees the work of the IUCMA.

So if we are doing Compliance, Monitoring and Enforcement and the quality of the resource is not improving then the Department will pick up on that and ask for reasons why. (Interview 2)

4.4.2. Sub-catchment Scale stakeholder roles and relationships in river protection

4.4.2.1. Interview Results

Table 17 provides a guide to the reader of the results presented in this section.

Table 17 Summary of results relating to sub-catchment scale stakeholder roles and relationships

		Results
CRC (Section 4.4.2.1.1)	Stakeholders involved in river protection	Sembcorp-Silulumanzi
		The Municipalities
		The Irrigation Boards
	Catchment stakeholder relations	Stakeholder-stakeholder relationships
		Stakeholder relationships with the IUCMA
	Crisis management, conflict resolution and enforcement	Contamination in the Kaap River Tributary
		Anoxic conditions caused by water hyacinth control
		Invasive crayfish
		Response to low flow in the Crocodile River
		Tension between stakeholders owing to a lack of conflict resolution
		Tension between stakeholders as a result of failing sewage treatment works
		Tension between stakeholders as a result of uncoordinated infrastructure development
		Tension between the MTPA and a company practicing aqua-culture in the Linskip River
		Lack of communication between a key stakeholder and the community

SRC (Section 4.4.2.1.2)	Stakeholders involved in river protection	Stakeholder efforts to improve water quality Stakeholder water quantity concerns
	Catchment stakeholder relations	Lack of communication between key stakeholders Collaboration between SANParks, the DoA and the emerging farmers
		Key stakeholders contacted in a freshwater crisis Lack of response to a waste incident at Nyaka Dam Lack of response to a cholera outbreak
	Crisis management, conflict resolution and enforcement	Confrontation between a conservation stakeholder and a forestry company

4.4.2.1.1. The CRC

A diverse number of economic activities occurring in the CRC require water, including: mining; milling; farming; hotels; industry including TSB Sugar (Pty) Ltd. (TSB) and Sappi Ngodwana Mill; private game farms and aquaculture. Irrigation is a major water user in the CRC and the Water Boards abstract water to provide bulk water supplies to the municipalities.

There are a large spectrum of users and a strong presence of Irrigation Boards controlling flows. (Interview 8)

The Crocodile River region near Mbombela is the economic hub outside the KNP. (Interview 5)

A big challenge to water quality in the catchment are issues related to waste water management.

A major problem in the CRC is that most of the WWTPs aren't operating. (Interview 8)

Stakeholders involved in river protection in the CRC

Stakeholders identified the roles of key stakeholders, including Sembcorp Silulumanzi (Sembcorp); the CMLM, and the Irrigation Boards involved in river protection in the CRC.

Sembcorp Silulumanzi

Sembcorp is a private company contracted by the CMLM. According to a 30-year concession contract with the CMLM, Sembcorp is responsible for all water and sanitation services within the concession area, which includes the city of Mbombela. Sembcorp runs five water treatment works, one water package plant, three full sewage treatment works and oversees one sewage package plant. Unlike the municipality which focuses on a broad range of issues (for example, roads and power), Sembcorp is purely focussed on water and sanitation services. The CMLM monitor Sembcorp on a continuous basis and conduct five year reviews to check that Sembcorp has met stipulated targets.

We (Sembcorp) do the abstraction, we do the water verification, distribution to the customers and the customers pay us, they won't pay the municipality for the potable water. We do the sewage connector system, we purify the sewage and we put it back in the river. They (the CMLM) have a section called the Monitoring Unit which monitors us

specifically on our contract and conditions and what do we do. They are based in our offices. If we do have any meetings we include them in that and that really works quite well. (Interview 10)

Sembcorp monitor the water quality upstream and downstream of their WWTPs weekly and river quality at random sites monthly. Sembcorp have early warning systems in place to alert them to any water quality issues before the water reaches their water treatment works. Water quantity is also monitored. Sembcorp is part of the CROCOC because low flow rates affect their ability to abstract from the river.

From a water quality point of view, we have early warning systems in Nelspruit as well as near Matsulu which give us a four-hour warning for instance on high turbidities entering our systems - so then we know we have to watch out for our water treatment works and then we know whether we can switch off or whether we will be able to cope with the high turbidities at the plant at that stage. (Interview 10)

We are part of the CROCOC Forum Technical Section because the flow definitely affects our abstraction, especially going down to Matsulu. If the flow is low, then we can't abstract. That's one of the first points we have issues with - water not being available for abstraction. For instance, we now even monitor the volumes of water released at the sluice gates of Kwena Dam. (Interview 10)

Sembcorp have their own laboratory (they conduct their own in-house analyses, but if a problem is detected, the samples are sent to an accredited laboratory for credible analysis), employ competent staff who are also offered training. Sembcorp has been recognised both locally and internationally for good performance in their concession area.

Our WWTPs are some of the only ones that have achieved a Green Drop for Mpumalanga. Mbombela hasn't lost a blue drop since the commencement of the programme in 2009. We've got good management systems in place. The World Bank did a study on us in 2010 and we were one of the few concessions that is really working and effective. There have been a number of delegations from all over the world, for example the Phillipines, that have come to us to see what we are doing and why it is working here. (Interview 10)

The Municipalities

In the IRC, the municipality faces challenges of having to use ageing infrastructure, being understaffed and having to deal with a very high backlog.

We always do have challenges, that one of saying we are understaffed and our infrastructure is ageing and the backlog is very high. (Interview 11)

The CMLM monitors water quality regularly. Water quality is monitored both upstream and downstream of the WWTP and the quality of the water being discharged from the plant is monitored. Water quality is also monitored in boreholes. Operational water quality tests are conducted by the municipality on a daily basis. An external laboratory tests water quality twice a month. The water quality results are uploaded onto the DWS platform where they can be accessed by the public.

The municipality prepares for potential risk within the catchment by developing Water Safety Plans for WWTWs and Waste Water Risk Abatement Plans for waste water pipelines. The municipality design engineers make use of WRC Guidelines in preparation of their Risk Abatement Plans. The WRC have published guidelines that are used to compile the Risk Abatement Plans. The municipality design engineers would appreciate feedback from other key stakeholders regarding documents submitted for comment.

We develop our documents, we also give them for commenting, of which we don't get that much response. We didn't get any inputs from the IUCMA. We didn't get any inputs from the Environmental Affairs. Nobody gave us input. We would value the input. We are not saying put your funding in, we are saying put your minds in because you are the one who is going to assess our plant. (Interview 11)

Unfortunately, when the infrastructure was transferred to the municipality not all the relevant documents were passed on. Now things are improving as the CMLM has developed all the necessary plans and documents for the operation of their plants.

When there was transfer there was no transfer of all the documents - so it's a matter of saying maybe you've got a very good car but you don't know that there's a cruise control...On the ground things are improving as the CMLM has now developed all the necessary plans and documents for the operation of their plants, including the operational manual. (Interview 11)

The Municipality has a 24-hour response maintenance team to fix broken infrastructure.

When our pump is broken we have the maintenance team. So every time the maintenance team will stand by. I know we have a 24-hour response team. (Interview 11)

The municipality are modifying their waste pipe design to minimise blockages like tin cans from occurring. Instead of a 110 or 160mm diameter pipe, they are planning to install 200mm diameter pipes. In certain areas they are installing grinders to grind material that may potentially block the pipe so that it can be pumped out.

The Irrigation Boards

The Irrigation Boards control, manage and administer their allocation of water amongst the farmers in each Irrigation District within the catchment. Although well run, subsistence farmers in the communities find it challenging to apply to an Irrigation Board for water.

We've got good Irrigation Boards and they are actually very active. (Interview 10)

We are finding that the Irrigation Boards are holding all of the water, even for communities to do subsistence farming it is very difficult. Because you must apply to the Irrigation Board. How do we then say what is the Irrigation Board willing to give up for empowerment? (Interview 2)

Catchment Stakeholder Relations

Stakeholder-Stakeholder Relationships

Interview results indicate that the stakeholders in the CRC are well-connected for several reasons: Relationships are built in the catchment by organisations being required to identify and involve relevant stakeholders in the catchment according to their ISO-accreditation status, WULs or Water Safety Plans.

In order to manage risk, as part of their Water Safety Plans, the municipalities are required to identify all stakeholders relevant to the abstraction area. Once identified, the municipality needs to visit the major stakeholder sites, look at their spill procedures in order to gain an understanding of what the effect would be on the municipality water supply should a spill occur (i.e. what possible contamination could occur). It is also important to understand how the stakeholder would react to an emergency and how they would notify the municipality. Often the WUL held by the major stakeholder in turn requires them to make relevant information available to the community

So, for instance, let's say SAPPI is one of our stakeholders in our Water Safety Plan. When we go to them they say but you should be on our emergency list as well and then they include us in their list. So we now are part of their environmental group even though we are downstream and we don't have anything physically to do with their operations. They include and invite us to their Environmental Stakeholder Forums so that we can continue to build a relationship with the respective Risk Managers, so in case of an emergency everyone knows everyone and it is easy to communicate with everyone. (Interview 10)

The stakeholders obtain each other's contact details at the CRF meetings.

So a lot of the members which we met there say let me get your number, so as soon as something happens they notify us and we do the same for them downstream as well. (Interview 10)

Everybody, the CRF Forum Chairman, the Irrigation Board, the users, the farmers downstream of the KNP, everybody is on the WhatsApp group and if somebody sees a dead fish out goes a message and everybody starts reacting. (Interview 12)

Stakeholder relationships with the IUCMA

The interviews reveal that stakeholders have a good relationship with the IUCMA. The IUCMA communicate regularly with stakeholders on their Water Users Registration Database. Unfortunately, at this stage, the IUCMA are unable to inform stakeholders when a WWTWs fails in the catchment

I think we've got a good relationship with them (the IUCMA). So I know I can phone any of them at any time and say we've got this problem and this is what we are doing to rectify the problem and they will come out on site and they will verify that this is what we are doing so that they know. (Interview 10)

We are constantly communicating with our stakeholders on the stakeholder database. We communicate on our electronic database things like the warning about the drought and any restrictions. (Interview 2)

Crisis Management, Conflict Resolution and Enforcement

In a water crisis, the first point of communication in the CRC is the IUCMA and then, depending on where the crisis is situated, everyone downstream of the site gets notified. WhatsApp groups, phone calls and emails are used. If necessary, the key stakeholders meet on site, to assess the incident.

The stakeholders reported on several incidents in the CRC where stakeholder collective action was instrumental in averting crises in the Catchment.

Contamination in the Kaap River Tributary

During the afternoon of the 24 September 2015 a report was received that fish were dying in the Kaap River, a tributary of the Crocodile River. It is known by the SANParks KNP freshwater management staff that there are illegal and abandoned mines in the Kaap River Catchment. The KNP freshwater ecologist flew by helicopter to the site and was able to take some samples which were sent to a laboratory for analysis. The KNP freshwater management team contacted the chairperson of the CRF using WhatsApp and a WhatsApp Group including people from the relevant sectors was established.

The laboratory analysis received the following day confirmed cyanide was present in the water analysed and the laboratory personnel advised that all abstraction from the river be ceased. Fortunately, Sembcorp had already been alerted to the potential water quality issue as there is an abstraction point in Matsulu (just upstream of the KNP) and it services approximately 500 000 people.

Owing to efficient real-time communication amongst the relevant stakeholders, a potential catastrophe was averted. Fortunately, the pollution was fairly localized within the Kaap River, but there had been a real possibility that cyanide could have gone into the water supply. Owing to the quick reaction of the KNP SANParks staff who were able to fly to the site and take samples, a potential socio-economic disaster was averted. The IUCMA tracked the cyanide spill back to one particular company, however, it is not known whether or not they were prosecuted. (Interview 5)

Two years back we had an incident in the Northern Kaap River where there was some contamination. We established a WhatsApp group immediately and everyone just went out and took samples out of their own will. It wasn't necessarily anyone's responsibility to do that, but because different stakeholders in different areas actually sampled so we could monitor the effect up and downstream in the river - so I think we've got good crisis communication systems set up already (Interview 10)

Anoxic water conditions caused by water hyacinth control

Also in September 2015, the DoA was spraying water hyacinth in the Crocodile River. The spraying resulted in the large scale decay of the water hyacinth and anoxic conditions in the river. By October, temperatures were rising (35-40°C during the day), the river was very low and so was the level of dissolved oxygen.

Despite notifying other water users in the catchment, the DoA did not inform SANParks of their intention to control the water hyacinth using spraying. Nevertheless, SANParks KNP staff managed to relate the kills to this aerial spraying. SANParks organized the temporary closure of a sugar mill which was abstracting water for its operations in order to protect the water resource.

SANParks was able to overcome a communication breakdown and co-operate closely with a neighbour to protect the water resource. (Interview 5)

Invasive Crayfish

A South American species of crayfish has been in the Komati River for a long time, but has successfully been kept out of the Crocodile River. Recently the Irrigation Board notified SANParks that there was a population of invasive crayfish at the Van Grannen weir which is one of their large abstraction points used to augment their water supply to the lower ends of the system. SANParks in association with the MTPA are conducting an Extent of Invasion Analysis in order to quantify the impact caused by the invasive species.

The Crayfish has entered the Komati River - it came from Swaziland. It will have a major impact on the prawn industry in Mozambique. It's going to affect dam safety and weirs as they crawl into the infrastructure. It appears to have an effect on the indigenous crab as well (Interview 8)

Response to low flow in the Crocodile River

During November and December 2015 and January 2016 the temperature was so extreme that the Crocodile River stopped flowing. All the farmers were using rock hauls and sandbanks to divert the flow to their farms. At Crocodile Bridge the river had stopped flowing, however, below Crocodile Bridge there was still a trickle of water flowing. The outflow at Tenbosch which is SANParks last gauging weir was 0.3 to 0.4m³ before the river flows into the Komati system and into Mozambique. Through direct communication between SANParks, the River Manager at the IUCMA and the head of the Irrigation Board, the Crocodile River was kept flowing.

Despite owners of lodges and hotels questioning the KNP about why water was being diverted to the river, a nasty conflict didn't result. This is thought to be owing to the progress made through the CROCOC. Successful collaboration between SANParks, the Irrigation Boards and the IUCMA ensured that the river kept flowing. (Interview 5)

Tension between stakeholders owing to a lack of conflict resolution

Failing sewage treatment works, uncoordinated development of settlements and aquaculture activities have caused tension between key stakeholders in the CRC.

Tension between key stakeholders as a result of failing sewage treatment works

Last year major blue algae problems were noted by stakeholders at the Primkop Dam. This dam supplies water to all the surrounding irrigation farms. The presence of the blue-green

algae was linked to the White River WWTP not operating effectively. Sewage was entering the dam and stakeholders had to stop abstracting from the river.

There was sewage getting into the system and we stakeholders couldn't abstract from the river. So it affected the municipality on its own, but if we didn't detect and do the analysis and so forth, no one would ever have realised that there was such a problem there and they still would have been abstracting to the community. (Interview 10)

The White Water WWTP – half the equipment isn't working. The algae was picked up maybe in February last year. We took pictures of blue green algae and as of middle January we took pictures of dead fish somewhere at a private lodge somewhere there. (Interview 12)

Tension between key stakeholders as a result of uncoordinated infrastructure development

Approximately ten years ago, Sembcorp organized for a temporary plant to be designed and installed to cater for the sewage produced at 300 stands in the Tekwane North township. The council subsequently built a new school, and more stands. The Department of Human Settlement also constructed 700 new stands in the township. The wastewater infrastructure has not been upgraded to cope with the increased development seen in the township.

We have a major challenge going here, at Tekwane North for instance, all the houses went up, there were no sewage works, no network systems. And the municipality still hasn't finalised the pipeline. It's in our concession area. So we received a directive for that, but there's nothing else that we at Sembcorp can do at this stage. So I think that sometimes things are a little bit lost between the municipality and Human Settlements and everyone, they don't get together and say that this is what we need to do before this can happen. (Interview 10)

Tension between the MTPA and a company practicing aqua-culture in the Linsklip River

The MTPA has confronted an aquaculture trout farm on the Linsklip River regarding the negative affect their operations are having on river water quality.

According to the RQOs, the Linsklip should be managed to a CB class. But high production, straight ammonia and other things in the rivers are causing negative effects. They divert the river and we (the MTPA) are in serious conflict with them. (Interview 8)

Lack of communication between a key stakeholder and the community

As a private company Sembcorp is not permitted to communicate directly with the community. Sembcorp has to get the approval of the ward councillor before issues can be discussed with the community directly.

If we (Sembcorp) want to speak to the community, we need to get the ward councillor's approval in getting in there. We can't publish things on the municipality's behalf because they are the authority, so everything needs to be communicated via them. So there's a specific process that needs to be followed for us to communicate from a private point of view. (Interview 10)

4.4.2.1.2. The SRC

The SRC can be divided geographically into two types of water users. West of Hazyview, commercial irrigated agriculture and agroforestry plantations farmers have established an Irrigation Board in the upper Sabie River. East of Hazyview, previously disadvantaged emerging farmers are farming public irrigation schemes adjacent to the KNP. The Sabie River has a higher species diversity than the Crocodile River with some endemic species occurring and larger sections of the river occur in conservation areas.

Stakeholders involved in river protection

Stakeholder efforts to improve water quality

River clean-up campaigns

Different stakeholder groups assist in river clean-ups, uprooting of alien plants and research to protect the Sabie River. The IUCMA, Working for Water (in collaboration with the DWS) and environmental groups from schools are involved in these campaigns. The White Water Irrigation Board is also very active on the Sabie River.

Adopt-A-River Group

A team of 30 Bushbuck Ridge community volunteers have formed an Adopt-a-River group that clean-up illegal waste in the local river. The Adopt-A-River campaign is active on the tributaries of the Sabie River as villages are polluting the tributaries which flow into the Sabie River.

In our village we have about 30 people who are volunteers to clear up illegal waste cleaning and we have adopted a river in our village. We concentrate on our region owing to limited resources, but we do involve people both upstream and downstream whenever we get the chance to meet with them. (Interview 4)

At this stage the Adopt-A-River groups are unaware of the water quality difference their efforts are making in the rivers they are working on. The Emerging Farmers Association do not do water quality monitoring.

No- that collaboration is not set up yet. I think that collaboration is very important, its critical for us to know what kind of difference we are making with our volunteer cleaning. We have heard that there was a difference in water quality after our cleaning efforts, but I think it would be very appreciated if the specifics of the water quality improvements could trickle down to the average volunteer doing the work. I don't think that this research should be limited to the so called academics. Community-based action research should be encouraged. (Interview 4)

As farmers (members of the Emerging Farmers Association) we don't check the quality. If you become aware of impure water, we put bleach or chlorine in the water. (Interview 7)

Stakeholder water quantity concerns

The stakeholders expressed concern over water availability in the Sabie-Sand River Catchment. The stakeholders are experiencing difficulties with drinking water availability from

the Nyaka Dam. The management teams operating the private game reserves in the Sabie-Sand are seriously concerned about the lack of water in the Sand River. The IUCMA are aware of the pristine nature of the SRC and are very conservative with license applications received from developments in the area.

The water in household taps are fed from the Nyaka Dam and there have been water availability problems with the taps. (Interview 4)

We have a serious problem now in the Sand River. It starts right up in the forestry area and then it enters the Bushbuck Ridge area – heavy urbanisation occurring here. This year there was no water coming through in the Sand River. (Interview 8)

Catchment Stakeholder Relations

Lack of communication between key stakeholders

Stakeholders expressed that the Upper SRC is overplanted with industrial timber plantations – the *Eucalyptus* uses a lot of water that negatively impacts the downstream water flow. Wetlands and grasslands area also negatively affected as a result of the upstream plantations. There is a lack of communication between the upstream plantation industry and the downstream communities.

I'm surprised that they talk about protecting this catchment along the Sabie – what are they doing? This place is overplanted with industrial timber plantations – the *Eucalyptus* that uses more water that destroys our wetlands, destroys our grasslands and destroys our downstream water flow. Since I was born I have never heard of a meeting being called by the plantation industry. (Interview 4)

At the upper end (of the Sabie River), above Hazyview, that's commercial irrigated agriculture and agroforestry plantations. So obviously they are well-empowered, they have established themselves an Irrigation Board, I don't have much direct communication with them yet. (Interview 5)

The VVELUW currently underway is a requirement by the NWA and carried out by the IUCMA and supported by the DWS. During the initial stakeholder engagement for this study, the IUCMA held separate meetings for the emerging farmers and the commercial farmers in the catchment. One stakeholder felt that the two groups should have been consulted at the same meeting.

The initial stakeholder engagement I went to on that kept the two users quite separate which I felt was quite wrong - it basically had the commercial farmers at one meeting and the emerging farmers at another. I just felt that they should get together as we are all utilising the same resource, of course at different volumes and whatever else. But in my mind, the emerging farmer doesn't want to be an emerging farmer forever, they want to have emerged so why not put them all on the same page? Moving forward they will probably bring the 2 groups together. But at the time I just thought it was strange that they were separate. (Interview 2)

Collaboration between SANParks, the DoA and the Emerging Farmers

SANParks is actively engaging with the emerging farmers bordering the KNP and there are several initiatives underway. These initiatives are not limited to water resources protection, but also involve conflict management issues relating to the shared management of fences and other access related issues. The emerging farmers are organized into five irrigation schemes. Currently a meeting of irrigation scheme representatives is held monthly as the five irrigation schemes have embarked on a joint proposed project together with the DoA and SANParks KNP.

The project involves the installation of a bulk water pipeline to serve the five irrigation schemes. The installation of the bulk water pipeline will assist the farmers in many ways.

This would mean that we would not have to use electrical or diesel pumps as some of the schemes are doing. Some of the schemes are in danger because the point where they are drawing water is sometimes inside the KNP so their safety is not guaranteed because there is no ranger looking after them when they go to start their engine. It would make a difference as the money we use for electrical or diesel pumping could be used in our farming. It would also take away the problem of cable theft which disturbs electrical pumping. It would also create jobs. (Interview 7)

The Sabie River Farmers Association (SRFA) is one of the irrigation schemes along the Sabie River. The SRFA is the only irrigation scheme not pumping water from the river. According to an agreement between the DoA, the DWS and the SRFA, the SRFA obtain water from a canal flowing from commercial farms upstream. The installation of the bulk water pipeline would assist the SRFA as sometimes the water supply from the upstream farms dries up.

When the water is supposed to return to the river, a canal brings the water to our farms. So during canal cleaning we run out of water and during drought periods they use a lot of water upstream and the canals runs dry. (Interview 7)

Crisis Management, Conflict Resolution and Enforcement

Key stakeholders contacted in a freshwater crisis

In a freshwater crisis, stakeholders indicated that they would contact the DWS, the IUCMA and the local radio station.

In a freshwater crisis the DWS at the provincial level would be contacted. Community members also use the local radio station to communicate disease outbreaks to people throughout the broader region. (Interview 4)

In the case of a crisis I would contact the IUCMA because they also tell us that if we see littering/pollution incident we need to phone them. (Interview 7)

The MTPA contact the IUCMA if any problems arise in the bio-monitoring results along the Sabie River. The management teams running the private game reserves in the catchment are also involved in river protection. The MTPA does the bio-monitoring for them and therefore works closely with them.

I deal directly with the IUCMA whenever I have problems. The Sabie Sand Nature Reserve is a major stakeholder involved in protection of the Sabie River. I contact these guys when we have problems. They do help us in a crisis. They haven't got the capacity to actually monitor these things, but we are doing it and we are working closely with them. So I am working in their areas and we are all working together. Then when I pick up problems, then I mention them and they talk about it with all the stakeholders in their area. Their stakeholders are all the wealthy people in the Sabie Sand and Mala-Mala areas, Timbavati etc. (Interview 8)

Collective response mobilised by the community

In times of crisis, community members try to raise a collective response by contacting different water governance stakeholders and hospital communication teams in the catchment. This has been met with mixed results as shown below:

Lack of response by key stakeholders to a waste incident at Nyaka Dam

About four years ago a load of pampers nappies was dumped into the Nyaka Dam. A community member mobilised a collective response. Although a number of key governance stakeholders were alerted to the situation, only the DEA and the Bushbuck Ridge Local Municipality responded to the situation and assisted on the ground.

We were in the papers, there was a dumping load of pampers in Nyaka dam the water supply I had to mobilise the people, I had to notify DEA, and they arrived with gloves and refuse bags. I called the DoH – they didn't pitch, I called DWA, but they didn't pitch, but they did give comment. We were also helped by Bushbuck Ridge Local Municipality - the person there working for the environment managed to come. (Interview 3)

Lack of response to cholera outbreak

A member of the community battled to get any response from the authorities when reporting a cholera outbreak in the local drinking water.

There was an outbreak of cholera last year so we are trying to check with the communication teams at the hospital that normally provides relevant information, but the communication team at the hospital does not respond. The spokesperson from the provincial MEC. I called him, I sent him sms's and emails, but he never responded. Then I tried again the local hospital spokesperson led me to the provincial spokesperson. There was nothing I could do. No – he did not respond. In the end, I went to the Bushbuckridge Municipality. I spoke to the former mayor. I said, " – ok – we know we have a water crisis, but do you have any plan in place so that people can purify the water? In our area we don't have water." Then he said, "no we are working on it". He directed me to the hospital where the relevant people are. (Interview 3)

Confrontation between a conservation stakeholder and forestry company

The conservation stakeholders have come into confrontation with a forestry company in the SRC. The forestry industry has a major negative impact in the upper catchment on instream habitat. This issue relates to the water consumption of alien plants, as well as siltation and sedimentation as a result of forestry activities.

Unfortunately, in the Sabie there is a great deal of forestry and that is a big problem there. We've taken on a forestry company about their high sedimentation loads after fires in the area and then they had to make plans. (Interview 8)

5. DISCUSSION

The current study deviates from previous research by having a more bottom-up approach and focusses on stakeholder views of river protection with the aim of improving collaborative stakeholder protection of the Sabie and Crocodile Rivers. This Chapter firstly considers how the conservation stakeholders can collaborate to enhance the relevance of the NFEPA Project amongst stakeholders. Secondly, participatory water governance in the catchment is considered by evaluating the strengths and weaknesses of the SRF and CRF stakeholder engagement platforms. Obstacles to meaningful stakeholder participation are highlighted and possible solutions provided where possible. Thereafter stakeholder collaboration and decision making power are discussed in the context of their importance to polycentric governance. Finally, the challenge of achieving adaptive governance in South African is confronted. It is suggested that by increasing the resilience of the local governance system, effective stakeholder collaboration in river protection will be promoted over time. Throughout this chapter, suggestions are made on how the stakeholder engagement platforms identified by stakeholders as relevant at the international, regional, catchment and sub-catchment scales can be incorporated to achieve solutions to the various challenges facing stakeholders with respect to river protection in the catchment.

5.1. THE NFEPA Project

The NFEPA project is being used by key conservation stakeholders in the IRC. The conservation stakeholders value the tool at the broad scale, but have encountered problems when trying to apply the NFEPAs to everyday management situations. Stakeholders expressed that water resource protection measures required legally according to the NWA, are being prioritized over the NFEPAs in the catchment. It was emphasized by all the conservation stakeholders that the NFEPAs need to be updated with more detailed information at the local scale to enhance their applicability.

The NFEPA project is more relevant to the conservation stakeholders than to the other stakeholders in the catchment. In general, the stakeholders interviewed appeared either unaware or vaguely aware of the project. It was noted that the NFEPA project is not being discussed at the forum meetings. It is clear from the results that opportunities exist for the conservation stakeholders to collaborate in order to promote local implementation of the NFEPA Project as discussed below.

5.1.1. Potential for conservation stakeholders to collaborate to update NFEPA information at the local scale

According to the Implementation Manual for NFEPAs (Driver *et al.*, 2011), the provincial conservation authority is responsible for (Appendix 2):

- Verifying all FEPAs, fish sanctuaries and free-flowing rivers that occur in the relevant province,
- Confirming their status (for example, ground-truthing their ecosystem type and condition), and-
- Filling in gaps in knowledge of freshwater ecosystems and species, for example:
 - Mapping wetlands that have not yet been included in the national wetland map, and
 - contributing these to the national wetland inventory coordinated by SANBI
 - Properly surveying the distribution of threatened fish populations.

The interview results revealed that the MTPA is currently commissioned by the IUCMA to carry out bio-monitoring surveys on the four priority rivers in the catchment on a four-year rotation. At this stage the results of these bio-monitoring surveys are not being used to update the NFEPA database at the local scale as the NFEPA project has not been incorporated into the RIFDEN model used by the MTPA aquatic scientists. If the data collected by the MTPA could feed into the NFEPA database, then the NFEPA information for each major river in the catchment could be supplemented every four years. Other conservation stakeholders, for example SANParks, who are also conducting bio-monitoring in the catchment could collaborate with the MTPA in this regard.

5.1.2. Potential for conservation stakeholders to collaborate to highlight the importance of the NFEPA Project at the local level.

The interview results show that awareness of the NFEPA project amongst stakeholders in the IRC is low (apart from amongst the conservation stakeholders). Currently the conservation stakeholders have to balance personal work load with attending the CRF and SRF meetings. These stakeholders prioritize attendance of the CROCOC over attendance of the CRF and SRF meetings as the CROCOC is the platform where decisions relating to water releases from the dams are made. It is suggested that the conservation stakeholders collaborate to ensure that they are well-represented at the CMF meetings in the catchment. These stakeholders should work together to promote awareness of the high conservation importance of the Sabie and Crocodile Rivers by bringing the NFEPA project to peoples' attention at these meetings. The interview results identified the following stakeholder engagement platforms relevant to

stakeholders at the sub-catchment level: The Integrated Water Resources Management Workshops; the Adopt-a-River meetings and media platforms.

It was noted during an interview that because the NFEPA project lacks legal status, it doesn't "filter through" and its "nice to look at." The NFEPA project has been incorporated into the NWRS 2 and the ICMS. The conservation stakeholders should be aware of the stipulations incorporating FEPAs in these documents and highlight these to the stakeholders at the above local-level stakeholder engagement platforms.

5.1.3. Potential for conservation stakeholders to collaborate in nurturing cross scale institutional linkages.

Conservation stakeholders should collaborate to ensure good representation at meetings that strengthen relationships with regional governance stakeholders. Research has shown that these cross-scale institutional linkages are vital to protection of water resources at the local scale. By nurturing cross-scale governance relationships, the conservation stakeholders can highlight the importance of the NFEPA project at the national scale and encourage its implementation into legal instruments as guided by the Implementation Manual for FEPAs (Driver *et al.*, 2011). The interview results identified the following meetings relevant to stakeholders that promote cross-scale governance interactions: The IDLC; the DWS Meetings and Workshops; the WRC Reference Groups and the Forum of Forums Meeting.

5.1.4. Potential for conservation stakeholders to collaborate in engaging with government to ensure conservation targets are incorporated into water management strategies

According to the Implementation Manual for FEPAs (Driver *et al.*, 2011):

- SANParks is expected to engage with the development of national to local water management strategies (e.g. CMSs) and participate in co-operative water governance in catchment areas relevant for national parks.
- The provincial conservation authority is expected to participate actively in processes led by Catchment Management Agencies, including the development of Catchment Management Strategies. Provincial conservation authorities should play a leading role in providing a regional freshwater ecological perspective as well as technical advice and input on the incorporation of FEPA maps into the work of Catchment Management Agencies.

The conservation stakeholders should collaborate to engage directly with local and national government as well as the IUCMA to promote conservation goals in the development of local

to national water management strategies and the incorporation of the NFEPA maps into the work of the CMA.

5.1.5. Strategies to promote mutual learning in transdisciplinary research settings

Roux *et al.*, (2017) provide ways to stimulate mutual learning in transdisciplinary research settings. These suggestions are derived from two transdisciplinary research projects carried out in South Africa. Particularly relevant to the current study are ways to promote more equitable participation amongst attendees during meetings. The following strategies (adapted from Roux *et al.*, 2017) are recommended to the conservation stakeholders as ways to potentially increase awareness of the NFEPA project at both local and regional stakeholder platforms in the catchment.

- a) The conservation stakeholders should be made aware that a long term investment in staff, time and resources will be required to increase awareness of the NFEPA project amongst stakeholders in the catchment.
- b) Analysis of the social networks in each catchment is suggested to improve the conservation stakeholders' understanding of who should be represented at the different meetings.
- c) Posting advertisements at central venues is an important practical step to alerting stakeholders that important river information will be shared at the relevant meetings.
- d) The assistance of community workers and community-based organizations in the catchments is recommended to link the conservation stakeholders with historically neglected stakeholders. These people or bridging agents should have established roles in the community in order to provide an ongoing communication link between the conservation stakeholders and community in the future.
- e) The conservation stakeholders should incorporate the use of appropriate boundary objects such as simple maps and participatory mapping exercises at meetings to encourage stakeholder involvement.
- f) The meetings should be held in a "neutral ground for engagement," (not a work place or a home) that is accessible to meeting participants.

5.2. Participatory Water Governance

5.2.1. Evaluation of the CRF Meeting

In a positive sense, the interview results reveal that the CRF meeting promotes good communication between stakeholders in the CRC. The CRF meeting was commended for providing a platform where stakeholders feel comfortable to raise any issues with the authorities. These issues are discussed until a "way forward" is agreed upon. The survey

carried out by the Chairman of the CRF provided useful positive stakeholder reflections for 2016. It was expressed that meeting organizers provide well-structured minutes and consistency in reporting. Several stakeholders expressed an improvement in stakeholder representation during 2016 and attendance was noted as being “good” and “satisfactory.” Some stakeholders noted an improvement in the enforcement of the CRF. Specific examples were provided by stakeholders where enforcement was successful and issues were resolved. Capacity building, empowerment and awareness were improved by implementation of the “War on Leaks Project,” raising awareness of sewage spills and enhancing knowledge of water management in the catchment.

Shortcomings to the CRF meeting were also expressed by the stakeholders during interviews. Lack of representation of municipalities was highlighted as a concern. It was also expressed that influential people from communities as well as the Department of Human settlement should be represented at the CRF meetings to improve planning of developments in the CRC. It was expressed that once people have settled in a wetland, “there is nothing much we can do to stop the pollution.” If the relevant decision-makers are present at the meetings, collaboration at the planning level would be encouraged: “We need to do the planning at the same time.”

The survey carried out by the Chairman of the CRF also provided information on where stakeholders felt the biggest challenges to protecting the Crocodile River existed during 2016. The stakeholders presented suggestions on how these challenges could be met. Several stakeholders noted the absence of key stakeholders at the CRF meeting as the biggest challenge facing protection of the river. Specifically, the absence of the DEA, the DMR, HDIs, Tribal Authorities and farmers was noted. Concern was also expressed that the forum is limited in term of achieving results for issues raised. No clear solutions were expressed to address this challenge and stakeholders appeared confused about the role of the forum with respect to implementation in the catchment, “we have the policies and the manpower, but we lack the implementation.” Many stakeholders identified failure to resolve pollution caused by municipal waste treatment works and pump stations as the biggest challenge in the catchment. Various solutions to this problem were suggested including capacity building amongst the South African Police Service to promote enforcement; direct engagement with authorities; and enforcement by the IUCMA. River sand mining, as well as drought and climate change were also listed as major challenges to river protection. Capacity building and education, specifically with respect to nappy disposal and environmental management were highlighted as challenges in the catchment.

5.2.2. Evaluation of the SRF Meeting

The current research shows that while it is positive that the SRF meetings are being held regularly, these meetings have not yet gained credibility, legitimacy and saliency among the Sabie River stakeholders.

Stakeholders expressed concern over the lack of representation of relevant stakeholders at the SRF meeting. Specifically, it was expressed that there was a lack of community representation and lack of attendance by the commercial farmers. Stakeholders called for a change in how the forum is currently being held in order to engage with these groups. One suggestion was that the SRF meeting be hosted in a different village every two months. This would increase awareness of the meeting in the different communities, assist the people with travel costs and allow people a platform for expressing issues with local volunteer activities. The commercial farmers used to attend the SRF meeting about three to four years ago. It was suggested that they stopped attending because they felt the meetings were not benefitting them. In the future, the forum needs to find a way to re-engage these farmers.

The stakeholders are concerned that the SRF is not following up or reporting back on issues identified during the meetings. There is a call to assign task teams (including relevant stakeholders for each task) to issues raised at the SRF meetings. The task teams would be expected to provide feedback at the following SRF meeting detailing progress made in addressing the issue assigned to them. Issues that could be addressed by task teams and tracked in terms of progress made include the development of settlements too close to the river, littering and awareness campaigns in the communities.

Several comments were provided on how the running of the SRF meetings can be improved. It was expressed that the meeting should start on time and presentations should be made available to attendees before the meetings. The attendees need to be made aware of the purpose of the meeting and their questions should not be cut off or dismissed.

5.2.3. Comparison between the CRF and the SRF Meetings

Interview results indicate that the focus of the IUCMA has historically been more on the management of the Crocodile River than the Sabie River owing to the high priority economic activities occurring in the catchment. It was expressed that far more staff are employed at the IUCMA offices in Mbombela than at the IUCMA satellite office in Bushbuck Ridge office. Administrative challenges are experienced by the staff at the Bushbuck Ridge office, which the researcher experienced first-hand when requests were made for a record of recent minutes and attendee lists for the SRF during this study.

The following points were made from review of the minutes of the CRF and the SRF meetings as well as from general meeting observations:

- It took a long time to acquire the minutes for the SRF meeting compared to the CRF meeting owing to administrative challenges experienced by staff at the IUCMA Bushbuck Ridge Office. Four sets of meeting minutes for the CRF meeting were sent to the researcher efficiently. Only one set of meeting minutes was acquired by the researcher after about three months of waiting. The pages of the minutes for the SRF meeting were not numbered. This made it difficult for the researcher to compile the documents scanned.
- The CRF meeting promotes continuity between meetings by placing “matters arising” from the previous meeting minutes at the top of the agenda. Although there is a “resolutions” column in the SRF meeting minutes, there is no follow-up at the beginning of the SRF meeting on issues raised in the previous meeting minutes.
- The IUCMA provides more detailed water quality monitoring results at the CRF meeting than at the SRF meeting. The IUCMA provides regular detailed information of water quality monitoring results along the main stem of the Crocodile River. Areas of non-compliance relative to the RQOs are reported. Pollution incidents affecting the Crocodile River are also reported by the IUCMA. The SRF meeting minutes of the meeting held in February 2017 report broad observations only with respect to water quality monitoring results, for example “He indicated that all monitoring points are not complying because of illegal discharges and illegal dumping.” No details are given of the non-compliance relative to the RQOs nor where the non-compliant results were recorded.
- The IUCMA provides more detailed water quantity information at the CRF meeting than the SRF meeting. The IUCMA provide regular information pertaining to the dam releases, dam levels and rainfall status are presented at the CRF meeting. Only the dam levels were presented at the SRF meeting in February 2017 with some general statements about rainfall and water availability in the catchment.
- The local municipalities are better represented at the CRF meeting than at the SRF meeting. The CRF meeting minutes record presentations from Mbombela and Nkomazi Local Municipalities and Sembcorp on the status of the WWTWs in the catchment as fixed items on the agenda. The municipalities in the SRC do not appear to prioritize presenting on the status of the WWTW in the SRC as no such information was recorded in the SRF meeting minutes. Meeting observations recorded that the meeting attendees expressed disappointment that the Bushbuck Local Municipality

employee was not present in person at the SRF meeting, but sent a representative instead.

- General meeting observations note that stakeholders are given time to ask questions and make comments during the CRF meeting. Stakeholder questions and/or comments were noted in the CRF meeting minutes after presentations. No stakeholder comments or queries were recorded in the SRF meeting minutes. Meeting observations record stakeholders being deferred from asking questions and requested to raise the questions again at the next SRF meeting.

5.2.4. Challenges to meaningful stakeholder participation

The literature cautions that participatory water governance within the South African context is vulnerable to a diverse range of stakeholder interests at the catchment scale as well as to power relations that may negatively affect programmes. It has also been observed that the capacity of participants and their feelings about public participation processes have been overlooked in past consultations (Du Toit and Faysse, 2005 in Boakye and Akpor, 2012).

5.2.4.1. The impact of power relations on public participation

5.2.4.1.1. The CRC

Interview results reveal that representation of stakeholders at the CRF meeting has decreased over time, possibly owing to feelings of intimidation and lack of capacity amongst stakeholders. Lack of representation of municipalities was highlighted as a concern by stakeholders in the interviews conducted during this study as well as in the survey carried out amongst the meeting attendees. Specifically, in the survey results it was mentioned that there was a lack of decision-makers from the municipalities present at the CRF meeting and that municipal managers should be encouraged to attend. Many stakeholders identified failure to resolve pollution caused by municipal waste treatment works and pump stations as the biggest challenge in the catchment.

Review of the CRF meeting minutes spanning from August 2016 to February 2017 provides insight into the presentations made by the municipalities to the stakeholders under the fixed item on the agenda, “Feedback on municipal WWTWs.” The CMLM presentations at the CRF meetings for this period reveal that the local municipality was dealing with a number of serious issues relating to the operation of the WWTWs in the catchment. Interview results indicate that the municipalities in the IRC are challenged by ageing infrastructure and lack of qualified staff. In contrast, Sembcorp have their own laboratory and employ competent staff. The company has been recognized locally and internationally for good performance in their concession area.

There is a clear difference in the performance of WWTW maintained by CMLM and those maintained by Sembcorp.

Interview results indicate that Sembcorp, as a private company contracted by CMLM, are monitored on a “continuous basis” to ensure that targets are met. They are also subjected to five year reviews where the municipality review their performance over the previous 5 years and set targets for the next five years. As a platform where local municipalities are expected to present issues to stakeholders concerning the operation of their WWTWs alongside an internationally commended service provider in the catchment, it is understandable that the local municipalities (which are experiencing major challenges at WWTWs) are reluctant to attend.

The interview results reveal that in the past the CRF meeting has been used as a platform where the business of the day was “lashing down on the municipalities,” and “naming and shaming them.” It was noted that representation of stakeholders at the CRF meeting has decreased over time, possibly owing to feelings of intimidation and lack of capacity amongst stakeholders. Interview results reveal that the IUCMA intend to support the municipalities in the future by visiting them outside of meetings to assist them in addressing the challenges faced. In this way, the IUCMA hopes to encourage the municipalities to feel more empowered and more comfortable in attending the CRF meetings. The interview results indicate that the IUCMA is collaborating with the DWS and the COGTA to minimize pollute from failing WWTPs in the catchment by putting aside a small budget to assist with temporary solutions until the plants are fixed or new plants are built by the municipality.

This approach of visiting key stakeholders who are absent from the forum and encouraging them to attend is supported by the stakeholders in the catchment (as seen from their responses in the CRF meeting Reflection Survey in Table 13) and should be applied to other key stakeholders such as the DMR, DEA, HDIs, Tribal Authorities and farmers.

5.2.4.1.2. The SRC

Interview results revealed that key stakeholders in the catchment are prioritizing attendance of the CROCOC over attendance to the CMF meetings. The reason for this is that the CROCOC is the decision-making platform for releases from the dams upstream of the Sabie and Crocodile Rivers. In the SRC, the commercial farmers west of Hazyview form part of an Irrigation Board and are represented at the CROCOC meeting. These commercial farmers used to attend the CRF meeting, but haven’t attended for years. Interview results reveal that the emerging farmers active in the lower SRC adjacent to the KNP are not represented on Irrigation Boards. The more empowered stakeholders in the upper catchment are therefore

relating to a different public engagement forum than the less empowered stakeholders in the lower catchment.

The IUCMA carried out consultations in the SRC as part of the Validation and Verification of Water Usages required by the NWA. Interview results indicate that during the initial stakeholder engagement for this study, the IUCMA held separate meetings for the emerging farmers and the commercial farmers in the catchment. It was expressed during interviews that the stakeholders should have attended the same meetings as they are utilizing the same resource and the emerging farmers are aiming to become commercial farmers in the future

In order to address the power differentials in the SRC, the capacity of the emerging farmers and community members needs to be increased. Possible capacity building strategies are discussed in Section 8.2.4.3 below.

5.2.4.2. The impact of diverse stakeholder interests on public participation

The lack of representation of stakeholders at the CRF and SRF meetings indicate that some stakeholder groups do not view the meetings as being relevant or beneficial to them. For example, in the SRC, the lack of representation of community members and commercial farmers at the SRF meeting was voiced by stakeholders as a concern. It was suggested that the SRF meeting travel from village to village so that communities can become more aware of the meeting and voice their local concerns. If that advice is followed, the question is, would the meeting be more or less appealing to the commercial farmers upstream of Hazyview? It is a challenge to provide a single stakeholder engagement forum that it is relevant and beneficial to two such different stakeholder groups.

5.2.4.3. The impact of capacity of participants on public participation

Capacity building in the areas of education and awareness were identified by some stakeholders during the Survey carried out as the biggest challenge facing the catchment in 2016. The findings of the current study confirm the importance of capacity building in the IRC to promote meaningful participation between key stakeholders. Specifically, the capacity of the local municipalities in the CRC and the emerging farmers in the SRC is of concern.

The IWRM workshops being carried out in the IRC are an attempt by the IUCMA to address the capacity building intentions laid out in the ICMS. Unfortunately, to date, there has been little long-term return on the efforts invested by the IUCMA IWRM workshops. The new and innovative ideas of how to run the IWRM workshops should be encouraged and supported in both the Sabie and Crocodile River Catchments. The Women in Water Conference should be repeated and expanded to reach more women in both catchments and the school competition currently being held annually in the CRC should also organized in the SRC. The War on Leaks

Project was commended by one of the stakeholders during the CRF Meeting Reflection Survey as the best achievement of the CRF meeting during 2016. This Project should also be repeated in both catchments in the future.

5.2.4.4. The impact of considering stakeholder feelings on public participation

Literature supports social co-learning systems where stakeholders are involved in deriving management solutions in complex systems (Pollard and du Toit, 2008 in Jackson, 2014). The Stakeholder Engagement Strategy of the ICMS states that: "Social co-learning systems and co-generation of knowledge will be incorporated in to the IWRM decision making processes" (ICMS).

5.2.4.4.1. The CRF Meeting

The current research incorporates information from a Reflection on the 2016 CRF Meeting, survey carried out by the Chairman of the Forum. The responses of meeting attendees have supplied useful insights to the current study. It is recommended that similar surveys are carried out regularly by the IUCMA in the other catchments in the IRC. The results should be made available to stakeholders to encourage discussions and assist stakeholders in deriving management solutions in the catchments.

5.2.4.4.2. The SRF Meeting

More time should be set aside at the SRF meeting to allow for stakeholder questions and comments. Instead of having their questions deferred and told to bring them to the next meeting, stakeholder comments and queries should be recorded as part of the meeting minutes. If the relevant person is not present at the meeting, the query should be forwarded on to him to address and then followed up at the next meeting. There should be continuity between meetings where progress made on past issues raised are reported on. In this way stakeholders attending the SRF Meeting will feel empowered by seeing the issues raised at the SRF meeting being addressed in the catchment.

5.3. Adaptive Governance

Recently polycentric governance has been advocated in the literature as a governance system well-suited to deal with complex environmental problems at multiple scales (Morrison, 2017). This governance approach, involving multiple, overlapping decision-making centres choosing to act in ways that take each other into consideration through processes of cooperation, competition, conflict and conflict resolution (Carlisle and Gruby, 2017) has proven to have the potential to adapt to change better than more centralized forms of governance (Pahl-Wostl, 2009; Marshall, 2015 and Bixler 2014 *in* Carlisle and Gruby, 2017). Cooperative processes

allow for collective capacity to increase or for functions to be outsourced to more capable decision-making centres or supporting actors (Carlisle and Gruby, 2017).

5.3.1. Stakeholder cooperation in the IRC

The interview results indicate that the key stakeholders display overlapping roles and a high degree of collaboration in river management duties concerning water quality and water quantity at the catchment scale. Less duplication of tasks and stakeholder collaboration was evident from interviews in enforcement duties in the catchment. The IUCMA appears to be the primary stakeholder actively enforcing actions on the ground in the catchment. The only stakeholder collaboration mentioned was between the IUCMA, the DWS and the COGTA to address the biggest challenges faced in the catchment.

5.3.1.1. The CRC

At the sub-catchment level, it is clear that the IUCMA has good relationships with the CRC stakeholders. The IUCMA communicates regularly with stakeholders on their electronic water-user database. Stakeholders are well-connected through different stakeholder awareness campaigns run by different organisations and by sharing contact details at the CRF meeting. The stakeholders have successfully averted crises through communication and collective action in the CRC.

Certain major challenges in the CRC have negatively affected stakeholder relations. Failure of the White Water WWTWs has prevented a stakeholder from operating safely and resulted in the closure of a plant. Poor communication and co-ordination between stakeholders has resulted in the un-co-ordinated development of settlements in the Tekwane North region. An increased demand for services has resulted in the overloading of current wastewater infrastructure. The stakeholder responsible for the operation of the WWTW at Tekwane North is being unfairly held accountable for infrastructure being over-loaded.

Further challenges to stakeholder cooperation in the catchment include: a lack of direct communication between Sembcorp and the community and confrontation between the MTPA and an aquaculture trout farm on the Linsklip River.

5.3.1.2. The SRC

At the sub-catchment level, there is a lack of communication between the IUCMA and the SRC stakeholders. The community co-ordinator at the IUCMA Bushbuck Ridge office experiences administrative challenges owing to limited data bundles available for emailing. It was expressed during interviews that this limitation prevents regular electronic communication with stakeholders on the water-user database. Stakeholders expressed disappointment that the water quality monitoring results shared by the IUCMA at the SRF meeting are not shared at

the community level. This means that volunteers in river clean-ups are not aware of the difference their efforts are making.

There is a lack of communication between SRC stakeholders in the lower section of the catchment and the commercial farmers in the upper reaches of the catchment. Stakeholders highlighted water availability problems in the SRC. It was noted that the forestry industry negatively impacts instream habitat. A conservation stakeholder has had confrontation with a forestry company in the upper SRC. To assist the emerging farmers with water availability, SANParks is collaborating with the DoA to provide a bulk pipeline to five irrigation schemes along the Sabie River.

During times of crisis, community stakeholders react by contacting a range of governance stakeholders in an attempt to raise a response. Examples were provided where a stakeholder battled to mobilize a response from key stakeholders to water crises in the SRC.

5.3.2. Decision-making power of stakeholders in the IRC

In a polycentric governance system, Carlisle and Gruby (2017) specify that only those centres with “considerable independence to make norms and rules within a specific domain are considered to be decision making centres,” (Ostrom, 1992, p.552. in Carlisle and Gruby, 2017). Under the Water Act 54 of 1956 the minister transferred responsibility and accountability for the management of water allocations to Irrigation Boards in the IRC. The Irrigation Boards are still operating with this authority in the IRC and interview results show that subsistence farmers in the communities find it challenging to apply to an Irrigation Board for water. The results therefore appear to indicate that the Irrigation Boards have retained decision-making ability transferred to them under the previous Water Act.

The ICMS (p. 124) states that “The primary objective of the ICMA is to achieve full delegation of authority to the ICMA to ensure that effective IWRM can occur in the catchment.” There is an urgency in the catchment to develop a system of stakeholder engagement and co-operative governance (both enabled by efficient IWRM) to highlight the importance of water across local and regional government structures. The ICMS also highlights the importance of finalising a Memorandum of Agreement with the DWA as an urgent priority for the ICMA. This agreement was to outline avenues for future cooperation between the DWA and the IUCMA and the assignment and delegations of functions to the ICMA. On the 12 December 2015, the DWS withdrew some delegated powers and functions previously awarded to the ICMA. In the chairman’s report of the 2016/2017 IUCMA Annual Report (p.3), the chairman states, “The challenges experienced during 2016/17 emphasised the need for full delegation of the Responsible Authority powers and functions to the IUCMA by the minister...”

It is clear from interviews that the IUCMA is continuing to “manage the resource on the ground” and have recently formed a new Department called Compliance, Monitoring and Enforcement which makes appointments, conducts audits and responds to tip-offs. In terms of water quality regulation, the IUCMA conducts the full spectrum of duties (according to Section 19 of the NWA). In terms of water quantity regulation, the IUCMA is involved in assisting in processing WULs, but is not the responsible authority in terms of enforcing water quantity compliance in the catchment. No mention is made of the Memorandum of Agreement between the DWS and the IUCMA in the 2016/2017 IUCMA Annual Report.

Interview results indicate that stakeholders in the IRC view the withdrawing of the delegations from the IUCMA as “a risk to water resource protection in the catchment” and a “threat to the status of the catchment”. Stakeholders note that “the IUCMA is continuing to function and do what it can, but there are now challenges in getting things acted upon in the catchment, particularly in the SRC where sand mining is occurring.” Instead of reporting urgent matters to the IUCMA, a key stakeholder expressed that the Blue and Green Scorpions at the National Level of Government in Pretoria are contacted.

Survey results indicate that stakeholders in the CRC are concerned that the CRF fails to achieve its objectives owing to a lack of legal power and funding. When asked to provide possible solutions to this challenge, stakeholders stated that the issue is “not in our power to fix,” and that we need to “Increase power of the Croc Forum with media and SAPS.” According to the ICMS, the CMFs are the vehicles through which the CMAs plan to ensure collective responsibility of all stakeholders with respect to decision-making and accountability thereof.” In reality, the CMFs are not empowered by local government to address issues arising.

The literature supports that collective stakeholder efforts require endorsement by National Government in order to achieve their goals. Previous research in the SRC shows how volunteer stakeholder efforts towards achieving collective decisions through empowerment and capacity enhancement were halted owing to a lack of confidence that DWAF would support the process. Biggs *et al.*, (2017) note that the formation of the IDLC played a crucial role in promoting useful cross-scale interactions between stakeholders in the Olifants river basin and raised the levels of each of the four indicators for potential of regional governance described by Morissen (2014).

5.3.3. Adaptive local governance system to facilitate stakeholder collaboration

Morissen (2014) notes that some regional governance systems are more resilient in the face of change than others. She delves into the social sciences to provide a framework for comparatively assessing the institutional potential of governance at the regional level. The

decentralisation of power from central to local water institutions through IWRM in South Africa has resulted in satellite local governance systems similar to those described by Morissen in rural areas. These rural areas (and satellite local governance systems) are often a distance from decision-making centres, often have limited local capacity (Cheshire, 2010 in Morissen, 2014) and are subject to increasingly hybrid institutional arrangements (Morissen *et al.*, 2012; Cheshire *et al.*, 2014 in Morissen 2014). Morissen (2014) identifies four key factors influencing resourcefulness of a rural system to change (Table 18).

Table 18: Four key factors influencing resourcefulness of a rural system to change (Morissen, 2014)

Levels of engagement in regional networks.	High engagement by organisations and individuals in regional networks or organisations facilitates the coordination of policy goals at the same level (e.g. local, regional). This can include both cross-sectoral collaboration and/or collaboration between government and community. Knowing which local and regional organisations and individuals are involved and how they are co-ordinating policy making and implementation is central to measuring institutional resourcefulness of regions. This can be achieved by apprising the number of key regional networking arrangements, such as inter-organisational meetings, coordinating bodies, and co-located personnel arrangements, and then measuring the level of key actor engagement within those networks.
Levels of diversity and synergy across the instrument mix.	A comprehensive understanding of both formal (legal policies) and informal (social) arrangements is required to gauge a region's resourcefulness and ability of institutions to cope with unpredicted sudden changes. "The consensus is that diversified yet synergistic institutional arrangements provide a region with greater resistance against rapid and unexpected change," (Howlett <i>et al.</i> , 2006 and Wilson, 2010, in Morissen 2014, p.104).
Levels of robustness and "adaptability" of instrument design.	Consideration of regional plans based on scenario modeling and assessment, periodic review of policy and sequencing of policy instruments over time are all indications of long term adaptive planning. Such "temporal coordination" (Gunningham and Sinclair, 2005, in Morissen 2014, p.104) promotes resistance to undesirable changes and heightened flexibility to optimize on desired changes.
Levels of broader fiscal, administrative and democratic support.	To successfully transfer government functions from the administrative and political centre to the lowest feasible local level requires support of the centre "to enable regional strategies through providing the fiscal, administrative and democratic preconditions for bottom-up adaptation," (Crook and Manor, 1998, in Morissen, 2014, p.104). Integration is aided by the centre through provision of a strong leading institution, creation of inter-departmental units; involvement in the employment of personnel in units of other institutions, provision of democratic space for regional actors and the designation of spatial planning regions (Jordan and Shout, 2006, in Morissen, 2014). Regional governance therefore requires a broad base of collaborative support to be successful, spanning from local citizens to central government and other informal institutional arrangements.

In South Africa, the formation of the CMAs is a clear step towards a more polycentric governance regime (Herrfardt-Pahle, 2013). However, lack of co-ordinated processes between stakeholder groups and stakeholder decision-making power need to be addressed

before stakeholders can co-operate to collectively solve problems and resolve conflict in the IRC. Several studies (Cundill and Fabricius, 2010; Biggs 2017; Morrisen, 2014) have shown that more government support and social facilitation is needed to promote effective governance of water resources in the South African context. In a paper focussed on how to increase the adaptability of water governance and management in South Africa, Herrfahrdt-Pahle (2013) notes that the IWRM concept should be complemented with features of adaptive governance to better respond to unexpected changes.

Similarities between the devolution of power to local authorities in South Africa and the regional governance of rural areas as described by Morrisen (2014) are noted. By referring to the four key factors influencing resourcefulness of a rural system (Morrisen, 2014), recommendations are provided to guide the key stakeholders on how to improve the adaptive capacity of the local governance system operating in the IRC.

5.3.3.1. Recommendations to improve the levels of broader, fiscal, administrative and democratic support

To successfully transfer government functions from the administrative and political centre to the lowest feasible local level requires support of the centre to enable regional strategies through providing the “fiscal, administrative and democratic pre-conditions for bottom-up adaptation,” (Crook and Manor, 1998, in Morrisen 2014, p.104).

- In the IRC, there is an urgent need for full delegation of the Responsible Authority powers and functions to the IUCMA from the Minister to promote effective IWRM in the catchment. In turn the CMFs should be empowered by the ICMA in accordance with the ICMS with respect to decision-making to ensure collective responsibility of all stakeholders for decisions made.
- Central government support is required to carefully manage decision-making responsibilities previously transferred to Irrigation Boards within the IRC under the Water Act of 1956. Attention needs to be given to the current functioning of Irrigation Boards in the IRC to ensure that tensions between established commercial farmers and subsistence farmers do not escalate.

5.3.3.2. Recommendations to improve the levels of diversity and synergy across the instrument mix

An understanding of both formal (legal policies) and informal (social) arrangements is required to gauge a region's resourcefulness and ability of the institutions to cope with sudden change, (Morrisen, 2014).

- In the IRC, both regional and local-level governance stakeholders should be aware of national water policy (as laid out in the NWA and the National Water

Resource Strategies), national freshwater conservation (as set out in the NFEPA project) and any important collaborations or informal arrangements between stakeholders in the catchment.

- The current study highlights the need for capacity building of stakeholders in the IRC. Legal provisions for capacity building, awareness campaigns and empowerment programmes at the local level should be prioritized by local and regional government stakeholders. Specifically, the local municipalities in the CRC and the emerging farmers in the SRC require urgent support.
- Several opportunities exist for the conservation stakeholders in the IRC to collaborate to promote awareness of the NFEPA Project amongst local and regional stakeholders. In so doing the NFEPA Project will
 - become more refined at the local scale and therefore more useful in everyday management decisions;
 - become more relevant to other stakeholders in the catchment
 - be translated into legal instruments as guided by the Implementation Manual for FEPAs; and
 - be increasingly incorporated into local and national level water management strategies and the work of the CMAs

5.3.3.3. Recommendations to improve the levels of engagement in regional networks

High engagement by organizations and individuals in regional networks or organizations facilitates the co-ordination of policy goals at the same level. (e.g. local, regional). This can include both cross-sectoral collaboration and/or collaboration between government and the community, (Morrisen, 2014).

- Cross-sectoral linkages between stakeholders should be nurtured as supported in the literature (Biggs *et al.*, 2017).
- In the IRC collaboration between the government and the community occurs primarily at the CMF meetings. The current study revealed a lack of representation from key stakeholders at both the SRF and CRF meetings owing to the impact of power relations, lack of capacity amongst stakeholders and the impact of diverse stakeholder interests. Attention needs to be given to targeting absent key stakeholder from the CRF and SRF meetings.
- In the past, the IUCMA has invested more energy to the management of the CRF meetings than the SRF meetings owing to the high profile of economic activities in the CRC. As the Sabie River has been identified as a River FEPAs and has a higher species diversity than the Crocodile River (including some

endemic species), it is recommended that this river receive more attention from the IUCMA in the future.

- In accordance with the ICMS, the IUCMA should perform regular surveys at both the CRF and SRF meetings to gauge the impressions of the stakeholders with respect to the public participation process. The feedback received should be circulated amongst stakeholders and the points discussed to encourage collective problem-solving at the CMF meetings. Previous research in the IRC has noted that there was little overall sense of coordination or common narrative amongst the different stakeholder workshops occurring throughout the catchment. The IUCMA can use the feedback from stakeholders to improve meetings throughout the catchment and possibly predict and prevent issues in one catchment from stakeholder experiences in another.

5.3.3.4. Recommendations to improve the levels of robustness and “adaptability” of instrument design

Long term adaptive planning such as consideration of regional plans based on scenario modelling and assessment, periodic review of policy and sequencing of policy instruments over time

- The current study didn't focus particularly on the long term adaptive mechanisms in place in the IRC. In the future, long term adaptive planning measures in the IRC should be considered in similar studies.

Despite taking important legal steps towards polycentricity, the reality on the ground in South Africa is that time is required for relationships and trust to be established between stakeholders. A local governance system in the IRC supported to function adaptively as described by Morissen (2014) is a priority if key stakeholder groups are to be supported through a process of transformation over time as shown in Figure 12 below.

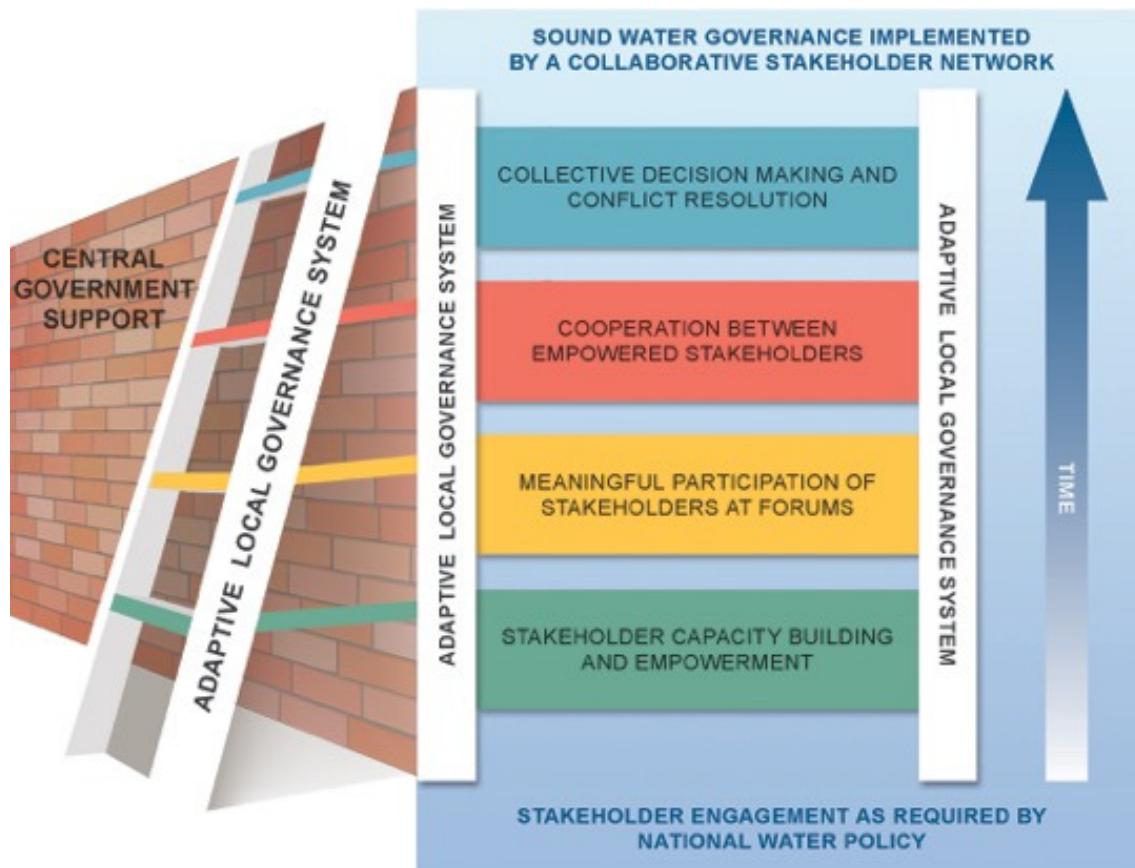


Figure 12: Adaptive local governance systems facilitate stakeholder collaboration in policy implementation in the IRC over time

When an adaptive local governance system is in place, supported by central government, it is proposed that knowledge-sharing within the catchment will facilitate capacity building and empowerment of the local government and stakeholders. Empowerment of stakeholder groups and high levels of attendance will encourage meaningful participation at relevant CMF meetings. Regular meaningful participation at relevant CMF meetings will promote cooperation between stakeholders. Once the stakeholder groups are empowered and co-operating in the catchment, they are well-positioned to contribute to collective decisions in a crisis and resolve conflicts between stakeholders as seen in successful polycentric governance systems. During this process, the stakeholder groups move from being engaged by local government as a national water policy requirement to being actively engaged in a collaborative network of relevant relationships (with both formal and informal water governance sectors) capable of implementing sound water governance in the catchment (Figure 12).

In the IRC, an adaptive local governance system would encourage implementation of IWRM and the NFEPA Project by promoting participatory water governance and central government

support. In addition, the stakeholders would move from being engaged by local government as an IWRM policy requirement to being actively engaged in a collaborative network of relevant relationships capable of implementing sound water governance in accordance with IWRM and NFEPA principles as shown in Figure 12.

6. CONCLUSION AND RECOMMENDATIONS

In the past there has been a predominance of studies in South Africa prioritizing the theoretical aspects of CMA operation. The current study deviates from the norm by focussing on the practical aspects of the local governance system operating in the IRC, particularly with respect to the Crocodile and Sabie Rivers. By adopting a social constructionist paradigm, the value of stakeholder perspectives is acknowledged amongst those actively involved in river-related issues on the ground. While the IUCMA is doing its best to operationalize sound water governance in the IRC, stakeholders often have to rely on the broader local water governance system for support in river protection efforts. By exploring stakeholder views of a) the NFEPA project, b) the relevant stakeholder platforms, and c) stakeholder roles and relationships relating to river protection in the IRC, this research promotes a better understanding of the implementation of South Africa's national water policy at the local level.

In this chapter, firstly the research findings are summarized in response to the objectives set out. Thereafter, in accordance with the overall aim of the research, recommendations are made on how stakeholders can collaborate to improve protection of the Crocodile and Sabie Rivers in the future. Finally, the relevance of this research is considered within the broader context of sustainability of South Africa's water resources in the future and reflections on the research process are provided.

In a positive sense, the results reveal that:

- a) The conservation stakeholders interviewed are aware of the NFEPA project and are applying the NFEPA information where possible to protect the Sabie and Crocodile Rivers.
- b) The CMF meetings are bi-monthly stakeholder platforms coordinated by the IUCMA for resolving the diverse range of social issues experienced by stakeholders within the river catchments in the IRC. The CRF meeting was commended by stakeholders for being well-organized, promoting good communication and conflict resolution amongst stakeholders and for notable achievements with respect to attendance, representation and enforcement in 2016.
- c) The key stakeholder groups are collaborating with each other in river management tasks at the catchment scale. At the sub-catchment level, stakeholder groups are well-connected, have a good relationship with the IUCMA and are collaborating to act collectively to water management crises in the CRC.

The results raise the following challenges to stakeholder protection of the Sabie and Crocodile Rivers:

- a) The stakeholders do not view the NFEPAAs as having legal status so the project is perceived as having limited application. The NFEPA project needs refining at the local scale to become more relevant. No mention of the NFEPAAs has been made at the CRF or SRF meetings and most of the stakeholders interviewed are unaware or only vaguely aware of the NFEPA project.
- b) While it is positive that the SRF meetings are being held regularly, diverse stakeholder interests and insufficient investment from the IUCMA impede the effective operation of the SRF meeting. The current study reveals a lack of representation from key stakeholders at both the SRF and CRF meetings owing to the impact of power relations and lack of capacity amongst stakeholders and the impact of diverse stakeholder interests. In the past, the IUCMA has invested more energy into the management of the CRF meeting than the SRF meeting. Insufficient action and feedback on issues at both the SRF and CRF meetings was noted as a concern.
- c) Unresolved conflicts around waste water management and unplanned developments in the CRC continue to challenge stakeholder collaboration. Relationships between key stakeholders in the SRC are hampered by a lack of communication and power differentials in a water scarce environment. Collaboration between stakeholders at the catchment scale is lacking with respect to the enforcement of tasks in the IRC. In terms of decision-making powers of key stakeholders in the IRC, the IUCMA is the primary stakeholder enforcing actions on the ground. The IUCMA recently lost certain delegated powers and functions previously delegated to them. The Irrigation Boards have retained decision-making ability transferred to them under the previous Water Act.

The challenges being faced by the stakeholders are typical of complex social-ecological systems. These “wicked problems” are characterised by a high level of uncertainty, shifting goal posts and changing issues (Berkes, 2017). To navigate such complex social-ecological systems the literature supports adaptive collaborative approaches (Berkes, 2017). Recently polycentric governance has emerged as a governance system well suited to deal with complex environmental problems at multiple scales (Morrison, 2017). In South Africa, the formation of the CMAs is a clear step towards a more polycentric governance regime (Herrhardt-Pahle, 2013). However, lack of co-ordinated processes between stakeholder groups and stakeholder decision-making power need to be addressed before stakeholders can co-operate to collectively solve problems and resolve conflict in the IRC. Previous studies (Cundill and Fabricius, 2010; Biggs 2017; Morrissey, 2014) have shown that more government support and

social facilitation is needed to promote effective governance of water resources in the South African context.

Similarities between the devolution of power to local authorities in South Africa and the regional governance of rural areas as described by Morissen (2014) have been noted. By considering the four key factors influencing resourcefulness of a rural system (Morrisen, 2014), recommendations have been provided to guide the key stakeholders on how to improve the adaptive capacity of the local governance system operating in the IRC. By implementing the above recommendations through the collaborative stakeholder actions in Table 19 below, stakeholders can collaborate to increase the resilience of the local governance system operating in the IRC.

Table 19 Guide to collaborative stakeholder actions supporting an adaptive local governance system in the IRC:

Key Resilience Factor (Morissen, 2014)	Collaborative Stakeholder Actions to enhance resilience of the IRC Local Governance System	Key Co-ordinating Stakeholders	Collaborating Stakeholders
Levels of broader fiscal, administrative and democratic support	Prioritize the Memorandum of Agreement between the IUCMA and the DWS to outline the avenues for future cooperation and the assignment and delegations of functions and related human, financial and other resources to the IUCMA.	DWS	IUCMA
	Promote the formation of task teams at the CMF meetings involving the relevant people assigned to address the issues raised. These teams should be given authority by the IUCMA to implement the tasks assigned to them and should be required to feedback regularly to stakeholders.	IUCMA	Competent stakeholders in leadership positions who regularly attend the CMF meeting
	Facilitate long-term stakeholder engagement platforms with the specific aim of improving relationships between the Irrigation Boards and the emerging/subsistence farmers. These platforms and relationships are important for addressing water allocation concerns and finding ways of promoting water allocation reform in the catchment.	DWS	IUCMA IB Emerging/ Subsistence Farmers
Levels of diversity and synergy across the instrument mix	Promote ongoing knowledge-sharing with respect to national water policy at both local and regional stakeholder engagement platforms relevant to stakeholders in the catchment. Implement the various strategies discussed in Chapter 8 for the conservation stakeholders in the IRC to collaborate to raise the awareness and relevance of the NFEPA Project amongst local and regional stakeholders.	IUCMA Conservation Stakeholders	All stakeholders in the IRC
	Apply knowledge of legal provisions for capacity building specifically to ensure that the municipalities in the CRC and the emerging farmers in the SRC receive capacity building support. Modify the IWRM workshops to be more interactive and integrate the idea of supporting volunteer groups responsibilities to promote NGO formation in the catchment. Repeat successful capacity building projects like The War on Leaks Project and the Women in Water Conference and the school competition.	IUCMA	All stakeholder in the IRC, specifically the municipalities and emerging farmers

Levels of engagement in regional networks	Local level key stakeholders should attend the National Freshwater Liaison Meeting, the Forum of Forum Meetings and the DWS Workshops and Strategy Meetings in order to nurture cross-sectoral linkages.	IUCMA Conservation Stakeholders	Representatives of key stakeholder groups in the IRC
	Attention needs to be given to targeting absent key stakeholder from the CRF and SRF meetings. An approach that is supported by the catchment stakeholders in the CRC is for the IUCMA to approach the stakeholders individually and encourage them to attend.	IUCMA	Municipalities Irrigation Boards, DMR, DEA, HDIs and TAs
	The IUCMA should direct more attention and resources to the Sabie River in the future: <ul style="list-style-type: none"> More IUCMA staff are required to support the IUCMA Bushbuck Ridge Satellite Office. Administrative issues hampering the staff at the Bushbuck Ridge Office should be resolved; Regular electronic communication between the IUCMA and the key stakeholders in the SRC should be promoted; Better representation of key stakeholders should be encouraged at the SRF meetings in the future. Stakeholders should be encouraged to participate in the meetings and an effort should be made to address the issues raised; Task teams should be formed with the relevant people assigned to address the issues raised and progress reports should be given by the task teams at subsequent meetings. Presentations should be available to stakeholders before the meeting; and meeting minutes should be made available to stakeholders electronically 	IUCMA	Stakeholders attending SRF meetings
	The IUCMA should perform regular surveys at both the CRF and SRF meetings to be aware of stakeholder impressions of the CMF meetings and to ensure that there is a common priority given to dealing with stakeholders in the different river catchments.	IUCMA	All stakeholders attending the CMF meetings

As the first CMA established in South Africa, the IUCMA has made great strides in IWRM implementation in the IRC as guided by the IWRM framework in the ICMS. In accordance with the ICMS, the IUCMA plays a central role in co-ordinating the related activities of water users and of the water management institutions within the IRC. In the Co-operative Strategy, the ICMS notes that the ICMA needs to consolidate its role as the central co-ordinating body within the catchment for all activities that affect water resources by continuing to prioritize informal and formal relationships with organisations. By acting as a key stakeholder co-ordinating the collaborative stakeholder actions in Table 19 above, the IUCMA can achieve this goal by enhancing the resilience of the local governance system operating in the IRC. By transferring responsibilities to competent stakeholders in task teams created at the CMF meetings to address issues raised, the CMA can endorse the activities of the CMF in the IRC. The current research shows how stakeholders prioritize attending meetings where important decisions are made that affect water-related activities in the catchment.

The DWS has a critical role to play in offering central government support to the IUCMA. As depicted in Figure 12, without central government support, the local governance system cannot function in a resilient manner. The IUCMA desperately requires central government support, firstly, with respect to enabling the IUCMA to enforce its authority in the catchment and, secondly, to assist the IUCMA in navigating the water allocation issues causing tension between the Irrigation Boards and subsistence farmers in the IRC. It has been pointed out in the literature that a lack of attention given to the political dimension of water management has negatively affected IWRM implementation in the past (Merrey, 2008).

A long term investment in staff, time and resources will be required to increase awareness of the NFEPA project amongst stakeholders in the catchment (Roux *et al.*, 2017). Several opportunities exist for the conservation stakeholders to collaborate in order to promote local implementation of the NFEPA Project. In so doing the NFEPA Project will: become more refined at the local scale and therefore more useful in everyday management decisions; become more relevant to stakeholders in the catchment; be translated into legal instruments as guided by the Implementation Manual for FEPAs and be increasingly incorporated into local and national level water management strategies and the work of the CMAs.

It has been proposed that when the stakeholders work together to support an adaptive local governance system in the IRC as presented in Table 19 above, stakeholder collaboration in the catchment is promoted over time. During this process, catchment stakeholders transform from being engaged by local government as an IWRM policy requirement to being actively engaged in a collaborative network of relevant relationships where they can contribute to implementing sound water governance in accordance with IWRM and NFEPA principles. The

positive relationship between the IUCMA and the stakeholders in the CRC, together with several successful collective action responses to crises, indicate that the stakeholders in the CRC are closer to forming a collaborative stakeholder network (or further up the ladder in Figure 12) than the stakeholders in the SRC. The reason for this is thought to be owing to the economically empowered nature of the stakeholders in the CRC and the efforts that the IUCMA have invested into regular stakeholder communication and facilitating of the CRF meetings. The high priority conservation status of the Sabie River together with water quality and availability challenges faced by stakeholders in the catchment highlight the national value and vulnerability of this river.

As the ICMA was the first CMA established in South Africa, IWRM implementation in the IRC is relatively more advanced than in other catchments. Similar studies probing stakeholder views of river protection on the ground in other catchments should be encouraged. Some catchments in South Africa contain River FEPAs and do not have the benefit of an operational CMA to assist in local water governance. By identifying the key stakeholders in these catchments, interviews should be carried out to determine the level of co-operative relationships and decision-making power amongst key stakeholders. This would provide an idea of the resilience of the informal water governance system operating in each catchment. Catchments containing River FEPAs and water governance systems with low resilience (little central government support, a local governance system displaying low-levels of decision-making power amongst stakeholders, low levels of stakeholder cooperation, and no functioning CMA) should be prioritized for government intervention and social facilitation efforts. These efforts should increase the four key factors identified by Morissen (2014) to improve the resilience of the local governance system, empower key stakeholder groups to collaborate in the catchment over time and increase protection of South Africa's vulnerable rivers in the future.

Although the IUCMA plays a central role in co-ordinating water-related activities in the IRC, the current research shows that it is facing significant challenges to policy implementation related to historical cultural inequities and lack of support from central government. Since the introduction of IWRM twenty years ago, stakeholder roles and relationships with each other and government in South Africa have become increasingly important in river protection as have the stakeholder platforms which facilitate these relationships. At times during the current research, the researcher had to resist approaching the research "from the top-down" by elevating the role and perspective of the IUCMA as being more important than that of the other key stakeholder groups. In these instances, a conscious effort was made to refocus on the "bottom-up" and the overall aim of the research – to interrelate stakeholder perspectives (in

the formal and informal sectors) in the ICR, Mpumalanga Province, South Africa, to promote collaborative stakeholder protection of the Sabie and Crocodile River.

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APPENDIX 1

Overall Management Objectives for River FEPAs and Sub-quaternary catchments (associated with river FEPAs, and Upstream Management Areas) (after Driver *et al.*, 2011)

Overall Management Objectives for River FEPAs and Sub-quaternary catchments associated with river FEPAs, and Upstream Management Areas (after Driver et al, 2011)

River FEPAs	
Overall Management Objective	<p>River FEPAs in a good condition (A or B ecological category) should remain so. This means that:</p> <ul style="list-style-type: none"> • Land-use practices or activities that will lead to deterioration in the current condition of a river FEPA are not acceptable.
<i>Water Quantity</i>	
Management Objective	<p>Flow regime and hydrology must support keeping river FEPAs in an A or B ecological category. This means that:</p> <ul style="list-style-type: none"> • Changes in flow regime that will lead to deterioration in the current condition of a river FEPA are not acceptable. • There should be no change in the natural hydrology (base flows and floods) of a river FEPA – e.g. from seasonal to perennial, or from ephemeral to seasonal, or from perennial to non-perennial.
<i>Water Quality</i>	
Management Objective	<p>Water quality must support keeping River FEPAs in an A or B ecological category. This means that: Changes in water quality that will lead to deterioration in the current condition of a river FEPA are not acceptable. Seasonal variability in water quality in river FEPAs must be retained, in permanent, seasonal and ephemeral river systems. A generic buffer of 100m measured from the top of the bank, should be established around river FEPAs. This buffer can be refined based on a site visit and application of the spreadsheet tool discussed in Section 5.7.5</p>
<i>Habitat and Biota</i>	
Management Objective	<p>Species diversity and the health of biotic communities supported by river FEPAs should be maintained. This includes the feeding, breeding and movement of fauna and flora. This means that:</p> <ul style="list-style-type: none"> • Loss of habitat availability and/or condition that leads to deterioration in the current condition of the river FEPA is not acceptable • A generic buffer of 100m, measured from the top of the bank, should be established around river FEPAs. This buffer can be refined based on a site visit and application of the spreadsheet tool discussed in Section 5.7.5
Sub-quaternary catchments associated with river FEPAs, and Upstream Management Areas	
Overall Management Objective	<p>Management of land-use practices within the associated sub-quaternary catchment and Upstream Management Areas must aim to maintain river FEPAs in their current condition.</p> <p>In managing the condition of a river FEPA, it is important to manage not just the river FEPA itself but also the network of streams and wetlands in the sub-quaternary catchment and Upstream Management Area that drain into the river FEPA. A proportion of these streams and wetlands need to remain healthy and functional in order for the river FEPA to maintain its A or B ecological condition. This requires managing the cumulative impacts of land-use in the surrounding subquaternary catchment and in Upstream Management Areas. Impacts tend to be more immediate in the associated sub-quaternary catchment than in an Upstream Management Area, but cumulative impacts from Upstream Management Areas have the potential to be very large and can be difficult to manage. This means that:</p> <ul style="list-style-type: none"> • Land-use practices or activities in the sub-quaternary catchment associated with a river FEPA, and not just at the site of the river FEPA itself, need to be managed. Land-use practices or activities in the sub-quaternary catchment that will lead to deterioration in the current condition of the river FEPA are not acceptable.

	<ul style="list-style-type: none"> Cumulative impacts of land use practices or activities in sub-quaternary catchments associated with river FEPAs and in Upstream Management Areas need to be managed. It may be acceptable for some streams and wetlands to be impacted, but only if the cumulative impacts do not result in the deterioration of the condition of the downstream river FEPA.
<i>Water Quantity</i>	
Management Objective	Flow regime in the sub-quaternary catchment associated with a river FEPA and in Upstream Management Areas should support the maintenance of river FEPAs in a good condition (A or B ecological category).
<i>Water Quality</i>	
Management Objective	<p>Water quality in the sub-quaternary catchment associated with a river FEPA and in Upstream Management Areas should support the maintenance of river FEPAs in a good condition (A or B ecological category).</p> <p>This means that:</p> <ul style="list-style-type: none"> Generic buffers of 100m should be established around streams and wetlands draining into river FEPAs. These buffers can be refined based on a site visit and application of the spreadsheet tool discussed in Section 5.7.5.
<i>Habitat and Biota</i>	
Management Objective	<p>Species diversity and health of biotic communities supported within subquaternary catchments associated with river FEPAs should be maintained, as these are refugia for supplying FEPAs. This includes the feeding, breeding and movement of fauna and flora. In Upstream Management Areas, conserving natural habitat and biota is not the primary objective; the emphasis is rather on maintaining functional ecosystems that are able to absorb impacts and that do not degrade downstream FEPAs.</p> <p>This means that:</p> <ul style="list-style-type: none"> Generic buffers of 100m should be established around streams and wetlands draining into river FEPAs. These buffers can be refined based on a site visit and application of the spreadsheet tool discussed in Section 5.7.5. Land use practices or activities that are not consistent with keeping natural habitat and biota intact in sub-quaternary catchments associated with river FEPAs are not acceptable.

APPENDIX 2

**Roles and responsibilities of the DWS, SANParks, Provincial
conservation authorities and CMAs**

Roles and Responsibilities of the DWS, DEA (now the DEAT), Provincial Conservation Authorities and CMAs (after Driver et al, 2011)

The Department of Water Affairs (Now the Department of Water and Sanitation)
Incorporating freshwater priorities through integrated water resource management, including: <ul style="list-style-type: none">• National strategic planning for water resources (e.g. development and review of National Water Resource Strategy)• Classification of all significant water resources• Determination of ecological water requirements, in particular the ecological Reserve and ensuring its successful implementation• Setting of resource quality objectives and ensuring their successful implementation• Water use authorisations Monitoring programmes which include monitoring the condition of freshwater ecosystems.
SANPARKS
<ul style="list-style-type: none">• Ensuring that freshwater ecosystem priorities inform the establishment, expansion and consolidation of national parks, as well as the delineation of buffer zones and other activities around parks.• Ensuring that freshwater ecosystem priorities inform the development and implementation of management plans for national parks.• Engaging with the development of national to local water management strategies (e.g. Catchment Management Strategies) and participating in co-operative water governance in catchment areas relevant for national parks.• Prompting and championing the role of parks within the multi-use landscape of freshwater conservation and management.• Contributing to the understanding of social ecological linkages and feedbacks within wider catchment or bioregional scales to establishing working models of adaptive management processes relating to freshwater conservation (which often start at and around parks but can effectively influence cooperation, management and governance across broader landscapes).
Provincial Conservation Authorities
<ul style="list-style-type: none">• Commenting on development applications, including environmental impact assessments, mining and prospecting applications and recreational fishing and aquaculture permit applications. This includes providing specialist freshwater ecological input and advising on mitigation measures and appropriate river and wetland buffers.• Participating actively in DWA-led reserve determination processes and the classification of water resources to ensure that freshwater ecosystem priorities and their freshwater requirements are taken into consideration.

- Participating actively in processes led by Catchment Management Agencies, including the development of Catchment Management Strategies. Provincial conservation authorities should play a leading role in providing a regional freshwater ecological perspective as well as technical advice and input on the incorporation of FEPA maps into the work of Catchment Management Agencies.
- Monitoring the condition of freshwater ecosystems, with a particular focus on regular monitoring of the FEPAs. This requires close collaboration with the River Health Programme.
- Identifying FEPAs that should be included in the consolidation and expansion of the provincial protected area network, including through biodiversity stewardship programmes.
- Ensuring that freshwater ecosystem priority areas inform the development and implementation of management plans for protected areas.
- Interacting with Working for Water, Working for Wetlands and Land Care to direct these programmes towards rehabilitating freshwater ecosystem priority sites.
- Initiating and/or participating in the development of biodiversity management plans in terms of the Biodiversity Act, for priority freshwater ecosystems and species.
- Verifying all FEPAs, fish sanctuaries and free-flowing rivers that occur in the relevant province, and confirming their status (for example, ground truthing their ecosystem type and condition).
- Filling in gaps in knowledge of freshwater ecosystems and species, for example: Mapping wetlands that have not yet been included in the national wetland map, and contributing these to the national wetland inventory coordinated by SANBI and surveying the distribution of threatened fish populations.

Catchment Management Agencies

- Ensuring that freshwater ecosystem priorities are meaningfully reflected in the development and implementation of the Catchment Management Strategies.
- Ensuring that freshwater ecosystem priorities are meaning fully reflected I the development and implementation of plans and programmes at the sub-water Management Area Scale.
- Contributing to monitoring the condition of freshwater ecosystems, ensuring that the monitoring strategy takes FEPAs into account.

APPENDIX 3

Monash University Consent Form



CONSENT FORM (Catchment Stakeholders)

Project: *To what extent are priority rivers that flow into the Kruger National Park protected by stakeholders within their catchments? - A comparative case study of the Sabie and Crocodile Rivers of the Lowveld, South Africa.*

Chief Investigator: Dr Dirk Roux

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
Audio recording during the interview/focus group	<input type="checkbox"/>	<input type="checkbox"/>
The data that I provide during this research may be used by the researchers in future research	<input type="checkbox"/>	<input type="checkbox"/>

Name of Participant

Participant Signature

Date

APPENDIX 4

Monash University Project Explanatory Statement

EXPLANATORY STATEMENT (Catchment Stakeholders)

Project Title: To what extent are priority rivers that flow into the Kruger National Park protected by stakeholders within their catchments? - A comparative case study of the Sabie and Crocodile Rivers of the Lowveld, South Africa.

Project Number: CF/201-2016000092

Chief Investigator: Dr Dirk Roux
Freshwater Conservation Scientist (SANParks)
Adjunct Research Fellow, Monash University
Phone: [REDACTED]
email: [REDACTED]

Student Researcher: Katherine Lishman
Phone: [REDACTED]
[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?

Background

In 1998, South Africa's water law was reformed by the National Water Act (NWA) shifting private ownership of water to state custodianship. The NWA has been heralded as one of the most progressive pieces of water legislation in the world as sustainability of water resources and equity took centre stage with the recognition of the Reserve as a constitutional right to water.

Since the early 2000s, South Africa has taken a leading role in freshwater conservation globally by launching the National Freshwater Priority Area project (NFEPA). The NFEPA project led to the identification of spatially explicit priority areas for conserving rivers, wetlands and estuaries known as Freshwater Ecosystem Priority Areas (FEPAs). The FEPAs comprise 22% of South Africa's river length, 38% of wetland area and 41% of estuaries. It was emphasized throughout the project that in order to conserve a river, it is important to manage the network of streams and wetlands in the Sub-Quaternary catchment and upstream management area that drain into the river.

The Study Area

The Kruger National Park (KNP) is an iconic protected area in South Africa covering almost 2 million hectares of the Mpumalanga and Limpopo Provinces of South Africa. The KNP has been identified as playing a very important role in achieving national freshwater ecosystem goals. A substantial proportion of the river length (50%) in the KNP has been selected as FEPAs and over 10 river ecosystem types occur in this park.

The Research Problem

Water is one of South Africa's most limited resources. Social and economic needs have resulted in the widespread degradation of freshwater ecosystems. Over half of South Africa's river, wetland and estuary ecosystem types in South Africa are threatened. This crisis is expected to worsen in the future with a predicted escalation in water demand and an increase in aridity in many parts of the country in response to climate change.

World class water legislation and freshwater conservation efforts, as well as the development of Strategic Adaptive Management in the KNP, highlight the need for co-ordinated freshwater governance involving multiple stakeholders within the catchments of priority rivers within South Africa. On-the-ground protection of priority rivers flowing into the KNP is often hampered by technical capacity deficits and administrative challenges in

South Africa's water governance structures. Owing to these challenges, there is now urgent need to explore the different levels of protection afforded to the nation's priority national freshwater assets.

The Research Question

To what extent are priority rivers that flow into the Kruger National Park protected by stakeholders within their catchments? - A comparative case study of the Sabie and Crocodile Rivers of the Lowveld, South Africa.

Research Sub-questions:

1. Who are the stakeholders involved in protecting water in the Crocodile and Sabie Rivers, how are they represented and how do they interact?
2. What protective action is taken by stakeholders in the Crocodile and Sabie River Catchments?
3. Are stakeholders aware of the National River Freshwater Ecosystem Priority Areas, as defined by the NFEPA project? If they are, to what extent have the FEPAs been incorporated into river protection?

Research Methods

Exploring the institutional framework of ecosystem-based management requires a qualitative approach, involving multiple sources of data and inductive data analysis. A comparative case study design will be adhered to as two priority rivers flowing through the KNP managed under different circumstances upstream have been selected. This research design will allow the researcher to explore and compare the diverse range of protection measures afforded to the Sabie and Crocodile Rivers within their catchments. The researcher will conduct two phases of semi-structured interviews. An initial phase of semi-structured interviews will be conducted with key river research and management SANParks personnel in the KNP. A second phase of semi-structured interviews will occur as the KNP personnel identify key contacts within the CMA and local organisations that they relate to upstream of the Sabie and Crocodile Rivers. It is possible that the researcher will make use of focus groups instead of a second phase of semi-structured interviews if a large number of local organisations would like to participate in the research.

Why were you chosen for this research?

The SANParks KNP river research and management team have identified your organisation as contributing to the protection of a priority river upstream of the KNP selected for the current research.

Consenting to participate in the project and withdrawing from the research

- I. the consent process involves reading an explanatory statement and then signing and returning the consent form,
- II. the participant has the right to withdraw from further participation at any stage, however, if the participant has submitted an anonymous questionnaire as part of this research, it should be understood that it will not be possible to withdraw data once the responses have been submitted, and
- III. if you choose not to participate in the interviews or focus groups, you can contribute to the research by offering to submit an anonymous online questionnaire

Possible benefits and risks to participants

The proposed study will assist the participating catchment stakeholders to protect the selected priority rivers flowing into the KNP. The information gathered during this research will be useful for improving the effectiveness of Catchment Management Strategies of these rivers. There are no foreseeable risks involved in this research as the identity of participants will be kept confidential. A low level of discomfort may be experienced only as being recognized as an employee of a participating organisation.

Confidentiality

No names of individuals interviewed will appear in any future reports or publications resulting from this research. Reference to research participants will be limited to the organisations they work for. This research is required for completion of the Degree of Master of Philosophy (MPhil) in Integrated Water Management at the Water Research Node, Monash South Africa, Monash University Australia. The research will be compiled into a research project report for submission to the university. Thereafter research will be published as a paper in a scientific journal and possibly presented at a conference. As part of a Research Agreement with SANParks, a research report as well as a copy of processed electronic datasets used will be submitted annually to SANParks. At all times, the identity of participants will be protected and remain confidential.

Storage of data

Data collected will be in the form of interview protocols, transcripts and audio recordings made and documents collected during the semi-structured interview conducted with the KNP management. The data will be stored on the researcher's computer and at in a lockable filing cabinet at Monash South Africa. Only the student researcher and the chief investigator will have access to the data. The computer files will be deleted and documents will be shredded 5 years after the research project has been completed.

Results

The completed research project report will be made available at the Monash University report repository as is standard Monash University practice.

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:

Ms Hester Stols
Monash South Africa

[REDACTED]

Tel: [REDACTED] Email: [REDACTED]

Thank you,

[REDACTED]

Dr Dirk Roux

APPENDIX 5

The CRF Meeting Minutes for the 17 February 2017

MINUTES OF THE CROCODILE CATHCMENT FORUM HELD IN MBOMBELA STADIUM

Date : 17 February 2017

Time : 08h30 for 09h00

Host : IUCMA

Items	Details	Responsible
1. Opening and welcoming	The chairperson of the forum officially opened the meeting. He welcomed all the attendees acknowledging the new faces and declared the meeting officially open at 09h05.	Mr Theo Dormehl
2. Introductions and Apologies	<p>All attendees introduced themselves respectively</p> <p>The following were apologies from stakeholders: -</p> <ul style="list-style-type: none"> • Dr Eddie Riddell – SANParks • Ms Nancy O’Farrell – Irrigation Board • Ms Estelle Bullen – • Mr Elijah Mogakabe - DWS • Ms Liketso Khaile – IUCMA • Ms Dudu Sifunda – Nkomazi LM • Mr Tom Jacobzs – Sempcor Silulumanzi • Ms Rofhiwa Ramunenyiwa – IUCMA 	All
3. Adoption of the agenda	<p>The agenda was adopted with the following additional items:</p> <ul style="list-style-type: none"> • Revenue Management feedback on tariffs • Hydrological status of the catchment • Report back on action card 	All
4. Minutes of previous minutes	<p>The minutes were reviewed per page and adopted as a true reflection of the previous meeting after the below alteration was made.</p> <ul style="list-style-type: none"> • Page 5, item 12(on feedback from the latest Bio-monitoring surveys in the Crocodile). <u>riches</u> changed to <u>reaches</u>. <p>Mr H Makhubele moved for the adoption of the minutes and was seconded by Mr N. Khoza.</p>	All
5. Matters Arising	<p>The following are matters that arose from the previous minutes: -</p> <p>4.1 Kabokweni Pump station</p>	

	<p>Mr Tobias Sondai reported that the municipality has appointed the contractor and confirmed that both sewage pump stations are currently functional. Ms Busi Mahlangu from the IUCMA also attest to that indicating that inspection was conducted by Ms Ramunenyiwa and confirmed that both pumps are functional.</p> <p>The chairperson appreciated the good work that has been done.</p> <p>4.2 Attendance of the forum by SAPS representative</p> <p>The chairperson appreciated SAPS representatives and Mr TJ Mare' from KLCBT for attending the meeting indicating that hopefully this would be a long-term relationship with the forum.</p>	
6. Report back on water quality status	<p>Main Stem</p> <p>The presenter outline the presentation lay out that covered the map for the entire crocodile catchment, RQOs, pollution incidents and recommendations. The presenter mentioned that the RQOs has been gazetted on the 13th of December 2016 and the presentation was based on the final gazetted RQOs.</p> <p>E-coli – at Dullstroom the limit is 120 CFU/100ml, the results focused from Nov 2016 – Jan 2017 the E-coli has been dropping because of the dilution received from the rain.</p> <p>E-coli- at the upper catchment limit 130 CFU/100ml, from November 2017 all points has been dropping down</p> <p>E-coli -at the middle part of the catchment, is the same trend e-coli is dropping down except one point at Crocodile river at Kanyamazane bridge and Nels River at Brondal</p> <p>E-coli- at the lower catchment, the limit is 130CFU/100ms, e-coli was elevated at Crocodile River D/S of Komatiport Golf Course</p> <p>EC – all the points were below the acceptable limit Of 30mS/m.</p> <p>EC- at the middle of the catchment all the points were below the acceptable limit of 70 mS/m.</p> <p>PO4 – from Nov 2016 to date there has been no change most points were within the limit of 0.01 mS/m</p> <p>PO4 – at the middle of the catchment from Nov 2016 has been complying</p> <p>PO4 – at Besterspruit had a spike from Nov 2016 to Jan 2017</p> <p>PO4 – at Malelane bridge to KNP has been complying from Nov 2016 to Jan 2017.</p> <p>Conclusion</p> <ul style="list-style-type: none"> ➤ E. coli counts in the Crocodile Catchment showed the lowest counts at upstream and downstream of Kwena Dam. The middle and upper catchment of Crocodile showed high E. coli 	Ms Mandy Mashaba – IUCMA

	<p>counts which periodically exceeded the set RQOs of Recreation (full contact), this is due to sewer manholes and pump station spillages, partially treated effluent from WWTW and illegal dumping especially the nappies it's a huge challenge.</p> <ul style="list-style-type: none"> ➤ Electrical Conductivity falls within the acceptable and ideal limits as per the RQOs (Aquatic Ecosystem drivers) and from October 2016 the decreasing due rainfall received, except for Besterspruit and Crocodile @Rivulets. ➤ Ortho-Phosphate most of the time falls within the acceptable and tolerable limits as the RQOs (Aquatic Ecosystem drivers) and is also observed that it has been decreasing from October 2016 due rainfall received. <p>Pollution Incidents:</p> <ul style="list-style-type: none"> • In the last 2 months, the following pollution incidents were reported and attended to: ➤ Sewer manholes overflowing from the manhole into the storm water channel which drains into the water resource. <ul style="list-style-type: none"> ➤ 21 Ehmke street, ➤ 9 De Villiers Street, and ➤ Bell Street. ➤ Fishkill at Kimberley creek tributary (Louville) ➤ IUCMA has reported overflow manholes to Sembcorp and the matters were resolved within 24 hours <p>See attached presentation</p> <p>Questions / Comments</p> <p>-Comments on the issue of informal settlement (above the Kwena dam). -construction along to Kanyamazane route, concern about informal settlement what happens to the waste? -Entokozweni settlement what is happening with the sanitation of that settlement. City of Mbombela responded that their project is still on progress at Thekwane North -Fish kills in the Kaap River happened in January 2017, to be investigated.</p> <p>Entokozweni issue most of the residents have their own connections with the sewer line, some that are residing close to the dam take out their sewer direct to the dam, the city of Mbombela is currently investigating</p> <p>The forum resolves that the City of Mbombela and IUCMA should investigate where do people from Entokozweni discharge their sewer, this should be investigated and brought to the attention of the council. Mbombela bylaws must take responsibility.</p>	
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<p>7. Feedback on Municipal WWTWs: City of Mbombela LM</p>	<p>7.1 City of Mbombela LM presented indicating that the City of Mbobela has got two service providers which Sempcorp Silulumanzi and Mpumalanga Rand Water. The presenter also clarified why they are now called the City of Mbombela indicated that it is because the former Mbombel LM has been amalgamated with the former Umjindi LM.</p> <p>The report back focused more on the WWTWs where Mbombela operates and Sembcorp Silulumanzi reported on their area of operation.</p> <p>Compliance level as per the attached presentation. Also, see the project status shared on the attached presentation.</p> <p>Sembcorp Silulumanzi – Reported indicating that they see positive results on the issue of chlorine and the phosphate has been going down. They will present the draft report in the next forum meeting and the final report will be forwarded to the IUCMA.</p> <p>Kingstone valle – they got a lot of overflow, dumping in the sewer manholes is a challenge. There was manhole overflow at Louis street and investigation is under way.</p> <p>Stakeholders were requested to report any overflow to the control room contact number 013 752 6839.</p> <p>Questions / comments</p> <p>Question: Where there any spillages on the construction? Response - No spillages from construction, the only challenge they only use one pump but by the end of this month(February) the second pump will be installed.</p> <p>Question: How does Mbombela measure the efficiency of the WWTWs? Response - They test the effluent on the upstream and D/S. The contractor has been on site from the 9th of January to the 9th of February 2017.</p> <p>Comment appreciating improvements at White River and posed a question seeking clarity if is there any staff allocated for White River pump station?</p> <p>Response- Human resource not yet appointed however; all process controllers are trained, the City of Mbombela has just finalised the process of amalgamation with Umjindi LM, replacement process is now under way so wherever there will be gabs posts will be advertised.</p>	<p>Mr Nhlanhla Khoza – City of Mbombela</p>
<p>7.2 Nkomazi Local Municipality</p>	<p>He gave a brief presentation indicating that Nkomazi LM two plants that rely on the Crocodile river.</p>	<p>Mr Buhle Shongwe – Nkomazi</p>

	<p>He flagged the locality map of Nkomazi LM, Effluent results see attached annexure</p> <p>-PH for final effluent was at 7.68 -EC was also at an acceptable range 105mS/m</p> <p>Way forward -They started trials on June replacing eco-tabs with bio-augmentation product.</p> <p>WC and WDM -They are working with DWS on the project called WAR on leaks, identifying leaks, issue water serving tips and report on water shortages. - They also have reporting system called CARS – to identify leaks they send a message via sms and attend to it.</p> <p>See attached presentation.</p> <p>Questions /comments</p> <p>Komatipoort pump station, what is the status there? Response – Previously there were no flow meters but since they've installed flow meters they know how much they are pumping into the river. There were also some blockage challenges which has been sorted now</p> <p>Stakeholders were urged to report direct to the Municipality in terms of any sewer spillage then inform the IUCMA.</p> <p>Presenter should also include blue drop /green drop status</p>	Local Municipality
	<p>Special guests</p> <p>The chairperson introduced the special guests from Dutch water authority in the Netherlands and they were given an opportunity to introduce themselves and briefly indicated the project they work on with IUCMA.</p> <p>They have developed the hydro net project with the IUCMA, developed some tools together.</p> <ol style="list-style-type: none"> 1) Rain watch application and 2) Water auditing tool. 	
8. Hydrological status of the catchment	<p>He presented an overview of the hydrological status of the catchment. He first displayed the real time overflowing and rainfall gauge instruments.</p> <p>Release at Kwena – 0.8 cumex , due to the faulty valve at Kwena . The intention is to release 0.5 cumex.</p> <p>Elands = 8.6cumex</p>	Mr Thabo Mahlobo - IUCMA

	<p>Bochrand =5.03 cumex (</p> <p>Karino = 24.64 cumex</p> <p>Kaap Dolton= 9.47 cumex</p> <p>Riverside flow= 26.16 cumex</p> <p>Tenbosch=36.24 cumex which is above normal</p> <p>Reserve Crocodile River from January we've been meeting the reserve</p> <p>Dam levels</p> <p>Kwena – 46.56%</p> <p>Witklip =63.29%</p> <p>Longmere =69.48% which higher compared to last year</p> <p>Primkop=80.67%</p> <p>Klipkopje =38.99 which is very low compared to last year</p> <p>Restrictions for domestic 5% calculated on the dam level</p> <p>Restrictions for irrigation = 60%</p> <p>Rainfall status</p> <p>Kwena dam – 2016/2017 above normal</p> <p>Witklip- above medium and probabilities, we might have above normal rainfall</p> <p>Questions / comments</p> <p>Stakeholders were very concerned about the issue of the faulty valve at Kwena. DWS should attend to give us progress on this crucial issue, the valve has been broken since December 2016.</p> <p>The Executive Manager from the IUCMA responded indicating that as stakeholders we've got a role to play, as a forum we need to put pressure about this issue to the DWS as the IUCMA we are trying our best.</p> <p>The question was asked if this issue has been escalated to the Minister? Stakeholders needed a clear indication if the delay on fixing the problem is it a financial problem or what so that stakeholders can intervene in terms of sponsorship.</p> <p>See attached presentation</p>	
9. Revenue Management	<p>Revenue Management (Tariffs)</p> <p>She gave feedback on the tariffs that stakeholders were consulted on last year. She indicated the relevant tariffs that were approved by the Minister;</p> <p>Presentation outline focus on the background. The tariffs are based on the NWA and the pricing strategy. She indicated that the consultation was conducted with the stakeholder in August 2016 covering Usuthu area and Inkomati area.</p>	Ms Winnie Mabuza - IUCMA

	<p>All issues of concern were consolidated and sent to DWS and the National consultation was held on the 26th of August 2016. She indicated issues that were raised during the consultation process, see attached presentation. We based the tariffs based on the activities done on the catchment, looking at the cost for the improvement of water services.</p> <p>Double billing by irrigation board and the DWS.</p> <p>Tariffs highlighted in red were the first requested tariffs but the Minister approved the tariffs highlighted in yellow colour. See attached.</p> <p>She also indicated that the budget was expected to be 50/50 contribution but now the department is expected to fund most of the activities due to the tariffs cuts down. 70 % from the Department 30 from collection.</p> <p>Currently the billing is still under the DWS, what happened last year in September the department introduced SAP system in our offices, they transferred the function of billing but unfortunately as IUCMA we were not vat registered so we could not bill our clients but the issue is now with the National treasury and the department they need to put some comments on the IUCMA application for vat before it gets approved. Hopefully by the beginning of 2017/18 financial year we will have the billing under the IUCMA.</p> <p>She concluded with appreciating the cooperation from the stakeholders indicating that their inputs are highly valued and encouraged stakeholders to continue participating to the consultation meetings.</p> <p>Contact numbers for revenue team will be circulated with the minutes.</p>	
10. Addition to the agenda	a) Database movements -Seven new stakeholders attended the meeting.	All
11. Reflection on 2016 Crocodile CMF	<p>Feedback on the assessment of the Croc CMF meetings 2016 was displayed with the views of forum members in terms of success, challenges, and ways of resolving the identified challenges. To name the few but not limited are:</p> <ul style="list-style-type: none"> • Bringing the relevant stakeholders together • Good attendance, knowledge sharing, well-structured minutes • Good participation • Stakeholders with knowledge of water management within the catchment • Raising awareness of sewage spillage • Mitigate over spillage 	Mr Theo Dormehl

	<ul style="list-style-type: none"> • Serious problems with waste water treatment especially Mbombela • Drought climate is a challenge • Align operating rules with the drought • Not all stakeholders are represented, encourage stakeholders DMR, Traditional authorities, HDIs and Emakhazeni LM to attend the forum. • We don't have powers • Involvement of all stakeholders including SAPS • The forum has no legal powers to further the objectives • No funding • Lack of authority to act against pollution • Illegal mining it's a challenge • Promote forum with Municipal managers <p>The chairperson also shared the information regarding the projects that were underway for the month of March 2017 in celebration of National Water Month 2017.</p> <p>Water week awareness and annual Science school competition whereby we are targeting the grade 10 and 11 to construct the water purification model. They will be given a 5L dirty water and they must treat it within 1hour, 30 rural schools are invited to participate in the project and they will be given cash voucher prizes. This is intended to entice learners into following careers that would be beneficial to the water sector, given the shortage of suitably qualified individuals in this field.</p>	
17. date of next meeting	The date of the next meeting is 05 May 2017 , host RCL Foods. Venue will be communicated in due course.	All
18. Closure, Lunch and departure		All

Acronyms: -

IUCMA	Inkomati - Usuthu Catchment Management Agency
WMA	Water Management Area
DWS	Department of Water and Sanitation
ComLM	City of Mbombela Local Municipality
IB	Irrigation Board
DARDLEA	Department of Agricultural Rural Development and Environmental Affairs
WWTW	Waste Water Treatment Works
WRVCB	White River Valley Conservation Board
NWRS	National Water Resource Strategy

Signed by:

Secretary: _____
Ms. Liketso Khaile

Chairperson: _____
Mr. Theo Dormehl

APPENDIX 6

The SRF Meeting Minutes for the 27 February 2017

MINUTES OF SABIE RIVER SUB CATCHMENT FORUM MEETING

DATE: 27 FEBRUARY 2017

VENUE: NUMBI HOTEL

ITEMS No.	ACTIVITY	RESPONSIBLE PERSON	RESOLUTIONS
1.	Arrival and registration	All	
2. Opening	The meeting was officially opened with a prayer		
3. Welcome	Everybody was welcomed and urged to participate freely using any language that a person is comfortable with.	Chairperson	
4. Apologies	Apologies were received from the following: 1.Kobus from Matikwane, 2.Maider from Mapulaneng 3 Khoza frank from Rand water 4.Shabalala Elvis from Mbombela 5.Mkhawane Norman from Bushbuckridge municipality.	All	
5.PRESENTATIONS	Presentations on water quality, waste management, emissions and WWTP in the Sabie River and state of WWTP in the Sabie River Sub Catchment: ► Thabachweu Municipality. ► Mbombela Municipality	Eugene Malungane	<ul style="list-style-type: none"> • To make some follow ups with the representatives of Thabachweu and Mbombela municipality representatives
5.1Thabachweu municipality	► Mbombela Municipality	Elvis Shabalala	
5.2Mbombela municipality	► Bushbuckridge municipality sent a person to represent it but was not having a presentation and answers on behalf of the municipality.	Norman Mkhawana	
5.3Bushbuckridge municipality	► Matikwane Hospital presentation.		
5.4Matikwane Hospital	- The person sent by Matikwane was not having a formal presentation he only indicated that water tests have been done and they are waiting for the results.	John Ubisi	

				<ul style="list-style-type: none"> - He also indicated the following challenges <ul style="list-style-type: none"> • Their borehole is not functioning • They are having budget constraints • Two water tank pumps are not serviced.
5.5 Mapulaneng Hospital	<p>► Mapulaneng Hospital presentation:</p> <p>-The representatives presented on the following:</p> <ol style="list-style-type: none"> 1. Waste management <ul style="list-style-type: none"> • She indicated that waste is collected by municipality on Monday, Wednesday and Friday • Medical waste is collected by a service provider in the name of Ubuuhle. • Their sewer is connected to the municipality pipe line. 2. Portable water. <ul style="list-style-type: none"> • They are supplied by the municipality. • The water come purified • They also test the water daily before it is consumed by patients in the hospital. 	Ntemane Florence		<ul style="list-style-type: none"> • Public works to fix their challenge. • To communicate with the district to assist them with budget • To prepare a formal presentation in the next forum
5.6. Bongani Hospital	<p>Bongani Hospital had a formal presentation where he presented on:</p> <ol style="list-style-type: none"> 1.Achievements. <ul style="list-style-type: none"> • Their sewage plant is being serviced. • Water samples are being taken and now they are in compliance. 2.Monitoring of purification of sewage system. <ul style="list-style-type: none"> • Every morning and afternoon the process controller check the availability of chemicals. 3. Health care waste management. 	Gazide Shadrack		<ul style="list-style-type: none"> • To build proper waste collection storage. • To come with water quality results of their Hospital in the next forum.

	<ul style="list-style-type: none"> • A service provider has been appointed to collect our waste and is collecting as required. • We don't have a challenge as far as waste is concern. <p>4. Challenges:</p> <ul style="list-style-type: none"> • Bongani purification plant not licensed. • They don't have proper waste collection storage. <p>► Environmental health presentation by Selby Mokoena.</p> <ul style="list-style-type: none"> • Samples for 5 jojo tanks did not comply with the standards. • Some of the jojo tanks are not covered and contamination is highly possible. • Building houses and rooms next to the rivers and streams causes pollution. • Educate communities to dump in legal dumping areas. • Avoid building houses next to the rivers and streams to avoid pollution. 	
6. Lima rural development	<p>Presentation on rural development by: Percy Maja.</p> <ul style="list-style-type: none"> • He presented on Lima and indicated that it is based in Bushbuckridge at Amashangane Traditional council. • It deals with farmer support. • It conducts training of farmers for free. • Give good agricultural practice training. • Water preservation training. • Encourage sustainable agriculture. • Buy farmers production inputs. <p>Requirements to qualify for loan.</p> <ul style="list-style-type: none"> • Be a farmer. 	Percy Maja

	<ul style="list-style-type: none"> • Be registered on Lima data base. • Have water on your farm. 		
7. Revenue management	<p>➢ IUCMA Presented on 2017/18 approved tariffs:</p> <ul style="list-style-type: none"> • Pricing strategy of 2007 Act • Tariff charges of Inkomati for 2017/18 financial year. • The IUCMA to take over the billing from DWS. • Tariff charges brought down. • No payment for domestic use water. 	Mabuza Winni	
8.Water Quality	<p>➢ Presentation on water quality in the Sabie River by Adolph Mbetsse.</p> <ul style="list-style-type: none"> • He indicated that recent rains led to improved levels at Inyaka and Dagama dam. • Inyaka is at 66.21%. • Dagama dam is at 43% • We don't have enough water yet we need to conserve the little that we are having 	Adolph Mbetsse	
9. Water Quantity	<p>➢ Presentation on water quantity by Thabiso Malemela.</p> <ul style="list-style-type: none"> • He indicated that all monitoring points are not complying because of illegal discharges and illegal dumping. • The above contributes negatively. • R40 has a lot of overflow points. • Electrical conductivity. - 2016 electrical conductivity was complying. - Postillcomplying. - 2015 to early 2016was not complying 	Thabiso Malemela	

APPENDIX 7

The 2016 CRF Survey Reflection Cards

The 2016 CRF Survey Reflection Cards

Reflection on 2016 Crocodile CMF	
1.	What has been our best achievement 2016
1.1	<u>Bringing relevant stakeholders together</u>
1.2	_____
2.	What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river
2.1	_____
2.2	_____
3.	How must we fix this (the above identified problem)
3.1	_____
3.2	_____

Reflection on 2016 Crocodile CMF	
1.	What has been our best achievement 2016
1.1	<u>AS A FIRST TIME VISITOR, THE AWARENESS CREATED HERE IS PHENOMINAL.</u>
1.2	<u>MONITORING APPROACH: DATA VALUES ACCUMULATED TO USE FOR FUTURE REFERENCES</u>
2.	What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river
2.1	_____
2.2	_____
3.	How must we fix this (the above identified problem)
3.1	<u>IT LOOKS LIKE YOUR STRATEGY IS WORKING! KEEP INVOLVING MORE STAKEHOLDERS!</u>
3.2	<u>CREATE OWNERSHIP BY ATTENDING THESE FORUMS. BASICALLY - MONEY + MONEY + PEOPLE</u>
3.3	<u>KEEP MONITORING</u>

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1 Good attendance & knowledge sharing

1.2 Well structured minutes, good communication

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 Not all stakeholders are presented e.g DMR

2.2 _____

3. How must we fix this (the above identified problem)

3.1 Invite DMR to form part of the forums

3.2 _____

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1 Make Water your Passion

1.2 ^{listen}
People learned, listened & attend meetings of the
Crock forum.

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 Policing the River.

2.2 Pollution.

3. How must we fix this (the above identified problem)

3.1 Combined effort with all involved.

3.2 Communication with all involved.

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1 JCLAGAAL MTNING IN NOORDKAAP ACHIEVED

1.2 KEPT ALL STAKEHOLDERS INVOLVED IN 2016

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 DID NOT GET UMJINDI ON BOARD

2.2 KABOKWENI SEWER PUMP STATIONS NOT SORTED

3. How must we fix this (the above identified problem)

3.1 ??

3.2 ??

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1 JCLAGAAL MTNING IN NOORDKAAP ACHIEVED

1.2 KEPT ALL STAKEHOLDERS INVOLVED IN 2016

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 DID NOT GET UMJINDI ON BOARD

2.2 KABOKWENI SEWER PUMP STATIONS NOT SORTED

3. How must we fix this (the above identified problem)

3.1 ??

3.2 ??

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1 Getting increased attendance & representation

1.2 Positive strides toward CME by the CAF

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 Water Quality - citizens need education & awareness
on nappy disposal

2.2 Commitment by Municipalities to prevent pollution

2.3 River sand - mining.

3. How must we fix this (the above identified problem)

*Include Doh, DEA,
SIPs etc*

3.1 Collaborate strategically w relevant department - Security, justice, health,
traditional leaders, COSTA, DMK, DAFF, & civil society

3.2 _____

7

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1 Having a conversation which is in the best interest
of the water resource

1.2 More enforcement achieved

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 Not all the water sector partners represented

2.2 _____

3. How must we fix this (the above identified problem)

3.1 Visit the different partners individually and
encourage them to attend the forum

3.2 _____

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1 A few not been part of the most meetings in 2016

1.2 _____

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 _____

2.2 _____

3. How must we fix this (the above identified problem)

3.1 _____

3.2 _____

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1 We continue to have well attended meetings with good participation.

(1.2) We have shown no progress in resolving WRWWTW pollution.

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 The Forum has no legal power to or status to further objectives.

2.2 The Forum does not have funding to achieve objectives

3. How must we fix this (the above identified problem)

3.1 Not in our power to fix

Funding - levels - but also is this our responsibility?

There are agencies to fix this. I believe it is the forum's responsibility to highlight issues and foster co-operation. Not to fix things.

Reflection on 2016 Crocodile CMF	
1.	What has been our best achievement 2016
1.1	<u>Raising awareness of sewage spills</u>
1.2	_____
2.	What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river
2.1	<u>Lack of authority to act against polluters</u>
2.2	_____
3.	How must we fix this (the above identified problem)
3.1	_____
3.2	_____

Reflection on 2016 Crocodile CMF	
1.	What has been our best achievement 2016
1.1	<u>Dont think we did achieve anything, we are still talking about the same issues as 12 months ago</u>
1.2	<u>The IUCN&Ours have to step up and act.</u>
2.	What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river
2.1	<u>Support from IUCN& Ours to be</u>
2.2	_____
3.	How must we fix this (the above identified problem)
3.1	<u>More pressure on Government to act!</u>
3.2	_____

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1 KEEP MEMBERS INTERESTED & ADD INTERESTING ITEMS ON THE AGENDA

- 1.2

GETTING CERTAIN MUNICIPALITIES ON BOARD-BRAVO!

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 TO GET OTHER MUNICIPALITIES TO PARTICIPATE ACTIVELY

2.2 POLLUTION

3. How must we fix this (the above identified problem)

3.1 TOGETHER WITH IUCMA AS LEADERS APPROACH THE MUNICIPALITIES AT THE STRATEGIC LEVEL

3.2 INVOLVEMENT OF ALL STAKEHOLDERS INCLUDING SHPS

13

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1 Nothing - the same problems are still on the agenda etc.

- 1.2

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 To follow through with reported actions and get results from IUCMA / SARS etc

- 2.2

3. How must we fix this (the above identified problem)

3.1 We have the policies, the manpower but we lack the implementation.

- 3.2

14

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1 HIGHLIGHTING PROBLEM AREAS & MAINTAINING focus on THOSE AREAS.

1.2 _____

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 RESPONSIBLE PEOPLE (DECISION MAKERS OF MUNICIPALITIES) NOT ATTENDING THE forum.

2.2 _____

3. How must we fix this (the above identified problem)

3.1 PROMOTE forum WITH MUNICIPAL MANAGERS

3.2 _____

15

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1 Satisfactory attendance by key clients

1.2 Consistency of reporting

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 Non-attendance by HDIs

2.2 Zero attendance by T.As (Chiefs)
* Declining water quality due to waste pollution

3. How must we fix this (the above identified problem)

3.1 Robust prog to woo them to attend

3.2 Robust programme to make people aware for mitigation atleast.

Reflection on 2016 Crocodile CMF	
1.	What has been our best achievement 2016
1.1	<u>Educate and empower the stakeholder with knowledge of water management within the catchment</u>
1.2	<u>WNTW, illegal dumping of wastes into the stream and continuous complaints are not solved by timely overflows.</u>
2.	What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river
2.1	<u>WNTW, illegal dumping of wastes into the stream and continuous complaints are not solved by timely overflows.</u>
2.2	<u>WNTW, illegal dumping of wastes into the stream and continuous complaints are not solved by timely overflows.</u>
3.	How must we fix this (the above identified problem)
3.1	<u>As one body, CMF we can oversee on the problems/challenges (put them as 'risk that will have danger to our river)</u>
3.2	<u>WNTW, illegal dumping of wastes into the stream and continuous complaints are not solved by timely overflows.</u>

Reflection on 2016 Crocodile CMF	
1.	What has been our best achievement 2016
1.1	<u>Keeping better issues fresh in our memories.</u>
1.2	<u>WNTW, illegal dumping of wastes into the stream and continuous complaints are not solved by timely overflows.</u>
2.	What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river
2.1	<u>Biggest problem WNTW (Especially Mbombela)</u>
2.2	<u>WNTW, illegal dumping of wastes into the stream and continuous complaints are not solved by timely overflows.</u>
3.	How must we fix this (the above identified problem)
3.1	<u>Meaningful prosecution & punishment to guilty parties.</u>
3.2	<u>WNTW, illegal dumping of wastes into the stream and continuous complaints are not solved by timely overflows.</u>

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1 Holding all stakeholders in the Catchment accountable

1.2 _____

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 _____

2.2 _____

3. How must we fix this (the above identified problem)

3.1 _____

3.2 _____

19

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1 Review of agenda - meeting all interests of water user

1.2 Effectiveness of the Crococ.

Increase in numbers

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 Drought / climate change

2.2 A

3. How must we fix this (the above identified problem)

3.1 Align operating rules with Climate / Drought strategies

3.2 Assess illegal water use

20

Reflection on 2016 Crocodile CMK

1. What has been our best achievement 2016

1.1 Getting a lot of different stakeholders to participate in the forum & without any fear, Municipalities continuously being honest about their challenges.

1.2 What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 Some of the stakeholders like Environmental Affairs not participating.

2.2 How must we fix this (the above identified problem)

3.1 ?

3.2 _____

21

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016
 - 1.1 Implementation of the War on Leaks project with a total of 1081 unemployed youth trained in the Province.
 - 1.2 _____
 2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river
 - 2.1 pollution from non-functional wastewater treatments and pump stations
 - 2.2 _____
 3. How must we fix this (the above identified problem)
 - 3.1 Direct engagements with the authorities both at local and provincial spheres of government to deal with poor infrastructure maintenance & rehabilitation.
 - 3.2 _____

22

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1 Getting more stakeholders involved from the different industries

1.2 _____

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 Dealing with Enforcing some of Environmental offences.

2.2 - Promotion educating our communities on environmental (resource) management.

3. How must we fix this (the above identified problem)

3.1 Promote some environmental awareness especially to our local communities.

3.2 _____

23

Reflection on 2016 Crocodile

1. What has been our best achievement 2016

1.1 Very good collaboration of all sector partners.

1.2 Involvement of Tertiary Institutions, researches done.
Being the best trust in the country out of 19 CMA's.

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 Involvement of the farmers

2.2 Drought

3. How must we fix this (the above identified problem)

3.1 Extend invitations to farmers and other

3.2 _____

24

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1 Being Heard by Authorities
1.2 Actions To Solve Problems

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 Authorities Must Listen To Recommendations

2.2 _____

3. How must we fix this (the above identified problem)

3.1 _____

3.2 _____

25

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1 We've managed to come together to discuss issues of concern w.r.t regard to Water Management in the catchment.
1.2 _____

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 The biggest problem is that no progress is being made in improvement of problematic water pumps especially in Kabokweni
2.2 _____

3. How must we fix this (the above identified problem)

The proposed

3.1 Capacity building is highly suggested, so that the SAPS will be able to understand our business & take action when cases are reported.
3.2 _____

26

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1 More issues are being indentified and resolve. The cmf is growing

1.2 _____

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 Some attendees are being intimidated by the Police Hug

2.2 _____

3. How must we fix this (the above identified problem)

3.1 ?

3.2 _____

27

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1 Fixing the problem @ King Hillsview

1.2 Avoiding the drought disaster @ Kwaren dam

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 Water pollution esp. from the municipal wtw

2.2 _____

3. How must we fix this (the above identified problem)

3.1 enforcement by the ucmfa

3.2 _____

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1

Ability to preserve our river system

1.2

2.1

Dry season → less rainfall

2.2

3. How must we fix this (the above identified problem)

3.1

Improve participation

3.2

Prayer - Rain & good governance

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1 Variety of stakeholders, Dept of health through to
Pvt Enterprises

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 MBombela Lm, a other non-conforming Lm's &
lack of participation. Sending variety of representatives
that pass the buck

3. How must we fix this (the above identified problem)

3.1 Identify one representative in Lm as agreed on with
management and deal with them exclusively.

3.2 _____

30

Reflection on 2016 Crocodile CMF

1. What has been our best achievement 2016

1.1 NETWORKING EXTENDING OUR KNOWLEDGE OF CROC.

1.2 _____

2. What do you think is the Croc forum single biggest problem or challenge for 2017 to achieve objective protect the river

2.1 WWTW. FAILURES TO IMPROVE,

2.2 FAL ALMOST BECOMMING TALK SHOP

3. How must we fix this (the above identified problem)

3.1 BUILDING MORE DIVERSE STAKE HOLDERS

3.2 INCREASE POWER OF THE CROC FORUM WITH MEDIA & SAPS

APPENDIX 8

Monash University Human Ethics Certificate of Approval

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: CF16/201 - 2016000092

Project Title: Local Implementation of South Africa's Freshwater Ecosystem Priority Areas (FEPAs): A Collective Case Study of Selected River FEPAs of the Lowveld

Chief Investigator: Dr Dirk Roux

Approved: **From:** 22 January 2016 **To:** 22 January 2021

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.



Professor Nip Thomson
Chair, MUHREC

cc: Mrs Katherine Louise Lishman

